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# Comparison of Pre-Stressed Hollow Core Slab and Precast Concrete Beams- Hcb Slab System

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**ABSTRACT:** *A prestressed hollow core slab element studied in this thesis is a precast prestressed concrete member with continuous voids provided to reduce weight and, therefore, cost and, as a side benefit, to use for concealed electrical or mechanical runs. Primarily used as floor or roof deck systems, hollow core slabs also have applications as wall panels, spandrel members and bridge deck units. This system of construction does not require form work and Propping during installation. Precast, prestressed concrete floors offer significant advantages in many types of building construction. They offer design, time and cost advantages over other flooring materials and systems and are suitable for use with all structural systems, i.e. concrete, masonry and steel. In our country precast prestressed concrete elements are not widely used for construction of most buildings. The*

*conventional cast in-situ construction require lots of formwork and construction time, and also the precast beam-slab system construction require propping and construction time too which increases the total cost of a project. When precast prestressed hollow core slab elements are introduced in vast amount in the construction of buildings, an economical construction could be achieved. The economy of the generalized hollow core slab system is require a short construction time compared to precast beam slab system and in the quantity of slabs that can be produced at a given time with a minimum of labor required. Each slab on a given casting line will have the same number of pre-stressing strands. Therefore, the greatest production efficiency is obtained by mixing slabs with the same reinforcing requirements from several projects on a single production line. This implies that*

*best efficiency for a single project is obtained if slab requirements are repetitive. In the present study, the advantages of prestressed hollow core slab elements, for construction of the floor slabs of four story building, is shown by making cost comparison between the precast beam-slab system and pre-stressed hollow core slab system. For this purpose, the same span length is chosen for the two slab systems. These elements are designed for loads they should sustain when used in the construction of slabs. Finally cost comparison is made between the two systems of slab construction. The cost comparison showed that the prestressed hollow core slab system of construction is more economical and faster than the precast beam-slab system.*

## **1.INTRODUCTION**

The use of inexpensive construction system in building construction is usually associated with the question of how economical the system will be, if it is used instead of the usual or traditional ones. However, the evaluation of the economical benefits gained from using such systems requires a thorough study on the system. Precast and prestressed concrete flooring offers an economic

and versatile solution to ground and suspended floors [12]. It gives both the design and cost advantages over the most common methods of construction such as cast in-situ concrete, steel-concrete composite and timber floors [12, 20]. Approximately, half of the floors used in commercial and domestic buildings around the developed world are constructed using precast concrete floors [12].

There are various methods of precast concrete flooring construction to give the most economic solution to various types of loadings having long spans. These floors give maximum structural performance with minimum weight and can be used with or without structural toppings and non-structural finishes. Precast prestressed hollow core concrete slab is one of the existing methods of flooring construction which has got a self weight of about one-half of a solid section of the same depth [12, 19]. It is now the most widely used type of precast flooring system in the developed and developing countries. This success is largely due to the highly efficient design and production methods, flexibility in use, surface finish and structural efficiency [1, 11, 12]. In addition precast beam elements studied in this thesis are reinforced concrete beams, in which their latticed reinforcement bars are projected out. They are used for construction of reinforced

concrete slabs, in combination with hollow concrete blocks, as case of ribbed slab construction. This system of construction does not require formwork

for the in-situ concrete slab. The increasing price of building construction, Primarily due to increasing prices of building materials, and construction delays, call for inexpensive and faster methods of construction. The use of such methods of construction, especially in a developing country like Ethiopia, where there is a limited source of building materials, might be proved economical. One of such cheaper and faster method of construction is the use of precast pre-stressed hollow core elements for the construction of slabs. Generally, the application of precast concrete floors in Ethiopia has been limited to small extent since its inception in the country. In this study an alternative method of precast concrete flooring, the precast prestressed hollow core concrete floors, is studied to come up with recommendations and conclusions for its wider application.

## 1.2 OBJECTIVE OF THE STUDY

The main objective of the present study is to investigate the advantage of precast prestressed hollow core concrete slab elements. This is achieved by making a cost comparison of floor

slabs, analyzed and designed by the precast prestressed hollow core concrete slab system and the precast beam-block slab system. For the purpose of the cost comparison the floors of a four-story condominium building slab is analyzed and designed using both systems. In addition, conclusions and recommendations are drawn which may be useful for further developments and the application of this system of construction.

## 1.3 METHODOLOGY OF THE STUDY

The following methods are employed to achieve the objectives of the research.

### Field work:

Assessment of the different plants and sites and the practice in Addis Ababa where precast and prestressed slab production and construction employed.

### Desktop works:

Literature survey on analysis and design of precast beam-block and precast prestressed

hollow core concrete floors slab systems which include:

### Loading computations

### Analysis

- Detailing for various design action including connections.
- Connection practice of hollow core concrete floors with beams and walls.
- Detailed analysis and design to be followed with the design guide.
- Comparison of the slab systems

#### **1.4 APPLICATION OF THE RESULT**

The result of the thesis discloses the existence and extent of employing precast pre stressed hollow core concrete floor in the country and the rational for its very small current application. This is followed by what is to be done to improve the use of the precast and prestressed concrete element technology in the country. The results of this thesis work also offer a design guideline for prestressed hollow core concrete slabs and pre cast beam for slab construction which can be used by the engineers.

## **2.PRECAST AND PRESTRESSED CONCRETE FLOORINGS**

**2.1.GENERAL** Precast concrete refers to concrete components no cast in place but rather, cast off site or in a location different from their final location. Precast concrete construction represents a viable alternative to construction

method utilizing cast-in-place concrete [3]. Structural elements may be precast either in a remote factory or at the job site. Precast concrete may be either ordinary reinforced or pre-stressed. Prestressed concrete, which may be considered as a modified reinforced concrete, was not practical in general applications as late as 1933[16].surprisingly enough, however, the basic ideas of prestressed concrete were connived almost as early as those of reinforced concrete [16]. Particular attention must be given in the design of precast and prestressed concrete units to reduction in weight and details to minimize the cost of erection and installation. There are a wide range of flooring types available to give the most economic solution for all loading conditions and spans.

## **3.BENEFITS OF PRECAST BEAM-BLOCK SLAB SYSTEM**

This modern\product allows the construction market to eliminate the need for conventional cumbersome\bulky\ in situ decking system. In addition the precast concrete and blocks reduce the amount of in-situ concrete required [7]. The relative speedy erection and completion ensures easy access to other trades and earlier occupation of completed building. Skilled laborers on site

like bar benders and carpenters are reduced considerably due to the simplicity of the system and ease of handling making it ideal for the builder. The precast beam and block slab system, eliminating the requirement for crane erection, has proven ideally suitable for commercial and industrial developments, schools, town houses, cluster homes and domestic homes. Due to the reduction in weight over in situ slab, the beam and block system has resulted in substantial savings in the building design support structure, and the erection, thus offering the client or the investor lucrative savings towards the overall price of his development [21]. Some of the detailed advantages of precast beam and block slab system are • Precast slabs can be erected a lot quicker than in-situ slabs. • Reduced erection time and labor cost over conventional reinforced concrete slabs • Excellent structural integrity (monolithic slab) • They are ideal for soffit plaster but fixing of suspended ceilings are also easy and simple • It provides an economical, versatile light weight monolithic slab system. Components are relatively light and no mechanical handling is necessary but needs a number of skilled and non skilled labors. • Non-highly skilled labor required for installation • No formwork but needs propping • Factory controlled superlative quality • Relatively

Lightweight structure • Fast, flexible and cost effective

## CONCLUSION

The use of a relatively cheaper system of construction for building construction instead of the widely used ones, will not only have economical benefits but also avoids the dependence on usual systems, thereby reducing the competition in the construction industry. Precast prestressed hollow core slab system of construction is a system, which does not need very heavy equipment for erection, and the component members can be produced with locally abundant construction materials. In addition it is a precast, prestressed concrete slab system with continuous voids provided to reduce weight and, therefore, cost and, as a side benefit, to use for concealed electrical or mechanical runs. Primarily used as floor or roof deck systems, hollow core slabs also have applications as wall panels, and bridge deck units. It should be understood that the main objective of the present study is to investigate the advantage of pre castprestressed hollow core slab elements for floor slab construction, by comparing with the precast beam-block slab system. All construction projects are designed to end up with an optimum economy and safety. To fulfill these criteria the construction method to be adopted should be the

one with minimum total cost that satisfies the strength requirements. A cost comparison between the two systems of construction the hollow core slab system and the precast beam slab system was made by designing the floor slabs of a typical four-story building, using both systems. Based on the cost comparison, the theoretical investigation the following conclusions and recommendations may be drawn.

1. The cost comparison shown that the hollow core slab system of construction is faster and less expensive than the precast beam-block slab system. The total saving obtained from the use of system is about 6.04% of the total construction cost of a building using the precast beam-block slab systems. In addition to the economical benefits gained the application of this system is believed to solve problems associated with delays in the construction industry, since construction delays are one of the main causes of disputes.

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