56th ENGINEERS' DAY

TECHNICAL SEMINAR

Eco-Friendly Sustainable and Integrated Infrastructure Development

Jharkhand Engineering Services Association (JESA)

Venue : Chanakya BNR Hotel, Ranchi

SEPTEMBER 15, 2023

MEET WITH OUR AMAZING TEAM

Er.. Jainendra Kumar, Executive Member

Er. Mithilesh Prasad, Executive Member

Er. Vikram Pratap Singh, Executive Member

Er. Bibhuti Narayan Singh, Executive Member

Er. Ashok Kumar, Treasurer

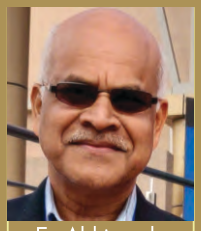
Er. Ramesh Prasad, Publicity Secretary

Er. Ashish Kumar Sinha, Executive member

Er. Vijay Kumar Agarwal, Organising Secretary

Er. Subhash Prasad, Joint Secretary

Er. Ravi Shankar Prabhakar, Organising Secretary



Er. Abhinendra Kumar, Vice President

Er.Anil Kumar, President

Er. Vikas Kumar, Joint Secretary

Er. Satyendra Prasad Singh, Executive member

Er. Onkar Nath, Executive member

Er. Manoj Kumar Verma, General Secretary

Souvenir

56th Engineers' Day

Technical Seminar on Eco-Friendly Sustainable & Integrated Infrastructure Development

Date :
15 September 2023

Venue :
Chanakya BNR Hotel, Ranchi

Organiser :

Jharkhand Engineering Services Association

Ranchi

56th ENGINEERS' DAY

।। हम सभी के शाश्वत प्रेरणा श्रोत भारत रत्न सर एम वी को उनके १६२ वें जन्म वर्षगाँठ पर शत शत नमन।।

मोक्षगुंडम विश्वेश्वरय्या

ऐसे लोग कम ही होते हैं जिनको सौ वर्ष का जीवन मिलता हो और उनमें भी ऐसे लोग तो बहुत ही कम हैं जिनका दीर्घ जीवन देश और समाज की सेवा में बीता हो। मोक्षगुंडम विश्वेश्वरय्या भारत के ऐसे ही इने-गिने सपूतों में से थे। उनकी गणना देश के महान इंजीनियरों और प्रशासकों में होती रहेगी।

उनका जन्म 15 सितम्बर 1861 को मैसूर राज्य के कोलार जिले में चिकवल्लपुर के पास मदनहल्ली नाम के एक गाँव में हुआ था। कोलार जिला अपने सोने की खानों के लिए प्रसिद्ध है। विश्वेश्वरय्या ने अपनी जन्मभूमि का नाम उज्ज्वल किया । जीवन की कसौटी पर वह खरे सोने की तरह चमके।

विश्वेश्वरय्या पढ़ाई-लिखाई में बचपन से ही बहुत मेधावी थे, लेकिन उनके माता-पिता बहुत निर्धन थे। वे विश्वेश्वरय्या की शिक्षा का खर्च नहीं उठा सकते थे। पैसे की कमी के कारण उनकी पढ़ाई में निरंतर बाधाऐं आती रही, पर उन्होंने हिम्मत नहीं हारी। हाई स्कूल में प्रवेश करने के लिए वह गांव से बंगलौर चले आए। उन्हें अपने रिश्तेदारों का सहारा लेना पड़ा। वह कहीं पर रहते थे, कहीं पर सोते थे और ट्यूशन पढ़ाकर जैसे-तैसे खर्च चलाते थे। ऐसी परिस्थितियों में विद्या प्राप्त करना कोई सरल काम नहीं है, किंतु अपनी असाधारण लगन के कारण विश्वेश्वरय्या बराबर सफल होते चले गये। जिन दिनों वह बी0ए0 की पढ़ाई कर रहे थे, कॉलेज के प्रिंसिपल एक अंग्रेज सज्जन थे। वह विश्वेश्वरय्या के गुणों पर मुग्ध हो गए। उन्होंने विश्वेश्वरय्या की सिफारिश करते हुए पूना के साइंस कॉलेज के प्रिंसिपल को चिट्ठी लिख दी। विश्वेश्वरय्या को इंजीनियरींग कॉलेज में दाखिला भी मिला और वजीफा भी। इंजीनियरींग की पढ़ाई के दिनों में उन्होंने दो आदतें डालीं, जिनको उन्होंने जीवन भर कभी नहीं छोड़ा। एक तो वह समय का कोई भी क्षण व्यर्थ नहीं गवाते थे और दूसरा वह कार्यक्रम बनाकर अध्ययन और सभी काम करते थे। परिणाम यह हुआ कि इंजीनियरींग की परीक्षा में वह प्रथम आए।

विश्वविद्यालय की इंजीनियरींग परीक्षा में प्रथम स्थान पाने के उपरांत वह तेईस वर्ष की आयु में बंबई सरकार के पी0डब्लू0डी0 (सार्वजनिक निर्माण) महकमें में सहायक इंजीनियर के पद पर नियुक्त हुए थे। विश्वेश्वरय्या बड़े तेजस्वी थे और प्रारंभ से ही कामों को अपनी अनोखी सूझबूझ के अनुसार करना चाहते थे। उन्हें जो पहला काम सौंपा गया था, उसके संबंध में सोच-विचार के बाद वह इस नतीजे पर पहुँचे कि उसे वर्षाकाल में पूरा करना कठिन होगा और उस पर खर्च भी ज्यादा बैठेगा। अपनी इस सच्ची राय से उन्होंने अपने वरीय पदाधिकिारी को अवगत कराय। इस पर उस इंजिनियर ने नाराज होकर उन्हें चेतावनी भरा पत्र लिखा कि काम करने की शक्ति और आज्ञाकारिता में यह पदाधिकिारी अच्छा नहीं है। इसे पढ़कर विश्वेश्वरय्या दंग रह गए। इन्होंने उस काम को आज्ञानुसार ही पूरा करने के लिए कमर कस ली और यद्यपि उन्हें ऐसा करने में बड़ी परेशानी उठानी पड़ी, फिर भी उन्होंने उस काम को समय पर पूरा कर डाला। अपनी कड़ी मेहनत, लगन और कार्य-कुशलता से वह शीघ्र ही अपने उच्चाधिकारियों की नजरों में उँचे उठने लगे। उनकी दिनों-दिन तरक्की होने लगी और वह एक के बाद एक उँचे पद पर काम करते चले गए। कई बार उन्हें कई ऐसे काम सौंपे गए जिनको अंग्रेज इंजीनियरों के वश से बाहर समझा गया। पानी पहुँचाने की व्यवस्था और जल-निकास के लिए नालियों का प्रबंधन करने में विश्वेश्वरय्या ने विशेष योग्यता प्रदर्शित की थी। बंबई सरकार की नौकरी के दिनों में उन्होंने बंगलोर, पूना, मैसूर, करॉची,बड़ौदा, हैदराबाद, ग्वालियर, इंदौर, कोल्हापुर, सूरत, नासिक, नागपूर, धारवाड़, बीजापुर आदि शहरों में पानी, नल और नालियों की व्यवस्था की थी। इसलिए अदन बंदरगाह में नल लगाने और जल-निकासी के लिए नालियों का प्रबंधन करने के लिए उनको विशेष रूप से भेजा गया था। कुछ अंग्रेज इंजीनियरों को यह बात पसंद नहीं आई कि उनके रहते एक भारतीय इंजीनियर को अधिक योग्य मानकर एक जिम्मेदार काम के लिए विदेश भेजा जाए। वे विश्वेश्वरय्या को नीचा दिखाने की कोशिश में रहने लगे। बढ़ते हुए मनमुटाव को देखकर विश्वेश्वरय्या चौबीस वर्ष तक बंबई सरकार की नौकरी करने के बाद स्वेच्छा से उससे अलग हो गए। उस समय वह अधीक्षण अभियंता के पद पर थे।

विश्वेश्वरय्या की ख्याति सारे देश में फैल चुकी थी। बंबई सरकार की नौकरी से अवकाश लेकर वह यूरोप-भ्रमण कर रहे थे कि हैदराबाद सरकार ने उन्हें विशेष सलाहकार इंजीनियर के पद पर अपने यहाँ बुला लिया। हैदराबाद रियासत में उन दिनों भयंकर बाढ़ आ चुकी थी और हैदराबाद के निजाम बहुत चिंतित थे। वह चाहते थे कि ऐसी आफत दोबारा न आने पाए। इस संबंध में उनकी निगाह विश्वेश्वरय्या पर ही जाकर टिकी थी। इससे विदित होता है कि विश्वेश्वरय्या की इंजीनियरी क्षमता में लोगों को कितना अधिक विश्वास हो गया था। कुछ ही महीनों बाद मैसूर नरेश ने विश्वेश्वरय्या को मैसूर के चीफ इंजीनियर पद पर बुला लिया। इस पर काम करते हुए उन्होंने कावेरी नदी पर कृष्णराज सागर बांध बनवाया। यह बांध उस समय भारत का सबसे बड़ा बांध था। इस बांध को देखकर महात्मा गांधी ने भी विश्वेश्वरय्या की प्रशंसा की थी।

भारत के स्वतंत्र होने पर देश की तीव्र प्रगति के लिए जल और बिजली की अनेक योजनाएँ बनाई गई और कितने ही बांधों का निर्माण हुआ किंतु योजनाएँ बनाकर विकास करने का जो काम भारत में अब आकर शुरू हुआ, उसी को मैसूर में विश्वेश्वरय्या ने बहुत पहले कृष्णराज सागर बांध बनवाकर कर दिखाया। जल और बिजली की इस योजना से मैसूर के उन्नति का सूत्रपात हुआ।

लगभग तीन वर्ष बाद विश्वेश्वरय्या को मैसूर का दीवान बना दिया गया। वह छः वर्ष तक मैसूर के दीवान रहे। इस बीच उन्होंने शिक्षा और उद्योगों का बड़ा विस्तार किया। उन्होंने मैसूर में इंजीनियरींग और तकनीकी शिक्षा का प्रबंध किया और मैसूर विश्वविद्यालय स्थापित किया। उन्होंने मैसूर का राज्य बैंक खोला और सीमेंट, कागज, साबुन आदि के नए उद्योग-धंधे स्थापित किए। मैसूर का प्रसिद्ध वृंदावन उद्यान भी उन्हीं का बनवाया हुआ है। भद्रावती में लोहा और इस्पात कारखाना खोलने का काम भी उनके समय में प्रारंभ हुआ था। बाद में दीवान के पद से अलग हो जाने पर इस कारखाने का प्रबंधन बिगड़ने लगा। कारखाने का प्रबंधन ठीक करने के लिए विश्वेश्वरय्या को विशेष रूप से बुलाया गया और कुछ ही समय में कारखानें को उन्होंने सुचारू रूप से चला दिया। कारखाने से पारिश्रमिक के रूप में उन्हें बहुत सा धन मिला जिसे उन्होंने नई शिक्षा संस्थाएँ खोलने के लिए दे दिया। वह कितने ही बड़े-बड़े पदों पर रहे, लेकिन उन्होंने अपने पद से कभी कोई लाभ नहीं उठाया। इतना ही नहीं उन्होंने अपनी माँ तक से वचन ले लिया था कि वह कभी किसी की सिफारिश नहीं करेंगी। 1922 में बंबई में देश के सभी राजनीतिक दलों का एक सम्मेलन बुलाया गया। इसमें महात्मा गांधी, मो॰ अली जिन्ना, मदन मोहन मालवीय और एम0आर0जयकर आदि बड़े-बड़े नेता शामिल हुए थे। विश्वेश्वरय्या को सम्मेलन का अध्यक्ष बनाया गया था।

विश्वेश्वरय्या को एक और बड़ा काम मिला, जिसमें बिहार राज्य में मोकामा में गंगा नदी पर पुल के निर्माण के संबंध में सलाह देना था। उन्होंने यह काम 92 वर्ष की आयु में लिया और उसे बड़े उत्साह से पूरा किया।

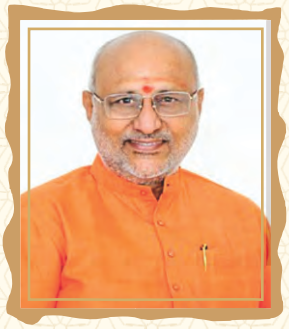
उनकी दीर्घकालीन सेवाओं के लिए कई विश्व विद्यालयों ने उन्हें डॉक्टरेट की उपाधि देकर उनका सम्मान किया। भारत सरकार ने उन्हें 1955 में 'भारत रत्न' से विभूषित किया।

विश्वेश्वरय्या बड़े शांत, गंभीर और स्वाभिमानी व्यक्ति थें। उनकी आंखों में चमक और आकर्षण था। वे कामदार पट्टीवाला प्रसिद्ध मैसूरी साफा बॉधते थे। सौ वर्ष की आयु में भी उनमें थकान का नाम नहीं था। वह बराबर काम में लगे रहते थें और काम के लिए अवसर ढूढ़ते रहते थे। कठिन परिश्रम को ही वह अपने जीवन का मूल रहस्य मानते थे। इसके अतिरिक्त वह इन बातों को जरूरी समझते थे- मन में संतोष हो, खूब खुली हवा में रहा जाए और चित सदा प्रसन्न रहे।

विश्वेश्वरय्या अनेक बार विदेश गए और पश्चिमी देशों की विशेष रूप से अमेरिका और जापान की उन्नति ने उनको बहुत प्रभावित किया। उन्होंने देखा कि इसके दो बड़े कारण हैं। एक तो यह कि इन दोनों

देशों में शिक्षा को बहुत महत्व दिया जाता है और दूसरा इन देशों के लोग बड़े परिश्रमी हैं। विश्वेश्वरय्या को यह कहावत बहुत पसन्द थी - जो काम नहीं करेगा, वह खायेगा भी नहीं। विश्वेश्वरय्या का कहना था कि बारह वर्ष की आयु से ही बालक को अपने पैरों पर खड़े होने की आदत डालनी चाहिए और यह सोचना चाहिए कि मुझे जो कुछ बनना है, अपनी मेहनत और लगन से बनना है। वह अनुशासन के कट्टर समर्थक थे। वह स्वयं जो कुछ करते थे, नियमपूर्वक योजना बनाकर करते थे। जीवन में सफल होने के लिए वह इस बात को जरूरी मानते थे कि परिस्थितियाँ चाहे अच्छी हों या बुरी, धैर्य रखना चाहिए। आत्मविश्वास किसी भी स्थिति में नहीं खोना चाहिए।

विश्वेश्वरय्या का देहांत 14 अप्रैल, 1962 को 101 वर्ष की आयु में हुआ। उनके जीवन की कहानी उनकी दीर्घ आयु के अनुसार ही लंबी कहानी थी। उनका जन्म 1857 के विद्रोह के लगभग चार वर्ष बाद हुआ था। उन्होंने किसी-न-किसी रूप में लगभग सत्तर-पचहत्तर वर्ष तक देश की सेवा की थी। वह एक सच्चे कर्मयोगी थे। उनका जीवन सभी लोगों के किए कुछ-न-कुछ संदेश लिए हुए है। गरीबों के लिए उसमें प्रेरणा है, छात्रों के लिए मार्गदर्शन है, सरकारी कर्मचारियों, समाजसेवियों और देशभक्तों के लिए वह कर्मठता का आदर्श है। वह ठीक ही कहते थे कि यदि व्यक्ति अच्छे और महान नहीं होगें तो देश भी अच्छा और महान नहीं होगा।



सत्यमेव जयते

GOVERNOR OF JHARKHAND

RAJ BHAWAN
RANCHI – 834001
JHARKHAND

Message

It is a matter of great pleasure that "Jharkhand Engineering Services Association" is celebrating 56th Engineers' Day on the occasion of 162nd Birth Anniversary of Bharat Ratna Sir Mokshagundam Visvesvaraya on 15th September, 2023 and is hosting a seminar on the topic of "Eco-friendly, Sustainable & Integrated Infrastructure Development". I am also happy to know that the association is bringing out a special souvenir to celebrate this day.

India is on a transformative journey towards eco-friendly, sustainable and integrated infrastructure development which will enable long term economic growth alongside preservation and nurturing of the environment. By embracing green initiatives, renewable energy, smart urban planning, and technological innovations, engineers are setting an example for the world. In this long-term vision of sustainable economic growth, the engineering community of Jharkhand is going to play a critical role.

On this occasion, I congratulate all the Engineers. I wish they continue to work hard with great technical skills, to inspire other sections of the society in the mission of nation building.

I also congratulate the organizing team of JESA & all the participants and wish the seminar a grand success.

(C.P. Radhakrishnan)

RABINDRA NATH MAHATO
Speaker
Jharkhand Legislative Assembly
Ranchi

सत्यमेव जयते

Message

I have learnt with pleasure that JESA (Jharkhand Engineering Services Association) is celebrating the 56th Engineers' Day on September 15 to commemorate the 162nd Birth Anniversary of legendry Indian engineer Bharat Ratna Sir Mokshagundam Visvesvaraya.

To make the event meaningful for all those who carry the responsibility of Nation and State building, the occasion has been chosen to host a .seminar on topic Eco-friendly, Sustainable & Integrated Infrastructure Development.

I am certain that our Engineers are deeply inspired by Sir M. Visvesvaraya and would carry forward his legacy. I am sure that the seminar will provide an excellent opportunity to Engineers for interaction, exploration and sharing the knowledge on the subject so dear to all of them.

I express my good wishes for grand success of the technical seminar organized by JESA.

Rabindra Nath Mahto
Speaker,
Jharkhand Legislative Assembly

अध्यक्षीय कार्यालय दूरभाष : 0651–2440400, फैक्स : 0651–2441712, मोबाईल : 9431370329, 8002513007
आवासीय कार्यालय दूरभाष : 0651–2281884, फैक्स : 0651–2284046
ईमेल : speaker.jla@gov.in

Hemant Soren
Chief Minister

झारखण्ड सरकार

Message

It is a matter of great pleasure to learn that Jharkhand Engineering Services Association is celebrating 56th Engineers' Day on 15th September 2023 as a befitting tribute to Bharat Ratna Sir Mokshagundam Visvesvaraya-an imminent Indian engineer and amongst the pioneer keystone layers of modem India. To mark the occasion a technical seminar on "Eco-friendly, Sustainable & Integrated Infrastructure Development" is being held and a special souvenir on the occasion of 162nd birth anniversary of sir M. Visvesvaraya is being brought out.

The seminar it is hoped will provide opportunity for technical discussion on development of eco-friendly, sustainable and integrated infrastructure development which is the need of the hour. The State, Nation and humanity at large is looking with hope towards Indian Engineers' for building eco-friendly and sustainable infrastructure across the nation at large and in the state of Jharkhand in particular.

I extend my heartfelt greetings and wish success to the organizers of the seminar.

(Hemant Soren)

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झारखण्ड सरकार

Arun Kumar Singh, I.A.S.
Development Commissioner
(Addl. Chief Secretary)

Message

Government of Jharkhand
Yojna Bhawan, Nepal House
Doranda, Ranchi - 834002
Tel.: 0651-2491410, Fax : 0651-2490369
Email : dsplan_jharkhand@rediffmail.com
dev.com.jhar@gmail.com

I am glad to know that "Jharkhand Engineering Services Association" is going to celebrate 56th Engineers' Day on 162nd Birth Anniversary of Bharat Ratna Sir Mokshagundam Visvesvaraya on 15th September, 2023 and hosting a seminar on the topic of "Eco-friendly, Sustainable & Integrated Infrastructure Development".

I have also been informed that to mark this great event a souvenir is being published.

Sustainable & quality infrastructure plays a crucial role in ensuring quality of life to the society and all round development of the economy. It is indispensable for delivering better and. more inclusive economic, social & environmental conditions and for supporting growth by expanding access to vital services and improving economic opportunities for all.

I firmly believe on event of this magnitude does create long lasting memories and a strong legacy to emulate.

I convey my best wishes for the grand success of this seminar.

(Arun Kumar Singh)

Ajoy Kumar Singh, I.A.S.
Principal Secretary

झारखण्ड सरकार

Message

Rural Works Department
& Finance Department
Government of Jharkhand
Ranchi - 834004
Ph.: 0651-2401741
E-mail : rwdjharkhand@gmail.com

I am happy to know that "Jharkhand Engineering Services Association" is going to celebrate 56th Engineers' Day on 162nd Birth Anniversary of Bharat Ratna Sir Mokshagundam Visvesvaraya on 15th September, 2023 and hosting a seminar on the topic of "Eco-friendly, Sustainable & Integrated Infrastructure Development". The souvenir brought out on this occasion will be useful and informative as well.

I am certain that our Engineers are deeply inspired to carry forward the legacy by Sir M. Visvesvaraya. This seminar is an excellent opportunity for them to interact, explore and share knowledge in the domain of civil engineering. There are lots of expectation from the Engineering fraternity. The state and nation is looking towards engineers for the sustained economic development of our nation. So on this occasion I wish that Engineers do their work with great technical skills and set an example for other people of society, in the mission of nation building.

I extend my greetings and good wishes to the organisers and the participants and wish the seminar a great success.

(Ajoy Kumar Singh)

झारखण्ड सरकार

Vinay Kumar Choubey, I.A.S.
Secretary

Secretary to Hon'ble Chief Minister,
Secretary, Urban Development
& Housing Department,
Dept. of Excise & Prohibition
Govt. of Jharkhand
Chief Minister Secretariat

Message

It is a matter of great pleasure that "Jharkhand Engineering Services Association" is celebrating 56thEngineers' Day on the occasion of 162nd Birth Anniversary of Bharat Ratna Sir MokshagundamVisvesvaraya on 15th September, 2023 and is hosting a seminar on the topic of "Eco-friendly, Sustainable& Integrated Infrastructure Development" and I am happy to learn that a souvenir is being published on this occasion.

At a time when India has pledged to embark on its decarbonization journey in order to achieve targeted green goals, the need for eco-friendly sustainable infrastructure is critical for a better tomorrow. Engineers are a part of this great community which work day and night towards development of the nation and state by building the required infrastructure. They change the world with their technical expertise, innovative ideas and efficient execution.

I would like to extend my compliments and blessings to the hard working members of the association JESA, and wish t he event a great success.

1/9/23

(Vinay Kumar Choubey)

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3, काँके रोड, राँची – 834008 (झारखंड), कार्यालय संपर्क नं. 0651–2446040/2284367 फैक्स : 0651–2400234, 2281300

झारखण्ड सरकार

Drinking Water & Sanitation Department
Government of Jharkhand
Ranchi

Dr. Manish Ranjan, I.A.S.
Secretary

Message

It gives me immense pleasure and joy to know that Jharkhand Engineering Services Association (JESA) will be celebrating 56th Engineer's Day on 15th September 2023, commemorating the 162nd birth anniversary of the illustrious engineer, Bharat Ratna, Sir Dr. Mokshagundam Visvesvaraya. This occasion pays tribute not only to a visionary but also to the invaluable contributions of the entire engineering community. In alignment with this celebration, JESA is organizing a seminar and publishing a souvenir, emblematic of our unwavering commitment to progress and innovation, inviting all to join in honouring Sir Dr. Mokshagundam Visvesvaraya's brilliance and embracing the limitless possibilities that lie ahead in the world of engineering, leaving an indelible mark on the sands of time.

Central to the process of nation-building is the pivotal role of nurturing conscientious citizens. Each accomplishment stands as an affirmation of the unwavering commitment exhibited by individuals. JESA, unwaveringly rooted in this ethos, has consistently championed the exemplar standards of professional behavior and moral integrity within its membership. This resolute dedication harmoniously corresponds with our overarching objective of serving society and actively contributing to the progress of our nation.

I take great pride in acknowledging the active engagement of JESA members in various departments of the Government of Jharkhand. As we approach Engineer's Day 2023, we must seize the unique opportunity it presents. This day not only allows us to comprehend upcoming challenges but also encourages us to devise innovative solutions. Our state confronts emerging challenges that call for our collective expertise and unwavering dedication. These challenges necessitate a comprehensive approach to infrastructure development that is not only sustainable but also seamlessly integrated, with a keen focus on eco-friendliness. I eagerly await the seminar and the unveiling of the souvenir, which promise to offer valuable insights into the intricate issues we face, paving the way for eco-friendly, sustainable, and integrated infrastructure development.

Let us unite on Engineer's Day 2023 to commemorate the enduring legacy of Sir Dr. Mokshagundam Visvesvaraya and reiterate our dedication to engineering excellence, ethical professionalism, and societal advancement. Together, we shall chart a path toward a brighter and more sustainable future for Jharkhand, serving as a distinguished model for eco-friendly, sustainable, and integrated infrastructure not only within our state but also across India and the global arena.

Wishing you all a fruitful and enlightening Engineer's Day celebration.

(Dr. Manish Ranjan)

Nepal House, Doranda, Ranchi - 834002 (Jharkhand) / नेपाल हाउस, डोरण्डा – 834002 (झारखण्ड)
Phone : 0651-2491410, Mob.: 94301-77777, Email : dwsdacs@gmail.com, manishranjan@berkeley.edu, manishranjanias@gmail.com

झारखण्ड सरकार

Sunil Kumar, I.A.S.
Secretary

Road Construction Department
& Building Construction Department
Government of Jharkhand
Ranchi

Message

It gives me immense pleasure to know that "Jharkhand Engineering Services Association" is going to celebrate 56th Engineers' Day on 162nd Birth Anniversary of Bharat Ratna Sir Mokshagundam Visvesvaraya on 15th September, 2023 and hosting a seminar on the topic of "Eco-friendly, Sustainable & Integrated Infrastructure Development ". I am also informed that to mark this great event a souvenir is being published.

The Road Construction Department, Jharkhand has a vision to have sustainable, efficient, safe and nationally comparable road infrastructure in order to achieve quick connectivity through a grid of road-network for enhanced and comfortable mobility of people, goods and services for accelerated socio-economic development of Jharkhand to match the demand with minimum adverse impact to environment. With the threat the climate change poses, there has never been a more urgent need to create resilient and sustainable infrastructure.

I am confident that this seminar will act as a vibrant forum for exchange of ideas & exposure to the latest innovations. It is an excellent opportunity for the Engineers to interact, explore and share knowledge in the domain of civil engineering.

I extend my good wishes for the grand success of this technical seminar.

(Sunil Kumar)

झारखण्ड सरकार

Prashant Kumar, I.A.S.
Secretary

Message

Water Resources Department
Government of Jharkhand
Ranchi

I am happy to know that "Jharkhand Engineering Services Association" is going to celebrate 56th Engineers' Day on 162nd BirthAnniversary of Bharat Ratna Sir Mokshagundam Visvesvaraya on 15th September, 2023 and hosting a seminar on the topic of "Eco-friendly, Sustainable & Integrated Infrastructure Development". The souvenir brought out on this occasion will be useful and informative as well.

I am confident that the seminar will provide a unique platform to the participants from different engineering departments of the state and will help the professionals in updating themselves on the latest eco-friendly and sustainable infrastructure practices. I am hopeful that the outcome of the deliberations of the technical seminar on such a relevant and futuristic topic will certainly enrich the construction industry to a great extent.

I extend my best wishes to the organisers and participant of the event & wish the seminar a great success.

29/08/23

(Prashant Kumar)

झारखण्ड सरकार

Raghunandan Prasad Sharma
Engineer-in-Chief

Message

Drinking Water & Sanitation Department
Government of Jharkhand
Ranchi

In 2010, the United Nations General Assembly formally recognized the right to clean water as a fundamental human right. Despite the abundant presence of water, the availability of safe drinking water remains a pressing issue. India has grappled with a dire shortage of clean drinking water since gaining independence. According to the NITI Aayog's Composite Water Management Index of 2018, 21 cities in India are at risk of running out of water in the near future.

Moreover, climate change is one of the biggest global challenges in the present scenario. Water and climate change share an intricate connection, as the effects of climate change intricately influence the world's water sources. Climate change affects water quality in many ways. Projections indicate that elevated water temperatures and increased occurrences of floods and droughts are expected to worsen various types of water pollution, encompassing sediments, pathogens, and pesticides.

In order to tackle the above challenges, the Honourable Prime Minister of India has launched the Jal Jeevan Mission on 15th August 2019 to ensure every rural household has a **Functional Household Tap Connection (FHTC)** by 2024 for an assured tap water supply in **adequate quantity (55 lpcd)** of **prescribed quality (BIS:10500)** with **adequate pressure** on a **regular** and **long-term basis.** A core tenet of the mission involves implementing source sustainability measures as mandatory components, including practices such as greywater management, water conservation, and rainwater harvesting. The expected outcomes of JJM in the alignment of Sustainable Development Goals (SDG)-6 are: - **Improved 'quality of life' and 'ease of living', reduced drudgery of women and girls, reduced water-borne diseases leading to healthy lives, increased employment opportunities in rural areas and dignity of life to communities, bridging urban-rural gap.**

In the context of above, Drinking Water & Sanitation Department (DWSD), Govt. of Jharkhand is implementing JJM in mission mode to ensure that all the **61.20 lakh rural families** of the State receive safe and sustainable drinking water through FHTC as environed. As on 30th August 2023, **25.14 families** have been provided FHTC, which is **40.93** percent of the total target. The Department is committed to provided FHTC to the remaining households in a time bound while ensuring quality works of the water supply systems.

In the climate change context, the Department is implementing the Jal Jeevan Mission in eco-friendly manner, with a focus on sustainable & integrated infrastructure of water supply systems. To saturate **61.20** lakh rural families with FHTCs, for **60% of the households the water supply schemes** are electrified surface water based Multi Village Water Supply Schemes (MVS) and for **40%** households the schemes are solar powered ground water based Single Village Water Supply Schemes (SVS).

On the one hand the state strategy has minimised the over extraction and exploitation of ground water and on the other hand it has also saved over consumption of electricity while using solar power- a natural source of energy.

The Department is equally committed to provide assured service delivery focusing on regularity (**adequate quantity -55 lpcd)**, sustainability and of **prescribed quality (BIS:10500).** Jharkhand has achieved NABL accreditation of 28 out of 31 water quality testing laboratories. Now all 24 District has a NABL accredited water quality testing labs, through which the Department is regularly conducting testing of water quality parameters of international standards for **assured water supply**. In the field, Jalsahiyas of Village Water & Sanitation Committees (VWSCs) are dedicated cadres of the Department, who are ensuring water quality testing using Field Test Kits (FTKs) and H2S vials while creating awareness at large scale on judicious use of water, water tariff collection for operation and maintenance of the water supply schemes, water conservation, grey water management, sanitation & hygiene and towards the promotion of eco-friendly behavioural practices for clean environment.

We Engineers play a crucial role in the promotion of "ease of living" while implementing sustainable and integrated development of infrastructures. Operation and maintenance of the water supply systems is an integral part for the optimum utilisations of the resources involved in the assured water supply to communities. The Department has developed **Jhar-Jal web portal with the** uses emerging technologies for citizen centric grievance redressal related to water supply. This initiative has enabled the Department in effective operation and maintenance of water supply schemes.

On the occasion of **56th Engineers' Day, I wish all the very best to all the engineers in their journey of serving humanity and making the world a safer place to live in.**

(Raghunandan Prasad Sharma)

झारखण्ड सरकार

Nagesh Mishra
Engineer-in-Chief

Message

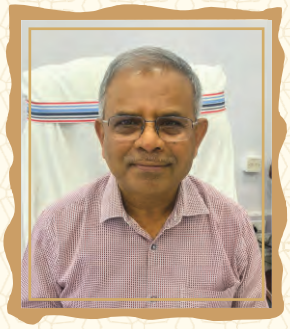
Water Resources Department
Government of Jharkhand
Ranchi

It is pleasant to know that "Jharkhand Engineering Services Association" is going to celebrate 56th Engineers' Day on 15th September 2023. In this auspicious occasion a souvenir is being published and a technical seminar is also being organised on "Eco-friendly, Sustainable & Integrated Infrastructure Development".

Vision of Water Resources Department is also to ensure the sustainable development and optimal use and management of the states water resources to provide the greatest economic and social benefit for the people of the State of Jharkhand in a manner that maintains important ecological values within rivers and adjoining lands. It is a great initiative and I am sanguine that the seminar will provide a forum for effective interaction and diffusion of knowledge regarding the latest innovations and sustainable practices for an integrated infrastructure development.

I extend my best wishes to the organisers of JESA and participants of the event & wish the seminar a great success.

(Nagesh Mishra)



झारखण्ड सरकार

Krishna Kumar Lal
Engineer-in-Chief

Message

Road Construction Department
Government of Jharkhand
Ranchi

It is gratifying to know that the "Jharkhand Engineering Services Association" is going to celebrate 56th Engineers' Day on 15th September 2023 to reminisce the accomplishments of the most decorated engineer of the nation 'Bharat Ratna Dr. Mokshagundam Visvesvaraya' on his birth anniversary.

The selected theme for this year's technical seminar "Ecofriendly, Sustainable & Integrated Infrastructure Development" is pertinent as it emphasizes an integrative and holistic process of maintaining a dynamic balance between the present needs and future demands. This is high time for an integrated approach to encourage sustainable & eco-friendly construction techniques so as to restore and maintain harmony between the natural and built environments.

I believe while the celebration will be a joyous one, it will also be genesis of new ideas to have well-conceived plans for future. With confidence that our fraternity will bring laurels to the State in years to come, I extend my greetings and best wishes to the organisers & participants on the occasion.

04/09/2023

(Krishna Kumar Lal)

झारखण्ड सरकार

Rajesh Solomon Tigga
Engineer-in-Chief

Message

Water Resources Department
Government of Jharkhand
Ranchi

It is heartening to know that "Jharkhand Engineering Services Association" is going to celebrate 56th Engineers' Day on 15th September 2023. On this auspicious occasion a souvenir is being published and a technical seminar is also being organised on "Eco-friendly, Sustainable & Integrated Infrastructure Development".

Integrated Water Resources Management is the coordinated development and management of water, land and related resources in order to maximize economic and social welfare, in an equitable manner, without compromising the sustainability of vital ecosystems. A seminar on such an important concept is going to offer immense opportunities to interact and acquire knowledge about the latest sustainable trends in the infrastructures field.

I extend my best wishes to the organisers of JESA and participants of the event & wish the technical seminar a great success.

(Rajesh Solomon Tigga)

झारखण्ड सरकार

Sanjay Kujur
Engineer-in-Chief

Building Construction Deptt.
Government of Jharkhand
Ranchi

Message

It is heartening to know that "Jharkhand Engineering Services Association" is going to celebrate 56th Engineers' Day on 15th September 2023. In this auspicious occasion a souvenir is being published and a technical seminar is also being organised on "Eco-friendly, Sustainable & Integrated Infrastructure Development".

Eco-friendly buildings and construction techniques have taken centre stage as a trend that is here to stay. From sustainable home builds to commercial developments, eco-friendly buildings are becoming the norm. It is a great initiative and I am sanguine that the seminar will provide a forum for effective interaction and diffusion of knowledge regarding the latest innovations and sustainable practices for an integrated infrastructure development.

I extend my best wishes to the organisers of JESA and participants of the event & wish the technical seminar a great success.

(Sanjay Kujur)

ENGINEERS' DAY ADDRESS

PRESIDENT, JESA
Er. Anil Kumar

My Dear Respected Engineers,

On the occasion of 56th Engineer's Day, we all are discussing on a very important & contemporary subject"Eco-friendly Sustainable and Integrated Infrastructure Development" in a Seminar in Ranchi, Capital of Jharkhand. On this occasion some scholar Engineers have written articles based on their experiences and knowledges. Compilation of these articles has been done in this Souvenir.

Infrastructure development is the foundation for any country's economic prosperity and helps in improving the quality of life of their citizens. Infrastructure and Sustainable development are completely interlinked.

During the blind run of Infrastructure development &Industrialization we are also damaging environment by excess exploitation and pollution of resources. As per estimates from UNEP, the global average temperature reached 1.1 degrees Celsius more than it was in pre-industrial times, making climate change the harsh reality of the modern era. Approximately 70% of greenhouse gases are linked to the construction and operation of infrastructure and buildings alone are estimated to account for more than 30% of global resource consumption and energy end use. As a result, the achievement of environmental SDGs such as climate action (Goal 13), life below water and life on land (Goals 14 and 15, respectively)is inextricably linked to present and future infrastructure assets. At the same time, we rely upon diverse forms of infrastructure to deliver essential services and support our economies.

Nevertheless, the Infrastructure industry is not far behind in being a forefront contributor to making things better. Green building codes are being placed by Govt. the world over to bridge the gaps.

Construction companies are now conscious of environmental labels and are choosing energy efficient technological practices to take their projects further. From using energy efficient lighting and air conditioning in buildings to choosing energy saving architecture, much is being done now. The Focus has also gone on using homegrown and recycled building

materials like fly ash and green coal (made of agricultural residues) for construction to reduce the overall carbon foot print.

Comprehensive development occurs in areas by integrating the physical, institutional, social and economic infrastructure. Many of the sectoral schemes of the Government converge in this goal, although their paths are different.

All countries including India need to have a eco-friendlysustainable infrastructure development approach with a balanced focus on increasing infrastructure investments raising the economic efficiency of projects, integrating concepts of life cycle, costs and benefits in project planning and improving the integration of environmental and social considerations in projects.

I believe that in order to achieve a more satisfactory relationship between society and its environment, timely provision should be made for the changes that human activities and competition over use of resources may bring about in order to minimize potential conflicts.

I hope that taking advantage from ideas which will be emerged during this Seminar, we will go ahead for sustainable development of State/Country. I wish all success of this Seminar and Souvenir with thanks to all of you & my organizing team.

Thank you all.
Happy Engineers' Day.

ENGINEERS' DAY ADDRESS

VICE-PRESIDENT, JESA
Er. Abhinendra Kumar

Respected all,

We all know that today is the 162nd birth anniversary of a shining star of India in the field engineering, Bharat Ratna, Sir Mokshagundam Visvesvaraya and this auspicious day is being celebrated as 56th Engineers' Day by the engineering fraternity all over India today. We all congregate to pay rich tributes to our perennial source of inspiration, Sir M. Visvesvaraya. we all congregate not only to celebrate his birth anniversary, but we also congregate to ideate (generate ideas), deliberate, debate and create which is called value engineering. In this backdrop, Jharkhand Engineering Services Association(JESA), Ranchi has been holding technical seminars on every Engineers' Day function to promote value engineering &innovative ideas since very long time back. In the continuing journey of taking this rich legacy of JESA, forward we are holding a technical seminar on a very apt and relevant burning engineering topic" Eco-friendly,Sustainable, Integrated Infrastructure Development on56th Engineers' Day today. Rapid industrialization, rapid urbanization and infrastructure development without an effective environmental impact mitigation plan &implementation in place, is rapidly degrading and depleting the life sustaining resources on our planet, the mother earth, thereby endangering the myriad life forms and the large biodiversity on it. So let's all protect the environment while we construct infrastructures. Eco-friendliness in every human intervention in the ecology and the environment on this beautiful planet is of paramount importance to combat the climate change. Reuse /Recycling of materials is also an effective way to combat the depleting material resources crisis as well as combating the challenges of waste management. Sustainability & reuse/ recycling is the soul of a resilient circular economy. Attainment of all the parameters of Sustainable development goals are a bit difficult but not impossible. Sustainable is attainable, provided we expand our thinking horizon, do value engineering through proper Research & Development.

We Indians have already emerged as winners of the race for lunar South pole. Let's all also emerge as winners of the race for combating the climate change on mother earth by bringing in eco-friendliness, sustainability, and integration in all our construction activities and other human activities. If we think we can, then we can really do it. Let's all take a firm resolve to go ahead on this pious mission with proper application of human brain, on this auspicious day of 56 th Engineers Day and 162nd birth anniversary of Sir M V. The towering, gigantic, inspiring persona of Sir M V keeps us ignited and inspired to think good and to do good. Engineering is the applied science of making the impossible possible.

Have a great & meaningful Engineers' Day, all of you. Best wishes to you all.

ENGINEERS' DAY ADDRESS

GENERAL SECRETARY, JESA
Er. Manoj Kumar Verma

My Dear Respected Engineers,

I am honoured to stand here before you today on this special occasion, celebrating the 56th Engineers' Day, on the occasion of 162nd Birth Anniversary of Bharat Ratna Sir M. Visvesvaraya, fondly remembered as the 'Father of Engineering' in India.
This day has great significance for all of us as it allows us to recognize and appreciate the remarkable contributions of our engineering community to the development of our state and the nation.
Engineers have been the backbone of India's progress. Their hard work, dedication and unwavering commitment have driven our country towards development in various sectors, industries and walks of life.

One of the fundamental pillars of India's progress has been its extensive road infrastructure network. Roads are the lifelines of any nation, and engineers have been at the forefront of connecting every corner of our country. At the national level, India has one of the world's largest road networks, covering more than 6.4 million kilometres. It is remarkable that this is the 2nd largest road network in the world, next only to the United States of America. Our beloved state of Jharkhand has also seen a remarkable growth in its road infrastructure, with thousands of kilometres of roads weaving through the state, facilitating improved connectivity, trade, and accessibility. The contribution of Jharkhand, with an estimated road network of 90000 km, to the vast national network underscores our state's commitment to India's growth and progress.

However, as we celebrate these achievements, it is imperative to address the extremely important issue of environmental sustainability in the present times. We are living in a world which has seen tremendous rate of industrialisation and urbanisation in its quest for economic growth over the last 3 centuries, but is today facing grave challenges posed by climate change and environmental degradation. Consequently, the focus on environment-friendly development is growing stronger by the day.
India is at the forefront of this vital journey towards eco-friendly, sustainable, and integrated infrastructure development. In the long run, economic growth has to go hand-in-hand with the preservation of environment and natural resources. I feel proud to know about initiatives such as:

1. Green Building Certification – led by organizations like the Indian Green Building Council (IGBC) and Leadership in Energy and Environmental Design (LEED)
2. Adoption of sustainable and eco-friendly practices including the use of renewable energy sources, promoting green highways, and adopting waste management practices, by organizations like NHAI
3. Smart Cities Mission – to promote smart urban planning with improved public transportation systems, waste management, and green infrastructure
4. National Electric Mobility Mission Plan (NEMMP) – to promote the adoption of electric vehicles towards the larger goal of green transportation
5. Initiatives like Swachh Bharat Abhiyan, Jal Jeevan Mission and National Clean Air Programme – promoting cleanliness, waste reduction, recycling and efficient use of natural resources.

These are just a few examples that highlight India's commitment to sustainable economic growth in the years to come. Needless to say, the engineering community of India is going to play a critical role in ensuring that our infrastructure projects are not only robust but also environmentally responsible.

For our beloved Jharkhand, known for its natural beauty and blessed with almost 40 percent of India's mineral reserves, sustainable infrastructure development becomes all the more important as a lever for growth. Our state's vast mineral deposits, sprawling forests, and fertile land shave long been the lifeline of our economy. The responsible harnessing of these resources in future will be key to safeguard and sustain them for a long time. This will require collaborated efforts from our engineers and our people.

I truly believe that all our engineers across different state engineering departments are fully committed to this vision of building great, sustainable infrastructure for Jharkhand and contribute in the overall sustainable development goals for our great nation.

To conclude, I wish to say that our pursuit of growth, driven by infrastructure development, should not come at the expense of our environment and the well-being of our fellow citizens and future generations. In the present times, eco-friendly sustainable integrated infrastructure development is not merely a choice; it is a critical paradigm shift that we all must accept for the long-term prosperity of our great nation, and of mankind.

Thank you all.
Happy Engineers' Day.

HOT MIX RECYCLING AND PREVENTIVE MAINTENANCE OF ROADS USING REJUPAVE AND TERASURFACING TECHNOLOGIES

SPEAKER:

MR. SATISH PANDEY
PRINCIPAL SCIENTIST IN FLEXIBLE PAVEMENT DIVISION OF CSIR-CENTRAL ROAD RESEARCH INSTITUTE, NEW-DELHI INDIA.

Mr. Satish Pandey is associated as an Associate Professor in Academy of Scientific and Industrial Research (An Institute of National Importance) and Border Road Organization, Govt. of India as an Officer on Board. He has around fifteen years of long research experience in the field of Transportation and Highway engineering as a scientist in CRRI. Mr. Pandey is credited to published around 28 research Papers in National and International journals and conferences and hold 2 Patents.

He is the inventor of cost effective maintenance and rehabilitation technologies REJUPAVE, TERASURFCING, Modified Mix Seal Surfacing, Cold Mix Technology, Macrosurfacing and Steel Slag Road. Mr. Pandey also did several R&D projects for leading steel industries in India such as TATA Steel, JSW Steel, Arcellor Mittal Nippon Steel, HARSCO, SAIL and Rastriya Ispat Nigam Limited to facilitate utilization of iron and steel Slag as road construction aggregates

He is the recipient of Global Slag Personality of the Year Award 2023, by Global Slag, Germany, CSIR Technology Award 2017 from Hon. President of India at Vigyaan Bhawan and SKOCH GOLD AWARD 2021 under Environment and Sustainability category for facilitating successful valorization and utilization of steel slag in road construction. He is credited to establish state of art Center for Research on Steel Slag, first of its kind in India to facilitate research on steel slag and allied products for possible utilization in infrastructure projects.

SPEAKER

N. N. BANDHU

(FIE, FIV, MIRC, MGIS, MICI, MIIBE, MIITArb)

Bridge/ Metro Expert

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Navi Mumbai 400706

9029540104
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Bridge Bearings- Manufacturing, Testing, Installation & Issues

SUSTAINABLE RURAL PIPED DRINKING WATER SUPPLY FOR MAJOR REGION OF SANTHAL PARGANA AREA IN THE STATE OF JHARKHAND FROM RIVER GANGA

SPEAKER

Vipin Bhardwaj

Vipin Bhardwaj, is a water supply expert who has more than 23 years' experience in Engineering Consultancy of Waste Water and Water supply Projects. He has a Bachelor's degree in Engineering from University of Pune, with Master's degree in Civil and Environmental Engineering from West Virginia University, USA. He is currently working as Vice President of Operations with Mars Planning &Engineering Services based at Ranchi and has worked in several leading consulting engineering firms in India such as STC, Tata Consulting Engineers and NJS. He has worked in external funded projects such as Asian Development Bank (ADB), Japan Bank for International Cooperation (JICA)and in USA. His experience has been multi disciplinary.

MARS PLANNING & ENGINEERING SERVICES

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INNOVATIVE BRIDGES & SUSTAINABLE TECHNOLOGY IN BRIDGES

Speaker #1

PANKAJ MOHABEY

Associate Vice President" at "TPF Engineering Pvt. Ltd. is having 33 Years of Professional Experience 28 years in construction and 5 years of consultancy. Mr. Pankaj has also worked on the Prestigious Projects like "Eastern Freeway, Mumbai" as a Project Manager and "Nashik Pimpalgaon Gonde Highway, Maharashtra" as a Team Leader, 455 MLD WTP for Mumbai as Project Manager, 765 KV transmission line as Sr Project Manager etc.

Speaker #2

BHUSHAN NAHIRE

General Manager in Design department at "TPF Engineering Pvt. Ltd., having 13 Years of Professional Experience in Design Consultancy. He has worked on various iconic project of India like Atul Setu Cable Stayed bridge on Mandovi River, Cable stayed Bridge over river Zuari, Elevated corridor at Nasik, Mumbai Trans Harbour Link Project, Elevated Corridor at Ravindra Bhavan Junction, Hybrid Cable Stayed bridge overriver Krishna, Telangana, etc.

DAM BREAK MODELING- NEED, PROCESS AND POSSIBLE OUTPUTS WITH RESPECT TO JHARKHAND

SPEAKER
Dr. Harinarayan Tiwari

Dr Harinarayan Tiwari is the Co-Founder and Managing Director of Floodkon Consultants. Dr Tiwari is the initiator of two diverse program "SOCH" (for Children Behavioural Change about Water) and Floodkon Practicum Program(For young minds to make industry ready) from Floodkon.Dr Tiwari is the Alumni of BIT Sindri and IIT Roorkee. He was the recipient of four distinct awards including Gold Medalist at IIT Roorkee.

Dr. Tiwari has to his credit 14 years of research and professional experience in Water Resources Engineering with a focus on River Engineering, Flood Management using RS & GIS, Hydraulic Structures, Irrigation Planning& Project Planning. Dr Tiwari has also served as Consultant (Technical) at Ministry of Jal Shakti, GoI. Dr Tiwari has worked over 70 prime consultancy projects. Inhis credit, over 50 National/International levels research papers. Dr. Tiwari has delivered several invited lectures on different aspects of flood and river management at different stage. He is the active member of several technical committee and reviewer of multiple peer-reviewed journals.

He has also started a magazine "Pani Teri Kahani" for360-degree views about water. He has also started OnlineTraining under Company Professional Education Responsibility (CPER) and provided the professional training to 1000+ young Engineering Students at no cost. He has delivered several capacity developments lectures to improve the nexus between Academia-Industry-Research (AIR). Under the program of corporate social responsibility, company has worked for after flood analysis using advanced remote sensing approach to get the remuneration of block level people in Bihar. Company is continuing the research along with his industrial works to explore the nexus between research & consulting in India under his leadership.

Jharkhand Engineering Services Association

ENGINEERS' DAY 2023

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•	Er. Kundan, AE, RCD	8507883907
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•	Er. Nishant Choubey, AE, RCD	9507974517
•	Er. Rahul Kumar, AE, RCD	8271308619

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•	Er. Abhishek Karn, AE, RCD	9060562644
•	Er. Anita Murmu, AE, RCD	6299595105
•	Er. Prita Tudu, AE, RCD	9631552523
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•	Er. Aman Kumar Lakra, AE, RCD	8210160487
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•	Er. Anish Anand, AE, CSVD	7903510034
•	Er. Akshay Kumar Mahatha, AE, CS&VD	9708229270
•	Er. Ankit Kumar, AE, CS&VD	7857859196
•	Er. Mannu Nayak, AE, CS&VD	9572887326
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•	Er. Nirman Priyanka Ekka, AE	7004505229

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Jharkhand Engineering Services Association

ENGINEERS' DAY 2023

Young Engineers Superannuated between Sept 2022 - Aug 2023

RCD

Name	Date of Superannuation	Last Post	Contact
Rash Bihari Singh	30-11-2022	EIC	7366096127
Dinesh Kumar	31-01-2023	EIC	7372024227
Arvind Pandey	31-03-2023	EIC	9431190881
Ajay Rajak	31-10-2022	CE	8340174577
Sanjay Kumar Singh	31-01-2023	CE	9199698445
Sushil Kumar	31-01-2023	CE	9431366639
Rajesh Kumar Singh	30-06-2023	CE	7979970686
Anil Kumar Singh	31-07-2023	CE	8757251568
Rajiv Verma	31-10-2022	SE	9431436601
Gautam Sinha	30-11-2022	SE	9430511691
Birendra Kumar	31-12-2022	SE	9234266731
Arun Kumar Rana	31-12-2022	SE	9431113967
Akshay Kumar Sinha	3-01-2023	SE	9431649177
Mani Bhushan Tiwari	31-01-2023	SE	9431396907
Surendra Prasad	31-01-2023	SE	7091129453
Devesh Bahardur Anand	31-01-2023	SE	9234601401
Dinesh Kumar Rajak	28-02-2023	SE	8294861846
Binod Ram	28-02-2023	SE	8084046833
Vijay Kumar	30-04-2023	SE	9955380940
Mritunjay Kumar	30-09-2022	EE	6205353031
Manoj Kumar Thakur	31-01-2023	EE	7091487264
Ramesh Chandra Prasad	31-01-2023	EE	9199657090
Vijay Kumar Sinha	31-01-2023	EE	9430143029
Surendra Prasad	31-01-2023	EE	8340142226
Rajendra Prasad	31-01-2023	EE	8789858559
Manmohan Jha	28-02-2023	EE	9771224232
Arun Kumar	30-06-2023	EE	9431370700
Abhay Kumar Rai	30-06-2023	EE	9431024895
Umesh Kumar Singh	30-06-2023	EE	9931130760
Mathuresh Kumar Verma	30-06-2023	AE	9431186802

DWSD

Name	Date of Superannuation	Last Post	Contact
Shailesh Kishore Sinha	30.11.2022	EIC	9431336486
Pradrip Kumar Chaudhary	30.09.2022	CE	9110919226
Sanjay Kumar Jha	31.08.2022	CE	9431120374
Suresh Prasad	31.05.2023	CE	

Jharkhand Engineering Services Association

ENGINEERS' DAY 2023

Young Engineers Superannuated between Sept 2022 - Aug 2023

WRD

Name	Date of Superannuation	Last Post	Contact
Srikant Saran	30.06.2023	Director	9431176912
Mukesh Kumar	31.04.2023	CE	9162828109
Ashok Kumar Das	31.05.2023	CE	8210017542
Rakesh Kumar	31.07.2023	CE	8789516242
Anil Kumar Bernwal	31.07.2023	CE	7654919828
Rajesh Kumar Chaudhary	31.08.2023	CE	9234669020
Rajesh Kumar	31.03.2023	CE	9430319558
Jaldhar Mandal	31.10.2022	CE	9431570051
Priya Nath Jha	30.09.2022	CE	7488091480
Suresh Prasad Bhagat	31.01.2023	SE	9430331666
Santosh Kumar Diwedi	31.07.2023	SE	7870608398
Sohan Seth	31.05.2023	SE	7033626040
Manoj Kumar Singh	30.04.2023	SE	8797041321
Rajesh Kumar	31.12.2022	SE	9334145850
Ajay Nath Thakur	28.02.2023	SE	9470524515
Raj Kumar Yadaw	31.01.2023	SE	9431543751
Indresh Kumar	30.04.2023	SE	9431120556
Mukendra Singh	31.01.2023	SE	9661716900
Dilip Kumar Singh	30.06.2023	SE	9430195390
Shiv Lal Ram	30.11.2022	SE	9430184750
Devendra Kumar Sinha	31.12.2022	SE	9431354976
Surendra Prasad Singh	31.10.2022	SE	9572670129
Maya Rani Lal	31.10.2022	SE	9304996722
Jawahar Lal Gupta	31.12.2022	SE	7903427121
Ramesh Kumar Chaudhary	31.03.2023	EE	9431353979
Milthilesh Kumar Singh	28.02.2023	EE	9431077815
Jai Prakash Chaudhary	31.05.2023	EE	9431365715
Manoj Kumar	28.02.2023	EE	8709858734
Anup Kumar Das	31.08.2023	EE	9122508362
Vijay Kumar	31.10.2022	EE	7992270668
Mahesh Kumar Chaudhary	31.12.2022	EE	7903894121

Jharkhand Engineering Services Association

ENGINEERS' DAY 2023

Delegates

Er. Nagesh Mishra, EIC, WRD, Jharkhand
Er. Krishna Kumar Lal, EIC, RCD, Jharkhand
Er. Sanjay Kujur, EIC, BCD, Jharkhand
Er. Niranjan, CE, WRD, Ranchi
Er. Shishir Kumar Soren, CE(HQ), DWSD, Ranchi
Er. Rakesh Kumar Srivastava, CE(Comm), RCD, Ranchi
Er. Umesh Kumar, CE, CDO, RCD/Member(Tech), SHAJ, Ranchi
Er. Abinash Kumar Dipak, Executive Director(CE), JSBCCL, BCD, Ranchi
Er. Wahid Qamar Faridi, CE, NH Wing, Jharkhand, Ranchi
Er. Rajiv Lochan, CE, RWD, Jharkhand, Ranchi
Er. Anil Kumar Jha, SE(Mech), DWSD, Dumka
Er. Prabhat Kumar Singh, CE, CDO, DWSD, Jharkhand
Er. Moti Lal Pingua, CE, WRD, Ranchi
Er. Vijay Shankar, CE, WRD, Ranchi
Er. Upendra Sharma, CE(Monitoring), RWD, Jharkhand, Ranchi
Er. Brijnandan Kumar, CE DWSD, Dumka
Er. Anil Kumar, Presi, JESA, SE, DWSD, Ranchi
Er. Md. Reyaj Alam, SE, DWSD, Dhanbad
Er. Manohar Prasad, SE, WRD, Ranchi
Er. Raj Mohan Singh, SE, DWSD, Medininagar
Er. Srikant SinghSE, QCD, Ranchi/Road Circle, Hazaribagh
Er. Arun Kumar Rai, SE, WRD, Ranchi
Er. Jai Prakash Singh, SE, BCD, Ranchi
Er. Vijay Rastogi, SE, WRD, Ranchi
Er. Md. Jamil Akhtar, SE, MPI&H(CDO), WRD, Ranchi
Er. Amresh Kumar, SE, WRD, Ranchi
Er. Nasim Ali, EE, BCD, Daltonganj
Er. Sanjiv Kumar, SE, WRD, Waterways Circle, Hazaribagh
Er. Sanjay Kumar, SE, WRD, Ranchi
Er. Shanker Das, SE, DW&S Mechanical Circle Ranchi.
Er. Shrawan Kumar, EE, RWD, Bokaro
Er. M.K.Verma, Gen. Secy. JESA, EE, QCD4, RCD, Ranchi
Er. Satyendra Prasad Singh, EM, JESA, EE RCD, Hazaribagh
Er. Mithilesh Prasad, EM, JESAEE RCD, Chatra
Er. Vicky Ravish Murmu, EE, BCD, Dumka
Er. Om Prakash Baraik, EE, RWD, Works Div. Latehar
Er. Deepak Sahai, EE, RCD, RD, Jamshedpur
Er. Subhash Prasad, JS, JESA, EE, RCD, RD, Hazaribagh
Er. Deepak Kumar Bhagat, EE, RCD, Khunti
Er. Rabipad Manjhi, EE, NH Division, Deoghar
Er. Sunil Kumar Rajak, TA, Road Circle, RCD, Chaibasa
Er. Amit SinghEE, RCD, RD, Bokaro
Er. Prem Prakash Kumar Singh, EE, RCD., RD, Giridih
Er. Avik Ambala, EE, DWSD, Chaibasa
Er. Nawal Kishor, TA, QCD, RCD, Ranchi
Er. Jainendra Kumar, EM, JESAEE, JSRRDA, Ranchi
Er. Arbind Kumar Verma, EE, RCD, RD, Latehar
Er. Munna Lal, EE, CE Office(NH Wing), Ranchi
Er. Salav Kumar, EE, BCD, Jharkhand
Er. Raghubansh Chaudhary, EE, RCD, RD, Manoharpur

Jharkhand Engineering Services Association

ENGINEERS' DAY 2023

Delegates

Er. Chandan Kumar, EE, BCD, BD, Dhanbad
Er. Jaikant Ram, EE, NH Division, Ranchi
Er. Raj Ranjan, EE, RCD, RD, Chaibasa
Er. Surendra Prasad, EE(Monitoring), RCD, Road Circle, Dumka
Er. Bipin Kumar Bhagat, EE, Water Ways Division, Ranchi
Er. Abhinandan Kumar, EE, BCD, Ranchi
Er. Saurav Kumar Jha, EE, RWD, Koderma
Er. Atul Kumar Singal, EE, BCD, Koderma
Er. Jitendtra Kumar Singh, EE, RCd, Ranchi Rural Division, Ranchi
Er. Sashi Shekhar Singh, EE, DWSD, Tenughat, Bokaro
Er. Ranjit Kr. Barnwal, EE, NH Division, Hazaribagh
Er. Gobind Kachchap, EE, DWSD, Sahibganj
Er. Binod Kumar, EE, DWSD, Ranchi
Er. Prabhakar Singh, EE, BCD, Ranchi
Er. Rajeev Ranjan, EE, Cabinet Vigilance, Ranchi
Er. Ravindra Kumar, EE, RCD, RD, Lohardaga
Er. Manoj Kumar Mundari, EE, DWSD, Hazaribagh
Er. Deepak Kumar Mahato, EE, BCD, Div-2, Ranchi
Er. Amrit Minz, EE, BCD, Building Division, Simdega
Er. Subodh Das, EE, RWD, Giridih
Er. Abhishek Kumar, EE, BCD, Building Design Circle
Er. Amod Kumar, DS, WRD HQ, Ranchi
Er. Deepak Kumar, EE, RCD HQ, Ranchi
Er. Kundal Kumar, EE, FSD, RCD, Ranchi
Er. Vikas Kumar, EE, RWD, Gumla
Er. Amit Kumar, EE, BCD, Hazaribagh
Er. Bijay Ranjan Kumar, EE, CDO, RCD, Ranchi
Er. Ravi Shankar Prabhakar, EE, SID, RCD, Ranchi/SHAJ
Er. Harsha Sinha, EE, CDO, RCD, Ranchi/SHAJ
Er. Manoj Kumar Mahto, EE, RCD, RD, Deoghar
Er. Abhishek Shresht, EE, CLD, QCD, Ranchi
Er. Sanjoy Kumar, EE, QCD1, RCD, Ranchi
Er. Ashok Kumar Rajak, TA, BCD, Dhanbad
Er. Abhay Toppo, EE, DWSD Div, Jhumaritilaiya
Er. Devendra Bhagat, EE, RMC, Ranchi
Er. Abhinendra Kumar, AGM, JUIDCO, UDHD, Ranchi
Er. Neeraj Kumar Mishra, EE, RWD, Ramgarh
Er. Prabhat Kumar, EE, WRD, Minor Irrigation, Ranchi
Er. Shardendu Narayan, Ex-EIC, DWSD, Jharkhnad
Er. Binay Kumar Longa, TA, RCD, RC, Hazaribagh
Er. Rajesh Ranjan, EE, QCD-2, RCD, Ranchi
Er. Dilip Kumar Shah, EE, NH Division, Dhanbad
Er. Lokesh Ranjan, EE, WRD, Ranchi
Er. Ashok Kumar EE, Office of EIC, RWD, Ranchi
Er. Pramod Kujur EE, Office of EIC, RWD, Ranchi
Er. Samrendra Prasad EE, Cabinet Secretariat & Vigilance Dept, Ranchi
Er. Chandan Kumar EE, WRD, Planning &Monitoring Div-3,Ranchi
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Er. Jawahar Ram EE, WRD, MI Division, Hazaribagh

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Delegates

Er. Chandra Shekhar EE, WRD, MI Division, Giridih
Er. Ramesh Kumar EE, QCD, RCD, Ranchi
Er. Md. Israil Mansuri, EE, RCD, RD, Ranchi
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Er. Chandan Kumar, EE, UDHD, Ranchi
Er. Ramendra Kumar, EE, UDHD, Project Building, Ranchi
Er. Bihari Prasad, EE, BCD Circle, Ranchi
Er. Anup Ranjan Lakra, EE(M), EIC office, RWD, Ranchi
Er. Bikas Chandra Bharti, EE, BCD, Ranchi
Er. Arpita Anna Barla, EE, FSD, RCD, Dumka
Er. Alok Kumar Bharti, EE, WRD, Mech. Division, Ranchi
Er. Vijay Agarwal, EE, RCD, RD, Jamtara
Er. Asim Chaudhary, EE, CDO, RCD, Ranchi
Er. Onkar Nath, EE(M),WRD Hq, Ranchi
Er. Apurb Nitesh Tigga, EE(M),WRD HQ, P&M Div-6, Ranchi
Er. Ruby Adline Toppo, EE(M),WRD HQ, P&M Div-2, Ranchi
Er. Vikram Pratap Singh, EE, RCD HQ, Ranchi
Er. Sanjay Kumar, EE, RDSD, Ranchi
Er. Ajay Tirkey, EE, JSRRDA, Ranchi
Er. Suman Shekhar, EE, RCD, NH Division, Gumla
Er. Kuldeep Kumar Minz, EE, RCD, RD, Lohardaga
Er. Amrit Topno, EE, BCD, Division, Bokaro
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Er. Siddhartha Raj Singh, AE, QCD4, RCD, Ranchi
Er. Kundan, AE QCD4, RCD, Ranchi
Er. Amish Kumar, AE, RCD, RD, Ranchi
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Er. Manish Kumar Nayak, AE, BCD, Gumla
Er. Shailesh Prasad Singh, AE, RCD, Road Subdivision, Madhupur
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Er. Kumar Hemant AE(M), RCD, Ranchi

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Er. Ritesh Kumar Singh, AE, RWD, Khunti
Er. Subodh Kumar Mehta, AE, WRD, MIDD, Ranchi
Er. Md. Asif Equbal, AE, WRD, MIDD, Ranchi
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Er. Saneepa Kumari, AE, Waterways Circle, Hazaribagh
Er. Pankaj Kumar Singh, AE(QC), RCD, RD, Ranchi
Er. Abhay Kumar, AE(M), RCD, RD, Hazaribagh
Er. Wasim Firoz, AE, WRD, Giridih Nagar Nigam
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Er. Prafull Kumar, AE, WRD, Project Planning Circle (Flying Squad), Ranchi

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Er. Deepa Beck Bhagat, AE, RCD, Road Circle, Ranchi
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Er. Pankaj Kumar Nag, AE, RCD, waiting for Posting
Er. Vishal Singh, EO, RWD, Koderma
Er. Nikhil Kumar, AE, DWSD, Hazaribagh
Er. Shubham Sachan, AE, BCD, Ramgarh
Er. Jagannath Hansda, AE, RCD, Sahibganj
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Er. Aman Prasad, AE, WRD, CDO, Ranchi
Er. Jaya Kindo, AE, DWSD, Hatia Project, Ranchi
Er. Abhash Bharadwaja, AE(Mech), Barrage Circle, Galudih
Er. Swati Oraon, AE, NH Circle, Ranchi
Er. Surendra Sundi, AE, Adityapur Nagar Nigam
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Er. Aditya Jha, AE, WRD, CE office, Deoghar
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Er. Rakesh Singh, AE, WRD, Planning and Monitoring Cicle-2, Ranchi
Er. Nipoon Gupta, AE, WRD, Planning and Monitoring Cicle-1, Ranchi
Er. Alok Kumar, AE, WRD, Planning and Monitoring Cicle-2, Ranchi
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Er. Manish Raj, AE, RWD, SID, Ranchi
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Er. Subodh Singh Chauhan, AE, BCD, Ranchi
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Er. Nitesh Kumar, AE, DWSD, Noamundi
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Er. Dipen Ujjwal Bilung, AE,WRD, Planning & Monitoring Div-3, Ranchi

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पत्रांक : JESA/23/Ranchi/08 दिनांक : 16/2/23

सेवा में,

मुख्य सचिव,
झारखण्ड, रांची।

विषयः **15 सितम्बर को सभी कार्य विभागों द्वारा इंजीनियर्स डे मनाने संबंधी सड़क, परिवहन एवं राजमार्ग मंत्रालय, भारत सरकार का निर्देश एवं झारखण्ड राज्य में इस निर्देश के कार्यान्वयन के संबंध में।**

प्रसंगः सड़क, परिवहन एवं राजमार्ग मंत्रालय, भारत सरकार, नई दिल्ली का मंत्रालय का पत्रांक RW/NH-33044/53/2022-S & R (P & B) दिनांक 31.08.2022

महाशय,

सड़क परिवहन एवं राजमार्ग मंत्रालय, भारत सरकार के प्रासंगित पत्र की छायाप्रति संलग्न करते हुए अनुरोधपूर्वक कहना है कि भारत रत्न सर मोक्षगुण्डम विश्वेसरैया के जन्म शताब्दी पर प्रत्येक वर्ष 15 सितम्बर को मंत्रालय द्वारा इंजीनियर्स डे मनाने का निर्णय लिया गया है। मंत्रालय द्वारा इस अवसर पर कार्यशाला, तकनीकी सेमिनार आदि आयोजित कर अभियंताओं को विविध तकनीकी क्षेत्र में उपलब्धियों के लिए सम्मानित किये जाने का भी निर्णय संसूचित किया गया है। साथ ही इस संदर्भ में संबंधित विभागों को दिशा–निर्देश निर्गत किये जाने का अनुरोध भी किया गया है।

उक्त आलोक में अनुरोध है कि सभी तकनीकी विभाग यथा पथ निर्माण विभाग, भवन निर्माण विभाग, जल संसाधन विभाग, पेयजल एवं स्वच्छता विभाग, ग्रामीण विकास विभाग, नगर विकास एवं आवास विभाग इत्यादि को तत्संबंधी निर्देश देने की कृपा की जाय, ताकि संबंधित विभागों द्वारा संकल्प जारी कर उक्त उद्देश्य की पूर्ति की जा सके।

अनु: यथोक्त

विश्वासभाजन,

महासचिव, 16/2/23
झारखण्ड अभियंत्रण सेवा संघ।

Ministry of Road Transport and Highways (MORTH) issued Advisory to all Central/ State Engineering Departments to Celebrate Engineers' Day on 15th September

No. RW/NH-33044/53/2022-S&R (P&B)
Government of India
Ministry of Road Transport & Highways
S&R (P&B) Section
Transport Bhawan, 1, Parliament Street, New Delhi-110001

Dated: 31.08.2022

To,

1. The Chief Secretaries of all State Governments/UTs
2. The Principal Secretaries/ Secretaries of all States/UTs Public Works Department dealing with National Highway, other Centrally Sponsored Schemes & State Schemes.
3. The Engineers-in-Chief and Engineers of all States/UTs Public Works Department dealing with National Highways, other Centrally Sponsored Schemes.
4. DG (BR), BRO, New Delhi.
5. The Chairman, NHAI
6. The Managing Director, NHIDCL
7. The Director, IAHE, Noida, U.P
8. The Regional Officers (CE-RO/ SE-RO)

Subject: Celebration of the Engineer's Day on 15th September

Ministry has decided to celebrate birth anniversary of Bharat Ratna Sh M. Visvesvaraya on 15th September as the Engineer's Day. The celebrations shall include holding workshops, encouraging communication skills, seminars, lectures on technical matters and recognize/award to the engineers in their achievements in various technical fields.

2. All are also requested to issue necessary instructions to all concerned to celebrate Engineer's Day in your organization.

3. This issues with the approval of Competent Authority.

Yours sincerely

(Jagat Narayan)
Superintending Engineer, S&R (P&B)
For DG (RD) & SS

Copy for information and necessary action to:-

1. PS to Hon'ble Minister, RT&H
2. PS to Hon'ble MOS, RTH
3. All Technical Officers
4. Establishment - II, MoRT&H
5. Secretary General, IRC, New Delhi
6. Chairman, Indian Engineers Federation (INDEF), 174D, Pocket-C, Siddharth Extension, New Delhi-110014

झारखण्ड अभियंत्रण सेवा संघ

निबन्धन सं.-783 (2007-08)

E-mail : jesajharkhand@gmail.com
Website : www.jesajharkhand.org

ई. अनिल कुमार
अध्यक्ष
9431042786

ई. अशोक कुमार
कोषाध्यक्ष
7368045204

ई. मनोज कुमार वर्मा
महासचिव
9431354849

उपाध्यक्ष
ई. जवाहर लाल गुप्ता
7903427121

ई. अभिनेन्द्र कुमार
9835165931

★ ★ ★

संयुक्त सचिव
ई. विकास कुमार
8292435100

ई. सुभाष प्रसाद
8709320541

★ ★ ★

संगठन सचिव
ई. विजय कु. अग्रवाल
8210084525

ई. रवि शंकर प्रभाकर
7903169581

★ ★ ★

प्रचार सचिव
ई. रमेश कुमार
9431151050

★ ★ ★

कार्यकारणी सदस्य
ई. सत्येन्द्र प्रसाद सिंह
6203257370

ई. ओंकार नाथ
7004400284

ई. जैनेन्द्र कुमार
8235984042

ई. आशीष कुमार सिन्हा
9955158425

ई. मिथिलेश प्रसाद
7762838047

ई. विक्रम प्रताप सिंह
7250355511

ई. विभुति नारायण सिंह
9955060610

★ ★ ★

पत्रांक : JESA/23/Ranchi/171 दिनांक : 11/9/23

सेवा में,

विकास आयुक्त, (अपर मुख्य सचिव) झारखण्ड, राँची।
प्रधान सचिव, ग्रामीण कार्य विभाग, झारखण्ड, राँची।
सचिव, नगर विकास एवं आवास विभाग, झारखण्ड, राँची।
सचिव, भवन निर्माण विभाग, झारखण्ड, राँची।
सचिव, जल संसाधन विभाग, झारखण्ड, राँची।
सचिव, पेयजल एवं स्वच्छता विभाग, झारखण्ड, राँची।
सभी जिलों के उपायुक्त, झारखण्ड।
अभियंता प्रमुख, पथ निर्माण विभाग, झारखण्ड, राँची।
अभियंता प्रमुख, जल संसाधन विभाग, झारखण्ड, राँची।
अभियंता प्रमुख, पेयजल एवं स्वच्छता विभाग, झारखण्ड, राँची।

विषयः **15 सितम्बर को सभी कार्य विभागों द्वारा इंजीनियर्स डे मनाने संबंधी सड़क, परिवहन एवं राजमार्ग मंत्रालय, भारत सरकार का निर्देश एवं झारखण्ड राज्य में इस निर्देश के कार्यान्वयन के संबंध में।**

प्रसंगः सड़क, परिवहन एवं राजमार्ग मंत्रालय, भारत सरकार, नई दिल्ली का मंत्रालय का पत्रांक RW/NH-33044/53/2022-S & R (P & B) दिनांक 31.08.2022 (छायाप्रति संलग्न)।

महाशय,

सड़क परिवहन एवं राजमार्ग मंत्रालय, भारत सरकार के प्रासंगिक पत्र की ओर ध्यानाकृष्ट करते हुए कहना है कि भारत रत्न सर मोक्षगुण्डम विश्वेसरैया के जन्म शताब्दी पर प्रत्येक वर्ष **15 सितम्बर** को मंत्रालय द्वारा इंजीनियर्स डे मनाने का निर्णय लिया गया है। मंत्रालय द्वारा इस अवसर पर कार्यशाला, तकनीकी सेमिनार आदि आयोजित कर अभियंताओं को विविध तकनीकी क्षेत्र में उपलब्धियों के लिए सम्मानित किये जाने का भी निर्णय संसूचित किया गया है। साथ ही इस संदर्भ में संबंधित विभागों को दिशा–निर्देश निर्गत किये जाने का अनुरोध भी किया गया है।

उपरोक्त क्रम में सूचित करना है कि झारखण्ड अभियंत्रण सेवा संघ द्वारा प्रत्येक वर्ष अभियंता दिवस पर महत्वपूर्ण Engineering Topic एवं Innovative Concept पर Technical Seminar का अयोजन किया जाता है, जिसमें राज्यभर के अभियंता भाग लेते हैं।

अतः अनुरोध है कि 15 सितम्बर 2023 को Engineers' Day के अवसर पर कोई बैठक नहीं रखने की कृपा की जाय एवं तत्संबंधी निदेश अभियंताओं को देने की कृपा की जाय।

विश्वासभाजन,

11/9/23

महासचिव,
झारखण्ड अभियंत्रण सेवा संघ।

ज्ञापांक :– प0नि0वि0 / विविध–06–85 / 2013 (अंश–I) –4375(5) राँची, दिनांकः– 12/09/23

प्रतिलिपि– सभी उपायुक्त, झारखण्ड को सूचनार्थ एवं आवश्यक कार्रवाई हेतु प्रेषित।

अनुरोध है कि इंजीनियर्स डे के अवसर पर पथ निर्माण विभाग अधीनस्थ सभी अभियंताओं को विधि–व्यवस्था आदि कार्यों से मुक्त रखा जाय।

संयुक्त सचिव,
पथ निर्माण विभाग।

ज्ञापांक :– प0नि0वि0 / विविध–06–85 / 2013 (अंश–I) –4375(5) राँची, दिनांकः– 12/09/23

प्रतिलिपि– संयुक्त सचिव, मुख्य सचिव कार्यालय, झारखण्ड, रांची को सूचनार्थ समर्पित।

संयुक्त सचिव,
पथ निर्माण विभाग।

ज्ञापांक :– प0नि0वि0 / विविध–06–85 / 2013 (अंश–I) –4375(5) राँची, दिनांकः– 12/09/23

प्रतिलिपि– सचिव, पथ निर्माण विभाग, झारखण्ड को सूचनार्थ समर्पित।

संयुक्त सचिव,
पथ निर्माण विभाग।

झारखण्ड सरकार
पथ निर्माण विभाग

पत्रांक– प0नि0वि0/विविध–06–85/2013 (अंश–I) – 4375(3)WE राँची, दिनांकः–17/09/23

प्रेषक,

विजय कुमार गुप्ता,
संयुक्त सचिव।

सेवा में,

अभियंता प्रमुख/सभी मुख्य अभियंता (रा0उ0प0 सहित)/
सभी अधीक्षण अभियंता (रा0उ0प0 सहित),
पथ निर्माण विभाग, झारखण्ड।

विषय :– 15 सितम्बर, 2023 को इंजीनियर्स डे मनाये जाने के संबंध में।

प्रसंगः– भारतीय राष्ट्रीय राजमार्ग प्राधिकरण (MoRT&H), भारत सरकार का पत्र दिनांक 31.08.2022.

महाशय,

आप सभी अवगत हैं कि प्रत्येक वर्ष 15 सितम्बर को भारत रत्न सर मोक्षगुंडम विश्वेश्वरैया के जन्मदिवस को इंजीनियर्स डे के रूप में मनाया जाता है। इस दिन विभिन्न अभियंत्रण संघों द्वारा जिला एवं मुख्यालय स्तर पर तकनीकी सेमिनार, कार्यशाला आदि का आयोजन किया जाता है। भारतीय राष्ट्रीय राजमार्ग प्राधिकरण (MoRT&H), भारत सरकार के प्रासंगिक पत्र द्वारा भी सभी राज्यों के मुख्य सचिव/ सचिव/ विभागाध्यक्षों को तत्संबंधी अनुरोध किया गया है।

निदेशानुसार उक्त परिप्रेक्ष्य में आवश्यक अग्रेतर कार्रवाई की जाय।

अनुलग्नकः– यथोक्त।

विश्वासभाजन,

(विजय कुमार गुप्ता)
संयुक्त सचिव।

Estd. 1983

Indian Engineers' Federation

(An apex body of State & Central Engineering Services Association of India)
INDEF (Eastern Region)

President's Office :
BESA, Abhiyanta Bhawan,
Jai Prakash Path (Boring Road),
Patna - 800 001

Secretary General Office :
Quality Control Directorate
Road Construction Department
Design Building, Room No.-110
Doranda, Ranchi-834002

President
Er. Arun Kumar (Bihar)
9430248243/8709487949
Vice-President
Er. Somnath Deb (W.B.)
8017105822
Er. (Dr.) Sunil Kumar Chaudhary (Bihar)
8969761969
Er. Debabrata Mohanty (Odisha)
9861145257
Er. Mani Bhushan Tiwary (Jharkhand)
9431396907
Secretary General
Er. Ramesh Kumar (Jharkhand)
9431151050
Secretary (Finance)
Er. Bibhuti Narayan Singh (Jharkhand)
9955060610
Secretary (Administration)
Er. Amrit Topno (Jharkhand)
9905899979
Secretary (Head Quarter)
Er. Shashank Shekhar (Bihar)
9470047080
Secretary (Co-ordination)
Er. Avinash Kumar (Bihar)
7781026599
Secretary (Publicity)
Er. Sudipta Sikdar (W.B)
8240572755
Secretary (Action-Programme)
Er. Prafulla Kumar Behera (Odisha)
9438079452
Joint Secretary
Er. Anjani Kumar (Bihar)
9431269531
Er. Arun Kumar (Andman & Nikobar)
9474216270
Er. Sudip Nath Chandra (W.B.)
9830807536
Er. Abhimanyu Barik (Odisha)
9437159643
Executive Council Members
Er. Siddartha Bose (W.B.)
9433177641
Er. Janardan Pd. Singh Kashyap (Bihar)
9431421408
Er. Manoj Kumar Verma (Jharkhand)
9431354849
Er. Abinash Roul (Odisha)
9437034763
Er. Dwipendra Das (Andman & Nikobar)
9474233652

Ref. INDEF/2021-23/32 Date...10/8/2023..

Engineers in carrying their Engineering duties and responsibilities and felicitate them with awards.We request to please direct concerned departments to celebrate Engineers Day from this year on 15th sept 2023.

Hoping action in this regard.

Thanking Sir,

Your's Faithfully

10/8/2023
(Er. Arun Kumar)
President
INDEF (ER)

Copy to:- Respectfully submitted along with Government letter to additional Chief Secretary, PWD, WRD, RDD for favour of information.

10/8/2023
(Er. Arun Kumar)
President
INDEF (ER)

Estd. 1965

Indian Engineers' Federation

(An apex body of State & Central Engineering Services Association of India)
INDEF (Eastern Region)

President's Office :
BESA, Abhiyanta Bhawan,
Jai Prakash Path (Boring Road),
Patna - 800 001

Secretary General Office :
Quality Control Directorate
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Design Building, Room No.-110
Doranda, Ranchi-834002

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Vice-President
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8017105822
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8969761969
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9861145257
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Er. Abinash Roul (Odisha)
9437034763
Er. Dwipendra Das (Andman & Nikobar)
9474233652

Ref INDEF/2021-23/32 Date...10/8/2023..

To,

The Chief Secretary
Govt. of Jharkhand,
Ranchi.

Sub:- Celebration of Engineers Day: 15th September.

Ref: Govt. of India GR No. RW/NH-33044/53/2022 . S&R (T&B) Dated 31/08/2022. (Copy enclosed For kind information).

Esteemed Sir,

We respectfully, invite your kind attention to the letter referred to above. The central Govt. has issued advisory to celebrate the Engineers Day every year on 15th September to commemorate the birth anniversary of Bharat Ratna Sir M Visvesvaraya. Sir M Visvesvaraya's contribution in technical economical planning, Industrial and Agriculture arena is legendary. In view to respect and remember the remarkable achievements of Sir M. Visvesvaraya, his birth date of 15th Sept. is decided by the central Government, to be celebrated as 'Engineers Day'.

Indian Engineers Federation(INDEF), an apex platform of Associations / Federations of Graduate in-service Engineers of all central,state and UTs has been requesting the Goverments since long to celebrate the Engineers Day on behalf of the Technical Ministers of Governments of central, state and UTs. We are happy to acknowledge that the central Government have rightly and pragmatically taken the relevant decision. We now request your kind self to please direct concerned technical Departments to take initiative to arrange function for celebration of Engineer Day on Dated 15/09/2023.

The celebration includes arranging seminars, lectures, workshop on technical matters. It is also directed by the central Government to recognize the unique contribution of

CONSTITUTION OF THE JHARKHAND ENGINEERING SERVICES ASSOCIATION

1. GENERAL

1.1 The association shall be known as "Jharkhand Engineering Services Association" and it s Head office shall be at Ranchi.

1.2 The supreme authority of the Association shall vest in the General Body consisting of all members of the Association. The affairs of the Association shall be managed and conducted by the State Executive Committee with the Assistance of the Zonal council. The State Executive Committee shall be the Chief Executive organ of the Association.

1.3 The Association shall have a two tier organization viz. Zonal level at District or any other suitable unit and state level at State capital, Ranchi.

1.4 "He" Will be read as He/She whenever applicable.

2. AIMS AND OBJECTS

aims and objects of the Association shall be: -

(a) To create and foster "esprit – de –corps" among the members of the service.

(b) To pool and disseminate technical knowledge, share experience and expertise among the engineer members of the Association.

(c) To build a healthy organization of the engineering fraternity within the state and forge a bond with similar organizations of other states and the centre.

(d) To protect and safeguard the general interests of its member, to assist them in discharge of their rights and obligations, to secure for them healthy and proper living and to enable them to play constructive role in management and administration of the Engineering and allied development departments of the Government and Government Undertakings in Public Sector.

(e) To ensure maintenance of high standard of Professional conduct and ethics by its members in furtherance of the interests of the society in general and the Engineering Community in particular and to extend all help to the Government in ensuring the above.

(f) To extend assistance and support to the dependents of a member, in the event of his death, and to the member, himself, in his hour of crisis, in case of injury.

(g) To do and perform such other acts and things as may be incidental to or conducive to the attainment of any or all the afore-said objects.

3. MEMBERSHIP

3.1 The Association shall be open to all the members of the Jharkhand Engineering

Service. For membership, application shall be accepted in prescribed preformed with an enrolment fee of Rs. 100/- only.

3.2 There will be an annual subscription of Rs. 250/- monthly subscription of Rs. 25/- payable by every ordinary member. An ordinary member can become a life member of the Association on payment of Rs. 1000.00 only, whereas a Life Member of the Association of Bihar Engineering Services Association will have to pay Rs. 500.00 only to become a life member of the Association. A Life Member shall pay only Rs. 100.00 annually or Rs. 10.00 monthly towards to Zonal office expenses of the Association.

3.3 A member of the Association shall cease to be so in the following cases:-

(i) If he requests to this effect, through to zonal council of his zone to the State Executive committee, or

(ii) If he resigns from the Jharkhand Engineering Services, or

(iii) If he is found to be guilty by the State Executive Committee of any misconduct detrimental of the interests to the Association or violation of a prescribed code of conduct subject to confirmation by the General Body.

3.4 Members failing to pay their due subscription shall have no right to vote in zonal or state Level meetings.

4. ZONAL COUNCIL

4.1 The primary units of the Association shall be the Zonal Councils at the District levels constituted by all the members of the Association servicing in that district. Every member shall have one vote and in deciding over all matters, the opinion of the majority shall prevail. The State Executive Committee may, however, decide to form more than one zonal council in one district, if it finds it necessary for more efficient functioning of the Association.

4.2 The zonal council shall elect a zonal committee. The Chairman of the zonal committee will preside over the meetings of the zonal council and shall have a decisive vote in case the opinion of the zonal council is equally divided on any issue. In any case of absence of the chairman, the members present in the meeting, shall elect one chairman from amongst themselves to preside over the meeting of the zonal council.

4.3 There shall be, generally one meeting of the zonal council every month, which will be held at a date, time and place decided by the zonal committee. However, an extra- ordinary meeting of the zonal council may be held at any time on the requisition of at least one third of total members attached with the zonal council or on direction of the zonal committee or the zonal chairman giving a 24 hours notice.

4.4 The zonal council shall be entitled to take decisions on local issues in accordance with the rules framed by the State Executive Committee from time to time.

4.5 The quorum for a general or an extra – ordinary meeting of the zonal council shall be one third of the total number of members on its register. If there is inadequate attendance even after one hour of the time fixed for the meeting, the meeting shall stand postponed and shall be reconvened at a new date and time. No quorum shall be necessary at such a reconvened meeting provided that it can only dispose of the matters initially on the agenda.

4.6 Members desiring to move a resolution in a zonal council shall be required to send a copy of the resolution to the Secretary of the zonal committee at least three days before the date of the meeting. (12 hours before the meeting in case of an extra – ordinary meeting.)

4.7 Copies of the proceedings of the meeting shall be forwarded to the Executive Committee and every member attached to the zonal council, shall have the right to inspect the proceedings book.

5. ZONAL COMMITTEE

5.1 The Executive organ of the zonal council shall be known as the zonal committee, consisting of a minimum of seven members and a maximum of eleven members including its office bearers.

5.2 There shall be a Chairman, a Secretary, a Joint Secretary, and a Treasurer in the Zonal Committee. The Zonal Committee Chairman shall not be below the rank of Executive Engineer.

5.3 A zonal committee shall be elected for one year, the tenure shall be from October to September. Thus, elections shall be organized by the zonal committee before 30th September every year.

5.4 The list of the member and the office bearers elected for the new zonal committee shall be forwarded to the State Executive Committee.

5.5 No office bearer of the Zonal Committee shall be allowed to be elected for more that two consecutive terms.

5.6 The Chairman of the Zonal Committee shall have the power to convene a meeting of the committee on a short notice. Such a meeting can also be convened on the requisition of one third members of the committee. At least one meeting every month shall be convened. The date, time, and venue of the meeting shall be fixed by the Chairman.

5.7 One third of the number of members shall be the quorum for a meeting of the zonal committee. If there is no quorum within one hour of the time notified for the meeting, the meeting shall be adjourned to be reconvened at another date and time to be notified by the chairman. No quorum shall be necessary at such reconvened meeting provided it discusses matters initially on the agenda.

5.8 In all the meetings, the chairman of the Zonal Committee shall preside over the proceedings. In case of his absence, any member of the Zonal Committee shall be elected to preside.

5.9 Ownership of all the properties of the Zonal council shall be vested in the zonal committee and the secretary shall be the custodian of the same.

5.10 Subject to limitations imposed by the zonal council or the State Executive Committee, the zonal committee shall be fully empowered to act on behalf of the zonal council towards the general welfare of the members of the Association and for attainment of the aims and objects of the Association.

6. POWERS AND FUNCTIONS OF ZONAL COMMITTEE

6.1 The Chairman of the Zonal Committee shall be the chief Executive officer of the zonal

body.

6.2 (a) The Secretary of the Zonal Committee shall act under the direction of the zonal committee and perform such duties as may be asked. (b) He shall prepare a report at least once every three months on the activities of the Association within the zone and forward a copy of the same to State Executive Committee. (c) He shall convene all meetings and records the proceedings of each in a book kept for the purpose. The proceedings of the meetings shall be signed by the presiding officer of the meeting.

6.3 (a) The function of the Treasurer of the zonal committee shall be to receive money towards the registration fee and annual/monthly subscription from the members attached to the zonal council on behalf of the association and issue receipts to them. (b) The funds collected at the zonal level shall be kept in a Bank Account in the name of the Association and shall be operated jointly by the secretary and the Treasurer. (c) The Treasurer of the zonal committee shall maintain all accounts, prepare the annual budget of the zone in consultation with the Secretary and get it approved by the zonal committee. (d) The expenditure of the zonal committee shall be made from the funds at its disposal on the Direction of the chairman and / or the Secretary in accordance with the decisions of the zonal Committee.

7. STATE COUNCIL

7.1 The Stare Council shall consist of (1) All members of the State Executive Committee including its office bearers. (2) Chairman and Secretaries of all the Zonal Committees. (3) Twenty one delegates nominated by the state executive committee and (4) Three delegates each nominated by all the zonal committees.

7.2 The State council meeting shall be presided by the President, in his absence Vice President or any other member elected shall preside over the meeting. The presiding members shall have a casting vote.

7.3 The State Council meetings shall be convened by the President of the State Executive Committee. An extraordinary meeting may be held at any time on requisition of one third of the total State Council members or of 1/20th members of the Association or on the direction of the State Executive Committee on three days notice.

7.4 The quorum for the General or Extraordinary meeting of the State shall be 1/3rd of the total members of the council, rounded of the next highest number. If there be no quorum within one hour of the time notified for the meeting the meeting shall be adjourned to be reconvened at a notified date and time. No quorum shall be required at such reconvened meeting provided that it can only dispose of matters initially on the Agenda.

7.5 Functions of the State Council (1) The General Secretary of the State Executive Committee shall submit for examination, the Annual report, all the resolutions and programmers of activities of the Association for the new term at the Annual Council meeting to be held before 31st October every year. All these reports, resolution and programmers as decided by the State Council shall be presented to the open session of General body for ratification. (2) The State Council shall constitute body at its annual meeting to conduct elections for the next State Executive Committee and decide time, venue and other

formalities to be carried out for such election. All office bearers of the State Executive Committee including seven of the Executive members shall be elected in the open session meeting where every member shall have a casting vote. (3) All important resolutions, activities and ratifications shall be examined by the state council. Also any activity initiated by the State Executive committee requiring mass participation as warranted by the situation extraordinary or emergent, any be discussed in the State Council meeting to be convened for the purpose.

7.6 The copies of the proceeding of the meeting shall be forwarded to all the zonal committees. Every member of the State Council shall have the right to inspect the proceeding book.

8. THE STATE EXECUTIVE COMMITTEE

8.1 The affairs of the Association at the State Level shall be looked after by a State Executive Committee consisting of 21 members, including its office bearers.

8.2 The State Executive Committee shall have the following office bearers. All the office bearers except one vice President and one organizing secretary shall be posted at Ranchi. (1) President (A member not below the rank of Superintending Engineer shall be eligible for this post). (2) Vice President (Two Post) (3) General Secretary (4) Joint Secretaries (Two Post) (5) Treasurer (6) Publicity Secretary (7) Organizing Secretaries (Two Posts)

8.3 In addition to the office bearers seven members of the State Executive Committee are to be directly Elected.

8.4 Four members shall be nominated by the newly elected State Executive Committee in its very first meeting after the State level elections. They shall be nominated in order to ensure a broad base for the Association taking different zones, departments and other factors into accounts.

8.5 The tenure of the State Executive committee shall be for one calendar year from January to December. Hence, elections for the new Executive committee shall be conducted before the 25th December every alternate year.

8.6 No office bearer shall be allowed to be elected for more than two consecutive terms.

8.7 The State Executive Committee shall be fully empowered to work on behalf of the General body of the Association in the interest of the members of the Association.

8.8 A meeting of the State Executive Committee shall be convened by the President after giving a notice to the effect 3 days prior to the date of the proposed meeting. At least one meeting of the State Executive committee shall be held every month. The President can call an emergent meeting of the committee on 24 hours notice. The President shall decide the date, time and venue of the meeting and the notice will be issued by the General Secretary, or , on his behalf by the Jt. Secretary.

8.9 (a) One third members of the State Executive Committee shall form a quorum for the meetings. In case of lack of quorum, one hour after the time of start of the meeting, the meeting shall be adjourned to be reconvened at a later date. No quorum shall be necessary at such a reconvened meeting provided that it discusses matters already on the agenda of the

original meeting. (b) A member of the Executive Committee who absents himself at three consecutive meetings other than an emergent meeting of the State Executive Committee without any prior intimation and valid reasons will cease to be a member of the Executive committee and the vacancy so caused shall be filled through co option by the committee.

8.10 The meetings shall be presided over by the President. In his absence the Vice President or any member of the committee, elected for the purpose shall preside over the meeting. The presiding member shall have a decisive vote to be case of an equally divided vote by the rest of the committee on any matter.

8.11 All the assets and the properties of the association shall be rested in the State Executive Committee and the General Secretary will be the custodian of the same.

9 POWERS & FUNCTION OF THE OFFICE BEARERS OF THE STATE EXECUTIVE COMMITTEE

9.1 The President of the Association shall be the Chief Executive of the Association. In his absence the Vice – President shall exercise his powers.

9.2 (a) The General Secretary of the State Executive Committee shall carry out all the day to day works of the Association under the guidance of the President. (b) The General Secretary shall be the Chief spokesman of the state Executive Committee. (c) He shall convene all the meetings on direction of the President and record the proceedings of all such meetings in a book kept for the purpose. He shall get the signatures of all the members present in the meeting on the proceedings, to be confirmed at the next meeting. (d) He shall perform any other duty assigned to him by the president and / or the State Executive Committee. (e) He shall present the annual report of the Association to the General body meeting to be held on yearly basis.

9.3 (a) The Treasurer of the State Executive Committee shall receive the money deposited to him by the zonal Treasurers and make funds available for expenditure at the instruction of the President and the General Secretary. (b) The Treasurer shall prepare a consolidated Budget for the State Executive Committee at the beginning of the financial year and shall get it approved by the committee. He shall include a report on receipt and expenditure made in the previous year in the General body, finally in its annual General Body Meeting. (c) The Treasurer shall maintain a detailed account of the receipts and expenditures, which shall be regularly checked and initialed by the President/General Secretary. It shall be the Treasurer's responsibility to get the account audited annually.

9.4 All other office bearers and members of the State Executive Committee shall assist the President and the General Secretary in the manner decided by them and in the best interests of the Association.

10. FUNDS AND ACCOUNTS

10.1 The funds of the Association shall be kept in a Bank Account in the name of the Association. The Treasurer and the General Secretary shall jointly operate the Account.

10.2 The zonal Executive Committee shall collect the annual/monthly subscription from the

individual Member of their zones, keep 40% of it with the Zonal Office for its expenses and deposit the rest with the treasurer of the State Executive Committee. In case of Life Members, the one time membership fee of Rs. 1000.00 (or Rs. 500.00 in case of Life Member of Bihar Engineering Services Association shall be entirely deposited with the State Executive Committee whereas the annual subscription of Rs. 100.00 or monthly subscription of Rs. 10.00 shall be kept with the zonal office for its expenses.

10.3 An Auditor appointed by the State Executive Committee shall examine the accounts of the Association for one year, as maintained by the Treasurer and shall submit his Audit Report at the annual General Body Meeting after approved of the same by the State Executive Committee.

11. GENERAL BODY

11.1 The General Body of the Association shall comprise of all the members of the Association. An open session of the General Body shall be held at least once a year. It shall elect every year the members and office bearers of the State Executive Committee including the President. Annual Report prepared by the State Executive Committee on the activities of the committee in past one year shall be placed before the General Body for its ratification.

11.2 The quorum of the Annual General Body meeting and the extra ordinary General Body meeting shall be 150 and 100 respectively. If no quorum is achieved within one hour of the time of the start, the General Body meeting shall be postponed and reconvened at another date and time notified by the committee. No quorum shall be necessary at such a reconvened meeting provided that it takes up only matter on the earliest agenda.

11.3 The Annual Budget for the activities of the State Executive Committee and Zonal Committees shall be required to be ratified by the General Body.

12. MISCELLANEOUS

12.1 In legal matters, any writ, suit or application shall be filed with the signature of the General Secretary on behalf of the Association.

12.2 Interpretation by the majority of all the members of the state Executive Committee in respect of the provision of the constitution shall be final.

13. AMENDMENT IN CONSTITUTION

Proposal for any amendment in the constitution shall be passed by majority of the members of the state Executive Committee and shall come into force only after ratification of the same by the General Body.

Hot Mix Recycling and Preventive Maintenance of Roads Using REJUPAVE and TERASURFACING Technologies

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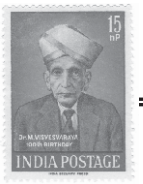
ABSTRACT

India is having world's second largest road neatwork in terms of length. Bituminous pavement constitutes 95 % of this road length and require bituminous overly in every four to five years to maintain the riding quality. Successive bituminous overlays over distressed bituminous surface using virgin aggregates and bitumen is not only a costly measure but also poses great demand for natural aggregates and bitumen binder. Bituminous pavement recycling using REJUPAVE Technology can facilitate 60 to 70 % Reclaimed Asphalt Pavement (RAP) material reutilization in recycled bituminous mixes which can lead to 40 to 50 % reduction in cost of road rehabilitation besides reducing reliance on natural materials. REJUAVE is a bio-oil based rejuvenator which replenishes the visco-elastic properties of oxidized bituminous binder of RAP material besides lowering down the mixing and laying temperature of the recycled bituminous mix thus facilitating the high RAP utilization in asphalt mixes without compromising its durability under rutting and fatigue damages. TERASURAFCING is processed steel slag aggregates and fly ash based thin surfacing for preventive and periodic renewals on bituminous and cement concrete pavement. TERASURAFCING is a polymer modified emulsion based ambient temperature technology which facilitate utilization of industrial waste aggregates in road construction and maintenance. This paper provides the brief overview of REJUPAVE and TERASURFACING technology for road recycling and maintenance works along with their application methodologies and benefits.

1.0 Introduction:

The benefits of using reclaimed asphalt pavement (RAP) in asphalt pavements include economics, conservation of natural resources (aggregate, binder, fuel), reductions in energy consumption, and decreases in emissions (including greenhouse gases). In contrast, the incorporation of elevated quantities of RAP in asphalt pavements presents several challenges, such as the variability of the RAP, design methodology, and adequate long-term performance. Bituminous mixes, used in road surfacing work, consists of aggregate and bitumen binder. As bituminous surfacing ages, the bitumen binder is oxidized and the bitumen loses its elastic properties. This oxidative hardening of the bitumen binder is manifested in the form of



different types surface distresses such as cracks, fatigue cracking, pot holes, raveling of the surface, etc. The riding quality and the structural integrity of distressed bituminous surface can be restored through recycling of bituminous layers. Reclaimed Asphalt Pavement Material (RAP) are milled through the pavement surface and can be reused with virgin hot mix asphalt (HMA) in different proportion depending upon the extent of oxidative hardening of the residual binder in the RAP. REJUPAVE technology of Hot Mix Recycling is based on the bio-oil based rejuvenator REJUPAVE which replenishes the viscoelastic properties of oxidized binder thus facilitating the uses of reclaimed aged bitumen and aggregates in recycled bituminous mixes. REJUAPEV technology of the pavement recycling is the combination of distinct asphalt mix design methodology including mixing and compaction temperature to facilitate high RAP utilization in recycled bituminous mixes using Hot-in Plant recycling technique. TERASURFACING is industrial waste aggregates based preventive and periodic renewal technology to restore and maintain the riding quality of bituminous and cement concrete pavement. TERASURFACING is an especially engineered blend of modified bitumen emulsion, mineral fillers, water and industrial waste aggregates such as steel slag and fly ash applied in-situ at ambient atmospheric temperature on distressed road surface. This paper proves a brief overview of This paper provides the brief overview of REJUPAVE and TERASURFACING technology for road recycling and maintenance works along with their material composition, application methodologies and benefits.

2.0 Material and Mix Design for Hot Mix Recycling

For hot-in plat recycling of asphalt mixes major ingredients are Reclaimed Asphalt Pavement Material, REJUAPVE Rejevenator, virgin aggregates and virgin bitumen binder. Following sun section provides the characteristics of different ingredients along with mix design methodology:

2.1 REJUAPAVE REJUVEANATOR

Rejupave rejuvenator is an organic bio-oil based rejuvenator developed by CSIR-CRRI to restore the rheological properties of oxidized binder of reclaimed asphalt pavement material. It also helps to lower down the laying and compaction temperature of recycled hot mix asphalt. Physical properties of Rejupave rejuvenator is given in Table 2.1:

Table 2.1: Properties of Rejupave Rejuvenator

S.No.	Properties	Values
1	Physical State	Liquid
2	Colour	Dark Yellow
3	Odour	Mild

4	Viscosity at 135°C	4 to 6 x 10^{-6} m^2/s
5	Specific Gravity	0.91-0.98
6	Flash Point	220°C
9	Miscibility	Soluble in available grade of bitumen
10	TFO Mass Loss	< 1%

2.2 Characterization of Reclaimed Asphalt Material (RAP):

Distressed bituminous material reclaimed through milling process is called Reclaimed Asphalt Pavement (RAP) Material. RAP can be extracted through DBM and BC layer and normally have the binder content between 2 to 4 %. Photo 2.1 shows the extraction of RAP through distressed bituminous layer using milling machine, while photo 2.2 shows the RAP sample subjected for laboratory analysis.

Photo 2.1 Distressed Bituminous surface Milled through Milling Machine for Extraction of RAP

Extracted RAP is further segregated in COARSE and FINE RAP by segregating it though deck sieves. Coarse RAP primary comprises the fraction 100% passing from 13.2 mm sieve while fine RAP consists of fraction 100 % passing from 9.5 mm sieve. Coarse and fine RAP were subjected to sieve analysis to determine their gradation. Residual binder content in the RAP is determined through binder extraction test by carrying out quantitative separation of aggregate and bitumen. Phto 2.2 shows the coarse and fine RAP samples while table 2.2 provide the gradation and characteristics of RAP samples.

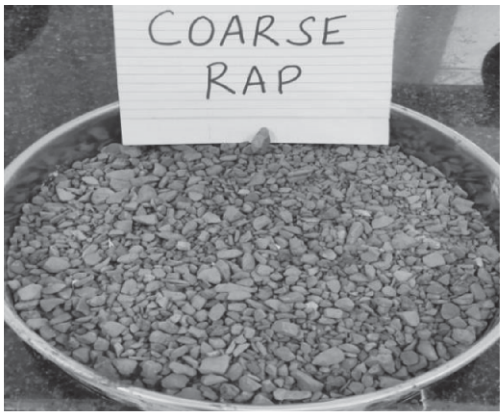


Photo 2.2: Coarse RAP < 13.2 mm sieve

Photo 2.2: Fine RAP < 9.5 mm sieve

Virgin coarse natural aggregates, belonging from basaltic rock groups were obtained from the project site and used to meet out the gradation requirement. Table 2.1 gives the gradation of coarse and fine RAP along with residual binder content and moisture content:

Table 2.2: Characterization of Coarse and Fine RAP Material

Sieve size in (mm)	Percentage Passing of Aggregate Passing through Sieve Size	
	Coarse RAP	Fine RAP
26.5	100	100
19	100	100
13.2	100	100
4.75	36	87
2.36	14	63
0.30	7	23
0.075	3	6
Recovered Binder Content in %	1.9	6.5
Absolute Viscosity of recovered binder at 60^0C, Poise	5250	5650
Moisture Content in %	0.85	0.9

2.3 Mix Design of Recycled Bituminous Mix:

Target viscosity of virgin binder VG 40 for variable RAP content i.e 40,50 and 60 % RAP content is determined through the viscosity vs. RAP % graph shown in figure 2.1. Equation 2.1 of ASTM

D 4887 standard is utilized to determine the target viscosity of virgin binder at variable rap contents.

$$Vv = \frac{Vb-(\%\ RAP*Vr)}{1-\%RAP} \quad \text{.....} \quad \textbf{Eq. 2.1}$$

Where,

Vv= Viscosity of Virgin Binder or Soften Virgin Binder (Poise),

Vb= Viscosity of Blend (Poise),

Vr= Viscosity of RAP Binder (Poise),

% RAP= Percentage of RAP in Recycled Mix

For 40 % RAP content to achieve target viscosity of virgin binder the doses of REJUPAVE comes out to be 2.8 % by weight of virgin bitumen. A trial mix blends with 50 % RAP content was developed by mixing the coarse and fine RAP with virgin aggregates and stone dust in such a manner that the resultant blend shall satisfy the stipulated gradation requirement for DBM grade II mix as prescribed in MoRTH specifications for Road and Bridge works, Vth revision. Table 2.3 and Fig. 2.3 shows the recycled mix blends with 40 % RAP content.

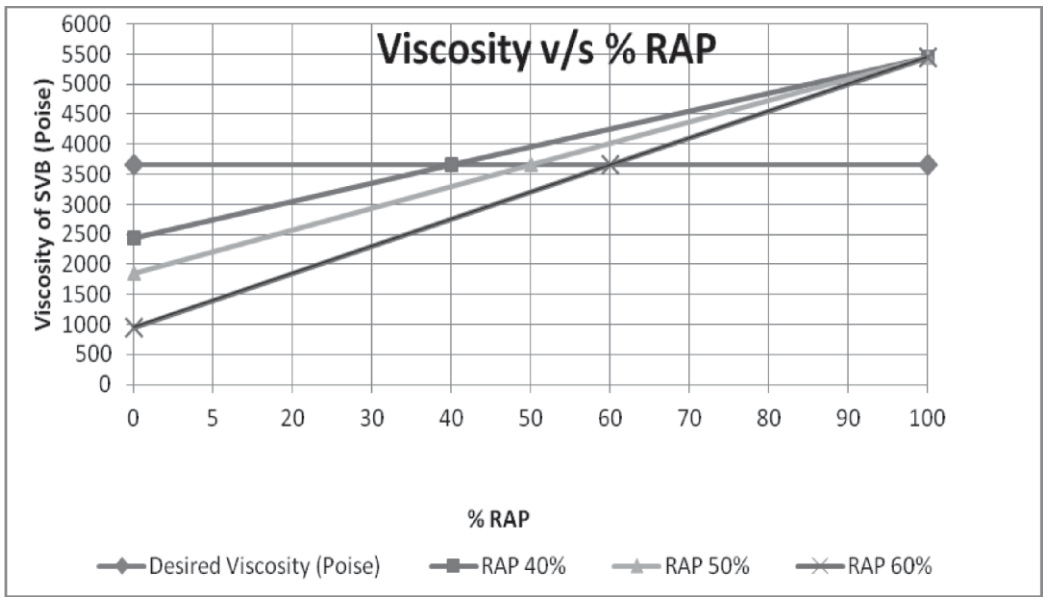


Fig. 2.1: Viscosity of Soften Virgin Binder (SVB) at different Percentage of RAP

Table 2.3: Gradation of Natural Aggregates and RAP blended for 50 % RAP Utilization

Percentage of Aggregate passing through Sieve Size						
IS Sieve Size (mm)	Virgin Aggregate		Reclaimed Asphalt Pavement Material		Blend Proportion by Wt. of Virgin Aggregate : RAP (50:50) A:B:C:D (28:22:25:25)	MoRTH Gradation for DBM II
	20mm (A)	Stone Dust (B)	Coarse RAP (C)	Fine RAP (D)		
26.5	100	100	100	100	100	90-100
19	64	100	100	100	90	71-95
13.2	12	100	100	100	75	56-80
4.75	0	96	43.3	80.6	52	38-54
2.36	0	68	8.3	55.2	31	28-42
0.3	0	32	1.6	8.4	10	7-21
0.075	0	10.5	0.8	4.5	4	2-8
Unit Weight in	1686.4	2307.33	1611	1869.33		

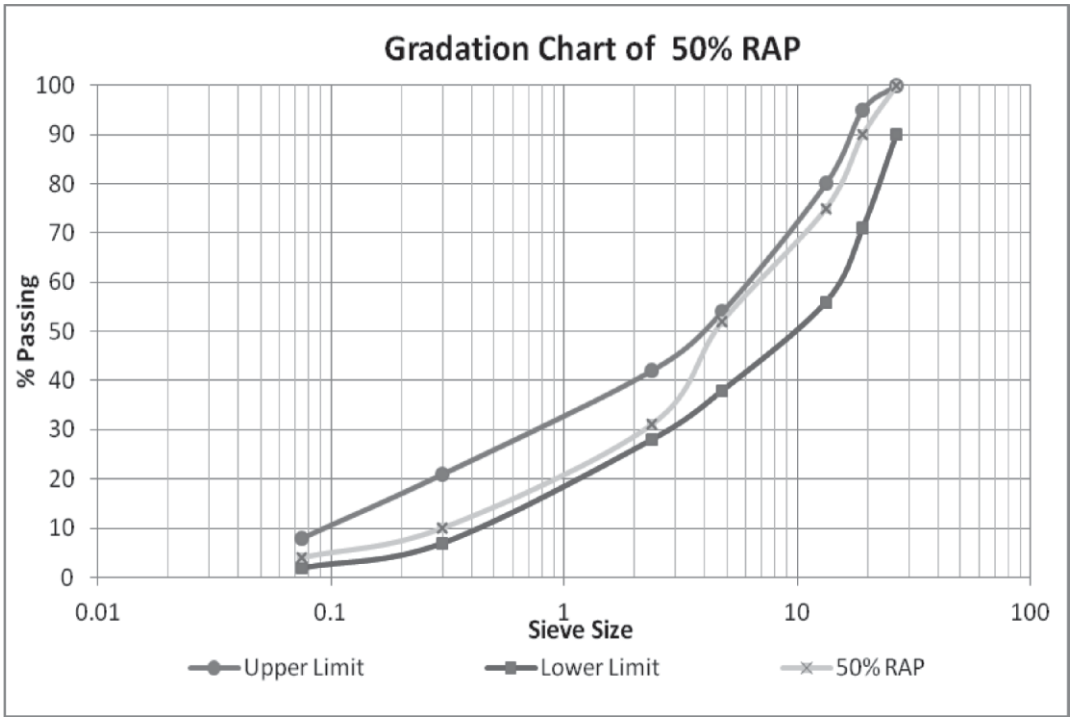
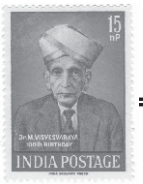


Figure 2.2: Gradation Graph of DBM -II at 50% RAP Mix



Job mix for 40 % RAP content is developed using Marshall method of mix design as stipulated in Asphalt Institute manual MS 20 for Hot Mix Recycling. Job mix is prepared to carry out Hot-in-Plant Recycling using Marini batch type hot mix plant having hot/coarse and cold/fine RAP feeding capacity. Total binder content in the recycled mix for 40 % RAP content is kept 4.75 % by weight of mix. Table 2.4 provides the job mix composition at 50 % RAP content along with the Marshall properties of recycled mix

Table 2.4 Job Mix for Dense Graded Bituminous Mix-II with 50 % RAP Content

S.No.	Job Mix Parameters with 50 % RAP Content	
1	Total Percentage of Reclaimed Asphalt Pavement Material RAP content in Recycled Hot Mix	40 %
	a) Percentage of Hot /Coarse RAP	25%
	b) Percentage of Cold/Fine RAP	25%
2	Total Binder content in the recycled mix by weight of Mix	4.75%
	a) Binder from the RAP material	2.03%
	b) Virgin Bitumen content VG 40	2.72%
3	Avg. Marshall Stability Value in KN at 60°C	19.78%
4	Flow (mm)	3.6
5	Percent Air Voids	3.12
6	Voids in Natural Aggregate, VMA (%)	12.47
7	Voids Filled with Bitumen, VFB (%)	74.90
8	Maximum Theoretical Density, gm/cc	2.470
9	Bulk Density, gm/cc	2.391
10	Rejuvenator doses by weight of virgin bitumen to be added in the bitumen tank	2.80
11	Compaction Level (Number of Blows) on each face	75

2.4 Preparation of Recycled Mix and Laying Protocol :

Recycled bituminous DBM II mix at 50 % RAP content is prepared using MARINI Hot mix

recycling plant with Cold and Hot RAP feeding facility as shown in photo 2.3.

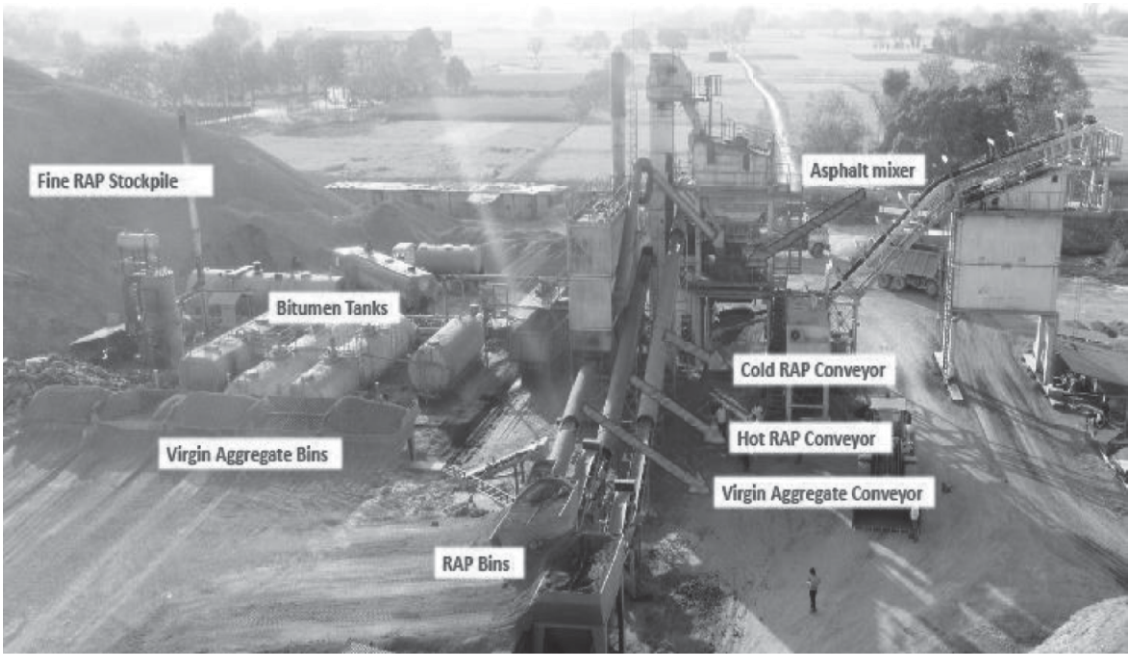


Photo 2.3 : Marini Batch type Hot Mix Recycling Plant with Hot and Cold RAP

REJUPAVE rejuvenator was added into the bitumen tank in virgin binder. Recycled bituminous mix with variable RAP content is laid on the project site as per clause 505 of MoRTH specification for Road and Bridge Work, 5th Revision. Photo 2.4 and 2.5 shows the road section built with 50 % RAP content in DBM-II Layer. Post construction bituminous cores were extracted to assess its mechanical and physical properties.

From the laboratory and field test results it is found that the recycled Dense Bituminous Macadam mix (DBM-2) prepared with 50 % RAP , rejuvenated through REJUPAVE rejuvenator is having requisite Marshall Stability, ITS, Resilient Modulus and Field density as per mix design requirement. Results of extracted bituminous cores and marshal specimen casted through plant mix are also satisfying the various requirements as stipulated in MoRTH specification 5th revision for Road and Bridge Work under clause 505 for Dense Bituminous Macadam Layer

Photo 2.4: Glimpse of Test section constructed with 50 % RAP content in binder course layer

Photo 2.5 Extracted recycled bituminous cores

3.0 TERASURFACING for Preventive Maintenance and Periodic Renewal

TERASURFACING is industrial waste materials i.e steel slag and fly ash based, preventive maintenance technology for quick rehabilitation and periodic renewal of bituminous pavement. TERASURAFCING can also be applied on cement concrete pavement showing early sign of distress in the from of hairline cracks to restore riding quality and to prevent further propagation of distresses in the concrete pavement. It's a customized polymer modified emulsion based thin surfacing which contain 100 % processed steel slag aggregates with marble dust or fly ash as substitute of natural aggregates. Thickness of TERASURFACING is ranges between 8 to 10 mm and applied through Micro surfacing paver on distressed pavement surface at ambient atmospheric temperature. Customized polymer modified emulsion content for TERASURFACING treatment is determined through mix design procedure as stipulated in IRC:SP:81 and it typically ranges between 11 to 13 % by weight of aggregate. Fig. 3.1 shows the gradation envelop of aggregates for TERSURFACING aggregates using processed steel slag aggregates while table 3.1 provides the typical composition of TERASURFACING treatment using processed steel slag aggregates.

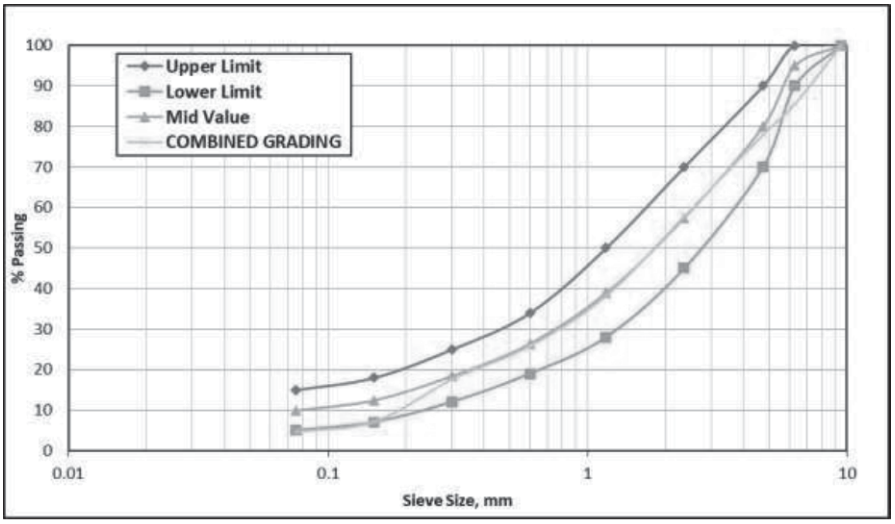


Fig. 3.1: Gradation Graph of TERASURFACING

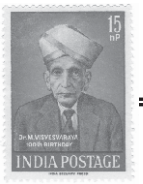


Table -3.1 Job Mix for Terasurfacing with Steel Slag Aggregates

S.No.	Particular	Concentration
1	Terasurfacing Bitumen Emulsion (Optimum) (By wt. of aggregate)	12.5 %
2	Portland Cement OPC 43 grade (By wt. of aggregate)	2 %
3	Terasurfacing Liquid Additive to be added in water (By wt. of water)	0.25%
4	Water * (By wt. of aggregate)	8%

*Quantity of water can be adjusted to achieve desired consistency and flow

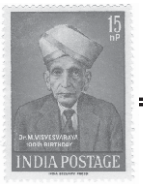
3.1 Application of TERASURFACING

Terasurfacing can be applied in single or double coat on distressed pavement surface using specifically designed Microsurfacing paver as shown in Photo 3.1. Distressed surface shall be air cleaned through compressed air to remove all the loose particle and dust on the surface. On cleaned surface TERASURFACING can be applied directly without any tack coat. Treated surface will be ready for traffic movement within an hour to two hour time.

Photo 3.1 Terasurfacing on Distressed bituminous surface

Photo 3.2: Application of Terasurfacing through Microsurfacing Paver

Photo: 3.3 Application of Terasurfacing on bituminous Pavement



4.0 CONCLUSION

Bituminous pavement recycling using REJUPAVE technology provides a cost-effective green alternative of conventional bituminous overlays to restore the riding quality of pavement. Reutilization of RAP material to the tune of 40 to 60 % in recycled bituminous mixes using REJUPAVE rejuvenator will significantly reduce the reliance on natural aggregates and bituminous binder thus reduce the cost of periodic renewal and structural rehabilitation. Preventive maintenance technology TERASURFACING facilitates the utilization of industrial waste materials such as steel slag and fly ash in place of natural aggregates which reduces the adverse impact of these waste materials on environment besides increasing the service life of the asphalt and concrete pavement by prolonging the requirement of structural overlays.

BRIDGE BEARINGS – MANUFACTURING, TESTING, INSTALLATIONS AND ISSUES

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ABSTRACT

Roads and Bridges are the two parts of Highways infrastructure, supplementary to each other. Bridges comprises of several components, bearing is one of them. Bearing is one of the most important components which plays a vital role to transfer the load of superstructures to Sub structure safely. Bearing allows movement and rotation of superstructure in all safe directions as required. Now a days Elastomeric Bearings, POT Bearings and Spherical Bearings are popularly used. This paper explains all activities related to manufacturing, testing, installation and issues related to Elastomeric, POT and Spherical Bearings. Issues related to bearing installation are also highlighted as this witnessed several incidences due to improper installation.

INTRODUCTIONS

Journey of bridges starts accidently by fallen tree across the river. Subsequently bridges were constructed by Wooden logs, Stones, Bricks, PCC, RCC, PSC, Steel or its combinations thereof. Several components are used in the construction of any bridges, bearing is one of them. Bearing is one of the most important components (Device) installed between super structure and sub structure to transfer the static & dynamic load and allow translational and rotational movements due to traffic rolling loads, temperature changes, wind, seismic effects, accidental forces etc. Safety and durability of super structure mostly depends on proper function of bearings. Earlier, only steel bearings were used for Road and Rail bridges both. In 1973, Ministry of Shipping & Transport (MOST) brought brief Standard Specifications covering Steel, Elastomeric and Paper bearings. In 1982, IRC brought the first Code of Practice on Metallic Bearings (IRC:83-Part-1) followed by a Code of Practice on Elastomeric Bearings (IRC: 83 Part-II) in 1987. Subsequently, IRC:83 Part-III on Pot, Pot-cum PTFE, Pin and Metallic Guide Bearings came in 2002 and IRC:83 Part IV on Spherical and Cylindrical bearings came in 2014. Hope, this technical paper will be very useful for site engineers, who use to go for factory inspection and witness the tests on bearings and for installation at site.

2. Classification of Bridges: - Two types of bridges are constructed, with and without bearings. However, number of bridges without bearings are very rare due to complexity in

design to control girder movement.

(1) Bridge with Bearing

(2) Bridge without Bearing

3. Function of Bearings: - Bearings have following measure three functions.

* Transfer all type of vertical and horizontal loads (forces) of superstructure to sub structures.

* Allow movement of superstructure in safe horizontal direction.

* Allow rotation of superstructure due to deflection etc.

4. Type of Bridge Bearings: - Following type of bearings are used in bridges i.e. Metallic Bearings, Elastomeric Bearings, Pot Bearings, Spherical Bearings, cylindrical Bearings. However, three popular type bearings- Elastomeric Bearing, Pot Bearing and Spherical Bearing have been taken in this paper.

5 ELASTOMERIC BEARINGS (IRC 83 PART II): - Elastomeric Bearing comprising a block of vulcanised elastomer reinforced with steel plates (laminates). Position wise, elastomeric bearing can be horizontal or vertical. Horizontal elastomeric bearing is used as individual supports to transfer vertical loads and non-seismic lateral loads and to accommodate imposed deformations and translations. Whereas, vertical bearing is used in seismic arrester system. Elastomeric bearings are mostly free type however, fixed elastomeric bearings are also used up to 85 % fixity. Elastomer is exposed to whether, life of elastomeric bearing is up to 15 years only if properly manufactured and installed perfectly. It is not suitable for long span bridge and where replacement is not easy.

As per IRC 83 Part II, provision for design and use of 9 type of elastomeric bearings have been made. As per requirement, specific type of bearing is being used for particular bridge.

5.1 **Design of Elastomeric Bearings: -** Once superstructure is designed and load coming on pier cap is known, type of bearing is decided for all span. Accordingly, bearings are designed based on latest codes & specifications and design and drawings are submitted to competent authority for approval. This type of bearing is designed to meet the relevant provisions of IRC 83 (Part II) at the Ultimate Limit State. Bearing design is done in accordance with the

requirements i.e. only elastomer, with number of laminates, side and top and bottom covers. A typical section of popularly used bearing is as below.

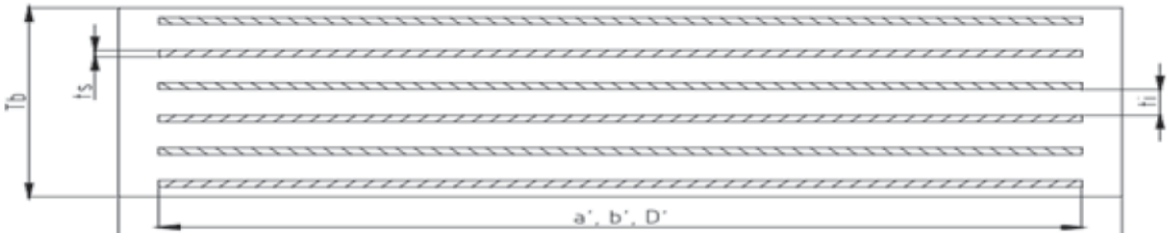


Photo – 03 Normal Elastomeric Bearing

A particular elastomeric bearing is designed with internal rubber layers of the same thickness (ti) from 8 mm and 20 mm in such a way normal average stress in rubber shall not exceed permitted concrete pressure. Minimum thickness of inner reinforcing plates (ts) shall be 3 mm and up to 5mm. Minimum thickness of outer layer of elastomer shall be 2.5mm and max up to 6 mm. Minimum side layer shall be 4 mm. Size of bearing can be considered as 100 x150 mm to 900 x 900 mm. Number of laminates layer can be from 2 to 11. Overall thickness can be 30 mm to 285 mm.

The Shear strain of the elastomer due to translatory movement shall not exceed 1.00. All designed bearings shall meet the requirements for maximum design strain; maximum tensile stress in reinforcing plates; stability criteria for rotation, buckling and sliding; forces, moment & deformation exerted on the structures.

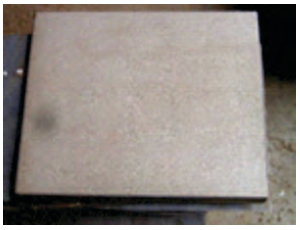
5.2 Manufacturing of Elastomer Bearing: - Raw elastomer (Any member of a class of Virgin Polychloroprene capable of being vulcanised with compounds, that possesses rubber like-properties after vulcanisation, especially the ability to regain shape almost completely after large deformation) is milled and rolled up to desired thickness with carbon black. Carbon black is added to make it UV resistant. Steel plates used as laminates is straighten sand blasted and cleaned. Adhesive is applied and elastomer sheet and laminates are kept in mould. After application of adhesive, top, bottom and side elastomer are also placed in mould. Bearing with steel laminates shall be moulded as single unit and vulcanised under heat and pressure. Different stages are shown below (Photos 4 to 15): -

4.Syprene in Packet

5. Syprene

6. Miling Machine

7. Miling with Carbon Black



8. Laminates

9. Adhesive Application

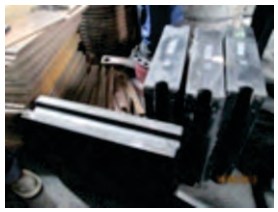
10. Elastomer & Laminates

11.Top Bottom and Side

12. Vulcanisation

13. Vulcanised Bearing

14. Finished Bearing



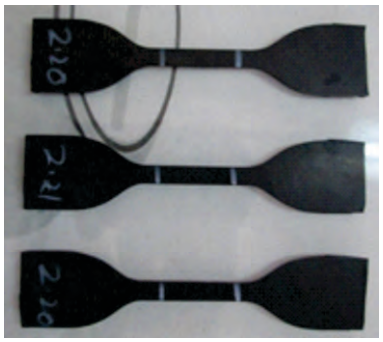
15.Finished FX Bearing

5.4 Testing on Elastomeric Bearings for acceptance: - The manufacturer must have all test facilities required for acceptance tests installed at his plant to the complete satisfaction of the engineer. All acceptance tests to be conducted at the manufacturer's plant. Tests are conducted on raw material and final product.

Acceptance tests shall be commenced as per approved testing programme. Lot by lot tests and acceptance shall be made. Lot size depends upon number of specific types of bearing ordered for manufacturing. Lot is classified as: - A lot size of 24 or larger number of any one type of bearings shall be defined as a large lot. A lot size of less than 24 bearings shall be defined as small lot. As per lot size, tests are conducted in two levels, Level 1 acceptance test and Level 2 acceptance test.

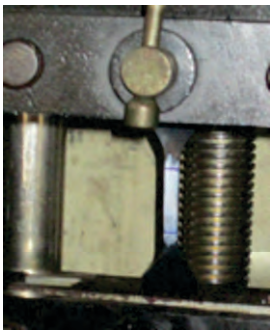
Acceptance test level 1 is a higher-level inspection and shall be applicable to large lots. This shall involve manufacture of extra bearings to be used as test bearing and used in destructive testing. Acceptance test level 2 is applicable for all lots. Acceptance testing shall comprise General inspection, Test on complete working bearings and Test on specially moulded test Bearings.

5.5 Tests on Raw Materials: - (Photo-16 to 19) (applicable for level 1 and Level 2), Generally, chemical tests on raw materials are conducted by out sourcing. In house test is conducted for Physical and mechanical tests. Mechanical tests on raw materials conducted on specially made mould shall satisfy the table (1).

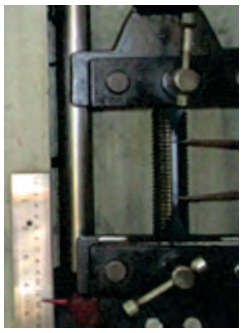


16. Molded Test Piece

17. Hardness Test



18. Testing & Elong Test



19. Measurement

Table (1); - **Properties of Elastomer**

Characteristics	**Requirements**		
G Modulus (MPa)	0.7	**0.9**	1.15
Tensile Strength (Test Piece)	≥ 16	**≥ 16**	≥ 16
Tensile Strength (Bearing Piece)	≥ 14	**≥ 14**	≥ 14
Min. Elongation at Break (%) (Moulded Test Piece)	450	**425**	300
Min. Elongation at Break (%) (Test Piece from Bearing)	400	**375**	250
Minimum Tear Resistance (kN/m) CR	≥ 7	**≥ 10**	≥ 12
Minimum Tear Resistance (kN/m) NR	≥ 5	**≥ 8**	≥ 10
Compression Set (%) 24h; 70 °C	CR ≤ 15	NR ≤ 30	
Hardness	50 ± 5	60 ± 5	70 ± 5
Accelerated Ageing - Maximum Change in Hardness (IRHD)	NR 7d, 70 °C: -5, +10; CR 3d, 100 °C: ± 5		
Accelerated Ageing - Maximum Change tensile Strength %	NR 7d, 70 °C: ± 25; CR 3d, 100 °C: ± 25		
Accelerated Ageing - Max. Change in Elongation at Break %	NR 7d, 70 °C: ± 25; CR 3d, 100 °C: ± 25		
Ozone Resistance Elongation: 30% - 96h at 40 °C ± 2 °C	No Cracks		

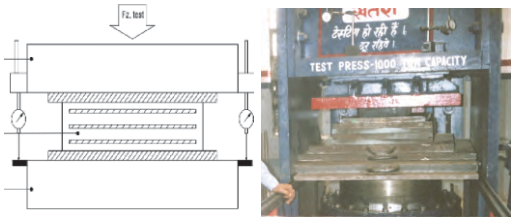
5.6 Tests on Complete Bearings: - It consists of---

5.6.1 General Inspection: - (Applicable for Level 1 and Level 2), this includes visually inspected for absence of any defects in surface finish; shape; hardness or any other superficial defects. All bearings of the lot shall be checked for tolerances for overall dimensions, mean bearing thickness, parallelism of bearing surfaces and flatness of load bearing surfaces specified in **Table (2).**

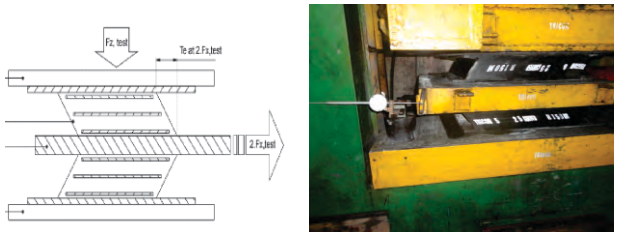
Description	Tolerances
Overall Plan Dimension	-2mm, +4mm.
Overall mean thickness	± 2mm for ≤ 100mm; ± 3mm for 100mm < Tb ≤ 150mm; ± 4mm for 150mm < Tb
Parallelism	Top and Bottom 1 in 300, Sides 1 in 100
Thickness of elastomer	Inner layer up 10mm ± 15%; 15mm - ± 12%; 25mm- ± 10%
Outer and side cover	Outer layer 0 mm, +2 mm; Side Cover - 0 mm, +3 mm
Laminates Plan	+2 mm, +1mm,
Thickness of Laminates	≤ 4mm +0.8mm, −0.4mm; > 4mm - +1.1mm, −0.4mm
Parallelism w.r.t. base	1 in 100

Flatness of load bearing surface	Tb ≤ 50mm - ± 1mm; 50mm < Tb ≤ 100mm - ± 1.5mm; 100mm < Tb ≤ 150mm - ± 2mm; 150mm < Tb - ± 2.5mm
Steel laminates	1% of diameter or diagonal (max of 1.5 mm)

5.6.2 Tests on complete Bearings: - (Applicable for both Level 1 and Level 2), Bearings shall be tested not earlier than a week after vulcanization. Two bearings are selected at random from the lot as test bearings and the following tests are conducted for compression stiffness and shear modulus (on a pair of bearing).



20-21. Compression Stiffness Test



22-23. Shear Modulus Test

5.6.2a Apparent Compression Stiffness Test: - (Photo- 20 21) Single bearing is used for the compression stiffness test. Specimen bearing is preloaded up to $F_{z,test}$ and load is retained for 10 minutes and unloaded up to compressive stress = 2 MPa before actual test. After pre loading, Design Load (calculated as $F_{z,test}$ = 5xGxSxA_1/1.5) is applied and settlement in bearing is noted as mean value of four dial gauges. Load is given in equal (minimum 5) intervals. The test result is satisfactory if the value of apparent compression stiffness determined from the deflection between 30 percent and 100 percent of the test load is within ± 20 percent of the value specified by the manufacturer and no defect is found visually. It can be understood how to calculate Compressive Stiffness by an example by tests on two bearing of size L=630 mm, B=320 mm, H=84 mm. Effective size L = 61.8cm B = 30.8cm t = 1.6 cm (Thickness of one elastomer layer)

Shape Factor (S)= L x B / (2 x t x 1.4(L+B)) =4.59

Max Test Load ($F_{z,test}$)= 5 x G x S x A/1.5) =2833696 N =14.89 Mpa

30% of Max Load ($F_{z1)}$= 850108.8 N +4.47 Mpa

Vertical deflection at Max Load (V_{Z2})= 6.5425 mm

Vertical deflection at 30% Load (V_{z1})= 2.4025 mm

Difference in test load from 100% to 30 % (ΔF_z)=(F_{Ztest}-F_{Z1}) = 1983587 N = 10.42 Mpa

Deflection between from 100% to 30 % (ΔV_z)=(V_{Z2}-V_{Z1})/2= 2.07 mm

Apparent compression Stiffness (Ea)= ΔF_z/ ΔV_z = 95824.69 N/mm

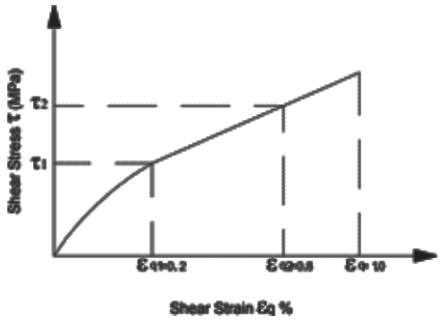
Permissible Limits ±20%=79056 to 118583 N/mm.

5.6.2b Shear Modulus Test: - (Photo 22 & 23) Before actual test starts, bearings are preloaded with maximum horizontal load 2 x Fx (with Fz,test load constant) and unloaded. Fz, test corresponding to σm = 5 MPa shall be held constant during test and the horizontal loading 2 x Fx is gradually increased to yield a shear stress rate of approximately 0.05 to 0.5 MPa per minute. Horizontal loading 2 x Fx is increased up to a maximum 2 x Fx,test which corresponds to horizontal deflection equal to T_e. Shear Modulus (G) is calculated by drawn graph and formula mentioned below-

$$\varepsilon_{q1} = V_{x1}/T_q \, , \varepsilon_{q2} = V_{x2}/T_q$$

$$\tau_1 = F_{x1}/A \, , \tau_2 = F_{x2}/A$$

$$G = (\tau_2 - \tau_1)/(\varepsilon_{q2} - \varepsilon_{q1})$$



Test result is deemed- satisfactory and valid if G determined is within the tolerance limit of value specified in Table 2 and provided there is no evidence of instability, defect or damage discovered by close inspection during the test.

5.6.3 Tests on complete Bearings (additional for level 1): - In addition to above mentioned common tests for level 1 and 2, following tests are required to be conducted under level 1.

5.6.3a Compression load test: - The test is carried out on all bearings as part of the standard production process. All bearing of the lot are axially load tested corresponding to the design load and visual inspection is made to check the defects like − Misalignment of reinforcing plates − Poor bond at laminate/steel interface − Variation in elastomer layer thickness − Any surface defects developed during testing. The temperature of the room in which the bearing is tested shall not vary more than 10°C.

5.6.3b Test for determination of Shear Bond Strength: - This is a destructive test and the test bearings is not used in the structure. Maximum test loading: Fz,test corresponding to σm = 12 MPa is to be held constant during the test. If required, compressive load is increased to prevent slippage. Horizontal loading is gradually increased to yield a shear stress rate of 0.05 to 0.5 MPa per minute. The horizontal loading 2Fx shall be increased gradually up to a maximum 2Fxtest which corresponds to horizontal deflection equal to 2Te (i.e., 58 mm for the specified size 200 mm x 300 mm x 41 mm). When the maximum deflection is reached (shear strain = 2) the deflection shall be maintained for 5 min in order to allow flaws to develop.

After completion of test result is evaluated by examining the test bearing for cracking or peeling both in the strained and unstrained state. After removal of the shear force the bearing is also examined visually. While it is under compressive load, any bulges which indicate bond failure is be noted. It may be necessary to cut the edge cover to confirm the presence of flaws arising from bond failure. If neither of the test bearings shows evidence of peeling or separation at or near the interface between rubber and reinforcement layers and there is no sign of bond failure the test shall be deemed to be satisfactory

5.7 Certification and Marking on Bearings: - Each bearing is individually numbered for identification on its external faces. Identification number is marked uniquely to avoid mixing during installation on different spans. Marking shall be water proof and contains manufacturer's name, unique identification number, Date of manufacturing, Dimensions, Batch number, Acceptance lot number, Project and specific location. On the top of bearing, direction is marked for the ease during installation.

5.8 Installation of Elastomeric Bearings: - Packed Bearings are transported to site, stored at a specified covered area to avoid any mechanical damage. It is stored at levelled, plain and smooth surface with maximum undulation of ± 1 mm. Methodology for installation of bearings is get approved by competent authority.

In case of cast-in-situ superstructure, bearings are installed prior to its concreting. Bearings are placed as per approved layout. Top of bearing pedestal must be true horizontal without any irregularity. 6 mm deep recess is made in pedestal for bearing to sit in (Photo – 24) For better contact between bearing bottom and pedestal top, 2-3 mm thick layer of cement / GP2 grout is sprayed and bearing is placed and pushed to squeeze out additional grout to ensure 100 % contact. Soft forms around the bearings are erected for the safety of installed bearings and prevent any leakage of mortar grout. Any mortar leaked on the bearings during concreting is completely removed before setting. (Photo – 25, 26)

Photo-24 Recess for bearing

Photo 25 & 26 Elastomeric bearing fixed in position and loaded.

In case of precast concrete or steel superstructures, placement of bearing on pedestal is done with the methodology mentioned above. After specified surface preparation, approved quality of epoxy resin adhesive is applied between top of bearing and bottom of superstructure. After

application of adhesive, superstructure is lowered down slowly without any impact or lateral movement. After installation, bearing and their surrounding areas is cleaned.

6. POT BEARINGS (IRC 83 PART III): - Earlier it was known as POT and POT cum PTFE Bearings. It consists of bottom plate (Pot) and top plate (Piston) for fixed bearing whereas for free and guided bearings it consists of bottom plate (Pot), Intermediate plate (with piston at lower side and recess for PTFE on upper side) and top plate fitted with SS plate and guide bar(s) is/are attached with top plate for guided bearings. For proper and safely transfer of load of superstructure, following four type of pot bearings are used in any individual span. As elastomeric pad is confined, life of POT bearing is up to 30 years.

6a(i) **Fix Pot Bearing**: - Its function is to transfer the vertical and horizontal forces and arrest the horizontal movement of superstructure at this location. It comprises of bottom plate known as pot, and top plate known as piston. Elastomeric pad is placed in pot below piston which allows rotation of top plate of bearing as superstructure rotates in vertical direction. A pair of open diagonally cut brass ring in layers of approved width and thickness is used to stop flow of elastomer due to vertical load and rotation. This arrangement of elastomer and brass ring is made for free and guided bearing also. Bottom plate is fixed to bearing pedestal on pier cap and top plate is fixed with soffit of superstructures. (Photo – 27)

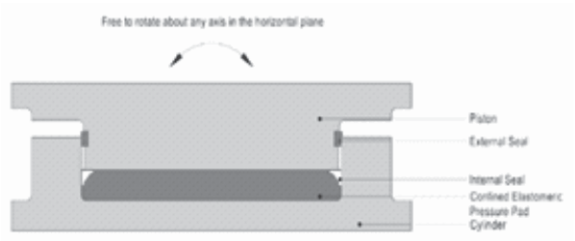


Photo – 27 POT Fixed Bearing

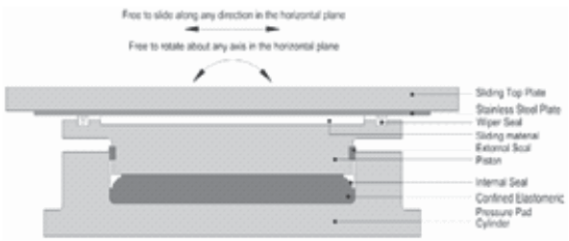


Photo – 28 POT Free Bearing

6a(ii) **Free Pot Bearings**: - (Photo-28) This bearing transfer the vertical load and allow horizontal movement in longitudinal, transverse and its resultant direction as per design. It comprises of bottom plate known as pot. Intermediate plate with piston at lower side and recess to fix PTFE at upper side and top plate attached with SS plate interface. Elastomeric pad is placed between pot and piston which allows rotation of top plate of bearing as superstructure rotates in vertical direction. Silicon grease is applied on PTFE surface to reduce the friction between PTFE and SS Plate interface. Similar to POT bearing, Bottom plate is fixed to bearing pedestal on pier cap and top plate is fixed with soffit of superstructures.

6a(iii) **Guided Bearing**: - This bearing Transfer the vertical load and allow horizontal movement of super structure at this location in longitudinal or transverse direction of alignment as per design. Shape wise, both longitudinal and transverse guided bearings are

similar. Permissible movement in longitudinal guided bearing is more whereas in transverse guided bearing it is less depending upon span length and distance between two adjacent bearing. Care is taken during fixing of guided bearing to avoid directional error. It comprises of bottom plate known as pot, intermediate plate with piston at lower side and recess to fix PTFE at upper side and bottom of top plate attached with SS plate interface and guide bar. Guide bar may be internal or external. Silicon grease is applied on PTFE surface to reduce the friction between PTFE and SS Plate sliding interface. Elastomeric pad is used between pot and piston which allow rotation of top plate of bearing as superstructure rotates in vertical direction. Similar to POT bearing, Bottom plate is fixed to bearing pedestal on pier cap and top plate is fixed with soffit of superstructures. (Photo – 29 and 30)

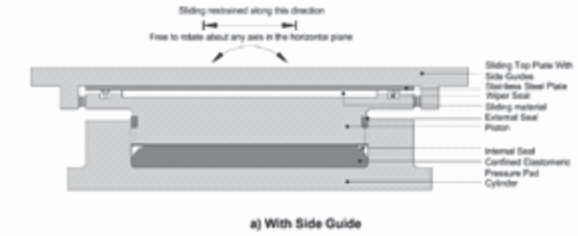


Photo – 29, Side Guided Bearing

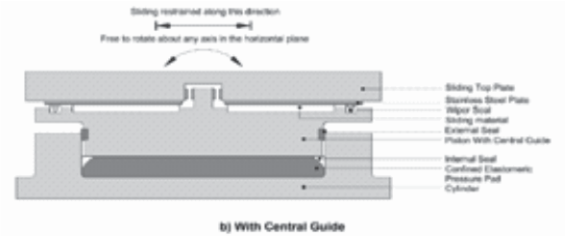


Photo – 30, Central Guided Bearing

6b Manufacturing of POT Bearings: - Once superstructure is designed and load coming on pier cap is known, type of bearing is decided for all span. Accordingly, bearings are designed based on latest codes and specifications and design and drawings are submitted to competent authority for approved.

After approval of design and drawings, manufacturer starts its manufacturing. Bearings are manufactured to high standards both in terms of material quality and workmanship. Mild steel or Cast steel are considered in design and manufacturing of main components. Dimension of main components are based on vertical, horizontal and seismic forces. Safe movement and rotation of superstructure is also considered in the design. To resist horizontal forces, anchoring system is designed.

Main Components: -Thickness of pot base shall not be less than 2.5% of the inner diameter of the pot cylinder. Thickness of the steel backing plate of stainless steel for sliding component shall not be less than 4% of the maximum dimension in plan. However, minimum thickness of any steel component or its part shall not be less than 12 mm. (Photo – 31-34)

31. POT (Cylinder)

32. intermediate plate

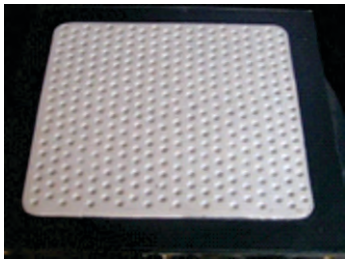
33. Guide & SS plate

34. Central guide & PTFE

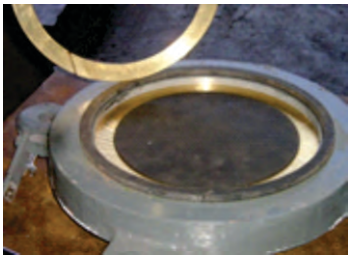
Elastomer: -The elastomer used for of bearings shall generally be made of Chloroprene Rubber (CR) or Natural Rubber (NR). The dimension of the confined elastomeric pressure pad shall be such that at design rotation the deflection at the perimeter shall not exceed 15% of the pad thickness. Minimum average stress in confined elastomeric pressure pad of Pot bearing shall not be less than 2 MPa. Thickness of elastomer taken such that permissible rotation of top/intermediate plate shall not exceed 0.03 radians. (Photo- 37)

PTFE / UHMWPE: - Low Friction Thermo-Plastic Sliding Material having high strength is used as shown below. Minimum thickness of PTFE / UHMWPE shall not be less than 4.5 mm. Dimple of 8 mm dia and 2 mm deep is provided at staggered patter @ 13.5 mm in traffic direction and 15 mm in cross direction. **(Photo-36)**

35. POM Seal



36. PTFE SHEET



37. Brass Seal & Pad.

38. Anchorage

Internal Brass seal: **- (Photo-37)** The internal brass seal is fitted into a recess in the upper edge of the elastomeric pad. 2 seals of minimum size 6 x 1.5mm for Pad dia ≤ 330 mm and 2 seals of minimum size 10 x 2.0 mm for Pad dia = 715 <1500 mm shall be used.

Stainless Steel Sliding Interface: - (Photo 33) It shall conform to AISI 316 or AISI 316L with a minimum thickness of 1.5mm if fillet welded and 2.5mm if screwing with backing (top) plate. Surface roughness of the polished Stainless-Steel sheet shall not exceed 1 µm

Anchoring system: - Anchorage is provided both to superstructure and bearing pedestal to transfer the horizontal force coming from superstructure. Diameter of the anchor sleeves is provided is such a way it shall not be less than twice the nominal diameter of bolts/screws. Length of sleeve shall in no case be greater than five times its diameter. **(Photo-38)**

Corrosion Protection: - After production of bearing all non-working exposed surfaces, including 50 mm (min.) return on surfaces to be in contact with concrete / steel shall be treated with full corrosion protection system having high durability life more than 15 years. All fasteners shall be hot dip galvanized to minimum 40 µm thick.

Table (3): - Manufacturing Tolerances for POT Bearings

Description	Tolerances
Plan dimension of assembled bearing	-0 : +5 mm or 0.5 % of plan diameter or diagonal, whichever is higher

Overall height of assembled bearing	-0 : +5 mm or 3 percent of overall height, whichever is higher
Parallelism of top surface of assembled bearing w.r.t. the bottom surface as datum	1 in 200
Height of confined elastomeric pressure pad	-0 : +2.5 mm for di ≤ 750 mm and -0 to +di/300 for 750 mm < di < 1500 mm
Thickness of any machined steel component	-0 to +1 mm
Centre to centre of anchor bolt holes	-1 mm to +1 mm
Stainless steel sliding surface Flatness	0.0003L or 0.2 mm whichever is higher, where L = length in direction of major movement
Stainless steel sliding surface finish	Rz ≤ 1 µm as per ISO 4287

6c. Testing and inspection: - Once manufacturing of any lot of bearings are completed, manufacturer submit the test plan to client for approval. Accordingly, tests are conducted in manufacturer's test house. Following tests are required to be conducted for the acceptance of bearings.

6c(i) Routine tests by the manufacturer: - Routine tests include the tests to be conducted in presence of inspector on finished bearing is carried out by the manufacturer for the bearings of each lot under acceptance. In addition, a detailed quality control report of routine test is furnished by the manufacturer to the inspector, for each lot of bearing offered for inspection.

6c(ii) Tests on raw materials: - Either Mill Test Certificates (MTC) produced by the manufacturer or test on raw materials is carried out by the manufacturer and Test Report shall be furnished. Following tests are required to be conducted on raw materials.

Mild steel and cast steel- Chemical tests for C, Mn, Si, S, P; Mechanical tests for Ultimate Tensile Strength, Yield Stress, % Elongation, Charpy Impact Test, Ultrasonic Test for Soundness.

Stainless Steel: - Chemical Test - C, Mn, Ni, Cr, Si, S, Mo & P; Mechanical Test – Hardness.

PTFE: - Mechanical Test- Mass density, Tensile strength, Elongation at break, Ball hardness. (Table – 4)

Table (4): - Properties of PTFE

Properties	Testing Standard	Requirement
Mass Density	EN ISO 1183 (all parts)	2140 to 2200 kg/m3
Tensile Strength	EN ISO 527-1 and 3	29 to 40 MPa
Elongation at Break	EN ISO 527-1 and 3	≥ 300
Ball hardness	EN ISO 2039-1	H132/60 = 23 to 33 MPa

UHMWPE: – Valid approval document from international approving bodies like ETA, FHWA.

Elastomeric Pad: - Mechanical Test- Tensile strength, Elongation, Hardness, Tear resistance,

Compression Set, Accelerated Ageing and Ozone test confirming Table (1).

Fasteners: - Chemical Properties and Mechanical Properties.

Shear Stud: - Chemical Test - C, Mn, Si, S, P; Mechanical Test – UTS, Yield Stress, % Elongation.

6c(iii) Inspection of finished POT Bearings: - All bearings of the lot are visually inspected for absence of any defects in surface finish, shape or any other discernible superficial defects. All bearings are checked for overall dimensions as per manufacturing tolerances. Table (3) (Photo-39)

39. Dimension

40. Proof Load Test

41. Friction Test

42. Rotation Test

6c(iv) Proof Load test: - Bearings shall be load tested **(Photo-40)** for a test load equal to 1.5 times the specified design vertical load in SLS condition. Load shall be applied gradually and the test load shall be held for 30 minutes. The load shall then be removed and the bearing shall be dismantled and visually examined.

6c(v) Friction test: - Friction test is performed to determine static coefficient of friction of properly lubricated sliding interface of bearing at constant vertical load equal to the design vertical load in SLS condition. Test assembly **(Photo-41)** is comprising of a pair of bearing. The horizontal load is applied till sliding occurs is detected with dial gauge. Coefficient of friction (μ) is determined as the ratio of Horizontal Load at which sliding occurs divided by 2 times the applied Vertical Load (as two sliding interfaces are used, two times the vertical load in denominator) The value of coefficient of friction shall not exceed the value calculated. In no case it shall exceed .08.

6c(vi) Rotation test: - Rotation test is performed on Pot Bearing with properly lubricated elastomeric pressure pad under a constant vertical load equal to design load in SLS condition and for rotation value of 0.02 radian or design rotation, whichever is higher. Rotation is achieved by the use of tapered plate **(Photo-42)** having slope of test rotation value.

6c(v) Dye Penetration Test: - This test is required to find oud out any defects in welding of SS Plate with backing plate. Welded area is cleaned with cleaner, once it is dry, dye is spayed on entire welding area. Colour is removed completely with jute cotton. Whitener is sprayed on welding area. Watch whether earlier sprayed colour is coming out over whitener. If, no colour comes out indicates perfectness of weld. **(Photo 43-46)**

Photo-43 Cleaning of weld

Photo-44 Colour applied

Photo-45 Colour removed

Photo-46 Whitener applied

6c(vi) Paint Thickness Test: - Thickness of paint dry film is measured with Paint Thickness Gauge. Digital Paint Thickness Gauge gives direct reading of dry film thickness. Before testing, Paint Thickness Gauge is calibrated**. (Photo- 47 &48)**

Photo-47, Calibration

Photo-48, Painting DF Test

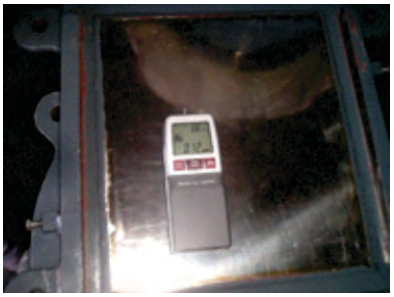


Photo-49, Roughness test of SS Plate

6c(vii) Surface Roughness Value (Ra) Test on SS Plate: - **(Photo-49)** After finishing buffing and polishing of SS Plate, roughness is measures with Roughness meter.

6c(viii) Hardness test on Elastomer: - (Photo-50) Hardness of elastomeric pad is checked with Durometer. It gives direct hardness in BHN. Hardness value of all elastomer pad is checked and list is prepared for submission.

Photo-50, Elastometer Hardness Test

Photo-50, Brinell Hardness Tester

6c(ix) Hardness test steel surface: - (Photo-51) Hardness of steel surface is checked with Brinell Hardness Tester. It gives harness value of metal surface.

All the tested bearings are visually examined both during and after the test. Any visual defects such as physical destruction, cold flow of sliding material, damage of internal seal and/or extrusion of the confined elastomeric pressure pad for Pot bearing, defects at metal-to-metal contact surfaces etc. may cause for rejection.

6d Installation: - lay out (as shown below in Photo 52 & 53) of bearing is one of the important activities to satisfy the design. After acceptance test, duly locked and packed bearings are transported to site carefully to avoid any mechanical damage. Bearing should be installed with care to ensure their correct functioning in accordance with the design for the structure. Bearings are so stored as to avoid accumulation of dirt and debris likely to interfere with their performance. Proper installation of bearing is of utmost importance to ensure proper functioning of bearing with its durability. Poor installation may not only damage the bearing but also may cause damage, instability and collapse of superstructures.

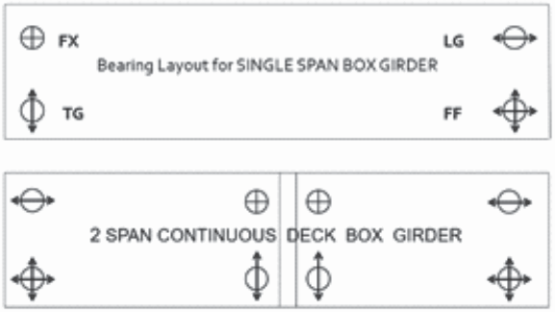


Photo – 52, Pot Bearing Layout for Box Girders

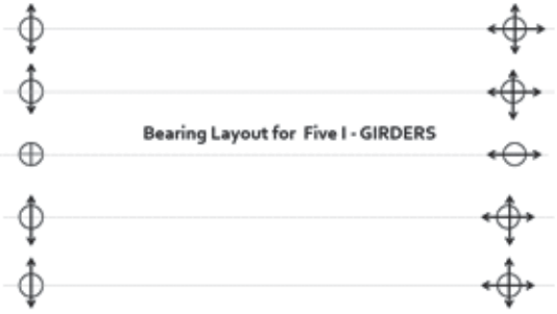


Photo – 53, Pot Bearing Layout for I- Girders

In case of cast in situ superstructure, bearing is fixed before its casting. Anchor Sleeve holes (with double the c/s area of anchor sleeve area) are left in bearing pedestal as per drawing (Photo-54 & 55). Bearing is placed as per approved layout and design (Photo-56). Anchor sleeves are placed in sleeve hole (Photo-56). Hole is grouted with cement or GP2 as required up to bottom of bearing. Care is taken to fill the entire bottom surface of bearing. (Photo – 58 & 59)

Photo 54 Sleeve hole position

Photo 55 Sleeves

Photo 56 Bearing fixed

Photo 57 Bearing fixed

Photo 58 Pot bearings fixed for I-girders

Photo – 59 Guided bearing in position

In case of precast girders, anchor sleeves are placed with accuracy (in micron) in soffit of superstructures. As in case of cast in situ sleeve hole is left in in pedestal. After erection of girder, bearing is fixed with girders in hanging position. All bolts must be tightened. Girder is lowered down so that bottom anchor sleeve will insert in the hole left for. Girder is allowed to rest on temporary support in correct position. Anchor sleeve hole is grouted and grout filled up to bottom of bearing with help of bund or shuttering. Once grout sets, temporary support of girders removed. (Photo-59)

7. SPHERICAL BEARINGS (IRC 83 part IV): - Spherical Bearings are suitable for all types of superstructures especially for long span and continuous structures, Cable Stay and Suspension Bridges with relatively large and repetitive rotation and translation requirements. Similar to POT bearing, following four type of spherical bearings are used in bridges.

In spherical bearing, elastomeric pad is not used. As name implies, spherical concave surface in bottom plate and spherical convex surface of intermediate (top plate in case of pot fixed bearing) plate allow rotation. It consists of a pair of matching concave and convex steel spherical backing plates with a low friction sliding interface in between thereby permitting rotation by in-curve sliding. As elastomeric pad is not used, life of spherical bearing may be up to 30 years with PTFE and of 50 years with UHMWPE.

7a(i) Fixed Spherical Bearing: - Its function is as same as of pot fixed bearing to transfer the vertical and horizontal forces and arrest the horizontal movement of superstructure at its location. It comprises of bottom plate whose top side is concave type fitted with PTFE/ UHMWPE and lower side of top plate with matching convex type. Spherical hard smooth surface of stainless steel, polished steel or chrome plated slides against the PTFE or UHMWPE fitted on concave surface. Silicon grease is applied on PTFE or UHMWPE surface to reduce the friction between sliding interface. Bottom plate is fixed to bearing pedestal on pier cap and top plate is fixed with soffit of superstructures.

7a(ii) Free Spherical Bearing: - This bearing transfers the vertical load and allow

horizontal movement in longitudinal, transverse and its resultant direction as per design. It comprises of bottom plate as same as it is used in fixed spherical bearings. Bottom of intermediate plate is also as same as it is used for fixed spherical bearings. Upper side of intermediate plate consists of recess to fix PTFE/UHMWPE and bottom of top plate attached with SS plate as sliding interface. Silicon grease is applied on PTFE or UHMWPE surface to reduce the friction between sliding interface. Similar to fixed spherical bearings, bottom plate is fixed to bearing pedestal on pier cap and top plate is fixed with soffit of superstructures.

7a(iii) Guided Spherical Bearing: - This bearing transfers the vertical load and allow horizontal movement in one direction as per design. It may be longitudinal guided or transverse guided. Shape of both the guided bearings are similar. But allowable movement in transverse direction is less than the longitudinal guided spherical bearings. It comprises of bottom plate with concave surface at upper side fitted with PTFE/ UHMWPE and bottom of intermediate plate is matching convex fitted with hard smooth surface of stainless steel, polished steel or chrome plated material. Upper side of intermediate plate consists of recess to fix PTFE/UHMWPE and bottom of top plate attached with SS plate interface. External or internal guide bar is attached with top plate. Silicon grease is applied on PTFE or UHMWPE surface to reduce the friction between sliding interface. Similar to fixed spherical bearings, bottom plate is fixed to bearing pedestal on pier cap and top plate is fixed with soffit of superstructures.

7b Manufacturing of Spherical Bearings: - After approval of design and drawings, manufacturer starts its manufacturing. Bearings are manufactured to high standards both in terms of material quality and workmanship. All components of spherical bearings are manufactured considering the minimum dimension within tolerance limit (Table-5).

7b(i) Curved Backing Plate: - (Photo -60, 61, 62) this is bottom part of the bearing made from mild steel or cast steel. The minimum thickness of the curved backing plate (concave sliding surface) shall be 12 mm and the space available on upper sides shall be minimum 20 mm all-around the circumference at top of backing plate. Recess in the Backing Plate for confinement of the Sliding Surface (PTFE/UHMWPE) is sharp and square to restrict the flow of the sliding surface and the radius at the root of the recess shall not exceed 1 mm.

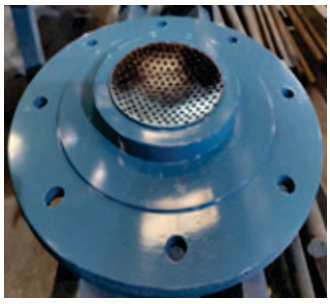


Photo-60, Bottom Backing Plate

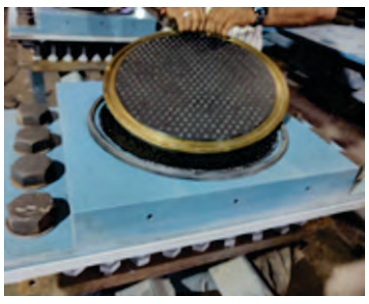


Photo-61, Intermediate Plate

Photo-62, Spherical Guided Bearing

7b(ii) Intermediate Plate: - (Photo 43) Its lower surface is convex to fit in with concave surface of bottom backing plate. Bottom Convex surface is Hard Chromium Plated mating surface fully covers concave sliding surface. The thickness of the hard chromium plating shall be at least 100 µm This Concave and convex sliding surface is responsible for rotation. Top portion of intermediate is fixed with PTFE/UHMWPE in a recess made for the purpose act as horizontal sliding interface.

7b(iii) Top plate: - Bottom of top plate is fixed with stainless steel mating surface shall cover the flat sliding surface (PTFE/UHMWPE) fully under maximum design displacement and shall not cease or become unstable for providing the full design displacement.

7b(iv) Guide Bar: - Purpose of this ring is to design and verification of the steel restraining ring capacity to withstand the effect of applied horizontal forces. It is welded with top plate as shown in Photo 64

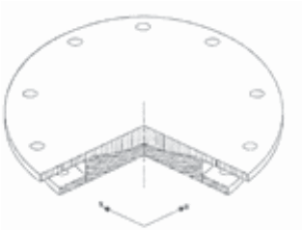


Photo 63 Spherical Fix Bearing

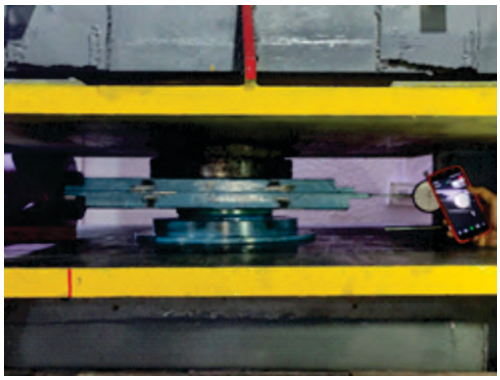
Photo 64 Guided Bearing

(Table 5) Tolerance on Dimension of Components of Spherical bearings Bearing

Parameter	Tolerance
Overall Plan Dimension (a) Machined	0 to + 5 mm or 0.5 percent of the drawing dimension whichever is higher
Overall Plan Dimension (b) un Machined (flange)	0 to + 10 mm or 1.0 percent of the drawing dimension, whichever is higher
Over all Height of Bearing	0 to + 5 mm or 1 .0 percent of the drawing dimension, which is higher
Parallelism of Bearing top surface w.r.t. b ottom	1 in 200
Height of individual machined steel component	± 1 mm
Radius of Curvature for the concave machined steel component	0 to + 0.25 m
Radius of Curvature for the convex machined steel component	-0.25 to 0 mm

7c(iii) Inspection and Testing on finished Spherical Bearings: Inspection and tests like Defect identification, Dimensional check, Hardness Test on elastomer and Metallic surface, Paint Thickness test, Compression stiffness test, Friction Test and Rotation Test on spherical bearings are same as tests on POT bearings. One additional test for Spherical bearing is Combined Vertical and Horizontal Load Test. This test is required to be conducted on Fixed and

Slide Guide Types. Vertical load of 1.1 times the design vertical load and 1.1 times horizontal load is applied. Both the loads are released after 10 minutes. Bearings are verified for any distortion, defects etc. before approval.



Photo–65 Vertical and Hor Load Test on spherical Bearing.

Photo–66 Rotation Test on Spherical Bearing.

8. Pre-Set of Bearing: - Pre-setting is the construction phase shifting of upper sliding component to a predetermined position with respect to its mean position**.** Any pre-setting of top sliding element, if required, shall preferably be done in the manufacturer's workshop before dispatch**.** Pre-set is required in case of cast-in-situ pre stressed girder. It is a position of top plate of bearing in longitudinal direction with respect to center line of bottom plate which is kept temporarily away opposite to fixed bearing.

Pre-set is required in free and longitudinal guided bearings to adjust the shortening of girder due to shrinkage effect and due to stressing shortening. Preset is a method to reduce the size of upper plates of sliding bearings in order to save the material cost.

Numerically (assumed value), it can be understood like- suppose length of PTFE is 300 mm. The required half-length of SS Plate will be 150 mm + expansion (20 mm) + extended length beyond PTFE (20 mm) = 190 mm. Total length can be 380 mm. In this case, centre line of PTFE and SS Plate shall be the same. In case of cast in situ prestressed structure, there will be shortening in girder length due to stressing and shrinkage in concrete. After stressing, centre line of SS Plate will shift by the value of shrinkage (5mm) and stressing shortening (10mm). Centreline of SS Plate will shift by 15mm towards fixed bearing end. Now offset of SS plate left is 25mm only. So, we have to increase the SS plate by 15mm at one side, then SS plate length will be 380+30mm = 410 mm. If preset is provided, centreline of SS Plate is to be kept 15 mm away from centreline of PTFE opposite to Fixed end. After stressing, SS Plate will move permanently by 15 mm towards fixed end and both the centre of PTFE and SS Plate will be at one line.

9. ISSUES: - Being one of the most important components of bridges**,** Engineers at site are taking utmost care however, sometimes bearing are not installed properly causes damage to bearing and structures too. Several issues related to installation is mentioned here to avoid reoccurring of mistakes.

9a Gap between bearing surface and concrete surface: - This is either due to bearing is not placed horizontally or soffit is not horizontal. (Photo- 67 & 68). In this case contact area get reduced resulted in increase in pressure of elastomeric bearing and elastomer will be crumbled. Bearing will need to be replaced.

Photo- 67 Gap at bottom of Bearing

Photo- 68 Gap at top of Bearing

Photo- 69 Shear Force due to Hor movement of Girder

Photo-70 Pedestal is not horizontal

9b. Lack of proper Down Stand: - Sometimes Flyovers and bridges are in gradient and therefore, soffit is not horizontal. Bearing top shall always be horizontal. For 100% contact between bearing and soffit, bearing area of soffit is made horizontal with down ward monolithic projected concrete known as down stand so that bottom of down stand is truly horizontal (Photo-71). Thickness of down stand in longitudinal direction varies as per gradient of flyover / bridges. If down stand is not provided during concreting of soffit of superstructures, People use to fill with concrete which will not stand during service condition (Photo-73. If down stand is not provided due to any reason, MS plate with required tapering shall be provided (Photo-72)

Photo- 71 Proper Down stand

Photo-72 Steel Down stand

Photo – 73 Worst Down stand

9c. Missing Anchor sleeve: - Anchor sleeve plays an important role to transfer horizontal forces of superstructure to sub structure. Number of anchor sleeves decided based on design. Site engineers must respect religiously the data mentioned in the drawing. Due to ignorance, bearing and superstructure may fail. (Photo- 74, 75, 76)

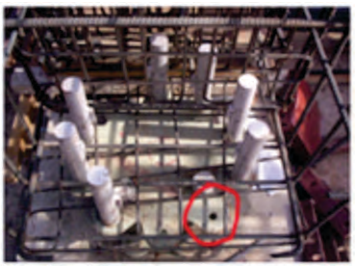


Photo-74 Missing Anchor Sleeve

Photo-75 Missing Anchor Sleeve

Photo-76 Girder toppled down

9d. Bolts of bearing are not tightened: - Due to misalignment of sleeves cast with superstructure, it is very difficult to tight all th bolts. In this case hole of lugs shall be modified to tight the bolts. In no case any bolt shall be left without tightening case any bolt shall be left without tightening. In this case one end of top plate is touching the girder whereas another is about 20 mm below from girder soffit surface. While starts resting on pedestal girder tilted by 150mm resulted in toppling over railway track. This type of negligence has place in sound engineering practice. (Photo- 77, 78, 79)

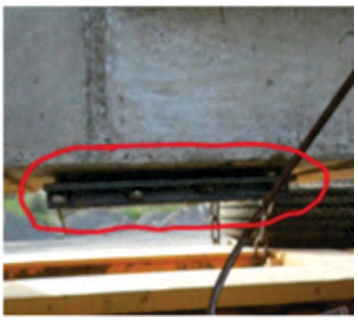


Photo- 77 Gap with girder

Photo- 78 Gap with girder

Photo- 79 Girder toppled

9e. Low pedestal height: - FRL of Road is well defined in the drawing. Based on thickness of different components of superstructure, level of soffit is derived. Top of bearing pedestal is derived once thickness of bearing is designed. Care shall be taken during casting of pedestal otherwise rework to be done after erection of girder and that will be weak portion and project will delayed. (Photo - 80)

Photo-80 Low Pedestal height

Photo 81 No proper assembling

Photo 82 No proper assembling

9f. Bearings not assembled properly: - Some times, manufacturers are reluctant, not assembling and locking the bearing properly. Bearing with this type of defects should not be used at any cost. Project may be delayed by a day or two however, this delay will be cheaper than any accident. In this situation, manufacturer shall called to re-assemble the bearing. Locking clamp is removed and fresh clamp with proper dimensional hole is used to lock the bearings. (Photo- 81 & 82)

9g. Length of anchor bolt is more than the clear gap between bottom of top plate and top of bottom plate.: - This situation comes specially in case of steel structures when hole in top lugs is just above the bottom plate extension or vise versa and length of bolt is more than the clear gap between top and bottom plate. In this case, it is not possible to insert bolt to connect bearing with steel girders especially for fixed pot bearings. In this situation, we have no choice other than to dismantle the bearing to insert the bolt for connection. Bearing is kept at horizontal platform and all locking clamp is cut gently in presence of manufacturer's representative. Top plate is raised such that the bolt for top plate is inserted invertely. Similarly bolts for bottom plate are also inserted. Top plate is lowered down at its original position and lock clamp of bearing is welded again without disturbing the other components of the bearings. (Photo- 83, 84, 85)

Photo-83 Less gap

Photo 84 Lock Clamp cutting

Photo 85 Bearing fixed with girder

9h. Misaligned Pot Bearing: - Due to negligence, bearings are fixed without considering their proper line and alignment. It is shown, misaligned installed bearing is being corrected. (Photo-86, 87)

Photo 86 Wrongly installed Pot Bearing

Photo 87 Rotating top plate after cutting Lock Clamp

9i. Orientation issue among Longitudinal and Transverse Guided Bearings: - shape wise, both the Longitudinal and Transverse guided bearings are similar except provision for movements. Superstructures is allowed to move more in longitudinal direction than in transverse direction. If care is not taken, it may be danger for bearing and superstructures as well. Top plate alongwith Intermediate plate is being rotated. (Photo-88-89)

Photo 88 Wrongly installed Pot Bearing

Photo 89 Rotating top plate after cutting Lock Clamp

10. Vertical Bearings: - During earthquake, there is a chance of sliding, shifting, toppling of bridge superstructure. To stop this type of incidents due to seismic effect, seismic arresters are used. Vertical elastomeric bearings are also used in seismic arrester system. RCC block is cast on pier cap and recess is made in superstructure to accommodate the seismic block.

Generally, five vertical bearings are used to arrest seismic effect for both longitudinal and transverse direction. Arrangement is shown in photo 90, 91, 92.

Photo-90, Sesmic Block on Pier Cap

Photo-91, Sesmic Block and Bearing

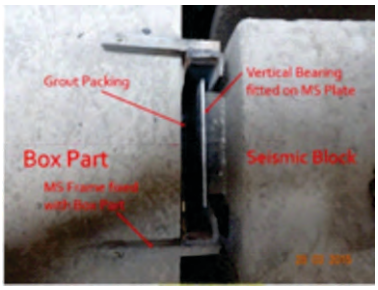


Photo-92, Vertical Bearing positioned

11. Conclusion and recommendations: - Being important component, special care must be taken in Design, Manufacturing, Testing, Packing, Transportation Storage and Installation. Proper functioning of superstructures depends upon proper function of bearings. Cooking time is never be a wastage. Proper attention must be taken and adequate time must be spent on layout and installation of bearings. Engineers working at site must not work under pressure for pregress at the cost of quality and durability. Any defects, missmatching must be informed to concern seniors to take appropriate action. No place for ***chalata hai, hota hai*** in Bridge Engineering.

12. References and acknowledgement: - This technical papers on bearings has been written based on my field experience. All actual photographs has been taken from my collections from different projects for testing and installation wherever I had worked. Several datas and sketches has been taken from IRC 83 part 2, IRC 83 Part-3 and IRC 83 Part 4. Thanks to Mr. Sukumar of M/s TRICON who has provided some photos and test report on Spherical bearings. Thanks to officials of JESA who have given opportunity to prepare this technical paper for Souvenir 2023.

Use of Fly Ash in construction - A step towards better environment

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Fly ash is a coal combustion product that is taken out from coal fired boilers. This is largely produced as a by-product from Thermal Power plants. Fly ash causes pollution to water and air. Sometimes, high heaps of fly ash looks like mountain and wind causes dust particles to fly and reach human habitations. Water bodies are also polluted due to this. Fly ash causes severe pollution of air and water, and its disposal requires large tracts of land. Hence there is urgent need to utilize fly ash in beneficial uses so that this menace is addressed properly.

Benefits of Fly Ash uses for Environment

The increase in greenhouse gases, out of which CO_2 is one of the major constituents, increases the global warming year after year, causing drought and floods. The total CO_2 Emissions globally account for 37.50 billion metric tonnes at 2022 levels. Cement and building materials industry is one of the major contributors. As per the on-going practices in India, each million clay bricks consume about 200 tons of coal (or any other fuel with equal quantity of thermal values) and emit around 270 tons of CO_2. Fly ash bricks production in energy-free route saves the emissions totally, befitting the project to qualify under Clean Development Mechanism (CDM), as envisaged by Kyoto Protocol towards the welfare of Mother Earth.

India is second largest coal producing country in the world. In India, 85% of India's power plants are coal based. These power stations generate nearly 180 million tonnes of fly ash annually. This fly ash is used as a raw material for manufacture of various raw materials for construction industry. .

The major uses of fly ash are listed below:

1. Manufacturing of Portland cement.
2. Embankment construction.
3. Soil stabilisation material.
5. Used as the filler mineral in asphalt road laying to fill the voids.
7. Used in Roller compacted concrete dams.
8. Manufacture of fly ash bricks

Fly Ash bricks:

Bricks are major components of construction sector which are not only used in Government's developmental sector, but also by common person and real estate sector.

Flowchart Showing the Manufacture of Fly Ash Bricks

1. Mixing Fly Ash with sand, cement and water
2. Pouring the mortar into mould
3. Drying at atmospheric temperature and pressure
4. Curing for 28 days
5. Removing from Mould
6. Fly ash bricks.

Properties	**Clay Bricks**	**Fly Ash Bricks**	**Remarks**
Density	1600-1750 kg/m^3	1700-1850 kg/m^3	Higher load bearing
Compressive strength	30-35 kg/cm^2	90-100 kg/cm^2	Higher load bearing
Absorption	15-25%	10-14%	Less dampness
Dimensional stability	Very low tolerance	High tolerance	Saving in mortar up to 25%
Wastage during transit	Up to 10%	Less than 2%	Saving in cost up to 8%
Plastering	Thickness vary on the both sides of wall	Even on both sides	Saving in plaster up to 15%.

Hence, there is every reason that we always prefer Fly Ash bricks as per local availability.

Fly ash use in embankment construction:

Indian Road Congress has published Special Publication IRC: SP-58-Guideleines for use of Fly Ash in Road Embankment. Fly Ash possess following favourable properties for embankment construction:

1. Light weight
2. Non plastic
3. High shear strength
4. Ease of compaction
5. Self-hardening
6. Amenable to stabilization
7. Faster rate of stabilization

Fly Ash use in Concrete Pavement Construction

Fly Ash concrete pavement gives the following properties:

1. By use of fly ash in concrete pavement mix, concrete is placed at lower sump value but workability is not affected. This concrete requires less hand work and gives better finish.

2. If 25% of cementitious material is substituted by fly ash, same compressive strength is obtained at all ages.

3. Use of fly ash in concrete results in denser concrete with greater ultimate strength and durability. Fly ash provides good-quality hydration products, which reduces the amount of non-hydrated cement in the concrete. It reduces the amount of air voids, making the concrete more dense and impermeable.

4. Fly ash concrete pavement has more resistance to sulphate attack compared to conventional concrete pavement.

5. It is more resistant to freezing and thawing.

6. The chances of an alkali-aggregate reaction are less in fly ash concrete pavement.

7. Fly ash concrete pavement has a lower cost compared to asphalt pavement.

Fly Ash has found applications in roller compacted concrete dams where heat of hydration is less. Also in manufacture of floor tiles, wall tiles, hollow bricks,

Fly ash polymer composites which is a wood substitute. Fly Ash is also used for the manufacturing of paints and enamels.

Regulatory provisions:

The ministry of Environment & forest Government of India has issued Notification NO. S.O. 763(E), Dated 14.09.1999 & the same is amended on 27.08.2003, regarding the utilization of fly ash/Bottom ash generated from Coal/Lignite based thermal power plant, to protect the

environment, conserve top soil & prevent the dumping & disposal of fly ash discharged from coal or lignite based thermal power plants. Further there is need for restricting the excavation of top soil for manufacture of bricks & promoting the utilization of fly ash in the manufacture of building material & in construction activity within the radius of 100 Km from coal or lignite based thermal power plants.

As per the above notification, fly ash/bottom ash generated from lignite/coal based thermal power plants in to the brick manufacturing & other construction activities all manufactures of clay bricks, or tiles or blocks for use i.e. construction activities, within 100 KM radius from lignite/coal based thermal power station are required to mix at least 25% of ash with soil on weight to weight basis.

Every construction agency engaged in the construction of buildings within a radius of fifty to one hundred kilometres from coal or lignite based thermal power plants shall use fly ash bricks or blocks or tiles or clay fly ash bricks or cement fly ash bricks or blocks or similar products or combination aggregate of them in such construction as per the following minimum percentage (by volume) of the total bricks, blocks & tiles, as the case may be, used in each construction project, namely:-

(i) 25 per cent by 31 st August 2004;

(ii) 50 per cent by 31 st August 2005;

(iii) 75 per cent by 31 st August 2006; and

(iv) 100 per cent by 31 st August 2007.

In respect of construction of buildings within a radius of 50 kilometres from a coal or lignite based thermal power plants the following minimum percentage (by volume) of use of bricks, blocks and tiles shall apply:-

(i) 50 per cent by 31 st August 2004;

(ii) 100 per cent by 31 st August 2005.

The Central Government has further made amendment to the said Notification vide S.O. 2804 (E), dated. 03.11.2009, prescribing the percentage of fly ash utilization by weight in the building material or products and prescribing the target of fly ash utilization for all coal and or lignite based Thermal Power Stations and, or expansion units in operation before the date of the said amendment to achieve 100% fly ash utilization within 5 years from the date of issue of the said Notification dated 03.11.2009. The target date for achieving 100% utilization of fly ash generated from new coal and or lignite based Thermal Power Stations and or expansion units commissioned after the date of the said amendment dated 03.11.2009 shall be within 4 years from the date of commissioning thereof.

As per the Amendment to the Fly Ash Utilization Notification dated 03.11.2009, it is obligatory on the part of every construction agency including all the construction agencies of Central or State or Local Government and Private or Public Sector within a radius of 100 kms. from a coal or lignite based Thermal Power Plant to use fly ash based products for construction, such as: Cement or Concrete, Fly Ash Bricks or Blocks or Tiles or Clay fly ash bricks, Blocks or Tiles or Cement fly ash bricks or Blocks or similar products or a combination or aggregate of them in every construction project, provided that such Thermal Power Plant Stations shall facilitate the availability of required quality and quantity of fly ash as may be decided by the Expert Committee.

Fly ash construction materials have now been placed in various Schedule of Rates so that there is no difficulty in framing estimates and execution of projects with fly ash products. We all must endeavour wholeheartedly for the pious goal of mitigating environmental pollution by such measures for the sake of better conditions on mother earth.

JACK JETTY-AN ECO-FRIENDLY & ECONOMIC RIVER TRAINING STRUCTURE

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1. NEED OF PERMEABLE TYPE RIVER TRAINING STRUCTURES

Applications of conventional impermeable structures like spurs, cut offs, levees, pitching of banks, guide banks, pitched islands, revetments and longitudinal dikes are becoming too expensive and comparatively less effective due to several factors involved. In the current circumstances, river professionals are looking forward not only in the usefulness of the structure, but also different characteristics like cost factor, navigation or bank nourishment, augmentation of ecological diversity including coastal engineering for bank and beach shielding are also considered. Compared to the conventional impermeable structures like dikes/groynes, permeable structures like RCC jack-jetties and porcupines may be economically implemented to overcome the increase in the prices of steel and other construction materials. In several situations, these permeable structures are more successful in creating living environment for aquatic habitats rather than conventional structures. Consequently, field pools created around these jetties provide shelter to aquatic habitats. However in some situations, these jetties can be used in combination with impermeable dikes to make the system sustainable and cost-effective.

2. HISTORICAL USE OF JACK JETTY

Grassel (2002) reported briefly about jack jetty invented by H.F.Kellner in the year 1920. This was a permeable form of dikes and performed at a lower cost than the impermeable type of dikes. Kellner started his experiments with jack made up of three willow poles tied together in the mid point on a small stream near Topeka, Kansas. He laced the willow poles with wire to keep them in the extended position. Later on, he replaced the willow poles with angles.

Grasel (2002) reported that in the early 1950's, installation of Jetty systems at five places in Arkansas River and two places in Rio Grande River were completed. Up to 1953's, seven nos. of additional installation were completed in the Rio Grande. High flows just after the installation of Jetty systems on the Purgatoire River, Higbee and Arkansas River, Manzanola were faced. The prime purpose of the installation of bank protection was resolved with no damages to the

systems indicates the efficacy of the systems.

The Middle Rio Grande Conservancy District (MRGCD) was created in 1925 and diversion dams, miles of drainage canals, and levees had been constructed by the highly involvement of U.S. Army Corps of Engineers and the Bureau of Reclamation in 10 years. In order to rehabilitate the MRGCD, structures like levees, channel improvement works, jetty fields were constructed by The Bureau of irrigation and drainage systems. The Espanola floodway also witnessed extensive levee rehabilitation and channel straightening with these jetty fields. After the implementation of these structures, the Rio Grande was converted to a highly modified storage and water conveyance system.(U.S. Army Corps of Engineers and Bureau of Reclamation 2002, Crawford et al.1993, Lagasse 1980, Najmi 2001)

The U.S. Army, Corps of Engineers (1978) reported that jacks placed in various locations on Big Sand Creek, Mississippi have successfully worked and also the jacks installed on the Lower Yellowstone River during 1965-1967 were in well condition even 10 years later.

In order to protect the bridge across Cimarron River situated at Sitka, Kansas, the State Department installed the Jetty systems. Prior to the installation of Jetty systems, the abutment of the bridge got washed out twice and extension of the bridge was done both times. These extensions were removed after the successful implementation of Jetty systems. Jetty systems were also used for the bank protection at Santa Fe Railway bridge location in Nebraska.

3. CONCEPT AND WORKING PRINCIPLE OF JACK-JETTY

Basically the concept about the jack jetty is that a single or stand unit of the model is said to be a jack and when they are tied together with a cable, it is called a jetty. When jetty lines are laid parallel to the channel bank, they are called as diversion lines and when the lines are laid at some angle to the bank, they are called as retards. Thus jetty field is nothing but a combination of retard and diversion lines.

Jack jetties are the permeable type of river training dikes and consist of three steel angles/ RCC Poles tied together & laced them with wires. It works by reducing the velocity and accumulating the sediment and debris during floods resulting to the formation of a new

bank. The jack jetty system functions well if placed appropriately in concave bend of banks and the incoming flow carries full of suspended sediments. Restriction created by the jetty to the sediment results to the deposition of the sediment in the jetty field.

4. STRUCTURE OF JACK-JETTY

The structural unit of the system is called a jack and is shown in Fig. 1. The jacks deployed in the USA followed a standard size and configuration given by Kellner. A jack was composed of three

4.88 m long, 0.1 x 0.1x 0.0006 m steel angles. These three angles were bolted together at their midpoints and placed back to back. The angles were fastened into place and formed three sets of intersecting planes with their common point at the centre. The planes were maintained by lacing them with wire at 0.381 m intervals. Then they were linked together in a line with thick cable to form a jetty. However, in the present scenario,

a modified version of a jack constructed from Reinforced Cement Concrete with cables (an RCC jack) is used instead of steel jetty. This is implemented to overcome the increasing steel prices in developing Asian countries. The RCC jack jetty system could also easily be fabricated and placed on site (Nayak et al. 2017). Trapping of small trees and debris in Solani River, Uttarakhand, India by RCC Jack- Jetty are shown in Fig. 2.

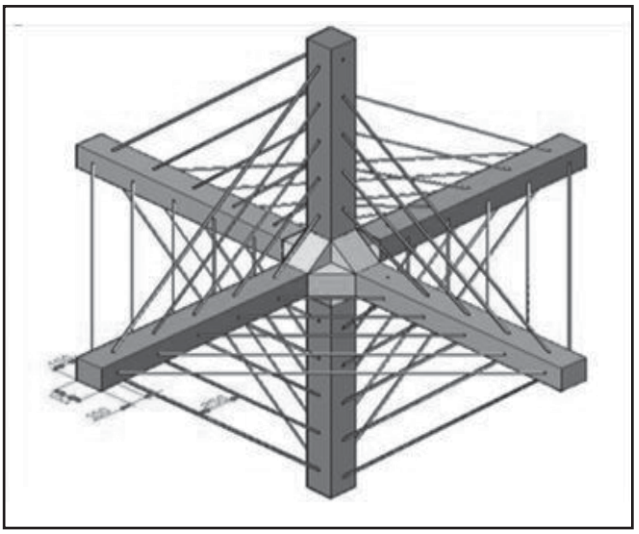

Fig. 1. RCC Jack Jetty

Fig. 2. Trapping of small trees and debris in Solani River, Uttarakhand, India by RCC Jack- Jetty

5. SUMMARY

A jack jetty field that has been properly laid out, traps sediment and debris during flood events and essentially builds up its own levee to confine the river channel. Steel jack jetties have been used in the past, however with the increase in steel prices in developing Asian countries, use of steel increases the structures cost. Therefore Reinforced Cement Concrete (RCC) might be used as an alternate to construct the jacks. These permeable structures may be utilized in creating friendly environment for aquatic habitats rather than conventional structures. These jetties, if used in combination with impermeable dikes, create the overall system more sustainable and cost-effective. More detailed and comprehensive studies are required to promote and utilize these structures efficiently.

CONSTRUCTION OF SUSTAINABLE ROAD INFRASTRUCTURE USING MUNICIPAL SOLID WASTE

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1.0 INTRODUCTION

Rapid growth of population, industrialization and urbanization during the last few decades has resulted in generation of huge quantities of Municipal Solid Wastes (MSW) in different cities of the country. Delhi alone generates about 7000 tons/day of MSW while the country generates about 1,00,000 MT/day. About 70 % of MSW is collected and dumped in an open space and the rest is processed/treated. Ghazipur landfill is one of the biggest landfills in Delhi and was started in the year 1984. At present, an average 2500 tons/day of MSW is being dumped there and this has created a height of about 60 m. It spreads over an area of approximately $3x10^5$ m^2 near National Highway-24 close to Hindon canal. The landfill MSW is a very heterogeneous material which includes: construction & demolition waste (C&D), groceries, food scraps, vegetable remains, packing materials, paper, remains of used coal, ash, wood, metals, plastics, ceramics, cloth, glass, etc. Further, waste from the adjacent poultry market, fish market, slaughter house, dairy farm and non-infectious hospital waste have also become part of the MSW landfill dump.

Large scale road infrastructural development is being carried out in the country which is resulting in depleting local soil and aggregates. Municipal solid waste landfills which have their presence all over the country are considered to be a potential source of sustainable road construction material especially for bulk utilisation in the construction of embankment. The municipal solid waste can be segregated/processed before using it as an embankment material. Very limited literature is available worldwide regarding the utilisation of such segregated MSW in the construction of embankment. This article summarizes the technical know-how about the methodology of segregation, results of geotechnical characteristics of segregated MSW after study at CSIR-CRRI, New Delhi.

2.0 METHODOLOGY OF SEGREGATION

Municipal Solid Waste has large size plastics, clothes and even boulder size C&D waste. These undesirable materials from MSW need to be segregated/separated by adopting a suitable methodology before using them in embankment construction. The segregated material can then be easily compacted in the field by conventional method and equipment. Municipal Solid

Waste was collected from Ghazipur landfill, East Delhi. This was collected from the three pre-identified locations according to its age, based on the height of the dump. The biodegradability of MSW depends on the time of dumping and it would affect its physical, chemical and geotechnical properties. Hence, approximately 70 tons of garbage was collected from each of these three locations of different ages (a) 5 years old (b) 10 years old and (c) 15 years old.

Segregation

The collected MSW was first air and sun dried at Okhla plant, New Delhi. The sample was then segregated on different sizes of trommels/sieves viz. 80mm, 35mm, 16mm and 4mm. About 65-79% of material passes through 80 mm sieve with substantial amounts of soil, plastics, paper & cloths etc. About 44-48% of MSW passes through a 16mm sieve with a minimum amount of plastics, clothes etc. There is no significant variation in the passing factions of each trommel size for different aged MSW samples (5-15 years old). This indicates the uniform nature of different aged samples after segregation.

3.0 GEOTECHNICAL CHARACTERISTICS

MSW is a coarse grained material with about 70% of its particles retained on 75 micron IS sieve. It is non-plastic in nature. Liquid limit ranged between 32-34% indicating its medium plasticity characteristics. It is classified as GM, i.e. silty gravel which indicates its suitability for embankment construction. Free swelling index value was obtained in the range of 12-24% which indicates low swelling potential. The compaction curves are found to be flat indicating that dry density does not vary much with the variation in moisture content. The MDD and OMC varied in the range of 16 – 16.7 kN/m^3 and 14 to 17% respectively. The strength parameters were obtained as i.e. cohesion = 10- 25 kPa and angle of internal friction = 28-35°. 14. The value of compressibility index varied in the range 0.14 to 0.19 which indicates that MSW material is a low to medium compressible soil. Permeability varies in the range 2.13 x 10^{-7} to 1.21 x 10^{-6} cm/s. The low value of the permeability is observed due to presence of plastics, rubber etc. in the MSW mix which obstructed the flow of water. So, it is required to provide an intermediate soil layer of low plasticity especially in high embankments for proper drainage of MSW embankment.

4.0 DESIGN OF MUNICIPAL SOLID WASTE EMBANKMENT

Embankment should be designed as a composite structure with MSW in the core and a cover of good earth on either side. It is proposed to provide 2 m thick soil cover of local non plastic nature, to prevent the possible erosion of MSW due to heterogeneity and to protect the local inhabitants from bad odour. Intermediate soil layers of 200 mm each compacted thickness should be provided for MSW embankment more than 3m height. Apart from practical feasibility this would provide good drainage in the embankment. A 500 mm thick local soil

should be used on top of the MSW embankment, which will not only act as a top cover but will also form the subgrade for pavement construction. Factor of safety with seismic conditions varied in the range 1.64 to 1.79 which is more than the minimum value of 1.25 required as per IRC-75 specifications. Total settlement estimated theoretically for 5m MSW embankment is 304 mm which is below 600 mm considered for road embankment as per IRC 75-2014. The total settlement shall be uniform and shall occur slowly over a period of time.

5.0 ENVIRONMENTAL ASPECTS

pH value is in the range of 7.4 to 7.6, indicates that MSW sample is slightly acidic in nature. The organic content varied in the range 10-12% by loss on ignition. Leachate test indicated that the concentration of heavy metals is within the permissible limit as per ministry of environment forest and climate change (2016). It is classified as a non hazardous material for construction of embankment.

6.0 CONCLUSIONS

About 65-75% of segregated Municipal Solid wastes can be used for the embankment construction. Other than soil, plastics and textiles are major constituents in MSW while metals, wood, paper, rubber, glass are less than 1%.

Strengthening of Highly Compressible Soil by using Glass Fiber

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Abstract

Now a days, sustainable development has become a necessity for civil engineers. The waste materials from the

industry are needed to be utilized for the given purpose. The glass fiber is such a waste produced from the weaving process which can be used to strengthen the soil. In current scenario, due to limited availability of land area for construction, a severe demand for construction of high rise building is raised causing tremendous pressure on soil beneath foundation. The shear strength and settlement behaviour are the most considerable property related to foundation soil of buildings. Foundation of the super structure is needed to be having their strength more than applied stresses and also the settlement within limits as per IS-code specifications. In highly compressible soils, the settlement used to reach up to the undesirable extent affecting the limit state of serviceability condition of the superstructure/building. In order to achieve such properties in highly compressible clay, the fiber-soil mixture is prepared with varying proportions of the fiber mix. Glass fiber of 12 mm size is used in this soil-fiber mixture in order to calculate, analyse and observe strength behaviour along with limiting the settlement of the soil. In this study, four fiber percentages (0%, 0.5%, 1.0% and 1.5%) are used to observe the experimental behaviour of the soil and results are anlysed to conclude most efficient and economical soil- fiber mix proportion. As in the first step, fiber content increases from 0% to 0.5%, the shear strength of mixture increases and consolidation settlement reduces gradually. After reaching certain fiber content as about 1.5%, no specific change in consolidation settlement behaviour of soil is observed. With an increase in fiber content, the density of the mixture increases causing the small increment in the dry density of the soil subsequently reducing its optimum moisture content. Specific gravity of the soil also increases with increase in the fiber content, causing similar changes in bulk density of the soil.

Keywords: Glass Fiber, Reinforcement, Strengthening, Highly Compressible Soil, Shear Strength.

1. Introduction

Soil is basically made up of four basic types which can be categories as gravel, sand, clay, and silt. Usually, the soil has low strength parameters and its characteristics might be affected by the available environmental conditions of the chosen site. On the other hand, reinforcement of a material in another material can be defined as "it consists of incorporating certain materials with some desired properties within other material which lack those properties" (Jones M., 1999). Hence the weakness of soil in shear and tensile stresses can be overcome by application of some reinforcing material in it. Therefore, soil reinforcement is defined as a technique to improve the engineering characteristics of soil in order to develop the parameters such as shear strength, compressibility, density and hydraulic conductivity (Kazemian et al., 2010). Reinforcement of soil can consist of stone columns, root piles or micro-piles, soil nailing and reinforced earth. Mainly, reinforced earth is a composite material consisting of alternating layers of compacted backfill and man-made reinforcing material. In general, the primary purpose of layers of compacted backfill and man-made reinforcing material. In general, the primary purpose of reinforcing soil mass is to improve its stability, to increase its bearing capacity, and to reduce settlements and lateral deformations as well.

The use and Applicability of synthetic materials like geotextiles, geogrids, geocomposites, geonets, geocells and randomly distributed fibers (Natural, man-made and mineral fibers) have evoked considerable interest among geotechnical engineers and manufacturers for using these materials as reinforcing element to improve the bearing capacity and strength behaviour of weak or expansive soils. Out of all these, fiber-reinforced foundation soil has many advantages, which comprise of low cost, lighter weight and strength uniformity in soil mass. One of the main advantages of using randomly distributed fibers is the maintenance of strength isotropy and the absence of potential planes of weakness that can develop parallel to the oriented reinforcement (Gray and Maher 1989). Its application in construction is also not significantly affected by weather conditions. Apart from all these, the fiber material can also be used in conjugation with conventional materials (like cement, lime and bitumen) and polymeric resins such as Polyvinyl alcohol, Polyvinyl acetate, Polyvinyl Acrylic, Urea formaldehyde and poly vinyl meta acrylate (PMMA).

The main objective of this study is to investigate the suitability and benefits of glass fiber-reinforced cohesive soil as a material beneath foundation of structure through laboratory consolidation test and Unconsolidated-Untrained triaxial test. The effects of fiber content on shear parameters and settlement were studied. An optimum soil-fiber mix which will give the maximum strength as a foundation material is to be determined.

2. Literature Review

In any type of soil, reduced settlement and better shear strength are basic characteristic requirement for construction work. For high rise buildings, improvement in these characteristics of soil is needed which could be achieved by various methods as addition of salt solution, sand, fiber etc. Among all of these, fiber is one of the best materials.

Keeping this in view, a detailed literature available on soil reinforcement by natural and artificial fibers has been screened out and summerised below:

2.1. Classification

McGrown et al., (1978) classified soil reinforcement into two major categories including ideally inextensibleversus ideally extensible inclusions. They tested on Leighton Buzzard sand with and without inclusion of aluminium foil, aluminium mesh and a non-woven melt bonded hetrofilament fabric. The researcher explained high modulus metal strips that strengthens soil and inhibits both internal and boundary deformations. However, catastrophic failure occurs where reinforced material was cracked. It was noticed that extensible inclusion gives relatively low modulus natural and/or synthetic fibers, such as plant roots; and geo-synthetics which provide some strengthening. Beside this, composite gives greater extensibility (ductility) and smaller loss of post-peak strength compared to the neat soil.

2.2. Natural Fiber

Babu and Vasudevan (2008) studied to investigate the effect of coir fiber (1%, 1.5%, 2% and 2.5%) on black cotton soil. Tri-axial shear test, swelling, and consolidation test were done to quantify the improvement of strength, swelling and compressibility characteristic of black cotton soil reinforced with coir fibers in a random manner. Test result showed that deviator stress increases as confining pressure and diameter of fiber increases. Cohesion and internal angle of friction were to be increased as fiber content increases. Expansive soil was reinforced with different fiber content (f = 0.25% and 0.5%) and aspect ratio (l/b= 15, 30, and 45). One-dimensional swell-consolidation test was performed for his investigation. It was reported that swelling pressure and heave reduced significantly at low aspect ratio at both the fiber contents of 0.25% and 0.5%.

Jamellodin et al. (2010) found that a significant improvement in the failure deviator stress and shear strength parameters (c and φ) of the soft soil reinforced with palm fibers can be achieved. The maximum dry density of reinforced soil ranges from 1.42 to 1.31 g/cm3. The OMC range of reinforced soil is between 29.1 and 26.8%. It is observed that the fibers act to interlock particles and group of particles in a unitary coherent matrix thus the strength properties of the soil can be increase.

Maliakal and Thiyyakkandi (2013) investigated to understand the influence of randomly distributed coir fibers on the shear strength of a silty soil of high plasticity. It observed that inclusion of coir fibers significantly alters the stress-strain characteristics of clay. Furthermore, no peak was noticed at higher fiber contents (1 and 2%),until the conventional serviceability failure state of 20% strain, whereas unreinforced clay attains peak deviator stress at an axial strain of about 10–15%.

2.3. Artificial fiber

Setty and Murthy (1987) examined to study the effect of PP fiber on black cotton soil. Test result showed that cohesion intercept increased with fiber inclusion and slightly decreased with frictional angle.

Puppala and Musenda (2000) examined to investigate the influence of discrete and randomly oriented polypropylene fiber on expansive soil. Two types and four fiber dosage (0, 0.3, 0.6, and 0.9 percentage by dry weight of soil) had used to stabilize the expansive soil. Result showed that UCS was increased by addition of fiber and decreased both volumetric shrinkage strains and swell pressure of the expansive clays. The fiber treatment also enhanced the free swell potential of the soil. It was reported that shear strength was attributed to the tensile strength of fibers in the soil-fiber mix.

Santoni and Webster (2001) concluded from the experiments on field test sections in which a sandy soil was stabilized with PP fibers, that the technique showed great potential for military airfield and road applications and that a 203 mm thick sand fiber layer was sufficient to support substantial amounts of military truck traffic. Field experiments also indicated that it was necessary to fix the surface using emulsion binder to prevent fiber pullout under traffic.

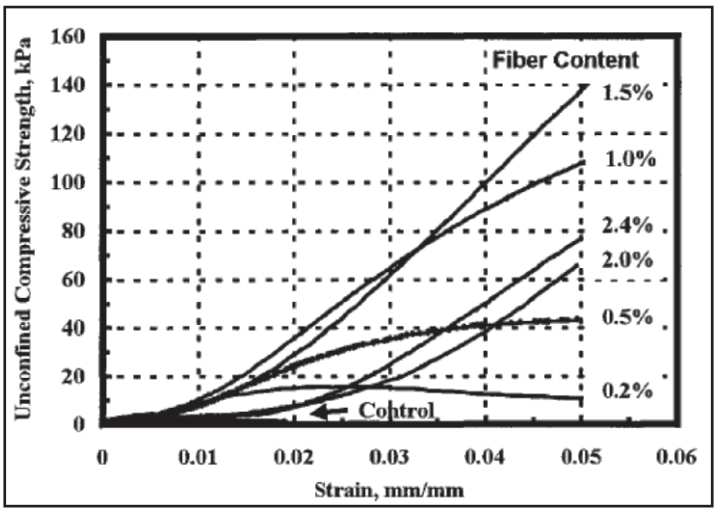


***Figure 1**. Relationship between Percent of Fiber and Permanent Deformation (Santoni and Webster, 2001).*

Millar and Rifai (2004) studied the impact of fiber reinforcement on the development of desiccation crack in compacted clay samples, as well as the impact of the fiber additives on soil workability, compaction characteristics and hydraulic conductivity. Four dosage of Polypropylene fiber (0.2, 1.0, 1.5, and 2%) was used to this present investigation. It was reported that the optimum fiber content necessary to achieve maximum crack reduction and maximum dry density, while maintain acceptable hydraulic conductivity, is between 0.4 and 0.5%. For this range of fiber content, the crack reduction observed approximately 50%, as compared to the unamended soil sample. The maximum crack reduction was observed approximately 90%, for a content of 0.8%. Hydraulic conductivity was increased significantly for fiber content exceeding 1%.

Casagranda et al. (2006) evaluated at large shear displacements by a series of ring shear test to study the effect of polypropylene fiber on bentonite clay. Normal stress was being varied between 20 and 400 kPa. Bentonite /polypropylene fiber composite were mixed with fiber length of 12 or 24 mm. Thickness of the fiber was 0.023mm and fiber content was either 1.5 or 3% by dry weight. Bentonite/fiber composites show peak strengths that are significantly higher than the nonreinforced specimen's at all confining pressure but the effect, was not as large as, has been observed in some other soil (using the same type of fiber, amount of fiber, and fiber thickness).It happens due to higher void ratio (4.9) or lower amount of fiber per unit volume. Perhaps, the most important observations were that lower shearing resistance between the fiber surface and the surrounding soil. However, It has also observed that post peak strain softening was greater than nonreinforced specimens at allconfining pressure. 25% improvement was observed for bentonite by inclusion of fiber at the same normal stress.

Abdi et al. (2008) examined the impact of random fiber (1, 2, 4, & 8% fiber as dry weight of soil with 5, 10 and 15 mm length) inclusion on consolidation settlement, swelling, hydraulic conductivity, shrinkage limit and the development of desiccation crack in compacted clays. It was observed that consolidation settlement and swelling of fiber reinforced samples reduced significantly whereas hydraulic conductivity increased slightly by increasing fiber content and length. Furthermore, shrinkage limit also increased with increasing fiber content and length. Indeed, consolidation settlement was more when fiber length increased from 5 to 10 mm. Hydraulic conductivity increased for fiber contents exceeding 1%. It can be happened that if fiber were longer, they would have provided longer paths for water to drain quicker, thus increasing the hydraulic conductivity of the samples. Random fiber inclusion improved the soil tensile strength very effectively and it gives greater contact surface area. As a result, fiber resists shrinkage on desiccation.

Akhras et al. (2008) investigated to study the effect of fiber (natural and synthetic) on the swelling properties of clayey soils. Nylon and Palmyra fibers (1, 2, 3, 4 and 5% with different

aspect ratio 25, 50, 75, and 100) used to evaluate the swelling pressure and swelling potential of three types of expansive soil for each combination. Minimum swelling potential was noticed for all soil when clayey soil was mixed with 5% fibers (Nylon and Palmyra).It was reported that swelling pressure decreased from 21% for the control clayey soil to an average of 5.25% and 4.62% for clayey soil mixed with nylon and Palmyra fibers respectively. Maximum swelling pressure was observed to be 410, 310, and 190 kPa for clay soil-1, soil-2 and soil-3. However, the minimum swelling pressures were noticed to be 120 and 82.5 kPa, 120 and 97.5 kPa, and 78 and 74 kPa, for soil-1, soil-2 and soil-3 containing nylon and Palmyra fibers, respectively. It was reported that decreasing reduction in the swelling pressure with increasing aspect ratio of the fibers was believed to be result of a greater amount of fibers available when fibers with low aspect ratio are used. Therefore the probability of fibers to cross potential failure plain was much higher for mixture with low aspect ratio fiber content. It was observed that the impact of the inclusion of fibers in clayey soils increased with increasing clay fraction of the clayey soil.

Moayed and Izadi (2011) described treatment of saline soil in Iran with lime resin-epoxy polymer and polypropylene fiber. Fiber dosage (0.1%, 0.2%, 0.3% and 0.4% by dry weight) had been used to reinforce the saline soil. It was reported that maximum dry density decreased and optimum moisture content increased (Cai et al., 2006) with inclusion of fiber. It was observed that 0.2% fiber dosage was the most optimum rather than other dosage. Compression index of soil with adding 0.1, 0.2, 0.3 and 0.4% of polypropylene fiber has been increased 1.23, 1.06, 1.19, and 1.24 time with respect to non-stabilize state respectively.

Sabat (2012) investigated to study the effect of randomly distributed polypropylene fibers, rice husk and lime on expansive soil. UCS increased from 60 kPa to 72 kPa at 10% addition of rice husk ash. Strength increased due to contribution of frictional resistance from RH (rice husk) along with cohesion from expansive soil and strength decreased because reduction of cohesion component. Maximum value of UCS was observed to be 174 kPa when percentage of RH and lime were 10% and 4%. It happened due to pozzolanic reaction of lime with the amorphous silica and alumina present in rice husk ash and soil. MDD of rice husk ash-lime stabilized expansive soil goes on decreasing. It was found to be observed as13.3 kN/m^3 for 2% fiber inclusion.

Mukherjee and Mishra (2014) investigated on the influence of glass fiber and geo-synthetic clay liner (GCL) on different sand bentonite mixture. It was noticed that swelling increased with inclusion of one layer GCL and significantly deceased with glass fiber. Test result shows that hydraulic conductivity was to be reduced significantly with interaction of GCL but slightly increased with addition of glass fiber. It has been also observed that compression index and swelling pressure has been reduced with addition of glass fiber. Unconfined compression strength was found to be decreased with addition of one layer geo-synthetic clay liner but UCS

was to be increased with inclusion of glass fiber.

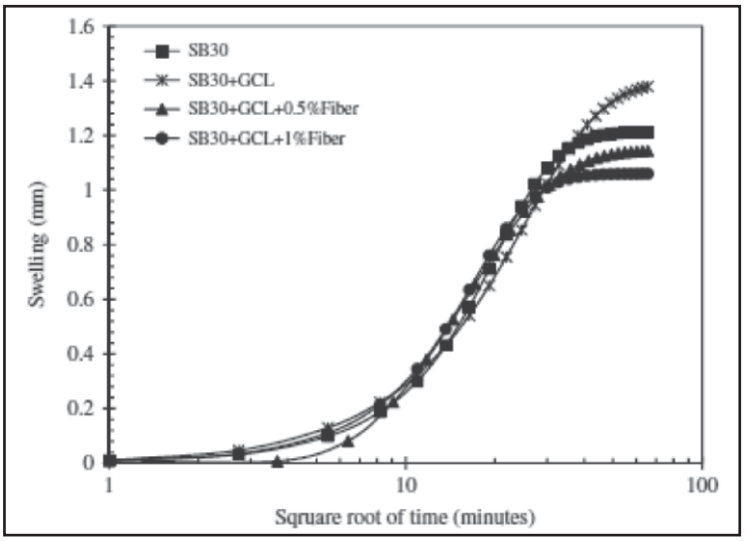


Figure 2. Swelling-time plot for mixture (Mukharji and Mishra, 2014)

Patel and Singh (2016) did an experimental study to investigate the application suitability of randomly distributed glass fiber-reinforced cohesive soil as subgrade material. Glass fiber of 20 mm length with varying fiber contents (fc = 0.25, 0.5, 0.75 and 1% by dry weight of soil) was used as reinforcement. The effects of fiber content variation on compaction parameters of soil, and the effect of fiber content and soaking time variation on CBR strength were investigated. The soaking time was varied from 4 to 40 days. The CBR and secant modulus were calculated at different penetration depths ranging from 2.54 to 12.7 mm. Test results have shown that the glass fiber content has insignificant effect on the OMC and MDD of the soil. The CBR strength is found to increase with penetration depth up to 7.62 mm penetration and thereafter remains almost constant at all fiber contents. The CBR strength and secant modulus of soil have improved significantly with fiber content up to an optimum fiber content value of 0.75%, and decrease with increase in soaking time at any fiber content. The maximum improvement in CBR strength is found out as 2.48, 2 and 1.5 times for 4, 20 and 40 days soaking for 0.75% fiber inclusion. It has been found that the glass fiber-reinforced soil can be extensively used as subgrade material.

3. Selection of Fiber Material

a) Maher and Ho (1994) studied the behavior of kaolinite–fiber (PP and glass fibers) composites, and found that the increase in the UCS was more pronounced in the glass fiber-reinforced specimens.

b) Consoli et al. (2004) examined the effect of PP (Polypropylene), PET (polyester) and glass fibers on the mechanical behavior of fiber-reinforced cemented soils. Their results showed

that the inclusion of PP fiber significantly improved the brittle behavior of cemented soils, whereas the deviator stresses at failure slightly decreased. Unlike the case of PP fiber, the inclusion of PET and glass fibers slightly increased the deviator stresses at failure and slightly reduced the brittleness.

c) Glass fibers have advantages such as easy availability, low cost, light weight, capability of maintaining strength isotropy within soil mass.

d) Nowadays, fiberglass threads termed "roving" can be used. Experimental studies have indicated that embedded roving increases soil cohesion between 100 and 300 kN/m2.

e) Use of glass fiber as reinforcing material reduces the frequency of future rehabilitation costs

4. Result and discussion

Table 2. Properties of clay

Soil Properties	Experimental Value
Liquid limit	50.52
Plastic Limit	21
Plasticity Index	29.52
Specific Gravity	2.7
%sand	3.72
% Silt	78.97
% Clay	17.31
Soil Classification	CH
OMC (%)	18.50
MDD, γ_d (g/cc)	1.769

In this study, glass fiber, A kind of artificial fiber is used to analyse and improve physical, mechanical and strength characteristics of the soil. A cohesive soil having 3.72% sand, 78.97% silt and 17.31% clay size particles with 51% and 41.45% as its plastic and liquid limits was used in this study. The soil is classified as high plastic clay (CH). The optimum moisture content (OMC) and maximum dry density (MDD) of the soil are 18.5% and 17.6 kN/m^3. Commercially available glass fiber of 12 mm length and different fiber content (fc = 0, 0.5, 1 and 1.5 % by dry weight of soil) was used as reinforcing material. The average diameter and specific gravity of fiber is 0.14 mm and 2.57, respectively. Soil and fibers as per their designated weights were manually mixed in different stages with appropriate amount of water in a steel tray. Fibers were segregated carefully during mixing as they tended to formlumps by sticking together with increasing fiber content. As the laboratory test results highly depend on the sample preparation method, proper care was taken at every step while preparing reinforced specimen. The uniform soil fiber mix was prepared prior to compaction of test specimens. Consolidation and triaxial tests were performed at various fiber inclusions.

4.1. Basic properties of soil

A cohesive soil having 3.72% sand, 78.97% silt and 17.31% clay size particles with 51% and

41.45% as its plastic and liquid limits was used in this study. The soil is classified as high plastic clay (CH). The optimum moisture content (OMC) and maximum dry density (MDD) of the soil are 18.5% and 17.6 kN/m^{3}respectively. The particle size of the soil sample is determined by the combination of wet sieving and hydrometer analysis. After that, the soil specimen is tested for consistency limits (eg. Liquid limit and plastic limit). The plasticity index is found to be 29.52 with liquid limit value of 50.52. The soil is classified as CH and further Heavy Compaction test is performed and relationship is plotted in Figure 6. The optimum moisture content (OMC) and maximum dry density (MDD) of the soil are determined 18.5% and 17.6 kN/m^3 respectively. The numerous properties of clay tested and determined in Geotechnical engineering lab of CED in MNNIT Allahabad, are enlisted in attached table given below.

4.2. Basic properties of Fiber Glass

The lack of strength in shear and tension in soil is fulfilled by addition of the glass fibers. The fiber has 57% glass content by weight embedded in it. The fiber embedded increases friction and cause cohesion increment in soil. Various properties of the glass fiber is enlisted below

Table 3. Properties of Glass Fiber

Sr. No.	Property		Value
1	Specific Gravity		2.67
2	Elastic Modulus (GPa)	a) Tensile	20.2
		b) Compression	16.9
		c) Flexural	17.1
3	Strength (MPa)	a) Tensile	384
		b) Compression	201
		c) Flexural	481
4	Dimension	a) Diameter(μm)	21
5		b) Length (mm)	12

4.3. Specific gravity

The fiber inclusion has very marginal effect on specific gravity as it hardly varies from 2.7 even after mixing of the glass fiber with 1.5% into it (by weight). The reason behind could be analysed as the difference between the specific gravity of the soil (Gs=2.7) and glass fiber (Gs=2.67) is just a case of points. The maximum negative deviation in specific gravity value is observed as 0.37% in case of 1.5% glass fiber mixture.

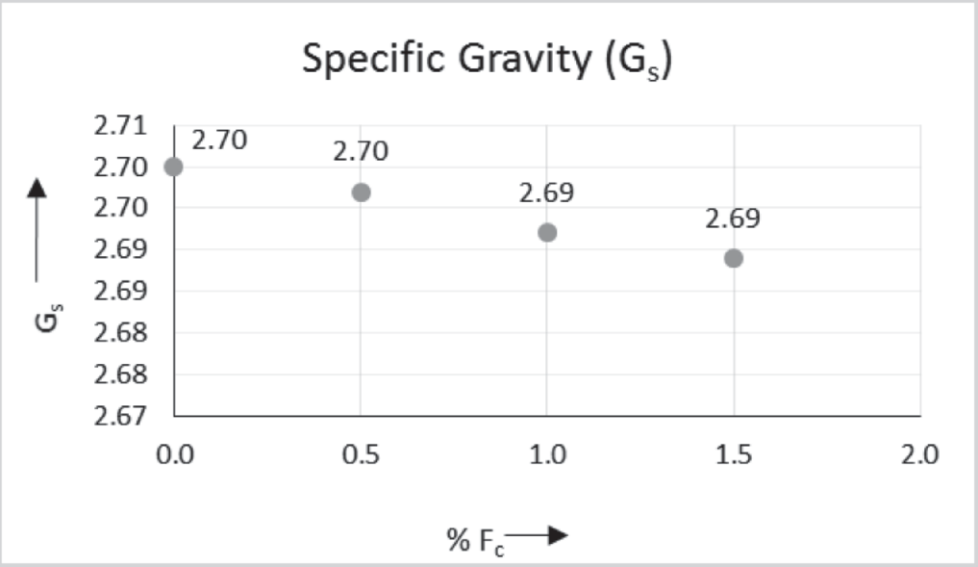


Figure 3. Variation of specific gravity at various fiber contents.

4.4. Dry density and optimum moisture content

The soil has been obtained from 2m depth and tested in lab by heavy compaction test. After first test on pure soil, maximum dry density and optimum moisture content has been observed to be 1.769 g/cc and 18.5 % respectively. To increase the MDD value and study the effect of glass fiber inclusion on soil properties, further soil-glass fiber mix is tested and graph is plotted between maximum dry density and optimum moisture content at 0.5%, 1.0% and 1.5% glass fiber inclusions respectively.

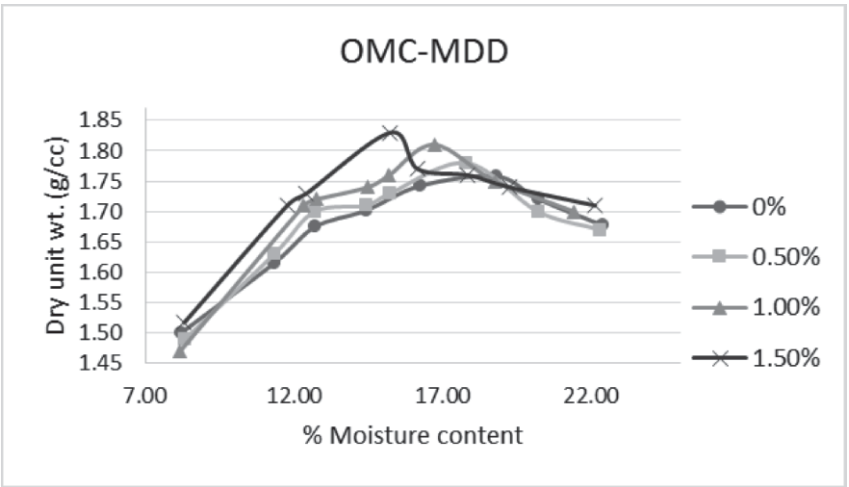


Figure 7. Relation between OMC and MDD at different fiber content.

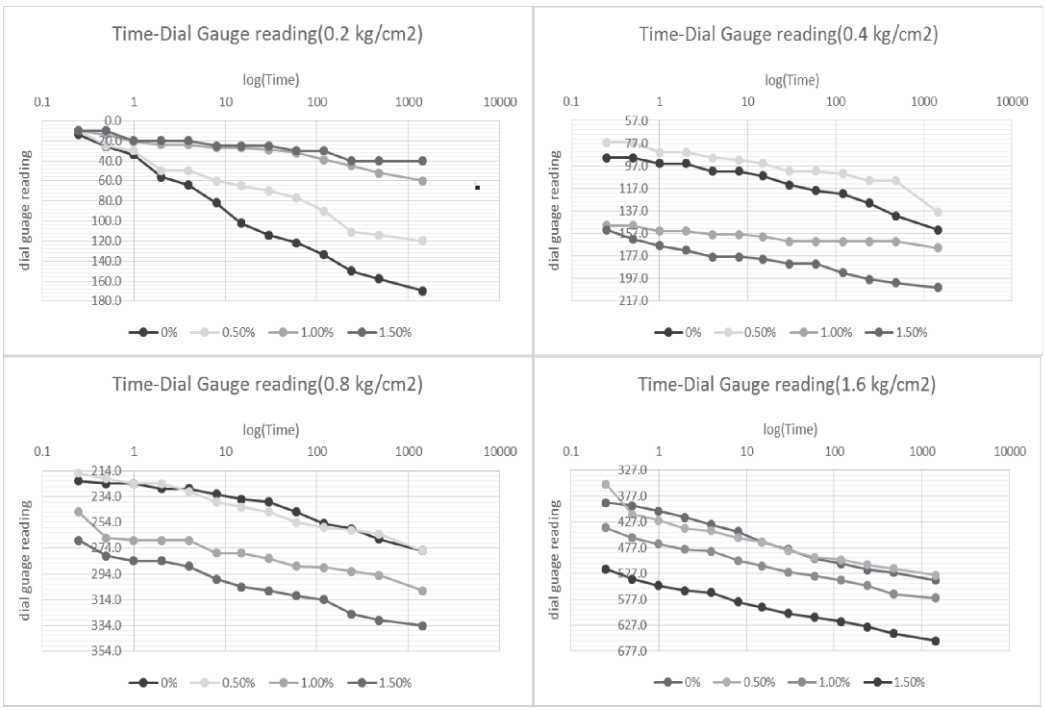
The above relationship shows that the OMC reduces as well as MDD increases with increase in fiber content in the mixture. This thing happens due to the increase in bonding and frictional drag between fiber and soil particles. The graph shows that OMC is reduced to 15.25% from 18.50% as maximum dry density (MDD) increases to 1.83 g/cc from 1.769 g/cc after 1.5% fiber inclusion.

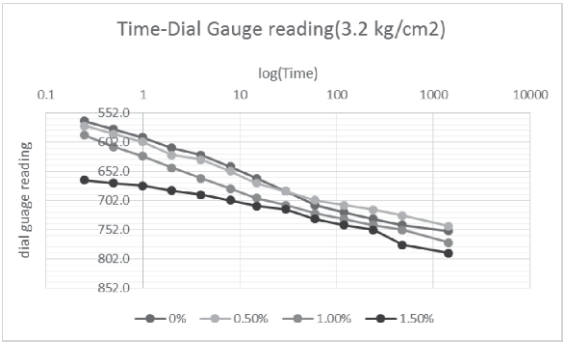
4.5. Consolidation behavior

To study the settlement behavior of the soil, consolidation test is performed. Consolidation of soil means the settlement of the saturated soil on some specific loading for some considerable duration of time. The reduction of bulk soil volume under loading due to flow of pore water. For saturated soils, any increment of loading (Δσ, called surcharge) will be initially taken up by the pore pressure and result in consolidation until a new equilibrium is reached where the soil solids (or skeleton) takes up the added load.

$$\text{Surcharge: } \Delta\sigma = \Delta\sigma' + \Delta u$$

The specimen is prepared with various fiber contents varying from 0% to 1.5% mixed in soil. The soil fiber composite is used to prepare the mold and placed under dial gauge check for consolidation. The initial loading applied till saturation and then experiment proceeds.





The deformation of specimen (settlement of sample) is found to be reduced significantly by fiber inclusion. The semi-log graph plotted between time and Dial gauge reading is attached shortly. It is found that settlement reduced significantly at *0.5% fiber content* in soil fiber composite.

5. Conclusion

The experimental work done has found that material property is found to be improved by inclusion of fiber. Settlement of foundation soil has to be controlled in fiber soil matrix by inclusion of fiber reinforcement in it. Cohesion value increased but internal friction angle increased up certain limit after that value is approximately constant. The maximum dry density increases with fiber inclusion up to 3.977% along with decreasing optimum moisture content of the soil. The tests show slight reduction in specific gravity of soil fiber composite (around 0.37%) as the specific gravity of the glass fiber (2.67) is just slightly less than that of highly compressible soil (2.70). For the consolidation settlement analysis, graphs are plotted and the desirable settlement reduction is found in composite at a fiber content of around 0.5%. This is found to be optimum on the basis of economy and requirement.

6. Future scope

The result of this study is helpful in construction on CH soil, but for other soil fiber combinations and fields further research is needed. The scope for future research is enlisted below

1) Effect of sand type (only one sand type was studied in this work).

2) Effect of fiber length on construction and performance.

3) Other types of fibers (such as fibrillated fibers and recycled materials).

4) Surfacing stabilizers other than tree resin.

5) Traffic performance at reduced fiber contents.

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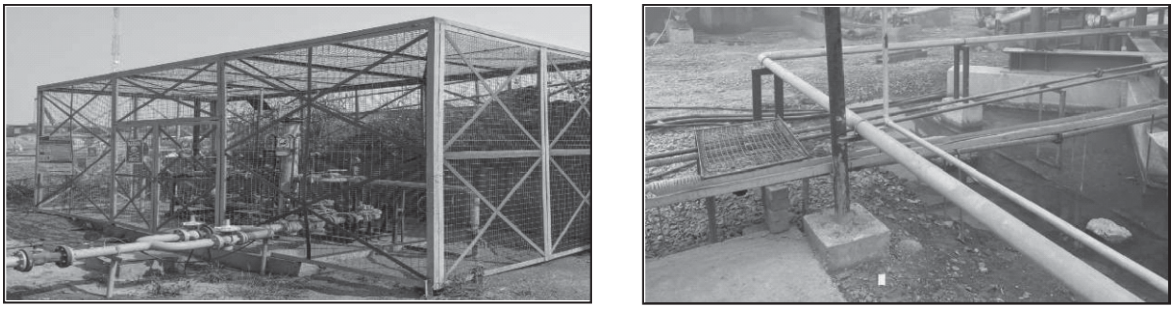

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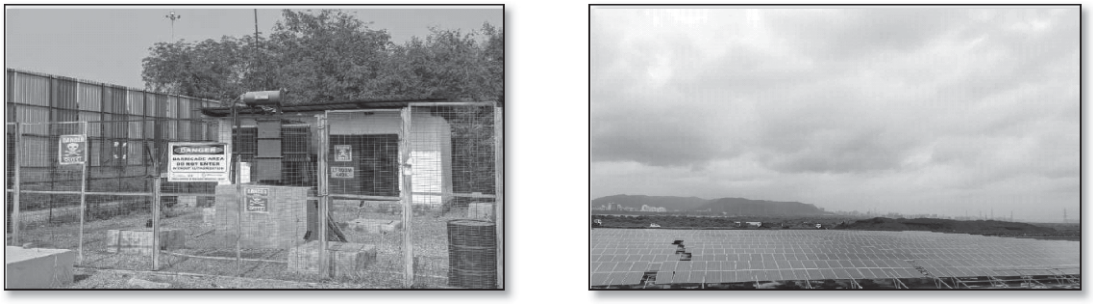

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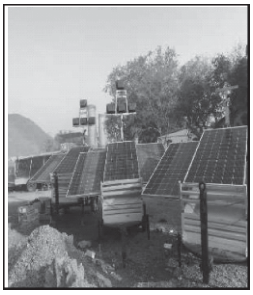

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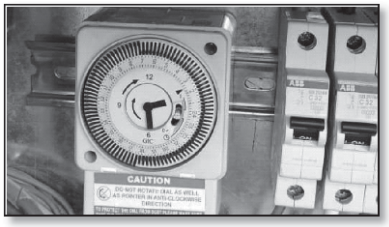

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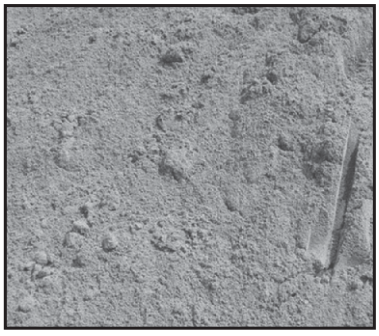


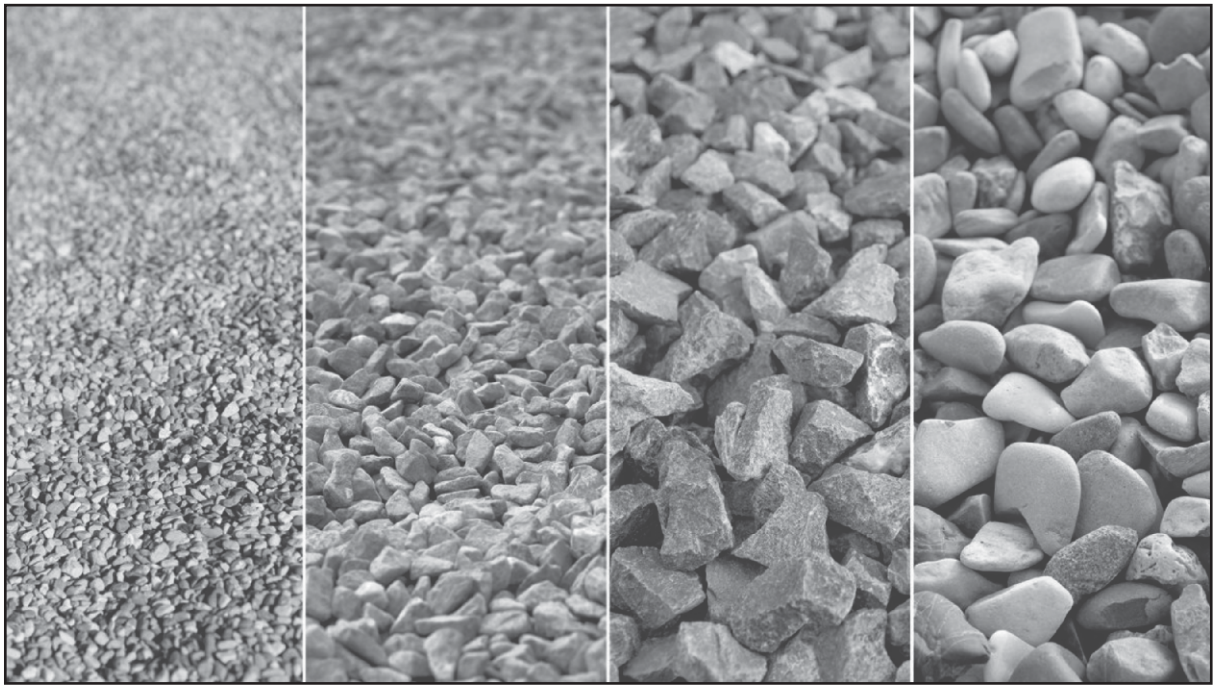

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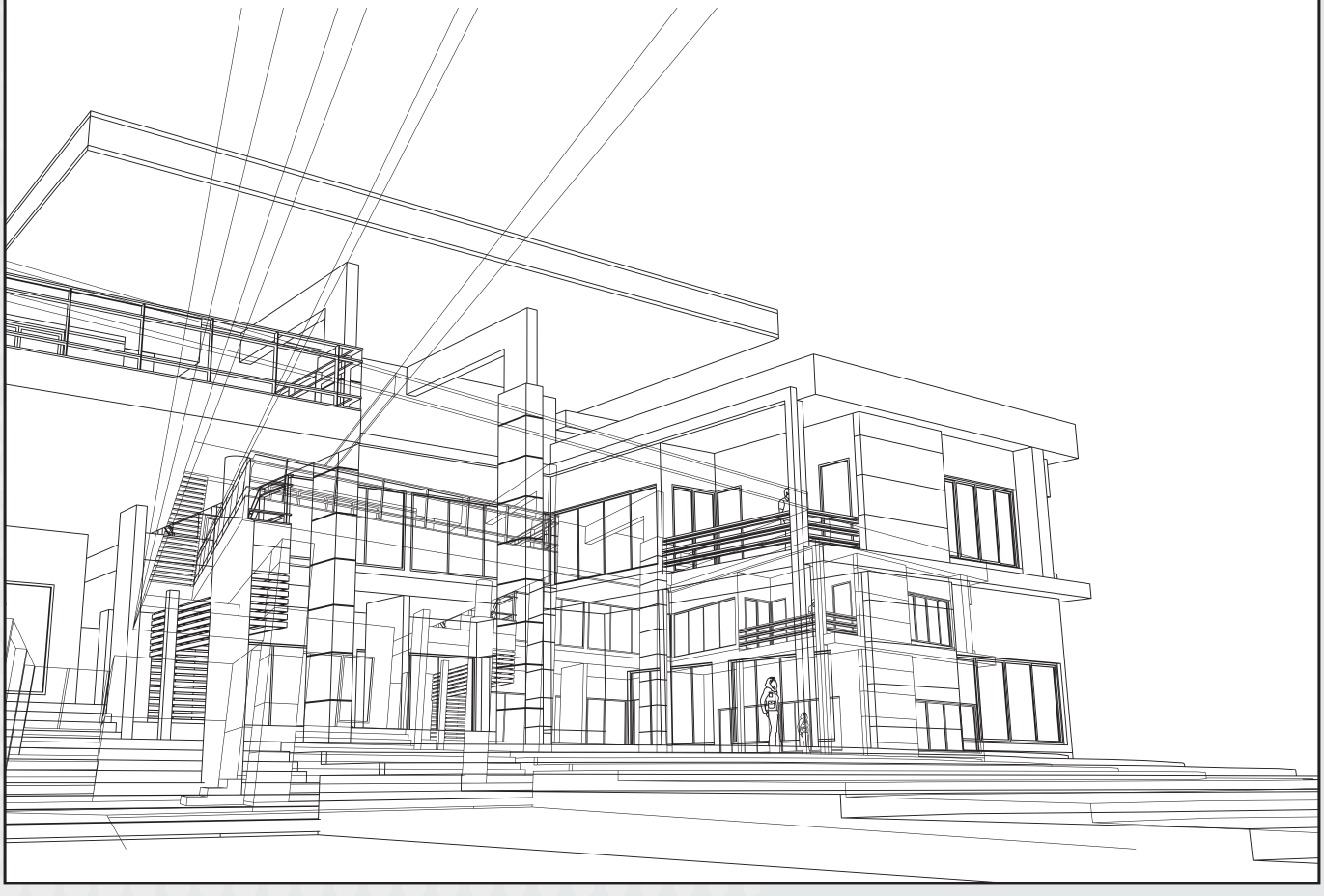

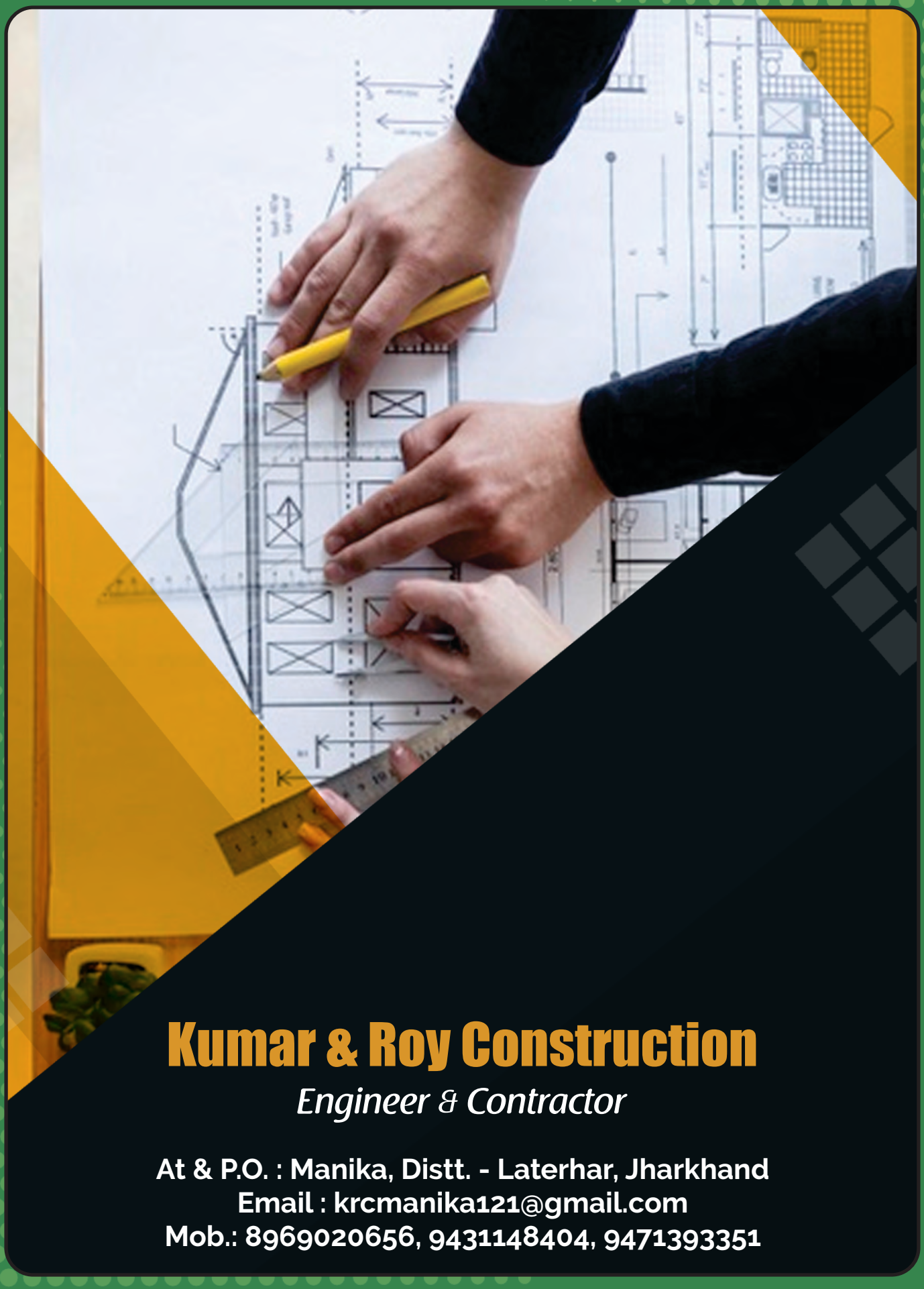

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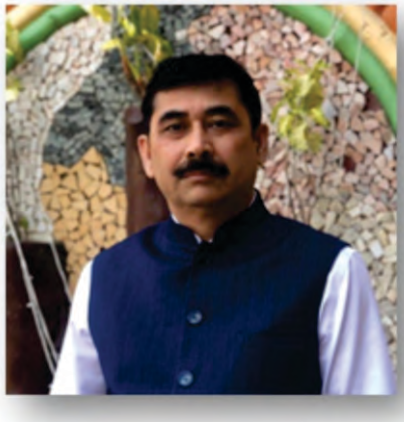

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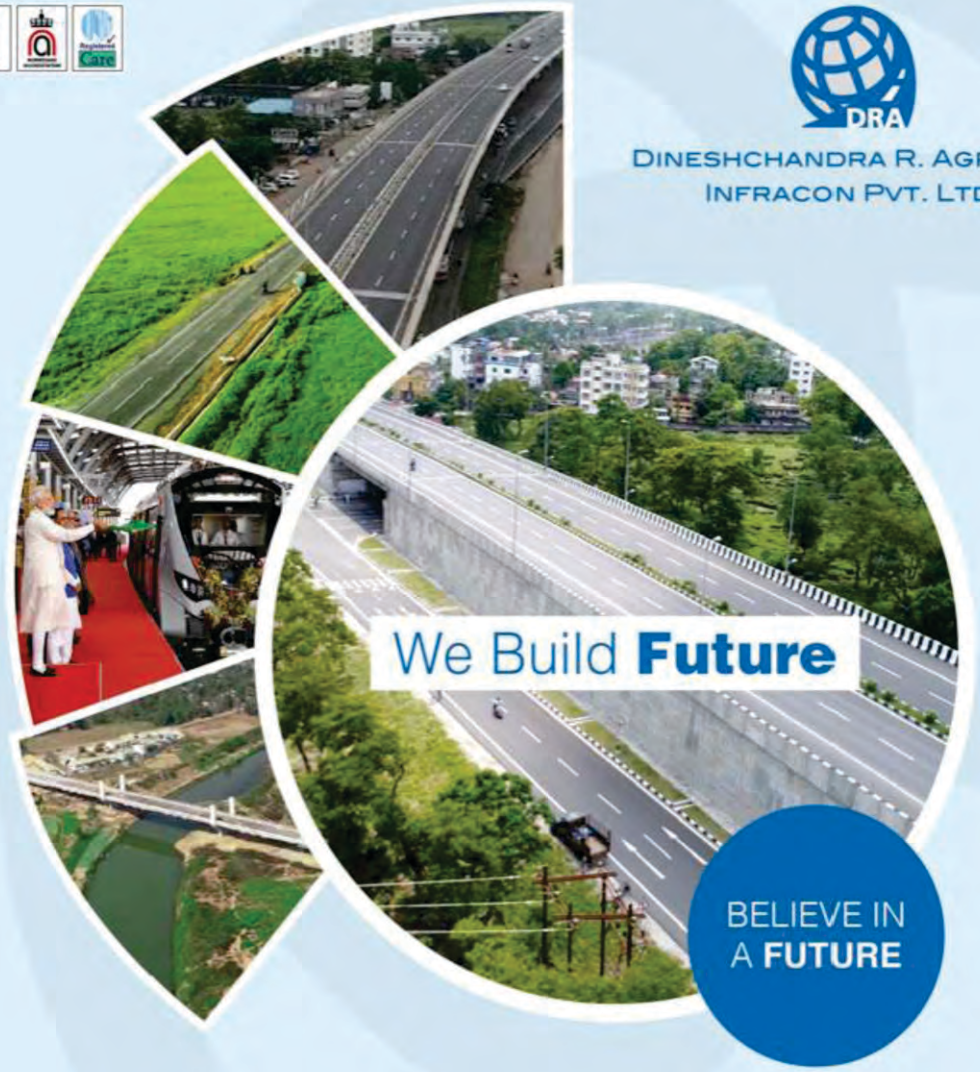

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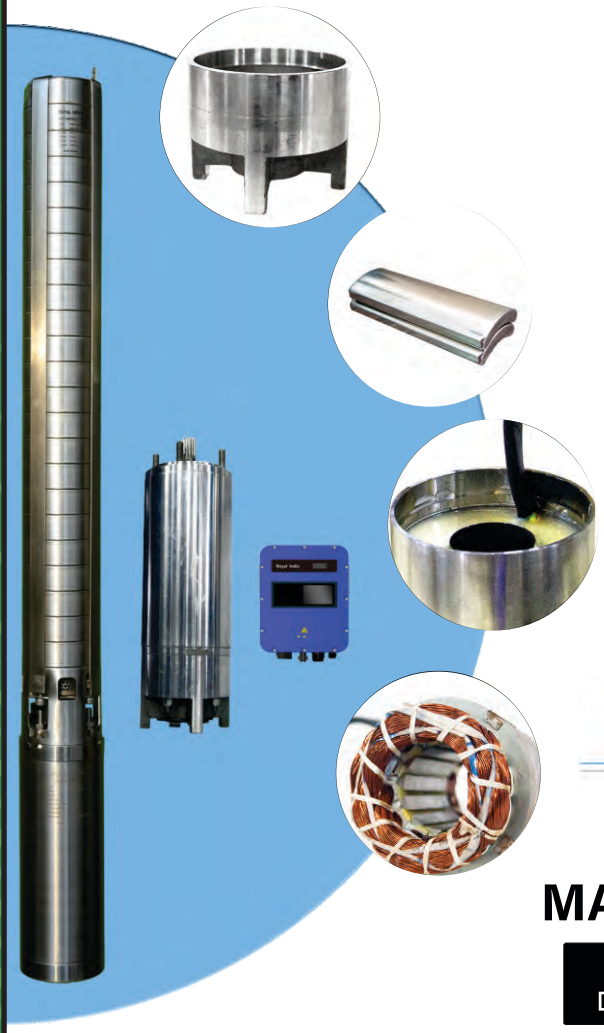

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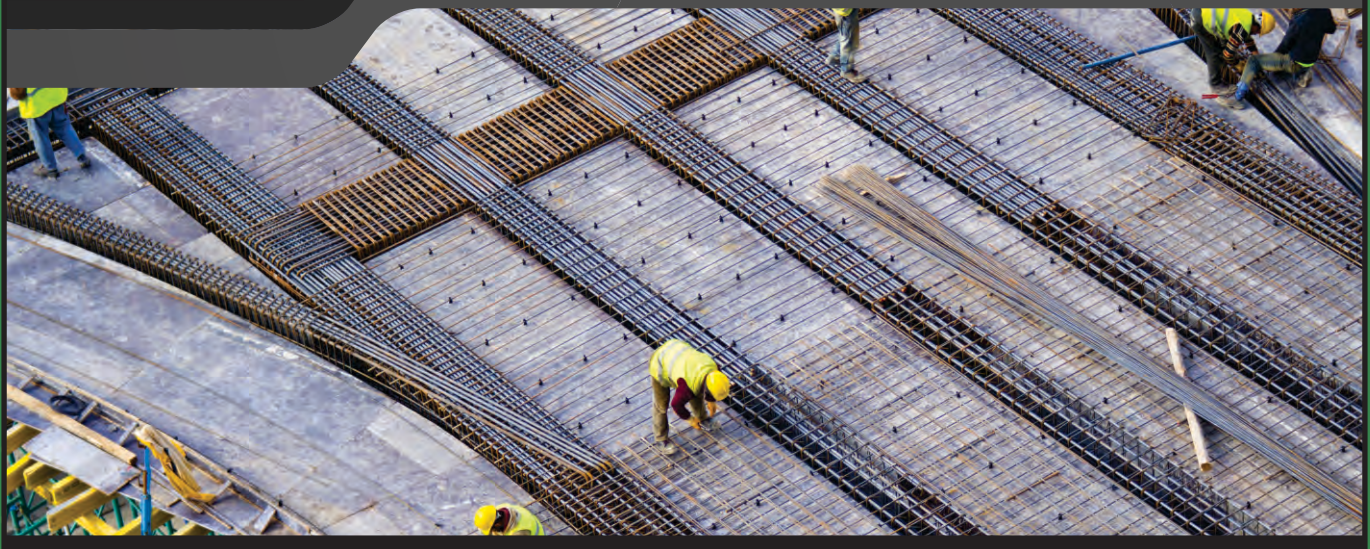

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