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Development of Jacketing Machine

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Abstract: ***Flat Belt is manufactured almost all over the world. In the Transmission Industries, Flat Belt is almost available in every part. In modern trend demand has been significantly increased. To fulfil the increased demand for flat belt, jacketing operation of flat Belt must be paced up. In traditional jacketing processes which are carried out manually take more time, labour work and also provide damage to industry growth. To overcome this and to minimize stress on workers, an attempt has been made to design a jacketing machine for flat belt, which is simple in design and can be handled by the common man. The demand for a flat belt jacketing machine is higher and it is time to respond to the problem raised. Designing and fabricating such types of functional machines is important to save money instead of investing money and time buying labor and conventional tool. Since metal resources are declining and their products are very expensive as compared to rubber, it's preferable to use Rubber flat belts rather than using chains for transmission. As per the studies, it is easier and economical to use belt drives replacing chain drives and it is good for the future without disturbing the ecosystem.***

Study shows that while analyzing the force and power for machines the designer takes the help of analysis software. The cost of software for analysis is high. So there is requirement to find simple formula. In this paper the various theories regarding bending are reviewed, formulae for force and power calculation are collected and finally a case study is taken where we have put together all the results of these formulae. Our main concern is to reduce the human effort required in jacketing of flat belt and also to save the time, labour work, lead time, and move towards the partial automation. The machine has been designed and developed to minimize the cost of production and increase the efficiency.

I. INTRODUCTION

Transmission Belt is manufactured almost all over the world. In the Transmission Industries, Transmission Belt is almost available in every part. Its Manufacturing provides job opportunities to many people, due to the properties of its various products have demand in construction, technology has increased a lot. PIX Transmission has pioneered in providing various transmission belts right from the industrial machineries to Automobile Sector. The Company features state-of-the-art Belt manufacturing units as well as an ultra-sophisticated, automated Rubber Mixing facility. Pix transmission Nagpur has fully automatic and semi automatic machines for the manufacturing of V belt and some of the flat belts. Pix Transmission do not have machines for manufacturing of 12 feet Flat Belt. They manufacture this belt using conventional methodologies as shown in the images below.





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II. LITERATURE STUDY

A. Roller by Theory of Machine (R. S Khurmi)

From these book, The comparison of Belt drive and gear drive are done . That whether we have to use belt drive to reduce the speed or gear drive. And get all detail knowledge of Gear i .e Gear terminology. Which material has to use for these as a cast iron is widely use for gear because it has a high wearing properties.

B. AC Motor

Highly reliable, high torque DC motor (Model Number – Rs-775) is best suitable for Combat robots, Drill machines, Cutting machines, and other high power applications. A DC motor is any of a class of rotary electrical machine that converts direct current electrical energy into mechanical energy. The most common types rely on electromagnetic flux. Every DC motor has its unique features. The motor which we use has shaft alignment done with ball bearing it also has a cooling fan, has copper sets of back-end.

1) The motor has a powder coated body.
2) Motor is highly efficient.
3) Motor enjoys longevity.
4) Trouble-free functioning.
5) It comes with overload protection.
6) Sealed ball bearings.
7) Motor consumes less power.
8) Bear heavy duty and high torque design.

a) Ari Ben-Menahem (2009). Historical Encyclopedia of Natural and Mathematical Sciences. Springer Science & Business Media. p. 2640. ISBN 978-3-540-68831-0. Archived from the original on 2016-12-03.

b) Matthew M. Radmanesh Ph.D. (2005). The Gateway to Understanding: Electrons to Waves and Beyond. AuthorHouse. p. 296. ISBN 978-1-4184-8740-9.

c) Jill Jonnes (2003). Empires of Light: Edison, Tesla, Westinghouse, and the Race to Electrify the World. Random House Publishing Group. p. 162. ISBN 978-1-58836-0007.

C. Gear Box by Theory of machine (S.S.RATAAN 2009)

From these book gear calculation are taken ,in which mainly Teeth , Diameter and speed are calculated as well as election of gear that which gear is sustainable for the these machine. Whether the Helical, Spur or Worm gear is withstanding the tangential force , axil force and radial force or not.

1) "Powertrain transmissions: Shift in power to the gearbox"(PDF). AMS. UnofficialBMW.com. September–October 2003. Archived (PDF) from the original on 17 July 2011. Retrieved 31 October 2009.

2) "Automatic-shifting dual-clutch transmissions are poised to grab share from traditional transmissions thanks to their combination of efficiency and convenience" (PDF). AEI-online.org. DCTfacts.com. June 2009. Archived from the original (PDF) on 7 October 2011. Retrieved 31 October 2009.

3) "Porsche Doppelkupplung (PDK)". Porsche.com. Archived from the original on 5 December 2008. Retrieved 31 October 2009.\\

D. Bearing i.e Block bearing

Pillow blocks are ideal for supporting rotating shaft applications, particularly those with low load-bearing requirements such as electric motors and gearboxes. This model from the quality RS PRO series.

1) *Deep Groove Metric Ball Bearings – Shielded:* SKF shielded deep groove ball bearings are versatile ball bearings that suit high and very high speeds, they will accommodate both radial load and axial load in both directions. The ball bearings need very little maintenance.

a) T.L, Prabhu (2019-11-12). Principles of MECHANICAL ENGINEERING: Vital Concepts of Mechanical Engineering. Nestfame Creations Pvt. Ltd. Retrieved 2020-09-19.

b) Jump up to:[a] [b] Renner, Barbara. Hands On Water and Wastewater Equipment Maintenance. CRC Press. pp. 40–43. ISBN 978-1-56676-428-5. Retrieved 2019-09-19.

c) Childs, Peter R. N. Mechanical Design Engineering Handbook. Butterworth-Heinemann.

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E. Shaft

1) Mahadevan K and Reddy K.Balaveera, (2015), 'Design data hand book', CBS publishers and Distributors (P) ltd., New-Delhi, ISBN 9788123923154

2) Theory of Machine (R. S Khurmi)

The comparison of solid shaft or hollow shaft are done. That whether we have to use solid shaft or hollow shaft. By applying shear stress, yield stress and factor of safety, we can determine that which shaft is suitable for our machine to sustain all the forces and vibrations which came during jacketing operation.

F. Guiding Rods

Theory of Machine (R. S Khurmi)

The comparison of solid shaft or hollow shaft are done. That whether we have to use solid shaft or hollow shaft. By applying shear stress, yield stress and factor of safety, we can determine that which shaft is suitable for our machine to sustain all the forces and vibrations which came during jacketing operation.

G. Linear Motion Slides

Linear motion slides are an inexpensive solution for a wide variety of applications. Linear motion slide guides consist of linear bushings that ensure quiet travel and a long service life. Linear motion slides with a closed design are suitable for self-supporting uses. Here, the guide is connected to the mounting base at both ends via shaft support blocks. Linear motion slides with an open design are fastened to the mounting base using shaft support rails.

Rexroth- A Bosch Company

https://www.boschrexroth.com/en/web/xc

III. OBJECTIVE OF PROBLEM

The specific objectives of the study can be summarized as follows.

A. To engineer the machine for jacketing of Flat Belt
B. To improve the quality, efficiency and precision of flat belt.
C. To design a machine that is economical, safe and convenient.
D. To reduces the time required for Jacketing.
E. To increase the production.

IV. MECHANICAL COMPONENTS AND SPECIFICATIONS OF ITS MATERIAL

A. Resource Used

Sr.No.	Resource Used	Quantity
1.	Main Roller	2
2.	Belt	1
3.	Folding Roller	1
4.	Base Plate	1
5.	Block Bearing	6
6.	Tapered Roller	4
7.	Conical Plate Roller	2
8.	Guiding Rod	4
9.	Pressure Roller	4
10.	Pneumatic cylinder	1
11.	Shaft and Key-way	3
12.	Bolts	12
13.	Nuts	12
14.	Motor	1
15.	Gear box	1
1.	Ball Bearing	12

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B. Specification

Sr.No.	Resource Used	Specification	Material Used
1.	Main Roller	OD=150mm ID = 140mm L=143mm	Mild Steel
2.	Belt	L=3600mm W=120mm	Rubber
3.	Folding Roller	D=100mm L=143mm	Mild Steel
4.	Base Plate	2000x300x965	Mild Steel
5.	Block Bearing	I.D.=30mm	Cast Iron
6.	Tapered Roller	D_1=80mm D_2=40mm L=55mm	Nylon
7.	Conical Plate Roller	D=140mm D=40mm L=30mm	Nylon
8.	Guiding Rod	OD=30mm T=1.5mm	Steel
9.	Pressure Roller	D=60mm L=150mm	Mild Steel
10.	Pneumatic cylinder	Max: 2000mm Min : 10mm	Steel, Aluminum
11.	Shaft and Key-way	D=30mm L=600mm	Mild Steel
12.	Bolts	D=17mm L=121.6mm	Mild Steel
13.	Nuts	ID = 17mm	Mild Steel
14.	Motor	1440 Rpm Sonee- DX 1 HP Electric Motor, 230 V	Aluminum
15.	Gear box	Gear Ratio = 1:12	Aluminum
16.	Ball Bearing	ID = 20mm	Steel

C. Mechanical Components

1) *AC Motor:* 1440 Rpm Sonee- DX 1 HP Electric Motor, 230 V. The motor which we use has shaft alignment done with ball bearing it also has a cooling fan, has copper sets of back-end, 5 groups windings and produces low noise. As the shaft is aligned with ball 16 bearing at the front end the torsional vibrations are minimum.
2) *Block Bearing:* Inside Diameter 30mm, . This model from the quality RS PRO series has an inside diameter of 30 mm. It features a two-bolt set-up that's more robust than a single bolt.This bearing housing has a pedestal mounting. It's 83 mm high, 38.1 mm deep and 165 mm long. The cast iron material is incredibly hardwearing and resilient, so you can expect a long lifetime.
3) *Pneumatic Cylinder:* Choose the diameter that is right for you, depending on the application you want to use this item for. You can select a size between 32mm and 100mm, as well as a stroke length anywhere between 10mm and 2000mm. This item also comes with adjustable cushioning and a position sensing system, as well as a male thread.
4) *Gear Box:* Torque range 100 ... 14,000 Nm (885 … 123,910 in-lb). Gear ratio 12, The A Series combines high efficiency and reliability, low maintenance costs and a wide torque range. The right angle layout between INPUT and OUTPUT makes the A Series particularly compact. The gear set combination makes this right-angle product the most efficient and durable in Bonfiglioli's light- and medium-duty portfolio. The A Series can be completed with a wide range of electric motors entirely manufactured by Bonfiglioli. Asynchronous motors both IEC and compact (BN-BE-BX/M-ME-MX), servomotors (BMD) and reluctance motors (BSR) can be coupled with the A Series.

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5) *Ball Bearing:* Deep Groove Metric Ball Bearings – Shielded, Outside Dia 42mm, Inside Dia 20mm,Race width 12mm. SKF shielded deep groove ball bearings are versatile ball bearings that suit high and very high speeds, they will accommodate both radial load and axial load in both directions. The ball bearings need very little maintenance. SKF deep groove ball bearings me in a range of different sizes. This range is single row ball bearings.

V. CONSTRUCTION

The machine works on the principle of the Jacketing mechanism. The main components of a Jacketing Machine for Flat Belt is as follow:

A. Motor
B. Gear Box
C. Pneumatic Actuators
D. Main Roller
E. Folding Roller
F. Tapered Roller
G. Conical Pate Roller
H. Guiding Rod
I. Pressure Roller
J. Shaft with Key-way

VI. WORKING OF JACKETING MACHINE

1) *Step 1. Mounting The Belt*

Initially the driven roller is at the upmost left and the bottom portion of the machine is initially at its upmost down. Then Operator have to manually mount the belt on bothe the driver roller and driven roller.

2) *Step 2. Switching on pneumatic actuator*

Then as he switches on the pneumatic actuators, on the same time both the actuators performs their respective operations. The pneumatic actuator which is horizontally mounted on the machine has to move the driven roller at its upmost right so that there will be some tension in the belt. On the same time the pneumatic actuator which is mounted vertically on the jacketing machine slides entire bottom assembly to upmost top so that the supporting rollers in the bottom assembly attaches to the belt and the operator should ensure that there will be very less clearance on the first pair of pressure rollers.

3) *Step 3. Switch ON power supply*

Operator needs to switch on the power supply of motor for the motion of belt on both the rollers.

4) *Step 4. Putting fabric on its place*

Operator needs to put the fabric roll in the jacketing machine and operator has to ensure that the first pair of pressure roller should press the fabric on the belt properly.

5) *Step 5. Folding of Fabric*

After fabric comes out from the pressure roller the operator has to ensure that the fabric gets fold over at the top side at the 90 degrees with the help of folding roller.

6) *Step 6. Closing action of fabric*

After fabric passes from folding roller the fabric will pass through the assembly of tapered rollers. Tapered roller has less Bottom diameter and more upper diameter so that the fabric gets fold over the belt properly from the upper side of the belt. Then the middle portion of the bottom assembly which consists of one conical nylon plat and tapered roller. This part ensures the proper jacketing of the fabric on the upper left side of the belt. Similarly the third portion of the bottom assembly ensure proper jacketing of the upper right side of the belt.

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7) Step 7. Final Pressing operation to ensure the proper jacketing of fabric

After the closing action of fabric the second pair of pressure rollers of mild steel will press the fabric coated rubber belt from the top and bottom side of the jacketed belt which ensures the better sticking of the fabric on the belt.

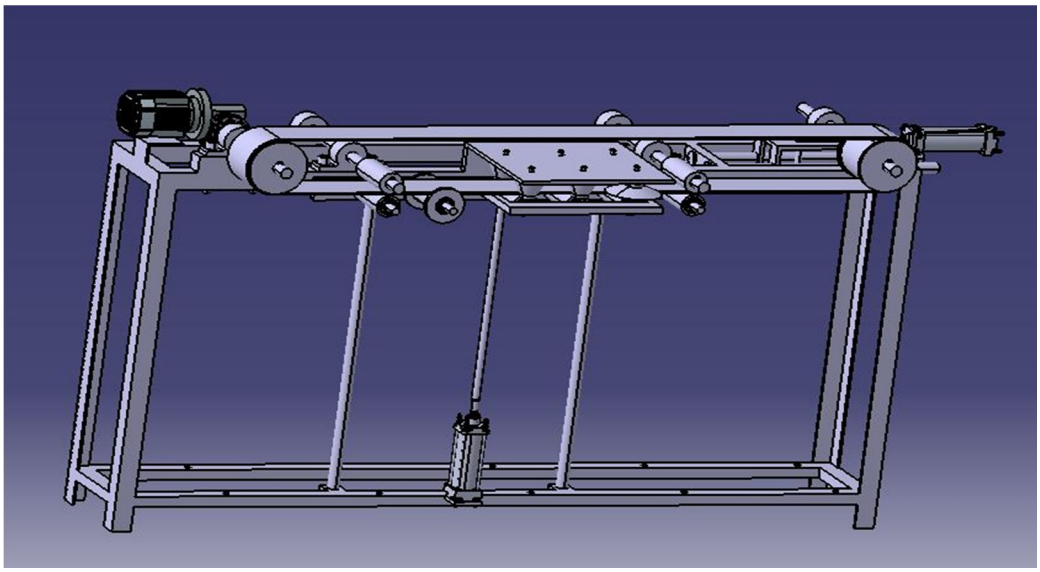
8) Step 8. Switch OFF Power Supply

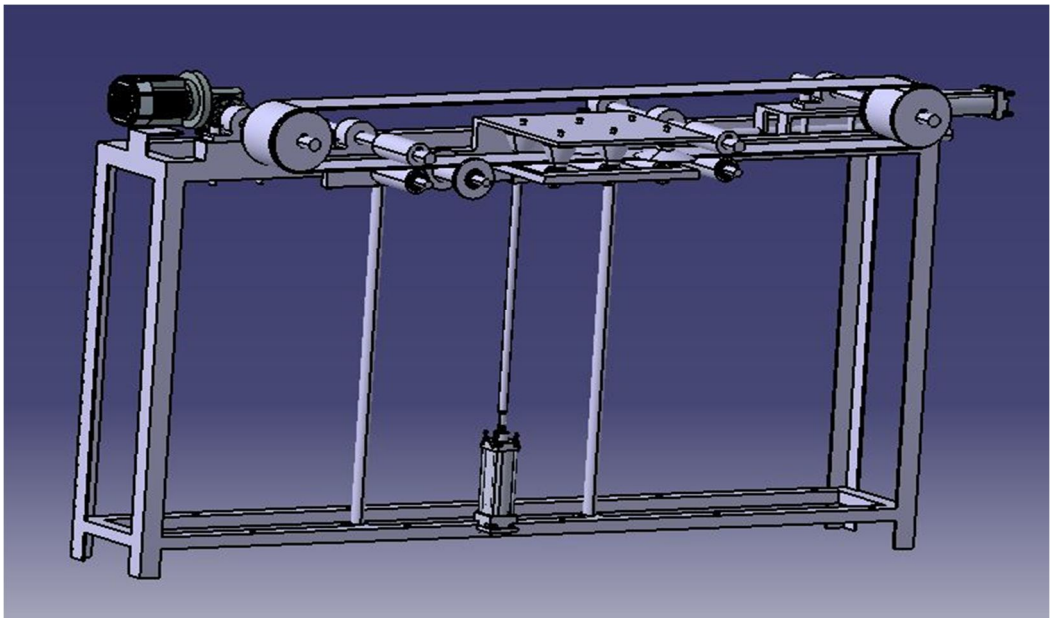
Operator needs to switch off the power supply of motor to stop the motion of belt on both the rollers.

9) Step 9. Unmounting the Final Product

Operator has to unmount the rubber flat belt from both of the roller properly in the jacketing machine. To unmount the belt the driven pulley on the right side need to slide towards left with the help of pneumatic actuators on the same time the bottom portion of the machine needs to move downward with the help of pneumatic actuators provided at the bottom side.

VII. CAD DESIGN





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VIII. RESULT AND DISCUSSIONS

A. *Interpretation Of Data*

The following figures and photos of the actual prototype cad design is done using CATIA V5 3D Modelling Software.The components did it to determine the problem, and data will also provide a sufficient result that leads the components to decide upon the appropriate material to be used.

B. *Design Constraints*

The project produces a minimal amount of vibration, so the materials that were used for the frame and the body were carefully selected. The location was also the part of consideration so the material we used is Mild Steel which is rust-resistant as the atmosphere at which this device is used can have a high percentage of moisture in it. The driven pulley can reciprocate at maximum of 2000mm.

IX. CONCLUSIONS AND FUTURE SCOPE

A. *Conclusion*

The jacketing machine is successfully designed. The machine can perform jacketing of flat belt even by unskilled labor with minimum human effort with high productivity and negligible maintenance cost. For different sizes of flat belts, pneumatic actuators can be placed at different interval with the help of adjustable slides. Automation of this machine by incorporating motor can be a boon in large scale industries. Based on the results obtained and discussions made in the previous chapter the following Conclusion were drawn:

1) The jacketing machine is suitable for Jacketing of different length of flat belt.
2) The output of this jacketing machine is more than conventional methods.
3) The power can be increased with an increase in current input which gives desired output.

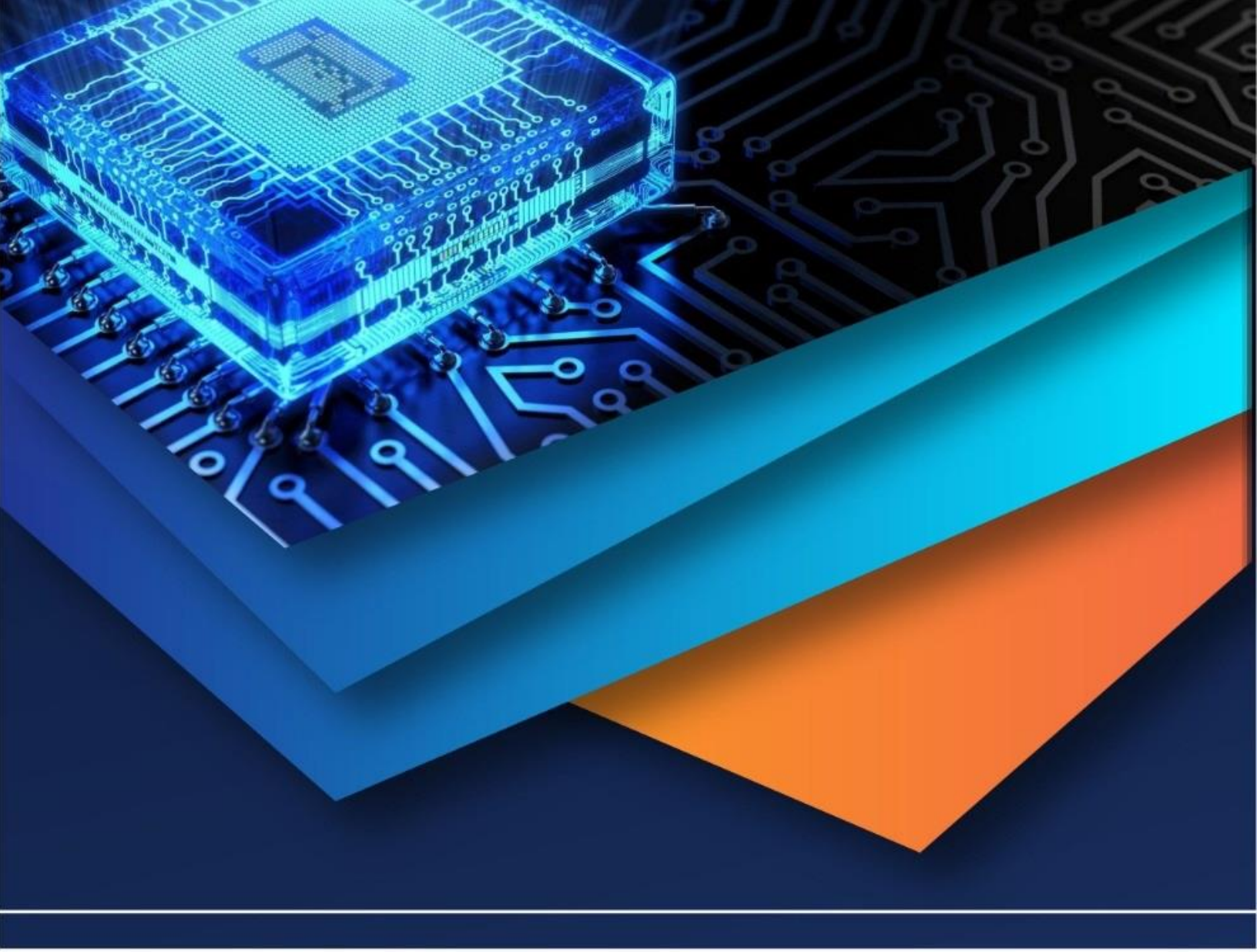
B. *Future Scope*

Study shows that while analysing the force and power for machines the designer takes the help of analysis software. The cost of software for analysis is high. So there is requirement to find simple formula. In this paper the various theories regarding bending are reviewed, formulae for force and power calculation are collected and finally a case study is taken .Our main concern is to reduce the human effort required in jacketing of flat belt and also to save the time, labour work, lead time, and move towards the partial automation and increase efficiency.

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