IRICEN Journal of Civil Engineering

ज्ञान ज्योति से मार्गदर्शन

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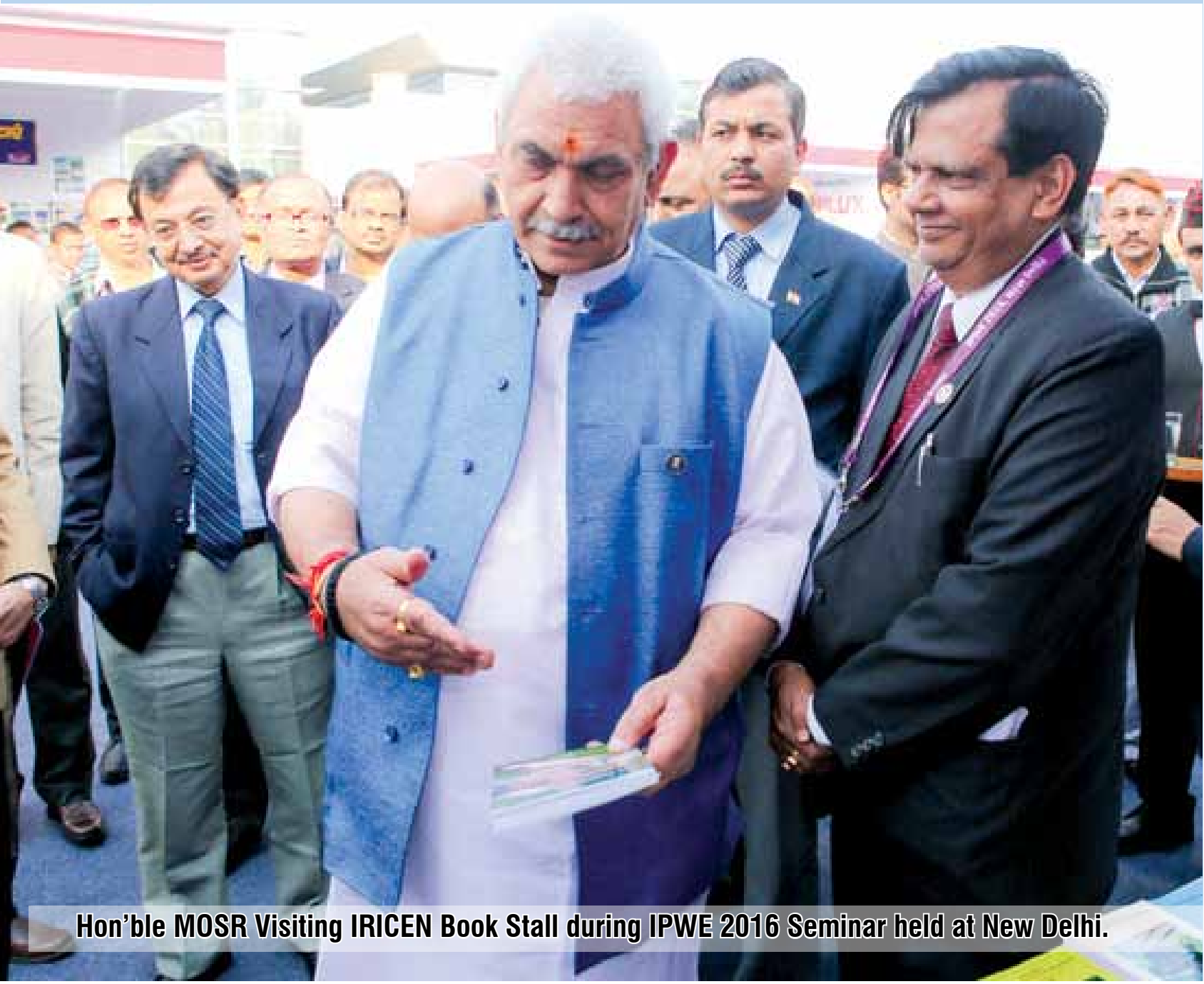

Hon'ble MOSR Visiting IRICEN Book Stall during IPWE 2016 Seminar held at New Delhi.

Indian Railways Institute of Civil Engineering, Pune

Sr-No	Codes/Manuals	Last Correction Slip no.
1	Indian Railways Permanent Way Manual(second Reprint-2004)	139 of 08-02-2016
2	Indian Railways Bridge Manual-1998	31 of 09-02-2015
3	Indian Railways Works Manual-2000	10 of 17-2-2005
4	Manual of Instructions on long Welded rails-2006(II reprint-2005)	16 of 12-6-2014
5	Manual for Flash Butt welding of Rails(reprint-2012)	2 of 05-06-2014
6	Manual for Fusion welding of rails by the Alumino Thermit Process (Revised 2012)	2 of 30-06-2015
7	Manual for Ultrasonic testing of rails & welds (revised 2012)	03 of 04-03-2016
8	Manual for Glued insulated rail joints-1998	5 of 28/8/2012
9	Indian Railways Track Machine Manual (2005)	17 of 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	17 of 03-08-2015
13	Indian Railways code for the engg dept (third Reprint-1999)	49 of 25-08-2014
14	Guidelines for Earthwork in Railway projects-2003	1 of 22-07-2004
15	Indian Railways Small Track Machine Manual (2000)	5 of 14-01-2015

From director's desk

Dear Readers,

After meeting the ambitious targets set during 2015-16, the beginning of new Financial Year presents new opportunities and raised bar in terms of higher unprecedented capex of ₹1,21,000 crores. Therefore, all infrastructure departments associated with creation of assets have to gear up and improve on the delivery so that the investments made are prepared into services to generate resources for further expansion.

This edition of Journal includes papers on wide ranging topics. The paper on "Finalization of span arrangement and assessment of foundation depth" is considered relevant for those, who are associated with construction of new line/ doubling etc.

A paper on Rain Water Harvesting elaborates the various methods of conservation of precious water resources. Considering the fact that substantial areas in various states are fighting with water scarcity, there is emergent need to take all efforts in right earnest.

At the end of the financial year, it is time to take stock of newer technologies/ materials adopted and innovations carried out, which are worth emulating on a larger scale. It has been desired by ME that the zonal railways are expected to publish a compilation of technical papers/articles on quarterly basis for circulation on their Railway and also sent to IRICEN, where from the selected articles/papers could be considered for inclusion in future editions of IRICEN Journal. Notwithstanding the above, contributions for publication of technical papers, articles, news items etc for IRICEN Journal can be sent on regular basis for wider publicity and application.

Pune

April - 2016.

(Vishwesh Chaubey)
Director

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Suggestion for improvement of **Iricen Journal of Civil Engineering** are welcome from the readers. Suggestions 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.

Suresh Prabhu Inaugurates Implementation of e-Enabled Track Management System

Minister of Railways, Suresh Prabhakar Prabhu inaugurated Implementation of e-enabled Track Management System (TMS) & Mobile Application of TMS on Indian Railway and Track Inventory Management System on Northern Railway. The Minister said the e-enablement of Track Management System (TMS) is an important milestone in promoting e-working in civil engineering department of Indian Railways. The system is being implemented on all the 68 divisions of Indian Railways. With its implementation, various activities of Track Inspection, Monitoring and Maintenance have come on IT platform. This system is designed for decentralized data capturing, speedy information dissemination along with centralized data keeping and analysis. It provides alerts in the form of SMS and e-mails to all concerned, right from Jr. Engineer in field upto the Railway Board. TMS Mobile Application has also been developed to use this system on mobiles and tablets to view certain important exception reports. This will prove to be useful for senior management and for officials on the move. Track Store Inventory Management for such a mammoth widespread system is an important facet of Asset Management. The system will contribute significantly to planet earth by removing more than 1.0 lakh registers related to track maintenance. This will result in saving of close to 500 trees a year.

Ref: Master Builder,Jan 2016

Railway Regulatory Authority may be Renamed as Railway Development Authority

In line with railway reforms, the Railway Regulatory Authority is likely to be renamed as Railway

Development Authority and would undertake various developmental activities besides fixing freight rates and passenger fares. Railway Minister, Suresh Prabhu has suggested that the regulator's functions should include laying down the framework for monitoring of passenger and freight tariffs, Public Private Partnership (PPP) projects and efficiency. A proposal has been formed for the name change from Railway Regulatory Authority to Railway Development Authority and make it broad-based, a senior Railway Ministry official said. The setting up of the authority is crucial for attracting private investment in railways as to ensure fair play for entities. The railways will seek suggestions from all stakeholders, including the public, on constitution as well as broad-basing the functioning of the authority. An independent rail regulator has been recommended by most committees that have looked into railway reforms for over a decade.

Ref: Master Builder,Jan 2016

Railway Board Sanctions Proposal for a Third Broad Gauge Line from Tambaram to Chengalpattu

Thousands of commuters from areas between Tambaram to Chengalpattu will, in a year's time, have better access to Chennai Beach. The Railway Board has sanctioned the detailed Estimate of the Southern railway's proposal for a third broad gauge line from Tambaram to Chengalpattu. The Board has accepted the proposal to create a third line of 30 kms between the two towns.

The proposal was sent alongwith the doubling work of Chengalpattu –Villupuram stretch. Though issues like floating tenders, identifying land for acquisition and selecting the contractor for the project are yet to be done, the Southern railway has set a tentative deadline of 2017 for completing the project.

The commissioning of the doubling work from Chengalpattu to Villupuram along with the third line between Tambaram to Chengalpattu will ensure dedicated tracks for operating additional suburban train services between Chengalpattu and Chennai Beach, which are about 250 a day now. Total project between Chengalpattu and Villupuram(103 km) along with the third line project will be executed at an estimated cost of ₹ 951.24 Crore. Under this almost 83kms of doubling work at a cost of ₹ 663 crore has already been completed.

Ref: Master Builder,Jan 2016

Railways to Spend Rs 82,000 Crore in Capex

The Indian Railways is on a major capital expenditure (Capex) drive with ₹ 82,000 crore worth of orders being placed, Railway Minister, Suresh Prabhu said at 95th Annual Session of ASSOCHAM held in New Delhi. Railways is taking a slew of steps to upgrade customer service including clean stations, e-catering and improved services. The capex spend would include a ₹ 40,000 crore order with the GE. Indian Railways upgrade to boost Economic Growth by 3%, says Suresh Prabhu. He added that projects were being awarded in a transparent manner. Funds were raised at an affordable rate from the LIC which is just above the government security (G-Sec) rate paid in 30 years. The ministry is also discussing the creation of a $30 billion fund with the World Bank to finance key rail projects, he said, further adding that the capex plans included ₹ 82,000 crore for a Dedicated Freight Corridor project. The Minister also said that capital expenditure of ₹ one lakh crore on building new infrastructure would be spent within the current financial year in the most transparent manner. As for structural reforms, the Indian Railways, Prabhu said, is trying to frame a regulatory system, Mr. Prabhu said. He said if things go as planned for the capex spend and boosting the Indian Railways activity, this alone could contribute between two and 2.5 per cent to the country's GDP.

Ref: Master Builder,Dec 2015

Rail Line Projects Worth ₹ 8351 Cr Cleared

The Centre has cleared four rail line projects in Odisha, Andhra Pradesh and Chhattisgarh at a cost of around ₹ 8351 crore. Government gave its approval for the doubling of 189.278 km Kottavalasa-Koraput railway line with a completion cost of ₹ 2977.64 crore. It also approved doubling of 164.56 km Koraput-Singapur Road section railway line with a completion cost of ₹ 2361.74 crore and 110.22 km Jagdalpur-Koraput section railway line with a completion cost of ₹ 1839.02 crore. The demand of goods traffic on these existing single lines was increasing over a period due to increase of production of goods and minerals in the vast catchment and subsequent transportation requirement. These projects are likely to be completed in the next seven years during 12th and 13th Plan period. Besides, the Union Cabinet also gave its approval for third and fourth lines between Budhapank and Salegaon via Rajathgarh railway line. This 85 km long stretch will cost a sum of ₹ 1172.92 crore. The project is likely to be completed in the next three years. The existing line is catering to the originating traffic from Mahanadi Coal Fields to the Paradip and Vishakhapatnam ports.

Ref: Master Builder,Jan 2016

Wi-Fi Facilities for 400 Railway Stations

In a bid to boost internet penetration in India, RailTel Corporation of India Ltd (RCIL), a PSU under the Railway Ministry, has signed an agreement with Mahataa Information India Pvt Ltd (MIIPL), an arm of Google, inc., to provide Wi-Fi facilities at 400 stations in two phases across the country.

In the first phase, as many as 100 stations out of the total A1 and A categories would be covered. The facility would be extended to 300 stations in the second phase. Non-suburban stations with annual passenger earnings of more than ₹ 60 crore are categorized as A1 stations, while those with yearly passenger income between ₹ 8 crore to ₹ 60 crore fall under the category of "A" stations.

Mumbai Central is expected to be among the first railway stations to boast of Wi-Fi services, which will be free to users for the first 30 minutes, but beyond that they would be charged a particular amount. Google has promised high-speed connectivity with the ability to download a movie in just four minutes.

The capital expenditure for the project would be incurred by both RCIL and MIIPL.

Ref: Civil Engineering and Construction Review, January 2016, Pg 16

IR All Set to Get its First Bullet Train

With the signing of the historic agreement with Japan for constructing the country's first high speed rail corridor linking the 505 km from Mumbai to Ahmedabad. IR with Japan funding is well set to get its first bullet train. The contract agreement on country's first bullet train was signed recently between the Indian PM and his Japanese counterpart who was on his official visit to India.

The PM noted in a joint statement that India's rail modernization and expansion plans open up commercial opportunities for Japanese companies in high speed rail, station redevelopment and rolling stock manufacturing. Earlier in its feasibility report, the Japan International Cooperation Agency (JICA) indicated to a seven year construction plan (2017-23) for the high speed corridor that will reduce travel time between the two cities from the existing seven and half hours to two hours flat with train zipping along at up to 320 km ph.

It has recommended that the project be taken up on the internationally accepted Standard Gauge instead of the existing Broad Gauge. A consortium including Kawasaki Heavy Industries and Hitachi is expected to bid for this project.

Ref: New Bldg Materials & Construction world, Jan 2016,Pg 40

Railways Inks Pact for Loco Factories

The Railways has signed two important contracts with US-based GE and France-based Alstom to set up locomotive factories in Bihar's Marhowra and Madhepura respectively. The contract, valued at ₹ 40,000 crore, is spread over 10 years.

Speaking about these developments, the Railway Minister said the contracts for the factories which will roll out energy efficient locomotives, were signed coinciding with the global climate change meet at Paris. President of Alstom said the factory will create about 1,000 jobs within Alstom, and another 3,000 jobs in the ancillary units.

Ref: New Bldg Materials & Construction world, Jan 2016,Pg 40

Railways Unveils JV for Rail Lines in Kerala

In an attempt to make states as partners in development of rail infrastructure, the Indian Railways has signed MoUs with Kerala and Andhra Pradesh governments for formation of joint venture companies whereby the states will have 51% stake and the rest 49% will remain with railways. The joint venture has been aimed at fast tracking rail projects in the region, railways minister Suresh Prabhu said, adding that similar joint ventures are being signed with 17 other states. As a matter of fact, it is a unique idea to enter into JVs with state governments for project implementation. Ensuring smooth execution of the projects, the minister, who has delegated powers to general managers, will go a long way fulfilling the demand for new rail lines from states and huge requirement of funds to execute them, JV firms will now be responsible for identifying projects, land acquisition and possible financing in addition to government funding and monitoring. After finances for a project are tied up, a project specific SPV (special purpose vehicle) would be formed to execute a project under the JV arrangement, he said.

Tata Projects Commences Work on Western Dedicated Freight Corridor

Tata Projects Limited has begun work on the Rs.4,328 crore project to build a 320 Km stretch of the Western Dedicated Freight Corridor (DFC), a dedicated freight line that would connect Delhi and Mumbai.

Tata Projects along with IRCON International Limited is part of the Express Freight Consortium, which is led by Mitsui and Co Ltd of Japan.

Segregating freight and passenger traffic will pave the way for high speed movement of goods. One of the most important infrastructure projects taken up by Indian Railway, it is planned to complete the work in the scheduled 48 months using the latest technology of Automated Track Laying Machines.

The machines lay the sleepers, special Head Hardened (HH) 250 m rails imported from Japan, and clamp them together simultaneously. The special rails are welded together using Flash Butt welding machines to create smooth tracks with an axle load of 32.5 tonnes and would be on paper with those in Japan.

The DFC is an ambitious programme of the Ministry of Railways involving construction of two corridors – the Eastern Dedicated Freight Corridor from Ludhiana to Dankuni, and the Western Dedicated Freight Corridor from Dadri to Jawarharlal Nehru Port, Mumbai. It is being implemented by the Dedicated Freight Corridor Corporation of India Ltd. (DFCCIL).

The DFC project will link the four hubs of Delhi, Mumbai, Chennai and Kolkata at the corners of India's Golden Quadrilateral. Japan has provided loans for the Western DFC project under special terms for the bilateral economic partnership. And, Tata will leverage its project execution skills to carry out the civil engineering work and lay the tracks jointly with IRCON and Mitsui will provide its established expertise.

Ref: Civil Engineering and Construction Review, February 2016 ,Pg 18

Bangalore Metro

The long-awaited Bangalore Metro (Namma Metro in Kannada), which is expected to be completed by March 2016, has come as a boon for property developers. The realtors are witnessing huge appreciation in property prices every since the construction for this large infrastructure project began way back in 2007. Property prices have increased by up to 450% along the corridors of Metro. According to real estate experts, the demand for properties – land, office space and even residential space- along the stretch between MG Road and Baiyappanahalli on the East-West Corridor and Yeshwantpur, Kanakapura road, J P Nagar, Jaya Nagar on the North-south corridor has increased manifold. This has resulted in property prices shooting up enormously.

"Prices have picked up ever since Metro project work started. For example, in yeshwantpur, prices have zoomed up to ₹ 11,000 per square feet and going up to ₹ 15,000 per square feet from just about ₹ 2000 per square feet in 2008 when the work started for Metro, "Satish B.N, executive director, Knight Frank India, the Indian arm of global property consultancy firm said.

Property prices in Yeshwantpur area were quoted at ₹ 1,500 per sqft to ₹. 2,000 per sqft in 2007-08, he said. Similarly, despite general market slowdown, the southern parts of Bengaluru, where Metro is still under construction, highest number of new projects have been launched in localities like Kanakapura Road, J P Nagar and Anjanapura among others.

In total, the Metro Rail in Phase-I comprises of 42.30 kms between two corridors. The East-West corridor covers 18.10 km and North-South corridor covers 24.20kms. The East-West corridor begins from Baiyappanahalli in the east and reaches up to the outer ring Road of Nayandanahalli by connecting Mysore Road in the west.

(Ref. Builders'Friend, Jan 2016, Pg. 22)

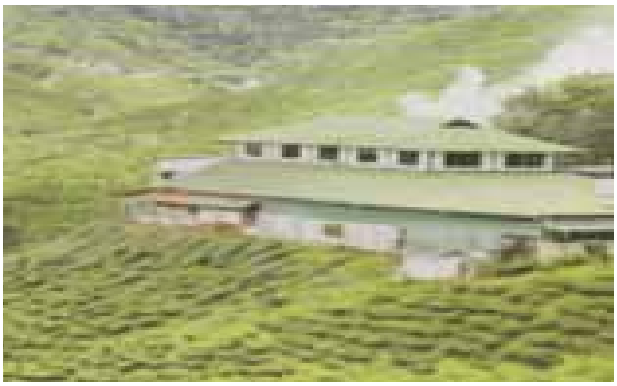
Metro Corridor Gets New FAR in Noida

In order to provide more realty space available for builders along the Metro corridors in Greater Noida, the state government in a recent move has increased the floor area ratio (FAR) by 0.5. The new FAR will be applicable within a 1,000-metre radius of Metro corridors and that the amendment in Greater Noida's building regulation came through a cabinet meeting held by the state government. The Greater Noida Industrial Development Authority (GNIDA) had proposed to revise its building by-laws and enhance the FAR in February last year and that the nodal agency also sought objections and suggestions on the modified plan from the local residents. Following this, the proposal was forwarded to the state government for approval, GNIDA is expected to issue the notification within a fortnight. According to officials, once the gazette notification is issued declaring the increases of FAR in Greater Noida, the sale of the additional

realty space is expected to go up generating Rs 3,500 to Rs 4,000cr. This amount will be used for funding the Noida-Greater Noida Metro track, which is under construction, claimed official sources.

Indo-Sweden Inks MoU for Building Rail Infra

In order to provide more realty space available for builders In order to bring the Indian rail sector matching global standards, Indian government has recently cleared the Memorandum of Understanding signed with Sweden for technical cooperation in the rail sector. The MoU, signed by the two sides in February this year, invisages cooperation in areas of benchmarking railway policy and regulation development, exchange of knowledge and technical expertise, freight operations in colder regions and tilting coaches. In fact, the rail ministry has signed pacts with multiple nations that allow technical cooperation in the railway sector with focus on high speed corridors, raising speed on existing routes, development of world-class stations, heavy haul operations and modernization of rail infrastructure. The cooperation is achieved through exchange of information on developments in areas of railways technology and operations, knowledge sharing, technical visits, training and seminars and workshops in areas of mutual interest, said official sources, adding that the MoU also provide a platform for Indian Railways to share the latest developments in the rail sector and facilitate exchange of technical experts, reports and documents, besides providing training and seminars focusing on innovative and specific technology.



Sikkim : India's First 'Complete Organic State'

Sikkim has become India's first 'Complete Organic State.' Implementing the practices and principles as per guidelines laid in 'National Programme for Organic Products,' it has gradually converted 75,000 ha of agricultural land to organic farming land. In 2003, Sikkim government declared their 'Sikkim Organic Movement' which aimed to make Sikkim a fully organic state by the end of 2015. Consequently, the state government banned the use and sale of chemical fertilizers and pest controls for agricultural land, leaving farmers with no option but to use organic products. Organic agriculture helps to preserve biodiversity and environment in the long run while helping build soil health and increasing crop production.

Ref : TERRAGREEN Vol. 8, Issue 11, Feb.206, pp 4.

Green Building Council Norms for Affordable Housing Soon

The Indian Green Building Council of the Confederation of Indian Industry (CII) is set to come out with the much awaited rating system for the country's affordable housing segment during the forthcoming glob al conference on Green Buildings to be held in Gujarat next month. The 13th Edition of the Green Building congress 2015 and International Conference and Exhibition on Green Buildings is slated to be held at Gandhinagar in Gujarat during November 19-21. The conference theme, "Green,Smart and healthy Cities," expects to bring together more than 2,000 delegates from India and abroad at the platform.

A number of initiatives have been taken by the Centre and various States Governments to encourage affordable housing, a segment which has immense demand in both urban and semi-urban and rural parts of the country. S. Raghupathy, Executive Director of CII Green Business Centre, told Business Line. "CII IGBC, the Union Ministry for Housing and Poverty Alleviation, and various stakeholders from the industry have worked for the more than a year to come out with a comprehensive guidelines and a framework, which will guide prospective developers in setting up affordable homes."

Äll the elements of quality, comfort and basic amenities would become part of these affordable homes. As against say Rs.1400 per sqft required for a conventional home for construction, we are looking at bringing it down to Rs. 1200 per sq ft. And typically, these affordable homes would be in the 300 to 500 sq.ft size and part of the larger building complex," he explained.

(Ref. Builders'Friend, Jan 2016, Pg. 24)

Flag hosting by Director IRICEN on the occasion of Republic Day 2016

'Desh Bhakti Geet' by probationers

Faculty and trainees present on the occassion

Method Statement for Finalisation of Span Arrangement & Foundation Depth

By
Ramesh Pinjani*

Synopsis:
The detailed guidelines & procedure is available for working out design discharge (Q50) as contained in flood estimation reports for various sub zones (For catchment size 25 sqkm & more) & RDSO RBF-16 (for catchment less than 25 sqkm). For the given design discharge , requirement of linear waterway & span arrangement for the bridge is to be finalised. In this context guidelines are available in substructure code, bridge manual & flood estimation report, however step by step approach is not available to deal the subject issue.

This paper deals with step by step approach/method statement to finalise span arrangement and foundation depth using the available guidelines contained in substructure code, bridge manual and flood estimation report.

A) Finalisation of span arrangement for given design discharge (Q_{50}):

Following steps are involved to finalise the span arrangement for a given design discharge

Step-1: Estimation of linear water way based on various guidelines

i) Based on Flood Estimation Report

The Flood estimation report suggests/ recommends the linear water way width, required to be provided, to cater given design discharge (Q_{50}).

Eg : sub zone 3 (i) kaveri basin, Linear water way recommended is = 4.98 $(Q_{50})^{1/3}$

ii) Based on Lacey's Regime width(Para 4.5.3 SSC)

Wetted perimeter $P\omega = 1.811\ C\ \sqrt{Q}$

Where C = a coefficient normally equal to 2.67, but which may vary from 2.5 to 3.5 according to local conditions depending upon bed slope and bed material/Considering C = 2.67 the $P_w \Rightarrow 4.83\ (Q)^{0.5}$

Accordingly Wetted perimeter $P_w = 4.83\ (Q_{50})^{1/2}$

iii) Based on width of active channel in stream/ River (Para 4.5.1 of S.S.C)

a) Bank to Bank width of River regime = ---------

b) Extent of spilling of water beyond bank to bankwidth = ----------

c) Width of Active channel of water in the River regime = ----------

Waterway based on width of active channel including spilling of water if any=----------

Step-2: Possiblemaximum & minimum linear water way width

Min. Possible linear Water way Width= ---------- (generally based on flood estimation report)

Max. Possible linear Water way Width=---------- (based on bank to bank width + water way for spill water).

Step-3: Selecting type of bridge (pipe culvert / Box culvert / Arch / Slab / Girder Bridge)

The type of bridge shall be selected on the basis of various factors such as design discharge (Q_{50}), linear water way requirement, velocity of flow, scour depth requirement, approach bank height, soil strata conditions.

*Senior Professor Bridges 2/IRICEN,PUNE

Step-4: Fixing norms for Free board, vertical clearance based on type of bridge selected)

i) **Norms for Free Board** The Minimum free Board from water level of design discharge to formation level of Railway embankment or top of guide bund shall be one meter; however CE/CBE can relax Free Board in special Circumstances as indicated below:-

Discharge (cumecs)	Less than 3	3 to 30	More than 30
Min free board (mm)	600 mm	750 mm	No Relaxation

ii) **Norms for vertical clearance:**

Bridges excluding arch bridges, pipe culvert and Box culverts	
Discharge (cumecs)	**Vertical clearance (in mm)**
0 - 30	600 mm
31-300	600 – 1200 mm
301 - 3000	1500 mm
Above 3000	1800 mm

Syphons, Pipe & Box culverts	**Arch Bridge**	
No clearances are considered necessary	**Span of Arch**	**Clearance (in mm)**
	Less than 4 m	Rise or 1200 mm
	4.0 to 7.0 m	2/3 rise or 1500mm
	7.1 to 20.0 m	2/3 rise or 1800 mm
	Above 20.0 m	2/3 rise

The vertical Clearance can be relaxed by CE/CBE provided:Adoption of prescribed clearance results in heavy expenditure and /or serious difficulties---The clearance can be safely reduced to:-

Discharge (cum)	Less than 3	3 to 30	31 to 300
Clearance (mm)	300	300 - 400 (Pro-rata)	400 - 1200 (Pro-rata)

It shall be personally exercised by PCE/CBE, due consideration being given to past history of bridge.

iii) **Norms for velocity of flow**

The norms for velocity of flow can be taken as 3 m/sec based on sub structure code Para 5.9.2.1.2. However, velocity during annual peak flow if available can be used for guidance.

iv) **Norms for HFL**

The computed value of HFL based on depth of flow calculated for assumed water way width should be close to observed HFL.River flow conditions during annual peak flow can also be used for guidance.

Step-5: Value of n & bed slope of stream:

The Value of n & slope to be considered as under:

Slope (S) :While calculating velocity of flow ($V = 1/n \times R^{2/3} \times S^{1/2}$), the average slope (S) of the river bed is to be determined from a point about 2 kms upstream of the Railway crossing to a point 2 kms downstream of the same. In case there are sharp changes in the bed slopes, the local bed slope should be determined over a shorter length. (Para 305(2) Bridge manual).

Value of n:

Channel Condition	**Value of n**
i) Natural channel in fairly good condition	0.030
ii) Natural channel in fairly bad condition	0.040
iii) Natural channel with variable section & some vegetation growing on banks	0.050
iv) Vegetation growing on banks in very bad condition	0.060-0.10

Step-6: Working out depth of flow (d) for assumed width of water way (B)

Total width of waterway assumed = B

No of piers assumed = N

Effective width of pier assumed = b

Effective width of waterway shall be (B') = B – n x 2 b

$Q_{50} = A \times (1/n \times R^{2/3} \times S^{1/2})$

$\mathbf{Q_{50} = (B' \times d) \times (1/n) ((B' \times d)/ (B' + 2d))^{2/3} (S^{1/2})}$

Using above equation, work out depth of flow (d) for assumed value of width of water way (B)/ effective width of waterway B'.

Step-7: Estimating various parameters for the set of assumed value of B(width of water way) & calculated value of d (depth of flow)

1. Actual Velocity of flow V = 1/n x $R^{2/3}$ x $S^{1/2}$ = (1/n) ((B'x d)/ (B'+ 2d))$^{2/3}$ ($S^{1/2}$)
2. Calculated HFL = Bed level + d
3. Vertical clearance = bottom of slab / girder or underside of box top/pipe – (HFL + afflux)
4. Free board = Approach bank height – (HFL + afflux)

Note: For various widths of waterway as assumed @ suitable interval , between the minimum & maximum possible width of waterway estimated in the step-2, workout depth of flow d for 5 to 7 values of assumed width of waterway & the calculate the above 4 parameters i.e. velocity of flow , calculated HFL, vertical clearance, free board. Compare the values of calculated parameters with laid down norms as discussed in step 4 above.

Step-8: Finalisation of span & working out various parameters for chosen span

Based on the exercise done under step-7, the minimum span, which satisfy all laid down norms in terms of velocity of flow, HFL, vertical clearance, free board and which can utilise as far as possible the available standard spans of RDSO is finalised.Now for this proposed span arrangement, the depth of flow is calculated on the basis of accurate value of hydraulic radius and the various parameters i.e. actual velocity of flow, HFL, vertical clearance & Free board are computed, compared& checked again with norms laid down for these parameters to finalise the span arrangement.

B) Estimation of depth of foundation for given span arrangement based on scour depth criteria

Step 1 - Design discharge for foundation: The design discharge for foundation (Q_f)shall be estimated based on Q_{50} & size of Catchment (Design discharge for foundation (Para 4.4 S.S.C)

Catchment area	Up to 500 km^2	> 500 & upto 5000 km^2	> 5000 & upto 25000 km^2	> 25000 km^2
Increase over Q50	30%	30% - 20%	20% - 10%	Less than 10%

Step 2 - Scour depth: Now for the given Q_f, the scour depth is estimated using following formula.

a) The normal depth of Scour (D) below the foundation design discharge (Qf) level may be estimated from Lacey's formulas as indicated below

$D = 0.473 (Q_f/f)^{1/3}$ -----Eq-1 (Para 4.6.3 SSC)

b) Where due to constriction of waterway, the width is less than Lacey's regime width for Q or where it is narrow and deep as in the case of incised rivers and has sandy bed, the normal depth of scour may be estimated by the following formula :

$D = 1.338 (q f^2/f)^{1/3}$-------Eq-2 (Para 4.6.4 SSC)

Step 3 - Maximum anticipated scour level from water level corresponding to Q_f: The depth calculated based on equation 1ORequation 2 above (as the case may be), shall be increased as indicated below, to obtain maximum depth of scour for design of foundations,

For Abutment: 1.25 x D For Pier: - 2 x D

Step 4 - Maximum anticipated scour level from bed level:The scour depth calculated in step 3 above,refers to maximum anticipated scour level from the water level corresponding to Q_f, therefore the depth of maximum scour level from the bed level can be ascertained if depth of flow corresponding to Q_f is known.

The depth of flow corresponding to design discharge for foundation **(Q_f)** for given span arrangement shall be worked out using equation discussed under para A step-6 above. The maximum anticipated scour depth from bed level shall be accordingly worked out after deducting the depth of flow corresponding to Q_f.

Step 5 - Grip Length : The foundation should rest below the maximum anticipated scour length for certain length called as grip length, the value of grip length in case of open foundation is 1.75 m in case of ordinary soil. However if the rock strata (soft or rock) is available at higher level which is considered as non-erodible bed then the foundation should keyed in rock for 0.3 m (in case of hard rock) & 1.5 m (in case of soft rock) .

Step 6–Depth of foundation : The depth of foundation shall be accordingly = Maximum scour depth from bed level (as worked out in Step 4) + Grip length (as discussed in Step 5).

Note : In case non scourable strata (rock strata) is available at shallow depths, then the foundation shall rest at that level suitably keyed into the rock strata (as discussed in Step 5 above), irrespective of scour depth calculated in the Step 2 and 3 above.

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Policy Related to Railway's Land Management

By
Shri S. K. Garg*

1.0 Introduction :

Indian Railways is the second largest owner of land in the country next to the Ministry of Defence. Indian Railways is holding approximately 4.32 lakh hectares of land. Out of this land, nearly 75% is used for operational and service requirement. Out of the remaining 25%, part of it is already inalternate uses with long term "Leasing" and "Licensing". Further, approximately 10% of total land at present is vacant, and thus has to be put to some alternate use to generate additional resources. This land is also prone to encroachment. Hence, Railway Board has issued comprehensive policy to manage this vacant land for proper custody and to utilise in due course of time for creating the infrastructure.

As a Policy of Government of India, Railways does not hold on to surplus land, i.e., any piece of land if not required by Railways, should be returned back to State Govt for further disposal. Out of this approximately 44894 hectares of vacant land, nearly 2000 hectares is under encroachment at various locations. Time and again, Railways keep on removing, rehabilitating such encroachers. In order to prevent misuse of Railway land, it is necessary to put the vacant land to alternate uses such as leasing, licensing, aforestation, grow more food, etc. We will further discuss about such policy of Railways.

2.0 Railway's obligation-WAY LEAVE FACILITY/ Accommodation works:

Sections 16 and 17 of the Indian Railways Act 1989 enjoin upon the railways to make and maintain specified works for the accommodation of the owners and occupiers of lands adjoining the Railway, for the purpose of making good any interruption caused by the Railway to the users of the land through which the Railway is made. These works include crossings, passages, pipe line, over head wires, drains etc.

As such, whenever a railway line is constructed, by nature of railway working, we are creating the obstruction to the habitants living across the railway line. These stipulations of the Railways' Act, make it mandatory for the Indian Railways to provide the relief to the occupants by providing different types of accommodation works.

Such, requests are often received for provision of way leave/easement on railway land in the form of passage/access to private houses and establishments, underground pipelines for water supply and sewage, electrical and telecommunication lines and Optic Fiber Cables, Cable TV lines etc. Railway Board issued detailed guidelines in November 2001 for granting way leave facilities/easement rights and fixed the rates to be levied for way leave facilities/easement rights on railway land for different purposes in genuine and unavoidable cases.

If these accommodation works are to be provided while the railway line is being laid, the cost of these will have to be borne by the Railways. Further, if the owners and occupiers of the land adjoining the railway line, approach to the railway after 10 years of commissioning of the railway line, then such works will have to be constructed at the cost of the local body/State Governing Body and the use of this land purely on a temporary basis will have to be treated as Way-Leave facility. This kind of permission does not transfer any Land Rights except for the occasional use, to the users, however, railway charges some nominal fees as "Way-Leave Charges".

3.0 Alternate use of Vacant Land

Following are permitted alternate use of vacant land of Railways for the purpose of preventing encroachment and for generating revenues from alternate sources.

3.1 Leasing of Railway Land: Leasing of Railway land is in some way similar to licensing, but, leasing is done

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as a long term commitment compared to licensing. In case of the leasing, we are transferring most of the rights on the land use to the 'Leasee' while we continue to hold the rights in the case of Licensing. Last but not the least, the returns expected in case of lease (Long term commitment) is more as we are getting 99% of current market value of land as the upfront lease amount, besides some token lease amount on annual basis.

It is very difficult to get back the land during the lease period while we can force the Licensee to vacate the land in case of License. Considering the nature of parting away the rights on the land for a longer period and difficulty in getting back the land even after the expiry of the lease period, Railway Board, in its rightful wisdom has banned the leasing of Railway Land since June 1984, except with the prior approval of Railway Board in exceptional circumstances.

Railway Board has issued comprehensive guidelines in the form of Master Circular in February 2005, superseding all the previous policy directives on such issues. As per this circular, ban on the leasing of Railway Land continue, while licensing of Railway land is permitted for Railway related activities with the personal approval of GM in consultation with the FA&CAO. This Master circular also specifies the rates of license fee for the different categories of plots.

For fixation of land value, the rates prevailing as on 01-01-1985 as determined by the local revenue authorities was to be taken into account and the land value had to be increased every year on the 1st April starting from 1986 at the rate of 10 % over the previous year's land value and seven per cent from April 2004. For fresh cases of licensing after 1st April 2004 the prevailing market value of land shall be taken for arriving at the license fee to be recovered.

3.2 Licensing: Railway Board in February 2005 issued the comprehensive guidelines for licensing of land to various users. Temporary licensing of railway land to private individual, for setting up of shops, commercial offices, vending stalls, etc, not connected with the Railway's working was stopped by the Railway Board since June 1984. This ban was continued, with direction that in exceptional cases, the licensing can be permitted for the railways' related activities with the personal approval of the General Manager in consultation with FA&CAO. Licensing of railway land is done for the following purposes:

3.2.1 Grow More Food Scheme: Considering the acute shortage of food in the country, a decision was taken to license strips of vacant railway land in the vicinity of stations to Railway employees for growing food crops under Grow More Food (GMF) scheme in early 1970. Due to problems such as non-payment of dues, large quantum of work involved in licensing, retrieval of land etc, Railway Board decided in 1984 to stop licensing of Railway land for cultivation and take back the land except from those belonging to SC/STs and weaker sections. The matter was subsequently reconsidered by Railway Board in March 2000 and it was decided to revive the licensing of railway land to railway employees in identified urban areas as an anti-encroachment measure and revenue earning measure. This scheme is further extended all over the Railways i.e. even in non suburban areas, vide RB's letter no.98/LML/16/9 of 16-07-2010. Main thrust of this scheme is prevention of encroachment and experience of last about 16 years reveals that land could be secured to a large extent in suburban areas of Mumbai

3.2.2 Licensing of Land for Pisciculture: As per this policy, Railways could license abandoned borrow pits/tanks for Pisciculture to co-operative societies formed by Railway employees and registered fishermen co-operative societies on the basis of limited tenders, public auction/open tenders in the same order of priority. In the case of cooperative societies, the license fee was to be fixed on the merits of each case in consultation with the FA&CAO. While doing so financial return commensurate with the prevailing market situation as well as Railway's overall situation are to be considered.

3.2.3 Licensing of Land for Central Warehousing Corporation: Ministry of Railways entered into a Memorandum of Understanding (MOU) with CWC for development of warehousing facilities on railway land in December 2003. As per the MOU, CWC has to construct, develop and maintain the warehousing complexes at their own cost on leased railway land.

3.2.4 Licensing of Land to Indian Railway Catering and Tourism Corporation Limited: After incorporation of IRCTC in later 90s, a MOU was signed between Ministry of Railways and IRCTC. As per this, Railway land and buildings may be leased to IRCTC on nominal

license fee/lease charges for setting up budget hotels, food plazas etc. It was decided in November 2005 that the license fee payable by IRCTC to IR included nominal annual land license fee at the rate of Rs.5 per sqm per annum and share of revenue to the extent of 40% of total revenue subject to minimum of 2.5 per cent of the market value of land. License fee for establishment of Rail Neer plant initially fixed at the rate of 7.5 per cent of the market value of land was also reduced to 2.5 per cent of market value of land.

3.2.5 Licensing of Land to Concor: Policy was laid down to license railway land to Container Corporation of India (CONCOR) for setting up Inland Container Depots. In May 1990, the Railway Board formulated policy guidelines for allotment of Railway land to CONCOR and instructed all Zones to fix the License Fee at the rate of six per cent of the book value of the land per annum. In subsequent years, there have been certain changes for charging license fee from the CONCOR. Railway Board in the year 2001 constituted a Committee comprising 3 officers from Railway Board and 1 from CONCOR to examine the issues such as Land requirement for container depots, remaining area of land under possession, additional land reserved for future use and levying of License Fee. The committee recommended in February 2002 that land given to CONCOR in the future should be charged at 6 % of the Market Value of the Land or as per extant rate of TEUs basis, whichever is higher and land given for existing depots should also be charged on TEUs basis.

4.0 Policy of Maintenance of Land Records in Railways

Comprehensive guidelines to maintain land records are available in Engg code and chapter 8 of Works manual. Basic land records such as Land Records Register, Land Boundary Verification Register and Encroachment Inspection Registers are required to be maintained in accordance with instructions contained in Para 850 of Indian railways Code for Engineering Department and also as per Para 806, 807 to 812 of Indian Railways Works Manual.

4.1 Maintenance of Land Records in P.C.E.'s Office:

i. As per para 850 of the Indian Railways Code for the Engineering Department a complete series of land plans for the entire Railway should be maintained in the Chief Engineer's office.

ii. The original tracings that are duly certified by the State Governments should be kept as permanent records in the C.E.'s office.

iii. Sufficient copies of certified plans after carrying out necessary consolidation and mutation should be made out and supplied to the Divisional Engineers for reference, a copy being kept in the cover of each relevant file.

iv. No noting should be made on certified plans and declarations or on important letters from the State Governments in connection with acquisition or relinquishment of land as these may, at times, be required in a Court of Law to prove the Railway's title.

v. All certified land plans shall be transferred land plans shall be transferred as micro-films, requisite sets of which can be kept in safe custody both in Headquarters Office and in Divisional Offices.

4.2 Land Records in Divisional offices:

i. Copies of all land plans should be maintained in DEN Office.

ii. All changes should be certified.

iii. Final land plans after mutation entries, should be sent to the CE's office for the safe custody of record. Copies should be available in Divisional and field offices.

iv. Copies of certified land plans should be available in AEN/SSE(Works/P.Way) Office.

v. Every SSE(Works/P.Way) should maintain land record as per para 806(b) in land record register.

vi. During inspection of higher officials this register should be kept by ADEN.

vii. The register should be checked annually by ADEN/DEN/Sr.DEN and observations recorded should be followed by SSEs.

4.3 Land Plans: Vide Para 850 of Engineering code, a complete series of original land plans for the whole line should be kept in the office of the Chief Engineer of Railways. Divisional/Executive Engineers shall be responsible to ensure that records are carefully preserved and kept up to date by noting all changes on the copies of the authorized land plans in their possession.

4.4 Land Records Register: Land records Register should contain details of land plans, area, kilometre, cost, description, reference to correspondence, government resolutions and date of sanctioning the transfer of land, etc. This register has to be maintained in Headquarters/P.Chief Engineer's Office as well as in Divisional /Executive Engineers' office. As per the subsequent instructions of September 2001, a register of total railway land with up to date entries shall be maintained by DEN and the Section Engineers (Works/P.Way) of the Engineering Department. Land records "must be digitized" as per Rly. Board Letter No. 2009/LML-II/13/19 dated 21.07.14.

4.5 Land Boundary Verification Register:

Policy as laid down in Works manual makes it mandatory that, all lands, permanently occupied for the purposes of Railway, shall have their boundaries demarcated in such a manner as to enable such boundaries to be readily ascertained and identified. For this purpose, the boundary of the railway land has to be defined by a continuous wall, fence or ditch or by detached marks, posts or pillars. Guidelines for demarcation of land boundaries, erecting of boundary stones, boundary walls, fencing etc as per Para 808 to 813 IRWM should be followed. Land Boundary Verification Register should contain the details of Boundary stones available along the railway boundary on both right and left side of the track with location thereof, for the land under their control. Vide para 812 (d) of IRWM, a certificate on land boundaries verification in the prescribed proforma should be given by the Section Engineer (P.Way/Works) once a year which is to be verified and counter-signed by ADEN with regard to correct demarcation of land boundaries and is required to be submitted to CE office through DEN.

4.6 Enchroachment Register: Vide para 814(e) of IRWM, a register showing the encroachments on Railway land noticed during inspections by various officials has to be maintained by each SSE duly furnishing the location, name of the encroacher, area encroached, type of encroachment (Commercial/residential/cultivation), date of commencement of unauthorised occupation, date on which the encroachment came to notice for the first time, action taken and date of removal of encroachment. The encroachment plan to scale shall also be pasted on the right side of the register. Vide para 814 (e) of IRWM, Section Engineer (Works/P. Way) shall give a certificate of encroachment in the prescribed proforma, once in three months which shall be verified and countersigned by the ADEN. This register should be scrutinised by the CE office from time to time.

5.0 Conclusion: Protection of Railway Land is one of the prime responsibilities of all Railway official and specially of Engineering Officers/Supervisors. Our efforts should be to utilise the vacant land in a way that it generates additional revenue by either leasing/ licensing/various other schemes of Railway Board, so that land is also prevented from encroachments. Proper maintenance of records of the land related activities, in Chief Engineer's office, DEN's office and Supervisors office should be ensured and the staff should be sensitised from time to time to ensure that the land is free from encroachment or any misuse by the miscreants. Timely action should be taken by the authorities to remove the temporary encroachments immediately and to remove the permanent encroachments by following the provisions given in the "Public Premises Eviction Act of 1971".

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Inaugral function of **"Gatimaan Express"**

A Triumph over Technical Challenges in 92 meter Long Box Pushing under Nine Tracks

By
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Ch.Gavaraiah**

Synopsis :
The paper brings out the useful technical aspects from the construction RUB with box pushing method. It also brings out challenges faced and problems encountered during construction of the longest subway by box pushing method in Bilaspur on SECR. It also brings out various timely actions taken then and there not only during pushing operation but also remedies toit's after effects of pushing in pure black cotton soil that to during monsoon period also.

1.0 Introduction:

Bilaspur is situated at Km. 718 on HAWRAH-MUMBAI main line having a three lines block section. There was an L.C. at Km 718/21-23 on NGP end of Bilaspur yard. This LC was situated on yard lines having 9 tracks. Heavy rail traffic at this LC on nine tracks was forcing the gates to be closed for 30 to 40 minutes in between opening periods of 5 to 10 minutes. Road traffic was also increased many folds due to fast growth on the other side of the LC which lead the public to trespass the LC while the gates were closed. Due to this trespassing, on a fateful night of 22.10.11, a heart breaking incident occurred when 12 peoplewere killed in a run over on this LC. So, Railway has decided to close this LC by providing RUB as an alternative way on war foot basis. It was a tough task to construct RUB under nine busy running lines in yard. The constructionwas witnessed by many groups of people. The media has nurtured it as delayed. The critics have commented it as impossible and the common public murmured that the construction technique was quite surprising and amazing. But the technical experts expressed it is a technically challenging job.

2. Salient Features& General Method of construction:

Size of the box 7.2 X 4.2 (Internal); Grade of concrete M 35; Cushion over top of the box 1.3 m up to bottom of sleepers; Main thrust bed 12.9m X 9.9 m; Auxiliary thrust cum casting bed 21.9m x 12 m; Type of strata from bottom of sleepers: Black cotton soil throughout the depth of Box; Ramp gradient 1 in 15 at both ends due to space constraints; Sump & pump arrangement on south end with pumps of capacity 2 HP and 7.5 HP. Thrust bed and casting bed for casting of two boxes were constructed and three boxes were casted before starting of box pushing. The box was casted over thick layer of grease covered with polythene cover for free movement of the box over the bed. Front box was provided with the cutting edge in front side and all the other boxes except the last box and including the first box rear shields with 20 mm thick MS sheet was provided to facilitate pushing. To house the jacks for pushing, Jacking points in the bottom slab was provided. Additional jacking point slots of size 60x60x100cm were provided at 2/3 height from bottom in the walls of boxes in front sides were provided for correcting the levels.

3.0 Why this project is a technically challenging:

3.1 Geometrical constraints: Total length of box is 92 meters with internal dimensions of 7.2x4.2 meters and two ramps on both sides parallel to the track making the total path like 'U' shape due to space constraint on both the ends of the box. The inner dimensions of the box are 7.2 X 4.2 meters. The shape of the path and size of the box are such that use of trucks or tractors is not possible for removal of the cut spoil from inside of the box for taking up quick pushing. So cut spoil was removed manually in multiple shifting which was a time consuming activity and this problem was continuously increased with the increase in length of pushing. The size of box is neither so big to take rotation of JCB for loading in to trucks nor so small to remove easily by man power as done in the most of the cases. There was a space constraint for casting of boxes also.

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** Dy.CE/Con/III/BSP

3.2 Poor Soil Condition: The natural soil in the vicinity is poor quality black cotton soil overlaid by cinders under the track which has very less cohesion strength having tendency to fall during excavation and pushing operation.

3.3 Heavy Rail Traffic over the box pushing area: As explained earlier the site is situated in the middle of the important junction station yard in 'A' route with nine tracks above it. Here one or the other track is always occupied and rare time was available for box pushing operation.

4.0 Brief Description of Work: The main activities of works involved in the project are construction of thrust bed & casting bed, casting of boxes, box pushing and construction of ramps and its roof.

4.1 Construction of thrust bed: Thrust bed & Casting bed was constructed in 'L' shape as it was not possible to construct in straight line due to space constraint. The bed was constructed to accommodate three boxes such that one under pushing and two under construction. No more extra space was available for making another casting bed.

4.2 Casting of Boxes: Internal dimension of boxis 7.2x4.2 meters with thickness of wall as 90cm. Overall box size is 9.0x6.0 meters. The length of each box is taken as around 10meters. Quantity of concrete and steel used in each box is around 250cum and 40MT respectively. Weight of each box is around 650 MT. Epoxy paint was applied on the outer surface of the box to minimise the friction.

4.3 Box Pushing: Box pushing was done with Jacks of 200 MT capacity behind each box by deploying one PWI round the clock and sufficient labour to look after the safety of track.

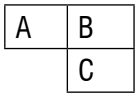
4.4 Construction of Ramp and its roof: Ramp was designed to act the base slab and two side walls as a single unit for proper moment distribution to reduce the quantity of materials. Ramp wall was kept by one meter above the road and the floor at the entrance of the ramp was also kept by 450mm above the level of the road and connected the road by a small reverse ramp to prevent the entry of water in to the box. Parabolic shaped roof was constructed over the ramps with galvolium sheeting to enhance the aesthetics of the RUB.

5.0 Planning & Execution of Work: As there are total nine number of boxes to be casted and pushed one after other, the average rate of pushing per day could be only 30 to 35 cm. The important task in the whole project is to get the casting of each box ready by the time previous box is pushed and to complete the pushing work between two monsoons. So it was planned to start the box pushing immediately after monsoon period during year 2013 and to complete before onset of next monsoon of year 2014. Accordingly three boxes were casted during monsoon and kept ready for pushing from 1st November-2013 after closure of LC. District Collector was approached for closure of the LC during the month of June-2013. After rigorous chasing with the state authorities, the permission for closure of LC was given in the middle of December-2013 and finally pushing could be started at the end of the December-2013 after closing the LC in consultation with local bodies. So an unwanted delay of two months occurred on account of granting permission to close the LC.

5.1 Planning for casting of boxes in series:

5.1.1 Planning was done under the able leadership of Sri Lajkumar, AM/Works/Railway Board, the then CAO/C/ SECR. His close monitoring and guidance in frequent visits to the site has helped in developing the planning.

5.1.2 By the time the box pushing started, three boxes were ready for pushing. So another six boxes were to be casted and pushed simultaneously such that much time is not be wasted for want of casting of boxes. But the minimum time required for casting of one box is 55 days including 28 days of curing etc. But whereas the time required for pushing of one box is only 25 days. The casting bed was in 'L' shape as shown below and it was required to make available each box with in 25 to 30 days.



5.1.3 Flow chart for construction of one box along with the days required shown in brackets is as follows: Fabrication and erection of rear shield (2) →Cutting, placing reinforcement and casting of bottom slab (7) → Placing reinforcement & Casting of haunch (1) → Casting of side walls in four lifts (8) → Placing reinforcement, shuttering and casting of top slab (9). Another 28 days are required for curing and attaining

strength. So total time required to make available one box is about 55 days. This is all squeezed out minimum time for casting of one box even keeping the technical aspects in view.

5.1.4 In the above figure 'C' is the thrust bed and 'A' & 'B' are the casting beds. By the time pushing was started boxes on the beds A,B& C were ready. After pushing the 1st box from 'C' 2nd box was shifted from 'B' to 'C' and 3rd box from 'A' to 'B'. Then casting of 4th box started at 'A' while the 2nd box was being pushed. After the 2nd box was pushed, the 3rd box was shifted from 'B' to 'C' leaving the place 'B' vacant. At this juncture, in general, work in new box would be started at 'B'. But this will take another 55 days to complete and till such time it obstructs the shifting of box at 'A' which was completed one month before to completion of box at 'B'.

Thrust bed and casting bed. Work in casting of box under progress.

5.1.5 Here OUT OF BOX solution was found to save time and to have continuous pushing. By the time 2nd box is totally pushed and 3rd box was shifted to 'C', casting of side walls of 4th box was under progress. Now the 4th box was shifted to 'B' after testing the cubes of bottom slab. By that time as more than 7days were passed after casting of bottom slab, good strength was always obtained. Care was also taken to stop concrete work in the 4th box 3 days before to shifting, to avoid any air cracks.

5.1.6 Immediately work in 5th box was started at 'A' simultaneously keeping the work in 4th box in continuation at 'B' while the 3rd box was being pushed from 'C'. In the similar way all the other boxes were casted. With this innovative and out of box decision, boxes were made available for every 30 to 35 days.

5.2 In such a way work in 4th box was started in last week of December-2013 and 9th box was casted in middle of July-2014. As per actual program, box pushing was planned to start from first week of November-2013 to complete the box pushing before onset of monsoon in the next year i.e by the end of June-2014. But two months delay occurred for granting permission for closure of LC by the State Government which has created multiple hindrances in subsequent period.

5.3 Box pushing operation:

5.3.1 The 1st box was provided with cutting edge on front side. An intermediate horizontal plate was also provided in the cutting edge at 2/3 height from bottom to break the free height of earth cutting to reduce the chances of collapse of earth during pushing operation. Subsequent boxes were provided with intermediate Jacking stations to place the jacks for pushing.

5.3.2 Equipment Used for box pushing:

1. Two power packs of capacity 20 & 16 HP attached with a pump of 27 & 25 L.P.M capacity respectively were used for operation of jacks working at a maximum pressure of 400kg/Sq.cm.
2. 6 to 8 numbers of Jacks of maximum capacity 200 MT were used behind each box.
3. Thrust pins of size 480x480x1000mm made of 25mm thick M.S. plate suitably reinforced with stiffeners were used in pin pockets of thrust bed.
4. Spacers for filling the gap after pushing in each stroke of jack.
5. JCB for cutting of earth inside the box.

5.3.3 Provision of Rail Cluster: Rail cluster consists of 5 rails was provided parallel to track on both the sides at 2.5 meter from centre of track to support transverse clusters of three rails each which were interlaced between the sleepers. Rail cluster was provided under the track while the first box was pushed to give extra strength to track by distributing the load away from sleeper edge.Two rail clusters were made and the same were shifted to the next tracks after box crossed that track.

5.3.4 Protection of Track: Two PWIs were nominated (one from construction and one from open line) to look after the safety of track for whole time of 24x7.

Contractor labour was engaged day and night as per requirement to attend picking of slacks & packing for overall safety of track. During pushing operation block was not taken but open line has engaged two look out men on both the sides of affected track during pushing operation with banner flag.

5.3.5 As the size of the box is large giving cut spoil of 54 Cum per meter length, manual cutting was not resorted to as it takes more time resulting into collapse of earth on drying and affect the progress. So inside the box, controlled cutting was done using with JCB at the central portion and the sides were cut manually using crowbars for a distance of 40 to 50cm ahead of the bottom slab leaving the cutting edge inside the natural earth. The intermediate horizontal cutting edge gave extra protection by breaking the height of cutting and reduced the chance of collapse of earth.

Work in progress in Box no 1 & 2

5.3.6 As the movement of tractor or truck is not possible inside the box due to space constraint between boxes at 'B' and 'C', the excavated earth was removed manually from the box and then loaded in to tractors outside the box and disposed. This task sometimes gave trouble whenever there was rain making the complete path sticky and slippery. During such incidents JCB was resorted to for shifting the earth from farthest box to front box.

6.0 Problems Encountered During Execution:

6.1 Collapse of earth face of pit made for thrust bed: The LC exists almost at ground level. Therefore complete box was made under the ground. Bottom of thrust bed is at 9 meter below the ground level and the site where thrust bed was made was surrounded by Track on onside at 8 meters and Road on the other side at 5 meters from the face of the pit. So sufficient side slopes could not be provided. So it was planned to construct the MCC wall on three sides after rail piling. Rail piling was done along with the excavation to arrest the collapse of the earth. But while the excavation was in completion stage sudden and heavy rains inundated the pit tending the track to be unsafe. About one thousand sand bags which were kept ready as reserve were dumped on the face of earth pit on track side and protected the track from any unsafe condition. Thereafter the pit was dewatered and MCC wall was constructed.

6.2 Permission for closure of the LC for taking up box pushing work: There was no other location for construction of RUB except exactly under the LC. So for construction of RUB, closure of LC was required. State authorities do not have any inclination to give permission for closure of the LC and desired the work to be done without closing the LC. District Collector was pursued for six months for getting the permission but no result. So Box pushing was started in first week of December-2013 to make the state authorities to know about the consequences after pushing. After pushing three meters, a cave-in occurred at the edge of the road and box pushing was stopped. Photos were shown to District Collector and after inspecting the site immediately permission was given to close the LC in the middle of December-13. Gate closed in last week of December and there after continued pushing. Work was delayedby two months on the account of granting permission for closure of LC.

3rd box being shifted in line from position 'A' to 'B'. 1st box partly pushed while the gate is being closed.

6.2.1 Incidents of Cave-in's. : Cave-in's occurred whenever it rained while the box was under track. It happened in four occasions. The main reasons observed for such cave-in were: (1) Presence of cinder type material with less cohesive strength under

the track above the box (2) These cinders have heavy water retentive property absorbing the water during rains and swelled and increased its weight (3) Transfer of Vibrations duringpassing of heavy loaded trains with high frequency.

Cave-in under the track

6.2.2 The box had crossed three tracks safely without any hindrance until unseasonal incessant rains occurred from 27.02.14 to 12.03.14. During further pushing when the top cutting edge of box was under tip of the sleeper of DN Departure goods line, cave-in occurred on 14.03.14 at 17.30 hrs. Track was required to be suspended and the box was continuously pushed by 2.5 meter overnight and filled the gap above box with moorum and then given track fit at 05.30 hrs on 15.03.14. It was experienced that whenever cave-in occurred, the best method to restore traffic in a shortest period is to push the box quickly under the suspended track and to fill the gap above box with good earth or moorum instead of resorting to working with relieving girder in which 'mode of operandi' is very critical and longer.

6.2.3 In similar manner another cave-in occurred under MID line on 22.03.14 at 06.30 hrs in the morning which was reported by night watchman. It was attended with in five hours in the same corrective measures and given track fit. There after pushing was done for next three months without occurrence of any cave-in as there were no rains when the tip of the first box was near the track.

6.2.4 Almost 72 meters was pushed when the monsoon entered in the mid June leaving only two tracks to cross. Many times problems encountered in crossing these two lines apart from two cave-in due to rains.

6.2.5 Role of Rail cluster: Unlike acting like a bridge, it was observed that the role of rail cluster ceases once cave-in is formed. Rail cluster only distribute the load beyond the edge of sleepers. It takes load while the first boxis under the sleepers. But once a small pocket of hole is formed, due to any reason like frequent movement oftrains creating vibrations during rains etc, it spreads full width of the of the box with in a short period leaving the track unsafe.

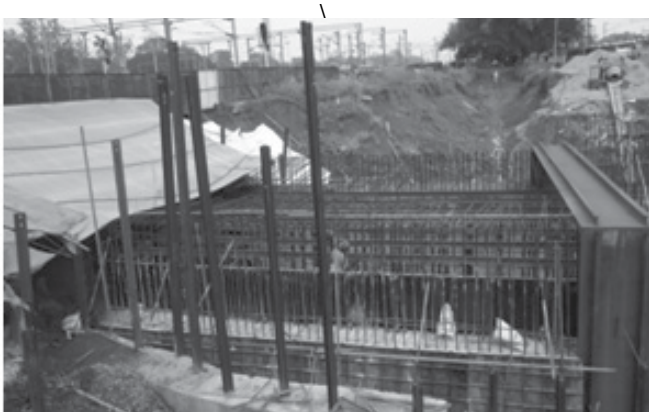
6.3 Separation of top plate of rear shield: While the rainy season was started and it was frequently raining, top plate of rear shield of third box was separated from the box due to shear of weld at the corners after pushing of 78 meters. Suddenly long hole was formed in full width of box under the track and the earth was slipping into box. As a remedy, a 'V' type notch was inserted on this hole and gap was filled with sand bags and ballast. There after box no 3 & 4 were pushed as a single unit by deploying more jacks behind the 4th box. Later on this was rectified by excavating the earth up to top of box and connected the plate to box with hold fasts and welding to rear shield after the joint between 3rd and 4th box reached the wide space of 9 meters between the tracks.

Rear Shield

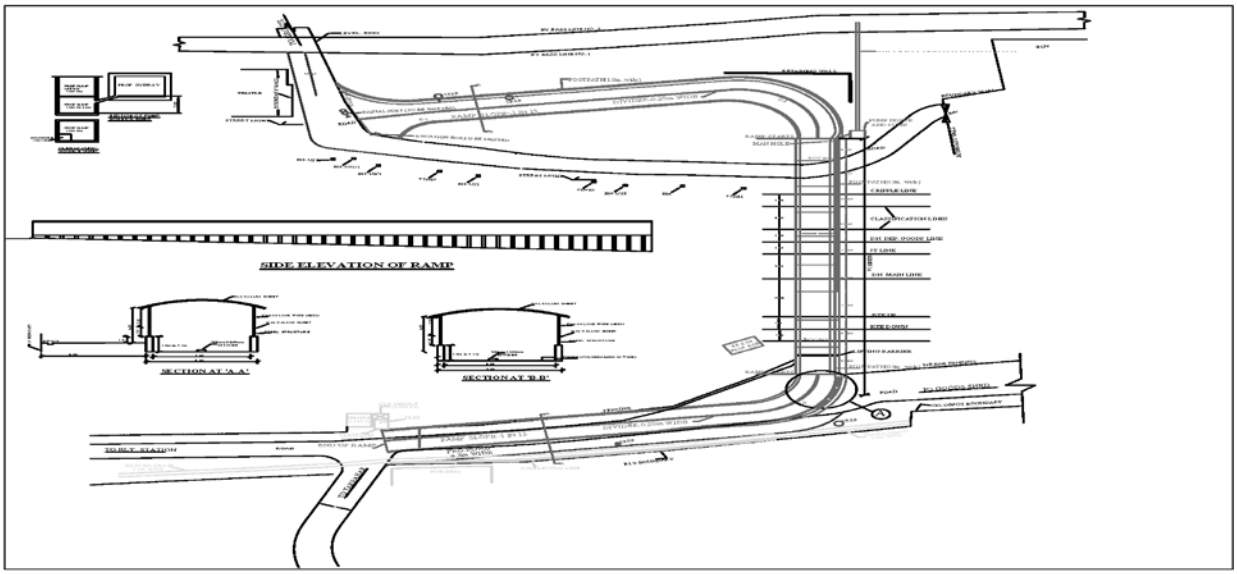
Aesthetic view of Ramp in curve

Land separation during push in Approach at almost 90°

Aesthetic view of Ramp and stair case



Polythene sheet over Greased surface



Layout plan of RUB at Tarbahaar

6.4 Shifting of Track during pushing in monsoon: As per the original planning boxes were made available for every 30 to 35 days to complete the work before onset of next monsoon. But start of pushing was delayed by two months for want of LC closing permission from the State Government and unexpected unseasonal rains in month of March were occurred. Due to this delay, pushing was entered into monsoon and it was required to go ahead with pushing during monsoon also because there were another two tracks to cross and the tip of the front box is near the track. As the earth was totally saturated and stuck to the box, movement of complete soil mass above the box was started along with the box during pushing. So tracks were shifted as much as pushing was done with lifting. Disposal of soil from inside the box was another major issue because the path in the box has become long and slippery, so movement of labour became a problem.

Shifting started with JCB but covering the gaps between the boxes for the movement of JCB was another problem. So Pushing was required to be stopped while the earth was carried out side. For pushing of one foot it was required to push 8 boxes each by one foot with two inches pushing each time by observing the shifting of track and pulling it back to safe condition. So pushing during monsoon faced multiple problems and should not be resorted to.

6.4.1 As a remedy to arrest shifting of track, horizontal rail clusters of 5 rails were provided with its axis kept horizontal at the side of track which was supported by two pillars casted beyond the line of box pushing. Then the sleepers of the track were supported with rails placed horizontally and supporting to this cluster. With this method, shifting of track was minimised.

Anchoring arrangement of Track

6.5 Differential levels at the soffit of the two boxes at junctions: Alignment and level were maintained perfectly up to pushing of 73 meters without any deviation. But when the monsoon started, different problems arose which were solved as per the type of problem. Out of them, the major problem was differential levels at the soffit of the two boxes at the junctions. At every junction of two boxes, there was about 150 to 200mm level difference between two boxes. At the junctions preceding box was about 200 mm lower than the following box.

6.5.1 Causes for such level difference:(1) Soil collapsing in the jacking pockets between two boxes during pushing operation was cleaned every time before next pushing. But during monsoon it was not possible to clean due to presence of water. So the soil felled in the pockets was deposited under the edge of following box at the junction during the pushing operation. So over a period of time the box started lifting on front side. (2) During monsoon, soil under the box was saturated. Therefore, its SBC was reduced and the soil under the box was also in jelly like state. When the jacking force was applied at rear end of the box, it tends to push the soil forward under the box. Gradually this earth was deposited towards front side of the box increasing its inclination. This has given a very shabby look and has thrown a challenge to bring back the level difference to zero.

6.5.2 Correction of level difference at the junction of the boxes: Every problem has its solution and it also has. It is just impossible to bring back the levels by application of forces as it has to deal with thousands of Tons of vertical loads. This problem was solved only by application of mind on spot. First of all, the problem was studied from all angles and found the causes for such level differences. There was only 10 meters left for pushing when the level difference was noticed about 200mm. In October, when monsoon was recessed, deposited soil under the box tip, up to one meter width was removed manually with a special type of tool made in 'J' shape after every push. The box was further pushed for another five meters with a planning to apply the correction after repair of rear shield (as the top plate of rear shield of third box was detached and required this pushing for its repair). It was observed that the level difference was not increased in this operation. Thereafter the corrective method applied as here under.

(1) The corrective method applied is simply a reverse process. Each box was pushed back about half a meter in every operation of pushing. It was done by creating gap between box no. 3&4 and applying Jack force between box no. 2&3 and so on.

(2) Pushing Jacks were adjusted to upward inclination of about 5 degrees in forward direction by inserting wedges.

(3) Water was poured under the box to bring back the loose soil to jelly state before pushing the box back and forth to facilitate movement of soil.

(4) Bottom plate of rear shield was cut by 40 cm out of 75cm overhang in full width of box and made a drain type cut of 30x20cm below the box bottom level in front of rear box to accommodate deposition of extra soil rolled out of forward pushing. The soil spilled out of box in excess was removed manually.

(5) This process of pushing the box back and forth was followed in the next five meters of pushing and brought levels at all the junction to zero difference. (It can be seen in the photos)

7. Grouting of joints between boxes: The side joints were filled with concrete by providing nominal reinforcement. Top portion of joint was grouted in the following manner:

(1) MS plate of 6mm thick was fitted with screws to cover full width of gap and an overlap of 75mm on each side leaving two holes to insert pipes for grouting.

(2) A mesh of width 85cm made of 12mm diameter rods were welded to the above plate before it was fitted and kept this mesh in the gap between boxes.

(3) Two pipes of length 87cm (Box top slab thickness 90cm) were inserted in the two holes and welded for grouting and inspection before fitting the MS plate.

(4) By keeping one pipe open grouting was done from the other pipe with the grouting material. The ingredients of grouting material are (a) Water- 10.5 litres (b) Cement -12.5 Kgs (c) K-10 Cement based grout mix powder – 50 gr (d) SBR Latex bonding Chemical in liquid state (to arrest shrinkage of cement) – 1000ml (e) Plasticiser - LW(+) Chemical in liquid state (To import consistency and to increase strength) -50ml.

(5) The above mix was grouted with grouting machine from one pipe and checked for discharge from the other pipe. After observing the grout through the other pipe for required consistency, this pipe was closed and further grouting was done to fill the remaining gap.

8. Provision of Sump for dewatering: Sump well was constructed with automatic pump system for dewatering of leakage water from joints of ramp wall and percolated water.

9. Construction of ramp and its roofing: Ramp and roof were constructed keeping the aesthetics in view by providing the parabolic shape roofing and beautiful galvolium sheeting.

10. Conclusion: This work is a unique type by its nature coming across typical problems coupled with track safety. Delay in granting permission for closure of LC was an added problem which led the pushing operation into monsoon and was required to face multiple and simultaneous problems. But even after facing all these hurdles, there was no single untoward incident occurred with any of the nine tracks. The work was completed safely and satisfactorily and dedicated to public on 11.06.15. Public is very happy after this RUB was opened and traffic is also increased by two fold.

On completion of this project, the Technical Experts have nodded it as great triumph. The media has witnessed all along and wiped its opinion as delayed project while the critics observed its completion. But the general public who was staring with wide spread eyes enjoyed, jumped with ecstasy.

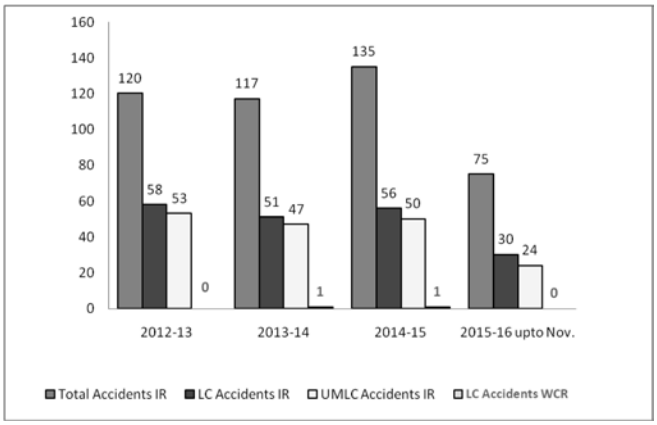
■■■

Safety for Road Users by Elimination of Unmanned Level Crossings on West Central Railway

By
R. N. Sunkar*

Indian Railways (IR) system is unique and distinctive in character. It is an enormous challenge for Railways to make it a safe and reliable system. Safety on the Railways is the end product of the cohesive fusion of its myriad parts. Level Crossings (LCs) form an important part of the system posing challenge in the operation of safe and reliable train services.

I. The accident scenario on Indian Railway



II. Details of accidents vis-à-vis accidents at UMLCs

Year	Total railway accidents	Accidents at LCs	Share of LC accidents	Share of UM LC Accidents in LC Accidents
	(Nos.)	(Nos.)	(%)	(%)
2009-10	165	70	42%	91%
2010-11	141	53	37%	90%
2011-12	131	61	46%	91%
2012-13	120	58	48%	91%
2013-14	117	51	43%	92%
2014-15	135	56	41%	89%
2015-16	75	54	72%	80%

Unmanned Level Crossings

* CBE/WCR

Accidents at Unmanned Level Crossings

Increasing road construction and road vehicle population create greater chances for LC accidents to happen.

III. Response to the Needs of the Community

Indian Railway Network has 31,254 Level Crossings (as on 01.04.2013) out of which, 18,672 (60%) are Manned and balance 12,582 (40%) are unmanned. The corresponding figures for WCR were 792 and 118 as on 01.04.14.

- These Level Crossings contribute 40% of all Consequential Train Accidents and 70% Fatalities over Indian Railways out of which 90% of LC Accidents are on UM Level Crossings.
- The onus for safe movement over unmanned level crossing lies with the road users (Section 131 of "Motor Vehicle Act" and Section 161 of "Indian Railway Act") as per existing Law in India.
- The Corporate Safety Plan (CSP) emphasized (August 2003) the need of arresting the rising trend of accidents on level crossing gates.
- The Vision 2020 Statement of Railways (December'2009) observed that nearly 70% of the fatalities in Railway mishaps took place at unmanned level crossings. The Vision 2020 envisaged that UMLCs would be progressively manned or protected or replaced by Subways/Road Over Bridges/Road under Bridges in the five years' time (2010-15). Quoting the Vision 2020, Railway Board (RB) in May 2010 issued instructions to zonal railways to prepare a Master Plan for elimination of UMLCs in five years' time.
- High Level Safety Review Committee (HLSRC) headed by Shri Anil Kakodkar recommended (February'2012). Elimination of all UMLCs over a period of five years
- Thus, Accidents at Unmanned Level Crossings are most severe and therefore, require a mechanism by means of which the same can be reduced. The only mechanism is the "Elimination of Unmanned Level Crossings".
- To enhance safety, therefore, best way is to replace all Unmanned Level Crossings by Limited Height Subways/Road Under Bridge.
- Elimination of LCs by LHS ensures:
  - o Safety to Road users
  - o Ease of Movement to Public at Large.
  - o Faster Access.

IV. Various methods of elimination of unmanned LCs are briefly described as under:-

(i) **Construction of Road Under Bridge (RUB) to eliminate LC:** Construction of RUB in lieu of level crossing. The cost varies from Rs 1 to 2 crores and completion takes approx. 1 year. This is the most cherished method of elimination but is technically feasible only where the Rail Track is on high embankment and does not remain on water stagnant area.

(ii) **Merger or Diversion:** Railways have planned construction of Diversion Roads from Unmanned crossing to nearby Manned Xing or ROB/RUB to divert road vehicles for safe passage and have constructed Diversion Roads through Railway land.

(iii) **Closure:** By closing unmanned level crossings having NIL/negligible traffic by way of Train Vehicle Unit where roads are non-existent on either side after obtaining NOC from Collectors of respective Districts.

(iv) **Manning:** The unmanned level crossings which cannot be eliminated by other means (ROB/RUB, Merger/ Diversion, and Closure) were progressively manned.

V. Steps Involved in construction of Limited Height Subways:

The various Steps involved in Construction of LHs are as under:

1. **Site Survey:** Suitable Site with sufficient Bank and Proper Drainage feasibility is selected for construction of Subway. All details are collected and GAD is prepared.

2. **Design of LHS:** The Boxes to be used for construction of Subway are designed and Grade of Approach Road and Curvature are also decided.

3. **Design of Drainage Arrangement:** The Drainage Arrangement is also designed for efficient drainage of Water from the Subway.

4. **NOC from District Collector:** NOC is to be obtained from District Collector for closure of Level Crossing so as to build a Subway for which meeting at the level of Principal Secretary/Transport and Principal Secretary/ PWD and District Collectors.

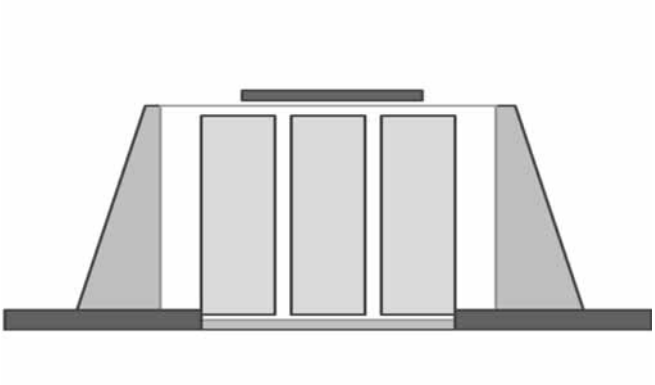
5. **CRS Sanction:** CRS Sanction is to be obtained from Commissioner of Rail Safety for Closing of LC after Construction of LHS.

6. **Execution of Work:**

   a. Casting of RCC Boxes
   b. Insertion of RCC Boxes during Traffic Block of 05 Hrs.
   c. Casting of Wing Return and Side Walls and Approach Road
   d. Drainage Arrangement
   e. Fixing of Height Gauges
   f. Provision of Signage on LHS

7. **Commissioning of LHS and Closure of Level Crossing after NOC from Collector.**

VI. Construction of LHS on Single Line



a) Methods of Construction of LHS on Single Line

- Cut & Cover Method
- 4 to 5 Hrs Traffic Block
- Using RH girder
- 1st block 2.5 hrs
- 2nd block 3.5hrs
- Box Pushing method
- Without RH Girder - 15 days
- With RH Girder - 02 days

b) Methodology Of Launching Of Rcc Boxes By Cut & Cover Method

Step-1: Dismantling of track

Step-2: Excavation of Embankment

Step-3: Providing Protection Screen

Step-4: Leveling & Marking

Step-5: Placement of precast RCC Base Slab

Step-6: Placement of precast RCC Boxes

Step-7: Providing Murrum/sand filled bags at the end on all four sides of RCC box

Step-8: Linking of track & restoration of traffic

c) Use of RH girder in case of Single line busy section:

d) Use of RH girder on both lines on busy section having sandy soil in formation:

e) Using RH girder on both lines on heavy density section for Air pushing of precast RCC boxes:

f) Using RH girder on one line of double line section:

g) Block Requirement for

- **Cut & Cover Method on Single Line**

Method of Execution	Size of Box	Block Timing on S/L
Cut and Cover on Single Line	5 x 6	4-5 Hrs
	4.5 x 6	4.5 Hrs
	4 x 6	4.5 Hrs
	3.5 x 6	4.5 Hrs

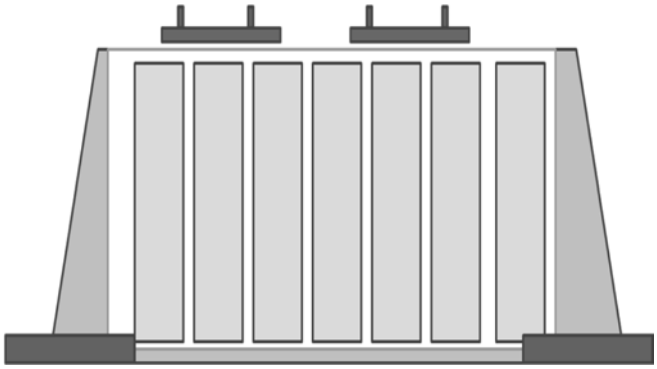
- **Using RH girder on Single Line**

Method of Execution	Size of Box	Block Timing on S/L	
		R/H Girder Insertion (1st block)	Box Insertion (2nd block)
RH Girder on Single Line	5 x 6	2.5 Hrs.	3.5 Hrs.
	4.5 x 6	2.5 Hrs.	3.5 Hrs.
	4 x 6	2.5 Hrs.	3.5 Hrs.
	3.5 x 6	2.5 Hrs.	3.5 Hrs.

- **Box Pushing Method**

Method of Execution	Block Requirment	
	Without RH Girder	With RH Girder
Box Pushing Method on single Line	15 Days	02 Days

Vii. Construction Of LHS On Double Line



a) Methods of Construction of LHS On Double Line

- Cut & Cover Method :
  - a) Block on both lines simultaneously for 5 Hrs
  - b) Block on 1st line for 5 Hrs and 5 Hrs block on the other line with 1.5 Hrs staggered.
- RH Girder One Line :

a) Block on 1st line for RH girder (2.5 to 3 Hrs)

b) Block on 5Hrs block on 2nd line

c) Block on 3.5 Hrs block on 1st line

- RH Girder Both Lines :
  - a) Block for RH Girder on 1st line :- 2.5- 3Hrs
  - b) Block for RH Girder on 2nd line :- 2.5- 3Hrs
  - c) Block for RCC box insertion on 1st line :- 3.5 Hrs
  - d) Block for RCC box insertion on 2nd line :- 3.5 Hrs
- Box Pushing method
  - a) Without RH Girder
  - b) With RH Girder on both lines
  - b) Block Time required for LHS on double line
- Cut and Cover method

Method of Execution	Size of Box	Block Timing on UP M/L	Block Timing on DN M /L	Remarks
Cut and Cover with Both Lines Blocked Simultaneously	5 x 6	5 Hrs	5 Hrs	
	4.5 x 6	4.5 Hrs	4.5 Hrs	
	4 x 6	4 Hrs	4 Hrs	
	3.5 x 6	4 Hrs	4 Hrs	
Cut and Cover with Both Lines Blocked Staggered by 1.5 Hrs	5 x 6	5 Hrs	5 Hrs	Block Timing on DN M /L (1 ½ Hrs after)
	4.5 x 6	4.5 Hrs	4.5 Hrs	-do-
	4 x 6	4 Hrs	4 Hrs	-do-
	3.5 x 6	4 Hrs	4 Hrs	-do-

- **Block Time required for LHS on double line**

Rh Girder On One Line

Method of Execution	Size of Box	Block Timing on UP M/L		Block Timing on DN M/L
		R/H Girder Insertion	Box Insertion	
RH Girder on One Line	5 x 6	2.5 to 3 Hrs.	3.5 Hrs.	5.0 Hrs.
	4.5 x 6	2.5 Hrs.	3 Hrs.	4.5 Hrs.
	4 x 6	2.5 Hrs.	2.5 Hrs.	4.5 Hrs.
	3.5 x 6	2.0 Hrs.	2.5 Hrs.	4.0 Hrs.

- **RH Girder on Double lines**

Method of Execution	Block Requirement
For RH Girder on 1st line	2.5-3 Hrs
For RH Girder on 2nd line	2.5-3 Hrs
For RCC Box insertion on 1st line	3.5 Hrs
For RCC Box insertion on 2nd line	3.5 Hrs

- Box Pushing

Method of Execution	Block Requirement	
	Without RH Girder	With RH Girder
Box Pushing	30 days	02 days

VIII. Pros and cons of different Methods

1. Cut & Cover Method

Advantages

- Fairly Economical

Disadvantages

- Larger Duration Blocks are required.
- Engagement of officers/supervisors and staff is more
- Heavy Machinery is required.

2. RH Girder method on one line

Advantages

- Fairly Economical
- Major Disruption of Traffic on Only on One Line

Disadvantages

- Heavy Machinery is required.
- RH Girder Dependency is more.
- Chances of Bank Slippage.
- Number of blocks required are more
- Engagement of officers/supervisors and staff is more

3. RH Girder method on both line

Advantages

- Less Disruption of Traffic.
- Smaller Duration Blocks are required.

Disadvantages

- Heavy Machinery is required.
- RH Girder Dependency is high.
- More Cumbersome.
- 4 blocks required for each LHS
- Officers, supervisor and staff requirement for blocks is more.

4. Box Pushing Method

Advantages

- No disruption to rail traffic.
- Better quality control.
- Saving in Man power & Machinery.
- No involvement of crane & heavy equipment.
- Less involvement of other Departments.

Disadvantages

- Costly.
- Needs trained staff and skilled supervision.
- Imposition of caution order for a longer duration.
- Chances of Sudden Collapse at the face of cutting edge

5. Ranking of Methods

Parameter Method	Cost	Safety At Work Site	Block Requirement	Machinery & Man-Power	Safety Of Train & Staff
Cut & Cover	1	5	5	5	5
Cut &Cover using RH Girder on One Line	2	4	4	4	3

Table Contd...

Parameter Method	Cost	Safety At Work Site	Block Requirement	Machinery & Man-Power	Safety of Train & Staff
Cut & cover using RH Girder on Both Lines	3	2	3	3	2
Box Pushing Without RH Girder	4	3	1	1	4
Box Pushing With RH Girder	5	1	2	2	1

IX. Steps taken to ensure the sustainability of the programme.

West Central Railways have decided to progressively eliminate level crossings by various means:

- Fixing a nodal officer in the HQ
- Nominations of field officers and staff for the task
- Approval of design, drawings in a time bound manner
- Finalization of contracts in a time bound manner
- Ensuring availability of funds for the work being executed
- Ensuring Traffic block availability and 5-6 hours for construction of RUB/LHS
- Providing safety equipments/medical aids during execution of work
- Establishing the coordination between different departments for shifting of utility.
- Coordination with state govt. at the level of Principal Secretary/PWD, District Collectors, Gram Panchayat level for NOC to get for closure of LC.
- Obtaining CRS sanction on time for closure of LCs
- Weekly review of works through Video conference at highest level. (GM level on every Tuesday)
- Awarding the officers and staff for excellent performance exhibited by them.

All above initiatives have helped in achieving the task.

X. Risk analysis for the Project's success

Risk analyses was classified on following categories and addressed:

1. Technical

Issues related to

- Bank Height
- Drainage Arrangement
- Grade and Curvature on approach Roads

2. Safety:

Issues related to

- Earth collapse during block
- Injury to the workers

3. Administrative Technical sanction, funds availability, Safety aspects

Issues related to

- NOC from Collector
- CRS sanction
- Finalization of GADs

4. Public Related

There is public outrage

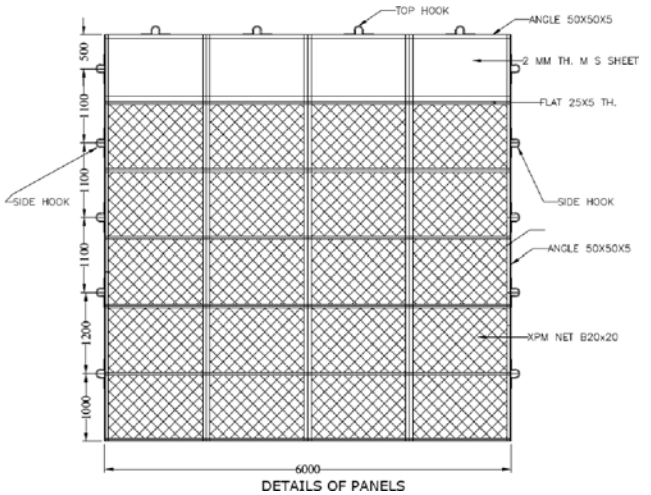
- during traffic blocks
- during closure of Level Crossing.

Due to meticulous planning, execution, close monitoring of works at all stages, provision of safety equipments, first aid, deployment of medical teams at site, coordination with the State Govt. and Commissioner Railway Safety, WCR could come out of all hurdles and was successful in eliminating all unmanned level crossings from the system on 31.08.15 .

XI. Steps towards Safety

- Arrangement of sufficient no. of Sand & Murrum filled bags

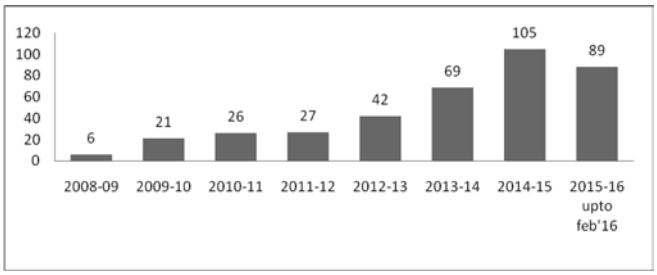
- Arrangement of 1st aid equipment box, oxygen cylinders, stretcher and Helmets for workmanship
- Testing of soil in advance to design stable slope.
- Arrangement of chahli for movement of labours from approach to RCC box
- Arrangement of water tanker for watering the newly filled approaches of LHS.
- Lighting arrangement
- Arrangement of sufficient numbers of cranes, Pneumatic concrete breakers, Proclains, JCB & other machinery duly tested.
- Preparation and approval of GAD & working drawings for each case.
- Arrangement of mega phone & walkie-talkie
- Cordoning of working area to keep outsider away from work spot
- Ensuring details of nearby doctor & 108 emergency mobile service
- Provision of protection screen to prevent injury to workman



DETAILS OF PANELS

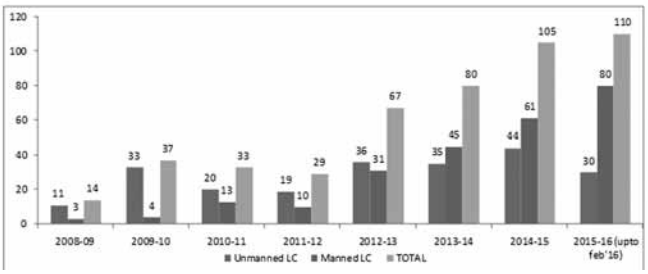
XII. Construction of LHS in lieu of Level Crossings on WCR

Bar chart indicates the yearly progress of LHS in past 8 years:-



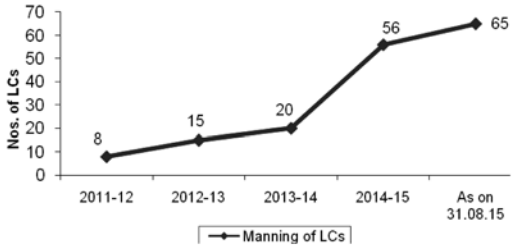
XIII. Elimination of level crossings in WCR

The Bar Chart below indicates the numbers of LCs Closed by WCR in the past 8 Years:

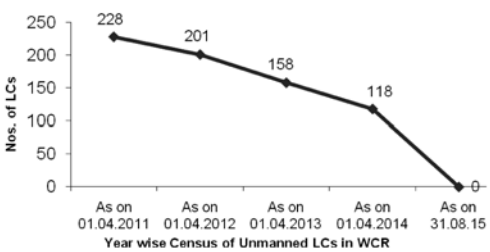


a. Cumulative manning of unmanned LCs in WCR

Elimination of unmanned LCs in last five years is shown in the graph:-



b. Year wise Census of unmanned LCs in WCR



Check list for insertion of RCC Box in lieu of Level crossing

S. No.	Description of the item	Min. requirment	Actual available
1.	Approval of GAD NO.	1	
2.	Approval of TAD	1	
3.	Soil boring report		
4.	Slope proposed as per TAD (enclosed)		
5.	Poclains	2 for Single line & 4 for D/L	
6.	Mechanical/Hydraulic cranes	2 for Single line & 4 for D/L	
7.	JCB	1	
8.	Nets set to cover cutting slope on both side	2	
9.	Dumpers	4	
10.	Tractors	2	
11.	Helmets	20	
12.	Hooters	1	
13.	Megaphones	2 sets	
14.	VHF sets	4 sets	
15.	Banner flags (to be erected at site)	2	
16.	Caution board (to be erected at site)	2	
17.	Plastic bags filled with • Ballast	2500 Bags for S/L & 5000 Bags for double line	
	• Earth	2000 Bags for S/L & 4000 Bags for double line	
18.	D.G. Sets	2	
19.	Pavement Breaker	2	
20.	Officers to be present	DyCE(Br.)/DyCE(C), Sr.DEN/DEN, AEN (Br.) & Sectional AEN	
21.	Railway Supervisors	SSE (Works) In-Charge SSE (P.Way) In-Charge 20 Nos. Gang staff which are working nearby site	
22.	S & T staff	1 Supervisor with adequate staff	
23.	Contractor's staff • Contractor himself • Supervisors • Site Engineer • Labours	 1 6 1 100	
24.	Medical team with atleast one docter	1	
25.	Stretcher	1	
26.	Oxygen Cylinder with mask	1	
27.	First Aid box	1	
28.	RPF staff	2	
29.	Chahlies of 2.5m length	4	
30.	Mobile No. of nearest hospital		
31.	Mobile No. of nearest police station		
32.	Special remarks related to site		

Above arrangement has been checked by me & are found satisfactory to carry out block for insertion of RCC Box.

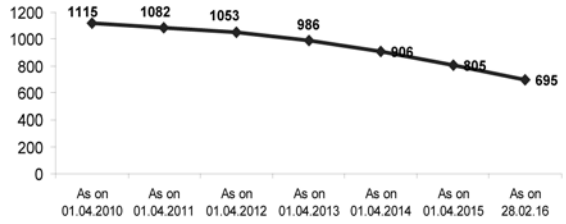
Supervisor In Charge **AEN**

I have verified the above arrangement and they are considered satisfactory to operate the block.

DyCE(Br.) / DyCE(C) / Sr.DEN/DEN

XIV. Year Wise Census of LCs in WCR

Graph indicating the census of total LCs in WCR is as under:-



Under the direction and support of GM Shri Chandra and the guidance of Principal Chief Engineer Shri J.S. Sondhi, the work of construction of LHS was spearheaded by Chief Bridge Engineer Shri R.N. Sunkar. Chief Operating Manager Shri A.K. Jain took all initiative to ensure required traffic block for this purpose. Chief Signal & Telecommunication Engineer Shri S.P. Trivedi gave his valuable contribution in providing communication facilities on UMLC to make them manned.

XV. All unmanned level crossing gates have been eliminated from WCR as on 31.08.15.

With this, West Central Railway has become the first Unmanned LC free Railway Zone.

■■■

Six Kms Long Tunnel Project up for Grab

The Ahmedabad metro rail project is all set to float tenders for the construction of the 6.335 km long underground tunnel and that the design for the project has already been finalized, said sources adding that the stretch, which will be a part of Shahpur to Apparel Park (Kankaria) route of Metro project, will have four stations at Kalupur railway station, Kankaria, Shahpur and Gheekanta, said Metro Link Express Gandhinagar-Ahmedabad (MEGA) sources, claiming that the designs of the tunnel, stations and other minute details have been approved, and the department will soon start the construction of the tunnel after meeting the mandatory requirements and that the AMC will also award the contracts for work from APMC to Jivrajpark and from Ranip onwards. Further the work between Apparel Park and Vastral has already begun, said Metro officials of the North-South corridor, which is from Vasna to Motera with 15 stations in the 18.50-km elevated corridor, while the East-West corridor, from Thaltej to Vastral, which is 19.43 km, will have 6.335 km underground. The East-West corridor will have four stations underground and 13 on the elevated corridor.

Approach to Standardisation of Cut-&-Cover Method for Launching of L.H.S. on Adra Division

By
S.P Chandrikapure *
Abhijit Agarwal**

Synopsis :
Indian Railways has adopted a policy for replacement of unmanned level crossings by means of manning, by providing diversion road to any nearby manned level crossing, outrightclosure of low TVU un-manned LCs and by constructing RUB and Limited Height Subway (LHS) wherever feasible. The concept of construction of LHS is new one where height of opening is restricted dueto site constraints.Various challenges have to be tackled when such construction is carried out under the rail traffic. Various divisions have taken a number of measures to reduce the traffic block period and faced various problems during execution of such work. In Adra Division also a lot of experiments have been carried out for evolving a final methodology for optimizing the time period and utilization of resources in a better manner which is the subject of this study paper.

1.0 Introduction

The concept of construction of LHS is the latest policy for crossing of road and rail traffic without any hindrance toboth the movements. The basic idea is to provide a passage for road traffic across the sufficiently high embankment at level crossing gate thereby eliminating the level crossing.

In LHS,unlike RUB, full height clearance cannot be provided. LHS are provided in lessimportantvillage road of low TVU but having potential of manning. Minimum 2.5m to 3m height of embankment is required.Provision of LHS in lieu of Unmanned Level Crossing requires the involvement of Railway, Local as well as State Government Authority.

2.0 Various Launching Techniques

As execution of LHS work requires suspension of Rail Trafficforsome time, a proper planning and adaptation of proper launching technique is very important. However, adaptation mainly dependsupon the local site condition,availability oftools and plants and expertise in the concerned field. Different launching methods adapted in India are appended below:

i) Relieving girder method:

The method is best suited for double line section on busy routes where complete interruption of traffic is not possible for a longer period.

One of the line is provided with Restricted Height relieving girder to permit traffic with restricted speed.

The other line is dismantled and pre-cast Base slabs and RCC Boxes are placed just like in cut- and –cover method. The other line is tackled in the next block.

At least three Traffic Blocks are required i.e. one for placing relieving girder, second for placing Base Slabs and boxes for one of the line and third for placing Base Slabs and boxes by removing relieving girder of the other line.

More hours of traffic blocks are required in this method which is generally not desirable.

ii) Box pushing method:

It is suitable when adequate earth cushion is available i.e. about 1m above the top of the RCC boxes and where multiple lines are involved.

In this method, Box is cast monolithically in phased manner while simultaneous pushing of the box is carried out with the help of hydraulic jacks. Traffic block is not required.The whole work is carried out under temporary speed restriction of 20kmph.

This method is highly sophisticated and requires imposition of speed restriction for a longer period. Cost is more as sophisticated machinery is involved and also the risk is more in this process.

* Sr.DEN/Co-ordination/Adra
** SSE/W/PLG

Generally, not desirable unless site conditions are imperative.

iii) Cut and Cover method:

Adra division has adopted Cut-and-Cover method.

In this method, the embankment is cut-through keeping proper earth slopes and pre-cast RCC Base slabs and RCC Boxes are placed in position with the help of road cranes. After this, the cut gap is back filled with boulders and granulated earth like sand and murrum. Ballast is spread and track linking is done.

3.0 Advantages/Disadvantages

The advantages and disadvantages of these methods are tabulated below under various heads:

Parameter	Box Pushing Method	Relieving Girder Method	Cut-and-Cover method
Suitability	Suitable for multiple lines	Suitable for double line on busy section	Suitable for single and double line section
Block Period	Traffic not blocked but allowed at restricted speed of 20kmph for longer period (6 months approx.)	Average 20 hours total in at least 3 spells.	Average 6hrs for single line and 7hrs for double line.
Technology	High end, sophisticated	Simple	Simple
Cost (Considering double line)	2.89Cr	2.55Cr	1.44Cr
Advantages	1. Traffic not blocked. 2. Multiple lines tackled.	1. Traffic blocked for 4 hours and then single line working @ 20kmph adopted till the operation is complete.	1. Entire work done in one single operation 2. Traffic blocked only for 6hrs on SL and 7hrs on DL. 3. Traffic can be opened for 30kmph immediately after passing of first train. 4. TSR can be relaxed to normal in 21 days gradually. 5. Cost effective 6. Time effective 7. Can be adopted for variable bank heights from 2.5m to 4m and more.
Disadvantages	1. TSR continues for longer period (6months approx.) 2. A cushion of about 1-1.5m is required below formation top. 3. Costly method 4. Risk of embankment subsidence involved.	1. Three operations to be carried 2. Longer block period (Total 20hrs)	1. Pre-block activities and on site time management is required. 2. Adequate capacity cranes with adequate boom length are a pre-requisite.

4.0 Case Study of Adra Division

4.1 Pre-Cast Boxes and General Arrangement (RDSO Drg. No. M00008)

A minimum opening of 4m width and 2.5m height has to be provided in case of LHS. In Adra Division, RDSO Drawing No. M00008 has been followed.

The size of the RCC boxes and base slabs (M30) were as below:

Base slab (Intermediate) = 5.5x1.402x0.25m,
Wt. =4.8tonne

Base slab (End slabs) = 5.5x1.803x0.25m,
Wt. =6.2tonne

RCC box (Intermediate):

Internal dimension = 4x3.75x1.392m
(width x height x breadth)

Outer dimension = 5x4.75x1.392m
(width x height x breadth)

Wt. = 29.80tonne

RCC End box is of the same dimension as that of the intermediate but parapet wall is monolithically casted.

Wt. = 34.80tonne

4.2 Challenges:

There were two cases in South Eastern Railways where bank slip occurred at LHS site causing causality and injuries during launching of LHS by cut and cover method.

In the first LHS block in Adra division, cut and cover method was adopted with nil experience and hence with no proper planning. It was LHS TB-24.

4.3 Experience of LHS At TB-24

It was one of the early day'sworks of launching LHS in Adra division and is typically marked to have taken 18 hours to complete the work of launching, which was a lesson to learn. The work was done in the month of Aug'2013.

LHS TB-24 is situated in between railway stations Ispatnagar & Bokaro Steel City which is a single line section called TT line. Only goods trains run on this section. The traffic-cum-power block of 8 hrs. was planned but it exceeded by 10 hrs.& 05 minutes.

Two nos. road cranes of 110T capacity and two pocklains (1cum bucket size) were used.

4.3.1 Causes Leading to Excessive Block Bursting in Case of TB-24

a) For excavation of earth, no pre-excavation was carried before the actual block. Pre-excavation should have been done on cess side prior to block. As a result more time was lost in excavation.

b) Stability of slope of cut embankment was not considered during execution of the work since excavation was taking more time and by cutting slopes in 1:2 proportion would have caused further delay. As a result, slip of embankment occurred during excavation which was uncontrollable and beyond expectation. Top width of the cutting became 20 min stead of presumed calculated width of 10.5m.

c) Due to large opening the quantity required for back filling was much more than the calculated one.The boulders and filling material become insufficient and hence excavated earth was used to complete the backfilling which led to subsidence of filled portion under traffic.

d) The placements of cranes were not pre-defined.

e) The Box segment & base slabs were lying in the field haphazardly as and where they have been cast. As a result a considerable time was lost in collection & placement of base slabs and boxes.

f) For back filling purpose it had been planned to do manually by engaging 60 nos. of labourers which was later on found very much inadequate.The on-site decision was taken to employ one pocklain for back filling against unwilling operator.

4.3.2 Consequenses

The TT line is exclusively used for goods train. Hence there was no detention for any passenger train, but 6 numbers goods train were detained. The first train after track fit was a multi loco with 04 Nos. locos. The back filling gap was about 4-5m having semi-compacted soil. While passing of multi-loco, this loosely compacted portion sank down causing level difference between box top and its approach. It resulted into decoupling of all the locos while passing over the LHS.

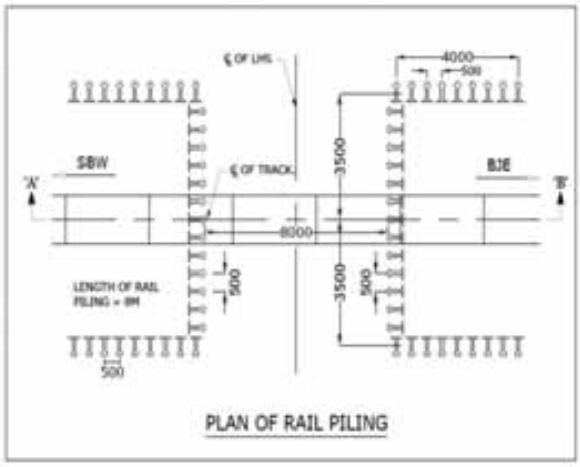
Thereafter, Adra division has so far launched 18 Nos. of LHS and has reduced the traffic block period from 19 hrs of its first block of single line to less than its half i.e. 06 hrs 45min in double line section.

4.4 Improvements

Phase I: Rail piling and pre-work

To stop the bank slip, Rail piling was planned to retain the cut embankment in position.

It is shown in the sketch below:



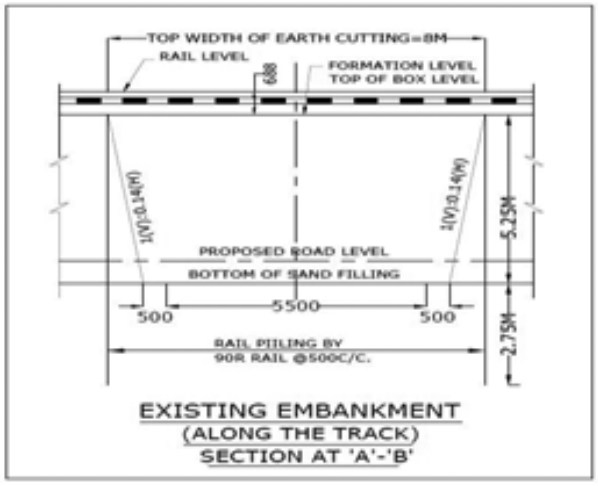


Fig 1: Rail Piling Plan

1. Pre-excavation was carried out before actual block period to reduce the time of excavation.

2. Exact locationsfor cranes' placements were pre-determined considering the boom length required for critical position as per the load chart of the cranes. The base of 2x2m size was prepared prior to block by using boulder and stone dust over which a steel plate of 25mm thickness was kept for placing cranes jacks to reduce crane placement time.

3. Box segments and base slabs were placed nearby the site at a predefined location and base slabs were placed above the erected boxes. Slings and ropes were fixed well in advance before the block period.

4. The back filling materials were placed nearby the site and one pocklain on each side was utilized along with manuallabourers for back filling.

5. For providing pathway for supply of ballast over box tops, MS plates were welded with angles/joist for providing pathway from existing embankment top of box. And thus a lot of time was saved.

Photo 1: Rail piling at BG-3 (SL)

Photo 2:

(i) MS plate to bridge gap between embankment and boxes at PK-26 (SL)

(ii) Rail piles holding the earth vertical

Following table shows the time taken for launching LHS in single line section with this improvement. The least is being 4 hours and 55 minutes.

Lhs Blocks In Single Line Section (Adopting Rail Piling)				
Date	**LHS No.**	**Block granted (Hrs)**	**Block availed**	**Special feature**
09/15/13	P.K-34	8.00	9.20	Improved method
02/09/14	P.K-16	8.00	4.55	Improved method
02/16/14	P.K-26	6.00	4.15	Improved method
02/27/14	TB-3	6.00	8.00	Improved method, bad soil, OHE cut by crane working
06/01/14	P.K-19	6.00	5.25	Improved method
06/06/14	BG-3	6.00	5.00	Improved method
10/17/14	P.K-32	8.55	7.30	Improved method, one sided working of cranes due to peculiar site
10/19/14	P.K-32	8.55	9.30	Improved method, one sided working of cranes due to peculiar site
		Average	6hrs, 44 min	-
		Average time (Neglecting PK-32)	6hrs, 09 min	-

Drawbacks: The rail piling was a tedious work which required traffic block while doing rail piling in the track portion. The overall requirement of traffic block for rail piling was 8x3hrs = 24 hours which was not desirable.

Phase II: No rail piling, granular back fill, higher capacity cranes

1. In this stage, the rail piling was done away. Instead, it was planned to cut the embankment into stable slopes. The desirable stable slope was 2 horizontal : 1 vertical. However, it would have caused excessive backfilling gap, which had a very bad experience of TB24 of subsidence of the embankment. To counter this, it was planned to use 100% granular material i.e. sand for backfilling.

2. Higher capacity cranes i.e. 02 nos. 150T capacity cranes and one standby were deployed as against 02 nos. 110T capacity cranes used in single lines.

3. One poklain of 2.25cu.m capacity bucket and one poklain of 1.2 cu.m capacity bucket were used as against 02 nos. 1.2 cu.m capacity poklains.

4. Planned cut slopes were marked on the embankments with lime for three slopes i.e. 1:1, 1:1/2 and 1:3/4. The sleepers where these slope lines meet were marked with different colours so that they are visible to poklain operators all the time. Pegs were also used to preserve cutting slopes demarcation.

5. The steepest slope was taken up at the start of the excavation and depending upon the soil type, the onsite decision were made to what slope it should be cut.

Phase III: 4 nos. poklains used

1. In addition to above improvement, 4 nos. poklains (01 no. of 2 cum capacity and 03 nos. of 1.2 cum capacity) were deployed to further improve the backfilling time.

2. With this arrangement, 6 nos. LHS were launched in Double line section out of which, 02 nos. were done using 04 nos. poklains.

3. After launching the boxes, the construction of wing walls also take considerable time. Also, lesser barrel length may pose unsafe condition during construction of foundation of wing walls. To address this problem, 12 boxes were used to increase the barrel length in place of 10 boxes planned for JC-5, the last of above 6 LHS so that height of wing wall can be reduced.

Following sketch shows the embankment cutting profile

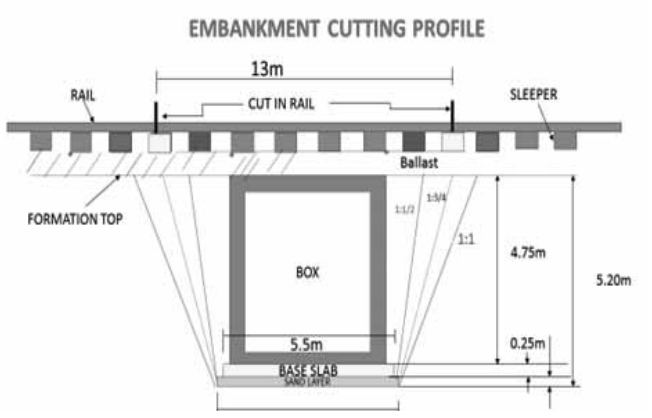


Fig 2: Embankment Cutting Profile

Following sketch shows the position of various machineries and materials just prior to the start of the block.

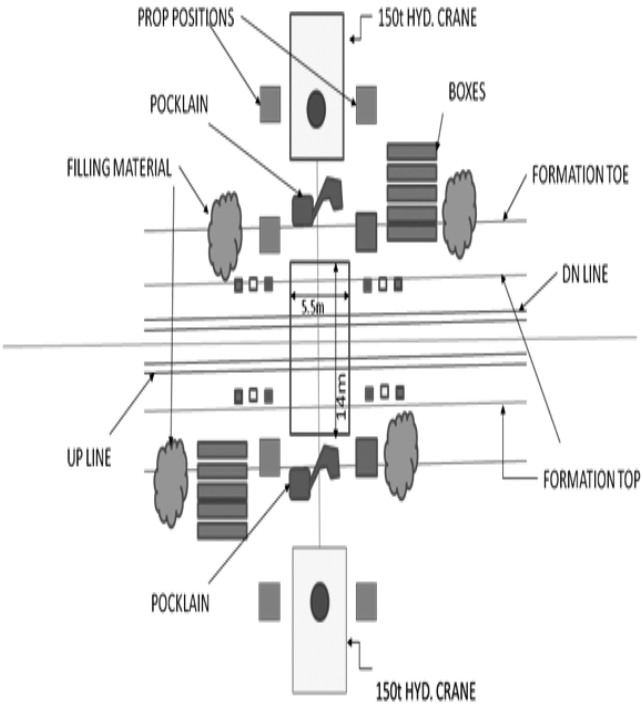


Fig 3: Pre-Block Arrangement

Photo 3: LHS KA87 (Double Line): In Making

Photo 4: KA87 : Commissioned

Following table shows the time taken for launching LHS in Double line section with this improvement. The least is being 6 hours 50 min.

Activitiwise time taken in Launching of LHS in 2015-16 (Double Lines)

Figures In Minutes

Activities	LHS nos.						Average Time taken
	KA87	KA77	KA76	JC15	KA58	JC5	
Track Dismantling	40	10	23	4	10	5	15
Excavation	150	150	102	128	75	95	117
Base Preparation	45	15	25	30	35	25	29
Placing Slabs And Boxes	245	135	132	110	122	170	152
Backfilling	240	120	98	140	108	65	129
Track Linking & Track Fit	20	20	30	25	30	35	27
Total Time	740= 12'-20''	450= 7'-30''	410= 6'-50''	437= 7'-17''	380= 6'-20''	395= 6'-35"	469= 7'-49"
Ohe And Line Fit	30	0	45	90	60	15	40
Overall Time	770= 12'-50''	450 = 7'-30''	455= 7'-55''	527= 8'-47''	440= 7'-20''	410= 6'-50"	509= 8'-30"
Special Feature	one crane failed	Excavation started early	Steeper slope cut	4 nos. poklains used	4 nos. poklains used & steeper slope cut	One crane worked much slower	

5.0 Best Fit Activity Timings:

From the above table, the best fit activity timings and Realistic timings can be listed as below:

Activities	Best Timing Achieved (Min)	Realistic timings for planning purpose (Min)
Track Dismantling	4	15 min (Both lines may not be blocked at the same time)
Excavation	75	100 (depends upon the cut slopes)
Base preparation	15	20
Placing slabs and boxes	110	130 (depends on skill of crane operator)
Backfilling	65	110 (Depends upon cut slopes)
Track linking & track fit	20	30
Total time	289 = 4 hrs, 49 min	405 = 6 hrs, 45 min
Ohe and line fit	0	15
Overall time	289 = 4 hrs, 49 min	420 7hrs

6.0 Crane Selection:

Placement point of crane for placing slabs and boxes:

The crane selection depends upon the capacity of the crane at minimum boom length required to lift place the farthest box. The calculation of minimum boom length to place the farthest box can be understood from following diagram.

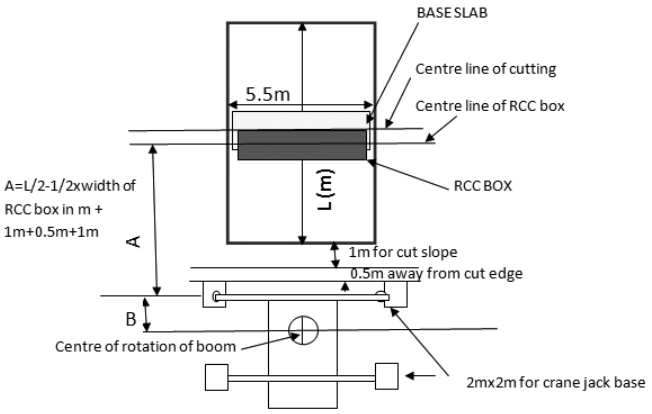


Fig 4: Crane Placement

Where, L= absolute length required across the track to accommodate all the base slabs

B= distance from rear edge of crane to the center of rotation

Generally, the excavation goes below the ground level. The cut edges cannot be vertical. Hence, actual cut will be generally at 1m distance from the absolute cut required. 0.5m distance may be left to protect slippage of crane jacks. Beyond that, a base of 2mx2m may be prepared for supporting crane jacks.

From above geometrical construction, the radius of crane can be formulated as

Radius = A+B

where

A= L/2-1/2xwidth of RCC box in m + 1m+0.5m+1m

B= Distance of centre of rotation of boom from the edge of the crane as shown in the diagram

This gives the maximum radius at which crane will work. The gross capacity of the crane for this consideration shall be checked for deciding the crane.

For double line section in Adra division,

L= 7x1.4 + 2x1.8 = 13.4m

Width of RCC box = 1.932m

B= 3.5m

The critical radius worked out to be 13.4/2 – 1.932/2 + 1+0.5+1 + 3.5 = 11.734m

The capacity of the crane at 11.734m boom length was more than the weight of the farthest box (29.8 tonne) was to be placed.

The above formula can be used to calculate the critical radius and help in deciding the crane to be deployed.

It also helps in deciding the point of placement of the crane.

7.0 Recommendations

7.1 Pre-Block Preparation

- Boxes are erected in position.
- Base slabs placed on the erect boxes.
- Slings are kept tied to slabs and boxes.
- Sand bags for side plugging are staked on cess.
- Ballast is taken out from track and kept filled in bags behind the sand bags.

- Back filling materials are collected at all four sides.
- Propping position of cranes is pre-decided and propping base is prepared.
- Crane working area is worked by filling boulder and stone dust/murrum and rolled.
- The crane testing is done on penultimate day of the traffic block by erecting the boxes at pre-decided place.
- Cutting profiles are marked with colored pegs.
- Meeting with crane and pocklain operator.
- One rail post of about 1.5m height above the rail top is erected to hold down the contact & catenary cables.

7.2 During Block

- Excavation started just after passing of last train after confirming through control without waiting for block.
- Just after passing of last train, fishplates are opened and slings are tied to track.
- Cranes kept in ready position, and just after OHE power off, cranes lift the track.
- 4 pocklains are used. Two for excavation and two for disposing the cut earth.
- Base preparation and crane placement is done simultaneously.
- During placement of slabs and boxes, pocklains are used to make ramp for backfilling
- Steel plates stiffened with angles and I-sections are used to bridge the gap between cut embankment ants the placed boxes.
- These are used to carry ballast bags to the placed boxes while backfilling was in progress
- Side plugging is done simultaneously on all four sides.
- Back filling done from all four sides using 4 pocklains
- Ballast is spread using pocklains
- Just after placement of last box, OHE is tied back to masts in position.

8.0 Conclusion

1. Cut and cover method with proper planning proves to be most economical and time saving method with least risk.
2. With proper planning, the block period can be reduced to less than 6 hrs in single line section and to less than 7 hours in double line section and has a scope to further reduce the block time if no abnormal situation occurs.
3. The Embankment Cutting Profile diagram shown in Fig 2 may be adopted as standard practice.
4. The Pre-block Arrangement diagram shown in Fig 3 may be adopted as standard practice.
5. The rail piling to hold the earth is effective but is tedious and consumes considerable time.
6. The paper gives definite guidelines for selection of crane capacity and calculating the critical radius of boom rotation.
7. The method depicted in this paper may be adopted as standard for cut-and cover method. The method can be easily transformed to suit the different site conditions.
8. Construction of LHS by 'cut and cover' method is most suitable method for replacement of unmanned Level Crossing. It requires less man power during execution of work; speedy completion of work; close-eye monitoring during every step of work; less traffic block period resulting to a low expenditure. Though sophisticated machineries like 150 MT heavy road cranes, 150 MT BD crane, heavy duty pocklains, tower wagons, etc. are involved, yet all these machineries are working simultaneously during the block period under the close supervision of Senior Railway Officers and not much technicality is required.

9.0 Final Comment

Planning plays a major role for proper and timely completion of this work. Preparedness for every likely eventuality in case of natural misfortune like heavy rains is one of the major challenges for Engineering. In such case, the timely decision of the Engineer is the only thing that warrants. The placement of major machineries, materials, tools and plants, box segment and base slabs are marked in the site for its proper functioning. The crane operator, pocklain operators, side engineers are taken into confidence beforehand for smooth launching procedure. Testing of all heavy machineries at least one day in advance is must and no laxity should be shown in this regard and if required, there is no hesitation in postponement of launching date. Sequence of every workshould be prepared before starting of the work. Thus, with proper planning and with all the precautionary measures, realistic approach of every case should be taken into consideration for speedy launching procedure of LHS.

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Design,Construction and Maintenance of Station Yards

By
Konda Srinivas*

For designing the station yards the governing factor are listed as:

I. Yard Layout:

(a) Turnouts

The turnouts of running loops in the station yard for higher speed should cover all the contiguous stations of that section to raise the speed potential of that entire section. The requisite track structure for the proposed turnouts/existing turnouts to be updated shall be- minimum of 52 kg rail (90 UTS) section, PRC sleepers ,Curved switches on PSC sleepers. All the joints shall be welded as extent as possible.

Railway Board have advised for Higher speed turnouts(HST) for speeds of 30kmph and above vide letter no.2005/CE-II/TK/9 dated:24.01./07. HST comprises of those 1 in 8.5 symmetrical split and 1 in 12 turnouts with thick web switches and 1 in 16 and 1 in 20 are of ordinary curved switches. Thick Web Switches are fabricated with Zu-2-49 material for 52 kg rails and Zu-1-60 material for 60 kg(UIC) rails.and the web thickness much ore than the rail section. For 52kg rail section (15.50mm), the web of the TWS is 40mm and for 60kg rail (15.50mm) is 44mm.

The advantage of TWS is that the tip of the tongue rail is in level with stock rail, hence twist is eliminated.The entry angle is 0-20-00 only which is flatter when compared with 0-27-35 of 1 in 12 curved switches. Hence the entry into the turnout is smooth. The switch is operated by double pull arrangement with which maximum flange way clearance can be obtained at JOH However, the disadvantages of TWS are of high cost and unsatisfactory operation of double pull arrangement.

Hence, the next option for turnouts for higher speed layouts is 1 in 16 turnouts.The yard designers have to consider 1in 16 turnouts keeping the future requirements (Higher speeds) in mind to avoid large scale yard remodeling works coupled with regarding of the track at grade posts.

(b) Turn-in curves are danger prone areas.These have to be to be flattened preferably to the radius of 1 in 12 turnout though the radius can be relaxed upto 350m radius and in exceptional cases 220m.The rail section should be same as that of turnouts (i.e minimum 90R trails). Sleepers shall be PRC/ST/CST-9. No wooden sleepers are permitted. Extra shoulder ballast of 150mm should be provided on outside.

(c) Crossovers: All the lines negotiating with passenger trains have to be laid with the 1 in 12 curved switches with TWS and higher turnouts(flatter).As far as possiblethe crossovers have to be in one grade and one plane only. Grade change has to be avoided in crossover portion. All the facing points of emergency crossovers have to be replaced with 1 in 12 curved switch with TWS in lieu of on 1 in 12 curved switch.The run through train operations can also be planned through in one side of the main line .

II. Loops:

(i) Track structure

(a) Conventional Ballasted Track: On running loops the track structure shall be minimum of 52 kg 90 UTS rails with M+4 density on PRC/ST/CST sleepers on 250mm ballast cushion .PSC sleepers shall provided on Points & crossings, on main line beyond 400m from top point on either side and on loops to suit the track circuiting

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(b) Ballastless Track: The high speed track needs the ballast less track to cope up with the noise and vibrations to fall in line with environmental considerations. RDSO has recently developed the ballasteless track and named it as BLT-IFS. This track has been designed for platform lines as washable aprons well as at formation lines in the mid section and put into trial .The main features of this design are:

- Welded joints in the track shall be supported with joggled fishplates.
- Breathing length of the LWR shall not fall in the transition portion of the track between ballasted andballast less track.
- Proposer drainage shall be arranged
- Zero missing fitting s shall be ensured throughout the LWR on BLT-IFS portion.

The speed on this track is maximum of 110kmph and the sectional speed whichever is less. Hence full speed on the yard portion can be achieved by this BLT-IFS track if this design is put into function.

(ii) Clear Stranding Room(CSR): The CSR of the direction loop will be counted as 686/m 715m/732m from FM in the rear to the Starter signal ahead and that of siding lines is 750m or longest train length plus 35m.

The starter signals in the station yard are normally located 24m beyond the SRJ of running loop. For convenience of the loco running staff the starters all lines (including main line) will be placed in one straight line keeping the loop line CSR as maximum. This affects maximum utilization of CSR of the main line as the starter can even be moved beyond towards FM of the main line. This 24.00m distance can be reduced to 13.00m (6.5m rail piece abutting SRJ and another 6.50m of Glued joint piece). Thus the CSR of the loop can be increased to 11.00m if directional and 24.00, if bi- directional. Recently the operating department of SC Railway have advised to increase the CSR of existing loop lines to accommodate 59 BOX`N` +8 wheel brake van with multi engines.

Many times the main lines used for detaining the goods train to allow the fast moving/ non-stop/ run through trains. This is because of inadequate line capacity of the loop line. Then the fast moving trains have to be routed through the loop line, thus affecting the speed of those trains. To overcome this problem the CSR of the loop line has to be increased.

III. Curves (Horizontal mainly): It is important to note that Points in the yard should not take-off from the transition portion of the curve and there shall not be any change of super elevation within 18m. between SRJ/Nose of crossing and transition end of the curve. Hence the transition portion of the curve has to be located only beyond these points. If the points are taken off from the curves , the resultant radius must be within the limits (not shaper than 5 degrees).

To run the trains without imposing the SR, i.e. with the speed depending on its route, the minimum degree of the curve required is as below:

1.19 degree for 160kmph (A Route)
1.80 degree for 130 kmph (B Route)
2.5 degree for 110 kmph (D &D Spl. Route)
3 degree for 100 kmph (E Route)

Resultant Radius For Lead Curve- Similar Flexure

- **For similar flexure,**

$D_2 = D_1 + D$,
$1750/R_2 = 1750/R_1 + 1750/R$,
$1/R_2 = 1/R_1 + 1/R$

For contrary flexure,

$D_2 = D_1 - D$,
$1750/R2 = 1750/R1 - 1750/R$,
$1/R_2 = 1/R_1 - 1/R$

Calculation of Cant

- **Contrary flexure-**
  - Calculate equilibrium super elevation for turnout side as per maximum speed permitted on turnout side (i.e. Ceqto)

    Ceqto = GV2/127Rto (Rto is the resultant radius of Lead curve)
  - Deduct it from 75mm i.e. cant excess, this is the super elevation which can be provided on turnout (i.e. Ca)

    Ca =75mm - Ceqto

- Speed for main line can be calculated by taking Ca as calculated above and taking Cd as 75mm.

  $Ca + Cd = GV2/127Rm$

- **Contrary flexure-**
  - Calculate equilibrium super elevation for turnout side as per maximum speed permitted on turnout side (i.e. Ceqto)

    Ceqto = GV2/127Rto (Rto is the resultant radius of Lead curve)

    Deduct it from 75mm i.e. cant excess, this is the super elevation which can be provided on turnout (i.e. Ca)

    Ca =75mm - Ceqto

    Speed for main line can be calculated by taking Ca as calculated above and taking Cd as 75mm.

    $Ca + Cd = GV2/127Rm$

- **Similar flexure turnout not followed by reverse curve**– On a main line curve from which a curve of similar flexure takes off, not followed immediately by a reverse curve, the turn-out curve shall have the same cant as the main line curve.

  Similar flexure turnout followed by reverse curve- A change of cant on the turn-out may be permitted starting behind the crossing and being run out at a rate not steeper than 2.8 mm. per metre and subject to the maximum cant on the main line turn-out being limited to 65 mm on Broad Gauge, 35 mm. on Metre Gauge and 25 mm. on Narrow Gauge (762 mm)

  So while increasing the speed, the curves are also to be flattened to suit the speed of the next higher route to avoid Speed restriction. This applies curves in the yards as well as the mid section also.

Extra Clearances Due To Curvature

Lean (L) = $H*C_a/G$

Sway (S) is ¼ of lean due to super elevation

End throw (V_E) $=(21.34^2-14.785^2)/8*R$

Over throw(V_0) $=14.785^2/8*R$

H is the height of the structure or maximum height of vehicle whichever is less.

Ca is Cant, G is Dynamic Gauge, R is Radius of Curve

- **Platforms/ structures**
  - Inside of curve
    - $(V_0+L+S-51)$
  - Outside of curve
    - (V_E-25)mm
- **Between Adjacent Tracks**

  $V_0+ V_E+2*(L/4)$
  - In new works, if c/c track is 5300 mm, extra clearance is to be provided for curves beyond 5 degrees only.

IV. Gradients in Yards:

The recommended gradient in the station is yard is 1 in 1200. Grades upto 400 can have the condonation of the General Manager, up to 260 of concerned CRS and beyond 260 grade that of Railway Board with provision of special precautionary measures. Good drainage arrangements have to be panned in the yard.

Grade change should at a minimum distance of 30m beyond the points of turnout.

There shall not be any change of grade on transition portion of the curved line.

No siding line should join a passenger line in a grade steeper than 1 in 260.

Normally vertical curves do not occur in the yards. If so, the minimum radius for the vertical curves are: 4000 radius for Group A route, 3000 radius for Group B route and 2500 Radius for C, D &E routes. The vertical curves also have to be flattened according to the next higher group.

V. Other parameters:

Track circuiting- Track circuiting: Trains for higher speeds exceeding 50kmph shall not be allowed if the points are not interlocked and if interlocked , the lines shall be properly isolated from all other lines. if the train is allowed run through on non-isolated line, all shunting operations have to be stopped at that time and no vehicle shall be attached to any engine in the connected line.

Tress-passing- Trespassing will be mainly in the thickly populated areas and in the couinrtysidewhere cattle-trespassing will be high. This causes the derailments and loss of punctuality. Fencing should bed planned for critical points particularlyadjacent to

big station yards by planning limited height subways away from the last stop signals. The distance between LHS and the station PF/Entry shall be fenced.

Infringement due to permanent structures: Old Foot over Bridges (FOB) in the existing yards of more than three lines / multiple lines having intermediate supports have to be taken care not to infringe the SOD norms.

Trains on Platform lines : The platform lines may be avoided for run-through /fast trains on safety grounds.

Standard Isolations: In standard layout of stationyard, sand humps and Traps are provided in front and rear respectively inuni-directional running loop and on both ends in case of common loops. But in many cases overshoot lines are being provided in lieu of sandhumps. These overshoots are advantageous when there is space constraint. And also these overshoots can be extended in future. In SCR the Operating Dept have advised to provide all the Engg. sidings as an extensions of these overshoot lines only. Hence, Overshoots have become inescapable.. While upgrading the section for higher speeds, these overshoots have to be replaced either with 1 in12 curved switches with TWS, if they are designed as double end points. Speeds on the turnouts cannot be increased if the main lines are physically isolated either with sand humps or with adequate distance of 300m from the signals While designing new yards, adequate space provision shall be made for next higher turnouts / crossovers.

Fouling mark Boards shall preferably placed at the opposite of the SRJs for safety purpose.

Construction;-

Important points to be kept in mind during construction

- **Formation;-**
  - (a) Quality of soil and
  - (b) necessity of blanketing or not
  - (c) If required thickness, rolling ,compaction
  - (d) Gradient to be maintained
- **Drainage;-**

1. Ballast section in station yards must be the same as on main line
2. Every station yard shall have network of cross and longitudinal drains, whether earthen or masonry, such that the storm water is led away in the least possible time.
3. Arrangements for surface drainage at carriage watering points and washing hydrants shall be efficiently maintained. The water must be adequately trapped and led away in a pipe or line drain.
4. The yards must be kept clear of all of all loose materials, heaps of earth or cinder which will interface with drainage.
5. Every yard must have a Master Plan For Drainage.

The drainage plan shall show reduced levels of rails at suitable intervals from which the cess levels can be derived and levels of outfalls, drain crossings and other obligatory points determined.

Point & crossings;-

- Correct marking of centre to centre of track, SRJs, Cross over's, Signal posts , Dead ends ,Buffer stops , Sand humps etc.
- Sleeper spacing LH/RH or both sides for symmetrical splits.
- Correct fittings ,stretcher bars ,blocks, slide chairs etc with proper drawing numbers.
- Drilling of holes at SRJ, Xings ,Glued Joints ,joint works with S&T should be well planned.

Maintenance;-

- Proper drainage without water logging, stagnation in normal and quick disposal during monsoon and should not interrupt the track circuit system.
- Washable aprons, Platforms should be easy to clean give neat ambience.

Conclusion: The station yard has to be designed for the normal speed i.e without giving scope to speed restrictions in the yard portions. Particularly the design of curves, the grades and location of grade posts to be given more importance as to not infringe the norms. The L-Sections or the Index section of the entire yard has to be shown to have quick glance of the yard. Yard designers should always in consultation with the concerned P-way/field staff for the exact field details for the design and preferably site should be inspected to know the ground realities.

■■■

Rainwater Harvesting in Adra Division

By
A.K. Harit *
M.L. Meena**

Synopsis :
Water is the most essential natural resource for existence of life and also most abundantly available resource on earth. We can use about 0.5% water of total water available on the earth and we all take water for granted. Demand of water was on increase trend in last few decades due to impact of increasing population, growth of industries and urbanization resultant which over exploitation of our water resources has come in force and excessive tapping of ground water has led to a decline in the water table. It is estimated that by the year 2050, half of India's population will be living in urban areas and will face acute water problems. It is important to prevent waste and conserve water by rain water harvesting either storage of rain water for future use or recharge the groundwater. Now , Government of India, and many State Governments, Non-Government Organizations and other institutions are taking steps to encourage rain water harvesting in our country and are introducing by-laws making rainwater harvesting compulsory in all new structures. Indian Railway not only carries the passengers and traffic but also bear the social obligation and rain water harvesting is being provided successfully in different location such as New Delhi and Adra division.

1.0 Introduction

Water is the most essential natural resource for existence of mankind on blue planet. It is also one of the most abundantly available resources on earth but it is not equally distributed due to variations in latitude, longitude, rainfall patterns, topography, etc. Water is a resource which cannot be produced or added as and when required by any technological means. The fresh water which is so essential for existence of life- about 2.5%of the total water available on this earth. Nearly all of this 2% is locked in the masses of ice caps, glaciers and clouds. The remaining small fraction of fresh water has accumulated over centuries in the lakes and underground sources of the world.

Table:-1 Distribution of Fresh Water

S.N.	Water Type	% of Total Fresh Volume
1.	Glacier	85.00
2.	Ground Water	14.00
3.	Lackes And Reservoir	0.60
4.	Soil Moisture	0.30
5.	Atmospheric Water	0.05
6.	River Water	0.04

We know that the earth has a limited amount of water. That water keeping going around in cycle form: - Evaporation- Condensation-Precipitation-Collection ---- Evaporation. Almost 85% of rain water falls on directly into the sea and never reaches on the land. The sea and never reach on land. The small remainder that (about15%) precipitates on the land fills up the lakes and wells, and that keep the river flowing. The condition of India is worse. Although India is one of the wettest countries in the world, the availability of water with time and space is highly uneven. On the average, it receives about 1150 m, of rainfall annually, but its distribution is highly uneven such as average number of rainy day in a year is only 40 and long spell of dry period in a year. Also, the rainfall is as high as 11.872m in Mawsynram lies in North-East regions on the other hand less than 30 cm in certain parts of Rajasthan. This serious inequity in the distribution of water rainfall results in severe water scarcity in many parts our country.

The pressure of increasing population, growth of industries, urbanization, energy intensive life style, loss of forest cover, lack of environmental awareness and lack of implementation of environmental rules and regulations are reasons for put additional demand for water resultant which over exploitation of our water resources has come in force. Excessive tapping of ground water has led to a decline in the water table. It is estimated that by the year 2050, half of India's

* DEN/TM/ADA/SER
** ADEN/ESTATE/NDLS/NR } Integrated course no-15104

population will be living in urban areas and will face acute water problems.

It is likely to become a critical scarce resource in many regions of the world in the coming decades. Hence, it is important to prevent waste and conserve water. Therefore, efforts are required to retain or store more and more rain water for use during the dry period. Rain water harvesting at local level by either storing in ponds, tanks and lakes or by recharging ground water are simple methods of augmenting water supply. In ancient times, water was acknowledged and regarded as a valuable resource. In fact, almost every ancient culture has regarded water as sacred.

2.0 Traditional Rainwater Harvesting In India:-

Ancient Indian methods of water harvesting in India since antiquity, with our ancestors perfecting the art of water management. They harvested monsoon runoff by capturing water from swollen streams and rivers during the monsoon season and stored it various forms of water bodies. One of the oldest water harvesting systems is found about 130 km from Pune along Naneghat in the Western Ghats of India. A large number of tanks were cut in the rocks to provide drinking water to tradesmen who used to travel along this ancient trade route.

The traditional way of rain water harvesting are-

(a) **Lakes/Tanks:-** Most of the old cities, which were not on river banks, had huge lakes or tanks to store water. Either these have been lost or their capacity greatly reduced due to silting or habitation.

(b) **Tanka:-**Small underground tanks in houses/temples/ Dharamshalas. These were popular in Bikaner, Dwarka etc.

(c) **Baoli/Bavadi:-**Traditional step wells in Rajasthan and other states of northern India.

(d) **Khadirs:-**Long earthen embankment built across the lower hill slopes lying below uplands were constructed in Jaisalmer, Western Rajasthan.

(e) **Bhandaras:-**Checkdams / diversion /weir used to impound water or raise water levels in rivers. These were popular in Maharashtra.

(f) **Johad:-**Small earthen check-dam which captures and conserves water and it was found in Bihar and Utter Pradesh.

(g) **Kere:-**Tanks fed by channels branching off from check dams. Out flow of one tank supplied water to another tank. (Popular in Central Karnataka)

(h) **Zings:-**Small tanks found in Ladakh which collected melted glacier water.

(i) **Kul:-**Water channels in mountains to take water from glaciers to villages

3.0 Modern Methods of Rainwater Harvesting:-

There are two main techniques of rain water harvesting:

1. Storage of rain water on surface for future use:- Traditional technique and structures used were tanks, ponds, check dams, weirs etc.

2. Recharge to ground water is a new concept of rain water harvesting and different type of structures used for it.

A. Storage of Rain Water on Surface for Future use (Rainwater Harvesting at Household Level):-

Water harvesting is simply collecting rainwater that falls over building and then putting it to use around the building or open area/yard—that's all!

Many house owners of public building in our country already use rainwater to irrigate trees, lawns and for landscaping etc. Construction a new house on a single plot, designing a major subdivision, or just making a few improvements around it, rain water harvesting can be easily incorporated into the plans. The system of Rain Water harvesting may be varies from the simple to complex, depending on the area, need and budget. The rain water harvesting system as having four main components:-

a. Rainwater Collection: - First, rainwater can capture from any rooftop area, patio or other impermeable surface. The amount of water you will be able to harvest depends on the size of your catchment area. To determine the amount of water you can collect, multiply the area of your roof (catchment) in square metre times the amount of rain received each year in metre. (Average rainfall in India is 1.17 m) and Run off coefficient (See the Table-1).The collected water is kept at least three feet away from the foundation of your house.

Annual Rain Water Harvesting Potential

= Catchment Area X Average Annual Rain Fall X Run off coefficient

For example:-

Location Delhi where average rain fall =611mm.

Area of Roof =200 Sq. m

Type of Roof- Flat terrace-

Run off coefficient =0.85

Annual Rain Water Harvesting Potential =200 x 0.611 x 0.85

=103.870 Cum

=103.870 x 1000

= 103870 litres

Table-2

S. N.	Type of Catchment Area	Run off coefficient
Roof Catchment		
1.	Tiles	0.8-0.9
2.	Corrugated Metal Sheets	0.7-0.9
Ground Surface Coverings		
3.	Concrete	06.-0.8
4.	Brick Pavement	05.-06.
Untreated Ground Catchment		
5.	Soil on Slopes less than 10%	0.0-0.3
6.	Rocky Natural catchment	0.2-0.5

(Source: - Table 1.3 of Rain Water Harvesting published by IRICEN, PUNE)

b. Storage Storage:-Systems can vary in complexity depending on one's needs. An effective system can involve a 250 litre drum fed by rooftop gutters and downspouts. Debris and leaves should be filtered before storing the water by placing screens over gutters or downspouts. Water kept in tanks or cisterns should also be covered to minimize algal growth and eliminate the potential for mosquito breeding. Placing floating lids on storage tanks is an effective solution.

c. Distribution: - Gutters and downspout or berms and swales can be designed to catch rainwater and distribute it directly to landscape plants or into the soil. Many people store harvested rainwater and then distribute it later through their regular drip irrigation system.

(Gutters:-a narrow channel which collects rainwater from the roof of a building and diverts it away from the structure, typically into a drain. Downspout: - a vertical pipe for carrying rainwater from a rain gutter to ground level. Berms: - a level space, shelf or raised barrier separating two areas. Swales: - a low tract of land, especially one that is moist or marshy.)

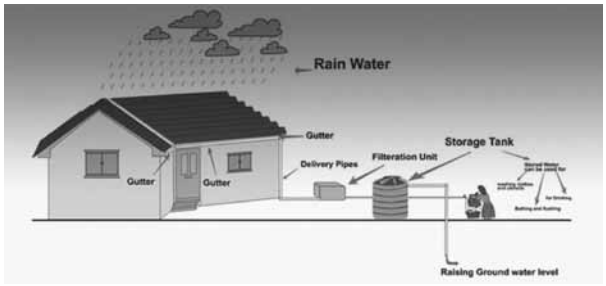


Fig:-A Typical Rain Water Harvesting(Household Level)

d. System maintenance:-Water harvesting systems require occasional maintenance, but this is easily accomplished. Debris screens over gutters should be cleaned periodically and storage tanks should be drained and cleaned when it is convenient to do so.

B. Recharge to Ground:-

Recharge to ground water is a new concept of rain water harvesting and the structures generally used are:

i. **Recharge pits: -** are constructed for recharging the shallow aquifer.

Aquifer: The aquifer is porous, water saturated layers of sand, gravel or bed rock that can yield significant or usable amount of water. These are constructed 1 to 2 m wide, 1 to 1.5 m deep which are back filled with boulders, gravels, coarse sand.

ii. **Trenches:** These are constructed when the permeable rock is available at shallow depth. Trench may be 0.5 to 1 m wide, 1 to 1.5 m deep and 10 to 20 m long depending upon the availability of water. These are back filled with filter materials.

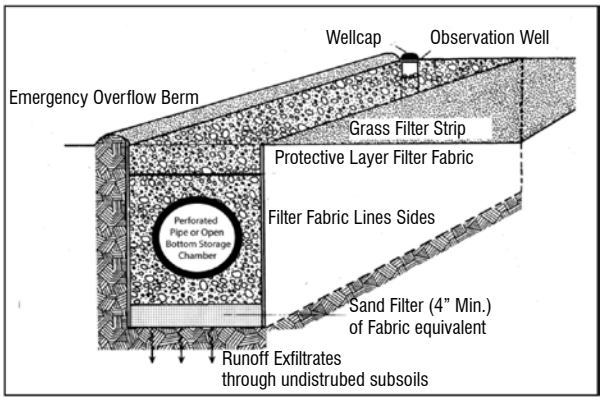
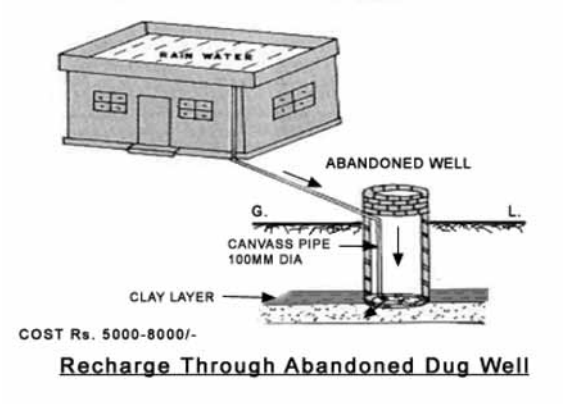
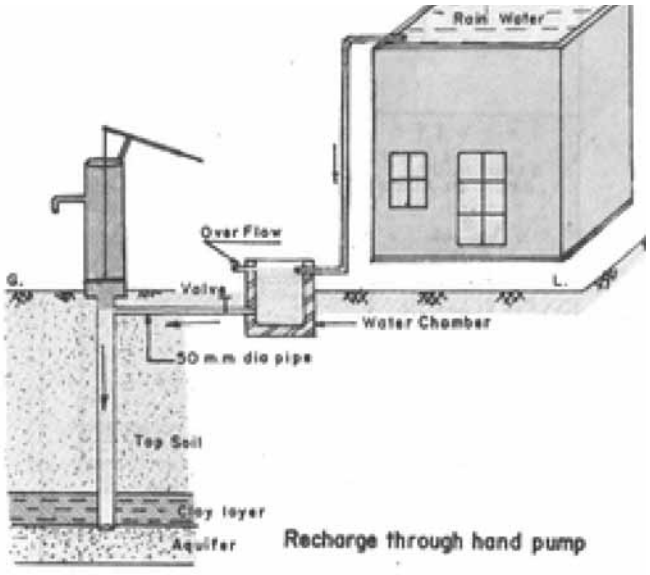


Figure: - A Typical Drawing Of Trench

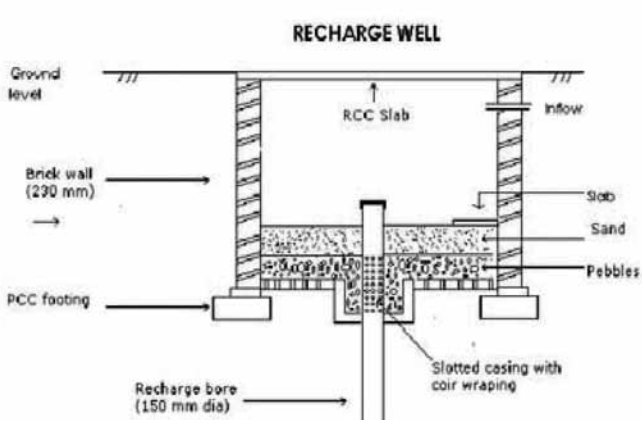
iii. Existing dug wells may be utilized as recharge structure and water should pass through filter media before putting into dug well.

iv. Hand pumps: The existing hand pumps may be used for recharging the shallow/deep aquifers, if the availability of water is limited. Water should pass through filter media to avoid chocking of recharge wells.





v. **Recharge wells:** Recharge wells of 100 to 300 mm diameter are generally constructed for recharging the deeper aquifers and water is passed through filter media to avoid choking of recharge wells.



vi. **Recharge Shafts:** For recharging the shallow aquifer which is located below clayey surface, recharge shafts of 0.5 to 3 m diameter and 10 to 25 m deep are constructed and back filled with boulders, gravels and coarse sand.

vii. **Lateral shafts with bore wells:** For recharging the upper as well as deeper aquifers lateral shafts of 1.5 to 2 m wide and 10 to 30 m long depending upon availability of water with one or two bore wells is constructed. The lateral shaft is back filled with boulders, gravels and coarse sand.

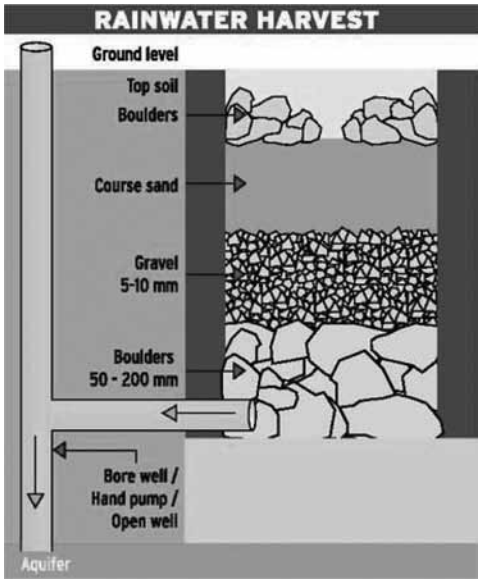


Figure:- Lateral Shafts With Bore Wells

viii. **Diversion of run-off into existing surface water bodies:-**The result of Construction activity in and

around the city is drying up the water bodies and reclamation of these water bodies for conversion into plots for houses. The flow of storm runoff of these tanks or water bodies can be used as harvesting system through diverted the flow into the nearest tanks or depression, which will create additional recharge. This depression may be converted into small lagoons and green field etc.

Figure:-Small Lagoons With Green Field

Rainwater harvesting essentially means collecting, storing rainwater also recharging the ground water for later use. Not only does this recharging arrest groundwater depletion, it also raises the declining water table and can help augment water supply. Typically, rain is collected on rooftops and other surfaces, and the water is a carried down to where it can be used immediately or stored. No water or sewage connection would be given if a new building did not have provisions for rain water harvesting.

4.0 Legislation on Rainwater Harvesting

Realising the importance of recharging of ground water, the Government of India and many State Governments, Non-Government Organizations and other institutions are taking steps to encourage rain water harvesting in our country. Town planners and civic authority are introducing by-laws making rainwater harvesting compulsory in all new structures.

Implementation of the Bye-Laws in Different States & Cities

A. States

Arunachal Pradesh:-Building By-laws are being framed keeping provision for rain water harvesting as mandatory in Government Buildings.

Andaman and Nicobar:-Building Byelaws are being amended to incorporate mandatory provision of rainwater harvesting.

Daman & Diu: - Administration of Daman & Diu has issued instructions to the local PWD and local bodies such as Municipality & District Panchayat for construction of roof top rainwater harvesting structures and accordingly, they has initiated action.

Goa:-PWD, Goa has been asked to take up rainwater harvesting structure for Government buildings. Rainwater harvesting already implemented at Government Engineering College at Farmagudi, Ponda, and Goa by the PWD.

Gujarat: -The state Roads and Buildings Department of Gujarat has made rainwater harvesting mandatory for all government buildings. Under the Gujarat Development Control Regulations, buildings with area between 500 and 1500 sq.; the owner or developer shall have to undertake Rainwater Harvesting as per the Authority Specifications. For buildings with area between 1500 to 4000 sq.m, owner/developer has to provide percolation wells with rain water harvesting system @ one percolating well for every 4000 sq. or part thereof of building unit.

Haryana:-Haryana Urban Development Authority (HUDA) has made rainwater harvesting mandatory in all new buildings irrespective of roof area. In the notified areas in Gurgaon town and the adjoining industrial areas. The CGWA has also banned drilling of tube wells in notified areas.

Himachal Pradesh: -Installation of rainwater harvesting system has been made mandatory for all buildings to be constructed in urban areas of the state and no building plan without rainwater harvesting system can be approved. Construction of rainwater harvesting system has also been made mandatory for all schools, govt. buildings and rest houses, upcoming industries& bus stands.

Karnataka: - Action to amend building byelaws in major cities having population of more than 20 lakh to make rainwater harvesting mandatory has been initiated. Rural Development & Panchayati Raj Department has issued orders for implementation of roof top rainwater harvesting in all Government buildings. State has also

extended help to the individual people also to the tune of 20% rebate on tax payment for 5 years duration.

Kerala: - The Kerala Municipality Building Rules, 1999 were amended by a notification dated January 12, 2004 (Local Self Government Department Notification) issued by the Government of Kerala to include rainwater harvesting structures in new constructions.

Meghalaya:-The State Government of Meghalaya has instructed the concerned Department to provide funds under their respective annual plans for construction of roof top rainwater harvesting structures in the Govt. buildings.

Nagaland:-The State Government has already made provision for roof top rainwater compulsory for all new Government buildings.

New Delhi:- Since June 2001, the Ministry of Urban Development has made rainwater harvesting mandatory in all new buildings with a roof area of more than 100 sq. m. and in all plots with an area of more than 1000 sq. m., that are being developed. The Central Ground Water Authority (CGWA) has made rainwater harvesting mandatory in all institutions and residential colonies in notified areas (South and South-west Delhi and adjoining areas like Faridabad, Gurgaon and Ghaziabad).

Orissa:-Formulation of a comprehensive Water Law is under active consideration by the competent authorities

Pondicherry: -Approvals are issued to new constructions subject to the provision of rainwater harvesting in building designs. PWD, Pondicherry has started constructing roof top rainwater harvesting structures in the Government buildings since 2002.

Rajasthan: - The State Government has made rainwater harvesting mandatory for all public establishments and all properties in plots covering more than 500 sq m in urban areas.

Tamil Nadu: - Tamil Nadu Municipal Laws Ordinance, 2003, dated July 19, 2003, t has made rainwater harvesting mandatory for all the buildings, both public and private, in the state. RWH has been made mandatory in three storied buildings irrespective of the size of rooftop area.

West Bengal:-Vide Rule 171 of the West Bengal Municipal (Building) Rules, 2007, installation of rainwater harvesting system has been made mandatory.

B. Important Cities:-

Hyderabad: - Rainwater harvesting has been made mandatory in all new buildings with an area of 300 sq. m or more irrespective of the roof area. Mandatory to provide RWH in all Group Housing, Commercial Complexes and all categories of buildings including residential.

Gwalior:-By order dated 27th January 2006 rainwater harvesting has been made mandatory for buildings having an area more than 250 sq. m. The engineer in charge of the area has been authorized to impose a penalty of Rs.7000 in case of non-compliance. A rebate of 6 % in property tax in the year in which the construction of rainwater harvesting facility has offered.

Indore: - Rainwater harvesting has been made mandatory in all new buildings with an area of 250 sq. or more. A rebate of 6 per cent on property tax has been offered as an incentive for implementing rainwater harvesting systems.

Jabalpur:-Rainwater harvesting has been made mandatory in all new buildings with an area of 250 sq. or more from 1 April 2005. A rebate of 6 per cent on property tax has been offered as an incentive for implementing rainwater- harvesting systems in the building

Kanpur: - Rainwater harvesting has been made mandatory in all new buildings with an area of 1000 sq. m or more.

Lakshadweep:-Lakshadweep Administration has already taken up construction of rainwater harvesting structures in different islands.

Mussoorie:-The Mussoorie Dehradun Development Authority has made provision for installation of rainwater harvesting system in its building byelaws.

Mumbai: - The State Government has made rainwater harvesting mandatory for all buildings that are being constructed on plots that are more than 1,000 sq. m in size. By 2007, the same provision became mandatory to buildings with plot area of 3,000 square meters and above and now it is 5,000 square meters.

Ranchi:-The Ranchi Regional Development Authority has included rainwater harvesting in its byelaws.

Surat:-Surat Municipal Corporation intends to implement the rainwater harvesting plan step by step. Currently, 50 % subsidy maximum amount up to Rs. 2000/- is given to the citizens to encourage the noble cause of rainwater recharging.

5.0 Precautions for Rain Water Harvesting:-

1. Before rain, roof should be clean.
2. The water of first 10-15 minute rain fall should be diverted through flushing devise etc.
3. Rain water should be clean trough filter media before recharging the ground water or storing.
4. The rain water which is planned to direct use should be collected from roof.
5. The collected water and collection drains to be kept at least three feet away from the foundation of buildings.
6. All rain water tanks should be fitted with filter and first flush system to improve bacterial and physical quality of water.
7. Householder should be made more aware of the Operation and Maintenance requirements of the tanks
8. Corroded GI roof can be source of metal contamination (Zn) of rain water, therefore care should be taken to replace corroded GI sheets.
9. Rain water tank should be securely covered for protection as well as to prevent dust and runoff as well as insects getting into the tank.

6.0 Benefits of Rainwater Harvesting:-Some of the benefits of rainwater harvesting are as follows:

- Increases water availability;
- Check the declining water table;
- Substantially lower water bill,
- Help reduce local flooding and reduce landscaping and property maintenance need
- It is environmentally friendly;
- Improves the quality of groundwater through the dilution of fluoride, nitrate, and salinity;
- Prevents soil erosion and flooding especially in urban areas.

7.0 Limitations of Rain Water Harvesting:-

a) **Unpredictable Rainfall:** Rain Water Harvesting is fully depend up on the rain fall but it is hard to predict the rain fall and sometimes it may be little or no rainfall. Hence, it is not advisable to depend on rainwater alone for all your water needs in areas where there is limited rainfall. Rainwater harvesting is suitable in those areas that receive plenty of rainfall.

b) **Initial High Cost:** Depending on the system's size and technology level, a rainwater harvesting system , the cost of system may be varies and benefit from it cannot be derived until it is ready for use. Like solar panels, the cost can be recovered in 10-15 years which again depends on the amount of rainfall and sophistication of the system.

c) **Regular Maintenance:** It requires regular maintenance as they may get prone to rodents, mosquitoes, algae growth, insects and lizards. They can become as breeding grounds for many animals like mosquito, if they are not properly maintained.

d) **Storage Limits:** The collection and storage facilities may also impose some kind of restrictions as to how much rainwater you can use.

However, the beneficial environmental impact of the system is what drives it further as of now.

8.0 Case Study:-

Rain Water Harvesting at Deisel Loco Shed at Bokaro (SER)

Bokaro steel city is an industrial city and important place of Adra division. A number of workshop and large settlement is situated here. During summer season water problem occur every year. Diesel loco shed BKSC having a huge roof area and rain water can be stored by rain water harvesting so that ground water get recharged for future use. For this work a storage tank for percolation and pipe line, drains for collecting roof water is required. An estimate for rain water harvesting including collection drains, landscaping of area was sanction by competent authority under head of allocation DF/4264.

Data:-

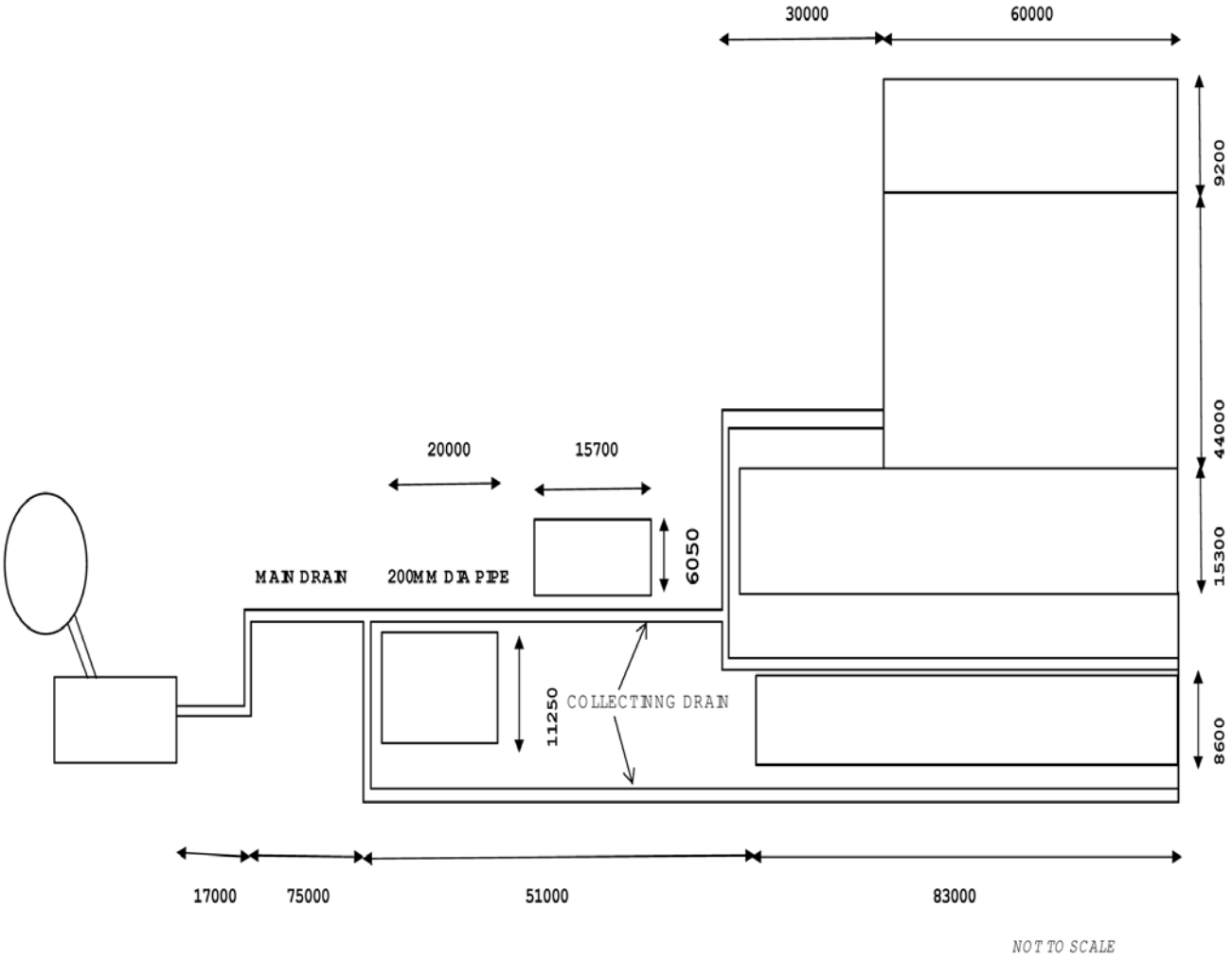
1. Average Rain Fall In Jharkhand =1142mm
   (From Table-3)
2. (i) Roof Area of Shed = 4035Sq. m
   (ii) Area of Plane Roof =1652.9Sq. m
3. Type of Roof Sloped (Corrugated Metal Sheets)
   Run off coefficient
   For Plane Roof = 0.80
   For Sloped Roof =0.7
   (Corrugated Metal Sheets)
   (From Table-2)

TABLE-3

Annual Rain Fall of Jharkhand

Sub-Division	Year	Annual Rain Fall (in mm)
JHARKHAND	2005	859.4
	2006	1356
	2007	1441.5
	2008	1200.6
	2009	1061.1
	2010	803.7
	2011	1274.8
Average Annual Rain Fall		**1142.4**

(Ref-https://data.gov.in/catalog/meteorological-sub-division-wise-annual-rainfall)



PLAN OF RAIN WATER HARVESTING AT DEISEL LOCOSHED AT BOKARO (JHARKHAND) ,IN ADRA DIVISION OF S. E RAILWAY

Drawing-1:- Plan of Rain Water Harvesting At DLS/BKSC

Annual Rain Water Harvesting Potential

= Catchment Area X Average Annual Rain Fall X Run off coefficient

(A) Plane Roof = 1652.9 x 1.142 x 0.8

=1510.167 Cum

(B) Shed (Corrugated Metal Sheets)

=4035 x 1.142 x 0.7

=3225.567 Cum

Annual Rain Water Harvesting Potential

= (A+B)

=1510.167 +3225.567

=4732.746 Cum

=4732746 Litres

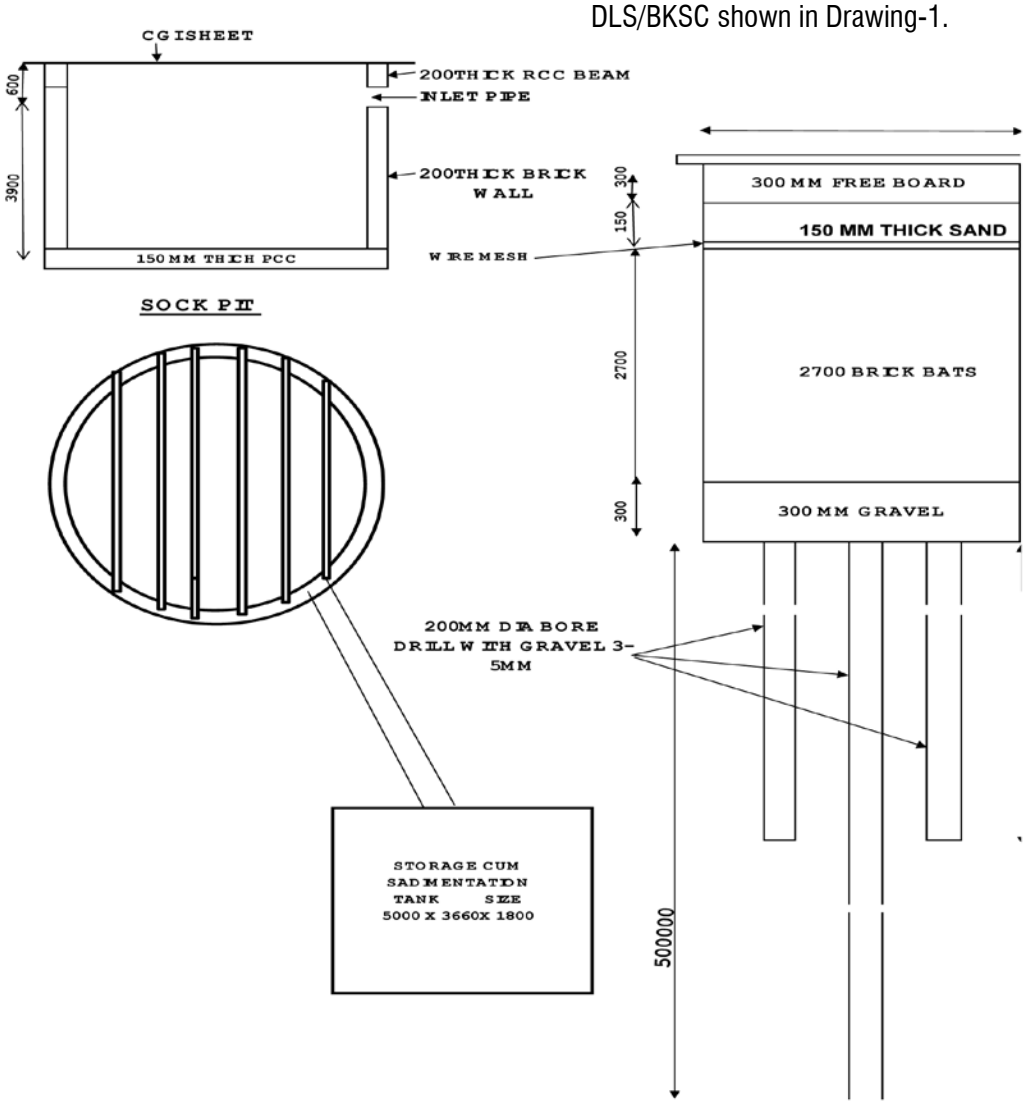
Size of Storage Tank =5.0 x 3.66 x 1.8

=27.00 Cum

=27000litre

Size of Sock Pit = 5 m dia having the depth 3.9 m

The Scheme for rain water harvesting implemented at DLS/BKSC shown in Drawing-1.



Drawing-2: Details Of Sock Pit And Sedimentation Tank

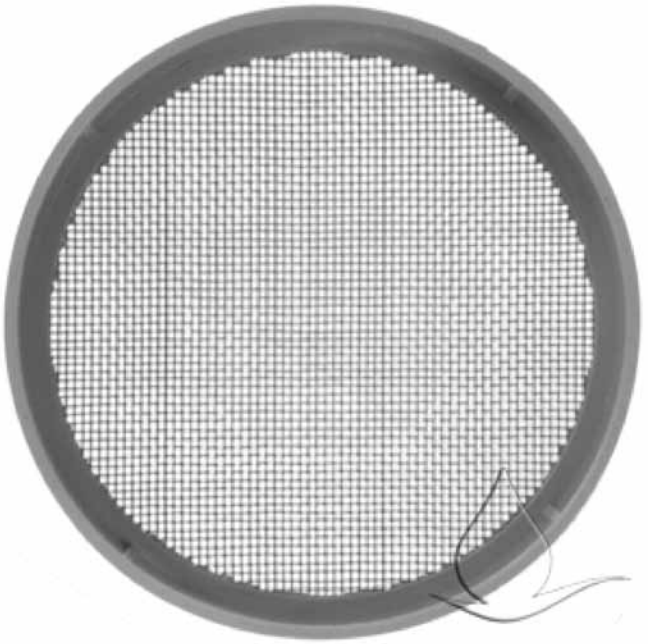
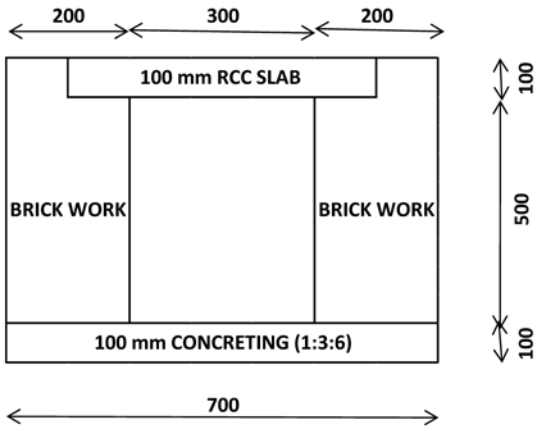
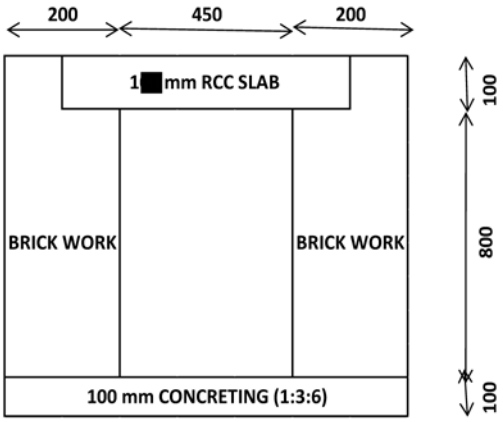


Fig:-Mesh Fixed At Mouth Of Outlet Pipe



SECTION OF COLLECTING DRAIN



SECTION OF MAIN DRAIN

The total rain water harvesting potential annually is 4732746 litres from the roof top of buildings and Sheds. After collection rain water trough conduits and gullies from roof top of buildings and Sheds respectively, it channelized though a network of drains of adequate size to settlement tank having capacity 27000 litre. The settlement tank retains the runoff from at least 15 minutes rainfall of peak intensity. Water of sedimentation channelized to sock pit where it pass through filter media and then enter into 3 nos bore well of dia 200mm having different depth 10m, 10m and 50 meter for recharging ground water aquifer. The over flow from sock pit enter into the nearest garden/ plantation area.

Downspout From Flat Roof

Downspout From Shed

Drain With Cover

Table:-4

Quantity Involved:-Item-Wise

S. N.	Item	Unit	Drain	Sedimentation Tank	Sock pit	Total	Remark
1	Earth Work in Excavation	Cum	201.02	38.367	75.539	314.93	
2	Concreting 1:3:6	Cum	29.133	3.288	2.943	35.364	
3	Brick Work (1:6)	Cum	91.65	6.518	11.679	109.85	
4	RCC 1:2:4	Cum	16.145	1.944	2.289	20.378	
5	Plaster	Sqm	458.25	36.636	79.8	574.69	
6	150 mm dia boring	Meter			70.6	70.6	
7	Shuttering	Sqm	123.46	29.76	1.67	154.89	
8	Supply of Gravel (Moorum)	Cum			5.887	5.887	
9	Supply of Brick Bats (Stone grit)	Cum			52.987	52.987	
10	Supply of Sand	Cum			2.943	2.943	
11	Supply of Reinforcement	Kg	1708.9	162.16	344.964	2216	
12	Supply of 200 mm dia Pipe (DI pipe)	Meter			70.6	70.6	

Table Contd...

Table Contd...

S. N.	Item	Unit	Drain	Sedimentation Tank	Sock pit	Total	Remark
13	Providing & Fixing of 110 dia PVC Bend	Each				196	For Collection of rain water from roof
14	Providing & Fixing of 110 solid waste pipe	Meter				210	
15	Lead	Cum				12	
16	S/H Rail	MT		2.16	1.24	3.4	For support of Cover Slab
17	Supply of Cement	MT	23.419	2.231	9.214	34.864	

Table:-5
Cost of Rainwater Harvesting at DLS/BKSC: Item Wise

S. N.	Item	Unit	Total	Rate per unit	Value
1	Earth Work in Excavation	Cum	314.93	97.21	30614.1
2	Concreting 1:3:6	Cum	35.364	1775.1	62774.6
3	Brick Work (1:6)	Cum	109.85	1752	192452
4	RCC 1:2:4	Cum	20.378	2123	43262.5
5	Plaster	Sqm	574.69	64.89	37291.4
6	150 mm dia boring	Meter	70.6	205	14473
7	Shuttering	Sqm	154.89	180.45	27949.2
10	Supply of Gravel (Mono)	Cum	5.887	373.75	2200.27
11	Supply of Brick Bats (Stone grit)	Cum	52.987	862.5	45701.3
12	Supply of Sand	Cum	2.943	412	1212.52
13	Supply of Reinforcement	Kg	2216	48.41	107279
14	Supply of 200 mm dia Pipe (DI pipe)	Meter	70.6	2164	152778
13	Providing & Fixing of 110 dia PVC Bend	Sqm	196	83	16268

Table Contd...

Table Contd...

S. N.	Item	Unit	Total	Rate per unit	Value
14	Providing & Fixing of 110 solid waste pipe	Meter	210	240	50400
15	Lead	Cum	12	88.5	1062
	TOTAL				785718
	Add&.5% Estimate Premium				844647
	Dedution 15.23% Accepted Rate		**(A)**		**716007**
16	S/H Rail	MT	3.4	23200	78880
				TOTAL (B)	**78880**
17	Supply of Cement	MT	34.864	5635	196459
	Add 7.5 % on S.N -17				14734.4
				TOTAL (C)	**211193**
				TOTAL (A) + (B) +(C)	**1006080**

Table:-6
Cost of Sub- Parts of Rain Water Harvesting: At a Glance

S. N.	Item	Cost
1	Provision of Drain	507143.8
2	Construction of Sedimentation Tank	100725.2
3	Construction of Sock pit including boring and fixing pipe	337458.1
4	Misc- Repair of Outlet of Roof etc	60753.04
	Total Cost	1006080

The cost of implementation of the rain water harvesting arrangement was Rs 1006080/- but including of improvement of drainage system etc at DLS/BKSC was Rs 25, 18,329 and the project was completed in July 2012.

Sadimentation Tank

Sock Pit

9.0 Conclusion: -Earth has plenty of water but freshwater is only a small fraction of it. With increasing demands for agriculture and Urbanization and industrialization other developmental activities, water resources are over-exploited. Although plenty of rain occurs in India, due to its un-even distribution over time it faces severe water scarcity in its many parts. Thus, conservation is one of the most important and simple methods of water conservation. Rainwater harvesting is one of the most important and simple methods of water conservation. Rainwater harvesting is getting significant importance in recent past due to severe scarcity being faced in many parts of the world including India. Several initiatives are taken by the government of India and various state governments to promote rainwater harvesting in the country. Many local bodies are considering making it mandatory to install rainwater harvesting system in housing complexes, large buildings and offices.

10.0 Recomondation:-

a. Introduce the loan scheme with low interest rate for construction of rain water harvesting in individual house as well as hosing societies for encourage the it.

b. Training should be provided on free of cost to house-holder for Operation and Maintenance requirements of the tanks and RWH system.

c. A rebate in property tax to house holder to be given in case of implementation of RWH system in their house.

d. Drinking rain water should be encouraged in dry zone district where the groundwater is both mineralized and contaminated. High content of calcium and minerals thought to be the cause of high incidence of kidney problems in the dry zone areas.

e. The generally good quality of rainwater should be made known so that more people will be encouraged to use it for drinking

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■■■

Cadastral Survey using GNSS and High Resolution Satellite Image.

Cadastral Survey – Is the field of surveying to establish Real estate or Land parcel property boundaryit includes spatial measurement principles of general survey with legal principles such as position with respect of neighboring titles.

Value of land is increasing rapidly worldwide due to urbanization and population growth; land owners are asking for accuracy in centimeters. Method of Graphical cadastral surveying does not satisfy the land owners due to scale constraint. The present trend is such that, land owners are asking for 3-D real estate objects.

Recent Technological advancement.

The traditional Plane Table Method has been replaced by modern numerical cadastral surveying method using Total Station instruments and the database has been developed in fully digitalized environment.

RTK GPS – 'Real Time Kinematic Global positioning System' using Global Navigation SatelliteSystem(GNSS) and satellite High Resolution Imagery are increasingly used for cadastral survey in many developing countries. The data thus obtained can be comparable with those acquired by Total station subsequently. These are appropriate techniques used for substituting digital cadastral system using total station to achieve required accuracies and reliabilities which is cheaper and more productive.

Ref: Coordinates, Vol-XI, Dec-2015

Combating Noise from the Shinkansen

This is because of aerodynamic phenomenon and noise associated with high speed trains. Air resistance is Proportionate the squire of speed and aerodynamic noise is proportional to sixth squire of speed .To reduce reduce overall resistance, it is therefore necessary to flattened the outer surfaces of Centre cars in the train, such as roofs, under floor equipment and gaps between the cars in this way great progress has been made on smoothening the outer surface of vehicles as counter measures to suppress noise and avoid sow accumulation and also reduces the air resistance. A typical problem of air pressure fluctuations which result in ear propping .This phenomenon is observed when a pressure wave generated by train running in to the tunnel infiltrates inside the train. Such phenomena had been foreseen theoretically, and a need for related countermeasures was identified and first ever air tight structure on mass produced railway vehicle was adapted.

When there were no noise barriers, rolling noise was dominant around the lines. Later rolling noise was reduced by installing noise barriers and the improvement of the wheel thread roughness condition due to adaptation of resign abrasive blocks to the wheel tread. Rolling noise was significantly to the application of Rail grinding and sparking noise was also virtually eliminated by connecting multiple pantographs with high voltage bus line wiring and thereby protecting contract breaks.

The measures relating to aerodynamics and noise will undoubtedly continue to play one of the key technological roles as speeds increase in the future.

By: Dr. Masanobu Iida

Ref- IRJ July 2015, Pg 27,28

Mitigating Track Displacement During Construction

It is the fore most point of interest to safe guard the adjacent running track during taking up any construction work near the running line or under the running line. In this aspect monitoring the track parameters is of prime importance. The construction method and other protective works are planned taking in the safety of the running line, how everthe it is still viltal to monitor the track parameters during the execution of work.

Several methods are used in monitoring the track movements which includes contacting sensors like tiltmeters, survey devices, total stations etc,. However the track engineers of Kouwenberg Infra, working for Dutch infrastructure manager Prorail in Netherlands using alternative have used an alternate method by Dynamic Monitoring system (DMS) developed by Imetrum, Britain delivered in Benelux by Rail Assist.

This system utilizes a high resolution, non-contact video system and is able to continuously monitor the track displacements during installation of a new under-trak crossing by open front drilling. This system was used to continuously measure the displacements of two rails while a 1.20m dia concrete pipe was driven through a Railway embankment. For comparison the conventional total station was also used for and data produced. The imetrum system was setup on the embankment at a safe distance which consists of single tripod mounted camera focused on a section of track. The frequency was setup at 2.5Hz and the field of view was set to 1m on either side of drilling. The real time measurements were captured recorded and displayed using video gauge software. This allowed the contractor to instantly monitor any impact of their work on the track.

The benefits of using DMS are listed below:

- Reduced cost due to no contact system, other wise costing much to obtain permission
- There is no need for the survey personnel to go near the track, thus improving the safety of the men
- Improved analysis of the data and preservation of data
- Can be used with higher frequency and measurement resolution up to 0.01mm

By:AurthurKappers and Paul Waterfall

Ref: International Railway Journal, August – 2015 (Issue 8), Pg 42-45

China Steps up Railway Diplomacy in East Asia

China's railway development strategy continues to dominate the agenda in east asia .According to IRJ research the country is on course to open a further 442Km of high speed lines ,the 362Km Zhengzhou-Xuhou and 82 km Channgzou-Zhangigjiagang links in 2016.The 1175Km Changsha-kunning line is also currently under construction and is expected to open in 2017.

The four north-souths and four easts –west corridor which form th back bon of China's high speed network were completely by the end 2015, with further projects intended to close any important gaps in the network which is now closing in on 18000km.

As the high speed network nears completion, attention is shifting to developing and completing intercity and upgrading conventional main line. China's passenger system will consist of 50000Km of lines by 2020 connecting most of the provincial capital and cities. Work on several key projects is expected to get underway which will contribute to plan to develop more than 2000Km of lines by 2020.Domestic orders account for 88%of CRRC's sale.CRRC is targeting 2.5bnUDS$ in international sale up to 2020 with other domestic suppliers also looking to expand overseas, China is aggressively pursuing opportunities to support infrastructure development that will provide domestic companies with the platform to export their technology.

Japan is also trying to secure further contracts for Delhi-Mumbai,Delhi-Kolkata, and Mumbai-Kolkate corridors which are potentially far more lucrative and reliable .China may now ramp up its efforts to secure the long anticipated high speed line between Kulalumbur and Singapur.The land transport authorities of Malaysia and singapur said at the end of Nov that they have received 98 responses to the request for information for the 330Km project. China is interest in the $US 14.9bn project and as completion heat up announced $US 10bn commitment to infrastructure lending in southeastAsia during the Asean-Japan summit in Kualaambur in November.

Despite its Indian success, Japan has vowed to halve the time it takes to approve infrastructure loans and to take on more financial risks with an apparent understanding in Tokyo that it can no longer rely on its track record for better quality ,safety and social and environmental protection than China. In addition land, infrastructure, transport and tourism minister promoted the Shinkansen during meeting with Singapur transport minister and MalasianPM .

With the government of Singapre and Malasia expecting to finalize the project by the end of 2015,ahead of tender in 2016,it is set to be one of the key contracts awards of the year. It will also be another key indicator of whether China can deliver its ambitious export agenda or if Japan can land another key contract

By: Kevlin Smith

Ref-International Railway Journal, January 2016, Volume 56, Pg 30,31&32

Is India Ready for High Speed Rails

India High speed aspirations are heading in right direction under the current political atmosphere. The current plan to link Mumbai with Ahmadabad by 505 Km high speed corridor at estimated cost of Rs 988.05 bn with completion time 2017 to 2023 with help of Japanese loan is started taking the shape as with the feasibility report by Japan international co-operation Agency (JICA).The issue of Gauge selection is also a matter of concern to the Indian establishment but JICA has recommended standard gauge (1435mm).

JICA has surveyed the current plan to connect Mumbai with Ahmadabad needs construction of 318 Km embankments, 162 Km viaduct, 11tunnel of total length of 27.01KM, including 2.16 Km tunnel underneath Thane Creek to link Mumbai with Navi Mumbai. With this high speed line the current journey time will reduced from current 7:30 hours to mere two hours.

Developing high speed lines has been high priority on prime minister agenda, But in current scenario of Indian railway where 12617 passengers and 7421 freight train runs every day ion 65436 Km network having average speed of Mail/Express train is just 54 Km/h and goods train has only average speed 25.9 Km/h.as the passengers traffic is

expected to grow from 11.7 billion in 2012-2013 to 11.7 billion in 2016-2017 and IR has long list of pending project including 154 new lines,42 gauge conversion and 166 track doubling in want of fund, So some one can argue that it might more prudent to focus on ramping up the existing speed than the taking to fanciful idea of high speed network. But IR viewed that it is high time to March with advancement with rail technology should took to the high speed route. However Railway minister emphasizes upon tackling of issues main network but same time high speed route to meet its future need.

The other proposal for high speed route connecting Delhi –Ahmedabad,Mumbai- Chennai and Delhi-Kolkata "Golden quadrilateral" has brought lot of interest to global companies They are also participated in Bidding process and it has been opened and undergoing evaluation with selection made on quality and cost basis. Chinese company ,china Railway Siyuan Survey And design Group is studying Delhi Chennai Route, while Spanish Infrastructure manager Adif will conduct survey on Mumbai –Kolkata route. Both company doing survey free of cost with agreement by respective country with India. Plan of high speed railway line are core of the prime minister national agenda and government has to move forward with the speed as anticipated which will be clear in the forthcoming month

By:Raghav Thakur,

Ref: International Railway Journal, July 2015, Volume 55 Issue 7, Pg 22-23

Mechanised Track Maintenance: -A Matter of Merit also for Developing Countries

Track maintenance is aimed at extending the service life and, thus, attaining the lowest possible life cycle cost (LCC) of a Rly track.especially in developing countries, the choice of the maintenance method adopting are labour intensive or mechanised. Mechanised method may merit the adoption of track maintenance in developing countries.

After a certain time period and tonnage of traffic the track quality will deteriorate .Again, the maintenance has to be carried out which attains a lower track quality then the new one due to track component wear. This process of deterioration and maintenance repeats itself rusulting lowest possible life cycle cost (LCC) ,despite the cost of the maintenance.FullyMechanised maintenance method can be achieve the preciosion and quality of work required to bring the track back as much as possible to its as built condition.

Various track maintenanc task in mechanised methods are Ballast cleaning, Ballast regulating,Tamping, Track renewal and Rail grinding.

As regards Mechanised maintenance method track maintenance machines come in various shape and size as well as function and can be tailor made to meet specific requirement.The main AIM of track maintenance,regardless of the method deployed,isalwaysto achieve the highest possible track quality in the most efficient and cost effective manner.

Ref:Rail Engineering International 2015, volume 44, no. 3, Pg-5

Synthetic Sleeper still going Strong after 30 Years

Synthetic sleeper i.e. Fibre reinforced foamed urethane (FFU) sleeper may be the best alternative solution in place of traditional wooden sleeper that would offer the same performance with a far longer life with better resistance. FFU sleepers were first installed in Japan in the year 1980 and now in use on more than 1400km of track around 16 countries in the world. One of the major benefits of the sleeper is their longevity.

FFU sleeper is produced by compressing single strands of glass fibre with polyurethane foam using a high pressure extraction press. The manufacturing process is initiated by mixing the base materials polyole and isocyanide with several additives and after compounding and extrusion, the raw mixture is reinforced with long glass fibres. Foaming and curing then takes place before the finished product is cut to a standard length of 12m for further processing and sizing to any length determined by customers. The result of physical property tests show that the sleeper continues to meet JIS E 12031 and ISO 12856-1 standards.

As per recently demonstrated study conducted by Japan's Railway Technical Research Institute (RTRI) on the behalf of Sekisui of FFU synthetic short sleeper and FFU synthetic bridge sleeper which have been in service in Japan for the last 30 years, show that even after 30 years in service the short sleeper exhibited no cracks and warping, no change in the colour of the surface layer, and no loose screw spikes and overall were in good fixed conditions. Further, the bridge sleeper also exhibited no crack and warping on their surface and no peeling of the bonded surface in the bonded area over the last 30 years with a passage of 180 Million tonnes traffic even after no maintenance of track for 20 years.

Ref –International Railway Journal, Dec 2015, Pg 49

Inspection Quality and Performance by Axle Testers

In present scenario, Indian Railway and demand of the age is high speed trains and moreover the train travelling with high speed subjects to hollow axle due to increase in the strains which puts the structural integrity and reliability at risk. As a result the hollow axle must be inspected regularly for early detection of flaws to ensure the cracks don't propagate quickly or to take care of the measures.

The new sophisticated instruments can be adopted to have a regular evaluation and create a dynamic inspection plan through faster data acquisition and image display with intuitive interface and advance software's. This level of inspection quality and flexibility to the rail industry at a significantly lower price than existing automated system are coming in the present market and one should go through those products and select as per the requirement.

One of the manufacture GE's CHAT gives the solution with following features:

- Light and compact design enabling single person to move the trolley around and operate it alone.
- Ability to transport it in a small van without lifting tools
- Composite frame for electrical protection to operate where electrified rails are present
- Quick installation on site for immediate inspection
- Multi Channel UT instrument USIP 40 in 2, 5 and 10 Channels configuration
- Closed loop and seals for oil coupling to minimize the oil spillage during inspection
- Quick inspection time: 8 minutes for signal acquisition and less than 15 minutes including installation and recording of results.
- Large variety of probe holders for various bore diameters and no. of probes for various specifications.
- Compliance with all specifications for conventional UT inspection of Hollow Axle

GE's Measurements and control has inducted the compact Hollow Axle tester combining Hollow Axle inspection machine and Ultrasonic angle beam probes with GE's high quality Ultrasonic instrumentation.

Ref: Railway Age Magazine, Dec 2015, Pg-44

Mixed Fortunes for Australian Light Rail

Faced with increasing inner city congestion and predicted rapid growth in urban populationsfrom 22.3 million in 2011 to 30.5 million by 2031, car journey time will increase by about 20 % in congested corridors and in some places even travel time could be more than double between 2011 and 2031. Because of this, Australian cities are turning to high efficiency public transport system i.e.light rail to relieve traffic congestion problems.

Despite Melbourne, the city having World's most extensive light rail network with 176.9 million passengers in 2013-14, most of Australian cities as Gold Coast, Perth, Canberra except Sydney are yet to cope with this problem. The current focus is 12 Km South East Light Rail in the city of Sydney from Circular Quay to south East major residential areas with a $A2.0 bn with target completion by 2018 in 4 years from contract signing.

In Queensland gold Coast city, already opened 13 Km G: Link has an impressive 6.2 million passengers in its first year of operation and will have second stage to comprise 7.3 Km from QR to Gold coast University Hospital.

In the city of Perth due to local economy deterioration and in Canberra dueto resistance to the scheme from opposition party in Australian Capital Territory Parliament, the Light rail project could not geared up. Despite success of Gold coast and New South Wales,Government's enthusiastic expansion of existing rail line, there is still opposition to light rail projects largely from Australia's Dominant car culture and unfavorable community attitudes to public transport. However Federal Government in Australia is playing important role in financing and providing unfunded scheme with the hope to get off the transport problems.

Ref:International Railway Journal, Nov 2015, Vol-55; issue 11, Pg 33-35

Pushing the Limits of Ballasted Heavy Haul Railway Track by Means of High Strength Under Sleeper Pads Made of A Specially Developed PUR

Heavy haul railway traffic and its negative impact on track quality: Conventional ballasted heavy haul railway track, due to the high axle loads and high tonnages of traffic born, is subjected to extremely high stresses, which leads to a deterioration in the quality of the track installation including the ballast. At places, where is discontinuity, ballast grain are prone to fracture and pulverisation,due to high increase in dynamic loading in these location. To minimize track maintenance. The use of high quality UNDER SLEEPER PADS (USP) with suitable rail pads can effectively counteract this negative impact.

Benefits of using under sleeper pads; under sleeper pads, increase the/ballast contact area from2-8 % (WithoutUSP) to over 30% (withUSP) and an improvement in load transmission to the ballast bed and reduction in stress on sub grade, resulting ballast grain fracture is prevented and track settlement is minimized.

A new USP with an ideal combination of plastic and elastic properties for heavy haul track: The latest generation of under sleeper pad made of SYLOMER, Which is an ideal combination of Elastic and plastic properties provide an optimum load, distribution in the track, as well as a reduced sleeper/ballast contact pressure.

Ballast contact pressure: The plasticity of under sleeper pad allows the ballast layer to embedded itself in the padding material. Ingeneral, the lateral resistance of padded concrete sleeper is higher than that of non-paddedones. The PUR have largest contact area 27.8%. The larger the ballast contact area, ore uniform load transmission is and smaller the ballast contact pressure on track.

Track settlement reduction: With the section padded with USP the track had settled by an Average of 7.5mm.

Conclusions: Under sleeper pad made of SYLOMER is an idle combination of elastic and plastic properties, which provide an optimum load distribution as well as alower,contact pressure between the sleeper and theupper ballast layer offering ahigh level of ballast protection.

By: Harald Loy,Andereas Augustin

Ref: Rail Engineering International, Edition 2015, No.4 Page 3-6

Seeking a New Route for Trespass Prevention

The European Restrail research project investigated to reduce fatal incidents and suicides on Europe's railways, including two approaches to prevent illegal trespassing in Finland. While it is illegal and punishable with a fine in Finland, with a largely-unfenced 6000 Km network, and with railways often dividing communities, shopping areas and schools in urban communities, people are tempted to cross the tracks. Clear and regularly used footpaths across railway lines have emerged in many places, making it safe to assume that trespassing is frequent. Preventing trespassing is a challenge.

Two pilot tests led by VTT Technical Research Centre of Finland were conducted within the framework of European Restrail Project, which was coordinated by International Union of Railways, to look at a warning system and enhancing education to prevent trespassing.

The first project was implemented at two sites duly introducing a system of Camera enforcement and sound warnings in areas where illegal crossings have developed due to pedestrians routinely taking a short-cut across the railway. The aim was to reduce the number of pedestrians crossing at that location to reduce the risk of people being hit by train. The results revealed that the reduction of 44% at one location and an 18% at other location. The large difference found between test sites also indicates that the effect depends greatly on local circumstances, and perhaps also on the safety culture of the society in general.

The second project emphasized improving education and awareness of level crossing safety in schools duly conveying themessage that railway lines are only meant for trains and trespassing, playing and loitering in railway areas is forbidden, and that they are responsible for behaving safety in a railway environment in lesson for safe behavior in a railway environment for 8-11 years old attending four schools located near railway lines. The short surveys were delivered by teachers based on instructions written by the researchers and measured three variables which are considered as strong determinants of actual behavior: behavior of intention, estimated dangers of the behavior and level of knowledge on the legality of the behavior. The results show that railway safety education in schools has a positive effect for all the measured variables.

The results of the above shows a positive impact on reduce in trespassing.

By:Dr. Anne Silla, Veli – PekkaKalberg

Ref: :International Railway Journal, July 2014

The Indian PEB Scenario

The origins of Metal buildings nearly 150 years back when British metal building companies developed this application. During World War- llthe need for "ready to erect" structure &post-war construction boom offered an ideal opportunity mass produce buildings for briety of non-residential industries.

Pre-engineered Steel Buildings PEB is designed by a PEB supplier or manufacturer, using sophisticated design soaftware which takes into account the strength and thickness of available steel and all loadings effect on the building. Today's PEB can efficiently satisfy a wide range of structural and aesthetic design requirements.An efficiently designed pre-engineered building can be lighter than the conventional steel buildings by upto 30%.

The Indian Scenario: Pre-engineered metal buildings were introduced in India in the mid-1990s.This rapidly growing industry has enormous growth potential in India. India has quickly embraced the modern PEB design soaftware; the two main types of soaftware used are MBS and STAAD PRO due to which Indian PEB industry is fully tuned to world standards.

The most common design soafware used around the world is MBS(Metal Building Soaftware). In MBS specify the load and code: in the resultant design, all member of the structure conform to the specified loads and code, if not, the soaftware throws a structural error and that section must be redesigned untill the error is removed.

Indian engineers, consultants, specifiers and building owners must understand that building failure has major implications and liabilities. In addition to the repair or replacement cost of the building, the lost time and opportunity cost and above all liability for any loss of life or property is significant and must be considered in the final dicision making process. Due to increase awareness by consultants, specifiers and building owners in understanding how a uniform value for minimum structural standards is critical to the future of safe PEBs in India and hence have a bright future in India.

By Larry Stevensand

Ref:Modern Green Structure&Architecture, Sept 2015

Rethinking Switches to Boost Reliability

Abstract:

The article offers information on the research project at Loughborough University designed to improve performance and redundancy while reducing the cost of railway turnout maintenance. Topics covered include the switch design that the project is considering to improve network performance, the four principles of a concept design developed by the project for a novel switch arrangement, and the aim of the project to bring stub switches on a modern railway.

Study:

Majority of railway turnouts have operated in the same way tapered switch blades are moved horizontally between fixed stock rails to set the route for each train. But if this movement is not fully completed and the blade stops in an intermediate position, there is a risk that a passing train may be derailed. To mitigate the risk, layers of sensors, signalling protocols and operational procedures have grown up, adding cost and complexity.

Switches present a single point of failure, and even when operational they can introduce capacity constraints due to design of the physical track components and associated signalling systems. Because of this complexity, turnouts are significantly more expensive than plain line, both to install and to maintain.

Report:

Rail traffic volumes increased significantly, it is decided to improve the present sinario, and a research has been done by the University for the Switches by 'lift and drop' motion to move the rails between positions. A patented rotary mechanism lifts the rails, which are carried together on a hopper that maintains the gauge without stretcher bars.

By: Roger Dixonand Sam Bemment

Ref: Railway Gazette International; Jan 2016, Vol. 172, Pg - 36

Keeping Track of Rail Freight

European Rail Freight sector is dramatically lagging behind 'Road haulers 'as per Professor Markus Hecht from University at Berlin pointed out that at present European Rail Freight sector handles only 17% of the total freight volume in Germany & earns only 2% of the revenue. The reason for low utilisation of Rail freight sector is the average delay in the delivery of wagons to German consignees is around 23 hours .

To enhance the utilisation of rail freight sector, a seminar on the application of advance technologies in Rail Freight was held by Luzern based company recently. In this seminar

prospects for using Telematics on European Freight trains was discussed. In this seminar 300 delegates from 17 countries plus 11 exhibitors showcasing a wide range of mature equipments from sensors to data processing. Seven speakers analysed various aspects of supply chain management, safety economics and Rail operation where Telematics could play a valuable role. Telematics have been offering benefits to shippers and operators in the road sector for many years, and a wide range of tools and technologies is now available. By about 2003, most trucks were fully digitised, allowing the logistics companies and their customer to retrieve and display virtually all vehicle related operational &customer related information in real time. This not only allows them to monitor continuously the condition of the vehicle and its cargo but also the driver's driving hours and legally prescribed breaks. Customers can be given accurate real time information about vehicle progress and forecast delivery times, allowing them to update their plans where necessary.

It is clear that greater use of Telematics on freight wagons could help to meet a wide variety of objectives, from reducing the risk of accidents to cutting maintenance costs & real time information for the train operators, freight shippers and wagon owner.

Thus by adopting above technology, European rail industry will definitely earn more revenue.

By : Reinhard Christeller

Ref : International Railway Gazette, Feb-2016

Power Drivers Debuts Diesel Fuel Filtration, Warming Systems

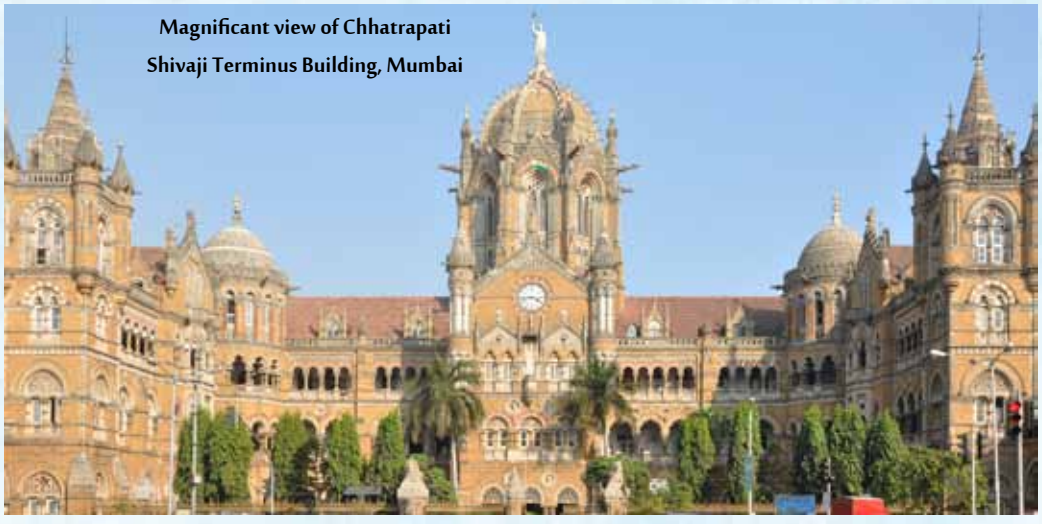
Power Drives Inc. (PDI), a Buffalo, N.Y.- based supplier of diesel engine heating/idle reduction and fuel filtration systems with manufacturing facilities in Erie, Pa., Falconer (Jamestown), N.Y., and Haiyu Town, Changsu City, China, spotlighted two recently introduced technologies at Railway Interchange 2015 in Minneapolis.

PDI's new fully synthetic, dual-layered diesel fuel filtration system pictured, with Global Accounts Manager Eric Knechtel, co-developed with Schroeder Industries, "increases dirt-holding capacity by 242% vs. An OEM unit, offers an efficiency of 99.98% of particles at 4 microns or greater and a 50% pressure drop reduction, doubles the life between change-outs, with half the maintenance installation time, and offers improved cleanliness per ISO Code 4406, which exceeds Tier 4 requirements. A more robust end cap prevents deformation, allowingthe filter to sit flush and seal properly, eliminating common misalignment and premature failure problems," according to PDI.

PDI's powerhouse Diesel Warming System (DWS) is available in two configurations. The DWS-APU and the DWS-120. The DWS-APU (Auxiliary Power Unit) incorporates a Tier 4-compliant, 9.5 hp single-cylinder Kubota engine. The DWS-120 operates from a 120/240 VAC, 5/2.5-amp external electric power source. Both units, described as "compact," feature the Powerhouse Heat Exchanger" rated 136,000 BTUs/hour ($0kW). The heat exchanger "provides rapid coolant heating plus rock-solid reliability, "maintaining an engine coolant temperature of 100 degrees F" even in the coldest of temperatures."

The DWS-APU consists of two modular components, the APU and the heat exchanger/pump, that can be mounted up to 20 feet apart. It consumes, on average, 0.38 GPH (gallons per hour) of fuel once at temperature, the DWS-120 consumes, on average, 0.35 GPH of fuel at temperature.

Ref : Railway Age-Nov. 2015



Magnificant view of Chhatrapati Shivaji Terminus Building, Mumbai

First Major Trial of Self Healing Concrete in UK

A CARDIFF University-led project is testing ways of automatically repairing concrete without human intervention.

The first major trial of self¬healing concrete in the UK is being undertaken at a site in the South Wales Valleys. The research team also includes academics from the Universities of Bath and Cambridge.

The project, entitled Materials for Life (M4L), is piloting three separate concrete-healing technologies for the first time in real-world settings, with a view to incorporating them into a single system that could be used to automatically repair concrete in the built environment.

It is estimated that around £40billion a year is spent in the UK on the repair and maintenance of structures, the majority of which are made from concrete.

The overall aim of the Cardiff¬led project is to develop a single system that can be embedded into concrete when it is initially set and then automatically sense when damage occurs. Once damage is detected, the system will be able to repair itself autonomously without the need for human intervention.

The trial is being undertaken in collaboration with one of the major industrial partners on the project, Costain, and is taking place at one of its construction sites on the Heads of the Valleys road improvement scheme in south Wales - the A465.

Ref : Concrete, Dec 2015, Pg-10

GSSI Bridge Scan

Geophysical Survey Systems,Inc. ‘s, BridgeScan” is a flexible Ground Penetrating

Radar(GPR) system for assessing concrete condition on bridge decks, parkingstructures, and balconies. Users can identify the location and depth of reinforcing bars, making Bridge can an option for conducting bridge deck condition assessments, determining concrete cover depth on new structures, measuring slab thickness, and detecting locating voids. Users can also use the unit as a basis for a utility locating GPR system to map and locate underground infrastructure¬- pinpointing the depth and position of pipes in real time. BtidgeScan is tailored for bridge condition assessment, accurately representing bridge data by automatically accommodating for bridge skew angle.

Ref: Concrete International, Jan 2016, Pg-57

PCE-MWM 210 VHF-Band Moisture Sensor

PCE-MWM 210 VHF-band moisture sensor measures moisture content inside concrete mixers. Its front surface is protected by a plate made ofGOST 40X13 stainless steel alloy with high resistance to abrasive wear. With the supplied software, the user can adjust moisture meter calibration

data for the enhancement of moisture measurement. PCE-MWM 210 may be installed in a hole drilled in the bottom of a concrete mixer. The package includes all necessary mounting hardware. The required cable length between the sensor and the electronic unit can be also selected during the ordering process.

Ref: Concrete International, Dec 2015, Pg-56

Bath and Whirl Tubs

DURAVIT has launched Bath and Whirl tubs that have hexagonal exterior, oval interior and extreme comfort bottom line. These 2x3 tubs have 2000x1000mm dimensions, and are available with bathtub anchors for mounting and support of bathtubs and shower trays. Also, the tubs include rubber profile for noise reduction and sealing against moisture, and LED coloured light with air-system, jet-system, combi-system P and durapearl-system.

Ref. Builders'Friend, Jan 2016, Pg 94

Tensile Fabric Material

DURAVIT has launched Bath and Whirl tubs that have hexagonal exterior, oval interior and extreme comfort bottom line. These 2x3 tubs have 2000x1000mm dimensions, and are available with bathtub anchors for mounting and support of bathtubs and shower trays. Also, the tubs include rubber profile for noise reduction and sealing against moisture, and LED coloured light with air-system, jet-system, combi-system P and durapearl-system. Tensile structure is an expression of intensive thinking in terms of building designs. It offers great independence to an architect/designer for creating unique and innovative forms and adds an appeal to the surroundings. Being an advanced method of lightweight planning, it enables in the development of various structures such as atrium roofing, car parking shades, swimming pool covering, stadium stand's covering and etc. with various safety & aesthetic features. Moreover, this building material is less expensive in comparison to the conventional construction materials.From a small tent to big arenas, fabric form plays an integral role in balancing the whole concept. The solar and thermal properties of fabric structures make them energy efficient. The translucency of the fabric can be varied between 6% and 13%, allowing daytime lighting to be reduced or eliminated.

IRICEN SSTW(SR.SUPERVISORS TRAINING WING) CALENDAR OF COURSES 2016 (Rev. 06)					
Course No.	**From**	**To**	**Name of the course**	**Duration**	**Eligible Group**
16822	04-04-16	08-04-16	Management of Store & Land (MLS)	1 week	SSEs/P.Way
16823	04-04-16	15-04-16	USFD,Welding & Rail Grinding (USFD)	2 weeks	SSEs/P.Way
16824	04-04-16	08-04-16	Track Monitoring (TMo)	1 week	SSEs/P.Way
16825	11-04-16	15-04-16	Long Welded Rail (LWR)	1 week	SSEs/P.Way
16826	11-04-16	15-04-16	Land Management (LM)	1 week	SSEs/Works
16827	18-04-16	22-04-16	Points, Xings & curves (PXC)	1week	SSEs/P.Way
16828	18-04-16	29-04-16	Mech.Track Maintenance & Renewals (TM)	2 weeks	SSEs/P.Way
16829	18-04-16	22-04-16	Contract Management (CM)	1 week	SSEs
16830	25-04-16	29-04-16	Formation (FMN)	1week	SSE/Works of Const. Organization
16831	02-05-16	06-05-16	Survey (SRVY)	1 week	SSE/Works of Const. Organization
16832	02-05-16	06-05-16	TMS	1 week	SSEs
16833	02-05-16	06-05-16	Insp.& Maint. of Bridges (BR)	1 week	SSEs/Br
16834	09-05-16	20-05-16	Rail Wheel Interaction & derailments (RWI)	2 weeks	SSEs & Instructor of ZRTI/ DTC/P.Way
16835	09-05-16	13-05-16	Building Construction (BC)	1 week	SSEs/Works
16836	09-05-16	17-05-16	Fabrication of Steel Bridges (FSB)	9 Days	SSEs/Bridges
16837	16-05-16	27-05-16	Mech.Track Maintenance & Renewals (TM)	2 weeks	SSEs/P.Way
16838	16-05-16	24-05-16	PSC Construction (PSCC)	9 Days	SSEs/Bridges
16839	23-05-16	27-05-16	Concrete Technology (CNCT)	1 week	SSE/Works of Const. Organization
16840	30-05-16	03-06-16	Points, Xings & curves (PXC)	1 week	SSEs/P.Way
16841	30-05-16	10-06-16	USFD,Welding & Rail Grinding (USFD)	2 weeks	SSEs/P.Way
16842	30-05-16	03-06-16	Building Construction (BC)	1 week	SSEs/Works
16843	06-06-16	10-06-16	Management of Store & Land (MLS)	1 week	SSEs/P.Way
16844	06-06-16	10-06-16	Long Welded Rail (LWR)	1 week	SSEs/P.Way
16845	13-06-16	24-06-16	Rail Wheel Interaction & derailments (RWI)	2 weeks	SSEs & Instructor of ZRTI/ ZRTS/P.Way
16846	13-06-16	17-06-16	Contract Management (CM)	1 week	SSEs
16847	13-06-16	24-06-16	Mech.Track Maintenance & Renewals (TM)	2 weeks	SSEs/P.Way
16848	20-06-16	24-06-16	Land Management (LM)	1 week	SSEs/Works
16849	27-06-16	15-07-16	Training of Trainers (TOT/W&B) (Works & Bridges)	3 weeks	SSEs/Works & Bridges
16850	27-06-16	01-07-16	Survey (SRVY)	1 week	SSE/Works of Const. Organization
16851	27-06-16	01-07-16	Concrete Technology (CNCT)	1 week	SSE/Works of Const. Organization

Table Contd...

IRICEN SSTW(SR.SUPERVISORS TRAINING WING) CALENDAR OF COURSES 2016 (Rev. 06)					
Course No.	**From**	**To**	**Name of the course**	**Duration**	**Eligible Group**
16852	04-07-16	15-07-16	USFD,Welding & Rail Grinding (USFD)	2 weeks	SSEs/P.Way
16853	04-07-16	08-07-16	Points, Xings & curves (PXC)	1 week	SSEs/P.Way
16854	11-07-16	22-07-16	Rail Wheel Interaction & derailments (RWI)	2 weeks	SSEs & Instructor of ZRTI/ DTC/P.Way
16855	18-07-16	22-07-16	Track Monitoring (TMo)	1 week	SSEs/P.Way
16856	18-07-16	29-07-16	Mech.Track Maintenance & Renewals (TM)	2 weeks	SSEs/P.Way
16857	25-07-16	29-07-16	Long Welded Rail (LWR)	1 week	SSEs/P.Way
16858	25-07-16	29-07-16	Contract Management (CM)	1 week	SSEs
16859	01-08-16	05-08-16	Insp.& Maint. of Bridges (BR)	1 week	SSEs/Br
16860	01-08-16	19-08-16	Training of Trainers (P.Way) TOT(P. Way)	3 weeks	SSEs/P.Way
16861	01-08-16	05-08-16	Land Management (LM)	1 week	SSEs/Works
16862	08-08-16	12-08-16	Management of Store & Land (MLS)	1 week	SSEs/P-Way
16863	08-08-16	16-08-16	Fabrication of Steel Bridges (FSB)	9 Days	SSEs/Bridges
16864	16-08-16	26-08-16	Rail Wheel Interaction & derailments (RWI)	1 week	SSEs/P.Way
16865	22-08-16	26-08-16	Long Welded Rail (LWR)	1week	SSEs/P.Way
16866	22-08-16	26-08-16	Points, Xings & curves (PXC)	1 weeks	SSEs/P.Way
16867	29-08-16	02-09-16	Concrete Technology (CNCT)	1 week	SSE/Works of Const. Organization
16868	29-08-16	02-09-16	Building Construction (BC)	1 week	SSEs/Works
16869	06-09-16	16-09-16	USFD,Welding & Rail Grinding (USFD)	2 weeks	SSEs/P.Way
16870	06-09-16	09-09-16	TMS	1 week	SSEs
16871	06-09-16	16-09-16	Mech.Track Maintenance & Renewals (TM)	2 weeks	SSEs/P.Way
16872	13-09-16	16-09-16	Long Welded Rail (LWR)	1 week	SSEs/P.Way
16873	19-09-16	23-09-16	Survey (SRVY)	1 week	SSE/Works of Const. Organization
16874	19-09-16	27-09-16	PSC Construction (PSCC)	9 Days	SSEs/Bridges
16875	19-09-16	23-09-16	Formation (FMN)	1 week	SSE/Works of Const. Organization
16876	26-09-16	30-09-16	Points, Xings & curves (PXC)	1 week	SSEs/P.Way
16877	26-09-16	07-10-16	Rail Wheel Interaction & derailments (RWI)	2 weeks	SSEs & Instructor of ZRTI/ DTC/P.Way
16878	26-09-16	30-09-16	Management of Store & Land (MLS)	1 week	SSEs/P.Way
16879	03-10-16	07-10-16	Track Monitoring	1 week	SSEs/P.Way
16880	03-10-16	07-10-16	Land Management	1 week	SSEs/Work
16901	23-05-16	27-05-16	Water Supply and Sewerage including Water Audit	1Week	SSE's /Work

Table Contd...

IRICEN CALENDAR OF COURSES 2016 (Rev. 06)					
Course No.	**From**	**To**	**Name of the course**	**Duration**	**Eligible Group**
PROBATIONARY COURSES					
16003	28-03-16	13-05-16	IRSE Ph.I (Gr.Q)	7 weeks	IRSE (Q) 2014 Exam.
16004	25-04-16	29-04-16	IRSE Posting Exam	1 week	IRSE (P) 2013 Exam.
16005	13-06-16	14-06-16	IRSE M.Tech, Sem-I	2 weeks	IRSE 2014 Exam.
16006	30-05-16	03-06-16	Orientation	1 week	IRSE (P) 2013 Exam.
16007	22-08-16	21-10-16	IRSE Ph.II (Gr.P)	9 weeks	IRSE (P) 2014 Exam.
16008	17-10-16	21-10-16	IRSE Posting Exam	1 week	IRSE (P) 2013 Exam.
16009	07-11-16	06-01-17	IRSE Ph.II (Gr.Q)	9 weeks	IRSE (P) 2014 Exam.
16010	12-12-16	16-12-16	IRSE Joining	1 week	IRSE (P) 2015 Exam
17001	09-01-17	20-01-17	IRSE M.Tech, Sem-II	2 weeks	IRSE 2014 Exam.
INTEGRATED COURSES					
16101	21-03-16	9-06-16	Integrated	12 weeks	Gr.B officers
16102	13-06-16	01-09-16	Integrated	12 weeks	Gr.B officers
16103	06-09-16	01-12-16	Integrated	12 weeks	Gr.B officers
SR. PROFESSIONAL COURSES					
16202	02-05-16	03-06-16	Sr.Prof(Br &General)	5 weeks	JAG/SS officers with minimum 6 years of Service in Gr.'A'
16203	18-07-16	19-08-16	Sr.Prof(P.Way)	5 weeks	JAG/SS officers with minimum 6 years of Service in Gr.'A'
PCE/HAG/SAG/SEMINARS/WORKSHOPS/MEETINGS					
16301	31-03-16	01-04-16	Seminar for CE/TP	2 days	CETPs
16302	21-04-16	22-04-16	CE/TMs' Seminar	2 days	CE/TMs
16303	09-06-16	10-06-16	CTEs' Seminar	2 days	CTEs
16304	21-07-16	22-07-16	CE(W)/CPDEs' Seminar	2 days	CE(Works)/CPDEs
16305	18-08-16	19-08-16	CAOs' Seminar	2 days	CAOs
16306	22-09-16	23-09-16	Trg Mgr/CGE Seminar	2 days	CGEs/Pr.CETCs
16307	06-10-16	07-10-16	CBEs' Seminar	2 days	CBEs
SPECIAL COURSES (TRACK/BRIDGES/WORKS)					
16407	04-04-16	09-04-16	Rail Wheel Interaction & derailments (T-2)	6 Days	JS/SS/JAG of Open Line
16408	04-04-16	15-04-16	Contract, Arbitration and Project Management (W-2)	2 weeks	SS/JAG
16409	11-04-16	15-04-16	Points & Crossings and Yards (T-3)	1 week	JS/SS/JAG
16410	02-05-16	10-05-16	PSC (B-2)	9 Days	JS/SS/JAG
16411	02-05-16	06-05-16	TMS (T-5)	1 week	JS/SS/JAG

Table Contd...

IRICEN CALENDAR OF COURSES 2016 (Rev. 06)					
Course No.	**From**	**To**	**Name of the course**	**Duration**	**Eligible Group**
SPECIAL COURSES (TRACK/BRIDGES/WORKS)					
16412	06-06-16	14-06-16	Steel Structure (B-3)	9 Days	JS/SS/JAG
16413	11-07-16	22-07-16	Contract, Arbitration and Project Management (W-2)	2 weeks	SS/JAG
16414	27-06-16	01-07-16	Special course for NTPC Engineers (NTPC)	1 week	NTPC Engineers
16415	27-06-16	02-07-16	Rail Wheel Interaction & derailments (T-2)	6 Days	JS/SS/JAG of Open Line
16416	04-07-16	08-07-16	Land Management (W-1)	1 week	SS/JAG
16417	04-07-16	15-07-16	Construction Engineers (C-2)	2 weeks	JS/SS/JAG of Construction Organization
16418	16-05-16	27-05-16	Mechanized Track Maint-, Renewal,Rail Grinding, USFD & Track Monitoring, (T-1)	2 weeks	JS/SS/JAG
16419	25-07-16	29-07-16	Arbitration for Arbitator (W-3)	1week	JAG/SAG
16420	25-07-16	02-08-16	PSC (B-2)	9 Days	JS/SS/JAG
16421	01-08-16	05-08-16	Modern Surveying (C-1)	1week	JS/SS/JAG of Construction Organization
16422	01-08-16	05-08-16	Points & Crossings and Yards (T-3)	1 week	JS/SS/JAG
16423	08-08-16	13-08-16	Rail Wheel Interaction & derailments (T-2)	6 Days	JS/SS/JAG of Open Line
16424	08-08-16	12-08-16	TMS (T-5)	1 week	JS/SS/JAG
16425	22-08-16	09-09-16	Bridge Design Asstt (B-1)	3 Weeks	ABEs/DESIGN ASST
16426	06-09-16	16-09-16	Construction Engineers (C-2)	2 weeks	SS/JAG
16427	26-09-16	30-09-16	Modern Surveying (C-1)	1 week	JS/SS/JAG of Construction Organization
16428	03-10-16	07-10-16	Arbitration for Arbitator (W-3)	1 week	JAG/SAG
AWARENESS COURSES					
16701	11-07-16	15-07-16	Awareness course	1 week	IRSEE Prob. 2014
16702	16-08-16	19-08-16	Awareness course	1 week	IRPS Prob. 2014
16703	18-04-16	22-04-16	Awareness course	1 week	
16704	09-05-16	13-05-16	Awareness course	1 week	
16705	23-05-16	27-05-16	Awareness course	1 week	
16706	13-06-16	17-06-16	Awareness course	1 week	IRTS Prob. 2014
16707	20-06-16	24-06-16	Awareness course	1 week	IRTS Prob. 2014
16708	18-07-16	22-07-16	Awareness course	1 week	IRSSE Prob. 2014
16709	19-09-16	23-09-16	Awareness course	1 week	IRSME Prob. 2014
16429	10-10-16	21-10-16	Mechanized Track Maint., Renewal,Rail Grinding, USFD & Track Monitoring, (T-1)	2 weeks	JS/SS/JAG
16430	17-10-16	25-10-16	Steel Structure (B-3)	9 Days	JS/SS/JAG
16431	15-11-16	18-11-16	Points & Crossings and Yards (T-3)	1 week	JS/SS/JAG

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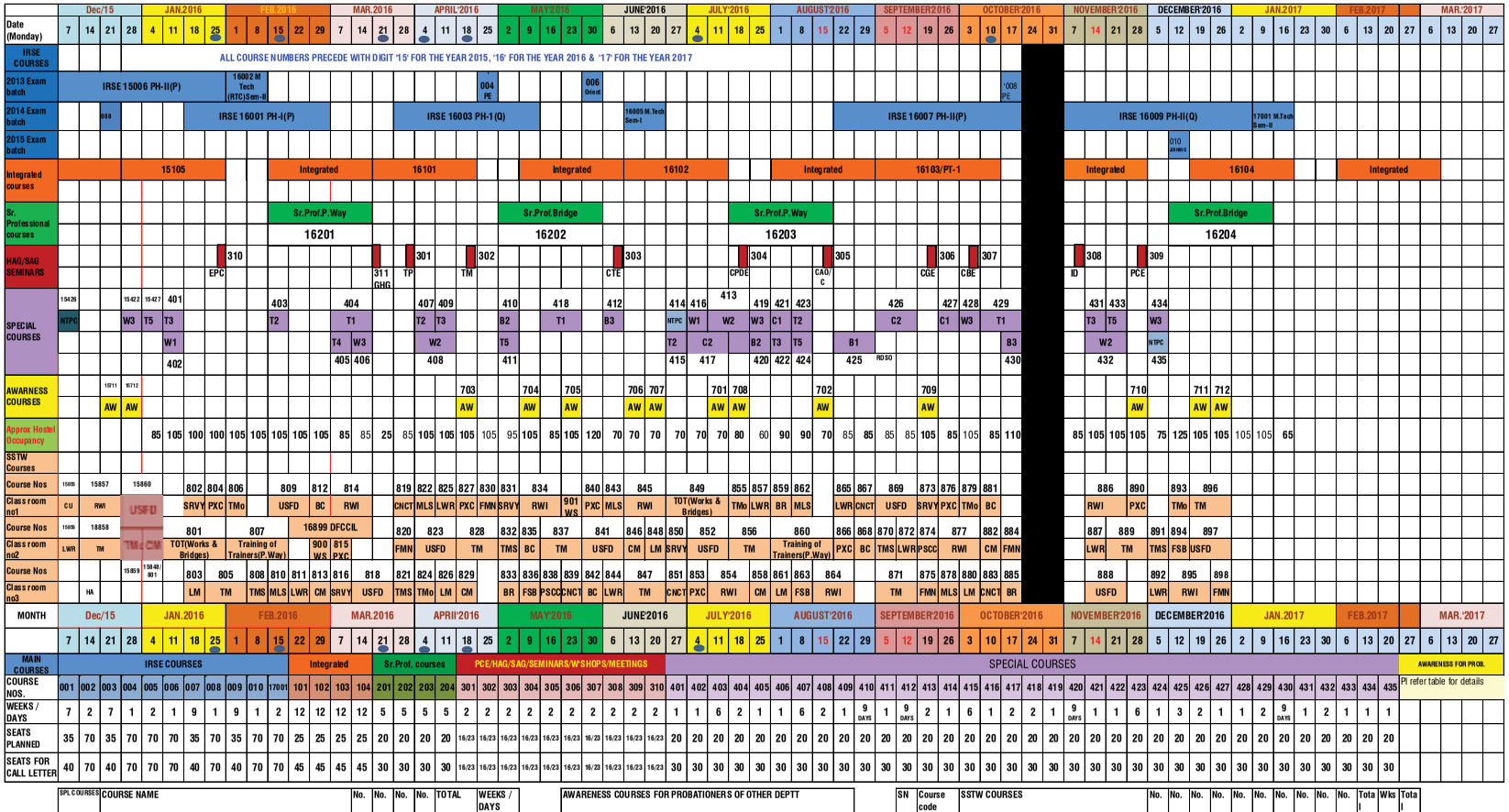
CALENDER OF COURSES 2016 CHART (Rev. 06)



SPL COURSES	COURSE NAME	No.	No.	No.	No.	TOTAL	WEEKS / DAYS
T-1	MECHANIZED TRACK MAINT. & RENEWAL,RAIL GRINDING, USFD & TRACK MONITORING,	404	418	429		3	2
T-2	RAIL WHEEL INTERACTION & DERAILMENT INVESTIGATION	403	407	415	423	4	6 DAYS
T-3	POINTS & CROSSINGS AND YARDS	401	409	422	431	4	1
T-4	RAILWAY FORMATION & GEO TECH INV	405				1	1
T-5	TMS	411	424	433		3	1
B-1	BRIDGE DESIGN ASSISTANT	425				1	3
B-2	PSC	410	420			2	9 DAYS
B-3	STEEL STRUCTURE	412	430			2	9 DAYS
W-1	LAND MANAGEMENT	402	416			2	1
W-2	CONTRACT & ARBITRATION AND PROJECT MGMT	408	413	432		3	2
W-3	ARBITRATION FOR ARBITRATOR	406	419	428	434	4	1
C-1	MODERN SURVEYING	421	427			2	1
C-2	CONSTRUCTION ENGINEERS	417	426			2	2
NTPC	SPECIAL COURSE FOR NTPC ENGINEERS	414	435			2	1
						35	

AWARENESS COURSES FOR PROBATIONERS OF OTHER DEPTT					
AWARENESS COURSES	Course No	SEATS PLANNED	Course No	SEATS PLANNED	WEEK
ACCOUNTS					1 WEEK
ELECTRICAL ENGG					1 WEEK
MECHANICAL ENGG					1 WEEK
SIGNAL ENGG	16701				1 WEEK
STORES					1 WEEK
PERSONEL					1 WEEK
TRAFFIC	16706	32	16707	31	1 WEEK

SN	Course code	SSTW COURSES	No.	No.	No.	No.	No.	No.	No.	No.	No.	Total	Wks	Total wks
1	TOT(P.WAY)	Training of Trainers (P.Way)	807	860								2	3	6
2	TOT(B&W)	Training of Trainers (Works & Bridges)	801	849								2	3	6
3	RW	Rail Wheel Interaction & derailments	814	834	845	854	864	877	886	895		8	2	16
4	TMS	TMS	808	821	832	870	891					5	1	5
5	PXC	Points, Xings & Curves	804	815	827	840	853	866	876	890		8	1	8
6	USFD	USFD, Welding & Rail Grinding	809	818	823	841	852	869	888	897		8	2	16
7	LM	Land Management	803	826	848	861	880					5	1	5
8	MLS	Mangement of Store & Land	810	822	843	862	878					5	1	5
9	TMo	Track Monitoring	806	824	855	879	893					5	1	5
10	BR	Inspection & Maintenance of Bridge	833	859	885							3	1	3
11	LWR	Long Welded Rails	811	825	844	857	865	872	887	892		8	1	8
12	TM	Mechanized Track Maint. & Renewals	805	828	837	847	856	871	889	896		8	2	16
13	CM	Contract Management	813	829	846	858	882					5	1	5
14	FSB	Fabrication of Steel Bridges	836	863	894							3	9 Days	3
15	PSCC	PSC Construction	817	838	874							3	9 Days	3
16	CNCT	Concrete Tech	819	839	851	867	883					5	1	5
17	FMN	Formation	820	830	875	884	898					5	1	5
18	BC	Building Construction	812	835	842	868	881					5	1	5
19	SRVY	Survey	802	816	831	850	873					5	1	5
20	WS	Water Supply and Sewerage including Water	900	901								2	1	2
21	DFCCIL		899									1	1	4
												101		136

Indicates Holiday in that week

Indicates Monday being holiday

1 Week at RDSO for BDA course

To IRTMTC / RDSO

BREAK FOR PROJECT