International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-3 Issue-10, March 2014

Design of Cold Rolling Mill Components

Firoj U. Pathan, Santosh N. Shelke

Abstract— ***the process of plastic deformation of metal by passing it through the rolls called as the metal rolling. Rolling is widely used forming process, which can have high production figures and precise control of final product. Rolling is classified in two major parts the cold rolling and hot rolling. Every part has its own theory, development of rolling process and subsequently the designing of the cold rolling mill components, like rolls and rolling mill housing. The aim of the present paper is to understand the various methodologies which are used to design the cold rolling mill. We have focused on the history of the rolling process; it is understand that the rolling process was adopted since year 1590. Although it was raw method but it initiated the slitting rolling mill and the actual experimentation were started from year 1670. In those days rolling was concerned with rolling of bars only after few years the rolling of bars were started. We also tried to discuss the earlier patents which were granted in 18th century and was related to the tandem mill which were using copper and brass as the rolling materials. In year 1783, after the entry of grooved rolls the rolling production increased up to 15 times and that was the start of modern rolling mill. While reviewing the design of rolling mill components our area of interest is to visit design of rollers and rolling mill housing. We have discussed the different parameters and factors that affect the roll design. The calculations for the power required for rolling operation and the roll dimensions are also discussed. In reviewing the design of rolling mill housing, we try to explain the load that comes on the rolls during the rolling operations and how it affects the bearing life. The rolling mill housing designed optimisation has achieved by using different Finite Element Analysis techniques and various experimentation for rolling mill housing structural analysis is also reviewed.***

Keywords— ***cold rolling, plastic deformation, design methodologies, housing, rolls,*** *Split end, central burst*

I. INTRODUCTION

Design of rolling mill is a tough process where the designer should have clear knowledge and understanding of the rolling process. There are various conflicting goals which need to satisfy, many investigations need to be done for the complete analysis [1]

II. HISTORY OF ROLLING MILLS

The earliest rolling mills were slitting mills which were introduced from what is now Belgium to England in 1590. These passed flat bars between rolls to form a plate of iron, which was then passed between grooved rolls (slitters) to produce rods of iron. The first experiments at rolling iron for tinplate took place about 1670. These were followed by the erection by 1697 by Major John Han bury of a mill at Pont pool to roll 'Pont pool plates' - back plate. Later this began to be reenrolled and tinned to make tinplate.

Manuscript published on 30 March 2014.
*Correspondence Author(s)
Firoj U. Pathan, Department of Mechanical Engineering, Sir Vishwashwarrayya Institute of Technology, Chinchothat, Sinnar, Dist. Nasik, India.
Santosh N. Shelke, Department of Mechanical Engineering, Sir Vishwashwarrayya Institute of Technology, Chincholi, Sinnar, Dist. Nasik, India.

The earlier production of plate iron in Europe had been in forges, not rolling mills. The slitting mill was adapted to producing hoops (for barrels) and iron with a half-round or other sections by means that were the subjects of two patents of c. 1679.Some of the earliest literature on rolling mills can be traced back to Christopher Polhem in 1761 in Patriotism Testament, where he mentions rolling mills for both plate and bar iron. He also explains how rolling mills can save on time and labour because a rolling mill can produce 10 to 20 and still more bars at the same time which is wanted to tilt only one bar with a hammer. A patent was granted to Thomas Block leys of England in 1759 for the polishing and rolling of metals. Another patent was granted in 1766 to Richard Ford of England for the first Tandem Mill. A tandem mill is where the metal is rolled in successive stands; Ford’s tandem mill was for hot rolling of wire rods. Rolling mills for lead seem to have exited by the late 17th century. Copper and brass were also rolled by the late 18th century.

III. MODERN ROLLING

The modern rolling practice can be contributed to the efforts of Henry Cort of Fontanel Iron Mills, near Fare ham, England. In 1783 a patent was issued to Henry Cort for his use of grooved rolls for rolling iron bars. With this new design mills were able to produce 15 times the output per day than with a hammer. Although Cort was not the first to use grooved rolls; he was the first to combine the use of all the best features of various iron making and shaping processes known at the time. Thus the term “father of modern rolling” was giving to him by modern writers. The first rail rolling mill was established by John Birkenshaw in 1820 where he produced fish bellied wrought iron rails in lengths of 15 to 18 feet. With the advancement of technology in rolling mills the size of rolling mills grew rapidly along with the size products being rolled. Example of this was at The Great Exhibition in 1851 a plate 20 feet long, 3 ½ feet wide, and 7/16 of inch thick, weighed 1,125 pounds was exhibited by the Con set Iron Company. Further evolution of the rolling mill came with the introduction of Three-high mills in 1853 used for rolling heavy sections.

IV. DESIGN METHODOLOGY

The process of rolling mill design starts from finalizing the specifications of the product. In initial stage there can be approximation and goes on to specific values.

According to Dixit, Robi and Sarma [1], in designing rolling mill there are three stages. Conceptual design, embodiment design and detailed design. Broad solutions are the results of conceptual design for the problem statement under study. In relation to design a rolling mill, conceptual design deals to different patterns to arrange the rolls, the power driven and suitable mechanisms, arrangement and decision of power sources generally the electrical motors.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

In next embodiment design stage, the concept are moulded to solid forms. The critical rolling specifications are decided here. It includes to decide rolling mill layout with output as many drawings along with the clear specifications. The final review contains to verify the functional requirements, space requirements, the design economy is also important. From detailed design we can have detailed drawings obtained from detailed calculations.

In the paper by E.K. Antonson, K.N. Otto, [2] explained the utility theory used for the rolling mill design optimisation. They also discussed the matrix method along with necessity method. Probability and fuzzy set based method during design procedures.

V. DESIGNING OF ROLLS FOR ROLLING MILL

Roll is the major component in rolling mill set up, and very first to loaded in rolling process. In the paper Dixit, Robi and Sarma [1], explained the procedure to finalise the rolling specifications, according to authors following are the minimum required parameters to deal with,

1. Yield strength and hardening co-efficient of material.
2. Width of the strip to be rolled.
3. Inlet thickness and outlet thickness of the strip.
4. Roll radius.
5. Coefficient of friction.
6. Roll velocity.

During design follow the procedure to first decide the inlet thickness, while the outlet thickness of required strip will decide the reduction ratio. The aim of designer is to achieve maximum reduction ratio along the high rolling speed. These parameters are limited by the type of drive and roll separating force ultimately they decide the cost of rolling mill set up.

The rolling power P is given by, [3].

$$P = \sigma_0 b h_1 \frac{1-r}{1-0.5r} v \ln\frac{h_1}{h_2} = \sigma_0 b h_1 \frac{1-r}{1-0.5r} v \ln\frac{1}{1-r} \qquad (1)$$

Where σ_o is the average flow stress, b the width of the strip, h_1 the inlet thickness of the strip, h_2 the outlet thickness of the strip, r the reduction and v the velocity.

Roll diameter selection is based on the strip thickness, material of the strip, the reduction ratio & rolling speed. Large diameter is the first choice because it gives good cooling over the small diameters. The defects of split end and central burst also have major considerations in design of rolls. Split end defect produce the crack in centre plane of rolling strip while the internal void generate the central burst. The paper by Avitzur [4] explain the causes of central burst as follows

- Small roll radius
- Large initial thickness of the sheet or strip
- Small percentage reduction
- Tensile pull or force on both or single front or back of the strip

Zhu and Avitzur , in their paper [5] discussed the criterion to deal with spilt ends. Accordingly the split ends can appear if

$$\frac{h_1}{R} > 1.81\left(\frac{h_1}{h_2} - 1\right) \qquad \text{............ (2)}$$

Where, R is the roll radius, which can vary depending upon the strip inlet thickness and the ratio of reduction.

`There is also second simple equation to obtain the minimum allowed radius of rolls. [3]

$$\mu_m \approx \frac{1}{2}\sqrt{\frac{h_1 r}{2R}} \qquad \text{.............. (3)}$$

Where, μ_m is the co-efficient of friction.

In roll design the heat transfer has major influence, it assumed that the heat loss in the total rolling power and can be given by equation,

$$P = 2\pi R l h(t_R - t_0) \qquad \text{…............. (4)}$$

Where, 'l' is the length of roll, h is heat loss coefficient, t_R and t_O are the temperature of roll surface and the ambient. [1]

VI. DESIGNING OF HOUSING FOR ROLLING MILL

Housings are elements in a rolling mill, which house the chock assemblies, the adjusting and other mechanisms, and retain them in their proper positions. Their construction and dimensions thus have to take into account the sizes of various other elements. The forces, which act on the rolls during rolling, are completely transferred on to them through the nut of the adjusting mechanism. in addition, there exists a tendency for the stand to return as a result of the torques acting on the rolls, which get transmitted to the frame in case of bearing seizures or when rolls are unable to pass the metal due to lack of sufficient power .The housings therefore should be adequately clamped to the foundation to withstand the overturning moments. The frame is also to be checked for stresses as well as rigidity.

VII. CALCULATION OF ROLL LOAD

The Rolling Load in a Rolling Mill can be calculated by the methods used by Tselikov [19].Since the forces on the roll neck and in the Housing posts are identical, and the strength of the neck (with a constant relation between its diameter and length) is approximately proportional to d^2

Where, d = diameter of Roll neck bearing.

For various mills Roll load depends on the Roll material as:

1. For iron rolls approximately
   $F = (0.6 \text{ to } 0.8)\, d^2$ ……………………. (4)
2. For carbon steel Rolls
   $F = (0.8 \text{ to } 1.0)\, d^2$ ..…………………. . (5)
3. For Rolls of Chromium Steel (Four high mills)
   $F = (1.0 \text{ to } 1.2)\, d^2$ … … … … … … .. (6)

We are making use of four high mills with Chromium Steel Rolls so Roll load is calculated from the equation (6) i.e. $F = (1.0 \text{ to } 1.2)\, d^2$

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-3 Issue-10, March 2014

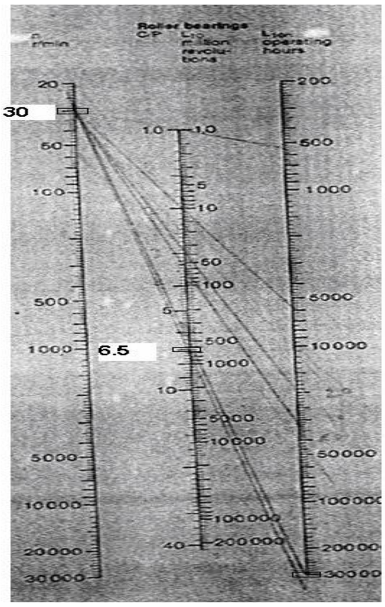

Fig. 1 Life calculation chart for roller bearing

Since each roll neck consists of two bearings 23056 mounted on each roll neck so specification of bearing used is [20]:

d = diameter of Roll neck bearing = 280 mm

D = outer diameter = 420 mm

B = width = 106 mm

C = Dynamic capacity = 1520000 N

Therefore,

$F = (1.0 \text{ to } 1.2)\ d^2$

$F = (78400 \text{ to } 94080)\ (9.81)$

$F = (769104 \text{ to } 922924)$ N ……....… … … (7)

Also the Rolling Load in a Rolling Mill is calculated from the dynamic capacity of the Roll bearings and their service life. In order to achieve a service life of about 3 Lakhs hrs minimum at 30 R.P.M the ratio of bearing capacity to load applied can be calculated from life calculation chart as shown in figure 1.

Therefore C/P = 6.5

Therefore P = 1520000/6.5 = 233 KN

We are making use of four bearings,

so Total load is P * 4 = 930 KN (approximate.) . … (8)

Comparing equations (7)and (8) we make use of 900 KN of Rolling load in our Housing design.

This Rolling Load of 900 KN is transferred from the top chock to Housing which has spherical seating on the screw and through lower chock to Housing because it rests on a spherical liner .

Remn-Min Guo [6] generated a method by combining the Goodman line technique, and the cumulative damage method to estimate the housing life. A method was also developed to estimate the upper and lower bounds of the housing life using the average equivalent stress. These methods can be extensively used in all machine elements subjected to cyclic loads. The extensive usage of the Goodman line technique in conjunction with Miner's accumulative damage method provides a method to estimate the housing life knowing the force spectrum and the material S-N curve or Basq in equation. A force spectrum including instantaneous force changes could be established by combining the average in-coil force variation and coil-to-coil force variation. The former was obtained directly from the force and/or strain gauge measurement. In order to detect the dynamic change during impact, the FM tape with high frequency data collection was recommended. The coil-to-coil force variation could be obtained from the rolling schedule calculation or the load cell readings for various material, width, and gauge. The amplitude stress was computed from the amplitude to mean ratio. Further mathematical derivation and assumptions leads to the upper and lower bound estimation of the life expectancy. Using this preliminary estimation can eliminate the measurement of the in-coil force variation, which is in general costly and timely. The averages mean force could be calculated directly from the rolling schedules according to expected product mix. The average amplitude force could be roughly estimated by observing the strip chart of the rolling force. A detailed finite element analysis on the mill housing was necessary to convert the force into the stress using the proportion rule. If the lower bound exceeds the expected life, there was no reason to go for the upper bound or even the accurate solution; otherwise, the further studies could be required. In presenting and discussing structural analysis and design an engineer/analyst is always emphasizing the importance of strength and stiffness and endeavouring to get a balance between them both that suits the design in hand. It seems logical therefore in presenting structural optimization that both these crucial items be objectives of the process rather than having one as the objective and the other as a constraint as has traditionally been the case. It initially feels more appropriate to be trying to maximize stiffness whilst simultaneously maximize the strength. Also the goal of maximizing strength of a structure should, to the authors mind, be in the form of minimizing the maximum stress under all load cases. Traditionally structural optimization has targeted stress equalization or the achievement of "fully stressed" design as the stress objective/constraint. The authors consider that such an objective, especially coupled in with FEA still can lead to high localized stresses which therefore do not improve the strength of the structure.

G. P. Steven [7] aimed at exploring the application of the evolutionary structural optimization method to such multi criteria design problems. To evaluate the overall effect on the design of material variation due to these two optimality criteria, a weighting scheme was adopted, whereby the weight factors emphasize and/or balance the stiffness and stress criteria. The work can accommodate various situations involving shape and topology design with multiple criteria. Also the important practical aspects of possible multiple peak stresses and multiple load cases were taken into account. A number of examples demonstrate the capabilities of the proposed method for solving multi-criteria design optimization structural design problems.

J. H. Rong [8] proposed an improved method for evolutionary structural optimization against buckling for maximizing the critical buckling load of a structure of constant weight. First, based on the formulations of derivatives for eigenvalues, the sensitivity numbers of the first eigenvalue or the first multiple eigenvalues (for closely spaced and repeated eigenvalues) were derived by performing a variation operation. In order to effectively increase the buckling load factor, a set of optimum criteria for closely spaced eigenvalues and repeated eigenvalues were established, based on the sensitivity numbers of the first multiple eigenvalues.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Several examples were provided to demonstrate the validity and effectiveness of the proposed method

Kurt Maute [9] presented an interactive method for the selection of design criteria and the formulation of optimization problems within a computer aided optimization process of engineering systems. The key component of the proposed method was the formulation of an inverse optimization problem for the purpose of determining the design preferences of the engineer. These preferences were identified based on an interactive modification of a preliminary optimization result that was the solution of an initial problem statement. A formulation of the inverse optimization problem was presented, which was based on a weighted-sum multi-objective approach and leads to an explicit optimization problem that was computationally inexpensive to solve. Numerical studies on structural shape optimization problems show that the proposed method was able to identify the optimization criteria and the formulation of the optimization problem, which drive the interactive user modifications.

Theodore G.ToRidis [10] formulated a general method of elastic-inelastic analysis of rigid frames, which was based on the finite element method, and the concept of initial strain as applied to plastic strains. The analytical expressions obtained in this manner were used as a basis for the development of a general purpose computer program . This program enabled the user to exercise several options corresponding to the static, free vibration, elastic dynamic and plastic dynamic analysis of two and three-dimensional framed structures.

William Prager [11] encountered typical difficulties in the formulation of problems of optimal structural design .For the optimal design of a statically determinate or indeterminate truss of given layout, a method was presented by which necessary and sufficient conditions for global optimality may be derived when an upper bound is prescribed for the compliance of the truss under one or several sets of loads and a lower bound is prescribed for the cross sectional area of each bar. The extension of the method to other structures and constraints was briefly discussed with reference to the literature, and the general form of the resulting optimality conditions is given.

Rafael Febres [12] discussed a model of the behaviour of metallic structures subjected to flexural effects . The model focused on the description of failure due to local buckling. It was assumed that the main inelastic phenomena involved in the process: plasticity and local buckling, could be lumped at inelastic hinges. The model took into account that in planar frames, two local buckling could appear in the plastic hinge region: one due to a positive moment the other one related to a negative moment. The elastic behaviour of frame members with two local buckling was assumed as unilateral. The plastic behaviour was described using the concept of equivalent moment on a damaged plastic hinge. A new hypothesis, that authors have called "counter-buckling", was introduced. The counter-buckling concept states that as a consequence of the evolution of one local buckling, the other one results partially blocked. The notion of counter-buckling was used to describe local buckling evolution during cyclic loadings. Finally, the model was verified through the numerical simulation of several experimental tests on frame members and framed structures.

K. G. Mahmoud [13] recognized that structural optimization using mathematical programming techniques can be employed efficiently only in conjunction with explicit approximate models. In the work an efficient optimization methodology combining a finite element-based approximate analysis model, a sequential quadratic programming algorithm incorporating an active set strategy and a direct method of design sensitivity analysis was developed. The methodology involves the solution of a sequence of explicit high-quality approximate problems subject to given move limits in the design space. A new technique for constructing approximation functions with a high quality adaptive capability to the original functions was proposed by using the values of the state variables (displacements and/or stresses) and their derivatives at points obtained in the process of optimization. Other approximation techniques had been presented and comparisons had been made using real-life automobile structures to demonstrate the power and generality of the approximation concepts in structural optimization.

V. Braibant [14] was focused on the use of optimization techniques in the framework of Computer Aided Design and Finite Element Methodology. A design model was developed which could be used for structural sizing as well as for shape design. An essential aspect of the work was sensitivity analysis, which consists of computing derivatives of the functions which define the optimization problem. Attention was restricted on static linear problems involving shape variables. A new and rather general mathematical programming method was described. For structural sizing as well as for shape optimal design, the method generalizes previous approaches and had excellent convergence properties. A sample of numerical applications was given showing the efficiency and reliability of the proposed formulation. Finally, the concept of interactive redesign allowing the designer to monitor the optimization process on a graphic terminal was envisaged. It was expected that in the future the concept will lead to integration of structural optimization methods into Computer Aided Design systems. The design problem of frames with beams subject to stress, displacement, and buckling constraints in the paper was treated as two-level structural optimization. The weight of structure, the areas of cross sections for the independent elements were in system level taken as objective function and system design variables, respectively. They would satisfy the overall deformation and the overall buckling constraints. At the component level the objective was to minimize the weight of each independent element, and the cross-sectional dimensions were the component design variables. The local stress and buckling in each independent element were component constraints. Yunliang Ding [15] added an additional constraint corresponding to system design variable into component level to assure consistency between system and component variables.

M.E. M. El-Sayed [16] presented a method for considering fatigue life requirements in the optimal design of structures. The basic concept was to use the load history data combined with the finite element stresses of the structure and the material fatigue properties to calculate the fatigue life during the optimization process. The life requirement was considered as side constraints and the structure weight as the objective function.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

To demonstrate the concept, the optimization task with fatigue life constraints and the fatigue life calculation, based on the contemporary approach, were discussed.

M. Haririan [17] described procedures for design sensitivity analysis and optimization of nonlinear structural systems with the computer program Adina. Formulation of the structural optimization problem, design sensitivity analysis with nonlinear response using incremental finite element procedures, and two strategies to use Adina for design optimization are described. A database and a modem database management system were used to couple Adina with design sensitivity analysis and optimization modules. Comparison of optimum designs with linear and nonlinear structural responses for trusses with material and geometric nonlinearities were given.

Michael A. Vehmeier[18] proposed the new method to optimize both the structural parameters and time-invariant control gains while including the effects of transient loads. The control force gains were written as explicit functions of the response and were included in the equation of state, which in turn is directly embedded into the augmented performance index. Variations were taken with respect to all of the design variables (state, co-state, structural parameters, and position and/or rate feedback control gains) to generate the governing equations for the system. A computer code was developed to solve the resulting equations and simultaneously solve for the optimal control gains and structural parameters using gradient-based search techniques. The resulting structure was optimal for the specified service environment (initial conditions and/or transient loads) with constant control force gains (position and/or rate feedback).

CONCLUSIONS

The present paper tries to review on the design procedures for designing the rolling mills. The different methodologies described many aspects while deciding the specifications of the rolling mill. We also discussed the optimum roll radius which can be a result of two contradictory objectives. The motor power requirement calculated by the demands of process parameters. While reviewing housing mill design, the structure is designed on the basis of roll load calculations. These calculations are variant on types of rolling strip materials and the material of rolls. A review is also taken for the different design methodologies adopted for the design of rolling mills.

ACKNOWLEDGMENT

We are greatly indebted to professors and lecturers of Department of Mechanical Engineering, Sir Vishwashwarrayya Institute of Technology, Chincholi, without whose advice and guidance this work would have never been possible We are indebted to Department of Mechanical Engineering for giving me an opportunity to learn and do this paper work. We once again extend our sincere thanks to the entire college for all those who directly or indirectly involved in our work.

REFERENCES

1. Dixit U.S., Robi P.S., D.K. Sarma, 2002, 'A systematic procedure for the design of cold rolling mill', Journal of material processing Technology 121, (2002), Pages 69-76.
2. Antonsson E.K., Otto K.N., 1995, 'Imprecision in engineering design', ASME J. Mech. Des. B 117, 1995, 25-32.
3. Roberts W.L.1978 , 'Cold Rolling of Steel', Marcel Dekker, New York, 1978.
4. Avitzur B., Van Tyne C.J., Tureczyn S. 1988 , 'The prevention of central bursts during rolling', ASME J. Eng. Ind. 110 (1988), 173-178.
5. Zhu Y.D., Avitzur B.,1988 ,'Criteria for prevention of split ends', ASME J. ENG. Ind. 110 (1988) 162-178.
6. SDRC report project number 17140, June1990,'Final Report on ARMCO Mill StandEvaluation', June1990.
7. Steven,G. P., 2002, 'Multicriteria optimization that minimizes maximum stress and maximizes stiffness', Computers & Structures Volume 80, Issues 27-30 , November 2002, Pages 2433-2448
8. Rong J. H.,2001, 'An improved method for evolutionary structural optimization against buckling' Computers & Structures ,Volume 79, Issue 3 , January 2001, Pages 253-263.
9. Kurt Maute, 2004, 'An interactive method for the selection of design criteria and the formulation of optimization problems in computer aided optimal design', Computers Volume 82, Issue 1 , January 2004, Pages 71-79
10. Theodore G. ToRidis,1971, 'Computer analysis of rigid frames, Computers',Volume 1, Issues 1-2 , August 1971, Pages 193-221.
11. William Prager ,1972,'Conditions for structural optimality', Computers & Structures',Volume 2, Issues 5-6 , 1972, Pages 833-840
12. Rafael Febres, 2003, 'Modeling of local buckling in tubular steel frames subjected to cyclic loading' , Computers & Structures ,Volume 81, Issues 22-23 ,September 2003.
13. Mahmoud K. G.1997,1987, 'An efficient approach to structural optimization ' Computers & Structures Volume 64, Issues 1-4 , July-August 1997, Pages 97-112 Computational Structures Technology
14. Braibant V.1987, 'Optimization techniques: Synthesis of design and analysis' , Finite Elements in Analysis and Design Volume 3, Issue 1 , April 1987, Pages 57-78
15. Yunliang Ding,1989, 'Multilevel optimization of frames with beams including buckling constraints' , Computers Volume, 1989, Pages 249-261
16. El-Sayed M. E. M.,1990, 'Structural optimization with fatigue life constraints' , Engineering Fracture Mechanics Volume 37, Issue 6 , 1990, Pages 1149-1156
17. Haririan M.1987, 'Use of ADINA for design optimization of nonlinear structures' ,Computers & Structures Volume 26, Issues 1-2 , 1987, Pages 123-133
18. Michael A. Vehmeier,1990, 'A new method for simultaneous structural/control optimization' Mathematical and Computer Modeling Volume 14 , 1990, Pages 248-253
19. Tselikov,1962., A.I., Theory of calculation of forces in Rolling Mills 1962.
20. SAE Bearings manual.

AUTHOR PROFILE

Prof. Firoj U. Pathan had done B.E mechanical from Walchand college of engineering, Sangli with Distinction, Currently doing M.E (Mechanical design)from SVIT, Chincholi Nasik, Has Industrial experience of 8 yrs, and teaching experience of 3yrs. His interest fields are in Mechanical Design, Industrial engineering, Metrology, Quality Control. He is also an certified Lead Auditor for ISO 9001:2008 & currently is Management Representative in QMS ISO 9001:2008 of Sandip Institute Of Technology & Research Centre, Nasik.

Prof. Dr. Santosh Shelke was born on 2 June 1977 in India. He has completed his Mechanical Engineering and post graduation in Design Engineering in Pune University, Maharastra, India in the years 1999 and 2005 respectively. Later he did his Ph.D in Mechanical Engineering at National Institute of Technology, Warangal (A.P.) in 2013.He has total 14 years teaching experience and presently working as Associate professor and Head of Mechanical Engineering, Vice Principal at Sir Visvesvaraya Institute of Technology, Nasik, India. His reaserch interest incudes Design and optimization, Vibration and theory of elasticity. He has published total 26 papers in National/ International journals and conferences.