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A Project Study of Designing and Fabricating an Innovative Concrete Form Moulder

Ronilo D. Juevesa, Jr.[1*], Michael V. Machica[2], Roel D. Juevesa[3]
[1]*Faculty, TechVoc Program, Technical Education and Skills Development Authority-Gensan, General Santos, Philippines*
[2]*Faculty, Graduate School Program, University of Southeastern Philippines, Davao, Philippines*
[3]*Faculty, Business College, Ramon Magsaysay Memorial Colleges, General Santos, Philippines*
*Corresponding author: rdjuevesa@gmail.com

***Abstract*: Civil construction industry played a significant role in maintaining the physical and naturally built environment in the art of building construction. The project study is entitled, "Designing and Fabricating an Innovative Concrete Form Moulder". It aimed to be Functional and Time Efficient in creating a concrete column. It is a hollow form moulder, made of steel with three main parts; the outside frame, the inside frame, and the tosser. Results revealed that the Innovative Concrete Form Moulder is highly Functional in moulding concrete blocks to be used as column forms with a Grand Mean of 4.92, and Time Efficient with a Grand Mean of 4.99. It was interpreted as highly efficient in creating concrete column structure that eliminates the time allotted in fabrication, installation, stripping/erecting/ removing, curing period process, re-fabricating and re-installing of formworks. The moulding of concrete blocks is faster than the fabrication of formworks and the filing of concrete blocks is faster than conventional installation of formworks. Based on the findings; it was recommended that inside frame of the Innovative Concrete Form Moulder should be removed easily when pulled after moulding process, the concrete blocks should not shrink and warp when the tosser applies slight force to push. Moreover, the Innovative Concrete Form Moulder should mould concrete blocks in just five minutes, the plain sheet should be at least gauge 16 or 14, and the stainless steel was highly recommended for better quality and efficient moulding.**

***Keywords*: Civil Construction Technology, Concrete Blocks, Concrete Form, Moulder.**

1. Introduction

Construction comprises a wide range of activities, which starts with comprehensive analysis of planning and specific detailed of designing. It involves construction process/ procedures, resources and timeframe necessary to ensure quality.

The civil construction industry comprises an assembly and erection of structures. Using of formworks is one of the identifying factors significant in concrete forming system. There are three sub-factors that had impact on the reuse of timber formwork: working attitudes of workmen, efficiency of workmen, and formwork stripping process (Ling and Leo, 2000).

Mouldings are used to form a plurality of lineal mouldings in parallel simultaneously such as base (floorboard skirting), flat and split door jambs, crown (ceiling surrounds), rabbeted jambs (frames), brick mould, and casing (door and window surrounds) (Seidner,1996).

Moulder is an improved machine used for cutting grooves and other continuous features along a surface of a piece of timber or of a plastics material or composite material of generally similar working characteristics (Robson, 1989).

Routers are most likely similar to Moulder used by most woodworkers because they are versatile power tools for channeling, edging and joint cutting, but they are rowdy, with a mind of their own unless you keep them under tight control (Bullar, 2010).

According to Mercurio (2016) the rate of construction growth in the Philippines will remain relatively high until 2020, fueled by greater focus on infrastructure improvement and the continued expansion of residential and commercial buildings. The government's Home Development Mutual Fund or PAG-IBIG Fund financing scheme is expected to provide continued support to low-and middle-income households which will help the market grow further (Philippine Star, 2016).

The Regional Development Plan of SOCCSKSARGEN (South Cotabato, Sultan Kudarat, Sarangani and General Sants City) towards a vibrant and sustained growth of the economy; in which everyone is included and no one is excluded. It spells out that one of their major program and project and the priorities is to increase and improve infrastructure facilities of the region (Custodio, 2011).

With the strong demand of construction industry, the researcher aimed to develop a technology which will make a better method to create a new concrete column structure in the absence of formworks, promotes new methods of technology and efficiently to lessen the time of construction procedures which can save money, time, and effort.

2. Objectives of the Study

The following were the objectives of the study:

1. Design and fabricate an Innovative Concrete Form Moulder.
2. Test project in terms of:
   2.1 Functionality, and

2.2 Time Efficiency

3. Revise defect found during the testing.

3. Conceptual Framework

The process consists of designing, fabricating, testing, revising, and evaluating. The output is the Designed and Fabricated Innovative Concrete Form Moulder.

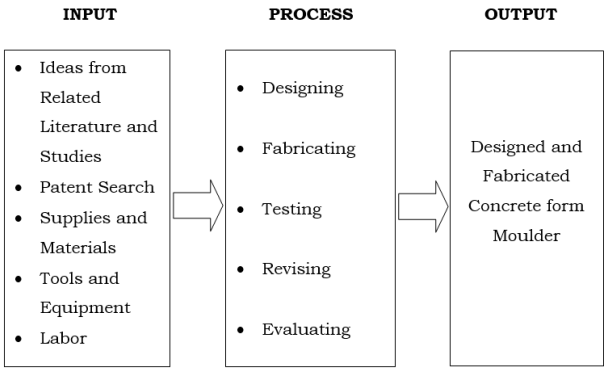

Fig. 1. The conceptual model of Innovative Concrete Form Moulder

4. Methodology

A. *Research Design*

The developmental method of research was used in this study. The term developmental research refers to the systematic study of designing, developing, and evaluating instructional programs, processes, and products that must meet the criteria of internal consistency and effectiveness. Developmental research is particularly important in the field of instructional technology. The most common types of developmental research involve situations in which the product-development process is analyzed and described, and the final product is evaluated (Richey,1994).

Since the present study is concerned with the Design and Fabrication of Innovative Concrete Form Moulder, thus, developmental method of research was the most appropriate to use.

B. *Research Locale and Evaluators*

The study was conducted at the General Santos City Technical Vocational Training Institute where the project was tested by the Respondents: (a) seven (7) Trainers, teaching in the field of civil technology/civil construction sector, (b) twelve (12) Industry Experts, a construction technician in the field of civil construction industry either Foreman/Mason or Carpenter, and (C) twenty-one (21) students, a trainee under the field of civil construction sector. A total of forty (40) respondents in the conduct of the study.

5. Results and Discussion

A. *Project design phase*

This following are the concept design, necessary calculations and dimensions, supplies and materials, and tools, instruments, and equipment used in the study.

1) *Concept Design*

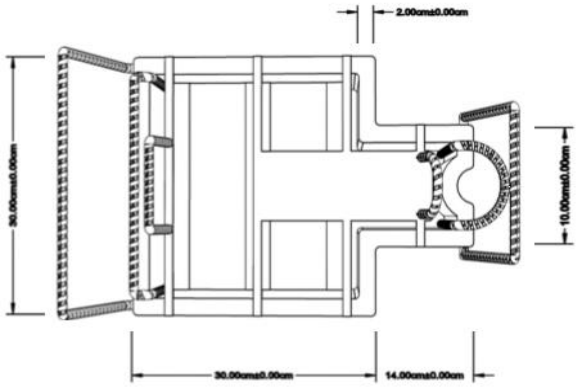

Fig. 2. Top View of the Project

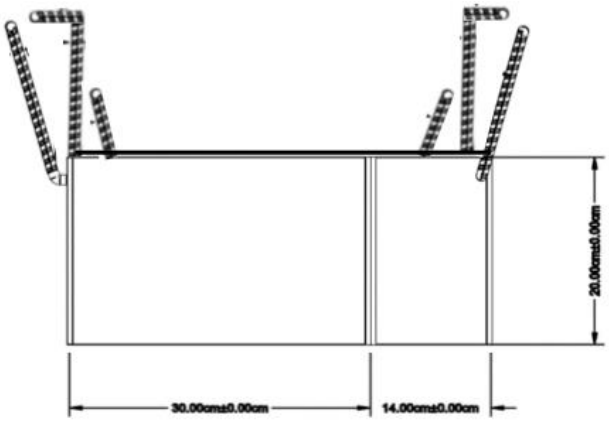

Fig. 3. Side View of the Project

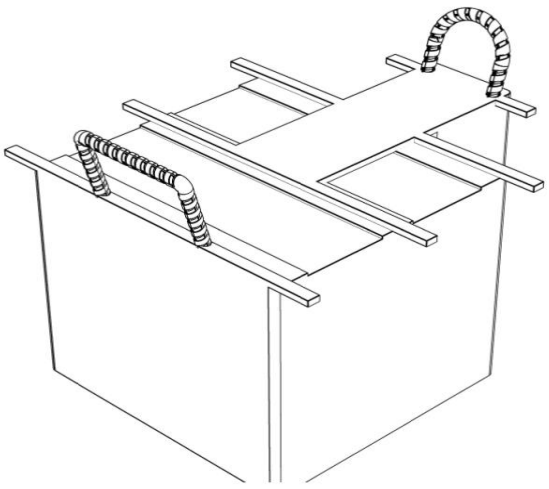

Fig. 4. Isometric View of the Inner Frame

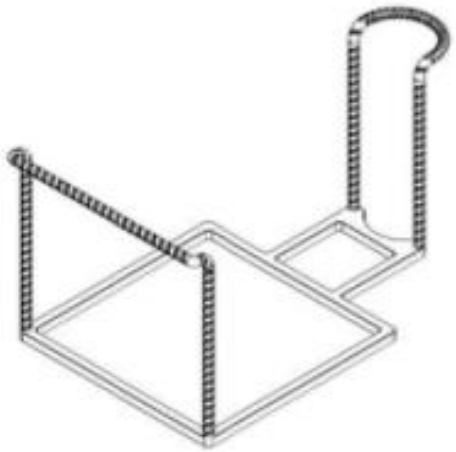

Fig. 5. Isometric View of the Tosser

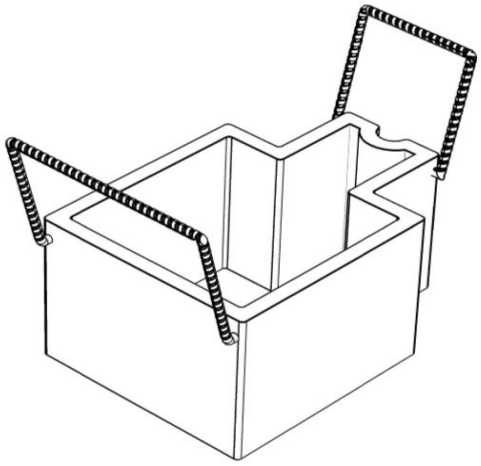

Fig. 6. Isometric View of the Outer frame

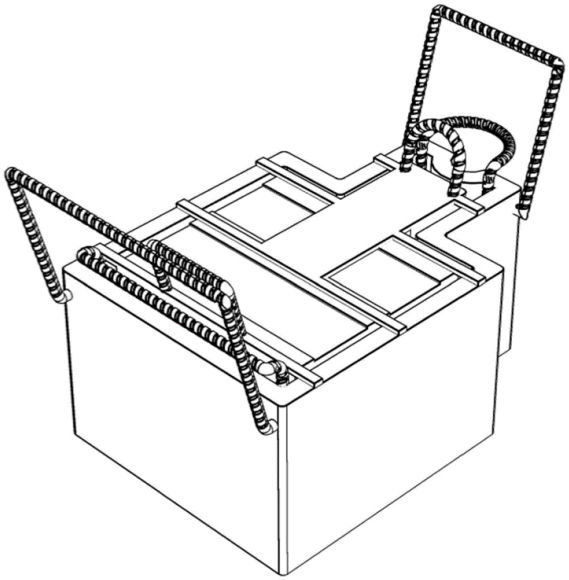

Fig. 7. Isometric View of the Project

2) Specification of the Project

Height : 36 cm
Width : 30 cm
Length : 44 cm
Thickness: 2cm
Texture: Metal/steel

- Outside and Inside Frame # 16 plain sheet
- Outside frame handle 12mm Ø round bar
- Inside frame handle 10mm Ø corrugated bar
- Tosser 5mm x ¾ flat bar
- Tosser handle 10mm Ø corrugated bar

Table 1 shows the list of supplies and materials with its quantity, unit and description related to mechanical used for fabrication of the Innovative Concrete Form Moulder.

Table 1
Supplies and Materials

No.	Quantity	Units	Description
1.	½	Sheet	Plain G. I. sheet #16 x 4' x 4'
2.	1	Length	Flat bar ¼''x ¾''x 6m
3.	½	Length	Flat bar ¼''x½''x3m
4.	¼	Length	Round bar12mmx5'
5.	½	Length	Corrugated bar 10mmx3m
6.	1	Kilogram	Welding Rod (E6013)
7.	1	Quart	Red oxide
8.	1	Pc	Paint brush (2")
9.	1	Bottle	Paint thinner
10.	1	Quart	Body filler (time out brand)
11.	¼	Kilogram	Blind rivets ¼"x½"

Table 2 shows the list of tools and equipment used in the study with its corresponding function.

Table 2
List of Tools and Equipment

No.	Tools and Equipment	Function
1.	Welding Machine	Used for joining metals parts
2.	Angle Grinder	Used for cutting and grinding metal (square bar, round bars and plain sheet)
3.	Hack saw	Used to cut small pieces of metal in various parts of the project
4.	Mechanical pliers	Used to hold objects upon welding
5.	Bench vise	Used to hold metal/object during fabrication such as grinding, cutting and bending
6.	Pull push rule	Used to measure exact length before cutting
9.	Pressing Machine (manual)	Used for pressing plain sheet
10.	Hammer	A hand tool used to forge metal that give a sudden impact.
11.	Riveter	Used to fixed blind rivets

B. Development phase

Construction, Assembly and Fabrication Procedures

The following procedures enumerate the steps in Fabricating the Innovative Concrete Form Moulder.

Objective 1: Design and fabricate of Innovative Concrete Form Moulder.

1) Preparing all the materials and tools needed.
2) Lay-outing and establishing all measurement.
3) Cutting of materials based on the specific/exact dimension.
4) Pressing of plain sheet both outside and inside part.
5) Fixing all joint using welding machine.

Table 3
Cost of Supplies and Materials

No.	Qty.	Units	Description	Unit Cost (Php)	Total Cost (Php)
1.	½	Sheet	Plain G. I. sheet #16 x 4' x 4'	390.00	1560.00
2.	1	Length	Flat bar ¼''x ¾''x 6m	149.00	149.00
3.	1	Length	Flat bar ¼''x½''x 6m	156.00	156.00
4.	1	Length	Round bar12mm x 6m	175.00	175.00
5.	1	Length	Corrugated bar 10mm x 6m	113.00	113.00
6.	1	Kilogram	Welding Rod (E6013)	100.00	100.00
7.	1	Quart	Red oxide	160.00	146.00
8.	1	Pc	Paint brush (2")	25.00	25.00
9.	1	Bottle	Paint thinner	35.00	35.00
10.	1	Quart	Body filler (time out brand)	156.00	156.00
Total					**2,615.00**

Table 5
Functionality testing of innovative concrete form moulder as perceived by all respondents

Item	Weighted Mean	Descriptive Rating
The Innovative Concrete Form Moulder can mould concrete blocks/precast depending on the mixing ratio.	5.00	Highly Functional
The outside and inside frame of the Innovative Concrete Form Moulder can withstand a 14 kilograms of aggregates.	4.90	Highly Functional
The Inside frame of the Innovative Concrete Form Moulder can be removed easily when pulled after moulding process.	4.66	Highly Functional
The Outside frame of the Innovative Concrete Form Moulder can be removed when pulled to release the blocks after moulding process.	5.00	Highly Functional
The tosser of the Innovative Concrete Form Moulder provide ease when the aggregates formed is released.	5.00	Highly Functional
The concrete blocks does not shrink and warp when the tosser applies slight force to push.	4.62	Highly Functional
The distance between the tosser handle and the outside frame handle allows the user to exert minimal force when removing the frame.	5.00	Highly Functional
The tosser of the Innovative Concrete Form Moulder can be move freely during pulling and pushing the blocks.	5.00	Highly Functional
The 25cm x 25cm inner column space of the moulded block meets the standard dimension used in a one storey building construction.	5.00	Highly Functional
The 2cm thickness space of the moulded blocks can withstand column volume of 20cm x 25cm x 25cm when the aggregates are poured.	5.00	Highly Functional
Grand Mean	**4.92**	**Highly Functional**

6) Putting and welding necessary brazes/support.
7) Bending and welding of Round and Corrugated bars as handle.
8) Grinding all parts having welding slag.
9) Applying body filler and metal primer (red oxide) to avoid rush.

Objective 2: Test project in terms of functionality time efficiency.

1) Mixing of aggregates.
2) Setting up Moulder.
3) Putting/placing of aggregates in the Moulder.
4) Compacting and removing excess mixture by wood tamper.
5) Placing Moulder in designated area of blocks.
6) Removing of Moulder both inside and outside frame.

Objective 3: Revise defect found during the testing.

1) Testing the functionality of the Moulder.
2) Revising the defects.

C. *Project cost*

This section shows the total cost of the proposed project including the supplies and materials, and the overall project cost, which involves the labor and overhead cost.

Table 4
Total project cost

Description	Cost (Php)
Supplies & Materials	2,615.00
Labor (60%)	1,569.00
Overhead (10%)	336.10
Total	**4,520.00**

D. *Project testing*

The following table shows the Functionality and Time Efficiency Testing of the Innovative Concrete Form Moulder based on the experiences of the respondents in the testing of the project.

The Functionality Testing of all respondents shows; item number 1, 4, 5, 7, 8, 9 and 10 got the highest weighted mean of 5.0 with a descriptive rating of highly functional. While item number 2 got 4.90, item number 3 got 4.66 and item number 6 got 4.62 also having descriptive rating of highly functional. The overall Grand mean is 4.92 which are interpreted as highly functional.

The Time Efficiency testing of all respondents shows; number 1, 2, 3, 4, 5, 6, 7, 9 and 10 got a highest weighted mean of 5.0 with a descriptive rating of highly efficient. While only item number 8 has a different result with a weighted mean of 4.94, but also described as highly efficient. The overall Grand Mean is 4.99, which are still highly efficient.

Table 6
Time efficiency testing of innovative concrete form moulder as perceived by perceived by all respondents

Item	Weighted Mean	Descriptive Rating
The Innovative Concrete Form Moulder eliminates the time allotted in the fabrication of formworks.	5.00	Highly Efficient
The Innovative Concrete Form Moulder eliminates the time allotted in the installation of formworks.	5.00	Highly Efficient
The Innovative Concrete Form Moulder eliminates the time allotted in stripping/ erecting/removing of formworks.	5.00	Highly Efficient
The Innovative Concrete Form Moulder eliminates the time allotted in curing period/process.	5.00	Highly Efficient
The Innovative Concrete Form Moulder eliminates the time allotted in re-fabricating of formworks.	5.00	Highly Efficient
The Innovative Concrete Form Moulder eliminates the time allotted in re-installing of formworks.	5.00	Highly Efficient
The moulding process is faster than the process of fabricating formworks.	5.00	Highly Efficient
The Innovative Concrete Form Moulder can mould concrete blocks in just five minutes.	4.94	Highly Efficient
The filing of concrete blocks/precast is faster than using the conventional installation of formworks.	5.00	Highly Efficient
The Innovative Concrete Form Moulder can reduce and save time of at least 2 hours in the construction process than the conventional procedure.	5.00	Highly Efficient
Grand Mean	**4.99**	**Highly Efficient**

Table 7
T-test for moulding process vs. Fabricating of formworks

	N	Mean	Standard Deviation	Standard Error Mean	T-Value	T-Value at 5% Significance level (t_{crit})
Moulding process	20	23.10	3.14	.70	-31.89	-1.68
Fabricating of formworks	20	65.97	5.12	1.14		

Table 8
T-test for Filing of blocks vs. Installing of formworks

	N	Mean	Standard Deviation	Standard Error Mean	T-Value	T-Value at 5% Significance level (t_{crit})
Filing Blocks	20	9.38	1.54	.34	-16.32	-1.68
Installing of Formworks	20	35.43	7.80	1.74		

Table 7, reveals the t- test result that there is a significance difference in the Time Efficiency between the Moulding process versus Fabricating of formworks since tcrit- value (-1.68) is greater than the t-value (-31.89).

Table 8, reveals the t-test result that there is a significance difference in the Time Efficiency between Filing of blocks versus Installing of formworks since tcrit- value (-1.68) is greater than the t-value (-16.32).

E. Pilot testing and revision of the project

After the fabrication, the project was evaluated for its Functionality and Time efficiency. Table 9 shows the defects that were found during the testing and the revision made to solve any defects.

Table 9
Pilot testing and Revision

Defects found during testing	Revisions made
The aggregates form is too hard to push	Detach inside frame and have its own handle.
The outside frame handle is straight which make the tosser not to release.	Bending the handle in 30 degrees inclination
The tosser is pulldown because the handle is straight.	Bending the handle in 90 degrees outside position
The tosser is too slim/thin to push the aggregates.	Additional flat bar to add strength

6. Conclusion

Based on the findings of the study, the Innovative Concrete Form Moulder can be designed, developed, tested and revised appropriately if found defective.

It was concluded that the Innovative Concrete Form Moulder is highly functional in moulding concrete blocks to be used as column forms. Time efficient in creating concrete column structure eliminates the time allotted in fabrication, installation, stripping/ erecting/removing, curing period/process, re-fabricating and re-installing of formworks.

Also, the moulding of concrete blocks is faster than the fabrication of formworks and the filing of concrete blocks is also faster than conventional installation of formworks.

7. Recommendations

The following were the recommendations based on the findings of the study.

1. The Inside frame of the Innovative Concrete Form Moulder should be removed easily when pulled after moulding process.
2. The concrete blocks should not shrink and warp when the tosser applies slight force to push.
3. The Innovative Concrete Form Moulder should mould concrete blocks in just five minutes.
4. The plain sheet should be at least gauge number 16 or 14 to prevent shrinking and warping of concrete blocks.
5. The stainless steel is highly recommended for better quality and efficient moulding.

8. Acknowledgement

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