IRICEN JOURNAL OF CIVIL ENGINEERING

ज्ञान ज्योति से मार्गदर्शन

VOLUME 7, No. 4 www.iricen.indianrailways.gov.in DECEMBER 2014







Indian Railways Institute of Civil Engineering, Pune

Recommendation of Training Manager Seminar Held on 9th & 10th Oct 2014

1. ER has prepared a Compendium of instructions covering Railway Land-Leasing, Licensing, Way Leave facilities, etc. ER shall print sufficient copies and supply to all railways.
2. Railway Board may please review Para 6.2 of Freight Circular No.1 of 2012 on 30.1.2012 on siding matters.
3. NFR shall send proposal of enhancing training allowance of faculty members of Training Institute of Non-Gazetted staff to Board with accounts observation and GMs approval.
4. The head of Divisional Permanent Way Training Institute shall be designated as Principle irrespective of grade of the incumbent.
5. Power of Heads of CTIs shall be given to PHOD of zonal Railways for Training Schools. NCR to send vetted proposal to Railway Board.
6. Ceiling limit for training of Gazetted Railway employees in Non-Railway Institutions shall be increased to Rs 10000/- per delegate per day and Rs 50000/- per delegate per course.



Group Photo of Silver Jubilee IRSE Batch (1988) on the occasion of IRICEN DAY - 1st Nov. 2014



From director's Desk

Dear Readers,

I wish all the readers of this journal and the entire engineering fraternity a very Happy and prosperous new year 2015.

The quarter gone by had special significance for IRICEN, as we celebrated the IRICEN Day on 1st of November. It also marked completion of first year since the IRICEN started operating from the new Green Building.

The IRICEN Day celebrations were graced by presence of Member Engineering, Railway Board. He also facilitated the officers, who have excelled in various training programmes of IRICEN during last one year and the officers of the Silver Jubilee (IRSE-1988) Batch. Hon'ble Member Engineering underlined that civil engineering is the most challenging and noble engineering profession responsible for raising dwellings, construction of a roads, building dams etc. and creation of backbone infrastructure leading to other developments. He also hoped that future generation of Engineers will continue to guide the society at large.

This issue of journal contains papers on the issues relevant for the present times viz. Empowerment at field level for efficient delivery of works and effective project management. I am sure that these thoughtful and well written papers coming out of the rich practical experience of mainly 1988 batch of IRSE officers would enable welcome change in our approach.

Another paper on Self Supported Curved Metal Roofing Systems presents an opportunity to minimize wastage of precious space otherwise lost in locating spatially inefficient framed structure elements.

I hope that readers would find the content in this Journal informative and useful. I also invite suggestions and contributions for the forthcoming issue of this journal.

(Vishwesh Chaubey)
Director

Pune
Jan. 2015

EDITORIAL BOARD

Shri Vishwesh Chaubey
Director/IRICEN
Chairman

Shri R. P. Saxena
Sr. Professor Engineering
Co - Chairman

EDITING TEAM

Shri C. S. Sharma
Sr. Professor Track
Executive Editor

TRACK

Shri N. C. Sharda
Dean

Shri A. K. Patel
Professor - Track I

Shri Sunil Pakhare
Professor - Track II

Shri M. B. Dekate
Professor - Track Machine

Shri N. K. Mishra
Associate Professor - Track I

Shri J. M. Patekari
Lecturer - Track I

Shri R. K. Kathal
Lecturer - Track II

WORKS

Shri S. K. Garg
Sr. Professor Works

Shri Surendra Kr. Bansal
Sr. Professor Projects

Shri Gautam Birhade
Professor Works

Shri Neeraj Khare
Associate Professor/Est.

Shri N. R. Kale
Lecturer - Works

BRIDGES

Shri Vineet Gupta
Sr. Professor Bridge - I

Shri. Sharad Kumar Agarwal
Professor Bridge

EDITORIAL ASSISTANCE

Shri Pravin Kotkar
Sr. Instructor - Track I

The papers & articles express the opinions of the authors, and do not necessarily reflect the views of IRICEN editorial panel. The institute is not responsible for the statements or opinions expressed in its publication.

Index

I) Railway News 03

II) Other News 05

III) Events 06

IV) Achiever's Series 08

V) Technical Papers

1. Self Supported Curved Metal Roofing Systems 09
   By : Sh.MK Gupta, CAO/C, C.Rly, Sh.AK Agrawal, CE/C/MTP, C. Rly, Sh.Paramjeet Singh DY CE/C, C. R
2. Fast Track Project Implementation And Management – Experiences and Overview 21
   By : Sh. Rajesh Prasad, Chief Project Manager(M) RVNL, Kolkata
   Course No. - 14308
3. Hiring Knowledge for Bridge Design – Empower Yourself First with Design Basis Note 34
   By : Sh. R. K. Goel, CE/Const/CR
   Course No. - 14308
4. Effective Project Management : Consultancy Contracts 45
   By : Sh. Sanjay Shrivastava, GM (Civil) RITES
   Course No. - 14308
5. Project Management Scenario on Indian Railways 47
   By : Sh. Akshay Kumar Jha, CE/C-V/SCR
   Course No. - 14308
6. Empowerment of Field Officials – Some Issues and Thought Thereupon 51
   By : Vivek Kumar Gupta, CE(TMC) WR
   Course No. - 14308

VI) Literature Digest 53

Suggestion for improvement of **IRICEN JOURNAL OF CIVIL ENGINEERING** are welcome from the members. Suggestion may be sent to mail@iricen.gov.in

Guidelines to contributors

Articles on the Railway Civil Engineering are welcome from the authors. The authors who are willing to contribute articles in the IRICEN Journal of Civil Engineering are requested to please go through the following guidelines :

1. The paper may be a review of conventional technology, possibilities of improvement in the technology or any other item which may be of interest to the readers. The paper should be reasonably detailed so that it could help the reader to understand the topic. The paper may contain analysis, design, construction, maintenance of railway civil engineering assets. The paper should be concise.
2. The journal is likely to be printed in a paper of size 215 mm X 280 mm. While sending the articles the author should write in 2 columns. Sketches, tables and figures should be accommodated in a 2 column set up only.
3. Author should send the original printout of photograph along with the digital copy of the photograph.
4. Soft copy as well as hard copy of article must be invariably sent to the editors of concerned subject.
5. Only selected articles will be included in the IRICEN Journal of Civil Engineering.

Delhi Metro to Become World's 7th Largest Network in 2016

Within 12 years of its inception, the Delhi Metro is on track to achieve feats surpassing the world's historic metro stations.

The completion of Delhi Metro's Phase III will not only increase the total length of its network in the national capital but also make Delhi a city with one of the highest number of metro stations anywhere in the world, according to a DMRC spokesperson.

The Delhi Metro network will have more than 241 stations after Phase III, which will make it the seventh city in the world to have more than 200 metro stations. In Asia, Delhi will have the highest number of metro stations after Shanghai, Tokyo and Seoul.

Most of the metro networks with more than 200 stations are operated by multiple operators, while in Delhi, apart from the six stations of the Airport link, all other lines are run by Delhi Metro Rail Corporation (DMRC).

In 2016, the DMRC network will be of about 330 kilometres and after completion of 103 km long section under Phase IV, the Delhi Metro will surpass the 150 year old London underground system.

The Delhi Metro by 2016 will have 241 stations and the length of its network in the city will be a total of 330 kms. The London underground, which was built in the year 1863, is 402 km long and has 270 stations.

The Seoul and Tokyo metro systems are 317 kms in length and have 293 and 274 stations respectively. The 424 km long Shanghai Metro has 234 stations. Russia's Moscow metro is 305 km long with 185 stations while Paris' 215 km long subway has 301 stations. In China, 336 km long Beijing metro system has a total of 172 stations while the Hong Kong metro is 211 km long with 155 stations.

Approximately, there are about 160 Metro stations in the world in about 54 countries across the world. Delhi Metro was recently ranked second among 18 international Metro systems in terms of overall customer satisfaction in an online customer survey.

In the survey conducted among the commuters of those Metro systems by Global metro Benchmarking Groups 'NOVA' and 'CoMET'. Delhi Metro along with London DLR and Bangkok were the best three performers in the 'Net Promoters Score' (NPS) category.

Ref : Civil Engineering & Construction Review, Vol. 27, No. 11, Nov. 2014, Pg 14

Railways to Study Delhi-Amritsar High Speed Route

Railways have undertaken a study to run trains at a high speed of 300 kmph on Delhi-Chandigarh-Amritsar route to reduce travel time between the national capital and the holy city to just about two-and-half hours from the existing six hours.

The pre-feasibility study of the proposed 450 km long Delhi-Chandigarh-Amritsar corridor project will be conducted by French consultant agency Systra along with railways subsidiary RITES and a senior Railway Ministry official.

The study will explore the possibility of running a bullet train at a maximum speed of 300 km per hour on the proposed Delhi-Chandigarh-Amritsar route. "It would cost about Rs. 7 crore and the contract for undertaking the study has been awarded," the official said.

The study will identify suitable routes for high speed alignment and station locations using satellite imagery data.

The report expected to be submitted in seven months also include environment impact, potential passengers as well as an indicative estimate of the cost to connect Delhi with Chandigarh and Amritsar on high speed rail network.

Systra and RITES have also carried out the study on the Mumbai-Ahmedabad high speed rail corridor project. Apart from Delhi-Chandigarh-Amritsar and Mumbai-Ahmedabad routes, railways had identified five more corridors for running high speed train with the aim to connect commercial, tourist and pilgrimage hubs in India.

The routes include Hyderabad – Kazipet - Dornakal-Vijayawada - Chennai, Howrah - Haldia, Chennai-Bangalore - Coimbatore - Ernakulam - Thiruvananthapuram, Delhi - Agra - Lucknow - Varanasi - Patna and Delhi - Jaipur - Jodhpur.

The high-speed rail corridors will be built as elevated corridors.

Railways' white-paper "Vision 2020" submitted to Parliament in 2009 envisages implementation of regional high-speed rail projects to provide environment friendly time-efficient journeys, which can be provided by the new high speed rail systems designed for trains traveling upto 300 km per hour.

Ref : Civil Engineering & Construction Review, Vol. 27, No. 11, Nov. 2014, Pg 16

AP Govt. Proposes Metro Rail for Tirupati

Andhra Pradesh government aims to complete two metro rail projects in Vishakhapatnam and VGTM (Vijayawada-Guntur-Tenali-Mangalgiri) area within three and half years and has proposed similar venture for the temple town of Tirupati. The state government has assigned the construction of these two projects to Delhi Metro Rail Corporation (DMRC), whose principal advisor adviser E. Sreedharan has been appointed as the advisor for AP government on the metro rail projects. The Chief Minister asked Sreedharanto prepare feasibility report for rail-based mass rapid transit system.

Ref: The Masterbuilder Sept. 2014, Pg 34

Mauritius looks to India for Light Rail Transit System

Mauritius is in discussion with India for technical as well as financial assistance with regards to building a Light Rail Transit (LRT) System in the island nation. The LRT System, which would link capital city Port Louis with residential hub Curepipe, is expected to cost about Rs. 40 billion. The proposed project will cope with increasing road traffic congetion in Mauritius. The propose rail project would cover over 30km from the capital city to centre of the island nation.

Ref: The Masterbuilder, Oct. 2014, Pg 32

Chennai Metro Rail to be Launched in March 2015

Union Minister for Urben Development M Venkaiyah Naidu said that the Chennai Metro Rail will be launched in March next year between Koyambedu and Alandur section. Hailing the project as an "engineering marvel," Mr. Naidu said cue must be taken from Kochi and cost escalation should be avoided in the Rs. 14,600 crore Chennai project. He also added that the request of the State government to extend the metro rail network upto Tiruvottiyur would be considered.

Ref: The Masterbuilder Sept. 2014, Pg 34

Bangladesh Likely to Restore Abandoned Rail Linkage with India

The Bangladesh might restore an abandoned railway connectivity that existed before the partition of India to boost trade and people-to-people contact according to Mahammad Mazibul Hoque, Bangladesh railway minister. The total cost of the proposed project is estimated at Rs. 252 crore. IRCON would lay the new railway track s on both sides of the border. Of the 15 km rail line, five km of tracks fall in the Indian territory and remaining in Bangladesh. The Bangladesh government has launched an ambitious plan to create simultaneous dual-gauge (B.G. and M.G.) railway line to further develop the internal connectivity and also to improve the railway linkages with India

Ref: The Masterbuilder, Oct. 2014, Pg 32

Government Aiming to Complete 34 Rail Projects in North East

Union Government is aiming to complete 34 various ongoing projects of Indian Railways in the northeast over the next 5-6 years that will entail an additional investment of around Rs. 35,000 crore. About Rs. 20,000 crore have already been spent for these projects as on March 31, 2014.

Ref: The Masterbuilder, Oct. 2014, Pg 32

Indian Cabinet Approves Nagpur Metro

India's Union Cabinet granted its approval on August 20 for the first phase of the Metro network in Nagpur, Maharashtra state which is India's 13th largest city with a population of 2.2 million. The initial phase comprises two lines totaling 38.2 km. The north-south line will run for 19.6 km from Automotive Square to the city's international cargo hub and airport, while the 18.6 km east-west corridor will link Prajapati Nagar with Lokmanya Nagar.

The total cost of the project is expected to be Rs 86.8 bn ($US 1.44bn), with the Government of India pledging to provide Rs 15.6 bn in the form of equity and subordinate debt. The project will be implemented by Nagpur Metro Rail Corporation, a 50:50 partnership between the state of Maharashtra and Government of India.

Ref: International Railway Journal, Oct. 2014, Pg 12

Aubagne Launches Zero Fare Tramway

Aubagne, a town of 46,000 inhabitants situated east of Marseille, inaugurated its first light rail line on September 1, 2014. Like town's bus network, no fares are charged for travel on the tram line, making it the first free to use light rail system in France and one of the first in Europe.

The 2.7 km line has seven stations and links the main line station in Aubagne with Charrel. Construction began in early 2013 and the project had a budget of € 166 m including rolling stock. Services operate at 10 – minute intervals using a fleet of 22m long Citadis Compact low – floor LRVs.

The trams have been painted with brightly coloured monstrosities that all speak French and are designed to frighten small children. It is all part of the Tramway Aubagne's safety program.



Ref: International Railway Journal, Oct. 2014, Pg 12

Fibre-Reinforced-Polymer Composites Make Leap from Aerospace to Infrastructure Benefits of FRP Structures

The benefits of composite structures over steel and concrete equivalents include the facts that they are resistant to frost and corrosion are waterproof, need no painting and are much lighter. These attributes result in easier and quicker installation on site and potential savings of over 20% in whole life costs.

A recent example is the new FRP composite road bridge over the River Frome in Frampton Cotterell near Bristol, UK. Assembled at the nearby National Composites centre, its 12 m x 8.9 m 16 t deck was lifted into place in August and is expected to cost 50% less to maintain over its 120 year life.



The new deck – understood to be one of the largest of its type in Europe – consists of triangular glass-fibre-reinforced polyester resin pultrusions with interlocking plate top skins reinforced with carbon-fibre-reinforced epoxy laminates. The project team included client and contractor South Gloucestershire County Council, lead designer Atkins, fabricator CTS Bridges, manufacturer Fibreline and subconsultant Jacobs.

Civil Engineering Vol 167, Nov. 2014, Pg 148

Free Gauge Train

J R Kyushu and Japan Railway Construction Transport & Technology Agency launched test running with the gauge-changing Free Gauge Train prototype on October 19. Built by Kawasaki Heavy Industries, it is derived from two prototypes which were tested in Japan and at the Transportation Technology Centre in USA.

The Series 9000 FGT is designed to run at upto 270km/h on the standard gauge Shinkansen network and 130 km/h on 1067 mm gauge conventional tracks. The lead cars incorporate a carbon fibre reinforced plastic bodyshell, and have dimmable window glass rather than blinds. The train also has lightweight high-voltage electrical components.

The prototype is expected to run for 600000 km over three years to ascertain its suitability for commercial operation and the level of maintenance required. JRTT anticipates that a further five or six years will then be needed to develop and build a series of production train-sets for regular use.

JR Kyushu is planning to use gauge-changing train-sets on Shinkansen services between Hakata and Nagasaki, where an isolated section of high speed line is expected to open in 2022. The 45.7 km section between Takeo-Omen and Ishaya has been under construction for some years, and in 2012 the government authorised work on the 21 km western section from Ishaya to Nagasaki. The gauge-changing train-sets will use an existing 1067 mm gauge line to bridge the gap from Takeo-Onsen to Shin-Tosu on the Kyushu Shinkansen.



Railway Gazette International, Nov. 2014, Pg 12

Road-Rail Fire Engines

In order to respond to emergencies on the underground sections of the Diabolo link to Brussels Airport, Belgian infrastructure manager Infrabel has acquired two road-rail fire-fighting vehicles at a cost of €3m.

To be based at fire stations in Brussels and Zaventrem, the vehicles will be able to travel at up to 40 km/h on rail, carrying a crew of eight as well as 2500 litres of water and 500 litres of foam.

The MAN vehicles have been equipped for fire-fighting duties by Rosenbauer of Austria, and are fitted with the Loctrac ZW 332 road-rail system supplied by Zweiweg of Germany. Specialist equipment for tackling fires in rail tunnels includes additional lighting, infrared cameras and a water spray to protect the vehicle and its occupants.



Railway Gazette International, Nov. 2014, Pg 21

IRICEN DAY
(1st Nov 2014)

1st November is celebrated as IRSE Day. After commissioning of new IRICEN building last year on 1st November, we have started celebrating this day as IRICEN Day i.e. Foundation Day of IRICEN also. There were many activities planned for this IRICEN Day which included one Seminar by Silver Jubilee batch of 1988 exam batch officers. They deliberated on the following themes of the Seminar which was conducted in 2 Sessions on 31.10.14 :

- *Empowerment at field level for efficient delivery of works*
- *Effective Project Management*
- *Managing Water Supply*

Further on the evening of 31st October, a cultural programme was presented by the IRSE probationers of the 2012 batch in which Hon. ME was the Chief Guest. Hon. ME had interacted with Silver Jubilee batch officers and later with FMs during a meeting conducted in the wee hours of 1st Nov. 2014.

Further, following had been the highlights of IRICEN Day 2014.

- Two innovative additions to IRICEN
  - *Souvenir shop containing 6 items*
  - *Open air Gym in the hostel*
- *Escorting of senior officers by young probationers – breaking the ice.*
- *Interaction Session among 1988 batch IRSE officers and present IRSE Batch Probationers.*
- *Formal dress code for the main function on 1st November.*
- *Coffee Table book by IRSE 1988*



Hon'ble Member Engineering Inspecting IRICEN's Laboratory

Glimpses of IRICEN DAY

















Achievers Series Lecture on 12th Nov. 2014



Shri S. M. Roy, CEO L&T and Lanco Infratech, Kolkata delivered a lecture on "The Leader in the Manager" bringing out the essence of leadership vis-a-vis the Manager. He essentially brought out the difference between just being a MANAGER, who usually accepts and manages a status quo & the LEADER who is instrumental in transformational changes in the organization. He explained that in today's world a manager ought to be a leader and add to values in organisation through behavioural changes. Leadership involves setting direction with a vision to be followed and goal to be achieved by motivating and inspiring people and aligning them. Steps involved are leading the Self, a team and ultimately the organization. He brought out that various elements of behavior will lead to belief and add true values. He explained that challenges faced by leaders are to lead by example, create and inculcate values, bring about transformational changes, moderate behavior of people in organization, build trust, ethics, principles to bring about a wholesome and lasting progress not only of the organization but benefit people, society and nation at large.

The lecture was heard by IRSE(P) batches of 2012 and 2013 exam and Integrated course batch along with IRICEN faculty.

Achiever Series Lecture on 22nd Dec. 2014



Sh Radhakrishna, Retd Dy CE of Central Railway was invited to deliver a lecture on 22nd December, 2014 under the Achiever Series of Lectures. He also worked at IRICEN, Pune as Professor. Sh Radhakrishna is Graduate in Civil and Mechanical Engineering and an MBA.

Apart from his technical prowess Sh Radhakrishna has diversified into Vipassana Meditation and is a renowned trainer in that field. Post retirement he has acquired 'Kovid' degree in Sanskrit and Pali and has translated books from these languages into Telugu.

He recounted his experiences in Railways and his passion for innovations. He was the first person to lay a curved switch in Diamond Layout which was later on standardized by Railways. He is a believer in idiom 'where there is a will there is a way'. He gave example of making films on P Way by using donated equipments from UN. For getting help on editing these films from FTTI/Pune he went and met the then Cabinet Minister for I&B and got the orders for all the help. He recounted the occasion when an IRICEN staff needed a surgery costing Rs 25,000 and with great effort he could only collect a donation of Rs 15-16000/-. Nevertheless he tried his luck with the Doctor and he readily agreed to do the surgery for collected amount.

Sh Radhakrishna explained the virtues of Vipasana Meditation. He also delved on the motto of his life ***'Life is an art of keeping oneself in a state of constant growth'***. He himself is a shining example of this looking at post retirement active career in Vipasana and book translations. The translated books on meditation is available free of cost which is a great philanthropic effort.

The lecture was heard by IRSE(P) batches of 2012 and 2013 exam and Integrated course batch along with IRICEN faculty.

Self Supported Curved Metal Roofing Systems

By
Shri M.K.Gupta *
*Shri A.K. Agrawal***
Shri Paramjeet Singh ****

1.0 Introduction:

For years now, metal has been proclaimed throughout the industry as the most versatile roofing material available. The popularity of metal roofing products has increased dramatically over the past decade. In fact, during the last 20 years, a whole new genre of metal roofing materials has hit the market.

Conventionally in Railway structures such as Good Sheds, Workshops, Warehouses, Platform Shelters the roofing material used is Steel Truss with AC sheet or Metal sheet, which poses perennial problem of roof leakage, maintenance, Sheet Replacement and shabby look.

Present Day Metal Roofing is a far cry from the corrugated “tin” barn roofs that leap to mind at the mention of metal. They are high-tech answers to the need for durable, fire-resistant, lightweight roofing .Metal roofs are favored for their fire-resistant qualities, longevity, Low Weight, and speed of installation, low-maintenance, recyclable, predictable and reliable material.

Metal roofing also lends itself well to many design elements currently used in today's architecture. Hips, valleys, slope changes, transitions and dormers are all available to the designer.

2.0 Classification by Spanning Ability:

Metal roofing can be divided into many different classifications based on Spanning Ability, classification by Seam Type, Classification by Method of Attachment to Support and Classification by Slope. But for our purposes of Spanning Ability, we can divide metal roofing into two categories:

I. **Non structural roofing** requires a continuous support or closely spaced Purlins or Channels.

II. **Structural roofing** can span the distance between the supporting roof purlins /Beam by itself, similar to metal decking. It is also Called “Self Supported Roofing”. Today, structural roofing is used in many industrial and commercial applications worldwide.



Fig: Non Structural Metal Roofing



Fig: Structural Metal Roofing (Self Supported)

* CAO/C, C.Rly
** CE/C/MTP, C. Rly
*** DY CE/C, C. Rly

3.0 Self Supported Roofing System (Proflex Roofing) :

The self-supported roofing system – this technology is based on the arch-principle. It is a Self-supported structure without trusses, purlins or ancillary support, with unobstructed clear spans 9 meters to 35 meters.

It provides larger enclosed volumes, free movement & effective handling of goods and higher flexibility in space utilization.

Roofing panels are mechanically seamed (inter-locked) and they are free from holes, nuts, bolts, overlaps or sealants, ensures zero maintenance and are also resistance to extreme weather conditions. Following are the salient features and distinct advantages:

I. Self Supporting Roofing system Based on **Arch Principle without Truss**, Purlins or Ancillary support

II. Can be used up to unobstructed clear span of 9 Mtrs to 35 Mtrs. (Used in Central Railway for New Station Building at LTT for 15 Mtr Span and two workshop Shed at Matunga, Mumbai for 19 mtr and 25 Mtr span)

III. Roofing panels are **mechanically seamed** (Interlocked) and they are free from Holes, nuts, bolts overlaps and sealants, ensures zero maintenance and also resistance to extreme weather conditions.

IV. This Unique Mechanical sealing ensures **100% Leak Proof** Roofs

V. Economical compared to Conventional Roofing Systems.

VI. Faster pase of Execution and Erection due to Innovative technology of on-site panel formation and Installation giving incredible installation speed of around 2000 sq. mtrs in 12 hrs.

VII. Require less Maintenance during service period as it is Resistant to Damage and Corrosion

VIII. **No Bird nuisance** and hence provides cleaner and more hygienic Building.

IX. Distinguished Arch Shape and Flexibility of colors result in strong **aesthetic appeal**.

4.0 Material and Technology:

Proflex Roofing system uses High Quality, High Grade, Pre-Coated Galvalume Sheet of Thickness 0.8 mm to 1.6 mm**.** Galvalume steel is the ideal material for metal Roof systems its 55% aluminum- 45% zinc coating. GALVALUME is a flat rolled steel sheet coated with alloy of Aluminum & zinc, produced by a continuous hot dip process. It has an attractive appearance and is widely accepted as a preferred alternative over both galvanized steel sheets and Aluminum coated steel sheets used mainly in Roofing, Cladding, Gutters and Accessories.
Another advantage of GALVALUME is that it is four times more corrosion resistant than Galvanized steel in similar environmental conditions.

Grade 550 Steel used is known as High tensile steel with a minimum tensile strength of 550 MPA. This will not fly off when a strong wind blows unlike commercial quality or low tensile steel.

When properly installed, Galvalume steel panels shed rain and eliminate ponding of water. It exceeds a solar reflectance requirement that's what makes it perfect for all kinds of buildings and all types of climates. The specifications are as under:

Base Metal	Cold Rolled Structural Quality Steel In Coil Form, Coil Width : 914 mm
Steel Grade	GRADE D: 350 MPa Yield Strength. Min.
Steel Thickness Range	0.8 mm To 1.60 mm (Base Metal Thickness)
Bare Galvalume Coating	AZ 150, 150 Gms./Sq. M. Alu-Zinc Coating (55% Al. & 45% Zn.)
Colour Coating & Testing Methods	Top Side – Suitable for Roll-Forming, 20 microns total dry thickness, Pencil hardness HB – 2H. NCCA Standard T-Bend Test method or ASTM D4 145-83 Back Side – 12 microns total dry thickness, epoxy primer and polyester wash-coat.
Weight Per Sq. Mtr.	Thickness:0.8mm 0.9mm 1.0mm 1.1mm 1.6mm Weight Kg/Sq Mtrs :10k 1.1 12.5 13.9 20
Coil Weight	Approx. 3.75 Tons
Standard	ASTM A792 (American Society for Testing and materials) Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

5.0 Primary Sheeting Material :

High Quality, High Grade, Pre Coated Galvalume Sheet. It comes in Cold Roll Coilsof width 0.914 Mtrs, Length varying from 400 to 450 Mtrs, each roll weighing approx. 3.5 Tonnes.



Fig: Cold Rolled Galvalume Sheet Rolls



Fig: Pre Painted Galvalume Sheet Rolls

6.0 Fabrication and Panel Formation:

The thickness of the sheet is determined from the span. For 15 Mtrs span, thickness is 0.9mm, for 20 Mtrs, its 1.0mm and for 25 Mtr span 1.2 mm. The Panel formation is done as per the required length and Curvature at site. The Sheet from the roll is passed through a Hydraulic Profile machine (MIC Machine) to give it the Trapezoidal shape and cut to the required length. In this process the width of the sheet reduces from 0.914mm to 0.61mm and weight per Sq Mtr increases by 50%. After the profiling, these panels are passed through another Hydraulic machine for Pre Curving as per the design. The rise of circular portion at the center is approximately 1/5th of span.



Fig: MIC Profiler Machine



Fig: Trapezoidal Shape Pannels

7.0 Mechanically Seaming

Mechanical seaming is like 'zipping up' of a rolled metal panels together using a Mechanical Seaming Tool to create the leak proof attachment.

Three Roofing Pannelsare **Mechanically seamed** (Interlocked) at site along with the Light fixures

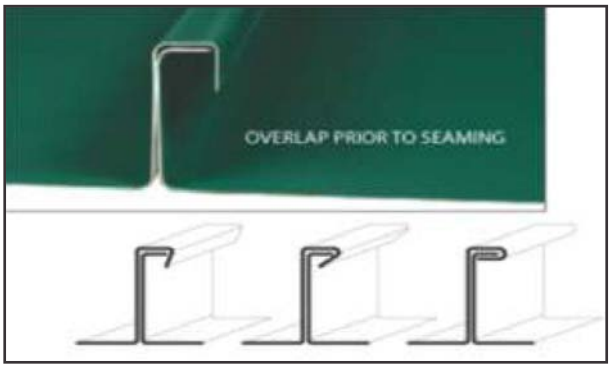


Fig: Sketch of Mechanical Seaming



Fig: Mechanical Seaming Tool

and hangers. These and they are free from Holes, nuts, bolts overlaps and sealants which ensures zero maintenance and also resistance to extreme weather conditions. Hanger, if any needed for lighting etc are also fixed in this Seam.

8.0 Execution and Erection:

Pre Curving and assembly of Sheets is done at Site which are Erected by Road Crane. The Process allows



Fig: Launching of Pre Assembeled Pannels

High Speed Erection of Roofing Sheets giving incredible installation speed of around 2000 sq. mtrs in 12 hrs. After Erection , it is bolted with the supporting Structure by Self Splitting screws or Nuts& Bolts.

9.0 Fixing of Pre Curved Sheets with Main Structure:

The Pre Curved Proflex Sheet, after launching is fixed at the supporting structure or eavewith self splitting High



Fig : Mechanical Seaming After Launching

Tensile Screws or Nuts & Bolts. In case of single span, we need side /End Support with gutters for collection and disposal of rain water. In case of multiple spans the center support with gutter is required. These supports with gutters can be RCC or Steel.

9.1 Support Arrangement: Steel Gutter with Runner Plate:

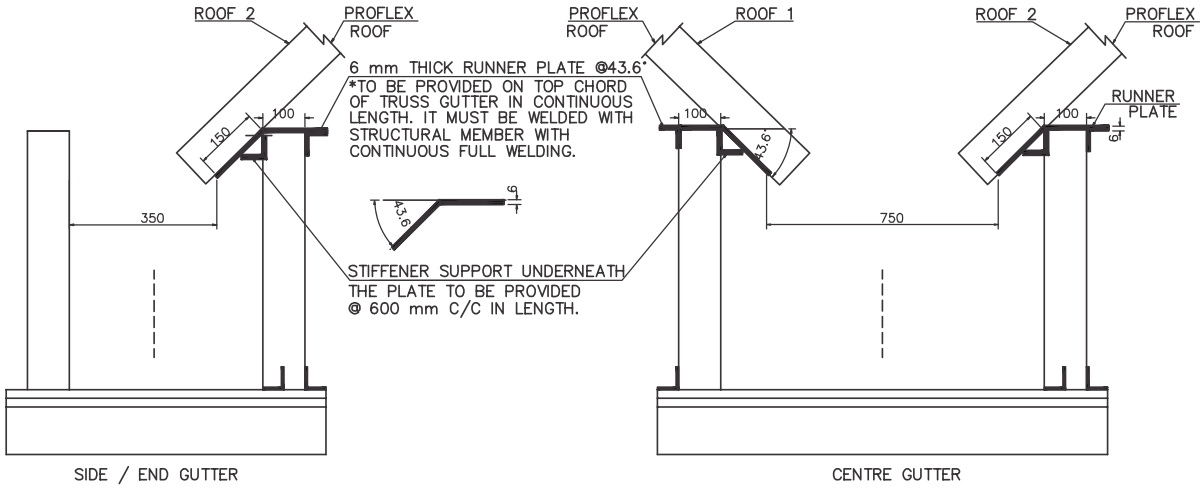
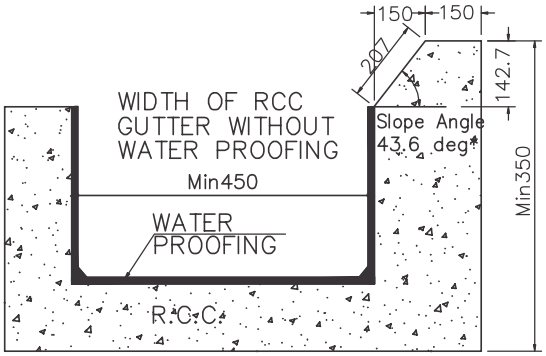


Fig: Steel Gutter with Runner Plate



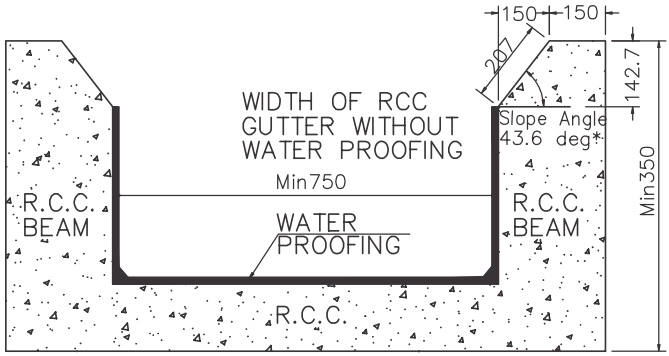
Fig: Centre Steel Gutter with Runner Plates on Both Side

9.2 RCC Gutter with Slope



SIDE/END GUTTER

Fig: End RCC Gutter



CENTRE GUTTER

*THIS SLOPE ANGLE IS FOR BUILDING
WHERE ARCH RISE IS SPAN/5

Fig: Centre RCC Gutter

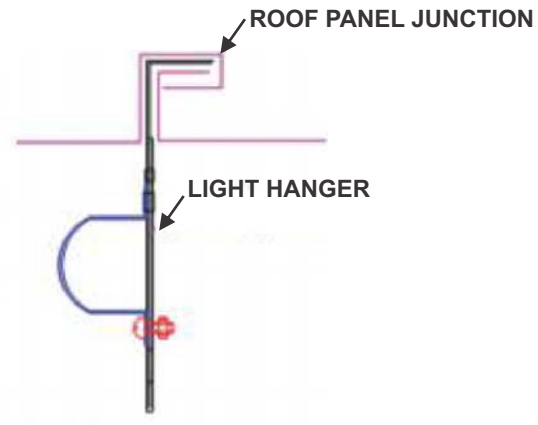




Fig: RCC Gutter with Fixing Arrangements.

10.0 Hanging Arrangements from Curved Sheets:

Hanging arrangements for fixtures can be fixed during Mechanical Seaming of the panels. These hanging arrangements are seamed in the pre curved panels by seaming Tool at the required Location. These hangers are used for hanging lights and other fixtures.



HANGER FIXING
JUNCTION DETAIL



Fig: Sketch and Photos Showing the Hanger Arrangement



Fig: Sketch and Photos Showing the Hanger Arrangement.

11.0 Lighting and Ventilation:

For the Natural lighting, proflex sheet Roof is fitted with 2mm Thick transparent Poly Carbonate Sheets in the designed length and spacing. This fixing is done by cutting the Proflex Sheet and fixing the Flat Polycarbonate sheets. This arrangement makes the working area well lit during the day time and helps saving electricity cost.

For the Ventilation, 65cm dia Turbo Ventilators which are self rotating, are provided at top of Proflex Roof which throws out the hot air and keeps the covered are fully ventilated. These ventilators do no require electricity.



Fig: Lighting Arrangement with Poly Carbonate Sheet.



Fig: Turbo Ventilator at Roof Top.

1ST CASE STUDY

Construction of New LTT Station Building (Span 15 Mtrs)



Central Railway Construction Department has used Innovative Approach in successfully using the Self Supported Curved Metal Roofing Systems in Public Place at New Station Building at LTT, CST Mumbai of size 150mtrx30 mtr. The Span of Proflex Curved roof is 15 Mtrs.

Cost of Conventional Roof with Steel Truss and Pre Painted GI Sheets

•	Total Area of Roofing	-	4500 SqMtr.
•	Cost of Roofing with Steel Truss and Pre painted GI Sheets	-	Rs 6500 / SqMtr.
•	**Total Cost of Roofing**	**-**	**Rs 2,92,50,000**

Cost of Proflex Curved Roof: (Span 15 Mtrs, Thickness 0.90 mm)

•	Total Area of Roofing in LTT	-	4500 SqMtr.
•	Total Area of Roofing with curved profile	-	5033 SqMtr.
•	Cost of Proflex Sheet Roofing	-	Rs 2304/ SqMtr*
•	**Cost of Proflex Roofing**	**-**	**Rs 1,15,96,000**

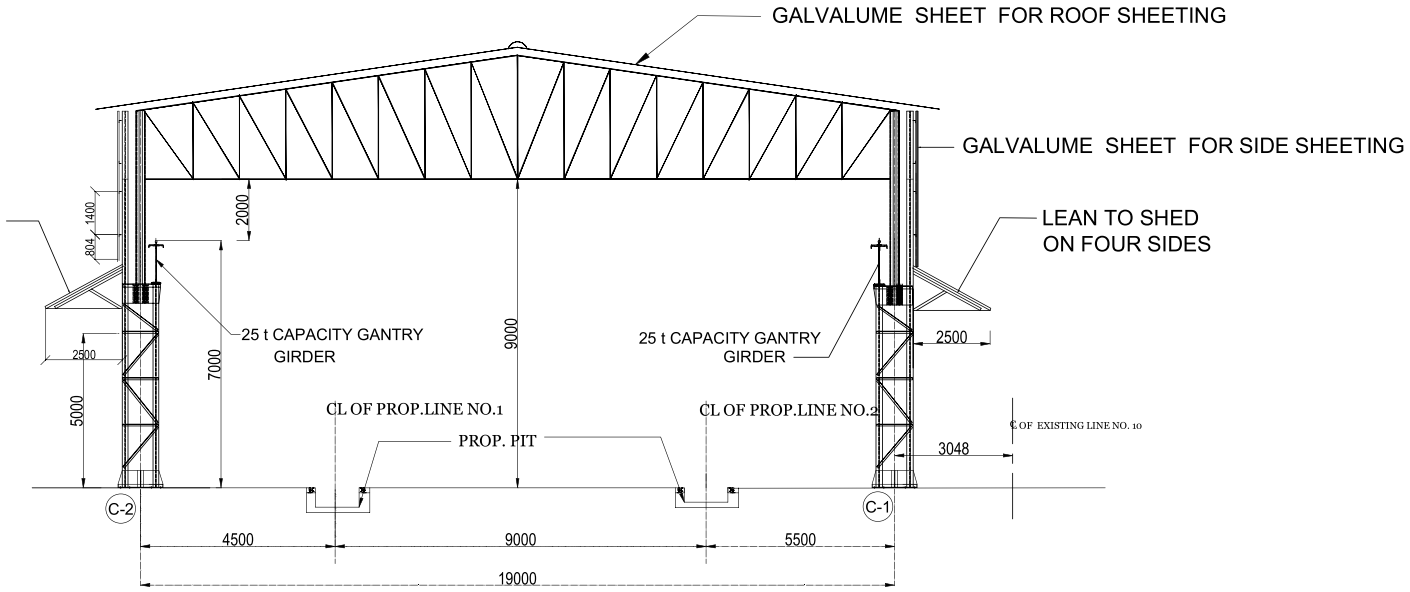
* The current cost of proflex sheet has been adopted for calculation, as the work has been executed in 2009.

Saving in cost: Rs 1,7654,000 for the area of 4500Sq Mtrs. i.e. Rs 3923 per Sq Mtrs.

2nd CASE STUDY

IDLI Shed at Matunga Workshop (Span 19 Mtrs)





One Workshop shed, named IDLI Shed has been constructed with 2 Pit Lines and Gantry Girder crane in Matunga Workshopof Mumbai Division, Central Railway. The size of the shed is 19 mtrs x146 mtrs. Initially it was designed with Steel Truss and Pre Painted GI sheets.

Cost of Conventional Roof with Steel Truss and Pre Painted GI Sheets

- Total Area of Roofing - 2565 SqMtr.
- Cost of Roofing with Steel Truss and Pre painted GI Sheets - Rs 7230 / SqMtr.
- **Total Cost of Roofing** **-** **Rs 1,85,44,950**

Cost of P Aluminum proflex Curved Roof: (Span 19 Mtrs, Thickness 0.90 mm)

- Total Area of Roofing - 2565 SqMtr.
- Total Area of Roofing with curved profile - 3027 SqMtr.
- Cost of Proflex Sheet Roofing - Rs 2304/ SqMtr*
- **Cost of Proflex Roofing** **-** **Rs 69,74,200**

Saving in cost : Rs 1,15,70,750 for the area of 2565Sq Mtrs. i.e. Rs 4511 per Sq Mtrs.

3rd CASE STUDY

Paint Shop Shed at Matunga Workshop (Span 25 Mtrs)



Paint Shop Shed of size 25mtrsx48.8 Mtrs. has been constructed Matunga Workshopof Mumbai Division, Central Railway. Initially the shed was designed with Steel Truss with two spans of 12.2and Pre Painted GI sheets, but later canned to single span of 24.4 mtrs with self supported Proflex sheet roofing. The cost comparison is as under:

Cost of Conventional Roof with Steel Truss and Pre Painted GI Sheets

•	Total Area of Roofing	-	1220SqMtr.
•	Cost of Roofing with Steel Truss and Pre painted GI Sheets	-	Rs5242 / SqMtr.
•	**Total Cost of Roofing**	**-**	**Rs 63,96,250/-**

Cost of Proflex Curved Roof:: (Span 25 Mtrs, Thickness 1.20 mm)

•	Total Area of Roofing	-	1220SqMtr.
•	Total Area of Roofing with curved profile	-	1403SqMtr.
•	Cost of Proflex Sheet Roofing (Thickness 1.2mm)	-	Rs 2525/ SqMtr
•	**Cost of Proflex Roofing**	**-**	**Rs 35,42,575/-**

Saving in Cost : Rs 28,53,675/- for the area of 1220Sq Mtrs. (Span 25 mtrs) i.e. Rs 2340 per Sq Mtrs.

(The cost saving is less because the initial design of thr structure was with 2 spans of 12.2 mtrs. In curved Roof it was kept as single span od 25 Mtrs, which required higher thickness of Proflex sheet)

12.0 Other Applications:

This curved proflex roofing system can be used in Workshops, Warehouses, covered public places.



Fig: Warehouses



Fig: Workshops



Fig: Public Places

13.0 Non Structural Roofing Systems:

While extending the Platform shelters on Navi Mumbai stations on Harbor and Trans Harbor Line, the Non Structural Metal roofing sheets as been used on Koparkhairane, Rabale, Airoli, Nerul,Sanpada and Juinagar stations.

The Galvalume sheets of angular interlocking standing seam trapezoidal rib profile roofing sheet with unique Clip Lock system for holding the sheet , has been fixed on steel Truss/Purlins in different shapes.



Koparkhairane



Nerul



Juinagar



Sanpada



Airoli

KalZip System

Kalzip is a multi-purpose, multi-component system offering a wide range of solutions and finishes for roofs, façades and the entire building envelope.





Fig: Kalzip System Roofs

Kalzipis a **Non structural roofing** requires a continuous support or closely spaced Purlins or Channels.

Kalzipalu minium standing seam sheets are able to take the profile of supporting structure to meet the most demanding construction and design requirements to create roofs and facades that successfully combine out standing functionality with stunning aesthetics. The design potentials virtually limitless – from the discreet to elaborate, combining sophisticated elegance with contemporary design. Following are the features.

- Can be flexibly adjusted to suit the layout, geometry and dimensions of any building.
- Extremely strong and lightweight.
- Ideal for large spans and renovating old roofs.
- Continuous lengths of 150 meters and more, when production takes place on-site.
- A non-penetrative patented clip attaches the sheets to the substructure. These clips are locked into the seam to ensure smooth thermal cycling of the external sheet over the clip head whilst facilitating outstanding spanning capacity under high wind loading.
- Kalzip aluminum sheets can be used as a lightning conductor in accordance with International Standard ENV 61024-1. Durability and economy
- Highly resistant to corrosion.
- Non-sensitive to UV rays, resistant to micro-organisms and 'ageing'. Valuable ecological and sustainable properties
- The raw material that contains aluminum - bauxite - is the third most commonly occurring element in the earth's crust with at least 300 years of current reserves left at the present rates of usage – a figure that is improved by the increasing amount of aluminum that is being recycled.

14.0 Advantages of Self Supported Curved Roofing Systems.

Central Railway Construction organization has used Self Supported Curved Roofing Systems (Proflex) with three different spans of 15mtrs, 19 mtrs and 25 Mtrs successfully, which has given following

I. Since it's a Self Supporting Roofing system Based on **Arch Principle without Truss**, Purlins or Ancillary support, it's very Economical compared to Conventional Roofing Systems. The %age reduction in cost achieved for various spans is as under:

Sr No	Span in Mtr.	Roofing Cost in Rs/Sq Mtrs		Saving	% age Saving
		Conventional	Curved Proflex		
1	15	6500	2304	4196	65%
2	19	7230	2304	4926	68%
3	20	5242	5242	2717	52%

II. Faster pase of Execution and Erection: The Curved Proflex roof of LTT Station Complex (4500 Sq Mtrs) was erected in 15 Days, IDLI Shed Matunga (2774 Sq Mtrs) was erected in 4 Days, Paint Shop Curved roof (1220 Sq Mtrs)was erected in just 3 days including on-site panel formation and Installation of curved Roof. In conventional Steel Truss roofing, it takes months for Fabrication, erection and Sheet fixing.

III. It gives **100% Leak Proof** Roofsas Roofing panels are **Mechanically seamed** (Interlocked) and they are free from Holes, nuts, bolts overlaps and sealants.

IV. Distinguished Arch Shape and Flexibility of colors result in strong **Aesthetic Appeal**.

15.0 Recommendations:

Curved Metal Roofing system of proflex is most suitable for Workshops, Warehouses, covered public places of span varying from 9 mtrs to 35 mtrs. Proflex roofing is very economical, leak proof, Low maintenance and aesthetically appealing roof. Installing Proflex Roofing system is a specialized job, therefore following precautions may be taken.

1. In case, the agency supplying the patented item is not the contractor to whom the work is assigned and these items are being procured by the contractor, an agreement/MOU is to be entered between the main contractor and the party supplying the patented items, clearly bringing out the responsibility of the party supplying such patented items.
2. The agency supplying the patented item shall provide complete details/specifications/ drawings of the items including the manner in which it is to be used.
3. During the installation of such patented items, authorized representative of the firm supplying such patented/propriety items shall be present and after the execution of work, a certificate to be issued by the firm supplying the patented item indication its proper installation.



Lokmanya Tilak Terminus CSTM



IDLI Shed Matunga Workshop

Fast Track Project Implementation and Management - Experiences and Overview

By
Rajesh Prasad *

1.0 Introduction:-

Project management is nothing but the processes and body of knowledge of specific goals, tools and techniques used to bring structures and planned order to implement projects successfully. Every project is unique in nature having own goals, objectives, budgeting schedules, risk factors involved etc. Normally a typical Railway project takes years for completion. In the unit of Chief Project Manager (M)/RVNL/Kolkata, the Diesel Loco Component factory, Dankuni and Haldia DMU factory were completed in record time and handed over to the Railways. The final bills have also been paid and completion reports drawn. This is normally rare in our project management system, be in any Government or PSU organization. Another project i.e. Electric Loco factory at Dankuni was transferred to RVNL in May, 2012 and physical work commenced from December, 2012 and in less than 2 years of time more than 90% work worth Rs 180 crores has been completed and left over work shall be completed by 30th November, 2014. In this paper, efforts have been made to talk about the projects, project implementation, fast tract execution, importance of fast track execution along with the experience of various fast track projects which have been successfully implemented or substantially completed in record time.

2.0 Status of Railway Projects:-

The most authentic figures and status can be seen from the various paras of budget speech of Hon'ble Minister for Railways delivered on 08.07.2014 and the details are as follows:

"Para – 18: There has been focus on sanctioning projects rather than completing them. In the last 30 years, as many as 676 projects were sanctioned worth Rs 1,57,883 crore. Of these, only 317 projects could be completed and 359 projects remain to be completed which will now require as much as Rs 1,82,000 crore."

"Para – 19: In the last 10 years, 99 new line projects worth Rs 60,000 crore were sanctioned out of which only one project is complete till date. In fact, there are 4 projects that are as old as 30 years, but are still not complete for one reason or another. The more projects we add, the thinner we spread our resources and longer it takes to complete them.

I am sure, if this trend is allowed to continue, many more thousands of crore will get spent yielding hardly any returns."

"Para – XX: Railways have been suffering heavily because of time overrun and cost overrun due to poor project management. In order to overcome delays in project execution, I propose to set up Project Management Group at the level of Railway Board. Similarly, to expedite the projects at the ground level, a Project Monitoring & Coordination Group consisting of officials of State Government, Railways and professionals will be set up."

The above paras simply indicate how the projects in general have been managed and implemented in Indian Railways and certainly the health of Project Management has really been poor.

3.0 Importance of Fast Track Implementation:-

Once the project is conceived and sanctioned, if the implementation is not done in time then it could lead to various problems as indicated under:

3.1 The cost over-run: It is an unanticipated cost incurred

* *Chief Project Manager(M)/RVNL, Kolkata*
Course No. 14308

in excess of the budgeted amount due to under estimation of the scope and actual cost. Due to under estimation/ non-assessment of actual scope, the cost over-run in most of the Railway projects over-run to the tune of more than 50 – 100% in general. Here, the cost over-run should be distinguished from the cost escalation which is used to express an anticipated growth in a budged cost mainly due to inflation.

3.2 Time over-run: It is nothing but an unexpected time incurred in excess of estimated/ allocated time. Almost all the projects in Railways faces the time over-run.



Projects having Cost Over-run and Time Over-run.

3.3 Contractual complication: Because of the time over-run and cost over-run there is always possibility of contractual complication and many a times it goes to a vicious cycle and disputes remain unresolved. Timely completion of projects, timely preparation of completion reports are very rare.

Typical example of the time over-run and cost over-run: Bandra-orly sea link – cost escalation was from Rs 300 crores to Rs 600 crores with 5 years of delay. Similarly construction of Opera House was delayed by more than 10 years and cost escalation was $ 7 million to $ 102 million i.e. by 1400%.



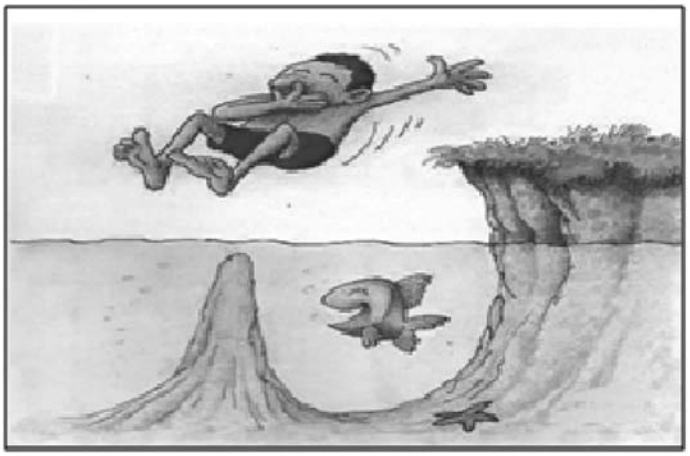
4.0 Project Implementation on Fast Track:

For implementation of projects in fast track, it is necessary to understand the various aspects related to it.

Fast track project Management may lead to ……

4.1 What is Project ?:- It simply means converting vision into reality. A set of activities are undertaken to meet the specified objectives for the changes. The various features of typical projects are as under:

- Temporary - have a definite beginning and an end.
- Unique – no two projects are identical.
- Predefined goals & objectives – financial/social/ economic.
- Budgets & schedules – prefixed budget and time frame.
- Uses Resources & Manpower – both are limited.
- Quality/ performance - determined at beginning.
- Face Risks – known and unknown risks
- Have a project life cycle – many phases from start to end.



4.2 Project Life Cycle (PLC):-

- A PLC is a sequence of phases from project start to project end – a start, a middle and an end.
- Each phase associated with major processes and deliverables.
- Length of each phase will vary.
- Start or Concept phase, Intermediate phases & a Closeout phase.
- Number of phases in PLC may vary depending on the kind of projects.

4.3 Project life cycle – The project life cycle can be defined through the various stages as indicated under:

Concept stage

Development stage

Definition stage

Design stage

Procurement stage

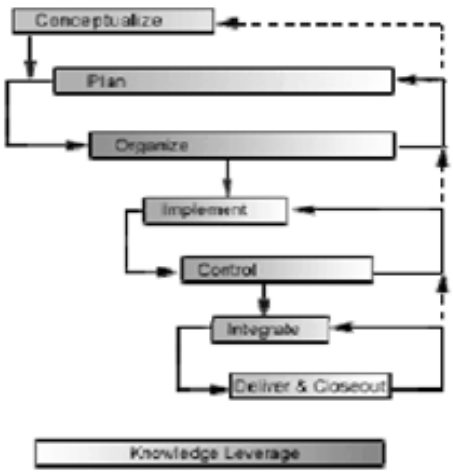
Construction stage

Commissioning stage

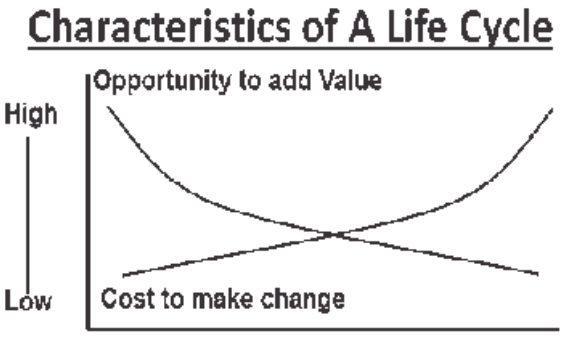
Operation stage

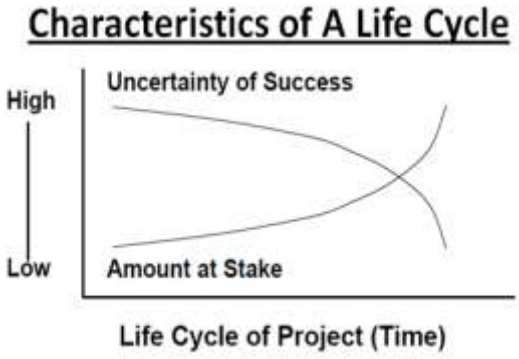
The various generic phases can be defined through the following flow chart:

- **Conceptu**
- **Plan**
- **Organize**
- **Implemen**
- **Control**
- **Integrate**
- **Deliver &**
- **Knowledg**



At the beginning of the project, the possibilities of change of scope is high but there is much more of uncertainty as explained below:



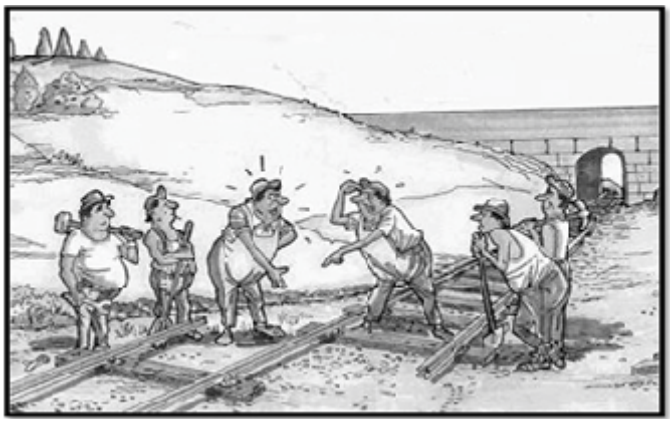


That is why it is necessary to freeze scope, drawings, etc. in the beginning. These were done for the projects implemented and cited in this paper. In fact along with LOA most of the drawings were also issued to the agency.

4.4 Project Management :-

Project Management is the processes & body of knowledge of specific skills, tools and techniques used to bring structure and planned order to deliver projects successfully.

Project Management is the most efficient way for implementing unique changes.



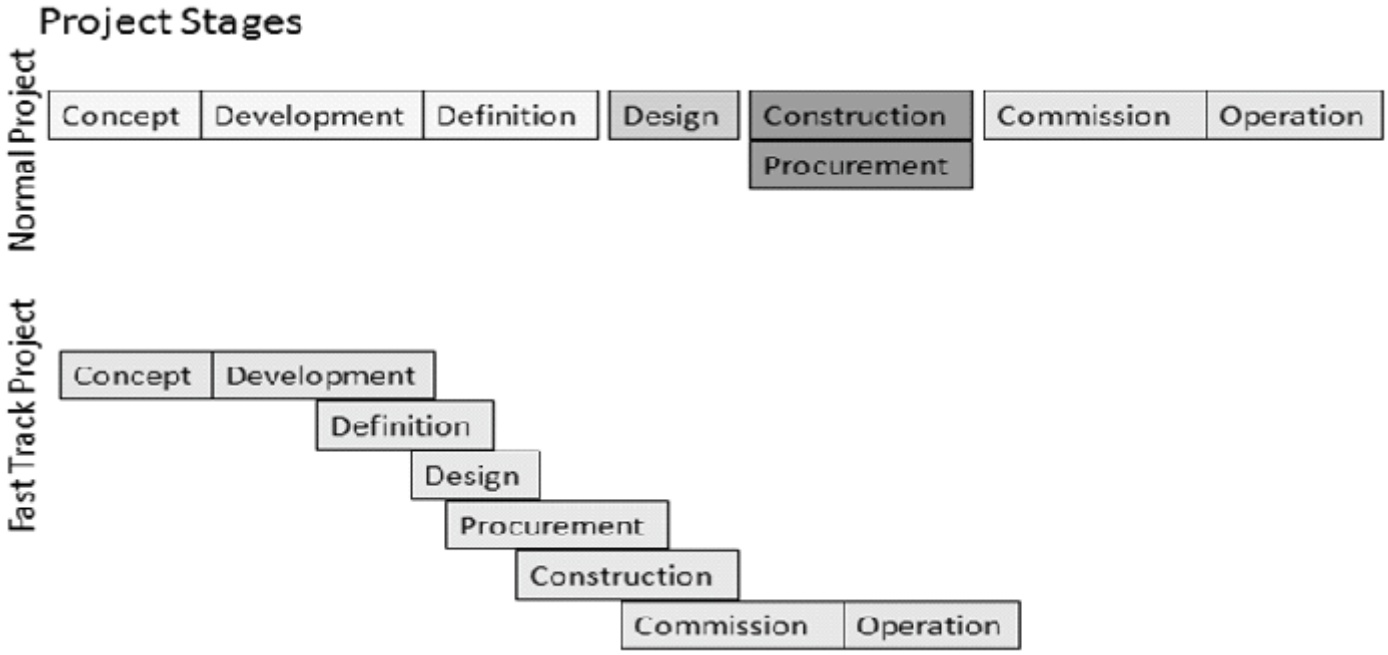


Team work and Project Management

4.5 How the Fast Track Project is Different Than a Normal Project?

The fast track implementation needs the management group to have aggression, killer instinct and passion for implementation. The team and the leader need to be fearless in taking decisions. This is possible only when the project leader and team are neat and clean and people down the lines respect

each other. There are various activities which are required to be executed in parallel rather than in series as indicated in the following graph:



4.6 Fast Tracking of Construction Projects:

Important steps which can be followed and have been followed for ensuring fast track implementation in construction projects include the following:

Finalizing the scope of project by involving all concerned stake holders. For example in case of the work of setting up an industrial unit, the detailed layout plan showing the sizes of the structures, road, etc. requires to be approved by all concerned including production experts, HR experts, architects, electrical engineers, etc. This is the one of the most important activity and all concerned stakeholders are required to participate to freeze this drawing.

The items not included in the scope of the work must be clearly indicated. For example, some of the electrical works or mechanical works may not be included in the scope of work required to be executed for the time being. In such a case, work has to be carried out taking cognizance of the future work which would be executed. For example, flooring has to be executed leaving pockets for the M&P to be installed later on.

All statutory clearances have to be ensured beforehand such as forest clearance for tree cutting, environmental clearance, factory inspector clearance, etc.

The design and drawings must be got prepared to sufficient accuracy so that tenders for construction can be floated in such a way that there would not be much deviations in execution.

Availability of site for work has to be ensured before a construction agency is deputed to prevent idling of resources and ensure fast execution.

If there are several utilities required to be shifted, it is prudent to ensure diversion of utilities before deputing main agency for construction work.

Deployment of project management team, i.e., the engineer for the work.

During execution of work, the adequacy of funds has to be ensured as timely payments are mandatory condition for fast implementation.

Quality Assurance and Control must be an integral part of the project management. In absence of it, there would be poor quality, litigations and hence poor progress of execution.

Proper monitoring of the project at various levels. Such as constant supervision and monitoring by site officials, weekly monitoring by project coordinators and director, monthly reviews by higher management.

Ensure speedy resolution of conflicts. A dead lock would slow down the fast track work.

5.0 Experience :-

5.1 Dankuni Diesel Component Factory:-

The work of setting up of Diesel Loco Component factory at Dankuni was transferred to Rail Vikas Nigam Limited (RVNL) by Railway Board for fast track implementation for Civil, Electrical & Telecommunication works on 30th April 2010. Subsequently, the construction contract was awarded by RVNL on 26th July 2010 and the commencement of the work was done on 7th August 2010 by the then Hon'ble Union Minister of State for Shipping. The first phase of the factory comprising of feeder and underframe shops, compressor room and store was handed over to Eastern Railway in October 2011 and the fabrication of underframe of high horsepower diesel locomotives was also started by Eastern Railway. The remaining portion of the factory was completed in May 2012. In this portion, the machining of crankcase of high horsepower diesel locomotives was started subsequently by the Eastern Railway.

The said contract for construction for Civil, Electrical & Telecommunication works was awarded on a turnkey basis at a cost of Rs 84.21 crores. The procurement of machinery & plants was done by the Mechanical Department of Eastern Railway. The salient features of the above mentioned factory are as follows:

- Total area of factory – 85,500 Sqm. (21 acres)
- Covered area – 23,682 Sqm. (28% of total area)
- Covered sheds – 12,528 Sqm
- Buildings – 7,122 Sqm
- Boundary wall length – 2080 metres
- Length of road inside factory – 1,100 metres
- Overhead water tank – 50,000 gallons (height 20 metres)

The various timeframes followed and achieved are as under:

Foundation stone laid by the then Hon'ble Minister for Railways.

- Work intended to be transferred to RVNL : 15.04.2010
- Work sanctioned by Rly. Board and formally transferred : 30.04.2010
- Tender floated on : 30.04.2010
- Tender opened on : 10.06.2010
- LOA issued on : 26.07.2010
- Commencement of work : September, 2010 (after mobilization period)
- Completion of work (Phase-I) : 20.10.2011
- Completion of work : 31.05.2012

The final bill of the said project has been paid long back and the completion report has also been drawn.









Few Pictures of DLCF, Dankuni

5.2 Haldia DMU Factory:-

The then Hon'ble Minister of Railways had announced in the Railway Budget Speech for the year 2011-12 that new DMU factory would be set up in Sankrail to meet the unmet and growing demand of DMUs in Indian Railways. Accordingly, a committee was formed to work on the project. Subsequently, in the year 2010-11 (Supplementary Grant – Item No. 67), a project for DMU factory at Sankrail for South Eastern Railway was sanctioned to manufacture/refurbish the DMU coaches. The work was transferred to Rail Vikas Nigam Limited (RVNL) in August, 2010 and the contract was awarded in December, 2010. Due to non-availability of land at Sankrail, Railway Board transferred this project to Haldia vide Railway Board's letter dated 02.02.2011.

The foundation stone for the DMU factory at Haldia over an area of 45.7 acres was laid by the then Hon'ble Minister for Railways on 04.02.2011. This could have resulted into abnormal delay in implementation, but Rail Vikas Nigam Limited, Kolkata PIU awarded the contract on turnkey basis on 20.07.2011 with target date of completion as November, 2012 having cost of the project as Rs 115 crores. The previous contract was closed without any financial liabilities. The main feature of the project was pre-engineered buildings for faster execution over a shed area of more than 13000 sqm. The scope also includeed a huge area of land development, provision of DMU factory yard and track connectivity from the existing line, construction of road outside the factory, provision of drainage system, etc. The salient features, in brief, of the project are as under:

- Pre-engineered buildings & sheds : 13110 sqm
- Porta blocks for canteen, administrative building, toilet blocks, etc,. : 678 sqm
- Flyash filling for land development : 185000 cum
- Coarse sand filling for road : 40000 cum
- Silver sand/earth filling over flyash : 100000 cum
- Earthwork filling for track : 37000 cum
- Railway track : 4.5Tr.Km (including 10 Nos.of turnouts)
- Hume pipes (750 mm & 450 mm dia) for drainage system. : 1350 m
- EOT crane (15 T) : 1 No.
- EOT crane (35 T) : 2 Nos.
- Traversers : 2 Nos.
- Load test box : 1 No.
- Electrical sub-station : 1 No.

The factory has been completed in record time of 18 months time schedule for the said project was as under :

❒	Work Transferred to RVNL	August,2010
❒	Contract Awarded for Factory at Sankrail	Dec,2010
❒	Factory Shifted to Haldia	02.02.2011
❒	Foundation Stone Laid At Haldia	04.02.2011
❒	Tender Closed for Factory At Sankrail	17.02.2011
❒	Tender Floated for Factory at Haldia	18.02.2011
❒	Turnkey Contract Awarded For Factory At Hadia	20.07.2011
❒	Work commenced after initial mobilization	Nov, 2011
❒	Boundary Wall Along Peripheral road constructed	Mar,2012
❒	Peripheral road constructed	Apr,2012
❒	Major Filling Work Completed (about 3 lac cum)	Apr,2012
❒	Furnishing & Assembly Shop, ESS, Porta Blocks	Oct,2012
❒	Track work including Take off Point Insertion	Oct,2012
❒	Erection of Traversers & EOT Cranes	Nov,2012
❒	Electrical and S & T work	Dec,2012
❒	Joint inspection & Handing Over	April, 2013



Few Pictures of the DMU Factory, Haldia

5.3 Electric Loco Factory, Dankuni:-

For the purpose of manufacturing of 900 HP electric locos, the work was transferred to RVNL on 07.05.2012 and the contract was awarded and physical works commenced from December 2012. The total cost of the project is Rs 180 crores and the work is likely to be completed by November, 2014 i.e. in about 2 years of time. The Railway Board targets vis-à-vis progress is indicated in the table below:

i)	Finalization of scope of the work and transfer by Railway Board by 30.04.2012	The work was transferred to RVNL by Rly. Board on 07.05.2012
ii)	Completion of soil, investigation, survey, sanction of detailed estimate & BOQ by RVNL by 31.05.2012	Detailed estimate & BOQ work sanctioned on 23.05.2012
iii)	Calling of Tender by RVNL by 15.06.2012	Tender was called on 28.05.2012
iv)	Contract to be awarded and the work to commence in October, 2012 with date of completion of 2 years	Letter of acceptance issued on 02.10.2012 with time of completion of 18 month only including mobilisation period of 42 days



(Few Pictures of Electric Loco Factory, Dankuni)



6.0 Management Tools Followed for the Implementation of the Above Project :-

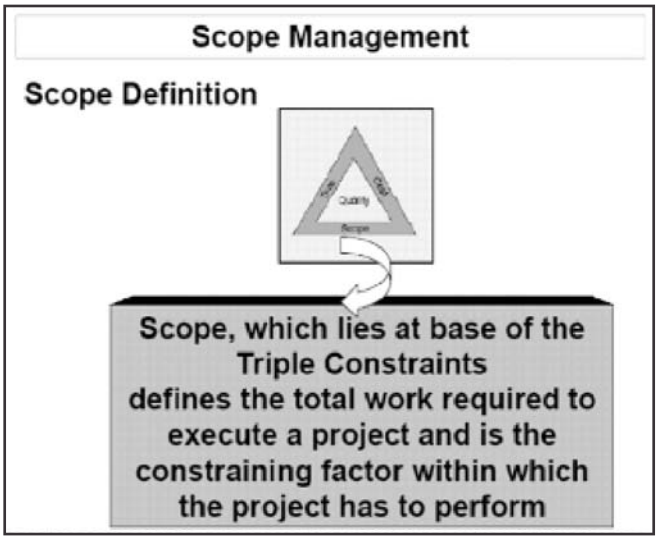
Work Programme :- A detailed work programme was made for completion of the various activities matching the requirement of key dates provided in the contract agreement.

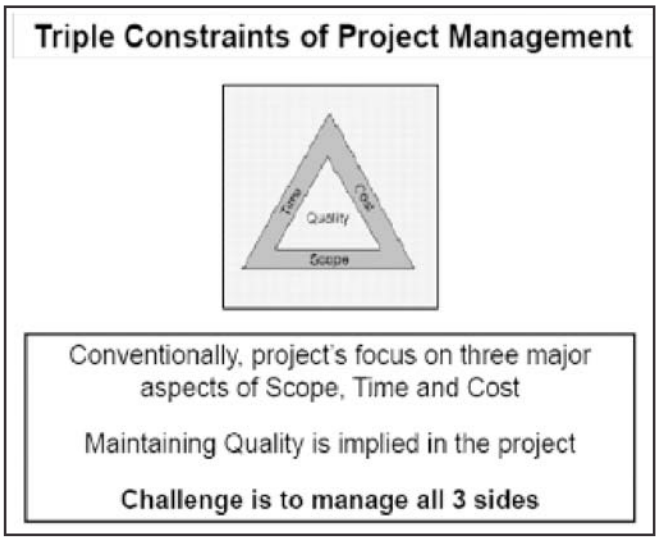
- Drawings were made, concluded and frozen well in advance.

- 3 months rolling programme and monthly programmes were made by the agency matching the requirement of work programme.
- Weekly review meeting and targets were fixed for achieving intermediate goals to address constraints, resource mobilization, etc.
- Microsoft Project was used for monitoring the projects, dash board charts were also prepared for better appreciation. (Annexure –II,III)
- REMS – RVNL has introduced a remote eye monitoring system and the PMC/RVNL Supervisors have been provided with mobile phones with facility to upload pictures of the work site. This enables the officials and management to monitor the remotely located site in real time through website which is protected with password. (Annexure –IV)
- Quality Management- Detailed quality assurance programmes & quality control plans were made for all the projects. One of the GMs during his inspection recorded in the inspection note about the quality and asked the officials of other Railways to visit for the quality control measures adopted.



7.0 Constraints of Project Management and Scope Management :





Project Manager and project team must have clear understanding of the scope.

Scope covers two aspects :

- The product or service to be delivered by project
- The project work that will have to be done to successfully deliver the product or service.
  In the above cited projects, all efforts were made to freeze the scope of work beforehand. The exclusions from the scope were also clearly informed.

8.0 Time Management and Cost Management

Time Management involves the following:

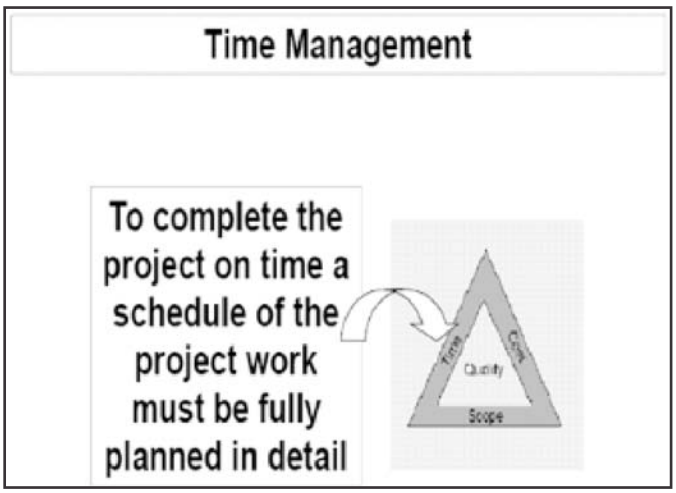
- Work packages are broken down to activities that are used to estimate, schedule, assign, implement and control project work.
- Project schedule is developed for the total work required to be done to plan and control the time.
- Time buffers/reserve/contingency are kept in schedule to meet unanticipated delay.
- The Project Manager normally uses a formal change control process to control any changes in the schedule.

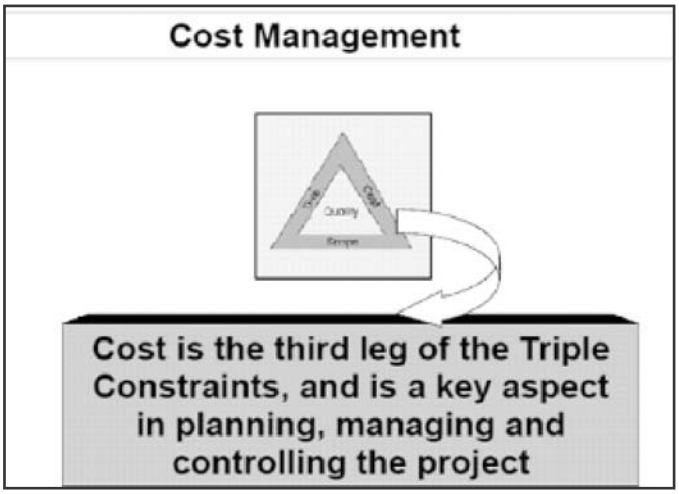
Costs of the project are of two type- Direct and indirect costs. Direct costs are directly related to project and include the following :

- Labour
- Material
- Plant & Equipment
- Subcontractors

Indirect Costs, which are indirectly related to project include the following :

- Overhead & administration
- Training
- Insurance
- Inflation & exchange rate
- Taxes
- Freight
- Licenses
- Contingencies





In the projects being implemented with effective project management and fast project implementation, the cost involved is much less than the normal Railway projects with huge manpower having conflicting decision making and diversified nature of the officials.

9.0 Quality Assurance

For fast track implementation of the projects, it is necessary that the aspects related to quality should not at all be compromised. If Quality assurance and control is not done properly, the work cannot be done on fast track and the project would go into a vicious cycle.

A Quality Assurance programme must be prepared along with a quality control plan. The objective of quality assurance programme is to ensure the construction activities are carried out in a systematic manner and quality of construction work is in conformity with the approved specifications, drawings, etc. It is based on the following quality system procedure:

(a) Document Control
(b) Material Control
(c) Non-conformance Control
(d) Procurement Control
(e) Training of Personnel
(f) Production Control
(g) Setout control



Quality Control does not mean to stop the work

Control of processes and special processes are exercised through a series of instruction documents designated as Method Statements (MS) and Quality Control Plans (QCP).

Summary of some of the quality assurance plans in brief are as under:-

9.1 Quality Assurance and Control for Concrete Work in a RVNL Project

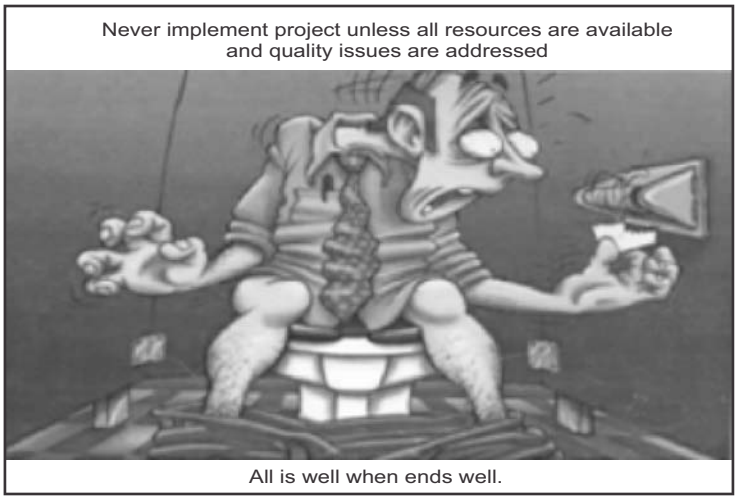
Inspection and Test Plan (ITP)								
CONCRETE								
Item	Description	Frequency of test	Test Centre	Inspection Agency		Documentation No.	Approved by	Acceptance Criteria Test Method
				GPT-RANHILL (JV)	RVNL/ PMC			
1	**Fresh Concrete**							
1.1)	Slump Test	For each Concrete Transit Mixer	Inhouse	Testing	Witness	Lab Register / Pour / Delivery Card	RVNL/PMC	IS 1199
1.2)	Temperature	For each Concrete Transit Mixer	Inhouse	Testing	Witness	Lab Register / Pour / Delivery Card	RVNL/PMC	IS 456
1.3)	Air Content	As directed by Engineer	Inhouse	Testing	Witness	DOC/QA-QC-FORM	RVNL/PMC	IS 456
1.4)	Yield	As directed by Engineer	Inhouse	Testing	Witness	DOC/QA-QC-FORM	RVNL/PMC	IS 1199
1.5)	Sampling of Cube	As per IS 456 / MORTH	Inhouse	Testing	Witness	-	RVNL/PMC	IS 456 / IS 4926
2	**Hardened Concrete**							
2.1)	Compressive strength	As per IS 456 / MORTH	Inhouse	Testing	Witness	DOC/QA-QC-FORM	RVNL/PMC	IS 516
2.2)	Chloride Penetration Test	As directed by Engineer	Independent house	Testing/ Review	Witness/ Review	DOC/QA-QC/ EXTERNAL	RVNL/PMC	IS 456
2.3)	Permeability Test	For each Grade of Concrete (RCC) / As required	Independent house	Testing/ Review	Witness/ Review	DOC/QA-QC/ EXTERNAL	RVNL/PMC	MORT&H

9.2 A Sample of Gist of Quality Assurance and Control for Steel Fabrication in a RVNL Project

QUALITY ASSURANCE PLAN (QAP)	Prepared based on project technical specifications and codal provisions	Approved by PMC, DDC & RVNL
WELDING PROCEDURE SPECIFICATION (WPS) PROCEDURE QUALIFICATION RECORD (PQR)	As per AWS D1.1, 1. SAW (Submerged Arc Welding) 2. GMAW/ MIG (Gas Metal Arc Welding/Metal Inert Gas) 3. SMAW (Shielded Metal Arc Welding)	Approved by PMC/DDC/RVNL Welding consumable. Filler wire/ electrodes and Flux - By approved vendor - ESAB
WELDER QUALIFICATION TEST (WQT)	Qualified welders SAW : 5 nos MIG/ SMAW : 7 nos.	SAW welders tested in 1G Position MIG/ SMAW welders tested in 3G position
NDT (NON DESTRUCTIVE TEST)	Tension Joints – 100 % UT Compression Joints - 25 % UT Double V butt joints – 100 % RT	
Raw material Testing at Outside laboratory	49 nos HT Steel Plate Samples and 5 nos. Rolled Steel Sections Tested so far	NABL Accredited laboratory







Quality of Food is Important for Him. Quality of Construction is Important for Us.

10.0 Final/Likely Status of the Projects

SN	Project Name	Cost of execution (Cr.)	Date of LOA *	DOC	Completion date	Remarks
1.	Diesel Loco Component Factory at Dankuni.	91.05	26.07.2010	18 months	Phase I- 20.10.11 Phase-II 30.11.12	As per the original planned DOC %age progress 90. Cost overrun – 6%.
2.	DMU Factory at Haldia	112.65	20.07.2011	18 months	30.01.13	As per the original planned DOC %age progress 92. Cost overrun – 5%.
3.	Electric Locomotive Factory, Dankuni	200 (likely)	02.10.2013	24 months	10.11.14	As per the original planned DOC %age progress 90. Cost overrun – 9%(likely).

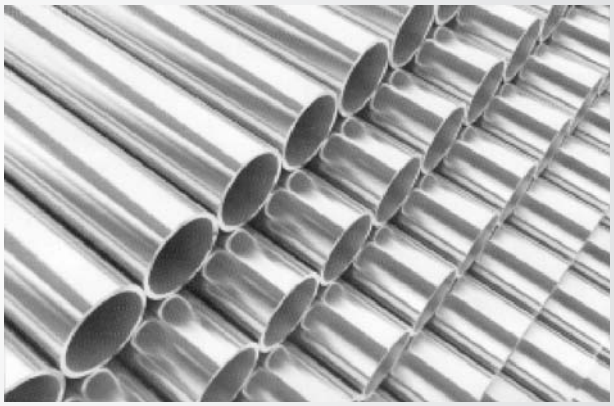
11.0 Conclusion

By citing all the above 3 projects, this can be very well concluded that if the projects are planned well and sufficient money is made available in time, these can be implemented in time and we can save cost over-run and time over run and system of project management will improve over the entire Railways.

◆◆◆

Scientists Make a Glass Stronger than Steel

Scientists at Yale University have developed a new type of glass that is stronger than steel, thus paving way for its applications in various industries. They have devised a dramatically faster way of identifying and characterizing a complex alloy known as bulk metallic glasses (BMGs). BMGs are metal alloys composed of three or more elements such as magnesium, copper and vitrium. The glass can be used for producing hard, durable and seamless complex shapes that no other metal processing method can. About 120,000 metallic glasses have so far been produced to date.



Ref: Modern Green structures & Architecture, May 2014, Pg-90

Hiring Knowledge for Bridge Design – Empower Yourself First with Design Basis Note

By
R.K. Goel *

"DESIGN & PREPARATION OF GAD, STRUCTURAL DRAWINGS FOR MINOR, MAJOR BRIDGES & ROB'S FROM Ch. 0 TO 16700 IN WARDHA-PUSAD-NANDED NEW B.G. LINE PROJECT."

Disclaimer : This Design Basis Note is meant as a guideline to be used for undertaking similar works of getting design of railway Bridges done through consultants. The data given is based on limited knowledge gathered by author on the specific project site and the same should be adopted with due considerations to actual field situations as prevailing.

SALIENT FEATURES OF DESIGN BASIS NOTE

1.0 Introduction :

This Design Basis Note has been primarily developed for design of MINOR/MAJOR bridges from Ch. 0 TO 16700 in WARDHA-PUSAD-NANDED NEW B.G. LINE PROJECT. As per the general requirements of the railway, the Minor and Major bridges are to be designed and detailed as per the RDSO drawings. A few ROBs are required to be provided as per the policy of railway board to avoid the level crossings on New Railway line projects. The ROB's are required to be designed as per the alignment requirements at ch. 5859 and 12221. The design basis lays down the Technical Design hypothesis and the loads to be adopted for designing the structures, the permissible structural parameters as per relevant Indian & International codes of practice and a schedule of design and drawings as given. Methodology for carrying out waterway calculations based on design discharge calculations as per RDSO guidelines is also given. To be concise, the details for major and minor bridges only have been given and the same for ROBs have been deleted.

2.0 Concept And Structural System

The structural system shall be as follows:

1) For minor bridges RCC box culverts as per RDSO drawings shall be proposed. The PSC slabs as per standard RDSO drawings may also be proposed for minor bridges.

2) For major bridges also the superstructure shall as far as possible comprise of decking as per standard RDSO drawing and sub structure and foundations shall be designed as per the actual soil report.

3) For ROB's, RC Voided slab decking/precast post tensioned decking in approaches also standard spans as per MOST shall be adopted if applicable, and steel girder composite deck slab decking over railway span shall be proposed.

4) Annexure A for the location and list of Minor bridges, Major Bridges and ROB's. (Deleted)

METHODOLOGY FOR SOIL EXPLORATION, ANALYSIS AND DESIGN

3.0 Soil Exploration

The soil exploration is to be carried out through competent agencies using the following standards with latest editions-

i) IS:1892 "Code of Practice for Sub-surface Investigation for Foundations"

ii) IS:6935 "Method of Determination of Water Level in a Bore Hole."

iii) IS:2720 – "Method of Test for Soils." The tests on undisturbed samples shall be conducted as far as possible at simulated field conditions to get realistic values.

iv) IS:1498 "Classification & Identification of Soils for General Engineering Purposes."

v) IRC:78 "Standard Specification and Code of Practice for Road Bridges, Section VII– Foundation and Sub-structure."

4. 0 Open Foundations

Open foundations of suitable size will be provided for pier locations where rock is available at depths less than 4.0 m depending on design requirements. Open foundations will be designed as per IRS/IRC and IS-456 provisions (latest edition) as applicable. Flexure

* *CE / Const., CR*
Course No. 14308

theory shall be used for design of the open foundations and one way and two way shear checks shall be made as per the codal provisions. Grouting for ground improvement and rock anchors if required on the basis of soil investigation reports shall be provided.

5.0 Pile Foundations& Sub-Structure

Pile foundations of suitable diameter will be provided for pier locations where rock is available at depths more than 4.0 m depending on design requirements. Pile foundations will be designed as per IRS Sub structure code, Concrete bridge code and IRC-78 and IS-2911 provisions (latest edition) as applicable. Pile spacing shall be kept between 3d to 4d however in case of rock if required same may be reduced to 2.5d.

Piles shall be considered to be subject to axial load and bending and considering fixity effects. The section shall be checked by working stress method as plain cement concrete section or reinforced concrete section depending on the magnitude of tensile stresses developed in the concrete. RC Design of piles shall conform to IRS concrete bridge code & IRC: 21.

Pile cap shall be designed as per Truss analogy and provisions shall be as per IRS concrete bridge code and IRC: 21 2000 as applicable. Pile cap depth shall be kept at 1.5 times the pile diameter as per IRC 78.

R.C.C solid plate type piers shall be provided at each pier location. Piers shall be designed for axial force and bending moment following working stress/limit state method of design. Theeffective lengthof pier shall be considered under different service condition as per table given in IRS Concrete Bridge Code.

Abutments shall be considered for design as buried abutment if the height of bank is more than 5.0 m based on economical considerations. (In case of doubling projects, providing an additional smaller span on each side may help to construct the piers and abutments at reduced track center, without damaging the wing walls of existing bridges)

Formation Width for abutment shall be kept as 7.85 m to accommodate the ballast profile for LWR as per latest instructions issued by Railway Board.

Foundations levels shall be decided keeping in view the depth of maximum scour likely to occur for the Design Discharge calculated. Use of Melville Formula as per IIT Kharagpur report, can be made for a reasonable assessment of maximum scour depth. (In case of doubling projects the foundation levels of piers and Abutments shall be collected and compared with calculated levels for a reasonable assessment of maximum scour depth)

6.0 Super Structure Decking

Major and Minor Bridges :

Reference shall be made as far as possible to the standard RDSO drawings.

ROB's:

The Railway span decking shall comprise of T-girders with composite deck slab simply supported as per RDSO drawings. The analysis of the decking will be done by beam theory using a commercial software package STAAD-PRO/ ADAPT ABI. Loads due to dead load, wearing course, railings and live loads shall be carried by hyperstatic behaviour by the integrated decking system i.e Shored construction shall be followed. Stress checks shall be carried out based on provisions of IRC codes. In case relevant information as per this code is not applicable and therefore not available, reference shall also be made to BS 5400 and other relevant technical literature and sound engineering practice in that order with prior approval of Railways.

RCC Voided Slab Decking

The road approaches on ROBs shall be on earthen embankment as far as possible. This is to avoid the construction cost, however if the land is too costly or there are built up constructions, the approach spans may also be provided. In approach spans if feasible, the RCC continuous decking shall be provided and analysed as above. RCC design shall be as per IRC:21-2000. The void spacing, diameters and drainage arrangement shall be as per AASHTO SPECIFICATIONS.

7.0 Distortion & Torsion:

The effects of torsion & distortion shall be evaluated using rigorous theory as specified in the BS 5400.

8.0 Active and Passive Earth Pressures :

Shall be worked out as per methodology given in IRS Substructure code.

9.0 Safe Bearing Capacity:

SBC at founding levels shall be as per the Soil Investigation reports based on the confirmatory boreholes at site.

For the combinations of loading under wind or Seismic, 33% higher bearing pressure shall be allowed. Reduced area of contact shall not be less than as specified in IRS SUB-STRUCTURE CODE/ IRC:78-2000.

10.0 Codes and Order of Precedence

1) It is proposed to use IRS Standards wherever applicable and supplement with BS, UIC and other international standards for the Minor and Major bridges.
2) The IRC standards wherever applicable and supplemented with BS, AASHTO and other international standards with prior approval of Railways shall be followed for the ROB's.

11.0 Design Loads

Design loads will be taken from the IRS Bridge Rules / codes and applied as nominal loads for the limit state analysis. Wind loads for the relevant zones shall be taken as per IRS Bridge rules and IRC/IRS standards. Seismic loads shall be taken as per the relevant zone and further detailed in Table- 2 below.

Railway Loading

Single track Broad Gauge loading comprising the **IRS 25 t Loading - 2008** loading shall be the main loading for the design of Minor and Major Bridges. The ROB's shall be designed for Class A 2 Lane or Single lane of IRC 70R.

Thermal Loading

Use of IRC 6 2000/BS5400 adapted for Indian climatic conditions shall be made.

Seismic Provisions

For **Zone II** Seismic forces shall be considered in case of the bridges where overall length is more than 60 m or span length is more than 15.0 m. Further all **MAJOR BRIDGES** shall be designed for seismic forces irrespective of span criteria above. IS 1893 2002 and IS 13920 and other appropriate provisions for reinforced concrete seismic detailing will be used. Reference shall be made to **IITK-RDSO guidelines**, AASHTO, Indian Codes and published guidelines to achieve best practical design.

Wind

The wind speed, terrain and topography factors and height factors shall be taken as per the IS 875 Part III as applicable to bridge site. Application and load combinations shall be as per IRS bridge rules and IRC 6 2000 as applicable for Rail & Road bridges.

Load Combinations and Partial Load factors

Partial safety factors for materials will be taken from relevant codes.

For concrete structure the combination of load and partial load factors will be taken according to IRS concrete bridge code (New table 12). In this table the value of f_3 shall be taken as 1.0 as IRS code already takes this value into consideration.

For steel structures there are no partial load factor given in the IRS code for limit state design, thus except partial load factors for dead load, the other factors given in the new table –12 for concrete shall be adopted for design as the level of uncertainties for load remains almost identical for steel as well as concrete structure and new table-12 for concrete provides the best guidelines and logical support for adapting them for steel structures as well. In case of dead load, since the uncertainties are limited the factors given in the BS 5400 can be adapted. While adopting partial load factor from IRS the value of $_{f3}$ as given in the BS 5400 can be taken as unity as IRS code already takes this value into consideration. However if the partial load factors are taken from BS 5400 the value of f_3 will be taken as given in the BS 5400 .

Permissible stresses under various load combinations:

Permissible stresses for concrete shall be as per IRS, and for steel reinforcement as per IS 456: 2000. HYSD bars of grade Fe500 conforming to IS1786-1985 shall be used as reinforcement in all R.C.C. components of the bridge.

Permissible overstress in steel reinforcement shall be as per IRS & BS provisions with the addition that in case of the decking the permissible stresses under temperature and 50% live load shall be increased by 33.333%

Permissible overstress under various load combinations:

Permissible overstress values shall be as per IRS for MINOR/MAJOR bridges and IRC for ROB's. In case relevant information is not available in this code reference will be made to IS and BS codes.

Increase in bearing capacity:

For open foundations with seismic/wind loading, the allowable bearing pressure on the founding strata will be increased by suitable percentages as per IRS/IRC as applicable.

Structural Deformation Limits

Limits will be calculated using the UIC codes for lateral motion. UIC checks if required may also be carried out on vertical deformations particularly with regard to passenger comfort.

Material and specifications

Specifications of Post tensioning bars and strands will be taken as per IS/ASTM/Euro codes.

Other specification shall be as per Standard Specifications as applicable for Central Railway.

12.0 Bearings and Expansion Joints

The number of bearings, particularly on the approach viaduct in ROB portion, shall be minimized through the use of continuous construction if asked for. This is advantageous as it reduces the maintenance and inspection effort and improves the riding quality. POT/PTFE bearings shall be provided for the ROB's and Elastomeric Bearings shall be provided for the Major Railway bridges, if standard spans of RDSO are not being used. Bearings as per RDSO standard spas shall be used where ever available.

Expansion joints of elastomeric/strip seal type will be provided.

Deck Furniture

This shall be provided as per the Railway GAD for MINOR, MAJOR BRIDGES &ROB's. It is recommended that for the ROB's, atleast one side footpath in addition to crash barriers on either side with a minimum 2 lane carriageway may be provided.

Construction Tolerances

For Concrete Bridge Structures the more severe tolerance of IRS Concrete Bridge Code or BS- 5400 Parts 7 and 8 shall be used.

For steel structures for railway track, Manufacturing Tolerances of IRS B-1/ 2001 or BS-5400 Part - 6 shall be used. However, for steel girders in ROBs, construction tolerances as given in IRC -24 shall be followed. The reference of construction tolerances shall be given in GADs of Bridges.

Deflections / Preset and pre-camber

Presets and pre-camber for the deck will be specified on the fabrication/Design drawings. Deflection checks will be carried out to verify that the actual deflections after construction are within permissible limits. The assumed support conditions while making design calculations shall realistically match with those followed during construction or erection of girders. The design drawings shall specify the method of construction / erection accordingly.

13.0 Inspection, Maintenance and Access Systems

Maintenance provisions shall be specified in the contract. Ladder access will be required to all elements. Landing platform will be provided as per requirement and site feasibility. Inspection platforms at pier caps shall be proposed. All pier tops should be accessible from deck/platform level as shown in the GADs. Arrangements for inspection of piers from outside and inside (for Hollow Piers) shall be proposed while designing. Suitable provision for electric posts for electrification of lines should be kept. Electric posts should preferably be supported on piers. Side walkways and trolley refuses on bridges shall be provided as per instructions of IR Pay Way Manual. The jacking point for lifting of the girders is to be provided and shown on drawings. All bearing shall be accessible for inspection and maintenance. For this purpose walkway with railing at appropriate level or along the piers are to be provided.

14.0 Lightening Protection

Structure will be provided with lightning protection as per latest international practices if required.

15.0 Bridge Health Monitoring and Warning Systems and Instrumentation

This is relevant in cases of special type of designs of important bridges and not required to be provided in the present case. Instrumentation system in form of strain gauges etc may be proposed if applicable in the construction contract. The instrumentation system needs to be linked to the overall railway monitoring system. This instrumental scheme, if decided to be implemented will be finalized in consultation with CENTRAL RAILWAYS.

16.0 Design Standards

Available National Standards

The Indian Railways have a set of codes and standards for the design and construction of railway bridges in India (IRS Standards). The IRS standards shall be supplemented by other Indian Standards (IS), which provide some additional coverage. Since, the design of major arch rail bridges requires the consideration of a number of additional parameters, such global stability and second order column effects, etc.

Other international codes may be referred to enable the designer to produce a safe design.

ANNEXURE - A

Table 1 - General and Material

S N.	ITEM	DESCRIPTION
1	Bearing	Elastomeric Bearing for Major Bridges and Pot -PTFE Bearings for ROB's
2	Design Life	100 Years
3	Design Speed	100 KMPH, However full CDA as per Bridge Rules is to be taken.
4	Structural Steel Reinforcement	*IS:2062 1992 Grade B* Fe 500D
5	Minimum Grade of Concrete (i)Foundation (ii)Piers (iii)PSC DECKING iv) Approach Slab v) Ballast retainer vi) RCC box vii) PSC Slab 6.10 m span viii) PCC/Mass concrete	 M 35 M 35 M 50 M 35 M 35 M 35 for span or height > 4.0 m M 30 for span or height < 4.0 m M 50 M25
6	Reinforcement Bars	As per IS:1786
7	Post tensioning Bar	ASTMA 722 (Type-II)
8	Strand pre-stressing steel	As per IS 14268 class-2 LOW RELAXATION strands
9	Pre stressing method and specification	To comply with requirements of IS 1343 & as per RDSO drawing
10	Bolts	As per IS: 4000/BS: 4395 HSFG dia>24mm so that they cannot be opened without compressor.
11	Expansion Joint	Strip seal/Elastomeric Type expansion Joint shall be proposed as per MOST specifications.
12	Exposure Condition	Moderate

Table 2 - DESIGN LOADS

S N.	ITEM	DESCRIPTION
	Design loads :	**All the loading should be taken as per IRS Bridge Rules as mentioned below for Minor & Major railway bridges and IS 875 in general.** (In case of any ambiguity or item that may not have been covered below the relevant standard as mentioned shall be followed for design.)
1	Dead load: (DL) (a) Plain Concrete (b) Steel (c) RCC	 24.0 KN/m^3 78.5 KN/m^3 25.0 KN/m^3
2	Super Imposed dead load: (SDL) (a) Ballast (b) Outer steel railing. (c) Sleeper (d) Rail + connection **(e) Utilities** (i) Water pipes 2 Nos. Φ 300 mm, cables etc. (ii) Access routes	 350 mm cushion for BG loading 2.0 KN/m (per track) 6.0 KN/m (per track) 5.0 KN/m (per track) 3.0 KN/m on Major bridges 1.0 KN/m/route

S N.	ITEM	DESCRIPTION
3	Live load (LL) Centrifugal force Eccentricity of Track. Lurching Nosing Raking Force	IRS 25 t Loading - 2008 BG. IRS Bridge Rules clause 2.5 100 mm (IRS Bridge Rules Clause 2.5) BS 5400 Pt.8 100 KN As Per BS5400 As per IRS Bridge Rules Clause 2.9
4	Dynamic augment	As Per IRS Bridge rules clause 2.4 (Provisions of clause 3 are for assessment of existing bridges and shall not be used). However for design of Major/minor Bridges the maximum value of CDA i.e**1.0** shall be taken irrespective of Design Speed.
5	Braking and Tractive Effort force: (BA)	Longitudinal forces shall be as per Clause 2.8 of IRS Bridge Rules. No dispersion of longitudinal forces shall be considered in design as per Clause 2.8.3.4 of Bridge Rules.
6	Temperature Effect (A) Uniform Temperature (T) (i) Mean Temperature (ii) Co-eff. Of Thermal Expansion (a) Steel & RCC (iii) Variation of effective temperature. *(B) Differential Temperature (DT)* (i) Differential temperature-Lateral (ii) Safety factor for expansion displacement.	 20^0 C 11.7x $10^{-6}/^0$ C (Bridge rule clause 2.62) 40^0 C to 10^0 C As per IRC 6 clause 218.3 1.2
7	Frictional Resistance of Expansion Bearings a)Roller Bearings b)Sliding bearings Steel on steel c)Sliding bearing ptfe/elastomeric d)Concrete over concrete with bitumen layer in between	 0.03 0.25 0.1 0.5
8	In Service Wind (SW) Load.	Corresponding to wind pressure of 150 kg/m^2 at deck level without live load.
9	Wind forces (W)	*As per 1S:875 for 100 year return period.* Basic wind speed (Vb) 44 m/s, (K1) Risk coefficient = 1.07 for design life of 100 years, Terrain height and structure factor (K2) for terrain category 3 and class C structure: (K2) = 0.93 for a height of 10m *(K3) Topography factor = 1.0.*
10	Seismic Forces (EQ) Seismic Zone / imp factor a) Structural Damping. (iii) Concrete b) LL during Seismic conditions c) Combination of effects.	IS: 1893, 2002 Zone II. Z = 0.1, I = 1.25, S_a/g = from IITK/RDSO guidelines/ IRC 6 2000 corresponding to medium soil. 5% As per IITK/RDSO guidelines
11	Derailment load. (DLR) (i) Load Value (ii) Dispersion (iii) Impact	 IRS Bridge Rule Appendix IX No Dispersion Without impact
12	Snow load.	No Snow loads need to be taken.
13	Differential settlement. (DS) (i) Pier foundations	 6mm No live load to be considered and E value to be considered as 50% of instantaneous value.
14	Forces due to LWR (LWR)	As per UIC 774-3R and clause 2.8.2.4.3 of IRS Bridge rules. In Abeyance till further order.

Hydraulic Design Methodology

Certain equations may be used such as the Lacey's and Manning's formula etc. However, the Hydraulic Analysis and Design shall follow the general procedure as outlined below:

1) ***Location :****Identify the suitable location for the Bridge opening.*

2) ***Examination of existing data:*** *Examining, assembling and reviewing all available data such as Topographic Maps, satellite images (Google Earth), Construction details of existing bridges if available, annual flood observations, Meteorological data.*

3) ***River Channel Data:*** *In hydraulic calculations the slope of the water surface or energy line over a distance of 10-20 times channel widths is required. In absence of observed data, the physical slope of the can be obtained from field survey.*

4) ***Field investigation:*** *Identification of bed material, local bends and turns/ meandering of the channel. Any possibility of outflanking to be specially avoided.*

5) ***Catchment Area :****The catchment area is calculated based on the GOOGLE EARTH or ground survey levels. Similarly the general slope of the channel is also evaluated from field survey.*

6) ***Design Discharge :*** *The design discharge is calculated by the method given in the RBF- 16, theHandbook for estimation of design discharge for Railway bridgespublished by RDSO.In case of Catchment areas more than 25 sq km the discharge shall be arrived at using Unit Hydrograph Method and for smaller catchments by other Simplified Methods.*

7) ***Linear waterway :*** *The requirement can be assessed keeping in view the general cross section of the channel and using the Lacey's equation. Thus overall width of waterway is fixed. Choose the number of spans based on likely soil strata, height of piers and type of foundation likely to be provided. Larger span might be economical in case pier heights are more and soil strata is poor.The required opening dimensions(area) are tentatively calculated by assuming a velocity and Depth of flow.T he depth of the water so assumed is then used to calculate the velocity by Mannings method -*

8) ***Manning's formula*** *is to be used as follows:*

Q/ A= V= A/n $R^{2/3}$ $S^{1/2}$, where S is to be determined/ fixed based on general slope of the channel,R = A/P and P is wetted perimeter. 'P' is a function of number of spans chosen and depth of flow for a given waterway. The Rugosity Coeficient ' n ' will depend upon the material of construction in piers and type of soil at the location of bridge. A composite value of 'n' may have to be worked out for big channels. For RCC box bridges, n-value corresponding to RCC may be adopted. By assuming a trial depth of flow, the above equation may be solved for velocity. This velocity is then matched with the RBF 16 calculation valuesusing V = Q /A , and trials are done till it matches.Thus the velocity and depth of flow in the channel gets validated by both methods.

9) ***Verification of Froude number (F) :***

F = V / $(gy)^{1/2}$, Vis the mean velocity, g is acceleration due to gravity& ' y ' is characteristic depth of flow.

F < 1 Flow is sub critical flow.

F = 1 Flow is critical flow.

F > 1 Flow is supercritical flow.

ANNEXURE - F

Codes and Standards

Indian Railway Standard Codes and Specifications:

1. *Central Railway Engg. Dep't. General conditions of contract and instructions to tenderers and Standard Form of Contract, 1999.*
2. *Central Railway Engg. Deptt. Standard Schedule of Rates, 1996 with errata and corrections slip up to date.*
3. *Central Railway Engg. Deptt. Standard Specifications for material and works, 1987 with errata and correction slip up to date.*
4. *I.R.S. Code of practice for plain concrete construction, 1982.*
5. *I.R.S. Code of practice for electric welding of mild steel structures.*
6. *Indian Railway Code of Practice of Plain/Reinforced and Pre-stressed concrete for general/bridge construction (Concrete bridge Code IInd revision, 1997 and with all latest correction slips).*
7. *Indian Railway Bridge Rules, specifying the loads for Design of Superstructure and substructure of Bridge including chapter-VII for the rule for the opening of Railway adopted in 1941 – Revised -August, 1982 incorporating up-to-date corrections slips including RDSO letter No. CSB/PBR/RCS, dated 31/12/87 (herein after referred to as the bridge rules).*
8. *Indian Railway Standard (IRS) Bridge sub-structure and foundations code-code of practice for the design of the substructure and foundation of Bridges adopted 1936 – Revised – 1985 (Hereinafter referred to as "Substructure Code") – with up to date correction slip.*
9. *Indian Railways Schedule of dimensions for Broad Gauge.*
10. *IRS: Welded Bridge Code for steel bridge girders, 2001.*
11. *IRS: Fabrication and Erection of Steel Girder Bridges & Locomotive Turn Tables. (B1-2001)*
12. *IRS: Erection and Riveting of Bridge Girders (B2-1979)*
13. *IRS Code of Practice for the Design of Steel or Wrought Iron Bridges Carrying Rail road or Pedestrian Traffic (Steel Bridge code) Revised 1962*
14. *Indian Railways Bridge Manual, 1998*
15. *Indian Railways Permanent Way Manual.*
16. *Indian Railways Works Manual.*

In the present cases of all the minor bridges the case is of a Gradually Varied Non Uniform flow wherein the velocity, depth, area of cross section and slope of bed Flow channel do not remain constant. The preferred value of Froude number is less than 1, indicating that the flow is sub critical. This shall be verified in the Hydraulic calculations for each bridge. In case the flow comes out to be super critical, the detailed Hydraulic Analysis will be required.

SITING OF THE BOX:

The sitting of the box shall be done in the following manner as per the recommendations of the MORT&H.The INVERT LEVEL of top surface of bottom slab at centre of minor bridge barrel is assumed as the Bed level and this shall be kept 300 mm below the Natural Ground level. The Natural Ground level is assumed as the lowest point in the plan area of the box at the UP STREAM END.The slope of the top surface of bottom slab shall be kept at 1 in 100 uniformly for all minor bridges. The proposed sitting shall be clearly shown in the minor bridge drawings. The structural dimensions and Reinforcement of the minor bridges shall be as per the Standard RDSO drawings. Further the box opening sizes will preferably be kept higher than that may be required by the hydraulic calculations to enable the box openings to be used as grade crossings for the rural population during the dry weather.

Annexure - H

Stages For Monitoring And Model Time Schedule For

The Design Work Of Major / Minor Bridges

SN	DESCRIPTION OF ITEMS	Approximate Time in days
1	Submission of Preliminary / Conceptual GAD	D + 15
2	Draft Design Basis Note by Consultant	D + 30
3	Approval of Preliminary / Conceptual GAD	D + 30
3	Geo-tech investigation (as per requirement)	D + 45
4	Approval of Design Basis Note By Railway	D + 60
4	Finalization of GAD with selection of proof consultants and Start of Design work	D + 75
5	Submission of Design Document as per approved DBN to HQ only	D + 90
6	Comments of HQ (if any) and preliminary approval.	D + 105
7	Design drawings 1st submission on check print to HQ Design cell and	D + 120
	field unit for feasibility (one set each)	
8	Remarks/comments by HQ Design cell / field unit	D + 135
9	Submission of Design Drawings to Proof Consultant	D + 150
10	Report of proof consultant with comments on drawings	D + 180
11	Examination of report by Dy CE/Design and meeting with Consultant / Design consultant (if required)	D + 195
12	Final approval of Design Document and Design Drawings.	D + 210

Note :The above stages may overlap with each other.

Guidelines To Be Followed For Getting The Design Drawings Of Bridges Developed From Design Consultants

1. ***Design Basis Note****: The Design Basis Note (DBN) will consist of standard of loading adopted, standard codes of practices and specification to be followed, materials to be used and their specifications, method of analysis, standard software proposed, authority and method of proof checking, manufacturing tolerances, design parameters to be used with respect to specific locations of the structure and the authority thereof. Any design input parameter proposed to be used beyond standard practice will be bought out specifically.*

2. ***Geotechnical Investigation****: A standard Geotechnical investigation as per IS code as applicable will be undertaken covering the locations of all the piers and abutments. Bore logs shall be taken and bearing capacity of the soil shall be assessed based on C, Ø parameters as determined by bore log detail or standard penetration Test. A comprehensive report shall be prepared and submitted.*

3. ***GAD*** *: The GAD as initially prepared may be modified, if required based on above investigations and got approved.*

4. ***Start of Design Work*** *: A meeting will be held between the consultants, Dy CE/C/Design and concerned DyCE/C in-charge to finalize the Design Basis Note and GAD. Design work shall be undertaken only after finalization of all the issues of GAD and design input parameters.*

5. ***Periodical Review****: Consultant shall give fortnightly report on status of Design and a monthly meeting will be held with DyCE/C/Design to review the design document under preparation and resolve the issue if any. At every stage of design, the design document should give references of relevant clauses of standard codes of practice, loading standards as agreed in DBN. The hand sketches should be given to bring out the concept used in analyzing the structure. Similarly, the hand sketches should be given to suggest the design details proposed to be adopted.*

6. ***Design Drawings:*** *Design drawings shall be developed simultaneously and reviewed by DyCE/C/Design during the monthly meeting held. All the notes as per RDSO practice will be incorporated in the design drawings. The parameters, specifications, manufacturing tolerances etc. with relevant codes/standards adopted for design shall be mentioned on the drawings. The summary sheet of stresses under various load combination shall be prepared to show that the same are within the permissible stresses. All Design drawings shall be cross checked with respect to the design document for correctness of dimensions.*

6.1 ***Steel girders and composite girders:*** *Fabrication drawings, sequence of welding, welding technique and tests, which are required to be conducted, shall be given by the consultant. The acceptance criteria forwelds, concreting & testing including the inspection of raw material and consumables shall also be specified with relevant IS/IRS/IRC codes.*

6.2 ***PSC/Composite girders or slabs :*** *Pre-stressing sequence, design of formwork and on site supervision during critical stages shall be done by the consultant. Verification of steel reinforcement/ pre-stressing provided/given during the construction as per the design shall be the responsibility of consultant and a certificate of verification shall be given.*

6.3 ***Sub-Structure and Foundation :*** *The designs should be with respect to latest provision of RDSO/BIS taking full advantage of the flexibility and ductility of the proposed structure. Design should be done keeping in view the economy and faster construction techniques available in the industry. The approach slab and transition systems on approaches are to be provided as per RDSO practice. Design should cater for the adequate seating widths at pier top and other maintenance requirements of the structure during its service.*

7. ***Selection of proof consultant:-*** *IIT/NIIT/VJTI or other such govt. institute of repute shall be considered for appointment as proof consultant. The proof consultant shall be approved by Head Quarter office of Central Railway, Construction Organization.*

8. ***Role of Proof Consultant****: Proof consultant shall be supplied with one set of design drawings and Design Basis Note. Analysis and design of components shall be done independently with reference to DBN and the adequacy to design as given by consultant shall be verified. The method of analysis / software used and the design calculations in this regard shall be produced by the proof consultant in his report. The report shall also have a summary sheet of stresses under various load combinations and comments about adequacy of design submitted by the prime consultant. The proof consultant shall ensure the consistency of dimensions of various details in plans, elevations and cross sections. The check prints, showing the evidence that such a check, has been exercised, shall be submitted by proof consultant.*

9. ***Approval of Drawings*** *: DyCE/C/Design shall verify the designed drawings and satisfy themselves by exercising random checks. Comparison will also be made with standard/Non-standard drawings of similar type already approved. Design document shall be verified with respect to DBN approved and by conducting sample checks on vital calculations before putting the same for approval.*

◆◆◆

IIT Research Centre for Bullet Train Technology to be Ready this Year.

A Research centre on developing bullet train technology will be ready at IIT-Kharagpur by the end of this year.

Funded by the Indian Railway Board, the new building of the Centre for Railway Research (CRR) is being constructed at a cost of Rs. 20 crore inside the IIT campus, centre in-charge Prof.Subhransu Roy told PTI.

He said that the Indian Railways has identified four thrust areas for research – high speed trains, developing heavy haul capacity to carry more freight, intelligent maintenance and use of advanced materials like polymers, rubbers etc.

"The new centre, which would be ready in the next 7-8 months, will work according to the "Make in India" campaign to develop indigenous technology in railways. Developing technologies related to bullet trains is one of our focus areas," Roy said.

India is currently considering two corridors for high speed trains. While Japan is conducting the feasibility study for the bullet trains project in the Mumbai-Ahmadabad corridor, China will do the same for the Delhi-Chennai route.

Operating out of a temporary set-up, IIT researchers have already started working on suspension and bogies technology for high-speed trains.

Other sanctioned projects worth Rs. 20 crores related to R&D of railway technology include the development of provisions for design of steel concrete composite railway bridges for high speed passenger traffic.

Developing bullet trains would require an array of rolling stock design aspects to be addressed, such as, aerodynamic design of rolling stock, vehicle dynamics, vibration and noise control, advanced control of electric loco drives, static and dynamic analysis of railway bridges, etc. Roy said.

Around 40 faculty members from different departments of the institutes and as many scholars are engaged in the research projects.

Once fully ready with high-end specialised labs, CRR will also house an academic unit offering MTech courses in railway management and engineering.

Besides the regular civil and mechanical engineering aspects, students would be taught on rail wheel dynamics, track, geotechnical aspects, transport planning, etc, Officials said. For operational aspects related to trains they will invite working rail professionals as adjunct faculty.

The proposed degree course, whose curriculum is yet to be finalized, will have a maximum of 30 seats having space for both railway sponsored employees as well as candidates who have cleared GATE entrance exam.

Currently, technical aspects are dealt by railway PSUs like Research Design and Standards Organisation (RDSO).

The Railways have their own training centres for its manpower requirements and now they are planning to come up with a railway university.

(Source: Hitvada Newspaper dt. 10-01-2015)

Effective Project Management : Consultancy Contracts

By
Sanjay Shrivastava *

1.0 Introduction:

Textbook description of Project Management encompass large territory from Planning to Execution and from Control and Monitoring to Commissioning. Each part of the process is important in effective management of the project. This paper aims to explore a very small component of the entire process viz. Consultancy Contracts.

Consultancy Contracts are of little value in Open Line working or even in construction projects of routine nature. For such projects enough technical expertise is available in-house in the Railways and need for outside consultants is generally not felt. Even when, a consultant is engaged, it is not due to any technical expertise limitation but mainly because in-house resources are stretched.

2.0 Need for Consultant for Effective Project Management :

However, in recent years we have seen explosion of rail based transportation technologies in India. The trend started with Delhi Metro and has been gaining momentum as newer projects of Metro, LRT, Monorail and High Speed Rail are being taken up by various agencies. Some of these projects may not be under direct ambit of Indian Railways, however, Railway officers are involved in these projects in various capacities. Since many of these rail based systems are new to India, enough technical expertise is not available within the country. Due to this reason, it is becoming more and more common to engage outside consultants to assist the project at different stages or even to manage the project entirely on client's behalf from concept to commissioning. A proper understanding of consultancy contracts becomes essential foe effective management of the projects as a whole.

3.0 Why Consultancy Contracts are Different?

Consultancy contracts are qualitatively different from works contracts in several ways. The most important difference comes from the Information Asymmetry between the contracted parties. In works contracts, it is assumed that Engineer has got necessary technical knowhow to check the quantity as well as quality of contractor's output. Engineer can measure the payable output to any degree of precision he likes. Therefore, at least in theory, both the contracted parties are at par in terms of access to information regarding delivery output. This assumption is not true in Consultancy contracts. Consultancy contracts are engaged precisely because the Engineer lacks specific technical knowhow required for the project. Thus the Engineer may not be in a position to evaluate either the quality or the quantity of consultant's output. In technical literature, this situation is called Information Asymmetry. Therefore the relationship between the Consultant and the Client is envisaged as a relationship of “implicit trust” unlike the relationship between the Contractor and the Engineer which is based on verifiability of output. Therefore selection of the right Consultant requires a different approach that should be able to take care of “trustworthiness” of the Consultant in the selection process unlike the selection of Contractor which primarily factors into “resourcefulness” of the contractor.

4.0 Selection of “Right” Consultant:

The basic document that is used in the industry for selection of consultants is “Selection and Employment of Consultants by World Bank borrowers” issued by World Bank in year 2004. This document covers various procedures recommended and in vogue, for selection of Consultants. Though primarily meant for World Bank borrowers, this document with project specific modifications is used widely even for non World Bank funded projects due

* *GM (Civil) RITES*
Course No. 14308

to its simplicity, standardization and comprehensiveness. Because of the critical role played by the Consultant, funding agency may also have active interest in the selection of the consultant. For example, in case of JICA funded projects, JICA usually insists on vetting the selection procedure at every stage as a precondition of funding. They also have their own guidelines for selection of consultants for JICA funded projects. Similarly other funding agencies such as Asian Development Bank or African Development Bank also have their own guidelines. By and large all these guidelines are modified versions of World Bank guidelines which forms the basic document.

5.0 Procedure for Selection:

The procedure for selection of consultants involves certain standard steps such as 1.Preparation of Terms of Reference, 2.Expression of Interest, 3.Shortlisting of Consultants, 4.Preparation of RFP, 5.Evaluation of Proposals, 6.Negotiations and 7.Award. Out of these, Preparation of RFP and Evaluation of Proposals are critical.

Before preparing the RFP, the Engineer should decide what type of tender he intends to invite based on time availability, magnitude of Consultant's scope, complexity of project and funding agencies restrictions. While several types of tenders are explained in concerned funding agencies' literature, Quality cum Cost Based Selection (QCBS) and Quality Based Selections (QBS) are most common. In normal works tenders all tenderers who cross the eligibility bar are treated at par and further selection is on basis of financial quote only. In QCBS/QBS, all Consultants who cross the eligibility bar are graded on “Quality” and a composite score is prepared factoring “Quality” as Technical Score and financial quote as Financial Score. Relative weight of Technical Score and Financial Score is informed in advance. Typically Technical Score carries a weight of 70% or more – depending upon the complexity of the project.

Combined Technical cum Financial score is computed as follows:

$$S = S_T X T_W + S_F X F_W$$

Where -

S = Combined Score

S_T = Technical Score

T_W = Weight assigned to Technical Score

F_W = Weight assigned to Financial Score (=1- T_W)

S_F = Financial Score

$= 100 X F_M / F$

Where-

F_M = Minimum Financial Offer

F = Financial Offer under evaluation

Computation of Financial Score is a straight forward exercise that depends only on the minimum financial quote received and the financial quote received for the offer under evaluation. However, computation of Technical Score needs a strategy to minimize the element of subjective judgment during evaluation. In order to achieve this goal, the evaluation criteria of Technical Score is divided into several components, which are further subdivided into smaller and smaller components with the aim of basing the evaluation on measurable items as far as possible. For example a typical breakup of Technical Score in a World Bank funded scheme may look like the following:

S.N.	Item	Points
1.	Consultant's Specific Experience	0-10
2.	Methodology	20-50
3.	Key Personnel	30-60
4.	Transfer of Knowledge	0-10
5.	Participation by nationals	0-10
	Total	**100**

In the next step each component say Key Personnel is further divided into Educational Qualification, Number of years of service, Level in Organization, Number of years of experience related to the project, Membership of professional bodies etc. so that final components are “measurable” – as far as possible. RFP for the contract lists out in detail the evaluation criteria that will be used in evaluating Technical Score.

Quality Bases System (QBS) is a special type of QCBS where Technical score is given 100% weight. In other words, Financial Bid is opened only for the highest scorer in the Technical Bid.

6.0 Conclusion:

Consultancy Contracts are new for Railway officers and hence special care is needed while preparing the RFP for consultancy contracts since similar work might not have been done by the organization in the past. Moreover, since element of subjectivity cannot be altogether avoided in Technical score, the officer framing the RFP needs to be very clear to avoid any criteria that will lead to ambiguity in Technical Evaluation. A good starting point may be to study RFPs of various global consultancy tenders invited for similar projects and then to modify them for Indian conditions after understanding the implication of each line of RFP.

◆◆◆

Project Management Scenario on Indian Railways

By
Akshay Kumar Jha *

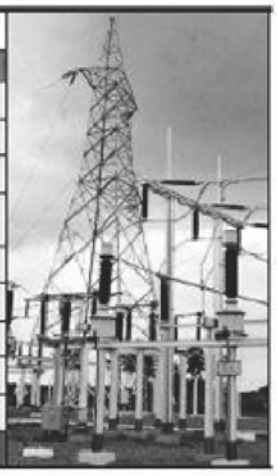
1.0 Introduction :

1.1 Project Management is very important for any organization in order to deliver services, product etc on time. Table Below shows the badly delayed Projects in India.

Why Project Management

GETTING STUCK

Sector	Projects	Delayed
Power	62	30
Railways	45	18
Petroleum	36	21
Road Transport & Highways	32	13
Coal	9	5
Steel	6	6
Shipping & Ports	6	2
Atomic Energy	4	2
Others	7	0
Total	207	97



Sources: Ministry of Statistics report, May 2013

1.2 Overall: Around 46.8% (97) of 207 projects classified as mega infrastructure projects costing Rs 1,000 crores or more are facing delays. According to a report of the ministry of statistics and programme implementation, till May 2013 the delayed projects saw a cost overrun of 11.8% from the originally sanctioned Rs 6.99 Lakh crores to Rs 7.81 Lakh crores.

According to latest data, 64 projects are on track and three projects ***are ahead of the completion deadline.*** Of the rest, 38 projects do not have fixed dates for completion while two projects were sanctioned without any timeframe but later, dates for completion were fixed.

1.3 Indian Railway : *The five projects with highest cost overrun in percentage terms are being executed by railways*. Nangaldam-Talwara new rail line under Northern Railway, under construction for 32 years, has registered the maximum cost overrun of 2651.54%. The project, which was approved in 1981 at a cost of Rs 37.68 crores, is now expected to cost Rs 1,036.78 crores.

Among the five projects with highest cost overrun in absolute terms, two projects belong to Indian railways. The Udhampur-Srinagar-Baramulla new line, which was launched in 1995 to connect the Kashmir valley with rest of India at an estimated cost of Rs 2,500 crores, has seen the maximum cost overrun of Rs 17,500 crores. The Bangalore metro project, executed by the urban development ministry, was cleared in 2006 at an estimated cost of Rs 6,395 crores which has now increased to Rs 11,609 crores, an increase of Rs 5,214 crores.

The above ones are Mega Project details but it remains a fact that Projects delays are a common scenario in our system of working i.e Railways; of course exceptions are also there.

2.0 What is to be Managed in a Project:

SN.	Item Description	I R Scenario
1.	Time (Due Date)	Rarely Projects are completed on time but exceptions are there
2.	Cost (Budgeted Cost)	Cost Overrun is normal and completion of project within budgeted cost is an exception
3.	Performance (Required)	Project normally serves intended purpose of course with strings attached to it sometimes

* GM (Civil) RITES

3.0 Project Selection:

Should be selected to meet Organisational Objectives**:**

We have Projects which are Scared Cow

Operating Necessity Projects

We List out projects with comparative benefits and choose out of them as per laid down procedures by way of LSWP, PB etc but process is not very objective.

4.0 The project **Planning, Scheduling, Resource Allocation, Monitoring** and **Controlling** etc are discussed below**.**

4.1 Project Planning: Typical Contents of Project planning are summarized below :

SN	Item	IR Scenario
1.	Overview	Detailed Estimate (D.E.)
2.	Objective	
3.	Contractual Aspects	After Estimate Sanction
4.	Schedules	Based on Detailed Estimate
5.	Resource Requirement	*Very rarely it is even thought off or discussed at appropriate level.*
6.	Personnel	
7.	Evaluation Method (procedure and requirements for monitoring, collecting and storing data on Project performance etc)	
8.	Potential Problem	Depends on Investigation and Planning of project *which does not get due importance even when time permits.*
9.	Learning from past Mistakes	*Not documented as System does not support such action*

4.2 Planning Process:

SN	Item	IR Scenario
1.	Involves determining and listing the various tasks that must be accomplished in order to complete the project	On IR this is done at the stage of Final Location Survey/Feasibility study Report. ***But not a complete process in it self***
2.	Work Breakdown Structures	Worked out at the Stage prior to Tender Invitation from D.E., ***Use of Software needs to be encouraged***
3.	The Linear Responsibility Chart	For everything The Field Manger (Dy. CE/CE) are questionable. ***Whole Team does not have same goal and are not answerable.***

4.3 Scheduling of Project:

- The Project Schedule is simply the project Plan in an altered form.
- For Scheduling most common formats adopted in industry is
  - Gantt Chart Network
  - CPM Chart Network
  - PERT Chart Network
  - Above Charts developed from Work Breakdown Structure

- IR Scenario- above formats Rare, Bar Charts are used in different format sometimes excel sheet etc.

4.4 Allocating Resources:

- Physical Resources – Could be equipment, Material etc
- Human Resources
- On IR- for Big Projects the process is good and depending on Project's priority resources are assigned by the management to complete the project **but Dynamics of the organisation does play a role and could make or mar project.**

4.5 Monitoring and Controlling the Project:

SN	Item	IR Scenario
1	Monitoring: is data collection, recording and reporting of project information that is of importance to Project manager and Other Stake Holder	*Depends on Organisational set up, Taste of Individual, Resource available, But there is rarely any structured system – Like Formats, Reports, Method of Communication like verbal, Written, through email/web based etc. IR Lags in this Respect*
2	Control: Uses Monitored data and Information to bring actual performance in to agreement with the plan	*Control: on IR we use Monitored data and Information to bring actual performance in to agreement with the plan i.e. to adhere to the Target dates etc. by way of Review Meetings daily, weekly, monthly progress etc.*

4.6 Evaluating and Project Termination:

SN	Item	IR Scenario
1.	Progress and Performance Relative to Projects Initial or Revised Plan (at the end)	Normally done like say Opening of Track at Specified Speeds etc
2.	Evaluation Relative to Other Similar Projects	
3.	Evaluation at number of Crucial Points project Life Cycle to give feedback to Senior management for Decision and Control Purposes	Done But always not very objective, feedback not used often for Decision and control purposes. It is in the form of Progress Review Meeting
4.	Post Progress Evaluation : to Help Organisation to improve the project management skills	**Unfortunately No**

4.7 Project Auditing:

It's a Very Special type of Evaluation whereby

– The whole project is examined w.r.t.

- ❖ Management of Project
- ❖ Methodology
- ❖ Procedures
- ❖ Its Records
- ❖ Inventories
- ❖ Budget
- ❖ expenditure , Progress and so on

– Normally it is done by an independent Agency of repute.

– On IR We do not have this system of Project Auditing

4.8 Project Termination:

SN	Types of Termination	IR Scenario
1	Termination by Extinction (either due to successful completion or Because chances of Failure were Very High)	Mostly on Successful completion
2	Termination by addition (Transfer to new Identity)	Rare but happens like IRIFM Case
3	Termination by Starvation - Budget for Projects is squeezed i.e. Budget allotment just to keep the project alive due to various reasons	Large No of Such projects on IR

4.9 Project Termination Process :

SN	Project Termination Involves	IR Scenario
1.	Documentation Including Project Finale Reports	***Not done by Project Team as Personnel deployed on some other job***
2.	Reassignment of Project Personnel	Not an Issue rather you do not have people to close the project
3.	Closure of Contracts	Very slow process after completion of projects
4.	Redistribution of Material , equipment and other resources	Material redistribution an issue but other things take place automatically
5.	Determining what records to keep and Handing Over of such Documents to responsible people	***Very Poor***

4.10 Use of IT for Monitoring and communication Purposes :

Web based data collection and project monitoring using Smart Phone (to be provided be provided to each officer and Inspector of Unit) and i Pad (to be provided to all officer and Inspector of the unit) and using tailor made softwares

Productvee.com : for Monitoring and communication Purpose

Whats App : WhatsApp Messenger is a cross-platform mobile messaging app which can be used for Project Monitoring as well.

5.0 Road Ahead/Conclusion:

5.1 Road Ahead

- IR Corporate Objective for may be 10 Years must be Laid down and should be sacrosanct for all including Highest Level except aberrations.
- No of Projects to be Limited to bare minimum
- Focussed Approach for Projects with Organisational Operating Requirement
- Project Units : Start to Finish
- Funding Commensurate with Target taking in to account the feasibility part of it.
- Work to be executed in such a manner that it is put to use.
- Digitisation and On Line System for Documentation and Monitoring and system of having a document controller on each project.
- Codes and Manuals, Policy Guidelines, Circulars, Drawings, Plans, etc to be on web based with Search facility.
- Lessons Learnt and Technical Knowledge must be documented and web based.

5.2 Conclusion

- Effective Project Management is the need of the hour to minimize cost and time overrun and to improve health and image of the organization.
- Technology must be used as effective tool for project management and to reduce burden on subordinate staff.
- At least process of project management which can be adopted easily by IR we must make efforts for implementation of the same.

◆◆◆

Empowerment of Field Officials – Some Issues and Thought Thereupon

By
*Vivek Kumar Gupta**

1.0 Introduction:

Empowerment, by definition is sharing information, rewards, and power with employees so that they can take initiative and make decisions to solve problems and improve service and performance.

Empowerment is based on the idea that giving employees skills, resources, authority, opportunity, motivation, as well holding them responsible and accountable for outcomes of their actions, will contribute to their competence and satisfaction.

Empowerment is not giving people power. People already have plenty of power, in the wealth of their knowledge and motivation to do their jobs magnificently. Empowerment is defined as letting this power out. It encourages people to gain the skills and knowledge that will allow them to overcome obstacles in life or work environment and ultimately, help them develop within themselves or in the society.

Simply defined, empowerment is to operate one self and with enthusiasm. Empowerment is meant to realize full potential of employees and 'not a zero sum' commodity. Empowerment operates on basic premise of give power to gain power.

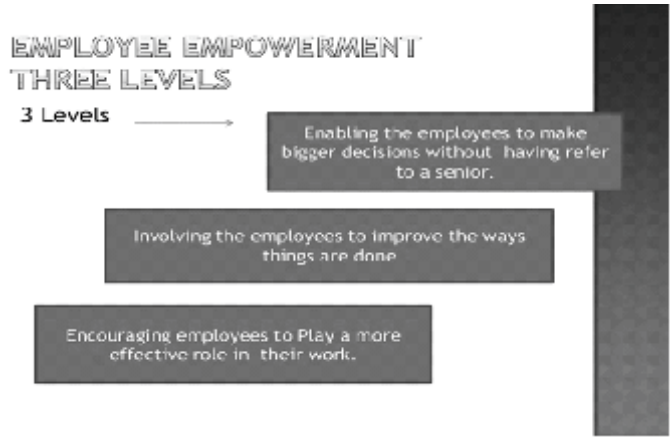
2.0 Steps to Empowerment

Empowerment can be achieved in a progressive manner by creating an atmosphere where each person wants to be responsible. The ownership of the work should be felt by the employees executing the work. The employee feels empowered once the ownership is assigned directly to him. It is also a fact that employee rise to challenge if they take up the challenge as their own challenge. It is also important that personal capabilities are given due weightage by regular training programmes directed towards shaping areas of development of personal traits. The environment should also be created in the organisation to promote learning and also to keep the employees motivated for fast learning of new ideas .The empowerment steps can be summarised as under:

- Assigning ownership to those who execute
- Create environment where each person wants to be responsible
- Coach the development of personal capabilities
- Be a fast learner and promote quick learning
- Learn that people rise to challenge when it is their challenge

3.0 Levels of Empowerment

The employee empowerment operates at 3 levels i.e enabling, involving and encouraging.



4.0 Few Areas at Field Level for Engineering Department for Empowerment

Few areas targeted for discussion in this paper relevant to engineering department of Indian Railways are Man power, Material, Works Planning and Works execution. These are areas where constraints are felt at field level and empowerment at field level in these areas would go a long way in not only improving the efficiency but also to achieve organizational objective as a whole. The areas are:

i) Man power Management
ii) Material Management
iii) Works Planning
iv) Works Executed

* *CE(TMC) WR, Course No.-14308*

5.0 Issues and Thoughts Arising there upon on the Identified Areas.

Identified areas can be briefly summarized as below:

Issues	**Thoughts thereupon**
1**. Manpower**	
HR functions with 'P' branch	Unambiguous scale of reasonable staffing
'P' branch role restricted to IR	Well laid down rules to compensate shortfall
Very limited say of executive	Nil vacancies targets for 'P' branch
Thought thereupon	
2.**Material**	
Almost same procedure for very high/high /small and petty item procurement	Clear cut delegation of powers for material indenting and usage within available grant
Accountability of usage of material	Material consumption accountability linked with cost index(CI)
Inadequate transportation arrangements	Higher priority of transportation within organisation

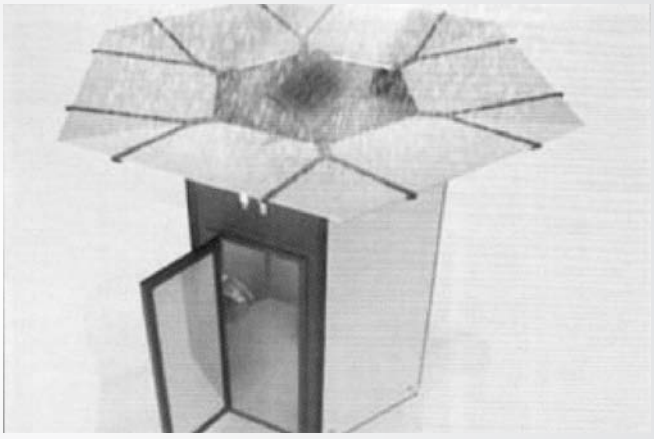
6.0 Acountability and Responsibility

Empowerment is likely to result in huge dividends in terms of increased productivity. At the same time, accountability and responsibility associated with empowerment need to be inbuilt to keep checks and balances in the system. The basic objective is to fulfill organizational objective with financial prudence and accordingly suitable financial modelling is to be adopted . One such financial modeling parameter could be Cost Index(CI) as far as track maintenance is concerned.

The cost of hourly occupation/utilization of track is to be computed and called cost index (CI).This index will have to be defined in terms of definite monetary value and would depend on GMT of the section, standard of infrastructure, geographical location, connectivity and such other factors. The track is to be made available by engineering department for use on CI basis and the user i.e Traffic department shall be charged on hourly basis for use of track. Engineering department shall have to generate funds out of usage of track for maintenance of track, renewals and special works. Speed restrictions on track and traffic blocks are to be discounted on basis of cost index. Track renewals and maintenance are to be executed out of generated funds of cost index. There should be annual plan on works based on available funds generated out of usage by traffic department. The modalities of utilization of CI transferable from one area to another in same jurisdiction are to be decided in consultation with stack holders. Weightage should be given to all important activities in right proportion while calculating and fixing cost index.

◆◆◆

World's First Solar Powered Toilet in India



A revolutionary waterless toilet powered by the sun, developed to help some of the 2.2 billion people lacking sanitation around the world, is to be launched in India this month.

Designed and built using a grant of $777,000 from Bill Gates Foundation, the self-contained, waterless toilet with its innovative technology converts human waste to biochar, a highly porous charcoal. Its aims to provide an eco-friendly solution. The toilet has the capability of heating human waste to high temperature to sterilise it and create bio-char charcoal.

Ref: Modern Green structures & Architecture, April 2014, Pg-119

Toronto Lab Hopes to Refine 'Green' Roof Design.

Covered at they are with vegetation, “green” roofs are known to convey a host of environmental benefits, but researchers at the University of Toronto say that more can be done to assess their performance so as to optimise roof design. The university's Green Roof Innovation Testing Laboratory (GRIT Lab) is conducting three studies that examine the performance of various green roof features and configurations, including a program launched this year that explores the benefits of incorporating solar photovoltaic panels into such roofs.

Studies have shown that green roofs can help to filter air pollutants, reduce runoff through storm-water retention, lower ambient temperatures in warm climates, provide insulation in colder climates, and supply essential habitat for many species of animals and insects. Nonetheless, designers are often unaware of which material properties and which configurations of green roofs are responsible for the performance obtained, says Liat Marglis, the GRIT Lab's principal investigator and an assistant professor of landscape architecture at the university.

Margolis says that while many people have a general understanding of green roofs, there is little information outside of the academic world about how the design of such roofs should be tailored to achieve certain goals. Researchers at the GRIT Lab hope that their work will improve public understanding of green roofs and facilitate a shift from one size fits all designs to ones that are optimized for particular climates and environmental needs.

“people still think of green roofs as one generic type of system that meets all objectives,” Margolis says. “Overall, the intention of legislating and building green roofs is good, but we are far from having a full understanding of the environmental effects of these systems.”

The GRIT Lab was established in 2010 in response to a 2009 Toronto ordinance mandating green roofs for new buildings of more than 2,000 m^2. The move was widely applauded as a fillip for sustainable development in the city of 2.8million people, but researchers were concerned when they found that the city had no mechanism for inspecting the roofs or monitoring their effects over time.

The first of the lab's three ongoing studies compares two vegetation types, two soil compositions two soil depths, and three irrigation schedules. The researchers will evaluate these variables for their effectiveness in reducing storm water runoff, lowering ambient temperature, and increasing biodiversity. Different configurations are used in the test beds, and various sensors are used to monitor soil moisture, effluent flow rates, and temperatures. In this way the researchers are obtaining valuable data on how different types of beds perform under certain climatic conditions.

“Changing any of these variables affects the function of the entire system,” Margolis says. We are analysing the sensor readings from each bed in relation to the climate data gathered by on-site weather stations. Eventually, we will be able to determine which variable is most critical for water management, thermal regulation and biodiversity.

The second study is examining green walls or facades as a means of cooling building envelops and decreasing the energy required for interior cooling. Researchers are using metal wire trellis structures covered with vines to test the effects of green walls, and Margolis says that the study has thus far shown that the technique can cool a building wall surface by as much as 3^0C.

The GRIT Lab's third project, which is examining the effectiveness of combining green roofs with photovoltaic panels, is testing the hypothesis that a green roof's evaporative cooling qualities could help to improve the energy production of such panels, which lose efficiency when overheated. At present green roofs and solar panels are rarely combined. Margolis says.

Roofing companies prefer to install photovoltaic panels at least 4 ft above roof surfaces to facilitate maintenance, and the researchers are examining whether such a configuration gives too much shade to the plants beneath, stunting their growth. They are also studying whether the angle at which panels are typically installed (20 degrees) might lead to excessive runoff on the vegetation below.

“We are looking at two heights above the vegetated surface: 2 feet and 4 feet,” Margolis says. “The goal is to assess which height would be most effective in terms of energy production.”

The GRIT lab researchers plan to conclude their studies in 2018. They regularly post data and images to the lab's website and share many of their findings with industry partners and city officials through articles and conference papers. Margolis says that the researchers hope to present their findings in graphic form online and make the data more accessible to a wider audience.

Margolis believes that the lab's findings could inform green roof construction standards in Toronto and other regions with similar climates. However, she adds that the research could also help regions with dissimilar

climates by demonstrating how to match roof design to environmental objectives and by emphasising the importance of a tailored approach in furthering the goals of sustainable development.

"We need to rethink how municipal green roof construction standards are developed to address a variety of environmental performance criteria in each city region," Margolis says. "We still have a lot to learn in terms of what components and maintenance plans are going to make these systems the most efficient in the long run.

By- David Hill

Ref. Civil Engineering, ASCE, Dec. 2014, Pg. 40 & 41

Gapped-Inclined Braces for Seismic Retrofit of Soft-Story Buildings

Abstract: Although soft-story mechanisms are generally undesirable for the seismic response of building structures, they provide potential benefits caused by the isolating effect they produce for the stories located above. In this paper, an approach for enhancing the seismic response of soft-story structures is proposed that takes advantage of the positive aspects of their response while mitigating the negative ones. To this end, an additional gapped-inclined brace (GIB) is introduced to reduce the impact of P-Delta effects on the displacement demands and to increase the deformation capacity of existing columns in soft stories without significantly increasing their lateral resistance. The mechanics of the proposed system are first defined, and theoretical relations and numerical models are then derived to verify the response. The cyclic behavior of a single-degree-of-freedom single-bay RC frame is then investigated numerically to illustrate the effect of the retrofitted system on the global response of a structure. The analytical results indicate that the hysteretic response of the retrofitted system is highly improved in terms of the energy dissipation and the residual deformation while not significantly increasing the overall strength of the structure. Although the equations governing the response of the system are derived for a single story, the concept is primarily intended to be applicable to multistory buildings.

By: Hossein Agha Beigi, Constantin Christopoulos, Timothy Sullivan, and Gian Michele Calvi,

Ref: American Society of Civil Engineering, Nov., 2014, Pg 1&10

Design Methods for Flexibly Formed Concrete Beams

This paper presents an iterative method for the design of structurally optimised, simply supported, flexibly formed, concrete beams. The design and construction method using flexible formwork has been shown to facilitate material savings of up to 40%, providing significant opportunities for low-carbon-dioxide concrete design. The proposed method considers both ultimate and serviceability limit states for the optimised beam. The iterative nature of the design process, and its interdependency with the construction method, is demonstrated. Further considerations such as reinforcement detailing, methods to support the flexible mould and alternative support conditions are also discussed. It is demonstrated that replacing conventional orthogonal moulds with a flexible system composed primarily of high-strength, low-cost fabric sheets, utilises concrete to create extraordinary possibilities for highly optimised, low-carbon-dioxide, architecturally interesting building forms.

By: John J. Orr, Antony Darby, Tim Ibell & Mark Evernden

Ref: Institution of Civil Engineering, Nov. 2014, Pg 655-665

Delivering the Emirates Air Line, London, UK: Design and Construction of the Steel Main Towers

This paper presents the design, fabrication and erection process of the three main towers of the Emirates Air Line cable car, which spans the River Thames in London, UK. The towers consist of geometrically complex arrangements of a circular hyperboloid shaft topped by a tapering elliptical hyperboloid head. The shafts are formed of interlocking, alternatively and differently pitched, spiralling, doubly curved, structural steel plate elements of varied typologies. The paper presents the extraordinary technical demands including the plate forming process, the complex array of loadings, the nature of the wind responses investigated including impacts of aerodynamic effects from cyclic wind loading, specific requirements for advanced connection stiffness modelling to ensure the extremely tight movement criteria, the challenges of erection over the river Thames and the details of site assembly to tight tolerances. This paper is one of a series of four which describe the delivery of the Emirates Air Line project.

By: Peter Miller, Matthew Birchall, D Fergus McCormick, Bura Happold, Bathtowers

Ref: Institution of Civil Engineering, Oct. 2014, Pg 570-580

Emirates Air Line, London, UK: South Tower Substructure in the River Thames.

This paper presents the challenges associated with the delivery of the south tower base to the 90 m steel tower, in the tidal Thames, to a tight programme, with an Olympic deadline. The paper presents an appraisal by the team of the given reference design of caisson construction at tender and the decision to develop a different design to meet programme. This is followed by a detailed optioneering of the design of the substructure elements leading to selection of the optimal approach employing large concrete precast elements for site assembly. The elements included a protective silt skirt to avoid erosion of the riverbed. Aesthetic considerations are discussed, including the tower, located offshore on piles that are visible at low tide, which required careful attention to the compositional aspect of its overall substructure. To continue the elegant form of the twisting tower, the piles were fitted with double curved precast concrete sleeves to continue the curvature of the steel ribbons down into the Thames. Finally, construction challenges are outlined and a description is given of the dramatic site delivery of the 200 t precast skirt using river- based shear legs.

The construction of this critical element of the cable Car Project was pivotal in the timely delivery of this project which took just over 15 months from design-and-built contract award to completion – a remarkable achievement. It is one of the aspects that demonstrates creative design engineering and timely controlled programming of construction ativities, but above all, illustrates the necessary and enjoyable interrelationship between them.

By: Claire Smith, Bura Happold, Alex Nikolic, B Charlotte Baxter Meng,

Ref: Institution of Civil Engineering, Oct. 2014, Pg 591-597

Track Deflection and Stiffness Measurements from a Track Recording Car

A new innovative method for track deflection and track stiffness measurement is described and used on the iron-ore line in Sweden. The method uses two different measurement systems of longitudinal level on one axle, and by comparing them in a new way it is possible to extract the unloaded level and the effect of the loading from the loaded longitudinal level. Displacement due to loading can also be interpreted as a track stiffness value if the wheel load is simulated or measured. With this method, a new approach to condition monitoring of track is created due to the possibility of monitoring stiffness and longitudinal level at the same time using a track recording car. The method has been used in an extensive measurement campaign on the iron-ore line in the north of Sweden. Many examples are given in this paper to illustrate different track defects. Hanging sleepers and mud pumping places have been successfully located using the new method. The method has been used in both winter and summer conditions. It is found that the track stiffness/deflection level does not vary considerably with change of season. This result is explained by the design decision in the 1980s to use soft fastener pads, which seems to have been a very good decision.

By: Eric G. Berggren, Arne Nissen, Bjorn S. Pauisson,

Ref: Journal of Rail and Rapid Transit, Aug. 2014, Pg 570

Investigation of the Mechanics of Rail Seat Deterioration and Methods to Improve the Abrasion Resistance of Concrete Sleeper Rail Seats

A sustained increase in gross rail loads and cumulative freight tonnages on heavy haul railways, as well as increased interest in high- and higher-speed passenger rail development, is placing an increasing demand on railway infrastructure and its components. Rail seat deterioration (RSD) refers to the degradation of the material at the contact interface between the sleeper's rail seat and the pad that protects the bearing area of the sleeper.

RSD continues to be identified as one of the primary factors limiting concrete sleeper service life, particularly in heavy haul operations. This paper includes results from two laboratory experiments that used test setups and protocols and were designed to isolate the abrasion mechanism. The first experiment was used to acquire quantitative and qualitative data related to the frictional properties of rail pad materials sliding on a concrete surface under various normal loads. The second experiment quantified the abrasion resistance of rail seat materials. Results confirmed that abrasion is a feasible RSD mechanism and that the frictional characteristics at the contact interface between the rail pad and concrete rail seat appear to have an impact on the transfer of forces and relative movement, and thus the abrasion mechanism. Also, the abrasion resistance of the rail seat's surface can be improved by grinding off the top cement paste layer to expose a hard aggregate surface and also by applying an epoxy coating to the surface. Increasing the service life of railway track components will facilitate capacity building on heavy haul, mixed-traffic and passenger railways around the world by reducing maintenance costs and decreasing the demand for maintenance windows.

By: Ryan G. Kernes, Amogh A. Shurpali, J. Riley Edwards, Marcus S. Dersch, David A. Lange & Christopher P. Barken

Ref: Journal of Rail and Rapid Transit, Aug. 2014, Pg -581

Finite Element Modeling and Validation of the Fastening Systems and Concrete Sleepers Used in North America

Significant increases in rail loads, as well as growing interest in providing higher-speed passenger rail services, is placing new and increasing existing demands on fastening systems and concrete sleepers. Consequently, there is a strong need to better understand the response of fastening systems and concrete sleepers to these significantly increased demands. This paper presents an experimentally validated three-dimensional (3D) finite element (FE) model of a fastening system & concrete sleeper that can be used to study & improve the design & performance of this systems. In this 3D FE model, the following mechanisms that are critical to the performance of fastening systems and concrete sleepers are included: frictional interaction between components of the fastening system; interaction between shoulders & concrete; and the plastic behavior of each component in the system. The **FE** model is validated using laboratory experimental tests, in which a lateral load is applied to a single concrete sleeper with two sets of fastening systems. The validated **FE** model is used to analyze the sleeper/fastening system under different loading scenarios involving various v lateral load combinations. Both component stress and system deflection of the model are analyzed to invest system performance at the component and system levels. The results of the study show that **FE** modeling can be used to investigate the complex behavior of fastening systems and concrete sleepers.

By: Zhe Chen, Moochul Shin, Sihang Wei, Bassem Andrawes & Daniel A. Kuchma

Ref: Journal of Rail and Rapid Transit, Aug. 2014, Pg 591

Geometrical Degradation of Railway Turnouts: A Case Study from a Swedish Heavy Haul Railroad

Turnouts are critical components of track systems in terms of safety, operation and maintenance. Each year, a considerable part of the maintenance budget is spent on their inspection, maintenance and renewal. Applying a cost-effective maintenance strategy helps to achieve the best performance at the lowest possible cost. In Sweden, the geometry of turnouts is inspected at predefined time intervals using the STRIX IIMV 100 track measurement car. This study uses time series for the measured longitudinal level of turnouts on the Iron Ore Line (Malmbanan) in northern Sweden. Two different approaches are applied to analyze the geometrical degradation of turnouts due to dynamic forces generated by train traffic. In the first approach, the recorded measurements are adjusted at the crossing point and then the relative geometrical degradation of turnouts is evaluated by using two defined parameters, the absolute residual area and the maximum settlement, In the second approach, various geometry parameters are defined to estimate the degradation in each measurement separately. The growth rate of the longitudinal level degradation as a function of million gross tonnes I time is evaluated. The proposed methods are based on characterisation of the individual track measurements. The results facilitate correct decision-making in the maintenance process through understanding the degradation rate and defining the optimal maintenance thresholds for the planning process. In the long run, this can lead to a cost-effective maintenance strategy with optimised inspection and maintenance intervals.

By: Iman Arasteh, Per-Olof Larsson-Kraik, Arne Nissen, Jan Lundberg & Uday Kuamr

Ref: Journal of Rail and Rapid Transit, Aug. 2014, Pg 611

Effect of Head Wear and Lateral Forces on Under-Head Radius Crack Propagation

This paper investigated the effect of rail head wear (HW) and lateral forces on underhead radius stress conditions and resulting stress intensity factors (SIFs) of a long transverse crack. The occurrence of tension spikes at the underhead radius of the rail as a result of localised vertical and lateral bending of the head-on-web was significantly exacerbated wittincreasing rail HW. The extended finite element method (X-FEM) modelling, which had previously been validated b comparison with in-track measurements to verify the prediction of tension spikes, was used to model a single rail or; discrete elastic foundations. SIFs along the crack front were parametrically evaluated in terms of changes in the contact patch offset (CPO), the (UV) ratio of lateral (L) to vertical (V) loads, the rail HW, and crack size and shape. The X-FEM results revealed that for a long transverse crack, extending the crack length to the underhead radius position results ill higher SIFs across the underhead radius as a result of tensile bending stresses. These higher SIFs can contribute to a massively higher crack growth rate at this location, as was evidenced by the crack growth morphology at the underheac radius.

By: Sagheer Abbas Ranjha, Peter Mutton, Ajay Kapoor

Ref: Journal of Rail and Rapid Transit, Aug. 2014, Pg 620

Dutch Research Results on Wheel/Rail Interface Management: 2001-20 I 3 and Beyond

This paper discusses the state-of-the-art procedures obtained in the research projects performed by Delft University Technology and ProRail, together with other partners and experts, such as Netherlands Railways, to optimize the rail interface on the Dutch rail system. The wheel/rail interface has been the focus of a significant number of projects and improvement measures in the Netherlands over the last I 0 years. ProRail's rails are subjected today to a 'stress regime', with high friction and loads from their operation, certainly since the introduction of new rolling stod new rail types. This has resulted in cracks and premature loss of rail life due to rolling contact fatigue (RCF), in curves and turnouts. Once damage occurs, it accelerates the degradation of track. This can be avoided by grinding introduces artificial wear and moving more towards a 'wear regime', where initial cracks do not 'survive' and do not have the possibility to initiate and grow to form deep defects. Following this philosophy, a preventive gradual grinding strategy has been implemented to remove developing fatigue damage. Also, resistance to stress and avoidance of stress or rails have been identified as possible strategies. This has led to various developments. A new 'anti-head check' rail (54E5) and use of new rail steels have led to reduced contact stresses and RCF initiation. Wheel/rail interface conditioning is being introduced to reduce noise and contact stress using on-train applicators. Wheel profiles have optimized based on the new 54E5 profile and ongoing research focuses more and more on a holistic approach to wheel, rail and bogie design. This paper presents key projects and outcomes of the RCF research programme.

By: Arjen Zoeteman, Rolf Dollevoet, Zili Li

Ref: Journal of Rail and Rapid Transit, Aug. 2014, Pg 642

Reinforced Soil Walls - Design and Construction

This paper gives a very brief description of the most common types of reinforced soil walls used around the world today and an explanation of the key design calculations that are required for the design of typical structures. The paper is largely based on North American experience but the wall types described here and basic design calculations are accepted practice worldwide and thus the lessons gathered from this paper are equally applicable to civil engineering practice in India.

By: Richard Bathurst

Ref: The Bridge and Structure Engineer, Sept. 2014, Pg 15

Design, Construction and Performance of GRS Structures For Railways in Japan

Geo synthetic-reinforced soil retaining walls (GRSRWs)) have been constructed for a total length of about 160 km as of June 2014 mainly for railways, including high-speed train lines. After a full-height wrapped-around GRS wall has been constructed and the major residual deformation of the backfill and supporting ground has taken place, a full-height rigid (FHR) facing is constructed by casting-in-place concrete on wrapped-around wall face in such that it is firmly connected to the reinforcement layers. A number of this type GRS RWs performed very well during the 1995 Great Kobe and the 2011 Great East Japan Earthquakes. The seismic design code for railway soil structures has been revised taking into account such high level seismic loads as experienced during the 1995 Kobe Earthquake A number of conventional type RWs and embankments collapsed during these and other embankments. Among a couple of new bridge types that have been developed, GRS integral bridge comprises a continuous girder of which both ends are structurally integrated without using bearings to the top of the facings of a pair of GRS RWs. The first prototype was constructed for a high-speed train line in 2011 and three more were constructed to restore bridges that fully collapsed by great tsunami during the 2011 Great East Japan Earthquake.

By: Fumio Tatsuoka, Kenji Watanabe

Ref: The Bridge and Structure Engineer, Sept. 2014, Pg 25

Reinforced Soil Wall Design Code Implementation in the United States

For reinforced soil walls in the USA is well defined, and if applied properly, will result in safe, well-built walls. National level evaluation protocols and programs, such as implemented by HITEC and AASHTO NTPEP, have been developed for reinforced soil walls as complete systems as well as for the key materials from which they are built. These protocols and evaluation programs are important for maintaining consistency in the quality of such systems, and to insure a competitive, but fair market for the suppliers of reinforced soil wall systems and the materials from which they are built. However, there are some remaining gaps, which include: (1) how reinforcement loads are estimated, (2) how to extend the current reinforcement load estimation procedures to newer types of reinforcement, and (3) is the lack of reliability theory calibrated load and resistance factors for reinforced soil walls in the national design standards.

By: Tony Allen

Ref: The Bridge and Structure Engineer, Sept. 2014, Pg 48

Trains Return to Northern Sri Lanka after 24 Years

The President of Sri Lanka Sh. Mahindra Rajapaksa officially reopened the penultimate section of the island's 339 km Northern Railway on October 13, restoring train services to the town of Jaffna 24 years after it was severed from the network by the country's civil war. Following the signing of a peace treaty in May 2009 plans were drawn up to rebuild the line and Yal Devi services returned to the town of Thandikulam in June 2009 and Omantahi in May 2011. Services were extended to Kilinochchi in September 2013 and Pallai in March this year.

The reconstruction of the Pallai – Jaffna section included the rebuilding of three stations. As well as the three daily Yal Devi services from Colombo to Jaffna, the line is served by two daytime intercity trains and an overnight service from the capital, which operate at up to 120 km/hr. The final phase of the Rs 58 bn ($US 444 m) project, the reconstruction of the section from Jaffna to Kankasanthurai, is due to be completed in December.

Ref: International Railway Journal, Nov. 2014, Pg 09

Vienna Inaugurates € 987m Main Station

Vienna celebrated the official opening of its new main station on October 10 following a seven year project that cost € 987m and was funded from Austrian Federal Railways (öBB), the city of Vienna, EU sources and property developments. Construction of the station started in 2007 and some platforms were opened for regional trains in December 2012. Now the station building, the remaining platforms, a passenger tunnel to metro Line U1 and a shopping mall are open.

The big changes will take effect in December 2015 once all track works is complete at which point the station is expected to handle 145,000 passengers and 1000 trains per day. All öBB fast trains from Linz and beyond will be routed to the central station and there will be half-hourly Railjets and inter-city trains from Salzburg to the airport.



Ref: International Railway Journal, Nov. 2014, Pg 10

Shinkansen – Half a Century of Speed

The October 1964 opening of the 552.6 km Tokaido Shinkansen was a major news event not just in Japan but globally as the striking image of streamlined electric trains flashing past Mount Fuji captured the public's imagination. The term bullet train was quickly coined to describe this technological wonder. While a maximum speed of 210 km/h might not sound particularly fast by modern standards, the consistent operation of trains at this speed was a huge step forward, particularly in Japan where trains could only reach 110 km/h on the conventional 1067 mm-gauge network. The new standard gauge double track railway also doubled the capacity of the Tokyo – Nagoya – Kyoto – Osaka rail corridor, which was vital as the existing narrow gauge line was operating at capacity.

The Tokaido Shinkansen has carried 5.6 billion passengers since it first opened and daily ridership has soared from 61,000 in 1964 to 420,000 today, making it by far the busiest high speed line not only in Japan but also the world.

JR Central currently operates 323 trains per day with a staggering annual average delay of just 0.9 minutes per train including delays caused by things beyond JR Central's control such as natural disasters. This



exceptional level of punctuality is attributed to a highly reliable operating system, very reliable infrastructure and rolling stock, comprehensive staff education and training, and vertical integration.

The Tokaido Shinkansen has maintained a flawless safety record throughout its half century of operation with zero fatalities or injuries to passengers caused by train accidents such as derailments or collisions. There are several reasons for this. Having a dedicated high speed passenger railway without any level crossing obviously reduces the risk of collision with other types of train or road vehicle. The line has been fitted with an automatic train control (ATC) system without line side signals from the outset which is designed to prevent a train from getting too close to the train in front.

Ref: International Railway Journal, Oct. 2014, Pg 16-20

How China Builds High Speed Rail For Less

China has the world's largest high speed network and it has reached this position in little over a decade. The high speed programme started in 2003 with a 404 km line between Qinhuangdao and Shenyang, which was designed for 250 km/h. It rapidly gained momentum with the mid to long term Railway Network plan adopted in 2004 and updated in 2008, which sets out to develop strategy for the network up to 2020. By the end of 2013, most of the metropolitan regions in china are either connected, or in the process of being connected, to lines with maximum speed of 200 km/h or above. High density corridors such as Beijing – Shanghai and Beijing – Guangzhou tend to be designed for 350 km/h running, while 250 km/h suffices for lines with more modest volumes.



The cost of building high speed lines in China is significantly lower than those in Europe and Japan. Aside from the lower cost of labour, several other factors are likely to have led to lower unit costs in China. At a programme level, the declaration of a credible medium term plan for the construction of 10,000 km of high speed lines in China over a period of six to seven years energized the construction and equipment supply community to build capacity rapidly and adopt innovative techniques to take advantage of very high volumes of work. This has led to lower unit cost as a result of the development of multiple competitive local sources for construction including earthworks, bridges, tunnels and rolling stock – that adopted mechanization in construction and manufacturing. Furthermore large volumes and ability to amortise capital investment in high cost construction equipment across a number of projects also helped to reduce costs.

Travel time contour of High Speed Rail in China

Ref: International Railway Journal, Oct. 2014, Pg 32 - 35

Details of latest Correction Slips

Sr. No	Codes/Manuals	Last Correction Slips
1	Indian Railways Permanent Way Manual(second Reprint-2004)	**136 dt 14-11-2014**
2	Indian Railways Bridge Manual-1998	**30 dt 25-11-2014**
3	Indian Railways Works Manual-2000	**10 dt 17-2-2005**
4	Manual of Instructions on long Welded rails-2006(II reprint-2005)	**16 dt 12-6-2014**
5	Manual for Flash Butt welding of Rails(reprint-2012)	**2 dt 05-06-2014**
6	Manual for Fusion welding of rails by the Alumino Thermit Process (Revised 2012)	**nil**
7	Manual for Ultrasonic testing of rails & welds (revised 2012)	**2 Dt 18-12-2014**
8	Manual for Glued insulated rail joints-1998	**5 dt 28-08-2012**
9	Indian Railways Track Machine Manual (2000)	**17 dt 21-02-2014**
10	Manual of Inspection schedules for officials of engg. Dept-2000	**nil**
11	Railways (opening for public Carriage of Passengers)Rules-2000	**nil**
12	Indian Railways Schedule of Dimensions 1676 gauge revised 2004	**15 dt 19-06-2014**
13	Indian Railways code for the engg dept (third Reprint-1999)	**48 dt 01-05-2014**
14	Guidelines for Earthwork in Railway projects-2003	**1 dt 22-7-2004**

ITTI CALENDER OF COURSES 2015

Course No.	From	To	Name of the course	Duration	Eligible Group
15801	12-01-2015	16-01-2015	Contract Management	1 week	SSE's
15802	19-01-2015	30-01-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15803	02-02-2015	06-02-2015	TMS	1 week	SSE's
15804	09-02-2015	27-02-2015	Training of Trainers (P.Way)	3weeks	SSE's/P.Way
15805	23-02-2015	27-02-2015	Curves	1 week	SSE's/P.Way
15806	02-03-2015	05-03-2015	LW	1 week	SSE's/P.Way
15807	02-03-2015	13-03-2015	Mechanized Track Maintenance and Renewals	2 weeks	SSE's/P.Way
15808	09-03-2015	20-03-2015	USFD,Welding & Rail Grinding	2 weeks	SSE's/P.Way
15809	16-03-2015	20-03-2015	Points & Xings	1week	SSE's/P.Way
15810	23-03-2015	02-04-2015	Mechanized Track Maintenance and Renewals	2 weeks	SSE's/P.Way
15811	23-03-2015	02-04-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15812	06-04-2015	10-04-2015	Management of Store & Land for SSE(P.Way)	1 week	SSE's/P.Way
15813	06-04-2015	10-04-2015	Track Monitoring	1 week	SSE's/P.Way
15814	13-04-2015	24-04-2015	Fabrication of Steel Bridges & PSC Construction	2 weeks	SSE's/P.Way
15815	13-04-2015	24-04-2015	USFD,Welding & Rail Grinding	2 weeks	SSE's/P.Way
15816	27-04-2015	30-04-2015	Land Management for SSE/Works	1 week	SSE's/Works
15817	27-04-2015	30-04-2015	Contract Management	1 week	SSE's
1581	05-05-2015	08-05-2015	Points & Xings	1 week	SSE's/P.Way
1581	05-05-2015	15-05-2015	Mechanized Track Maintenance and Renewals	2 weeks	SSE's/P.Way
15820	11-05-2015	22-05-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15821	25-05-2015	29-05-2015	Curves	1 week	SSE's/P.Way
15822	25-05-2015	29-05-2015	LWR	1 week	SSE's/P.Way
15823	01-06-2015	12-06-2015	USFD,Welding & Rail Grinding	2 weeks	SSE's/P.Way
15824	08-06-2015	12-06-2015	Track Monitoring	1 week	SSE's/P.Way
15825	15-06-2015	26-06-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15826	15-06-2015	26-06-2015	Mechanized Track Maintenance and Renewals	2 weeks	SSE's/P.Way
15827	29-06-2015	03-07-2015	TMS	1 week	SSE's
15828	29-06-2015	03-07-2015	Land Management for SSE/Works	1 week	SSE's/P.Way
15829	06-07-2015	17-07-2015	Mechanized Track Maintenance and Renewals	2 weeks	SSE's/P.Way
15830	13-07-2015	31-07-2015	Training of Trainers (Works & Bridges)	3 weeks	SSE's/W&B
15831	20-07-2015	31-07-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15832	03-08-2015	07-08-2015	Track Monitoring	1 week	SSE's/P.Way
15833	03-08-2015	07-08-2015	Management of Store & Land for SSE(P.Way)	1 week	SSE's/P.Way
15834	10-08-2015	21-08-2015	USFD,Welding & Rail Grinding	2 weeks	SSE's/P.Way
15835	10-08-2015	14-08-2015	LWR	1 week	SSE's/P.Way
15836	17-08-2015	21-08-2015	Points & Xings	1week	SSE's/P.Way
15837	24-08-2015	04-09-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15838	24-08-2015	04-09-2015	Mechanized Track Maintenance and Renewals	2 weeks	SSE's/P.Way
15839	07-09-2015	18-09-2015	USFD,Welding & Rail Grinding	2 weeks	SSE's/P.Way
15840	07-09-2015	11-09-2015	Curves	1 week	SSE's/P.Way
15841	14-09-2015	25-09-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS
15842	21-09-2015	25-09-2015	Points & Xings	1 week	SSE's/P.Way
15843	28-09-2015	01-10-2015	Track Monitoring	1 week	SSE's/P.Way
15844	28-09-2015	01-10-2015	LWR	1 week	SSE's/P.Way
15845	05-10-2015	09-10-2015	Inspection and Maintenance of Bridge	1 week	SSE's/Br
15846	05-10-2015	09-10-2015	Management of Store & Land for SSE(P.Way)	1 week	SSE's/P.Way
15847	12-10-2015	23-10-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15848	19-10-2015	23-10-2015	Contract Management	1 week	SSE's
15849	26-10-2015	30-10-2015	Land Management for SSE/Works	1 weeks	SSE's/Works
15850	26-10-2015	06-11-2015	USFD,Welding & Rail Grinding	2 weeks	SSE's/P.Way
15851	02-11-2015	06-11-2015	Curves	1 week	SSE's/P.Way
15852	23-11-2015	04-12-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15853	23-11-2015	27-11-2015	TMS	1 week	SSE's
15854	30-11-2015	04-12-2015	Points & Xings	1 week	SSE's/P.Way
15855	07-12-2015	11-12-2015	Curves	1 week	SSE's/P.Way
15856	07-12-2015	11-12-2015	LWR	1 week	SSE's/P.Way
15857	14-12-2015	23-12-2015	Rail Wheel Interaction & derailments	2 weeks	SSE's & Instructor of ZRTI/ZRTS/P.Way
15858	14-12-2015	23-12-2015	Mechanized Track Maintenance and Renewals	2 weeks	SSE's/P.Way
15859	28-12-2015	01-01-2016	Track Monitoring	1 week	SSE's/P.Way
15860	28-12-2015	08-01-2016	USFD,Welding & Rail Grinding	2 weeks	SSE's/P.Way

IRICEN CALENDAR OF COURSES 2015 (Rev. 01)

Course No.	From	To	Name of the course	Duration	Eligible Group
			PROBATIONARY COURSES		
15001	02-02-2015	28-05-2015	IRSE Ph.I(Gr.P)	8 weeks	IRSE (P) 2013Exam.
15002	02-03-2015	23-04-2015	IRSE Ph.I(Gr.Q)	8 weeks	IRSE (P) 2013 Exam.
15003	27-04-2015	01-05-2015	IRSE Posting Exam	1 week	IRSE (P) 2012 Exam.
15004	01-06-2015	05-06-2015	IRSE Orientation	1 week	IRSE (P) 2012 Exam.
15005	31-08-2015	05-11-2015	IRSE Ph.II (Gr.Q)	10 weeks	IRSE (P) 2013 Exam.
15006	23-11-2015	28-01-2016	IRSE Ph.II (Gr.P)	10 weeks	IRSE (P) 2013Exam.
15007	30-11-2015	04-12-2015	IRSE Posting Exam & Orientation	1 week	IRSE (P) 2012 Exam.
15008	14-12-2015	18-12-2015	IRSE Introduction	1 week	IRSE (P) 2014 Exam
			INTEGRATED COURSES		
15101	27-01-2015	16-04-2015	Integrated	12 weeks	Gr.B officers
15102	20-04-2015	09-07-2015	Integrated	12 weeks	Gr.B officers
15103	13-07-2015	01-10-2015	Integrated	12 weeks	Gr.B officers
15104	05-10-2015	23-12-2015	Integrated	12 weeks	Gr.B officers
15105	28-12-2015	17-03-2016	Integrated	12 weeks	Gr.B officers
			SR. PROFESSIONAL COURSES		
15201	12-01-2015	13-02-2015	Sr.Prof(P.Way)	5 weeks	JAG/SS having 6 yrs service in Group A
15202	23-03-2015	24-04-2015	Sr.Prof(Br &General)	5 weeks	JAG/SS having 6 yrs service in Group A
15203	25-05-2015	26-06-2015	Sr.Prof(P.Way)	5 weeks	JAG/SS having 6 yrs service in Group A
15204	06-07-2015	07-08-2015	Sr.Prof(Br &General)	5 weeks	JAG/SS having 6 yrs service in Group A
15205	10-08-2015	11-09-2015	Sr.Prof(P.Way)	5 weeks	JAG/SS having 6 yrs service in Group A
15206	21-09-2015	23-10-2015	Sr.Prof(Br &General)	5 weeks	JAG/SS having 6 yrs service in Group A
			PCE/HAG/SAG/SEMINARS/WORKSHOPS/MEETINGS		
15301	07-05-2015	08-05-2015	Seminar for CE/TP	2 days	CETPs
15302	21-05-2015	22-05-2015	CE(Work)/CPDEs' Seminar	2 days	CE(Works)/CPDEs
15303	18-06-2015	19-06-2015	CTEs' Seminar	2 days	CTEs
15304	09-07-2015	10-07-2015	CBEs' Seminar	2 days	CBEs
15305	30-07-2015	31-07-2015	CAOs' Seminar	2 days	CAOs
15306	20-08-2015	21-08-2015	CE/TMs' Seminar	2 days	CE/TMs
15307	14-09-2015	15-09-2015	Training Manager/CGE Seminar	2 days	CGEs/Pr.CETCs
15308	31-10-2015	01-11-2015	IRICEN Day Seminar for IRSE '89' Exam	2 days	SAG (IRSE '89')
15309	03-12-2015	04-12-2015	PCEs' Seminar	2 days	PCEs
			SPECIAL COURSES (TRACK/BRIDGES/WORKS)		
15401	05-01-2015	16-01-2015	USFD testing, welding, rail grinding, Track monitoring & Track Machine (T-1)	2 weeks	JS/SS/JAG
15402	19-01-2015	23-01-2015	Laying of Pts & Xing, Plg. of yards & design of track using MX rail(T-3)	1 week	JS/SS/JAG
15403	09-02-2015	14-02-2015	Rail Wheel Interaction & derailments (T-2)	6 Days	SS/JAG
15404	16-02-2015	20-02-2015	Land Management (W-1)	1 week	SS/JAG
15405	09-03-2015	13-03-2015	TMS (T-5)	1 week	JS/SS of OL
15406	16-03-2015	02-04-2015	Special Course on Track & Bridge Maintenance for Bangaladesh Engineers	3 weeks	
15407	06-04-2015	10-04-2015	Arbitration for Arbitator (W-3)	1week	JS/SS/JAG
15408	20-04-2015	25-04-2015	Rail Wheel Interaction & derailments (T-2)	6 days	JS/SS/JAG Of OL
15409	05-05-2015	15-05-2015	Contracts & Arbitration and project Management for SS/JAG officers (W-2)	2 weeks	SS/JAG
15410	08-06-2015	12-06-2015	Modern Surveying(C-1)	1 week	JS/SS/JAG of Const. Org
15411	15-06-2015	19-06-2015	Arbitration for Arbitator (W-3)	1week	JS/SS/JAG
15412	22-06-2015	26-06-2015	Rly. Formation and Geo. Tech. Inves(T-4)	1 week	JS/SS/JAG
15413	29-06-2015	10-07-2015	Course for Construction Engineers (C-2)	2 weeks	JS/SS of Const. Org.
15414	13-07-2015	17-07-2015	Laying of Pts & Xing, Plg. of yards & design of track using MX rail(T-3)	1 week	JS/SS/JAG
15415	03-08-2015	07-08-2015	TMS (T-5)	1 week	JS/SS Of OL
15416	03-08-2015	07-08-2015	Land Management (W-1)	1 week	SS/JAG
15417	10-08-2015	21-08-2015	Contracts & Arbitration and project Management(W-2)	2 weeks	SS/JAG
15418	24-08-2015	04-09-2015	USFD testing, welding, rail grinding, Track monitoring & Track Machine (T-1)	2 weeks	JS/SS/JAG
15419	07-09-2015	11-09-2015	Modern Surveying(C-1)	1 week	JS/SS/JAG of Const. Org
15420	14-09-2015	19-09-2015	Rail Wheel Interaction & derailments (T-2)	6 days	JS/SS/JAG Of OL
15421	21-09-2015	01-10-2015	Steel structure &PSC (B-2)	2 weeks	JS/SS/JAG
15422	05-10-2015	09-10-2015	Arbitration for Arbitator (W-3)	1week	JS/SS/JAG
15423	12-10-2015	30-10-2015	Courses for Br. Design Asstt.inclu. Earthquake complaint structure(B-1)	3 weeks	ABE;sDesign Asstts.
15424	23-11-2015	27-11-2015	Arbitration for Arbitator (W-3)	1week	JS/SS/JAG
15425	30-11-2015	05-12-2015	Rail Wheel Interaction & derailments (T-2)	6days	JS/SS/JAG Of OL
15426	07-12-2015	11-12-2015	Special Course on Track & Bridge Maintenance for NTPC Engineers	1 week	NTPC Engineers
15427	21-12-2015	24-12-2015	TMS(T-5)	1 week	JS/SS of OL
			AWARENESS COURSES		
15701	02-02-2015	06-02-2015	Awareness for IRSSE 2012	1 week	IRSSE (P)
15702	02-03-2015	05-03-2015	Awareness for IRSSE 2012	1 week	IRSSE (P)
15703	30-03-2015	02-04-2015	Awareness for IRSSE 2012	1 week	IRSSE (P)
15704	13-04-2015	17-04-2015	Awareness for Prob	1 week	
15705	25-05-2015	29-05-2015	Awareness for Prob	1 week	
15706	01-06-2015	05-06-2015	Awareness for Prob IRSS 2012 (P)	1 week	IRSS (P)
15707	13-07-2015	17-07-2015	Awareness for Prob	1 week	
15708	20-07-2015	24-07-2015	Awareness for IRSEE 2013 (P)	1 week	IRSEE (P)
15709	27-07-2015	31-07-2015	Awareness for Prob	1 week	
15710	24-08-2015	28-08-2015	Awareness for IRSEE 2013 (P)	1 week	IRSEE (P)
15711	21-12-2015	23-12-2015	Awareness for Prob	1 week	
15712	28-12-2015	01-01-2016	Awareness for IRPS 2013 (P)	1 week	IRPS (P)

INDIAN RAILWAYS INSTITUTE OF CIVIL ENGINEERING, PUNE-411001

CALENDAR OF COURSES 2015 CHART (Rev. 01)

+	Months / Date (Monday)
MONTH	DECEMBER '14 (1, 8, 15, 22, 29); JAN.2015 (5, 12, 19, 26); FEBRUARY (2, 9, 16, 23); MARCH (2, 9, 16, 23, 30); APRIL (6, 13, 20, 27); MAY (4, 11, 18, 25); JUNE (1, 8, 15, 22, 29); JULY (6, 13, 20, 27); AUGUST (3, 10, 17, 24, 31); SEPTEMBER (7, 14, 21, 28); OCTOBER (5, 12, 19, 26); NOVEMBER (2, 9, 16, 23, 30); DECEMBER (7, 14, 21, 28); JAN.2016 (4, 11, 18, 25); FEB.2016 (1, 8, 15, 22, 29); MAR.2016 (7, 14, 21, 28)
IRSE COURSES	ALL COURSE NUMBERS PRECEDE WITH DIGIT '15' FOR THE YEAR 2015; PE
2011 Exam batch	Intro; 008; 15001 PHI(P); 15001 PHI(P); 004; ort; IRSE 15005PH-II(Q); 007; 008; IRSE 16001 PH-I(P)
2012 Exam batch	14005; PE; IRSE (P); 15002PHI(Q); PE; IRSE (P); IRSE (P); IRSE 15006 PH-II(P)
2013 Exam batch	14006 PHASE II Group Q; 003
INTEGRATED COURSES	Inte 14104; 15101; INTEGRATED; 15102; INTEGRATED; 15103; INTEGRATED; 15104; INTEGRATED; 15105; INTEGRATED
SR.PRO/DEV.COURSES	Sr.Prof.P.Way 15201; Sr.Prof.Brg 15202; Sr.Prof.P.Way 15203; Sr.Prof.Brg 15204; Sr.Prof.P.Way 15205; Sr.Prof.Brg 15206
HAG/SAG/ SEMINARS	CE/TP 301; CPDE 302; CTE 303; CBE 304; CAO 305; CE/TM 306; CGE 307; ID 308; PCE 309
SPECIAL COURSES	415; 421; NTPC; T1 401; T3 402; T2 403; W1 404; T5 405; BANGALADESH ENGRS 406; W3 407; T2 408; W2 409; C1 410; W3 411; T4 412; C2 413; T3 414; 415; T5; W1 416; W2 417; T1 418; C1 419; T2 420; B2 421; W3 422; B1 423; W3 424; T2 425; 426; T5 427
AWARNESS COURSES	701 AW; 702 AW; 703 AW; 704 AW; 705 AW; 706 AW; 707 AW; 708 AW; 709 AW; 710 AW; 711 AW; 712 AW
ITTI COURSES	801, 802, 803, 804, 806, 808, 811, 812, 814, 816, 818, 820, 821, 823, 825, 827, 829, 831, 832, 834, 837, 840, 841, 843, 846, 847, 849, 851, 852, 855, 857, 860
	TM; BR; RW; CM; RW; TMS; TOT(P.WAY); LWR; USFD; RW; MSL; FSB; LM; PX; RW; CU; USFD; RW; TMS; TM; RW; TMo; USFD; RW; CU; RW; TMo; MSL; RW; LM; CU; RW; CU; RW; USFD
	14816; CU; TM; PX; TM; TMo; USFD; CM; TM; LWR; TMo; TM; LM; TOT(B&W); MSL; LWR; PX; TM; USFD; PX; LWR; BR; CM; USFD; TMS; PX; LWR; TM; TMo
	805, 807, 809, 810, 813, 815, 817, 819, 822, 824, 826, 828, 830, 833, 835, 836, 838, 839, 842, 844, 845, 848, 850, 853, 854, 856, 858, 859

MAIN COURSES	COURSE No.	WEEKS / DAYS	SEATS PLANNED	SEATS FOR CALL LETTER
IRSE COURSES	001	8	25	35
	002	8	25	35
	003	1	50	70
	004	1	50	70
	005	10	25	35
	006	10		
	007	1	6	
	008	1	50	70
INTEGRATED	101	12	25	45
	102	12		
	103	12		
	104	12		
	105	12		
SR.PROFESSIONAL COURSES	201	5	20	30
	202	5		
	203	5		
	204	5		
	205	5		
	206	5		
PCE/HAG/SAG/SEMINARS/WORKSHOP/MEETINGS	301	2	16/23	16/23
	302	2		
	303	2		
	304	2		
	305	2		
	306	2		
	307	2		
	308	2		
	309	2		
AWARENESS FOR PROBATIONERS	701	1	20	30
	702	1		
	703	1		
	704	1		
	705	1		
	706	1		
	707	1		
	708	1		
	709	1		
	710	1		
	711	1		
	712	1		
SPECIAL COURSES	401	2	20	30
	402	1		
	403	6d		
	404	1		
	405	1		
	406	3		
	407	1		
	408	6 d		
	409	2		
	410	1		
	411	1		
	412	1		
	413	2		
	414	1		
	415	1		
	416	1		
	417	2		
	418	2		
	419	1		
	420	6 d		
	421	2		
	422	1		
	423	3		
	424	1		
	425	6 d		
	426	1		
	427	1		

SPL COURSES for IRICEN

SPL COURSES	Course Name	No.	No.	No.	No.	TOTAL	WKs
T-1	USFD, Welding,RG,Track Moni & M/C	401	418			2	2
T-2	Rail Wheel Intraction & Derailment	403	408	420	425	4	6d
T-3	Points & crossing and Yards	402	414			2	1
T-4	Railway Formation & Geo Tech Inv	412				1	1
T-5	TMS	405	415	427		3	1
B-1	Bridge Design Assitant	423				1	3
B-2	PSC & Steel Structure	421				1	2
W-1	Land Mgt	404	416			2	1
W-2	Contract & Arb and Project Mgt	409	417			2	2
W-3	Arbitration for Arbitator	407	411	422	424	4	1
C-1	Morden Surveying	410	419			2	1
C-2	Construction Engineers	413				1	2
BAN ENGRS	Special course for Bangalades Engineers	406				1	3
NTPC	Special course for NTPC Engineers	426				1	1

AWARNESS COURSES

Awarness Courses	No.	No.	No.	No.	WKs
Accouts					1
Electrical engg.					1
mechanical Engg					1
Signal Engg.	701	702			1
storres					1
personel					1
traffic					1

SPL COURSES for ITTI

	C.No	ITTI COURSES	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	Total	Wks
1	TOT(P.WAY)	Trainers (P.Way)	804										1	3
2	TOT(B&W)	Trainer	830										1	3
3	RW	Rail Wheel Interaction & derailments	802	811	820	825	831	837	841	847	852	857	10	2
4	TMS	TMS	803	827	853								3	1
5	PX	Points & Xings	809	818	836	842	854						5	1
6	USFD	USFD, Welding & Rail Grinding	808	815	823	834	839	850	860				7	2
7	CU	Curves	805	821	840	851	855						5	1
8	LM	Land Management	816	828	849								3	1
9	MLS	Mangement of Store & Land	812	833	846								3	1
10	Tmo	Track Monitoring	813	824	832	843	859						5	1
11	BR	Inspection & Maintenance of Bridge	845										1	1
12	LWR	LWR	806	822	835	844	856						5	1
13	TM	Mechanized Track Maintenance & Renewals	807	810	819	826	829	838	858				7	2
14	CM	Contract Management	801	817	848								3	1
15	FSB	Fabrication of Steel Bridges & PSC constructio	814										1	2

IRTMTC | BREAK