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Design and analysis of roller conveyor and fixture

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ABSTRACT

Roller conveyor for diesel engine assembly line is a effective technique for numbering engine blocks using laser machine. Main objective of roller conveyor for diesel engine assembly line is to modernize the manual technique. By using this technique, the roller conveyor for diesel engine assembly line we can number the engine parts automatically and computerized by using laser with it. This technique is time saving over the conventional technique. Manually printing numbers and verification on engine blocks is time consuming process. This process includes manual printing and inspection which leads to increase the lean time of operation as well as manual efforts. This project presents design of automatic conveyor system which contains design of roller, fixture. It proposes a new approach for fixture configuration design for a family of diesel engine block with technique are using laser as a printing elements which print engine serial number by using roller conveyor assembled in a single reconfigurable line. The problem formulated as a constrained design by considering frame of roller conveyor, roller, fixture with pins,. The result using this technique is time saving over the conventional technique. Main conclusion of roller conveyor for diesel engine assembly line is to modernize the manual technique. The aim of this research is to help these numbering of engine block with using laser machine by totally computerized process. The problem formulated as a constrained design by considering frame of roller conveyor, roller, and fixture with pins used to solve the design of machine problem and established the total layout of the diesel engine assembly line.

Keywords— roller, fixture, engine block, automatic conveyor system, laser printing machine.

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I. INTRODUCTION

Conveyor is used in many industries to transport goods and materials between stages of a process. Using conveyor systems is a good way to reduce the risks of musculoskeletal injury in tasks or processes that involve manual handling, as they reduce the need for repetitive lifting and carrying. Conveyors are a powerful material handling tool. They offer the opportunity to boost productivity, reduce product handling and damage, and minimize labor content in manufacturing or distribution facility. Conveyors are generally classified as either Unit Load Conveyors that are designed to handle specific uniform units such as cartons or pallets, Process and Unit Load conveyors in its operations. It is not subjected to complex state of loading still we found that it is designed with higher factor of safety. If it is redesign critical parts e.g. Roller, Shaft, and Bearing& Frame. With the experience of the Service provider in analysis field, CATIA / PRO-E appear as a competent tool to pursue Analysis for this Project Work. The roller conveyor assembly has to be installed over varying lengths in the assembly line area for multi-national company manufacturing excavators (client Of sponsoring Company).The transportation can cause a problem if such assemblies are made as one-piece units. The roller conveyor assembly normally involves the use of channels, rollers and

/bars that are heavy by virtue of their structure and the material used (steel)[4]

Roller conveyor for diesel engine assembly line is a effective technique for numbering engine blocks using laser machine. Main objective of roller conveyor for diesel engine assembly line is to modernize the manual technique. By using this technique, the roller conveyor for diesel engine assembly line we can number the engine parts automatically and computerized by using laser with it. This technique is time saving over the conventional technique is The problem formulated as a constrained design by considering frame of roller conveyor, roller, fixture with pins, laser machine adjustable frame, sensor position, bearings, sprocket and chain and alignment of pins were serially programmed and used to solve the design of machine problem and established the total line layout of the diesel engine assembly.

II. LITERATURE REVIEW

This section elaborates literature survey on the substantial achievement in roller conveyor and fixture.

Rajratna A. Bhalerao et al. discusses current trends to provide weight/cost effective products which meet the stringent requirements. The aim of this paper is to study existing conveyor system and optimize the critical parts like roller, shafts, C-channels for chassis and support, to minimize the overall weight of assembly and material saving[1].

M. A. Alspaugh et al. discussed about Bulk material transportation requirements that have continued to press the belt conveyor industry to carry higher tonnages over longer distances and more diverse routes. In order keep up, significant technology advances have been required in the field of system design, analysis and numerical simulation. The application of traditional components in non-traditional applications requiring horizontal curves and intermediate drives have changed and expanded belt conveyor possibilities. Examples of complex conveying applications along with the numerical tools required to insure reliability and availability will be reviewed [2].

M. Y. Dakhole et al. required to fix typical shape engine components on conveyor while performing cleaning operation. In convey or used multistage washing machine, to fix these typical shape components is very difficult. Hence these components need dedicated fixturing with poke-yoke to avoid accidents inside the zone on conveyor. This project gives feasible solution on conventional roller chain conveyorised arrangement with dedicated moving fixture with conveyor for the tractor components like rear axle career, bull gear and shaft of a tractor model. This arrangement will be widely used for numerous cleaning purposes owing to its effectiveness for high production volume, reliable and durable performance [3].

. Suhas et al. continued with great effort to save weight and cost of applications. The current trend is to provide weight/cost effective products which meet the string entrequirements. The aim of this paper is to study existing conveyor system and optimize the critical parts like roller, shafts, C-channels for chassis and support, to minimize the overall weight of assembly and material saving [4].

Pawar Jyotsna et al. studied existing Belt conveyor system and optimize the critical parts like Roller, L channels and support, to minimize the overall weight of assembly. Paper also involves geometrical and finite element modeling of existing design and optimized design. Geometrical modeling was done using Catia V5R20 and finite modeling done in ANSYS14.0. Results of Linear static, Modal and Transient analysis of existing design and optimized design are compared to prove design is safe. In this paper we work on the roller design and optimization [5].

Wang Yan et al. Fixture design in industry is largely an experienced-based, ad- hoc process. In the case of the design of fixtures for complex components, this approach often results in a need for rework and consequent delays to production. Machining fixture design has been the subject of considerable research efforts; however most research activities have addressed one or a small number of interactions between fixture and other manufacturing system elements. In this paper, a novel fixture design methodology based on concurrent engineering is described. This methodology models physical space, loads, stress, deformation, thermal effects, vibration, etc., determines the loads and deflections arising from the locating, clamping and machining procedures, and estimates the resultant effects on component quality. To assist in the development of the methodology, the high technology industrial partner originally provided the researchers with a range of complex machined. Components of various sizes, incorporating many different features. The methodology has been tested against a range of successful and unsuccessful fixture designs supplied by the industrial partner [6].

III. METHDOLOGY

A. Design of Roller

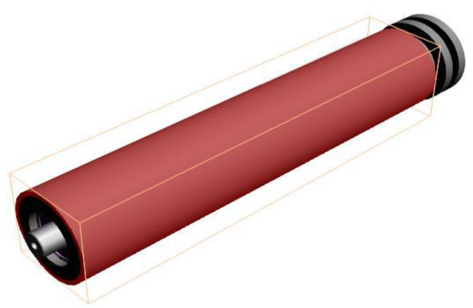

Fig 1.3D design of roller, shaft and sprocket assembly

In this technique before implement we analyse the testing instrument availability. Then the initial layout is generated so that we will select proper location. The main parts of the project are roller. We proper study for roller materials and design with proper selection of inner diameter, outer diameter and check the stress, stain and bending capacity of rollers. Its collective information we implement the design of roller and its material. The problem formulated as a constrained design by considering of roller conveyor, roller, bearings, sprocket and chain and alignment of pins were serially programmed and used to solve the design of machine problem and established the total layout of the diesel engine assembly line.

TABLE I

Configuration of Roller Assembly

Name of component	Material	Diameter		Qty
		Inner diameter	Outer diameter	
Roller	EN9	54	60	30
Shaft	MS	-	20	30
Bearing	6206Z	17	35	60
Dual chain sprocket	MS	35	44	30
Sprocket chain	S.S	-	-	2

B. *Fixture Design*

Fixtures have a much-wider scope of application than other work holding system. These work holders are designed for applications where the cutting tools cannot be guided as easily as a drill. With fixtures, an edge finder, center finder, or gage blocks position the cutter. Examples of the more-common fixtures include milling fixtures, lathe fixtures, sawing fixtures, and grinding fixtures. Moreover, a fixture can be used in almost any operation that requires a precise relationship in the position of a tool to a work piece.

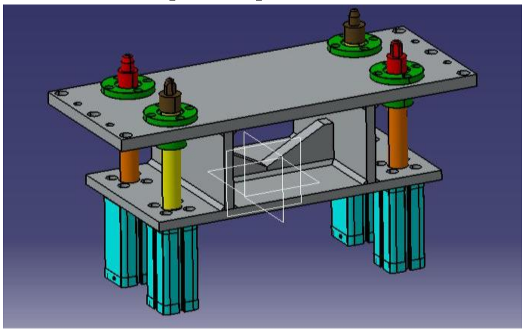

Fig.2.catia 3D model of fixture design

Main parts of fixture we select the shape and size properly locate the locket pins in engine blocks cylinder bore. We study the different materials and then we select best one of them and then we prepare the design of fixture. By using roller conveyor the object will roll on the sprocket and chain and that object will be sensed by sensor which is fixed at near the chain and as sensor activated it will stop the object using stopper. After that as soon as stopper stops the object it will activate fixture and fixture will lift the object by using rods.

TABLE III
Configuration of Fixture Assembly

Component Name	Material	Weight	No. of component
Fixture	M.M	25kg	1nos
Festo Cylinder	S.S	1.5kg	4nos

IV. MATHEMATICAL MODELLING

Design of roller: Material – EN9

E = 2.10*105 Mpa, F= 7850 Kg/m3, Yield stress=200 Mpa

Considering uniformly distributed load & FS = 1.5 D1= 60 mm

D2 =54 mm w =285 mm

y = Distance from neutral axis

Allowable Stress (σall) = Syt / Fs =200/1.5 =133.33 Mpa

Moment of Inertia (I) =(D14 – D24)/64 Maximum bending stress

Max σb = y/ I

Shaft Calculation

Diameter of Shaft - 20mm Length - 335mm

Shear Stress = 500 MPa Formula –

$T/J = \tau/r$

$J = \pi/32 \times d^4$

Therefore,

$T/ (\pi/32 \times d^4) = \tau / (d/2)$

$M = W \times L$

For Bending Stress,

$\sigma_b = \sigma_{tu} / F.S.$

to selection of diameter of shaft

$M = \pi / 32 \times \sigma_b \times d^3$

Equivalent Twisting Moment, $T_e = \sqrt{M^2 + T^2}$

$T/J = \tau/r$

$J = \pi/32 \times d^4$

Therefore,

$T/ (\pi/32 \times d^4) = \tau / (d/2)$

$M = W \times L$

For Bending Stress,

$\sigma_b = \sigma_{tu} / F.S.$

to selection of diameter of shaft

$M = \pi / 32 \times \sigma_b \times d$ Equivalent Twisting Moment, $T_e = \sqrt{M^2 + T^2}$

V. FEA ANALYSIS

Below result shows by applying force 35.97N

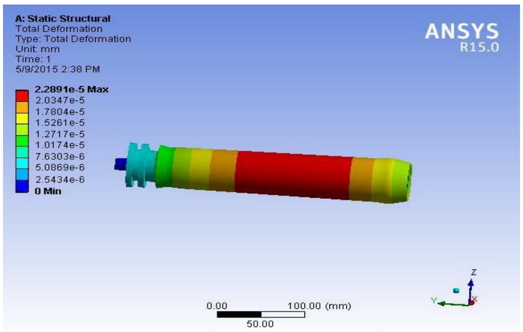

Fig.3 shows solution of shaft by applying force 35.97N

Above result shows static deformation. Here maximum deformation is 2.2891e-5. Minimum deformation is 2.5434e-6.

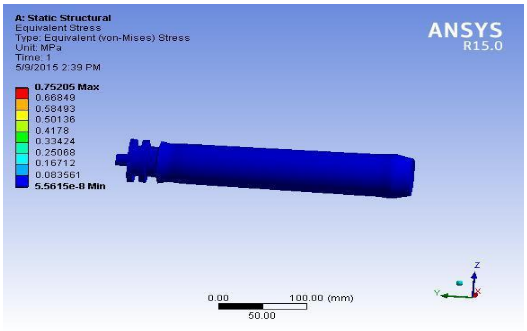

Fig.4 shows solution of shaft by applying force 35.97N

Above result shows equivalent stress (von- mises). Here maximum equivalent stress is 0.75205. Minimum equivalent stress is 5.5615e-8.

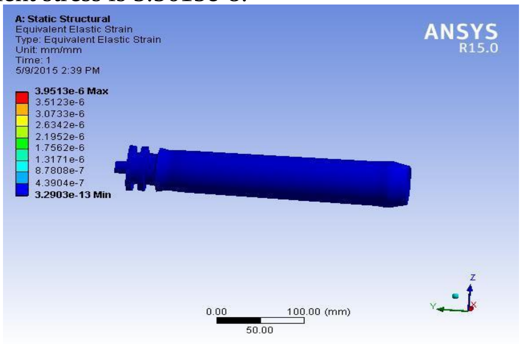

Fig.5 shows solution of shaft by applying force 35.97N.

Above result shows equivalent elastic strain. Here maximum elastic strain is 3.9513e-6. Minimum elastic strain is 3.2903e-13.

Below result shows by applying force 29.43N.

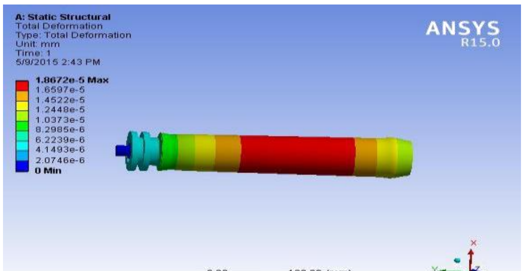

Fig.6 shows solution of shaft by applying force 29.43N

Above result shows static deformation. Here maximum deformation is1.8672e-5. Minimum deformation is 2.0746e-6.

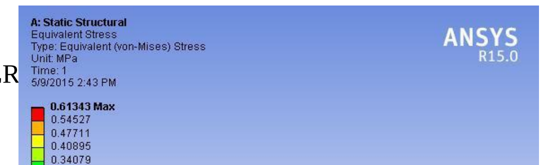

Fig.7 shows solution of shaft by applying force 29.43N

Above result shows equivalent stress (von- mises). Here maximum equivalent stress is 0.61343. Minimum equivalent stress is 4.5364e-8.

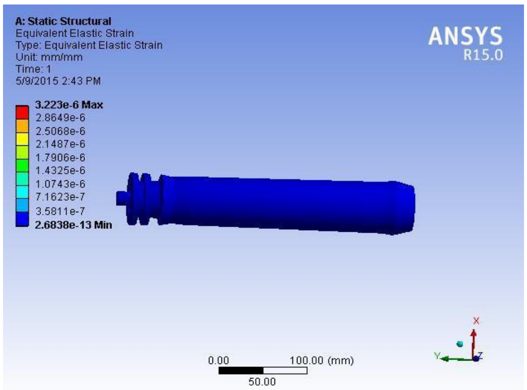

Fig.8 shows solution of shaft by applying force 29.43N.

Above result shows equivalent elastic strain. Here maximum elastic strain is 3.223e-6. Minimum elastic strain is 2.6838e-13.

Below result shows by applying force 88.29N

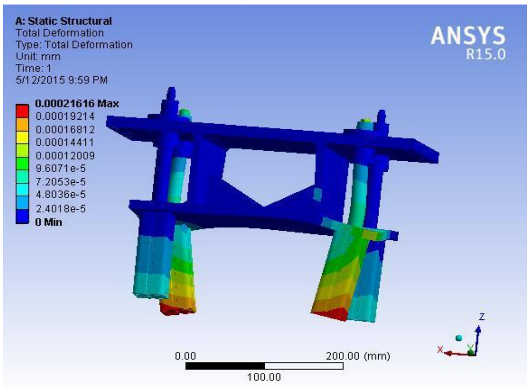

Fig.9 shows solution of fixture by applying force 88.29N

Above result shows static deformation. Here maximum deformation is 0.00021616. Minimum deformation is 2.4018e-5.

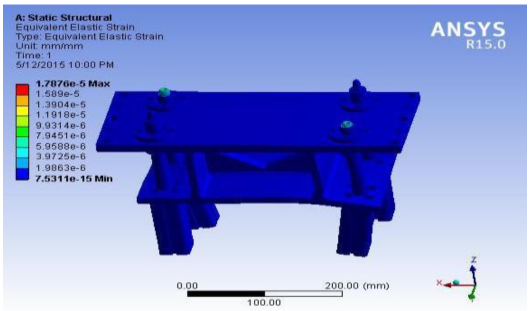

Fig.10 shows solution of fixture by applying force 88.29N.

Above result shows equivalent elastic strain. Here maximum elastic strain is 1.7876e-5. Minimum elastic strain is 7.5311e-15.

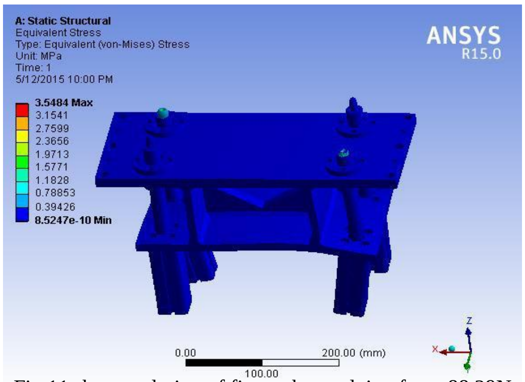

Fig.11 shows solution of fixture by applying force 88.29N.

Above result shows equivalent stress (von- mises). Here maximum equivalent stress is 3.5484. Minimum equivalent stress is 8.5247e-10.

Below result shows by applying force 107.91N

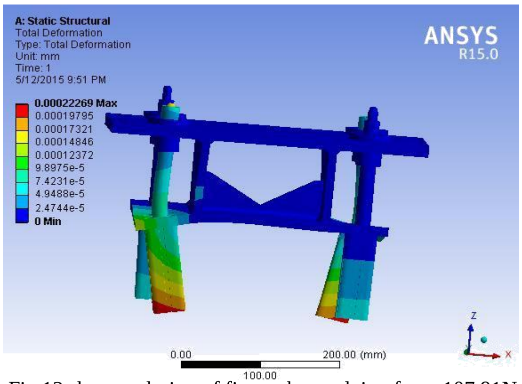

Fig.12 shows solution of fixture by applying force 107.91N.

Above result shows static deformation. Here maximum deformation is 0.00022269. Minimum deformation is 2.4744e-5

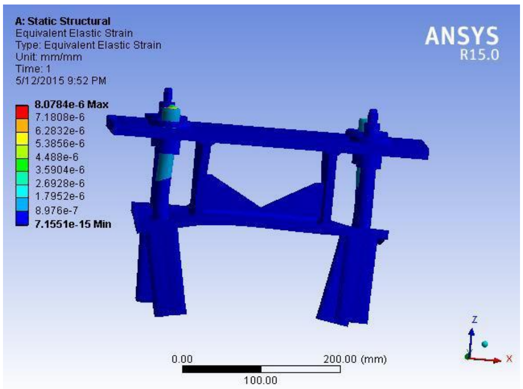

Fig13. Shows solution of fixture by applying force 107.91N.

Above result shows equivalent elastic strain. Here maximum elastic strain is 8.0784e-6. Minimum elastic strain is 7.1551e-15

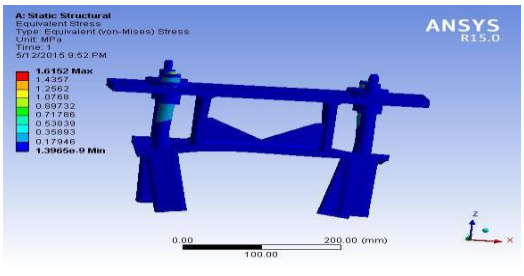

Fig14. Shows solution of fixture by applying force 107.91N

Above result shows equivalent stress (von- mises). Here maximum equivalent stress is 1.6152. Minimum equivalent stress is 1.3965e-9.

TABLE IIIII

Final FEA Result for Roller

Applied Load	**static deformation**		**equivalent stress (von-mises)**		**equivalent elastic strain**	
	maxi mum	**mini mum**	**maxi mum**	**mini mum**	**maxi mum**	**mini mum**
107.91N/3 =35.97N	2.2891 e-5	2.543 4e-6	0.752 05	5.561 5e-8	3.951 3e-6	3.290 3e-13
88.29N/3 =29.43N	1.8672 e-5	2.074 6e-6	0.613 43	4.536 4e-8	3.223 e-6	2.683 8e-13

TABLE IVII

Final FEA Result for Fixture

Applied Load	**static deformation**		**equivalent stress (von-mises)**		**equivalent elastic strain**	
	maximum	**minimum**	**maxi mum**	**mini mum**	**maxi mum**	**minimum**
107.91 N	0.0002226 9	2.4744e-5	1.6152	1.396 5e-9	8.0784 e-6	7.1551e-15
88.29 N	0.0002161 6	2.4018e-5	3.5484	8.524 7e-10	7876e-5	7.5311e-15

VI. CONCLUSION

In this paper we had done design and analysis of roller conveyor and fixture. Main objective of roller conveyor for diesel engine assembly line is to modernize the manual technique has been achieved. By using this technique, the roller conveyor for diesel engine assembly line we can number the engine parts automatically and computerized by using laser with it. This technique is time saving over the conventional technique. We have measure the stress, strain and strength of roller and fixture in FEA.From this we can easily conclude factor of safety of this roller and fixture. In future work, this FEA result will be compared experimental setup results,

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IV. RESULT

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ACKNOWLEDGEMENT

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