Manufacturing Process of Transverse Slider on Civil Building 3D Printing Machine

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Keywords: Slider, Manufacturing Process, 3D Printing.

Abstract: The transverse slider is one of the components in the 3D machine civil building printing which serves to help bring the nozzle to the coordinates according to the desired building design in order to produce the shape according to the design. 3D machine printing Civil buildings require a device designed to be a carrier for other components. Transverse slider will carry the nozzle with the help of the motor movement, then with the help of the control the slider will move according to its coordinates so as to help bring the nozzle to the coordinates of the building design. The construction of the transverse slider on the Civil Building 3d printing machine is carried out by machining and fabricating the parts such as lathe, milling, grinding, and welding. After the Slider is completed and realized at the Bandung Manufacturing Polytechnic Department of Manufacturing Engineering, it is hoped that the Slider can be used for the manufacture of civil buildings and function properly and be useful for the Polman academy, and the State of Indonesia.

1 INTRODUCTION

Along with the times, the manufacturing industry is always developing continuously so that advances in manufacturing technology can simplify and speed up the production process, as well as its relation to civil technology that applies the Additive Manufacturing method by means of 3D Print for building construction. Additive Manufacturing is a manufacturing process by adding material in layers so that it can form something called finished product, this building construction can be operated by 3D Print which processing time is relatively faster compared to manufacture by human labor.

3D Print building or 3D building concrete casting machine (3D Concrete Building Printing) has a working principle similar to 3D Print in general, namely the FDM type, where the building to be printed can be formed by adding concrete material and removing it layer by layer through a nozzle whose movement is operated by the program. 3D Print this building requires nozzle for Secrete ingredient geopolymer which becomes ingredient building, so it is necessary sliders for bring nozzle to the desired coordinates so that the designed building could formed.

The working principle of the 3d printing transverse slider for civil buildings is that the servo motor will rotate according to the direction of the computer. The servo motor will turn the gears on the rack gear to move Slider according to coordinates. The slider will bring the nozzle to form the desired civil building design.

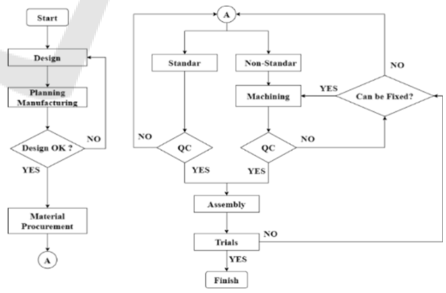

Figure 1: Flowchart manufacturing transverse sliders.

2 SOLUTION METHODS

In this solution method, it begins by making design based on found references. After To do planning start the planning process making about how sliders this will made. After planning done so start at stage material procurement, material procurement is

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divided into 2, namely standard materials and non-standard materials. On standard materials done QC for knowing can the material used for construction sliders machine 3d printing Building Civil. On non-standard materials apply machining process for make the desired part, after that then the part already through the machining process enter Step QC for be measured can parts used in construction sliders.

After all parts collected so start assembly process is carried out or assembly for shape construction sliders transverse. After the construction is done assembled, a trial is carried out on the slider construction to find out whether the slider can function properly or not.

Slider already experience trial stage and test results obtained that sliders could used for construction machine 3d printing building Civil , then the manufacturing process sliders transverse done.

2.1 Design

Slider transverse is the slider that brings the nozzle to the required coordinates, the placement of the transverse slider on the construction of a 3d printing machine for civil buildings as in the following picture:

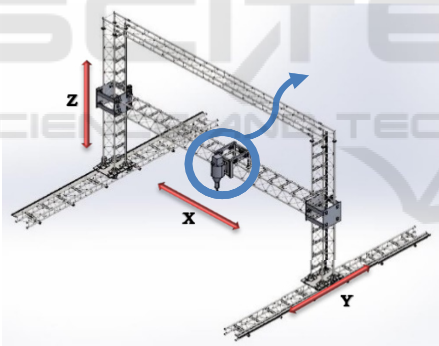


Figure 2: Construction machine 3d printing.

slider is on the x-axis carrying the nozzle to direct the nozzle to print the geopolymer according to the desired design.

The design for the transverse slider is made as follows:

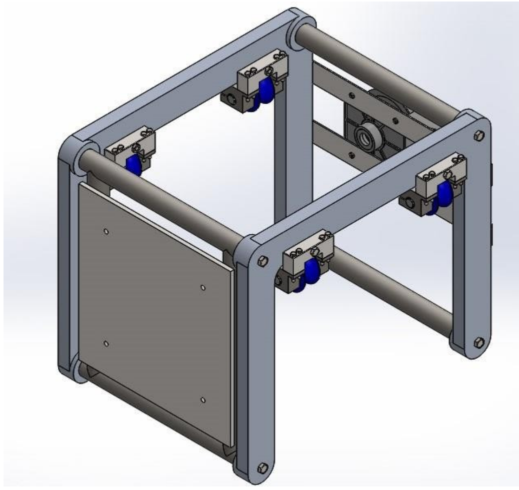


Figure 3: Design slider.

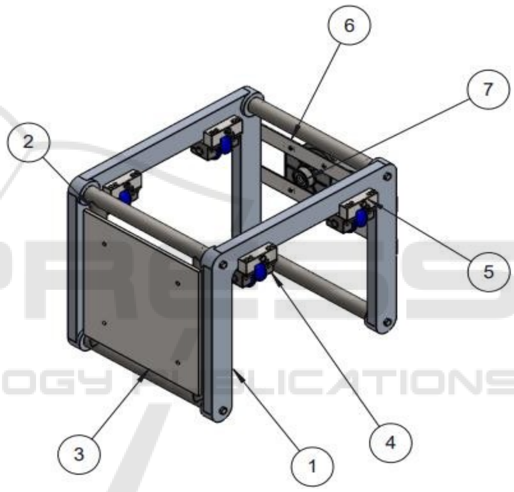


Figure 4: Parts slider.

Table 1: Part names Slider.

No Part	Component Name
1	Slider Frame
2	Bracket Mount Pipe
3	Bracket Plate Nozzle
4	Wheel Assy
5	Wheel Spacers
6	Servo Motor Bracket
7	Gearbox Nema

design frame Sliders:

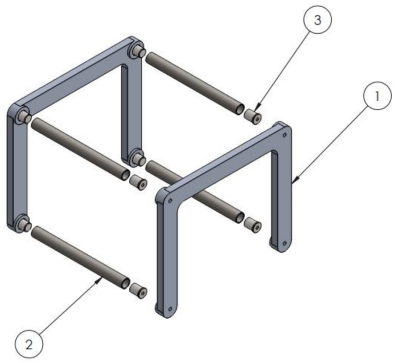


Figure 5: Parts frame sliders.

Table 2: Part names frane sliders.

No	Part Name
1	U- frames
2	Connecting Pipe
3	Shaft cover

design assy Wheels:

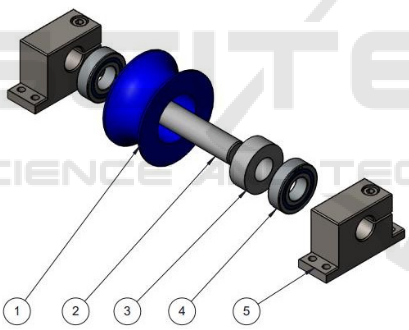


Figure 6: Parts wheel assy.

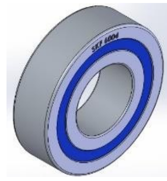
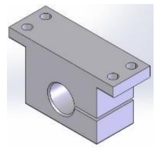
Table 3: Part names wheel.

No Part	Component Name
1	U Groove Wheel
2	Wheel axle
3	Spacers
4	Bearing SKF 6004
5	Shaft Support

2.2 Material

2.2.1 Standart Material

Table 4: Standard components.

No	Part Name	Specification	Picture
1	Bearing	SKF 6004	
2	Shaft Support	SHTCMN 20	
3	Bolt	7000454	
		7040172	
		7040140	
		7000182	
		DIN933	

2.2.2 Non-Standard Material

Table 5: Components non-standard.

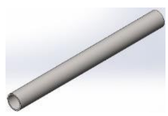
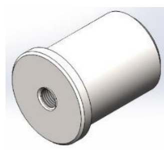
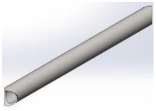
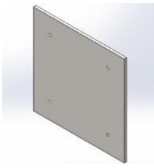
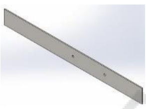
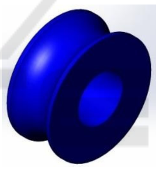
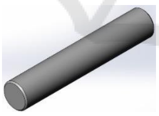
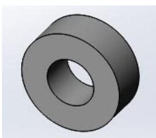
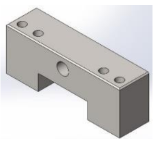
No	Part Name	Specification	Picture
1	Frames Slider	Junk aluminum	
2	Retaining Pipe	S45C	
3	Shaft Cover	ST37	

Table 5: Components non-standard. (cont.)

4	Mount bracket pipe	S45C	
5	Bracket Plate nozzle	ST37	
6	Servo Motor bracket	ST37	
7	Wheel	PTFE	
8	Shaft	ST37	
9	Spacers	ST37	
10	Top wheel spacer	ST37	

2.3 Calculation

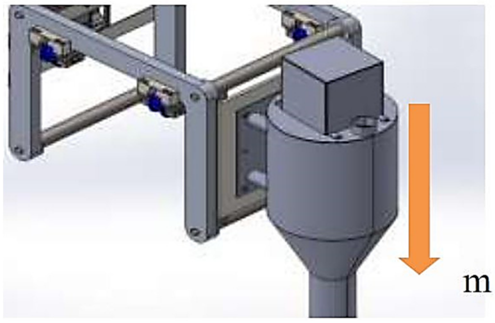


Figure 7: Load from nozzle.F.

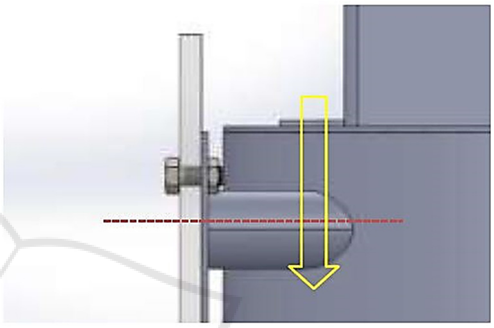


Figure 8: Forces acting on bolts.

Known:

Table 6: Nozzle Technical Information.

No	Technical Information	Score
1	**Nozzle Mass**	**107.82 Kg**
2	**Yield strength ST 37**	**250 MPa**
3	**Sectional area M10 bolt**	**52.30mm2**

$$\sigma_{pm} = Re / Sf = 250 / 2 = 125 \text{ N/mm}^2 \qquad \tau pm = 0.7 \text{ x } \sigma pm = 0.7 \text{ x } 125 \text{ N/mm}^2 = 87.5 \text{ N/mm}^2 \quad (1)$$

Description

σpm = Voltage pull /normal clearance (N/mm^2)

τpm = Permissible shear stress (N/mm^2)

Re = Resistant extension (N/mm^2)

Sf = Safety factor

⁂Safety Factor for static loading = 1.2 – 2

- Maximum load of M10 baut bolt

$$\tau = F / A \quad (2)$$

$$F = \tau \times A$$
$$= 87.5 \times 52.30 \quad (3)$$
$$= \underline{4576.25\ N}$$

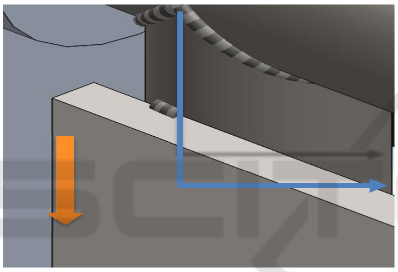
The force from the nozzle is 1078 N, it can be said that 1 M10 bolts are able to withstand the nozzle load However, with all considerations, 4 M10bolts are used.

Description
τ = sheer stress (N/mm2)
A = Cross-sectional area (mm2)

- Determining the shear stress received by the bolt.

F = 1078 N
Loading divided by 4bolts
F = 1078 N/4 = 269.5 N

$$= F / A$$
$$= 269.5\ N / 52.30\ mm^2 \quad (4)$$
$$= 5.15\ N/mm^2$$



Welded part

Figure 9: Force on welding.

Table 7: Welding technical information.

No	Technical Information	Score
1	**Permit voltage σ**	125 N/mm ^{2}
2	**Coefficient γ2**	0.5
3	**Welded length (l1)**	160.45 mm
4	**Hem welding**	3 mm

- Welding clearance voltage.

$$\sigma pm = Re/Sf \qquad \sigma wpm = \gamma 2 \times \sigma pm$$
$$= 250 / 2 \qquad = 0.5 \times 125 \quad (5)$$
$$= 125\ N/mm^2 \qquad = 62.5\ N/mm^2$$

Description

σpm = Tensile stress/normal allowable (N/mm²)

Re = Resistant extension (N/mm²)

σwpm = Allowable welding stress (N/mm²)

sf = Safety factor

⁂Coefficient γ2 for weld seams that have not been tested = 0.5

- Welding area

$$L = l_1 - 2A \qquad Aw = L \times A$$
$$= 160.45 - 2\,(3) \qquad = 154.45 \times 3 \quad (6)$$
$$= 160.45 - 6 \qquad = 463.35\ mm^2$$
$$= \underline{154.45\ mm}$$

- The stress that occurs in the weld seam

$$\sigma = F / Aw \qquad \leq \sigma_w\ izin$$
$$= 539\ N/463.35\ mm^2 \qquad \leq 62.5\ N/mm^2 \quad (7)$$
$$= 1.16\ N/mm^2 \qquad \leq 62.5\ N/mm^2$$

⁂The force given by the nozzle is 1078 N, welding is carried out on 2 pipes as a support, then the load is divided on both pipes into F = 1078 / 2 = 539 N

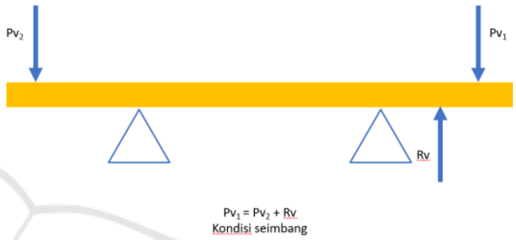


Figure 10: Balance.

Note;
Pv_1 = Load from nozzle
Pv_2 = Load of motor
Rv = Resistance vertical from the strength of resistance M6 bolt shear stress in therack along the pillar

$$Pv_1 = Pv_2 + Rv \quad (8)$$

1078N = 23N + Rv
Rv = 1055N

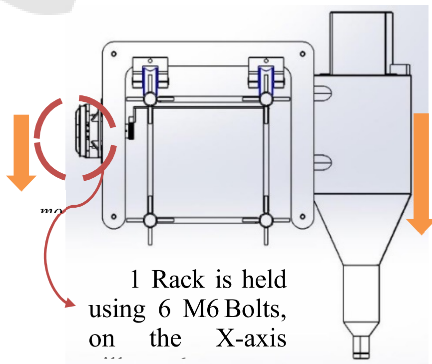


Figure 11: Balance on the slider.

$$\tau = F / A \quad F = \tau \times A \tag{9}$$

$$\begin{aligned} &\geq 1055\ N \\ = 87.5 N/mm^2 \times 17.89 mm^2 \quad &\geq 1055\ N \\ = \underline{1565.37\ N} \quad &\geq 1055\ N \\ &\geq 1055\ N \end{aligned} \tag{10}$$

The force from the nozzle is 1078 N, it can be said that 1 M6 bolt is able to withstand the nozzle load.While the pillars are installed 24 M6 bolts.

2.4 Machining Process

Information :

F = Foundry	CML = CNC Milling
HG = Hand Grinder	BW = Bench Work
BS = Bend Saw	ML = Milling
BO = Bor	GC = Grinding Cut
L = Lathe	QC = Quality control

Table 8: Stages of the construction process Slider.

No.	Part Name	Qty (pcs)	Stages of the Working Process				
			1	2	3	4	5
SM-01-01	U-frames	2	F	CML	QC		
SM-01-02	Connecting Pipe	4	GP	HG	QC		
SM-01-03	Shaft Cover	8	BS	L	QC		
SM-02	Bracket Mount Pipe	2	GC	HG	QC		
SM-03	Bracket Plate Nozzle	1	HG	BO	QC		
SM-04-01	U Groove Wheel	4	BS	BW	L	QC	
SM-04-02	Shaft	4	L	QC			
SM-04-03	Spacers	4	GC	BW	L	BO	QC
SM-05	Spacers top wheel	8	ML	BO	QC		
SM-06	Servo Motor Bracket	2	HG	BO	QC		

Information :
EW = Electric Welding Th = Adjustment/Thread HG = Hand Grinder QC = Quality control

Table 9: Stages of the process of working on sub- assembly parts.

No.	Part Name	Qty (pcs)	Stages of the Working Process			
			1	2	3	4
SM-01-00	Slider Frame	1	EW	HG	Th	QC
SM-04-00	Assy Wheel	1	Th	QC		

2.5 Assembly

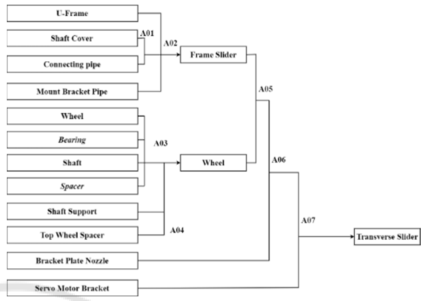


Figure 12: Assembly Diagram.

2.6 Estimated Time

Table 10: Estimated Time.

No.Part	Part Name	Qty	Estimate		Total (Minute)
			TNC	TC	
SM-01-01	**Frame**	**2**	**85**	**90**	**175**
SM-01-02	**Connecting pipe**	**4**	**17**	**0,94**	**17,94**
SM-01-03	**Shaft cover**	**8**	**57**	**49,6**	**106,6**
SM-02-00	**Bracket Mount Pipe**	**2**	**11**	**7,72**	**18,72**
SM-03-00	**Bracket Plate Nozzle**	**1**	**20**	**80,3**	**100,3**
SM-04-01	**Wheel**	**4**	**25**	**100**	**125**
SM-04-02	**Shaft**	**4**	**35**	**55,4**	**90,4**
SM-04-03	**Spacer**	**4**	**16**	**9,4**	**26,4**
SM-05-00	**Top Wheel Spacer**	**8**	**41**	**95**	**136**
SM-06-00	**Servo Motor Bracket**	**2**	**19**	**95,3**	**114,3**
Total :			**326**	**583,66**	**910,66**

Adding with 33.95 welding time, the estimated machining process = 944.61 Minutes

2.7 Estimate Cost

Table 11: Estimation Cost.

No.	Detail cost	Total cost
1	**Machining Process**	**Rp 458.100**
2	**Operator (man power)**	**Rp 227.415**
3	**Standart Part**	**Rp 4.114.876**
4	**Non standart part**	**Rp 2.244.590**
5	**Overhead cost**	**Rp 1.426.996**
Total Cost :		**Rp 8.561.977**

3 CLOSING

1. The construction have dimensions 540 x 568.30 x 720.50 mm with weight 56 Kg,using 4 wheels, 2 pieces frame, 4 connecting pipes, motor bracket on the side right and nozzle bracket on the sideleft . Materials used in the form of aluminum, carbon steel and PTFE.
2. In machining process moment making Transverse slider through various machining and fabrication processes likemilling, lathe, grinding, and welding.
3. Estimate time needed to make Transverse slider on machine 3d printing of buildings civil is 15.74 Hours
4. Estimate cost required for make Transverse slider on machine 3d printing of buildings civil is Rp8.561,977

REFERENCES

Goeritno Wahjoe; Wikanda Uli; and S.Ecep. 2000. Standar polman Seri 0 Bandung; Bandung Polytechnic of Manufacturing.

Elemen Mesin 3 Perhitungan Elemen Mesin; Bandung Polytechnic of Manufacturing.

Pendidikan Dosen, 2. 2022. Transmission is. July 19,2022 accessed from Transmission are – Functions, Types, Components & Working Methods (dosen Pendidikan.co.id)

Waloeyo, Gamawan A. 2021. Biaya Dasar PPC. Bandung; Bandung Polytechnic of Manufacturing.

Susanti O. 2021. DESIGN AND CONSTRUCTION OF TAILSTOCK ON MINI 2 AXIS CNC LATHE MACHINE AT MANUFACTURING POLYTECHNIC, BANDUNG. (BANDUNG MANUFACTURING POLYTECHNIC)

Gallavotti, Giovanni. The elements of mechanics. Springer Science & Business Media, 2013. Mechanics and Elements PDF Engine (Free 220 Pages) (pdfdrive.com); July 15, 2022; accessed from pdfdrive.com

Hashim, Jasmi. The production of metal matrix composites using the stir casting technique. Diss. Dublin City University, 1999. Casting Technique Metal & Treatment Hot PDF (196Pages) (pdfdrive.com); July 16, 2022; accessed frompdfdrive.com.

No	Rincian Biaya	Biaya Keseluruhan