FINAL PROJECT RC14-1501

RISK BASED TIME AND COST SCHEDULING FOR ITS FMIPA TOWER

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TUGAS AKHIR RC14-1501

PERJADWALAN BIAYA DAN WAKTU BERBASIS RISIKO UNTUK PEMBANGUNAN GEDUNG FMIPA-ITS

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Surabaya 2017

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RISK BASED TIME AND COST SCHEDULING FOR ITS FMIPA TOWER

FINAL PROJECT

Presented to fulfill the requirements for the award of Bachelor Degree of Civil Engineering, Institut Teknologi Sepuluh Nopember - ITS

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SURABAYA, JUNE 2017

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RISK BASED TIME AND COST SCHEDULING
FOR ITS FMIPA TOWER

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ABSTRACT

Time and cost parameters of a construction project, have been identified as major facets of the decision-making process due to uncertainties and the complexity of construction works, that affects duration and budget of the project. In a series of interesting empirical studies covering 20 countries across the five continents including Indonesia, concluded that delays and cost overruns are fairly vast over and common problem in large project. Thus, in order to minimize uncertainty and create most value for money a project scheduling is required and a good schedule should include risks analysis.

This research aims to identify risks and schedule a project using risk analysis to improve both the process of time-cost estimating and the quality of the cost estimates. ITS FMIPA Tower has been used as case study, where all possible risk based time and cost scheduling were considered in order to obtain valuable results. Risk variables were collected from literatures and interview with expert of construction management and finally the schedule was done through RiskyProject Professional from Intaver Institute.

Five risks threats that affect the structural works directly were identified from the previous research. Moreover 3 risks event factors such as weather condition, labors' availability and material availability are ranked as the most crucial risks that affect the project budget and duration. Surprisingly all of these risks are identified in the work presented by Kaming et al in 1997.

The normal cost estimation (without risks) for the project structural works is Rp.27,007,477,878.31 (Including 10% of tax) but with risks analysis it becomes 31,913,283,306. Relatively to Time estimation, were discover that the normal duration is 329 days but with risks analysis it changes to 353 days.

Keywords: Construction Industry, Scheduling, Indonesian Project, Time and Cost Parameters, Risk, Uncertainty, ITS FMIPA Tower.

PERJADWALAN BIAYA DAN WAKTU BERBASIS RISIKO UNTUK PEMBANGUNAN GEDUNG FMIPA-ITS

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ABSTRAK

Parameter waktu dan biaya dalam proyek konstruksi merupakan aspek utama dalam proses pengambilan keputusan. Tingkat kerumitan pekerjaan konstruksi mempengaruhi kebutuhan dana dan durasi pekerjaan. Pada serangkaian studi terdahulu yang dilakukan di 20 negara dalam lima benua termasuk Indonesia menyimpulkan bahwa penundaan dan kelebihan biaya merupakan masalah umum dalam proyek besar. Sehingga untuk meminimalkan ketidakpastian dan mengoptimalkan dana, penjadwalan proyek yang baik adalah yang mencakup analisis risiko.

Tujuan dari penelitian ini adalah mengidentifikasi risiko dan kemudian menjadwalkan satu proyek menggunakan analisis risiko untuk meningkatkan kualitas estimasi biaya dan waktu. Penelitian ini menggunakan pembangunan Gedung FMIPA-ITS sebagai studi kasus. Kemungkinan risiko yang terjadi pada proyek dianalisa untuk mendapatkan waktu dan biaya yang paling optimal. Variabel risiko dikumpulkan dari literatur dan wawancara dengan ahli manajemen konstruksi. Pengerjaan tugas ini menggunakan aplikasi RiskyProject Professional dari Intaver Institute.

Dari hasil analisa telah diidentifisikan 5 risiko yang mempengaruhi perkerjaan struktur. Faktor seperti weather condition, labors availability dan material availability ditinjau *sebagai faktor yang paling mempengaruhi kenaikan dana dan durasi pekerjaan. Pada kenyataannya semua resiko pekerjaan yang telah didentifikasikan dalam proyek adalah yang telah dikerjakan oleh Kaming at el pada tahun 1997.*

Dari hasil perhitungan diperoleh hasil yaitu didepatkanya biaya normal proyek Rp.27,007,477,878.31 (Termasuk PPN 10%), tetapi dengan risiko menjadi Rp. 31,913,283,306. Dalam sisi waktu ditemukan durasi normal 329 hari, tetapi Setelah analisa risiko durasi proyek telah menjadi 353 hari.

Kata kunci: Construction Industry, Perjadwan, Indonesian Project, Biaya dan waktu parameter, Risiko, Uncertainty, Bangunan FMIPA-ITS

PREFACE

This final project, entitled "Risk Based Time And Cost Scheduling For ITS FMIPA Tower" would be just impossible without the blessings from God the Mighty and valid support and guidance from many personalities who believed in me and my undertakings. Moreover I would like to record my warmest gratitude to:

1. My Parents and Families for the moral and financial support.
2. Angolan Catholic Church in the person of Father Dominikus SVD, Francisco SVD for taking the risk in being my sponsor during my studies in Indonesia.
3. My learned supervisor, Prof. Tri Joko Wahyu Adi, ST., MT., Ph.D whose sharp sense of research direction have provided invaluable feedback to improve the quality of this final project.
4. All lecturers and Staff of Civil Engineering whose superbly willing to share their knowledge during my studies in ITS.
5. All my colleagues who have been supporting me, giving their humble and usuful comments while this final project had been writing.

This final project, may still have some shortcomings. Therefore, critics and constructive suggestions are welcome in order to improve its quality. Hopefully, this final project may provide benefits for readers, writers and all those who are enrolled in the world of construction management.

Surabaya, June 2017

Author

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CHAPTER I
INTRODUCTION

1.1 Background

The construction industry is by far one of the most important economic sectors worldwide and more complex than the manufacturing industry. While the manufacturing industry exhibit high-quality products, timelines of service delivery, reasonable cost of service, and low failure rates, on the other hand the construction industry is totally opposite; most projects exhibit cost overruns, time extensions and conflicts among relationship.

Time and cost parameters of a construction project, have been identified as major facets of the decision-making process. Construction planning has been the biggest challenging task for construction project managers, due to uncertainty and complexity of construction works that affect duration and budget of the Project.

Delays and cost overruns are fairly vast. In a series of interesting empirical studies covering 20 countries across the five continents, Flyvbjerg and Buhl (2004) have shown that infrastructure projects often suffer from cost overruns. In Indonesia for example, delays and cost overrun are common problems in large project, said Kaminget.al. (1997a). He identified that only 54.5 % of project managers completed more than 90% of their projects; 15.2% of completed only between 70 – 90% of their projects and 30.3% completed less than 70%.

Trigunarsyah (2004) claimed that only 30% of the projects were completed within the budget, 34% were less than the budget, and the remaining 36% exceeded the budget. His research also illustrated that only 47% of the projects were completed within the time frame, 15% ahead of schedule, and 38% were behind schedule. Thus, in order to minimize uncertainty and create most value for money a project scheduling is required and a good schedule should include risks analysis.

A risk analysis framework for estimating time and costs holds considerable promise for improving the time-cost estimation quality at civil works projects, since it provides opportunities to explicitly address much of the uncertainty inherent in the cost estimating process. At a time when cost estimators are being asked to provide more and better cost information earlier in project planning and design than ever before, every opportunity to improve the quality of time-cost estimating should be explored and exploited.

The process of engineering design and planning includes assessing the risks associate with specific design and appropriate modification. Risk assessment in civil engineering, particularly in the construction planning and cost estimate is very important to carried out.

Cavignac (2012) claimed that cost of risk is a concept many construction companies have never thought about despite the fact that it is one of the largest expense items. Furthermore, according to PMI (2008) risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives. Construction projects can be managed using various risk management tools and techniques.

Therefore the purpose of this research is to identify risks and schedule a project using risk analysis to improve both the process of time-cost estimating and the quality of the cost estimates. ITS FMIPA Tower was chosen as case study, where all possible risk based time and cost scheduling will be considered in order to obtain valuable results. The project construction is located in ITS campus, precisely at Mathematics and Natural Science Faculty as shown the figure 1.1.

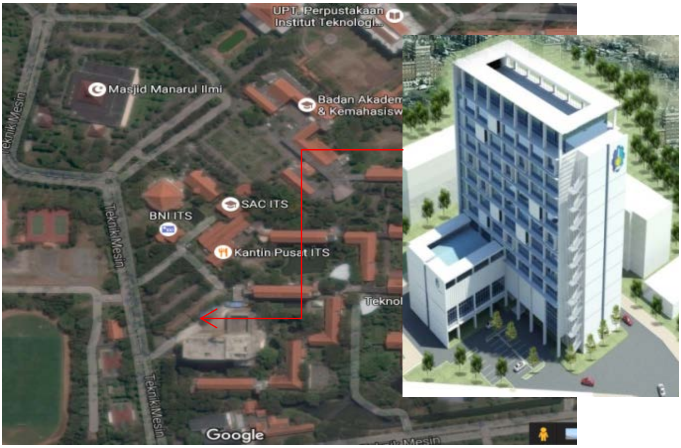

Figure1.1 ITS FMIPA Tower Location

1.2 Problem formulation

The following research questions will be analyzed throughout this research:

1. What kind of risks should be considered for ITS FMIPA Tower Planning.
2. What is the real time - cost when those possible risks are acknowledged in order to obtain valuable results.

1.3 Research Objectives

The objectives that will be achieved through this research are:

1. Identify and highlight risk factors influencing time and cost overruns on Indonesia construction projects.
2. Rescheduling time-cost of ITS FMIPA Tower, based on risks analysis.

1.4 Problem Limitations

1. The research does not cover time-cost scheduling for the architecture, electrical and mechanical stages. All analysis focus only in the executive structural planning.

1.5 Research benefits

The benefits of this research consisted on:

1. Introducing another reference for ITS FMIPA Tower regarding to time-cost scheduling, based on risk analysis.
2. Generating researcher’s attention in order to improve the quality of project scheduling.
3. Presenting how the cost and time estimate can influence authorization and appropriation decisions.
4. Helping the author to consolidate his knowledge regarding to time-cost scheduling.

CHAPTER II
LITERATURE REVIEW

2.1. Construction Industry

The construction industry differs greatly from others, since it presents peculiarities that reflect a very dynamic and complex structure. The art of building gathers a range of professionals, machinery and supplies in general and by associating them, leads to obtain a successful project. Palacios (1995) said that civil construction is considered a highly fragmented industry in a large number of small companies, involving a huge variety of stakeholders in relation to other sectors and it is not sophisticated. In contrast, nowadays the civil construction is the most intensified sector, becoming more sophisticated and has more tendencies in following up the technology development. Nevertheless, it can be considered a sector that depends on many internal and external factors.

These industry characteristics show that a planning development and management control interconnected, allows several companies to compete each other without exception. The small companies may suffer a huge disadvantage compared to bigger one, precisely because most of them do not have any strategic planning.

2.1.1 Planning and Construction Control

According to Chiavenato (1983), planning is a permanent and continuous process. It lead us to understand that the early determination of what to do and what goals are to be achieved make all difference, because the effect planning absolve uncertainties and allows greater consistency development of the companies.

Assed (1986) said, planning is an administrative function that includes the selection of objectives, guidelines, plans, processes and programs. So that these objectives may be achieved effectively, the company needs to get harmony between the financial and physical resources available. This harmony is done through rational planning. This approach breaks down the process of strategic planning into three distinct steps: Strategic analysis (examination of the current strategic position), Strategic choice and Strategic implementation as shown the figure 2.1.

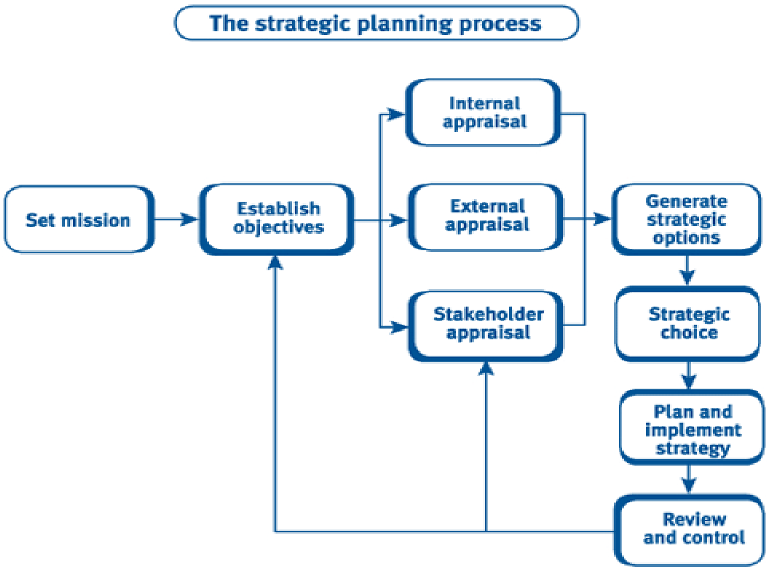

Figure 2.1 Traditional approach of rational planning
Source: Kaplan Financial Knowledge Bank, (2012)

2.1.2 The Need of Planning and Scheduling

2.1.2.1 Identification

Planning and scheduling are closely related; they're both processes that apply to almost every element of starting and running a construction. The project schedule is one of the most important tools in creating a successful project. However, the true value of the schedule is only achieved if several other tools are implemented and integrated.

The schedule is an integral part of the project management system required on move projects. It is integrated with budget, resources, WBS, scope, and quality requirements to produce a virtual model of the project execution plan to guide the work and reflect progress and performance through the life of the project. According to Shruti (2009), Scheduling is the way we actually manage a project. Without scheduling, nothing or nobody is managing the project and hence amounts to failure of a project. He understood that scheduling is process which describes guidance and pathway for a project to run and in order to succeed this process risk should be part of it.

2.1.2.2 Significance

There are a couple of important reasons why planning and scheduling are important for construction field:

a) A solid plan and schedule helps keep costs down and allows operating according to a budget.
b) Set strict ad budget restrictions based on your plan.
c) Having a plan and schedule also helps make project goals seem more realistic and achievable

One issue that may arise in the process of planning and scheduling is a situation where the owner has to address multiple objectives at the same time. This implies that the two problems often cannot be solved separately; they may have to be solved together. For example, if one of manager objectives is to increase productivity and the additional goal tied to that objective might be to train the worker. These competing needs may complicate the process and cause delays in the project plan until both issues are addressed.

2.2 Construction Productivity

The most challenging issue in Construction industry in the last decade is how to improve the productivity. Many construction managers in Indonesia believed that the occurrence of waste might affect the productivity level. Since the last two decades, some researchers had investigated the sources of reducing construction productivity. The Business Roundtable construction industry cost effectiveness study (1983) concluded that the primary causes for the decline of construction productivity directly or indirectly involved poor management practice.

However, these studies generally only focused on the evaluation of productivity at the level of activity of a job. Productivity itself can be measured at various levels, such as: at the national level, at industry level, at company level, at project level, or at the level of task or activity of a job. Productivity data at the level of activity can not be directly used to measure productivity at the project level because there is missing in linkages between the activity factors. Meanwhile, researcher like Haskell (2004) in America found that many productivity data in the construction industry are incomplete and contradictory. Besides that, there is no regular data collection and no regular measurement of productivity, either by industry or by government.

Kaming et al. (1997) also stated that the main craftsmen’s productivity problems in Indonesia were identified as lack of material and followed by rework, absenteeism, interference, lack of tools and equipment break downs. The causes of the material unavailability problems were “on-site transportation”, "inadequate material storage", "excessive paper-work requests" and "inadequate planning". The main causes of rework were found as design changes and poor instruction.

As a comparison, Table 2.2 (Adapted from Kaming et al., 1997) presents the productivity problems in Indonesia with other countries.

Table 2.2 Productivity Problems in Several Countries

Productivity problems	Indonesia Rank	Nigeria Rank	UK Rank	USA Rank
Lack of material	1	1	1	1
Lack of equipment	5	3	5	2
Interference	3	6	2	5
Absenteeism	4	5	6	6
Supervision delays	6	4	4	4
Rework	2	2	3	3

Moreover one of the newest researches about construction productivity in Indonesia appointed also 9 groups of factors that need special attention in an effort to increase the local project productivity completion are:

a) Factors relating to the design,
b) The factors associated with implementation and planning,
c) Factors related to labor,
d) Factors associated with supervision,
e) Factors associated with material,
f) Factors related to site management,
g) Factors associated with equipment,
h) Factors associated with leadership and coordination,
i) External factors.

The research concluded also that factors associated with occupational safety and health (OSH) also require attention even if only a has relatively low position, according to its role in improving motivation and loyalty of workers and increasing dignity, and quality of life of workers.

2.3 Causes of Time and Cost Overruns in Indonesia

Delay of project and cost overruns in Indonesia is one of most important problems at construction management field. Cost overrun is defined as excess of actual cost over budget. Cost overrun is also sometimes called "cost escalation," or budget overrun." (Zhu et al 2004). The predominant factors influencing time and cost overruns/delays are design changes, poor labor productivity, inadequate planning and resource shortages. Table 2.4 and 2.5 illustrates the variables of delay and cost controls, which studied by Kaming et al (1997) in Indonesia.

Table 2.4: Variables influencing cost control in Indonesia

Code	Variables of delays and cost controls
a	Environment restriction
b	Experience of project location
c	Accurate prediction of equipment production rate
d	Equipment availability
e	Experience of local regulation
f	Weather conditions
g	Inflation of material cost
h	Accurate quantity take-off
i	Experience of project type

Table 2.5: Variables influencing time control in Indonesia

Code	Variables of time controls
a	Build ability
b	Labor productivity
c	Level of planning
d	Material availability
e	Accuracy of materials estimate
f	Accurate prediction of craftsmen production rate
g	Skilled labor availability
h	Locational restriction of the project

Kaming et al (1997) examine the factors influencing construction cost overruns on high-rise projects in Indonesia, They found that cost overruns occur more frequently and are thus a more severe problem than time overruns on high-rise construction in Indonesia. The predominant factors influencing cost overruns are material cost increases due to inflation, inaccurate materials estimating and degree of project complexity. In addition apart from Kaming claimed the table below illustes others reference of high risks toward Time-Cost over Construction Project.

Table 2.6: High Risk toward Time-Cost Scheduling

No.	High Risks toward Time-Cost Scheduling Variables Control	Literatures
A	**Contractual**	
A1	Incomplete contractual degree	Project Risk Management Hand Book)
A2	Late payment by the owner	(PT.PP (Persero)
A3	Failure realization of loans for the financing project	Project Risk Management Hand Book

B	**Management**	
B1	Priorities Changes on program that already underway	PP. No. 29/2000
B2	Works delay due to subcontractors	*Survei Pendahuluan*, Laia 2010
B3	Bureaucratic project permission	Djojosoedarso, 2003
C	**Productivity**	
C1	Lack of equipment	Kaming et al., 1997
C2	Low labor productivity	PT.PP Persero
C3	Supervision delays	Kaming et al., 1997
D	**Design and Technology**	
D1	Design changes	Kaming et al., 1997 and *Survei Pendahuluan*, Laia 2010
D2	Complexity work due to site construction elevation	*Survei Pendahuluan*, Laia 2010
C	**Internal Approval**	
C1	Interference (Owner)	Rudi Iskandar,2002

2.4 Project Objective

A project can be defined as an activity which has a beginning and an end, which achieves specific objectives trough a set of defining tasks and effective use of resources. A specific project objective or outcomes include: To scope, within time, within cost, good accident record; Quality; Utility and dependability.

Project scope is the work that needs to be accomplished to deliver a product, service or result with specified feature and functions. It should include tangible resources (Men, Money, Machines, Material and Management expertise) and intangible resources (Information). It is reasonable to assume that the objective of a building project is to create the best possible facility for a given level of expenditure, stated Wideman (1981).

Indeed, even in develop countries, the adversarial attitude amongst the various segments of the building industry is so entrenched that it is sometimes difficult to persuade the parties to the project to act together in the common interest.

Then, the project manager must be aware of the dichotomies that exist and the pitfalls that may be faced. This is the first step in understanding and improving the performance of the team and the resulting development process.

2.4.1 Project Life Cycle

Project Life Cycle, refers to a logical sequence activities to accomplish the project goals or objectives. Regardless of scope or objectives, any project goes through a series stages during its life. Since management is process of planning, supervising and controlling project resources in such a way that positive outcomes (project objectives) are achieved. Projects can be managed by using a life cycle approach: The figure 2.4 shows a typical project life cycle separated into its generally accepted four fundamental phases. It also lists the activities to be expected in each phase. The phase separations correspond to key decision points for purposes of executive level control.

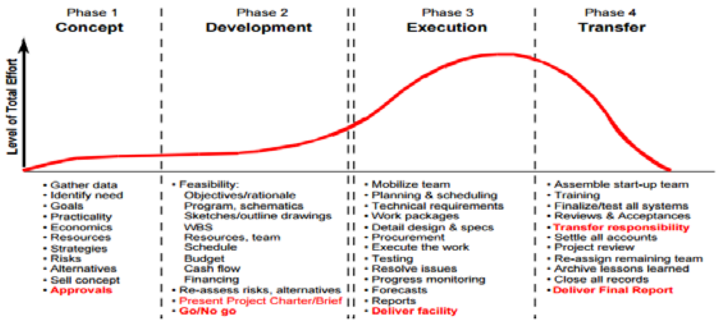

Figure 2.2 Typical project life cycle and activities performed (Source: Wideman, 1981)

Of course, not all projects conform rigorously to the stages shown and the activities within each may vary somewhat. However, less than satisfactory project performance and lack of control can frequently be traced to significant departures from the division of activities as shown.

2.5 Construction Risk Management

Risk management is one of the nine knowledge areas propagated by the Project Management Institute. The benefits of the risk management process include identifying and analyzing risks, improvement of construction project management processes and effective use of resources, (Project Management Institute; 2008).

The PMBOK® Guide defines a project risk as "an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective". There are many possible risks which could lead to the failure of the construction project, and through the project, it is very important what risk factors are acting simultaneously. As stated by Raz et al (2002), too many project risks as undesirable events may cause construction project delays, excessive spending, unsatisfactory project results or even total failure.

Cost of risk is a concept many construction companies have never thought about despite the fact that it is one of the largest expense items, stated Cavignac (2009). Risk management helps the key project participants – client, contractor, consultant, and supplier – to meet their commitments and minimize negative impacts on construction project performance in relation to cost, time and quality objectives.

The risk analysis and management techniques have been described in detail by many authors and according to John Wiley & Sons (2009), a typical risk management process includes the following key steps:

1. Risk identification;
2. Risk assessment;
3. Risk mitigation;
4. Risk monitoring.

From those steps, risk identification perhaps the most important step in the risk management process, as it attempts to identify the source and type of risks. It includes the recognition of potential risk event conditions in the construction project.

Risks and uncertainties, involved in construction projects, cause cost overrun, schedule delay and lack of quality during the progression of the projects and at their end . As stated by Baloi and Price (2003), poor cost performance of construction projects seems to be the norm rather than the exception, and both clients and contractors suffer significant financial losses due to cost overruns.

2.5.1 Accounting for Risk in Project Cost and Schedule

Accounting for risk is critical to developing more accurate project estimates. Identifying possible risks and determining their potential impact will allow Project Managers to take into account factors that are not yet well defined but may ultimately influence project cost.

When comparing risk-based cost estimation methodology to traditional approaches the differences are instead of applying a factor for unknowns, specific event risks are identified and quantified in place of these contingencies and allowances. To determine an accurate estimate range for both cost and schedule, risk must be measured. Project estimates should be comprised of three components:

a. Base Cost
b. Uncertainty
c. Risk

2.5.2 Risk Analysis for an Accomplished Project

The application of risk management procedures in construction can give early visibility to potential "problem areas" and opportunities, where effort and money can be expended early in the design and construction phases to reduce vulnerability and insurance costs.

However the post construction analysis may selves as key point when there is an unexpected new development in a project or change in the life-cycle of a project. APM (2000), claimed that there are no particular circumstances under which Project Risk Analysis and Management should not be used expect perhaps for repeat project, where such analyses have already been carried out, unless of course there specific differences between the projects. So the absence of relevant data may make a quantitative assessment not worthwhile but such circumstance must never a rigous qualitative analysis being carried out.

Thus this research providing an additional review of the literature on methodologies and concepts of risks in construction and examines how probabilistic methods can be used to develop a strategic model, combining an explicit understanding of the risks that construction projects may faces.

CHAPTER III
METHODOLOGY

3.1. Research Stages

In this research the following methodological sequence has been used:

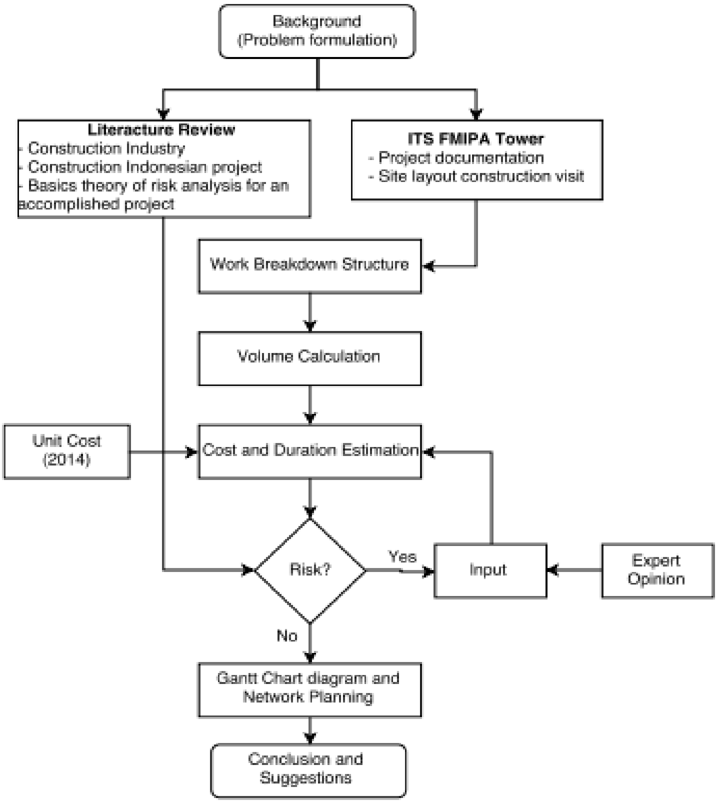

Figure 3.1 Methodology Flowchart

3.2. Methodology Flowchart Explanation

In the previous chapter, the underlying theoretical framework of this study has been presented. This chapter describes the methodology undertaken in relation to justification of the research paradigm, questionnaire design, sampling process and data collection.
This research methodology focuses in 4 main stages:

a. On the first stage illustrates the general concept of this research, problem formulation, research objectives, problem limitation and benefits of the research. Furthermore provides data collections that are divided into 2 sub-parts: Literature review and ITS FMIPA Tower documentation.
b. The second stage focusing on tasks outcome predication.
c. The third stage is time-cost estimation by acknowledging its possible risks, conclusions and suggestions.

3.2.1 Data Collation and Interpretation Step

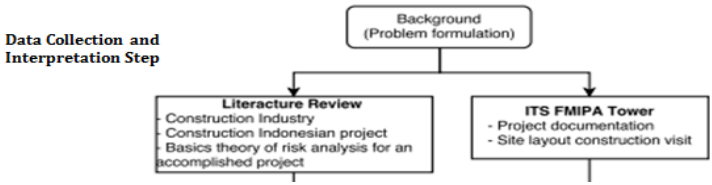

Figure 3.2 Preparation Step

The preparation stages focusing in to two main parts, problem formulation literature review and ITS FMIPA Tower documentation such as Secondary data and Project drawing (See appendix 3.1a). The literature review presents an overview of construction industry management, Indonesia construction projects and the need of scheduling as sources to minimize uncertainty and Basic theory risk analysis for an accomplished project.

3.2.2 Tasks Outcome Predication Step

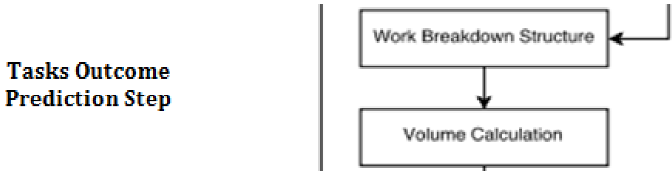

Figure 3.3Tasks Outcome prediction Step

The tasks outcome prediction covers two main components:

a. WBS (Work Breakdown Structure)
b. Quantity volume

WBS is required at this stage because it may assist key personnel in the effective allocation of resources, project budgeting, procurement management, scheduling, quality assurance, quality control, risk management, product delivery and service oriented management.

3.2.3 Time-Cost Estimation and Risk Analyze

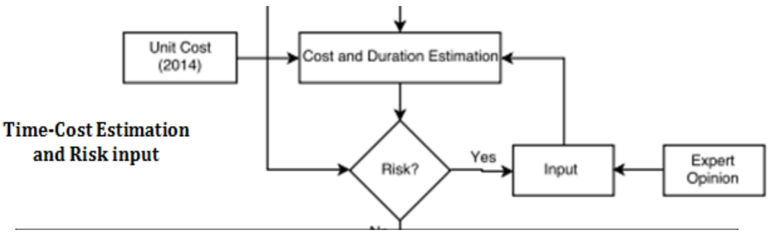

Figure 3.4 Time-Cost Estimation and Risk Analyze

In these stages the will be estimated the time-cost for ITS FMIPA Tower construction development. Based on the literature review and project characteristics, the author will identify critical activities and acknowledge the possible risks both related for time and cost analyze. The Cost estimation has three main factors: Quantify volume, Unit cost and Risk input.

Cost Estimate - A prediction of quantities, price of resources required by the scope of an asset investment option or project. As a prediction, an estimate must address risks and uncertainties.

In order to minimize uncertainty, rise risk time-cost will be considerate only for those tasks that appear to be more complex. The risk analysis will be conducted through quantitative analysis and qualitative analysis (See Appendix 3.1b). The expert will be someone from construction management field and familiar with Indonesian construction works.

Both for the quantitative and qualitative risk analysis (Inputs) will be through Data Gathering and Representation Techniques, as following:

a. **Interviewing:** Interviewing techniques are used to quantify the probability and impact of risks on project objectives. The information needed depends upon the type of probability distributions that will be used.
   For instance, information would be gathered on the optimistic (low), pessimistic (high), and most likely scenarios for some commonly used distributions, and the mean and standard deviation for others.

b. **Probability distributions:** Continuous probability distributions represent the uncertainty in values, such as durations of schedule activities and costs of project components. Discrete distributions can be used to represent uncertain events, such as the outcome of a test or a possible scenario in a decision tree.

Two examples of widely used continuous distributions are shown in Figure 3.5:

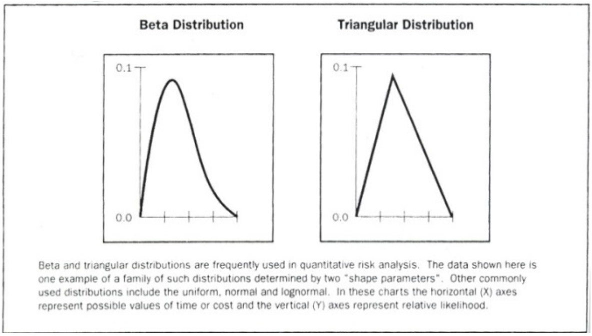

Figure 3.5 Probability Distributions

In this research, one of the two continuous distributions available in RiskyProject Professional software will be used. This software was deloveped from Intaver Institute and has an integrated risk analysis such as: task duration, start and finish times, uncertainties in costs and resources, uncertainties in quality, safety, technology, and others.
RiskyProject analyzes project schedules with risks and uncertainties, calculates the chance that projects will be completed within a given period of time and budget, ranks risks, and presents the results in formats that are easy to read and understand. It seamlessly integrates with Microsoft Project or can run as a standalone application.

c. **Expert judgment:** Subject matter experts internal or external to the organization, such as engineering or statistical experts, validate data and techniques.

However it is extremely important to stress, on this research the variables control will be only what had been identified from previous research as high risk structural works, except if the expert judgment suggests something else. The high risk toward Time-Cost Scheduling Variables Control can be seen in table 3.2.

3.2.4 Diagrams and Final Considerations

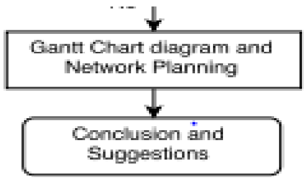

Figure 3.6 Diagram and Final Considerations

This step focuses on analyzing the scheduling from the "bottom up". This technique breaks the larger tasks down into detailed tasks and shows the time needed to complete each WBS element. In order to oversee the tasks progress will be drown a chronogram type Gantt Charts and network diagram (RiskyProject Professional Software). Gantt Charts are a way to graphically show progress of a project. Management of a project is made easier if it is viewed as small manageable items where the dependencies are visually illustrated, the overall processing time determined and progress tracked.

So far, at this stage will be taken the final analysis resulting. The conclusion will present how risks based time – cost scheduling may minimize uncertainty and adding value to our project schedule performance. In addition it will shows to the reader, how the researcher objective has been accomplished. Moreover, the author would like also to address some suggestions based on research object for further research development or decision making.

CHAPTER IV
PROJECT DESCRIPTION

4.1. Project Background

4.1.1. General data

- Owner : ITS Campus
- Consultant : ARKONIN
- Contractor : PT.WASKITA KARYA
- Building characteristics : High Rise Building
- Project designation : ITS FMIPA Tower
- Location : Jln Raya ITS, Sby
- Land area : ±4.245.10 m2
- Land clearing : 2.611.84 m2
- Building size : 2.149.00 m2
- Foundation type : Pile (foundation)

4.1.2. Engineering data

a. Pile Foundation

- Pile length of precast concrete : 18m
- Diameters : 300, 400 and 500mm
- Pile connection : Las
- Pile implementation : Pile Injection Machine

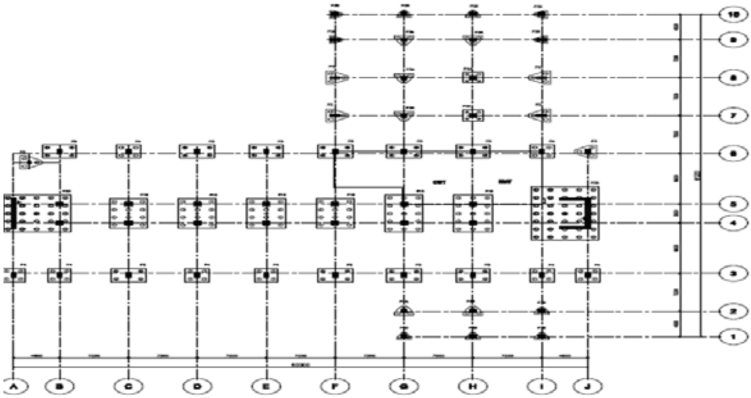

Figure 4.1: Sketch drawing of the project Foundation

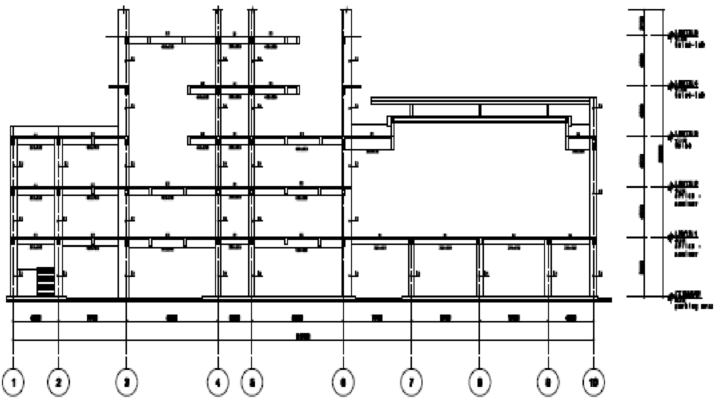

Figure 4.2: Half Section Portico

b. Structural design

ITS FMIPA Tower building use concrete reinforcement in major part of its construction and the material specifications are given as:

1. Ground floor
   - Concrete strength : K-350
   - Reinforcement (diameter < Ø10)
   - Reinforcement (diameter < Ø16)
   - Reinforcement (diameter < Ø19)
   - Reinforcement (diameter < Ø25)

2. Floor 1 to 3
   - Concrete strength: K-350
   - Reinforcement (diameter < Ø10)
   - Reinforcement (diameter < Ø 13)
   - Reinforcement (diameter < Ø19)
   - Reinforcement (diameter < Ø 25)

3. Floor 4 to 10
   - Reinforcement (diameter < Ø10)
   - Reinforcement (diameter < Ø19)
   - Reinforcement (diameter < Ø 25)

c. Other materials

Table 4.1 Required materials construction

No	Materials	Specification	Origin	Transportation
1	Sand		District around Project Location	Dump Truck
2	Coal		District around Project Location	Dump Truck
3	Gravel		District around Project Location	Dump Truck
4	Cement	Gresik Cement	Solo	Truck
		Holcim		
5	Bars reinforcement	Master Steel	Surabaya	Trailer Truck
		Cakra Steel	Jakarta	
6	Formwork	Meranti wood	District around Project Location	Truck

d. Equipment

- Concrete Mixer
- Concrete Mix Truck
- Concrete vibrator
- Bar cutter
- Bar bender
- Pile Injection machine
- Crane Service
- Theodolite
- Water pass

4.1.3. Work Background Structure

A Work Background Structure (WBS) is a deliverable-oriented grouping of work involved in a project that defines the total scope of the project. For this project the proposed WBS is given below:

Table 4.2 WBS Elements

No.	Task Name	Unit
1	**ITS FMIPA TOWER CONSTRUCTION**	
2	**I. PRE - CONSTRUCTION**	
3	Clean the site construction	m2
4	Demolition and Mobilization services equipment	Ls
5	Temporary light installations contract	Monthly
6	Temporary water facilities	Ls
7	PDA test	Point
8	**II. STRUCRURAL ACTIVITIES**	
9	**SPUN PILE (Foundation)**	m'
10	**SUB-STRUCTURE WORKS**	
11	Bauwplank Installation	m'

12	Soil excavation	m3
13	Installation of sheet piles	
14	Compacting the subgrade	m2
15	Termite protection over foundation and ground floor	m2
16	Soil consolidation	m3
17	Moving the excavated soils	m3
18	Dense sand consolidation over foundation	m3
19	Base slab of cement concrete	m3
20	Joining Spun pile with Pile cap reinforcement	Pc
21	Pile cap	m3,kg,m2
22	Ground floor beam	m3,kg,m2
23	Slab	m3,kg,m2
24	Ground Water Tank (GWT)	m3
25	Sewage Treatment Plant (STP)	m3
26	Shear Wall	m3,kg,m2
27	**UPPER-STRUCTURE WORKS**	
28	**GROUND FLOOR**	
29	Column	m3,kg,m2
30	Shear wall	m3,kg,m2
31	Stairs heading to first floors	m3,kg,m2
32	**FIRST FLOOR**	
33	Beam	m3,kg,m2
34	Slab	m3,kg,m2
35	Column	m3,kg,m2
36	Shear wall	m3,kg,m2
38	Stairs heading to second floor	m3,kg,m2
39	**SECOND FLOOR**	
40	Beam	m3,kg,m2
41	Slab	m3,kg,m2

42	Column	m3,kg,m2
43	Shear wall	m3,kg,m2
44	Stairs heading to third floor	m3,kg,m2
45	**THIRD FLOOR**	m3,kg,m2
46	Beam	
47	Slab	m3,kg,m2
48	Column	m3,kg,m2
49	Shear wall	m3,kg,m2
50	Stairs heading to fourth floor	m3,kg,m2
51	**FOURTH FLOOR**	m3,kg,m2
52	Beam	m3,kg,m2
53	Slab	
54	Column	m3,kg,m2
55	Shear wall	m3,kg,m2
56	Stairs heading to fourth floor	m3,kg,m2
57	**FIFTH FLOOR**	
58	Beam	m3,kg,m2
59	Slab	m3,kg,m2
60	Column	m3,kg,m2
61	Shear wall	m3,kg,m2
62	Stairs heading to sixth floor	m3,kg,m2
63	**SIXTH FLOOR**	
64	Beam	m3,kg,m2
65	Slab	m3,kg,m2
66	Column	m3,kg,m2
67	Shear wall	m3,kg,m2
68	Stairs heading to seventh floor	m3,kg,m2
69	**SEVENTH FLOOR**	m3,kg,m2
70	Beam	
71	Slab	m3,kg,m2

72	Column	m3,kg,m2
73	Shear wall	m3,kg,m2
74	Stairs heading to eighth floor	m3,kg,m2
75	**EIGHT FLOOR**	
76	Beam	m3,kg,m2
77	Slab	m3,kg,m2
78	Column	m3,kg,m2
79	Shear wall	m3,kg,m2
80	Stairs heading to ninth floor	m3,kg,m2
81	**NINETH FLOOR**	
82	Column	m3,kg,m2
83	Shear wall	m3,kg,m2
84	Column	m3,kg,m2
85	Stairs heading to tenth floor	m3,kg,m2
86	**TENTH FLOOR**	
87	Column	m3,kg,m2
88	Steel support	kg

Notice that the intranet WBS are mostly presented in Tabular form, Chart and in Mind-Mapping Approach. For instance in this project the Tabular form is taking place in order to provide more detail about Time-Cost estimates.

4.1. Normal Cost Estimation

Cost estimation is an approximation of the probable cost of a product or resources computed on the basis of available information. The fees are calculated based on the volume of each WBS element and unit cost value set by the government or the results of field surveys.

The project cost includes must include required processes to ensure that the project may be completed within an approved budget.

It is crucial to stress that before cost estimation we need to ensure that quantity take-off has been taken already. For instance, in this analysis most of volume data had been taken from the previous schedule, provided by Alkoni Consultant. The remaining volume estimation such as concrete reinforcement from the sixth floor was conducted by the author based on the project engineering drawing (see appendix 2).

The required data relatively to the estimated volume can be seen in the following recap tables:

Table 4.3 : Take-off volume of Pre-construction

No	WBS ELEMENTS	Volume	Unit
<1>	**I. PRE - CONSTRUCTION**		
1	Clean the site construction	2611.84	m2
2	Demolition and Mobilization services ec	1	Ls
3	Temporary light installations contract	21	P/M
4	Water (Jet pum and water tank 500 L inst	1	Ls
5	PDA test	2	Pt
No	**WBS ELEMENTS**	**Volume**	**Unit**
<2>	**STRUCRURAL ACTIVITIES**		
I	**SPUN PILE (Foundation)**		
1	**Spun Pile (Supplier)**		
a	Diameter 500 mm	3924	m'
b	Diameter 400 mm	468	m'
c	Diameter 300 mm	540	m'
2	**Draving Spun pile**		
a	Diameter 500 mm	3924	m'
b	Diameter 400 mm	468	m'
c	Diameter 300 mm	540	m'
3	**Pile connector (Electrical Las)**		
a	Diameter 500 mm	218	ctr
b	Diameter 400 mm	26	ctr
c	Diameter 300 mm	30	ctr
4	**Cutting the Head of Spun Pile**		
a	Diameter 500 mm	218	pc
b	Diameter 400 mm	26	pc
c	Diameter 300 mm	30	pc
5	**Wast of Spun Pile Head**	46.17	m3

Table 4.4 Take-off Volume of the Structural Works

No	WBS ELEMENTS	Volume	Unit
<2>	SUB-STRUCTURE WORKS		
1	Bauwplank Installation	266.4	m'
2	Soil excavation	3184.75	
3	Soil consolidation (addicional)	1390.65	m3
4	Moving the excavated soils	1191.88	m3
5	Dense sand consolidation over foundation	105.76	m3
6	Base slab of cement concrete	75.54	m3
7	Sheet Pile Installation For GWT		
a	GWT Excavation Area	268.26	m2
b	SPT Area	225.46	m2
8	Compating the subgrade (ground floor and f	1510.83	m2
9	Applying termite protection over foundatior	4818.53	m2
10	Soil consolidation (addicional)	1390.65	m3
11	Moving the excavated soils	1191.88	m3
12	Dense sand consolidation over foundation	105.76	m3
13	Base slab of cement concrete	75.54	m3
14	Joining Spun pile with Pile cap	248	
a	Concrete strength K-350	848.01	m3
b	Reinforcement	81946.31	kg
c	Form work	2877.4	m2
<3>	UPPER STRUCTURE WORKS		
15	Concrete strength K-350	2291.79	m3
16	Reinforcement	303599.8	kg
17	Form work	26969.11	m2

In this research the calculation approaches for the normal Cost estimates is done as follows:

1. Soils and Concrete

   Volume = length x width x height (5.1)

2. Reinforcement
   Volume = length x 2(diameter) x 0.006165 (5.2)
3. Cost estimation
   Cost = Unit cost x volume (5.3)

Example:
Clean the site construction
Unit cost (2014) = Rp 7,950
Volume = 2611.84m^2

Cost = Rp 7,950*x* 2611.84m^2 = Rp 20,764,128

Then, the clean the site construction cost is Rp 20,764,128. For further result relatively to cost estimation, can be seen on the tables below:

Table 4.5 Normal Cost Results of the Pre-construction, Spun Pile Foundation and Sub – Structure Works

No.	Task Name	Normal Cost (Rp)	Risks
	ITS FMIPA TOWER CONSTRUCTION		
I	**PRE - CONSTRUCTION**		none
1.1	Demolition and Mobilization services equipament	20,764,128.00	
1.2	Clean the site construction	20,000,000.00	
1.3	Temporary light installations contract	26,250,000.00	
1.4	Temporary water facilities (Jet pum and water tank 500 L)	9,130,000.00	
1.5	PDA test	15,000,000.00	
Sub - Total <I>		**91,144,128.00**	
II	**SPUN PILE FOUNDATION**		none
2.1	Spun Pile (Supplier)	1,937,677,019.04	

2.2	Draving Spun Pile	1,841,690,808	
2.3	Pile Connection (Electrical Las)	36,825,326.00	
2.4	Cutting Head Spun Pile	50,194,380.00	
2.5	Spun Pile Head Wast	18,779,647.50	
Sub - Total <II>		**3,885,167,180.54**	
III	**SUB - STRUCTURE WORKS**		none
3.1	Bauwplank Installation	24,914,234.16	
3.2	Soil excavation	119,560,610.60	
3.3	Installation of sheet piles	366,774,389.86	
3.4	Joining Spun pile with Pile cap reinforciment	77,767,580.12	
3.5	Concreting Pile Cap	997,078,989.13	
3.6	Ground floor beam	527,001,791.32	
3.7	Concreting Ground Water Tank (GWT)	423,368,960.11	
3.8	Sewage Treatment Plant (STP)	291,057,623.25	
3.9	Slab and Shear Wall	17,170,118.59	
Sub - Total <III>		**2,844,694,297.14**	

Table 4.6 Normal Cost Results of the Upper Structure Works

No.	**Task Name**	**Normal Cost (Rp)**	**Risk**
	ITS FMIPA TOWER CONSTRUCTION		
IV	**UPPER-STRUCTURE WORKS**		
4.1	GROUND FLOOR		
	Column	542,479,680.98	
	Shear wall	216,055,325.51	none
	Stairs heading to first floors	137,810,087.16	
4.2	FIRST FLOOR		none

	Beam	1,088,323,747.74	
	Slab	715,483,052.18	
	Column	354,448,228.33	
	Shear wall	120,227,139.49	
	Stairs heading to second floor	74,443,884.83	
4.3	SECOND FLOOR		none
	Beam	1,088,323,747.74	
	Slab	715,483,052.18	
	Column	354,448,228.33	
	Shear wall	120,227,139.49	
	Stairs heading to third floor	74,443,884.83	
4.4	THIRD FLOOR		none
	Beam	1,088,323,747.74	
	Slab	715,483,052.18	
	Column	354,448,228.33	
	Shear wall	120,227,139.49	
	Stairs heading to fourth floor	74,443,884.83	
4.5	Fourth FLOOR		none
	Beam	819,297,182.15	
	Slab	421,452,938.99	
	Column	234,510,420.86	
	Shear wall	89,790,144.13	
	Stairs heading to fourth floor	55,832,913.62	
4.6	FIFTH FLOOR		none
	Beam	819,297,182.15	
	Slab	421,452,938.99	
	Column	234,510,420.86	
	Shear wall	89,790,144.13	
	Stairs heading to sixth floor	55,832,913.62	

4.7	SIXTH FLOOR		none
	Beam	819,297,182.15	
	Slab	421,452,938.99	
	Column	234,510,420.86	
	Shear wall	89,790,144.13	
	Stairs heading to seventh floor	55,832,913.62	
4.8	SEVENTH FLOOR		none
	Beam	819,297,182.15	
	Slab	421,452,938.99	
	Column	234,510,420.86	
	Shear wall	89,790,144.13	
	Stairs heading to eighth floor	37,221,942.41	
4.9	EIGHT FLOOR		none
	Beam	819,297,182.15	
	Slab	421,452,938.99	
	Column	234,510,420.86	
	Shear wall	89,790,144.13	
	Stairs heading to ninth floor	37,221,942.41	
4.10	NINTH FLOOR		none
	Beam	819,297,182.15	
	Column	421,452,938.99	
	Shear wall	234,510,420.86	
	Column	89,790,144.13	
	Stairs heading to tenth floor	37,221,942.41	
4.11	TENTH FLOOR		none
	Column	106,655,074.74	
Sub - Total <IV>		**17,731,247,010.97**	

For further detail about normal cost estimation (Unit cost and volume) can be seen in appendix.

4.3 Normal Duration Estimation

The duration estimation determines the required time to complete a WBS element. Mostly durations are calculated based on the volume (see 4.2) as well as through productivity, derived from SNI, Unit Cost or field surveys.

- Productivity equation:

$$productivity : \frac{1}{koeficient} \qquad (5.4)$$

Example:

Clean the site construction produactivity

Koefisien = 0.0500 (From Unit cost 2014)

Productivity = 1/ 0.0500 = 20

- Duration equation:

$$Duration : \frac{volume}{productivity} \qquad (5.5)$$

Example:

Clean the site construction

Volume = 2611.84m^2 (See 4.3 and appendices 3)

Productivity = 20 (From previous calculation)

Labors = 10 (Assumption)

Duration = 2611.84m^2/20 *x10* = 15.0952 ≈ 15 days

For further result relatively to productivity (See appendix 3) but for estimation duration resulta are showing in the tables below.

Table 4.7 Normal Duration Results of the Pre-construction, Spun Pile Foundation and Sub – Structure Works

No.	Task Name	Normal Time (days)	Risk
	ITS FMIPA TOWER CONSTRUCTION		
I	**PRE - CONSTRUCTION**		none
1.1	Demolition and Mobilization services equipament	15	
1.2	Clean the site construction		
1.3	Temporary light installations contract		
1.4	Temporary water facilities (Jet pum and water tank 500 L)		
1.5	PDA test	2	
Sub - Total <I>		**17**	
II	**SPUN PILE FOUNDATION**		none
2.1	Spun Pile (Supplier)		
2.2	Draving Spun Pile	7	
2.3	Pile Connection (Electrical Las)	13	
2.4	Cutting Head Spun Pile	6	
2.5	Spun Pile Head Wast	1	
Sub - Total <II>		**27**	
III	**SUB - STRUCTURE WORKS**		none
3.1	Bauwplank Installation	4	
3.2	Soil excavation	3	
3.3	Installation of sheet piles	14	
3.4	Joining Spun pile with Pile cap reinforciment	3	
3.5	Concreting Pile Cap	15	
3.6	Ground floor beam	3	
3.7	Concreting Ground Water Tank	15	

	(GWT)		
3.8	Sewage Treatment Plant (STP)	11	
3.9	Slab and Shear Wall	3	
Sub - Total <III>		**71**	

Table 4.8 Normal Duration result of the Upper Structure Works

No.	Task Name	Normal Time (days)	Risk
	ITS FMIPA TOWER CONSTRUCTION		
IV	**UPPER-STRUCTURE WORKS**		
4.1	GROUND FLOOR		none
	Column	10	
	Shear wall	5	
	Stairs heading to first floors	4	
4.2	FIRST FLOOR		none
	Beam	8	
	Slab	7	
	Column	4	
	Shear wall	2	
	Stairs heading to second floor	2	
4.3	SECOND FLOOR		none
	Beam	8	
	Slab	7	
	Column	4	
	Shear wall	2	
	Stairs heading to third floor	2	
4.4	THIRD FLOOR		none

	Beam	8	
	Slab	7	
	Column	4	
	Shear wall	2	
	Stairs heading to fourth floor	2	
4.5	Fourth FLOOR		none
	Beam	6	
	Slab	5	
	Column	4	
	Shear wall	4	
	Stairs heading to fourth floor	2	
4.6	FIFTH FLOOR		none
	Beam	6	
	Slab	5	
	Column	4	
	Shear wall	4	
	Stairs heading to sixth floor	2	
4.7	SIXTH FLOOR		none
	Beam	6	
	Slab	5	
	Column	4	
	Shear wall	4	
	Stairs heading to seventh floor	2	
4.8	SEVENTH FLOOR		none
	Beam	7	
	Slab	6	
	Column	5	
	Shear wall	2	
	Stairs heading to eighth floor	1	

4.9	EIGHT FLOOR		none
	Beam	7	
	Slab	6	
	Column	5	
	Shear wall	2	
	Stairs heading to ninth floor	1	
4.10	NINTH FLOOR		none
	Beam	7	
	Column	6	
	Shear wall	5	
	Column	2	
	Stairs heading to tenth floor	1	
4.11	TENTH FLOOR		none
	Column	2	
Sub - Total <IV>		**215**	

This is end of the normal Time-Cost estimation. For further details about duration estimation (Volume, Coefficient, Productivity and labour's quantity) can be seen in the appendices 3. The appendices shows that the overall duration is 628 days that correspond a period of 8 hours a day. In order to increase productivity and give more value to time, the project development has been taken the following approach:

- Duplicating daily work period (From 8h/day to 16 h/day).
- The strategy focus on having two groups of labors with same number of labors and each group works in different period over 8 h/day.
- Since the normal duration for the structural work took place based in one group, then 628 dividing 2, the overall normal duration of structural works will be 314 days as summarized in table 4.8 and 4.9

Table 4.9 Recap of Normal Time - Cost Estimation

No	**WBS ELEMENTS**	**Subtotal of Normal Time-cost estimation**		**days**
<1>	**PRE-CONSTRUCTION**		**Rp.91,144,128.00**	15
<2>	**STRUCTURAL WORKS**		**Rp.24,461,108,488.64**	314
I	SPUN PILE	3,885,167,180.54		
II	SUB-STRUCTURE	2,844,694,297.14		
III	UPPER STRUCTURE	17,731,247,010.97		
	10% OF TAX:		Rp.2,455,225,261.66	
	TOTAL:		**Rp.27,007,477,878.31**	**329**

Thus, the normal Cost estimation for the overall project structural works is Rp. 27,007,477,878.31 while the normal duration is 329

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CHAPTER V
TIME - COST RISK ANALYSIS

5.1 Risk collection and Expert Judgment Process

In the methodological sequence risk analysis is the most crucial point of this final project. Many qualitative risks that are qualified as variables of delays and cost control have been identified in the literature (see tables 2.4, 2.5 and 2.6. However, all variables are not analyzed on this research.

Apart from the literature review an interview or consultation with expert and familiar with Indonesian construction project took place in order to verify whether the required data can be applied on this research.

This final had two main correspondents. The primary and direct consultation was with the current Infrastructure Manager of ITS Campus.Through his remarkable response risks like Material Availability Weather Condition, Labors availability were concluded that are totally suitable on this analysis. In addition, also another direct interview was with one of the Expertindo trainer and lecturer at UGM University. Based on problem formulation of this research and from normal time-cost presented, he agreed with previous expert and suggested also to consider Poor Time-Cost estimates as threats along this analysis.

The interview and consultation with experts regarding to this object was significant, through that qualitative values were obtained as shown in recap tables 5.1 and 5.2. Further details about expert response can be seen in the appendix 1.

Table 5.1 Selected Cost Risks for Structural Works

Variables of delays and cost control					
No	WBS Elements	Normal Cost (Rp.)	Experte Response		
			Risks	Mitigation/ Impact	Code
<1>	PRE-CONSTRUCTION	91,144,128.00			
<2>	STRUCRURAL ACTIVITIES				
I	Sub-Structure				
1	Spun Pile (Foundation)	3,885,167,180.54	Materials Availability	10 – 25%	A
II	Sub-Structure	2,844,694,297.14	Materials Availability	10 – 25%	A
	Bauwplank Installation		Weather Condition	5 – 10%	B
	Soil excavation		Labors Availability	5 – 10%	C
	Sheet pile installation		Materials Availability	10 – 25%	A
	Joining Spun pile		Design changes;		
	Concreting Pile Cap		Poor cost estimates	1 – 3% (Re-estimate if needful)	D
	Ground floor beam				
	Concreting Ground Water Tank (GWT				
	Sewage Treatment Plant (STP)				
	Slab and Shear Wall				
III	Upper Structure		Materials Availability	10 – 25%	A
a	Ground Floor	17,731,247,010.97	Design changes		
b	First to Third Floor		Labors Availability	5 – 10%	C
c	Fourth to Six Floor		Poor cost estimates	1 – 3% (Re-estimate if necessary)	D
d	Seven to Ten Floor				
	Normal Project Budget (Including 10% of tax)	27,007,477,878.31			

Table 5.2 Selected Delays Risks for Structural Works

`	Variables of time control				
		Normal Duration (days)	Risks	Mitigation/ Impact	Code
<1>	PRE-CONSTRUCTION	17			
<2>	STRUCRURAL ACTIVITIES				
I	Sub-Structure				
1	Spun Pile (Foundation)	27	Materials Availability	10 – 30%	A
			Weather Condition	10 – 25%	B
II	Sub-Structure	71	Materials Availability	10 – 30%	A
	Bauwplank Installation		Weather Condition	10 – 25%	B
	Soil excavation		Labors Availability	5 – 10%	C
	Sheet pile installation		Poor time estimates	1 – 3% (Re-estimate if needful)	E
	Joining Spun pile				
	Concreting Pile Cap				
	Ground floor beam				
	Concreting Ground Water Tank (GWT				
	Sewage Treatment Plant (STP)				
	Slab and Shear Wall				
III	Upper Structure	214	Materials Availability	10 – 30%	A
a	Ground Floor		Design changes;		
b	First to Third Floor		Labors Availability	5 – 10%	B
c	Fourth to Six Floor		Weather Condition	5 – 10%	C
d	Seven to Ten Floor		Poor time estimates	1 – 3%	E
	Normal project duration	329			

a) Material Availability and Design Change

From the expert response, materials availability is a big threat in the construction industry, especially when we are running a project and the local government has specific project that must be finish in short time. Supplier focusing on the government project due to the government legislation and other projects may suffer huge disadvantages. This happened when the "*Highway Tanjung Benoa Bali Bridge and the Surabaya –Jakarta double track Railways* has been built, the price of spun piles, concrete and its components increased significantly from to 10-25% . Such kind of event mostly may lead to project design change that may affect the proposed schedule.

Regarding the design change it is necessary to understand how to do the changes. Effective change management helps us to avoid additional and excessive costs we will incur if we do not adequately manage the people side of change. Has mentioned earlier, normally design change may happen when there is poor material availability or when the stakeholders decide to change the geometry of building. So far, if such thing happens the project may suffer a huge disadvantage regarding the project accomplishment with an probabilistic delay over 10%, said the correspondent. Thus, it is extremely important to consider those issues on this analysis.

b) Weather Condition

In Indonesia, particularly in Surabaya there is an intensity of rain falls from October - April, which means that during those periods the project budget may increase significantly from 5-10% due to the challenge to explore natural resources such as sand, gravel and cement components. As delay control or risk threat, may affect up to 20% because it is difficult to carry out soil excavation as well as pouring and curing concrete.

c) **Labors' Availability**
The availability of labors is another threat that should be acknowledged in order to improve project schedules. All great managers agree that the availability of labors are not equal all time. In the end of a year and Ramadan periods for example, is quiet difficulty to find labors and it may affect the project budget in that period from 5-10% and boost up the project delay significantly.

d) **Poor Time-Cost Estimates**
Most of the Consultants and Contractors with high standard agree that poor time-cost estimation may have a significant impact within a project. One of consulted expert mentioned, this issue is mostly addressed by reviewing the schedule estimates. Yet, in this project planning apart from the time-cost being reviewed, the experts suggested to input a significant value from 1-3% from the Time-Cost estimation. In the previous schedule made by consultant, this issue seems being considerate but unfortunately just for the upper structure works but the substructure works was totally neglected.

5.2 Risk probability Distribution Report

In order to obtain the probabilistic values for this structural development, triangular technique available from Risky Project Professional software has been used. Notice that this software is provided by Intaver Institute and both cost and duration results are shown in the following figures:

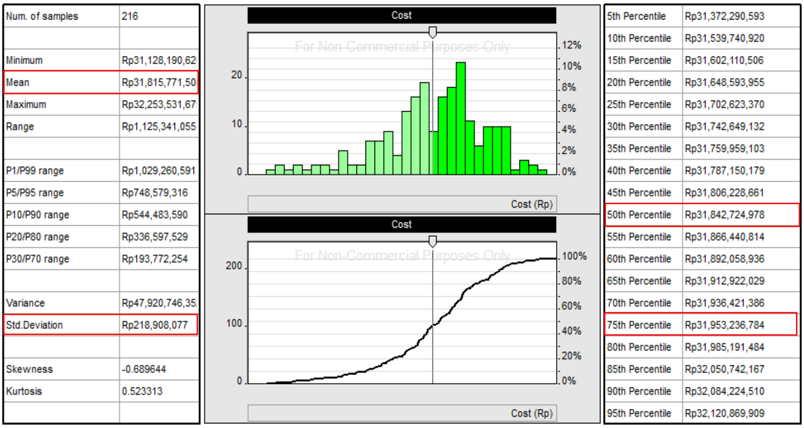


Figure 5.1 Cost Risk Analysis Results

From figure 5.1, it can be seen that the mean cost risk of ITS FMIPA construction is 31,819,771,500 with a standard deviation around Rp.218,908,077.00. Most manager agrees that apart from mean cost we still need to consider an contingency cost, which is from 50th percentile over 75th.

Then : Contingency Cost = (range within P50 to P75)

= (31,842,724,978) / (31,936,236,784)

= Rp.93,511,806

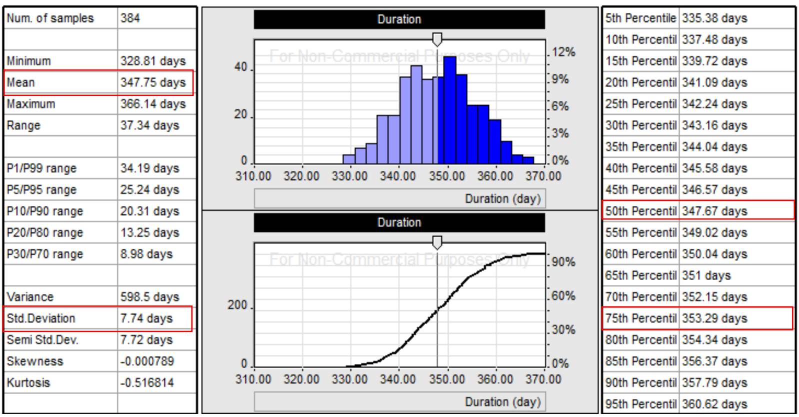
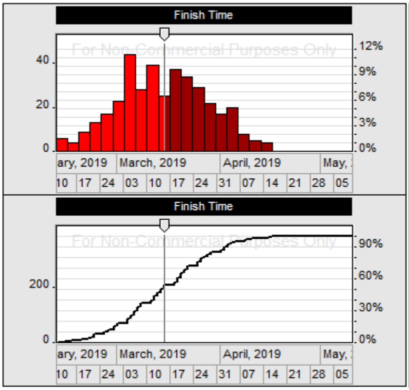


Figure 5.2 Time Risk Analysis Results

From figure 5.2, it can be seen that the mean risk duration probability of ITS FMIPA Tower construction is 348 days with a standard deviation around 8 days. Moreover the contingency duration is 5 days, from the range among P50 to P75 percentile, which is above the project deadline mean (03/15/2019).

Num. of samples	384
Minimum	02/11/2019
Mean	03/15/2019
Maximum	04/16/2019
Range	37.34 day
P1/P99 range	34.20 day
P5/P95 range	25.24 day
P10/P90 range	20.31 day
P10/P90 range	20.31 day
Variance	1059.24 day
Std.Deviation	32.55 day
Semi Std.Dev.	32.10 day
Skewness	0.006810
Kurtosis	-3.023640
Sens.Threshold	0.16



5th Percentile	02/21/2019
10th Percentil	02/25/2019
15th Percentil	02/28/2019
20th Percentil	03/04/2019
25th Percentil	03/05/2019
30th Percentil	03/06/2019
35th Percentil	03/08/2019
40th Percentil	03/11/2019
45th Percentil	03/13/2019
50th Percentil	03/14/2019
55th Percentil	03/18/2019
60th Percentil	03/19/2019
65th Percentil	03/20/2019
70th Percentil	03/22/2019
75th Percentil	03/25/2019
80th Percentil	03/26/2019
85th Percentil	03/29/2019
90th Percentil	04/02/2019
95th Percentil	04/05/2019

Figure 5.3 Project deadline report

Furthermore the figure 5.4 illustrates tasks and its coefficient in order to oversee critical path among them.

Tas...	Task Name	Coefficient	Correlation between finish times
28	Task: UPPER STRUCTURE WORKS	1.00	
32	Task: THIRD FLOOR	0.68	
31	Task: SECOND FLOOR	0.38	
33	Task: FOURTH FLOOR	0.27	
37	Task: EIGHTH FLOOR	0.27	
35	Task: SIXTH FLOOR	0.26	
39	Task: TENTH FLOOR	0.20	
34	Task: FIFITH FLOOR	0.17	

Figure 5.4 Sensibility to time finish to another

From figure 5.4 can be seen that the upper construction tasks has strong correlation between risks and project duration. It make all sense because is the summary task with critical and had been suffered a significant impact from the assigned risks. Another important detail from mentioned figure, is that although the tenth floor is having the lowest duration, its coefficient value is higher than the fifth floor and this is because if we look at figure and 5.5, it is having more assigned risk compared to the fifth floor.

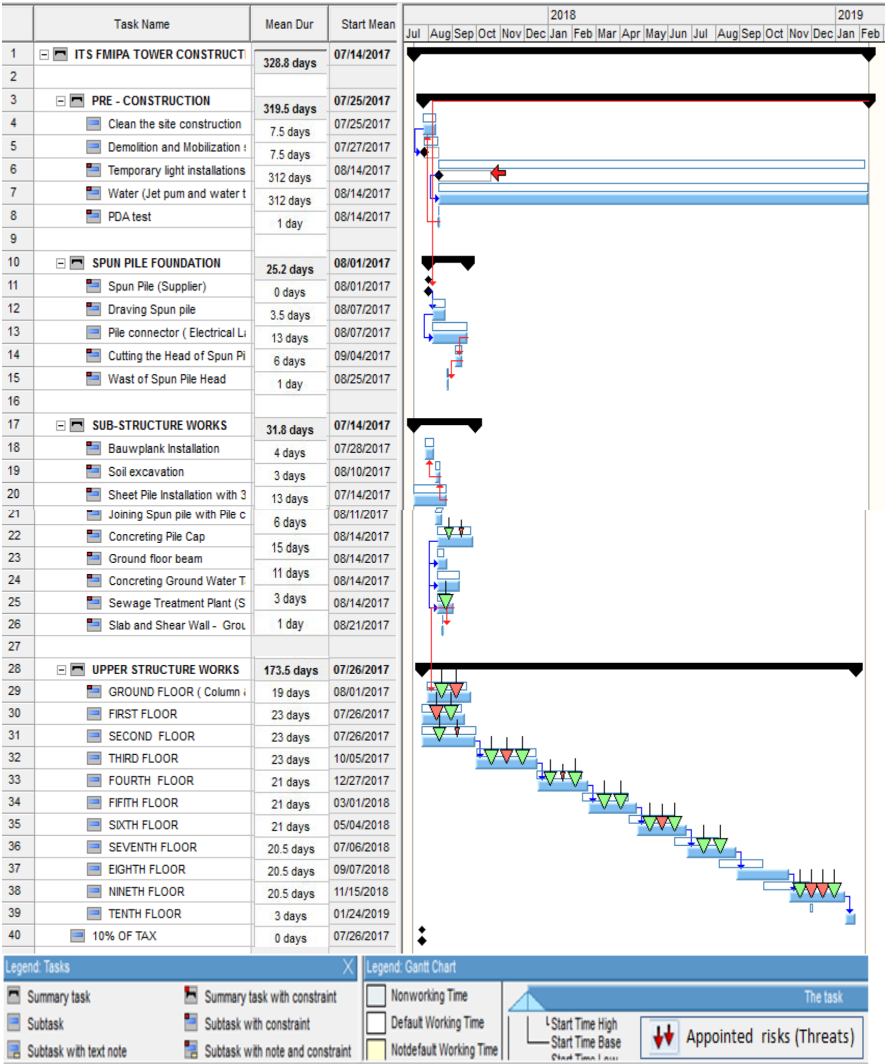


Figure 5.6 Time-Cost Risk Report Based on Monte Carlo Simulation

In addition, further details about scheduling and risks assigned are shown in figure 5.6 as well as in the appendix 4.

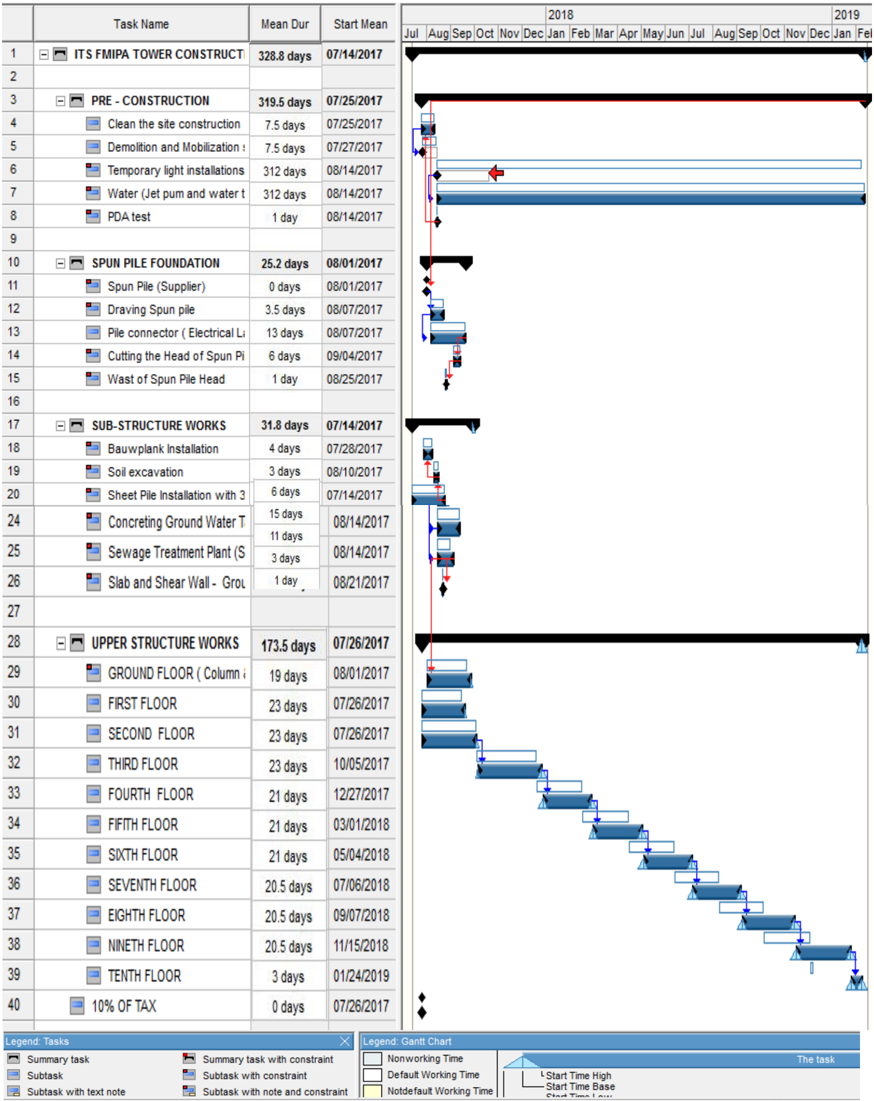


Figure 5.6 Normal and Risk Diagram for FMIPA Tower Construction

Another way to demonstrate how time-cost risks analysis impacts the project is based on presenting a short comparison between normal time-cost and the time-cost risk. Thus, WBS element with its time and cost delta are summarized in table 5.3 and table 5.4

Table 6.3 : Delta Cost among Normal Cost and Risk Cost

No.	Task Name	Normal Cost (Rp)	Risk Cost (Rp)	Delta (Rp)	Delta (%)	Risks/Code
	ITS FMIPA TOWER CONSTRUCTION					
I	PRE - CONSTRUCTION	91,144,128.00				none
II	SPUN PILE FOUNDATION	3,885,167,180.54	4,811,821,645.00	926,654,464.46	24%	A , D
III	SUB - STRUCTURE WORKS	2,844,694,297.14	3,402,687,744.16	557,993,447.02	20%	A , D
IV	UPPER-STRUCTURE WORKS					
4.1	GROUND FLOOR	896,345,093.66	1,198,759,611.00	302,414,517.34	25%	A, B, C, D
4.2	FIRST FLOOR	2,352,926,052.57	2,875,029,200.00	522,103,147.43	18%	A, B, C, D
4.3	SECOND FLOOR	2,352,926,052.57	2,875,149,192.00	522,223,139.43	18%	A, B, C, D
4.4	THIRD FLOOR	2,352,926,052.57	2,675,231,284.00	322,305,231.43	12%	A , B, D
4.5	Fourth FLOOR	1,620,883,599.75	1,996,715,771.00	375,832,171.25	19%	A, B, D
4.6	FIFTH FLOOR	1,620,883,599.75	1,856,135,989.00	235,252,389.25	13%	A, B, D
4.7	SIXTH FLOOR	1,620,883,599.75	1,852,735,336.00	231,851,736.25	13%	A, B, D
4.8	SEVENTH FLOOR	1,602,272,628.54	1,834,749,798.00	232,477,169.46	13%	A, B, D
4.9	EIGHT FLOOR	1,602,272,628.54	1,834,982,000.00	232,709,371.46	13%	A, B, D
4.10	NINTH FLOOR	1,602,272,628.54	1,847,874,000.00	245,601,371.46	13%	A, B, D
4.11	TENTH FLOOR	106,655,074.74	128,611,102.00	21,956,027.26	17%	A, B, C, D
	10% of Tax	2,455,252,616.00				
	Total :	**27,007,477,878.30**	**31,819,771,500.00**			

Table 5.4 : Delta Time among Normal Time and Risk Time

No.	Task Name	Normal Time (days)	Risk Time (days)	Delta (days)	Delta (%)	Risks/Code
	ITS FMIPA TOWER CONSTRUCTION					
I	PRE - CONSTRUCTION	17				none
II	SPUN PILE FOUNDATION	27	30	3	11%	A , E
III	SUB - STRUCTURE WORKS	71	75	4	6%	A , E
IV	UPPER-STRUCTURE WORKS					
4.1	GROUND FLOOR	19	22	3	16%	A, B, C ,E
4.2	FIRST FLOOR	23	27	4	17%	A, B, C ,E
4.3	SECOND FLOOR	23	27	4	17%	A, B, C, E
4.4	THIRD FLOOR	23	28	5	22%	A , B, E
4.5	FOURTH FLOOR	21	25	4	19%	A, B, E
4.6	FIFTH FLOOR	21	23	2	10%	A, B, E
4.7	SIXTH FLOOR	21	22	1	5%	A, B, E
4.8	SEVENTH FLOOR	20.6	22	1	7%	A, B, E
4.9	EIGHT FLOOR	20.6	22	1	7%	A, B, E
4.10	NINTH FLOOR	20.6	22	1	7%	A, B, E
4.11	TENTH FLOOR	1	3	2	160%	A, B, C, E
	Total :	**329**	**348**			

*Code / Risk:

A= Materials availability
B= Weather condition
C= Labors availability
D= Poor cost estimates
E= Poor time estimates

Both earlier tables (table 5.3 and 5.4) presented clearly how the time-cost risk approach improves project scheduling. Besides, as shown in figure 5.5 the risks were assigned according to their starting date. Note that the percentile delta in these tables does not match fully with the ranked coefficient; this is because the strong correlation between risks and project duration were based on project frame time and percentile delta for each WBS element delivery.

Table 5.5: Recap of the Time - Cost Risk Analysis

Project Name	ITS FMIPA TOWER CONSTRUCTION		
Project Manager			
Project Description	JL. TEKNIK MESIN, KAMPUS ITS SUKOLILO SURABAYA		
Company	ITS	Division/Group	
Project Created: 03/28/2017	Project Modified: 05/04/2017		

1

Three main project parameters			
		Without risks (Current Schedule)	Rp31,815,771,508
1	Total Project Cost	Rp27,270,755,282	Rp31,936,852,064
2	Project Finish Time	02/11/2019	03/14/2019
3	Project Duration	328.81 days	348 days

2

Three most crucial tasks		
	Affect on total project cost	Affect on project duration
1	Task: THIRD FLOOR	Task: THIRD FLOOR
2	Task: SECOND FLOOR	Task: SECOND FLOOR
3	Task: FOURTH FLOOR	Task: FOURTH FLOOR
3		Task: FOURTH FLOOR

3

Three most critical risks			
	Affect on total project cost (5 risks total)	Affect on project duration (5 risks total)	Risk: Material availability
1	Risk: Labors Availability	Risk: Material availability	Risk: Material restriction
2	Risk: Material availability	Risk: Material restriction	Risk: Weather Condition
3	Risk: Material restriction	Risk: Weather Condition	Risk: Poor Time Estimation

The recap table shows the difference between the current schedules without risks and changes when the possible time-cost control are acknowledged .In addition, it shows the most affected crucial tasks as well as summarizing the most relevant parameters towards ITS FMIPA Construction Project. Overall, the most important issue for time-cost risk analysis is to determine initial stage with a fixed date. Many new project managers still have trouble looking in the big picture and what to focus on. Time-Cost risk requires a quick response planning in order to unlike crisis management.

From this analysis can be inferred, Time-Cost risk make all difference into of project planning. Where the judgment expert also help to create and monitor a watch list of risks that are low priority, but are still identified as potential risks. A good result of project risks often lead Project managers strive to make their jobs looking easier and well-run project.

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CHAPTER VI
FINAL CONSIDARATIONS

6.1 Conclusion

From the analyzed data and statistical techniques used in this final project, the following statements can be inferred.

1. From the literatures and consultation with construction management expert were identified many risks, qualified as variables of delays and cost controls for Indonesia construction project. Yet, not all variables of delays and cost risks impact the structural works directly. Thus, for ITS FMIPA Tower structural planning were acknowledged the following risks:
   - Material availability
   - Weather condition
   - Labors availability
   - Poor Time estimation
   - Poor Cost estimation

2. Result of the normal Time-Cost estimation and with risks analysis:

a. The normal cost estimation for the structural project works is Rp.27,007,477,878.31 (Including 10% of tax) but with risks analysis it becomes Rp. 31,913,283,306. Expecting to overruns 18% from the normal cost .

b. The normal duration is 329 days but with risks analysis changes to 353 days. Expecting to be 7% ahead of the schedule.

c. Three most crucial tasks ranked and affecting on project duration are: third, second and fourth floor.

d. Three most crucial risks ranked and affecting project bufget are: Labors availability, Weather condition, Material availability. While for the project duration are known as Poor time estimates, Weather condition, Material availability.

e. The outcome of each assigned risk depends on the current schedule. For instance the starting point of this project schedule assumed to start on 07/14/2017 and the outcome Mean shows that the completion time will be on 02/11/2019 without risks and 03/15/2019 with risks.

6.2 Suggestion

Time risk and cost scheduling for high rise building should never be neglected. Apart from executive structural planning, further research development should include the architecture, electrical and mechanical as WBS elements. This research could be applied more widely for verifying to which extent the results can be transposed to other regions of the world.

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APPENDICES

APPENDIX 1: Questionnaire and Expert Response toward Time and Cost Risks for ITS FMIPA Tower

QUESTIONNAIRE FORM

- **What kind of risks should be considered for ITS FMIPA Tower Planning?**

`	Variables of cost control / Risks			
No	**WBS Elements**	**Normal Cost (Rp)**	**Experte Response**	
			Risks?	**Mitigation/ Impact?**
<1>	PRE-CONSTRUCTION	91,144,128.00		
<2>	STRUCRURAL ACTIVITIES			
I	Sub-Structure			
1	Spun Pile (Foundation)	2,844,694,297		
II	Sub-Structure	2,844,694,297		
	Bauwplank Installation			
	Soil excavation			
	Sheet pile installation			
	Joining Spun pile			
	Concreting Pile Cap			
	Ground floor beam			
	Concreting Ground Water Ta			
	Sewage Treatment Plant (ST			
	Slab and Shear Wall			
III	Upper Structure	17,731,247,011		
a	Ground Floor			
b	First to Third Floor			
c	Fourth to Six Floor			
d	Seven to Ten Floor			
	Normal project duration	27,007,477,878.31		

`	Variables of time control / Risks			
No	**WBS Elements**	**Normal Duration (days)**	**Experte Response**	
			Risks?	**Mitigation/ Impact ?**
<1>	PRE-CONSTRUCTION	17		
<2>	STRUCRURAL ACTIVITIES			
I	Sub-Structure			
1	Spun Pile (Foundation)	27		
II	Sub-Structure	71		
	Bauwplank Installation			
	Soil excavation			
	Sheet pile installation			
	Joining Spun pile			
	Concreting Pile Cap			
	Ground floor beam			
	Concreting Ground Water Ta			
	Sewage Treatment Plant (ST			
	Slab and Shear Wall			
III	Upper Structure	214		
a	Ground Floor			
b	First to Third Floor			
c	Fourth to Six Floor			
d	Seven to Ten Floor			
	Normal project duration	329		

FIRST CORRESPONDENT / PROJECT MANAGER

Profile:
Project Manager: TRI JOKO WAHYU, ST., MT, Ph. D
Institution/Firm: ITS CAMPUS
Position: Currant ITS Infrastructure Project Manager

`	Variables of time control / Risks			
No	**WBS Elements**	**Normal Duration (days)**	**Experte Response**	
			Risks?	**Mitigation/ Impact?**
<1>	PRE-CONSTRUCTION	17		
<2>	STRUCRURAL ACTIVITIES			
I	Sub-Structure			
1	Spun Pile (Foundation)	27	Materials Availability	10 – 30%
			Weather Condition	10 – 25%
II	Sub-Structure	71		
	Bauwplank Installation		Weather Condition	10 – 30%
	Soil excavation		Labors Availability	10 – 25%
	Sheet pile installation			
	Joining Spun pile			
	Concreting Pile Cap			
	Ground floor beam			
	Concreting Ground Water Ta			
	Sewage Treatment Plant (ST			
	Slab and Shear Wall			
III	Upper Structure	214		
a	Ground Floor		Weather Condition	10 – 30%
b	First to Third Floor		Material Availability	10 – 30%
c	Fourth to Six Floor		Labors Availability	10 – 25%
d	Seven to Ten Floor			
	Normal project duration	329		

`	Variables of cost control / Risks			
No	**WBS Elements**	**Normal Cost (Rp)**	**Experte Response**	
			Risks?	**Mitigation/ Impact?**
<1>	PRE-CONSTRUCTION	91,144,128.00		
<2>	STRUCRURAL ACTIVITIES			
I	Sub-Structure			
1	Spun Pile (Foundation)	2,844,694,297	Materials Availability	10 – 25%
II	Sub-Structure	2,844,694,297	Materials Availability	10 – 25%
	Bauwplank Installation		Weather Condition	5 – 10%
	Soil excavation		Labors Availability	5 – 10%
	Sheet pile installation		Materials Availability	10 – 25%
	Joining Spun pile			
	Concreting Pile Cap			
	Ground floor beam			
	Concreting Ground Water Ta			
	Sewage Treatment Plant (ST			
	Slab and Shear Wall			
III	Upper Structure	17,731,247,011	Materials Availability	10 – 25%
a	Ground Floor			
b	First to Third Floor		Labors Availability	5 – 10%
c	Fourth to Six Floor		Weather Condition	5 – 10%
d	Seven to Ten Floor			
	Normal project duration	27,007,477,878.31		

SECOND CORRESPONDENT / PROJECT MANAGER

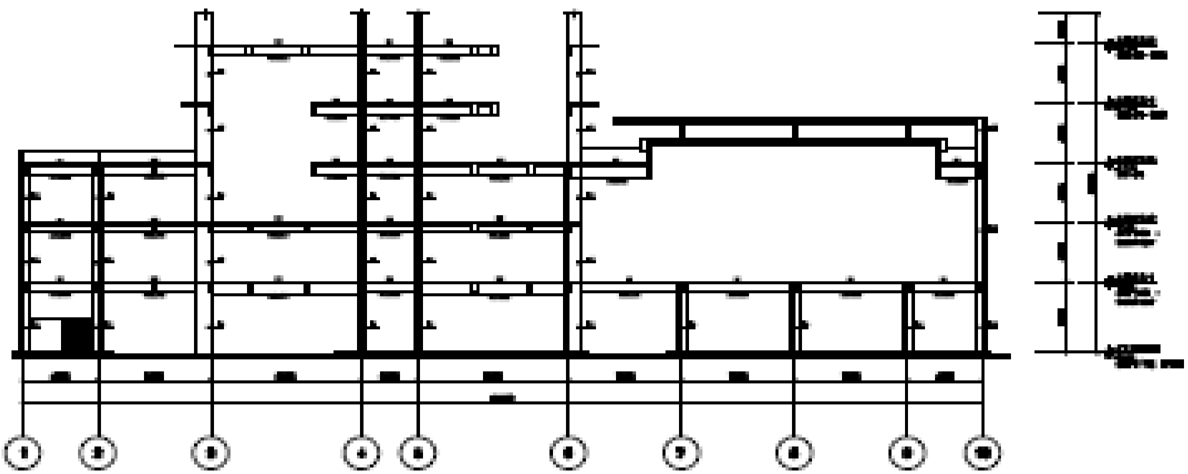
Profile:
Project Manager: TORIQ ARIF, ST., MT., CIPM
Experience : 12 YEARS
Institution/Firm : UGM UNIVERSITY, PT. EXPERTINDO

"I truly agree with the previous correspondent, those qualitative risks are the most common issues faced by Indonesian contractors. Yet, from my experience also it is necessary to consider risks like poor time-cost estimates," Stated Mr. Toriq. Notice, this interview was direct with the correspondent.

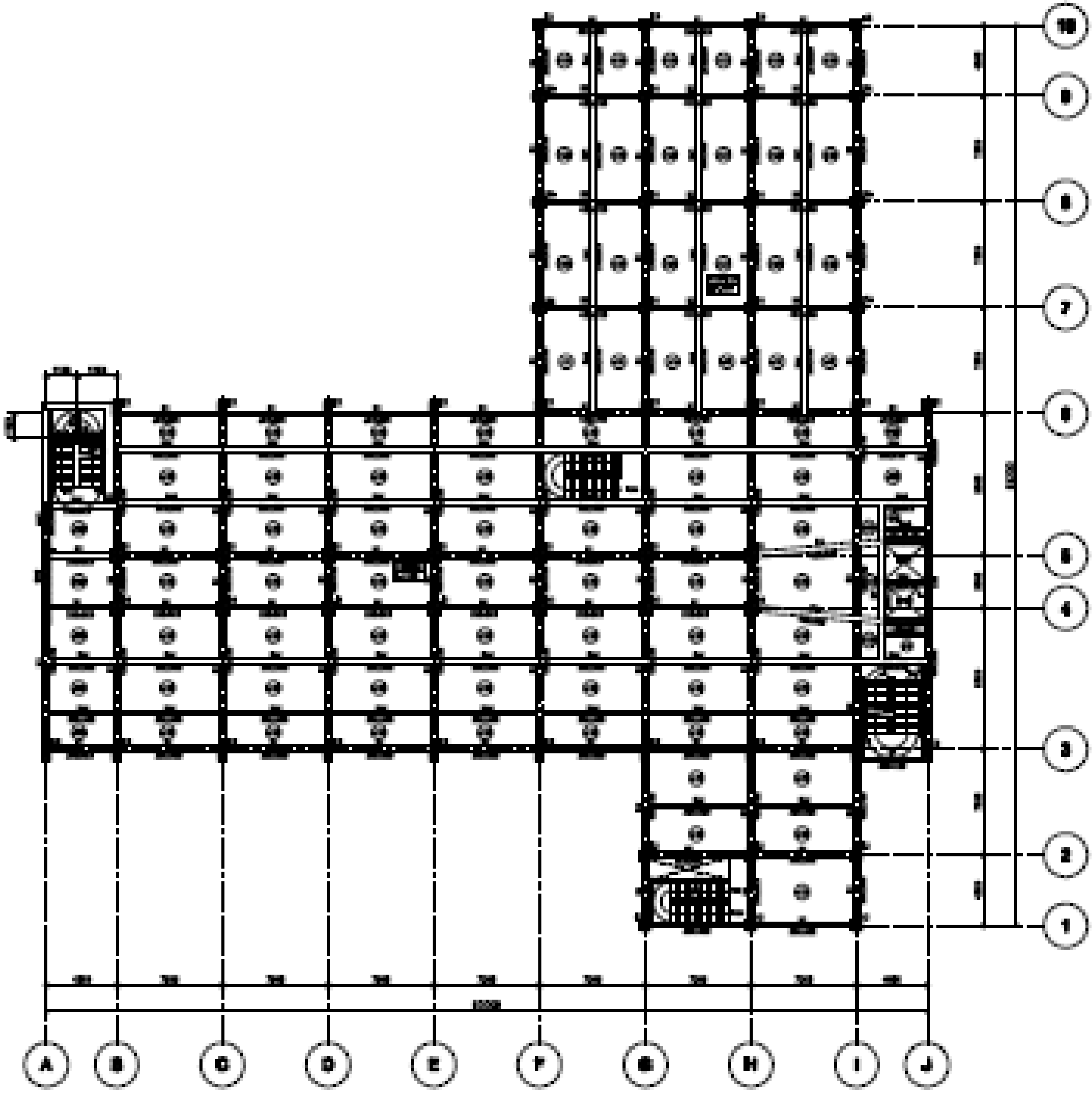
`	Variables of time control / Risks			
No	**WBS Elements**	**Normal Duration (days)**	**Experte Response**	
			Risks?	**Mitigation/ Impact ?**
<1>	PRE-CONSTRUCTION	17		
<2>	STRUCRURAL ACTIVITIES			
I	Sub-Structure			
1	Spun Pile (Foundation)	27		
II	Sub-Structure			
	Bauwplank Installation			
	Soil excavation			1 – 3%
	Sheet pile installation		Poor time estimates	(Re-estimate
	Joining Spun pile	71		if needful)
	Concreting Pile Cap			
	Ground floor beam			
	Concreting Ground Water Ta			
	Sewage Treatment Plant (ST			
	Slab and Shear Wall			
III	Upper Structure			
a	Ground Floor			
b	First to Third Floor	214		1 – 3%
c	Fourth to Six Floor		Poor time estimates	(Re-estimate
d	Seven to Ten Floor			if needful)
	Normal project duration	329		

`	Variables of cost control / Risks			
No	**WBS Elements**	**Normal Cost (Rp)**	**Experte Response**	
			Risks?	**Mitigation/ Impact?**
<1>	PRE-CONSTRUCTION	91,144,128.00		
<2>	STRUCRURAL ACTIVITIES			
I	Sub-Structure			
1	Spun Pile (Foundation)	2,844,694,297		
II	Sub-Structure			
	Bauwplank Installation			
	Soil excavation			
	Sheet pile installation			1 – 3%
	Joining Spun pile	2,844,694,297	Poor time estimates	(Re-estimate
	Concreting Pile Cap			if needful)
	Ground floor beam			
	Concreting Ground Water Ta			
	Sewage Treatment Plant (ST			
	Slab and Shear Wall			
III	Upper Structure			
a	Ground Floor			1 – 3%
b	First to Third Floor	17,731,247,011	Poor time estimates	(Re-estimate
c	Fourth to Six Floor			if needful)
d	Seven to Ten Floor			

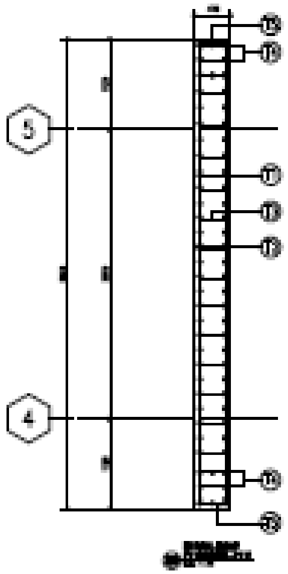
APPENDIX 2: Secondary Data and Project Engineering Drawings

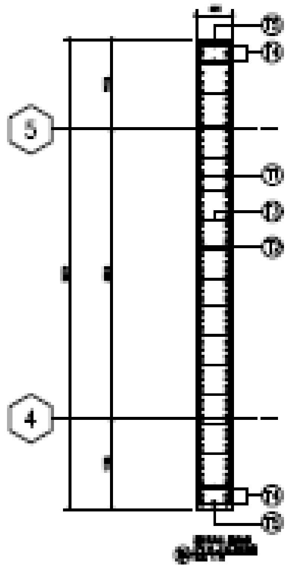


PORTAL AS



DENAH LANTAI 1



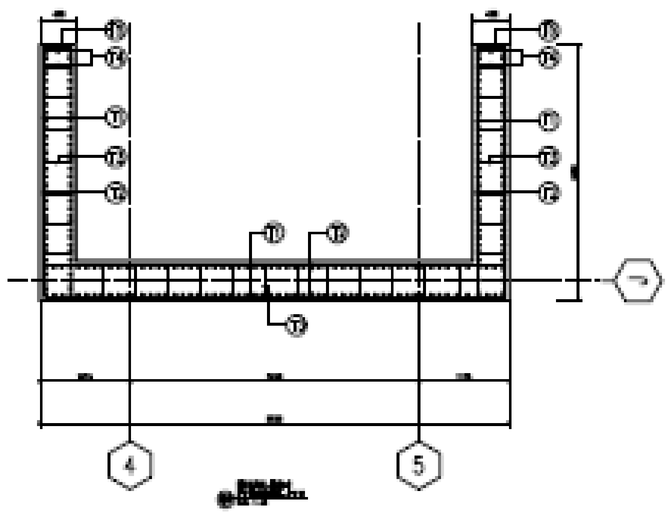


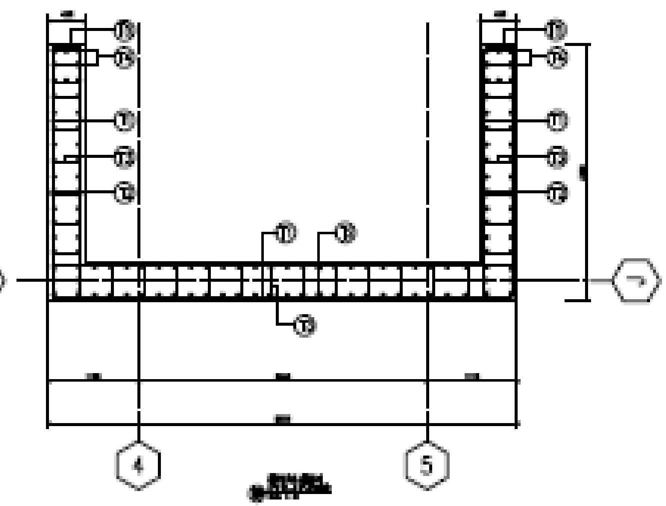
TULANGAN SW-1

LANTAI	T1	T2	T3	T4	T5
LT.10–LT.ATAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.4–LT.10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.3–LT.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.2–LT.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.1–LT.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.DASR–LT.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TULANGAN SW-2

LANTAI	T1	T2	T3	T4	T5
LT.10–LT.ATAP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.4–LT.10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.3–LT.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.2–LT.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.1–LT.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LT.DASR–LT.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

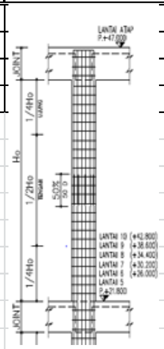
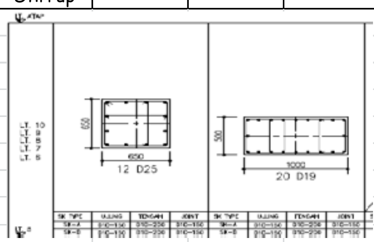




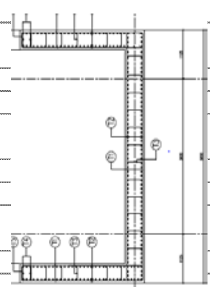
APPENDIX 3: Unit Cost (2014), Volume take-off Samples and Normal Time-Cost Estimation

- **TAKE-OFF VOLUME SAMPLES**

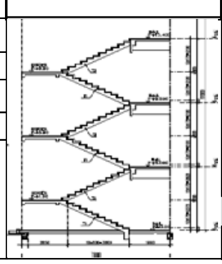
I. Column

	Take-off volume from Sixth to tenth floor (4.2 m height)											
No	Illustration	Colunm type	Quantity type	Number of floor	width	height	Length	Volume	DIAMETER	Amount	TOTAL	Weight
			bh	Floor	m	m	m	Point	DIAMETER	(bar)	(m)	kg/m
								Concrete (m3)		B	C=A*B	0.006165
1		C1	14	1	0.75	0.75	4.20	33.08	20	7	1605.24	4258.86
		Stirrup					29.00		12	2.84	1210.69	1074.80
2		C2	20	1	0.5	1	4.20	42	20	20	1519.00	3753.75
		Stirrup							12	3.14	158.26	36.76
												
						Total :		75.08				9124.18

II. Shear Wall

No	Illustraction	Shear wall type	Numeber of type	width	height	Length	Volume	DIAMETER	Amount	TOTAL	Weight
			bh	m	m	m	pint	DIAMETER	(Bar)	(m)	kg/m
							beton (m3)		B	C=A*B	0.006165
1		Shear Wall 1	1	0.4	4.2	5.8	9.744	16	131.92	382.57	603.78
		Stirrup						8	162.40	1364.16	568.24
2		Shear Wall 1	2	0.4	4.2	3.2	10.752	16	145.36	465.15	734.12149
		Stirrup						13	89.60	1860.61	969.27
3		Shear Wall 2	1	0.4	4.2	5.8	9.84	16	131.92	382.57	603.78
		Stirrup						13	162.40	1364.16	568.24
							30.34				4047.45

III. <u>Stairs from Sixth Floor</u>

No	Illustraction	Stair Elements	Type Quantity	width	height	Length	Volume	DIAMETER	Amount	TOTAL	Weight
			bh	m	m	m	point	DIAMETER	(Bar)	(m)	kg/m
							beton (m3)		B	C=A*B	0.006165
1		Triangles	20	1.5	0.16	0.3	1.852	13	3	1.06	1.10
								8	3	4.5	1.78
2●		bordes	1	3	0.13	1.95	0.7605	13	17	442	461
3		Stair slab	1	1.5	0.13	5.16	2.0124	13	11	22	23
									35.4	353.728	369
		Equivalent one stair					4.62				854.86

- **Unit Cost (2014)**

LAMPIRAN II KEPUTUSAN WALIKOTA SURABAYA
NOMOR
TANGGAL 2014

HARGA SATUAN POKOK KEGIATAN (HSPK)

NOMOR	URAIAN KEGIATAN	Koef.	SATUAN	HARGA SATUAN (Rp)	HARGA (Rp)
24.01.01.01	**Pembuatan Bouwplank /Titik**		**Titik**		
	Bahan/Material:				
20.01.01.28.04.05.F	Paku Biasa 2 - 5 inchi	0.05	Doz	27,000.00	1,350.00
20.01.01.43.04.03.F	Kayu Meranti Usuk 4/6, 5/7	0.012	M3	4,500,000.00	54,000.00
20.01.01.43.04.05.F	Kayu Meranti Bekisting	0.008	M3	3,200,000.00	25,600.00
				Jumlah:	**80,950.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.0045	Orang Hari	120,000.00	540.00
23.02.04.01.02.F	Kepala Tukang	0.01	Orang Hari	110,000.00	1,100.00
23.02.04.01.03.F	Tukang	0.1	Orang Hari	105,000.00	10,500.00
23.02.04.01.04.F	Pembantu Tukang	0.1	Orang Hari	99,000.00	9,900.00
				Jumlah:	**22,040.00**
				Nilai HSPK :	**102,990.00**
24.01.01.02	**Pengukuran dan Pemasangan Bouwplank (UITZET)**		**m1**		
	Bahan/Material:				
20.01.01.28.04.05.F	Paku Biasa 2 - 5 inchi	0.02	Doz	27,000.00	540.00
20.01.01.43.04.01.F	Kayu Meranti Papan 2/20, 4/10	0.007	M3	2,830,000.00	19,810.00
20.01.01.43.04.03.F	Kayu Meranti Usuk 4/6, 5/7	0.012	M3	4,500,000.00	54,000.00
				Jumlah:	**74,350.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.005	Orang Hari	120,000.00	600.00
23.02.04.01.02.F	Kepala Tukang	0.01	Orang Hari	110,000.00	1,100.00
23.02.04.01.03.F	Tukang	0.1	Orang Hari	105,000.00	10,500.00
23.02.04.01.04.F	Pembantu Tukang	0.1	Orang Hari	99,000.00	9,900.00
				Jumlah:	**22,100.00**
				Nilai HSPK :	**96,450.00**
24.01.01.03	**Pembersihan Lapangan "Ringan" dan Perataan**		**m2**		
	Upah:				
23.02.04.01.01.F	Mandor	0.025	Orang Hari	120,000.00	3,000.00
23.02.04.01.04.F	Pembantu Tukang	0.05	Orang Hari	99,000.00	4,950.00
				Jumlah:	**7,950.00**
				Nilai HSPK :	**7,950.00**
24.01.01.04	**Pembersihan Lapangan "Berat" dan Perataan**		**m2**		
	Upah:				
23.02.04.01.01.F	Mandor	0.05	Orang Hari	120,000	6,000.00
23.02.04.01.04.F	Pembantu Tukang	0.1	Orang Hari	99,000	9,900.00
				Jumlah:	**15,900.00**
				Nilai HSPK :	**15,900.00**
24.01.01.10	**Pembuatan Direksi Kit**		**m2**		
	Bahan:				
20.01.01.02.02.F	Semen PC 50 Kg	0.7	Zak	66,000.00	46,200.00
20.01.01.03.02.02.F	Kaca Polos 5 mm	0.08	M2	100,000.00	8,000.00
20.01.01.04.03.F	Pasir Pasang/Plester	0.15	M3	168,400.00	25,260.00
20.01.01.04.04.F	Pasir Cor/Beton	0.1	M3	232,100.00	23,210.00
20.01.01.05.04.02.F	Batu Pecah Mesin 2/3 cm	0.15	M3	262,000.00	39,300.00
20.01.01.05.06.01.F	Batu Bata Merah Kelas 1 (Uk. 22x11x4.5 cm)	30	Buah	950.00	28,500.00
20.01.01.07.02.01.F	Seng Gelombang BJLS 30, Uk. (0,8 x 1,50)	0.25	Lembar	59,000.00	14,750.00
20.01.01.11.01.F	Plat Besi/Baja	1.1	Kg	25,000.00	27,500.00
20.01.01.25.01.F	Kunci Tanam	0.15	Buah	70,000.00	10,500.00
20.01.01.28.04.05.F	Paku Biasa 2 - 5 inchi	0.85	Doz	27,000.00	22,950.00
20.01.01.34.01.F	Triplek Uk.110 x 210 x 4 mm	0.06	Lembar	67,700.00	4,062.00
20.01.01.43.04.03.F	Kayu Meranti Usuk 4/6, 5/7	0.18	M3	4,500,000.00	810,000.00
20.01.01.43.05.01.F	Dolken kayu gelam dia 8-10 cm, panjang 4m	1.25	Batang	8,500.00	10,625.00
				Jumlah:	**1,070,857.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.05	Orang Hari	120,000.00	6,000.00
23.02.04.01.02.F	Kepala Tukang	0.3	Orang Hari	110,000.00	33,000.00
23.02.04.01.03.F	Tukang	1	Orang Hari	105,000.00	105,000.00
23.02.04.01.03.F	Tukang	2	Orang Hari	105,000.00	210,000.00
23.02.04.01.04.F	Pembantu Tukang	2	Orang Hari	99,000.00	198,000.00
				Jumlah:	**552,000.00**
				Nilai HSPK :	**1,622,857.00**

24.03.01.19	**Pekerjaan Bekisting Balok**		**m2**		
	Bahan:				
20.01.01.28.04.03.F	Paku Triplek/Eternit	0.4	Kg	22,000	8,800.00
20.01.01.34.02.F	Plywood Uk .122x244x9 mm	0.35	Lembar	93,600	32,760.00
20.01.01.48.03.07.F	Kayu Kamper Balok 4/6, 5/7	0.018	M3	6,400,000	115,200.00
20.01.01.48.04.05.F	Kayu Meranti Bekisting	0.04	M3	3,200,000	128,000.00
20.01.02.01.08.F	Minyak Bekisting	0.2	Liter	28,300	5,660.00
				Jumlah:	**290,420.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.033	Orang Hari	120,000	3,960.00
23.02.04.01.02.F	Kepala Tukang	0.033	Orang Hari	110,000	3,630.00
23.02.04.01.03.F	Tukang	0.33	Orang Hari	105,000	34,650.00
23.02.04.01.04.F	Pembantu Tukang	0.66	Orang Hari	99,000	65,340.00
				Jumlah:	**107,580.00**
				Nilai HSPK :	**398,000.00**
24.03.01.18	**Pekerjaan Bekisting Kolom**		**m2**		
	Bahan:				
20.01.01.28.04.03.F	Paku Triplek/Eternit	0.4	Kg	22,000	8,800.00
20.01.01.34.02.F	Plywood Uk .122x244x9 mm	0.35	Lembar	93,600	32,760.00
20.01.01.48.03.07.F	Kayu Kamper Balok 4/6, 5/7	0.015	M3	6,400,000	96,000.00
20.01.01.48.04.05.F	Kayu Meranti Bekisting	0.04	M3	3,200,000	128,000.00
20.01.02.01.08.F	Minyak Bekisting	0.2	Liter	28,300	5,660.00
				Jumlah:	**271,220.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.033	Orang Hari	120,000	3,960.00
23.02.04.01.02.F	Kepala Tukang	0.033	Orang Hari	110,000	3,630.00
23.02.04.01.03.F	Tukang	0.33	Orang Hari	105,000	34,650.00
23.02.04.01.04.F	Pembantu Tukang	0.66	Orang Hari	99,000	65,340.00
				Jumlah:	**107,580.00**
				Nilai HSPK :	**378,800.00**
24.03.01.19	**Pekerjaan Bekisting Balok**		**m2**		
	Bahan:				
20.01.01.28.04.03.F	Paku Triplek/Eternit	0.4	Kg	22,000	8,800.00
20.01.01.34.02.F	Plywood Uk .122x244x9 mm	0.35	Lembar	93,600	32,760.00
20.01.01.48.03.07.F	Kayu Kamper Balok 4/6, 5/7	0.018	M3	6,400,000	115,200.00
20.01.01.48.04.05.F	Kayu Meranti Bekisting	0.04	M3	3,200,000	128,000.00
20.01.02.01.08.F	Minyak Bekisting	0.2	Liter	28,300	5,660.00
				Jumlah:	**290,420.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.033	Orang Hari	120,000	3,960.00
23.02.04.01.02.F	Kepala Tukang	0.033	Orang Hari	110,000	3,630.00
23.02.04.01.03.F	Tukang	0.33	Orang Hari	105,000	34,650.00
23.02.04.01.04.F	Pembantu Tukang	0.66	Orang Hari	99,000	65,340.00
				Jumlah:	**107,580.00**
				Nilai HSPK :	**398,000.00**
24.03.01.20	**Pekerjaan Bekisting Lantai**		**m2**		
	Bahan:				
20.01.01.28.04.03.F	Paku Triplek/Eternit	0.4	Kg	22,000	8,800.00
20.01.01.34.02.F	Plywood Uk .122x244x9 mm	0.35	Lembar	93,600	32,760.00
20.01.01.48.03.07.F	Kayu Kamper Balok 4/6, 5/7	0.015	M3	6,400,000	96,000.00
20.01.01.48.04.05.F	Kayu Meranti Bekisting	0.04	M3	3,200,000	128,000.00
20.01.02.01.08.F	Minyak Bekisting	0.2	Liter	28,300	5,660.00
24.03.01.21	**Pekerjaan Bekisting Dinding**		**m2**		
	Bahan:				
20.01.01.28.04.03.F	Paku Triplek/Eternit	0.4	Kg	22,000	8,800.00
20.01.01.34.02.F	Plywood Uk .122x244x9 mm	0.35	Lembar	93,600	32,760.00
20.01.01.48.03.07.F	Kayu Kamper Balok 4/6, 5/7	0.02	M3	6,400,000	128,000.00
20.01.01.48.04.05.F	Kayu Meranti Bekisting	0.03	M3	3,200,000	96,000.00
20.01.02.01.08.F	Minyak Bekisting	0.2	Liter	28,300	5,660.00
				Jumlah:	**271,220.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.033	Orang Hari	120,000	3,960.00
23.02.04.01.02.F	Kepala Tukang	0.033	Orang Hari	110,000	3,630.00
23.02.04.01.03.F	Tukang	0.33	Orang Hari	105,000	34,650.00
23.02.04.01.04.F	Pembantu Tukang	0.66	Orang Hari	99,000	65,340.00
				Jumlah:	**107,580.00**
				Nilai HSPK :	**378,800.00**
24.03.01.22	**Pekerjaan Bekisting Tangga**		**m2**		
	Bahan:				
20.01.01.28.04.03.F	Paku Triplek/Eternit	0.4	Kg	22,000	8,800.00
20.01.01.34.02.F	Plywood Uk .122x244x9 mm	0.35	Lembar	93,600	32,760.00
20.01.01.48.03.07.F	Kayu Kamper Balok 4/6, 5/7	0.015	M3	6,400,000	96,000.00
20.01.01.48.04.05.F	Kayu Meranti Bekisting	0.03	M3	3,200,000	96,000.00
20.01.02.01.08.F	Minyak Bekisting	0.15	Liter	28,300	4,245.00
				Jumlah:	**237,805.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.033	Orang Hari	120,000	3,960.00
23.02.04.01.02.F	Kepala Tukang	0.033	Orang Hari	110,000	3,630.00
23.02.04.01.03.F	Tukang	0.33	Orang Hari	105,000	34,650.00
23.02.04.01.04.F	Pembantu Tukang	0.66	Orang Hari	99,000	65,340.00
				Jumlah:	**107,580.00**
				Nilai HSPK :	**345,385.00**

24.03.01.01	**Pemancangan Tiang Pancang m1 (= 200m)**		**m1**		
	Bahan:				
22.01.01.08.05.01.F	Tiang Pancang	1	Batang	142,900.00	142,900.00
				Jumlah:	**142,900.00**
	Sewa Peralatan				
23.02.05.11.03.01.F	Sewa Crane 30 ton - Min. 8 Jam (Termasuk Mob/Demob Operator BBM)	0.218	Jam	188,800.00	41,476.40
23.02.05.11.10.01.F	Sewa Hammer Tiang Pancang min. 8 jam (Termasuk Mob/Demob Operator BBM)	0.218	Jam	188,100.00	41,005.80
				Jumlah:	**70,482.20**
	Upah:				
23.02.04.01.01.F	Mandor	0.125	Orang Hari	120,000.00	15,000.00
				Jumlah:	**15,000.00**
				Nilai HSPK :	**228,382.20**
24.03.01.12	**Pekerjaan Beton K-350**		**m3**		
	Bahan:				
20.01.01.02.01.F	Semen PC 40 Kg	11.2	Zak	63,000	705,600.00
20.01.01.04.04.F	Pasir Cor/Beton	0.416075	M3	232,100	96,756.63
20.01.01.05.04.01.F	Batu Pecah Mesin 1/2 cm	0.5263157895	M3	466,000	245,263.16
23.02.02.02.01.F	Air Kerja	215	Liter	27	5,805.00
				Jumlah:	**1,053,424.85**
	Upah:				
23.02.04.01.01.F	Mandor	0.105	Orang Hari	120,000	12,600.00
23.02.04.01.02.F	Kepala Tukang	0.035	Orang Hari	110,000	3,850.00
23.02.04.01.03.F	Tukang	0.35	Orang Hari	105,000	36,750.00
23.02.04.01.04.F	Pembantu Tukang	2.1	Orang Hari	99,000	207,900.00
				Jumlah:	**261,100.00**
				Nilai HSPK :	**1,314,524.85**
24.03.01.13	**Pekerjaan Beton (1Pc : 2 Ps : 3 Kr)**		**m3**		
	Bahan:				
20.01.01.02.01.F	Semen PC 40 Kg	9.275	Zak	63,000	584,325.00
20.01.01.04.04.F	Pasir Cor/Beton	0.43625	M3	232,100	101,253.63
20.01.01.05.04.01.F	Batu Pecah Mesin 1/2 cm	0.5510526316	M3	466,000	256,790.53
23.02.02.02.01.F	Air Kerja	215	Liter	27	5,805.00
				Jumlah:	**948,174.15**
	Upah:				
23.02.04.01.01.F	Mandor	0.083	Orang Hari	120,000	9,960.00
24.03.01.17	**Pekerjaan Bekisting Sloof**		**m2**		
	Bahan:				
20.01.01.28.04.03.F	Paku Triplek/Eternit	0.3	Kg	22,000	6,600.00
20.01.01.43.04.05.F	Kayu Meranti Bekisting	0.045	M3	3,200,000	144,000.00
20.01.02.01.08.F	Minyak Bekisting	0.1	Liter	28,300	2,830.00
				Jumlah:	**153,430.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.026	Orang Hari	120,000	3,120.00
23.02.04.01.02.F	Kepala Tukang	0.026	Orang Hari	110,000	2,860.00
23.02.04.01.03.F	Tukang	0.26	Orang Hari	105,000	27,300.00
23.02.04.01.04.F	Pembantu Tukang	0.52	Orang Hari	99,000	51,480.00
				Jumlah:	**84,760.00**
				Nilai HSPK :	**238,190.00**
24.03.01.18	**Pekerjaan Bekisting Kolom**		**m2**		
	Bahan:				
20.01.01.28.04.03.F	Paku Triplek/Eternit	0.4	Kg	22,000	8,800.00
20.01.01.34.02.F	Plywood Uk. 122x244x9 mm	0.35	Lembar	93,600	32,760.00
20.01.01.43.03.07.F	Kayu Kamper Balok 4/6, 5/7	0.015	M3	6,400,000	96,000.00
20.01.01.43.04.05.F	Kayu Meranti Bekisting	0.04	M3	3,200,000	128,000.00
20.01.02.01.08.F	Minyak Bekisting	0.2	Liter	28,300	5,660.00
				Jumlah:	**271,220.00**
	Upah:				
23.02.04.01.01.F	Mandor	0.033	Orang Hari	120,000	3,960.00
23.02.04.01.02.F	Kepala Tukang	0.033	Orang Hari	110,000	3,630.00
23.02.04.01.03.F	Tukang	0.33	Orang Hari	105,000	34,650.00
23.02.04.01.04.F	Pembantu Tukang	0.66	Orang Hari	99,000	65,340.00
				Jumlah:	**107,580.00**
				Nilai HSPK :	**378,800.00**

No	WBS ELEMENTS	Volume	Unit	Unit Cost	Total Cost (Rp)	Coeficient	Productivity	Labors	Duration (days)
<1>	I. PRE - CONSTRUCTION								
1	Clean the site construction	2611,84	m2	7950	20.764.128,00	0,1000	10	20	13,0592
2	Demolition and Mobilization services equipament	1	Ls	20000000	20.000.000,00				
3	Temporary light installations contract	21	P/M	1250000	26.250.000,00				
4	Water (Jet pum and water tank 500 L installation)	1	Ls	9130000	9.130.000,00				
5	PDA test	2	Pt	7500000	15.000.000,00				2
		Sub total <1>			91.144.128,00				15,0592

No	WBS ELEMENTS	Volume	Unit	Unit Cost	Total Cost (Rp)	Coeficient	Productivity	Labors	Duration (days)
<2>	STRUCRURAL ACTIVITIES								
I	SPUN PILE (Foundation)								
1	Spun Pile (Supplier)								
a	Diameter 500 mm	3924	m'	425366,77	1.669.139.205,48				
b	Diameter 400 mm	468	m'	323546,12	151.419.584,16				
c	Diameter 300 mm	540	m'	216885,61	117.118.229,40				
2	Draving Spun pile								
a	Diameter 500 mm	3924	m'	400656	1.572.174.144,00	0,0238	42,0	10	9,33912
b	Diameter 400 mm	468	m'	313958	146.932.344,00	0,0238	42,0	10	1,11384
c	Diameter 300 mm	540	m'	227008	122.584.320,00	0,0238	42,0	10	1,2852
3	Pile connector (Electrical Las)								
a	Diameter 500 mm	218	ctr	134399	29.298.982,00	0,4	2,5	3	29,06666667
b	Diameter 400 mm	26	ctr	134399	3.494.374,00	0,4	2,5	3	3,466666667
c	Diameter 300 mm	30	ctr	134399	4.031.970,00	0,4	2,5	3	4
4	Cutting the Head of Spun Pile								
a	Diameter 500 mm	218	pc	189566	41.325.388,00	0,35	2,9	15	5,086666667
b	Diameter 400 mm	26	pc	169567	4.408.742,00	0,29	3,4	15	0,502666667
c	Diameter 300 mm	30	pc	148675	4.460.250,00	0,25	4,0	15	0,5
5	Wast of Spun Pile Head	46,17	m3	406750	18.779.647,50				1
		Sub total <1>			3.885.167.180,54				52

No	WBS ELEMENTS	Volume	Unit	Unit Cost		Total Cost (Rp)		Coeficient	Productivity	Labors	Duration (days)	
<2>	SUB-STRUCTURE WORKS											
1	Bauwplank Installation	266,4	m'	IDR	93.521,9	IDR	24.914.234,2	0,2845	3,5	10	7,58	8
2	Soil excavation											5
a	For Pile and Sloof	1718,62	m3	IDR	37.541,6	IDR	64.519.744,6	0,0254	39,4	15	2,91	
b	For Ground Water Tank (GWT)	863,91	m3	IDR	37.541,6	IDR	32.432.563,7	0,0254	39,4	15	1,46	
c	For SPT	602,22	m3	IDR	37.541,6	IDR	22.608.302,4	0,0254	39,4	15	1,02	
3	Sheet Pile Installation with 3 cm for GWT excavation											31
a	GWT Excavation Area	268,26	m2	IDR	235.576,3	IDR	63.195.698,2	0,234	4,3	15	4,18	
b	SPT Area	225,46	m2	IDR	235.576,3	IDR	53.113.032,6	0,234	4,3	10	5,28	
4	Compating the subgrade (ground floor and foundation	1510,83	m2	IDR	22.464,0	IDR	33.939.285,1	0,0271	36,9	10	4,09	
5	Applying termite protection over foundation and ground floor	4818,53	m2	IDR	20.000,0	IDR	96.370.600,0	0,0271	36,9	20	6,53	
6	Soil consolidation (addicional)	1390,65	m3	IDR	16.248,0	IDR	22.595.281,2	0,311	3,2	10	2,00	
7	Moving the excavated soils	1191,88	m3	IDR	12.903,5	IDR	15.379.423,6	0,25	4,0	10	2,00	
8	Dense sand consolidation over foundation	105,76	m3	IDR	194.765,0	IDR	20.598.346,4	0,311	3,2	10	3,29	
9	Base slab of cement concrete	75,54	m3	IDR	815.233,3	IDR	61.582.722,7	1,2	0,8	20	4,53	
10	Joining Spun pile with Pile cap reinforciment											7
a	Diameter 500 mm	218	pc	IDR	289.224,8	IDR	63.051.004,2	0,4	2,5	20	4,36	
b	Diameter 400 mm	26	pc	IDR	269.224,7	IDR	6.999.840,9	0,4	2,5	10	1,04	
c	Diameter 300 mm	30	pc	IDR	257.224,5	IDR	7.716.735,0	0,4	2,5	10	1,20	
11	Concreting Pile Cap											34
a	Type P3A:											2
	Concrete strength K-350	12,57	m3	IDR	1.222.540,4	IDR	15.367.332,5	0,042	23,8	10	0,05	
	Reinforcement	1163,33	kg	IDR	10.555,5	IDR	12.279.529,8	0,007	142,9	20	0,41	
	Form work	29,46	m2	IDR	108.570,5	IDR	3.198.486,9	0,26	3,8	10	0,77	
b	Type P3B:					IDR	-					
	Concrete strength K-350	11,87	m3	IDR	1.222.540,4	IDR	14.511.554,2	0,042	23,8	10	0,05	2
	Reinforcement	1511,78	kg	IDR	10.555,5	IDR	15.957.593,8	0,007	142,9	20	0,53	
	Form work	37,02	m2	IDR	108.570,5	IDR	4.019.279,9	0,26	3,8	10	0,96	
c	Type P3											2
	Concrete strength K-350	19,57	m3	IDR	1.222.540,4	IDR	23.925.115,1	0,042	23,8	10	0,08	
	Reinforcement	1511,78	kg	IDR	10.555,5	IDR	15.957.593,8	0.007	142,9	20	0,53	
	Form work	36,75	m2	IDR	108.570,5	IDR	3.989.965,9	0,26	3,8	10	0,96	
d	Type P4					IDR	-					4
	Concrete strength K-350	42,5	m3	IDR	1.222.540,4	IDR	51.957.965,8	0,35	2,9	10	1,49	
	Reinforcement	2736,93	kg	IDR	10.555,5	IDR	28.889.664,6	0,007	142,9	20	0,96	
	Form work	68	m2	IDR	108.570,5	IDR	7.382.794,0	0,26	3,8	8	2,21	
e	Type P4A											1
	Concrete strength K-350	10,63	m3	IDR	1.222.540,4	IDR	12.995.604,2	0,042	23,8	6	0,07	
	Reinforcement	684,23	kg	IDR	10.555,5	IDR	7.222.389,8	0,007	142,9	20	0,24	
	Form work	17	m2	IDR	108.570,5	IDR	1.845.698,5	0,26	3,8	10	0,44	
f	Type P5											5
	Concrete strength K-350	47,25	m3	IDR	1.222.540,4	IDR	57.765.032,6	0,35	2,9	10	1,65	
	Reinforcement	3722,4	kg	IDR	10.555,5	IDR	39.291.793,2	0,007	142,9	20	1,30	
	Form work	64,8	m2	IDR	108.570,5	IDR	7.035.368,4	0,26	3,8	10	1,68	
g	Type P12											5
	Concrete strength K-350	88	m3	IDR	1.222.540,4	IDR	107.583.552,7	0,042	23,8	10	0,37	
	Reinforcement	6916,51	kg	IDR	10.555,5	IDR	73.007.221,3	0,007	142,9	20	2,42	
	Form work	76	m2	IDR	108.570,5	IDR	8.251.358,0	0,26	3,8	10	1,98	
h	Type P15											5
	Concrete strength K-350	56	m3	IDR	1.222.540,4	IDR	63.462.260,8	0,35	2,9	8	2,45	
	Reinforcement	4273,64	kg	IDR	10.555,5	IDR	45.110.407,0	0,007	142,9	20	1,50	
	Form work	44	m2	IDR	108.570,5	IDR	4.777.102,0	0,26	3,8	8	1,43	
i	Type P25											2
	Concrete strength K-350	63,7	m3	IDR	1.222.540,4	IDR	77.875.821,7	0,042	23,8	10	0,27	
	Reinforcement	4273,64	kg	IDR	10.555,5	IDR	45.110.407,0	0,007	142,9	20	1,50	
	Form work	36,4	m2	IDR	108.570,5	IDR	3.951.966,2	0,26	3,8	10	0,95	
j	Type P35											6
	Concrete strength K-350	105	m3	IDR	1.222.540,4	IDR	128.366.739,0	0,35	2,9	10	3,68	
	Reinforcement	9990,27	kg	IDR	10.555,5	IDR	105.452.295,0	0,007	142,9	20	3,50	
	Form work	51	m2	IDR	108.570,5	IDR	5.537.095,5	0,26	3,8	10	1,33	
12	Ground floor beam											17
a	Type B1 300x600mm											
	Concrete strength K-350	63,69	m3	IDR	1.222.540,4	IDR	77.863.596,3	0,042	23,8	10	0,27	
	Reinforcement	11400,49	kg	IDR	10.555,5	IDR	120.337.872,2	0,007	142,9	20	3,99	
	Form work	438,72	m2	IDR	108.570,5	IDR	47.632.049,8	0,26	3,8	10	11,41	
b	Type B2 400x700mm											3
	Concrete strength K-350	13,94	m3	IDR	1.222.540,4	IDR	17.042.212,8	0,35	2,9	10	0,49	
	Reinforcement	2044,95	kg	IDR	10.555,5	IDR	21.585.469,7	0,007	142,9	20	0,72	
	Form work	76,69	m2	IDR	108.570,5	IDR	8.326.271,6	0,26	3,8	10	1,99	
c	Type BA1 300x600											4
	Concrete strength K-350	16,09	m3	IDR	1.222.540,4	IDR	19.670.674,6	0,042	23,8	10	0,07	
	Reinforcement	2136,84	kg	IDR	10.555,5	IDR	22.555.414,6	0,007	142,9	20	0,75	
	Form work	110,86	m2	IDR	108.570,5	IDR	12.036.125,6	0,26	3,8	10	2,88	
d	BC4 300x600mm											2
	Concrete strength K-350	3,85	m3	IDR	1.222.540,4	IDR	4.706.780,4	0,042	23,8	8	0,02	
	Reinforcement	558,25	kg	IDR	10.555,5	IDR	5.892.607,9	0,007	142,9	20	0,20	
	Form work	20,54	m2	IDR	108.570,5	IDR	2.230.038,1	0,26	3,8	8	0,67	

e	Ground floor slab											8
	Concrete strength K-350	59,07	m3	IDR	1.222.540,4	IDR	72.215.459,8	0,042	23,8	6	0,41	
	Reinforcement	6912,11	kg	IDR	10.555,5	IDR	72.960.777,1	0,007	142,9	20	2,42	
	Form work	202,14	m2	IDR	108.570,5	IDR	21.946.440,9	0,26	3,8	10	5,26	
13	Concreting Ground Water Tank (GWT)											22
a	Ground Slab Type S-20 (200mm)											6
	Concrete strength K-350	35,9	m3	IDR	1.222.540,4	IDR	43.889.199,3	0,35	2,9	10	1,26	
	Reinforcement	2747,99	kg	IDR	10.555,5	IDR	29.006.408,4	0,007	142,9	20	0,96	
	Form work	179,52	m2	IDR	108.570,5	IDR	19.490.576,2	0,26	3,8	10	4,67	
b	Wall D1, (200mm)											8
	Concrete strength K-350	46,63	m3	IDR	1.222.540,4	IDR	57.007.057,5	0,042	23,8	10	0,20	
	Reinforcement	4800,14	kg	IDR	10.555,5	IDR	50.667.877,8	0,007	142,9	20	1,68	
	Form work	466,26	m2	IDR	108.570,5	IDR	50.622.081,3	0,26	3,8	20	6,06	
c	Wall D2, (250mm)											6
	Concrete strength K-350	39,49	m3	IDR	1.222.540,4	IDR	48.278.119,3	0,042	23,8	10	0,17	
	Reinforcement	3865,97	kg	IDR	10.555,5	IDR	40.807.246,3	0,007	142,9	20	1,35	
	Form work	315,9	m2	IDR	108.570,5	IDR	34.297.421,0	0,26	3,8	20	4,11	
d	Stair											2
	Concrete strength K-350	3,85	m3	IDR	1.222.540,4	IDR	4.706.780,4	0,042	23,8	10	0,02	
	Reinforcement	712,25	kg	IDR	10.555,5	IDR	7.518.154,9	0,007	142,9	20	0,25	
	Form work	27,91	m2	IDR	108.570,5	IDR	3.030.202,7	0,26	3,8	10	0,73	
e	Integral Waterproofing	125,87	m3	IDR	270.500,0	IDR	34.047.835,0	0,031	32,3	10	0,39	
14	Sewage Treatment Plant (STP)											14
a	Ground Slab Type S-20 (300mm)											2
	Concrete strength K-350	36,23	m3	IDR	1.222.540,4	IDR	44.292.637,7	0,042	23,8	10	0,15	
	Reinforcement	3466,34	kg	IDR	10.555,5	IDR	36.588.951,9	0,007	142,9	20	1,21	
	Form work	14,16	m2	IDR	108.570,5	IDR	1.537.358,3	0,26	3,8	20	0,18	
b	Wall D1, (200mm)											3
	Concrete strength K-350	13,2	m3	IDR	1.222.540,4	IDR	16.137.532,9	0,042	23,8	10	0,06	
	Reinforcement	1435,82	kg	IDR	10.555,5	IDR	15.155.798,0	0,007	142,9	20	0,50	
	Form work	132	m2	IDR	108.570,5	IDR	14.331.306,0	0,26	3,8	20	1,72	
c	Wall D2, (250mm)											6
	Concrete strength K-350	36,08	m3	IDR	1.222.540,4	IDR	44.109.256,6	0,042	23,8	10	0,15	
	Reinforcement	3603,59	kg	IDR	10.555,5	IDR	38.037.694,2	0,007	142,9	20	1,26	
	Form work	288,6	m2	IDR	108.570,5	IDR	31.333.446,3	0,26	3,8	20	3,75	
d	Leher Menhole (15cm)											1
	Concrete strength K-350	1,88	m3	IDR	1.222.540,4	IDR	2.298.375,9	0,042	23,8	10	0,01	
	Reinforcement	273,18	kg	IDR	10.555,5	IDR	2.883.551,5	0,007	142,9	20	0,10	
	Form work	24,87	m2	IDR	108.570,5	IDR	2.700.148,3	0,26	3,8	20	0,32	
e	Coviring Slab for STP (200mm)											2
	Concrete strength K-350	15,6	m3	IDR	1.222.540,4	IDR	19.071.629,8	0,042	23,8	10	0,07	
	Reinforcement	1336,88	kg	IDR	10.555,5	IDR	14.111.436,8	0,007	142,9	20	0,47	
	Form work	78	m2	IDR	108.570,5	IDR	8.468.499,0	0,26	3,8	20	1,01	
15	Slab and Shear Wall - Ground floor											1
	Concrete strength K-350	5,42	m3	IDR	1.222.540,4	IDR	6.626.168,8	0,042	23,8	10	0,02	
	Reinforcement	579,25	kg	IDR	10.555,5	IDR	6.114.273,4	0,007	142,9	20	0,20	
	Form work	40,8	m2	IDR	108.570,5	IDR	4.429.676,4	0,26	3,8	20	0,53	
		Sub total <2>					3.118.581.085				226	

No	WBS ELEMENTS	Volume	Unit	Unit Cost	Total Cost (Rp)	Coeficient	Productivity	Labors	Duration (days)	
<3>	UPPER STRUCTURE WORKS									
A	GROUND FLOOR									
1	Column from Pile Cap to First Floor									20
a	Column Type K1 750 x 750 mm									7
	Concrete strength K-350	53,21	m3	1.222.540,37	65.051.373,18	0,042	23,8	10	0,22	
	Reinforcement	9087,9	kg	10.555,50	95.927.328,45	0,007	142,9	20	3,18	
	Form work	283,8	m2	111.936,00	31.767.436,80	0,26	3,8	20	3,69	
b	Column Type K2 500 X 1000 mm									7
	Concrete strength K-350	62,05	m3	1.222.540,37	75.858.630,06	0,042	23,8	10	0,26	
	Reinforcement	9334,11	kg	10.555,50	98.526.198,11	0,007	142,9	20	3,27	
	Form work	248,2	m2	111.936,00	27.782.515,20	0,26	3,8	20	3,23	
c	Column Type K2A 500 X 1000 mm									2
	Concrete strength K-350	17,7	m3	1.222.540,37	21.638.964,58	0,042	23,8	10	0,07	
	Reinforcement	2712,21	kg	10.555,50	28.628.732,66	0,007	142,9	20	0,95	
	Form work	70,8	m2	111.936,00	7.925.068,80	0,26	3,8	10	1,84	
d	Column Type K4 650 x 650 mm									3
	Concrete strength K-350	19,94	m3	1.222.540,37	24.377.455,01	0,042	23,8	10	0,08	
	Reinforcement	2933,54	kg	10.555,50	30.964.981,47	0,007	142,9	20	1,03	
	Form work	122,72	m2	111.936,00	13.736.785,92	0,26	3,8	20	1,60	
e	Column Type K5 650 x 650 mm									1
	Concrete strength K-350	4,99	m3	1.222.540,37	6.100.476,45	0,042	23,8	10	0,02	
	Reinforcement	1019,33	kg	10.555,50	10.759.537,82	0,007	142,9	20	0,36	
	Form work	30,68	m2	111.936,00	3.4[illegible]4.196,48	0,26	3,8	20	0,40	
2	Shear Wall From Pile Cap to First Floor									10
a	Type SW-1									8
	Concrete strength K-350	40,76	m3	1.222.540,37	49.830.745,55	0,042	23,8	10	0,17	
	Reinforcement	10577,03	kg	10.555,50	111.645.840,17	0,007	142,9	20	3,70	
	Form work	165,99	m2	111.936,00	18.580.256,64	0,26	3,8	10	4,32	
b	Type SW-2									2
	Concrete strength K-350	13,81		1.222.540,37	16.883.282,53	0,042	23,8	10	0,06	
	Reinforcement	1028,84		10.555,50	10.859.920,62	0,007	142,9	20	0,36	
	Form work	73,75		111.936,00	8.255.280,00	0,26	3,8	10	1,92	
3	Stairs From Ground Floor to Firs Floor									8
a	Stair Type AS A-B 5-6 (Beam, Rise & Bordes)									2
	Concrete strength K-350	6,57	m3	1.222.540,37	8.032.090,24	0,042	23,8	10	0,03	
	Reinforcement	1214,81	kg	10.555,50	12.822.926,96	0,007	142,9	20	0,43	
	Form work	51,55	m2	111.936,00	5.770.300,80	0,26	3,8	10	1,34	
b	Stair Type AS F-G / 5-6 (Beam, Rise & Bordes)									2
	Concrete strength K-350	6,57	m3	1.222.540,37	8.032.090,24	0,042	23,3	10	0,03	
	Reinforcement	1214,81	kg	10.555,50	12.822.926,96	0,007	142,9	20	0,43	
	Form work	51,55	m2	314.385,50	16.206.572,53	0,26	3,8	10	1,34	
c	Stair AS G-H/ 1-2 (Beam, Rise & Bordes)									2
	Concrete strength K-350	6,57	m3	1.222.540,37	8.032.090,24	0,042	23,8	10	0,03	
	Reinforcement	1214,81	kg	10.555,50	12.822.926,96	0,007	142,9	20	0,43	
	Form work	51,55	m2	314.385,50	16.206.572,53	0,26	3,8	10	1,34	
d	Stair AS I-J/ 3-4(Beam, Rise & Bordes)									2
	Concrete strength K-350	6,57	m3	1.222.540,37	8.032.090,24	0,042	23,8	10	0,03	
	Reinforcement	1214,81	kg	10.555,50	12.822.926,96	0,007	142,9	20	0,43	
	Form work	51,55	m2	314.385,50	16.206.572,53	0,26	3,8	10	1,34	
			Sub total <A>		896.345.093,66				38	

No	WBS ELEMENTS	Volume	Unit	Unit Cost	Total Cost (Rp)	Coeficient	Productivity	Labors	Duration (days)	
<3>	UPPER STRUCTURE WORKS									
B	FIRST TO THIRD FLOOR									
1	Beam at First Floor									20
a	Type B1 300 x 600 mm									5
	Concrete strength K-350	64,1	m3	1.222.540,37	78.364.837,83	0,042	23,8	10	0,27	
	Reinforcement	9599,1	kg	10.555,50	101.323.300,05	0,007	142,9	40	1,68	
	Form work	448,69	m2	356.058,00	159.759.664,02	0,26	3,8	25	4,67	
b	Type B2 400 X 700 mm									3
	Concrete strength K-350	36,11	m3	1.222.540,37	44.145.932,82	0,042	23,8	10	0,15	
	Reinforcement	4754,25	kg	10.555,50	50.183.485,88	0,007	142,9	40	0,83	
	Form work	200,72	m2	356.058,00	71.467.961,76	0,26	3,8	25	2,09	
c	Type B3 400 X 800 mm									5
	Concrete strength K-350	48,38	m3	1.222.540,37	59.146.503,18	0,042	23,8	10	0,20	
	Reinforcement	10616,63	kg	10.555,50	112.063.837,97	0,007	142,9	40	1,86	
	Form work	263,09	m2	356.058,00	93.675.299,22	0,26	3,8	25	2,74	
d	Type B4 400 x 800 mm									1
	Concrete strength K-350	5,42	m3	1.222.540,37	6.626.168,81	0,042	23,8	10	0,02	
	Reinforcement	1312,92	kg	10.555,50	13.858.527,06	0,007	142,9	40	0,23	
	Form work	29,49	m2	356.058,00	10.500.150,42	0,26	3,8	25	0,31	
e	Type BA1 300 x 600 mm									6
	Concrete strength K-350	55,73	m3	1.222.540,37	68.132.174,92	0,042	23,8	10	0,23	
	Reinforcement	7595,82	kg	10.555,50	80.177.678,01	0,007	142,9	40	1,33	
	Form work	390,1	m2	356.058,00	138.898.225,80	0,26	3,8	25	4,06	
2	Slab at First Floor									21
	Concrete strength K-350	204,25	m3	1.222.540,37	249.703.870,92	0,042	23,8	10	0,86	
	Reinforcement	25755,53	kg	10.555,50	271.862.496,92	0,007	142,9	40	4,51	
	Form work	1786,09	m2	108.570,50	193.916.684,35	0,26	3,8	30	15,48	
3	Column from First to Second Floor									10
a	Column Type K1 750 x 750 mm									3
	Concrete strength K-350	33,08	m3	1.222.540,37	40.441.635,50	0,042	23,8	10	0,14	
	Reinforcement	5339,64	kg	10.555,50	56.362.570,02	0,007	142,9	40	0,93	
	Form work	176,09	m2	111.936,00	19.710.810,24	0,26	3,8	25	1,83	
b	Column Type K2 500 X 1000 mm									3
	Concrete strength K-350	39,9	m3	1.222.540,37	48.779.360,83	0,042	23,8	10	0,17	
	Reinforcement	5586,01	kg	10.555,50	58.963.128,56	0,007	142,9	40	0,98	
	Form work	159,6	m2	111.936,00	17.864.985,60	0,26	3,8	25	1,66	
c	Column Type K2A 500 X 1000 mm									1
	Concrete strength K-350	12,6	m3	1.222.540,37	15.404.008,68	0,042	23,8	15	0,04	
	Reinforcement	1764	kg	10.555,50	18.619.902,00	0,007	142,9	40	0,31	
	Form work	50,4	m2	111.936,00	5.641.574,40	0,26	3,8	25	0,52	
d	Column Type K4 650 x 650 mm									2
	Concrete strength K-350	14,2	m3	1.222.540,37	17.360.073,28	0,042	23,8	10	0,06	
	Reinforcement	1919,37	kg	10.555,50	20.259.910,04	0,007	142,9	40	1,34	
	Form work	87,36	m2	111.936,00	9.778.728,96	0,26	3,8	25	0,57	
e	Column Type K5 650 x 650 mm									1
	Concrete strength K-350	3,55	m3	1.222.540,37	4.340.018,32	0,042	23,8	10	0,01	
	Reinforcement	568,4	kg	10.555,50	5.999.746,20	0,007	142,9	40	0,10	
	Form work	87,36	m2	111.936,00	9.778.728,96	0,26	3,8	25	0,91	
f	Column Type K6 300x 700 mm									
	Concrete strength K-350	0,88	m3	1.222.540,37	1.075.835,53	0,042	23,8	10	0,00	
	Reinforcement	331,87	kg	10.555,50	3.503.053,79	0,007	142,9	40	0,06	
	Form work	5,04	m2	111.936,00	564.157,44	0,26	3,8	25	0,05	
4	Shear Wall From First Floor to Second									4
a	Type SW-1									3
	Concrete strength K-350	19,24	m3	1.222.540,37	23.521.676,75	0,042	23,8	10	0,02	
	Reinforcement	5039,36	kg	10.555,50	53.192.964,48	0,007	142,9	40	1,41	
	Form work	78,33	m2	108.570,50	8.504.327,27	0,26	3,8	25	0,81	
b	Type SW-2									
	Concrete strength K-350	9,83	m3	1.222.540,37	12.017.571,85	0,042	23,8	10	0,04	1
	Reinforcement	1638,07	kg	10.555,50	17.290.647,89	0,007	142,9	40	0,29	
	Form work	52,5	m2	108.570,50	5.699.951,25	0,26	3,8	25	0,55	
5	Stairs From Firs to Second Floor									4
a	Stair Type AS A-B 5-6 (Beam, Rise & Bordes)									1
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
b	Stair Type AS F-G / 5-6 (Beam, Rise & Bordes)									1
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
c	Stair AS G-H/ 1-2 (Beam, Rise & Bordes)									
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	1
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
d	Stair AS I-J/ 3-4(Beam, Rise & Bordes)									
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	1
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
		Sub total <B-1>			2.352.926.052,57				59	
		Sub total <B-C-D>			7.058.778.157,71				177	

No	WBS ELEMENTS	Volume	Unit	Unit Cost	Total Cost (Rp)	Coeficient	Productivity	Labors	Duration (days)	
<3>	UPPER STRUCTURE WORKS									
E	FLOOR FOUR TO SIXTH									
1	Beam at Fourth Floor									14
a	Type B1 300 x 600 mm									4
	Concrete strength K-350	40,85	m3	1.222.540,37	49.940.774,18	0,042	23,8	10	0,17	
	Reinforcement	6266,17	kg	10.555,50	66.142.557,44	0,007	142,9	40	1,10	
	Form work	285,96	m2	356.058,00	101.818.345,68	0,26	3,8	25	2,97	
b	Type B2 400 X 700 mm									4
	Concrete strength K-350	10,43	m3	1.222.540,37	12.751.096,08	0,042	23,8	10	0,04	
	Reinforcement	1339,52	kg	10.555,50	14.139.303,36	0,007	142,9	40	0,23	
	Form work	57,93	m2	356.058,00	93.675.299,22	0,26	3,8	25	2,74	
c	Type B3 400 X 800 mm									5
	Concrete strength K-350	48,38	m3	1.222.540,37	59.146.503,18	0,042	23,8	10	0,20	
	Reinforcement	10616,63	kg	10.555,50	112.063.837,97	0,007	142,9	40	1,86	
	Form work	263,09	m2	356.058,00	93.675.299,22	0,26	3,8	25	2,74	
d	Type B4 400 x 800 mm									1
	Concrete strength K-350	5,42	m3	1.222.540,37	6.626.168,81	0,042	23,8	10	0,02	
	Reinforcement	1312,92	kg	10.555,50	13.858.527,06	0,007	142,9	40	0,23	
	Form work	29,49	m2	356.058,00	10.500.150,42	0,26	3,8	25	0,31	
e	Type BA1 300 x 600 mm									4
	Concrete strength K-350	35,91	m3	1.222.540,37	43.901.424,75	0,042	23,8	10	0,15	
	Reinforcement	4884,24	kg	10.555,50	51.555.595,32	0,007	142,9	40	0,85	
	Form work	251,37	m2	356.058,00	89.502.299,46	0,26	3,8	25	2,61	
2	Slab at First Floor									12
	Concrete strength K-350	118,54	m3	1.222.540,37	144.919.935,66	0,042	23,8	10	0,50	
	Reinforcement	14885,09	kg	10.555,50	157.119.567,50	0,007	142,9	40	2,60	
	Form work	1099,87	m2	108.570,50	119.413.435,84	0,26	3,8	30	9,53	
3	Column from fourth to fifth Floor									10
a	Column Type K1 750 x 750 mm									3
	Concrete strength K-350	33,08	m3	1.222.540,37	40.441.635,50	0,042	23,8	10	0,14	
	Reinforcement	5339,64	kg	10.555,50	56.362.570,02	0,007	142,9	40	0,93	
	Form work	176,4	m2	111.936,00	19.745.510,40	0,26	3,8	25	1,83	
b	Column Type K2 500 X 1000 mm									3
	Concrete strength K-350	39,9	m3	1.222.540,37	48.779.360,83	0,042	23,8	10	0,17	
	Reinforcement	3790,51	kg	10.555,50	40.010.728,31	0,007	142,9	40	0,66	
	Form work	159,6	m2	111.936,00	17.864.985,60	0,26	3,8	25	1,66	
c	Column Type K6 300x 700 mm									1
	Concrete strength K-350	0,76	m3	1.222.540,37	929.130,68	0,042	23,8	10	0,00	
	Reinforcement	152,39	kg	10.555,50	1.608.552,65	0,007	142,9	40	0,03	
	Form work	78,33	m2	111.936,00	8.767.946,88	0,26	3,8	25	0,81	
4	Shear Wall From Fourth Floor to fifth									3
a	Type SW-1									2
	Concrete strength K-350	19,24	m3	1.222.540,37	23.521.676,75	0,042	23,8	10	0,02	
	Reinforcement	2875,32	kg	10.555,50	30.350.440,26	0,007	142,9	40	0,81	
	Form work	78,33	m2	108.570,50	8.504.327,27	0,26	3,8	25	0,81	
b	Type SW-2									
	Concrete strength K-350	9,83	m3	1.222.540,37	12.017.571,85	0,042	23,8	10	0,04	1
	Reinforcement	918,59	kg	10.555,50	9.696.176,75	0,007	142,9	40	0,16	
	Form work	52,5	m2	108.570,50	5.699.951,25	0,26	3,8	25	0,55	
5	Stairs From First to Second Floor									3
a	Stair Type AS A-B 5-6 (Beam, Rise & Bordes)									1
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
b	Stair Type AS D-E / 5-6 (Beam, Rise & Bordes)									1
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
c	Stair AS I-J/ 3-4(Beam, Rise & Bordes)									
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	1
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
		Sub total <E-1>			1.620.883.599,75				42	
		Sub total <E-F-G>			4.862.650.799,24				126	

No	WBS ELEMENTS	Volume	Unit	Unit Cost	Total Cost (Rp)	Coeficient	Productivity	Labors	Duration (days)	
<3>	UPPER STRUCTURE WORKS									
E	FLOOR SIX TO 9									
1	Beam at Fourth Floor									14
a	Type B1 300 x 600 mm									4
	Concrete strength K-350	40,85	m3	1.222.540,37	49.940.774,18	0,042	23,8	10	0,17	
	Reinforcement	6266,17	kg	10.555,50	66.142.557,44	0,007	142,9	40	1,10	
	Form work	285,96	m2	356.058,00	101.818.345,68	0,26	3,8	25	2,97	
b	Type B2 400 X 700 mm									4
	Concrete strength K-350	10,43	m3	1.222.540,37	12.751.096,08	0,042	23,8	10	0,04	
	Reinforcement	1339,52	kg	10.555,50	14.139.303,36	0,007	142,9	40	0,23	
	Form work	57,93	m2	356.058,00	93.675.299,22	0,26	3,8	25	2,74	
c	Type B3 400 X 800 mm									5
	Concrete strength K-350	48,38	m3	1.222.540,37	59.146.503,18	0,042	23,8	10	0,20	
	Reinforcement	10616,63	kg	10.555,50	112.063.837,97	0,007	142,9	40	1,86	
	Form work	263,09	m2	356.058,00	93.675.299,22	0,26	3,8	25	2,74	
d	Type B4 400 x 800 mm									1
	Concrete strength K-350	5,42	m3	1.222.540,37	6.626.168,81	0,042	23,8	10	0,02	
	Reinforcement	1312,92	kg	10.555,50	13.858.527,06	0,007	142,9	40	0,23	
	Form work	29,49	m2	356.058,00	10.500.150,42	0,26	3,8	25	0,31	
e	Type BA1 300 x 600 mm									4
	Concrete strength K-350	35,91	m3	1.222.540,37	43.901.424,75	0,042	23,8	10	0,15	
	Reinforcement	4884,24	kg	10.555,50	51.555.595,32	0,007	142,9	40	0,85	
	Form work	251,37	m2	356.058,00	89.502.299,46	0,26	3,8	25	2,61	
2	Slab at First Floor									12
	Concrete strength K-350	118,54	m3	1.222.540,37	144.919.935,66	0,042	23,8	10	0,50	
	Reinforcement	14885,09	kg	10.555,50	157.119.567,50	0,007	142,9	40	2,60	
	Form work	1099,87	m2	108.570,50	119.413.435,84	0,26	3,8	30	9,53	
3	Column from fourth to fifth Floor									10
a	Column Type K1 750 x 750 mm									2
	Concrete strength K-350	33,08	m3	1.222.540,37	40.441.635,50	0,042	23,8	10	0,14	
	Reinforcement	5339,64	kg	10.555,50	56.362.570,02	0,007	142,9	40	0,93	
	Form work	176,4	m2	111.936,00	19.745.510,40	0,26	3,8	25	1,83	
b	Column Type K2 500 X 1000 mm									3
	Concrete strength K-350	39,9	m3	1.222.540,37	48.779.360,83	0,042	23,8	10	0,17	
	Reinforcement	3790,51	kg	10.555,50	40.010.728,31	0,007	142,9	40	0,66	
	Form work	159,6	m2	111.936,00	17.864.985,60	0,26	3,8	25	1,66	
c	Column Type K6 300x 700 mm									
	Concrete strength K-350	0,76	m3	1.222.540,37	929.130,68	0,042	23,8	10	0,00	
	Reinforcement	152,39	kg	10.555,50	1.608.552,65	0,007	142,9	40	0,03	
	Form work	78,33	m2	111.936,00	8.767.945,88	0,26	3,8	25	0,81	
4	Shear Wall From Fourth Floor to fifth									3
a	Type SW-1									2
	Concrete strength K-350	19,24	m3	1.222.540,37	23.521.676,75	0,042	23,8	10	0,02	
	Reinforcement	2875,32	kg	10.555,50	30.350.440,26	0,007	142,9	40	0,81	
	Form work	78,33	m2	108.570,50	8.504.327,27	0,26	3,8	25	0,81	
b	Type SW-2									
	Concrete strength K-350	9,83	m3	1.222.540,37	12.017.571,85	0,042	23,8	10	0,04	1
	Reinforcement	918,59	kg	10.555,50	9.696.176,75	0,007	142,9	40	0,16	
	Form work	52,5	m2	108.570,50	5.699.951,25	0,26	3,8	25	0,55	
5	Stairs From Firs to Second Floor									2
a	Stair Type AS A-B 5-6 (Beam, Rise & Bordes)									1
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
b	Stair Type AS D-E / 5-6 (Beam, Rise & Bordes)									1
	Concrete strength K-350	4,62	m3	1.222.540,37	5.648.136,52	0,042	23,8	10	0,02	
	Reinforcement	854,9	kg	10.555,50	9.023.896,95	0,007	142,9	40	0,15	
	Form work	36,28	m2	108.570,50	3.938.937,74	0,26	3,8	25	0,38	
				Sub total <I-1>	1.602.272.628,54				41	
				Sub total <I-K-J>	4.806.817.885,62				123	

L	FLOOR TEN								
b	Column Type K2 500 X 1000 mm								
	Concrete strength K-350	39,9	m3	1.222.540,37	48.779.360,83	0,042	23,8	10	0,17
	Reinforcement	3790,51	kg	10.555,50	40.010.728,31	0,007	142,9	40	0,66
	Form work	159,6	m2	111.936,00	17.864.985,60	0,26	3,8	25	1,66
				Sub total L-1>	106.655.074,74				3

APPENDIX 4: Tasks and Assigned Risks

Figure 1A

	Risk Name
1	Risk
2	Weather Condition
3	Material restriction
4	Poor Time Estimation
5	Labors Availability
6	Poor Cost Estimation

2	Weather Condition
3	Material restriction
4	Poor Time Estimation
5	Labors Availability
6	Poor Cost Estimation

	Task Name	Base Dur	High Dur	Risks	Start	Finish	Pred...
3	**PRE - CONSTRUCTION**	**319.5 days**		**0**	**07/31/2017**	**02/08/2019**	
4	Clean the site constru c	7.5 days	7.5 days	0	07/31/2017	08/11/2017	8-4 day
5	Demolition and Mobiliz c	7.5 days	7.5 days	0	08/01/2017	08/14/2017	4SS
6	Temporary light install c	312 days	312 days	0	08/14/2017	02/08/2019	
7	Water (Jet pum and v c	312 days	312 days	0	08/14/2017	02/08/2019	6SS
8	PDA test d	1 day	1 day	0	08/14/2017	08/15/2017	
9							
10	**SPUN PILE FOUNDATIOI**	**25.2 days**		**0**	**08/01/2017**	**09/13/2017**	
11	Spun Pile (Supplier) fi	0 days	0 days	2	08/01/2017	08/01/2017	3
12	Draving Spun pile c	3.5 days	5.5 days	0	08/07/2017	08/11/2017	11
13	Pile connector (Electid	13 days	15 days	0	08/07/2017	08/29/2017	12SS
14	Cutting the Head of Sfi	6 days	8 days	0	09/04/2017	09/13/2017	13
15	Wast of Spun Pile Heid	1 day	2 days	0	08/25/2017	08/28/2017	14
16							
17	**SUB-STRUCTURE WORI**	**31.8 days**		**0**	**07/14/2017**	**09/07/2017**	
18	Bauwplank Installatiodi	4 days	4 days	0	07/28/2017	08/03/2017	19
19	Soil excavation fi	3 days	3 days	3	08/10/2017	08/15/2017	20
20	Sheet Pile Installation d	13 days	14 days	0	07/14/2017	08/07/2017	
21	Joining Spun pile withd	15 days	16 days	0	08/11/2017	09/06/2017	
22	Concreting Pile Cap fi	6 days	6 days	2	08/14/2017	08/23/2017	
23	Ground floor beam d	15 days	16 days	2	08/14/2017	09/07/2017	22SS
24	Concreting Ground Wd	11 days	12 days	2	08/14/2017	08/31/2017	23SS
25	Sewage Treatment Pfi	3 days	3 days	1	08/14/2017	08/17/2017	24SS
26	Slab and Shear Wall -d	1 day	1 day	2	08/21/2017	08/22/2017	25
27	**UPPER STRUCTURE WC**	**173.5 days**		**0**	**07/26/2017**	**05/24/2018**	
28	GROUND FLOOR (Ccd	19 days	19 days	4	08/01/2017	09/01/2017	25
29	FIRST FLOOR d	23 days	24 days	4	07/26/2017	09/04/2017	
30	SECOND FLOOR d	23 days	24 days	4	07/26/2017	09/04/2017	
31	THIRD FLOOR d	23 days	24 days	3	09/04/2017	10/13/2017	30
32	FOURTH FLOOR d	21 days	22 days	3	10/13/2017	11/20/2017	31
33	FIFTH FLOOR d	21 days	22 days	3	11/20/2017	12/26/2017	32
34	SIXTH FLOOR d	21 days	22 days	3	12/27/2017	02/01/2018	33
35	SEVENTH FLOOR i	20.5 days	21 days	3	02/01/2018	03/08/2018	34
36	EIGHTH FLOOR i	20.5 days	21 days	3	03/08/2018	04/13/2018	35
37	NINETH FLOOR i	20.5 days	21 days	3	04/13/2018	05/21/2018	36
38	TENTH FLOOR fi	3 days	3 days	4	05/21/2018	05/24/2018	37
39	10% OF TAX fi	0 days	0 days	0	07/26/2017	07/26/2017	

Figure 1B

Customize Report | Export Report | Risk Report

Risk: Weather Condition

Open Risk; Threat

Risks are assigned to:

Assigned to:	Task or resource name	Enabled
Task	Global Risk	Yes
Task	Task 31: THIRD FLOOR	Yes
Task	Task 32: FOURTH FLOOR	Yes
Task	Task 33: FIFITH FLOOR	Yes
Task	Task 34: SIXTH FLOOR	Yes
Task	Task 35: SEVENTH FLOOR	Yes
Task	Task 36: EIGHTH FLOOR	Yes
Task	Task 37: NINETH FLOOR	Yes

Risk: Poor Time Estimation

Open Risk; Threat

Risks are assigned to:

Assigned to:	Task or resource name	Enabled
Task	Task 19: Soil excavation	Yes
Task	Task 22: Concreting Pile Cap	Yes
Task	Task 23: Ground floor beam	Yes
Task	Task 24: Concreting Ground Water Tank (GWT)	Yes
Task	Task 26: Slab and Shear Wall - Ground floor	Yes
Task	Task 28: GROUND FLOOR (Column _Stairs)	Yes
Task	Task 29: FIRST FLOOR	Yes
Task	Task 30: SECOND FLOOR	Yes
Task	Task 31: THIRD FLOOR	Yes
Task	Task 32: FOURTH FLOOR	Yes
Task	Task 34: SIXTH FLOOR	Yes
Task	Task 36: EIGHTH FLOOR	Yes

Task	Task 24: Concreting Ground Water Tank (GWT)	Yes
Task	Task 26: Slab and Shear Wall - Ground floor	Yes
Task	Task 28: GROUND FLOOR (Column _Stairs)	Yes
Task	Task 29: FIRST FLOOR	Yes
Task	Task 30: SECOND FLOOR	Yes
Task	Task 31: THIRD FLOOR	Yes
Task	Task 32: FOURTH FLOOR	Yes
Task	Task 34: SIXTH FLOOR	Yes
Task	Task 36: EIGHTH FLOOR	Yes
Task	Task 37: NINETH FLOOR	Yes
Task	Task 38: TENTH FLOOR	Yes

Risk: Labors Availability

Open Risk; Threat

Risks are assigned to:

Assigned to:	Task or resource name	Enabled
Task	Global Risk	Yes
Task	Task 36: EIGHTH FLOOR	Yes
Task	Task 37: NINETH FLOOR	Yes

Risk: Material restriction

Open Risk; Threat

Risks are assigned to:

Assigned to:	Task or resource name	Enabled
Task	Global Risk	Yes
Task	Task 11: Spun Pile (Supplier)	Yes
Task	Task 11: Spun Pile (Supplier)	No
Task	Task 22: Concreting Pile Cap	Yes
Task	Task 23: Ground floor beam	Yes
Task	Task 24: Concreting Ground Water Tank (GWT)	Yes
Task	Task 25: Sewage Treatment Plant (STP)	Yes
Task	Task 26: Slab and Shear Wall - Ground floor	Yes
Task	Task 28: GROUND FLOOR (Column _Stairs)	Yes
Task	Task 29: FIRST FLOOR	Yes
Task	Task 30: SECOND FLOOR	Yes
Task	Task 31: THIRD FLOOR	Yes
Task	Task 32: FOURTH FLOOR	Yes
Task	Task 33: FIFTH FLOOR	Yes
Task	Task 34: SIXTH FLOOR	Yes
Task	Task 35: SEVENTH FLOOR	Yes
Task	Task 36: EIGHTH FLOOR	Yes
Task	Task 37: NINETH FLOOR	Yes
Task	Task 38: TENTH FLOOR	Yes

INSTITUT TEKNOLOGI SEPULUH NOPEMBER
FAKULTAS TEKNIK SIPIL DAN PERENCANAAN
PROGRAM SARJANA (S1)
DEPARTEMEN TEKNIK SIPIL FTSP – ITS

BERITA ACARA PENYELENGGARAAN UJIAN
SEMINAR DAN LISAN
TUGAS AKHIR

Pada hari ini **Kamis** tanggal **6 Juli 2017** jam **08.00 WIB** telah diselenggarakan **UJIAN SEMINAR DAN LISAN TUGAS AKHIR** Program Sarjana (S1) Departemen Teknik Sipil FTSP-ITS bagi mahasiswa:

NRP	Nama	Judul Tugas Akhir
3113100703	Domingos Romeu Chicoca	Risk Based Time and Cost Scheduling for ITS FMIPA Tower

Dengan Hasil :

□ Lulus Tanpa Perbaikan	□ Mengulang Ujian Seminar dan Lisan
□ Lulus Dengan Perbaikan	□ Mengulang Ujian Lisan

Dengan perbaikan/penyempurnaan yang harus dilakukan adalah :

1. Add some literature / Journal related to Construction risks
2. Combine Chapter 4 and 5.
3. More detail Calculation for Normal Cost and Normal duration
4. Describe The expert interview process an how to recap the result.
5. Check some terminology → Material Restriction → material availability.
6. Please Check why 10th floor with risk is 3x higher.
7.

Tim Penguji (Anggota)	Tanda Tangan
Ir. I Putu Artama Wiguna, MT. PhD	[signature]
Yusroniya Eka Putri RW, ST. MT	[signature]

Surabaya, 6 Juli 2017
Dosen Pembimbing I
(Ketua)

[signature]

Tri Joko Wahyu Adi, ST. MT. PhD

Dosen Pembimbing 2
(Sekretaris)

-

Dosen Pembimbing 3
(Sekretaris)

-

Form AK/TA-04
rev01

PROGRAM STUDI S-1 JURUSAN TEKNIK SIPIL FTSP - ITS
LEMBAR KEGIATAN ASISTENSI TUGAS AKHIR (WAJIB DIISI)
Jurusan Teknik Sipil lt.2, Kampus ITS Sukolilo, Surabaya 601111
Telp.031-5946094, Fax.031-5947284

GlobalGROUP ISO 9001 | UKAS MANAGEMENT SYSTEMS 0038

NAMA PEMBIMBING	: TRI JOKO WAHYU ADI ST., MT., Ph.D
NAMA MAHASISWA	: DOMINGOS ROMEU CHICOCA
NRP	: 3113100703
JUDUL TUGAS AKHIR	: RISK BASED TIME AND COST SCHEDULING FOR FMIPA TOWER
TANGGAL PROPOSAL	: 23 Januari 2017
NO. SP-MMTA	: 012867

NO	TANGGAL	KEGIATAN		PARAF ASISTEN
		REALISASI	RENCANA MINGGU DEPAN	
01	14-02-17	+ Project description and WBS + time-cost Estimation - pre-construction and spun pile (foundation)	+ time-cost Estimation - Sub-structural work.	[signature]
2	15/2	- Try to identify risk and put contingency time & cost in your schedule		[signature]
03	2/03	+ time-cost Estimation - Sub-structure work - upper structure work (Ground floor to second floor)	+ time-cost Estimation - Upper structure (third floor to fifth)	2/3 [signature]
04	10/03	* upper structure work - third to fifth floor - fifth to tenth floor - Risk Questionnaire input	* Risk Analysis - Sub structure - upper structure	[signature]
05	23/03	* Risk analysis - sub-structure work - upper structure work	* Gantt chart diagram (MS P) * Try to use @Risk.	23/3 [signature]
06	06/04	@Risk Software: - Gantt chart diagram - cost control (sensitivity analysis).	@Risk Software: - cost control schedules - S-curve + Risks - Network planning - Conclusion and Suggestion	[signature]

6

Form AK/ TA-04
rev01

PROGRAM STUDI S-1 JURUSAN TEKNIK SIPIL FTSP - ITS
LEMBAR KEGIATAN ASISTENSI TUGAS AKHIR (WAJIB DIISI)
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NAMA MAHASISWA	: DOMINGOS ROMEU CHICOCA
NRP	: 3113100703
JUDUL TUGAS AKHIR	: RISK BASED TIME AND COST SCHEDULING FOR ITS FMIPA TOWER
TANGGAL PROPOSAL	: 23 Januari 2017
NO. SP-MMTA	: 012867

NO	TANGGAL	KEGIATAN		PARAF ASISTEN
		REALISASI	RENCANA MINGGU DEPAN	
07	21/04	@Risk software: - Cost control schedule - S-curve (cash flow) - Network planning - Final considerations	+ Updating table contents, - List of figure and list of tables + Compiling the draft.	[signature]
		- Make some revision in risk schedule & cost - Revise conclusion. - Give me full book of final project		24/4 [signature]
08	27/04	- Time-cost Risk Analysis and conclusion Reviewed. - Submitting the Draft.		[signature]
09	16/5	- Register for oral Defense. - Bind the report.		[signature]

Author's Biography

Domingos Romeu Chicoca, was born on 25th March 1990, Kwanza Norte – Angola. He is the youngest of a twelve children and started taking his formal education in 1997 at Kifangondo Primary and Secondary School – 4032. He could not started earlier because in that time his country was facing civil war and unfortunately the local govern was unable to provide education to his citizen in that environment. In 2011, he was awarded as Technical of Civil Construction Works from IMPC 8072 at Luanda-Angola.

A year after he graduated from high school (2013), he started to attend the undergraduate program (Eng.), at Civil Engineering Department - ITS with registration number 3113100703. He was honored as Bachelor Degree of Engineering in 2017 with entitled Final Project *"Based Risk Time and Cost Scheduling for ITS FMIPA Tower"*, from Construction Management Laboratory.

Having carefully reviewed of the author's record, in 2015 he attended Asian-African Students conference as a young African Ambassador in Asia - Bandung / Indonesia. Moreover most recently he attended Asian-African Graduate Conference 2016 which took place at City of Solo- Indonesia by playing a role of key note speaker "*A Successful Leader*". Surprisingly, in the same year Toastmaster International with main office in USA awarded him as Competent Communicator and Leader.

From 2015 until now he has been a Spoke English Counselor and Motivator at LP3I Surabaya, ISTIKOM Surabaya, LPIA Sidoarjo and others Indonesian Institutions. In case someone wills to communicate with author, the given correspondence email is: dchicoca@hotmail.com.

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