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उत्तराखण्ड शासन

ANNUAL REPORT 2015-16

IRRIGATION RESEARCH INSTITUTE

(An ISO 9001 : 2008 Certified Organisation)

Roorkee - 247 667, Uttarakhand

SEPTEMBER 2016

COSULTANCY 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
- Ejecting Devices

- Siting of Bridges & Barrages

- River Training
- Flood Protection
- Anti-erosion Measures.

Geotechnical Investigation, Concrete Mix Design & 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 & Surface Water
- Water logging

- Suitability for Canal Linings
- Seepage from Canals & Tubewells

- 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 and Hydropowers.

ANNUAL REPORT 2015-16

IRRIGATION RESEARCH INSTITUTE

(An ISO 9001:2008 Certified Organization)

Roorkee - 247 667 (Uttarakhand)

Editorial Committee

हरीश रावत

मुख्यमंत्री,उ त्तराखण्ड

उत्तराखण्ड सचिवालय
देहरादून – 248 001

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दिनांक 25 July 2016

संदेश

मुझे यह जानकर प्रसन्नता हुई कि सिंचाई अनुसंधान संस्थान, रुड़की जो सिंचाई विभाग, उत्तराखण्ड का अग्रणी संस्थान है। लगभग सात दशकों से प्रत्येक वर्ष की भांति इस वर्ष (2015–16) में किये गये विभिन्न अनुसंधान एवं परीक्षण कार्यों की 86वीं वार्षिक विवरणिका प्रकाशित करने जा रहा है।

हिमालय जो अनादि काल से देवताओं व ऋषि मुनियों की तपोभूमि रहा है, की गोद में बसे उत्तराखण्ड राज्य में प्रकृति ने स्वयं ही नदियों एवं जल स्रोतों का अपूर्व भण्डार दिया है। उक्त संस्थान द्वारा इस अमूल्य भण्डार का उपयोग विभिन्न जन कल्याण योजनाओं के शोध कार्यों एवं प्रादेशिक / राष्ट्रीय स्तर पर हो रहे ऊर्जा एवं जल संकट के समाधान हेतु किया जा रहा है, जो कि एक सराहनीय प्रयास है।

इस अवसर पर मैं उक्त संस्थान के अधिकारियों, वैज्ञानिकों / अभियन्ताओं को विभिन्न क्रियात्मक एवं सृजनात्मक शोध कार्यों हेतु बधाई देता हूँ। साथ ही युवा वैज्ञानिकों / अभियन्ताओं के लिये यह शोध कार्य प्रेरणाप्रद होगें, ऐसा मेरा विश्वास है।

विवरणिका वर्ष 2015–16 के सफल प्रकाशन हेतु मेरी हार्दिक शुभकामनाएं।

हरीश रावत

यशपाल आर्य
मंत्री

राजस्व, सिंचाई, सहकारिता, तकनीकी शिक्षा, ग्रामीण निर्माण विभाग, ग्रामीण सड़कें एवं ड्रेनेज, भारत–नेपाल उत्तराखण्ड नदी परियोजनायें

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संदेश

मुझे यह जानकार हार्दिक प्रसन्नता हो रही है कि सिंचाई अनुसंधान संस्थान, रुड़की वर्ष 2015–16 हेतु अपने शोध कार्यों की 86वीं स्मारिका प्रकाशित कर रहा है।

विशाल जल संपदा वाले राज्य उत्तराखण्ड में नदियां, सिंचाई एवं जल विद्युत उत्पादन का प्रमुख स्रोत रही है। सिंचाई अनुसंधान संस्थान, रुड़की इस अक्षय ऊर्जा स्रोत को आधार बनाकर इसका उचित दोहन, उपयोग, संरक्षण एवं प्रबन्धन की योजनाओं हेतु शोध कार्य कर अपना सार्थक योगदान प्रदान कर रहा है, जो कि पर्यावरणीय समन्वय बनाये रखने में भी महत्वपूर्ण भूमिका प्रस्तुत कर रहा है।

आज के युग में ऊर्जा के इस अक्षय भण्डार के राष्ट्रीय एवं अन्तर्राष्ट्रीय स्तर पर रक्षण एवं पोषण करने की जो उपयोगिता इस संस्थान ने समझी है इसके लिए वह बधाई के पात्र है। साथ ही इस विवरणिका में वर्णित कार्य एवं पूर्व में इस संस्थान द्वारा किये गये शोध कार्य आगामी योजनाओं के क्रियान्वयन में मील का पत्थर सिद्ध होगें, ऐसी मेरी पूर्ण आशा एवं विश्वास 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 निभायेगें।

मेरी ओर से 86वीं स्मारिका के सफल प्रकाशन हेतु सिंचाई अनुसंधान संस्थान, रुड़की के समस्त अधिकारियों/वैज्ञानिकों एवं कर्मचारियों को हार्दिक शुभकामनाऐं।

आपका

(यशपाल आर्य)

Anand Bardhan
IAS
Secretary

GOVT. OF UTTARAKHAND

Irrigation, Minor Irrigation & Water Shed Dept.
Letter No. : PS-SECY/2016
Dehradun : Dated :
Tel. : 0135-2712802, Fax : 0135-2712096
secy-irri-ua@nic.in

Message

It is matter of great pleasure that Irrigation Research Institute, Roorkee is publishing it's 86th Annual Report for the year 2015-16.

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

I am happy to learn that during the year 2015-16 Irrigation Research Institute, Roorkee has undertaken hydraulic studies for various important hydroelectric projects like Kali Sindh Dam Project (Rajasthan), Kanhar Dam (U.P.), Lata-Tapovan H.E. Project, (Uttarakhand), Rapti Main Canal–Kachni Drain (UP), Rammam-III Hydro-Electric Project (West Bengal), Vyasi Hydro-Electric Project (Uttarakhand), Multipurpose Dam Project (U.P.), Bajoli Holi Hydro Electric Project (Himachal Pradesh), Gadarwara STPP (3200MW) (Madhya Pradesh), The Institute also had an important role as third party quality monitor for civil works executed under Ardh-Kumbh Mela-2016 by different govt. departments. I am happy to note that 28 Research Reports & 333 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.

(Anand Bardhan)
Secretary

Rajendra Chalisgaonkar
Engineer-in-Chief

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Message

I am pleased to know that the Irrigation Research Institute, Roorkee, which has a standing of about 62 years in the field of hydraulic modelling and has grown into a centre of excellence, is publishing its 86th Annual Report for Year 2015-16. I am privileged to write a message as 1st Engineer-in- Chief of Uttarakhand Irrigation Department for the Annual Report of Irrigation Research Institute, where I worked in the initial phase of my career and learned a lot.

I firmly believe that the Research and Development activities published in the Annual Report will grow the image and standard of the institute. I also appreciate the efforts of officers and employees of the Institute for their dedication and untiring efforts in executing the works and bringing out a comprehensive report.

As we grow, we need to find new ways and means to retain and enhance our spirit of innovation and entrepreneurship, and maintain an enthusiastic environment wherein people feel empowered to do things, to take on challenges, to innovate, and not be scared of making mistakes. It is important that we do not lose sight of our goals and the critical elements to achieve those goals.

I also extend my warm greetings to all employees of the Institute and wish them a great success in their endeavours. I am sure that they will continue to maintain its excellence with great distinction.

September 8, 2016

Rajendra Chalisgaonkar

D.P. Jugran
Former Chief Engineer & HOD

Message

It gives me immense pleasure that Irrigation Research Institute, Roorkee is publishing its 86th Annual Report for the year 2015-2016. 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 hydraulic 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. Rapti main canal, Kachni Drain (U.P.) and Rapti main canal Bahraich-Kharjar Drain (U.P.), Vyasi H.E.P. (120MW) Dehradun (Uttarakhand), Tehri and Koteshwar H.E.P. (Uttarakhand), Vishnugad Pipalkoti H.E.P. (Uttarakhnad), Bajoli Holi H.E.P. (Himachal Pradesh), Naitwar Mori H.E.P. Uttarakashi (Uttarkhand) , Rail cum road bridge at Bogibil across river Brahmputra (Assam), Gadarwara STPP (3200 MW) Narsinghpur (MP), Lata Tapovan H.E.P. Chamoli (Uttarakhand) etc.

The Institute has taken up the lead role in implementation of proposed National Hydrology Project 2015-2024 funded by World Bank and assisted by Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt. of India, New Delhi. Irrigation Research Institute is the nodal agency for implementation of NHP in Uttarakhand.

Third party quality control and assurance for more than 100 nos. of construction works under Ardha Kumbh Mela-2016 like Bituminous and Concrete Roads, Bridges (Temporary/ Permanent), Retaining Walls, Drainage works, etc were successfully completed by the Institute. For this approximately 6000 nos. of tests/visits were conducted at IRI, Roorkee laboratories.

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 2015-2016.

D.P. Jugran

Ajay Verma
Chief Engineer (Design)
& Director

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From Director's Desk

It gives me immense pleasure to present the 86th Annual Report of Irrigation Research Institute, Roorkee for the year 2015-2016. This annual report provides a glimpse 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 of 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 Hydraulics Research Station of Irrigation Research Institute, Roorkee located at Bahadrabad.

The institute has excellent facilities for carrying out hydraulic model studies in its Hydraulics Research Station, Bahadrabad. It is worth mentioning that model studies for major projects of international importance have been carried out at IRI only viz. Rapti main canal, Kachni Drain (U.P.) and Rapti main canal Bahraich-Kharjar Drain (U.P.), Vyasi H.E.P. (120MW) Dehradun (Uttarakhand), Tehri and Koteshwar H.E.P. (Uttarakhand), Vishnugad Pipalkoti H.E.P. (Uttarakhnad), Bajoli Holi H.E.P. (Himachal Pradesh), Naitwar Mori H.E.P. Uttarakashi (Uttarkhand), Rail cum road bridge at Bogibil across river Brahmputra (Assam), Gadarwara STPP (3200 MW) Narsinghpur (MP), Lata Tapovan H.E.P. Chamoli (Uttarakhand) etc.

Major completed and undergoing projects/activities of the institute during 2015-16 are:

1. During the year 28 research reports and 333 test reports were issued.
2. Successfully established 'Highway testing Laboratory' for conducting the tests related to various road works.
3. Successfully completed third party quality control assurance works of the construction works executed under Ardh Kumbh Mela 2016.
4. The Institute has taken up the lead role in implementation of proposed National Hydrology Project 2015-2024 funded by World Bank and assisted by Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt. of India, New Delhi. Irrigation Research Institute is the nodal agency for implementation of NHP in Uttarakhand.
5. Proposal of work of flood zoning/mapping at two stretches i.e. River Bhagirathi at Uttarakashi and River Ganga from Haridwar to Laksar is being done with the help of NIH.
6. State Specific Action Plan sponsored by Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt, of India, New Delhi is under preparation.
7. Initiative taken for joint collaborative research / sponsored studies with IIT Roorkee.
8. 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 made by the Institute towards R&D activities 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 show my gratitude to various sponsors all over the country who have shown their path by referring studies to the institute. I.R.I. has achieved commendable progress therefore, I take this opportunity to thank research personnels, engineers and staff who have assisted in achieving goal and are ready to undertake future challenges. Institute will continue to attain higher levels of achievements in years to come.

(AJAY VERMA)

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About The Institute

Irrigation Research Institute, Roorkee (Formerly UP IRI) 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 UP Irrigation Department. Mr. Gerald Lacey, the pro-pounder 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 became 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, and 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 UP PWD, 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 (SJVN) Ltd., GVK Ltd. Secundrabad, Lanco Infrastructure, Dans Energy Ltd., Teesta Jal Urja Ltd. GMR Consultancy by Angelique International Pvt. Ltd, Hydel/ Irrigation Departments of Chhattisgarh, 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.Also, this institute was awarded ISO 9001:2008 certificate on 15 Dec. 2012.

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

International

- Hasan Dam (Republic of Yemen).
- Nyabarango Hydroelectric Project, Rawanda (East Africa).
- Upper Marsyandi Hydroelectric Project, (Nepal).

National

- Baglihar Hydroelectric Project J&K, (India / Pakistan).
- Nathpa Jhakri Hydroelectric Project (Himachal Pradesh).
- Karcham Wang too Hydroelectric Project (Himachal Pradesh).
- Teesta Hydroelectric Project (Sikkim).
- Tenga Dam Hydroelectric Project (Arunachal Pradesh).
- Ban Sagar Project Mirzapur (Uttar Pradesh).
- Lahchura Dam, Mahoba (Uttar Pradesh).
- Rongni Chu Hydroelectric Project (Sikkim).
- Lower Rajghat Canal, Lalitpur (Uttar Pradesh).
- Rangit Hydroelectric Project (Sikkim).
- Saurashtra Branch Canal Project (Gujrat).
- Baspa Barrage (Himachal Pradesh).
- Polavaram Project (Andhra Pradesh).
- Miyar Hydroelectric Project (Distt. Lahaul & Spiti, Himachal Pradesh).
- Dibbin Hydroelectric Project (Arunachal Pradesh).
- Jorethang Loop Hydroelectric Project (Sikkim).
- Bajoli Holi Hydroelectric Project (Himachal Pradesh).
- Teesta-III Hydroelectric Project (Sikkim).
- Dam Spillway for Greater Shillong Water Supply Scheme (Meghalaya).
- Tail Fall of Escape Channel of WYC Hydroelectric Project Stage-II (Haryana).
- Hydraulic design of stilling basin for Ghagra Barrage (Uttar Pradesh).
- Teesta Hydroelectric Project Stage-VI (Sikkim).
- Siting barrage and training river across river Yamuna near Tajewala (Uttar Pradesh).
- Hydraulic design of Obra Dam Spillway (Uttar Pradesh).
- Training river Great Gandak in Nepal Territory.
- Baitarani Hydroelectric Project (Odisha).
- Kalisindh Dam Project (Rajasthan).

Uttarakhand State

- Tehri Dam Hydroelectric Project (UK).
- Vishnu Prayag Hydroelectric Project (UK).
- Maneri Bhali Project (Uttarakhand).
- Vishnugad Pipalkoti Hydroelectric Project (Uttarakhand).
- Koteshwar Hydroelectric Project (UK).
- Srinagar Hydroelectric Project (Uttarakhand).
- Virbhadra Barrage (Uttarakhand).
- Jamrani Dam Project (Uttarakhand).
- Yamuna Hydroelectric Scheme Stage II, Throttled Surge Tank for Chhibro Power House (Uttarakhand).

Basic Studies/Projects

- Design of Sharda Type fall for Canals.
- Design of surge systems under transient conditions for different HE Project.
- Evolving criterion for design of energy dissipaters at low Froude Number.
- Revision and updating of Manual on Canal Lining.
- Impact Type Energy Dissipaters for Ranipur Super passage.
- Design of Spurs.
- Studies for hydraulic design of Excluder.
- 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.
- Design of Syphon Aqueduct.
- Design of side training walls.

CO-ORDINATION WITH OTHER INSTITUTIONS

The institute is a member or representative 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)

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.

REPRESENTATION AT HIGH LEVEL COMMITTEES

The Chief Engineer (Design) & Director, IRI, 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.
- CBI&P Technical Committee on Management of Floods.
- Advisory Committee on Engineering Construction Technology of Council of Science & Technology, Lucknow, UP
- Science and Technology Advisory Committee of Ministry of Water Resources, New Delhi (STAC-MOWR).
- Academic Council, Indian Institute of Technology, Roorkee.
- Protective Works Committee of IRC, 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.

MAJOR STUDIES CARRIED OUT DURING YEAR 2015-16:

- Further Hydraulic Model Studies of Kali Sindh Dam Project (Rajasthan).
- Physical Model Studies for Flow Conditions & Observing Flow Behaviour of Kachchh Branch Canal SHP-3 at Ch. 82300 m (Gujrat).
- Further 2D Model studies of Kanhar dam spillway for profile on 100% & 90% of max head and for optimization of energy dissipater of Kanhar dam spillway Distt. Sonbhadra (UP).
- Physical Model Studies for Head Losses in Upstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).
- Physical Model Studies for Head Losses in Downstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).
- Physical Model Studies for Erach Multipurpose Dam Project Lalitpur, Jhansi (UP).
- Hydraulic model studies for syphon aqueduct at Km. 47.100 of Rapti Main Canal - Kachni Drain (UP).
- Model Studies for Vyasi Hydroelectric Project (2X60 MW) Dehradun, Uttarakhand.
- Further Hydraulic Model Studies for Syphon Aqueduct at Km. 49.500 on Rapti Main Canal, Bahraich-Kharjhar Drain (UP).
- Hydraulic model studies for Syphon Aqueduct at Km. 42.500 of Rapti Main Canal - Bahraich (UP).
- Model studies for Modified Spillway of Vishnugad Pipalkoti Hydroelectric Project, Uttarakhand.
- Model Studies for Sedimentation and Flushing of Reservoir of Bajoli Holi Hydroelectric Project, Himachal Pradesh.
- Model Studies for Rammam-III Hydroelectric Project (3X40 MW) Darjeeling, West Bengal.
- Model study of Power intake and Sediment accumulation in power channel of Naitwar-Mori Hydroelectric Project, Distt.- Uttarkashi (Uttarakhand).
- Model Studies for rail cum road Bridge at Bogibil across river Brahmaputra (Assam) on the basis of Post Flood 2014.
- Model studies for location of intake structure for proposed Gadarwara STPP (3200MW), Distt.-Narsinghpur, Madhya Pradesh.
- Model studies for Desilting Chamber of Lata-Tapovan Hydroelectric Project, Distt.-Chamoli, (Uttarakhand).
- Capacity Survey of Matatila Reservoir, Jhansi (U.P).
- Capacity Survey of Baur Reservoir, Rudrapur (Uttarakhand).

ACHIEVEMENTS

Quality Control Assurance Works of construction works proposed for Ardh-Kumbh Mela-2016 by Irrigation Research Institute, Roorkee.

Kumbh Mela is a mass Hindu pilgrimage of faith in which they gather to take bath in a sacred river. It is celebrated every third year at one of the four places by rotation: Haridwar (at the river Ganges), Allahabad (at the confluence of the Ganges, the Yamuna and the mythical Saraswati), Nashik (at the river Godawari) and Ujjain (at the river Shipra). Thus the Kumbh Mela is held at each of these four places every twelfth year. Ardha Kumbh Mela is celebrated at only two places, Haridwar and Allahabad, every sixth year. In the year 2016, ArdhKumbh Mela had been held at Haridwar.

For successful completion of Kumbh/Ardh Kumbh Mela, various temporary/permanent construction works has to be carried out. For timely and speedy construction of Mela works 18 no. of field agencies like PWD, Nagar Nigam Haridwar, Nagar Palika Parishad Rishikesh, Uttarakhand Pey Jal Nigam, Irrigation Department, Uttarakhand Jal Sansthan, Haridwar Roorkee Development Authority etc. were deputed by Kumbh Mela Adhikari, Ardh Kumbh Mela-2016. In order to ensure the quality of different construction works, the IRI, Roorkee was nominated as a 'Third Party Agency' for "Quality Control and Assurance Works" by Govt. of Uttarakhand vide his letter No.: 117/A.K.M./Technical Cell/III Party dated 06.06.2015. An MOU was signed between the Kumbh Mela Adhikari Haridwar and Chief Engineer IRI Roorkee specifying the terms and conditions of agreement.

After allotment of various construction works random site visits were done and the samples were taken as per the work plan. These samples were tested in various laboratories of IRI, Roorkee. Thereafter test results were submitted vide various interim reports to Kumbh Mela Adhikari, Arddha-Kumbh Mela 2016, Haridwar within the stipulated time. Based on there tests results improvements were suggested at sites, which were incorporated in construction and quality thus achieved. In some works where quality of work was very poor, reconstruction of poor work was carried out in presence of IRI team.

Before Relaying: Pot holes found on Chauk Bazar Kankhal to Anandmai Ashram Road, Haridwar.

After Relaying: Chauk Bazar Kankhal to Anandmai Ashram Road, Haridwar, Deffects removed

Dismantling of poor quality Drainage work at Bahadrabad -Gagalhedi Road

Reconstruction of dismantled Drainage work at Bahadrabad -Gagalhedi Road

It was tedious task to supervise and control of continuously ongoing construction work. But with the help of officials of working agency, proper quality of work was achieve successfully by team of IRI on behalf of Mela Adhikari, AKM-2016.

Moreover, 100 nos. of construction works like Bituminous and Concrete Roads, Bridges (Temporary/ Permanent), Retaining Walls, Drainage works, etc. were allotted to IRI, Roorkee for third party quality control and assurance. For successful quality control and assurance over various works approximately 6000 nos. of tests/visits were conducted and total 285 test reports were issued by IRI, Roorkee.

Quality Control & Assurance work by Irrigation Research Institute, Roorkee under AKM-2016

Inspection of IRI Laboratory during AKM-2016 Works in progress by Secretary, Irrigation, Engineer-in-Chief, Chief Engineer and other officers

IRI Research Team found poor quality of Chequered Tiles in foot path in inspection with working agency, contractor, Rep. of Chairman & SDM Kritinagar of Nagar Panchayat, Devprayag work under AKM-2016

IRI Research Team observed the deficiency in CC Road construction works at Pant Dweep in presence of Secretary, HRDA, Haridwar work under AKM-2016

After completion of third party quality control & assurance work done by IRI, Roorkee of Ardh Kumbh mela-2016 the quality of various construction works has been improved. By adding a new chapter in the glorious research field of IRI, Roorkee, the Highway Lab is not only gained laurels and applause but also the institutional capacity is enhanced in research/testing needs of road works. In addition to this revenue of about Rs. 55.00 Lacs has been generated by IRI, Roorkee from these quality control and assurance works.

NEW INITIATIVES

(1) National Hydrology Project:

The Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India, New Delhi is coordinating the implementation of National Hydrology Project (NHP) with the World Bank assistance. The National Hydrology Project is third phase of the Hydrology Project which was started in 1995 as **Hydrology Project - I (1995-2003)** and then continued as **Hydrology Project - II (2006 - 2014)**. The project is implemented by 47 implementing agencies covering up all the states, UTs and 10 central agencies. Uttarakhand is also involved in the Hydrology Project for the first time under NHP and **Irrigation Research Institute, Roorkee has been nominated as the Implementing agency for the entire state of Uttarakhand**.

The National Hydrology Project will be a central sector scheme (100% assistance from central govt.) funded by the World Bank. The budget outlay earmarked for Uttarakhand state is Rs. 75.00 Crores for an implementing period of 8 years. The main components of the project are as follows:

1. In-situ hydro-met monitoring system and hydro-met data acquisition system.
2. Setting up of National Water Informatics Centre.
3. Water Resources Operation and Management System
4. Water Resources institutions and capacity building

Activities proposed under NHP in Uttarakhand state:

- REAL TIME FLOOD FORECAST and EARLY WARNING SYSTEM in Ganga basin only.
- To develop DECISION SUPPORT SYSTEM (DSS) for river basins of Uttarakhand. (Ganga, Ramganga, Yamuna & Sharda river basins).
- Sediment potential assessment and water quality monitoring of different critical reaches of rivers and reservoirs of Uttarakhand.
- SWIC (State Water Informatics Centre) will be established at Roorkee.

Following instruments are proposed to be installed under NHP in Uttarakhand.

Sl. No.	Instrument Name	Purpose	Quantity (proposed)
1.	ADCP (Acoustic Doppler Current Profiler)	Discharge, Velocity, Cross-section of rivers	2
2.	Digital Rain Gauges (DRG) (Telemetry) (DRG + evap. sensor + VSAT telemetry)	Precipitation	52
3.	Snow Gauge with Telemetry / VSAT / INSAT	Snowfall	12
4.	Manual rain gauge station	Rainfall, Rainfall history	52
5.	AWLR - Radar type (Telemetry)+VSAT	To monitor, measure and record fluctuations in water level of surface water.	95
6.	Gauge plates / staff gauge	To measure the water level.	40
7.	Current Meter with accessories	Measure the velocity of stream	13
8.	Water quality measurement instruments	Water Quality Lab	2

(2) Establishment of Highway Lab at Irrigation Research institute, Roorkee

Uttarakhand being a young state has a huge scope of growth in infrastructure. The development of road transport network and to link various remote areas and villages with road network has received significant importance and priority under the past development plans of Uttarakhand. Keeping in mind the demands of highway materials testing and

research laboratory at state level, a new chapter in the glorious research field of IRI, Roorkee was added to cater the research and testing needs of highways. In the financial year 2015-16, a well - equipped highway materials testing laboratory was brought into function at Irrigation Research Institute, Roorkee on 6th of June, 2015. The testing facility covers almost all the tests during and after the construction of bituminous as well as the rigid (concrete) pavements. The laboratory has experimental facilities and consulting services in both the bituminous as well as concrete pavements during and after the construction phase. The testing facilities involved in various courses of pavement viz., Sub-grade course , Base course , Sub - base course and wearing/ surface course available in lab. can be grouped into the following categories:

A. Mix - Design:

1. Marshall method of mix design

B. Pavement evaluation

1. Benkelmen beam deflection apparatus
2. Core cutting tool for roads

C. Materials Testing Facility:

1. Bituminous binder
   - i. Ductility testing machine
   - ii. Flash point and fire point test apparatus
   - iii. Penetration testing equipment
   - iv. Softening point testing apparatus
   - v. Viscosity testing apparatus
   - vi. Loss on heating test apparatus
2. Aggregates
   - i. Abrasion test
   - ii. Aggregate shape test
   - iii. Aggregate impact value test
   - iv. Aggregate crushing value test
3. Bituminous mix
   - i. Aggregate-bitumen stripping value test
   - ii. Bitumen content test
4. Soil Stabilization for sub-grade course
   - i. Soil - Cement mixing device

D. Basic equipments/ facilities :

1. Thermostatically Controlled Oven
2. Moisture Chamber
3. Freezing Cabinet
4. Digital Balances
5. Compressive Strength Testing Machine
6. Stone - Cutting Machine

(3) State Specific Action Plan:

1. Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India has launched National Water Mission (NWM) as part of National Action Plan on Climate Change (NAPCC) with the main objective of "Conservation of water, minimising wastage and ensuring its more equitable distribution both across and within states through integrated water resources development and management". The National Water Mission has identified five goals and various strategies to achieve the objectives of the National Water Mission. The five goals of the National Water Mission are:

   Goal I: Comprehensive water data base in public domain and assessment of the impact of climate change on water resources.

   Goal II: Promotion of citizen and state actions for water conservation, augmentation and preservation.

   Goal III: Focused attention to vulnerable areas including over-exploited areas.

   Goal IV: Increasing water use efficiency by 20%.

   Goal V: Promotion of basin level integrated water resources management. "National Water Mission".

   Goal VI: Promotion of Basin level Integrated Water Resources Management", inter-alia, envisages review of National Water Policy, State Water Policy, Guidelines for different uses of water, planning on the principle of integrated water resources development and management, basin integration particularly for augmenting water by converting surplus flood water into utilizable water, and ensuring convergence among various water resources programmes.

2. The water resources situation, its development, management and availability vary considerably from State to State. Many of the identified strategies/actions to achieve the goals of the National Water Mission are required to be taken by the State Governments/ Union Territories. In this context, it is highly desirable to develop State Specific Action Plans for Water Sector aligned with the State Action Plan on Climate Change formulated by the States under NAPCC which give the holistic roadmap to achieve the desired goals. The State Specific Action Plans would essentially consist of:

(a) Present situation of water resources development and management, water governance, institutional arrangements, water related policies, cross-boundary issues, agreements etc. This would constitute the Status Report on the State/Union Territory. The document should also define problems/issues related to all the aspects of water resources specific to the State.

(b) Identifying a set of probable solutions to address the key issues/problem areas giving pros and cons of the solutions.

(c) Preparation of detailed Action Plan for each of the Strategy/Activity identified in the NWM to be implemented by the State/Union Territory.

RESEARCH UNITS / INFRASTRUCTURE

(1) HYDRAULIC RESEARCH UNIT - I

Hydraulic Research Unit - I 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 workstation is situated at Bahadrabad. Important studies carried out by this division during the year are as follows:

Sl. No.	R.R. No.	TITLE OF REPORT
(1)	86 RR (H_1-01)	Further Hydraulic Model Studies of Kali Sindh Dam Project (Rajasthan).
(2)	86 RR (H_1-02)	Physical Model Studies for Flow Conditions of Kachchh Branch Canal SHP-3 at Ch. 82300 m.
(3)	86 RR (H_1-03)	Physical Model Studies for Observing Flow Behaviour of Kachchh Branch Canal SHP-3 at Ch. 82300 m (Gujrat)
(4)	86 RR (H_1-04)	Further 2D Model studies of Kanhar dam spillway for profile on 100% of max head Distt. Sonbhadra (UP).
(5)	86 RR (H_1-05)	Further 2D Model studies of Kanhar dam spillway for profile on 90% of max head (Distt. Sonbhadra UP).
(6)	86 RR (H_1-06)	Further 2D Model studies for optimization of energy dissipater of Kanhar dam spillway (Distt. Sonbhadra UP).
(7)	86 RR (H_1-07)	Physical Model Studies for Head Losses in Upstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).
(8)	86 RR (H_1-08)	Physical Model Studies for Head Losses in Downstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).
(9)	86 RR (H_1-09)	Further Hydraulic Model Studies of Kali Sindh Dam Project (Rajasthan).
(10)	86 RR (H_1-10)	Physical Model Studies for Erach Multipurpose Dam Project Lalitpur, Jhansi (UP.)

(1) Further Hydraulic Model Studies of Kalisindh Dam Project (Rajasthan).

86RR (H_1-01)

Further 3D model studies were conducted on a geometrical similar model on scale 1:80 for the optimization of rock cutting in Upstream and downstream of Kalisindh Dam after its construction. Upstream cutting and muck removal is a difficult job, practically, as dam is constructed and filled. The hydraulic tests indicated that the very huge quantity of soil/ rock cutting will be required to pass the design discharge in the downstream of the dam avoiding excessive afflux, smooth flow through

each bays of the dam, to avoid backwater effect on the spillway, tail water level in the downstream, etc. The rock cutting in the downstream was done in different stages. In this proposal water levels are observed in downstream of dam (20m d/s) as El. 319.00 m at PMF and the same was observed as El. 312.60m at 50% of PMF.

(2) Physical Model Studies for Flow Conditions of Kachchh Branch Canal SHP-3 at ch. 82300 m.

86RR (H_1-02)

Hydraulic model studies were carried out for Kachchh Branch Canal (KBC) SHP-3 at Ch. 82300 m for observing flow behaviour of power channel at off-take and tail race channel at its confluence & its allied works on a geometrically similar 1:25 scale model.

The studies indicated that inflow conditions at off-take and outflow conditions at confluence are smooth. No surface swirls / rotational flow were observed in front of intake in any condition. An upsurge of maximum 0.4 m and downsurge of maximum 0.5 m was observed in transient condition: 100%-0% when a discharge of 220 cumec is passing through KBC and both machines are running at full load i.e. 100%. A maximum time of 50 minutes in proto was observed in damped out the surge. The maximum velocity of 1.70 m/sec was observed near off-take and 1.91 m/sec near confluence.

(3) Physical Model Studies for Observing Flow Behaviour of Kachchh Branch Canal SHP-3 at Ch. 82300 m (Gujrat).

86RR (H_1-03)

Hydraulic model studies were carried out for Kachchh Branch Canal (KBC) SHP-3 at Ch. 82300 m for observing flow behaviour of power channel at off-take and tailrace channel at its confluence & its allied works on a geometrically similar 1:25 scale model. The studies indicated that inflow conditions at off-take and outflow conditions at confluence are expected to be smooth in proto. No surface swirls / rotational flow were observed in front of intake in any condition of the test. An upsurge of maximum 0.4 m and downsurge of maximum 0.5 m was observed in transient condition: 100%-0% when a discharge of 220 cumec is allowed to pass through KBC and both machines are running at full load i.e. 100%. A maximum time of 50 minutes was observed to damp out the surge. The maximum velocity of 1.70 m/sec was observed near off-take and 1.91 m/sec near confluence of tailrace channel & KBC.

(4) Further 2D Model studies of Kanhar dam spillway for profile on 100% of max head Distt. Sonbhadra (UP).

86RR (H_1-04)

Hydraulic Physical Model studies were conducted with a geometrical similar flume model on 1:40 scale (discharge scale 1:10119.3) for Kanhar dam Spillway under Kanhar Dam Project, Distt. Sonbhadra, Uttar Pradesh. After conducting model studies, it was found that design flood (PMF) passes below the HFL (El. 267.92m) and in emergency conditions, it attains a maximum pond level of El. 267.8m which is about 0.1m below HFL. Coefficient of discharge at PMF is worked out as 1.864 and under emergency condition worked out as 2.015. Negative pressures were also observed along the spillway profile at different gate openings. The maximum length of the trajectory was observed as 67m from the end of bucket and its height above the tip of the bucket was observed of the order of 26.5 m at PMF.

(5) Further 2D Model studies of Kanhar dam spillway for profile on 90% of max head Distt. Sonbhadra,(UP).

86RR (H_1-05)

Hydraulic Physical Model studies were conducted with a geometrical similar flume model on 1:40 scale (discharge scale 1:10119.3) for Kanhar dam Spillway of Kanhar Dam Project, Distt. Sonbhadra, Uttar Pradesh. Model studies reveals that design flood (PMF) passes 1.1 m below the HFL(i.e. El.267.92m) while in emergency conditions, it attains a max. pond level of El. 267.6m. Coefficient of discharge at PMF is worked out as 1.95 and under emergency condition, it worked out as 2.046. It can be observed that hydrostatic pressure along the spillway as well as along the pier were observed almost positive in free flow condition as well as under gated condition. Maximum length of the trajectory is observed at 70% of design flood which is of the order of 57m from the end of bucket while it attains max length of 67 m under gated condition at 8.0m gate opening. A maximum height above the bed level is observed of the order of 26.5 m. The spillway profile designed for 90% of max. Head shows hydraulically better performance in comparison to the spillway profile designed for 100% of max. Head.

(6) Further 2D Model studies for optimization of energy dissipater of Kanhar dam spillway Distt. Sonbhadra, (UP).

86RR (H_1-06)

Hydraulic Physical Model studies were conducted with a geometrical similar flume model on 1:40 scale (discharge scale 1:10119.3) for Kanhar dam Spillway of Kanhar Dam Project, Distt. Sonbhadra, Uttar Pradesh. Kanhar Dam Project is proposed to construct a 39.6 m high earthen dam across river Kanhar, a tributary of river Sone for providing Irrigation in district Sonbhadra and Mirzapur. Ogee shaped spillway of concrete is proposed in the centre of river course to spill design flood of 29148 cumec. Depending upon the head, discharge intensity, tail water condition and nature of bed material, etc, ski-jump bucket with lip angle 370 and of radius 18.00 m was provided at invert level El 230.00 m, was proposed for the energy dissipation in the downstream of the spillway. After Model studies, it was observed that the ski-jump bucket with lip angle 370 and radius 18.00 m at invert level El 230.00 m was found hydraulically optimal.

(7) Physical Model Studies for Head Losses in Upstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).

86RR (H_1-07)

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, was 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) were conducted on a part physical model, built on geometrical similar model scales of 1:20. Final test results indicated maximum head loss in turbine mode during symmetrical and asymmetrical operation of penstocks is 0.89m and 2.71m respectively for 10% extra discharge. While, in pump mode these values were 0.29 and 0.75 m under symmetrical and asymmetrical operation of penstocks respectively for 10% extra discharge. No negative pressure or separation of flow in HRT-3 and HRT-4 was observed in all tested conditions under turbine as well as pumping mode. Hydraulic behavior of both legs under the symmetric observation is almost similar under both mode of operation.

(8) Physical Model Studies for Head Losses in Downstream Bifurcation of Tehri Pumped Storage Plant (Uttarakhand).

86RR (H_1-08)

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 PSP (Uttarakhand) were conducted on a part physical model, built on geometrical similar model scales of 1:20. Final test results indicated maximum head loss in turbine mode during symmetrical and asymmetrical operation of penstocks was 0.61m and 2.08m respectively for 10% extra discharge. While, in pump mode these values are 0.97 and 1.39 m under symmetrical and asymmetrical operation of penstocks respectively for 10% extra discharge. No negative pressure or separation of flow was observed in the downstream bifurcation in all tested conditions under turbine as well as pumping mode. Hydraulic behavior of both legs under the symmetric observation is almost similar under both mode of operation.

(9) Further Hydraulic Model Studies of Kalisindh Dam Project (Rajasthan).

86RR (H_1-09)

Further 3D model studies were conducted on a geometrical similar model on scale 1:80 for the optimization of rock cutting in downstream of Kalisindh Dam after its construction. Upstream cutting and muck removal is a difficult job, practically as dam is constructed and filled. The hydraulic tests indicated that the very huge quantity of soil/ rock cutting will be required to pass the design discharge in the downstream of the dam avoiding excessive afflux, smooth flow through each bays of the dam, to avoid backwater effect on the spillway, tail water level in the downstream, etc. The rock cutting in the downstream was done in different stages to avoid the submergence of tunion (El. 313.00) of dam at 75% of PMF discharge. In this proposal, under gated condition water levels are observed in downstream of dam (20m d/s) as El. 318.20 m at PMF and the same was observed as El. 312.0m at 75% of PMF.

(10) Physical Model Studies for Erach Multipurpose Dam Project Lalitpur, Jhansi (UP)

86RR (H_1-10)

Erach multipurpose dam of 21.0 m height above river bed level having 24 no. of bays. The physical 2D model study is conducted for observing adequacy of waterway at PMF, rating of gates, optimization of EDA, observing m height above river bed level having 24 The Erach dam is being constructed at Lalitpur, Jhansi in Uttar Pradesh. It has 21.0 no. of bays. The physical 2D model study is conducted for observing adequacy of waterway at PMF, rating of gates, optimization of EDA, observing flow pattern under free flowing and ponded condition and finding coefficient of discharge. A geometrical similar model of the overflow section to a scale of 1:25 flow pattern under free flowing and ponded condition and finding coefficient of discharge. A geometrical similar model of the overflow section to a scale of 1:25 representing two full and two half bays, 3 piers, profile, glacis, stilling basin and end sill was constructed. Model was tested different discharges varying from 10% to 100% design discharge and observations were taken. Test results indicate that provided waterway is adequate to pass the design discharge of 18500 cumec at proposed FRL of 156.5 m. A drown submerged jump forms at the glacis and remains confine within the 40.0 m long basin provided at El. 139.0 m without chute blocks. A discharge coefficient of 1.96 was observed for discharge of 18500 cumec under free flowing condition.

List of Test Reports of Hydraulic Research Unit-I:

Various Studies carried out during the year are:

Sl. No.	Title of the Report	TM No.
1	Widening & Strengthening of Bahadrabad-Dhanauri-Bedpur-Imlikheda-Hakimpurtura-Bhagwanpur-Gagalhedi Motor Road	TM No. 86 - TR {(H1-01)(I1)}
2		TM No. 86 - TR {(H1-01)(I2)}
3		TM No. 86 - TR {(H1-01)(I3)}
4		TM No. 86 - TR {(H1-01)(I4)}
5		TM No. 86 - TR {(H1-01)(I5)}
6		TM No. 86 - TR {(H1-01)(01-I6)}
7		TM No. 86 - TR {(H1-01)(01-I7)}
8		TM No. 86 - TR {(H1-01)(01-I8)}
9		TM No. 86 - TR {(H1-01)(01-I9)}
10		TM No. 86 - TR {(H1-01)(01-I10)}
11		TM No. 86 - TR {(H1-01)(01-I11)}
12		TM No. 86 - TR {(H1-01)(01-I12)}
13		TM No. 86 - TR {(H1-01)(01-I13)}
14		TM No. 86 - TR {(H1-01)(01-I14)}
15		TM No. 86 - TR {(H1-01)(01-I15)}
16		TM No. 86 - TR {(H1-01)(01-F)}
17	Renovation work of Damaged retaining walls and road by B.C at Hill bypass road	TM No. 86 - TR {(H1-02)(26-I1)}
18		TM No. 86 - TR {(H1-02)(26-I2)}
19		TM No. 86 - TR {(H1-02)(26-F)}
20	Renovation work of Jwalapur Laltarao Chandighat Motor road by B.C in Haridwar	TM No. 86 - TR {(H1-03)(64-I1)}
21		TM No. 86 - TR {(H1-03)(64-I2)}
22		TM No. 86 - TR {(H1-03)(64-I3)}
23		TM No. 86 - TR {(H1-03)(64-F)}
24	Renovation work of Old Delhi Nitipass Motor road by B.C in Haridwar	TM No. 86 - TR {(H1-04)(66-I1)}
25		TM No. 86 - TR {(H1-04)(66-I2)}
26		TM No. 86 - TR {(H1-04)(66-I3)}
27		TM No. 86 - TR {(H1-04)(66-F)}
28	Renovation work Tulsi Chauk to Shivmurti Chauk Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(27-I1)}
29		TM No. 86 - TR {(H1-05)(27-I2)}
30		TM No. 86 - TR {(H1-05)(27-F)}
31	Renovation work of Shanakaracharya to Dam Kothi Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(28-I1)}
32		TM No. 86 - TR {(H1-05)(28-I2)}
33		TM No. 86 - TR {(H1-05)(28-F)}
34	Renovation work of Tulsi Chauk to Stadium Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(29-I1)}
35		TM No. 86 - TR {(H1-05)(29-I2)}
36		TM No. 86 - TR {(H1-05)(29-F)}
37	Renovation work of Ranipur Mod to BHEL Barrier via Railway Crossing Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(30-I1)}
38		TM No. 86 - TR {(H1-05)(30-I2)}
39		TM No. 86 - TR {(H1-05)(30-F)}

40 41 42	Renovation work of Bilkeshwar Mandir Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(31-I1)} TM No. 86 - TR {(H1-05)(31-I2)} TM No. 86 - TR {(H1-05)(31-F)}
43 44 45	Renovation Work of Sanyas Road to Thanda Kuan Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(32-I1)} TM No. 86 - TR {(H1-05)(32-I2)} TM No. 86 - TR {(H1-05)(32-F)}
46 47 48	Renovation Work of Chauk Bazar Kankhal to Anandmai Ashram Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(33-I1)} TM No. 86 - TR {(H1-05)(33-I2)} TM No. 86 - TR {(H1-05)(33-F)}
49 50 51	Renovation Work of Jwalapur Aryanagar Chauk to Sewage Pumping Station Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(35-I1)} TM No. 86 - TR {(H1-05)(35-I2)} TM No. 86 - TR {(H1-05)(35-F)}
52 53 54	Renovation Work of Kankhal Bengali Mod to Jhanda Chauk Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(36-I1)} TM No. 86 - TR {(H1-05)(36-I2)} TM No. 86 - TR {(H1-05)(36-F)}
55 56 57	Renovation Work of Haridwar Shamshan Ghat Motor Road in Haridwar	TM No. 86 - TR {(H1-05)(37-I1)} TM No. 86 - TR {(H1-05)(37-I2)} TM No. 86 - TR {(H1-05)(37-F)}
58 59	Renovation Work of Dehradun Road to Sankyukt Bus Stand Motor Road in Rishikesh	TM No. 86 - TR {(H1-06)(38-I1)} TM No. 86 - TR {(H1-06)(38-F)}
60 61 62	Renovation Work of Lakshman Jhula Road to Triveni Ghat Motor Road in Rishikesh	TM No. 86 - TR {(H1-06)(39-I1)} TM No. 86 - TR {(H1-06)(39-I2)} TM No. 86 - TR {(H1-06)(39-F)}
63 64 65	Renovation Work of Triveni Ghat Motor Road in Rishikesh	TM No. 86 - TR {(H1-06)(40-I1)} TM No. 86 - TR {(H1-06)(40-I2)} TM No. 86 - TR {(H1-06)(40-F)}
66 67 68	Renovation Work of Dehradun Road to Hiralal Road to Haridwar Road in Rishikesh	TM No. 86 - TR {(H1-06)(41-I1)} TM No. 86 - TR {(H1-06)(41-I2)} TM No. 86 - TR {(H1-06)(41-F)}
69 70	Renovation Work of Mukherji Road (Lazpatrai Road) to Chandreshwar Road in Rishikesh	TM No. 86 - TR {(H1-06)(42-I1)} TM No. 86 - TR {(H1-06)(42-F)}
71 72	Renovation Work of Lakshman Jhula to Main Bazar Dot Motor Road in Rishikesh	TM No. 86 - TR {(H1-06)(43-I1)} TM No. 86 - TR {(H1-06)(43-F)}
73 74 75	Renovation Work of Subhash Chauk to Nav Ghat Motor Road in Rishikesh	TM No. 86 - TR {(H1-06)(44-I1)} TM No. 86 - TR {(H1-06)(44-I2)} TM No. 86 - TR {(H1-06)(44-F)}
76 77	Renovation Work of Haridwar Road to Hiralal Road (Tilak Road) in Rishikesh	TM No. 86 - TR {(H1-06)(45-I1)} TM No. 86 - TR {(H1-06)(45-F)}
78 79 80	Renovation Work of Hiralal Road to Oil mil via Gupta Farm Road in Rishikesh	TM No. 86 - TR {(H1-06)(46-I1)} TM No. 86 - TR {(H1-06)(46-I2)} TM No. 86 - TR {(H1-06)(46-F)}
81 82	Renovation Work of Hiralal Road to Jairam Ashram via Mukherji Road in Rishikesh	TM No. 86 - TR {(H1-06)(47-I1)} TM No. 86 - TR {(H1-06)(47-F)}

83 84 85	Renovation work of Main Bazar Road (Ghat Road to Old Tehri Bus Stand) in Rishikesh	TM No. 86 - TR {(H1-06)(48-I1)} TM No. 86 - TR {(H1-06)(48-I2)} TM No. 86 - TR {(H1-06)(48-F)}
86 87 88	Renovation work of Haridwar Marg to Shiv Mandir (Mukharji Marg) in Rishikesh	TM No. 86 - TR {(H1-06)(49-I1)} TM No. 86 - TR {(H1-06)(49-I2)} TM No. 86 - TR {(H1-06)(49-F)}
89 90	Renovation work of Lakshman Road to Shamshan Ghat Road in Rishikesh	TM No. 86 - TR {(H1-06)(50-I1)} TM No. 86 - TR {(H1-06)(50-F)}
91 92	Renovation Work of Sitapur Jamalpur Kalan Jiyapota Road	TM No. 86 - TR {(H1-07)(67-I1)} TM No. 86 - TR {(H1-07)(67-I2)}
93 94		TM No. 86 - TR {(H1-07)(67-S2)} TM No. 86 - TR {(H1-07)(67-I3)}
95 96	Renovation work of NH-58 to Bhimgoda Link Road in Haridwar	TM No. 86 - TR {(H1-08)(59-I1)} TM No. 86 - TR {(H1-08)(59-F)}
97 98	Renovation work of NH-58 to Chandracharya Chauk Road in Haridwar	TM No. 86 - TR {(H1-08)(60-I1)} TM No. 86 - TR {(H1-08)(60-F)}
99 100	Renovation work of Saptarishi Ashram & RTO Chauk to Khadkhadi Road via Pawan Dham inHaridwar	TM No. 86 - TR {(H1-08)(61-I1)} TM No. 86 - TR {(H1-08)(61-F)}
101 102 103	Renovation work of NH-58 to Rishikul Tiraha Road in Haridwar	TM No. 86 - TR {(H1-08)(62-I1)} TM No. 86 - TR {(H1-08)(62-I2)} TM No. 86 - TR {(H1-08)(62-F)}
104 105 106 107	Renovation work of Shankaracharya Chauk to Singh Dwar Road via Kankhal in Haridwar	TM No. 86 - TR {(H1-08)(63-I1)} TM No. 86 - TR {(H1-08)(63-I2)} TM No. 86 - TR {(H1-08)(63-I3)} TM No. 86 - TR {(H1-08)(63-F)}
108 109 110 111	Construction of Permanent/Temporary Road & SDBC Work in different Kumbh Sector	TM No. 86 - TR {(H1-09)(78-I1)} TM No. 86 - TR {(H1-09)(78-I2)} TM No. 86 - TR {(H1-09)(78-I3)} TM No. 86 - TR {(H1-09)(78-F)}
112	Aryanagar Chowk to Jwalapur railway Fatak & Motichur Railway feeder	TM No. 86 - TR {(H1-10)(98-I1)}
113	Renovation of Rishikesh Bhaniyawala Road portion that lie in Rishikesh city	TM No. 86 - TR {(H1-11)(99-I1)}
114	Testing of RCC slab construction work in SIDCUL Haridwar	TM No. 86 - TR {(H1-12)}

(2) HYDRAULIC RESEARCH UNIT - II

Hydraulic Research Unit - II generally deals with physical hydraulic modeling of dams, spillways, energy dissipater's 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
(1)	86 RR (H_2-01)	Hydraulic model studies for syphon aqueduct at Km. 47.100 of Rapti Main Canal -Kachni Drain (UP).
(2)	86 RR (H_2-02)	Model Studies for Vyasi Hydro-Electric Project (2X60 MW) Dehradun, Uttarakhand.
(3)	86 RR (H_2-03)	Further Hydraulic Model Study for Syphon Aqueduct at Km. 49.50 on Rapti Main Canal, Bahraich (UP).
(4)	86 RR (H_2-04)	Hydraulic model studies for syphon aqueduct at Km. 42.500 of Rapti Main Canal -Dodwa Drain (UP).
(5)	86 RR (H_2-05)	Model Studies for Modified Spillway of Vishnugad Pipalkoti HEP Uttarakhand.
(6)	86 RR (H_2-06)	Model Studies for Sedimentation and Flushing of Reservoir of Bajoli Holi Hydroelectric Project, Himachal Pradesh.
(7)	86 RR (H_2-07)	Model Studies for Rammam-III Hydro-Electric Project (3X40 MW) Darjeeling, West Bengal.

(1) Hydraulic model studies for syphon aqueduct at Km. 47.100 of Rapti Main Canal -Kachni Drain (UP).

86RR (H_2-01)

A syphon aqueduct is proposed to be constructed at Km. 47.10 (Kachni Drain) on Rapti Main Canal. A hydraulic model study has been conducted on a physical model constructed on a geometrically similar scale of 1:25 at the Field Research Station, Bahadrabad under IRI Roorkee. It was desired by the sponsor 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 study revealed the safe passage of design discharge (168 cumec) through all the 08 barrels of the syphon aqueduct with an upstream water level of 125.30 m which is marginally less than the theoretically computed affluxed HFL of 125.75 m. Observed water levels at various discharges in just upstream & downstream of aqueduct barrels are given in this report. The maximum velocity was observed to be 1.76 m/s. Also, the values of velocities corresponding to different discharge are also given in this report. A maximum head loss of 40.00 cm at a design discharge of 168 cumec was observed through the barrels.

(2) Model Studies for Vyasi Hydro-Electric Project (2X60 MW) Dehradun, Uttarakhand.

86RR (H_2-02)

Hydraulic model studies were conducted on the comprehensive physical model constructed on a geometrically similar scale of 1:50 incorporating the ground surface profile and location of various components of project as per the data supplied by the sponsor. The study indicated the adequacy of waterway for a

discharge of 8850 cumec as the dischargeassed safely through the spillways at a level below FRL 631.50 with only four bays in operation giving a coefficient of discharge of 0.789. No development of sub-atmospheric pressure was observed on the surface of spillway, breast wall, piers and abutment. The sill of power intake was found to be suitably located at El. 613 m so as to provide the minimum submergence required at El. 626 m (MDDL). Small surface vortex formation was observed at MDDL in the vicinity of power intake, however no vortex formation was observed at FRL. Also, no development of sub-atmospheric pressure was seen in the intake and HRT to power house.

(3) Further Hydraulic model study for Syphon Aqueduct at Km. 49.50 on Rapti Main Canal, Bahraich (UP)

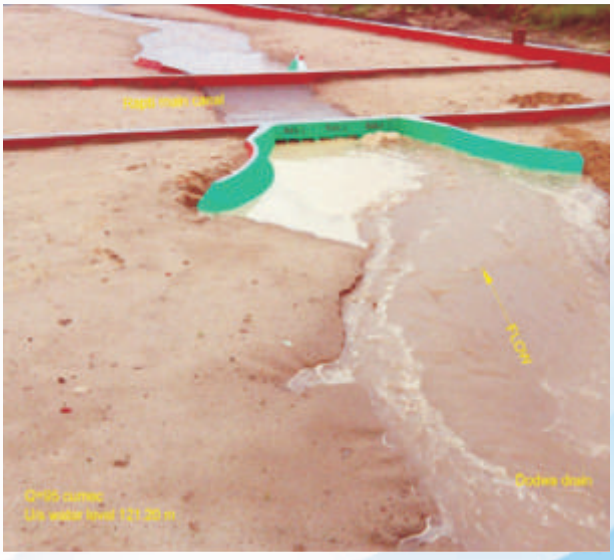
86RR (H_2-03)

In continuation to earlier model study carried out for syphon aqueduct at Km. 49.50 on Rapti Main Canal (Refer TM No.85-RR (H2-03) dated Mar.2015), further hydraulic model study has been conducted on a physical model constructed on a geometrically similar scale of 1:35 at our Hydraulic 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 (2920 cumec) was observed to have passed safely through the barrels (81 Nos.) at an upstream level of 121.80 m and downstream level of 121.20 m observed at the centre after necessary dredging and leveling of bed up to 800 m u/s and 400 m d/s of the aqueduct barrels. The maximum velocity was observed to be 3.64 m/s which is well within permissible limit of 6.0 m/s for M30 concrete structure. A maximum head loss of 0.70 m (avg.) at a design discharge of 2920 cumec was observed through the barrels. The study further suggested some training works which include modification in existing dykes, dredging and leveling of bed.

(4) Hydraulic model studies for syphon aqueduct at Km. 42.500 of Rapti Main Canal, Dodwa Drain (UP).

86RR(H_2-04)

The hydraulic model study for syphon aqueduct at Km. 42.500 (Dodwa Nala) on Rapti Main Canal has been conducted on a physical model constructed on a geometrically similar scale of 1:25 at our Hydraulic 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 (190 cumec) was observed to have passed safely through the 09 barrels of the syphon aqueduct at upstream water level of 122.10 m as against theoretically computed afflux HFL of 123.70 m. Observed water levels for different discharges at upstream & downstream of aqueduct barrels are given in this report. The maximum velocity was observed to be 2.5 m/s. Different velocities corresponding to different discharges are shown in this report. A maximum head loss of 50.00 cm (avg.) at a design discharge of 190 cumec was observed through the barrels.



(5) Model Studies for Modified Spillway of Vishnugad Pipalkoti HEP Uttarakhand.

86RR (H_2-05)

Hydraulic model studies for modified spilling arrangements of Vishnugad Pipalkoti HEP were conducted on a geometrical similar 3-D physical model on 1:50 scale for optimizing hydraulic performance of various structures of the project. The model studies indicate that proposed arrangement of sluice spillway and spill tunnel appears to be adequate enough to pass the design discharge at MWL of 1269.0 m.

The observed hydrostatic pressures and cavitation index assessment do not suggest any requirement of aerator on the spillway profile. On the basis of the performance of flip bucket and impingement of escaping trajectory in plunge pool, it may be concluded that proposed energy dissipation arrangements are hydraulically adequate. Responding behavior of proposed diversion cum spill tunnel (DSPT) was observed under different operative conditions and found hydraulically efficient. Intermittent formations of surface vortices at some locations were observed in the vicinity of power intake when operated at MDDL.

(6) Model Studies for Sedimentation and Flushing of Reservoir of Bajoli Holi Hydroelectric Project, Himachal Pradesh.

86RR (H_2-06)

The hydraulic model studies to access the performance of power intake and sedimentation of reservoir were conducted on a geometrical similar model built to scale 1:40 for Bajoli-Holi HEP (Himachal Pradesh). The sill of power intake was found to be suitably located at El. 2000.00 m so as to provide the minimum submergence required as per IS9761-1995 (clause 5.2.2) and Gordon's criteria. No vortex formation was observed at any reservoir level at the mouth of intake. Also, the head losses through the intake were of the order of 0.30 m to 0.35 m as compared to the theoretical value of 0.281 m.

As far as the reservoir sedimentation is concerned, under the ponded conditions 90% of sediment settles in the reservoir and less than 2% enters the intake. Even after continuous feeding of 3000 ppm sediment for 24 hours (corresponding to 6.32 days in proto), with intake drawing its designed discharge and rest of 500 cumec river inflow discharge passing through spillway, the deposited silt was about 6.30 m below the intake sill level.

(7) Model Studies for Rammam-III Hydro-Electric Project (3X40 MW)Darjeeling, West Bengal.

86-RR (H_2-07)

The Rammam-III hydroelectric project envisages construction of 122.5 m long & 23 m high diversion structure (Barrage) across river Rammam. Hydraulic model studies were conducted on the comprehensive physical model constructed on a geometrically similar scale of 1:30 after incorporating the ground surface profile and location of various components of project as per the data supplied by NTPC Ltd. Observations indicate that the waterway provided found would be adequate as a discharge of 1825 cumec passed safely through the barrage bays at a reservoir level of 890.60 with only four bays in operation giving a coefficient of discharge of 1.976 under free flow condition. Sub-atmospheric pressures were found to have developed on the surface of spillway of barrage bays &piers which are within the permissible limit. The sill of power intake was found to be suitably located at El. 884.75 m so as to provide the minimum submergence required at El. 892.0 m (MDDL). No vortex formation was seen at any reservoir level at and above MDDL in the vicinity of power Intake. Also, no development of subatmospheric pressure was observed in the intake and HRT.

(3) HYDRAULIC RESEARCH UNIT - III

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:

Sl. No.	R.R. No.	TITLE OF REPORT
(1)	86 RR (H_3-02)	Model study of Power intake and Sediment accumulation in power channel of Naitwar-Mori Hydro Electric Project Distt.- Uttarkashi (Uttarakhand).
(2)	86 RR (H_3-03)	Model studies for rail cum road bridge at Bogibil across river Brahmaputra (Assam) on the basis of Post Flood 2014.
(3)	86 RR (H_3-04)	Model studies for location of intake structure for proposed Gadarwara STPP (3200MW), Distt.-Narsinghpur, Madhya Pradesh.
(4)	86 RR (H_3-05)	Model studies for Desilting Chamber of Lata-Tapovan HE Project, Distt.- Chamoli, (Uttarakhand).

(1) Model study of Power intake and Sediment accumulation in power channel of Naitwar- Mori Hydro Electric Project, Distt.- Uttarkashi (Uttarakhand).

86 RR (H_3-02)

On the basis of an earlier report on hydraulic model studies for the above hydraulic report issued by IRI, Roorkee vide T.M. No.- 85RR(H3-02), May 2014, the sponsor's received proposal on the selection of power channel (keeping side slope of trapezoidal section as 1:0.084) was tested on model built to a scale of 1:20 at Hydraulic Research Station Bahadrabad to study the performance of power intake and sediment accumulation in power channel. The revised section was found to be effective in increasing the velocity of flow to a desire value, which resulted inappreciable reduction in accumulation of sediment in power channel. It was also found that approximately 25% of sediment load settles in reservoir and less than 11% of sediment enters the power channel under the ponded condition in semi regime state. Even after continuation feeding of 3000 PPM sediment for about 5.37 hours (equivalent to 24 hrs. in proto), at full design discharge of 88.2cumec in power intake and FRL maintain in the reservoir, the deposition of silt in power channel was found to be almost negligible indicating satisfactory performance of the channel with the received section.

(2) Model Studies for rail cum Road Bridge at Bogibil across river Brahmaputra (Assam) on the basis of Post Flood 2014.

86 RR (H_3-03)

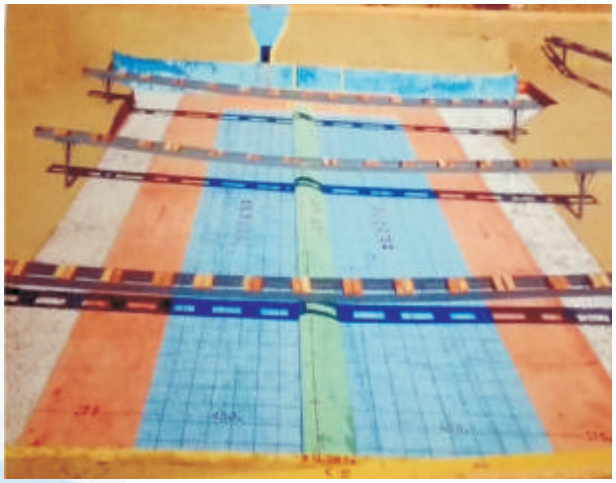
The model studies were carried out at Hydraulic Research Station, Bahadrabad to observe the responsive behavior of manmade structure so as to ensure the safety of the guide bunds of Bogibil Bridge, having waterway of 4875m, across river Brahmaputra on the basis of the river bed configuration as per post flood data of 2014. The studies have been conduct on the existing physical model built to horizontal scale 1:400 and vertical scale 1:50. The observation during hydraulic tests indicating that the suitable protection of both the dykes and guide bunds needs to be ensured in the light of velocities and other hydraulic parameters observed. Flow pattern and the responding behavior of the man-made structures are found to be almost same at both the discharges of 73,000 cumec and

80,000cumec. The flow was found to be more streamlined at 12 hours of the model run for 73,000 cumec discharge. A comparison of observed data in study no. 5, 6 & 7 suggested that launching apron along the south guide bund, with mole head apron extended upto 90° sweep angle and 1:10 transition as proposed in this study gives better performance in respect of velocity and bed scour. Thus, the south guide bund with the proposal in this study was found to be working satisfactorily.

(3) Model studies for location of intake structure for proposed Gadarwara STPP (3200MW) Distt.-Narsinghpur, Madhya Pradesh.

86 RR (H_3-04)

Hydraulic model tests for Gadarwara Super Thermal Power Project (Gadarwara STPP-3200 MW), Distt. -Narsinghpur, Madhya Pradesh were conducted to study the performance of proposed weir and in take structure on a geometrically similar comprehensive model built on a scale of 1:25. Observations of the hydraulic test results indicated that the minimum required discharge of 3.54 cumec (125 cusec) in the fore-bay would be easily available even without closing the flap gates at a river discharge of 18 cumec during lean period. Under the above condition, corresponding water level in fore-bay was found to be at RL 300.8 m which is approximately 0.30 meter above desired level of RL 300.5 m. Further, the whole discharge of 18cumec was observed to have diverted towards the fore-bay if the flap gate was kept fully closed and the corresponding water level in fore-bay was found to be RL 302.5 m. The test also revealed the constant availability of water level above RL 300.5 metre in fore-bay, which is the minimum suction head desired. It may therefore be concluded that the necessity of flap gates may be reconsidered taking into account the various design aspects of the project.



(4) Model studies for Desilting Chamber of Lata-Tapovan H.E. Project, Distt.-Chamoli (Uttarakhand).

86 RR (H_3-05)

Studies were carried out at Hydraulic Research Station, Bahadrabad for proposed Desilting Chamber of Lata Tapovan, H.E. Project on a geometrically similar model built on a scale of 1:10. Studies for silt removal efficiency of basins indicate average overall efficiency of the order of 89.31 %, silt trapping efficiency for +0.2 mm particles size of the order of 95.5% and silt efficiency of the order of 80.6% at FRL, whereas these values are found to be 86.24 %, 92.74% and 78.29% respectively at MDDL. All holes were found to remain opened upto silt load of 1000 ppm at intake. However, at higher silt load such as 2000 ppm, 3000 ppm and 5000 ppm, few holes located in upstream side were found to be chocked. Further the SFT was found to be clear upto a silt load of 3000 ppm and thus appears to be capable of flushing the silt load upto 3000 ppm in river flow satisfactorily. The thickness of sediment deposition at side slopes and upstream slope was of the order of 0.05 m for silt load up to 1000 ppm and it was found on higher side with increasing silt load. In view of the above, it is suggested that flushing with design discharge must be continued in non-monsoon period also.

(4) GROUND WATER RESEARCH UNIT- I

Ground Water Research Unit - I, 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.

(5) GROUND WATER RESEARCH UNIT - II

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. Various studies carried out during the year are:

View of EHDA Laboratory

Sl. No.	R.R. No	TITLE OF REPORT
(1)	86 RR (GW_2-02)	Hydraulic performance of pressure release value. (At Horizontal Side of Hydraulic Structure)
(2)	86 RR (GW_2-03)	Hydraulic performance of pressure release value.
(3)	86 RR (GW_2-04)	Hydraulic performance of pressure release value.

(1) Hydraulic performance of pressure releasevalue. (At Horizontal Side of Hydraulic Structure)

86RR (GW_2-02)

SNC Power Corporation Private Ltd. District Narsinghpur (MP) provided one number PVC made Flap Type Pressure Release Valve in this sub-division for testing their hydraulic performance. During Back Leakage Testing PRV failed at 0.5m vertical pressure head. The rubber flap placed on the PRV opening (as provided) warped inside. The rubber flap is much delicate/ soft and is deficit of top counter weight.

Therefore hydraulic performance of pressure release value is not good and valve can't be used for their purpose.

(2) Hydraulic performance of pressure release value.

86RR (GW_2-03)

NTPC GWSTPP provided two no's PVC make Flap Type Pressure Release Valve for testing their Hydraulic performance. The sensitivity and discharging capacity parameters are prominent and better. The neoprene rubber flap seated on PRV outlet has less seating/locking width available and henceforth resulting in excessive back leakage. As of recommendation, the flap and counterweight shall be modified accordingly.

(3) Hydraulic performance of pressure release value.

86RR (GW_2-04)

Two number "OMMA" Brand (single ball type outlet)-PVC-Pressure Release Valve was received from M/S Power Mech Projects Limited for Testing their Hydraulic Performance. The sensitivity and discharge capacity parameter seems prominent and far better.

The PRV well adheres to prevent the back leakage.

(6) BASIC RESEARCH UNIT

Basic Research Unit 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 unit has facility to measure discharge in lined / unlined canals. Presently many computers and peripherals devices 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 personnels.

The unit 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 unit has got capabilities to carry out these studies. Various studies carried out by this unit during the year are:-

Sl.No.	R.R. No.	TITLE OF REPORT
(1)	86 RR (B_1 - 02)	Capacity Survey of Matatila Reservoir (U.P).
(2)	86 RR (B_1 - 03)	Capacity Survey of Baur Reservoir (Uttarakhand).

Abstract of Technical Memorandum (Research Reports)

(1) Capacity Survey of Matatila Reservoir (UP).

86 RR (B_1-02)

The Matatila Reservoir was constructed in the year 1956 on Betwa river in Lalitpur district of U.P. for power generation and to increase the canal Irrigation system of Bundelkhand region of U.P. As per project report, the design capacity of the reservoir at an elevation 308.46m (F.R.L) is 1132.70 MCM and dead storage capacity is 113.30

MCM at an elevation 295.66 m while the live storage capacity of the reservoir between elevations 295.66m to 308.46m is 1019.40 MCM.

The Previous hydrographic survey of Matatila Reservoir was conducted by Irrigation Research Institute, Roorkee in pre monsoon period of the year 1990 and

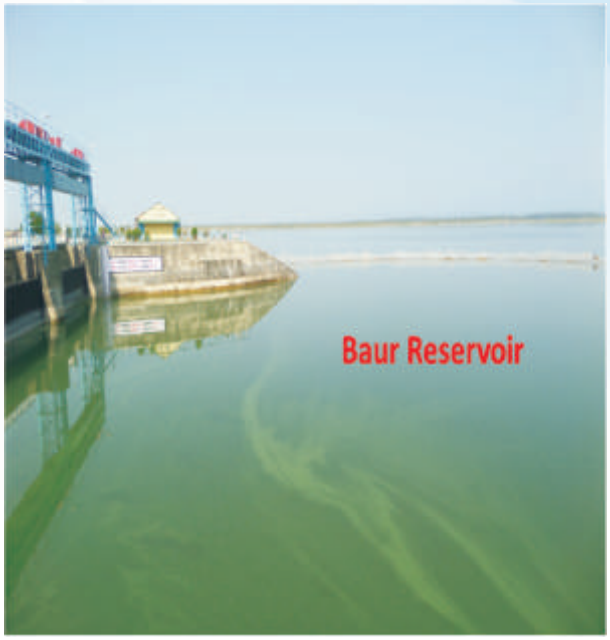
the total capacity was worked out to 748.72 MCM. The present report describes the sedimentation survey of Matatila Reservoir conducted by Irrigation Research Institute, Roorkee in post monsoon period of the year 2014. According to this survey, the present capacity of Matatila Reservoir has been worked out is 698.18 MCM at an elevation 308.46 m (F.R.L) and the dead storage capacity at an elevation 295.66 m is 15.09 MCM. The Siltation rate of the reservoir between 1990 to 2014 is 1.02 ha-m/100 sq.km/year, and overall sedimentation index between 1956 to 2014 is 3.62 ha-m/100 sq.km/year.

(2) Capacity Survey of Baur Reservoir, Uttarakhand.

86RR (B_1-03)

In the year 1967 an earthen dam was constructed on the river Baur, a tributary of river Ram Ganga & a reservoir thus formed for increasing irrigation capacity of district Udham Singh Nagar of Uttarakhand state. The design capacity of the reservoir is 103.36 MCM at an elevation 242.32m, dead storage capacity is 0.85 MCM at an elevation 230.43 m and the live storage capacity of the reservoir is 102.51 MCM.

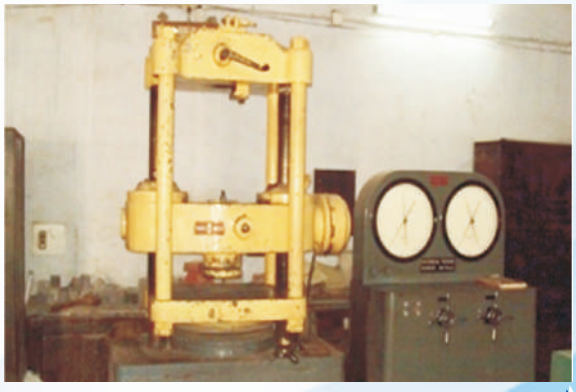
Capacity survey of this reservoir after monsoon period of the year 2015 was referred to IRI, Roorkee. The capacity



survey results show that the present capacity of reservoir is 75.85MCM at an elevation 242.32 m, dead storage capacity is 0.19 MCM at an elevation 230.43 m and the live storage capacity is 75.66MCM. The storage capacity is decreasing at a rate 18.66 ha-m/100 sq.km/year by sediment deposition. Total reduction in capacity of reservoir comes out 26.62% (27.51 MCM) in 48 years of its operation.

(7) MATERIAL TESTING UNIT - I

The Material Testing Unit - I 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 viz. 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
(1)	86 RR (MT_1-01)	Design of Concrete Mix for 33 MLD Capacity Sewage Treatment Plant and Sewage Pumping Station at Mahigran and Ganeshpur, Roorkee.
(2)	86 RR (MT_1-02)	Design of Concrete Mixes for Rural Self-Employment Training Institute for Punjab National Bank at Muzaffarnagar.

Abstract of Technical Memorandum (Research Reports)

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

86RR (MT_1-01)

This study was sponsored to design the concrete mixes for the concrete grades A20M25 and A20M25 at slump (50±10)mm on the basis of 28 compressive strength for 33 MLD Capacity Sewage Treatment Plant and Sewage Pumping Station at Mahigran and Ganeshpur, Roorkee by M/S KEC-WATERLEAU (JV), Flat No. -304, Divine Associates, Near St, Ann`s School, Jadugar Road, 44 Civil Lines, Roorkee. Study of concrete mix design for above grades of concrete has been carried out on 150mm size cube specimen. Ordinary Portland Cement 43-grade (Ultratech Cement and ACC Cement), Corse Aggregate (Crushed), Fine Aggregate (Crushed) and Water Reducing Concrete Admixture `Plastiment-100` have been used in the study of concrete mix design.

(2) Design of Concrete Mixes for Rural Self-Employment Training Institute for Punjab National Bank at Muzaffarnagar.

86RR(MT_1-02)

This study was sponsored to design the concrete mixes for the concrete grades A20M25 at slump (50±10) mm based on 28

compressive strength for Rural self-Employment Training Institute for Punjab National Bank at Muzaffarnagar by M/S Hindustan Prefab Ltd. Jagpura, New Delhi. Study of concrete mix design for above grades of concrete has been carried out on 150mm size cube specimen. Ordinary Portland Cement 43-grade (Ultratech Cement), Corse Aggregate (Crushed), Fine Aggregate (Crushed) and High range Water Reducing Concrete Admixture `Conplast SP-430G8` have been used in the study of concrete mix design.

List of Test Report of Material Testing Unit-I:

Various Studies carried out during the year are:

Sl. No.	Title of Test Report	TM No.
1.	Testing of TOR steel and coarse & fine aggregate received from Construction Unit, Uttarakhand Peyjal Sansadhan Vikas & Nirman Nigam, and Rishikesh.	86-TR(MT_1-01,25,27,28,29, 39,40,41)
2.	Testing of TOR steel, c.c. cubes and coarse & fine aggregate received from Construction Division, Uttarakhand Peyjal Sansadhan Vikas & Nirman Nigam, Rudraprayag.	86-TR(MT_1-02)
3.	Physical properties of cement sample received from Temporary Construction Division. U.P. Jal Nigam, Shamli.	86-TR(MT_1-03)
4.	Testing of coarse & fine aggregate received from M/S Shri Shantiram A Class Contractor, Shantiram S/O Harinand, Village-Purtad, P.O.-Dadmeegad, Teh.-Tuni, Dstt.-Dehradun.	86-TR(MT_1-04)
5.	Testing of TOR steel, bricks and coarse & fine aggregate received from Dakpathar Colony & Communication Division, Dakpathar, Dehradun.	86-TR(MT_1-05,06)
6.	Testing of c. c. cubes received from Dakpathar Colony & Communication Division, Dakpathar, Dehradun.	86-TR(MT_1-07)
7.	Physical properties of cement sample received from Construction Unit, Uttarakhand Peyjal Sansadhan Vikas & Nirman Nigam, Rishikesh.	86-TR(MT_1-08, 24,30,31,32,38)
8.	Testing of TOR steel and coarse & fine aggregate received from Construction Division, U. P. Jal Nigam, Muzaffarnagar.	86-TR(MT_1-09)
9.	Testing of TOR steel and coarse & fine aggregate received from Urban Works Unit, U P Jal Nigam, Muzaffarnagar.	86-TR(MT_1-10,11,22)
10.	Physical properties of cement sample received from Dakpathar Colony & Communication Division, Dakpathar, Dehradun.	86-TR(MT_1-12,13)
11.	Testing of TOR steel received from Temporary Construction Division. UP Jal Nigam, Shamli.	86-TR(MT_1-14)
12.	Physical properties of cement sample received from Construction Division, U. P. Jal Nigam, Muzaffarnagar.	86-TR(MT_1-15)
13.	Physical properties of cement sample received from Urban Works Unit, UP Jal Nigam, Muzaffarnagar.	86-TR(MT_1-16,17,23)
14.	Testing of coarse aggregate received from Construction Division, PWD, Narendra Nagar.	86-TR(MT_1-18,19)

15.	Testing of material for Repair of Sarswati Nala at Triveni Ghat, Rishikesh under AKM-2016.	86-TR(MT_1-20I_1, I_4)
16.	Physical & Chemical properties of cement for construction of Repair of Sarswati Nala at Triveni Ghat, Rishikesh under AKM-2016.	86-TR(MT_1-20I_2, I_3)
17.	Testing of material for Construction of Infiltration well at Gouri Shankar Dweep, Hridwar under AKM-2016.	86-TR(MT_1-21I_1, I_4, I_6)
18.	Physical & Chemical properties of cement for construction of Infiltration well at Gouri Shankar Dweep, Hridwar under AKM-2016.	86-TR(MT_1-21I_2, I_3, I_5)
19.	Testing of bricks received from M/S KEC-WATER LEAU (JV), Flat No.304, Divine Associates, Near St, Ann`s School Jadugar Road, Roorkee.	86-TR(MT_1-26)
20.	Testing of TOR steel received from Unit-46, Construction & Design Services, U. P. Jal Nigam, Meerut.	86-TR(MT_1-33,34,35,36,37)
21.	Testing of material for construction of 21 nos. Temporary Crate Bridges in Haridwar under AKM-16.	86-TR(MT_1-42I_1, I_3, I_4, I_5, I_6, I_7)
22.	Physical & Chemical properties of cement for construction of 21 nos. Temporary Crate Bridges in Haridwar under AKM-2016.	86-TR(MT_1-2I_2)
23.	Testing of material for construction of Temporary Crate Bridge at Basti Ram Pathshala, Haridwar under AKM-2016.	86-TR(MT_1-43I_1, I_3, I_4)
24.	Physical & Chemical properties of cement for construction of Temporary Crate Bridge at Basti Ram Pathshala, Haridwar under AKM-2016.	86-TR(MT_1-43I_2)
25.	Testing of material for construction of Repeater Centre near Anjnimata Temple under AKM-2016.	86-TR(MT_1-44I_1, I_3)
26.	Physical & Chemical properties of cement for construction of Repeater Centre near Anjnimata Temple under AKM-2016.	86-TR(MT_1-4I_2)
27.	Testing of material for construction of Transit Camp, Haridwar under AKM-2016.	86-TR(MT_1-45I_1, I_4)
28.	Physical & Chemical properties of cement for construction of Transit Camp, Haridwar under AKM-2016.	86-TR(MT_1-45I_2, I_3)
29.	Testing of material for construction of Briefing Hall, Haridwar under AKM-2016.	86-TR(MT_1-46I_1, I_3 I_4)
30.	Physical & Chemical properties of cement for construction of Briefing Hall, Haridwar under AKM-2016.	86-TR(MT_1-6I_2)
31.	Testing of material for construction of Barrack at Neelkanth Dham under AKM-2016.	86-TR(MT_1-47I_1, I_3, I_4)
32.	Physical & Chemical properties of cement for construction of Barrack at Neelkanth Dham under AKM-2016.	86-TR(MT_1-7I_2)
33.	Testing of material for construction of 100 Bedded Female Barrack, Haridwar under AKM-2016.	86-TR(MT_1-48I_1, I_3, I_4)
34.	Physical & Chemical properties of cement for construction of 100 Bedded Female Barrack, Haridwar under AKM-2016.	86-TR(MT_1-8I_2)
35.	Testing of material for construction of 100 Bedded Male Barrack, Haridwar under AKM-2016.	86-TR(MT_1-49I_1, I_3)
36.	Physical & Chemical properties of cement for construction of 100 Bedded Male Barrack, Haridwar under AKM-2016.	86-TR(MT_1-49I_2)
37.	Testing of material for construction of Barrack for 25 Jawans at Mayapur, Haridwar under AKM-2016.	86-TR(MT_1-50I_1, I_3)

38.	Physical & Chemical properties of cement for construction of Barrack for 25 Jawans at Mayapur, Haridwar under AKM-2016.	86-TR(MT_1-50I_2)
39.	Testing of material for construction of Mess Block at Police Chauki Dhalwala, Rishikesh under AKM-2016.	86-TR(MT_1-51I_1)
40.	Physical & Chemical properties of cement for construction of Mess Block at Police Chauki Dhalwala, Rishikesh under AKM-2016.	86-TR(MT_1-51I_2)
41.	Testing of material for construction of 10 Bedded Barrack at Bhadrakali, Rishikesh under AKM-2016.	86-TR(MT_1-52I_1, I_3, I_4)
42.	Physical & Chemical properties of cement for construction of 10 Bedded Barrack at Bhadrakali, Rishikesh under AKM-2016.	86-TR(MT_1-52I_2)
43.	Testing of material for construction of Horse Stable, Haridwar under AKM-2016.	86-TR(MT_1-53I_1)
44.	Physical & Chemical properties of cement for construction of Horse Stable, Haridwar under AKM-2016.	86-TR(MT_1-53I_2
45.	Testing of steel bars, bricks, coarse & fine aggregate received from Executive Engineer, T.P.H.D-2, and Dehradun.	86-TR(MT_1-54)
46.	Testing of Girder and Plate for construction of Semi-Permanent Steel Girder Bridge near Viswa Kalyan Ashram, Haridwar under AKM-2016.	86-TR(MT_1-55I_1)
47.	Testing of Girder and Plate for construction of Semi-Permanent Steel Girder Bridge near Jagjeetpur, Haridwar under AKM-2016.	86-TR(MT_1-56I_1)
48.	Testing of Girder and Plate for construction of Pre-Febricated Hut and Watch Tower in Haridwar under AKM-2016.	86-TR(MT_1-57I_1)
49.	Testing of c. c. cubes received from Construction & Maintenance Unit (Ganga). Uttarakhand Pay Jal Nigam, Srinagar.	86-TR(MT_1-58,62,67)
50.	Testing of c. c. cubes received from U.J.V.N. Ltd., Vyasi Project, Near St. Mary School, Tons colony, Dakpathar, Dehradun.	86-TR(MT_1-59)
51.	Physical properties of cement samples received from Research Officer, Hydraulics Research Unit-1, I.R.I. Roorkee.	86-TR(MT_1-60,72)
52.	Physical properties of cement sample received from Executive Engineer, T.P.H.D-2, Dehradun.	86-TR(MT_1-61)
53.	Testing of c. c. cubes received from U.J.V.N. Ltd., Vyasi Project, Near St. Mary School, Tons colony, Dakpathar, Dehradun.	86-TR(MT_1-63
54.	Testing pf steel bars received from Temporary Construction Division, UP Jal Nigam, Shamli.	86-TR(MT_1-64)
55.	Testing of material for construction of Rising Main from Munikireti to Vtthtal Ashram, Rishikesh under AKM-16.	86-TR(MT_1-65I_1)
56.	Testing of TOR steel received from Research Officer, Hydraulics Research Unit-1, I.R.I. Roorkee.	86-TR(MT_1-66)
57.	Testing of bricks and coarse & fine aggregate received from Unit-9, Construction & Design Services, UP Jal Nigam, Saharanpur.	86-TR(MT_1-68)
58.	Testing of Steel Plates for construction of Steel Girder Pile Bridge upon Mayapur Escape Channel and Ganga River between Daksh Dweep under AKM-2016.	86-TR(MT_1-69I_1)
59.	Testing of material for repair of UTC Bus Stand, Roorkee under AKM-16.	86-TR(MT_1-0I_1)
60.	Testing of material for repair of c.c. road Tourist Banglaw to Union Bank, Rishikesh under AKM-16.	86-TR(MT_1-71I_1)

61.	Physical properties of cement sample received from M/S KEC-WATER LEAU (JV), 20, Civil Lines, Roorkee.	86-TR(MT_1-73)
62	Testing of TOR steel and coarse & fine aggregate received from Urban Works Unit, U. P. Jal Nigam, Muzaffarnagar.	86-TR(MT_1-74)
63	Testing of material for repair of c.c. road Kalash Gate to Ganga Resort, Rishikesh under AKM-16.	86-TR(MT_1-75I_1)
64	Testing of material for Bas parking khara sharot by pass marg, Rishikesh under AKM-16.	86-TR(MT_1-76I_1,I_2)
65	Testing of material for repair of UTC Bus Stand, Haridwar under AKM-16.	86-TR(MT_1-77I_1)
66	Testing of coarse aggregate received from Construction Division, P.W.D., Narendra Nagar.	86-TR(MT_1-78,79,91,92, 99,104,105)
67	Testing of material for outfall seiver work on moter marg, on petrol pump Haridwar-Rishikesh under AKM-16.	86-TR(MT_1-80I_1)
68	Testing of tor steel received from Unit-9, Construction & Design Services, UP Jal Nigam, Saharanpur.	86-TR(MT_1-81)
69	Testing of TOR Steel received from Research Officer, Hydraulics Research Unit-1, I.R.I. Roorkee.	86-TR(MT_1-82,106,107)
70	Testing of c. c. cubes received from from U.J.V.N. Ltd., Joshiyara.	86-TR(MT_1-83)
71	Physical properties of cement sample received from Urban Works Unit, U. P. Jal Nigam, Muzaffarnagar.	86-TR(MT_1-90)
72	Testing of material for Repair of Sarswati Nala at Triveni Ghat, Rishikesh under AKM-2016.	86-TR(MT_1-20F)
73	Testing of material for construction of Infiltration well at Gouri Shankar Dweep Haridwar under AKM-2016.	86-TR(MT_1-21I_7,21F)
74	Physical properties of cement sample received from Construction Division, U. P. Jal Nigam, Hapur.	86-TR(MT_1-93)
75	Physical properties of cement sample received from Engineer Civil Hindustan prefab Limited New Delhi.	86-TR(MT_1-94)
76	Testing of TOR steel, bricks and coarse & fine aggregate received from Construction Division, U. P. Jal Nigam, Hapur.	86-TR(MT_1-95)
77	Testing of TOR steel, coarse & fine aggregate received from Construction Branch, Uttrakhand. PeyJal Sanshadan Vikash and Nirman Nigam, Rudraprayag.	86-TR(MT_1-96)
78	Physical properties of cement samples received from Research Officer, Hydraulics Research Unit-1, I.R.I. Roorkee.	86-TR(MT_1-97)
79	Testing of material for repair of Permanent C. C. & E.M.D marg Panthdeep and Gori Sankar Sector, Haridwar under AKM-16	86-TR(MT_1-98I_1,I_2,I_3, I_4,98F)
80	Testing of material for repair of fire hydrant & chamber under AKM-16	86-TR(MT_1-100F)
81	Testing of material for construction of 21 nos. Temporary Crate Bridges in Haridwar, under AKM-2016.	86-TR(MT_1-42I_8,I_9,42F)
82	Testing of material for construction of Repeater Centre near Anjnimata under AKM-2016.	86-TR(MT_1-44F)
83	Testing of material for construction of Transit Camp at Ranipur, Haridwar under AKM-2016.	86-TR(MT_1-45F)

84	Testing of material for construction of Briefing Hall Cum Training Centre at Haridwar under AKM-2016.	86-TR(MT_1-46F)
85	Testing of material for construction of Barrack at Neelkanth Dham under AKM-2016.	86-TR(MT_1-47F)
86	Testing of material for construction of 100 Bedded Male/Female Barrack under AKM-2016.	86-TR(MT_1-48F,49F)
87	Testing of material for construction of Barrack for 25 Police Jawans at Mayapur, Hridwar under AKM-2016.	86-TR(MT_1-50F)
88	Testing of material for construction of Police Chauki Dhalwala, Rishikesh under AKM-2016.	86-TR(MT_1-51F)
89	Testing of material for construction of 10 Bedded Barrack at Bhadrakali under AKM-2016.	86-TR(MT_1-52F)
90	Testing of material for construction of Horse Stable at Haridwar under AKM-2016.	86-TR(MT_1-53F)
91	Testing of material for construction of Rising Main from Munikireti to Vtthtal Ashram, Rishikesh under AKM-16.	86-TR(MT_1-65F)
92	Testing of material for construction of Steel Girder Pile Bridge upon Mayapur Escape Channel and Ganga River between Daksh Dweep under AKM-16.	86-TR(MT_1-69F)
93	Testing of material for repair of UTC Bus Stand, Roorkee under AKM-16.	86-TR(MT_1-70F)
94	Testing of material for repair of c.c. road Tourist Banglaw to Union Bank, Rishikesh under AKM-16.	86-TR(MT_1-71F)
95	Testing of material for repair of c.c. road Kalash Gate to Ganga Resort, Rishikesh under AKM-16.	86-TR(MT_1-75F)
96	Testing of material for repair of UTC Bus Stand, Haridwar under AKM-16.	86-TR(MT_1-77F)
97	Testing of material for outfall seiver work on moter marg, on petrol pump Haridwar-Rishikesh under AKM-16.	86-TR(MT_1-80F)
98	Testing of material for construction of Malveya dweep media platefram near har ki podi Haridwar under AKM-16.	86-TR(MT_1-84F)
99	Testing of material for Bas parking khara sharot by pass marg, Rishikesh under AKM-16.	86-TR(MT_1-85F)
100	Testing of material for construction of Laxman Jhula to Ganga line main marg Rishikesh under AKM-16.	86-TR(MT_1-86F)
101	Testing of material for construction of c.c. road in Laxman Jhula, Rishikesh under AKM-16.	86-TR(MT_1-88F)
102	Testing of material for construction of parking and puliya of kanth in Tapovan, Rishikesh under AKM-16.	86-TR(MT_1-89F)
103	Testing of TOR steel, bricks and coarse & fine aggregate received from Unit 25 Construction & Design Services, U. P. Jal Nigam Ganga Jawahar Colony Aligarh.	86-TR(MT_1-103)
104	Testing of material for construction of Pre-Fabricated Hut and Watch Tower in Haridwar under AKM-2016.	86-TR(MT_1-57F)
105	Testing of material for construction of Chandi Devi Footpath marg, Haridwar under AKM-16.	86-TR(MT_1-87F)
106	Testing of material for repair of footpath marg Kali mandir to Chandi mandir under AKM-2016.	86-TR(MT_1-101F)
107	Testing of material for construction of Pump House for Dheerwali Parking and Laying & Jointing of Rising Main under AKM-16.	86-TR(MT_1-102F)

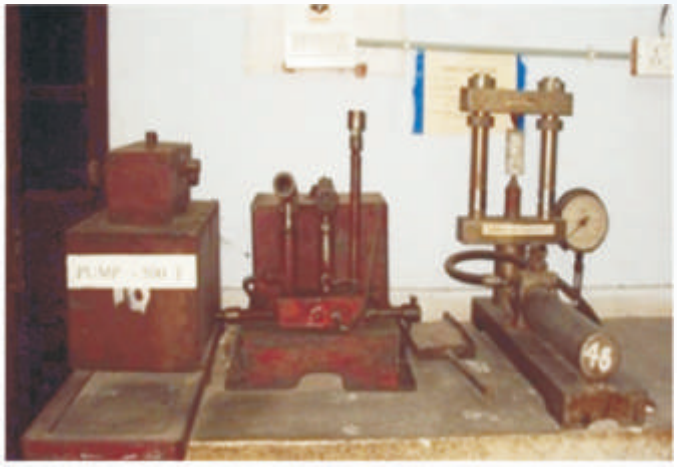
(8) MATERIAL TESTING UNIT - II

This unit deals with the determination of engineering properties of rock mass and rock samples received from different hydroelectric/ river valley and irrigation projects. It maintains the publication section of the Institute.

Facilities available in the Rock Mechanics Laboratory are given below :

(I) Laboratory Tests

- Modulus of Elasticity & Poisson's Ratio.
- Unconfined Compressive Strength on Rock core specimen.
- Shear Parameters - 'c' and'φ'.
- Point Load Strength Index.
- Water Absorption, Specific Gravity.
- Weathering / Durability / Porosity/ Soundness/Permeability Test of Natural Building Stone.



(ii) Field Tests

- Bearing Capacity by Plate Load Test.
- Block Shear Test for ('c' and 'φ').
- Pullout Test (Anchor Bar & Rock Bolts).
- Uniaxial Jacking Test (Modulus of Deformation).
- Load Test for Bridges and Aqueduct.

(9) SOIL RESEARCH UNIT - I

The Soil Research Unit - I, 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/cm^2), 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.

List of Test Reports:

Various Studies carried out during the year are:

Sl. No.	Title of the Report	TM No.
1.	Determination the Soil classification of 16 no. soil samples received from Research Officer Basic unit-1, Irrigation Research Institute Roorkee.	86TR(SRU_1-02)
2	Determination of silt factor of 03 nos. soil samples received from Excutive Engineer, Irrigation Division, Srinagar, Garhwal (Uttarakhand).	86TR(SRU_1-03)
3	Determination of silt factor of 02 nos. soil samples received from Executive Engineer, Irrigation Division, Ramnagar, Nainital (Uttarakhand)	86 TR(SRU_1-04)
4	Sieve Analysis of 01 no soil sample received from Assistant Research Officer-3, Hydraulic Resaerch Unit-2, Bahadrabad (Uttarakhand)	86 TR(SRU_1-05)
5	Determination the soil classification and gradation curve of 05 no. soil samples received from A.R.O-III Hydraulics Research Unit-II, Bahadrabad.	86 TR(SRU_1-06)
6	Determination the soil classification and gradation curve of 05 no. soil samples received from A.R.O-III Hydraulics Research Unit-II, Bahadrabad.	86 TR(SRU_1-07)
7	Determination of MDD & OMC of 01 no. soil sample received from Assistant Engineer, Rural Construction Department, Haridwar, Uttarakhand	86 TR (SRU_1-08)
8	Determination of Laboratory field density for construction of road from Village Khajuri to Jhabrrera block Bhagwanpur, Distt. Haridwar, Uttarakhand.	86 TR(SRU_1-09)
9	Determination of Laboratory field density for construction of road from Village Niyamatpur to Kherikalan block Khanpur Distt. Haridwar, Uttarakhand.	86 TR(SRU_1-10)
10	Determination of soil classification MDD & OMC of 01 no. soil sample received from Executive Engineer, Rural Construction Department, Prakhand Haridwar, Uttarakhand	86 TR(SRU_1-11)
11	Determination of soil classification and gradation curve of 01 no. soil sample received from A.R.O-II Hydraulics Research Unit-II, Bahadrabad.	Results have been send to the sponsor
12	Determination of soil classification and gradation curve of 04 nos. soil samples received from A.R.O-II Hydraulics Research Unit-II, Bahadrabad.	Results have been send to the sponsor
13	Determination of Laboratory & Field Densities for construction of road from Village – Takabhary to Manubaas Block Bhadrabad Distt. Haridwar.	86 TR(SRU_1-12)
14	Determination of Laboratory & Field Densities for construction of road from Village – Muldaaspur Mazra to Daulatpur Block Roorkee Distt. Haridwar.	86 TR(SRU_1-13)

(10) SOIL RESEARCH UNIT - II

The Soil Research Unit - 2, comprises of two sub divisions

(i) Chemical Laboratory (Sub Unit-I)

(ii) Soil Laboratory (Sub Unit-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 unit 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.

List of Test Reports:

Various Studies carried out during the year are:

Sl.No.	Title of Report	TM No.
1	Grain Size distribution of silt sample.	86TR (S_2-02,03)
2	Alkali Aggregate reactivity test of aggregate samples.	86TR (S_2-04,20,23,26)
3	Chemical analysis of water sample.	86TR (S_2-05,06)
4	Chemical analysis of cement samples.	86TR (S_2-07)
5	Grain Size distribution of silt sample.	86TR (S_2-08)
6	Chemical analysis of cement samples.	86TR (S_2-09)
7	Chemical analysis of cement mortar sample.	86TR (S_2-10)
8	Chemical analysis of water samples.	86TR (S_2-11)
9	Chemical analysis of cement samples.	86TR (S_2-12)
10	Chemical analysis of water sample.	86TR (S_2-13)
11	Alkali Aggregate reactivity test of aggregate sample.	86TR (S_2-14)
12	Chemical analysis of cement mortar sample.	86TR (S_2-15)
13	Chemical analysis of water samples.	86TR (S_2-16,22,27)
14	Chemical analysis of cement mortar samples.	86TR (S_2-17,18,19,21,25,28,30)
15	Chemical analysis of cement concrete/mortar samples.	86TR (S_2-24)
16	Chemical analysis of cement concrete	86TR (S_2-29)

List of Published Research Papers

- पी. एस. संत एवं राजेन्द्र चालिसगांवकर **'ढाल क्षेत्रफल विधि द्वारा नहरों / नदियों का जल प्रवाह आंकलन',** पांचवी राष्ट्रीय जल संगोष्ठी –2015, राष्ट्रीय जलविज्ञान संस्थान, रुड़की, सितम्बर 10–11, 2015.
- पी. एस. संत, एम. एस. संत एवं राजेन्द्र चालिसगांवकर **'बलुआ मिट्टी में नहरों के परिकल्पन के लिए सरलीकृत लेसी चार्ट',** पांचवी राष्ट्रीय जल संगोष्ठी –2015, राष्ट्रीय जलविज्ञान संस्थान, रुड़की, सितम्बर 10–11, 2015.
- राजेन्द्र चालिसगांवकर **'उत्तराखण्ड़ में हिमालय सुनामी – क्षति एवं पुनर्निर्माण',** पांचवी राष्ट्रीय जल संगोष्ठी –2015, राष्ट्रीय जलविज्ञान संस्थान, रुड़की, सितम्बर 10–11, 2015.
- अजय वर्मा, सुभाष मित्रा, शंकर कुमार साहा, **"गुडगॉव मे भूजल का कृत्रिम पुनःपूरण– एक वस्तुस्थिति अध्ययन",** पांचवी राष्ट्रीय जल संगोष्ठी –2015, राष्ट्रीय जलविज्ञान संस्थान, रुड़की, नवम्बर 19, 2015.
- अजय वर्मा, सुभाष मित्रा, शं**कर कुमार साहा, "उत्खनन पूर्व घोल अभिपूरण विधि की सहायता से नदी जनित सामग्री क्षेत्र मे सुरक्षित व तीव्रतर सुरंगन",** पांचवी राष्ट्रीय जल संगोष्ठी –2015, राष्ट्रीय जलविज्ञान संस्थान, रुड़की, नवम्बर 19, 2015.
- P.S. Sant and R. Chalisgaonkar, **'Flood Estimation by different flood frequency analysis methods- A comparison'**, in HYDRO 2015 International Conference, IIT Roorkee, Dec. 17-19, 2015.
- R. Chalisgaonkar , P.S. Sant, M.S. Sant, **'Simplified Lacey's Chart for alluvial channels'**, in HYDRO 2015 International Conference, IIT Roorkee, Dec. 17-19, 2015.
- R. Chalisgaonkar ,Shankar Kumar Saha, M.S. Sant, P.S. Sant, **'Design of Kosi Barrage based on formulae developed for bouldery rivers'**, in HYDRO 2015 International Conference, IIT Roorkee, Dec. 17-19, 2015.

VOCATIONAL TRAINING

Irrigation Research institute also provide Vocational Training for Engineering & Diploma Engineering Students.

Engineering Students of following Institutes took part as Group Trainees during 2015-16.

Sl. No.	Name of Institution	Period (In Weeks)
1	National Institute of Technology, Srinagar,(Uttarakhand)	04
2	G.B. Pant University of Agriculture & Technology, Pantnagar, (Uttarakhand)	04
3	G. B. Pant Engineering College, Ghurdauri, Pauri Garhwal, (Uttarakhand)	04
4	Dehradun Institute of Technology, Dehradun, (Uttarakhand)	04
5	THDC Institute of Hydropower Engineering And Technology, Tehri, (Uttarakhand)	04
6	College of Engineering Roorkee, Vardhamanpuram, Roorkee, (Uttarakhand)	04
7	Seemant Institute of Techology, Pithoragarh, (Uttarakhand)	04
8	Phonics Group of Institution, Roorkee, (Uttarakhand)	04
9	Techwords Wali Gramodyog Vikash Sansthan´s Group of Institution, Haridwar, (UK)	04
10	Bhagwant Institute of Technology, Muzaffarnagar, (U.P.)	04
11	Global Research Institute of Management & Technology, Yamunanagar, (Haryana)	04
12	Roorkee College of Engineering, Roorkee (Uttarakhand)	04
13	GRD Institute of Management & Technology, Dehradun, (Uttarakhand)	04
14	Venkateshwara Institute of Technology, Meerut, (U.P.)	04
15	Greater Noida Institute of Technology, Gautam Budh Nagar, (U.P.)	04
16	Bishamber Sahai Institute of Technology, Roorkee, (Uttarakhand)	04
17	R.V. Institute of Technology, Bijnor, (U.P.)	04
18	IMS Institute of Technology, Roorkee, (Uttarakhand)	04
19	College of Advanced Technology, Roorkee, Uttarakhand	04
20	Quantum School of Technology, Roorkee-Dehradun Highway, Roorkee (Uttarakhand)	04
21	Stallion College for Engineering & Technology, Behat, Saharanpur (U.P.)	04
22	Motherhood Institute of Management & Technology, Roorkee (Uttarakhand)	04
23	Institute of Professional Studies, Roorkee, (Uttarakhand)	04
24	B.S. Diploma Engineering College, Roorkee, (Uttarakhand)	04
25	Doon Institute of Engineering & Technology, Rishikesh, Dehradun, (Uttarakhand)	04
26	OM Institute of Technology, Daulatpur, Roorkee, (Uttarakhand)	04
27	Roorkee Institute of Technology, Puhana, Roorkee, (Uttarakhand)	04
28	K.L. Polytechnic, Roorkee, (Uttarakhand)	04
29	Government Polytechnic Srinagar-Garhwal, (Uttarakhand)	04
30	Government Polytechnic Tanakpur, (Uttarakhand)	04
31	B.S.M. College of Polytechnic, Roorkee-Laksar Road, Roorkee, (Uttarakhand)	04
32	Uttaratech Polytechnic, Dhanauri, Roorkee, (Uttarakhand)	04
33	Roorkee College of Polytechnic, Roorkee, (Uttarakhand)	04
34	Bhartiya College of Agriculture Engineering Durg (Chhattisgarh)	04

IMPORTANT MEETING & VISITS

Participation in High Level Meeting/Seminar /Workshop

Sl. No	Name of Meeting/Seminar/ Symposium/Workshop/Training	Place	Date	Participants Name and Designation
1	Hydromet Training under NHP	Kolkata	06-11 April 2015	Er. Manish Shankar Sant, AE Er. Anubhav Nautiyal, AE
2	Introduction to HEC based Modelling Solutions under NHP	NIH Roorkee	01-05 June 2015	Er. Anubhav Nautiyal, AE Er. Manish Shankar Sant, AE Er. Gourav Goel, AE Er. Pratibha Shankar Sant, AE
3	Wrap-up Mission of NHP	New Delhi	01-15 Sept 2015	Er. L.K.Sharma, SE Er. S.K.Saha, EE Er. B.K.Panday, EE Er. Anubhav Nautiyal, AE Er. Gourav Goel, AE Er. Manish Shankar Sant, AE
4	Workshop on Innovative Construction Machinery, Materials and Methods (ICMMM-2015)	IIT Roorkee	26-27 Oct 2015	Er. Neha, AE Er. Pratibha Sankar Sant, AE
5	Hydro 2015 20th International Conference on Hydraulics Water Resources and River Engineering	IIT Roorkee	17-19 Dec 2015	Er. R. Chalisgaonkar, CE Er. Pratibha Sankar Sant, AE Er. Manish Shankar Sant, AE
6	Workshop on Training Need & Assessment (TNA) and Purpose Driven Studies (PDS) under NHP	NIH Roorkee	15 Feb 2016	Er. B.k. Pandey, EE Er. M.K. Khare, EE Sh. Sushil Kumar, RO Er. Anubhav Nautiyal, AE
7	Fourth IIRS user interaction meet (IUIM-2016)	IIRS Dehradun	18 Feb 2016	Sh. Sushil Kumar, RO Sh. Chhatter Singh, RO Er. Neha, AE
8	Uttarakhand State meet on promoting space technology based tools and applications in Governance and Development	IIRS Dehradun	27 Feb 2016	Sh. Chhatter Singh, RO Er. Neha, AE
9	Jal Manthan-2	Vighyan Bhavan, New Delhi	Feb 2016	Er. N. K. Sharma, CE
10	16th Sectional Committee Meeting for WRD 22 Flood Management Erosion Management & Diversion Works	BIS, Manak Bhavan , New Delhi	31 March 2016	Er. Pratibha Shankar Sant, AE

LIST OF VISITORS

Sl. No.	Name / Designation	Project / Place	Date
1.	Sh. Saurabh Bhaumic, Asstt. Manager, L & T	Lata- Tapovan (Uttarakhand)	05.04.2015
2.	Sh. Neeraj Aggarwal, SDGM., Sh. Vikalp Pandey, AM, RITES Ltd.	Bogibil (Assam)	07.04.2015, 12.05.2015, 18.05.2015, 28.05.2015, 29.05.2015, 05.06.2015, 17.06.2015, 18.06.2015, 26.06.2015, 21.07.2015, 22.03.2016
3.	Sh. V.K. Tamta, HOD, Irrigation Department, Deharadun	-	08.05.2015
3.	Sh. Jitendra Singh, AGM , RITES Ltd.	Bogibil (Assam)	27.04.2015, 28.05.2015, 29.05.2015
4.	Sh. S.C. Mittal, Consultant Design Sh. Praveen Kumar, GM (Design) Sh. Trilochan Singh, Advisor (HM) Sh. Padmnabh Mishra,AGM(Geo & Engg.) Sh. K.P. Singh, Consultant	Teesta (Sikkim)	27.05.2015
5.	Sh. R.A. Oak (Hydraulic Expert) Pune	Bogibil (Assam)	28.05.2015, 29.05.2015
6.	Sh. Neeraj Aggarwal, SDGM, RITES Ltd.	Bogibil (Assam)	17.06.2015
7.	Sh. A. F. Bhoraiya, CE, Sh. M. C. Shukla, SE, Sh. S. N. Desai, EE, Sardar Sarovar Narmada NigamLtd., Gujrat	Kachchh Branch Canal (Gujrat)	04.09.2015
8.	Sh. V. C. Bhowmick Sh. Kaushik Chanda, Tata Consulting Engineers, New Delhi		
9.	Sh. J. P. Mathur, Sh. M. Srivallabha, M/s Om Metals, New Delhi		
10.	Sh. SNP Singh Yadav, SE Sh. Bijay Kumar, EE Sh. Ram Gopal, AE Kanhar Dam Project, Distt. Sonbhadra (U.P.)	Kanhar Dam Project (U.P.)	18.09.2015
11.	Ms. Neeta Arora Mr. Prashant Agarwal SMEC	Tehri PSP(Uttarakhand)	19.10.2015
12.	Mr. S.P.S. Chauhan, HCC, Mumbai	Tehri PSP (Uttarakhand)	19.10.2015

13.	Sh. Sanjay Goyal (DGM) Sh. U.D. Dangwal Sh. K.S. Rana Sh. Mayank Jain Sh. Ashish THDC, Rishikesh	Tehri PSP (Uttarakhand)	18.12.2015
14.	Sh. S.P.S. Chauhan Sh. Manish Gupta, HCC, Mumbai	Tehri PSP (Uttarakhand)	18.12.2015
15.	Sh. Anand Bardhan, Secretary(Irrigation), Government of Uttarakhand	-	25.01.2016
16.	Sh Prashant Agarwal, GM Sh Yunis But, Professional Eng. SMEC	Tehri PSP (Uttarakhand)	22.02.2016
17.	Sh. S.P.S. Chauhan HCC, Mumbai		
18.	Sh Sanjay Goyal, DGM Sh Mayank Jain, DGM Sh M. K. Rai Sh. Natrajan Krishna, Sr. Manager Sh V.D. Dangwal. Dy. Manager Sh. Ashish Kumar, Sr. Manager THDC, Rishikesh		
19.	Sh Ramgopal, AE	Kanhar Dam Project (U.P.)	23.02.2016
20.	Sh. Saibal Ghosh, Director , Sh. Rajesh Gupta, Deputy Director CMDD(N&W), CWC, New Delhi	Ratle HEP (HP)	24.02.2016
21.	Sh. T. K. Shivrajan, Director HCD (N&W), CWC, New Delhi		
22.	Sh. Shesh Sharma, Chief Engineer J&K State Power Corporation, Jammu (J&K)		
23.	Dr. V.V. Bhaskar, Scientist "E" Mrs. Neena Isaac, Scientist "C" Sh. P.S. Kujeer, Scientist "B" CWPRS Pune		
24.	Sh. A.P. Pokhrel, Chairperson, ADAPT, Nepal	-	28.03.2016
25.	Sh. Mayank Jain & other, THDC	Tehri PSP (Uttarakhand)	29.03.2016

PROMINENT VISITORS

Delegations from Nepal, Mr. A.P. Pokhrel, Chairperson, ADAPT, Shri Anand Bardhan, Secretary, Irrigation Deptt., Govt. of Uttarakhand & Head of the Department Mr. R. Chalisgaonkar visited HRS Bahadrabad & IRI Roorkee. Chief Engineer, IRI Roorkee welcomed the delegation and briefed about Hydraulic model studies being done at HRS bahadrabad and various research studies being carried out at IRI Rookree.

Visit of Sh. Anand Bardhan, Honorable Secretary, Irrigation Deptt., Govt. of Uttarakhand, along with Chief Engineers, on 25.01.2016

Visit of Mr. A.P. Pokhrel, Chairperson, ADAPT, Nepal, on 28.03.2016

REMARKS OF THE DIGNITARIES

Highly impressed by the work done by the institute and being carried out by the dedicated staff.

Er. K.C. Dhiman, CE, IPH Deptt.
Shimla (H.P.), 22.05.2015

Models showed today impressed me very much. I appreciate the work done & ongoing study by the Institute.

Er. S.R. Agarwal J.D. FMISC
WRD Bihar, Patna, 22.05.2015

I have visited different models constructed by the Institute & impressed with their functioning. The entire system is gravity fed & no recurring cost is involved. The institute has performed well and deserves attention of all stakeholders.

G.S. Jha, Chairman,
GFCC Patna, 24.05.2015

It is excellent institute having all infrastructure facilities for physical modeling for Hydro-electric projects as well as River Training works. The commitment of computing physical models within 4 months appraised me. I wish all the best for the institute.

A.K. Sinha, Member (Planning)
GFCC, Patna, 24.05.2015

Excellent study centre for Hydraulic modelling. It has a glorified history. Very helpful in studying feasibility of various hydroelectric project. Physical modelling compared with mathematical modelling provid excellent basis in concluding the performance and feasibility of projects

Sharad Chandra, Director (MP-I),
GFCC Patna, 24.05.2015

I had the opportunity of visiting the institute/centre that is doing a wonderful job in the field of hydropower/ hydraulics related model study at a very competitive & reasonable rate. I wish them all the best. Let they grow more so as to contribute more in the development of the country.

Anand Bardhan, Secretary,
Govt. of Uttarakhand, Dehradun, 06.06.2015

PUBLICATIONS

(i) **Annual Report** - Annual Report for the year 2014-15 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 2015-16, a total number of 28 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 and the abstracts of the Research Reports as well as Technical Papers are given in chapter Research Units/Infrastructure.

(iii) **Test Reports** - Test reports are issued on the basis of field or laboratory tests carried out by the respective divisions. During the year 2015-16, 333 Test Reports pertaining to various projects/agencies were issued.The following are the types of publications which were issued during the year 2015-16

LIBRARY

The Institute library has a rare and large collection of technical books, journals, reports and otherpublications. The Irrigation Research Institute (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 Hydraulic Research Station (H.R.S), Bahadrabad.

HUMAN RESOURCES

The quality of work in any Institute depends on the quantity & quality of available man power. Institute had a total sanctioned strength of 47 officers on 31st March' 2016.

Name	Designation	Email	Work Experience
 **Ajay Verma**	Chief Engineer (Design)	ce@iriroorkee.res.in	Investigation, Planning, Construction & Maintenance of Hydro Projects. Canal and Flood works. Training, Human Resources, Research & Design etc.
 **N.K. Sharma**	Chief Engineer/ SSO(Design)	nksharma11979@yahoo.co.in	Construction of Canals & Design of Hydraulic Structures. Maintenance of Power House, Canal, Power Channel, River Training Works & Physical Model Studies, Human Resources.
 **L.K. Sharma**	Superintending Engineer Research Circle	serc@iriroorkee.res.in serc.iri@gmail.com	Construction & Maintenance of Hydroelectric Projects, Canal Lining and Hydraulic Structures. Ground Water related studies and Physical Model Studies of various Hydraulic Structures.
 **Ajay Kumar**	Research Officer Hydraulic Research Unit-II	roh2.iri@gmail.com	Design & Hydraulic Model Studies of Different Hydraulic Structure.
 **B.K. Pandey**	Research Officer Hydraulic Research Unit-III	roh3.iri@gmail.com Pandey.bk2@gmail.com	Tehri Dam Rehabilitation work, Flood Protection Work and Hydraulic Model Studies of Different Hydraulic Structure.
 **Bijendra Pal**	Research Officer Material Testing Unit-I	romt1@iriroorkee.res.in	Research/Testing of Cement Concrete and Soil Testing & Lecturer on Ingredients of Concrete and Concrete Mix Design.

Name	Designation	Email	Work Experience
 **Chhatter Singh**	Research Officer Soil Research Unit-I	ros1@iriroorkee.res.in	Remote Sensing & Chemical Tests in Soil Research
 **Dheer Singh**	Research Officer Soil Research Unit-II	ros2@iriroorkee.res.in	Model Studies of Hydraulic, Sedimentation Survey of Reservoirs, Chemical Analysis of Cement Mortar/Concrete and Water & Alkali aggregate Reactivity Test of Aggregate Samples & Soil Investigation.
 **Kapil Kumar**	Research Officer Ground Water Research Unit-II	kapsh2007@gmail.com	Construction of power houses and EHDA Studiesof various Hydraulic Structures.
 **M.K. Khare**	Research Officer Hydraulic Research Unit-I	roh1.iri@gmail.com Maheshkhare2007@gmail.com	Construction & Maintenance of Hydro Electric Project, Construction & Maintenance of rural road under PMGSY & Design, Research of various civil project/Hydro projects.
 **R.R. Mohan**	Research Officer Ground Water Research Unit-I	rajmohan2261@yahoo.in	Regarding to 2D, 3D Physical Modeling of Hydraulic structure to determine the Uplift Pressure & Exit Gradient Beneath the Hydraulic Structures on Alluvium & Permeable Soil.
 **S. K. Srivastava**	Executive Engineer Administration Division	sksrivastaid@gmail.com eeadmin@iriroorkee.res.in	Construction & Maintenance of Canal & Administration Rural roads. Maintenance of Hydroprojects & DPR preparation, Flood protection works, Design works of civil structures.
 **Sushil Kumar**	Research Officer Basic Research Unit	robasic.iri@gmail.com rob1@iriroorkee.res.in	Hydraulic Model Studies, Capacity Survey of Reservoirs, Testing of Rock Material and Maintenance of Computer Centre.

Name	Designation	Email	Work Experience
 **Vinod Kumar**	Research Officer Material Testing Unit-II	romt2@iriroorkee.res.in	Remote Sensing Lab & Capacity Survey of Reservoir.
 **Ajay Kumar**	Assistant Research Officer Hydraulic Research Unit-III	ajakumar1963@gmail.com	Hydraulic Model Studies & Capacity Survey of Reservoir.
 **Ajay Kumar**	Assistant Research Officer Material Testing Unit-II	ajayaro1959@gmail.com	Hydraulic Model Studies, Photo Elastic Lab & Rock Mechanics Lab.
 **Amarjeet Sah**	Assistant Research Officer Hydraulic Research Unit-I	Amarjeet.sah@gmail.com	Conducting various hydraulic model studies.
 **Anubhav Nautiyal**	Assistant Research Officer Hydraulic Research Unit-I	nautiyal.anubhav@gmail.com	Involved in implementation of NHP funded by World Bank and assisted by Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt. of India, New Delhi. Successfully completed the quality control assurance works of Arddh Kumbh Mela 2016.
 **Arun Kr. Singh**	Assistant Research Officer Hydraulic Research Unit-III	arunkhundiyan@gmail.com	Hydraulic Model Studies.
 **Ashish Shukla**	Assistant Research Officer Material Testing Unit-I	shuklanitp@gmail.com	Research/Testing work of cement concrete testing.

Name	Designation	Email	Work Experience
 D. S. Rawat	Assistant Engineer Administration Division	aedsrawat@gmail.com	Maintenance of Civil Works.
 Deepak Joshi	Assistant Research Officer Hydraulic Research Unit-III	erdav.joshi@gmail.com	Hydraulic Model Studies, Current Meter Calibration.
 Jatin Bhardwaj	Assistant Research Officer Hydraulic Research Unit-I	Jatin.2at@gmail.com	Conducting Various Model Studies.
 J.K. Goel	Assistant Research Officer Ground Water Research Unit-II	Jkgoel56@gmail.com	Hydraulic Performance of Pressure Release Value.
 K.P. Singh	Assistant Research Officer Soil Research Unit-I	Singhkp1162@mail.com	Soil Testing and Hydrographic Survey.
 Khadak Singh	Assistant Engineer Administration Division	k.s.chauhan078@gmail.com	Maintenance of Civil Works.
 Kishan Lal	Assistant Research Officer Soil Research Unit-II	klsant25@gmail.com	Chemical Analysis of Cement, Cement Mortar/Cement Concrete, Water Samples, Alkali Aggregate Reactivity Test of Aggregate Samples and Grain size distribution of silt samples as per I.S. Codes and CRRI Reports.

Name	Designation	Email	Work Experience
 L. M. Kuriyal	Assistant Engineer Administration Division	lmkudiyal@gmail.com	Maintenance of Civil Works.
 Manish Shankar Sant	Assistant Research Officer Hydraulic Research Unit-I	manishshankarsant@gmail.com	Involved in implementation of NHP funded by World Bank and assisted by Ministry of Water Resources, River Development & Ganga Rejuven Rejuvenation, Govt. of India, New Delhi, Successfully completed the quality control assurance works of Arddh Kumbh Mela 2016.
 Manvendra Singh	Assistant Research Officer Material Testing Unit-I	Manuknit11@gmail.com	Research /Testing work of Cement Concrete Testing.
 Neha	Assistant Research Officer Ground Water Unit-I	nehakanojia24@gmail.com	3D EHDA Model Studies Siphon Aqueduct on Rapti Main Canal, Research Involving in World Bank aided project for Uttarakhand state & River Migration Study, Digitization with the help of Remote Sensing Techniques.
 Pratibha Shankar Sant	Assistant Research Officer Basic Research Unit	pratibha.sant@gmail.com	Involved in implementation of NHP funded by World Bank and assisted by Minisrty of Water Resources, River Development & Ganga Rejuvenation, Govt. of India, New Delh, Involved in State Specific Action Plan on Water Sector under National Water Mission.
 Ram Ashish	Assistant Research Officer Material Testing Unit-II	ram_ash_ish@yahoo.com	Statistical Lab & hydraulic model studies.
 Ram Swaroop	Assistant Research Officer Hydraulic Research Unit-III	rsarya3342@gmail.com	Hydraulic model studies.

Name	Designation	Email	Work Experience
 Rituraj Kr.Pandey	Assistant Research Officer Soil Research Unit-I	rkprbj@gmail.com	Soil Testing/Investigation.
 S. K. Mamgai	Assistant Engineer Administration Division	mamgaisk@gmail.com	Maintenance of Civil Works.
 Salma Jahan	Assistant Research Officer Hydraulic Research Unit-II	salmajahan786r@gmail.com	Hydraulic Model Studies of Different Hydraulic Structure.
 Shashwat Raj	Assistant Research Officer Hydraulic Research Unit-I	sharaj224@gmail.com	Conducting various Model Studies.
 Sheela Rani	Assistant Research Officer Soil Research Unit-II	sheelarani811@gmail.com	Soil Classification, Determination of Silt Factor, Compaction Test etc.
 Sumit Malwal	Assistant Research Officer Hydraulic Research Unit-II	sumit11malwal@gmail.com	Hydraulic Model Studies of different Hydraulic Structure.
 Surender Kumar	Assistant Research Officer Hydraulic Research Unit-II	sk2027.iri@gmail.com	Hydraulic Model Studies of different Hydraulic Structure.

Name	Designation	Email	Work Experience
 **Sukhvir Singh**	Assistant Research Officer Soil Research Unit-I	aro4.s1@gmail.com	Dam Tunnel Discharge, Seismological Observatory, Isotope, Chemical & Soil Laboratories.
 **Vivek Kumar**	Assistant Engineer Administration Division	ae55.adm@gmail.com	Maintenance of Civil Works, T&P.

APPENDICES

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 (37.5mmDia x75mm 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	Dispersibilty 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	Coefficient 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 Laboratory**

Sl. No.	Name of 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 Test	3
9	Float Test	3
10	Distillation Test	3
11	FRAASS Breaking Point Test	3

NOTES

NOTES

ORGANIZATIONAL STRUCTURE

Chief Engineer (Design) & Director, Irrigation Research Institute, Roorkee

Superintending Engineer
Research Circle,
IRI, Roorkee

- Executive Engineer
  Administration Division
- Research Officer
  Basic Research Unit
- Research Officer
  Ground Water Research Unit-1
- Research Officer
  Ground Water Research Unit-2
- Research Officer
  Material Testing Unit-1
- Research Officer
  Material Testing Unit-2
- Research Officer
  Soil Research Unit-1
- Research Officer
  Soil Research Unit-2
- Research Officer
  Hydraulics Research Unit-1
- Research Officer
  Hydraulics Research Unit-2
- Research Officer
  Hydraulics Research Unit-3

Aerial view of Hydraulic Research Station, Bahadrabad

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