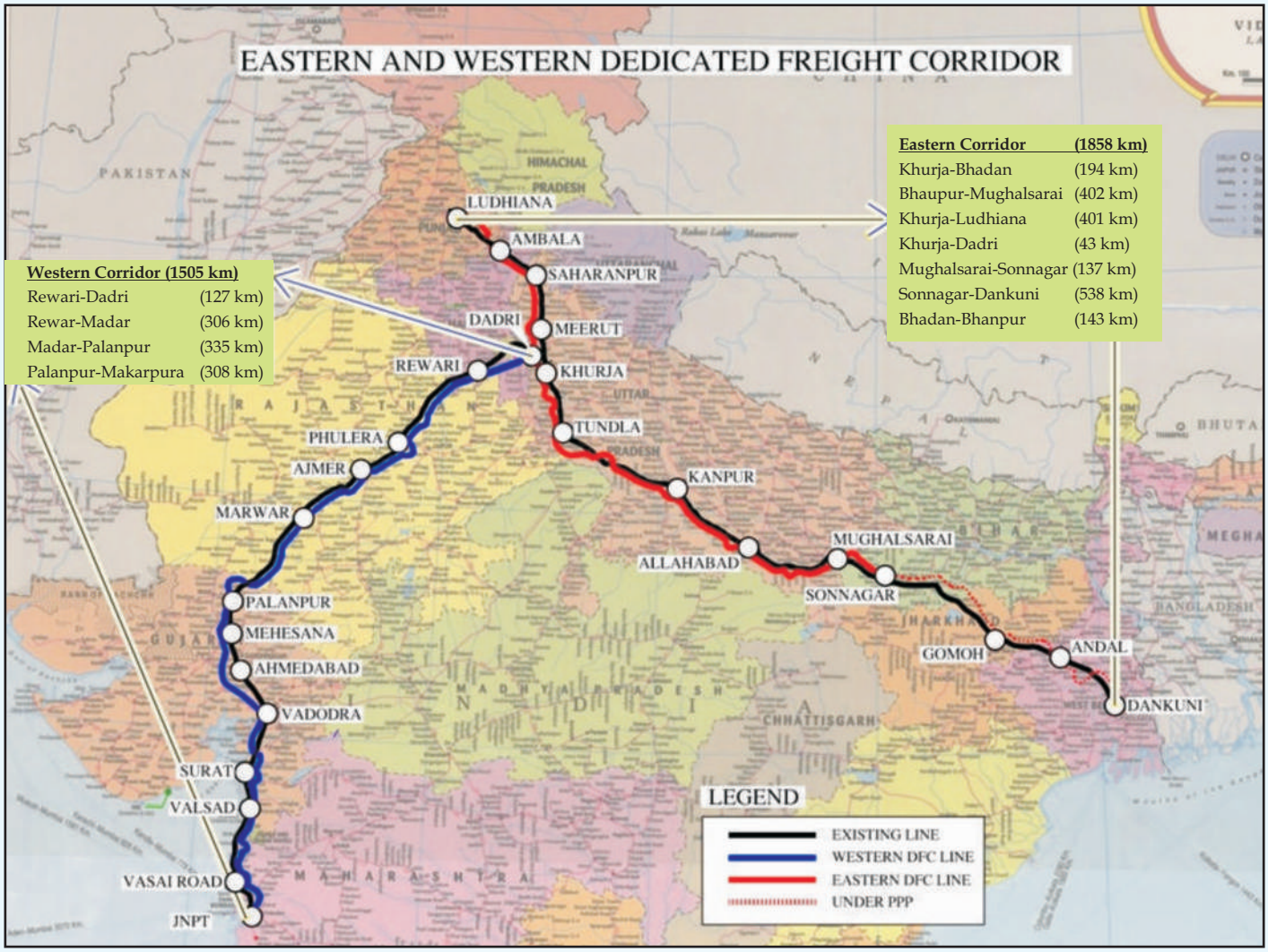
The DFCCIL JOURNAL

ISSUE VII, JUNE 2020

डेडीकेटेड फ्रेट कोरीडोर

TRANSFORMING TRANSPORTATION



Targets

Western Corridor

SN	Sections	Targets
1	Dadri - Rewari (127 Km)	March 2022
2	Rewari - Madar (306 Km)	Completed in December 2019
3	Madar - Palanpur (335 Km)	March 2021
4	Palanpur – Makarpura (308 Km)	March 2022
5	Makarpura – JNPT (430 Km)	June 2022

Eastern Corridor

SN	Sections	Targets
1	Ludhiana – Khurja (401 Km)	June 2022
2	Khurja – Bhadan (194 Km)	Completed in October 2019
3	Khurja – Dadri (46 Km)	June 2021
4	Bhadan – Bhaupur (157 Km)	October 2020
5	Bhaupur – Pt. Deen Dayal Upadhyaya Nagar (402 km)	June 2022
6	Pt. Deen Dayal Upadhyaya Nagar – Sonnagar (137 Km)	December 2021
7	Sonnagar – Dankuni (538 Km)	Proposed to be done through PPP

FROM THE *Editor's Desk*

Anurag Kumar Sachan
Managing Director, DFCCIL

Dear Readers,

As I pen down the introductory piece for this Journal, entire world is in the midst of the COVID 19 pandemic. It is a very difficult time for everyone and we all have a responsibility to follow the Government of India guidelines and do our best in stopping the spread of this deadly virus.

Someone has rightly said that **"Attention Energises and Intention Transforms"**. With this mantra DFCCIL is moving towards its envisioned goal of dedicating freight corridors to the Nation. Even during the difficult period when due to COVID-19 pandemic, our country was in lockdown since March 25, 2020, DFCCIL was able to complete certain construction activities. It could have been possible due to sincere co-operation rendered by various State Authorities and also by following the strict protocol of working during the pandemic which enabled various construction site CORONA free.

In this direction, some of the remarkable achievements such as Erection of 40 nos. of PSC Girders of 18.3 m span at Bridge no.154 over River Sahibi , 100m Tunnel excavation (heading) across Arawali Range of Mountains in Rewari – Dadri section, Erection of 06 nos. steel girders of size 48.5m at Bridge no.180 over River Yamuna, Successful Launch of Girders of Rail Flyover having spans of 76.2+45.7 m by cantilever launching method at Sonnagar in Bihar, Launching of First steel Girder of span 48.15 m on river Narmada near Bharuch etc. have been made by DFFCIL during the last Quarter i.e. (April'2020 to June'2020).

Apart from above, DFCCIL is committed to run trains 24 X7 to ensure supply chains of essential commodities. First long and Heavy Haul train run carrying a load of 9000 tonnes on EDFC Bhadan – Khurja section (194 km) was done successfully on 14.09.2019 and thereafter:

(i) Till date, more than 1200 trains trial run has been done in the sections

(ii) Record 20 train interchange between IR & DFC facilitated normal traffic movement on Kolkata – Delhi route.

(iii) Opening of this section by DFCCIL, has eased the Congestion of Allahabad - Delhi Section of IR. This helped in improving punctuality of Mail/Express Trains in NCR Zone. The performance of Allahabad Division has improved on both the counts - throughput and punctuality.

In this current **DFCCIL Journal-Issue-VII (June-2020)**, we bring to our readers well researched & suitably illustrated (with quality Pictures & Diagrams) articles from a wide ranging subjects of Faster Construction Methods in Launching of Open Web Girders , Technical Paper on Ground improvement by Dynamic compaction method, Technical Paper on use of Geo Composite Drain behind the Bridge, risk assessment and safe working protocols while working near the IR live operations, interactive case studies for enhancement of safety performance in construction of railway projects etc. I sincerely hope that you would find this issue of DFCCIL Journal informative

World Environment Day (WED) is a UN Environment Programme-led global event, celebrated widely across the globe on June 5 each year, since 1972. World Environment Day is a powerful platform to accelerate, amplify and engage people, communities and governments around the world to take action on critical environmental challenges being faced by the planet. This year WED theme is "Biodiversity".

Dedicated Freight Corridor Corporation (DFCC)'s mission is "to support the government's initiatives toward ecological sustainability and as such DFC alignment has been designed for conforming environment protection solution like minimum land acquisition, least forest land diversion and designing under passes of protection of wildlife wherever necessary.

I take this opportunity to thank all the Authors for their scholarly contribution for the knowledgeable and well researched articles. Your valuable suggestions would help us in making DFCCIL Journal a more informative publication.

Enjoy reading.

Anurag Kumar Sachan
Managing Director, DFCCIL

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GALLERY

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CTP-14: Dadri Station Building Roof slab completed

P2 well cap reinforcement work in progress (Tapi 240)

Technical Paper on Ground improvement by Dynamic compaction method

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ABSTRACT

For the construction of the double rail line of DFCCIL from Dadri to Rewari, the dynamic compaction method was adopted for ground improvement to mitigate the potential risk of liquefication.

Dynamic compaction (or dynamic consolidation) is a ground improvement technique which involves the use of freefalling weights (or tamper) to improve the density, bearing capacity, stiffness and liquefaction resistance of the granular soils. The choice of tamper and drop height depends on site conditions, compaction depths and materials to be compacted.

This technical paper explains the detailed process of dynamic compaction method which includes various arrangements required, type of machineries & equipment used, depth of ground improvement, calculation for height of fall, soil parameters before and after treatment by using standard penetration test i.e. N Value from SPT test.

Background of the Project:

The Ministry of Railways (MOR), Government of India, has planned to construct a High Axle Load Dedicated Freight Corridor (DFC) covering about 3325 km on two corridors, the Eastern and Western Corridors. The Western Corridor has been planned from Jawaharlal Nehru Port, Mumbai to Tughlakabad/ Dadri near Delhi, covering a length of 1,483 km (JNPT – Ahmadabad – Palanpur – Rewari – Asaoti - Dadri) and planned to be implemented in two phases. The first phase involves the construction of 935 km between Vadodara and Rewari, construction of double-track electrified railway lines capable of handling 32.5-ton axle load, longer trains and double stack containers. The bridges and other structures will be designed to allow movement of 32.5-ton axle load while the track structure will be designed for 25-ton axle load operating at maximum train speed of up to 100 Km/hr.

The Second Phase will cover a distance of 550 km of double line electrified track from JNPT to Vadodara (422 Km) and Rewari to Dadri (128 Km) and has been planned through nine (09) Contract Packages one of them being the CTP-14 Integrated Package of Civil, Building and Track Works, Electrical & Mechanical (E&M) Works & Signal and Telecommunication (S&T) Works (Rewari Dadri). The Dedicated Freight Corridor Corporation of India Ltd. ("DFCCIL" or "Employer"), has awarded the work of Design and Construction (Civil and Structures) of CTP14 Package of Western Dedicated freight Corridor project from Rewari to Dadri to L&TS ("Contractor") (approximately 128 km).

The Western DFC is proposed to join the Eastern Corridor at Dadri. The entire CTP 14 section of 128 Km is in a detour with junction stations between the existing railway systems passing through the states of Haryana, Uttar Pradesh, and Rajasthan.

Need of Ground Improvement:

The existing soils in this stretch are mostly sandy silt or silty sand deposits and the ground water table varies from 0.9m to more than 20m. Based on the available SPT 'N' values at these locations, it was concluded that the top soil up to around 2.0m depth from GL was loose ($N < 10$), thereafter it is of medium density ($11 < N < 30$) up to around 7m to 8m depth, followed by dense ($N > 30$) silty sand or sandy silt of low plasticity type of soil. As per proposed plan and profile, railway embankment of up to 14.94m (maximum) height needed to be constructed above ground level.

Based on the geotechnical investigation report of these stretches, the soils at few locations near the bank of the Yamuna river and low laying areas between the 'Nuh Canal' and 'Gurgaon Canal' were found to be susceptible to liquefaction up to a depth of 8m to 11 m from ground surface and these stretches, having the liquefaction potential more than 5m depth, had to be treated by dynamic compaction.

History of Dynamic Compaction Technique:

Dynamic compaction was invented and promoted as early as 1969 by the late French engineer Louis Menard, but it was not until May 29, 1970 that he officially patented his invention.

The concept of this technique is to improve the mechanical properties of the soil by transmitting high-energy impacts to loose granular soils. The impact creates body and surface waves that propagate in the soil medium. In non-saturated soils, the waves displace the soil grains and rearrange them in a denser configuration. In saturated ground the soil is liquefied, and the grains are rearranged in a more compact state. In both cases the decrease of voids and increase in inner granular contact results in improved soil properties

As shown in Fig. 1, the impact energy is delivered by dropping a heavy weight or pounder from a significant height, most often in the range of 8–30 t, although lighter or heavier weights are occasionally used. The heaviest pounder that has ever been used for dynamic compaction weighed 170 t and was used in 1978 for dynamic compaction works at Nice Airport in France (Gambin, 1983). Drop heights are usually in the range of 10–20 m, although 40-t pounders have been dropped from 40 m (Mayne et al., 1984).

Introduction of the Dynamic Compaction technique:

As per IRC 75:2015, clause no. 5.2.8.1, the Dynamic Compaction method can be used for the densification process for non-cohesive soil to reduce the potential risk of liquefication.

In this technique, soils are densified by using a drop weight. The drop weight with a mass ranging from 15 MT to 30 MT is lifted by a crane and repeatedly dropped onto the ground surface from heights ranging from 9 m to 30 m. Vibrations transmitted below the surface results in densification of the deposit to depths that are proportional to the energy applied. The depth of improvement generally range from 10 m to 15 m for light to heavy energy applications. The drop locations are typically plotted on a grid pattern, the spacing between which determined by the subsurface conditions and foundation loading and geometry.

Dynamic Compaction is applicable to all types of granular soils, particularly well adapted to non-organic, non- homogeneous fill, made ground, and reclamation areas with variable characteristics, even where underground obstructions are present. Dynamic Compaction is effective in both saturated and un-saturated soils. It densifies the soil mass which in turn, improves its shear strength and reduces compressibility. Treated granular soils have increased density, friction angle, and stiffness.

Dynamic compaction has been used to compact construction debris, urban fill, and sanitary landfills prior to construction of parking lots, roadways, and embankments. The removal of compressible, contaminated fills can be avoided by adopting this technique. The basic principle behind the technique consists in the transmission of high energy waves through a compressible soil layer to improve its geotechnical properties at depth. Dynamic Compaction is normally associated with a programme of in-situ testing to verify that the specified improvement has been achieved.

The spacing of the impact points and the unit energy, phasing and rest periods, depend on the soil types and level of improvement required. Designs are usually confirmed by on-site pilot test areas or calibration zones.

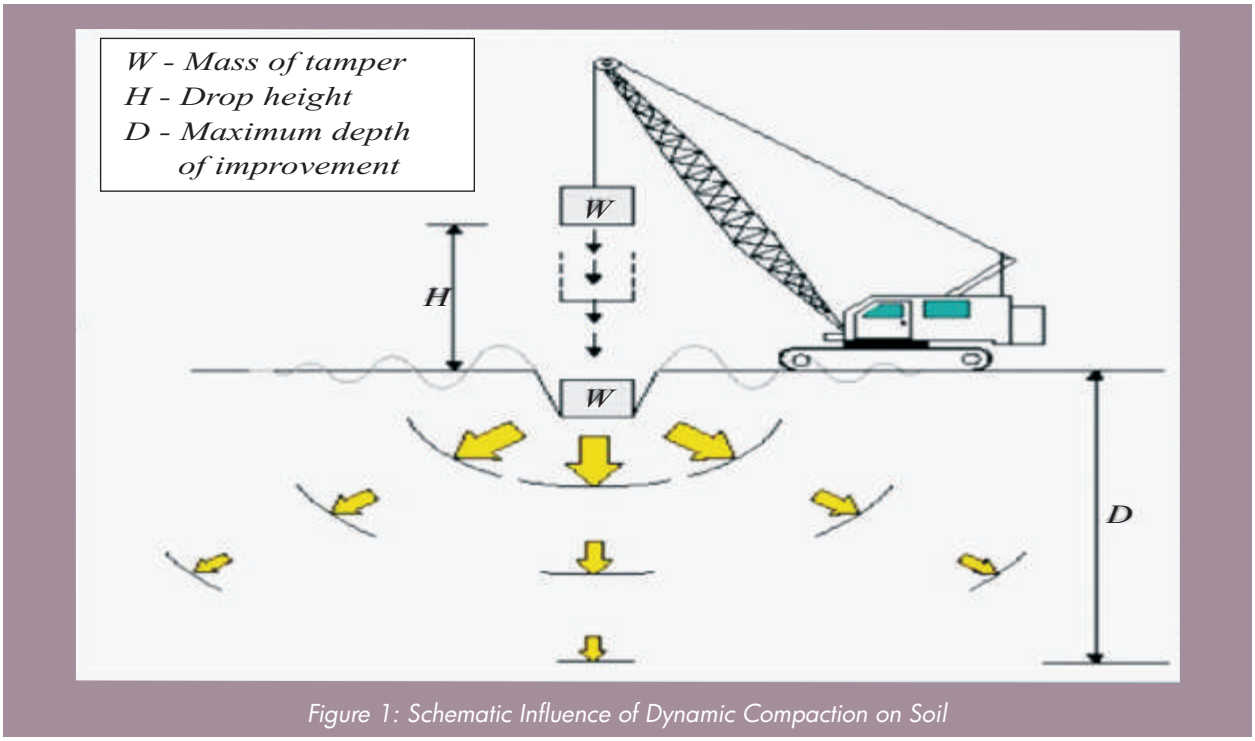


Figure 1: Schematic Influence of Dynamic Compaction on Soil

Detailed arrangement of Dynamic Compaction in CTP 14 Project:

The proposed arrangement and spacing of dynamic compaction points is given in Figure 2. Five to seven number of drops of tamper conducted at each compaction points. The compaction of the ground will be verified by in-situ test (N- Value). The compaction process can be repeated if the desired compaction is not achieved.

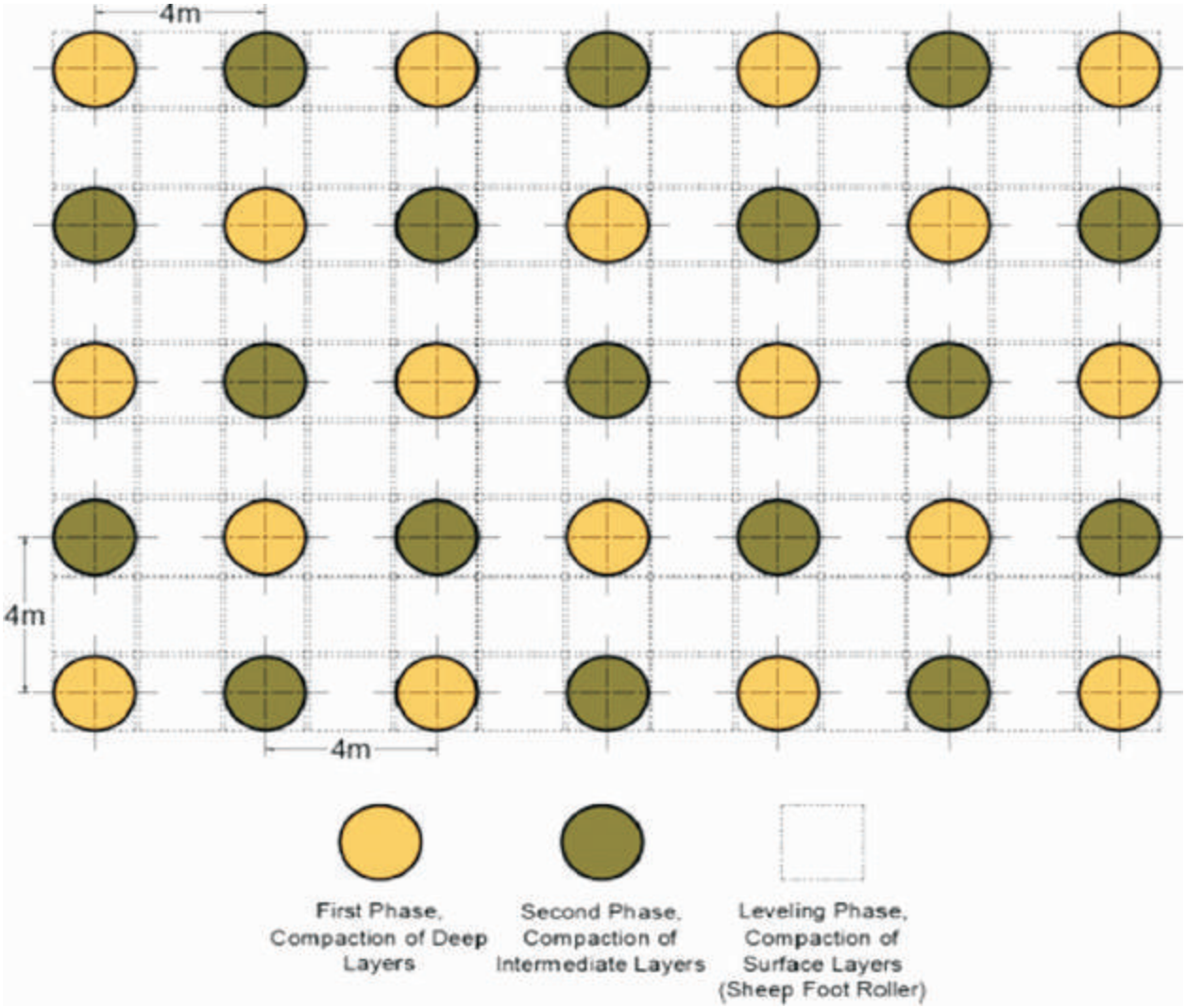


Figure 2 – Arrangement of Dynamic Compaction Test Table No 1 – Required parameters of Dynamic compaction

Table No 1 – Required parameters of Dynamic compaction

Required Improvement Depth (m)	Mass of Tamper (MT)	Height of fall (m)	No of Drops
8.0	30	9.0	5
11.0	30	16.5	5

Detailed calculation for the calling height of tamper:

As per Mitchell and Katti (1981), the depth of influence (D) up to which the ground is improved by using the tamper of mass (W) falling from the height (H) is given by: n√WH

Where D and H are in meters and W is in tones. n = modification factor (taken as 0.5)

For Depth of improvement required D: 11.0 m Mass of tamper: 30 MT

Height of fall (H) , m=(D/n)2 W =16.12 m say 16.5 m

Resources Used for the Dynamic compaction method:

a) Friction Crane – 200 MT Capacity

b) Concrete Block – 30 MT weight

c) Sling and d shackle D-cycle

d) Low back trailer of 35 MT capacity to shift the concrete block

e) 2 cranes for assemble & dismantle of the 200 MT friction crane: 1 crane of 70 MT and one of 50 MT

f) 7 different size of trailer for shifting of crane form one location other

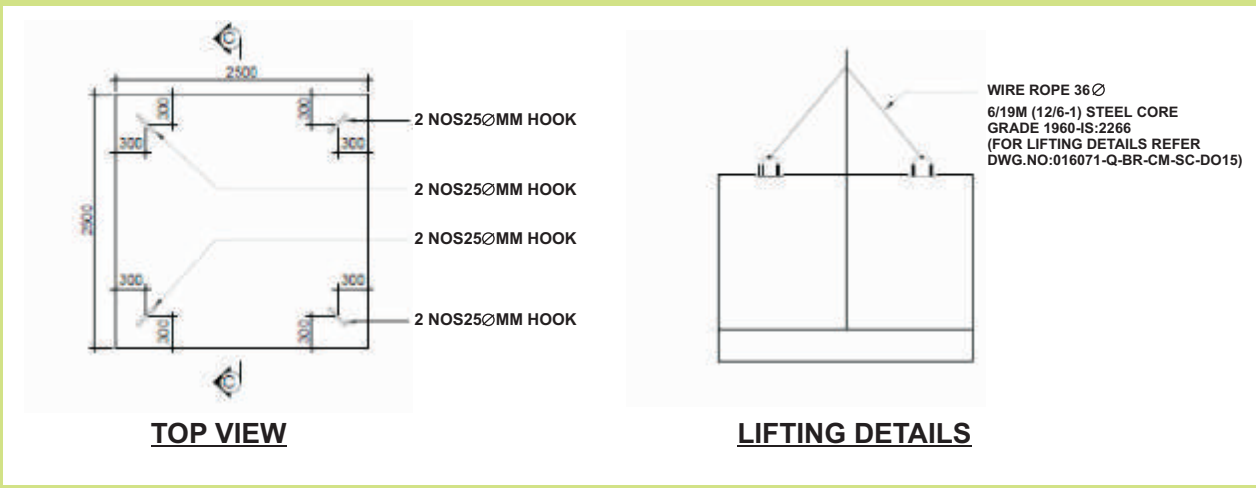
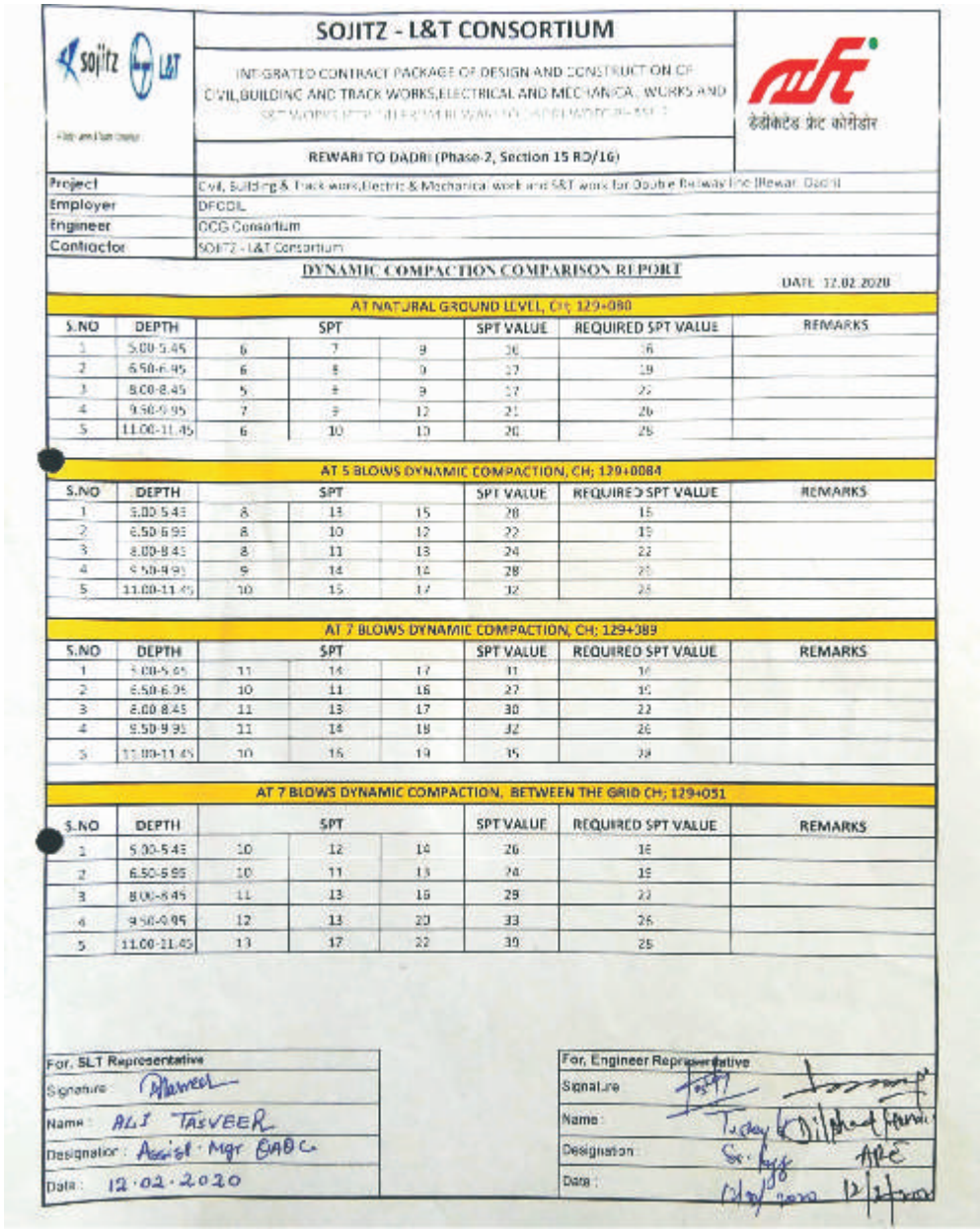


Figure 3 : Details of 30 MT Concrete Block

The Dynamic Compaction process was started as per proposed arrangement and spacing of dynamic compaction points is given in Figure 2. The compaction of the ground will be verified by in-situ tests (N- Value) at the various depth as per design and it was concluded that five to seven number of drops of tamper was enough to achieve the required N-Value at each compaction points. Results of the SPT test is as below.

Figure 4 : Photographs of Dynamic compaction at CTP 14 Project near area of Yamuna Bank



SOJITZ - L&T CONSORTIUM

INTEGRATED CONTRACT PACKAGE OF DESIGN AND CONSTRUCTION OF CIVIL,BUILDING AND TRACK WORKS,ELECTRICAL AND MECHANICAL WORKS AND [illegible]

REWARI TO DADRI (Phase-2, Section 15 RD/16)

डेडीकेटेड फ्रेट कोरीडोर

Project	Civil, Building & Track work,Electric & Mechanical work and S&T work for Double Railway line [Rewari- Dadri]
Employer	DFCCIL
Engineer	CCG Consortium
Contractor	SOJITZ - L&T Consortium

DYNAMIC COMPACTION COMPARISON REPORT

DATE: 12.02.2020

AT NATURAL GROUND LEVEL, CH: 129+080

S.NO	DEPTH	SPT			SPT VALUE	REQUIRED SPT VALUE	REMARKS
1	5.00-5.45	6	7	9	30	16	
2	6.50-6.95	6	8	9	27	19	
3	8.00-8.45	5	8	9	27	22	
4	9.50-9.95	7	9	12	21	26	
5	11.00-11.45	6	10	10	20	26	

AT 5 BLOWS DYNAMIC COMPACTION, CH: 129+084

S.NO	DEPTH	SPT			SPT VALUE	REQUIRED SPT VALUE	REMARKS
1	5.00-5.45	8	13	15	28	16	
2	6.50-6.95	8	10	12	22	19	
3	8.00-8.45	8	11	13	24	22	
4	9.50-9.95	9	14	14	28	26	
5	11.00-11.45	10	15	17	32	26	

AT 7 BLOWS DYNAMIC COMPACTION, CH: 129+089

S.NO	DEPTH	SPT			SPT VALUE	REQUIRED SPT VALUE	REMARKS
1	5.00-5.45	11	14	17	31	16	
2	6.50-6.95	10	11	16	27	19	
3	8.00-8.45	11	13	17	30	22	
4	9.50-9.95	11	14	18	32	26	
5	11.00-11.45	10	16	19	35	28	

AT 7 BLOWS DYNAMIC COMPACTION, BETWEEN THE GRID CH: 129+051

S.NO	DEPTH	SPT			SPT VALUE	REQUIRED SPT VALUE	REMARKS
1	5.00-5.45	10	12	14	26	16	
2	6.50-6.95	10	11	13	24	19	
3	8.00-8.45	11	13	16	29	22	
4	9.50-9.95	12	13	20	33	26	
5	11.00-11.45	13	17	22	39	28	

For. SLT Representative	
Signature	[signature]
Name	ALI TASVEER
Designation	Assist. Mgr (QA&C)
Date	12.02.2020

For, Engineer Representative	
Signature	[signature]
Name	[illegible]
Designation	Sr. Engg. / AM
Date	[illegible]

Figure 5 : soil parameters before and after treatment by using standard penetration test

Conclusion:

Initially it was presumed that the executing dynamic compaction would be tough but the successful outcome in this project was possible with correct design, selection of right resources, appropriate planning of activities, safety arrangement and careful execution.

It has therefore been concluded that ground improvement by the Dynamic Compaction method was suitable to nullify the potential liquefication with five blows, enough to achieve the required compaction as revealed from test reports. However, to be on the safe side, it is possible to go up to seven blows.

REMOVAL OF ENCROACHMENTS on Bhusawal Division DURING 2017-19 - A Case Study

Shri R. K. Yadav
Chief Administrative Officer (Construction)
NE Railway, (the then DRM-Bhusawal)

ABSTRACT

Bhusawal Station building with a single platform was constructed in 1860. Within next one year, Igatpuri-Bhusawal section was opened. By 1866, Bhusawal-Khandwa and in 1867, Bhusawal-Badnera sections were opened with single line working. In 1920, the Bhusawal Division was formed under the Great India Peninsula Railway (GIPR). Due to its strategic location, once Bhusawal was a major Steam Loco Shed. Over the years, due to expansion of towns around the Railway stations, encroachments had come up at various stations in and around Railway Colonies as well as in station premises. Situation had become alarming at Bhusawal, Manmad and Burhanpur stations.

In one of the biggest drive of removal of encroachments on Indian Railways carried out from 15th to 17th Nov.2018, after facing large number of Dharnas, Rail Rokos and 13 months long legal battle, more than 3000 houses (hutment/Pucca houses) and approximately 350 shops have been removed from Railway's land at Bhusawal and more than 120 acres of precious land have been reclaimed.

Process for removal of encroachments from Rlys' land was started in June-2017 in a mission mode and a large number of encroachments from Rlys land at various stations have been removed, as detailed below–

1) BHUSAWAL –

Sanctioned staff strength of Bhusawal division is 18,000. Out of which, approximately 8,000 employees are headquartered at Bhusawal. There are more than 4,000 staff-quarters available at Bhusawal, which are spread over approximately in 5 square kms. Many of the quarters are single-storied. At Bhusawal, apart from officer's colony, staff colonies were named after number of Bungalows (D-type quarter) e.g. Eight Bungalow colony (having Eight D-type quarters), Fifteen Bungalow colony (having 15 D-type quarters) and Forty Bungalow colony (having 40 D-type quarters). Forty Bungalow colony is the largest one and spread over a large area. There were large

number of K-type quarters for Group"D" staff adjacent to Steam Loco Shed and near Forty Block Colony, mostly divided in **three major parts:**-

i) Aagwali Chawl - Colony for Firemen (Steam Engine).

ii) Haddiwali Chawl - near boundary of Steam Loco Shed.

iii) Chandmari Chawl - near Fire range of Army and trenching ground.

Encroachments in Railway Colonies started since very long time. Railway staff, after retirement had made hutments adjacent to their quarters.

There were approximately 415 'K' type and 246 Mitra type quarters which were non-standard. All these quarters were unauthorizedly occupied by the retired railway staff and outsiders. Later-on some anti-social elements had started capturing the land and making hutments in these areas. They had made a large number of hutments and provided them on rent. They were using free electricity and water of the Railways. These anti-social elements due to their muscle-power started selling of railway land and hutments. These areas had become safe zone for criminals. After committing crime in train and outside, they use to take shelter in these areas. Slowly - slowly it became unsafe for railway staff. Several cases of thefts and manhandling have taken place. Railway staff were not feeling safe to traverse through these areas while going for duty and coming back home after carrying out duties in night time.

Few of the encroachments were existing since last 60 – 70 years. The situation had deteriorated to such a level that encroachers were ruling the area and railway staff in colonies had become second-grade citizens.

There are Depots of Electrical, S&T, Engg & Stores department near Haddiwali Chawl. Terror of anti-social elements was such that no materials could be loaded or unloaded by Contractors Labour, without paying levy to the Goons. Railway Supervisors were working in an atmosphere of terror.

These hutments were constructed mainly in the area of 'K' type quarters. Even some internal roads, toilets and drains were constructed through the fund of Municipality by the Corporators in these areas.

Besides, there are 'D' & 'B' type Bungalows at Bhusawal and each of them is having 5 to 6 Outhouses. The persons staying in the Outhouses were not doing any work for occupants of the quarters. However, over the years, they had made hutments around the Outhouses and thus the encroachments had become more than double the number of outhouses. They were using railway electricity and water and involved in all types of illegal activities.

Taking into consideration of the above facts, at Bhusawal, encroachments were removed in different phases as detailed below:-

1.1 South side of Bhusawal Railway station premises: In the circulating area, a large number of encroachments had taken place. In this area, antisocial elements were residing and preparing food etc for unauthorized vending in trains.

For removal of these encroachments from railway land, the process was started from June-2017 by giving individual notices & announcements through PA systems for vacating the railway premises.

(Announcement was done through PA system)

In the month of September-2017, 154 number of encroachments were removed from South side of Bhusawal Railway Station and approximately 18,000 sqr mtrs Railway Land got vacated with the help of City Police, RPF and GRP.

The vacated area has been utilized for expansion of circulating area. South side is the main entrance of Bhusawal Railway Station from city side. However, only 1000 sqr mtrs space was available as circulating area.




(New Circulating Area at East Side)

Now, after removal of the encroachments, the circulating area has become 12,000 sqr mtrs with proper space for parking of two-wheelers, 4-wheelers, auto-rickshaws etc and green patch. An Army Tank has been placed at circulating area. Also 100 ft monumental flag has been provided apart from developing a beautiful garden with water fountains in circulating area.

After successful operation, process was started for removal of encroachments from other parts of Bhusawal and from other stations of the Division.

1.2 North Side Colony of Bhusawal :

Large number of encroachments were there in Aagwali Chawl, Haddiwali Chawl and Chamdmari Chawl in and around K-type quarters. Also large number of unauthorized Shops had come up on RPD Road passing though the Railway colonies.

i) First time, date for removal of encroachments from these areas, was fixed from 24/10/17 to 26/10/2017 and Notices were published in Newspapers on 06/10/17 & 18/10/2017.

After publishing the above notices, a large number of Dharnas, Pradarshans and Rail-roko were started by the encroachers and Local Public Representatives. Even delegation of leaders (Hon'ble MPs and Hon'ble MLAs) have given several representations in this regard and thus the drive was postponed by the Railways.

ii) Meanwhile, a special drive was launched from 31/10/2017 to 03/11/2017 for disconnection

of Electricity in unauthorized structures in these areas with the help of local Police, RPF and Electrical staff called from other Depots.

(Unauthorised connection of Electricity was removed)

After removal of unauthorized electric connection, saving of 7,500 Units of Electricity consumption per day was recorded, thus saving Rs. 16.87 lakh per month and Rs. 2.05 Crore P.A. it has further improved voltage in Rly Colonies.

iii) Before removal of hutments from Chandmari Chawl, Haddiwali Chawl and Aagwali Chawl, a drive was launched for dismantling of all 'K' type and 'J' type encroached quarters from the Railway Staff Colonies at Bhusawal and Manmad.

iv) Again, the drive was fixed for removal of encroachments from Chandmari Chawl, Haddiwali Chawl and Aagwali Chawl from 22/11/17 to 24/11/2017, Notices in the Newspapers on 08/11/2017, but it was postponed on the request of Public Representatives to give some more time.

v) Thereafter, the encroachment removal drives in the above Chawls were fixed from 12/12/17 to 14/12/2017, however, the encroachers filed Writ Petition in the Hon'ble High Court, Aurangabad Bench on 11/12/2017. Hon'ble High Court while admitting the Petition orally advised the Railway Advocate for not taking action till next hearing of the case. Hon'ble High Court on 19/12/2017, dismissed the case in favour of Rlys, advising the Petitioners to approach the appropriate Court. Therefore, this drive was postponed and Caveat was filed by the Railways against the Petitioners on 22/12/2017 with District Court, Bhusawal and drive was postponed to 26/12/2017 to 28/12/2017. But, Police force was not made available by the District Administration.

vi) Thereafter, the drive was fixed from 16/01/2018 to 18/01/2018 and notices were published in the Newspapers on 04/01/2018, 08/01/2018, 10/01/2018 & 12/01/2018 and Civil Administration was asked to provide adequate number of Police Personnel. However, the encroachers approached the Collector, Jalgaon to postpone the encroachment removal drive on the pretext of Xth & XIIth examinations of their wards. On the advice of District Collector, Survey was made to assess number of students of these areas appearing Board Examinations of Xth and XIIth. During the survey, only 32 hall-tickets were received in such cases. Therefore, the District administration was requested to provide security force for removal of encroachments, other than 32 hutments.

vii) Accordingly, the date for the drive was fixed from 20/02/2018 to 22/02/2018. Meanwhile, in view of the letter from Shri Ramdas Athawale, Hon'ble Minister of State for Social Justice & Empowerment, District administration intervened and the drive was postponed till examination of Xth and XIIth students i.e. till March end.

viii) After the Xth & XIIth examinations, the drive was again planned to be conducted from 18/04/2018 to 20/04/2018. However, Police force was not made available due to the anticipated Law & Order situation.

ix) Meanwhile, the encroachers had filed Civil Suit before the Civil Judge Junior Bench, Bhusawal on 15/01/2018 which was dismissed by the Hon'ble Court on 25/04/2018.

x) The encroachers made Regular Civil Appeal before the District & Sessions Judge Bhusawal on 02/05/2018.

xi) After pursuing the case at Principal CSC(RPF)'s level and IG Nasik, the drive for removal of encroachments was fixed from 15/05/2018 to 17/05/2018. 300 number of Police Personnel, 150 RPF personnel and adequate number of JCBs and Trucks were mobilized and Route March was conducted on 13/05/2018 in the affected area. However, Hon'ble District & Sessions Court ordered on 14/05/2018 to maintain the status-quo till 06/06/2018, which further was extended upto 12/06/2018 and finally the case was dismissed by the Hon'ble Court on 12/06/2018 in favour of the Railways.

xii) Now, the Monsoon had set-in and as per the orders of Govt. of Maharashtra encroachments cannot be removed during Monsoon. Therefore, the Encroachment Removal Drive was postponed till the Monsoon is over.

xiii) Pending dismantling of unauthorized hutments, drive for dismantling of K-type and other sub-standard quarters and out-houses continued. During the period from Sept-2017 to Sept-2018, 385 'K' type quarters, 36 'J' type quarters, 150 MAP quarters, 14 RB-I abandoned quarters and 388 Outhouses were dismantled from different Colonies with the help of RPF and City Police.

xiv) After disconnecting Electric supply & Water supply in this area in Oct & Nov 2017, such drive was repeated on regular intervals. Due to these actions and repeated attempts made for removal of encroachments, approximately 20-30% number of occupants have removed their belongings and vacated the hutments. Also due to the constant pressure for removal of encroachments, most of the encroachers had made up their mind that they had to vacate the premises one day. But due to assurance given by the local leaders, they were having some hopes for retention of the same.

xv) During this period, whole Police set up starting from Police Inspector and Senior Divisional Police Officer at Bhusawal to Superintendent of Police, Jalgaon and IG, Nasik had been changed. Fresh co-ordination with the new set up was initiated and persuaded them to provide adequate Police force after Dusshera for removal of encroachments. We have changed the strategy. Strategy was changed regarding publication of date of operation in Newspapers. It was now decided to disclose only 2 days in advance.

xvi) Just after the Dusshera festival, removal of encroachments in 15 Bungalow area (where less resistance was anticipated) was planned on 30th October 2018 with the help of State Police and RPF. After successfully removing all 190 balance encroachments from this area, encroachment removal in Chandmari Chawl, Haddiwali Chawl and Aagwali Chawl of 40 Bungalow Colony was planned after Diwali festival.

xvii) **PLANNING** –

After Dusshera festival, DEN (SW) and ASC (RPF)/BSL were in touch with Senior Divisional Police Officer/Bhusawal continuously. Intelligence inputs from RPF & Local Police were being shared. Law & Order situation was assessed and SP/Jalgaon was being informed from time to time. Date of removal of encroachment was fixed on 15th & 16th Nov 2018, but it was not disclosed. Sr.DSC (RPF) BSL & Sr.DEN (Co) BSL & Senior Divisional Police Officer/Bhusawal along with their team met SP/Jalgaon and worked out a strategy. A meeting in this regard was held in meeting room of Collector/Jalgaon on 13th Nov 2018 which was attended by-

- DRM, Sr.DSC, ASC, Sr.DEN (Co), DEN (SW) from Rly.
- SP/Jalgaon, Addl.SP/Jalgaon, Senior Divisional Police Officer, Bhusawal, Police Inspectors of concerned Thanas of Bhusawal.

Following was discussed & decided:-

a) There were large numbers of hutments in the area. Many antisocial elements and history-sheeters were residing in this area. Therefore, stiff resistance was anticipated. As per Intelligence inputs, it was expected that they would use women as shield.

b) Deployment of Forces was done in large numbers

so that it would act as deterrent. Therefore, more than 700 Police / RPF Personnel were proposed to be deployed with at least 100 Lady Constables.

c) It was decided that by 13th evening Notice in Newspapers would be given for encroachment removal on 15th & 16th Nov 2018. Also notices under Section -149 of IPC signed by Police Inspector of concerned Thana would be issued by 13th evening.

d) RPD Road going through colony towards ZRTI would be blocked for two days and traffic would be diverted through Varangaon Highway. Notice in this regard would be published in Newspapers of 14th Nov.18.

e) Preventive detention of few antisocial elements would be done by Police.

f) Whole area would be cordoned off since 5:00 am of 15th Nov. till completion of encroachment drive.

g) There are few religious structure (Boudh Vihar, Mosques and Temples) in this area. In earlier, encroachment removal drive, religious structures were also removed. But it was decided that any religious structures would not be touched, so that sentiments of public could not be exploited by antisocial elements.

h) Atleast 10-12 JCBs should be deployed. Each machine will be manned by One Rly Supervisor, one Sub-Inspector (RPF) and one Sub-Inspector (Police).

i) Adequate number of Tractors should be arranged for shifting of household of needy ones.

j) Atleast two Ambulance and two Fire Brigades should be arranged. Railway Hospital staff should be ready to take care of any injured person in case of any eventualities.

k) All the Personnel involved in drive would be instructed to keep their cool and restrain themselves from any provocation.

l) It was decided that no Lathi-charge etc., would be done.

m) Videography by Drone has to be done for complete operation.

xviii) **EXECUTION** -

On 13th evening, a Route march was conducted in the area by Police & RPF. A notification was issued in Newspapers regarding encroachment removal drive planned on 15th & 16th Nov.2018 and about closure of roads and diversion of traffic during this period.

Notices under section 149 of IPC were issued to the encroachers that they will be responsible for any Law & Order situation during encroachment removal drive, if they do not vacate the premises immediately.

(Addressed by SP, Jalgaon & Sr. DSC [RPF])

On 14th evening all Police Personnel, RPF Personnel, workmen assembled in RPF Parade Ground. All machineries were also brought there along with the operators. Briefing was done by SP, Jalgaon and Sr. DSC (RPF) about Do's and Don'ts as decided on 13th in the meeting with Collector.

(The area was cordoned off by Barricades)

Also in the evening of 14th November-2018, Route-march was conducted in the area by Superintendent of Police, Jalgaon himself along with other Police Officers, full Police Force, RPF Personnel and Railway Officials. Encroachment drive was planned from 06:00 hrs in the morning of 15th Nov-2018. After the Route-march on 14th Nov, most of the encroachers had started vacating the premises whole night and by the morning of 15th Nov-2018, more than 50% of the structures had been vacated. At 05:00 hrs in the morning of 15th Nov-2018 whole area was cordoned off. Nobody was allowed to enter the area. Only exist from the area was permitted.

For this operation, total 460 State Police Personnel (including 50 Lady Constables) and 300 RPF Personnel (including 48 Lady Constables) were deployed. SP/Jalgaon was personally monitoring the operation and Addl, SP was available throughout the operation at Site. From Rly side, ADRM, Sr.DEN (Co), DEN(SW), Sr.DSC(RPF) and ASC(RPF) were available at spot.

14 JCBs, 2 Poclain and 20 tractors worked at the site. Fire Brigade and an Ambulance with Doctor were also available to handle the emergent situation. The drive started from 06:00 hrs in the morning till 18:00 hrs in the evening.

Encroachment drive was continued from 15/11/2018 to 16/11/2018. This drive was further extended till 17/11/2018 since the encroachments were more than the expected.

Before removal of Encroachment at Aagwali Chawl, Bhusawal
(The space visible between the encroachments is of K-type quarters, which were dismantled few months back)


(After removal of Encroachment at Aagwali Chawl, Bhusawal)


(Before removal of Encroachments at Haddiwali Chawl, Bhusawal)


(After removal of Encroachments at Haddiwali Chawl, Bhusawal)


(Before removal of Encroachments at Chandmari Chawl, Bhusawal)


(After removal of Encroachments at Chandmari Chawl, Bhusawal)


(Before removal of unauthorised Shops at Chandmari Chawl & RPD/POH Workshop Road, BSL)


(After removal of unauthorised Shops at Chandmari Chawl & RPD/POH Workshop Road, BSL)

A great deal of success has been achieved during this drive, in which more than 3000 hutments/ pucca structures and 350 shops have been removed, thus vacating 120 acres railway land from the clutches of encroachers. There was an illegal R.O. Water Plant being operated in this area which has also been dismantled.

During execution of complete drive, all the belongings of the encroachers have been removed by themselves and, if required by them, Railway Gangmen and other staff were available to help them. Not a single belongings were removed by force. For transportation, 20 numbers of Tractors were available. A dedicated group was formed for serving of food at fixed intervals to all Railway Officials, Police Officials and even encroachers, who needed them.

This has been the biggest ever encroachment Removal Drive in Maharashtra, as stated by SP/Jalgaon. Due to this, not only the precious Railway land has been vacated but also the Railway employees residing in the colonies

and the people in the town heaved a sigh of relief since the anti-social activities running from the encroached areas have been eradicated. Apart from huge saving in Electricity, Water and maintenance activities, confidence amongst the staff has been strengthened and their moral has been boosted.

1.3 Officer's Colony, Tapti Club Road:

There are 95 officers' quarters at Bhusawal. Out of which, 70 quarters are at one place on Tapti Club Road. Colony was porous and boundary wall was broken at several places. There were many entry & exit to the colony. Out houses were there at three locations. With passage of time, large number of hutments came up near out houses as extension to them. Most of the persons residing in outhouses were not doing any household work for Officers Bungalow. They were involved in petty crimes and doing their own business. They were having free Electricity and Water and also threatening officers, if they are asked for any work.

People from City used to do morning and evening walk in Officers colony. They used to do exercise in front of the Gates of Bungalows. Only chain-link fencing was provided around the quarters. There was no privacy to residents. Colony roads were being used for learning of driving for two wheelers & four wheelers whole day. During Sept'17, when an Officer was away on leave, his house was burgled and valuables were taken away. Also while walking on colony road in evening, chain snatching incident took place with wife of one of the officers. Due to this situation, Officers living in colony were not feeling safe.

Following action was taken:-

i) Broken boundary wall was repaired. Height of boundary wall adjacent to D.S. High School (Nagar Palika) ground was raised. All entry points except near Tapti Club were closed by constructing RCC wall.

ii) All the outhouses and encroachments around them were removed with the help of RPF.

iii) Around the quarters, along with chain link fencing, released AC sheets after cutting to a particular height, have been provided and painted with green colour to have privacy and ensure good aesthetic.

iv) Entry / Exit allowed through only one gate near Tapti Club. Proper gate has been constructed.

v) Round the clock security and proper gate has been provided at the entrance.

vi) Entry of morning / evening walkers restricted. Timing was fixed (morning 5:00 hours to 8:00 hours & evening 18:00 hours to 20:00 hours). Identity Card has been issued to walkers after verifying their Aadhar Card. Initially, there was reluctance from Public but now it has been streamlined. Do's and Don'ts have been issued to morning walkers.

Now the residents of Officer's colony are feeling safe in the colony.

1.4 Central Zone Staff Colony at Filter House Road :

There are 17 numbers of Officers' quarters and 86 numbers of Senior Supervisors' Quarters. Through this Colony, one road named Tapi Road was passing through and going to Tapi River along the Filter House. Municipal Corporation has included this road in Development Plan without consent of Railway. Towards Tapi River many private buildings have come up. Also there are many slums. Slum dwellers through this road used to come in colony to roam around the quarters. There are 6-7 entry/exit points to this colony. 91 numbers of outhouses were also there in which all type of illegal activities were taking places. Thefts were taking places in quarters even if it was unmanned for 1 to 2 Hrs. Therefore it was proposed to close the entry of Tapi Road towards River side.

Lot of resistance came from slum dwellers and occupants of private colony. Even delegation led by Hon'ble MPs came to DRM office and requested for not closing the entry. It was apprised to them that it was indeed required for safety of colony. Then they filed petition in Session Court. Matter went on in court for 3-4 months. Finally Court was convinced for closure of entry towards river side.

On suggestion of Hon'ble court, a passage was given at the boundary of colony and entry was closed. Other entry and exit were also closed. All the outhouses were dismantled. Only one entry / exit has been left for the colony, where round the clock security has been provided.

Now the occupants of this colony are feeling themselves safe.

1.5 Eight Bunglow Staff Colony:

In this colony there are 43 numbers of quarters for senior supervisors. 45 numbers of out- houses were also there. One road passing through this colony towards city side through which, anti-social elements used to come during night and take shelter in an around out houses. It became difficult for ladies to walk in colony road alone even during day time. In spite of stiff resistance of few persons from city, entry of road from city side was closed. All out-houses have been dismantled. Additional entry points were closed. Only one entry /exit point has been left after completing fencing work. A security guard has been provided during night time through contribution made by the occupants of colony.

Now occupants of this colony are feeling themselves safe.

1.6 Fifteen Bungalow Staff Colony:

In this colony, there are 748 numbers of quarters for Group C & D staff. There were 75 number of out-houses and 154 numbers of unserviceable quarters which were mostly occupied by encroachers. In addition, more than 150 hutments were existing in this colony. Unserviceable quarters and out houses were dismantled during last 4-5 months with the help of RPF and Local Police.

For removal of hutments encroachments, Removal Drive was conducted on 30.10.2018 with the help of State Police & RPF. Total 138 Police Personnel (including 26 Lady Constables) and 90 RPF Personnel (including 24 Lady Constables) were deployed. In addition, adequate manpower, 4 JCB, Fire Brigade, Ambulance were deployed. Route -march was done by Senior Divisional Police Officer/Bhusawal along with full force on 29th evening of Oct.2018. By 30th morning, more than 50 numbers of encroachers had vacated their hutments. Drive started from 06:00 hrs morning and continued till 17:00 hrs. Total 190 encroachments removed.




(Before removal of Encroachment at 15-Bunglow, BSL)

Work of repair and construction of boundary wall and closure of entry/exit point in the area of 15 Bungalow Colony and having 430 staff quarter, is in progress. Only one entry/exit gate has been proposed for this colony. Also round the clock security proposed at entrance gate.

(After removal of Encroachment boundary wall constructed at 15-Bunglow, BSL)

Advantages to Railways after removal of Encroachment removal :-

(1) Saving in Railway Resources :

(i) More than 150 Acres of valuable land has been re-claimed. This land can be utilized for setting up of POH Workshop for LHB Coaches and MEMU shed.

(ii) Saving of 12000 Units of Electricity per day resulting in saving of Rs.72,000/- per day i.e. saving of Rs.2.63 Cores Per Annum.

(iii) Saving of 30 to 40% towards water consumption.

(2) Reduction in anti-social activities :

(i) Cases of theft and assault on Railway employees and their families shall definitely be stopped. This will certainly boost the morale and confidence of the staff residing in railway colonies.

(ii) Nuisance caused by drunkards especially in the close proximity of railway school has been reduced to large extent.

(3) Health and Sanitation :

(i) It has improved the cleanliness and hygiene of railway premises due to drastic reduction in waste products.

(ii) Smooth movement of traffic due to removal of unauthorized shops on either side of the RPD road.

(iii) Massive reduction in sewerage maintenance.

(4) Other Advantages :

(i) System reliability improved due to curtailment in tripping/fluctuation of power supply.

(ii) Substantial reduction towards efforts on expenditure incurred in garbage collection/disposal.

(iii) 60 numbers of Railway quarters have been allotted to the employees immediately after the removal of encroachments, which resulted in saving to Railways in terms of House Rent Allowance and safeguarding of Railway quarters.

2. MANMAD

2.1 Manmad is also one of the important stations of Bhusawal Division. There are 1970 quarters at Manmad. Out of which, there were 184 'K' type unserviceable quarters and 133 Outhouses and the situation of encroachment in and around these areas was similar to Bhusawal Station. These quarters and Outhouses were occupied by

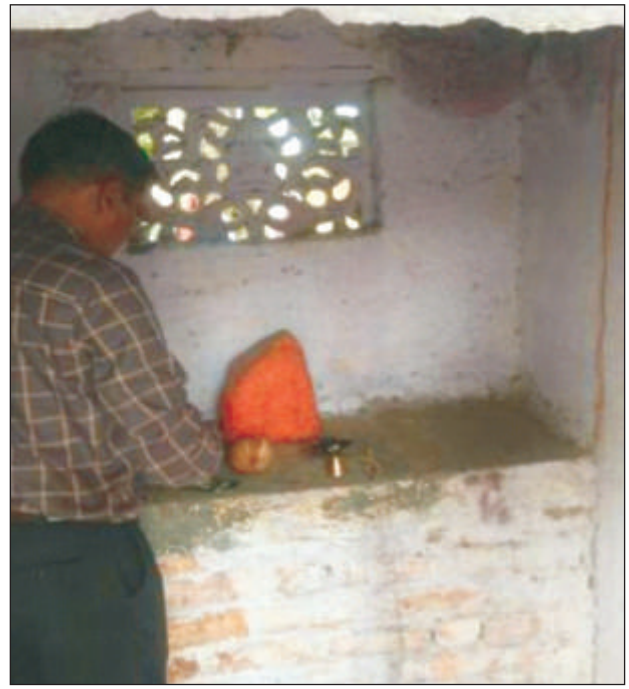
outsiders and antisocial elements and a large number of hutments i.e. 487 Nos. (76 hutments &32 shops on open land + 184 between unserviceable quarters + 133 in & around Outhouses) had come up in and around the area. They were utilizing free Railway Water and Electricity. There is already scarcity of water at Manmad, i.e. in Railway Colonies the water-supply was available for once in a week and once in 15-20 days in city.

In the month of November-2017, a Special Drive was conducted with the help of local Police and RPF for disconnection of Electric connections in the unauthorized structures and removal of encroachments. All encroachments including out-houses and unserviceable quarters were removed in a month long drive. After removal of unauthorized Electric connection & encroachment, saving of 1,100 Units of Electricity consumption per day has been recorded, thus saving Rs. 21.86 lakh P.A. and has improved voltage in colonies.

(After removal of Encroachment from Portal Chawl, boundary wall constructed at Manmad)

2.2 At Manmad Station premises also there were large number of pucca encroachments adjacent to P/F No. 1. The area was being used for various illegal activities including unauthorized vending at station and in trains by the anti-social elements. With the help of RPF City Police, 83 encroachments were removed during the two-day Drive conducted from 08/03/2018 to 09/03/2018 and 12 encroachments were removed on the drive conducted on 23/06/2018.





(Before removal of Encroachment at station premises, Manmad)

RCC boundary walls have been constructed along the Platform and, now Manmad station has become an encroachment-free Railway Station of the Division from 23/06/2018.


(After removal of Encroachment boundary wall constructed at Manmad)

3. BURHANPUR-

3.1 Burhanpur station is another important station of the Division, which has also been planned to be developed as Model Station. However, there were encroachments in station premises as well as on Municipal Corporation land in front of the station building.

3.2 Along Up platform, an infamous anti-social element had encroached the Rly. Land since last more than 30 yrs and using as Horse-Stable and made 07 hutments. While passing of Up trains, bad smell was being felt in train and it had become identity of Burhanpur Station while passage of trains. During the drive conducted on 14/12/2017, all the 7 hutments and 01 horse-stable which were existing in station premises have been removed and 2000 sqm Railway Land has been vacated with the help of RPF and City Police.

(Before removal of Encroachment at Burhanpur)

3.3 Joint survey was conducted with District Collector and SP Burhanpur and District administration and all the unauthorized stalls/ encroachments/ hotels/ gumtis etc., existing on the land of Municipal Corporation in front of station building got removed on 14.12.2017 for developing circulating area in front of the station.

After removal of the encroachments, RCC boundary wall have been constructed and proper circulating area, parking & green patch being developed in this area.

(After removal of Encroachment boundary wall constructed at Burhanpur)

4 DHULE

Two drives were conducted at Dhule for removal of encroachments. On 26/10/2017, 50 encroachments have been removed from the railway premises.

Another drive was conducted on 03/10/2018 at Dhule, for which 13 City Police (including 2 Lady Constables), 12 Personnel of Rapid Action Force and 22 RPF Personnel were deployed. The drive was started from 08:00 hrs in the morning till 17:30 hrs of the day and 57 encroachments (50 Houses and 7 temples) have been removed.

By removal of encroachments at Dhule during both the drives, 20,750 sqm Railway Land has been vacated.


(Before removal of Encroachment at Dhule)


(After removal of Encroachment at Dhule)

5 CHALISGAON

On 20/10/2018, a drive was conducted at Chalisgaon, for which 14 City Police (including 2 Lady Constables), 4 GRP Personnel and 28 RPF Personnel were deployed. The drive was started from 08:00 hrs in the morning till 17:00 hrs of the day and 30 Houses have been removed from the Railway Land, vacating 900 sqm land. RCC Boundary wall is being constructed along Rly boundary in Station area.


(Before removal of Encroachment at Chalisgaon)

RCC boundary wall have been constructed after removal of encroachment.

(After removal of Encroachment boundary wall constructed at Chalisgaon)

6 Other Stations

Besides above, drives for encroachment removal at other stations on the Division have been conducted with the help of RPF and City POLICE during the year 2018 and a lot of encroachments have been removed from the Railway land, as summarized below –

SN	Station	Drives conducted	No. of encroachments removed	Details
i)	Khandwa	Feb/Mar-2018	20	Outhouses surrounded with hutments.
ii)	Shegaon	20 & 21 June-2018	25	Unauthorized structures.
iv)	Chandani	June-2018	17	Temporary as well as Permanent hutments.
v)	Raver	Sept-2018	04	Hutments.
vi)	New Amravati-Walgaon section (Km 670)	Sept-2018	08	Hutments
		TOTAL:	**74**	

Removal of Encroachments from Railway Colonies and Station premises was an arduous task because of intervention of local representatives and legal complications. However, with the full support and guidance of General Manager/Central Railway, proper planning and coordination with State Administration and deployment of adequate security force all the encroachments were removed peacefully without any untoward incidence.

Summary of the No. of encroachments removed and railway land got vacated at all the above mentioned station, is as under.

Sr. No.	Name of Station		Nos. of Unauthorized Structures removed	Nos. of Rly Quarters removed	Nos. of Outhouses removed	Total
1.	Bhusawal	No.	3698	652	386	**4736**
		Area **(m^2)**	564325	110358		**674683***
2.	Dhule	No.	107	-	-	**107**
		Area **(m^2)**	20750	-		**20750**
3.	Manmad	No.	203	184	133	**520**
		Area **(m^2)**	3200	8100		**11300**
4.	Burhanpur	No.	08	-	-	**08**
		Area **(m^2)**	2000	-		**2000**
5.	Chandani	No.	17	-	-	**17**
		Area **(m^2)**	500			**500**
6.	Raver	No.	04	-	-	**04**
		Area **(m^2)**	80	-		**80**
7.	Khandwa	No.	-	-	20	**20**
		Area **(m^2)**	-	350		**350**
8.	Shegaon	No.	25	-	-	**25**
		Area **(m^2)**	450	-		**450**
9.	New-Amravati Walgaon section	No.	08	-	-	**08**
		Area **(m^2)**	1750	-		**1750**
10.	Chalisgaon	No.	30	-	-	**30**
		Area **(m^2)**	900	-		**900**
	Total	**No.**	**4100**	**836**	**539**	**5475**
		Area (m^2)	**593955**	**118808**		**712763**
		Area (Acre)	**146.77**	**29.35**		**176.12**

*(Includes **35 Acre**land of 15 Blocks + **120 Acre**land of Chandmari, Haddiwali & Aagwali Chawl + area of other land vacated at Bhusawal).

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Faster Construction Methods in Launching of Open Web Girders on EDFC

Seven Railway Flyovers (RFO) are made in approximately 353 Km length of EDFC alignment wherever DFC alignment is crossing over the existing Indian Railway (IR) Track. Out of these five are of Open Web Girder (OWG) type as below:

Structure	Location	Over	Span	Wt.(MT) Each Girder	Skew
HTMJ 2/3	Ch 6+709.746 IR 302.238 Hathras Detour	Mathura Kasganj line	46.12 m Length	615 degree	0.00
ETMJ -1	Ch 2+864.469 IR Ch1149.697-Etawah Detour	Allahabad-New Delhi line	75.335 M length	691	53.469 degree
ETMJ-2	Ch 16+254.834-Etawah Detour	Allahabad-New Delhi line	54.9 M Length	421	34.661 degree
ETMJ-4	Ch 22+120.851(IR 1167.72)-Etawah Detour	Allahabad-New Delhi line	67.529 & 82.276 M	576 & 835	69.51 degree
Bhaupur RFO	Ch 2+077.944 (IR 1043.250) Bhaupur Detour	Allahabad-New Delhi line	48.416 M	297	55.483 degree

1. Open Web Girders

Girders are typically the beams which support the deck slab along with live load coming over it. Height of the girder is the most important factor affecting its loading capacity and increases with increase in span length & traffic load. For smaller spans in Railways, generally Steel Plate Girders (I-beam cross section) are used which have a solid web with flange plates welded at its top & bottom. But in case of longer spans & heavy traffic, these girders become abnormally high and hence highly uneconomical & impractical. Therefore, these are replaced by Open Web Girders (OWG) for spans longer than 40 M.

Open Web Girders are truss type girders which can be designed for longer spans without requiring the height of beam to increase beyond practical limit. The load from superstructure is transferred to the substructure through the truss which acts like beam. OWG consists of two trusses positioned vertical & side by side. These trusses act as web and made by assembling individual members (Ties & Struts) forming triangles or quadrilaterals along its length & hence light weight. No individual member is subject to bending or torsion but only to compression & tension. These trusses are connected to each other by cross girders & bottom lateral bracings at the bottom and by sway girders & top lateral bracings at the top. Refer to Fig-1.

Fig-1 Open Wen Girder

The assembly of OWG requires lot of space & time and therefore is done at a convenient place outside its span location in case it is to be spanned over IR track or river or other inconvenient location. In such situation, properly planned and designed launching scheme is required to pull the assembled OWG to its proper span location.

Launching of these OWG has been carried out by adopting various methodologies keeping site specific factors in mind such as, crossing angle, girder span, number of tracks below the girder, weight of girder, importance and block availability of running line, working space availability, formation width and height, time constraints for speedy execution and safety. These launching methodology adopted on EDFC are eludiciated further.

2. Case 1 - HTMJ-2/3 : Launching by Simply supported Track beam and Trolley:

This structure has been constructed across Hathras – Kashganj Rail Section on NER having span length of 46.2 M crossing over three IR tracks near Mendu Station weighing 700 Ton approx (excluding dead load of RCC decks) designed to accommodate both tracks (UP-line & DN-line) in single OWG

2.1. Launching - Conventional Method :

This method is also called End Launching Method and generally adopted on new constructions. In this method, the girder is assembled on the approach bank and it is longitudinally traversed over the opening it has to span and lowered in position.

For this purpose, the properly designed temporary structure - (Fig-2) was erected in the gap between abutment (A1) and pier (P1) which consists of a pair of built-up I-girders connected together & placed over the trestles. Rails were fixed over the top flange of each I-girder. A pair of rail lines, thus laid, facilitates the four wheeled trolley (See Fig-3) to move over it. The assembled OWG was lifted on hydraulic jack and placed over the set of six trolley on each side as per the design requirement with one trolley placed below one the bottom chord joint (Fig-4). Thus OWG got ready to move over rail lines laid over the temporary staging across the gap.

Fig-2 Temporary Structure

Fig-3 Trolly

Fig-4 Chord Joints

2.2. Pulling mechanism:

It consisted of pulling winch & restraining winch of 20 Ton & 10 Ton capacity respectively, steel wire rope and pulley. One pair of pulley was fixed to the front end of OWG with one pulley at either side. Other pair of pulley was fixed on the vertical frame installed (over pier) at the other end near winch machine. OWG was connected with pulling winch by wire rope passing round the pulley. The two pulling winches were installed, one on either side. Refer to Fig-5. In order to avoid the risk of differential pulling, the electric motor of both pulling winch m/c (LHS & RHS) were set to run in synchronized way. Pulling speed of OWG is 200 mm per minute. Two restraining winches were also installed at the rear end of OWG so as to restrain the movement in case of any exigency. After all technical & safety check, trial pulling of OWG was done to check any discrepancy in the entire system and later on final pulling was done under Railway Traffic Block sanctioned by NER. Final position of OWG has been shown in Fig-6.

Fig-5 Pulling Arrangement

Fig-6 – OWG after completion of Pulling

2.3. Precautions :

- All the rail joints should be made smooth by grinding. There should not be any lateral or vertical offset between two rail segments at joints.
- The alignment of track laid over staging should be straight and should also be free from any kink or any abrupt change in rail top level.
- Rail top should have the same level all along its length.
- Rail top as well as all the moving parts like trolley wheels & pulley etc should be lubricated properly before start of pulling OWG. It reduces the friction and thus facilitates smooth movement of trolley over rail.

2.4. Advantages:

- This method is very safe,
- Suitable for pulling across unsupported gap up to 25 M
- Friction developed during pulling is less as trolley wheels roll over rails fitted on track beam.
- It is laterally guided and there is no possibility of any lateral shift during pulling since trolley wheels roll over rails fitted on track beam.

2.5. Disadvantages:

- For longer unsupported gap, it is unsafe, uneconomical and inconvenient as very heavy temporary structure required and hence not suitable.
- In case of any unevenness in rail joints, there is possibility of breaking of trolley wheels.
- Traffic requirement is heavy.

3. Case 2 - ETMJ-2- Launching by Simply supported Track beam and sliding block:

This major structure has been constructed across Etawah – Mainpuri Section of NCR having span of 54.9 M crossing over one existing IR track & two future tracks weighing 500 Ton approx and having non-ballasted deck. This was also launched in position by the Conventional Launching Method but by using sliding blocks of PTFE.

3.1. Launching - Conventional Method :

Therefore the launching scheme followed was similar to case1 - HTMJ-(2/3) above except the following:

- The trolley was replaced by the sliding block. Refer to Fig-7. It contains nearly 250 mm long & 50 mm wide PTFE strip fit in the groove cut under the block. It slides smoothly over the rail.
- As the pulling winch m/c had been installed on the approach constructed behind abutment (A2), in same level as of the bottom chord of OWG, it didn't need installation of any vertical frame. Refer to Fig-8.

Fig-7 – PTFE Sliding Block

Fig-8 – Pulley & Wire Rope Connection and Winch

3.2. Precautions :

- All the rail joints should be made smooth properly by grinding. There should not be any lateral or vertical offset between two rail segments at joints. Vertical offset should strictly avoided otherwise PTFE strip will be trapped and crush.
- The alignment of track laid over staging should be straight and should also be free from any kink or any abrupt change in rail top level.
- Rail top should have the same level all along its length.
- Rail top as well as all the moving parts like pulley etc should be lubricated properly before start of pulling OWG. It reduces the friction and thus facilitates smooth movement of sliding block over rail.
- Lateral Guide Angle fitted in the sliding block should be strong enough and its fitting should be strong so as not to yield under lateral thrust.
- All the key persons of commanding team including winch operators should be in contact with each other by walky-talky.

3.3. Advantages:

- This method is very safe.
- Suitable for pulling across unsupported gap up to 25 M.
- Friction developed during pulling is less as PTFE pad slides over lubricated rail.
- There is no chance of any breakage during pulling as wheels of rail trolley are replaced by PTFE pad.

3.4. Disadvantages:

- For longer unsupported gap, it is unsafe, uneconomical and inconvenient as very heavy temporary structure required and hence not suitable.
- Its lateral guide arrangement is not proper as compared to rail trolley since the sliding block is prepared at site by crude method.
- In case of any unevenness in rail joints, there is possibility of sliding block getting stuck and PTFE be damaged.
- Pulling speed is less

Use of PTFE sliding block is convenient and facilitates smooth movement over rail. Therefore it is best preferred in conventional pulling.

4. Case 3 - ETMJ-1- Cantilever Launching with Launching Nose and Beam:

This major structure has been constructed across Kanpur – Delhi Main Line of NCR between Ekdil and Etawah station. This is single span skew bridge having span length of 75 M and having skew angle of 54. This steel structure with non-ballasted deck weighs 700 Ton approx.

4.1. Launching with Launching Beam and Stationary Hillman Rollers Method

This method was adopted as the unsupported part of the span was longer due to 54 degree skew angle and site condition was not permitting to erect staging. Skew launching nose of light weight truss of 14.725 M on LHS & 5.250 M was connected to the front portion of OWG with the help of suitably designed temporary connections. During pulling of girder, it acted as cantilever till its nose tip reaches the support at the other end and hence it was designed to take the cantilever stress during launching. Refer to Fig-10. Rolling platforms were provided on each abutment, pier and intermediate trestles and stationary Hillman rollers were fitted over trestles -Fig 11. The combination of OWG & launching nose was then pulled longitudinally with the help of a winch machine till OWG reached its desired position. See Fig-9.

Bottom chord joints of OWG containing HSFG bolts projected downward thus obstructed rolling of OWG over Hillman Rollers. So, launching beams were fixed below bottom chords (LHS & RHS) all along the length with the help of stools and braced with each other in such a way as to provide smooth and continuous bottom flange surface to roll over the Hillman rollers smoothly. See Fig-12.

The launching beam attached under the bottom chord of OWG simply rested on the Hillman roller fixed over trestles and hence it was free in transverse direction. So to avoid lateral slip off the Hillman roller lateral guide roller was installed on every trestle on LHS & RHS to restrain the lateral movement of OWG. Refer to Fig-13.

Fig-9–Cantilever pulling with Launching Nose and launching beam

Fig-10 – Launching Nose

Fig-11 (a) – Temporary Structure

Fig-11(b) – Hillman Roller

Fig-12 – Launching Beam fitting under Bottom Chord

Fig-13 – Lateral Guide Roller

4.2. Pulling mechanism:

Pulling mechanism is similar to as in HTMJ-(2/3) except the slight change, as per that a vertical frame was installed at the far end near winch machine. Refer to Fig-14. It consists of pulling & restraining winch of 25 Ton & 15 Ton capacity respectively, steel wire rope and pulley. In order to avoid the risk of differential pulling, the electric motor of both pulling winch m/c (LHS & RHS) were set to run in synchronized way with pulling speed of 600 mm/min. Two restraining winches, each of 15 Ton capacity, were also installed at the rear end of OWG, like in ETMJ-2 above, so as to restrain the movement in case of any exigency. Wire ropes were pulled across the overhead 25kV OHE wire with the help of cranes and Manlift under Railway Traffic Block sanctioned. Refer Fig-15.

4.3. Pulling Operation :

- In first stage, pulling was done outside the Track and hence without Railway Traffic Block till the tip of launching nose reached the support over the trestles over track . Refer to Fig-16.
- The second & third stage pulling was done under Railway Traffic Block sanctioned and in this stage pulling, the launching nose crossed IR track and its tip reached the support over trestles on the other side of IR track. Refer to Fig-17.
- In third stage/final pulling, OWG reached in the desired position on abutment - A2. Refer to Fig-18.

Fig-14 – Pulling Mechanism

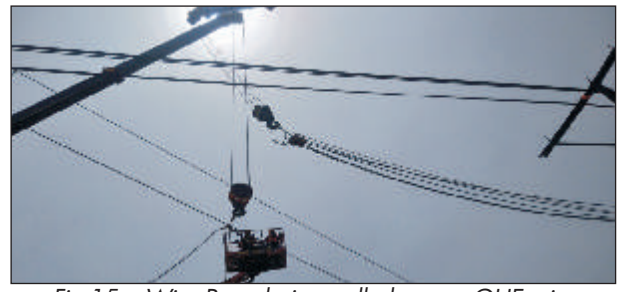

Fig-15 – Wire Rope being pulled across OHE wire

Fig-16 – First Stage Pulling of OWG

Fig-17 – Second Stage Pulling of OWG

Fig-18 – Third Stage Pulling OWG

4.4. Precautions :

- Jointing of launching beam segments should be done in such a way as to make the bearing surface of the bottom flange smooth and continuous strip leaving no gap so as to facilitate smooth rolling over Hillman rollers. There should not be any lateral or vertical offset between the bearing surfaces of bottom flanges at joints. Vertical offset should strictly be avoided otherwise Hillman roller pin will be trapped and crushed during pulling.
- Hillman rollers' top should in the same level, everywhere.
- All the moving parts like Hillman roller pins, pulley etc should be lubricated properly before start of pulling OWG. It reduces the friction and thus facilitates smooth rolling of launching beam over Hillman rollers.
- Some wedges (strips made of plate of varying thickness from 10 mm to 20 mm with one end wedge shaped) should be kept at site. In case, OWG shifts laterally during pulling, these wedges can be inserted between the lateral guide roller and the top flange of launching beam so as to bring OWG in proper alignment.
- The vertical post on which Lateral Guide Roller is fitted should be strong enough so as not to yield under lateral thrust during pulling operation.
- All the key persons of commanding team including winch operators should be in contact with each other by walky-talky.

4.5. Challenges Faced During Pulling Operation :

At one splice of launching beam (LHS), a vertical offset between the bottom flange surfaces remained noticed. During third stage pulling, this joint reached over the trestle on the other side of IR track. At the same time, it was accompanied by some lateral shift in OWG. Consequently, the bottom flange at this joint infringed with the collar of Hillman roller. See Fig-19. As the pulling winch was running, excessive longitudinal force was exerted on the trestle resulting into uprooting of holding down bolts. Also, bolts in the bracings got sheared, bracings of trestle broken at their weld locations with cracking bursting sound and further pulling was stopped immediately. Trestle also leaned in the direction of pulling. The tip of launching nose was hanging in air just short of the support over abutment. Any further pulling would have resulted in falling down of trestle. It was very unsafe situation.

Fig-19 – Bottom Flange of Launching Beam trapped by Collar of Hillman Roller

Fig-20 – Rection Truss erected to support the trestle

4.6. Remedial Measure :

It was decided to provide a horizontal support to the trestle at its top in the direction opposite to the pulling direction with the reaction born by the abutment. As shown in Fig-20. After completion of reaction truss, further pulling was done safely and successfully.

5. Case 4 - ETMJ-4- Cantilever Launching with Launching Nose Only :

This major two spanned 70[redacted]kew bridge with span length of 82.5 M having between Jaswantnagar Etawah station over NCR track. This has also two separate OWGs – one for UP/line and one for DN/line.

5.1. Launching Method

The pulling has been done by Cantilever Launching Method as in ETMJ-1 mentioned above except in this case no launching beam has been used. In this case, launching nose was 39.5 M long.(See Fig-22) with unsupported gap of 54M. Here, Hillman rollers were fixed to the bottom chord of OWG to roll over the guided pathway. Robust channel (acting as a trough) of size (310 x 100) fabricated by 16 mm thick was welded on the top of pathway all along its length acts as a guide to prevent any lateral shift of OWG during pulling. See Fig-23(a).

On the approach, launching pathway (without guide) was constructed by anchoring 16 mm thick MS plate (300 mm wide) on the top of concrete pad all along its length and OWG was assembled over this platform. However, for hassle-free pulling of OWG, it should also be guided. On the temporary structure (erected between IR track& abutment), launching beams with fabricated guide channels were placed as simply supported on the trestles to form the pathway, so as to provide guided pathway to the Hillman rollers to roll over it. See Fig-23 (a) & (b).

Fig-21 – RFO-ETMJ-4

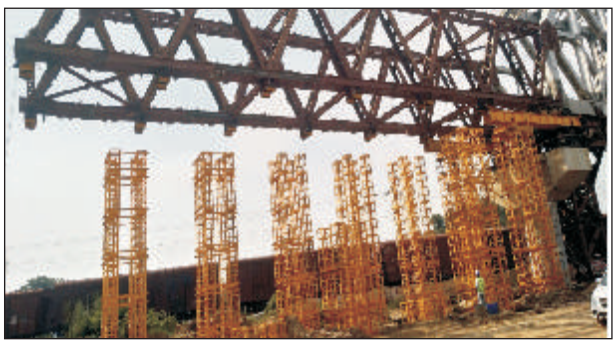

Fig-22 – Launching Nose

Fig-23– Fabricated Guide Channel- guided pathway on temporary structure

5.2. Pulling mechanism :

OWG-82M –UP/line) span was assembled on the approach and planned to pull up to pier by rear pulling. Accordingly, the steel frame (spreader beams & pulley columns) was designed to hold pulley and wire rope. Spreader beams were fitted to the rear end of OWG, both sides. See Fig-24 (a). Two pulley columns were erected at the pulling end of OWG, one at each side near the foot of abutment. See Fig-24 (b).

At the pulling end of OWG, Pulling Winch m/c (2 no), each of 20 Ton capacity, were installed on the ground in front of abutment See Fig-25. Two restraining winch m/c of same capacity were also installed at the rear end in order to hold or pull back OWG in case of any exigency during pulling. See Fig-24 (a)-(ii).

Fig-24 (a)– (i) – Spreader Beam holding Pulley at the rear end of OWG

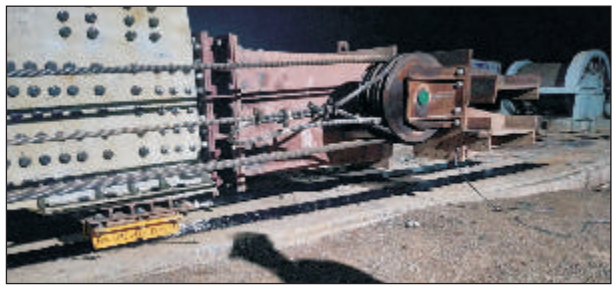

Fig-24-(a)-(ii) – Spreader Beam holding Pulley at the rear end of OWG

Fig-24-(b) –Pulley Column holding Pulley at the front end of OWG

Fig-25 – Pulling Winch Machines at the front end of OWG

- In first phase, OWG was pulled upto launching nose reached over the trestles just before track boundary. See Fig-26. In this stage, Railway Traffic / Power Block was not required as the pulling was done outside the track limits.
- In second phase, pulling was done under Railway Traffic / Power Block sanctioned. During this phase, as the pulling was going on, the launching nose gradually becomes cantilever while crossing track. Therefore, pulling should be done very carefully as it involves high risk. See Fig 27 & 28. Further pulling was continued till the tip of launching nose reached over the trestle near pier (P1) on the other side of IR track. See Fig-29.
- In third/final phase, OWG was pulled to the desired position on pier See Fig-30. In this phase also, pulling was done under Railway Traffic / Power Block. Thus, pulling operation was completed. Further, after dismantling of launching nose, OWG was kept on temporary support. Then launching beams and trestles were dismantled. Finally, OWG was lowered in position.

Fig -26-First Phase Pulling

Fig-27 – Cantilevered Launching Nose during Second Phase Pulling

Fig-28 – Cantilevered Launching Nose during Second Phase Pulling

Fig-29 –Second Phase Pulling - Launching Nose Tip reached over Trestle on other side of IR Track

Fig-30 – Final position of OWG

5.3. Precautions:

- Jointing of guide channel segments should be done in such a way as to make the bearing surface smooth and continuous strip leaving no gap so as to provide smooth surface on which Hillman rollers roll smoothly. Vertical / lateral offset between the bearing surfaces at the joints of guide channels should strictly be avoided otherwise Hillman roller pin will be trapped and crushed during pulling.
- Guide Channels should be strongly welded to the top flange of launching beam.
- All the moving parts like Hillman roller pins, pulley etc. should be lubricated properly before start of pulling OWG. It reduces the friction and thus facilitates smooth rolling of Hillman rollers in the guided pathway.
- During pulling, slight deviation in transverse direction should be minimized by differential pulling.
- Launching beams should be braced laterally over the trestles to prevent any side sway under load. All trestles should be braced properly in longitudinal as well as transverse directions.
- Manlifts, cranes and hydra should be stationed in position to meet any exigency.
- All the key persons of commanding team including winch operators should be in contact with other by walki-talki.

5.4. Advantages :

- Suitable for pulling across longer unsupported gap above 40 M as launching nose is used to balance the cantilever weight of OWG
- Friction developed during pulling is less as Hillman rollers roll over the flat and smooth MS rolling pad.
- Pulling can be done fast in comparison to the Conventional Pulling Method (simply supported track beam and trolley method).
- Here, the launching beams are stationary and Hillman rollers roll inside the fabricated guide channels placed over the top flange of launching beams. Hence, there is almost zero risk of any lateral shift of OWG during pulling. Therefore, this method is one of the best preferred methods for cantilever pulling.

5.5. Disadvantages :

- There is possibility of lateral shift in the tip of launching nose while reaching the support at the other side of IR track. So, utmost care is required during cantilever pulling.
- In case of any offset at the joints of guide channels, there is possibility of Hillman rollers being damaged.

6. Conclusion :

There has been a major challenge in the design build contract to design, validate, fabricate and launch the seven Rail Flyovers approximately 6500 MT in a time bound manner which were on critical path in completion of DFC line of EDFC. Also, most of these Girders were to be launched on most busy sections of North Central Railway where traffic block availability has always remained a constraint. Requirements of design for 25 T capacity, track canters, skew angle, nature of soil, constructed formation, fabrication capacity in market, constraints of inspection agency, weight of girders, proof checks by IITs, sanctions of commissioner of Railway safety, etc., dictated a tough time line and therefore a stiff challenge. Careful planning, constant monitoring by DFCCIL and continuous follow up by Project Management Consultant and execution agency has made it possible to fabricate and launch these open web girders in timely, safe and successful manner.

Technical Paper on use of Geo Composite Drain behind the Bridge Abutment, Retaining wall and Earth Retaining Structures

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ABSTRACT

For the construction of the double rail line of DFCCIL from Dadri to Rewari,CTP 14 has initiated to replace the existing practice of use of 600 mm thick hand pack boulder behind structure as a filter media with the new practice of use of geo composite drain.

Presence of seepage water in the structure may lead an unexpected behavior of the structure, sometimes more harmful than expected. So, there is an utmost need to drain away the water present in a structure. Conventionally this drainage is carried out by means of providing hand pack boulder. Advancement in the civil engineering field brought some new innovative solution for the drainage application.

This technical paper explains the function of drainage behind the structures, existing practice of use of hand pack boulder and new initiative of use of geo composite drain and its advantage.

Background of the Project:

The Ministry of Railways (MOR), Government of India, has planned to construct a High Axle Load Dedicated Freight Corridor (DFC) covering about 3325 km on two corridors, the Eastern and Western Corridors. The Western Corridor has been planned from Jawaharlal Nehru Port, Mumbai to Tughlakabad/ Dadri near Delhi, covering a length of 1,483 km (JNPT – Ahmadabad – Palanpur – Rewari – Asaoti - Dadri) and planned to be implemented in two phases. The first phase involves the construction of 935 km between Vadodara and Rewari, construction of double-track electrified railway lines capable of handling 32.5-ton axle load, longer trains and double stack containers. The bridges and other structures will be designed to allow movement of 32.5-ton axle load while the track structure will be designed for 25-ton axle load operating at maximum train speed of up to 100 Km/hr.

The Second Phase will cover a distance of 550km of double line electrified track from JNPT to Vadodara (422 Km) and Rewari to Dadri (128 Km) and has been planned through nine (09) Contract Packages one of them being the CTP-14 Integrated Package of Civil, Building and Track Works, Electrical & Mechanical (E&M) Works & Signal and Telecommunication (S&T) Works (Rewari Dadri). The Dedicated Freight Corridor Corporation of India Ltd. ("DFCCIL" or "Employer"), has awarded the work of Design and Construction (Civil and Structures) of CTP14 Package of Western Dedicated freight Corridor project from Rewari to Dadri to L&TS ("Contractor") (approximately 128 km).

The Western DFC is proposed to join the Eastern Corridor at Dadri. The entire CTP 14 section of128 Km is in a detour with junction stations between the existing railway systems passing through the states of Haryana, Uttar Pradesh, and Rajasthan.

Function of providing drainage system:

The main function of providing drainage system behind the abutment, wing wall of major and minor bridge and earth retaining structure is to dissipate the pore water pressure due to excess moisture. In absence of this layer or system, fine grained soils may gradually infiltrate into the weep holes and may block it entirely or partially, which may lead to major distress in the back fill. Locking of water inside the structure shall impose extra water pressure and due to that the horizontal forces increase substantially. This shall reduce the stability of structure and can even lead to catastrophic failure. Hence providing proper drainage system for structures is of great importance. In short, this layer act as a filter media.

Figure 1: Effect of pore water pressure on structure

Existing practice:

600 mm thick Hand pack boulder is being used as a filter media layer behind the structures. Boulder filling shall consist of well hand pack boulders and cobble to thickness not less than 600 mm with smaller size towards the back-fill material. Existing practice of use of hand pack boulder is labor oriented task consuming more time. Hand pack boulder was one of the critical activities as it is a labour intensive work and depending upon the labour availability and output varies due to the availability of seasonal labour.

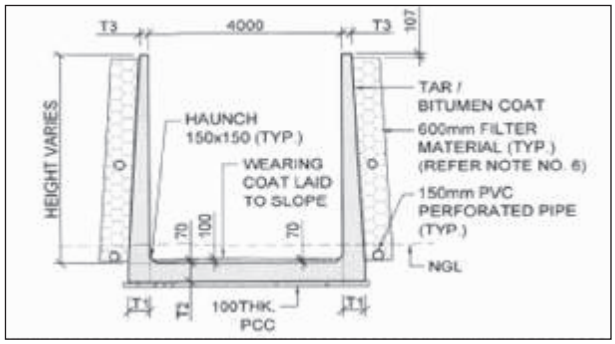


Figure 2: Cross section of Minor Bridge

Figure 2: Cross section of Minor Bridge

New Practice of use of Geo composite Drain:

RDSO has released a specification No. RDSO/2018/GE: IRS-0006 – "Specification for Geo composite drain to be used behind Bridge Abutment/Retaining wall" for the use of geo composite drain.

- **Material composition:** It is a combination of two Geosynthetics material and hence known as Geo composite which is used for drainage applications. Drainage composite are formed by a combination of Geotextile (Woven or Nonwoven), acting as a filter and separator on one or both sides with a core of Geonet. These are prefabricated subsurface drainage products which directly replace the granular drainage layer completely.They are normally consisting of polymer sheet core covered by a geotextile acting as a filter and separator on one or both sides.

  This allows water to pass through into the polymer core but prevent the soil particles to entre inside. Drainage plays a critical role in the design and construction of below grade applications. Without proper drainage, ground water seepage may cause hydrostatic pressure and leakage, resulting in structural damage.

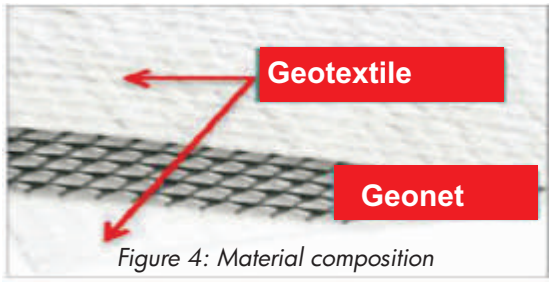


Figure 4: Material composition

- **Working mechanism:**

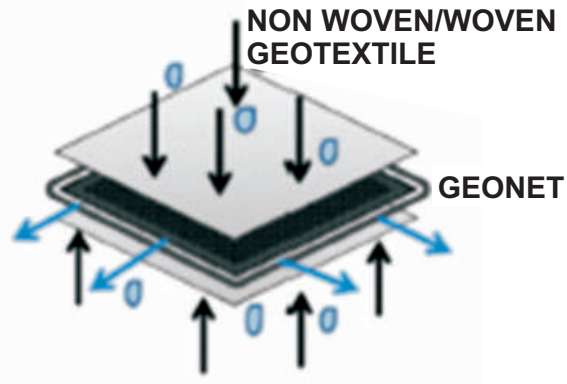
a) Geotextiles are intended to hold the surrounding soil allowing the water to pass through it.

b) Drainage core carry the water through it and drain away to discharge outlet

c) It's a multi-directional flow design allows a continuous path for water discharge, eliminating the potential for hydrostatic pressure build up.

d) Water passes into the 2-D/3-D core structure and flows along its plane. By draining excess pore water from the adjacent soil mass stability of the structure and the soil is improved and maintained. It allows water to pass freely into the drainage core, where it is a gravity fed into the main drainage collection system. By this system, lateral ground pressure on the structure is also reduced.

e) Drainage composite provides a medium for guiding ground water and seepage water to drainage pipes/weep holes and it reduces the pore pressure on wall.



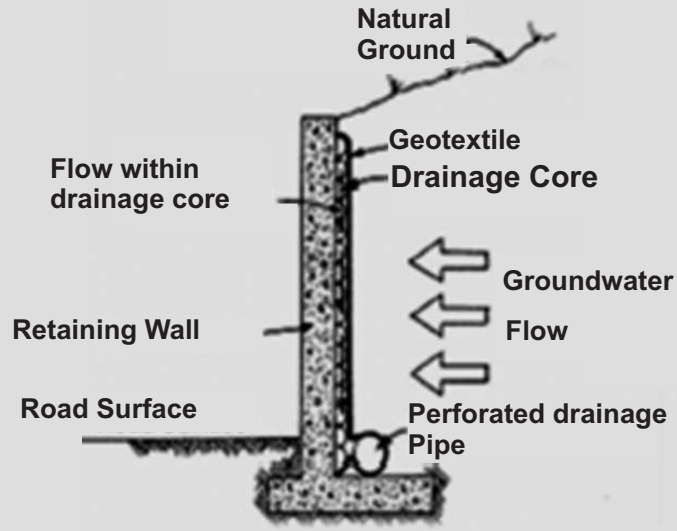


Figure 5: Working mechanism of Geo composite Drain

Advantage of use of Geo composite drain:

a) It prevents the intermixing of the backfill soil with filter media, thus avoiding the clogging of the filter media.

b) By using Geo composite, work can be executed at faster pace and labour requirement is very less and can be fixed with easily available tools

c) Existing practice of use of hand pack boulder is labor oriented task consuming more time which is substantially reduced by use of Geocomposite drain.

d) It is an engineer efficient solution by minimizing aggregate requirement.

e) **Sustainability:** Existing practice i.e., hand pack boulder has dependency of natural resources that leads to environmental imbalance. New initiative i.e., use of geo composite drain minimize depletion of natural resources (Stone Quarry) which substantially reduce carbon emission that results in an enabling environment.

f) **Environment and Health:** As the stone quarry are located near villages, the production and transportation lead to dust nuisance and chances of silicosis to workmen and villagers. Geo composite material Rolls are transported from warehouse/ factory to Construction site thereby reducing the transit through village roads and eventually controlling dust nuisance. So, it is beneficial for environment and Health on account of reduction in emission of greenhouse gases.

Cost: The cost of Geo composite drain is a 2 % to 3 % higher than the conventional method. However, there are intangible benefits such as sustainability, Environment, health and time saving, it is indorsed to use geo composite drain over conventional method of hand pack boulder.

There are various reasons for the higher cost of geo composite drain such as

a) 44% excess geo composite drain material required due to overlap and odd/varying dimensions of structure.

b) 600 mm width of hand pack boulder is replaced with the select soil. As entire alignment of CTP 14 project is passing through Delhi NCR hence ownership cost of soil is very high.

c) Higher testing and material handling charges of geo composite drain

Specification requirement of Geo composite drain as per RDSO Specification No. RDSO/2018/GE: IRS-0006

Sl. No.	Property	Test Method	Proposed value
I	**Composite Drain (Non-Woven geotextile on both sides)**		
1	Tensile Strength	ASTM D459 5-2017	20 KN/m in both MD & CD (± 10 %)
2	In-plane Water flow for i=1, Rigid/Soft Contacts) At 100 kPa (To be tested in Lab)	ASTM D471 6-2014	1.5 Lit/m.sec.
3	Static puncture Resistance CBR (*)	ASTM D 624 1-2014	3000 N
4	Ultraviolet Stability Requirement after 500 Hours of exposure (*) retained breaking strength in Strip Tensile Test .	ASTM D435 5-2018	Not Less than 70 % (after unwrapping, the Geocomposite should be installed and covered within a maximum of 14 days)
5	Minimum retained Ultimate Tensile Strength (*)	EN: 12447-2001 and EN ISO: 13438-2004	50% (tested as per Clause B.4 of EN; 1325 0-2016 for 100-year service life)
II	**Core**		
1	Material		HDPE/Polypropylene/Polyethylene, Polyester or combination thereof
III	**Filter (Non-woven Geotextile)**		
1	Material		Polypropylene/Polyamide/Polyethylene, Polyester or combination thereo f
2	Type/Structure		Non-woven Needle Punched & Mechanically or Thermally Bonded type or equivalent.
3	Permeability (perpendicular to Plane)	ASTM D449 1-2016	70 Lit. m^2. S (Min.)
4	Apparent Opening Size	ASTM D475 1-2016	150 Micron (Max.)
5	Puncture Strength - CBR (*)	ASTM D624 1-2014	1400 N
6	Ultraviolent Stability Requirement after 500 Hours of exposure (*) Retained breaking strength in Strip Tensile test .	ASTM D435 5-2018	Not Less than 70 % (after unwrapping, the Geocomposite should be installed and covered within a maximum of 14 days)

- MD: machine Direction (Longitudinal to the roll)
- CD: Transverse Direction i.e., 90° to MD, (Across the roll width)

* Is Minimum Average Roll Value (MARV), which is derived statically as average value minus tow standard deviations.

PROCEDURE FOR INSTALLATION OF GEOCOMPOSITE DRAIN AND BACKFILLING

- **Packing, Handling and Installation of Geocomposite drains:**

a) The geo composite drain shall be provided in wraps with a protective covering. A tag or other method of identification shall be attached to each wrapped package indicating the following:

   i) Manufacturer or Supplier Name

   ii) Product Name and Style

   iii) Roll Identification Number

   iv) Lot or Batch Number.

b) Rolls of Geocomposite drain should not be dragged on the ground and they must be lifted off the ground before moving them.

c) Geocomposite drain should be adequately protected from Ultraviolet (UV) exposure during storage at site. The protective wrapping, in which the Geo-Composite drain come wrapped from factory, should be kept on till their installation. After unwrapping, the Geo-composite drain should be installed and covered within a maximum of 14 days.

d) If store outside, they should be elevated from the ground surface and adequately covered to protect them from site construction damage, precipitation, UV radiation, chemicals that are strong acids/bases, flames including welding sparks, temperature in excess of 71°C etc.

- **Application of Geocomposite drain:**

(i) The surface on which the Geo composite drain is to be installed shall be free from any oil/grease or any sharp objects/edges.

(ii) The Geo composite drain roll shall be opened up to the required length on flat surface.

(iii) The length and width of Geocomposite drain shall be measured and cut as per site requirement.

(iv) Behind structures installation can be done by unrolling and supporting Terrain Drain with the help of locally available boulders and stones without any use of adhesive

(v) At the Junction of two Geocomposite drain sheets, 150mm overlap of Geotextile shall be ensured. If the overlap edges of Geotextile are available, then the Geocomposite drain is provided with the butt joint. If there are no extended edges, 100mm wide geotextile shall be provided at the junction of 2 rolls and shall be sealed with tape.

(vi) Geocomposite drain should be hold by pinning using fastener or concrete nail of 7 to 10 mm diameter at a grid of 1.0m X 1.0 m. Proper care shall be taken so that Geocomposite drain will remain in the position and shall not damage during the period of Construction

(vii) Geocomposite drain shall be laid in such a fashion that machine direction of the Drainage Composite shall be in vertical direction and Cross Machine Direction of Geo Composite shall be in Horizontal direction of wall or vice a versa

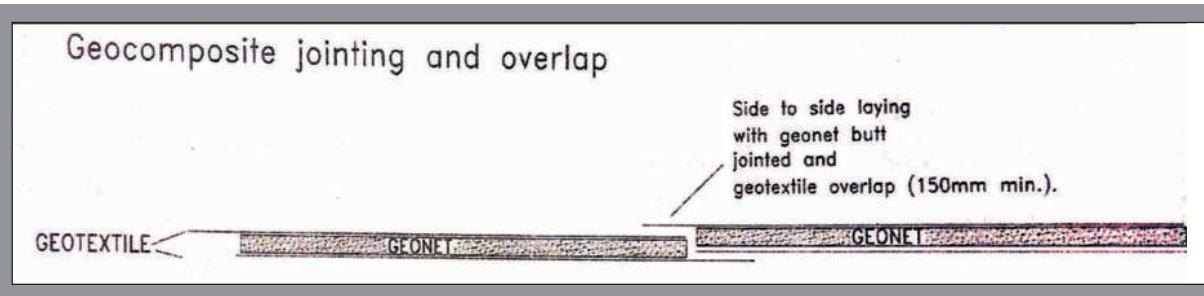


Figure 6: Jointing and overlapping

viii) Care must be taken to ensure that large, stones are not allowed in the soil & large projection abutment surface to damage the surface of geotextile filter.

xv) In case of use behind Bridge Abutment or retaining wall, slotted pipe can be provided for horizontal drainage at bottom, by placing Geonet inside slot and both layers of geotextile to be wrapped around the slotted pipe & pasted at the overlap with suitable tape. Or perforated pipe can be provided for horizontally drainage bottom, by placing Geonet is terminated at the top of perforated pipe and both layer of geotextile to be wrapped around the perforated pipe and pasted at the overlap with suitable tape.

x) Geocomposite drain shall be capable of being connected longitudinally or laterally into pipe system or chambers for outflow purpose. Joint parallel to the direction of flow and any exposed edge shall be protected from the ingress of soil by Wrapping with a minimum overlap of 150mm or other measures.

xi) Filling material/Backfill can be dumped to half of the structure height immediately after complete area has been covered with Geocomposite drain in order to ensure proper placement of rolls. Compaction of backfill shall be done at the height intervals of every 200mm. Next layer of backfill shall be dumped only after previous layers have been compacted to 95% compaction.

Figure 7: Site photographs of installation of Geo composite drain at CTP 14 Project

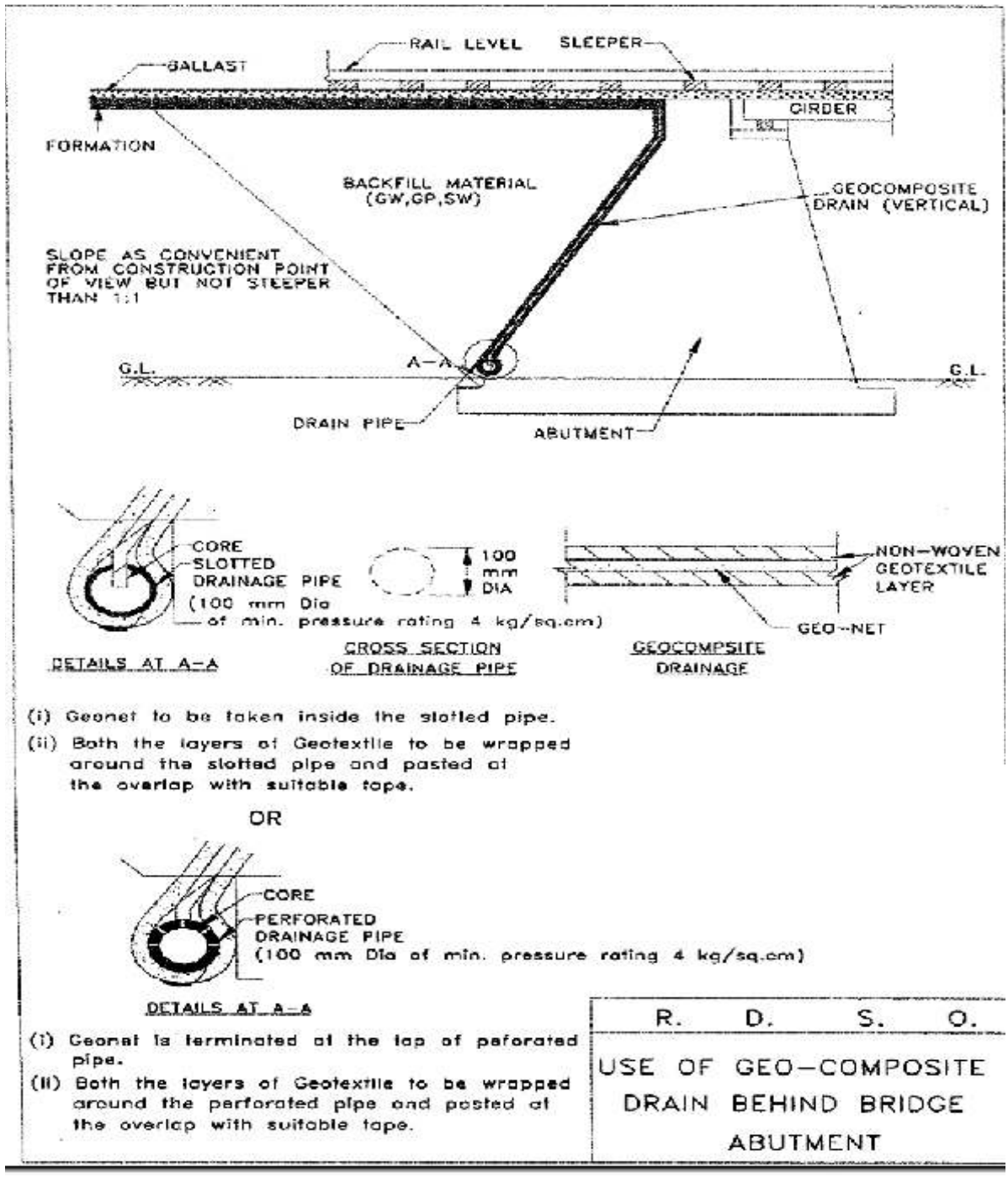


Figure 8: A diagram showing Geocomposite Drain behind bridge abutment

Conclusion: Use of geo composite drain as a replacement of 600 mm thick hand pack boulder results in additional cost to the project than conventional method but this engineering efficient solution is recommend to use given easy constructability, sustainability, ecofriendly and faster operation than conventional method mitigating the risk of delay of project.

RISK ASSESSMENT AND SAFE WORKING PROTOCOLS WHILE WORKING NEAR THE IR LIVE OPERATIONS IN PILKHANI - SAHNEWAL SECTION (EDFC 301)

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ABSTRACT

In worldwide industrial field, if any industry to be successful, it has to be safe, reliable, and sustainable in its operations. The industry has to identify the hazards and assess the associated risks in orderto bring the risks to a widely tolerable level.

Hazard Identification and Risk Assessment (HIRA) is carried out for identification of undesirable events that can lead to a hazard.The analysis of hazard of this undesirable event that could occur and is usually an estimation of its extent, magnitude and likelihood of potential harmful effects. It is widely accepted within the construction/railway industry in general that the various techniques of risk assessment contribute greatly toward improvements in the safety of complex operations and equipment.

The objective of this work of hazards and risk analysis is to identify and analyze hazards, the event sequence leading to hazards and the risk associated with hazardous events. Many techniques ranging from the simple qualitative methods to the advanced quantitative methods are available to help identify and analyze hazards. The use of multiple hazard analysis techniques is highly recommended as a belt and braces approach because each analysis has its own purpose, strengths, and weaknesses.

Keywords: Hazard Operability Studies (HAZOP), Failure Mode Effect Analysis (FMEA), Process Hazard Analysis (PHA), Layer of Protection Analysis (LOPA).

INTRODUCTION

The project EDFC 301 betweenPilkhaniin Uttar Pradesh to Sahnewal near Ludhianain Punjab covers the three states including Haryana. The horizontal alignment crosses districts of Saharanpur (Uttar Pradesh), Yamunanagar&Ambala (both in Haryana) and Patiala, Fatehgarh Sahib & Ludhiana (all in Punjab).

The EDFC rail lines have been generally planned adjacent to the existing Indian Railways (IR) rail line except at detours (Ambala, Rajpura and Sirhind) and grade separations (Ambala, Shambhu, and Sirhind). Under this Project, an electrified single line of 175 km between Pilkhani and Sahnewal is being constructed with no level crossing of existing IR lines.

Prior to the commencement of any design and construction tasks, an HSE risk assessment will be carried out bycompetent personnel in the Contractor's team then Safe work will be carried out based on risk assessment hierarchy. Until now8million safe work man hours have been achieved without any LTI in this Project.

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The objective of this work of hazards and risk analysis is to identify and analyze hazards, the event sequences leading to hazards and the risk associated with hazardous events. Many techniques ranging from the simple qualitative methods to the advanced quantitative methods are available to help identify and analyze hazards. The use of multiple hazard analysis techniques is recommended because each has its own purpose, strengths, and weaknesses.As the part of the work. Hazard identification and risk analysis was carried out for construction activities and the hazards were identified and risk analysis was carried out. The different segments of activities were divided in to high, medium and low depending upon their consequences and likelihood. The high risks activities have been marked in red color are un-accepted and must be reduced. The risks which are marked in yellow color are tolerable, but efforts must be made to reduce risk without expenditure that is grossly disproportionate to the benefit gained. The risks which are marked in green have the risk level so low that it is not required for taking actions to reduce its magnitude any further.

Hazard identification and risk analysis (HIRA) is a collective term that encompasses all activities involved in identifying hazards and evaluating risk at facilities, throughout their life cycle, to make certain that risks to employees, the public or the environment are consistently controlled within the organizations risk tolerance level. These studies typically address three main risk questions to a level of detail commensurate with analysis, objective, life cycle stage, available information, and resources.

Tools for simple hazard identification or qualitative risk analysis include hazard and operability analysis (HAZOP), what –if/checklist analysis, and failure modes and effect analysis (FMEA)

Tools for simple risk analysis include failure modes, effects and critically analysis (FMECA) and layer of protection analysis (LOPA).

Tools for detailed quantitative risk analysis include fault trees and event trees. For example, some companies may judge the mere existence of an explosion hazard to be an unacceptable risk, regardless of its likelihood. Others may be willing to tolerate an explosion risk if proper codes and standards are followed. Still there could be some those may be unwilling to accept an explosion risk unless it can be shown that the expected frequency of explosion is less than 10-6/yr. HIRA encompasses the entire spectrum of risk analysis, from qualitative to quantitative. A process hazard analysis (PHA) is a HIRA that meets specific regulatory requirement in the U.S.

Construction is the process of constructing a building or infrastructure. Construction differs from manufacturing typically involves mass production of similar items without a designated purchaser, while construction typically takes place on location for

known client. Construction as an industry comprises 6 to 9 percentage of the Gross Domestic Product (GDP) of developed countries. Construction starts with planning, design and financing and continues until the work is built and ready for use.

HIRA:

To manage risk, hazards must first be identified, and then the risk should be evaluated and determined to be tolerate or not. The earlier in the life cycle that effective risk analysis is performed, the more cost effective the future safe operation of the process or activity is likely to be. The risk understanding developed from these studies forms the basis for establishing most of the other process safety management activities undertaken by the facility. An incorrect perception of risk at any point could lead to either inefficient use of limited resources or unknowing acceptance of risks exceeding the true tolerance of the company or the community.

Procedure for HIRA

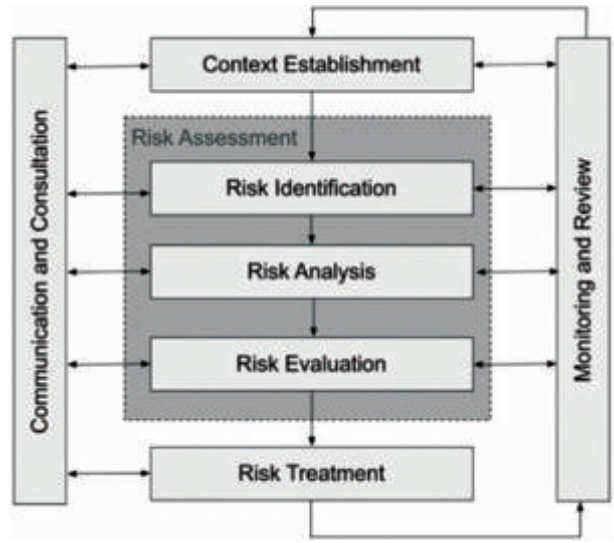
At each stage in the work life cycle, a review team questions process experts about possible hazards and judges the risk of any hazards that are identified. Several common methods exist for questioning a design, ranging from simple qualitative checklists to complex quantitative fault tree analysis. The result of the review process is typically documented in a worksheet form, which varies detail, depending on the stage of the work and the evaluation method used. Risk studies on operating processes are typically updated or revalidated on a regular basis. The purpose of this work is to identify the hazards and risk by analyzing each steps involved in various activity in the construction, and to give suggestion in order to eliminate orreduce the risk assessment (HIRA). Industry becomes successful by not only meeting the production requirements but also should have high employee satisfaction by providing the safety requirements in the workplace. The Hazards and risk assessment should be done and actions to be taken to convert the risk to a tolerable level on regular basis.

HIRA Process:

HIRA Process it consists of four steps as follows:

I. Hazard identification
II. Risk assessment
III. Risk analysis
IV. Monitor and review

Hazard identification-

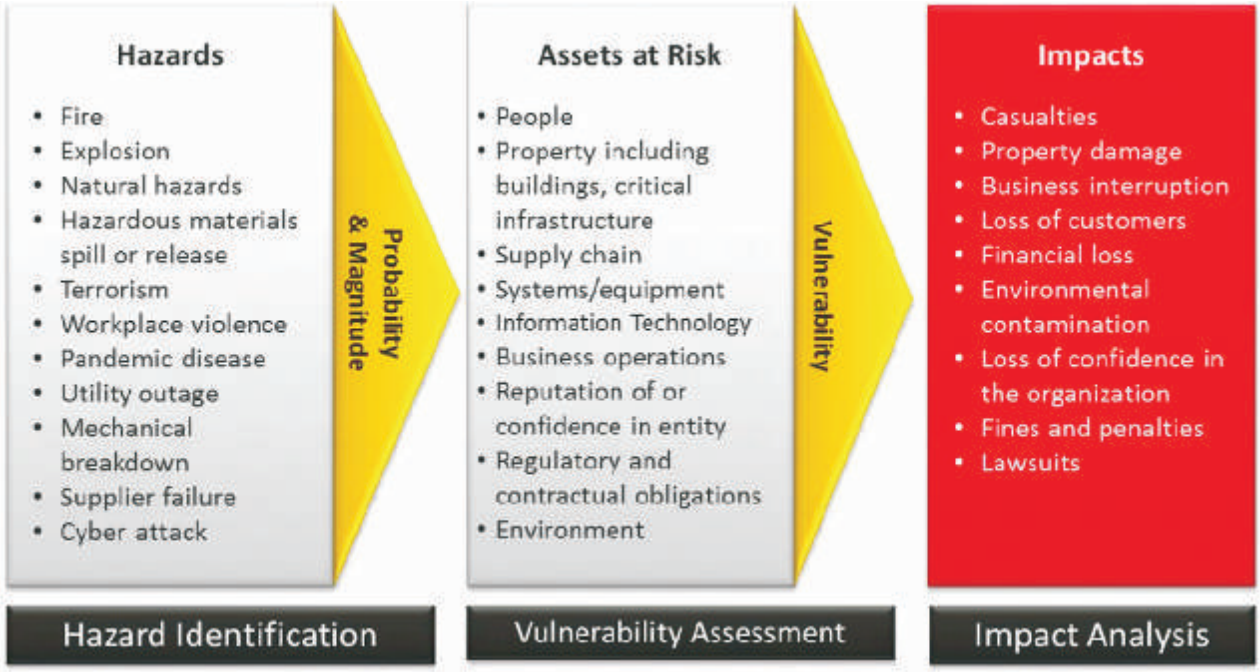


Workplace hazards can be identified in a number of ways. Inspections provide a system of recognizing hazardous conditions so that those conditions can be corrected. The data collected while performing inspections will be used to identify hazards and barriers to working safely and in an environmentally

protective manner so that they can be addressed such as procedure changes or purchasing different PPE. The data also will be tracked as a protective measure of acceptable HSE behavior on the site. reports and safe work observation information will be shared with employees at toolbox safety meetings.

Assessment –

Assessment is estimating what the chances are (probability) of an accident happening, and if it does happen, what are the chances that someone will be hurt? What will be the extent of equipment or environmental damage, and how bad will it be (severity)? The level of risk is dependent on the exposure to the hazard and the probability and consequences of an event occurring.



Once the hazard has been identified, it is necessary to assess what risk they pose to employees in the workplace. In this way we can establish a measure of the risk and determine what priority they should have for corrective actions. The risk assessment step is that part of the process that assesses the probability (likelihood) and consequences (severity) of hazard that have been identified. Once we have estimated the probability and consequences for each hazard then we can allocate it a priority for corrective action.

Risk Analysis

The risk analysis determined the frequency and potential impact of hazards on business operations, community, associated stakeholders, related infrastructure, and the environment. Historical occurrences, changing circumstances, outside influences and similar occurrences happening elsewhere are examined when analyzing risks.

Impact was split into five groups:

Human Impacts - The direct negative effects of an incident on the health of people including; fatalities, injuries or evacuations.

Property Impact - The direct negative effects of an incident on buildings, structures and other forms of property.

Business Impact - The negative economic or social lossesdue to an incident.

Critical Infrastructure Service Disruptions/Impact - The negative effects of an

incident on the networks of institutions, services, systems and processes that meet vital human needs, sustain the economy, protect public safety and security, and maintain continuity of and confidence in government. This category is divided into two; Damage to Critical Facilities and Damage to Lifelines.

Environmental Damage- The negative effects of an incidenton the environment, including the soil, water, air and/or plants and animals.

HIERARCHY OF CONTROLS

Having identified the potential hazards, the team is further responsible for identifying solutions to those hazards, the preferred hierarchy for developing solutions/controls is provided below.

Elimination - eliminating toxic substances, hazardous equipment or processes that are not necessary for a system of work.

Substitution- where hazardous materials /chemicals have been identified as a hazard, the preferred option is to replace the material with a less hazardous one. Engineering-the removal of potential hazards by reengineering the job is a preferred option. This includes design modification, guards, permanently fixed physical barriers, interlocked physical barriers, physical barriers, presence sensing systems, enclosures, ventilation, automation and isolation.

Administrative controls -the application of administrative controls to hazards may include such actions as limiting the time of exposure, rotating employees, and training of employees.

PPE-the provision of PPE does not eliminate the hazard, but only shields the individuals from it. Such action may have to couple with training in the correct use of the equipment.

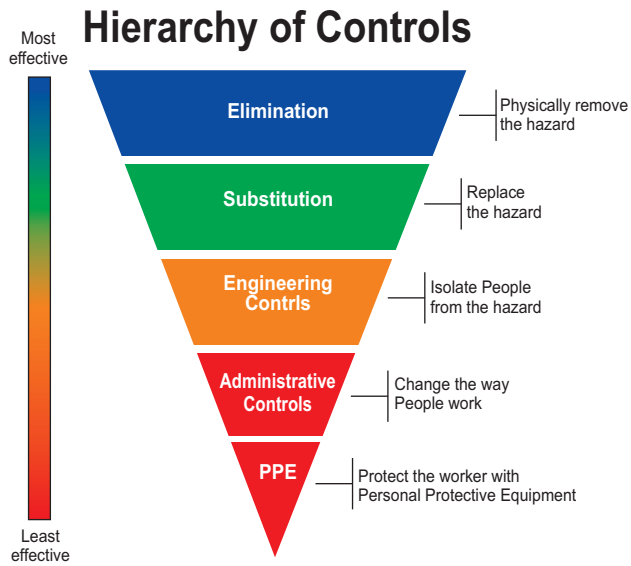
Evaluation -this steps means checking to see whether the introduced changes reduce the risk previously assessed. it may involve repeating the process of hazard identification, risk assessment, and risk control to verify that all risks to health.

Need for risk assessment:

Risk assessments will help the mine operators to identify high, medium and low risk levels. Risk assessments will help to priorities risks and provide information on the probability of harm arising and severity of harm by understanding the hazard, combine assessments of probability and severity to produce an assessment of risk and it is used in the assessment of risk as an aid to decision making. In this way, mine owners and operators will be able to implement safety improvements. Different types of approaches for the safety in mines various tools and appropriate steps have to be taken to make mining workplace better and safer.

Hazards in rail industry and their analysis

Construction sites are dangerous places where injury, death or illness can occur to workers. These can happen due to electrocution, falling from height, injuries from tools, equipment and machines; being hit by moving construction vehicles, injuries from manual handling operations, illness due to hazardous substance such as dust, chemicals, etc. Even a nail standing up from a discarded piece of wood can cause serious injury if trodden on in unsuitable shoes.



In context to Indian scenario:

The construction is the second largest economic activity in India after agriculture which is maintained at the first level. It has accounted for around 40% of the development investment, during the past 50 years. Around 16% of India's working population depends on construction for its livelihood.

The Indian construction industry employs over 35 million people and creates assets worth over Rs. 200 billion. Construction accounts for nearly 65% of the total investment in infrastructure. Investment in construction accounts for nearly 11% of India's GDP. The market size of the construction industry for the 12th Five Year Plan period indicate that the aggregate output of the industry during the period 2012-13 to 2014-17 is likely to be 52.31 lakh crores.

There are a number of Indian regulations dealing with the working conditions of construction workers. The main Indian regulations are:

Building & Other Construction Workers (Regulation of Employment and Conditions of Services) Act, 1996.

Building & Other Construction Workers (Regulation of Employment and Conditions of Services) Central Rules, 1998.

Building & Other Construction Workers Welfare Cess Act, 1996.

These rules came into force on 19 November 1998. These rules apply to all buildings and other construction work relating to any establishment in which appropriate government is the Central Government. Some of the other statutory provisions/codes in force to take care of the working conditions of the construction workers are:

The Fatal Accidents Act, 1885,

The Factories Act, 1948,

The Workmen's Compensation Act, 1923,

The Employees State Insurance Act, 1948,

The Central Labor (Regulation & Abolition) Act, 1970,
The National Building Code of India, 2005

SITE PREPARATION:

Preparation of a construction site is an important aspect which should focus on a good site layout, easy access to the site and easy movement of vehicles in the site.

Site Layout: A badly planned and untidy construction site can lead to many accidents at construction (Rail industries) sites, which may arise from: (i) fall of materials, (ii) collision between the workers,

(iii) plant or equipment. To avoid the above causes of accidents, a good layout of the site is a must. While preparing the site layout, at-most care should be taken to avoid overcrowding the site. Also, enough space should be provided for the movement of men, material and construction equipment within the site.

Movement of Vehicles: It is a common sight on the construction site that many vehicles (trucks, cranes, forklifts, etc.) carrying construction materials move crisscross on the construction site, which results in several accidents and mishaps. Construction sites often operate on the ground, which is muddy and uneven, and where driver visibility is poor. People

walking on the site are injured or killed by moving vehicles especially reversing ones. Many workers, particularly drivers and operators are killed by overturning vehicles. Hence, at-most care should be taken for the movement of vehicles on the construction sites. The following points should be taken into consideration, while moving the vehicles on the construction site:

Vehicles and pedestrians should be kept apart on site, i.e. separate them as much as possible using barriers.

Adequate clearance should be provided around vehicles.

As far as possible, avoid reversing the vehicles. It is better to use one-way system.

Vehicles used on the sites must have reversing alarms/sirens.

SITE OPERATION:

The type of railway work operations/activitiescarried out in a construction site are many (See attach pictures) and they vary from site to site. However, all of them should be carried out only with due regard to safe

operations. Some of the routine work/operations carried out in construction sites are listed below:

1. IR Safety works;
2. Excavation / Piling Work;
3. Scaffolding Work;
4. Crane / Lifting operation.

IR Safety Works:

Figure 1.A typical view of a construction site

Indian Railway is a leading transportation operations work in Indiaand responsible for running the trains in safe and punctual manner.

DFCC Project main aim is to construct and build the new DFCCIL line near the IR live track in India a safe manner as to not to disrupt IR Operations. As per Safety system need to protect the running train from emergency and prevent multi injuries/ accident in 301 Project.

- Works which executed within 3.5 mtr from centre line of existing Indian Railway track should be executed under block protection and with permit to work from concerned railway dept.

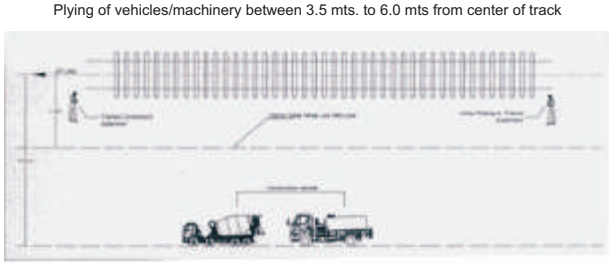


Figure 2.Typical line diagram for vehicle movements near the IR.

- For works to be executed between 3.5 mtr to 6 mtr from centre line of existing Indian Railway track work to be executed after erection of fencing as per approved plan.
- For works to be executed beyond 6 mtr from centre line of existing Indian Railway track, it must be ensured that no vehicle / constructionequipment infringes demarcation line marked at 3.5 mtr from centre of existing railway track.

The basic emergency response procedure applies to supervision of work on jobsite and using local access roads on the alignment in proximity to Indian Railway Tracks.

Basic Rail Safety training of all Employees, drivers, operators and site workers.

In case of emergency or accidents in the running IR tracks related to DFCCIL project works, the following immediate response must be followed.

Typical IR Safety training room – Risk briefing to all work force.

Excavation/ Piling Work:

Typical Excavation with sheet piling

Soil Erosion may occurs – During excavation

Sheet Piling works – to prevent soil erosion during excavation

Excavation work is an important activityin the construction sites. However, many fatal accidents do occur in excavation work, if proper precautions are not taken. Many lives are lost being buried alive in the trenches. It should be remembered here that there is no safe ground that will not collapse and thereforeany trench sites can collapse without any warning.

All excavation works deeper than 1.25 meters must be shored or battered. Excavation deeper than 2 meters must be guarded by rails or barriers. Vehicles workingtoo close to the side of the trench or rubble piled on the sides may cause collapse and therefore at most care should be taken.

Vehicles tipping into the excavation work must use stop blocks, to avoid the collapse of the trench. Make sure that the excavation work is inspected daily.

Make sure that you know where the position of underground pipes and electric cables were laid in the site, so that you will not hit them during the excavation work.

Sheet piling is used to prevent the soil erosion for the deep excavations.

Scaffolding/ Height Work:

Scaffolds are temporary structures of steel work, timber or bamboo. The criteria for their erection are the same as those for permanent structures. The strength of the scaffolding depends upon the combined strength of individual members. Failure of one or two of them can result in the collapse of the entire structure. Modern scaffolds are invariably made of steel tubes, prefabricated in convenient units.

They are safer and turn out good quality work. The steel scaffolds are too costly, but it would be cheaper in the long run. In spite of the fact that the steel scaffolds are much safer, many of the smaller and medium size builders in India neglect the safety aspects and prefer to use timber or bamboo scaffolds see the attached photosin order to cut the cost. In any case, while erecting the scaffolds, the workers should be forced to wear necessary safety belts with fall arrestors and helmets, so that the fall accidents can be avoided.

A typical view of scaffolding/ Height works.

Crane/ Lifting Operations:

Various type of cranes are used in construction sites, which includes (i) Portable Cranes (ii) Tower Cranes. A number of accidents are reported in the use of cranes, and many of them could be averted by adopting safe methods of operations. Some of the methods to be adopted for safe crane operations are given below:

- The weight of the load intended to be lifted by the crane must be carefully estimated;
- The crane must be fitted with an automatic safe load indicator;
- The crane must always work on a hard, level base;
- The load must be properly fixed and secured;
- The signal man must be trained to give clear signals;
- The ropes, hooks, chains, slings, etc. used in the lifting operations, must be inspected regularly for their worn out;
- When mobile cranes are used, care must be taken to prevent overturning of cranes.

Typical Crawler crane operation near IR

Typical View of the Mobile crane operatoion &Various Inspection (PMC & TPI)

Typical View of the Mobile crane operatoion &Various Inspection (PMC & TPI)

- Never walk, stand or work beneath a hoist/ Lift.
- Isolate hoisting area with barriers, guards and signs as appropriate.
- Never exceed the capacity limits of your hoist.
- Wear gloves, helmets and other personal protective equipment as appropriate, when working with hoists and cables.
- Ensure that hoists are inspected regularly.
- When the work is completed, always rig the hoist down and secure it.
- Be prepared to stop operations immediately of signaled by the safety watch or another person.
- Do not pick up loads by running the cable through, over or around obstructions. These obstructions can find the cable or catch on the load and cause an accident.
- Do not hoist load when any portions of the hoisting equipment within 6 feet of high-voltage electrical lines or equipment.
- If you need to hoist near – voltage electrical lines or equipment, obtain clearance from your electrical supervisor first.
- Lifts are very commonly used in construction sites for movement of many construction materials and stacking them at heights.

TYPES OF HEALTH AND SAFETY HAZARDS ON CONSTRUCTION SITE

- Height;
- Slips and trips;
- Equipment, machinery, tools and transport;
- Electricity;
- Fire;
- Manual handling;
- Noise;
- Chemical substance;
- Dust.

There are no fixed rules about how the risk assessment should be undertaken. The following steps could be used as guidance.

- Initiating the HIRA;
- Identify the hazard;
- Identify all parties affected by the hazard and determine how they can be affected;
- Evaluate or assess the risk.

Step 1: Initiating the HIRA and selecting the approach

Two principles should be taken in consideration before an assessment is carried out: Structure the assessment to ensure that all relevant hazards and risks are addressed. This should be done to ensure that tasks like night security that might take place ''out'' of working hours, is not overlooked. When a hazard is identified, the first option should always be to eliminate it first.

A number of approaches and combinations there of to risk assessment can be adopted to perform the HIRA.

The approaches to risk assessment at work which are used are normally based upon:

Observation of the workplace environment (e.g. means of access, conditions of floors; machinery safety; dust and fumes, temperature, lighting; noise; etc.)

Identification of tasks carried out at the workplace to identify all tasks so that they are all included in risk assessment.

Consideration of tasks carried out at the workplace as evaluation of risks from the different tasks.

Observation of work in progress (check that procedures are as laid down or predicted, and that there are no other risks arising).

Consideration of patterns of work (to access exposure to hazards).

Consideration of external factors that could affect the workplace (e.g. weather consideration for outdoor workers).

Review of psychological, social and physical factors which might contribute to stress at work, how they interact together and with other factors in the workplace organization and environment.

Consideration of organization to maintain conditions, including safeguards e.g. that systems are in place to assess risks from new plant, materials and so on to update information on risks.

After the selection of the desired HIRA approach, the following information should be completed by the above-mentioned assessor(s).

Date: Insert date that assessment form is completed. The assessment must be valid on that day, and subsequent days, unless circumstances change and amendments are necessary.

Assessed by: Insert the name, designation and signature of the assessor or in the case of a team the names, designations and signatures of all the team members.

Checked by: Insert the name and signature of someone in a position to check that the assessment has been carried out by a competent person who can identify hazards and assess risk, and that the control measures are reasonable and in place. The checker will normally be a line manager, supervisor, principal investigator, etc. Checking will be appropriate for most risk assessments.

Validated by: Use this for higher risk scenarios, e.g.- where complex calculations have to be validated by another "independent" person who is competent to do so, or where the control measure is a strict permit-to-work procedure requiring thorough preparation of a workplace. The valuator should also be a competent

engineer or professional with expertise in the task being considered. Examples of where validation is required include designs for pressure vessels, load-bearing equipment, lifting equipment carrying personnel or items over populated areas, and similar situations.

Location: Insert details of the exact location, e.g. building, floor, room or laboratory etc;

Task / premises: Insert a brief summary of the task, e.g. typical office activities such as filing, DSE work, lifting and moving small objects, use of misc electrical equipment. Or, research work [title] involving the use of typical laboratory hardware, including fume cupboards, hot plates, ovens, analysis equipment, flammable solvents, etc;

Activity: use the column to describe each separate activity covered by the assessment. The number of rows is unlimited, although how many are used for one assessment will depend on how the task / premises is sub-divided. For laboratory work, activities in one particular lab or for one particular work might include; use of gas cylinders, use of fume cupboard, use of computer or other electrical equipment, use of lab ovens, hot plates or heaters, use of substances hazardous to health, etc.

Hazard: for each activity, list the hazards.

Step 2: Identify the hazards

The importance of this element cannot be over emphasized. It is by far the most important element of the risk assessment process and should be performed in a systematic manner.

Gathering and analysis of information before the assessment

The gathering and analysis of information is an essential task before the risk assessment can start. This would normally be conducted by the safety practitioner or person responsible for health and safety and it is one of his more important duties. The person should access the databases on the business to assess the types and major underlying causes of past accidents and incidents. It is advisable to also review accident reports and investigations together with other records such as those maintained by engineering staff, logbooks and audit reports.

Externally, he or she may be able to gather information from government and industry organizations or from publications and databases.

During the physical assessment or after the assessment,

The adoption of some systematic way of allowing relevant persons to ''see'' or ''spot'' the hazards present in the workplace. If the hazard identification is not carried out carefully, the subsequent analysis of risk and the development of risk control measures become pointless. The identification of hazards is not only an essential part of the risk assessment process, but also acts very effectively to change the way people think, causing them to act more safely and so become more proactive in hazard awareness. When you work in a place every day it is easy to overlook some hazards. There are many techniques and tools that can be used as part of the hazard identification process, here are some tips to help you identify the ones that matter:

Observation - walk around your workplace and look at what could reasonably be expected to cause harm.

Communication - ask your employees what they think. They may have noticed things that are not immediately obvious to you.

Information - check ''manufacturers'' instructions or MSDS for chemicals and equipment as they can be very helpful in spelling out the hazards and putting them in their true perspective.

Records - Have a look at your incident and sickness records – these often help to identify the less obvious hazards.

Visit relevant Websites to gain information. Increasingly, the internet is a valuable means of gathering international data. All this data needs to be assimilated and converted into a useful format to prepare the team who undertakes risk assessment. Calling legal your labor inspector at the labor centre. Consultation with the workplace health and safety committee and representatives. Brainstorm ideas and group under appropriate risk headings. Consider the

effects on people (staff, students and other people), information, physical assets and finances, reputation. Write the final list onto the table (risk assessment summary). Data from health surveillance program.Consulting with subject matter experts or consultants.SABS codes and standards.

Step 3: Identify all parties affected by the hazard and determine how they can be affected

Next you need to identify who might be harmed; it will help you identify the best way of managing the risk. That doesn't mean listing everyone by name, but rather identifying groups of people (e.g. people working in the storeroom or kitchen). In each case, identify how they might be harmed, e.g. what type of injury or ill health might occur.

Remember:

Some workers might be more vulnerable like new and young workers, new or expectant mothers and people with disabilities, lone workers.

Cleaners, visitors, contractors, maintenance workers etc, who may not be in the workplace all the time.

Members of the public, if they could be hurt by your activities.

If you share your workplace, you will need to think about how your work affects others.

As well as how their work affects your staff – talk to them; and ask your staff if they can think of anyone you may have missed.

Identify groups or people who may be affected.

Examples of people at risk

Employees	Cleaners
Temporary workers	Security personal
Shift workers	Children
Contactors	Volunteers
Visitors	Students
Customers	Tenants
Members of the public	Relief workers

Examples of vulnerable people:

New or expectant mothers	Lone workers
Employees, customers or visitors with	Students
Disabilities	
Young people	Non-English Speakers
Inexperienced workers	

If the risk assessment is job-specific, use the individual's job title, not their name.

Step 4: Evaluate or assess the risk

Having identified the hazards, you then have to decide what to do about them. Legislation requires you to do everything "reasonably practicable" to protect people from harm.

RISK RATING

One of the most simplistic forms of risk assessment is to rate the remaining risk as high, medium or low, depending on how likely the activity is to cause harm and how serious that harm might be. This is called "Risk rating".

LEVEL OF RISK

Low risk items-Need to be considered, but there is a smaller chance that they will cause the entire work to go off the rails. It is most unlikely that harm would arise under the controlled conditions listed, and even if exposure occurred, the injury would be relatively slight.

Medium risk items-These types of risks are ones that could cause issues, but that there is still a lower chance that they will cause your work to fail. It is more likely that harm might actually occur and the outcome could be more serious (e.g. some time off work, or a minor physical injury).

High risk items-These are the risks that take the highest priority. They can cause your work to fail, and you need to plan for these risks ahead of time. If injury is likely to arise (e.g. there have been previous incidents, the situation looks like an accident waiting to happen) and that injury might be serious (broken bones, trip to the hospital, loss of consciousness), or even a fatality.

RISK RANKING MATRIX

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			

In order to do a "risk rating", we normally make use of a matrix scoring system. Numerical scores are given to the different elements (e.g. consequence, exposure, likelihood) of risks and these scores are added or multiplied to get a rating for the risk. For the initial risk evaluation, consider the risks identified in the worst-case scenario before any controls are applied.

Elements of risk:

Consequence/ severity (How serious)

Consequences are the expected severity. The severity is expressed in terms of the effect on the person, whether injury or ill health, and ranging from minor injury to death. Think about how serious the likely outcomes would be if harm from a hazard was realized. The risks are clearly higher if an accident is likely to result in serious injury or death, for example, than a bruise or a scratch.

Probability/ Likelihood (How likely)

By evaluating the risks associated with each hazard you have identified, you're deciding how likely it is that harm will occur from the hazard. The likelihood is the probability of loss when a sub-standard act occurs or sub-standard condition exists.

The likelihood should be based on the worst-case scenario, ranging from a remote possibility to the inevitable. Factors affecting the likelihood include:

- Number of times the situation occurs;
- Location of the hazard;
- Duration of the exposure;
- Environmental conditions;
- Competence of the people involved and
- The condition of equipment;\
- Frequency (How often).

Risk assessment sheet –In an DFCC RAIL corridor

Sno	Sub-Activity	Potential Hazard	Consequence	Base Risk			Control measures	Proposed Control	Residual Risk		
				P	S	R			P	S	R
1.	Execution of work within 3.5M from the existing IR Track	1. Contact with moving train 2. Equipment / Men coming close to IR Track / Infringement of unauthorized vehicles into the train movement zone.	Injury and multiple fatalities.	4	5	20	1. Should be executed under block protection and with permit to work from concerned railway. 2. Tie up with local hospitals. 3. Provide supervision / Look out man. 4. Ensure Daily HIRA Talk talk/HIRA Talk Talks 5. Ensure Emergency vehicle availability 6. Provide a flagman aAnd No night work is allowed. 7. Intimate to local authorities. 8. Ensure proper hard barricades as per IR Standards. For ex. DFCCIL projects, barricades shall be as per drawing.	1. Ensure the engagement of competent and trained operators. 2. Boundary illumination 3. Battery operated yellow - red stickers. 4. CCTV surveillance round the clock.	1	5	5
2.	Execution of work within 3.5M from the existing IR Track	Working near to the underground utilities	Injury	3	3	9	1. Provide barricades and IR specifications. 2. HIRA Talk shall be delivered. 3. Obtain PTW from IR team while working near to the railway electrical lines. 4. Underground while working near to the other LT/HT lines.	1. Ensure dynamic HIRA precautionary measures are in place 2. Use utility detector to identify the existing utility system.	1	3	3
3.	Execution of work within 3.5M from the existing IR Track	Working near to OHE Line	Fatality due to Electrical shock/burns	4	5	20	1. Provide barricades and IR specifications. 2. HIRA Talk shall be delivered. 3. Obtain PTW from IR team while working near to the railway electrical lines. 4. Relocate / underground while working near to the other LT/HT lines.	Ensure dynamic HIRA precautionary measures are in place	1	5	5
4.	Execution of work between 3.5 M to 6 M from centre line of existing Indian Railway track.	Equipment / Men coming close to IR Track / Infringement of unauthorized vehicles into the train movement zone.	Injury or Fatal	3	5	15	1. Tie up with local hospitals. 2. Provide supervision / Look out man. 3. Ensure Daily HIRA Talk 4. Ensure Emergency vehicle availability 5. Provdie a flagman. 6. Intimate to local authorities. 7. Barricading at 3.5 m are being provided for an example: per NCR approved drawings.	Ensure dynamic HIRA precautionary measures are in place	1	5	5
5.	Execution of work between 3.5 M to 6 M from centre line of existing Indian Railway track.	Slip, trip and fall while working near to the underground utilities.	Injury	3	3	9	1. Check for any underground utilities with CAT and refer other drawings from municipal / local bodies to identify any utility services. 2. A Clear demarcation shall be given to the underground utilities. 3. HIRA Talk talks shall be delivered before start of work. 4. Use cable detector to identify the existing utility system.	Ensure dynamic HIRA precautionary measures are in place	1	3	3

6.	Working beyond 6M from centre of UP Line track of IR.	Slip, trip and fall and electrocution	Injury or Fatal	2	4	8	1.Ensure the engagement of competent and trained operators. 2.Conduct HIRA Talk talks before start of job. 3.Vehicle movement area shall be defined and away from men movement. 4 Ensure the vehicle / equipment fitness condition based on checklists	Ensure dynamic HIRA precautionary measures are in place	1	4	4
7.	Tipper movement without repositioning of back bucket	Hit with overhead cables/structures / may lead to toppling of vehicle during Tipper movement without repositioning of back bucket.	Injury or Multiple severe injury	2	4	8	1. Trained operator only allowed to move the vehicle inside the plant. 2. Install goal post where ever OHE crossing are there.	To implement safety checklist before commencing of work.	2	3	6
8.	Unloading of Soil	Toppling of heavy vehicle during unloading of Soil.	Injury or Multiple sever injury	3	3	9	After ensuring the Pin and proper opening of back door the bucket should be lifted for unloading the materials.	To implement safety checklist before commencing of work.	3	2	6
9.	Unauthorized operator operating Heavy Vehicles	Incompetent Operator	Injury/Multiple sever injury	2	4	8	1. Authorized operator with valid driving license only allowed to operate the plant equipment's/ Heavy vehicles allowed after the medical induction. 2. To ensure screening of operator. 3. Operator should have minimum 05 Yrs. 4. Experience with Construction Equipment Operating driving License. 5. To organize periodical training. 6. Operator should maintain daily checklist of equipment. 7. To check Alcoholic by tester of operator and health condition.	Vehicle should be less than 10 years old.	2	2	4
10.	Transportation of concrete from Batching Plant to location by Transit Mixer	Placement / Reversing of Transit Mixer near Batching plant & location	May hit the person or any nearby vehicle resulting human injury (LTA/fatal) or property damages.	4	4	16	1.Depute Signalman 2. Restrict the area for unauthorized entry 3. Ensure Reverse horn and other safety devices to the transit mixer 4.Ensure only trained, experienced driver, holding a valid driving license 5. Ensure adequate space for turning the vehicle 6. Ensure strict supervision, 7. Impose warning and penalty for any violation of control measures.	Ensure dynamic HIRA precautionary measures are in place	1	4	4
11.	Deployment of Concrete mixer	Wrong placement of mixer leads toppling of machine	May cause severe crush injury.	3	3	9	1. Ensure concrete mixer is placed on even surface with proper pegs. 2. Designated area shall be planned prior to placement of mixer		1	3	3
12.	Concrete pouring by Boomer.	Loose/uneven ground	Tilting of boomer causing injury to person and property	3	3	9	1. While setting up a concrete boomer ,the area shall be leveled and made firm. 2. Vehicle shall park at least 1.5m from excavation.		1	3	3

HAZARD IDENTIFICATION AND RISK ASSESSMENT

The purpose of this guideline is to provide a systematic and objective approach to assessing hazards and their associated risks that will provide an objective measure of an identified hazard as well as provide a method to control the risk. It is one of the general duties as prescribed under the Occupational Safety and Health Act 1994 (Act 514) for the employer to provide a safe workplaces to their employees and other related person.

BASIC CONCEPTS:

Risk:

Risk is something that we as individuals live with on a day -to-day basis. People are constantly making decisions based on risk. Simple decision in daily life such as driving, crossing the road and money investment all imply an acceptance risk. Risk is the combination of the likelihood and severity of a specified hazardous event occurring.

In mathematical term, risk can be calculated by the equation - Risk = Likelihood x Severity

Where, Likelihood is an event likely to occur within the specific period or in specified circumstances and, Severity is outcome from an event such as severity of injury or health of people, or damage to property, or insult to environment, or any combination of those caused by the event.

PLANNING AND CONDUCTING OF HIRA:

The purpose of HIRA are as follows: -

To identify all the factors that may cause harm to employees and others (the hazards);

To consider what the chances are of that harm actually be falling anyone in the circumstances of a particular case and the possible severity that could come from it (the risks); and

To enable employers to plan, introduce and monitor preventive measures to ensure that the risks are adequately controlled at all times.HIRA activities shall be plan and conducted.

Process of HIRA requires 4 simple steps:

Classify work activities;

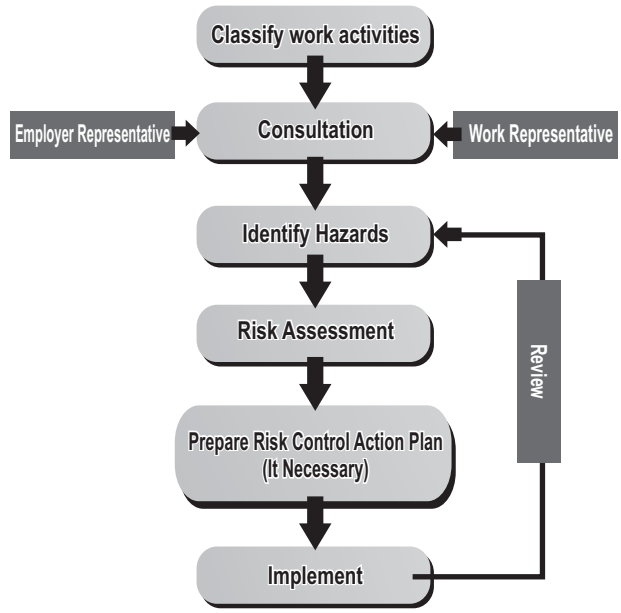
Identify hazard;

Conduct risk assessment (analyze and estimate risk from each hazard), by calculating or estimating -

Likelihood of occurrence, and Severity of hazard;

Decide if risk is tolerable and apply control measures (if necessary).

Flow chart for HIRA process



Classify work activities:

Classify work activities in accordance with their similarity, such as:

Geographical or physical areas within/outside premises;

Stages in production/service process;

Not too big e.g. building a car;

Not too small e.g. fixing a nut; or

Defined task e.g. loading, packing, mixing, fixing the door.

HAZARD IDENTIFICATION:

The purpose of hazard identification is to highlight the critical operations of tasks, that is, those tasks posing significant risks to the health and safety of employees as well as highlighting those hazards pertaining to certain equipment due to energy sources, working conditions or activities performed. Hazards can be divided into three main groups, health hazards, safety hazards, and environmental hazards.

Health hazards:

An occupational health hazard is any agent that can cause illness to an individual. A health hazard may produce serious and immediate (acute) affects, or may cause long-term.

Safety hazards:

A safety hazard is any force strong enough to cause injury, or damage to property. An injury caused by a safety hazard is usually obvious. For example, a worker may be badly cut. Safety hazards cause harm when workplace controls are not adequate.

Some examples of safety hazards include, but are not limited to: Slipping/tripping hazards (such as wires run across floors); Fire hazards (from flammable materials);

Moving parts of machinery, tools and equipment (such as pinch and nip points); (chronic) problems. All or part of the body may be affected. Someone with an occupational illness may not recognize the symptoms immediately. For example, noise-induced hearing loss is often difficult for the affected individual to detect until it is well advanced. Health hazards include chemicals (such as battery acid and solvents), biological hazards (such as bacteria, viruses, dusts and molds), physical agents (energy sources strong enough to harm the body, such as electric currents, heat, light, vibration, noise and radiation) and work design (ergonomic) hazards.

Work at height (such as work done on scaffolds);

Ejection of material (such as from molding);

Pressure systems (such as steam boilers and pipes);

Vehicles (such as forklifts and trucks);

Lifting and other manual handling operations; and Working alone.

Environmental hazards:

Figure - Environmental Hazard

An environmental hazard is a release to the environment that may cause harm or deleterious effects. An environmental release may not be obvious. For example, a worker who drains a glycol system and releases the liquid to a storm sewer may not be aware, of the effect on the environment. Environmental hazards cause harm when controls and work procedures are not followed.

HAZARD IDENTIFICATION TECHNIQUE:

The employer shall develop a hazard identification

and assessment methodology taking into account the following documents and information:

Any hazardous occurrence investigation reports;

First aid records and minor injury records;

Work place health protection programs;

Any results of workplace inspections;

Any employee complaints and comments;

Any government or employer reports, studies and tests concerning the health and safety of employees;

Any reports made under the regulation of Occupational Safety and Health Act, 1994

The record of hazardous substances; and Any other relevant information.

THE HAZARD IDENTIFICATION AND ASSESSMENT METHODOLOGY:

The hazard identification and assessment methodology shall include:

Steps and time frame for identifying and assessing the hazards. One must define the steps for the identification of hazards and a time frame for this identification. The following information should be included:

Who will be responsible for the identification: for example, it may be the workplace health and safety committee, or an individual or individuals appointed by the committee;

The way in which the identification reports are processed: for example, they may be compiled and processed by the committee, or by individuals appointed by the committee:

The identification time frame.

The keeping of a record of the hazards.

After having identified the hazards, one must establish and maintain an identification record, either in print or electronic format.

A time frame for reviewing and, if necessary, revising the methodology. The date for the review of the identification: for example, the review of the identification method will be carried out every three years. To complete hazard identification, one can use techniques to identify hazards. Some examples of techniques include, but are not limited to:

Workplace inspections;

Task safety analysis or job hazard analysis;

Preliminary investigations;

Potential accident factors;

Failure analysis;

Accident and incident investigations.

It is in your interest to adopt your own process and your own identification techniques so that they match one management procedures and the size of business. In fact, the identification method may vary depending on the size of the work place.

Analyze and estimate risk:

Risk is the determination of likelihood and severity of the credible accident/event sequences in order to determine magnitude and to priorities identified hazards. It can be done by qualitative, quantitative or semi quantitative method.

Methodologies of risk analysis-

A qualitative analysis uses words to describe the magnitude of potential severity and the likelihood that those severity will occur. These scales can be adapted or adjusted to suit the circumstances and different descriptions may be used for different risks. This method uses expert knowledge and experience to determine likelihood and severity category. Quantitative analysis uses numerical values (rather than the descriptive scales used in qualitative and semi -quantitative analysis) for both severity and likelihood using data from a variety of sources such as past accident experience and from scientific research. Severity may be determined by modeling the outcomes of an event or set of events, or by extrapolation from experimental studies or past data. Severity may be expressed in terms of monetary, technical or human

impact criteria, or any of the other criteria. The way in which severity and likelihood are expressed and the ways in which they are combined to provide a level of risk will vary according to the type of risk and the purpose for which the risk assessment output is to be used. In this guidelines qualitative and semi quantitative method uses as an example. Likelihood of an occurrence:

This value is based on the likelihood of an event occurring. You may ask the question "How many times has this event happened in the past?" Assessing likelihood is based worker experience, analysis or measurement. Likelihood levels range from "most likely" to "inconceivable." For example, a small spill of bleach from a container when filling a spray bottle is most likely to occur during every shift. Alternatively, a leak of diesel fuel from a secure holding tank may be less probable.

Table A indicates likelihood using the following values

LIKELIHOOD (L)	EXAMPLE	RATING
Most likely	The most likely result of the hazard/event being realized	
Possible	Has a good chance of occurring and is not unusual	4
Conceivable	Might be occur at sometimes in future	
Remote	Has not been known to occur after many years	3 2
Inconceivable	Is practically impossible and has never occurred	1

Table A

Severity of hazard:

Severity can be divided into five categories. Severity are based upon an increasing level of severity to an individual's health, the environment, or to property. Table B indicates severity by using the following table:

SEVERITY (S)	EXAMPLE	RATING
Catastrophic	Numerous Fatalities, irrecoverable property damage and productivity	5
Fatal	Approximately one single fatality major property damage if hazard is realized	4
Serious	Non-fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasions, bruises, cuts first aid type injury	1

Table B

RISK ASSESSMENT:

Risk can be presented in variety of ways to communicate the results of analysis to make decision on risk control. For risk analysis that uses likelihood and severity in qualitative method, presenting result in a risk matrix is a very effective way of communicating the distribution of the risk throughout a plant and area in a workplace.

Risk can be calculated using the following formula:

L x S = Relative Risk

L = Likelihood

S = Severity

An example of risk matrix (Table C) is shown below:

	Severity (S)				
Likelihood (L)	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Table C

High

Medium

Low

To use this matrix, first find the severity column that best describes the outcome of risk. Then follow the likelihood row to find the description that best suits the likelihood that the severity will occur. The risk level is given in the box where the row and column meet.

The relative risk value can be used to prioritize necessary actions to effectively manage workplace hazards. Table D determines priority based on the following ranges:

Hazards assessed, as "High Risk" must have immediate actions, to resolve risk to life safety and or the environment. Individuals responsible for required action, including follow up must be clearly identified. A

further detail risk assessment method may require such as quantitative risk assessment as means of determine suitable controls measures.

RISK	DESCRIPTION	ACTION
15-25	HIGH	A HIGH risk requires immediate action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment from including date for completion
5-12	MEDIUM	A MEDIUM risk requires a planned approach to controlling the hazard and applies temporary measure if required. Actions taken must be documented on the risk assessment from including date of completion.
1-4	LOW	A risk identified as LOW may be considered as acceptable and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implemented and recorded.

CONTROL:

Definition: Control is the elimination or inactivation of a hazard in a manner such that the hazard does not pose a risk to workers who have to enter into an area or work on equipment in the course of scheduled work.

Hazards should be controlled at their source (where the problem is created). The closer a control to the source of the hazard is the better. This method is often referred to as applying engineering controls. If this does not work, hazards can often be controlled along the path to the worker, between the source and the worker. This method can be referred to as applying administrative controls. If this is not possible, hazards must be controlled at the level of the worker through the use of personal protective equipment (PPE), although this is the least desirable control

Selecting a suitable control:

Selecting a control often involves:

Evaluating and selecting short and long term controls;

Implementing short-term measures to protect workers until permanent controls can be put in place;

and Implementing long term controls when reasonably practicable.

For example, suppose a noise hazard is identified. Short-term controls might require workers to use hearing protection. Long term, permanent controls might remove or isolate the noise source.

Types of Control:

At the source of the hazard

Elimination - Getting rid of a hazardous job, tool, process, machine or substance is perhaps the best way of protecting workers. For example, a salvage firm might decide to stop buying and cutting up scrapped bulk fuel tanks due to explosion hazards.

Substitution - Sometimes doing the same work in a less hazardous way is possible. For example, a hazardous chemical can be replaced with a less hazardous one. Controls must protect workers from any new hazards that are created.

Engineering control:

Redesign - Jobs and processes can be reworked to make them safer. For example, containers can be made easier to hold and lift.

Isolation - If a hazard cannot be eliminated or replaced, it can sometimes be isolated, contained or otherwise kept away from workers. For example, an insulated and air-conditioned control room can protect operators from a toxic chemical.

Automation - Dangerous processes can be automated or mechanized. For example, computer-controlled robots can handle spot welding operations in car plants. Care must be taken to protect workers from robotic hazards.

Barriers - A hazard can be blocked before it reaches workers. For example, special curtains can prevent eye injuries from welding arc radiation. Proper equipment guarding will protect workers from con tacking moving parts.

Absorption - Baffles can block or absorb noise. Lockout systems can isolate energy sources during repair and maintenance. Usually, the further a control

keeps a hazard away from workers, the more effective it is.

Dilution - Some hazards can be diluted or dissipated. For example, ventilation systems can dilute toxic gasses before they reach operators.

Administrative controls:

Safe work procedures - Workers can be required to use standardized safety practices. The employer is expected to ensure that workers follow these practices. Work procedures must be periodically reviewed with workers and updated.

Supervision and training – Initial training on safe work procedures and refresher training should be offered. Appropriate supervision to assist workers in identifying possible hazards and evaluating work procedures.

Job rotations and other procedures can reduce the time that workers are exposed to a hazard. For example, workers can be rotated through jobs requiring repetitive tendon and muscle movements to prevent cumulative trauma injuries. Noisy processes can be scheduled when no one is in the workplace.

Housekeeping, repair and maintenance programs - Housekeeping includes cleaning, waste disposal and spill cleanup. Tools, equipment and machinery are less likely to cause injury if they are kept clean and well maintained.

Hygiene - Hygiene practices can reduce the risk of toxic materials being absorbed by workers or carried home to their families. Street clothing should be kept in separate lockers to avoid being contaminated by work clothing. Eating areas must be segregated from toxic hazards. Eating should be forbidden in toxic work areas. Where applicable, workers should be required to shower and change clothes at the end of the shift.

Personal Protective Equipment:

Personal protective equipment (PPE):

Personal protective equipment means any equipment which is intended to be worn or held by a person at work and which protects him against one or more risks to his health or safety and any additional accessory designed to meet that objective;

PPE is usually chosen to provide protection appropriate to each of type of hazard present. There are specifications for the types of PPE used for protecting an individual's head, eyes, footwear, limb and body, fire retardant clothing, respiratory, hearing, and personal flotation devices.

It may also include required apparel for example when traffic hazards are present high visible and distinguishable "vests must be worn"

Personal Protective Equipment (PPE) and clothing is used when other controls measures are not feasible and where additional protection is needed. Workers must be trained to use and maintain equipment properly. The employer and workers must understand the limitations of the personal protective equipment. The employer is expected to require workers to use their equipment whenever it is needed. Care must be taken to ensure that equipment is working properly. Otherwise, PPE may endanger a workers health by providing an illusion of protection.

SAFE WORK PROCEDURES:

Through the completion of a Job Hazard Analysis, sometimes hazards are identified and cannot be eliminated or engineered out of a particular task. Safe Work Procedures are step by step instructions that allow workers to conduct their work safety when hazards are present. A Safe Work Procedure identifies the materials and equipment needed, and how and when to use them safety.

Safe Work Procedures are generally prepared for –

Critical high risk jobs where accidents have or could result in severe injuries; Hazardous work where accidents occur frequently. New or altered tasks have been introduced. New equipment has been added to a process; A job that requires many detailed tasks; Where two or more workers required for a job, and each must perform specific tasks simultaneously; and

Specific tasks are done infrequently; Safe Work Procedures must include: Regulatory requirements; Necessary personal protective equipment; Required training; Worker responsibilities; Specific sequence of steps to follow to complete the work safely; Required permits; and Emergency procedures.

An example of a task that requires the development of a safe work procedure is confined space entry. Individuals who must work within confined spaces must ensure that safe work procedures are developed and followed to maximize life safety.

DOCUMENTING HIRA:

Responsibility and accountability

Proper management of hazards sporadically identified in the workplace can be done through effective process. Ultimately, the individual or team who identified the hazard must ensure proper communication of the hazard to the appropriate workplace authority (manager, department head, or designated person). Each HIRA must be fully documented. The HIRA form must be completed by the HIRA team and signed by the in charge personnel of the area. Departments responsible for the hazards and their control are required to maintain all records of assessments for at least 3 years. (In some cases, legislative requirements will determine the minimum time to retain records).

The appropriate authority is responsible for ensuring that effective and timely controls are applied to the hazard and communicating the results back to the originator. Management or employer must endorse and approve the HIRA results. Employer must communicate all HIRA to employees, monitor the follow up action and keep the records. The HIRA Form (Link below the page) is an example to document the HIRA process.

Documenting process:

Instructions to team leader and persons conducting HIRA:

Complete HIRA Form. It is recommended to use a single form for each work process;

Record the names and designation of HIRAC team members;

Outline the process workflow and indicate in the form under 'process/ location column;

List all activities (routine and non-routine) for each work process under the "Work Activity" column;

Identify the hazards associated with each activity and record in "Hazard" column;

Determine the effect of each hazard identified and record in "Effect" column;

Record any existing hazard control measures;

Determine likelihood (L) from Table A and severity (S) from Table B for each hazard. Assign P and C rating in respectively column. The existing control measures should be take into consideration while determine (L) and (S);

By using Risk Matrix (Table C and D) assign one risk and record in "Risk" column;

Based on the risk assigned, recommend appropriate risk control measures (see Table D);

Assign a suitable person to implement the recommended risk control and indicate the follow up action date and status;

Repeat the HIRA for other activities and process;

Conduct another round of HIRA after control measures have been implemented; and

Review HIRA for every three years or whenever there are changes in process or

Examples of Workplace Hazards:

The Hazard Identification listed is to assist in the identification of hazards in the work place. This table provides some additional explanation of the meaning of the hazard classifications.

WORK ENVIRONMENT	
Adequate Access	Refers to adequate access to, from and within the workplace
Air Conditioning	Refers to uncontaminated air in the work space
Confined	Means enclosed work space where people do not normally work (defined in standards)
Temperature Extremes: a) Head	This includes contact with hot objects, hyperthermia, fire (Not explosions)
b) Cold	This includes contact with cold objects, hyperthermia
Lighting	Refers to adequate illumination for the particular work being done
Mental Stress	Includes bullying, workplace violence, shift work, excessive work loads
Dehydration	Adequate water supply for the individuals while working
ENERGY	
Electrical	Includes contact with exposed wires and contact with high voltage
Gravity	Includes falls, trips and slips of persons as well as objects falling, working at heights
Kinetic Energy a) The body hitting object b) Hit by moving object c) Explosion d) Pentrating object	Hitting objects with part of the body Being hit by moving objects but excluding falling objects An explosion may also include heat as a hazard This includes all objects that can penetrate including needles
Vibration	Includes vibration to parts or to the whole body
Acoustic/Noise	Includes exposure to single sudden sound or long term exposure
Pressure	Pressure in hydraulic and pneumatic systems
MECHANICAL	
Vehicles	Being caught between, struck by or against vehicles (includes fork lifts)
Mobile and Fixed Plant	Being caught between, struck by or against plant (defined in legislation)

RISK ASSESSEMENT PROCEDURES HAZARD AND OPERABILITY ANALYSIS (HAZOP)

A HAZOP is an organized examination of all possibilities to identify and processes that can malfunction or be improperly operated.

HAZOP analyses are planned to identify potential process hazards resulting from system interactions or exceptional operating conditions.

Features of HAZOP study are:

It gives an idea of priorities basis for thorough risk analysis,

It provides main information on the potential hazards, their causes and consequences,

It indicates some ways to mitigate the hazards,

It can be executed at the design stage as well as the Operational stage,

It provides a foundation for subsequent steps in the total risk management program.

Advantages:

Offers a creative approach for identifying hazards, predominantly those involving reactive chemicals.

Thoroughly evaluates potential consequences of process failure to follow procedures.

Recognizes engineering and administrative controls, and consequences of their failures.

Provides a decent understanding of the system to team members.

Disadvantages

Requires a distinct system of engineering documentation and procedures.

HAZOP is time consuming.

Requires trained engineers to conduct the study.

HAZOP emphases on one event causes of deviations or failures.

Failure Mode and Effect Analysis (FMEA)

An FMEA is a systematic method for examining the impacts of component failures on system performance. Basically FMEA focuses on failures of systems and individual components and examines how those failures can impact facility and processes. FMEA is most effective when a system is well defined and includes the followings key steps:

Listing of all system components;

Identification of failure modes (and mechanisms) of these components;

Description of the effects of each component failure mode;

Identification of controls (i.e., safeguards, preventive) to protect against the causes and/or consequence of each component failure mode;

If the risks are high or the single failure criterion is not met.

Fault Tree Analysis (FTA)

A fault tree is a detailed analysis using a deductive logic model in describing the combinations of failures that can produce a specific system failure or an undesirable event. AnFTA can model the failure of a single event or multiple failures that lead to a single system failure.

FTA is often used to generate:

Qualitative description of potential problems.

Quantitative estimates of failure frequencies/ likelihoods and relative importance of various failure sequences/contributing events&Suggested actions to reduce risks and Quantitative evaluations of recommendation effectiveness.

The FTA is a top-down analysis versus the bottom- up approach for the event tree analysis. The method identifies an undesirable event and the contributing elements (faults/conditions) that would initiate it.

The following basic steps are used to conduct a fault tree analysis:

Define the system of interest.

Define the top event/system failure of interest.

Define the physical and analytical boundaries.

Define the tree-top structure.

Once the fault tree has been developed to the desired degree of detail, the various paths can be evaluated to arrive at a probability of occurrence.

Advantages

It directs the analyst to ferret out failures deductively;

It points out the aspects of the system which is appropriate for an understanding of the mechanism of likely failure; define the system or operation identify the initiating events identify controls and physical phenomena define accident scenarios analyze accident sequence outcome summarize results use result in decision making

It provides a graphical assistance enabling those responsible for system management to visualize the hazard; such persons are otherwise not associated with system design changes;

Providing a line of approach for system reliability analysis (qualitative, quantitative);

Allowing the analyst to give attention to one particular system failure at a time;

Providing the analyst with genuine understandings into system behavior.

Disadvantages

Requires a skilled analyst. It is an art and also a science

Focuses only on one particular type of problem in a

system, and multiple fault trees are required to address the multiple modes of failure

Graphical model can get complex in multiple failures

Event Tree Analysis (ETA)

An ETA is an inductive analysis that graphically models, with the help of decision trees, the possible outcomes of an initiating event capable of producing a consequence.

Procedure of Event Tree Analysis

An analyst can develop the event tree by inductively reasoning chronologically forward from an initiating event through intermediate controls and conditions to the ultimate consequences.

An ETA can identify range of potential outcomes for specific initiating event and allows an analyst to account for timing, dependence, and domino effects that are cumbersome to model in fault trees. 49

An ETA is applicable for almost any type of analysis application but most effectively is used to address possible outcomes of initiating events for which multiple controls are in place as protective features.

Advantages

Accounts for timing of events, Models domino effects that are cumbersome to model in fault trees analysis.

Events can be quantified in terms of consequences (success and failure)

Initiating event, line of assurance, branch point, and accident sequence can be graphically traced

Disadvantages

Limited to one initiating event.

Requires special treatment to account for system dependencies.

Quality of the evaluation depends on good documentations

Requires a skilled and experienced analyst

The above techniques provide appropriate methods for performing analyses of a wide range of hazards during the design phase of the process and during routine operation. A combination of two or three methods is more useful than individual methods as each method has some advantages and disadvantages.

Failure Mode Effect and Critical Analysis (FMECA)

The FMECA is composed of two separate investigations, the FMEA and the Criticality Analysis (CA). The FMEA must be completed prior to performing the CA. It will provide theadded benefit of showing the analysts a quantitative ranking of system and/or subsystem failure modes. The Criticality Analysis allows the analysts to identify reliability and severity related concerns with particular components or systems.

CONCLUSION

The first step for emergency preparedness and maintenance of a safe workplace is by defining and analyzing hazards. Although all hazards should be addressed, resource limitations usually do not allow this to happen at one time. Hazard identification and risk assessment can be used to establish priorities so that the most dangerous situations are addressed first and those least likely to occur and least likely to cause major problems can be considered later.

The study also revealed that systematic methods were used and risk was assessed by brainstorming, checklist and health and safety regulations. Working at height, and manual handling were observed to be most critical hazards in the Indian construction industry.

Based on methods used to communicate risk at construction sites, it was revealed that toolbox meetings, site meetings, posters and informal verbal communication are used to communicate risks in daily work activities. It was also revealed that safety committees and gang supervisors play a major role in communicating health and safety risks. However the issue of power relations and conflicts was observed when there is a clear separation between health and safety communication and quality and productivity.

The study also reveals that PPE is the main item used for risk control. However, there was enough PPE on the sites. Based on factors influencing risk management, the study reveals that legal system plays a major role in risk assessment, communication and control. The regulations provide for some hazards such as falling from a height and control mechanisms. They also require that health and safety risk be communicated to workers and that PPE be provided for all workers.

Regular inspections, penalties and compliance certificates issued by regulatory institutions influence risk management more. Furthermore, the organizational culture of safety is another factor influencing risk management. It is observed that construction firms with a safety culture considered health and safety as priority when employing the site manager, the safety coordinators and safety officers. Knowledge of health and safety is hence a major criterion for employment. Meanwhile firms with a safety culture provide resources for site workers, such as PPE and training. Additionally, individual characteristics such as experience of those working on construction sites, their educational background and knowledge of health and safety matters also influence health and safety risk management. It was observed that risks were assessed based on experience and educational background. Furthermore, the study revealed that the work environment such as site layout and location, the nature and the size of the work, working methods and working team influence health and safety risk management.

The study also provides factors hindering health and safety risk management at construction sites. The factors include the low level of public awareness of regulations, lack of resources such as personnel and funds, coverage of the regulations, complexity of design, the procurement system, and the low level of education, site configuration, and location. Thus the main 'mantra' is that every job on the construction site must be carried out with at-most activity.

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Need to strengthen the mechanism of the Dispute Resolution in the Contracts through the Dispute Adjudication Board

ABSTRACT

The objective of constitution of **Dispute Adjudication Board (DAB)** within 90 days of signing of the Contract Agreement is to adjudicate the disputes, if any, that arises during the execution of the work and have it resolved through the DAB to facilitate smooth progress of the works. However, much needs to be done by all the stakeholders namely the Contractor, the Employer, the Engineer and most importantly by the DABs themselves to strengthen the mechanism of the dispute resolution provided in the Contract by way of proper appreciation/understanding/application of the provisions in the GCC.

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Introduction

Dispute(s) may arise in a contract when

(a) One party makes a claim against the other party (which may be a Claim as defined in FIDIC conditions or a matter to be determined by the Engineer under these conditions);

(b) The other party (or the Engineer under GCC sub-clause 3.7 {Engineer's determination}) rejects the Claim in whole or in part.

Provided however that a failure by the other party to oppose or respond to the Claim, in whole or the part, may constitute a rejection, if in the circumstances, the DAB or the Arbitrators, as the case may be, deem it reasonable for it to do so.

In FIDIC guided contracts, there is an elaborate dispute redressal mechanism to take care of the disputes arising between the Employer/Engineer and the Contractor.

Multi-tier dispute management is envisaged in the Contract which mainly consists of

- Dispute Adjudication Board (DAB)
- Amicable Settlement
- Arbitration

Constitution of standing Dispute Adjudication Board in a timely manner right at the start of the work is provided in the Contract.

Adjudication of disputes through a Dispute Adjudication Board (DAB) is the first step in this process with an option of Amicable Settlement thereafter and further going in for Arbitration Process, if required. The purpose of having a DAB in contracts is that all disputes where there is a difference in opinion between the Employer and the Contractor are sorted out amicably and impartially through the DAB in least possible time without resorting to further arbitration/litigation. It would be worthwhile to mention that the DAB carries high standing in contract implementation as their decision on disputes carry a lot of significance since the parties involved have to honour the same if perceived to have been dealt impartially and diligently. DABs are contract specific and all disputes pertaining to the contract would have to be dealt by the same DAB. Therefore, the DABs have a huge responsibility of deliberating and deciding the claims through an unbiased and professional approach with ample due diligence so that further arbitration / litigation is avoided. It is imperative that the final award/decisions are diligently checked and proof read by the DAB before the same is issued on conclusion of such an unbiased and logical deliberations.

The party (the Employer) who has to implement the DAB's decision, if dissatisfied with the decision, is required to give **Notice of Dissatisfaction (NOD)** to the other party (the Contractor) within 28 days after receiving the decision in terms of fifth para of GCC sub-clause 20.4.This maintains the Employer's right reserved for initiating process of amicable settlement as per GCC sub-clause 20.5 or approaching a competent Arbitral Tribunal for review of the decision of the learned DAB as per GCC sub-clause 20.6, if so required. Once the Employer has given "Notice of Dissatisfaction" under GCC sub-clause 20.4 within time limit of 28 days after receiving the decision, the dispute in respect of such DAB's decision has not become final and binding and it shall be finally settled by arbitration as per GCC sub-clause 20.6.

DAB's decisions are binding on both the parties unless or until it gets revised in an amicable settlement or an arbitral award. Therefore, the other party (mostly, the Employer) should promptly give effect to the DAB decision otherwise it tantamount to breach of contract and consequent implications come in effect.

Under GCC sub-clause 20.5, both parties are permitted to attempt to settle the dispute amicably. Therefore, amicable settlement needs be initiated by both the parties promptly within 56 days of the NOD.

Unless both parties agree otherwise, arbitration may be commenced on or after the 56 day after the day on which NOD was given even if no attempt at amicable settlement has been made.

Mechanism of dispute resolution through the Dispute Adjudication Board

The mechanism of dispute resolution through the **Dispute Adjudication Board (DAB)** can be easily understood after going through flow diagram given at the end. However, in practice, there are various impediments in its implementation by the respective stake holders thereby restricting the effective implementation of dispute resolution through the DAB.

Time is essence

There is a time limit of 84 days prescribed in the GCC sub-clause 20.4 for DAB to deliberate and give decision in the dispute. In order to meet with the aforesaid timeline, as soon as a dispute is referred by any party namely the Contractor or the Employer to the DAB, the Chairperson of DAB should call for a preliminary meeting with both the parties and set the ball rolling by fixing up a firm timetable for making written submissions by both the parties, payment to DAB and sittings to be held after consulting both the parties. Some margin should be kept for holding internal meetings by the DAB to draw the decisions on conclusion of sittings.

Essentially, the proceedings by the DAB commence with the presentation of the dispute by the Party who has referred the dispute (called the Claimant), followed by the presentation by the defending party (called the Respondent) and lastly the rejoinder presentation by the Party who referred the dispute (the Claimant) to cover all those issues which came up during the presentation by the defending party(the Respondent).

It is the responsibility of the Parties to arrange for the sittings an appropriate venue with proper facilities for audio / visual presentation and inform to all concerned well in time. Since the cost is divided equally amongst both parties, choice of any neutral venue should be preferred over the office facility normally offered by one of the party so that no aspersions are cast by the other party.

No postponement/adjournment should ordinarily be sought by the parties until and unless it is absolutely unavoidable and agreed by the DAB.

Sometimes, a Party issues notice to the DAB referring some dispute with a view to exert pressure on the other party but not seriously pursue the rigmarole of the proceedings. Such tendencies should be nipped in the bud by the DAB in the preliminary sitting itself.

There is an instance when the DAB on being referred about a dispute by the Contractor held several meetings internally in some Clubhouses and finally called both the parties towards the end and disposed of the dispute without giving any decision. This is just nothing but sheer abuse of the quasi-judicial position on the part of the DAB and wastage of fees paid to the DAB which was borne by both the parties without any purpose. The worst part is that none of the parties protested about it and accepted it as fait accompli just to avoid offending the DAB but this has brought process to dead end by no more referencing of disputes to DAB.

There is a tendency amongst some DABs to proliferate number of sittings with a view to claim hefty amount on account of fees payable besides the transportation cost as well as the cost of hotel accommodation arranged for the outstation members. In this case also, none of the parties protested about it even though the time limit of 84 days went hay wire and paid the fees and other expenditures meekly. It is the responsibility of both the parties to present their case in a crisp manner in minimum number of sittings. Had they presented their respective case timely, it would not have given any liberty to DAB to postpone the decision for long time.

Last not the least, in case the decision can't be given in the stipulated time limit, the DABs should seek extension in the timeline provided in the Sub-clause 20.4 and it is for both the parties to consider the request made by the DAB and grant approval. Seldom, it is denied.

Pitfalls in the Decisions by the DAB

After the proceedings have been concluded by the DAB involving considerable time and cost, it is a pity to

find that the decisions by the DAB are having minor discrepancies which could have been easily avoided.

GCC Sub-clause 20.4 stipulates that the DAB shall give its decision which shall be reasoned and shall state that it is given under this Sub-clause.DAB's failure to comply and mention categorically such a simple thing in their decision constitutes violation of the provision in the contract and the decision is liable to be rejected by the other party (Respondent).

It may so happen that same members get nominated in the DABs of the different Contracts. However, in such cases, the DABs while giving decisions in different contracts have to be careful in exercising proper scrutiny of the provisions in the respective contracts so that they don't commit mistakes while deliberating their decisions in different contracts. If it occurs, the decisions quoting erroneous provisions from the Contract are liable to be rejected by the other party (Respondent) plainly on this ground. The above can't be termed as minor omissions. In fact, it reflects the manner in which important issues are dealt by the concerned DAB, keeping in mind that same DAB has been nominated in other contracts. These can't be construed merely as typographical errors. This reflects a callous approach on part of the DAB in deciding important contractual matters which entail huge financial implications.

Many a times, the decisions of the DAB are not unanimous. In those cases, the majority members of the DAB don't comment on the findings and decision of the minority member. The decision of the majority members is liable to be rejected by the other party (Respondent) on the ground that same set of information/ document can't give rise to different decisions by the members of the DAB unless it is reasoned out by the majority members of the DAB.

Reconstitution of Dispute Adjudication Board as a solution to discrepancies in the DAB's decisions

The Contract vide PCC Sub-clause 20.2 provides for appointment of a suitably qualified person or persons to replace any one or more members of the DAB, if the parties so agree. Also, the appointment of any member may be terminated by mutual agreement of both the parties. There are certain exigencies ,for example ,repeated instances involving discrepancies in the DAB's decisions due to which the affected Party may suggest to the other Party to reconstitute DAB by appointing new members under PCC Sub-clause 20.2. However, this clause does not provide solution to this sort of situation until and unless other party agrees to the suggestion. There is no sanctity in replacing members of DAB as a solution to discrepancies in the DAB's decisions because there is no guarantee that this will not happen again when new DAB is constituted.

What is the solution to this problem? GCC sub-clause 20.4 provides for issuing "Notice of Dissatisfaction" against the decisions of the DAB. It is for the affected party to invoke this provision to highlight the same with a view to check the tendencies on the part of the DABs.

Role of the Engineer in the DAB proceedings

Contractually speaking, the dispute is between the Contractor and the Employer. Therefore, the Engineer is not a party to the dispute. The Engineer is recognised as a separate entity in DAB proceedings. This may give an opportunity to the Contractor to raise objections before the DAB not to allow the Engineer to participate in the DAB proceedings.

In that eventuality, the DAB may be requested by the Employer to grant permission to one person from the Engineer after being authorised by the Employer to present/supplement the case of the Employer before DAB for better appreciation of the dispute and with a purpose to provide sufficient and fair opportunity to the Employer. The said person of the Engineer can further be assisted by another person from the team of the Engineer who is authorised by the Employer.

The DAB after hearing the views of the other party (Contractor) may pass order to that effect.

Bank Guarantee to be furnished by the Contractor to receive award monies

The contract between the parties vide GCC sub-clause 20.4, 20.5 and 20.6 sets forth the process of Dispute

Resolution and defines the rights and obligation of the parties at every stage of the process.

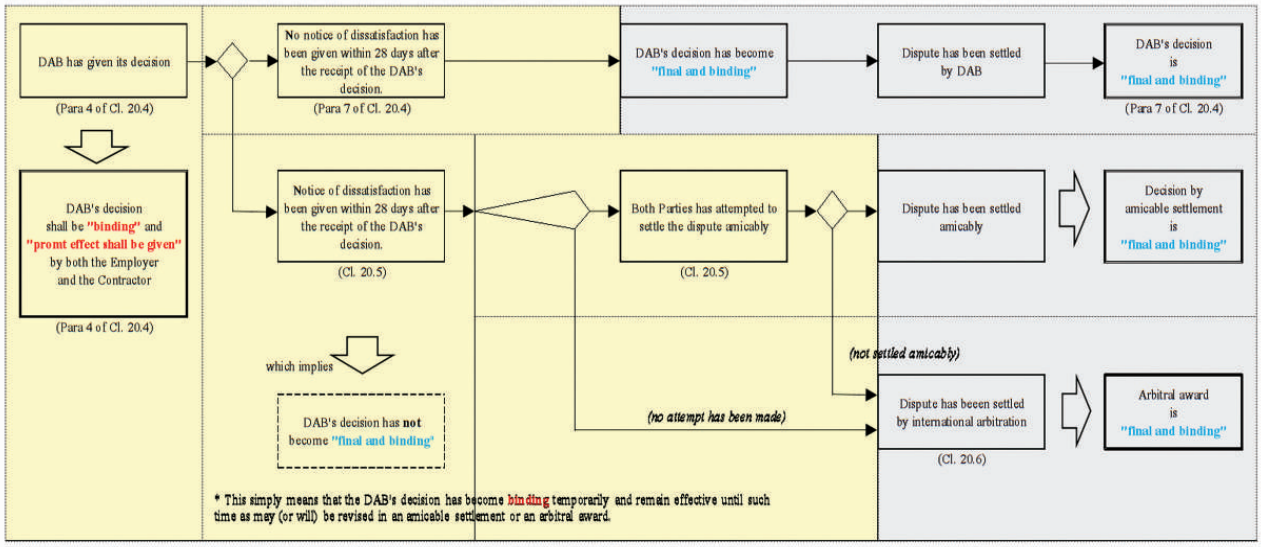
GCC sub-clause 20.4 states without any ambiguity the enforceability of the award as "The decision shall be binding on both Parties, who shall promptly give effect to it unless and until it shall be revised in an amicable settlement or an arbitral award as described below."

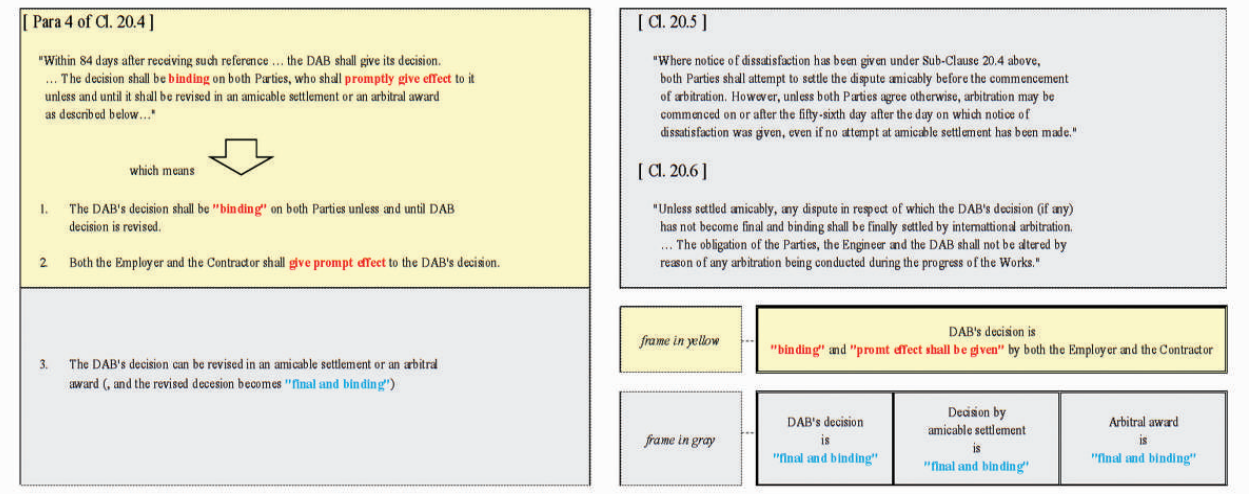
There is no specific requirement of Bank Guarantee to be issued by either Parties to receive award monies. If it is imposed, it also exposes Contractor to keep furnishing a Guarantee after another one submitted to the Employer in such events, which proscribes the Bank guarantee limit prescribed inthe bid by the Employer. The Contract does not require any amendment to give effect to implement the award.

Conclusion

It is duty of all stake holders in FIDIC governed contracts to ensure that mechanism of the DAB is harnessed properly by way of proper appreciation /understanding/ application of the provisions in the GCC. This will result in better contract management during execution stage.

Flow Chart of Dispute Resolution as per FIDIC Conditions





INTERACTIVE CASE STUDIES FOR ENHANCEMENT OF SAFETY PERFORMANCE IN CONSTRUCTION OF RAILWAY PROJECTS

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ABSTRACT

Construction work includes many hazardous activities and conditions and thus requires each site worker and staff to be aware of associated risks and dangers on the ground to prevent serious injuries and fatalities on construction sites. The construction work of railway projects is highly labor intensive and at the same time employs extensive use of construction equipment and machinery. Due to its critical working nature and heavy civil & track works, it requires more focus on the effective implementation of safety practices, development of safety culture, positive approaches towards safety &health to prevent injuries and other losses, which could occur in different levels of severity, some causing minor and major injuries with others resulting in fatality and dangerous occurrences. It is the responsibility at all levels of management, project-linked staff, engineers, managers, supervisors, workers, etc. to pay special attention towards prevention of any untoward incident till the completion and commissioning of the project.

Safety analysis in such large-sized construction projects on major causes that usually leads to unexpected accidents has revealed some of the key factors, which relates to poor instructions by the supervisors to the workers (mainly unskilled); lack of adequate and effective training; lack of workers' awareness and communication on job hazards and risks; over confidence; lack of scheduled maintenance of equipment / machinery; and underestimating potential hazards and their associated risks by staff and workers employed on construction sites.

In order to enhance the performance of safety &health measures in railway construction projects in line with the International & National Best Practices, this paper has discussed the practical safety tips and precautions through "interactive case studies" for a) Earth Moving Machinery on High Embankment, b) Operations of Dumpers during Loading and Unloading, c) Welding and Cutting of Used Drums, and d) Operations of Dumpers in Stockpile Area with Overhead Electric Cables, to identify potential hazards, enhance understanding of unsafe acts & conditions, analyze the causes of accidents and suggest possible control measures for their prevention. The depth of analysis elucidated in specific case studies shall help in preventing and minimizing the occurrence of related incidents and contribute to build an efficient and safe working environment/culture on all work sites of the project.

Such practice of continual improvement, knowledge and experience sharing from construction sites for dissemination of information among all stakeholders shall build the railway projects with high standards of construction site safety in a sustainable manner. Understanding of perils at hand and sustaining a perpetual state of alertness is perhaps the number-one best way to prevent accidents.

INTRODUCTION

"Safety is 30% common sense, 80% compliance and the rest is good luck"

– Barry Spud

Majority of hazards that occur are preventable if only safety was ensured in the first place. Every large-sized construction project is prone to accidents and at higher risk compared to other sectors. Accidents in construction works lead to severe difficulties to every stakeholder such as the Employer, Consultant, Contractor, Sub-contractor, Workers and the third party. However, accidents can be controlled by establishing proper safety management system on construction sites. All efforts should be made to continuously review the current safety management system in practice in large construction projects to establish a safe and health conscious working environment on construction sites during the entire period. Suitable control measures should be taken to ensure the compliance of all the required safety measures in an effort to prevent any accident in construction sites.

"Accident Case Studies" is a powerful safety training tool which provides many benefits to prevent accidents and helps in wider dissemination and sensitization. Case studies break-down the events leading up to the accident and helps to -

- Identify potential hazards;
- Understand accident causes;
- Discuss possible preventive measures;
- Determine the best methods for preventing a similar accident;
- Generalize the information learned to other safety issues in the work place; and
- Transfer the analysis, problem-solving, and decision-making skills learned during the case study process to real situations on the job.

It is imperative in large construction projects, such as railways, to take proactive measures and precautions to prevent occurrences of accidents / incidents on the work sites that can happen as a result of carrying out routine activities. Such incidents not only affect the health and lives of the workers, but also slow down progress of the projects.

It is with this objective that a **"multiple-part series of a safety training primer"** has been initiated **consisting of case studies on a real situation** to provide an effective way to identify potential hazards, enhance understanding of unsafe acts & conditions, analyze the causes of accidents and suggest possible measures for their prevention. Each case study carries an in-depth analysis in a simple and understandable manner on specific situations and real accidents / incidents scenarios on construction sites with real consequences for the people involved. This helps to expand knowledge relating to similar situations at sites for preventing cases of occurrences of serious injuries and fatalities (SIFs) resulting in enhanced site safety.

It is the responsibility of all project-linked staff, engineers, managers, supervisors, workers, etc. to pay special attention towards prevention of any untoward incident till the completion of the project.

Such construction safety training primer shall enhance awareness and knowledge among employees, engineers, field units' staff, workers, etc. of Employer, Contractors / Sub-contractors, Project Management Consultants (PMC), and other stakeholders to identify the potential risks leading to accidents / incidents / near miss cases and to implement such corrective measures which can ensure prevention of such occurrences on construction sites.

CASE STUDIES

"Analyzing accident case studies on a real situation provides an effective safety training tool for engaging staff, managers, workers, drivers, operators, etc. working on construction sites in a discussion about the causes of these injuries and solutions for preventing similar occurrences."

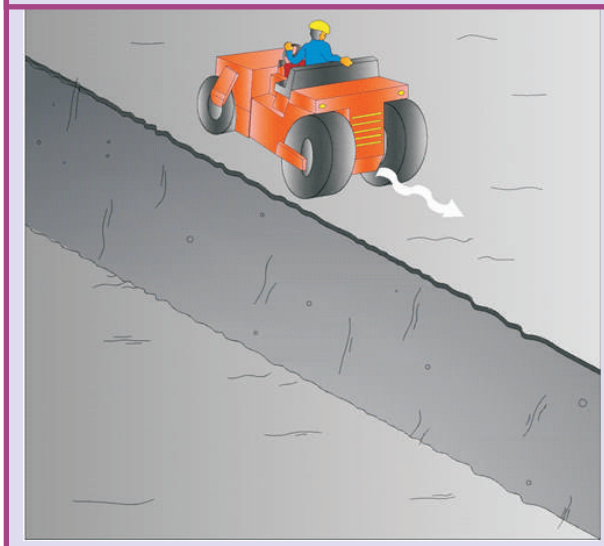
In this paper, following four interactive case studies are discussed along with practical "Safety Tips", which if

diligently taken on the construction sites will result in preventing serious injuries & fatalities (SIFs) and loss of life &property. The analysis on a real situation for these selected case studies have actually brought out those safety non-compliances / deficiencies, which could result in occurrence of similar types of incidents. These interactive case studies are related to safety considerations in –

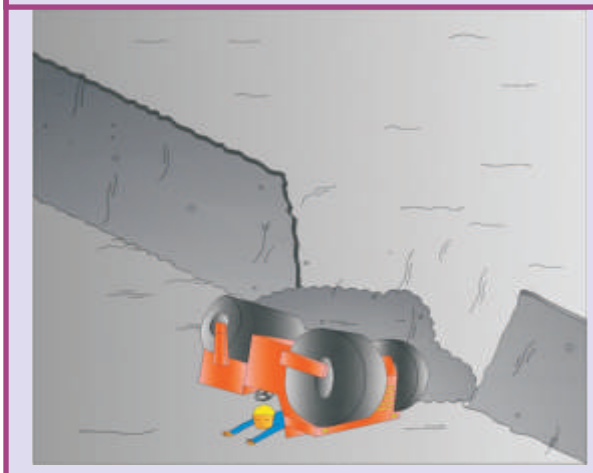
1. Working of Compaction Roller / Earth Moving Equipment on High Earth Embankment
2. Loading / Unloading Operation of Dumper
3. Welding / Cutting of Used Drums on Work Sites
4. Working of Dumpers in Stockpile Area with Overhead Electric Cables

CASE STUDY - 1: TOPPLING OF COMPACTION ROLLER ON HIGH EMBANKMENT

A roller operator engaged in rolling work for earth embankment drove vehicle in reverse direction near the edge of the high embankment area of the formation bed for a railway project.



Due to soft soil near the edge of 1-m high embankment area, the operator lost balance of the vehicle resulting in the roller falling down along the berm and getting tilted on one side, thereby trapping the operator under it. Luckily the operator sustained only minor injuries.



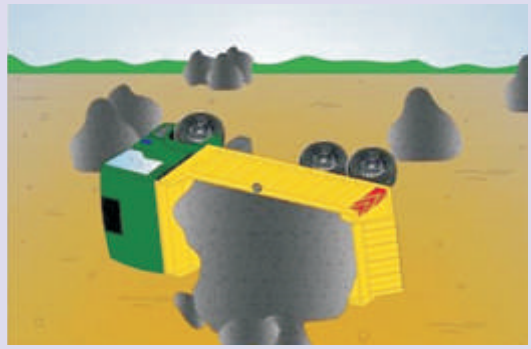
SAFETY TIPS

Operator	☑ Never drive the compaction roller for rolling work near the edge of high embankment area. ☑ Before starting operation look for bystanders. ☑ Do not use 'Mobile' while driving the compaction roller on the formation bed. ☑ Never turn machine on a slope. ☑ Never drive roller or any other earth moving equipment during unsafe behavioral condition (such as under drunken condition, poor health condition, lack of sleep condition, over exhaustion, etc.) ☑ Ensure working conditions of all warning devices like braking system, horn, reverse horn/buzzer, flashing lights, fuel level etc. and carry out daily inspections of fuel, oil, lights and radiator ☑ Regularly attend 'Pep-talks / Tool-box talks' conducted by Contractor's site engineer or supervisor. ☑ Before start of work, the roller operator should be checked for any unsafe behavioral and site conditions. ☑ Conduct Pre-shift inspection to make sure equipment is safe for use. ☑ Park the equipment on level ground & away from the railway track and neutralize the control during lunch time and end of the shift.
Contractor's Site Engineer or Supervisor	☑ Roller operator should be Qualified & Competent. He should have clear understanding of the instructions for operation and maintenance. ☑ Always put white distinct mark line at nearly 1m inside from the edge of the high embankment area. ☑ Instruct roller operator not to drive roller beyond white line and towards the edge of high embankment area. ☑ Instruct operator to always wear seatbelt as well as safety shoes and Hi-viz jacket whenever operating the equipment. ☑ Provide regular 'Pep-talks / Tool-box talks' and on-site defensive driving training to the drivers and operators and explain the hazards of unsafe driving practices. ☑ Keep extra precautions during foggy conditions in winter and engage trained signaler/spotter for the earth moving equipment. ☑ Roller is to be inspected and regularly maintained in accordance with manufacturer's instructions. ☑ Ensure that Banksman / Signalman is present to guide operator during reversing and himself standing in a safe position. ☑ Ensure arrangements of emergency rescue equipment is in place. i.e. rescue crane, First aid box, stretcher, fire extinguishers etc. ☑ Risk Assessment & their control measures should be done prior to operation.

CASE STUDY– 2: TOPPLING OF DUMPER DURING UNLOADING

A driver of a dumper (also called 'tipper') carrying blanketing material (crusher dust) during wet season arrived in a stockpile area and stationed itself for unloading by reversing on almost even surface & started dumping by lifting of the bucket (dump box) using an in-built hydraulic jack.

After partial lifting, the main hydraulic hose between pump and lifting jack burst due to improper weight distribution of wet material within the dump box. The whole weight of the bucket fell back on chassis, resulting in truck front portion jumped up and toppled on the ground with the driver inside of the vehicle.



MAJOR FACTORS FOR TOPPLING OF DUMPERS AND SAFETY CONSIDERATIONS

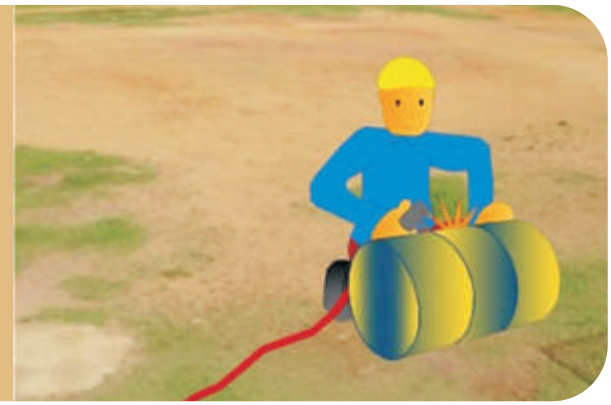
- Overloading of materials
- Incompetent and illegal Drivers.
- Improper weight distribution while loading or shifting of materials during transport – both side to side and front to back.
- Not fully opening rear doors when dumping OR engaging the tip function without unlocking the tail gate first.
- Improper maintenance of hydraulics related to dump box.
- **Not dumping from a solid and level foundation** - A soft and/or uneven surface may cause the tipper to tip over when the dump body is raised.
- Jerking the trailer, or hydraulics, to loosen the load.
- Driver stay in the cabin with seat belt during the entire dumping process
- No banksman / spotter to assist the dumper operator.
- Modifying or altering hydraulic components.
- Modifying or altering dump controls.
- **Risk of Electrocution** – Dumper body coming near or contacting overhead power lines when body is raised can cause electrocution. Electrocution can occur without contact. Be sure, there are no overhead power lines over or near the dumper before raising dump body.
- Dumper is not inspected and maintained regular in accordance with manufacturer's instructions.

KEY LESSONS FROM OTHER SIMILAR ACCIDENTS OF DUMPERS

- Before dumping, operators should ensure that the tailgate is unlocked and that the vehicle is on a reasonably level surface. Dumping on surfaces that are not level is one of the main causes of tip- overs.
- Banksman / spotter / signallers to be in attendance when any unloading is taking place. Site team should ensure that all site vehicles are always properly guided and attended while traversing or in operation at site.
- Plant Department carried out toolbox talks to all tipper drivers on safe tipping techniques and recorded attendance. The toolbox talk stressed the importance of releasing tailgate locks or latches prior to tipping.

CASE STUDY - 3: EXPLOSION OF USED DRUM CAUSING BURN ACCIDENT

A site worker (non-welder) under no one's instruction and supervision surprisingly collected an empty used drum closed on both sides lying unattended & disposed at inappropriate place on work site. He tried to cut it into two halves using an oxy-acetylene gas cutter, for using them as waste bins for the site to impress upon his colleagues and seniors.

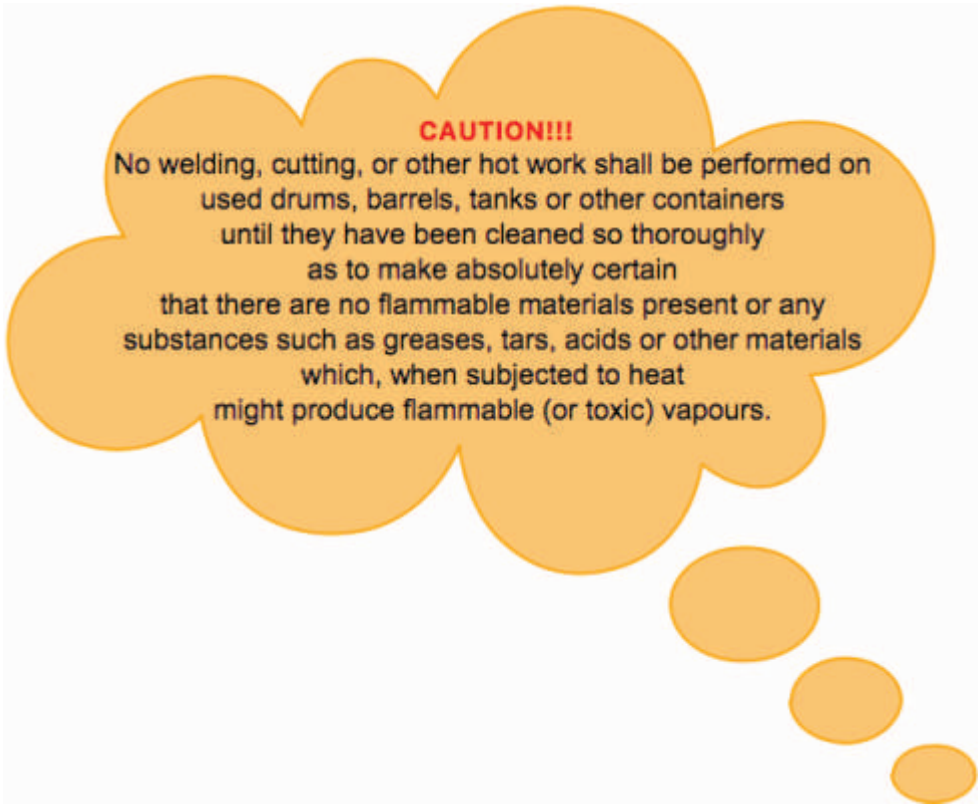


The heat from the cutting torch combined with residue of flammable material (bitumen) that was inside the drum released causing explosion and cutting open the drum resulting in metal fragments from the drum as well as chemical residue showered on the worker and he suffered severe burns.

WARNING !! – It is extremely dangerous to try any unsupervised activity without competency certificate on site.

SAFETY TIPS

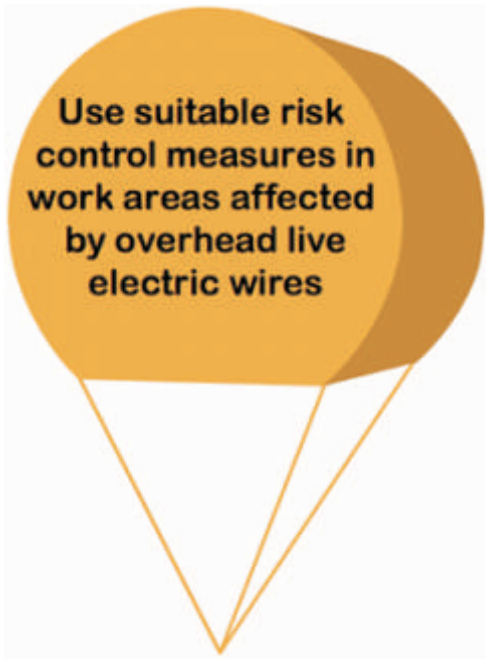
1. • Effective supervisory work to be done on site.
2. • Cutting of empty waste drums should be prohibited on site.
3. • Continuous improvement in hot work permits.
4. • Disposal method of waste drums should be regulated on site.
5. • Daily pep talk to be conducted on all sites.
6. • Potential risks of explosion & fire by waste drums should be told to workers.
7. • Restrict unauthorized working on site.
8. • Improve housekeeping on site to secure empty drums.
9. • Improvement in work competency certificates.

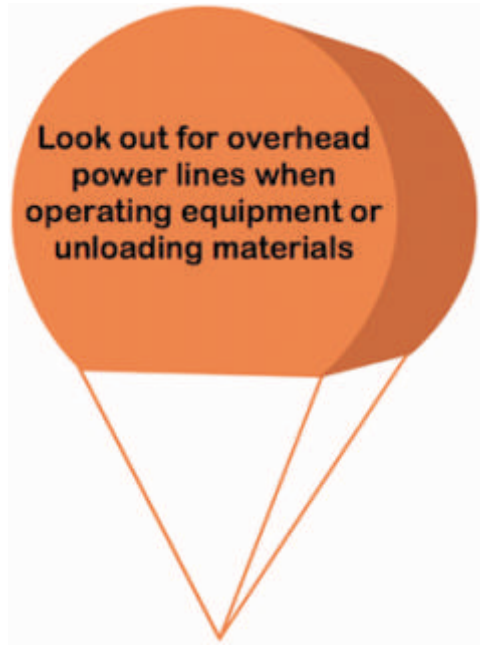


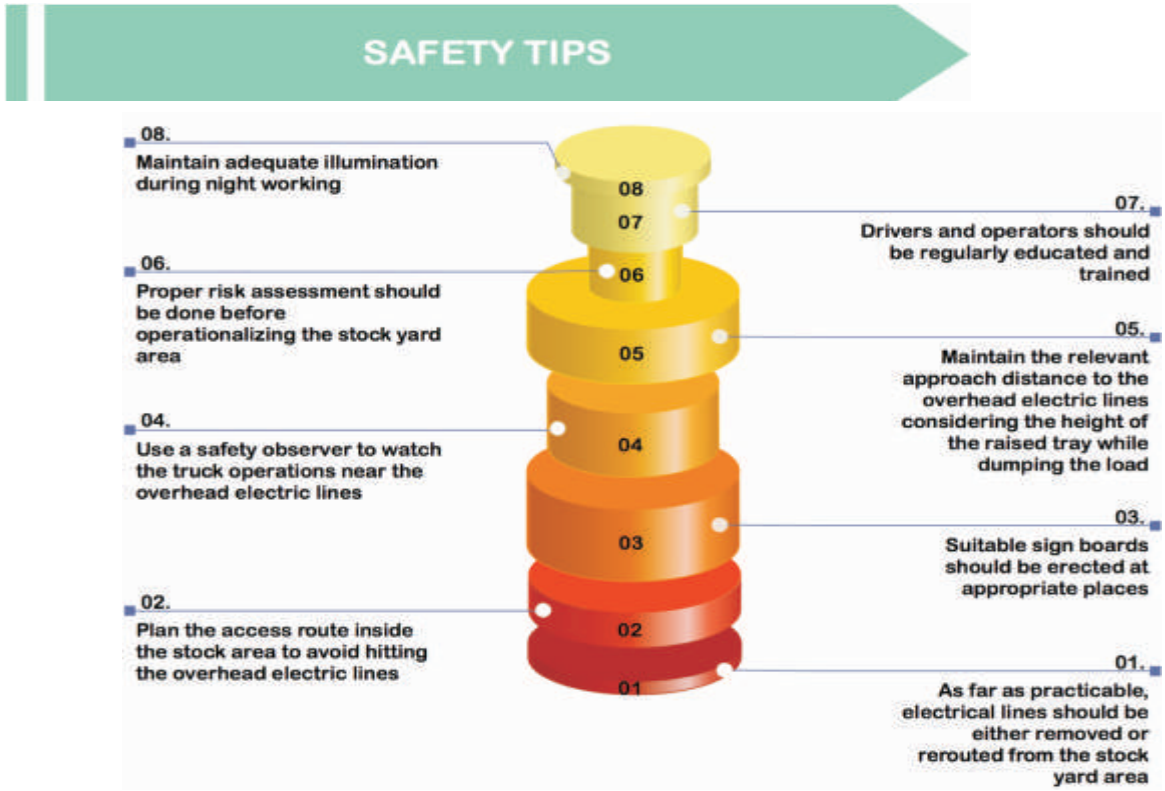
CASE STUDY - 4: DUMPER HITTING O/H ELECTRIC CABLE IN STOCKPILEAREA

A dumper truck (also called "Tipper") arrived in the stock yard for storage of stockpile to dump crusher dust (blanketing material) for construction work of a new railway and stationed itself on a leveled ground for unloading BUT did not realize the presence of overhead live electric line crossing across the yard area. Moreover, no access route was planned / demarcated inside the stock yard area for movement of external vehicles.

The dumper after unloading its weight drove vehicle with its bucket (dump box) in upward position and struck the overhead electric cable causing it to break and disrupted the power supply in the vicinity. It was a sheer luck at that moment due to pre-existing power breakdown which averted any electric shock to the driver & his accomplice and damage to the vehicle.







CONCLUDING REMARKS

This paper has reiterated the fact that most accidents on construction sites can be prevented by taking simple and appropriate measures based on informed actions; adopting Safe Working Procedures, including good housekeeping at construction sites; right man for right job; correct use of required personal protective equipment; provision of safety awareness & training; effective communication &consultation; no unsupervised activity without competency certificate; etc. If we work carefully and take appropriate safety measures, there will definitely be fewer work injury cases, and our sites will become a safe and secure place to work in.

It is also true that the severity of injuries caused by unsupervised activity without competency certificates is very high and potentially fatal. However, such accidents can also be prevented as they are mostly foreseeable. It is important to first recognize the potential hazards and deal with each situation seriously. Only with such right attitude can we rectify / correct them in time to prevent another serious accident/ incident from occurring.

Through the identification of critical causes and effects of incidents in the selected four case studies in this paper, it comes to the fact that human behaviour is identified as the main cause of construction accidents. Negligence or mistakes can happen due to uncertain circumstances. Hence, unavoidable accidents have to be expected in the construction projects. The commitment of all humans involved, from the project manager to the labourer towards good practices would enhance the safety performance in construction sites.

It is expected that different project sites shall disseminate these case studies to train people for prevention of potential accidents and injuries on construction sites.

Availing Traction Energy for WDFC-II through Open Access

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ABSTRACT

Prior to 2015-2016, Indian Railway were procuring electricity as an ordinary consumer for its traction application by paying extremely high charges despite being the largest single user of electricity in the country. The Electricity Act' 2003 conferred Deemed Licensee status to IR to avail electricity through open access due to its involvement in generation, transmission and distribution of energy. This enabled IR to buy Energy directly from generators by paying haulage (transmission/wheeling) charges to central and state transmission systems under open Access. This facilitated IR to procure energy from any generating unit, Captive power plant, traders or through power exchange up to connection point of Railway Network thereby resulting in saving of Energy bills of IR.

As per Railway Board Policy, DFCCIL TSSs shall also be fed through Open Access. This paper intends to highlight the requirements to be fulfilled by DFCCIL even though the traction power shall be availed by Indian Railway for DFCCIL TSSs as deemed Licensee through open Access.

INTRODUCTION

The power sector in India has undergone unprecedented reforms during last two decades. The focus of reforms in the electricity sector in India was on introduction of competition and reducing monopoly. One of the most important steps taken towards achieving this was the introduction of open access in the Electricity Act, 2003, where large consumers can have access to the Transmission and Distribution (T&D) network to obtain electricity from generating companies other than the local electricity distribution company (DISCOM). In other words, Open access allows large users of power — typically having connected load of 1 Megawatt (MW) and above — to buy cheaper power from the open market. This allow customers to choose among a large number of competing power companies–instead of being forced to buy electricity from their existing electric utility monopoly. It not only helps large consumers to ensure regular supply of electricity at competitive rates but also improves the economic health of the Distribution Licensees by reducing power procurement at higher marginal cost so that the non-open access retail consumers of the Distribution Licensees would not get unduly burdened. Open Access on Transmission and Distribution on payment of charges to the Utility has enabled number of players utilizing these capacities and transmit power from generation to the load centre. This also helped in utilization of existing infrastructure and easing of power shortage.

The Electricity Act 2003 was a landmark legislation as it opened the power sector to a number of players by laying down provisions for a power market and competition among them. As per Electricity Act 2003 Open Access is:

"Non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission".

On the basis of location of buying and selling entity, the open access is further categorized as:

Inter State Open Access: When buying and selling entity belongs to different states. In this case CERC regulations are followed. It is further categorized as:

Short Term Open Access (STOA): Open access allowed for the period of less than three months.

Medium Term Open Access (MTOA): Open access allowed for a period of 3 months to 3 years.

Long Term Open Access (LTOA): Open access allowed for a period of 12 years to 25 years.

Intra State Open Access: When buying and selling entity belongs to same state. In this case SERC regulations are followed. It is further categorized as STOA, MTOA, and LTOA and the duration of which depends on the respective state open access regulations.

Purchase of Electricity:

In general, the buyer and seller of electricity can go for bilateral or collective transactions. In bilateral transactions, a PPA (Power Purchase Agreement) is signed between the buyer and seller, which is generally facilitated by a trader for a little margin. In case of collective transactions, the electricity is traded through exchanges, by exchange members for a very small margin fixed by commission. Currently India has two power exchanges namely Power Exchange India Ltd (PXIL) and Indian Energy Exchange Ltd (IEXL).

Open Access Charges:

There are several charges to be paid by open access consumers to transmission licensees, distribution

licensee, and other related entities, other than the power purchase cost paid to the generator or supplying entity. These charges include:

i. Connectivity Charges

ii. Point of Connection (POC) Charges

iii. Transmission Charges

iv. Transmission Losses

v. Wheeling Charges

vi. Wheeling Losses

vii. Cross Subsidy Surcharge

viii. SLDC Charges

ix. RLDC Charges

** In addition to these charges, the open access consumers also have to fulfil the Renewable Purchase Obligation (RPO), in which they have to purchase a part of their total consumption through electricity generated from renewable sources.

Railway as a deemed Licensee-Difficult road travelled:

IR were procuring electricity as an ordinary consumer for its traction applications despite being largest single user of electricity. IR was paying higher tariffs for energy to DISCOMs duly taking burden of distribution losses, cross subsidy charges etc..IR was trying hard to get the provision of deemed licensee status operational. However due to various factors, the same was not happening. Finally, an application was made to Central Electricity Regulatory Commission (CERC) seeking necessary directions on Railways status in this regard.

In Nov.' 2015, CERC, in its historic judgment clarified that Railways are authorized entity to undertake transmission and distribution, in connection with its working and Railway is a deemed Licensee under Electricity Act. It directed all Regional Load Dispatch Centres (RLDC), State Transmission Utilities (STU) and State Load Dispatch Centres (SLDC) to facilitate Railway's medium and long-term access from generating unit and other sources to Railway network.

As per CERC orders, Indian Railways got the status of deemed Licensee. However, there are some statutory requirements needs to be fulfilled by Indian Railways such as:

i. Provisioning of ABT meters (Availability Based Tariff meters).

ii. Provisioning metering CT/PT (Current transformer/Potential transformer) of correct Specification.

iii. Obtaining clearances (NOC) from DISCOMs.

iv. Working out Deviation Settlement Mechanism (DSM) with SLDC.

v. Sorting out issues related to provision of backup power.

vi. Developing a reasonable accurate day ahead load forecasting mechanism.

2.0 How DFCCIL is affected?

Railway Board vide Dir/Plg (Spl) letter No.2016/Infra/62 dated 25.07.2016 advised DFCCILthat "as per Concession Agreement signed between MOR and DFCCIL, the traction Energy cost of DFC will be borne by Indian Railways as long as IR is the only operator on DFC. As, IR has been granted deemed Licensee status by Ministry of Power under the Electricity Act, 2003 and therefore, to avail the benefit of deemed licensee, DFCCIL to take Traction Supply connections in the name of Indian Railways". Accordingly, action was initiated by DFCCIL field units to terminate the agreements with DISCOMs which were earlier made to take energy as an ordinary Consumer and approached Zonal Railways to apply for open Access for DFCCIL TSSs. Also, all fresh Agreements were made through Indian Railway to

avail power through open Access.

Most of the statutory requirements as given above are to be taken care of by Indian Railway. However, some are also required to be fulfilled by DFCCIL as well. These are elaborated in following paras:

3.0 Steps to be taken by DFCCIL:

3.1 Provisioning of ABT meters (Availability Based Tariff meters) & Current Transformers (CTs)/Potential Transformers (PTs) at GSS(Grid Sub-Station) end of State Transmission Utility (STU):

The provision of ABT meters (Availability Based Tariff meters) & CTs/PTs at GSS is being done by STU as per their specification and charges are paid by DFCCIL.

3.2 Provisioning of ABT meters (Availability Based Tariff meters) &CTs/PTs of required specification at DFCCIL TSSs.

3.2.1 In EMP-16 Contract, only Energy Meters are part of Contract and ABT meters are not in the scope of supply. EMP-16 Contractor is supplying Multi-Function Meters (MFMs). Multi-Function Meters are normally used for metering purpose and ABT meters are used for billing purpose. Hence, DFCCIL is required to provide ABT meters as per STU specification in each TSS.

3.2.2 The CTs and PTs are part of scope of supply in EMP-16 Contract. However, when we avail supply through open Access, STU insists to install CTs and PTs as per their specification as accuracy of CTs & PTs may depend on the actual TSS load which remains very low at the time of commissioning and increases afterwards. This means that the CT specification at initial load say up to 10 MVA may not work with desired accuracy when load changed to 20 MVA or more. Thus, initially DFCCIL has to provide CTs and PTs suiting to 5-10 MVA load and later on same shall be required to be changed when load increases subsequently. Also, the designed burden of CT should be kept almost same as actual burden else the accuracy of CT shall be affected.

There are two options i.e. DFCCIL provide ABT meters and associated CTs& PTs at DFCCIL TSS by themselves or through variation in the existing contract. Any of the option can be selected as per feasibility. However, while selecting specification of CTs, PTs & ABT meters, there may be issues related with accuracy and hence it is suggested that these specifications may be got consented through concerned State Transmission Utility (STUs).

3.3 Developing a reasonable accurate day ahead load forecasting mechanism.

This aspect is very important as Railway has variable demand. Large variation in load forecasting may result into paying extra amount and leading to increased tariff.

In order to operationalise distribution licensee status and to create a robust mechanism to sustain savings, Indian Railway is in the process of creating visibility of entire network and capture traffic flows to generate more accurate load forecasts through Integrated Rail Energy Management System (IREMS). Basic Block Diagram of load forecasting mechanism is shown in Figure.1. Also, to meet the requirement of Grid code 2010, a real-time system needs to be created which would be interfaced with existing Indian Railway's SCADA systems as shown in Figure.2 below:

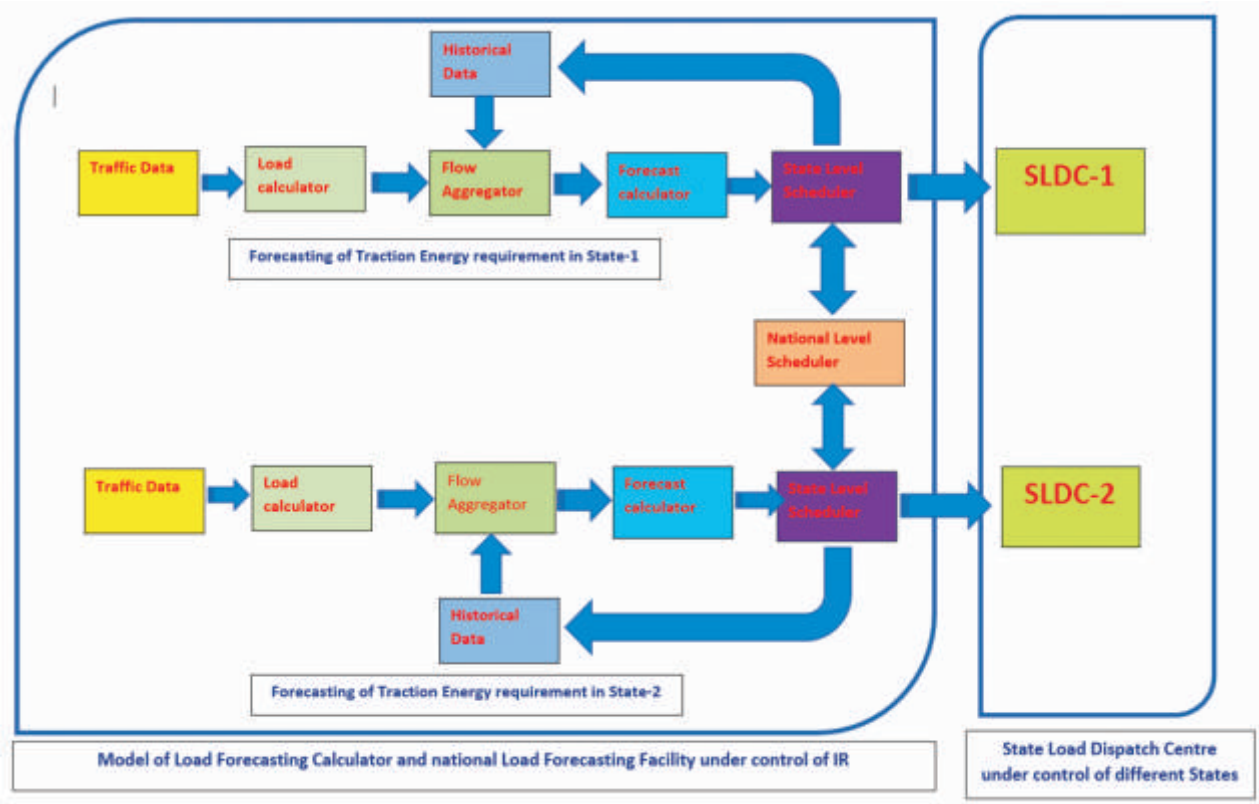

Figure.1: Overview of Load forecast calculated based on the Traffic flows and Historical data a nd further communicated to SLDC

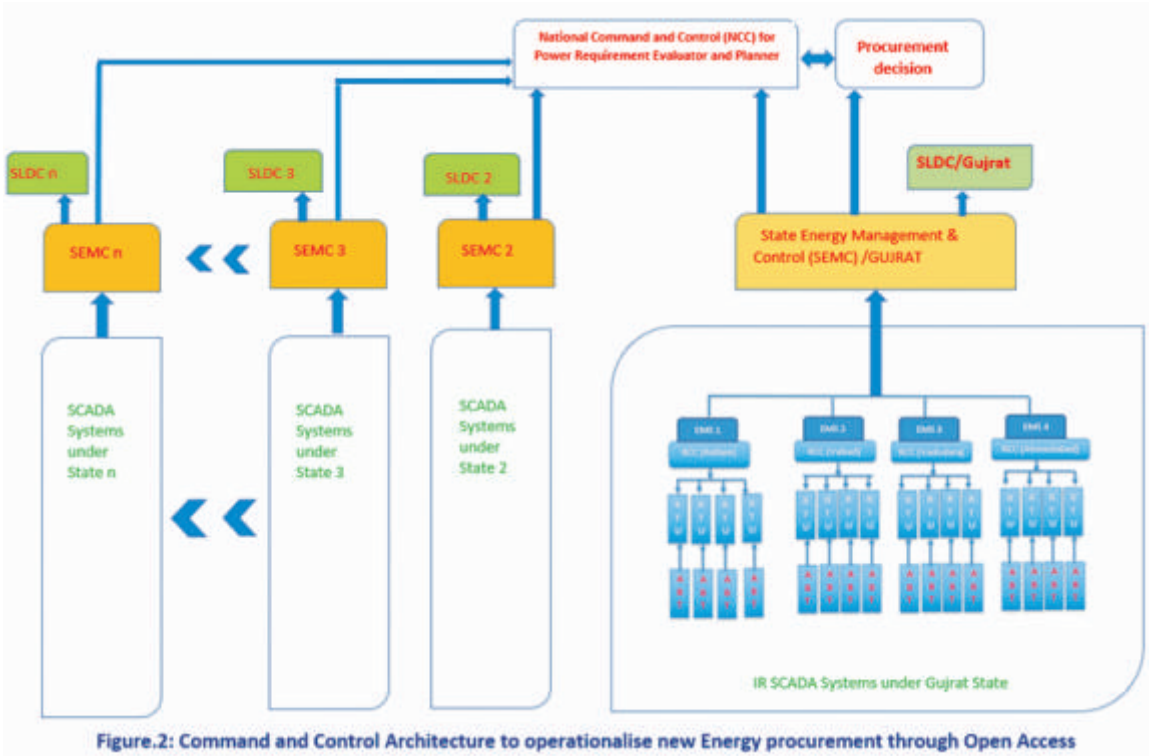

Figure.2: Command and Control Architecture to operationalise new Energy procurement through Open Access

The Energy data is required at SLDC in one day advance for their scheduling purpose. Presently this data is compiled at designated RCC of IR and is further transmitted to SLDC through e-mail manually which shall require to be transmitted in the desired format automatically in future. Indian Railway is upgrading their SCADA systems. SEMC (State Level Energy Management and Control Centre) are proposed to be created by IR in each state so that energy data from all RCCs of IR of that particular state is collected at a common location and same is transmitted to SLDC of that state for proper scheduling. The integration of Energy data at common location for Gujrat state is shown in Figure.2 above. In similar manner Energy data of all states shall be integrated.

While IR is upgrading their SCADA systems to comply the above requirements, few changes are needed in the DFCCIL SCADA system as well. These are as follows:

3.3.1 Interface of ABT meters with proposed Remote Terminal Units (RTUs) in DFCCIL TSS:

In the existing EMP-16 Contract, the interface of Energy Meters/Multi-Function Meters with TSS RTU is to be done. However, as per the revised requirements, ABT meters needs to be interfaced with TSS RTU. The proposed RTU is capable of communicating with ABT meters through RS 485 link on Modbus protocol. Hence there shall not be any issue. Only Upgradation of RTU as well as OCC software shall be required.

3.3.2 Provision of Energy Management Servers at OCC/Ahmedabad:

Once ABT meter raw data is received at OCC, same shall be required to be compiled in the desired format at OCC and same shall have to be transmitted to SEMC of IR. Thus, OCC needs to be provided with Energy Management Servers (Two Nos.) to capture ABT meter data, analyse the same and convert it in report form. Necessary Software for this purpose shall be required to be installed in Energy management Servers. Also, communication link needs to be established between OCC/Ahmedabad and SLTPDC controlled by IR.

4.0 Conclusion:

In view of above discussion, it is clear that required changes needs to be initiated by DFCCIL. PMC-2R has already been advised by BRC unit to take necessary steps so that the statutory requirements are fulfilled well with in time. Also, communication link for data transfer between OCC/Ahmedabad and SLTPDC is yet to be worked out. Other Project units may also take similar steps.

Terminology:

CERC: Central Electricity Regulatory Commission

SERC: State Electricity Regulatory Commission

NTPDC: National Traction Power Dispatch Centre,

SLTPDC: State LevelTraction Power Dispatch Centre

RLDC: Regional Load Dispatch Centre

SLDC: State Load Dispatch Centre,

TSS: Traction Sub Station

GSS: Grid Sub Station

SCADA: Supervisory Control and Data Acquisition System,

RCC: Remote Control Centre

OCC: Operation Control Centre

RTU: Remote Terminal Unit

EMS: Energy Management Server

EMP-16: Electrical Mechanical Package (Contract)

PMC: Project Management Consultant

References:

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3. Write up on Open Access at indianpowersector.com/open-access by Shri Sumit Kumar.

Carbon Sequestration through Green Belt Development to offset the tree cutting impacts and a comprehensive statement on Compensatory Afforestation in Lieu of Forest land Diversion for Non forestry use by Forest Department due to freight Construction in Bhaupur-Mughalsarai Section of EDFC

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ABSTRACT

This paper discuss the tree plantation and CO_2 Sequestration by tree planted vis a vis tree cut while track laying activity and details of Compensatory afforestation to rationalize tree felling in forest Diversion for railway projects. It is not an easy task but we have to judiciary ensure that activities involved in infrastructure development causes least harm to our nature and environment and has a net positive impact on our quality of life and society. For linear infrastructure project, massive land being acquired and utilities like Cable/Structure Trees etc. falling in RoW (Right of Way) being dismantled/shifted. The process of transplanting trees is complicated and successfully conducted only if trees that don't have deep roots. Soon Transplanting trees policy will be considered too in DFC future corridor but currently efforts for minimum no. of trees cutting with all precaution to not harm other one. Tree plantation vis a vis tree cutting is being done.

1.0 Introduction

Dedicated Freight Corridor Corporation of India Limited (DFCCIL), a mega infrastructure project of the Ministry of Railways which will be a game changer in the freight logistics scenario of the country. The Eastern Dedicated Freight Corridor with a route length of 1856 km consists of two distinct segments.

- An electrified double-track segment of 1409 km between Dankuni in West Bengal & Khurja in Uttar Pradesh
- An electrified single-track segment of 447 km between Ludhiana (Dhandarikalan) - Khurja - Dadri in the state of Punjab, Haryana and Uttar Pradesh.

Due to non - availability of space along the existing corridor particularly near important city centers and industrial townships, the alignment of the corridor takes a detour to bypass densely populated towns such as Mughalsarai, Allahabad, Kanpur, Etawah, Ferozabad, Tundla, Barhan, Hathras, Aligarh, Hapur, Meerut, Saharanpur, Ambala, Rajpura, Sirhind, Doraha and Sanehwal. The Eastern Corridor will traverse through 6 states.

Eastern Corridor is projected to cater to a number of traffic streams-coal for the power plants in the northern region of U.P., Delhi, Haryana, Punjab and parts of Rajasthan from the Eastern coal fields, finished steel, food grains, cement, fertilizers, lime stone from Rajasthan to steel plants in the east and general goods.

2.0 EDFC- II (Bhaupur–Mughalsarai 393 km)

The project corridor or the APL-2 comprises. Mughalsarai – Bhaupur section covering about 393 Km as depicted in Figure 1-1. The EDFC (APL-2) mostly runs parallel to the existing rail tracks with 143 Km in detour section and balance 250 Km in parallel to the existing North Central Indian Railway Track at a distance of 13 -15 meters. APL-2 corridor i.e. Mughalsarai to Bhaupur section (total length 393 Km) falls within the jurisdiction of two Chief Project Managers (CPM) i.e. Allahabad (East) and Allahabad (West).The proposed Freight Corridor section traverses through 7 districts and 373 villages in the state of Uttar Pradesh. Proposed RoW width is around 20-40m in the parallel section and 40-60m in detour.

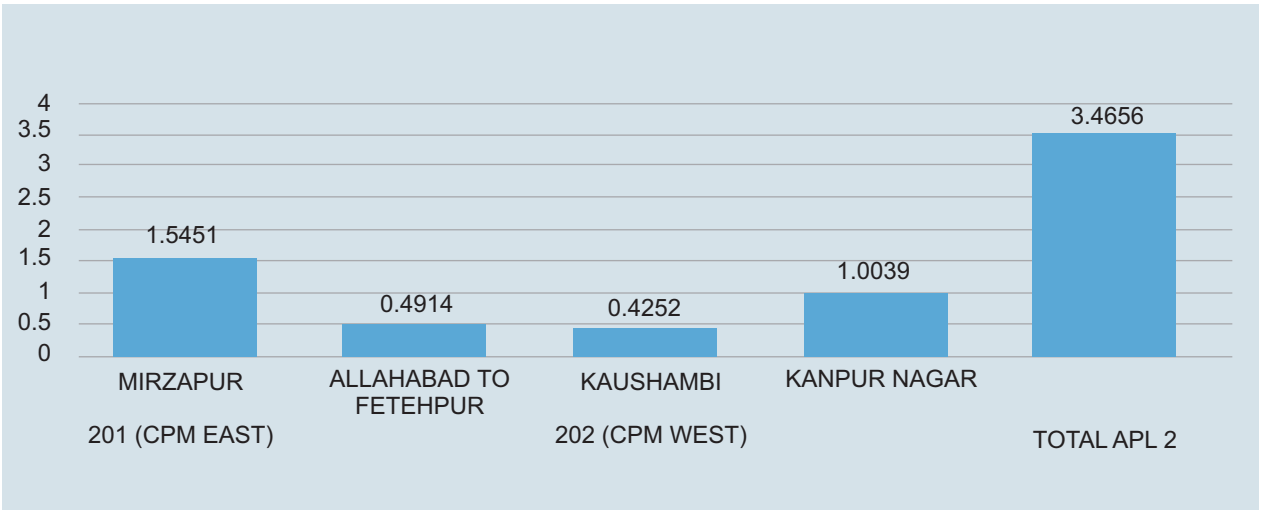
Table 2.1 Broad Details of Project Stretch

Package	Chainage km (From - To)	Length (km)		Length including link lines (km)	No. of Districts	No. of villages
		Parallel	Bypass			
CP-201 (Allahabad East)	119.550-278.155 (including 22.430 Km of link lines)	121.985	36.620	181.035	3	200
CP-202 (Allahabad West)	278.155 - 507694 (including 6.720 Km of link lines)	141.000	90.000	236.259	4	173
Total	119.550 - 507.694	**262.985**	**126.620 (143.000)**	**417.294 (393.000)**	**7**	**373**

Table 1.2 Total Land Acquisition and Forest Land and Private Tree

District	Length (km)	LAND AREA REQUIRED (Ha.)		
		Pvt.	Govt.	Total
Allahabad (E)	181	732.88	92.79	825.67
Allahbad West	237	576.88	95.03	671.91
Total	418	1309.76	187.82	1497.58

Total 188 ha. Government Land, 3.4656 ha.Inclusive of Reserve and protected forest land has been diverted for non-forest use. The EDFC-2 project is a large-scale project with anticipated reversible impacts on environment during construction phases and some impact, not of much significance though, during operation of the project. The project railway line passes through very small patches of protected forests area. No presence of endangered fauna and flora along the project railway line has been noticed. A small parcel of 3.4656 ha forest land was impacted in the complete project, 1.5451 ha was impacted in Package 201 and balance 1.9205 ha was impacted in Package 202. The district wise breakup of the forest land diverted is given in below Figure



2.1 Detail of District wise Forest Land is as below

A small parcel of 3.4656 ha forest land was impacted in the project, 1.5451(0.9571in Mirzapur + 0.588 ha in Allahabad Detour) ha.was impacted in Package 201 and balance 1.9205 ha.was impacted in Package 202.

Lot	District	Forest Land in ha	Total Forest Land in ha	PF/RF	No. of cut Trees in Forest Land	Area earmarked for CA Plantation
201	Mirzapur	0.9571	1.5451	0.5491 (Protected Forest + 0.408 Reserve Forest)	22	1.9142 (2200 trees planted on 2.0 ha area)
	Allahabad Detour	0.588		Protected Forest	17 Trees and 10 Plants	1.176 ha (1294 trees plantation completed)
202	Fatehpur	0.4914	1.9205 PF	PF	48	3.3496 ha area plantation completed (3360 trees planted) and remaining 0.4914 ha area plantation (310 trees) will be completed by 2020
	Kanpur Nagar	1.0039		PF		
	Kaushambi	0.4252		PF		

3.0 Statutory Provisions for Compensatory Afforestation

The Forest (Conservation) Act, 1980 and The Indian Forest Act, 1927 governs; Diversion of Forest Land for non-forest land, Compensatory Afforestation (CA), Tree Felling permission and Permission for Transportation of wooden log after cutting of trees in the project corridor under EDFC-II in the State of Uttar Pradesh., Forest Land Diversion proposals, Compensatory Afforestation and Tree Cutting Permission is being executed in association with Social Forestry Division and Forest & Wildlife Department, Government of Uttar Pradesh and Ministry of Environment, Forest & Climate Change, Government of India.

3.1 Compensatory Afforestation in lieu of Diversion of Forest Land

According to the provisions of The Forest (Conservation) Act, 1980, whenever Forest Land is proposed to be diverted for non-forestry purposes, the conditions for raising Compensatory Afforestation (CA) are imposed in In-Principle approval of Forest Diversion Proposal along with payment for NPV (Net Payment value) . Funds for compensatory afforestation scheme are provided by the Project Proponent diverting the Forest Land and to be deposited in "Compensatory Afforestation Management Planning Fund Authority" (CAMPA) of the Government of India.

Forest Department has been paid by DFCCIL and entrusted with the task for compensatory afforestation.

Respective forest departments have completed compensatory afforestation in both Allahabad and Mirzapur divisions.

For EDFC-II (Bhaupur-Mughalsarai) section, diversion of 3.4656 hectares Forest Land is proposed in 5districts; Kanpur Nagar, Mirzapur, Allahabad, Fatehpur, Kaushambi Districts. In-principle approval (Stage-I Forest Clearance) and Final Approval (Stage-II Forest Clearance) have been issued by Ministry of Environment, Forest & Climate Change, and Government of India for all three forest Proposal.

As per stipulated conditions of Stage-I Forest Clearance, Compensatory Afforestation against the 0.9571 forest area in District Mirzapur, 1.176 ha. area in District Mirzapur has been proposed. For Allahabad division, total 1294 trees on 1.176 ha land have been planted by forest division in Meja at Kharka Forest Block in approximately 25 degree north and 81 degree east.

As per stipulated conditions of Stage-I Forest Clearance, Compensatory Afforestation against the 0.588 forest area in Allahabad detour, 1.176 ha. area in District Mirzapur has been proposed. Total 1294 trees have been planted. In Mirzapur division in Akhori compartment for 0.09571 ha forest land diversion, compensatory plantation has been done in Behnaizila in Kanpur dehat on 4.6182 ha land.

As per stipulated conditions of Stage-I Forest Clearance, Compensatory afforestation against the 1.9205 forest area, 3.841ha.area in District Mirzapur has been proposed.

4.0 Green Belt Development by JV

What is Green Belt?

When Plants /trees are grown in a row that can be single or multiple in green belt space provided along the infrastructure projects are known as Green Belt. When Trees grown in single row that acts as oxygen generator, pollutant absorber or if in multiple row they have add on benefits like noise attenuator.

The development of green belt has been recommended as one of the major components of the Environmental Management Plan which will further enhance the environmental quality and lead to compensate the loss caused due to cutting of trees. Even though the loss is not completely counterbalance but planting 1:2 or more trees may to an extent can help in balancing the damage.

Generally for double track laying and associated ancillary activities approx. RoW width estimated to be around 60-70 m. and Single track is 30 m. For Single line formation width approximately 8 m and Double is 14 m and at approx. 1 m from toe of embankment/ formation S&T cable laid down after that space is available for plantation activity beside plantation at station building/Yard.

- Minimum 6 feet above ground and 2 years old saplings are being preferred for plantation.
- Native Species have been preferred for plantations prescribed in EA Reports.
- Plantation should be done two weeks after the rain starts, as the trees benefit from the seasonal rains.

Benefits of Green Belt

Green Vegetal cover is not only pleasing to eyes but also beneficial in many ways as follows;

- Bio diversity retention
- Soil moisture retention
- Ground water recharge
- Microclimate moderation
- Acting as a carbon sink
- Mitigation of air pollution problems
- Attenuation of noise level
- Maintain the Green area and improve aesthetics.
- Thrive in pollutants atmosphere.

The major species affected due to construction of alignment are babool, neem, shisam, peepal, mango, bargad, kanji, labhera, ashok, sirsa, guler, jamun, ber even though many efforts have been taken to reduce the no. of trees to be cut. There are approximately 17901 private trees affected due to Railway line construction activity.

DFCCIL has its corporate Environment Policy and EMF, there is a provision to compensate the tree felling as per the state tree cutting act accordingly double the Tree planation vis a vis tree cut and additional 10 trees /Km tree planation too. Hence 31114 trees will be planted to compensate the approx..15000 tree cutting loss.

Mainly Ashok, Karanj, Neem, Mango, Bakul, Imli, Ashok, Satparna, mahua, bel, Tendu, Mar Maharakha, Bakain, Imli, Arjuna, Neem, Savukkamaram. Shrubs and grasses: Akand, Harsighar, Kaner. Trees have been planted in Green Belt Development Activities. Green Belt development within the DFCCIL Right of Way been carried out. The status of plantation undertaken by JV as on date are as below:

Under the provisions of Contract Agreement (CA-part-2-Volume 6, Appendix 13). Green Belt development within the DFCCIL Right of Way to be carried out by JV contractor and to be maintained till the expiry of Defect Liability Period. As in the above figure, there are 15,557 trees affected within the ROW of DFCCIL under EDFC 2. To mitigate impacts arising out of felled trees within ROW, there was proposal for a total of 31114 numbers of trees as a part of Green development Plan. This is twice a number of total trees impacted. As on March 31, 2020, approximately 7319 in LOT 201 were planted, only 2197 survived. Approximately 4252 in LOT 202 were planted, only 1166 survived rest will be planted with focus on enhancing survival rate and some extra measures.

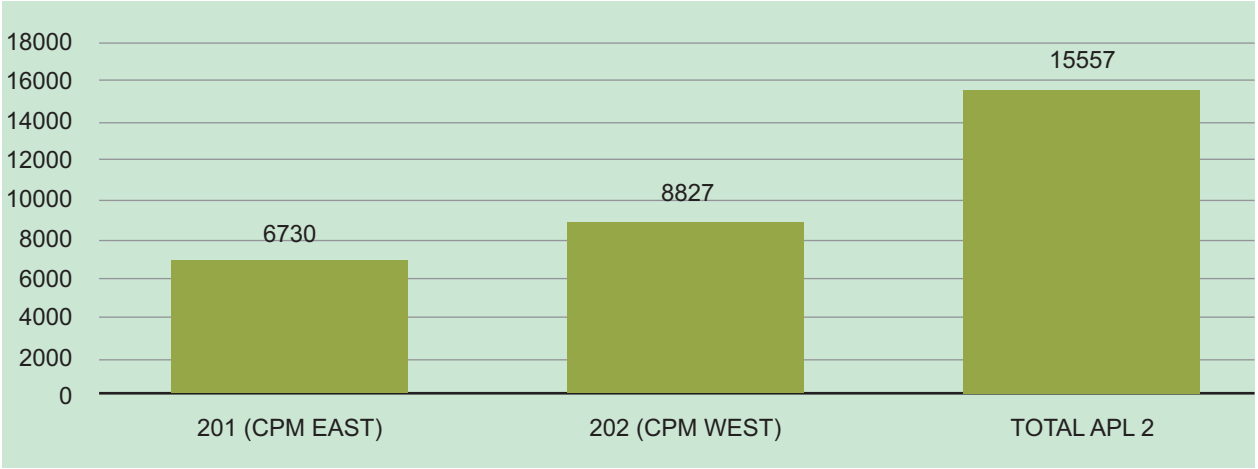


Figure Showing status of impacted tress in both lots of EDFC-II

Plantation undertaken by GMR JV.

Green belts act as containment of air pollution in the human environment, especially in Industrial and urban environs. Improvement of aesthetics is a bonus derived through the presence of greenery in these areas. As living organisms, plants have their limits to tolerate toxicity of air pollutants and to function as pollution ameliorants. Nature and levels of sensitivities of plant species towards anthropogenic air pollutants, are discussed.

Besides acting as a carbon sink. Certain species of plants can even absorb the pollutants while others can thrive in polluted atmosphere.

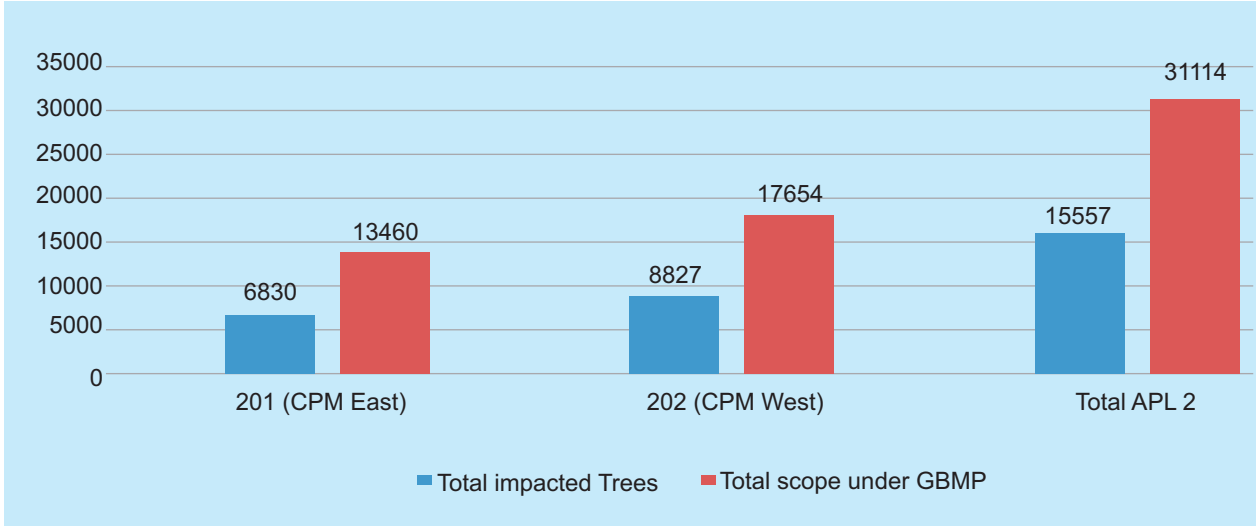
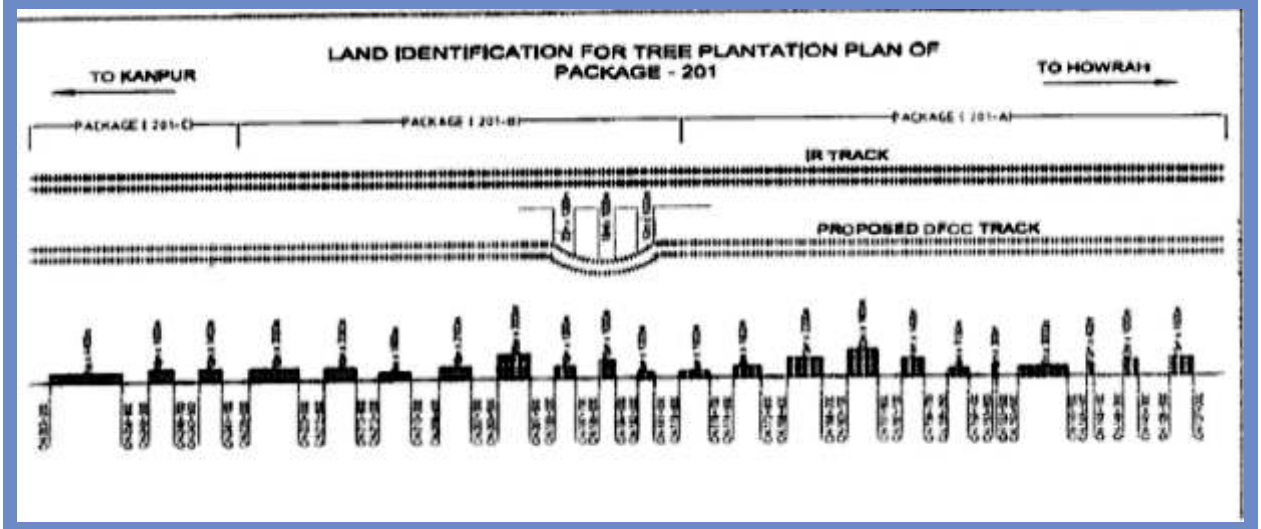
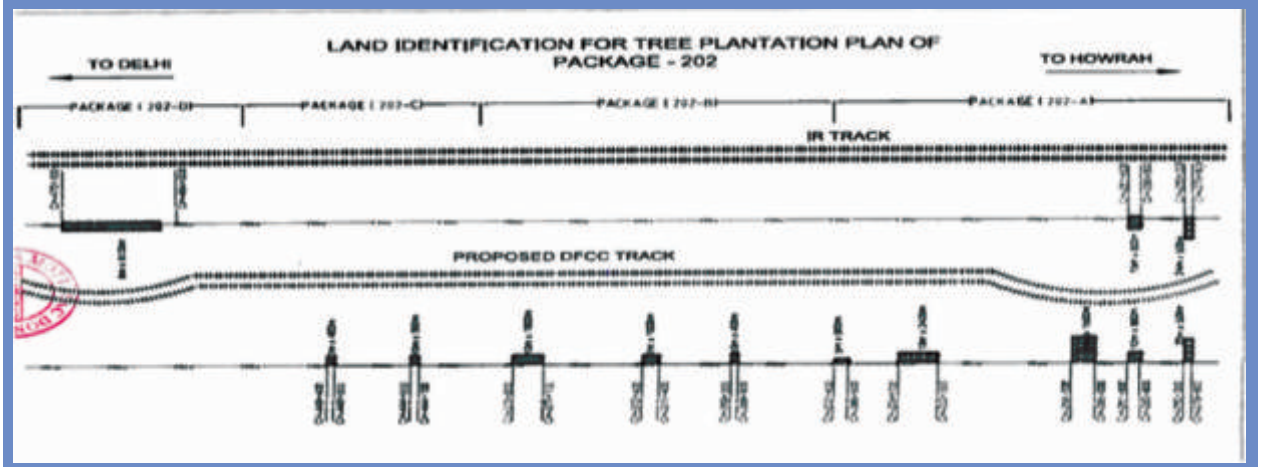


Figure: Green belt Development details under EDFC-II

In DFC how and where it has been developed





Carbon Sequestration

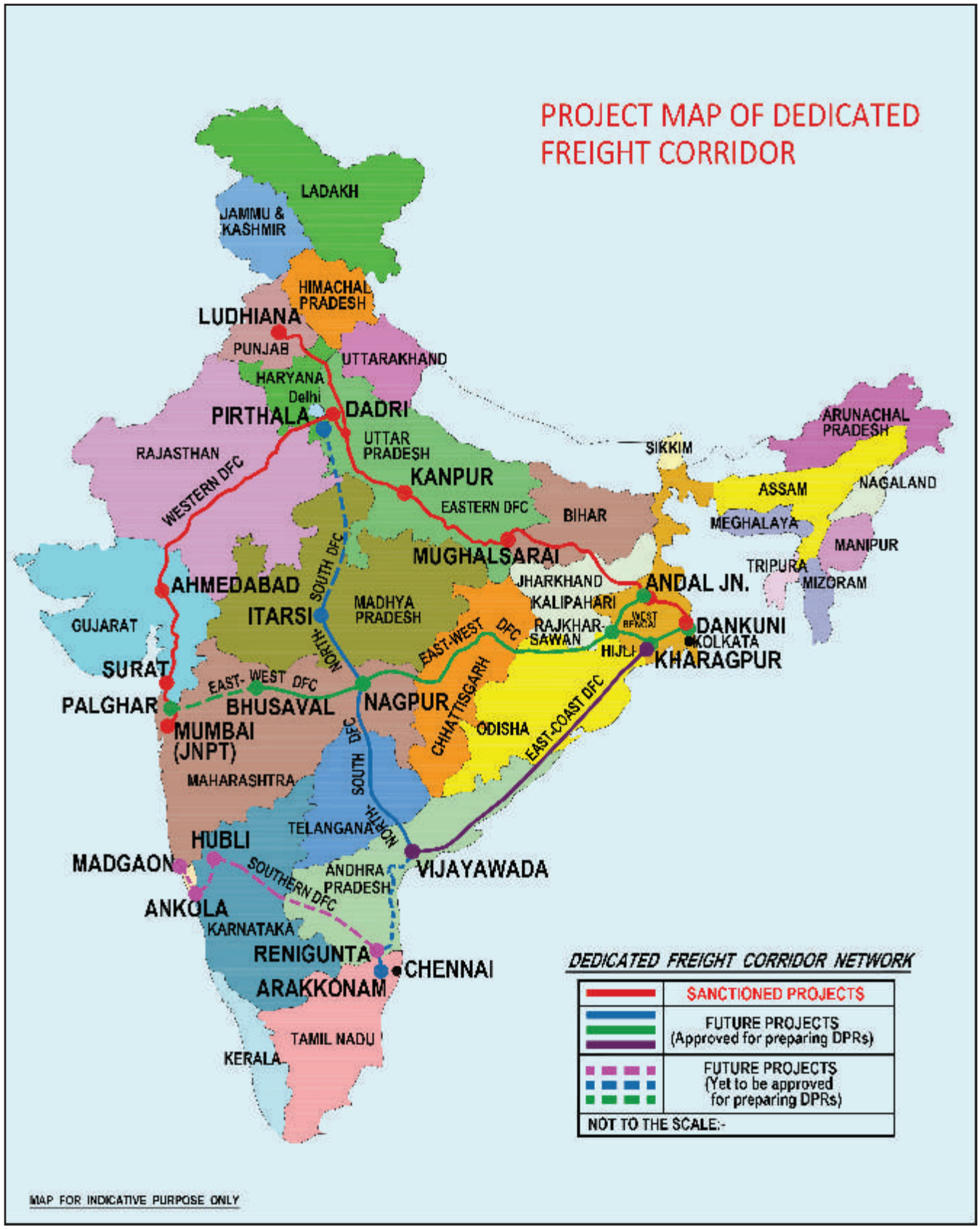
Tree cover acts as a carbon sink. Certain species of plants can even absorb the pollutants while others can thrive in polluted atmosphere. As a thumb rule it is estimated that "A tree can absorb as much as 48 pounds of Carbon Dioxide per year and can sequester 1 ton of carbon dioxide by the time it reaches 40 years old".

It is found that a tree can absorb as much as approx. 48 pounds of carbon dioxide per year hence total tree plantation to be carried out is 31114. It is estimated to sequester total 746.73 tons (31114 X48= 1493472 pounds) Co2 through plantation activity annually". And over the period of 40 years as thumb rule 29869.2tonns of carbon dioxide by the time it reaches 40 years old.

Recommendation;

Although it is very hard to retrieve the losses caused due to cutting of mature tree, but while adopting compensatory tree plantation will help in minimizing the impact induced due to felling of tree. the actual challenge is to nurture the saplings for at least one summer as eight of the 10 saplings die within a year. This paper focuses the benefits of green belts and adopting rational tree policy we can help in undo the loss caused due to unavoidable activities involved due to construction of corridor. Now a days many tree translocation with good survival rates techniques are available same can be opted while formulating DFCCIL own tree policy.

DFC through tree plantation, only in EDFC-2 along the corridor beside Compensatory Afforestation and Additional Compensatory Afforestation "estimated to sequester 746.73 tons Co_2 through plantation activity annually. It is also has been calculated that a tree can sequester 1 ton of carbon dioxide by the time it reaches 40 years old hence over the 40 years total 29869 tons CO_2 will be sequester ".


PROJECT MAP OF DEDICATED FREIGHT CORRIDOR
LADAKH
JAMMU & KASHMIR
HIMACHAL PRADESH
LUDHIANA
PUNJAB
UTTARAKHAND
HARYANA
Delhi
PIRTHALA
DADRI
UTTAR PRADESH
RAJASTHAN
WESTERN DFC
KANPUR
EASTERN DFC
BIHAR
SIKKIM
ARUNACHAL PRADESH
ASSAM
NAGALAND
MEGHALAYA
MANIPUR
TRIPURA
MIZORAM
SOUTH DFC
MUGHALSARAI
JHARKHAND
ANDAL JN.
AHMEDABAD
ITARSI
MADHYA PRADESH
KALIPAHARI
GUJARAT
RAJKHAR-SAWAN
DANKUNI
KOLKATA
HIJLI
KHARAGPUR
NORTH
EAST-WEST DFC
SURAT
EAST-WEST DFC
PALGHAR
BHUSAVAL
NAGPUR
CHHATTISGARH
ODISHA
EAST-COAST DFC
MUMBAI (JNPT)
MAHARASHTRA
SOUTH
NORTH
DFC
TELANGANA
HUBLI
MADGAON
SOUTHERN DFC
ANDHRA PRADESH
VIJAYAWADA
ANKOLA
KARNATAKA
RENIGUNTA
CHENNAI
ARAKKONAM
TAMIL NADU
KERALA
DEDICATED FREIGHT CORRIDOR NETWORK
SANCTIONED PROJECTS
FUTURE PROJECTS (Approved for preparing DPRs)
FUTURE PROJECTS (Yet to be approved for preparing DPRs)
NOT TO THE SCALE:-
MAP FOR INDICATIVE PURPOSE ONLY

डेडीकेटेड फ्रेट कारीडोर कारपोरेशन ऑफ इंडिया लि.

Dedicated Freight Corridor Corporation of India Limited

(भारत सरकार का उपक्रम)

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