IEI Epitome

March 2020, Volume 5, Number 3

A CENTURY OF SERVICE TO THE NATION

Contents

Members in the News

Dr Wooday P Krishna, FIE

Council Member & Chairman, Research and Development Committee, IEI

Dr Wooday P Krishna was conferred with the Distinguished Alumnus Award by Trustee of Ramakrishna Math & Mission, Swami Muktidananda on behalf of Sri Ramakrishna Vidyashala Old Boys' Association, Mysuru, on 19th January 2020 in recognition of his lifetime achievement in the fields of education and social service.

Mr Avinash Shirode, FIE

Ex-ISRO Engineer, NSS-Space Ambassador, Director - National Space Society

Elected on the most prestigious Board of Directors of a USA based International Organization, National Space Society, established in the year 1974, comprising members from all over the world. He is the First Indian to get elected in the National Space Society.

Prof D K Chaturvedi, FIE

Professor, Department of Electrical Engineering, Dayalbagh Educational Institute, (Deemed University), Dayalbagh, Agra

Granted Patent from Government of India for an invention titled 'Continious Gas Fired Annealing Surface'.

Mr Sandip Kumar Deb, FIE

Council Member & Chairman, West Bengal State Centre, IEI

Mr Sandip Kumar Deb, Vice President, Institution of Valuers & Registered Valuer Member (IOVRVF) has been selected as a member of IVSC Tangibile Assets Board (TAB). Mr Sandip Kumar Deb is the first Indian to be inducted in the IVSC Tangible Assets Board.

Mr Narayan Acharya, FIE

Sr.Manager (Excavation), Mahanadi Coalfields Limited (Coal India Limited), Burla, Sambalpur, Odisha

Awarded Doctor of Philosophy in Mechanical Engineering from Veer Surendra sai University of Technology, Burla, Odissa on the topic 'Some Studies on Performance and Emission Characteristics of Diesel Enginer using Bio-Diesel as Alternative Fuel'.

Dr Abhishek Kanoungo, AMIE

Assistant Professor, Department of Civil Engineering, Chitkara University, Himachal Pradesh, India

Awarded Doctor of Philosophy from Chitkara University, Himachal Pradesh on the topic "Characteristics of Asphalt Modified with Industrial Waste Sludge Containing Calcium Carbonate" under the guidance of Prof (Dr) Varinder S Kanwar, Vice Chancellor, Chitkara University, Himachal Pradesh and Prof (Dr) Sanjay K Shukla, Program Leader of Civil Engineering at Edith Cowan University, Australia on 13th July, 2019.

Members in the News

Dr Bangali Baboo, FIE
Former National Director, NAIP, ICAR

Received Outstanding Alumnus Award of University from Alumni Almamater Advancement Association (4A), GB Pant University of Agriculture and Technology (GBPUAT), Pantnagar towards the dedication for exemplary contribution in nation building and bringing many laurels to the University. The Award was conferred by the Vice-Chancellor of the University on Nov. 17, 2019 on the occasion of Golden Jubilee year of his batch and Foundation Day of the university.

Mrs Sasmita Acharya, MIE
Assistant Professor, Department of Computer Application, VSSUT, Burla, Odisha

Awarded Doctor of Philosophy in Computer Science and Engineering from Veer Surendra Sai University of Technology, Burla, Odisha, on the topic 'Studies on Fault Tolerance in Wireless Sensor Network'.

Mr Ankit Shukla, AMIE
Senior Component Design Engineer at QuEST Global, Bangalore

Awarded Employee of the Quarter, Strong Contender by the organisation. The Award was presented by Niketh Sundar, Senior Vice President - Human Resources, QUEST Global.

The Institution of Engineers (India)
Appeal

Dear fellow Engineers,

As we are all aware the ' lockdown' has been further extended till 3 May 2020. I request you all to follow the Government guidelines and specially the 7 points mentioned in the Hon'ble Prime Minister's address to the Nation. Through our collective efforts, we will definitely overcome the COVID -19 pandemic.

I take this opportunity to request all engineers to contribute generously in this noble cause by donating to PM-CARES FUND directly, with an intimation to IEI at director_finance@ieindia.org

Prevention is better than cure. Please take care & stay at home.

I look forward to your encouraging response.

14th April, 2020

Er. Narendra Singh, FIE
President, IE(I)

Publication
by Members

Mr Jayaraman Anandha Kumar MIE
Lecturer Department of Textile Processing, GRG Polytechnic College, Kuppepalayam, S.S.Kulam, Coimbatore, Tamil Nadu

E-mail: anna_781@rediffmail.com

Title of Paper: "Implementation of Lean Concept to Improve Productivity in an Apparel Industry Case Study", *International Journal of Scientific Research in Engineering and Management, 4 (1), 2020, ISSN - 2582-3930, pp 01-05.*

http://ijsrem.com/current-issues

Abstract: Garment Industries face many global challenges due to various factors including competition, higher production costs, less productivity and labor attrition. In the Current scenario, Lean Concept has a very wide scope in the garment industry for productivity improvement. The methods to improve the production in garment industries are planning layouts, monitoring production flow system, deciding the machines and attachments for all styles, pay system, monitoring and improving the operators' performance, operator training, production control system and quality control. Higher productivity brings higher margin in a business. And increment in Productivity level reduces garment manufacturing cost. Hence factory can make more profit through productivity improvement. In this article the ways of productivity improvement are discussed that will certainly help factories to boost up current labor productivity. All the means that had been explained here can be implemented as because most of these are within your reach. Machine productivity as well as labor productivity increases when a factory produces more pieces by the existing resources like Manpower, time and machinery. When we look into the processes and operations during factory visit, we find improvement potential is there in every area. Initially, you may not be able to find and measure potential areas but you can improve productivity. Most of the tips mentioned in this article are mainly on time-saving tips, discipline, and proper planning. To get an excellent result you may need external recommendation and support but without the external help, you can surely get measurable improvement by implementing Lean concepts. This Research work is aimed to improve productivity in the garment industry by implementing lean concept.

Keywords: Garment industry; Productivity; Lean concept; Fabric inspection

Mr Raj Kumar Saini, MIE
Associate Professor, Shoolini University, Solan

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Title of Paper: "A New Design for Low Rating Three Phase Squirrel Cage Induction Motor with Improved Performance Operating Under Rated Voltage-A Design Consideration for Rural Areas". *i-manager's Journal on Electrical Engineering, 13(2), 2019, pp 11-17.*

https://doi.org/10.26634/jee.13.2.16219.

Co-authors : Devender Kumar Saini, Rajeev Gupta, Piush Verma

Abstract: This research article deals with modified and ideal plan parameters of 1HP three phase squirrel cage induction motor working under rated voltages. The simulated results are calculated with the assistance of JMAG Express (an electrical machine design software) under rated voltage. Based on the simulated results of stator and rotor design of 1 HP three phase squirrel cage induction motor is casted in the industry. The experimental results of a new 1 HP motor are compared with experimental results of standard motor of the same rating which was designed at rated voltage. The after effects of new planned motor was better when compared with old one. These types of low rating induction motors can be used in the villages for agribusiness and domestic purposes to show signs of improvement effectiveness.

Keywords: Induction motor; Under rated voltage; Torque; Efficiency

Publication by Members

Dr Abhishek Kanoungo, AMIE
Assistant Professor, Department of Civil Engineering, Chitkara University, Himachal Pradesh, India

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Title of Paper: "Effect of Aging on Characteristics of Bitumen Modified with Waste Lime Sludge,"*Advances in Civil Engineering Materials, ASTM International, 8(1), 2019, pp 298-307.*

DOI: https://doi.org/10.1520/ACEM20180166

Co-authors: Varinder S Kanwar, Sanjay K Shukla

Abstract: The design of pavement must be carried out to make it capable of evenly transferring the wheel load to the subgrade soil without exceeding its bearing capacity. However, failure occurs before the design life because of structural defects shown by pavements, such as low skid resistance, fatigue, and rutting. Because low-temperature cracking is more predominant in cold-temperature regions, this aspect of failure is considered within the future scope of study. To address this concern, waste lime sludge was added to improve the properties of bitumen in the present research work. In order to examine the effect of aging, the rolling thin-film oven test was conducted to replicate the short-term aging process, and pressure aging vessel test was used to resemble long-term aging. The viscosity test, softening point test, and penetration test were carried out to assess the physical properties, whereas the dynamic shear rheometer test was conducted to investigate the rheological properties of aged and unaged bitumen binders. It is observed that sludge acts as an aging inhibitor. The complex modulus was enhanced as a result of addition of sludge up to 20 %, which also lowered the values of phase angle, depicting high resistance to permanent deformation. The rutting and fatigue resistances of the binder improved, and soft grade bitumen was converted to hard grade bitumen.

Keywords: Modified bitumen, Waste sludge, Rolling thin-film oven test, Pressure aging vessel test, Dynamic shear rheometer test

Mr Sajan K Jose, FIE
Associate Professor & Head, Department of Civil Engineering, LBS College of Engineering Kasaragod, Kerala

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Title of Paper: "Experiments on Foamed Concrete for the Development of Building Blocks", *International Journal of Recent Technology and Engineering (IJRTE) 8 (5) 2020, pp 2824 -2829.*

DOI:10.35940/ijrte.C6250.018520

Co-authors - Mini Soman, Sheela Evangeline Y

Abstract: Foamed concrete is an innovative and versatile lightweight building material, which is a cement-based mortar consisting of at least 20% of its volume filled with air. Use of lightweight foamed concrete blocks with densities less than 1800 kg/m^3 as infills will lead to the design of slender sections. Further, the thermal insulation properties of foamed concrete blocks made it more popular in the construction industry. This paper discusses the development of foamed concrete building blocks for load bearing and non-load bearing structures. To make the mix more sustainable, the feasibility of fly ash as a partial replacement for cement is also explored. The variables considered for the production of foamed concrete are foam volume, water/powder (mix of cement and fly ash) ratio, fly ash content and sand/powder ratio. Analytical model is also developed for compressive strength and dry density of foamed concrete considering different variables and it is validated. Compressive strength is found to be increasing with the increase in dry density and with an increase in fly ash content. Thermal conductivity is observed to be reduced by the addition of fly ash content.

Keywords: Foamed concrete; Fly ash; Compressive strength; Sustainability; Thermal conductivity

Publication
by Members

Mr Ebin P M, AMIE
Assistant Professor, Department of Computer Science and Engineering, IES College of Engineering, Chittilappilly, Thrissur

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Title of Paper: "Knowledge Assimilation of Machines using Various Approaches", *International Journal of Innovative Technology and Exploring Engineering, ISSN: 2278-3075, 8 (6), 2019, pp 257-260.*

DOI : ijitee.org/wp-content/uploads/papers/v8i6/F3484048619.pdf

Co-authors : Kavitha Nair R, Pradeeba V

Abstract: Machine learning (ML), Artificial Intelligence (AI) and Data science are some of the top trending topics today. Machine learning can be seen as a branch of Artificial Intelligence and using machine learning; programs can scan and process huge databases. One of the core objectives of machine learning is to construct algorithms that can learn from the previous data and make predictions on new input data also called an automated learning. Knowledge assimilation of machines can be done through supervised learning, unsupervised learning, semi supervised learning and reinforcement learning. In this article, we present two most widely used supervised learning algorithms for knowledge assimilation. The machines learn things from data, usually known as training data, and apply the knowledge to different circumstances and this learning is a continuous process.

Keywords : Decision tree; Machine learning; Supervised learning; Support vector machine

Mr Ajmal Muhammed, AMIE
Dept. of Civil Engineering, K S R College of Engineering, Tiruchengode, Tamil Nadu

E-mail: erajmalmuhammed@gmail.com

Title of Paper: "Experimental Investigation on FACA and FACACRETE – An Innovative Building Material", *KSCE Journal of Civil Engineering , 23(11), 2019, pp 4758-4770.*

https://link.springer.com/article/10.1007/s12205-019-0046-x

Co-author: Palanisamy Thangaraju

Abstract: Recently, many studies are put forward by researchers to utilize waste materials like fly ash, GGBS, etc. in the construction industry due to the problems arise in the disposal of these materials. A novel study on incorporating the FACA (fly ash artificial coarse aggregate) in concrete is illustrated in this paper by comparing fly ash artificial coarse aggregate concrete (FACACRETE) with normal concrete. Different mixtures of geo-polymers were prepared using different molarities of NaOH solution and varying alkaline solution to fly ash ratio. These mixtures were cast to form a hard mass and cured. It is then pulverized in to fly ash artificial coarse aggregates (FACA). The properties of FACA were determined and are compared with conventional coarse aggregates. From the experiment, it is found that the FACA is a lightweight aggregate. It can be used for wearing as well as non - wearing surfaces as per IS: 383 - 2016. It is found that 8MA1 (8 Molar NaOH solution and 0.4 is the alkaline solution to fly ash ratio) is economical and can be used for further research as NaOH needed is less. This mix (8MA1) of FACA is used to prepare fly ash artificial coarse aggregate concrete (FACACRETE). The mechanical properties of both normal concrete and FACACRETE are compared and the results suggest that the compressive, splitting tensile, flexural strengths and the stress - strain relationship of FACACRETE is comparable with conventional concrete of same grade as per IS 456. The compressive toughness and compressive index of the FACACRETE is found to be more than the conventional concrete. The failure pattern of FACACRETE is associated with multiple cracking and that of normal concrete is localized failure. On considering the experimental investigations conducted here, it is found that the FACA can be used to replace conventional coarse aggregate in concrete.

Keyword: Geo-polymer, fly ash, FACA, FACACRETE, alkaline solution

Publication by Members

Dr K S Raghuram, MIE

Associate Professor, Department of Mechanical Engineering, Vignan's Institute of Information Technology, Visakhapatnam

E-mail: k_sraghuram@yahoo.co.in

Title of Paper: "Analysis of Inverse Kinematics of Redundant Robots. In: Deepak B., Parhi D., Jena P. (eds) Innovative Product Design and Intelligent Manufacturing Systems". *Lecture Notes in Mechanical Engineering. Springer, Singapore, 2020, pp 943 - 950.*

DOI https://doi.org/10.1007/978-981-15-2696-1_91

Co-authors: Bhavani G., Harish Kumar K. Bendu H.S.

Abstract: The objective of the present work is to finalize a numerical solution that operates on the inverse kinematic mechanism of redundant robots leading to a robust method. After considering the consequences of all numerical ways of solving the inverse kinematics problem with their limitations and difficulties, it aimed to receive the best one of them and find a final effective solution. Now, the results obtained till now are implemented to the task space trajectory planning and redundancy resolution.

Keywords : Keywords Inverse kinematic mechanism; Redundant robots; Limitations; Difficulties

Mr Avinash Vitthal Borgaonkar, MIE

Research Scholar, Department of Mechanical Engineering, National Institute of Technology, Warangal

E-mail: avi.borgaonkar@gmail.com

Title of Paper: "Effect of Coatings on Rolling Contact Fatigue and Tribological Parameters of Rolling/sliding Contacts Under Dry/Lubricated Conditions: A Review", *Sadhana-Indian Academy of Sciences,45(30), 2020 pp. 1-16.*

DOI: https://doi.org/10.1007/s12046-020-1266-y

Co-author: I Sayed

Abstract: The application of coating gets exceptional importance since it improves the tribological properties of the contacting surfaces. Different input parameters like coating deposition processes, coating material properties and its thickness, use of lubricant and its additives, surface roughness and temperature affect the tribological properties and the rolling contact fatigue (RCF) life of coated rolling and sliding contact elements. In this paper, an attempt has been made to review for the clear understanding of the effect of these input parameters on the RCF life and tribological performance of coated rolling and sliding contact elements. It has been observed that coating deposition process must be chosen based on technical and economic aspects. Among the different techniques, thermal spraying technique is cost effective, and it also provides better bonding strength, which improves the RCF life in comparison with other techniques. Similarly, the effect of other input parameters has been reviewed and possible combination of the input parameters that help improve the performance of coated contacting elements summarized. Furthermore, the current status of research and the scope of future work to be carried out, in this area, have been outlined.

Keywords: Rolling contact fatigue life; Coating; Friction; Wear; Thermal spraying

Title of Paper: Effect of Coating Material Properties on the Lubrication Performance of Rolling Contacts under TEHL Regime", *Australian Journal of Mechanical Engineering, 2020, pp. 1-9.*

DOI: https://doi.org/10.1080/14484846.2019.1710018

Co-author: I Sayed

Abstract : The mechanical and thermo-physical properties of a coating material affect the lubrication nperformance. The present study aims at to investigate the effect of mechanical and thermo-physical properties of coating material on the lubrication performance of rolling contact operating under Thermal Elasto-Hydrodynamic Lubrication (TEHL) regime. The mechanical and thermo-physical properties of the coating material considered in the present analysis are elastic modulus, density, thermal conductivity and specific heat. Furthermore, the effect of coating thickness is also studied. The Commercial Multiphysics software ANSYS is used in the present analysis to model and analysis of the finite line contact obtained in the rolling contact. It is observed that the pressure intensity increases with the elasticity of the coating. The maximum fluid pressure developed at the contact region 1.2GPa with the application of material possessing higher modulus of elasticity i.e. 420 GPa. With increase in coating thickness the contacts width reduces. The material having lower density, thermal conductivity and heat capacity exhibits as an insulating material which obstructs the transfer of heat from the fluid to the contacting surfaces. This leads to increase the temperature of the lubricant. With these properties the maximum developed temperature observed to be 351K.

Keywords: Coating material; Finite element model; Fluid–solid interaction

Publication
by Members

Mr Swapnil Sunil Karekar, AMIE
P G Student, Department of Civil Engineering, MGM's College of Engineering & Technology, Navi Mumbai

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Title of Paper: "Comparative Study of Plate Girder & Pratt Truss for Footbridge", *International Journal of Management, Technology and Engineering (IJMTE), ISSN: 2249-7455, 9(5), 2019, pp 1864-1881.*

DOI:16.10089.IJMTE.2019.V9I5.19.28238

Co-author: P J Salunke

Abstract: The objective of this paper is to select an appropriate type of footbridge structural system between plate girder and Pratt truss for a suitable spans. STAAD.Pro software will be used to analyze and design the footbridge. Footbridges needs to withstand dead loads, live loads, seismic loads and wind loads. For evaluating seismic loads static method is used with IS 1893. Since the work is being carried out, expected results from work after complete analysis and design of plate girder and Pratt truss will be in the form of comparison between base shear, wind shear, horizontal and vertical displacements for zone III & V.

Keywords: Footbridges; Plate girder; Pratt truss; Seismic Co-efficient method; Static analysis; Displacement; Optimum design

Dr Jignesh G Vaghasia, FIE
Associate Professor & Head, Mechanical Engineering Department, Shree Swami Atmanand Saraswati Institute of Technology, Surat

E-mail: vaghash3478@yahoo.com

Title of Paper: "Experimental Performance Investigations on Various Orientations of Evacuated Double Absorber Tube for Solar Parabolic trough concentrator.

Journal: INTERNATIONAL JOURNAL OF AMBIENT ENERGY, Taylor & Francis, Published online: 22 Aug 2019

https://doi.org/10.1080/01430750.2019.1653980

Co-authors : Jayesh K Ratnadhariya, Hitesh Panchal, Kishor Kumar Sadasivuni, Deepalekshmi Ponnamma, Medhat Elkelawy, Hagar Alm-Edin Bastawissi

Abstract: The parabolic trough concentrator is a widely used concentrator to harness and concentrate on the solar energy. The performance of the parabolic trough concentrator depends upon its various parameters like reflecting surface, mass flow rate, concentration ratio, heat transfer fluid, rim angle, tracking of system, evacuation of absorber, and absorber tube. An absorber tube or receiver is the most important parameter that has an effect on the enhancement of heat transfer which was further specified by its material, surface coating, length, diameter, type of flow through it, number of absorber tube, various orientations of double tube, internal flow obstructions like twisted tape, different shape insertion in it etc. Different researchers had worked on different modifications of the absorber tube to increase the effective heat transfer. In this present experimental work, an investigation of the evacuated double tube absorber with its various orientations carried out for the designed and developed prototype of PTC.

Keywords : Orientations of absorber tube; Solar parabolic trough concentrator, Heat transfer enhancement by modified absorber; Evacuated double tube absorber

Publication
by Members

Dr Sukhbir Singh, AMIE
Research Fellow, Department of Electronics & Communication Engineering, Sant Longowal Institute of Engineering & Technology,Sangrur, Punjab

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Title of Paper: "Design of Optical Wavelength Conversion Based on Cross Polarization Modulation Effect of SOA-MZI", *Optical and Quantum Electronics, 52(122), 2020.*

https://doi.org/10.1007/s11082-020-2238-5

Co author - Surinder Singh

Abstract: In this paper, the all optical up and down wavelength converter based on cross polarization modulation (XPolM) effect in semiconductor optical amplifier Mach–ZehnderInterferometer (SOA-MZI) has been proposed and evaluated for error free operation toshow the feasibility of 40 Gbps differential phase shift keying modulated data signal. Thewavelength conversion is achieved by rotational state of polarization of pump and probesignal in SOA. Also, investigation of wavelength converter is theoretically and analyticallyvalidated for optimum performance and investigation results show good agreement witheach other. The impact of variable signal power along with different parameter of SOAon performance of converted wavelength signal in terms of optical received power andQ-factor has been given. The investigations revealed that wavelength converter based onXPolM effect in SOA-MZI can be the promising option to enhance the expandability andaccessibility of future hybrid optical access networks.

Keyword: All optical wavelength conversion; Cross polarization modulation; SOA-MZI; Q-factor; Converted optical power

Mr Asim Kumar Nath, MIE
AGM (DRI Plant), Jindal Steel & Power Ltd

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Title of Paper: "Best Practices of Lubrication Management', Steel and Metallurgy". *A Complete Steel Magazine. 22 (01), 2019, pp 50-54.*

http://www.steelmetallurgy.com/interface/eMagazine.php?ID=wtoy

Abstract: A lubrication management program can be defined as the sum of all the activities performed in a given facility to help ensure the right lubricant is provided in the right quantity to the right point at the right time with the right method. If you want to improve the performance and service life of your lubricants, take a look at your selection, uses and storage procedures. These three processes are most significant impact on the success of your lubrication program. There are tons of products can be seen in the market. There have been ever increasing trend to market more and more customized products suiting a specific customer requirements in industries like steel, cement, automotive, chemical, oil & gas etc. On the other hand, the knowledge of end use customer is limited and decision about what type of grease to be used, how much and on what frequencies. They are mainly governed by supplier's recommendation which sometime may be biased and possibly misleading. This article is focused around the concept of what one should know about best practices of lubricating system so that end use customer could be smart enough to select right product, use right quantity and right frequency.

Keywords: Lubrication Quantity, Over Greasing, Correction Factor, Lubrication Frequency

Publication
by Members

Ms Chaitanya Mayee M, MIE
Faculty, Department of Mechanical Engineering, Sanketika Vidya Parishad Engineeering College, Visakhapatnam

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Title of Paper: "Economic Design of X Charts with Multiple Assignable Causes using Genetic Algorithm", *AIP Conference Proceedings 2200, 020086, 2019.*

https://aip.scitation.org/doi/abs/10.1063/1.5141256

Co-Authors: P N E Naveen, VijayaBabūVommi

Abstract: The Economic Design of X control charts involves the determination of the optimum values of the three control chart parameters: The sample size n, the control limit coefficient k and the sampling interval h. Earlier Duncan and other developers has pioneered different models and approximate methods for the economic design of X control charts. This paper deals with the economic design of X control charts for multiple assignable causes. Genetic Algorithm (GA) is applied to optimize the loss cost function and for obtaining the optimal solutions of these parameters n, k & h for such charts. The results of all numerical examples show that the proposed optimization procedure is better than the earlier mentioned models.

Keywords: Genetic algorithm; X control charts; Duncan method; Loss function

Title of Paper: "Use of Six Sigma in Productivity Improvement and Cycle Time Reduction in Piping Installation during Vessel Construction", *AIP Conference Proceedings 2200, 020081, 2019.*

https://doi.org/10.1063/1.5141251

Co-Authors: P N E Naveen, Indrajeet Kumar Thakur

Abstract : Six Sigma (6σ) is a set of techniques and tools for process improvement. It seeks to improve the quality of the output from a process by identifying and removing the causes of defects and minimizing variability in manufacturing or the process. Some have found the Six Sigma methodology an excellent way to improve their processes as it uses statistical tools to measure processes in terms of defects and variation, transforming them into opportunities for business growth. The project would aim to examine the established piping installation process of a vessel construction, analyse the relevant data to reduce the variability and reduce the cycle time by reducing the rework. It would aim to focus on the existing quality process, analyse the data of acceptance of installed pipes as per QAP, use five established steps of six sigma to provide the requisite control measure for improving the productivity and reducing the cycle time in a vessel construction project. Consistency in achieving planned targets during vessel construction project requires timely availability of Inspection cleared pipes/spools for subsequent processes of Flushing, Leak test & Final Inspection before connecting them, with live engineering systems. The project would also measure the initial sigma level of the existing process and aim to conclude by providing recommended ways of reducing the rejection during quality inspection using established six sigma processes. This project would eventually aim to improve the production process and reduce the cycle time of the entire piping installation process.

Keywords: Six Sigma (6σ), Cycle time, QAP, Vessel

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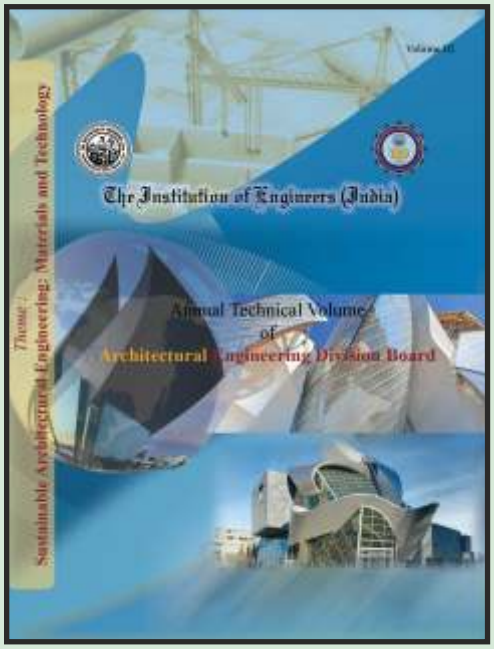

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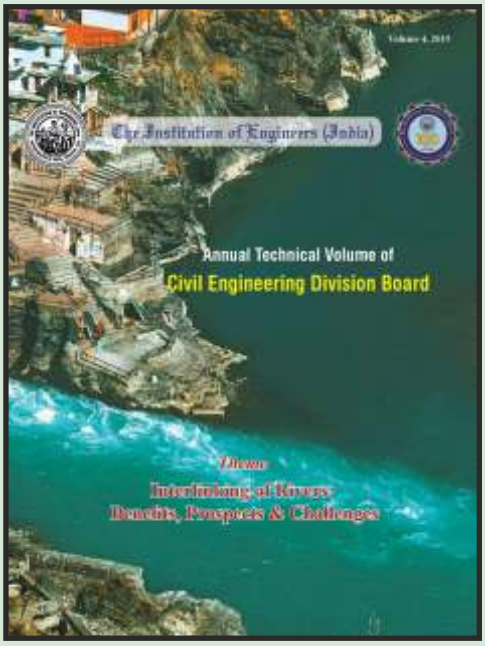

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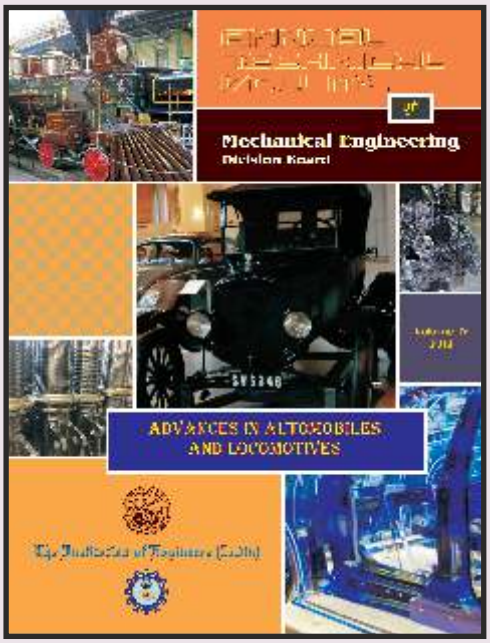

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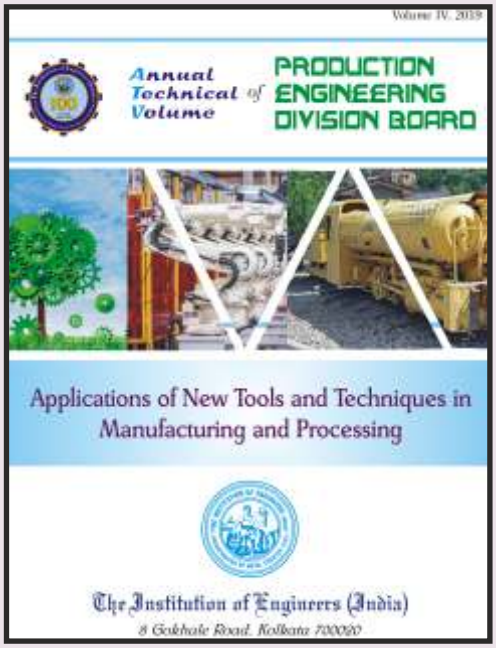

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