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TIMBER FORMWORK

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Abstract- Formwork is significantly important activity for concreting. Good quality of formwork can contribute a great too good quality of concrete. It not only holds the concrete during its wet stage but has many other important functions in this activity of concreting. Bad formwork has often yielded failures of minor as well as major magnitude. It is also fairly popular as shuttering. Its functional as well as financial share in the entire concreting activity can't be ignored.

Many types of formwork exist across the globe. Many dimensions are attached to this activity. It is desired to touch upon some normal facts about formwork in the paper. An effort is made here to bring them before you in understandable manner. Let us begin this small trip of understanding about formwork which is like a preparation for big journey to concreting.

Lot of people tend in think that formwork is semi skilled occupation. To be fair there are a lot of guys who start off as laborers and finish up a formwork carpenters without any formal training. It is a fair bit of hard manual labor involved, but it is a very tricky job and it takes just as much know how to do properly as any other jobs in the building trade.

Keywords: Formwork, Mould, Timber, Column, Cost, Quality, Safety.

I. INTRODUCTION

Formwork is a die or a mould including all supporting structures, used to shape and support the concrete until it attains sufficient strength to carry its own weight. It should be capable of carrying all imposed dead and live loads apart from its own weight. Formwork has been in use since the beginning of concrete construction. New materials such as steel, plastics and fiberglass are used in formwork. Greater attention is being given to the design, fabrication, erection and dismantling of formwork.

In other words "Formwork is a structure, temporary which is designed to contain fresh fluid concrete. Form it into the required shape and dimensions. Support it until it cures sufficiently to become self-supporting." The term 'formwork' includes the actual material contact with the concrete, known as form face, and all the necessary associated supporting structure.

II. NECESSITY OF TIMBER FORMWORK

1. Requirements of good formwork:

In order to successfully carry out its function, formwork must achieve a balance of following requirements:

- **Containment**: formwork must be capable of shaping and supporting the fluid concrete until it cures.
- **Strength:** formwork must be capable of safely withstanding without distortion or danger the dead weight of the fluid concrete is placed on it, labour weight, equipment weight and any environmental loadings.
- **Resistance_to_leakage**: all joints in form work must be either close fitting of covered with form tape to make them grout tight. If grout leakage occurs the concrete Will leak at that point. Leakages cause honeycombing of the surface.
- **Accuracy:** formwork must be accurately set out so that the resulting concrete product is in a right place and is of correct shape and dimensions.
- **Ease of handling:** form panels and units should be designed so that their maximum size does not exceed that which can be easily handled by hand or mechanical means. In addition all formwork must also be designed and constructed to include facilities for adjustments, leveling, easing and striking without damage to the form work or concrete.
- **Finish and reuse potential:** the form face material must be selected to be capable of consistently imparting the desired concrete finish (smooth, textured, featured or exposed aggregate etc.) At the same time it should also achieve the required number of reuse.
- **Access for concrete:** any formwork arrangement must be provide access for placing of the concrete. The extent of this provision will be dependent on the ease of carrying out the concrete operations.
- **Economy:** all the formwork is very expensive. On average about 35% of the total cost of any finished concrete unit or element can be attributed to its formwork; of this just over 40% can be taken for material for formwork and 60% for labour. The formwork designer must therefore not only consider the maximum number of times that any form can be reused, but also produce a design that will minimize the time taken for erection and striking.

III. Scope and Study Area

The scope of this Project is limited to the structural elements of building projects such as column, beam, slab, shear wall and stair that are casted in the construction site. In addition this research will be based on the comparison of two type of formwork for concrete elements. It will not be focused on the rivalry between two specific opposing systems, nor that between two different manufacturers. The purpose is not to prove that one product is superior to another, but rather to determine which systems, steel panel or timber panel, are superior.

The research was conducted for different category of building type such as apartment, office, multipurpose, condominium and hospital buildings. The study compromise different category of contractors, starting from grade 6 up to grade 1 contractor, involved in the construction of building projects.

IV. OBJECTIVES OF RESEARCH WORK

- To study the present condition of timber formwork and its material.
- To do various types of timber formwork to obtain the good design.
- To design the best and effective formwork.
- To design and analysis the timber formwork in different types.

V. Economical Consideration of Formwork

- ✓ To simplify and permit maximum reuse of formwork, the dimensions of footings, columns and beams should be of standard material multiples, and the number of sizes should be minimized;
- ✓ When interior columns are the same width as or smaller than the girders they support, the column form becomes a simple rectangular or square box without box outs, and the slab form does not have to be cut out at each corner of the column ;
- ✓ When all beams are made one depth (beams framing into beams as well as beams framing into columns), the supporting structures for the beam form can be carried on level platform supported on shores;
- ✓ Considering available sizes of dressed lumber, plywood, and other ready-made formwork components and keeping beam and joist sizes constant will reduce labor time;
- ✓ The design of the structure should be based on the use of one standard depth wherever possible when commercially available forming systems, such as one or two-way joist systems, are used;
- ✓ The structural design should be prepared simultaneously with the architectural design so that dimensions can be better coordinated. Room sizes can vary a few inches to accommodate the structural design ;
- ✓ The engineer/architect should consider architectural features, depressions, and openings for mechanical or electrical work when detailing the structural system, with the aim of achieving economy. Variations in the structural system caused by such items should be shown on the structural plans. Wherever possible, depressions in the tops of slabs should be made without a corresponding break in elevations of soffits of slabs, beams or joists;
- ✓ Embedment for attachment to or penetration through the concrete structure should be design to minimize random penetration of formed surface;
- ✓ Avoid locating columns or walls, even for few floors, where they would interfere with the use of large formwork shoring units in otherwise clear bays.

VI. LITERATURE REVIEW

The type of formwork systems used is among the key factors determining the success of a construction project in terms of speed, quality, cost and safety of works. Therefore, selecting the formwork system, that is, making structural frames faster, simpler, and less costly to build, must begin in the earliest phase of the design efforts(Basher Alamin, 1999).Generally there are two board category of formwork system as horizontal and vertical formwork system; these are described in detail below.

As we research the topic of timber formwork for concrete it is anticipated that this review will continue to grow as we find more work previously done, more opinions and are able to search more specifically following our own findings in preliminary tests. It is also to be expected that the literature review will begin to become more specific as we become experts on the subject and follow detailed areas of research within the field.

At this time, much of the literature reviewed is broad overviews as we familiarize ourselves with the timber formwork process and what has been done in the field as a whole rather than looking too specifically at the formwork for non-prismatic columns.

Among the first pieces of literature looked at was **Formwork for Concrete Structures, 1965 by A.E. Wynn & G.P. Manning**. This was to gain a better understanding of traditional formwork solutions, primarily the application of timber formwork. The book stresses the need for skilled and experienced craftsmanship highlighting the potentially huge costs in time, money and materials should the formwork be constructed incorrectly. Just some of the problems that can arise include; material waste due to excessive timber used, failure due to inadequate timber used, lengthy construction due to inexperience, lengthy dismantling due to inexperience, high transport costs… etc. The book also states that these issues are particularly important when casting concrete columns as strength is extremely important and any finish defects will be more obvious than on other elements.

Pedreschi also highlights three perceptions of concrete construction that fabric formwork directly challenges. These are;

- It is a harsh and unforgiving material
- Accuracy requires great skill and detail specification
- Complexity in form is expensive

RESULTS AND ANALYSIS

Table (1). Average cost of formwork per square meter

Structural element	Respondents(R)									Steel Average Cost	Timber Average Cost
	R1	R2	R3	R4	R5	R6	R7	R8	R9		
Beam	35*	65	70*	250*	150	132*	108*	90		119	101.67
Column	35*	65	70*	250*	150	94*	108*	90	72	115.75	94.2
Slab	35*	40*	55	250*	150	132*	108*	90	72	113	91.75
Stair	35*	55*	75*	250*	150	132*	108	90	72	109.4	105
Shear wall	35*	90	70*	250*	150	94	108	90	72	118.33	100.67

Table (2). Average cost difference for steel & timber formwork per square meter.

Structural elements	Steel formwork average cost per meter square.	Timber formwork average cost per meter square.	Difference in both
Beam	119	101.67	17.4
Columns	115.75	94.2	21.55
Slabs	113	91.75	21.25
Stairs	109.4	105	4.4
Shear wall	118.33	100.7	17.66

CONCLUSION

The main objective of this research is to compare steel and timber formwork for building projects and to come up which system advantageous in regarding with cost, quality and completion time of the of building projects. Considering these three parameters analysis has been done in chapter four and based the results of the analysis the following conclusion has been made:-

- ✓ Initial cost analysis of the formwork shows that timber formwork is cheaper than steel formwork but most of the respondents prefer to buy steel formwork over timber formwork system.
- ✓ Based on rental cost of the formwork system all respondents prefer steel formwork system than timber formwork system. As remark all respondents pointed out that finding rental timber formwork is difficult and there is no company that involved in renting timber formwork.
- ✓ Modern timber formwork system such as MDF and ply wood improve productivity of labour force. Factors such as less required time of maintenance, large panel size and smooth formwork face for modern formwork system with compared to steel formwork system helps in improving productivity of MDF and ply wood formworks.
- ✓ The average per meter square cost of steel formwork is higher than timber formwork system. Cost of steel beam formwork is 17.05% higher than timber beam formwork, column steel formwork costs 22.88% higher than timber column formwork and steel slab formwork costs 23.16% than timber slab formwork. Taking average the difference is steel formwork costs 16.96% higher than timber formwork.
- ✓ The main justifications for this statement is steel formwork can be reused for so many time than timber formwork system, it required less number of props for beams and slabs, it easily available for rental and it is possible to maintain.
- ✓ For best quality of finished concrete, it is better to use modern timber formwork system such as MDF and ply wood. Modern timber formwork system have smooth surface that helps in the time of removing the formwork from concrete surface.
- ✓ The type of formwork used in building projects affects the productivity of labour force.

RECOMMENDATIONS

Based on my findings the following two recommendations are given on cost and time of construction of the formwork.

1. Cost of formwork system:-

Unlike our perception the cost of steel formwork system does not have much difference with compared to cost of timber formwork system. Even in same projects the cost of imported modern timber formwork system is greater than conventional steel formwork system. Thus proper life cycle costing should be performed by contractors to accurately determine whether the steel formwork system used in building projects will justify the higher initial cost when looked at over the lifespan of the forms.

2. Completion time of formwork:-

Steel formwork can have faster rate of erection during construction when we compared with timber formwork system but this is not always true when comes to modern timber formwork system they improve the productivity of the crew. Thus future research should focus on better defining and quantifying the influence of type of formwork on productivity of crew. Factors such as formwork maintenance,

panel size and formwork face were touched upon in this thesis, but require further research to determine their precise impact on productivity.

Future Study:-

The following three suggestions are put forward for future research to further improve the understanding of formwork construction for building projects:

- ✓ The effect of type of formwork on the productivity of the crew
- ✓ The impact of formwork maintenance, panel size and formwork face on the productivity
- ✓ Life cycle costing of the formwork in the projects

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