

COST ANALYZE OF DEWATERING WORK AT FOUNDATION CONSTRUCTION

(Case Study Anugerah Palace Hotel (HAP) Project in Surakarta)

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ABSTRACT

The problems that were encountered in building construction with a basement is the presence of water in the excavation area is located below the ground water table. One of the cases is the construction of Raft foundation Hotel Anugerah Palace (HAP) Project in Surakarta. In which construction in order to dry from puddle, so made the construction of foundation finished without disruption. To keep the area foundation worked well and dry, the foundation construction used dewatering system. Dewatering system at Hotel Anugerah Palace (HAP) Project is a predrainage method and open pumping method. To analyze dewatering system at Hotel Anugerah Palace (HAP) Project a series of studies were conducted i.e : studies the implementation of foundation method, dewatering method, analysis of standing water volume with number of pump and analyze of total cost dewatering. This is expected to be a parameter in the analyze of the effect puddle water on the foundation and dewatering costs to complete the implementation of the first stage of the project construction problems effectively and efficiently. The result shows in the Hotel Anugerah Palace ((HAP) Project Surakarta, normal water volume 2,049 m³ / 2 minutes (cycle pump will run every 5 minutes because the system live two minutes three minutes off). Requires six surface pumps, four submersible pumps and two engine pumps (incidental). With details of operational cost analysis, equipment materials and labor to the use of dewatering is completed during the 1.5 year total cost ± Rp 267,978,500, -

Key words : Hotel Anugerah Palace (HAP), foundation work, analyze cost.

INTRODUCTION

Over time, with a problem of limited land caused by increasing land prices, it required a great alternative to overcome these problems. One alternative which is contrary to the principle of development principles skyscraper, is known as landscaper, called as basement. In the construction of buildings which has more than five floors it usually with need to add a basement room which is used as a parking lot. To construct the basement, then excavation can not be avoided.

According to Denny Karyadi (2010) The problems that were encountered in the construction of basement is the presence of water in the excavation area is located below the ground water table.

Dewatering is also necessary to cope in the event of a puddle on the basement or foundation construction, either due to rain or ground water seepage, Dewatering is operated for 24 hours during the work of basement. (Asiyanto 2006)

According to Asiyanto (2006) Dewatering costs for surface water is calculated based on the method chosen, and is usually included in the preliminaries job. Fundamentally there are three ways (methods) in order to control the ground water in the process of implementation of construction projects, namely:

a. Open Pumping Method

This method is still considered as a commonly accepted technique in which the collector is used to collect surface water (rain water in particular) and seepage from the edge of the excavation.

b. Predrainage Method

The principle of the method is predrainage lower the water level before excavation work begins.

c. Cut Off Method

In this method the flow of land cut in several ways (can not serve as a retaining wall).

This job is also important to note, it affect to the implementation of the job, especially in areas of groundwater is in place it is very annoying process of implementation of the work. Dewatering system for surface water, mostly use a water pump. So the cost includes building a cofferdam dewatering, and operating costs used of the pumps.

The dewatering job in building construction usually related to construction of foundation, especially for raft foundation.

According to Niken Silmi Surjandani (2007) usually raft foundation is designed in the form of concrete

slab. Load down to the foundation raft load is derived from each column or wall. Heavy raft foundation is not taken into account in the planning of the structure because it is directly supported by the subgrade.

So it is very important to have this system at work dewatering for raft foundation, because it can reduce the decline in the building on the ground state with a high ground water table.

The foundation is part of the structure that serves towards the continuing burden of supporting soil layers underneath. In any structure, whether the expenses incurred due to its own weight or due to the load plan must be passed into a support layer in this case is that there is ground beneath the structure. At the foundation may not decrease local foundation or foundation evenly decrease exceeds certain limits, namely:

The maximum consolidation in building types

1. Public buildings 2.54cm
2. Factory building 3.81cm
3. Warehouse 5.08cm
4. Foundation machine 0.05cm

(Source : *Foundation Design – W.C Teng*)

Dewatering system will be definitely related to water discharge, as the water discharge from foudation work can nott be calculated. So the analysis of water discharge in foundation work is conducted by measure volume of puddle.

Something very important (significant), but it is not known with certainty at the dewatering system is total water (Q) roomates must be pumped out and the amount of water (QW) are expected to be disposed for each well or wellpoint dewatering system on the existing conditions. Based on Q and QW dewatering system design is established. Existing understanding of this formula has at least been able to give understanding about the variables that affect the magnitude of Q and QW. (I Made Kamiana : 2012)

In the possibly formula to analyzes volume of water puddle :

$$a. \quad V_{\text{water}} = (p \times l) \times t_{\text{water}} \quad (1)$$

(Volume of area foundation)

$$b. \quad V_{\text{water}} = (3.14 \times r \times r) \times t_{\text{water}} \quad (2)$$

(Volume of well poin and sum pit)

Information:

V_{water} : volume of standing water in the area (m^3)

p : length foundation area (m)

l : wide area foundation (m)

t_{air} : puddle height (m)

r : radius (m)

This research based on study of the dewatering system applied to project development Anugerah Palace Hotel Surakarta. Because the hotel development plans will be built with the number nine and also the construction of the basement floor. Based on the research above, the application is very important especially dewatering system is implemented in the project Anugerah Palace Hotel is very susceptible to standing water in the project area because of the location in the city center near a residential area and the water table is very large in the project area. At the time of discharge of the water to stagnate in the area of foundation, foundation work will make a stop. Because the role of dewatering system is very important and can influence design changes to affect the overall cost of building the need for analyze of the costs incurred for the cost of dewatering.

According to Ricky and Priyono (2007) In calculating the cost of dewatering, there are two kinds of costs, the direct costs and indirect costs. Usually the direct costs of dewatering costs consist of three elements, namely:

1. Mobilization and demobilization costs are required.
2. The cost of installing and dismantling dewatering equipment.
3. Operation and maintenance costs.

While indirect costs, consisting of:

1. Backup benefits specialist subcontractors.
2. Overhead subcontractors.
3. Insurance jobs.

RESEARCH METHOD

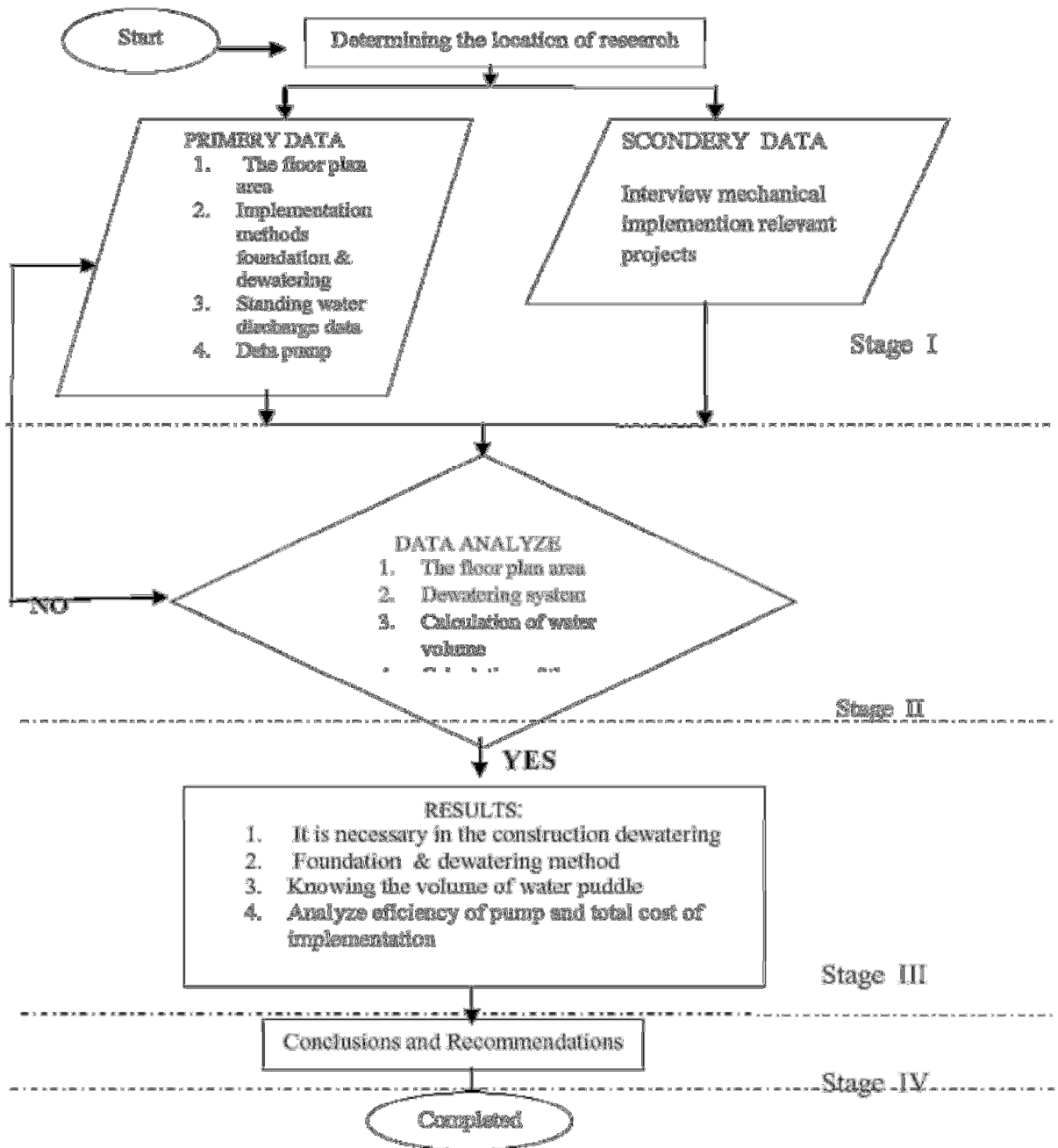


Figure 1 Flow chart of research

Stage of implementation :

As describe in the figure the stage of research analyze

Stage I

The first stage of this final project is to collect data. Data obtained including foundation method used, the data volume of standing water and dewatering methods of implementation. The data collection is done also to the performer interviews mechanical Hotel Anugerah Palace (HAP) project in Surakarta. Interviews are the primary means for preparing a summary of the problems occurred during the construction of foundation.

Stage II

Calculation data from stage I include :

- a. Wide of the floor plan area
- b. Calculation of volume and the number of pump

- c. Labor cost analyze
- d. Equipment and materials cost analyze
- e. Analyze of pump operating costs during the process of making basements.

If there is an uncertain result in the calculation, the data will be corrected and if nothing the stage can be continued.

Stage III

Based on stage II results of this analyze found that there are five main things that include things that need to be considered in the implementation of dewatering, foundation execution method, the volume of standing water in the area and pump capacity, which exist in the implementation so that the foundation can be seen in the total amount spend to cope with inundation accurately and efficiently.

Stage IV

Conclusion of our final guides shaped flow-chart form puddles on the analysis of the implementation of the foundation in terms of the cost of dewatering. Suggestions from our end regarding the task efficiency and the number of pump dewatering costs incurred on Hotel Anugerah Palace (HAP) projec Surakarta who became our case as well as others who pursue the field of building construction basement.

With this research expected to help resolve the problems that occur in the world of work in accordance with the discussion topic and add to the general knowledge and academic communities.

RESULT

The research was conducted at Hotel Anugerah Palace Surakarta (HAP) project in April-August 2013, the result of analyze are:

The foundation in Hotel Anugerah Palace is raft foundation. Raft foundation, because with a raft foundation is not a decline, but the decline in Hotel Anugerah Palace Surakarta (HAP) project will be same in all parts of the building. Reduction is not same in stage 2 building, will make our buildings cracked and suffered failures both structurally and architecturally. Raff foundation building foundation system be able to unite and come down with the same force.

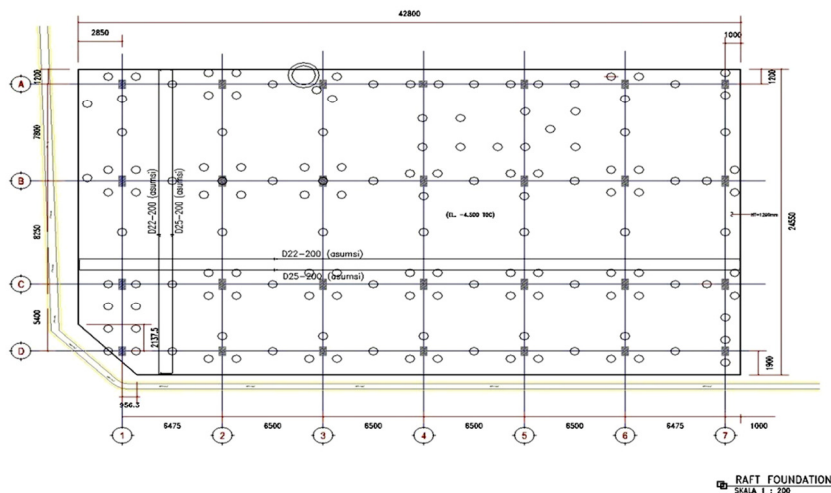


Figure 2 Reinforcement plan Raft Foundation

Beside foundation subsidence at Hotel Anugerah Palace (HAP) Project in Surakarta the other problem a high water table. To overcome the problem of ground water level dewatering system was applied predrainage method and open pumping method.

The method of Dewatering Systems Hotel Anugerah Palace (HAP) Project Surakarta consist of:

- a. System dewatering i.e : Predrainage method and Open pumping method
- b. Dewatering wells (predrainage method) used for lower the ground water level will go to the foundation area.
- c. There are six dewatering wells made of PVC pipe with hole and dept 8 m, on it related a pumps for sucked a water (Figure 4)
- d. Automatically, when the water which height of water in the well reach 4 m the pump water will run for two minutes and will stop for three minute until the high of water reach censorship.

- e. At the foundation area, the dewatering system consist four point holes made from bis concrete with dept 1,5 m (Figure 4)
- f. Automatically, when the water which height of water in the well reach 4 m the pump water will run for two minutes and will stop for three minute until the high of water reach censorship.
- g. all the water from the dewatering wells and the sum pit will be sucked and towards to the channel irrigation

The dewatering system need other analyze i.e : analyze water volume, specification analyze the number of pumps and total cost analyze dewatering job

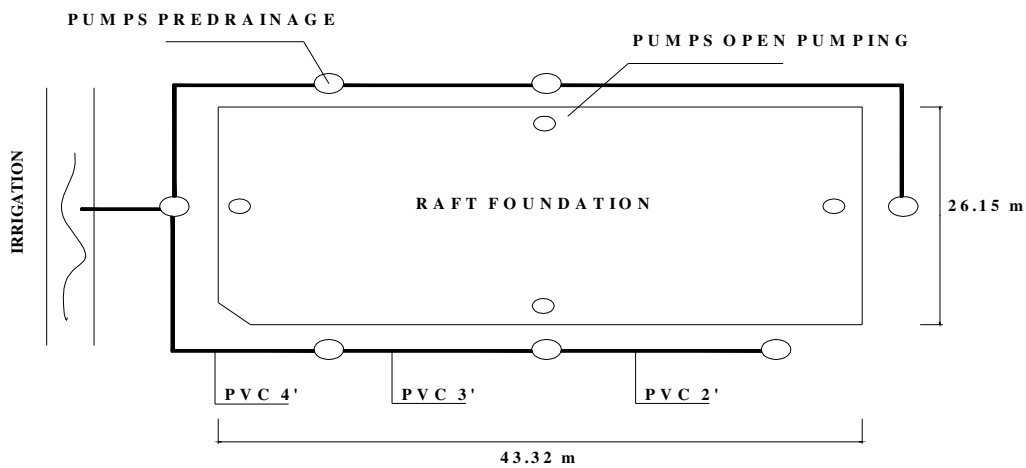


Figure 3 Plan of Dewatering method

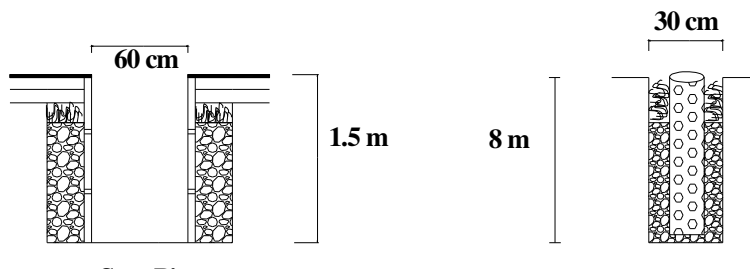


Figure 4 Sum Pit and Dewatering Wells

Analyze of four Sum Pit

Data d : 60 cm = 0.6 m
 r : 30 cm = 0.3 m
 t_{water} : 0.8 m

information :

t_{water} is the maximum height of the water in the sum pit that will suction automatically with pumps

$$\begin{aligned}
 V_{\text{water}} &= (3,14 \times r \times r) \times t_{\text{water}} \\
 &= (3.14 \times 0.3 \times 0.3) \times 0.8 \\
 &= 0.22608 \text{ m}^3 \longrightarrow 226.1 \text{ liter/ 2 minute} \\
 &= 226.1 \text{ liter} \times 4 \text{ sum pit} \\
 &= 904.4 \text{ liter/ 2 minute} \\
 &= 452.2 \text{ liter/ minute}
 \end{aligned}$$

Analyze of six Dewatering Wells

Data d : 30 cm = 0.3 m
 r : 15 cm = 0.15 m
 t_{water} : 3.5 m

information :

t_{water} is the maximum height of the water in the wells dewatering that will suction automatically with pumps

$$\begin{aligned}
 V_{\text{water}} &= (3,14 \times r \times r) \times t_{\text{water}} \\
 &= (3.14 \times 0.15 \times 0.15) \times 3.5 \\
 &= 0.2473 \text{ m}^3 \longrightarrow 247.3 \text{ liter/ 2 minute} \\
 &= 0.2473 \text{ m}^3 \times 6 \text{ dewatering wells} \\
 &= 1.4838 \text{ m}^3 / 2 \text{ minute}
 \end{aligned}$$

So in normal condition the average pump to remove the water is 2,049 m³ / two minutes and it will stop for three minute until the high of water reach 4 m.

conversion
 1 m³ = 1000 liter

During the observation there was an unexpected situation when the rainfall was very high, Water puddle in the area Raft Foundation

Information l : 26.15 m
 P : 43.32 m
 t_{water} : 25 cm = 0.25 m

$$\begin{aligned}
 V_{\text{water}} &= p \times l \times t_{\text{water}} \\
 &= (43.32 \times 26.15 \times 0.25) \\
 &= 283.2 \text{ m}^3
 \end{aligned}$$

V_{water in area} + V_{rwater of Sump pit} = 283.2 + 0.5652 = 283.7 m³ (Very large amount of water due to rainfall and water runoff from the road into the foundation area).

Table 1 Specification number of pumps

Wells pump specifications	Submersible pump specifications	Engine pump specification (incidental)
Brand : Barbinter	Brand : HCP pums	Brand : Water Pump Engine
Type : water pums	Type : submersiblme pums	2 ‘
Suction : 8 m	Capacity : 100 liter/ minute	Type : Honda GX 160
Capacity : 600 ltr / minute	Power : 400 watt	Power : gasoline
Pipe size : 2’ x 2’	Pipe size : 2’	Capacity : 1000 liter / minute
Power : 1000 watt	Number : 4 pumps	Dimention : 550 x 390 x 450 mm
Number : 6 pumps		Suction : 8 m
		Number : 2 pumps

Based on analyze the cost for dewatering system at HAP project are :

Table 2 Cost Analyze of job HAP Project

No	Name	Number	Unit	Salary	time	Cost
1	Ahli teknik	2 Person	Day	@ 150000-300000	1.5 years	162000000
2	Pengebor	3 person	Day	@ 50000-150000	5 day	750000
3	Tenaga harian	2 person	Day	@ 45000-90000	20 day	1800000
Total Cost						164550000

Table 3 Cost Analyze of Operations and Maintenance HAP Project

No	Name	Unit	Price	Needed/ day	Time total	Cost
1	fuel	Liter	5500	5 liter	1.5 year	14850000
2	gasoline (2 pompa engine)	Liter	6500	2 liter	5 day	32500
3	Diesel Jensest large	Year	10000000	Rent	1.5 year	15000000
4	Tank car	Day	350000	rent	2 day	700000
5	Maintenance	year	10000000	-	1.5 year	15000000
Total cost						45582500

Table 4 Cost Analyze of Tools and Materials HAP Project

No	Name of Materials	price	number	unit	cost
1	Engine Pums	5200000	2	unit	10400000
2	submersible pump	1584000	4	unit	6336000
3	Pompa Permukaan	1840000	6	unit	11040000
4	PVC 2',3',4' rucika	52500	50	4 m	2625000
5	PVC 8'	635000	24	4 m	15240000
6	Make dewatering wells	760000	6	m3	4560000
7	Make Sum pit	1400000	4	unit	5600000
8	other	-	-	-	2045000
Total cost					57.846.000

The total cost of work dewatering at Hotel Anugerah Palace (HAP) Project is :

- a. Cost Analyze of Tools and Materials HAP Project : Rp 57.846.000
 b. Cost Analyze of Operations and Maintenance HAP Project : Rp 45.582.500
 c. Cost Analyze of job HAP Project : Rp 164.550.000

Total cost : Rp 267.978.500

CONCLUTION

The construction Hotel Anugerah Palace (HAP) Project in Surakarta have a problem related to the high water table and resulted in puddle in the area of foundation job its affect work performance will result in a decrease. Some analyze were conducted to deal with the problem i.e : analyze of the foundation, analyze dewatering system, analyze of water volume and cost analyze. The result shows with the use raft foundation at Hotel Anugerah Palace (HAP) Project in Surakarta, it need dewatering system with method predrainage and open pumping. The pump normal work for two minutes for the water volume 2,049 m³ and it will stop for three minute until the high of water reach 4 m. The total cost dewatering system was Rp 267.978. 500. Based on the conclusion above, it can be a discourse for engineering students in the construction of buildings with problems on a high water level in area basement. Further research is expected to add data average groundwater discharge and rainfall in Surakarta.

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