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Comparative Study on Precast Stair Case – A Review

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ABSTRACT: In India most of construction is work by conventional method (cast in situ). So a country goes to fast, time effective and achieving advance technique type of construction. Precast is one the source which gives the construction time fast, with proper stability, economy, durability etc. Precast staircase is constructed in factory with required quality, quantity, easily mix, and curing achieved with good desired strength. After the precast staircase constructed it should be go for erection in site. Different type of precast staircase should be design in factories. So various literatures as studied and a review of those all has been given in this paper. Also the advantages of precast staircase are also discussed here.

KEYWORDS: Precast Staircase, Construction, Time, Labour, Conventional method.

I. INTRODUCTION

At present precast concrete buildings are the advanced construction techniques available over worldwide. Precast construction technology is a system of casting concrete in a reusable mould or “form” which is then treated in a controlled environment, conveyed to the construction site and lifted to the place. This technology is suitable for construction of high rise buildings resisting seismic and wind induced lateral loads along with gravity loads. Different types of precast elements are cast in a controlled factory condition. The factory is developed at or near the site which provides an economical solution in terms of storage and transportation.

Staircase is an important component of a building providing access to different floors and roof of the building. It consists of a flight of steps (stairs) and one or more intermediate landing slabs between the floor levels. Different types of staircases can be made by arranging stairs and landing slabs. Types of precast staircase should design in factories like steps ladder, flight, landing etc. As the structural elements in precast building will only form a stable structural system after the joints are connected, structural considerations for stability and safety are necessary at all stages. A designed staircase should be comfortable for users and should provide proportionality, regularity, rhythm and order. When designing staircases, it is necessary to correctly design the dimensions of the staircase area, construction system of the staircase, dimensions of stairs, stair shapes, etc.



(a) Production in Factories

(b) Transported to Site

(c) Assembled at Site

II. LITERATURE REVIEW

Lakhi M. Chavan & Prof. D.B.Desai (2017): The work in this paper is focusing on time – cost comparison between precast and conventional method. Conventional method requires large amounts of time and labour at project site. The case study is discus on the project Maharashtra state police housing and welfare corp.ltd.at site

location: F.P.NO.:Karad: 394 Address: Karve road, Tal-Karad, Dist- Satara. All building components study on this paper like column, beam, staircase and lintel. Using prefabrication in a project allows to reduced time duration. This means that the impact of the site on the local environment is for a shorter period of time. Using this prefabricated building components in building construction projects can reduced the curing times from the critical path of the project and eliminating the need for temporary formwork. The purpose of this project is to determine prefabrication and onsite trends and effects on the construction workforce and use of these techniques to reduce project duration, & costs. The difference between the conventional and precast staircase cost is 5536 Rs. It means that the precast stair cost value is less than the conventional method. The conclusion of precast building components we reduce the cost up to 17.24 %, using the methodology we can reduce the project duration up to 26 %. Construction of various elements by use of precast methodology helps us to achieve economy and fast track construction which is need of construction industries. It is found that the time required in case precast construction is quite less as compared to conventional. Quality obtained in precast construction is better as compared to in-situ construction. [1]

Richard OduroAsamoah, John Solomon Ankrah, Kofi Offei-Nyako, and Ernest Osei Tutu (2016): This paper study about analyze cost estimating of the structural frame (column and slab) by considering cast-in-place and precast concrete slabs and columns, respectively. There are 13 public building study and analyse of cost comparison between cast-in-place and precast concrete in Ghana. The use of precast concrete has various advantages which include the reduction of the site labours, less wastage, less volume of building materials, and increased environmental and construction site cleanliness. The methodology in this paper include the case study of project were in Ashanti, Greater Accra, and BrongAhafo regions of Ghana; 7 of the projects were on-going projects, and 6 were completed. Relative Important Index (RII) was used to rank the advantages of using precast concrete from the professionals who were involved in all the selected projects. The study established that precast concrete slabs were on average 23.22% cheaper than the cast-in-place concrete elements and precast columns were averagely 21.4% less than cast-in-place concrete columns. [2]

Andrew Baldwin, Chi-Sun Poon, Li-Yin Shen, Simon Austin and Irene Wongl (2006): Carried out a thesis to study and analyze, waste construction material in high rise building. The majority of construction waste is generated from the concreting process. In general, any reduction in on-site concreting leads to waste reduction. Precasting and prefabrication therefore offers significant opportunities for the reduction of waste. If precasting is adopted there are significant implications for the design phase of the project. Additional information is needed by design staff, construction expertise is required as part of the design process. This paper shows how information modeling and Design Structure Matrix, (DSM), techniques enable designers to model and understand the implications of such decisions within the detailed design process. precast design and is most suitable for the design of high-rise residential buildings. Techniques that adopt information modeling such as ADePT have been proven to enable designers to visualize the complicated building design process and to increase efficiency by optimization. [3]

Jan Pencik (2015): Thesis research and analyse is about the wooden prefabricated staircase with one-sided suspended stairs made from Scots pine (*Pinussylvestris*) in the wall with steel support bars. The article describes experimental tests of a detail of a wooden prefabricated staircase with one-sided suspended stairs made from Scots pine (*Pinussylvestris*) in the wall with steel support bars. It is a detail under high stress which was identified by a 3D numerical analysis performed with the use of finite element methods using the calculation system ANSYS. It contains a comparison of the results from experimental tests and numerical 3D analyses. In addition, it describes material models used with the numerical 3D analysis (rectangular orthotropy and cylindrical anisotropic plasticity) as well as non-interactive (maximum stress criterion) and interactive (Hoffman and Tsai-Wu criteria) failure criteria for prediction of the occurrence and propagation of failures in wood. Using a 3D numerical analysis of a wooden staircase with one-sided suspended stairs made from Scots pine place of increased concentration of stress was identified. To identify this place by wood modelling, a rectangular orthotropic material model was used and failures were predicted using the Hoffman and Tsai-Wu criteria. To assess the behaviour and bearing capacity of the identified place, i.e. place of supporting of stairs into the wall using steel support bars were experimentally tested using partial experimental models. [4]

VaishaliTurai&AshishWaghmare (2016): The paper based on time comparison of precast concrete vs. cast-in-place (i.e. traditional) concrete. How total time of construction by precast concrete system is less than the time by use of cast-in-place concrete. Time of any construction is directly varied with cost of construction. The time

required for steel binding, shuttering, concreting then time required for curing will be minimize (7 days). Precast concrete is manufactured in factory and transport to site for erection. For precast construction less manpower is required, labors are required only to joint precast members and for erection of elements. That means time required for excavation, PCC, steel binding, shuttering and deshuttering is eliminated. Precast members are cured in factory till gate desired strength so no need to cure on site result into save in time of currying. The time for shuttering and deshuttering is eliminated by using precast will result into saving total time of construction. The time of rework due to improper work, faulty construction method, unskilled labor, material quality, onsite environmental problem can be eliminated by using precast members. Breakeven formula is derived to preliminarily evaluating and selecting best alternative between two competing construction methods offered by two different contractors for the structural members, those of Cast-in-Place concrete vs. precast concrete. The outcome of this research paper is, transportation & shifting cost of precast members considerably affective on total cost of construction which help to assist decision makers and engineers to compare both concrete construction methods early in the construction planning phase of a project. By using Pay Back Period method we conclude that the Cast-In-Place Concrete system takes more time for Pay back the Invested Cash as compare to Precast Concrete System. [5]

Mayank Sharma, Deepak Parashar, Er. Anil Kumar (2018): Carried out the study to compare the staircase with various support condition using STAAD.RPO software. Different types of staircase support used here and analyze that. The present report tries to discover the conduct of stair section display hypothetically utilizing limited component strategy for a given arrangement of limit condition. Analytical results of bending moment and deflection of stair slab, have been compared with six different support types (CASE I to CASE VI), using STAAD.Pro. Variation in moments and deflections at critical locations, along the stair slab model has been presented in the graphical form. It is also found from the analysis that the stair slabs with landings supported on the different support arrangements behave differently and the specifications available as per Indian Code may not be applied uniformly to different support arrangements. Different supports arrangements have different distribution of moments. Significant restraining effect has been seen due to additional supporting arrangements. [6]

N.Dineshkumar, P.Kathirvel, (2015): Thesis research on a present situation of the precast construction industry in India. In his study two main factors are considered which are cost and time and comparison between them. For this research purpose data collection is done in the form of questionnaire survey and from this survey the present status and scope of precast techniques are known. A residential building is taken as case study and comparison is done. The comparison showed there is enormous cost difference between the methods, which the prefab is very high when compared to conventional on this type of individual houses. The time duration of the project difference is 63 days between the prefabrication and conventional construction. The prefab construction for individual double storey residential building cost is 13% more than the conventional construction. This is main drawback for prefab construction which is not economical to construct in this case. At this stage conventional construction is economical and comfortable when compared to the prefabrication construction. [7]

M.J.Gopinathan, K.Subramanian, (2013): Thesis research on a two dimensional 3-bay G+5 storeyed prefabricated frame subjected to lateral loading. The joints in beam column junction and joints in beam to beam connection were strengthened by specially designed steel bolts and L-angles by welding and bolting. The frame was subjected to lateral cyclic load until failure. The results are compared with ANSYS model. The efficiency and performance of beam-column joints and beam-beam joints were studied and the behaviour of prefabricated frame is compared with monolithic frame. In this research Joints in beam column junction & Joints in beam to beam connection were studied experimentally. It is concluded that the precast models performs efficiently than the conventional one. [8].

III. ADVANTAGES OF PRECAST STAIR

- i. High quality product with excellent concrete finish.
- ii. Time saving, reduced construction site costs. Using precast concrete stair cases will save both time and cost when site shuttering and scaffolding can be eliminated.
- iii. The speed of construction is higher.
- iv. Saving in shuttering cost in precast construction.
- v. Precast stairs are fast and easy to install and can be utilized immediately after installation.

- vi. As all risers on flights are of exactly the same height, precast stairs are therefore much more comfortable to walk on compared to most stairs cast in situ.

IV. CONCLUSION

From the analysis done from various literatures it has been found that,

- i. It should be pointed out that controlling the production of precast pieces is imperative.
- ii. It has good quality control.
- iii. The time & cost of precast staircase is less than the conventional staircase.
- iv. The Labour requirement in precast staircase is very less.
- v. The connections and joints are responsible for stability as well as strength of the precast structures
- vi. The main purpose of joints and connections is to transfer the load between the components
- vii. Precast concrete is the process where concrete is placed in moulds off site under controlled conditions. The concrete is cast around steel reinforcement bars which add strength to the product. It offers significant benefits over in-situ cast concrete due to the additional control over the mix used, casting conditions and performance. Therefore, precast concrete stairs and landings make the ideal solution for fast track high quality concrete staircase construction.

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