

## CHAPTER II

### LITERATURE REVIEW

#### 2.1 Definitions of Formwork

Formwork is a help tool to cast the concrete with desired size, shape and position from the design (Trijeti & Muis, 2013). She also adds formwork is composed of several parts that are assembled into a particular construction unitary with practical system. According to Adiansyah (n.d), formwork is a place to cast the concrete based on the desired shape from the design, so the formwork must be able to function as temporary structure that can resist its own weight, wet concrete, live load, and the working equipment. Furthermore, Hanna (1999) says formwork system is defined as a total support system for placing fresh concrete including mold or area of contact with the concrete along with the supporting mold. From three definitions above, the writer conclude that formwork is wood base material that has function to maintain the shape of structural elements during the concrete casting. The formwork later will help the structure to resist the load from any direction.

Despite the function of formwork as temporary helping tool, it also plays an important role. Not only the financing (such as wage per hour and cost of materials and tools), but the quality of formwork materials also determined the form and shapes of concrete. Therefore, formwork must be made from qualified material and should be designed in such a way so the structure will not be damaged due to deflection occurs when concrete is poured (Sagel, Kole, & Kusuma, 1993: p.41).

Based on the workmanship, formwork can be formed in two methods that are conventional formwork and fabricated formwork. Conventional formwork is a traditional method that can be constructed directly in the field. Conversely, fabricated system of formwork is constructed in manufactory. So it is easier to install and reinstalled, and can be used for many times, even though the price is more expensive for one unit formwork.

### **2.1.1 Functions of Formwork**

Wigbout (1992) stated that generally, formwork has three main functions that are:

1. To give shape to a concrete structure elements.
2. To get the desired surface of the structure.
3. To resist the load from concrete, until the structure is hard enough to resist its own weight, equipment and the worker load.

In brief, the concrete structure work really depends on the formwork, even though it is only a temporary tool.

### **2.1.2 Formwork Requirements**

Wehrmann (n.d) says formwork is the main means of work in the molding process of the concrete. Basically the process of formwork making has to meet the following requirements:

1. The structural component to be produced is to be molded with the desired dimensions keeping the admissible tolerances.
2. The dead loads of the fresh concrete and of the reinforcement as well as the temporary load of persons and working tools must be safely

resisted and carried off to the soil or supporting members of the structure.

3. The concrete must be protected against too high or too low temperatures as well as vibrations.
4. The thin concrete mix must not flow out of the formwork.
5. The future concrete component must have a surface finish meeting the required quality after stripping.
6. The placement of necessary steel reinforcements must be easily possible during the erection of the formwork.
7. Stripping of the concrete components produced must be uncomplicated.

Furthermore, formwork should be economical both in terms of cost and time. Formwork should be easy to be installed / reinstalled so it will not need many workers, and can save cost.

## **2.2 Types of Formwork**

Due to rapid development and many demands must be met for the result of a good and economical construction, so based in Wigbout (1987) the current formwork types developed into three, namely:

1. Conventional Formwork
2. Semi System Formwork
3. Full System Formwork

### **2.2.1 Conventional Formwork**

Meant by conventional formwork is every time it has been detached and demolished until basic pieces, it could be arranged again into another form. Generally, the materials of conventional formwork consist of plywood, while the support of construction composed of timber and iron elbow (for slab). Conventional formwork can be formed in accordance with the desired.

### **2.2.2 Semi System Formwork**

According to Trijeti & Muis, Semi system formwork material is essentially adjusted to the concrete construction, so that repetition can be done much more if the concrete construction itself does not change shape and size. Consideration of the use of semi formwork construction system is at a high enough repetition use on a print job formwork system is made of plywood or plate material, while the jib scaffolds made of steel fabricated. Semi formwork system is the development of conventional formwork, improving the quality of the formwork. Conventional become semi formwork system rests on the use of the formwork itself. The materials required for semi system formwork are scaffold, u-head, vertical support tube, the support tube horizontal, jack base, joint pin, and supporting tools.

### **2.2.3 Full System Formwork**

Full system formwork experiencing further development into a universal formwork that with all probability can be used on a wide variety of building project, the use of formwork system aims to re-use. Implementation of the formwork system is faster than conventional formwork and semi systems because the components of the existing system formwork standard sizes. Cost of formwork

system can be said to be expensive at first, but with the implementation of a relatively short and repeated use, the additional cost is not too take effect (Trijeti & Muis, 2013).

One of the examples of full system formwork is Knock Down formwork. The differences of knock down formwork and conventional formwork are shown in Table 2.1.

**Table 2.1 Comparison of Conventional and Knock Down**

<b>Conventional</b>	<b>Knock Down</b>
Only can be used for not more than twice	Can be used for more than 30 times
Mostly made by wood	Made by plywood and hollow
Use plywood that needs to coated with formwork oil	Use plywood coated polyfilm (no need formwork oil) or steel plate
Cheap	Expensive
Fabricated directly in the field	Pre-fabricated formwork
Need longer time to install	Fast installation
Need more worker	Need less worker
No need crane to install	Need crane to move and install the formwork



**Fig. 2.1 Conventional Formwork**



**Fig. 2.2 Knock Down Formwork**

### **2.3 Time**

According to Sun and Olawale (2010) time management is important in any construction project. Without proper time management, many problems will occur such as extension of time or time overrun. Some of the researchers describe

time overrun as delay and some of them describe that the time overrun is an effect from the construction delay, no matter what it was described, time overrun become the most general problem in construction industry worldwide. Hence, time in construction projects need to be controlled from the beginning of the construction process until the project is totally completed.

#### **2.4 Cost**

Fellows et al. (2002) explained in the construction industry, almost all budgeting techniques are based upon cost. However, in any sale three basic concepts are present: cost, price and value. Cost is what must be given (or foregone) to obtain something. Price is what is received in return for giving up something. Value is a measure of the utility of the item(s). According to Pratt (1995), the functions of cost estimating in construction industry are:

1. To know if the estimate cost of construction can be fulfilled by the provided cost.
2. To control the cash flow of on-going construction project.
3. Competencies during the bidding process. The cost estimation which based on specification and designed drawings from the owner should ensure that the project will be finish on time and the contractors could receive decent profit.

In general, the cost of components listed in construction cost estimations are includes direct cost and indirect cost.

### **2.4.1 Direct Cost**

Direct cost is cost that can easily be directly identifiable with or attributable to a particular job. For examples include direct materials, direct labor, and sub-contractors costs. For instance, a direct subcontractor would submit invoices from the particular job that they are working on.

### **2.4.2 Indirect Cost**

Indirect costs are expenses that are directly identifiable as costs of construction but are not easily attributable to specific contracts. Examples include labor not directly attributable to any one job (for example a project manager working on multiple jobs in the office), contract supervision, tools and equipment, supplies, quality control and inspection, insurance, repairs and maintenance, depreciation, and amortization.

## **2.5 Productivity**

### **2.5.1 Definition of Productivity**

According to Hasibuan (1996 : p.126) productivity is comparison between output (result) with input. The productivity can possibly increase because there is efficiency increases (duration, materials and labor) and work system, production technic and skill increases of the worker. Furthermore, Riyanto (1986 : p. 22) says technically productivity is a comparison between the result achieved (output) and the whole resources required (input). Productivity implies a comparison between the results achieved with the role of labor per unit time.



From the above definitions it can be concluded that labor productivity is the ability of employees in production compared to the inputs used. An employee who is able to produce goods or services in accordance with expected within a short time or right can be said as productive employee.

### 2.5.2 Work Productivity Method

Wuryanti (2010) said that methods of work productivity can be obtained based on the data sources, namely:

1. Factual data in field by observes the total duration and volume of work directly in the field.
2. Historical data that is done by review the daily / weekly / monthly reports.

For direct observation in the field, the productivity measurement is done by continue observation for particular type of works and measure duration nor the amount of worker to complete particular work. There are varies of work productivity method that each of method has its own advantages and disadvantages as shown in Table 2.2

**Table 2.2 Various Method of Productivity Data Collection**

No.	Measurement Methods	Implementation
1	Time and Motion Study	Note the duration needs to complete particular activities. The observer must determine first the beginning and the end of a cycle.

No.	Measurement Methods	Implementation
2	Method Productivity Delay Model	A method to measure, predict, and fix productivity by identify the delay occurs in some cycle of an operation.
3	Work Sampling / Activity Sampling	A random observation method without observing the work and labor every time. The aim is to measure the activity time that include in direct work.

(Source : Wuryanti, W. and Wibowo, A. 2010)