International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
Vol.6, No.7, June 2017 DOI:10.15693/ijaist/2017.v6i11.240-243

Formwork Requirements, Types, Materials & Accessories

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

1. Introduction:

This chapter provides information related to the importance of economy, safety structures, planning and designing the formwork system as an integral part of the process of designing and constructing concrete structures. There are decisions that must be made during the design process that will have major impacts. This chapter also deals with formwork materials, accessories and systems. Materials generally used in formwork are Timber, Steel and Plastics with different types and classifications. The systems used can be a combination of two materials. Selection of materials suitable for formwork should be based on maximum economy to the contractor, consistent with safety and the quality required in the finished work. Formwork system can be generally classified as Vertical Systems (wall and column) and Horizontal Systems (slab and beam). The material serving as the contact face of forms is known as sheathing and it is used in both the vertical and horizontal systems.

2. Formwork Requirements:

Formwork is made from different materials, and requires great skill and experience in its manufactures. To produce concrete forms that meet all job requirements, the construction engineer must understand the characteristics, properties, and behaviors of the materials used; be able to estimate the loads applied to the forms; and be familiar with the advantages and shortcomings of various forming systems. In designing and building formwork, four major objectives must be considered:

3. Economy:

The main materials of the reinforced concrete work are concrete, reinforcement and formwork, so the total cost can be approximately distributed among the three items. Economy should be considered when planning the formwork for a concrete structure. It involves many factors; including the cost of materials, the cost of labor in making, erecting, and removing the forms and the cost of equipment required to handle the forms. Economy also includes the number of reuses of the form materials, the possible salvage value of the forms for use elsewhere, and the cost of finishing concrete surfaces after the forms are removed. A high initial cost for materials, such as steel forms, may be good economy because of the greater number of uses that can be obtained with steel so steel formwork has replaced wood formwork to some degree, although the use of wood is still substantial because of its availability and ease of fabrication. Design of the proposed formwork for a

given project usually will enable the job planner to determine, in advance of construction, what materials and methods will be the most economical.

Forms must be built efficiently, minimizing time and cost in the construction process and schedule for the benefit of both the contractor and the owner. Forms must be simple to erect & dismantle and modular dimensions should be used. Economy in formwork design depends partly on the ingenuity and experience of the form designer, whether a contractor or an engineer. Judgment with respect to the development of a forming system could both expedite a project and reduce costs. Although forms may be job built, many proprietary forming systems are available. In addition a large proportion of the cost of conventional formwork is related to formwork labor costs. Significant cost saving could be achieved by reducing labor costs. In the design of concrete structures, the common approach is to select the minimum size of structural members and the least amount of steel to sustain

4. Quality:

Forms must be designed and built with sufficient stiffness and accuracy so the size, shape, position, and finish of the cast concrete are attained within the required tolerances. The quality of the formwork itself has a direct impact on safety, accidents, and failures. Correctly designed formwork will ensure that the concrete maintains the desired size and shape by having the proper dimensions and being rigid enough to hold its shape under the stresses of the concrete. The quality of the resulting concrete is dictated by the quality of formwork materials and workmanship. Many concrete-related problems such as discoloration, stains, and dusting are attributed to concrete formwork. Also, some deformed concrete surfaces are due to deformed formwork systems caused by repetitive reuse and inadequate support of formwork. Also joints that are insufficiently tight will leak cement paste. The surface of the concrete will thus be disfigured by fins of the cement paste, and honeycombing may result adjacent to the leaking joints. Final shape of the formwork in contact with the concrete should be so arranged and jointed as to produce a concrete surface of good appearance. Wires, nails, screws, and form surface flaws must not be allowed to disfigure the concrete surface. In some cases a provision of special form

Lining may be necessary to achieve the desired surface finished.

5. Safety:

Formwork operations are risky, and workers are typically exposed to unsafe working conditions. Partial or total failure of concrete formwork is a major contributor to deaths, injuries, and property damages within the construction industry. Forms must be built with sufficient strength and factors of safety so they are capable of supporting all dead and live loads without collapse or danger to workers and to the concrete structure. Contractors are generally responsible for stability and safety of concrete formwork. Also they are guided by several federal, state, and local codes and regulations that regulate formwork safety. Most of these documents provide general guidelines for safety but provide no guarantee against failure. Contractors typically are trying to achieve fast removal of formwork elements without compromising the safety and integrity of structures. A floor formwork system filled with wet concrete has its weight at the top and is not inherently stable. As a result, one of the most frequent causes of failure is from effects that induce lateral forces or displacement of supporting elements; therefore, inadequate cross-bracing or horizontal bracing is one of the most frequently involved factors in formwork failure. Also vibration is one factor that can trigger failure through inadequate bracing. In addition formwork failures result from faulty formwork structural design, inadequate shoring and reshoring, improper construction practices during construction, unstable support or mudsills, and insufficient concrete strength to sustain the applied load after construction. The failure at one point in the formwork that can become an extensive collapse through chain reaction. So Formwork should be designed by an engineer or by someone who has sufficient knowledge of forces and resistance of form materials. The safety of workers is a concern of all parties: owners, designers, and contractors. Safety is everyone’s responsibility, including workers in the field, supervisors, and top management. There are many risks in the process of erecting and dismantling

forming systems. Every precaution should be taken to ensure a safe working environment.

6. Speed and Time:

Speed of construction is defined as the rate in which concrete building is raised and can be expressed in terms of number of floors erected per week or months. Speed of construction can be also measured in terms of inches or millimeters of concrete poured per hour. Formwork operations can control the pace of construction projects. Formwork is typically supported by several levels of shores and restores that carry the loads until the concrete gains enough strength to support its own weight and all other externally applied loads. Shores are vertical members made of wood that support recently built concrete that have not developed full design strength. On the other hand, reshoring occurs when the original shoring is removed and replaced in such a manner as to avoid deflection of the cured concrete. As a result, several floors may be blocked, preventing the progress of any other construction activities. Faster formwork cycle from erection to stripping would allow for faster removal of shoring and reshoring and faster overall project progress

7. Formwork Types:

Formwork components can be assembled in a wide variety of systems for casting many structural shapes. The terms formwork and false work are often used in combination. Formwork system can be generally classified as Vertical Systems (wall and column) and Horizontal Systems (slab and beam). The material serving as the contact face of forms is known as sheathing and it is used in both the vertical and horizontal systems.

8. Formwork Horizontal Systems:

Horizontal formwork systems are used to temporarily support horizontal concrete work such as concrete beams and slabs. Formwork systems for horizontal concrete work can be also classified into two main categories: hand-set systems and crane-set systems. Conventional wood systems and conventional metal systems are classified as hand-set systems. In hand-set systems, different formwork elements can be handled by one or two laborers. Conventional wood system includes formwork for slabs, beams, and foundations. The system is generally built of lumber or a combination of lumber and plywood. Formwork pieces are made and erected in situ. For stripping, conventional wood systems are stripped piece by piece, then cleaned, and may be reused a few times. Flying formwork systems, column-mounted shoring systems, and tunnel formwork are classified under crane-set systems. In crane-set systems, adequate crane services must be available to handle formwork components.

9. Conclusion:

This research provides information related to the importance of economy, safety structures, planning and designing the formwork system as an integral part of the process of designing and constructing concrete structures. There are decisions that must be made during the design process that will have major impacts. To produce concrete forms that meet all job requirements, the construction engineer must understand the characteristics, properties, and behaviors of the materials used; be able to estimate the loads applied to the forms; and be familiar with the advantages and shortcomings of various forming systems. The Selection of the formwork system depends on the available materials, the size of the construction work and these factors affect the total cost of the construction project. Materials generally used in formwork are Timber, Steel and Plastics with different types and classifications. The systems used can be a combination of two materials. Selection of materials suitable for formwork should be based on maximum economy to the contractor, consistent with safety and the quality required in the finished work. Formwork system can be generally classified as Vertical Systems (wall and column) and Horizontal Systems (slab and beam). The material serving as the contact face of forms is known as sheathing and it is used in both the vertical and horizontal systems. Formwork consists of primary beam (stringer) and secondary beam (joist). Design of all members of formwork is satisfaction for bending, shear and deflection. False work (shoring system) consists of compression members Summary, Conclusion and Recommendations (standards), horizontal members (ledges) and diagonal members. Standards are

designed as studs, ledges and diagonal members are used for bracing. So Formwork should be designed by an engineer or by someone who has sufficient knowledge of forces and resistance of form materials. The safety of workers is a concern of all parties: owners, designers, and contractors. Safety is everyone's responsibility, including workers in the field, supervisors, and top management. There are many risks in the process of erecting and dismantling forming systems. Every precaution should be taken to ensure a safe working environment.

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