

Multipurpose Horizontal Mortising Machine for Domestic Purpose

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ABSTRACT: The main objective of the paper is to develop a multipurpose mortising machine for small scale wooden works by using a very cost effective and cheaper material. During the development process the main thing that was kept in mind was easy handling of machine by any person with least accidental problems. Different materials which are easily available in market are used for fabrication of machine and use of small tools made this machine multipurpose. Two different tools are used according to their usage. First is drill bit and second is end mill cutter. Drill machine is used for operating various operations. Along with that Bakelite material is used as a bed for positioning the job in various axis. The toggle clamp is used for clamping the job during work. Drill machine is attached with wooden sheet for positioning up and down according to work. So over all a simple, easily available and daily based materials are used in development of machine. At the end the Material Removal Rate is also calculated for drilling and slotting by end mill cutter.

KEYWORDS: Horizontal mortising machine, Drill machine, Drill bit 8mm, Four flute end mill Cutter 8mm, Material Removal Rate

I. INTRODUCTION

Due to modernisation of industry, the development of machines increases according to need in mechanical industry. Now days the main focus of manufactures is to manufacture machines of heavy duty with high profit. The economical and low cost machines are not developing now days. So we developed a machine for wood work which is useful at carpenter end as well as at domestic end. In this, energy saving days, the main motive is to develop an economical drilling and slotting operation machines in wood work. In this work we present a machine which is used for drilling and slotting wooden pieces. This machine is developed by using various materials which are economical. Due to increase investments in machine it is necessary to develop low cost machines (Parmod et al. 2016). With increase application of deep hole processing technology in various industries, it is required to develop economical ways of machining, which is very important in mechanical processing (Wang 2014).

There are lots of patents on mortising machines. These designs are available for heavy purpose work and are costlier in nature. Our main objective of the work is to simplify the design and operation of machine. So that the person using this machine can operate it easily. The mortising machines are vertically and horizontally operated according to its use.

Horizontal mortising machine are used for mortise and loose tenon joints and the main advantage of horizontal mortising is that the pieces are mortised into end grains. Traditionally slotting is done by router bits in wood works, but four flute end mill cutter is used in this work. It moves faster and provides good surface finish during the work and the ends of pieces are found to be very smooth after work. In Horizontal machine the bed on which job is clamped can be moved in any direction during the work according to requirement. The work performance is easy with this horizontal machine as compare to vertical machine.

Drilling and slotting is the main machining operation in mechanical field. These operations are performing on various kinds of materials i.e. mild steel, stainless steel, cast iron, aluminium, copper and wooden. So in this work the slotting operation is perform so that if we successful in setting this machining operation at low cost , then it is very useful for user and customers. These operations are vastly used in industry by various machines and numeric control machines. But by using using cheaper material for fabrication and cheaper tools for machining then it is very effortful and needful research work for users involved in woood work line. In this work we used to slot and drill wooden pieces and

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developed a machine for small purpose and various wooden works i.e. mortising wooden pieces and tangle joints , slotting and drilling work pieces. Searching the cheaper ways for machining is very useful for industrialists. In these days and main focus in present days is energy saving and cost saving with quality. These energy saving and economical concepts are quite effective and having good future scope.

II. METHODS AND MATERIALS

Mortising machine is specialised for wood working. Chain mortiser, square chisel mortiser and most recent horizontal mortisers are used for wood work. These machines remove the traditional ways to cut mortise such as, by hand. These traditional ways are time consuming and increase cost incurred. Horizontal mortise is recent innovation and is effective because the job is clamped on axis table and the table can be moved according to required position. There are various mortising machines available but the main focus of paper is to develop an effective machine at very low that is useful during the work. These machines are also helpful in energy saving and in small works.

Working of Mortising Machine: In this work the wooden pieces are used as a job. Various tools can be used according to power or requirement of work. For the same a four flute end mill cutter, which is a good option as compare to router bit, is used and the trails are made by using this end mill cutter. This operation is performed on twelve wooden pieces for observing and obtaining accurate work and the proper functioning of work and machine Also drill bit is used for drilling the pieces of wooden blocks. Twelve trails are made for testing the working of machine and to test the performance of assembled material in machine. The machine respond very well during work and the cheaper material used in this work becomes successful.

Machine Set up: In this research, the machine is fabricated with materials which are easily available in market at affordable cost. The drill machine is used for drilling and slotting. Bakelite wooden material is used for making bed on which the job is clamped. Three pieces are used of Bakelite material which is overlapped on each other and the job is clamped on this. The angle of 30 degree is provided on sides of pieces so that they gripped each other and move in any position manually.



Figure 1: Horizontal Mortising Machine

Four flute end mill cutter of HSS material and drill bit are used in this work for operating. Toggle clamp is used for clamping the job and this clamp cover fewer places on the bed where work is to be done. The M.S angles are used as a stand for working. The drill is attached to Bakelite piece which is easily adjusted up and down up to 6 inches according to job requirement.

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Machine Specifications and cost of material of developed machine:

Drill machine- 1500 rpm with adjustable speed (Rs1200)

Bakelite material- 3 pieces for bed (700)

Trolley M.S- Rs. 1500

Miscellaneous expenses included labour cost- Rs 1500

Design considerations: The points that are taken into consideration for designing a product are as following:

1. The bed of machine is made by using three pieces of Bakelite material and overlaps each other by providing angle of 30 degree at corners of pieces.
2. The important design consideration is clamping of job, it should be easy and less time and effort consuming.
3. The drill machine attached to wooden piece should be attached tightly so that during work the chattering problem doesn't affect the work.
4. The screws and accessories used for bed, clamps, and drill machine setting should be easily available.
5. The cost of fabrication of machine is cheap and design should be simple, so that it is possible for user end to operate machine easily.
6. The study of the design should be done thoroughly before fabricating. It should always be ensured that the work is done in proper sequence. This will ensure zero loss of material. It should always be preferred that there is maximum operation in a single setting of the work piece.

III. RESULT

Results for MRR: In this research after development of machine, trials were taken by using drilling and slotting process. Further MRR (Material Removal Rate) of the machine was calculated along with the working of machine. During drilling process a wooden piece of 3'' wide and 4'' long was taken and drilled at different lengths to test the capability and strength of machine. During the process of slotting an end mill cutter was used and a slot of 3'' wide was made with length of 3mm, 4mm, 5mm, and 6mm respectively. 12 pieces of weight 40 gm were used for slotting process and for drilling process. Slotting is done by using four flute end mill cutter and in drilling the normal wooden bits are used. Results for drilling and slotting process are given in table (i) and (ii). According to table (i) the drilling operation is perform and the final results are observed by calculating the weight of piece. It is clearly shown in table that the by increasing depth of cut the material removal rate is increased. In parallel the machine assembly is tested and observed manually and machine did not vibrate and chattered during work and the clamps used for clamping job clamped the job very tightly. In table (ii) the slotting operation is performed by using end mill cutter (four flute) in place of router bit and this is good option in wooden work. For slotting the depth of cut and slotting size is continuously increased during work. The material removal rate is calculated by subtracting the final weight from initial weight and the machine again perform well and did not show ant chattering during work.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

Table (i): Results for MRR by using drilling process

S.No	RPM	Depth of cut	Initial wt	Final wt	MRR(gm)
1	1400	0.5 mm	40 gm	39.2	.8
2	1400	1mm	40 gm	38.4	1.6
3	1400	1.5 mm	40 gm	37.6	2.4
4	1400	2 mm	40 gm	36.8	3.2
5	1400	2.5mm	40 gm	36.1	3.9
6	1400	3 mm	40 gm	35.2	4.8
7	1400	3.5 mm	40 gm	34.4	5.6
8	1400	4 mm	40 gm	33.6	6.4
9	1400	4.5 mm	40 gm	33	7
10	1400	5 mm	40 gm	32.2	7.8
11	1400	5.5 mm	40 gm	31.4	8.6
12	1400	6 mm	40 gm	30.4	9.6

Table (ii): Results for MRR by using slotting process

S.No	RPM	Depth of cut	Initial wt	Final wt	MRR(gm)
1	1400	0.5 mm	40 gm	37.5	2.5
2	1400	1mm	40 gm	35	5
3	1400	1.5 mm	40 gm	32.5	7.5
4	1400	2 mm	40 gm	30	10
5	1400	2.5mm	40 gm	27.5	12.5
6	1400	3 mm	40 gm	25	15
7	1400	3.5 mm	40 gm	22.5	17.5
8	1400	4 mm	40 gm	20	20
9	1400	4.5 mm	40 gm	17.5	22.5
10	1400	5 mm	40 gm	15	25
11	1400	5.5 mm	40 gm	13.4	26.6
12	1400	6 mm	40 gm	10.2	29.8

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IV. CONCLUSION

1. The machine provides good results during operating & there is no any kind of difficulties during work.
2. The fabrication of machine remains firm and strong. There is no chattering and vibrations which affect the work.
3. It can be easily handled by any person.
4. Small purpose operations can be easily done by using this machine.
5. Cheaper concept.
6. Slotting by horizontal machine is quite easy as compared to chisel mortising.
7. Four flute End mill can be used for mortising as this is quite a cheaper option as compare to many of router bits.
8. It provides a good surface finish.

V. FUTURE SCOPE

1. Various materials like plastic, nylon can be machined by this machine.
2. The research can be extended according to job requirement and power requirement.
3. Variety of tools can be used according to requirements.

REFERENCES

- [1] Pramod V.,Purushottam. K, Kadam M., Sarawade S. (2016). Design And Development Of Wood Cutting And Drilling Mechanism Using Sewing Machine.IOSR Journal of Mechanical & Civil Engineering (IOSRJMCE) pp.39-42.
- [2] Wang, X. W., & Qin, H. W. (2014). The Design of Depth Drill Machine Based on Automatic Control AC Servo System. In *Applied Mechanics and Materials*. Vol. 672, pp. 1779-1782). Trans Tech Publications.
- [3] Gye, H. R., Song, B. U., Lim, Y. S., Shin, Y. W., Jang, S. H., &Seo, T. I. (2013). Prediction of Cutting Force and Tool Deflection in Micro Flat End Milling. *International Journal of Materials, Mechanics and Manufacturing*,1(1), 13-16.
- [4] Lazoglu, I. (2003). Sculpture surface machining: a generalized model of ball-end milling force system. *International Journal of Machine Tools and Manufacture*, 43(5), 453-462.
- [5] Chen, C. H., Wang, Y. C., & Lee, B. Y. (2013). The effect of surface roughness of end-mills on optimal cutting performance for high-speed machining. *Strojnikivestnik-Journal of Mechanical Engineering*, 59(2), 124-134.
- [6] Godhavn, John-Morten, et al. "Drilling seeking automatic control solutions." *IFAC Proceedings Volumes* 44.1 (2011): 10842-10850.
- [7] CagdacArslan, M., BulentCatay, and ErhanBudak. "A decision support system for machine tool selection." *Journal of Manufacturing Technology Management* 15.1 (2004): 101-109.
- [8] Freeman, E. M. "The calculation of harmonics, due to slotting, in the flux-density waveform of a dynamo-electric machine." *Proceedings of the IEE-Part C: Monographs* 109.16 (1962): 581-588.
- [9] Jayabal, S., and U. Natarajan. "Modelling and optimisation of thrust force, torque and tool wear in drilling of coir fibre reinforced composites using response surface method." *International Journal of Machining and Machinability of Materials* 9.1-2 (2011): 149-172.
- [10] Muehlenbachs, Lucija, Elisheba Spiller, and Christopher Timmins. "The housing market impacts of shale gas development." *The American Economic Review* 105.12 (2015): 3633-3659.
- [11] Franca, Luiz FP. "Drilling action of roller-cone bits: modeling and experimental validation." *Journal of Energy Resources Technology* 132.4 (2010): 043101.
- [12] Lin, Weiren, et al. "Present-day principal horizontal stress orientations in the Kumano forearc basin of the southwest Japan subduction zone determined from IODP NanTroSEIZE drilling Site C0009." *Geophysical Research Letters*37.13 (2010).