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Comparative Study of Aluminum Formwork Design Using Various Codal Methods

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Abstract – Recent trends in construction become indispensable within the coming years to emphasize on sustainable development. The paper discusses the importance and scope of recent trends in construction techniques. The paper emphasizes on exploitation differing kinds of materials in modern trends and for effectiveness in infrastructure building for fast economic process and development of a nation exploitation recent advancements within the field of construction technology. Nowadays, the prefabrication and aluminium Formwork technique in trade construction industry is developed countries has improved the standard of the construction industry. Aluminium Formwork System is a construction system for forming cast in situ concrete structure of a building. Classified information's given for Aluminium Formwork technique and Conventional techniques. Two case studies are taken for the analysis of the construction techniques. The concept of formed (also called "prefabricated") construction includes those buildings wherever the bulk of structural parts are standardized and created in plants during a location far from the building, so transported to the location for assembly

Keywords—: Formwork design, Aluminium Formwork Technique, Conventional formwork technique

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I. INTRODUCTION

Aluform is a construction system for forming cast in place concrete structure of a Building. This system provides formwork for RCC, load-bearing and multi-storeyed buildings. This increases efficiency of structure, and also produces a strong structure with smooth concrete finish. Due to the fine tolerances achieved in the formwork components, consistent concrete shapes and finishes are achieved, so floor by floor, building after building, confirming to the most exact standards of quality and accuracy. This allows plumbing and electrical work to done while assemble of formwork only.. The dimensional accuracy of formwork also results in accurate fittings of doors and windows. The smooth off form finish of the concrete eliminates the need for costly plastering. This system of Aluminium Formwork has been used commonly in the construction of residential unit's low-rise as well as high-rise buildings and mass housing. It has proven to be very successful in the construction of mass housing project and implementations in various parts of the world. It is also a system for scheduling and controlling the work of other connected construction part such as steel reinforcement, concrete and mechanical & electrical work. The formwork system is unique because it enables the construction of the entire structure of a building in R.C.C. with all the members including walls, floor slabs, window hoods, balconies, sunken floors and various decorative features, being cast integrally for each floor as per the architect's requirement.

This system is based on a handled light aluminum formwork system. It is capable of forming the concrete for both, load bearing wall design and column beam design. Unlike other systems it is equally suited to both high rise and low rise buildings. In case of load bearing structure, the systems comes as all of the concrete in a building, including walls, floor slabs, columns, beams, stairs, window hoods and balconies. Specially designed to allow the rapid construction of multi-storied projects at optimum productivity, the aluminum formwork can be used for a wide range of applications, from straightsimple rectangular panels to complex structures like staircase.. The degree of pre engineering and inherent simplicity of the aluminum formwork enables unskilled labor to be used. Every component is light enough to be handled by one operative, minimizing the need for heavy lifting equipment.

Advantages of Aluminum formwork over conventional construction

1. More seismic resistance: - The box type construction provides more seismic resistance to the structure.

2. Increased durability: - The durability of a concrete structure is more than conventional structure i.e brickwork construction.

3. Lesser number of joints thereby reducing the leakages and enhancing the durability.

4. Higher carpet area- Due to shear walls the walls are thin thus increasing area.

5. Integral and smooth finishing of wall and slab- Smooth finish of Aluminum can be seen vividly on walls.

6. Uniform quality of construction – Uniform grade of concrete is used. Negligible maintenance – Strong built up of concrete needs no maintenance.

7. Faster completion – Unsurpassed construction speed can be achieved due to light weight of forms.

8. Less labor- Less labor is required for carrying formworks.

Relative Comparison Of In – Situ "Aluminum Form" System with Conventional Construction

6061 is a precipitation-hardened aluminium alloy, containing magnesium and silicon as its major alloying elements. Originally called "Alloy 61S", it was developed in 1935. It has good mechanical properties, exhibits good weldability, and is very commonly extruded (second in popularity only to 6063). It is commonly available in pre-tempered grades such as 6061-O (annealed), tempered grades such as 6061-T6 (solutionized and artificially aged) and 6061-T651 (solutionized, stress-relieved stretched and artificially aged).

Basic properties

6061 has a density of 2.70 g/cm³ (0.0975 lb/in³).

Chemical composition

The alloy composition of 6061 is:

a. Silicon minimum 0.4%, maximum 0.8% by weight

b. Iron no minimum, maximum 0.7%

c. Copper minimum 0.15%, maximum 0.4%

d. Manganese no minimum, maximum 0.15%

e. Magnesium minimum 0.8%, maximum 1.2%

f. Chromium minimum 0.04%, maximum 0.35%

g. Zinc no minimum, maximum 0.25%

h. Titanium no minimum, maximum 0.15%

i. Other elements no more than 0.05% each, 0.15% total

j. Remainder aluminium (95.85–98.56%)

II. PAST STUDIES

N.Kalithasan et. al (April 2016) In this paper, the comparison is done on design of aluminum formwork and framed structure. Mivan technology is designed manually and framed structure is designed by using STADD PRO software. Mivan technology is consisting of walls and slabs while framed structure is consisting of beam, column and slab. Aluminium formwork consists of high strength RCC wall. The load carried by RCC wall. This is more earthquake resistance compare framed structure. Aluminum is a high strength material and long life compares wood and plywood. In Aluminium formwork there is no need wall plastering. Framed structure need wall plastering. Results shows aluminium formwork structure is more costly compare than framed structure. But project time is half of framed structure. So, consider reducing labour cost in aluminium structure. And another think Aluminium formwork structure is more strength and earthquake resist compare than framed structure. Aluminium formwork structural manual design and analysis is easy in multi storey buildings. But framed structure manual design is difficult and not accuracy in multi storey structure.so, framed structure design is analysis in computer aided programme of STADD PRO.

Pawan S Khandelwal et. al (2016) The aim of this paper is to study different types of formwork systems in India and to show how each one will affect the project cost, project duration and the quality of the work. The research is done on comparative study of formwork using conventional formwork system and modern-day formwork system. The purpose of this paper is to identify the various factors that influence formwork productivity. When considering a construction project the contractor wants to finish the work quickly with higher profit and the client wants to use the building as soon as possible. To achieve both the most efficient way is to shorten the floor cycle. The type of formwork influence the floor cycle of any high-rise building. Thus comparing the statistical data of conventional and aluminium formwork, we can conclude that the number of labours required for aluminium formwork is less. Hence the labour cost can be optimized. Process of shuttering and deshuttering is quick in case of aluminium formwork. Therefore, the labour factor

and time factor are inter related and directly help to optimize the cost of project. We thus infer that aluminium form construction is able to provide high quality of construction at higher speed and at reasonable cost. Thus it can be concluded that quality and speed must be given due consideration with regards to economy. The construction work should be of good quality as it will never deter to project speed. Also it will be economical.

Divyang Solanki et. al (2013) This paper studies the building which are constructed at Low cost. Houses are constructed for EWS (economically weaker section) people. The buildings are the monolithic structures and constructed by using the MASCON technology in which the aluminum form work are used which is very efficient compared to the method used for the construction of the conventional structures. The monolithic structure constructed by using the MASCON technology is much better in strength than the conventional structures. Also the work of construction can be done faster and there are many advantages except the high initial cost.

This paper gives the detail study on monolithic structure in terms of their construction method, costing and timing. Also gives the detailing about Mascon Construction System. The main Objective of this project is to minimize the cost of building construction, also reducing the time of construction along with multi hazards resistance.

We concluded that Creativity and technical skill help to plan, design, construct and operate the facilities essential to life. Mascon technology is cost effective and efficient tool to solve problems of the mega housing project. Mascon construction is able to provide high quality construction at unbelievable speed and at reasonable cost.

Wenxue Zhang et. al (2016), In this study a series of experiments was conducted to reveal the effect of different factors on lateral pressure. The results show that concrete slump, casting speed and vibration mode can greatly influence the pressure and the data obtained in the experiments differ greatly from the values yielded by different specifications. A modification is proposed to the GB50666 specification in order to improve the accuracy and reliability of pressure estimations. The results in this study lead to the following conclusions. The values of the relative errors yielded by the TZ210 specification are small, but the probability of a value yielded by the TZ210 specification being less than the corresponding measured value is very high. The experimental results demonstrate that the ACI347 and CIRIA.108 specifications are conservative. The formula given in the GB50666 specification is modified in such a way that the applicable range of the concrete slump is extended, and the corresponding concrete slump adjustment factor is revised. Compared to the formula given in the GB50666 specification, the modified formula (F= 0:23Dcbt0R14) is more capable of effectively ensuring formwork engineering security and yielding accurate formwork lateral pressure values. The vibration mode and depth have significant effects on the maximum formwork lateral pressure. Increasing the depth of vibration and/or repeating vibration greatly increase the formwork lateral pressure and should be avoided. The concrete slump and the placement rate significantly affect the maximum lateral pressure. However, in previous research the influence of environmental temperature has not been thoroughly studied and remains unclear, especially in the cases when the casting process is completed before the initial setting of the concrete starts. The effects of environmental temperature should be investigated further.

Ninjal M Parekhet. al (2016) The paper discusses the importance and scope of recent trends in construction techniques. The paper emphasizes on exploitation differing kinds of materials in modern trends and for effectiveness in infrastructure building for fast economic process and development of a nation exploitation recent advancements within the field of construction technology. Nowadays, the prefabrication and aluminium Formwork technique in trade construction industry is developed countries has improved the standard of the construction industry. Aluminium Formwork System is a construction system for forming cast in situ concrete structure of a building. Classified information's given for Aluminium Formwork technique and Conventional techniques. Two case studies are taken for the analysis of the construction techniques. The concept of formed (also called "prefabricated") construction includes those buildings wherever the bulk of structural parts are standardized and created in plants during a location far from the building, so transported to the location for assembly. Finally concluded, Selection of Aluminium formwork construction is depending on the project type and project requirements. Aluminium formwork construction technique is cost effective for the mass construction and repetitive projects. Aluminium formwork construction is rapid construction technique in which construction at high speed. Aluminium formwork construction is offering high quality of construction and low maintenance at the minimum cost.

Ramesh Kannan. Ma et. al (2016) A valid comparison of different climbing formwork with the conventional formwork is done for the lift core-wall in the 20 storey high-rise building model using Building Information Modeling (BIM). From the developed 3D BIM model, the cost, time, quality, safety and

sustainability factors of both conventional and climbing formwork are explored in detail by quantitative and qualitative indices. The constructability factors associated with the conventional and different climbing formwork systems are generated.

III. PROBLEM STATEMENT

For this study a problem statement having details as mentioned below.

A Building of G+22 stories has been analysed for aluminum formwork. In this, wall panel of size 600x2450mm and 600x2300mm has been considered.

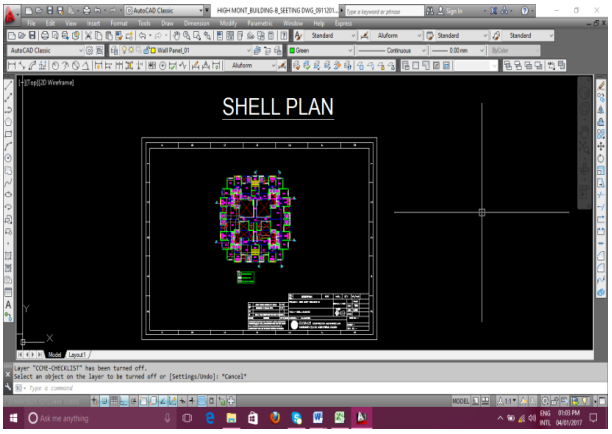

Fig.Proposed building plan

Fig.Section

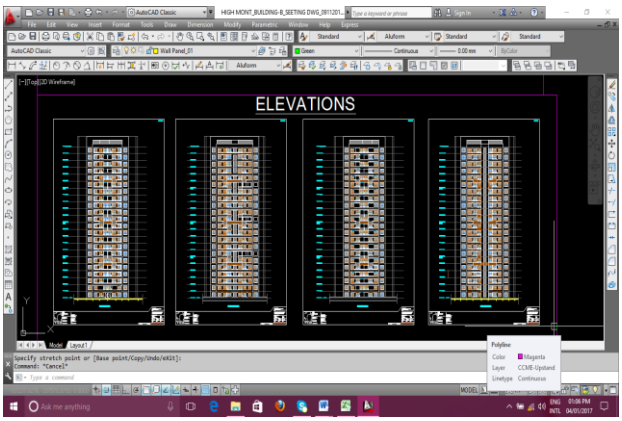

Fig. Elevations

IV. RESULT

From this study we have got results by doing manual calculations for Aluminum formwork Panel 600x2450mm dimension.

i. Bending in tension = 0.433 which is less than 1 so okay.

ii. Bending in compression = 0.56 which is less than 1 so okay

iii. Deflection = 1mm and allowable deflection= 3mm.

V. CONCLUSION

Based on the study of aluminum formwork design by Indian Standard code method and American Concrete Institute method by doing manual calculations the panel of size 600mmx2450mm thickness 4mm is safe in bending and deflection.

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