Design and Development of Bending Machine

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ABSTRACT

Nowadays for construction works bending of rods is necessary for constructing the pillars. Bending of such rods is done manually by setting angle plates. This wastes lot of labour (man) power and time. It is proposed to replace the manual work and reduce time taken for bending by designing an alternative machine to replace the manual work which works by the principle of simple chain drive system. This will reduce the time taken for bending operation. Bending can be done with required dimensions and accuracy is maintained during the entire operation. Along with the ease of operation use of this machine also makes it more precise, economical and compact. The entire machine is easily portable and having nice aesthetics as well.

Keywords: - *Bar Bending, Rotating Disc, Chain Drive, AC Gear Motor, Semi-Automatic, and Simple Working*

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1. INTRODUCTION

In traditional method bending of straight reinforcement bar is done with hand operated mechanism. Whole accuracy of bend is depend on Skill & experience of worker. So our project is to design and develop Bar Bending Machine. Which is used to bend bar of any free size with higher speed and desired accuracy. there are machine works on pneumatic and hydraulic are also used for making stirrups but those machine has major disadvantage of requirement of large space for storage tank and compressor which makes machine heavy and immobile.

1.1 OVERVIEW OF BAR-BENDING MACHINE

Bar bending machine is consist of electric motor, chain drive, Rotating Disc, extended shaft and ball bearing. Electric motor transmits power to shaft through chain drive. Which is used to bend bar with the help of rotating disc. Bend at any required angle for bar having dia. 6 to 10mm (i.e. ½ HP motor). By using higher HP motor it can bent up to 25mm.

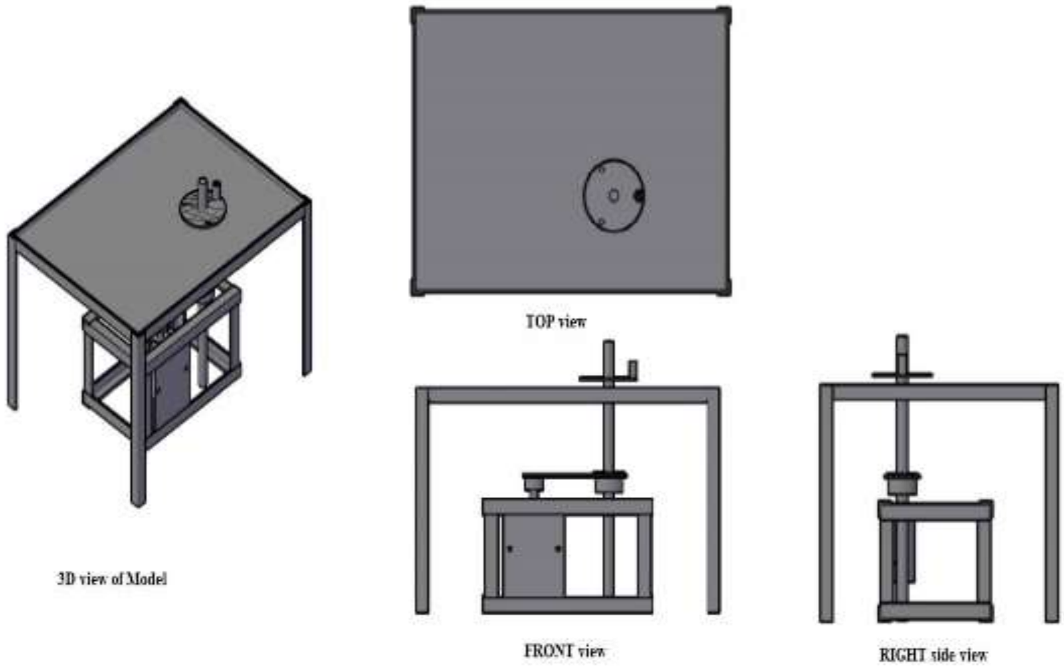

Fig.1: [3D view of Model]

1.2 ADVANTAGE

a. Low cost as compared to hydraulic and pneumatic machines.

b. Less skilled and uneducated worker can also operate this machine.

c. Less time consuming.

d. Less effort required.

e. Higher production rate with desired accuracy

f. It is portable

1.3 DISADVANTAGE

a. Chances of accident due to improper concentration on work.

b. It totally stops functioning in absence of electricity.

1.4 APPLICATION

a. For bend a bar up to 10 mm.

b. By using hollow pipe on rotating disc sheet metal can be bend up to 5 mm

2. DESIGN

Table 1 Component Description[5]

Component	Material	Description
Shaft	Mild Steel	Ultimate tensile strength 560-670 MPa Yield strength 320 MPa Shear strength IS 60% of min. tensile strength
Rotating Disc	CAST IRON	Shear strength 42MPa Tensile strength 151 to 427 MPa Compressive strength 572 to 1289 MPa
Chain Drive A. Sprocket B. Chain	A. Medium Carbon Steel B. Cast iron	A. Ultimate tensile strength 560-670 MPa Yield strength 320 MPa Shear strength IS 60% of min. tensile strength B. Shear strength 42MPa Tensile strength 151 to 427 MPa Compressive strength 572 to 1289 MPa
Ball Bearing	Stainless Steel	305 Standard
Structure	Iron	-----
AC Gear Motor		Parallel shaft gear motor. Power: 0.5 HP Power supply: 3 phase High torque 50 to 320 N.m

3. CALCULATION

3.1 Force required to bend bar

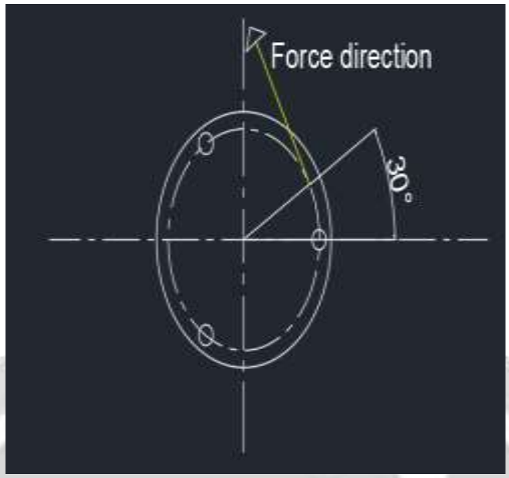

Fig 3: [Rotating disc force direction]

I=$\frac{\pi}{64}D^4$

Consider diameter of bar = 10 mm

Than moment of inertia, I = 490 mm^4

For SI Grade 20 Bar Yield strength is given below

S_{yt} = 271 N/mm^2 (from web)

y=D/2 = 5mm

σ= $\frac{S_{yt}}{fos}$ = 271/3= 90.33 N/mm^2

M= $\frac{I*\sigma}{y}$

=$\frac{490*90.33}{3}$

= 8868.05 N.mm

Considering bar as simply supported beam

Take a length of bar approx. 250mm

Load (w) = Force (F)

M = $\frac{w*L}{4}$ = $\frac{250w}{4}$

W= 285 N

F_t = Actual force

cos θ= $\frac{F}{F_t}$ =$\frac{285}{F_t}$

By take reading practically force are applied on fixed bar on rotating disc average angle is 30.

F_t= 285 cos 30 = 330 N

Now Torque T = F_t * R = 330 * 70 = 23100 N.mm= 23.1 N.m

Power, P= $\frac{2\pi NT}{60}$ = $\frac{2\pi 90*23.1}{60}$= 217.71watt

Hence a selected motor is sufficient for produce torque to bend bar.

3.2 Chain Drive

Chain dimensions

Length of chain: 65 cm

Pitch: 1 cm

Width: 0.5 cm

Driver Sprocket

No. of teeth: 16

Bore dia.: 15 mm

Outer diameter: 50 mm

Pitch circle dia.: 45 mm

Width of tooth: 3 mm

Thickness of tooth: 4 mm

Speed: 90 rpm

Driven Sprocket:

No. of teeth: 24

Bore dia.: 25.4 mm

Outer diameter: 80 mm

Pitch circle dia.: 70 mm

Width of tooth: 5 mm

Thickness of tooth: 4 mm

Speed N_2= $(T_1/T_2)*N_1$

= (16/24)*90

= 60 rpm

Velocity Ratio for Chain Drive = N1/N2

= 90/60

= 1.5

Breaking load on chain $W_b = 106p^2$

= 106*10*10

= 10600 N

Pitch line Velocity V1 = $\frac{\pi dn}{60}$

= $\frac{\pi * 0.05 * 90}{60}$

= 0.23 m/sec

Load on chain = $\frac{\text{Rated power}}{pitch\ line\ velocity(v1)}$

= 373/0.23

= 1621 N

Factor of safety = $\frac{Breaking\ load\ (Wb)}{Load\ on\ chain\ (W)}$

= 10600/1621

= 6.53 say 7

Table 2 Values are from BS 228, ISO 606

The normal maximum velocity relates to sprockets with 17-25 teeth. [6]

Pitch	**Normal Max. Velocity**	**Chain Identity**	**Breaking Force In Newton**
8	5000	05B-2	7800
9.525	4200	06B-2	16900
12.7	3750	08B-2	32000

The minimum centre distance between the smaller and larger sprockets should be 25 to 30 times the pitch. Let us take it as 25 times the pitch.

Centre distance between the sprockets, = 25*10 = 250 mm

In order to accommodate initial sag in the chain, the value of centre distance is reduced by 2 to 5 mm.

X =250-5 = 245 mm

We know that the number of chain links

K = $\frac{T1+T2}{2} + \frac{2x}{p} + [\frac{T2-T1}{2\pi}]^2 \frac{p}{x}$

= $\frac{16+24}{2} + \frac{2*245}{10} + [\frac{24-16}{2\pi}]^2 \ \frac{10}{295}$

= 69.054

Length of chain L = K.p

= 70*10

= 700 mm

3.3 Ball Bearing

Table 3 Principal dimension of ball Bearing [7]

Bearing No.	Bore(mm)	Outside Diameter	Width (mm)
205	25	52	15
305	25	62	17
405	25	80	21

Selected bearing 305 number.

3.4 Rotating Disc

Material: Cast Iron

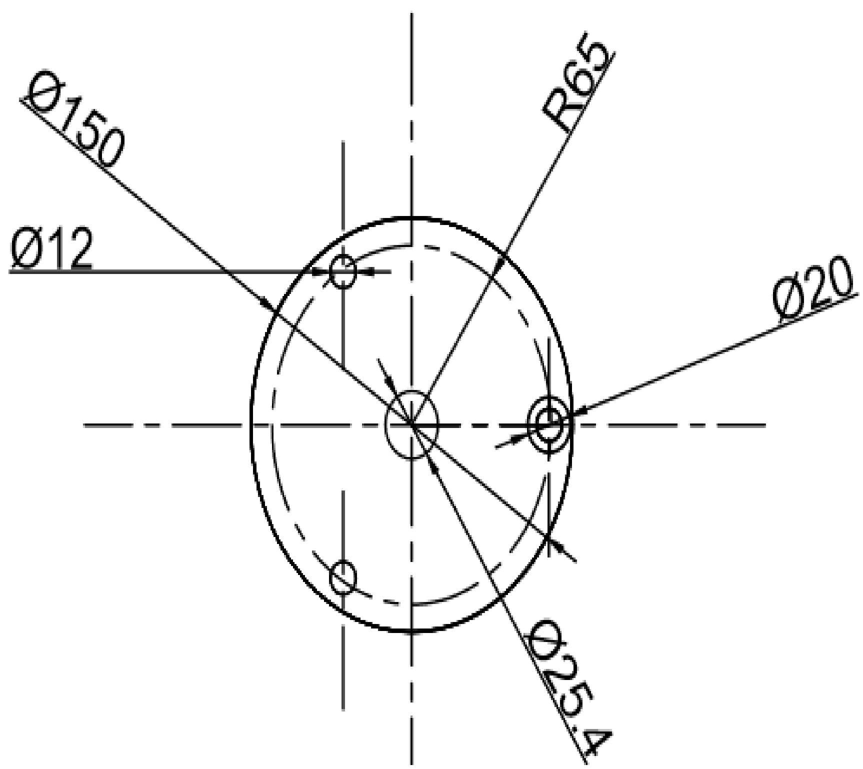

Fig 4: [Rotating Disc Dimensions]

3.5 Shaft

Material: Mild Steel

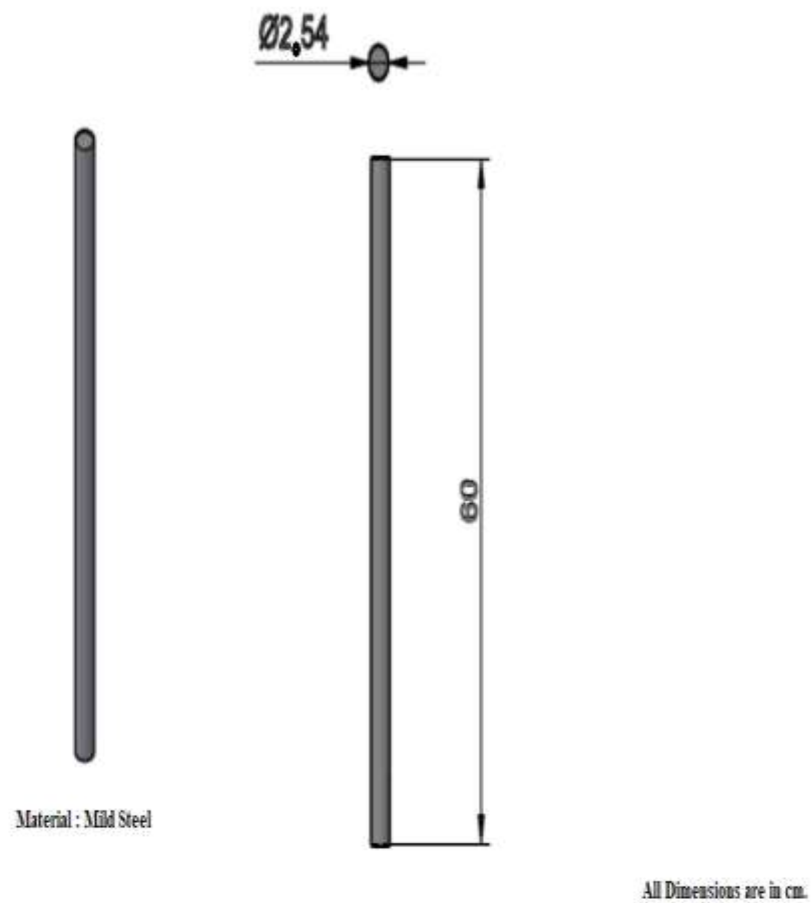

Fig 5: [Shaft Dimensions]

4. CONCLUSION

The project has carried on the detailed calculation and checking aiming at main components of bending machine.

Through complicated, accurate calculation can bring great convenience to choosing components precisely so as to guarantee the machine running in good condition, avoid wear and tear caused by some certain problems, and thus increase machine's service life.

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