PROJECT RISK MANAGEMENT IN MASSIVE CONSTRUCTION PROJECT

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การบริหารจัดการความเสี่ยงที่เกิดขึ้นสำหรับโครงการก่อสร้างขนาดใหญ่

นายวรงค์ ตังประพฤทธิ์กุล

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(Project Risk Management in Massive Construction Project)

อ. ที่ปรึกษาวิทยานิพนธ์หลัก : รศ.ดร. ปารเมศ ชุติมา , 175 หน้า.

งานวิจัยนี้มีวัตถุประสงค์เพื่อการบริหารจัดการความเสี่ยงในโครงการก่อสร้างขนาดใหญ่ โดยใช้เครื่องมือการบริหารจัดการความเสี่ยงสำหรับการก่อสร้าง (Project Risk Management) เพื่อลดผลกระทบอันเนื่องมาจากกการก่อสร้างล่าช้าและราคาก่อสร้างที่เพิ่มขึ้นจากปัจจัยต่างๆ เพื่อให้การดำเนินการก่อสร้างสามารถแล้วเสร็จตามกำหนดการที่กำหนดไว้ และเป็นไปตามงบประมาณค่าก่อสร้างที่เจ้าของงานต้องการ

ในการวิจัยการบริหารจัดการความเสี่ยงในโครงการก่อสร้างขนาดใหญ่ครั้งนี้นั้นได้คำนึงถึงปัจจัยที่จะมีผลกระทบในการก่อสร้างได้แก่งบประมาณค่าก่อสร้าง และ ระยะเวลาที่ใช้ในการก่อสร้าง โดยวิเคราะห์จากสัญญาระหว่างผู้รับจ้างและผู้ว่าจ้าง รวมถึงการวิเคราะห์การเปลี่ยนแปลงแก้ไขสัญญาจ้างก่อสร้างซึ่งมีถึงสี่ครั้งในการก่อสร้างครั้งนี้โดยมีผลกระทบต่อราคาค่าก่อสร้างที่มากขึ้นกว่าร้อยละ 10 (ประมาณ 300 ล้านบาท) และมีความล่าช้ากว่าระยะเวลาที่กำหนดถึงร้อยละ 50 (436 วัน) โดยการวิเคราะห์ในการวิจัยครั้งพบว่าการเปลี่ยนแปลงดังกล่าวเกิดจากความต้องการเพิ่มเติมในระหว่างงานก่อสร้างของผู้ใช hอาคารและผู้ว่าจ้าง รวมถึงปัจจัยภายนอกอันเนื่องมาจากมติคณะรัฐมนตรีในการช่วยเหลือผู้ประกอบการก่อสร้างในระหว่างการก่อสร้างโครงการนี้ นอกจากนี้จากการวิเคราะห์ได้พบว่า การเปลี่ยนแปลงซึ่งทำให้เกิดผลกระทบดังกล่าวได้เกิดมาจากงานสถาปัตยกรรมและงานตกแต่งภายในเป็นหลัก โดยพบว่าการเปลี่ยนแปลงดังกล่าวนั้นเกิดมาจากการเปลี่ยนแปลงเพื่อการใช้งานจริง เช่นการกั้นห้อง และการใช้งานของสำนักงานอื่นๆ ไม่ตรงกับแบบประกอบสัญญาได้ได้ดำเนินการ รวมถึงการเปลี่ยนส่วนใหญ่เกิดจากการเปลี่ยนรูปแบบในเชิงการใช้งาน มิได้เป็นการเปลี่ยนในเชิงวิศวกรรม หรือด้านเทคนิดแต่อย่างใด พร้อมทั้งได้นำเสนอวิธีการแก้ปัญหา โดยพบว่าสามารถลดผลกระทบของค่า RPN ได้ถึงร้อยละ 90

ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต ลายมือชื่อนิสิต……..

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The purpose of this research is to manage the risk and uncertainty in the massive construction project. The tool used in this research is project risk management. The objectives of this research include minimizing the impact from delay of the schedule and the budget overrun to finish the construction project on time within the given budget.

This research focuses on two main factors that affect the construction project, construction cost and project schedule by using the contract and their addendum of contract between contractor and client. The variation orders from the contract and their addendum during the construction project are the main causes of changes in the construction cost and project schedule. The result of the cost impact is the rise of construction cost over 10% (about 300 million baths) and the lag from the schedule for 50% (435 days). The results from this research analysis demonstrate that the requirement from the user of the building and the client of this construction project are the main causes of the variation orders. Moreover, the law and regulation during the construction project are the external factors that have a significant effect on the payment process between the client and contractor. Lastly, the delay of the schedule and the increase of the cost are mainly caused by the architecture and interior works when the function and layout of use are modified from the contract drawing not by the engineering and technique changes. Moreover the research recommended the preventive action and the result of the impletion can reduce RPN up to 90%.

The Regional Centre for Manufacturing Systems Engineering Student's Signature:……
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CONTENTS

Page

LIST OF TABLES

Page

Page

LIST OF FIGURES

Page

Page

CHAPTER I

INTRODUCTION

1.1 Background of the Research

Project management and construction supervision consultant (PMSC) in construction of government center project works as the collaboration between the Thai Government, who is the owner of this construction project and the contractors. When there are many parties involved, many problems and conflicts arises. Managing a mega project can definitely lead to issues and conflicts among parties including contractors, owner, and the consulting firm. These problems and conflicts may cause the delay of the work process.

In the current situation, the construction is behind the schedule. Part of this involves PMSC because one of its commitment roles is the confirmation that the project will finish on time.

According to the previous study, “Large construction projects in developing countries: A case study in Vietnam” by Neuyen Duy Long (2005) stated that problems occurring during construction projects are financial-related problems, owner-related problems, contractor-related problems, project attributes-related problems, environmental problems, and more importantly consultant related problems and coordination-related problems.

PMSC lies on the ability of its staff to work as effective coordinators between the project owner and those contractors. Thus, the most important resource for PMSC is its staff. The majority of the staff is consultants. The challenge is how we could improve the most important resource that gives the major impact to the organization, and its performance.

Due to the impediment in construction process, an attempt to understand the risk factors and to analyze impacts of the risk that caused the problems can be constructive. This will also help to avoid blaming on any party. As we can see that consultant and coordination related to the problems are one of the major key risk

factors that causes the delay. PMSC is a consulting organization. This related problems has been claimed to occur in most large construction project, so one assumption is that PMSC, itself, could be the part of this delay. However, a broad assumption would not be strong enough to prove to the management of PMSC. By conducting this research project could analyze causes of these problems by identifying and modeling risk factors that influence construction project and analyze impact of risk that occur in the project. The finding can be helpful in the decision making stage in the development process of the organization to create an effective working process.

1.2 Project and Company background

1991-1995	29 agencies requested to use 814 rai of land.
1992	The Cabinet passed a resolution ordering CAT to return 400 rai of state land.
1996 (12 Nov)	Cabinet approved a land use master plan and assigned Treasury Department to set up budget accordingly.
2000 (16 May)	The Cabinet approved an implementation plan to include new agencies according to the Constitution and the Justice Ministry into the plan. Engaged Chulalongkorn University (CU) to lay out a master plan. Submitted a request for budget allocation for the years 2000-2003.
2002	The Cabinet approved in principle the Bangkok Government Center Project. Treasury Department assigned to execute agency demand survey, collect data, and make a construction budget request. Designed energy-saving buildings with minimal budget requirement.

2003 (8 Jul)	The Cabinet approved the Treasury Dept.'s implementation on the Bangkok Government Center Project (approved compensation and design cost).
2003 (27 Oct)	The Facilitating Committee for the Establishment of the Government Center approved the Treasury Department to set up a special purpose vehicle (SPV) to seek the Cabinet approval.
2003 (3 Dec)	The Cabinet agreed that the Government Center needed to be constructed with the following proceedings: - Revision of land use demand - Preparation of detailed project information Cabinet made some notes from this project including: - Limited cost for the Government - Investment choices - Preparation for traffic mitigation
2004 (24 May)	The Cabinet made the following decisions: 1) Approved office space allocation to 29 agencies, with total construction area of 929,800 sq.m. and approved budget of 19,016 million baht. However, the allocation may be changed as appropriate. 2) Set up Dhanarak Asset Development Co., Ltd. (DAD), to be 100% owned by Ministry of Finance and managed by the Treasury Department. 3) Approved the Treasury Department to set up budget for rental and furniture procurement for all agencies in the project. 4) Approved DAD to raise fund via SPV, without being a burden to the government budget. Dhanarak Asset Development Co., Ltd. (DAD) establishment: - It was registered as a juristic person on 18 August, 2004. - The registered capital is 258.338 million baht.

- It is 100% owned by Ministry of Finance.
- The first mission of Dhanarak Asset Development Co., Ltd. (DAD) is to construct and manage Bangkok Government Center on Chaeng Wattana Road.

Sep 2004 Hire Project management and construction supervision consultant (PMSC) to work on behalf of DAD to undertake management of works and construction supervision of the project, to ensure that the project will:

- be completed on time,
- be within budget,
- meet the quality standards.

The consortium comprising of 6 consulting companies has been selected for Project management and construction supervision consultant (PMSC). The project organization chart was developed to manage the construction project and financial or budget of construction as Figure 1.1.

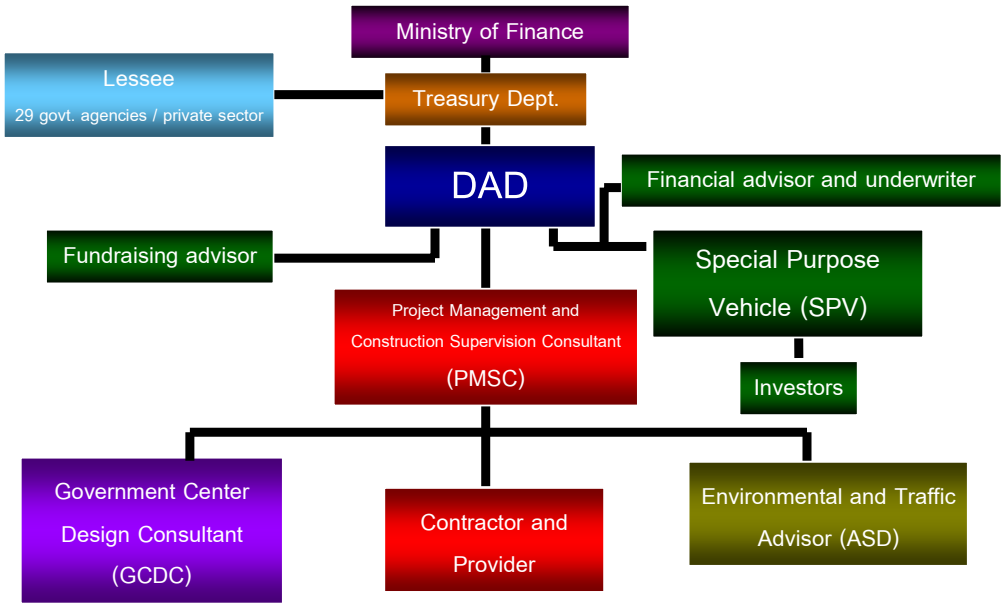


Figure 1.1 Project organization chart of government center construction project

Government Center Construction Project is divided into 9 packages and each schedule of finishing date at the beginning of the project as shown in Table 1.1, the detail of building construction size in Table 1.2 and project master plan in Figure 1.2.

Table 1.1 Detail of package in government center construction project

Package	Description	Budget (BAHT)	Start	Finish
1	Office building of the Administrative Court	1,813,000,000	22 Jun 2005	31 Aug 2008
2	Building A and Car park A	3,395,000,000	16 May 2006	June 2010
3	Building B	6,877,000,000	16 May 2006	16 Sep 2010
4	Car park building, Auditorium and Dormitory	1,860,000,000	16 May 2006	16 Sep 2009
5	Utilities and civil work outside building	1,100,000,000	16 May 2006	16 Sep 2009
6	Site Preparation	77,801,907	4 Oct 2005	10 Apr 2006
7	Landscape and softscape	134,490,000	10 Oct 2006	Dec 2009
8	Interior and furniture	969,440,000	20 July 2007	June 2010
9	Traffic network	180,000,000	31 Jan 2008	31 Oct 2009

Table 1.2 Building construction size of the project.

	Usable Area	Circulation Area	Building Area
Office building Space	460,000 sq.m.	153,333 sq.m.	613,333 sq.m.
Share space			
Library	7,000 sq.m.	2,333 sq.m.	9,333 sq.m.
Auditorium	18,000 sq.m.	6,000 sq.m.	24,000 sq.m.
Cafeteria	17,000 sq.m.	-	17,000 sq.m.
Warehouse	7,000 sq.m.	2,333 sq.m.	9,333 sq.m.
Shops	16,000 sq.m.	5,333 sq.m.	21,333 sq.m.
200 guest rooms			10,00 sq.m.
Recreational Centre			1,500 sq.m.
Parking Building Area 7,000 units 3,000 park on ground Total 10,000 units			224,000 sq.m.
Total construction size			929,833 sq.m

Figure 1.2 Project master plan

1.3 Statement of the problem

At current situation the overall progress of the project can be summarized as the following (from the information retrieved on 31 April 2009).

Package 1 Office Building of the Administrative Court

- Plan 100.00%
- Actual work done 100.00%
- Lead from plan 0.00%
- Cost of current construction 2,018.81 Million Bath
- Variation order from administration court adding requirement that extended the contract for 153 days and increased the cost by 205 million bath
- Construction is finished.

Package 2 Building A and Car Park A

- Plan 85.28%
- Actual work done 89.08%
- lead from plan 3.80%
- Cost of current construction 3,024.27 Million Bath
- According to the government policy, contractor can extend the contract to 180 days due to the flood disaster in Bangkok. Also changing requirement of owner had an effect on construction schedule.

Package 3 Building B

- Plan 99.57%
- Actual work done 99.99%
- lead from plan 0.42%
- Cost of current construction 6,876.31 Million Bath
- According to the government policy, contractor can extend the contract to 180 days due to the flood disaster in Bangkok. Also changing requirement of owner had an effect on construction schedule.

Package 4 Car Park Building, Auditorium and Dormitory

- Plan 99.91%
- Actual work done 99.33%
- lag from plan 0.58%
- Cost of current construction 1,846.54 Million Bath
- According to the government policy, contractor can extend the contract to 180 days due to the flood disaster in Bangkok. Also changing requirement of owner had an effect on construction schedule.

Package 5 Utilities and Civil Work outside Building

- Plan 97.27%
- Actual work done 94.15%
- lag from plan 3.12%
- Cost of current construction 1,035.65 Million Bath
- According to the government policy, contractor can extend the contract to 180 days due to the flood disaster in Bangkok. Also changing requirement of owner had an effect on construction schedule.

Package 6 Site preparation

- Construction work finished on April 2007.

Package 7 Landscape and Softscape

- Plan 80.96%
- Actual work done 70.83%
- lag from plan 10.13%
- Cost of current construction 97.38 Million Bath
- According to the government policy, contractor can extend the contract to 180 days due to the flood disaster in Bangkok. Also changing requirement of owner had an effect on construction schedule.

Package 8

Package 8.1 Furniture in Building A

- Plan 67.19%
- Actual work done 66.74%
- lag from plan 0.45%
- Cost of current construction 92.77 Million Bath

Package 8.2 Furniture in Building B part 1

- Plan 100%
- Actual work done 97.80%
- lag from plan 2.20%
- Cost of current construction 156.87 Million Bath

Package 8.3 Furniture in Building B part 2 and Other Building

- Plan 99.65%
- Actual work done 97.15%
- lag from plan 2.50%
- Cost of current construction 152.23 Million Bath

Package 8.4 Furniture Built-In in Building A

- Plan 32.82%
- Actual work done 30.43%
- lag from plan 2.39%
- Cost of current construction 44.64 Million Bath

Package 8.5 Furniture Built-In in Building B

- Plan 90.43%
- Actual work done 76.52%
- lag from plan 13.91%
- Cost of current construction 192.55 Million Bath

Package 8.6 Furniture Built-In in other Building

- Plan 88.74%
- Actual work done 55.60%
- lag from plan 33.14%
- Cost of current construction 16.36 Million Bath

Package 9 Traffic Network

- Plan 56.38%
- Actual work done 56.52%
- lead from plan 0.14%
- Cost of current construction 135.20 Million Bath

Overall Status of project

- Plan 93.89%
- Actual work done 93.98%
- lead from plan 0.09%

From the progress and actual work done for the project, the overall status is not quite bad from lagging to baseline plan for 3.96 %. However, when compared to the initial schedule stating that the project must finish within October 2008, the result is not quite impressive. Despite the 180-day extension of the contract due to flood disaster and the change of the owner's requirement that affected the construction schedule, the overall progress turned out well.

1.4 Objective of the Research

To identify risk factors that influenced the construction project and to analyze the impact of the risk that affected the project in viewing of client.

1.5 Expected Benefits

The finding of this project would work as a guideline in the decision making process in order to develop higher effectiveness in construction project based on risk factors and risk impact in construction project.

1.6 Scope of the Research

This research would identify the key risk factors that influence the construction of Government Center and analyze the impact of the important factors in viewing of client.

1.7 Methodology

To identify risk factors that influence this construction project, this research must be conducted from the progress and actual work done in the construction project with the condition among user of the building, owner, consulting and contractor.

In this research project, data analysis can be accomplished by using the appropriate tools to figure out the impact of the risk that will occur to the construction project (e.g. user of the building, owner, consulting and contractor).

Research Procedure

1. Review literatures of risk factors that influence construction project
2. Pre-analyze the current situation of construction project
3. Identify the key risk factors with technical tools to support the information
4. Analyze risks to figure out the impact of the risk factors with technical tools together with numerous data support
5. Review the risk analysis results
6. Monitor the risk that had an impact on the project and recommend the solution to respond to the risk
7. Conduct data analysis and content analysis
8. Discuss findings and write summary
9. Propose solutions and suggestions and prepare the draft of the thesis report
10. Take thesis examination

1.8 Conclusion and Organization of Thesis

This first chapter briefly describes the overview of Government Center construction project, the current situation and problem in this process which this project is currently facing with. Moreover, purpose and objective, scope, benefits, and methodology of the project risk management technique in this thesis are explained. Next, theoretical content and literature review related to this thesis are described in chapter 2. Then, the detail of project risk management methodology is described in chapter 3. From chapter 4 describes in details of project risk management result and analysis that occur in this thesis project. Finally, conclusion and recommendations in the thesis are described in the chapter 5 as the last chapter.

CHAPTER II

THEORIES AND LETERATURE REVIEW

Project Risk Management

2.1 Introduction

Project risk management is the method to control and manage all significant risks and uncertainties in a project including systematically identified, quantified, analyzed, acted upon and monitoring by the management team to maximize the likelihood of successful achievement of objectives within target budget and schedule.

Risks that occur in construction project can be divided into two categories, namely, external risk as risk from economic, political, regal, weather and public, etc. and internal risk as risk from financial, contractual, construction design, technical and personal, etc. The typical losses of these factors are generally relevant to project delay, project cost overrun, poor quality, lost of revenue, physical damage to project, physical harm to personal, loss of reputation and business and so on. (Papageorge, 1988).

Before considering the project risk management, nature of the risk is a necessary factor that should be considered. The level of the impact that activities have on a project can help to identify which one is risk. One that directly affects the project can be defined as a project risk. The numerical consideration and probability calculation must be used to analyze and quantify these factors.

The useful terms to study risks are listed below:

(1) Worries: undefined concerns

(2) Threats or Issues: defined uncertainties which are likely to occur with a probability of over 50%. These factors have to be mitigated or resolved immediately as another process of project management and to be funded from project budget.

(3) Risk: defined uncertainties with a probability of lower 50% recorded on the risk plan and funded from the risk provision.

The probability of risk occurrence cannot be proved accurately; in this case, the quantification of probability or likelihood can be applied as the following:

Probability of occurrence over 50%	Issue
Probability of occurrence around 50%	High Probability
Probability of occurrence around 10%	Low Probability
Probability of occurrence around 1%	Low Probability
Probability of occurrence around 0%	Very Low Probability

In addition to consider project risk management process, there is a need to understand the definition and nature of risk. Risk can be categorized into three components including:

(1) The risk event: what might happen to the detriment or in favor of the project
(2) The probability of occurrence: the probability of the event occurring
(3) The potential loss and gain: consequence of the event happening which can specify loss and gain.

According to these components, the risk events and condition can be categorized into:

(1) identifiable/unidentifiable
(2) quantifiable/unquantifiable
(3) controllable/uncontrollable

2.2 Project Risk Management Process

Project risk management process is composed of three main components including:

(1) Risk Identification
(2) Risk Analysis and evaluation
(3) Risk Response and Control

(Steele, 1992)

The risk management process's flow chart can be demonstrated as Figure 2.1.

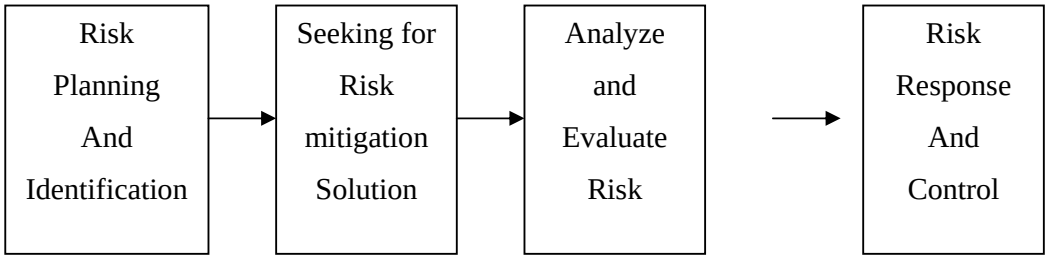


Figure 2.1 The risk management process

2.2.1 Risk Identification

Risk identification process is the process that puts the project risk into the perspective form by using tools and methods. Risk identification should include the project objectives, risk management scope, and historical data related to the project. The related document such as the contract of construction between client and contractor is the source of information used to identify the project risk. The identification of risks should be followed by a search for solutions that can eliminate these risks.

One of the tools that are used to identify the risk is check list or risk prompt for finding the project risk by using the experience in order to develop to risk check list. These are valuable resources but the new risks cannot be found for this tool, so the check list has to be used carefully.

There are a lot of sources that can identify the project risks occurring in the construction project (Chinyio and Ferguson, 2000) including:

Risk identification through use of personal and corporate experience

For the one who has no experience in project risk management, it is difficult to identify the risk. The related experience will help and make it easier for organizations to identify the key risks in construction project. For example, the contractor who has the experience in building construction for a long time can identify the project key risks for building construction project easier than the highway construction project.

Another method using the experience is database of past construction project that had been constructed. This contains a lot of valuable information resource such as construction methodology, defect analysis, method statement, prices and cost etc.

Risk matrix and checklist can be developed from database as a guideline for future related project.

Risk identification through safety review

Reviewing of previous projects can give the information of what can go wrong in the upcoming project and can be done on in-house projects conducted by an organization. It can be used as the guideline to identify risks and safety issues, and involved a retrospective of evaluation of how safety standards were achieved in the construction project. This will help and make it easier to review for previous project and tracking down the mistakes rather than looking forward.

Risk identification through intuitive insights

The potential change in law which creates the risk in the construction project. Taking a view of the future and make provision for some intuition can be helpful to identify risks. The intuition is readily available for pinpointing the long term implications of innovation solution.

Risk identification through brainstorming

The meeting and workshop are helpful for risk identification. The solution of puzzling issue encountered is brainstorming. Therefore, brainstorming for risk identification can lead to the solution for each project risk.

Risk identification through site visits

In case of the construction project that has already started, risk identification such as identifying and assessing the danger posed can be obtained during the construction. It is useful to visit the sites of construction projects to identify some risks.

Risk identification through the use of organization chart

The organization charts are useful to identify risk in construction project by assessing the quality and competence of personal availability within an organization or set of organization for construction project. The organization structure of establishments also gives information on the nature and efficacy with which the entire firm is managed.

Risk identification through the use of flow chart

Flow charts are particularly useful for depicting flow process such as material in construction project. It is easy to monitor which processor can go wrong including number and capability of personal need at various locations along the line of flow. The risks which come from human or absenting can be identified from this method.

Risk identification through research, interview and surveys

Research, interview and surveys are very effective technique to identify risk in construction project. This is particularly useful in case of planning the new job but previous information or experiences are unavailable.

Risk identification through analysis of assumption

The construction project in which client's information requirement is not fully certain have to design and plan based on assumptions to identify the project risk. Also, the checking back to the assumption is one of the necessary factors.

Risk identification through consultation of experts

In case of the organization which in-house expertise to assess certain risk are unavailable. Consulting expert in the risk assessment comes up with valuable resources of experience and come up with accurate data. Consultation ensures that many risks are inadvertently identified and mitigated before starting the construction project.

2.2.2 Risk Analysis and Evaluation

Project risk in the construction can be categorized into two features by Carter (1994) and Simon (1997) as:

(1) The probability

(2) The impact on the project

These two parameters will enable the project to decide in course with accurate assessment. Risk analysis will be helpful in the decision making process especially in the course of project formulation. The probability of occurrence and the impact on the construction project can be used as decision aid.

Probability	Priority		
High	Low	High	Very High
Medium	Low	Medium	High
Low	Very Low	Low	Medium
Impact	Low	Medium	High

Figure 2.2: Priority of risk

From Figure 2.2, the project risk that has high probability and high impact on the construction project will be the very high priority project risk. On the other hand, the low chance of happening project risk and low impact on the construction project will become the very low priority project risk. Therefore, risk project can be changed due to the period of time, based on risk management growth and experience embellishes. The profile of risk is always changing and many risks are managed unconsciously. In case of very high priority risk, the mitigation should be sought and evaluated. This can be in several times before reaching the comfortable position.

Risk analysis and evaluation can be categorized into three types as (Chinyio and Ferguson 2000):

(1) Qualitative: Both probability and impact are assessed subjectively. This is employed when uncertainty is prevalent because the absence of information subjectively prevails.
(2) Semi-Quantitative: Probability assessed subjectively but impact assessed objectively, which is employed when the impact of risk can be established accurately.
(3) Fully Quantitative: Both probability and impact assessed objectively. This is employed when the information is available from the safety review. Database and other sources of information can facilitate a quantitative assessment of risks.

To access the probability of risk, the statistical analysis is employed. The assessment of chance can facilitate accurate mapping of contemporary risk by using 'Bayes Theorem' which is used to combine the statistics of previous events to derive the probability of complex scenario (Steele 1992). However, quantifying project risk in term of measuring a real probability is still difficult because the underpinning information is usually unavailable or insufficient.

The impact of risk is usually assessed in terms of affection of the project. The organization also financially assessed several dimensions such as schedule delay from the target, embarrassment, function and quality of construction project. These parameters can be translated into cost of construction too. There are some strategies to access the risk in construction project (Chinyio and Ferguson 2000). For example,

(1) Access every risk as it is: Every risk will be assessed in this strategy. In this case, probability of risk occurring is high, so it's safer to price a full impact such as the organization who has few risks but high impact. It is easy to employ this strategy.
(2) Access every risk but model the price with probabilities: This strategy will take the account of all risks and prices with all identifiable risks in order to control cost consequence on probability consideration.
(3) Access the main risks only: This strategy will not consider all project risks with impact on the construction project but will concern the main risk which has high probability and high impact. In figure 2.3, in this case, the

organization will decide to concentrate on very high and high priority risk only.

Probability	Priority		
High	Low	High	Very High
Medium	Low	Medium	High
Low	Very Low	Low	Medium
Impact	Low	Medium	High

Figure 2.3: Impact, probability and priority matrix.

(4) Benchmarking: The organization that has the experience in the related construction project will decide to use the template as the starting point to assess the risk. Comparison with the past project is the helpful method to assess the risk.

(5) Adjudication in risk evaluation: Adjudication is the commercial decision method which depends on what organization will be comfortable with. This strategy will consider risks, the probabilities, and impact of risks. After balancing the output, the decision will be made for what is comfortable for the organization and what organization has to do more.

(6) Reactive risk assessment: This strategy will be suitable for very complex project which may be impossible to identify the impact and probability of risk of what can go wrong. Reactive risk assessment strategy will assess the identified risks first. However, the unidentified risk will not be assessed until a negative event occurs and will concentrate on impact and frequency of occurrence.

(7) Pro-Active risk assessment: For this strategy, all project risks can be identified and solutions can be sought for them up-front. In this case, risk allocation is important because the management will assign the risk for the suitable task or job description.

(8) Sensitivity analysis in risk evaluation: In the process of risk analysis, some cases will use the sensitivity to identify the most volatile risk. The cumulative influence of risk on the construction projects is assessed. It is viable to conduct sensitivity analysis after several project risks have been assessed. The sensitivity analysis will assess the impact on the project outcome and the impact of risks. The risks can have an influence on the project cost and project schedule and can be assessed as well as can run a check on the project features.

2.2.3 Risk Response and Control

Risk response and control concern the solution for countering the project risk. Not only are the risk analyses and risk identification important, the risk response and control is also the essential process in risk management.

Risk response aimed to obtain the effective response to identify and analyze risk of which the process is composed of the decision making in consideration that the risk should be managed by eliminating it, reducing it, transferring it or retaining it (Flanagan and Norman, 1993).

Risk response and control could last continuously throughout the life of construction project as the new solution can improve or change the previous actions. The decision that is made during the construction project in each risk and set of risk is circumspect and depends on the peculiarity of an organization and the surrounding circumstance. In case of the high priority of risks, they will be generated the impact outside the organization. The outsourcing in order to response and control the risk is another effective way to solve the risk.

Some of the organizations that have the related experience have developed the standard procedure as a manual to respond and control things that have already happened in the previous construction project. The organizations store them as the database for the future construction project.

Project response and control are also involved with the marketing impact concerning the competitor in the construction business. If a major risk is adverse consequences materialized in the course of project, the risk event will generate the negative image to the construction organization involved and will also discredit the

organization. These will have an influence on the future project for client to select the contractor, consultant and designer.

There are main four types of risk response and control in construction project (Flanagan and Norman 1993, Baker 1999) including:

(1) Risk Elimination: It's the process or action to avoid or abort the risk by elimination. The organization refuses to accept the risks because the project is too risky. As a result, the contractors refuse to bid for the project and the clients refuse to continue the project. However, if the risk elimination is extensively used, it will decrease the opportunity to gain the profit and achieve the objective.

(2) Risk Reduction: Instead of elimination, the reduction is one of the methods to employ through loss prevention and control. This method focuses on preventing the loss or reducing the chance that will occur from risk by acquiring more information. For instance, the action that could affect the chance of risk occurrence and loss prevention will be the redesign of the facilities to minimize the health and safety risk. However, the reduction could be considered insufficient to deal with risk because it is impossible to reduce or prevent all risks that will occur in construction project. Also, the cost and time of implementation can be more than the losses from the risks.

(3) Risk Transfer: Transferring the risk responsibility in construction to other parties who are able to bear the risk is one of the methods to respond to the risks. For instance, the options can be insurance and performance bond. In construction project, contractual transfer of risks usually happens when the organization decides to transfer the construction task. Thus, the risks become a distinct construction outfit. It is effective to transfer risk to the specialist who can handle or bear them. The task and risk transferring to the expert depends on requirement of each project. In addition, risk transfer can be divided into two forms (Thompson and Perry 1992): (1) The property or activity responsible for the risk may be transferred as outsourcing and subcontractor, (2) The property or activity may be retained but the financial risk is transferred as insurance.

(4) Risk absorption: Some of the risks cannot be eliminated or transferred to other parties, so the organization has to absorb them. This is a common method to deal with the risks. The possibility of losses involved in these risks is retained. The general risk that should be absorbed is the risk related to small losses with small consequences. Moreover, risk absorption can be divided into two forms (Flanagan and Norman 1992): (1) Active. This is when retention is referred to the organization itself. The consideration of management strategy is done after a conscious evaluation of the possible losses and cost of alternative ways to handle risks. (2) Passive. This occurs through neglecting, ignorance and absence of decision.

The examples of risk response tools are listed below (Chinyio and Ferguson 2000):

(1) Guarantees: These are issued on behalf of contractors by governments and banks to ensure the owner's recourse to the compensation in case of contractor's default.
(2) Letter of Credit (LOC): The guarantee issued by the bank in case of contractor is operating oversea. LOC entitles the client to withdraw cash on production of certain document and upon fulfilling certain condition.
(3) Bid Bonds: In this case, the cost of contractor's bid was accepted by the client. Bid bond will protect contractor to renege on entering into contract with the client.
(4) Performance bond: The surety company issues the performance bond to cover the aspect of non-performance on the part of contractor.
(5) Surety bond: This guarantees that other forms of resolution will be sought in case of non- performance contractor before the payment penalty is applied.
(6) Insurance: For the risk that cannot be managed, the mitigation to insurance is usually used to protect an organization from the consequence of disaster.
(7) Risk Premium: The equivalent of risk premium in construction project is the contingency. This usually added an estimation of account for unforeseen eventualities that cannot be fully priced when a cost estimated is prepared.

(8) Risk-adjust discount rate: This tools is normally use in banking business to adjust the risk free discount rate by accounting for future inflation and extraordinary risks.

2.2.4 Risk Allocation

For risk allocations in common construction project, the risks are enormously transferred from client to contractors, designers and consultants. In addition, most of the risks are transferred to contractors. In case of construction project, the engineer and architect would design a building structure as its finished condition. However, the problem from the construction might still occur. The risk themselves are not transferred but the responsibility if those risk are transferred. This one-sided attitude toward transferring risk to other parties can be divided into following strategies (Levitt and Ashley 1980):

(1) Imposing contingency change (either explicitly or in inflated unit prices)
(2) Adopting conservative approaches to construction design and construction method
(3) Refusing to utilize design alternatives involving new technology due to the potential liabilities arising from undue cost or failure to perform
(4) Resorting to ligature or a arbitration for any possible type of dispute, whether warranted or not

In the decision process, the new risk profile of the construction project is continuously assessed and the negotiations continue until all risks have been priced and allocated to the related parties. Account standard drives this process in a bid for risk to achieve balance sheet status. The optimum risk transferred by mean of absolutist approach to best value is, thus, sometimes restricted through observance of the accounting standard as figure 2.4. (Chinyio and Ferguson 2000).

The organization sought to transfer every risk to other parties. Moreover, different projects are underpinned in different circumstances and the impact of risks varies in different construction project. In some cases, it will be more cost effective for the owner to acquire and demolish any other existing building. Therefore, risk allocation could not be standardized on a permanent basis as individual circumstance

determines what will be the best. Also, a template can be established to inform risk allocation in current project (Chinyio and Ferguson 2000).

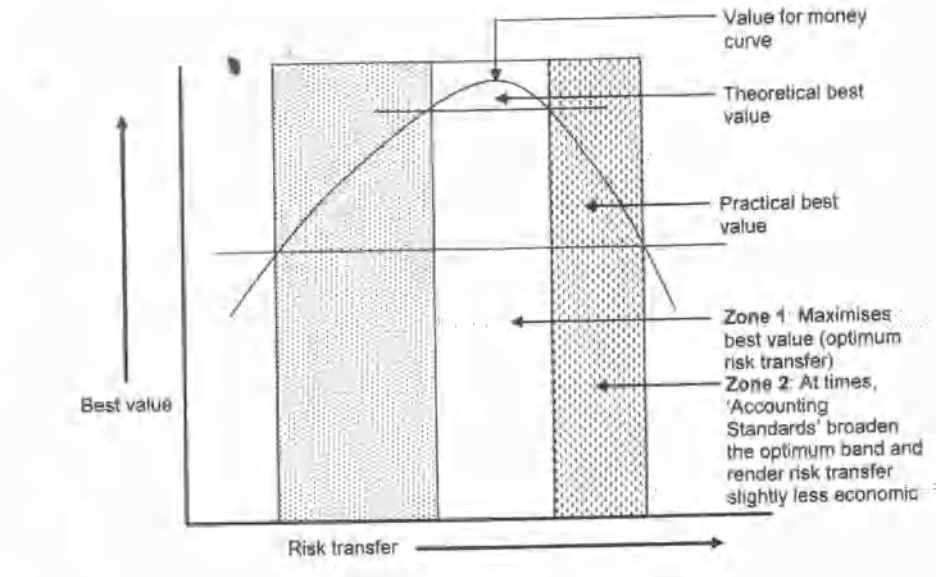
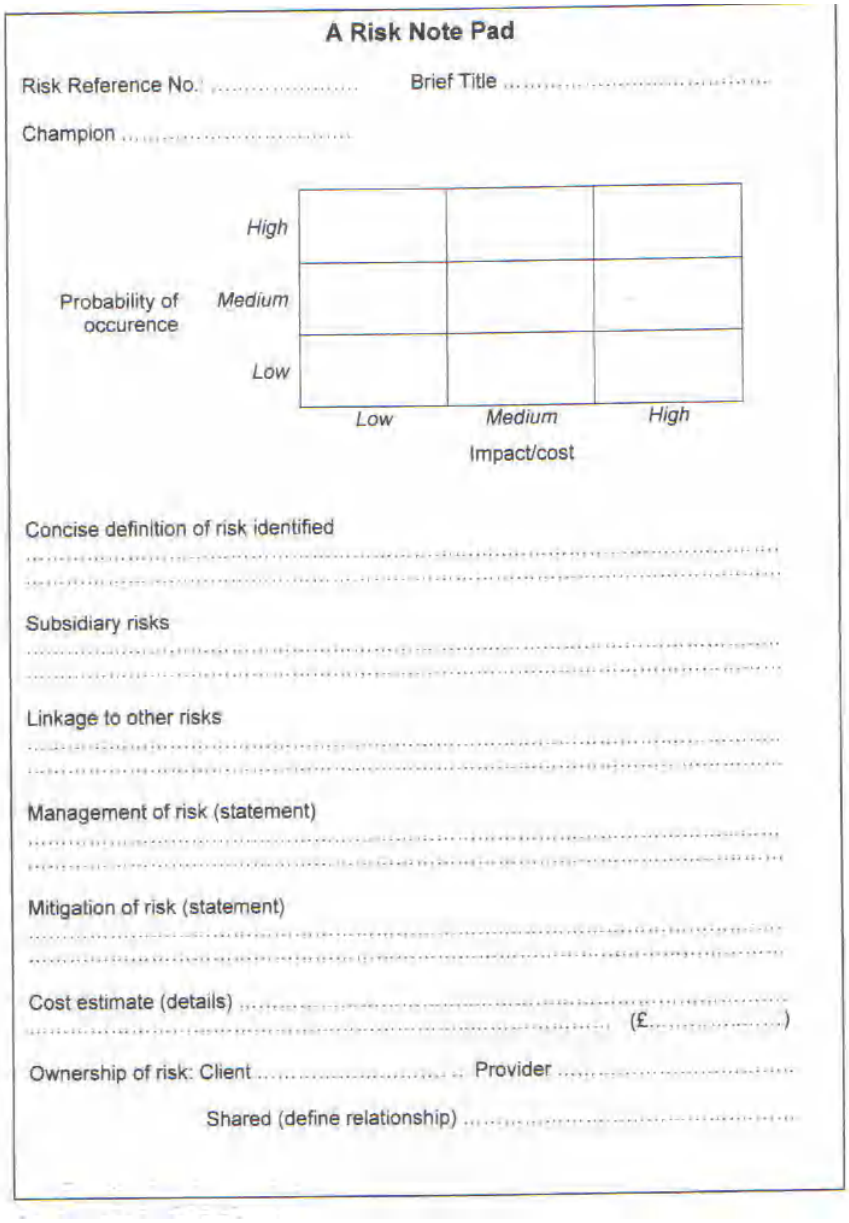


Figure 2.4: Accounting standards

2.2.5 Risk Documentation and Report

After the process of Risk Identification, Risk Analysis and Evaluation, and Response and Control, the documentation and report from the process are the essential parts of the process to record and document in order to monitor the risks through out the life of a construction project. The example of work sheet is shown in Figure 2.5 portraying information of different risks and informing the preparation of risk registers(Chinyio and Ferguson 2000).



A Risk Note Pad

Risk Reference No. ..... Brief Title .....

Champion .....

Probability of occurence	Low	Medium	High
High			
Medium			
Low			

Impact/cost

Concise definition of risk identified

.....

.....

Subsidiary risks

.....

.....

Linkage to other risks

.....

.....

Management of risk (statement)

.....

.....

Mitigation of risk (statement)

.....

.....

Cost estimate (details) .....

..... (£.....)

Ownership of risk: Client ..... Provider .....

Shared (define relationship) .....

Figure 2.5: Example of Risk documentation and Report

2.3 Literature Reviews

“The top-ranked problems of construction projects in term of occurrence were grouped under fives factors: (1) incompetent designers and contractors, (2) poor estimation and change management, (3) social and technological issues, (4) site related issues and (5) improper techniques and tools. It is noted that the findings confirmed the previous studies that most of problems on construction project involved human and management problems rather than technical in nature,” Long et al. (2004).

“Risk management is a critical part of the project management as ‘unmanaged or unmitigated risks are one of the primary causes of project failure. While numerous studies have concentrated on the subject of risk management, only little current information exist in the actual use of risk management in practice. The use of risk management is moderate to high, with little difference among the types, sizes and risk tolerance of the organization, and experience and risk tolerance of the individual respondents,” Lyons and MSkitmore (2004).

“The general consensus in current literature in the field of risk management incorporates four core steps in the process of risk management including: (1) risk identification, (2) risk analysis, (3) social risk response, and (4) risk monitoring. The importance of human risk factors should be highlighted because it appeared that this was the most importance risk in construction project,” Thevendran and Mawdesley (2004).

“The steps of controlling influence on effective risk identification and assessment for construction design management require (1) knowledge acquisition, (2) selection of core design team, (3) presentation of the process (4) identification (5) encoding and (6) verification,” Chapman (1999).

“Co-ordination with sub-contractors as well as an increase of manpower and equipments are considered to be the most effective risk mitigation methods utilized in the Kuwaiti construction industry. This result has highlighted the fact that sub-

contracting work agreements hold the key to mitigate the losses of delay impacts that general contractors have to bear in Kuwait," Kartam and Kartam (2001).

"Strategizing risks is almost always beneficial, but at some point diminishing returns set in and the costs of acquiring additional information or gaining control over risks fall shorts of their value. The design of responses to risk must be judged on a cost-benefit basis. Aligning performance incentives is critical when particular parties to the project have a significant degree of control over the economic value created by the project but do not have an incentive to maximize this overall value," Miller and Lessard (2001).

"Clients, designers and government bodies should take the responsibility of managing their relevant risks and work cooperatively from the feasibility phase onwards to address potential risks in time; contractors and sub-contractors with robust construction and management knowledge should be employed to minimize construction risks and carry out safe, efficient and quality construction activities," Zou et al. (2007).

Poor cost performance of construction projects seems to be the norm rather than the exception, and both clients and contractors suffer significant financial loss due to the cost overrun. It is suggested that global risk factors pose more challenges to construction contractors because the challenges are less familiar. In addition, they lack effective techniques and tools to handle these risks," Baloi and. Price (2001).

"Many infrastructure projects in Southeast Asian countries still have not secured good project goal achievements. Such failure can be realized from severe project delay. One major reason involves the common internal and external risks and uncertainties that are inherent in all stages of project such as planning, bidding, contracting to construction stages," Jirapong Pipattanapiwong (2004).

"The ontology-based risk management (ORM) framework aimed to verify the project risk ontology could enhance risk management (RM) workflow performance within the

construction organization by case study, and hence decrease risk impact on the project. Through the implementation of the ORM framework and the ontology development model, the selected contractor could integrate knowledge reuse in the RM operation. Consequently, based on knowledge accumulation and reuse, the aforementioned RM problems could also be overcome and hence support the RM decision making."
Tserng et al. (2009).

"The risk management is not carried out systematically in all phases of a project. The actors' participation in the risk management process is generally limited by their roles in the project. The absence of systematic risk management is especially noted in the programming (planning) phase, where it arguably has the greatest potential impact. The production phase is where most interest and activity is to be found. Unfortunately, this can easily prove to be too late in the day to mitigate some risks, including those that might have been avoided at an earlier phase." Osipova (2008)

"The important role of using mission, vision and strategy has been acknowledged in most organizations today. Mission is the reason why the organization exists. Vision is the ideal state of the organization in the future. Strategy defines the way of how to get towards the ideal state introduced in the vision. These tools are considered to be very useful in guiding the whole organization into the same direction. Different ways of producing mission, vision and strategy have been developed. In projects, using these tools is still quite rare even though it is acknowledged that projects in an organization should support the overall strategy of the organization. In addition, every project should have a clear direction where to go and this direction should be stated to every stakeholder of the project. In this paper we will discuss the possibilities of using strategic management tools in project environment." Naaranoja et al. (2007).

"The allocation of risk among the contracting parties in a construction contract is an important decision leading to the project success. The decision-making process, based on the established risk allocation principles expressed in linguistic terms, requires qualitative judgment and experiential knowledge of the construction experts. New and

project-specific risks emerged in today's multiparty complex construction projects that a tailor-made contract strategy allocating risks among the contracting parties based on the accepted allocation principles is more desirable." Lam et al. (2007).

CHAPTER III

PROJECT RISK MANAGEMENT METHODOLOGY IN THE EXISTING CONSTRUCTION PROJECT

3.1 Introduction

This research focuses on the Government Center Construction Project which is located on Cheangwattana Road, Bangkok Thailand. The construction project is composed of 9 packages as shown in Table 3.1:

Table 3.1 The detail of Government Center Construction Project

Package	Description	Budget (BAHT)	Start	Finish
1	Office building of the Administrative Court	1,813,000,000	22 Jun 2005	31 Aug 2008
2	Building A and Car park A	3,395,000,000	16 May 2006	June 2010
3	Building B	6,877,000,000	16 May 2006	16 Sep 2010
4	Car park building, Auditorium and Dormitory	1,860,000,000	16 May 2006	16 Sep 2009
5	Utilities and civil work outside building	1,100,000,000	16 May 2006	16 Sep 2009
6	Site Preparation	77,801,907	4 Oct 2005	10 Apr 2006
7	Landscape and softscape	134,490,000	10 Oct 2006	Dec 2009
8	Interior and furniture	969,440,000	20 July 2007	June 2010
9	Traffic network	180,000,000	31 Jan 2008	31 Oct 2009

This research decides to approach the project risk management in the first package which is the construction of the office building of the Administrative Court because this package has already been constructed over 1 year behind the schedule and more than 300 million bath is over the budget. (The construction layout and picture of construction project is shown in Figure 3.1 and 3.2.)

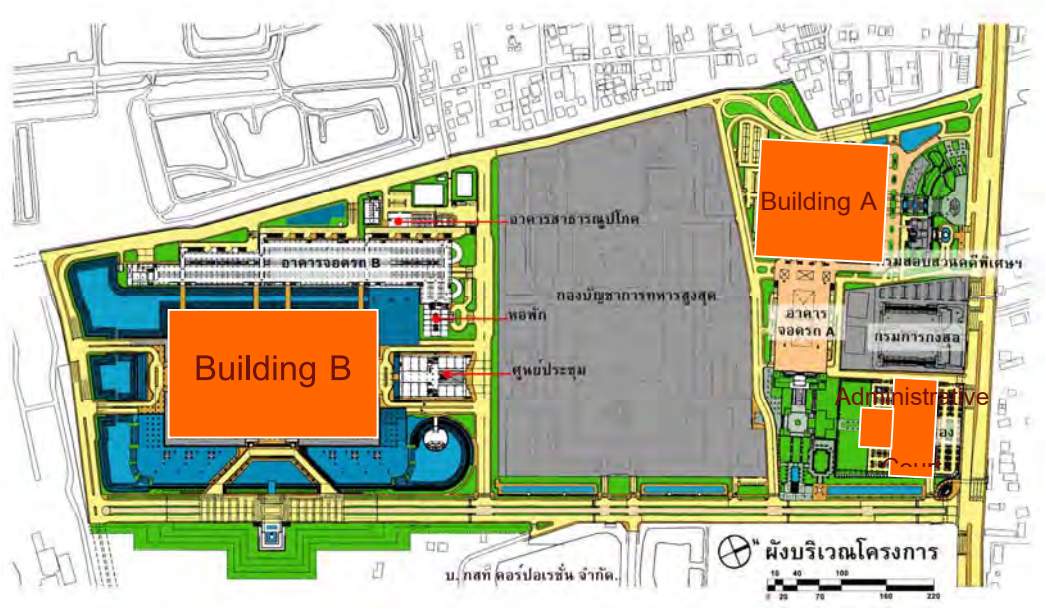


Figure 3.1 Layout of Government Center

This research will set project risk management team composing of the expert of stakeholder (Client, PMSC, Designer and Contractor) analyzing the process as follow:

Figure 3.2 Picture of Office building of the Administrative Court construction

3.2 Risk Management Planning and Risk Identification Process

The criterion in project risk management is composed of 3 main factors as cost of construction, time or schedule of construction and finance. This research will focus on the cost and schedule factors but will not focus on finance factor because in this case the client has the construction insurance to reduce the risk impact during the construction project and also uses the bond to establish the budget to construct the construction project.

The stakeholder of this case composes of 4 parties which can be summarized in the design process and construction process as shown in Table 3.2:

Table 3.2 Design and construction process stakeholders

	Design Process	Construction Process
Client	Requirement Decision	Requirement Monitoring Progress Decision
PMSC	Requirement Coordination Design Management and Supervision	Contractor Procurement Construction Management and Supervision Contract Administration
Designer	Conceptual Design Preliminary Design Detailed Design	Design Clarification Re-Design
Contractor		Shop-Drawing Construction Schedule and Cost Control

To identify the key risk in construction project, a check list is required in this case. The check list will be developed in the design stage and construction stage as:

Design stage

1. Requirement of client and user of the building
2. Environment and traffic concern
3. Design management
4. Designer Qualification
5. Time and Budget Control

Construction stage

1. Requirement of client and user of the building
2. External Factors
    a. Weather
    b. Politics
    c. Economic
    d. Law and Regulation

3. Environment and traffic concern
4. Construction Method
5. Contractor Qualification
6. Construction Management
7. Re-Design
8. Time and Budget Control

The role and responsibility of the stakeholder who is responsible for the risk and uncertainties from the check list can be categorized in Table 3.3:

Table 3.3 Roles and Responsibility in Design and Construction Process of Stakeholder

	Design Process	Construction Process
Client	Requirement Time and Budget Control Environment and Traffic Concern	Requirement Time and Budget Control External Factor Environment and Traffic Concern
PMSC	Designer Qualification Design Management Time and Budget Control	Contractor Qualification Construction Management Time and Budget Control
Designer	Design Qualification Design	Re-Design Construction
Contractor		Contractor Qualification Construction Method

In office building of the Administrative Court construction project, client and PMSC has produced the risk management plan and risk indicator to control, reduce and transfer the impact of risk. This content can be summarized as:

1. In the payment process, client will pay the money for cost of construction in not less than one time in each month and cost of construction will refer to the Bill of Quantity (B.O.Q.) that contractor proposed the quantity and price of project construction which will be taken off from drawing after

bidding process. This document will help the client in payment process to check and control by referring to B.O.Q. that contractor proposed. In case of some differences in price and quantity between actual and B.O.Q., the payment will refer to the B.O.Q. only. In this content of the contract the risk in price and quantity in contract drawing, client will transfer to the contractor directly. (Time and Budget Control) (Construction Management)

2. Contractor has to give the bank guarantee worth 10% of total construction cost before starting the project to client and client will return the bank guarantee after construction finished. This content is the protection of client to guarantee that contractor will not leave the construction project before construction finish. (Contractor Qualification)
3. Contractor has to propose the baseline program which is composed of the construction plan for the whole project within schedule that client defined. This baseline program must be approved by the client and stated in the contract document between client and contractor. The actual work done during construction will follow the baseline program if the actual work done is lag behind the baseline program more than 10%, contractor cannot have the payment from that construction work until actual work completion can reach the 90% of baseline program. This content is helpful parameter to control contractor to finish the construction project on time and reduce the risk impact in schedule. (Time and Budget Control)
4. Client will pay the advance payment to the contractor which is 15% of the total construction cost. This cost will help contractor to prepare and mobilize the construction project in initial stage. This content will be useful for contractor to manage the cash in initial stage and prepare the construction to finish the project in time. (Time and Budget Control) (Construction Management)
5. Client will deduct the construction payment from contractor 15% in each time as the retention cost of construction. This retention cost equals the advance cost and will finish the deduction in the final payment. This will

help the client to control the quality of the work until the construction finish. (Time and Budget Control) (Construction Management)

6. The contract document should state the milestone to control the actual work completion to finish within schedule. This project is composed of 3 milestones as:
    a. Milestone 1: basement structural work and slab of first floor must be finished within 300 days from the beginning of construction. If the work cannot be finished within time, client will deduct the penalty 200,000 baht per day and return after construction finish.
    b. Milestone 2: all structural work and roof slab must be finished within 510 days from the beginning of construction. If the work cannot be finished within time, client will deduct the penalty 300,000 baht per day and return after construction finish.
    c. Milestone 3: all interior work must be finished within 560 days from the beginning of construction. If the work cannot be finished within time, client will deduct the penalty 150,000 baht per day and return after construction finish.

    This milestone will help client to control the construction project to finish on time. (Time and Budget Control) (Construction Management)
7. If the contractor cannot finish the construction project on time, the client will have the penalty for 0.05% of the total construction cost which is 906,500.00 baht per day and 50,000 baht per day for consultant cost. Also the client will not return the milestone deduction cost if the project cannot finish on time. This penalty will help client to control the construction project to finish on time. (Time and Budget Control) (Construction Management)
8. The responsibility of contractor is stated in contract as in every defect of incomplete work after construction is finished, the contractor has to solve and repair every point within two years after client receives that work with additional cost. The contractor must solve it within 7 days after receiving the client request. (Contractor Qualification)

9. The contract document also stated that contractor must have workmen compensation insurance for the construction project including waiver of subrogation. (Construction Management)
10. The client must have all the construction under risk insurance, advance loss of profit and third person insurance for this project. (Construction Management)
11. Client also hires the environmental and traffic consultant to study the impact before, during and after construction to solve the environmental and traffic problem that will occur from the construction project. (Environment and traffic concern)
12. Before hiring the designer, there are conditions to screen the qualification of the designer based on the experience, workmen and the quality of the conceptual design supervising by PMSC and client before hiring the designer. (Design management) (Designer Qualification)
13. Before hiring the contractor, there are conditions to screen the qualification of the contractor based on the experience, workmen, organization chart, baseline program and the construction method supervised by PMSC and client before hiring the contractor. (Construction Method) (Contractor Qualification)

In this research, the process of risk planning and identification would be based on the actual change in schedule and budget from the changing of contract between the contractor and the client. Using the check list to identify each risk that has an impact on the schedule and the cost stated in the variation order in addendum of construction contract.

3.3 Risk Analysis and Evaluation

In this research, after identifying the risk in the construction of the office building of the Administrative Court, the analysis of each risk that has an impact on the project schedule and project budget is the next process. Based on the actual contract document, this research will analyze reasons and causes of the changing in cost and schedule in each item stated in the table and frequency. This part also

includes analyzing the type of work that changes based on cost of work and detail of change rating by FMEA method and RPN method.

3.4 Risk Response and Control

In this research, the risk response process will concentrate on the actual response and control that the client and the consultant have done in this construction project. Moreover, the actual response from the client and consultant will be analyzed according to actual situation.

3.5 Conclusion

In this research compose of 3 main process as risk management planning and risk identification process, risk analysis and evaluation process, and risk analysis and evaluation process. The resource of this thesis came from the actual documentations which are the construction contract between client and contractor and 4 addendums of construction contract. The variation order which enclose to the addendum which impact to the construction project schedule and cost will be analyzed base on the type of work and detail of change.

CHAPTER IV
PROJECT RISK MANAGEMENT RESULT AND ANALYSIS
(Office building of the Administrative Court)

This research will focus on the Government Center Construction Project and will approach the project risk management in office building of the Administrative Court. The contract's addendum in construction project of office building of the Administrative Court between client and contractor is the resource document for this research.

The result and analysis of data from change of the schedule and cost can be obtained by project risk management theories as the following:

4.1 Risk Identification Process

According to the contract's addendum in construction project of office building of the Administrative Court between client and contractor, the project risk that has an impact on the project schedule and cost came from the requirement of client and user of building. The constructing work affecting the schedule and cost can be categorized into:

1. Architecture
2. Civil
3. Mechanical and Electrical Work
    - 3.1 Water Supply and Sanitary System
    - 3.2 Electrical and Telecommunication System
    - 3.3 Air-Conditioning System
    - 3.4 Miscellaneous Work
4. Interior Work
5. Special Cost which is stated in the specification and contract such as the preparation of the equipment during the construction.

4.2 Risk Analysis and Evaluation

There are 4 contract's addendum in construction project of office building of the Administrative Court between client and contractor as shown below.

1. The First Addendum 19 June 2007

The first addendum is concerned with the change of the project schedule 284 days from 730 days to 1014 days (38.90%) because of the additional requirement of the client and user of the building. The detail of change is can be summarized as:

1.1) DAD.1654/2549 on 17 July 2006
The user of the building requires changing the drawing (requirement).
Cause the architecture drawing change for 1 page.

1.2) DAD.1-940/2549 on 22 August 2006
The user of the building notices changing the drawing (requirement).
Cause the architecture and M&E drawing change.

1.3) DAD.1-3924/2549 on 22 December 2006
The user of the building requires changing the drawing (requirement).
Cause the architecture and M&E 1st floor to 5th floor drawing change for 72 pages.

1.4) DAD.1-3968/2549 on 29 December 2006
The user of the building requires changing the drawing (requirement).
Cause the architecture and M&E 6th floor to 10th floor drawing change for 62 pages.

1.5) DAD.1-101/2550 on 26 January 2007
The user of the building requires changing the drawing (requirement).
Cause the architecture, M&E 1st basement floor to 2nd basement floor, panel board load schedule and air handling unit schedule drawing change for 49 pages.

1.6) DAD.1-121/2550 on 30 January 2007

The user of the building requires changing the drawing (requirement).

Cause the audiovisual aids 1st basement floor, 2nd floor and 3rd floor drawing change for 4 pages.

1.7) DAD.1-142/2550 on 2 February 2007

The user of the building requires changing the drawing (requirement).

Impact to the interior work 1st floor, 3rd floor, 4th floor and 5th, seminar room and investigate room drawing change for 60 pages.

1.8) DAD.1-266/2550 on 2 March 2007

The user of the building requires changing the drawing (requirement).

Impact to the interior work 1st basement floor, 9th floor and 10th, kitchen room , outside building architecture and M&E work drawing change for 95 pages.

1.9) DAD.1-276/2550 on 2 March 2007

The user of the building requires changing the drawing (requirement).

Impact to the interior work 1st basement floor, 9th floor and 10th, kitchen room , outside building architecture and M&E work drawing change for 95 pages.

1.10) DAD.1-549/2550 on 4 April 2007

The user of the building requires changing the drawing (requirement).

Cause the architecture work (building layout, gas station layout, and basement ceiling) electrical system, load schedule, 2 wire remote schedule and specification of nurse call drawing change for 106 pages.

1.11) DAD.1-590/2550 on 10 April 2007

The user of the building requires changing the drawing (requirement).

Cause the 1st basement fire protection and alarm system drawing change for 1 page.

1.12) DAD.1-598/2550 on 11 April 2007
The user of the building requires changing the specification (requirement).
Cause the interior work specification change for 62 pages.

1.13) DAD.1-599/2550 on 11 April 2007
The user of the building requires changing the specification of material (requirement).
Cause the interior work specification change.

According to 13 variation orders from requirement of the client and user of the building to contractor, the result and analyzes as Table 4.1. These variation orders affecting the project schedule 284 days are composed of architecture and interior work 11 orders for 162.79 days and M&E work 9 orders for 120.21 Days.

2. The Second Addendum 5 September 2007 (external factor during the construction project)

The second addendum is concerned with the contractor proposing to change the payment process to client. This is due to the law and regulation to help the contractor from the rising of gasoline price. This regulation stated that the retention cost which client has to cut from each monthly payment for 15% from the contractor can propose to use the bank to guarantee instead of cutting payment from that cost.

3. The Third Addendum 28 April 2008

The third addendum is concerned with the change of project schedule for 153 days from 1014 to 1167 days (21.10%) and increases the cost of construction for 205,808,168.73 baht from 1,813,000.00 to 2,018,808,168.73 (11.35%) baht because of the additional requirement of the client and user of the building. The detail of change is can be summarized as:

3.1) DAD.1654/2549 on 17 July 2006
The user of the building requires changing the drawing (requirement).
Cause the architecture drawing change for 1 page.

3.2) DAD.1-940/2549 on 22 August 2006
The user of the building notices changing the drawing (requirement).
Cause the architecture and M&E drawing change.

3.3) DAD.1-3924/2549 on 22 December 2006
The user of the building requires changing the drawing (requirement).
Cause the architecture and M&E 1st floor to 5th floor drawing change for 72 pages.

3.4) DAD.1-3968/2549 on 29 December 2006
The user of the building requires changing the drawing (requirement).
Cause the architecture and M&E 6th floor to 10th floor drawing change for 62 pages.

3.5) DAD.1-101/2550 on 26 January 2007
The user of the building requires changing the drawing (requirement).
Cause the architecture, M&E 1st basement floor to 2nd basement floor, panel board load schedule and air handling unit schedule drawing change for 49 pages.

3.6) DAD.1-121/2550 on 30 January 2007
The user of the building requires changing the drawing (requirement).
Cause the audiovisual aids 1st basement floor, 2nd floor and 3rd floor drawing change for 4 pages.

3.7) DAD.1-142/2550 on 2 February 2007
The user of the building requires changing the drawing (requirement).
Impact to the interior work 1st floor, 3rd floor, 4th floor and 5th, seminar room and investigate room drawing change for 60 pages.

3.8) DAD.1-266/2550 on 2 March 2007
The user of the building requires changing the drawing (requirement).
Impact to the interior work 1st basement floor, 9th floor and 10th, kitchen room , outside building architecture and M&E work drawing change for 95 pages.

3.9) DAD.1-276/2550 on 2 March 2007

The user of the building requires changing the drawing (requirement).

Impact to the interior work 1st basement floor, 9th floor and 10th, kitchen room , outside building architecture and M&E work drawing change for 95 pages.

3.10) DAD.1-549/2550 on 4 April 2007

The user of the building requires changing the drawing (requirement).

Cause the architecture work (building layout, gas station layout, and basement ceiling) electrical system, load schedule, 2 wire remote schedule and specification of nurse call drawing change for 106 pages.

3.11) DAD.1-590/2550 on 10 April 2007

The user of the building requires changing the drawing (requirement).

Cause the 1st basement fire protection and alarm system drawing change for 1 page.

3.12) DAD.1-598/2550 on 11 April 2007

The user of the building requires changing the specification (requirement).

Cause the interior work specification change for 62 pages.

3.13) DAD.1-599/2550 on 11 April 2007

The user of the building requires changing the specification of material (requirement).

Cause the interior work specification change.

3.14) DAD.1-792/2550 on 11 May 2007

The user of the building requires changing the specification of material (requirement).

Cause the architecture specification change.

3.15) DAD.1-944/2550 on 8 June 2007

The user of the building requires the construction on mock up room (requirement).

Cause the architecture work change.

3.16) DAD.1-991/2550 on 11 June 2007
The user of the building requires changing the drawing (requirement).
Cause the built-in kitchen closet drawing change for 2 pages.

3.17) DAD.1-1181/2550 on 27 June 2007
The user of the building requires changing the drawing (requirement).
Cause the circulation rout line in the building, air-condition system, meeting room, furniture and control room drawing change for 21 pages.

3.18) DAD.1-1315/2550 on 16 July 2007
The user of the building requires changing the drawing (requirement).
Cause the TV outlet layout, power supply system, detail of fountain, cat walk service, softscape work, detail of door and piping route drawing change for 17 pages.

3.19) DAD.1-1424/2550 on 21 July 2007
The user of the building requires changing the drawing (requirement).
Cause the basement ceiling layout, detail of balcony and detail of the pin drawing change for 3 pages.

3.20) DAD.1-1533/2550 on 10 August 2007
The user of the building requires changing the drawing (requirement).
Cause the electrical wire, signal wire and the audiovisual aids drawing change for 3 pages.

3.21) DAD.1-1703/2550 on 10 September 2007
The user of the building requires changing the drawing (requirement).
Cause the lighting system outside building and load of two way remote drawing change for 16 pages.

3.22) DAD.1-1720/2550 on 10 September 2007
The user of the building requires changing the drawing (requirement).
Cause the architecture of reservation area on the 6th floor, mechanical system, electrical system and electrical load schedule drawing change for 8 pages.

3.23) DAD.1-1722/2550 on 10 September 2007
The user of the building requires changing the drawing (requirement).
Cause panel load schedule and electrical diagram on the 3rd floor drawing change for 8 pages.

3.24) DAD.1-1723/2550 on 10 September 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of fence and detail of guard house drawing change for 1 page.

3.25) DAD.1-1724/2550 on 10 September 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of café drawing change for 3 pages.

3.26) DAD.1-1725/2550 on 10 September 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of built-in closet, ceiling layout of collection room, ceiling layout of reading room and detail of parking roof drawing change for 3 pages.

3.27) DAD.1-1726/2550 on 10 September 2007
The user of the building requires changing the drawing (requirement).
Cause the base of King Rama the 5th monument drawing change for 5 pages.

3.28) DAD.1-2034/2550 on 9 October 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of sign and detail of symbol drawing change for 9 pages.

3.29) DAD.1-2162/2550 on 29 October 2007
The user of the building requires changing the drawing (requirement).
Cause the building sign and detail of window drawing change for 5 pages.

3.30) DAD.1-2171/2550 on 30 October 2007
The user of the building requires changing the drawing (requirement).
Cause the architecture and piping system of driver room drawing change for 6 pages.

3.31) DAD.1-2230/2550 on 7 November 2007
The user of the building requires changing the drawing (requirement).
Cause the air-condition system 9^{th} floor to 11^{th} floor, panel board load schedule 2^{nd} floor to 4^{th} floor and two-way remote panel schedule drawing change for 7 pages.

3.32) DAD.1-2231/2550 on 7 November 2007
The user of the building requires changing the drawing (requirement).
Cause the floor plan of 10^{th} floor and ceiling plan 10^{th} floor drawing change for 2 pages.

3.33) DAD.1-2232/2550 on 7 November 2007
The user of the building requires changing the drawing (requirement).
Cause the electrical lighting plan of 2^{nd} floor, 4^{th} floor and deck floor drawing change for 3 pages.

3.34) DAD.1-2233/2550 on 7 November 2007
The user of the building requires changing the drawing (requirement).
Cause the building sign at the roof drawing change for 1 page.

3.35) DAD.1-2332/2550 on 19 November 2007
The user of the building requires changing the drawing (requirement).
Cause the floor plan of 4^{th} floor drawing change for 1 page.

3.36) DAD.1-2354/2550 on 21 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of book closet drawing change for 1 page.

3.37) DAD.1-2355/2550 on 21 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of fence and detail of guard house drawing change for 2 pages.

3.38) DAD.1-2407/2550 on 27 November 2007
The user of the building requires changing the drawing (requirement).
Cause the electrical system of café, lighting system of outside building, electrical system of 10^{th} floor meeting room and panel board load schedule drawing change for 13 pages.

3.39) DAD.1-2408/2550 on 27 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of disable entrance drawing change for 3 pages.

3.40) DAD.1-2409/2550 on 27 November 2007
The user of the building requires changing the drawing (requirement).
Cause the floor plan of 6^{th} floor drawing change for 1 page.

3.41) DAD.1-2410/2550 on 27 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of pin drawing change for 1 page.

3.42) DAD.1-2418/2550 on 28 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of electrical system change for 1 page.

3.43) DAD.1-2425/2550 on 30 November 2007
The user of the building requires changing the drawing (requirement).
Cause the ceiling plan of 10^{th} floor change for 1 page.

3.44) DAD.1-2426/2550 on 30 November 2007
The user of the building requires changing the drawing (requirement).
Cause the interior work of justice room change for 7 pages.

3.45) DAD.1-2427/2550 on 30 November 2007
The user of the building requires changing the drawing (requirement).
Cause the two wire remote system and layout of lighting system on the parking area change for 4 pages.

3.46) DAD.1-2671/2550 on 26 December 2007
The user of the building requires adding the equipment (requirement).
Cause the fiber optic wire drawing change for 1 page.

3.47) DAD.1-0032/2551 on 4 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of ceiling plan for 7^{th} floor to 10^{th} floor drawing change for 4 pages.

3.48) DAD.1-0033/2551 on 4 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of fence and detail of guard house drawing change for 2 pages.

According to 48 variation orders from requirement of the client and user of the building to contractor, the result and analyzes as Table 4.2. The 48 variation orders affect the construction schedule to delay for 153 days and increase the cost of construction for 205,808,168.73 baht. This change can be summarized in terms of type of work and cost of change as the following:

1. Architecture 28 orders 57,118,557.45 baht delay 48.13 days
2. Civil 1 order 404,297.82 baht delay 1.72 days
3. Mechanical and Electrical Work
3.1 Water Supply and Sanitary System 11 orders 1,499,433.87 baht delay 18.91 days
3.2 Electrical and Telecommunication 19 orders 23,644,193.06 baht delay 32.66 days
3.3 Air-Conditioning System 11 orders 42,892,256.00 baht delay 18.91 days
3.4 Miscellaneous Work 8 orders 2,785,250.97 baht delay 13.75 days
4. Interior Work 11 orders 64,892,250.36 baht delay 18.91 days
5. Special Cost 12,571,929.21 for 284 days (First Addendum)

Moreover the 48 variation orders that effect the schedule and cost in this addendum, contract did notice the variation orders that will be claimed in the further addendum as

3.49) DAD.1-0034/2551 on 4 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of fire protection system and server room layout drawing change for 4 pages.

3.50) DAD.1-0173/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of swimming pool drawing change for 4 pages.

3.51) DAD.1-0174/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of floor plan 1st basement floor to 11th floor drawing change for 4 pages.

3.52) DAD.1-0175/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of picture drawing change for 1 page.

3.53) DAD.1-0176/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of lamp drawing change for 2 pages.

3.54) DAD.1-0177/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the fire protection system, telephone riser diagram, fire alarm sound and CCTV system drawing change for 6 pages.

3.55) DAD.1-0224/2551 on 17 January 2008
The user of the building requires changing the drawing (requirement).
Cause to stop the construction of fence and guard house.

3.56) DAD.1-0225/2551 on 17 January 2008
The user of the building requires changing the drawing (requirement).
Cause to stop the construction of justice room on the 6^{th} floor.

3.57) DAD.1-0226/2551 on 17 January 2008
The user of the building requires changing the drawing (requirement).
Cause to stop the construction of lighting system outside building.

3.58) DAD.1-0336/2551 on 23 January 2008
The user of the building requires changing the drawing (requirement).
Cause the air condition system on 9^{th} floor to 10^{th} floor drawing change for 2 pages.

3.59) DAD.1-0337/2551 on 23 January 2008
The user of the building requires changing the drawing (requirement).
Cause the furniture layout, detail of meeting room and detail of reservation room drawing change for 4 pages.

3.60) DAD.1-0338/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the specification of lighting system outside building, panel board load schedule, lighting system layout, ground floor lighting plan, 2nd floor lighting plan, 4th floor lighting plan and deck floor lighting plan drawing change for 12 pages.

3.61) DAD.1-0339/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the detail of ward, ceiling plan of 1st basement floor and detail of window drawing change for 5 pages.

3.62) DAD.1-0340/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the floor plan of 1st basement floor and air condition system of reservation building drawing change for 2 pages.

3.63) DAD.1-0341/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the detail of justice room and furniture layout of 6th floor drawing change for 3 pages.

3.64) DAD.1-0442/2551 on 4 February 2008

The user of the building requires changing the drawing (requirement).

Cause the electrical system and lighting system of guard house drawing change for 6 pages.

3.65) DAD.1-0467/2551 on 6 February 2008

The user of the building requires changing the drawing (requirement).

Cause the floor plan and ceiling plan of additional reservation area on 6th floor drawing change for 1 page.

3.66) DAD.1-0500/2551 on 8 February 2008
The user of the building requires changing the drawing (requirement).
Cause the fiber optic wire drawing change for 1 page.

3.67) DAD.1-0501/2551 on 8 February 2008
The user of the building requires changing the drawing (requirement).
Cause the air-condition system drawing change for 1 page.

3.68) DAD.1-0502/2551 on 8 February 2008
The user of the building requires changing the drawing (requirement).
Cause the electrical system and single line diagram drawing change for 4 pages.

3.69) DAD.1-0571/2551 on 15 February 2008
The user of the building requires changing the drawing (requirement).
Cause the installation of lamp and interface process of telecommunication system drawing change for 4 pages.

3.70) DAD.1-0572/2551 on 15 February 2008
The user of the building requires changing the drawing (requirement).
Cause the BAS point summary and telecommunication system drawing change for 37 pages.

3.71) DAD.1-0573/2551 on 15 February 2008
The user of the building requires changing the drawing (requirement).
Cause the smoke detector, exit light and power supply system drawing change for 20 pages.

3.72) DAD.1-0684/2551 on 27 February 2008
The user of the building requires changing the drawing (requirement).
Cause the lighting plan of 2nd basement floor and two way remote panel schedule drawing change for 7 pages.

4. The Forth Addendum 18 November 2008

The Forth addendum is concern with the change of construction cost 89,598,514.16 baht from 2,018,808,168.73 to 2,108,406,682.89 (4.94%) baht because of the additional requirement of the client and user of the building. The detail of change is can be summarized as:

4.1) DAD.1654/2549 on 17 July 2006
The user of the building requires changing the drawing (requirement).
Cause the architecture drawing change for 1 page.

4.2) DAD.1-940/2549 on 22 August 2006
The user of the building notices changing the drawing (requirement).
Cause the architecture and M&E drawing change.

4.3) DAD.1-121/2550 on 30 January 2007
The user of the building requires changing the drawing (requirement).
Cause the audiovisual aids 1st basement floor, 2nd floor and 3rd floor drawing change for 4 pages.

4.4) DAD.1-142/2550 on 2 February 2007
The user of the building requires changing the drawing (requirement).
Impact to the interior work 1st floor, 3rd floor, 4th floor and 5th, seminar room and investigate room drawing change for 60 pages.

4.5) DAD.1-266/2550 on 2 March 2007
The user of the building requires changing the drawing (requirement).
Impact to the interior work 1st basement floor, 9th floor and 10th, kitchen room , outside building architecture and M&E work drawing change for 95 pages.

4.6) DAD.1-276/2550 on 2 March 2007
The user of the building requires changing the drawing (requirement).

Impact to the interior work 1st basement floor, 9th floor and 10th, kitchen room , outside building architecture and M&E work drawing change for 95 pages.

4.7) DAD.1-549/2550 on 4 April 2007
The user of the building requires changing the drawing (requirement).
Cause the architecture work (building layout, gas station layout, and basement ceiling) electrical system, load schedule, 2 wire remote schedule and specification of nurse call drawing change for 106 pages.

4.8) DAD.1-590/2550 on 10 April 2007
The user of the building requires changing the drawing (requirement).
Cause the 1st basement fire protection and alarm system drawing change for 1 page.

4.9) DAD.1-792/2550 on 11 May 2007
The user of the building requires changing the specification of material (requirement).
Cause the architecture specification change.

4.10) DAD.1-1315/2550 on 16 July 2007
The user of the building requires changing the drawing (requirement).
Cause the TV outlet layout, power supply system, detail of fountain, cat walk service, softscape work, detail of door and piping route drawing change for 17 pages.

4.11) DAD.1-1424/2550 on 21 July 2007
The user of the building requires changing the drawing (requirement).
Cause the basement ceiling layout, detail of balcony and detail of the pin drawing change for 3 pages.

4.12) DAD.1-1703/2550 on 10 September 2007
The user of the building requires changing the drawing (requirement).
Cause the lighting system outside building and load of two way remote drawing change for 16 pages.

4.13) DAD.1-1720/2550 on 10 September 2007

The user of the building requires changing the drawing (requirement).

Cause the architecture of reservation area on the 6th floor, mechanical system, electrical system and electrical load schedule drawing change for 8 pages.

4.14) DAD.1-1722/2550 on 10 September 2007

The user of the building requires changing the drawing (requirement).

Cause panel load schedule and electrical diagram on the 3rd floor drawing change for 8 pages.

4.15) DAD.1-1723/2550 on 10 September 2007

The user of the building requires changing the drawing (requirement).

Cause the detail of fence and detail of guard house drawing change for 1 page.

4.16) DAD.1-1724/2550 on 10 September 2007

The user of the building requires changing the drawing (requirement).

Cause the detail of café drawing change for 3 pages.

4.17) DAD.1-1725/2550 on 10 September 2007

The user of the building requires changing the drawing (requirement).

Cause the detail of built-in closet, ceiling layout of collection room, ceiling layout of reading room and detail of parking roof drawing change for 3 pages.

4.18) DAD.1-1726/2550 on 10 September 2007

The user of the building requires changing the drawing (requirement).

Cause the base of King Rama the 5th monument drawing change for 5 pages.

4.19) DAD.1-2034/2550 on 9 October 2007

The user of the building requires changing the drawing (requirement).

Cause the detail of sign and detail of symbol drawing change for 9 pages.

4.20) DAD.1-2162/2550 on 29 October 2007
The user of the building requires changing the drawing (requirement).
Cause the building sign and detail of window drawing change for 5 pages.

4.21) DAD.1-2171/2550 on 30 October 2007
The user of the building requires changing the drawing (requirement).
Cause the architecture and piping system of driver room drawing change for 6 pages.

4.22) DAD.1-2230/2550 on 7 November 2007
The user of the building requires changing the drawing (requirement).
Cause the air-condition system 9^{th} floor to 11^{th} floor, panel board load schedule 2^{nd} floor to 4^{th} floor and two-way remote panel schedule drawing change for 7 pages.

4.23) DAD.1-2231/2550 on 7 November 2007
The user of the building requires changing the drawing (requirement).
Cause the floor plan of 10^{th} floor and ceiling plan 10^{th} floor drawing change for 2 pages.

4.24) DAD.1-2233/2550 on 7 November 2007
The user of the building requires changing the drawing (requirement).
Cause the building sign at the roof drawing change for 1 page.

4.25) DAD.1-2242/2550 on 7 November 2007
The user of the building requires changing the drawing (requirement).
Cause the circulation area drawing change for 1 page.

4.26) DAD.1-2332/2550 on 19 November 2007
The user of the building requires changing the drawing (requirement).
Cause the floor plan of 4^{th} floor drawing change for 1 page.

4.27) DAD.1-2354/2550 on 21 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of book closet drawing change for 1 page.

4.28) DAD.1-2355/2550 on 21 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of fence and detail of guard house drawing change for 2 pages.

4.29) DAD.1-2407/2550 on 27 November 2007
The user of the building requires changing the drawing (requirement).
Cause the electrical system of café, lighting system of outside building, electrical system of 10^{th} floor meeting room and panel board load schedule drawing change for 13 pages.

4.30) DAD.1-2408/2550 on 27 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of disable entrance drawing change for 3 pages.
4.31) DAD.1-2409/2550 on 27 November 2007
The user of the building requires changing the drawing (requirement).
Cause the floor plan of 6^{th} floor drawing change for 1 page.

4.32) DAD.1-2410/2550 on 27 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of pin drawing change for 1 page.

4.33) DAD.1-2418/2550 on 28 November 2007
The user of the building requires changing the drawing (requirement).
Cause the detail of electrical system change for 1 page.

4.34) DAD.1-2425/2550 on 30 November 2007
The user of the building requires changing the drawing (requirement).
Cause the ceiling plan of 10^{th} floor change for 1 page.

4.35) DAD.1-2426/2550 on 30 November 2007
The user of the building requires changing the drawing (requirement).
Cause the interior work of justice room change for 7 pages.

4.36) DAD.1-2427/2550 on 30 November 2007
The user of the building requires changing the drawing (requirement).
Cause the two wire remote system and layout of lighting system on the parking area change for 4 pages.

4.37) DAD.1-2671/2550 on 26 December 2007
The user of the building requires adding the equipment (requirement).
Cause the fiber optic wire drawing change for 1 page.

4.38) DAD.1-0032/2551 on 4 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of ceiling plan for 7^{th} floor to 10^{th} floor drawing change for 4 pages.
4.39) DAD.1-0033/2551 on 4 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of fence and detail of guard house drawing change for 2 pages.

4.40) DAD.1-0034/2551 on 4 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of fire protection system and server room layout drawing change for 4 pages.

4.41) DAD.1-0173/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of swimming pool drawing change for 4 pages.

4.42) DAD.1-0174/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of floor plan 1st basement floor to 11th floor drawing change for 4 pages.

4.43) DAD.1-0175/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of picture drawing change for 1 page.

4.44) DAD.1-0176/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the detail of lamp drawing change for 2 pages.

4.45) DAD.1-0177/2551 on 9 January 2008
The user of the building requires changing the drawing (requirement).
Cause the fire protection system, telephone riser diagram, fire alarm sound and CCTV system drawing change for 6 pages.

4.46) DAD.1-0224/2551 on 17 January 2008
The user of the building requires changing the drawing (requirement).
Cause to stop the construction of fence and guard house.

4.47) DAD.1-0225/2551 on 17 January 2008
The user of the building requires changing the drawing (requirement).
Cause to stop the construction of justice room on the 6th floor.

4.48) DAD.1-0226/2551 on 17 January 2008
The user of the building requires changing the drawing (requirement).
Cause to stop the construction of lighting system outside building.

4.49) DAD.1-0336/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the air condition system on 9th floor to 10th floor drawing change for 2 pages.

4.50) DAD.1-0337/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the furniture layout, detail of meeting room and detail of reservation room drawing change for 4 pages.

4.51) DAD.1-0338/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the specification of lighting system outside building, panel board load schedule, lighting system layout, ground floor lighting plan, 2nd floor lighting plan, 4th floor lighting plan and deck floor lighting plan drawing change for 12 pages.

4.52) DAD.1-0339/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the detail of ward, ceiling plan of 1st basement floor and detail of window drawing change for 5 pages.

4.53) DAD.1-0340/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the floor plan of 1st basement floor and air condition system of reservation building drawing change for 2 pages.

4.54) DAD.1-0341/2551 on 23 January 2008

The user of the building requires changing the drawing (requirement).

Cause the detail of justice room and furniture layout of 6th floor drawing change for 3 pages.

4.55) DAD.1-0442/2551 on 4 February 2008

The user of the building requires changing the drawing (requirement).

Cause the electrical system and lighting system of guard house drawing change for 6 pages.

4.56) DAD.1-0467/2551 on 6 February 2008

The user of the building requires changing the drawing (requirement).

Cause the floor plan and ceiling plan of additional reservation area on 6^{th} floor drawing change for 1 page.

4.57) DAD.1-0500/2551 on 8 February 2008

The user of the building requires changing the drawing (requirement).

Cause the fiber optic wire drawing change for 1 page.

4.58) DAD.1-0501/2551 on 8 February 2008

The user of the building requires changing the drawing (requirement).

Cause the air-condition system drawing change for 1 page.

4.59) DAD.1-0502/2551 on 8 February 2008

The user of the building requires changing the drawing (requirement).

Cause the electrical system and single line diagram drawing change for 4 pages.

4.60) DAD.1-0571/2551 on 15 February 2008

The user of the building requires changing the drawing (requirement).

Cause the installation of lamp and interface process of telecommunication system drawing change for 4 pages.

4.61) DAD.1-0572/2551 on 15 February 2008

The user of the building requires changing the drawing (requirement).

Cause the BAS point summary and telecommunication system drawing change for 37 pages.

4.62) DAD.1-0573/2551 on 15 February 2008

The user of the building requires changing the drawing (requirement).

Cause the smoke detector, exit light and power supply system drawing change for 20 pages.

4.63) DAD.1-0684/2551 on 27 February 2008

The user of the building requires changing the drawing (requirement).

Cause the lighting plan of 2nd basement floor and two way remote panel schedule drawing change for 7 pages.

4.64) DAD.1-0776/2551 on 6 March 2008

The user of the building requires changing the drawing (requirement).

Cause the ceiling plan of justice room drawing change for 5 pages.

4.65) DAD.1-0777/2551 on 6 March 2008

The user of the building requires changing the drawing (requirement).

Cause the detail of fence, detail of justice room and detail of furniture on 2nd floor drawing change for 4 pages.

4.66) DAD.1-0778/2551 on 6 March 2008

The user of the building requires changing the drawing (requirement).

Cause the electrical system, architecture and air-condition system drawing change for 10 pages.

4.67) DAD.1-0785/2551 on 6 March 2008

The user of the building requires changing the drawing (requirement).

Cause the fountain system drawing change for 1 page.

4.68) DAD.1-0786/2551 on 6 March 2008

The user of the building requires changing the drawing (requirement).

Cause the architecture drawing change for 1 page.

4.69) DAD.1-0834/2551 on 11 March 2008

The user of the building requires changing the drawing and specification of material (requirement).

Cause the architecture specification and drawing, and water leakage detectors drawing change for 17 pages.

4.70) DAD.1-0835/2551 on 11 March 2008

The user of the building requires changing the drawing (requirement).

Cause the floor drain system drawing change for 4 pages.

4.71) DAD.1-1664/2551 on 21 May 2008

The user of the building requires changing the drawing (requirement).

Cause the load schedule, single line diagram, underground electrical system and diagram of air condition control system drawing change for 6 pages.

4.72) DAD.1-1832/2551 on 30 May 2008

The user of the building requires changing the drawing (requirement).

Cause the panel board load schedule and riser diagram drawing change for 5 pages.

4.73) DAD.1-1863/2551 on 4 June 2008

The user of the building requires changing the drawing (requirement).

Cause the power supply of audio visual aids, telephone riser diagram, roof plan, floor plan of 2nd floor and detail of window drawing change for 10 pages.

4.74) DAD.1-1914/2551 on 10 June 2008

The user of the building requires changing the drawing (requirement).

Cause the air-condition system of reservation building, balancing valve system, detail of closet in the reservation building and furniture layout of 2nd floor library drawing change for 12 pages.

4.75) DAD.1-1915/2551 on 10 June 2008
The user of the building requires changing the drawing (requirement).
Cause the base of lighting outside building, lamp of lighting outside building, CCTV system, BAS system and pattern of cafeteria drawing change for 17 pages.

4.76) DAD.1-1961/2551 on 12 June 2008
The user of the building requires changing the drawing (requirement).
Cause the roof structure of reservation building drawing change for 1 page.

4.77) DAD.1-2175/2551 on 3 July 2008
The user of the building requires changing the drawing (requirement).
Cause the boundary of cleaning of contractor drawing change for 4 pages.

According to 77 variation orders from requirement of the client and user of the building to contractor, the result and analyzes as Table 4.3. From the Table 4.3, client has 77 variation orders from requirement of the client and user of the building to contractor. The 77 variation orders affect to the cost of construction for 89,598,514.16 baht. This change can be summarized in term of type of work and cost of change as the following:

1. Architecture38 orders 10,594,706.97baht
2. Civil 0 order 0 baht
3. Mechanical and Electrical Work
3.1 Water Supply and Sanitary System 6 orders 535,165.89 baht
3.2 Electrical and Telecommunication 34 orders 30,182,799.49 baht
3.3 Air-Conditioning System 8 orders 14,500,890.58 baht
3.4 Miscellaneous Work 6 orders 2,887,340.03 baht
4. Interior Work 11 orders 24,242,136.28 baht
5. Special Cost 6,655,474.92 for 153 days (Third Addendum)

From the result of the fourth addendums in construction contract, the analysis in term of cause and their impact came from the requirement of the client and user of the building. The analysis of the type of work and the frequency of change can be obtain as shown in table 4.4, Figure 4.1, 4.2, 4.3, 4.4 and 4.5.

Table 4.1 Addendum of Construction Contract (1) Office Building of Administrative Court
บันทึกข้อตกลงแก้ไขเพิ่มเติม สัญญาจ้างงานก่อสร้างอาคารที่ทำการศาลปกครอง (ครั้งที่ 1)

No	Description	Date	Impact		Cause of Change	Type of Work	Detail of Change
			Cost (Baht)	Schedule (Day)			
1	DAD 1654/2549	17/7/2006	-	27.57	Requirment	Architecture	User change drawing
2	DAD 1-1940/2549	22/8/2006	-	27.57	Requirment	Architecture, M&E	User change system
3	DAD 1-3924/2549	22/12/2006	-	27.57	Requirment	Architecture, M&E	User change drawing
4	DAD 1-3968/2549	29/12/2006	-	27.57	Requirment	Architecture, M&E	User change drawing
5	DAD 1-101/2550	26/1/2007	-	27.57	Requirment	Architecture, M&E	User change drawing
6	DAD 1-121/2550	30/1/2007	-	27.57	Requirment	M&E	User Adding System
7	DAD 1-142/2550	2/2/2007	-	27.57	Requirment	Architecture	User change drawing
8	DAD 1-266/2550	2/3/2007	-	15.00	Requirment	Architecture, M&E	User change drawing
9	DAD 1-276/2550	2/3/2007	-	15.00	Requirment	Architecture, M&E	User change drawing
10	DAD 1-549/2550	4/4/2007	-	15.00	Requirment	Architecture, M&E	User change drawing
11	DAD 1-590/2550	10/4/2007	-	15.00	Requirment	M&E	User change system
12	DAD 1-598/2550	11/4/2007	-	15.00	Requirment	Architecture	User change material
13	DAD 1-599/2550	11/4/2007	-	15.00	Requirment	Architecture	User change material
Total			-	283.00			

Cause of Change

Requirment	283.00	Days	Arhitecture	11 orders	
	-	Baht	M&E	9 orders	

Type of Work

Architecture and Interior	162.79	Days	User Change Drawing	182.86	8
M&E	120.21	Days	User Change System	42.57	2
Total	283.00	Days	User Adding System	27.57	1
			User Change Material	30.00	2
				283.00	13

Table 4.2 Addendum of Construction Contract (3) Office Building of Administrative Court
บันทึกข้อตกลงแก้ไขเพิ่มเติม สัญญาจ้างงานก่อสร้างอาคารที่ทำการศาลปกครอง (ครั้งที่ 3)

No	Description	Date	Impact										Cause of Change	Detail of Change
			Cost (Baht)									Schedule (Day)		
			Architecture	Civil	M&E				Interior	Overhead	Total			
					W/S & San	Electrical	A/C	miscellaneous						
1	DAD 1654/2549	17/7/2006	6,346,506.38							12,571,929.21	18,918,435.59	3.26	Requirment	User change drawing
2	DAD 1-1940/2549	22/8/2006										3.26	Requirment	User change system
3	DAD 1-3924/2549	22/12/2006	6,346,506.38		187,429.23	2,955,524.13	5,361,532.00	348,156.37			15,199,148.12	3.26	Requirment	User change drawing
4	DAD 1-3968/2549	29/12/2006	6,346,506.38		187,429.23	2,955,524.13	5,361,532.00	348,156.37			15,199,148.12	3.26	Requirment	User change drawing
5	DAD 1-101/2550	26/1/2007	6,346,506.38	404,297.81	187,429.23	2,955,524.13	5,361,532.00	348,156.37			15,603,445.93	3.26	Requirment	User change drawing
6	DAD 1-121/2550	30/1/2007										3.26	Requirment	User Adding System
7	DAD 1-142/2550	2/2/2007							10,815,375.06		10,815,375.06	3.26	Requirment	User change drawing
8	DAD 1-266/2550	2/3/2007							10,815,375.06		10,815,375.06	3.26	Requirment	User change drawing
9	DAD 1-276/2550	2/3/2007	6,346,506.38		187,429.23	2,955,524.13	5,361,532.00	348,156.37	10,815,375.06		26,014,523.18	3.26	Requirment	User change drawing
10	DAD 1-549/2550	4/4/2007	6,346,506.38		187,429.23	2,955,524.13	5,361,532.00	348,156.37			15,199,148.12	3.26	Requirment	User change drawing
11	DAD 1-590/2550	10/4/2007										3.26	Requirment	User change system
12	DAD 1-598/2550	11/4/2007							10,815,375.06		10,815,375.06	3.26	Requirment	User change material
13	DAD 1-599/2550	11/4/2007	6,346,506.38								6,346,506.38	3.26	Requirment	User change material
14	DAD 1-792/2550	11/5/2007										3.26	Requirment	User change material
15	DAD 1-944/2550	8/6/2007										3.26	Requirment	User adding work
16	DAD 1-991/2550	11/6/2007							10,815,375.06		10,815,375.06	3.26	Requirment	User adding work
17	DAD 1-1181/2550	27/6/2007	6,346,506.38		187,429.23	2,955,524.13	5,361,532.00	348,156.37	10,815,375.06		26,014,523.18	3.26	Requirment	User adding work
18	DAD 1-1315/2550	16/7/2007	6,346,506.38		187,429.23	2,955,524.13	5,361,532.00	348,156.37			15,199,148.12	-	Requirment	User change drawing
19	DAD 1-1424/2550	27/7/2007										3.26	Requirment	User change drawing
20	DAD 1-1533/2550	10/8/2007			187,429.23	2,955,524.13	5,361,532.00	348,156.37			8,852,641.74	3.26	Requirment	User adding work
21	DAD 1-1703/2550	10/9/2007										3.26	Requirment	User adding work
22	DAD 1-1720/2550	10/9/2007										3.26	Requirment	User change drawing
23	DAD 1-1722/2550	10/9/2007										3.26	Requirment	User change drawing
24	DAD 1-1723/2550	10/9/2007										3.26	Requirment	User change drawing
25	DAD 1-1724/2550	10/9/2007										3.26	Requirment	User change drawing
26	DAD 1-1725/2550	10/9/2007										3.26	Requirment	User change drawing
27	DAD 1-1726/2550	10/9/2007										3.26	Requirment	User change drawing
28	DAD 1-2034/2550	9/10/2007										3.26	Requirment	User change drawing
29	DAD 1-2162/2550	29/10/2007										3.26	Requirment	User change drawing
30	DAD 1-2171/2550	30/10/2007										3.26	Requirment	User change drawing
31	DAD 1-2230/2550	7/11/2007										3.26	Requirment	User change drawing
32	DAD 1-2231/2550	7/11/2007										3.26	Requirment	User change drawing
33	DAD 1-2232/2550	7/11/2007										3.26	Requirment	User change drawing
34	DAD 1-2233/2550	7/11/2007										3.26	Requirment	User change drawing
35	DAD 1-2332/2550	19/11/2007										3.26	Requirment	User change drawing
36	DAD 1-2354/2550	21/11/2007										3.26	Requirment	User change drawing
37	DAD 1-2355/2550	21/11/2007										3.26	Requirment	User change drawing
38	DAD 1-2407/2550	27/7/2007										3.26	Requirment	User change drawing
39	DAD 1-2408/2550	27/7/2007										3.26	Requirment	User change drawing
40	DAD 1-2409/2550	27/7/2007										3.26	Requirment	User change drawing
41	DAD 1-2410/2550	27/7/2007										3.26	Requirment	User change drawing
42	DAD 1-2418/2550	28/7/2007										3.26	Requirment	User change drawing
43	DAD 1-2425/2550	30/11/2007										3.26	Requirment	User change drawing
44	DAD 1-2426/2550	30/11/2007										3.26	Requirment	User change drawing
45	DAD 1-2427/2550	30/11/2007										3.26	Requirment	User change drawing
46	DAD 1-2671/2550	26/12/2007										3.26	Requirment	User change drawing
47	DAD 1-0032/2551	4/1/2007										3.26	Requirment	User change drawing
48	DAD 1-0033/2551	5/11/2007										3.26	Requirment	User change drawing
Total			57,118,557.45	404,297.81	1,499,433.87	23,644,193.06	42,892,256.00	2,785,250.97	64,892,250.36	12,571,929.21	205,808,168.73	153.00		
		Schedule Delay	48.13	1.72	18.91	32.66	18.91	13.75	18.91		153.00			

Table 4.3 Addendum of Construction Contract (4) Office Building of Administrative Court
บันทึกข้อตกลงแก้ไขเพิ่มเติม สัญญาจ้างงานก่อสร้างอาคารที่ทำการศาลปกครอง (ครั้งที่ 4)

No	Description	Date	Impact Cost (Baht)									Cause of Change	Detail of Change
			Architecture	Civil	M&E				Interior	Special Cost	Total		
					W/S & San	Electrical	A/C	miscellaneous					
1	DAD 1654/2549	17/7/2006	402,145.93		-103,598.51	1,273,647.34	2,437,394.86	1,821,380.20	10,406,369.36	6,220,070.02	16,237,339.18	Requirment	User change drawing
2	DAD 1-1940/2549	22/8/2006									0.00	Requirment	User change system
3	DAD 1-121/2550	30/1/2007				154,210.50					154,210.50	Requirment	User Adding System
4	DAD 1-142/2550	2/2/2007							804,043.10		804,043.10	Requirment	User change drawing
5	DAD 1-266/2550	2/3/2007							2,577,075.55		2,577,075.55	Requirment	User change drawing
6	DAD 1-276/2550	2/3/2007							-4,059,358.57		-4,059,358.57	Requirment	User change drawing
7	DAD 1-549/2550	4/4/2007				3,485,862.49					3,485,862.49	Requirment	User change drawing
8	DAD 1-590/2550	10/4/2007									0.00	Requirment	User change system
9	DAD 1-792/2550	11/5/2007	-32,500.00								-32,500.00	Requirment	User change material
10	DAD 1-1315/2550	16/7/2007	-1,534,263.20								-1,534,263.20	Requirment	User change drawing
11	DAD 1-1424/2550	27/7/2007	78,833.33								78,833.33	Requirment	User change drawing
12	DAD 1-1703/2550	10/9/2007									0.00	Requirment	User adding work
13	DAD 1-1720/2550	10/9/2007			125,808.15	5,256,098.70	7,488,702.98				12,870,609.83	Requirment	User change drawing
14	DAD 1-1722/2550	10/9/2007				83,993.00					83,993.00	Requirment	User change drawing
15	DAD 1-1723/2550	10/9/2007	281,329.76			127,295.73					408,625.49	Requirment	User change drawing
16	DAD 1-1724/2550	10/9/2007									0.00	Requirment	User change drawing
17	DAD 1-1725/2550	10/9/2007	-1,534,263.20								-1,534,263.20	Requirment	User change drawing
18	DAD 1-1726/2550	10/9/2007	445,314.85								445,314.85	Requirment	User change drawing
19	DAD 1-2034/2550	9/10/2007									0.00	Requirment	User change drawing
20	DAD 1-2162/2550	29/10/2007	78,833.33								78,833.33	Requirment	User change drawing
21	DAD 1-2171/2550	30/10/2007	74,222.13								74,222.13	Requirment	User change drawing
22	DAD 1-2230/2550	7/11/2007					1,531,583.78				1,531,583.78	Requirment	User change drawing
23	DAD 1-2231/2550	7/11/2007									0.00	Requirment	User change drawing
24	DAD 1-2233/2550	7/11/2007									0.00	Requirment	User change drawing
25	DAD 1-2242/2550	19/11/2007									0.00	Requirment	User change drawing
26	DAD 1-2332/2550	19/11/2007	8,268.27					111,419.60			119,687.87	Requirment	User change drawing
27	DAD 1-2354/2550	21/11/2007							-7,500.00		-7,500.00	Requirment	User change drawing
28	DAD 1-2355/2550	21/11/2007	281,329.76								281,329.76	Requirment	User change drawing
29	DAD 1-2407/2550	27/11/2007				543,581.37					543,581.37	Requirment	User change drawing
30	DAD 1-2408/2550	27/11/2007	294,055.60								294,055.60	Requirment	User change drawing
31	DAD 1-2409/2550	27/11/2007									0.00	Requirment	User change drawing
32	DAD 1-2410/2550	27/11/2007	78,833.33								78,833.33	Requirment	User change drawing
33	DAD 1-2418/2550	28/11/2007									0.00	Requirment	User change drawing
34	DAD 1-2425/2550	30/11/2007									0.00	Requirment	User change drawing
35	DAD 1-2426/2550	30/11/2007				1,611,412.60					1,611,412.60	Requirment	User change drawing
36	DAD 1-2427/2550	30/11/2007									0.00	Requirment	User change drawing
37	DAD 1-2671/2550	26/12/2007				83,611.31					83,611.31	Requirment	User change drawing
38	DAD 1-0032/2551	4/1/2008	438,915.40			723,621.31					1,162,536.71	Requirment	User change drawing
39	DAD 1-0033/2551	4/1/2008	281,329.76								281,329.76	Requirment	User change drawing
40	DAD 1-0034/2551	4/1/2008	8,268.27			690,900.94		70,036.54			769,205.75	Requirment	User change drawing

Table 4.3 Addendum of Construction Contract (4) Office Building of Administrative Court
บันทึกข้อตกลงแก้ไขเพิ่มเติม สัญญาจ้างงานก่อสร้างอาคารที่ทำการศาลปกครอง (ครั้งที่ 4)

No	Description	Date	Impact Cost (Baht)									Cause of Change	Detail of Change
			Architecture	Civil	M&E				Interior	Special Cost	Total		
					W/S & San	Electrical	A/C	miscellaneous					
33	DAD 1-2418/2550	28/11/2007									0.00	Requirement	User change drawing
34	DAD 1-2425/2550	30/11/2007									0.00	Requirement	User change drawing
35	DAD 1-2426/2550	30/11/2007				1,611,412.60					1,611,412.60	Requirement	User change drawing
36	DAD 1-2427/2550	30/11/2007									0.00	Requirement	User change drawing
37	DAD 1-2671/2550	26/12/2007				83,611.31					83,611.31	Requirement	User change drawing
38	DAD 1-0032/2551	4/1/2008	438,915.40			723,621.31					1,162,536.71	Requirement	User change drawing
39	DAD 1-0033/2551	4/1/2008	281,329.76								281,329.76	Requirement	User change drawing
40	DAD 1-0034/2551	4/1/2008	8,268.27			690,900.94		70,036.54			769,205.75	Requirement	User change drawing
41	DAD 1-0173/2551	9/1/2008	407,503.14			213,539.42					621,042.56	Requirement	User change drawing
42	DAD 1-1074/2551	9/1/2008	373,070.45								373,070.45	Requirement	User change drawing
43	DAD 1-0175/2551	9/1/2008	808,066.98								808,066.98	Requirement	User change drawing
44	DAD 1-0176/2551	9/1/2008									0.00	Requirement	User change drawing
45	DAD 1-0177/2551	9/1/2008			443,152.00	1,876,812.04					2,319,964.04	Requirement	User change drawing
46	DAD 1-0224/2551	17/1/2008	281,329.76								281,329.76	Requirement	User change drawing
47	DAD 1-0225/2551	17/1/2008									0.00	Requirement	User change drawing
48	DAD 1-0226/2551	17/1/2008									0.00	Requirement	User change drawing
49	DAD 1-0336/2551	23/1/2008				1,096,179.54					1,096,179.54	Requirement	User change drawing
50	DAD 1-0337/2551	23/1/2008						437,857.58	5,963,782.56		6,401,640.14	Requirement	User change drawing
51	DAD 1-0338/2551	23/1/2008				3,507,699.66					3,507,699.66	Requirement	User change drawing
52	DAD 1-0339/2551	23/1/2008	3,545,386.70						1,952,862.82		5,498,249.53	Requirement	User change drawing
53	DAD 1-0340/2551	23/1/2008	243,931.55								243,931.55	Requirement	User change drawing
54	DAD 1-0341/2551	23/1/2008							1,952,862.82		1,952,862.82	Requirement	User change drawing
55	DAD 1-0442/2551	4/2/2008				97,243.18					97,243.18	Requirement	User change drawing
56	DAD 1-0467/2551	6/2/2008	3,205,193.00								3,205,193.00	Requirement	User change drawing
57	DAD 1-0500/2551	8/2/2008									0.00	Requirement	User change drawing
58	DAD 1-0501/2551	8/2/2008					1,123,188.45				1,123,188.45	Requirement	User change drawing
59	DAD 1-0502/2551	8/2/2008				1,262,560.33					1,262,560.33	Requirement	User change drawing
60	DAD 1-0571/2551	15/2/2008				485,298.19					485,298.19	Requirement	User change drawing
61	DAD 1-0572/2551	15/2/2008									0.00	Requirement	User change drawing
62	DAD 1-0573/2551	15/2/2008				644,652.10					644,652.10	Requirement	User change drawing
63	DAD 1-0684/2551	27/2/2008				57,653.27					57,653.27	Requirement	User change drawing
64	DAD 1-0776/2551	6/3/2008									0.00	Requirement	User change drawing
65	DAD 1-0777/2551	6/3/2008									0.00	Requirement	User change drawing
66	DAD 1-0778/2551	6/3/2008	689,385.48			1,209,529.28					1,898,914.76	Requirement	User change drawing
67	DAD 1-0785/2551	6/3/2008									0.00	Requirement	User change drawing
68	DAD 1-0786/2551	6/3/2008	8,268.27					70,036.54			78,304.81	Requirement	User change drawing
69	DAD 1-0834/2551	11/3/2008				1,113,802.51	28,600.00		1,314,281.49		2,456,684.00	Requirement	User change drawing
70	DAD 1-0835/2551	11/3/2008									0.00	Requirement	User change drawing
71	DAD 1-1664/2551	21/5/2008									0.00	Requirement	User change drawing
72	DAD 1-1802/2551	30/5/2008				472,794.75					472,794.75	Requirement	User change drawing
73	DAD 1-1862/2551	4/6/2008									0.00	Requirement	User change drawing
74	DAD 1-1914/2551	10/6/2008									0.00	Requirement	User change drawing
75	DAD 1-1915/2551	10/6/2008									0.00	Requirement	User change drawing
76	DAD 1-1961/2551	12/6/2008									0.00	Requirement	User change drawing
77	DAD 1-2175/2551	3/7/2008									0.00	Requirement	User change drawing
Total			9,212,788.67	0.00	465,361.64	26,071,999.56	12,609,470.07	2,510,730.46	20,904,419.14	0.00	71,774,769.54		
									Adding Profit anf Overhead cost 8%		77,516,859.10		
									Adding Special Cost due to Delay		83,736,929.12	6,220,070.02	
									Add Vat 7 %		89,598,514.16		

Table 4.4 the analysis of work type that change in the project and the frequency of change in each work.

Table 4.4

The analysis of work's type that change in the project and frequency of change in each work

No	Description	Frequency of Variation Order				Cost Impact (Baht)				Schedule Impact (Days)				Average impact/Frequency	
		Add 1	Add 3	Add 4	Total	Add 1	Add 3	Add 4	Total	Add 1	Add 3	Add 4	Total	Cost (baht)	Schedule (Days)
1	Architecture	11	28	38	77	-	57,118,557.45	10,594,706.97	67,713,264.42	81.40	48.13	-	129.53	879,393.04	1.68
2	Civil	-	1	-	1	-	404,297.81	-	404,297.81	-	1.72	-	1.72	404,297.81	1.72
3	Water Supply & Sanitary System	9	11	6	26	-	1,499,433.87	535,165.89	2,034,599.76	30.05	18.91	-	48.96	78,253.84	1.88
4	Electrical and Telecommunication	9	19	34	62	-	23,644,193.06	30,182,799.49	53,826,992.55	30.05	32.66	-	62.71	868,177.30	1.01
5	Air-Conditioning System	9	11	8	28	-	42,892,256.00	14,500,890.58	57,393,146.58	30.05	18.91	-	48.96	2,049,755.24	1.75
6	Miscellaneous	9	8	6	23	-	2,785,250.97	2,887,340.03	5,672,591.00	30.05	13.75	-	43.80	246,634.39	1.90
7	Interior Work	11	11	11	33	-	64,892,250.36	24,242,136.28	89,134,386.64	81.40	18.91	-	100.31	2,701,042.02	3.04
8	Special Cost	-	-	-	-	-	12,571,929.21	6,655,474.92	19,227,404.13						
	Total	58	89	103	250	0	205,808,168.73	89,598,514.16	295,406,682.89	283.00	153.00	-	436.00		

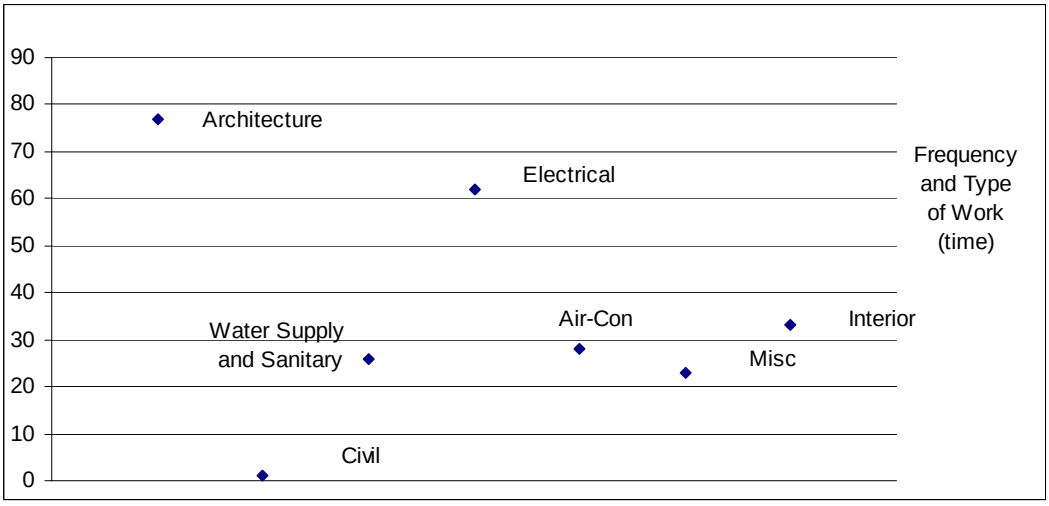


Figure 4.1 The relationship between Frequency and type of work

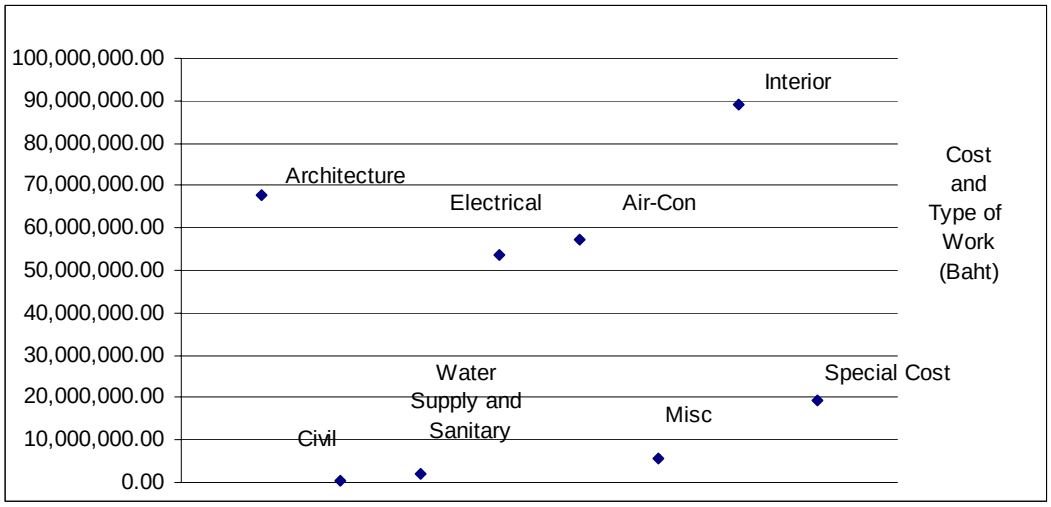


Figure 4.2 The relationship between Cost and Type of Work

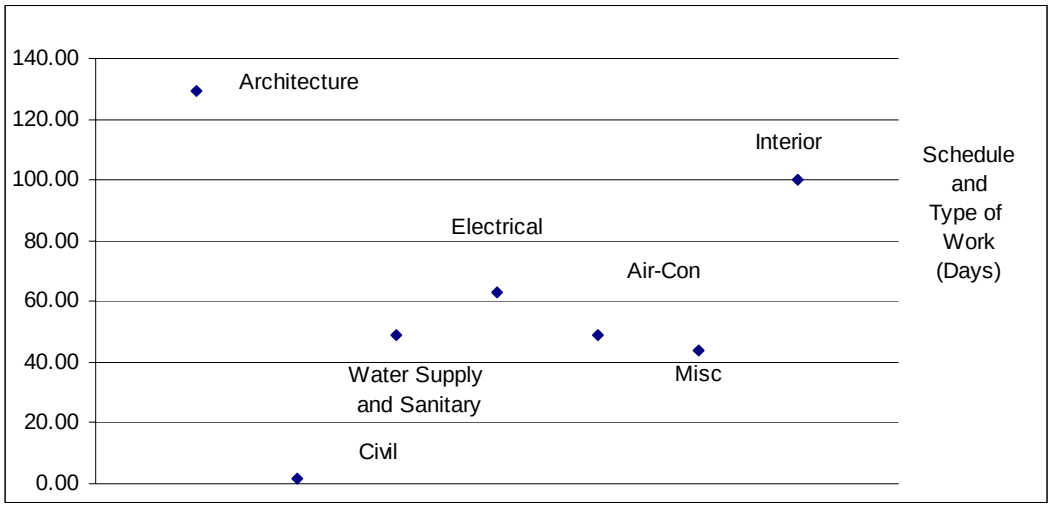


Figure 4.3 The relationship between schedule and type of work

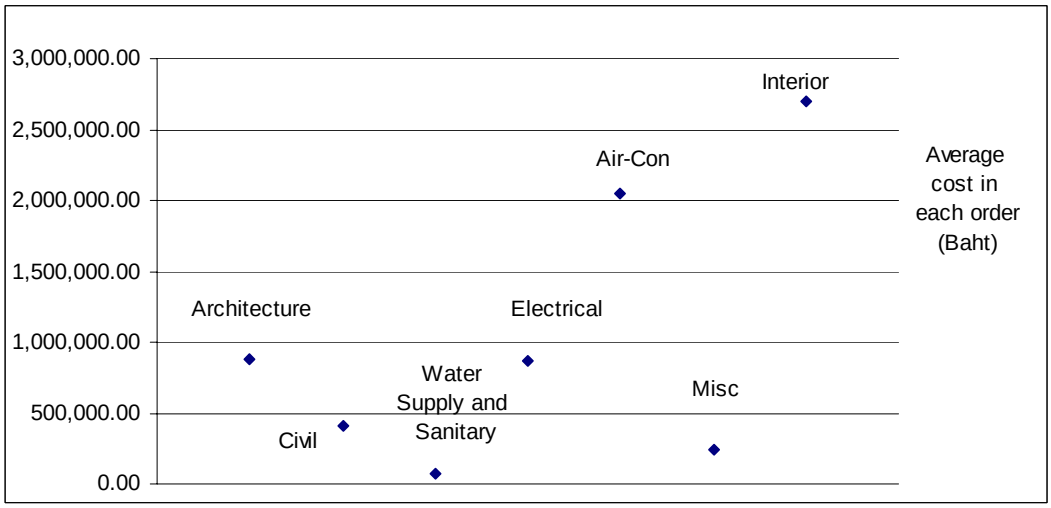


Figure 4.4 The relationship between Average cost in each order

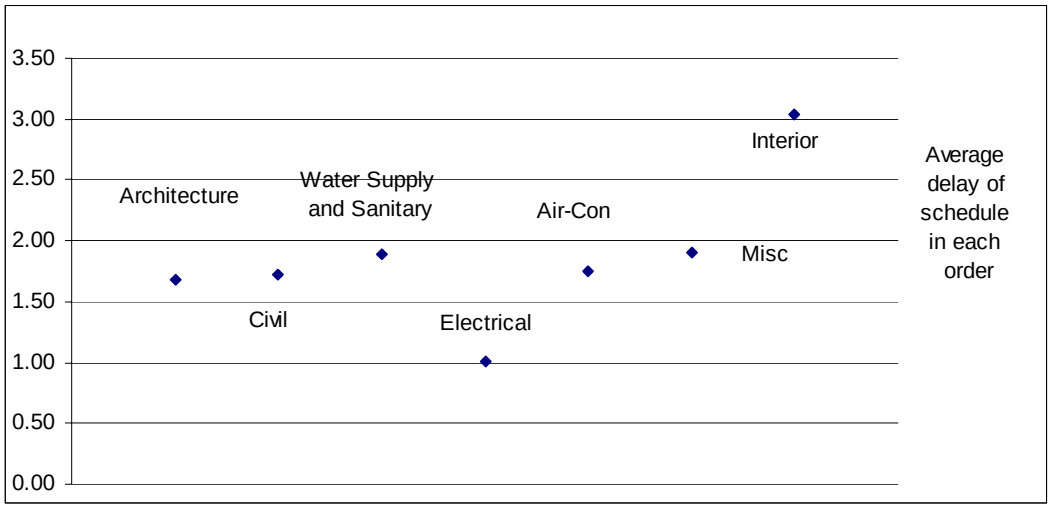


Figure 4.5 The relationship between average delay of schedule in each order

According to the cause of change coming from the requirement of the building' user and client, the detail of change is the useful factor to analyze the detail of change and their cost and schedule impact including average impact in each times. The detail of change can be categorized as follows:

1. User changes drawing – User decides to change the contract drawing in detail, so the construct will be delay and will start when the new drawing is completed. For example, the user of building needs to change the building layout, the designer has to redesign the change affecting all the drawing to fulfill that new requirement. In case of constructing any change, there will be additional cost with the same unit rate as the B.O.Q. stated in contract. If not, providing negotiation will be established.

2. User changes system- User decides to change all systems in the building. For example, the user of the building needs to change the telecommunication system for the whole building from the analog system to digital system. However, the service provider of telecommunication system is not related to the contractor of the building in term of cost impact but the impact schedule of the construction will be delayed.

3. User adds system- User decides to add the system and equipment to the building which is stated in the contract drawing and B.O.Q. For example, user requires more CCTV camera to locate in parking area and garden area. This change will affect the cost and schedule.

4.) User changing material- User decides to change the specification of material. For example, user needs to change the floor of the building from marble to granite. This change can reduce or add the cost of construction depending on the material of change.

5.) User adding work- User decides to add the work or equipment to the building which is not stated in the contract drawing and B.O.Q. such as user needs to have the traffic system in parking area which was not stated in contract drawing. This will affect the cost and schedule. The providing of negotiation will be established in unit cost.

The analysis in type of detail of change and their frequency of change can be obtained as shown in Table 4.5 Figure 4.6, 4.7, 4.8, 4.9 and 4.10.

Table 4.5 The analysis of detail of change from requirement in the project and frequency of change

Table 4.10

The analysis of detail of change from requirment in the project and frequency of change

No	Description	Frequency of Variation Order				Cost Impact (Baht)				Schedule Impact (Days)				Average impact/Frequency	
		Add 1	Add 3	Add 4	Total	Add 1	Add 3	Add 4	Total	Add 1	Add 3	Add 4	Total	Cost (baht)	Schedule (Days)
1	User change drawing	8	37	72	117	-	142,963,747.31	89,446,376.03	232,410,123.34	182.86	117.19	-	300.05	1,986,411.31	2.56
2	User Change System	2	2	2	6	-	-	-	0.00	42.5714	6.51	-	49.08	0.00	8.18
3	User Adding System	1	1	1	3	-	-	192,763.13	192,763.13	27.57	3.26	-	30.83	64,254.38	10.28
4	User Change Material	2	3	1	6	-	17,161,881.44	-40,625.00	17,121,256.44	30.00	9.77	-	39.77	2,853,542.74	6.63
5	User adding work		5	1	6	-	45,682,539.98		45,682,539.98	-	16.28	-	16.28	7,613,756.66	2.71
Total		13	48	77	138	0	205,808,168.73	89,598,514.16	295,406,682.89	283.00	153.00	-	436.00		

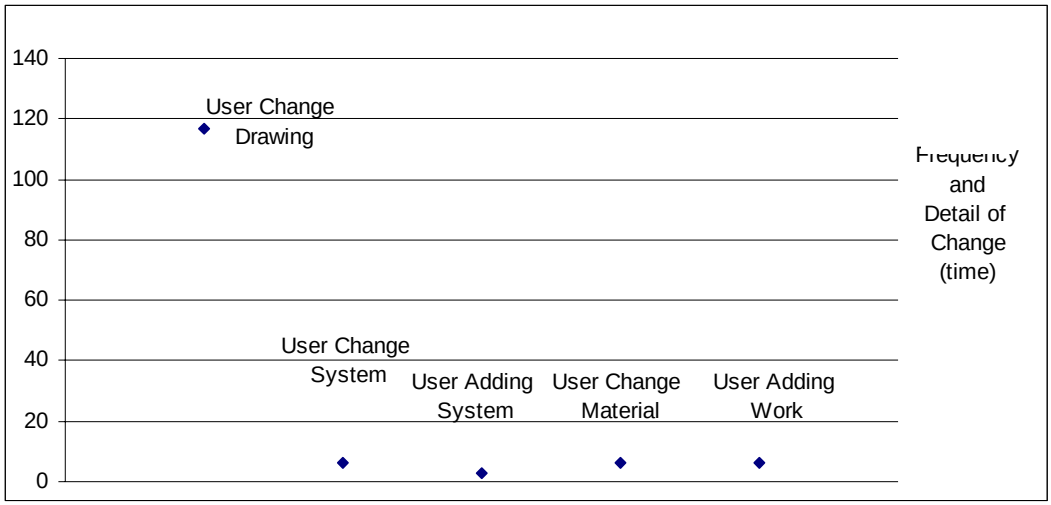


Figure 4.6 The relationship between frequency and detail of change

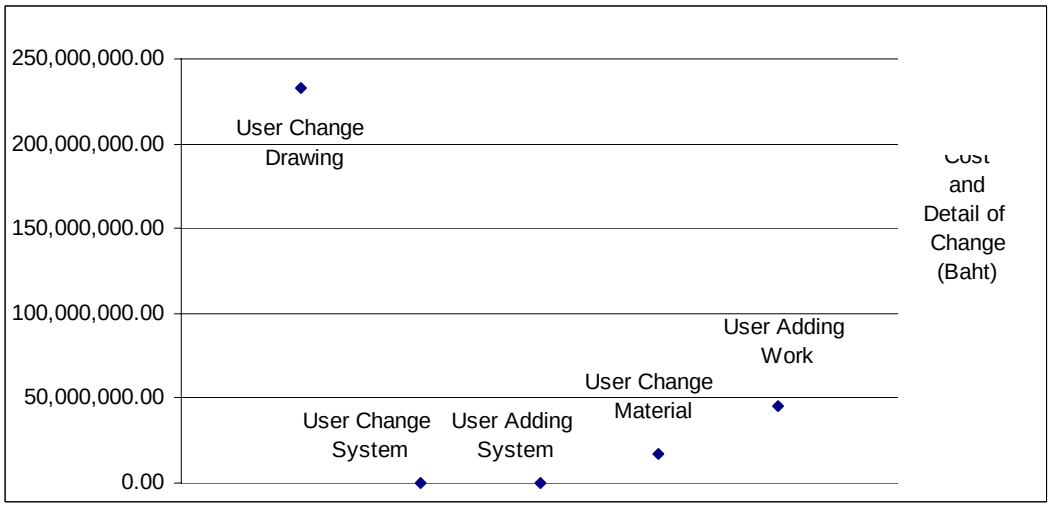


Figure 4.7 The relationship between cost and detail of change

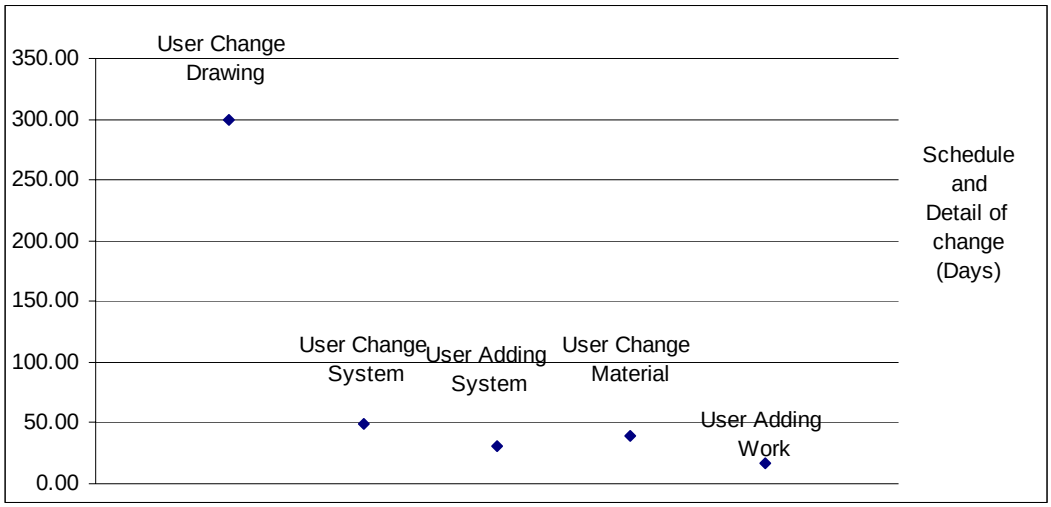


Figure 4.8 The relationship between schedule and detail of change

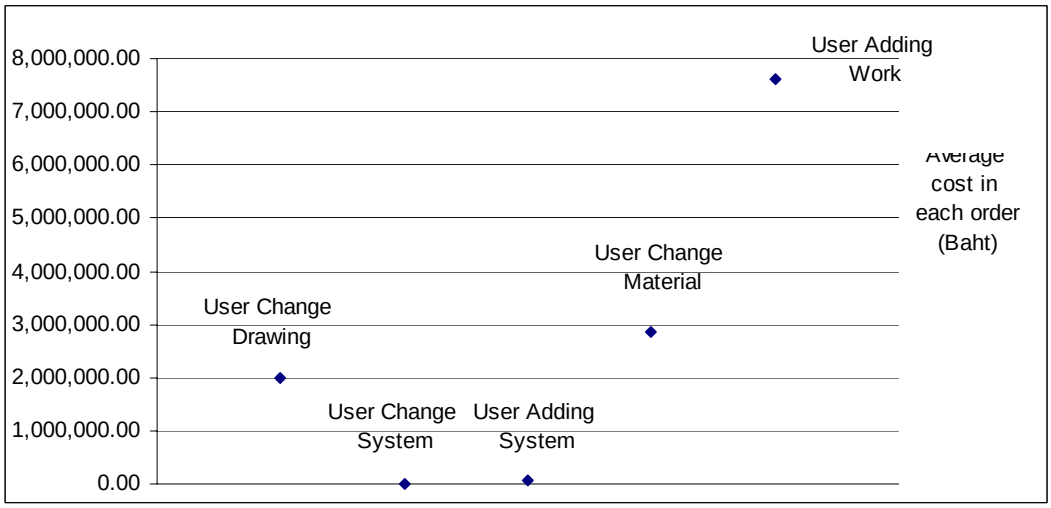


Figure 4.9 The relationship between cost and detail of change

After analyzing of the impact of construction project in term of project schedule delay and project adding construction cost, referring to the type of work and detail of change from requirement, the FMEA and RPN rating method is applied to

the result of previous process. The FMEA and RPN rating is come from the in dept interview of the all stakeholder (contractor, consult, designer and client).

The severity of project impact can be demonstrated in term of additional cost and project schedule delay as Table 4.6 and Table 4.7. The occurrence or frequency of variation order in each type of work and detail of change can be demonstrated as Table 4.8.

Table 4.6 Rating of severity in term of project time schedule delay criteria

Severity Effects	**Project Time effect Criteria**	**Score**
Hazardous effect	Effect cause 131 days or more delay	**10**
Serious effect	Effect cause 106-130 days delay	**9**
Very high effect	Effect cause 91-105 days delay	**8**
High effect	Effect cause 76-90 days delay	**7**
Moderate effect	Effect cause 61-75 days delay	**6**
Low effect	Effect cause 46-60 days delay	**5**
Very low effect	Effect cause 31-45 days delay	**4**
Minor effect	Effect cause 16-30 days delay	**3**
Very Minor effect	Effect cause 1-15 days delay	**2**
No effect	Effect cause 1 day or less delays	**1**

Table 4.7 Rating of Severity in term of project additional construction cost criteria

Severity Effects	**Project Cost effect Criteria**	**Score**
Hazardous effect	Effect cause 90 million or more baht	**10**
Serious effect	Effect cause 80-90 million baht	**9**
Very high effect	Effect cause 70-80 million baht	**8**
High effect	Effect cause 60-70 million baht	**7**
Moderate effect	Effect cause 50-60 million baht	**6**
Low effect	Effect cause 40-50 million baht	**5**
Very low effect	Effect cause 30-40 million baht	**4**
Minor effect	Effect cause 20-30 million baht	**3**
Very Minor effect	Effect cause 10-20 million baht	**2**
No effect	Effect cause 10 million or less baht	**1**

Table 4.8 Rating of the occurrence or frequency of variation order

Occurrence or frequency rate	**Times of variation order's Frequency (times)**	**Score**
Extremely high	More than 91	**10**
Very High	81 – 90	**9**
High	71 – 80	**8**
Frequent	61 – 70	**7**
Moderate	51 – 60	**6**
Occasional	41 – 50	**5**
Slight chance	31 – 40	**4**
Very slight	21 – 30	**3**
Remote	11 – 20	**2**
Extremely remote	0 – 10	**1**

From Table 4.4 and 4.5, the analysis of the cost impact, project schedule and the frequency of variation orders of types of work and detail of change from the requirement can be rated referring to the Table 4.6, Table 4.7 and Table 4.8 as Table 4.9 and Table 4.10

Table 4.9

The severity rating analysis of work's type that change in the project

No	Description	Frequency of Variation Order		Cost Impact (Baht)		Schedule Impact (Days)	
		Total	Rating	Total	Rating	Total	Rating
1	Architecture	77	8	67,713,264.42	7	129.53	9
2	Civil	1	1	404,297.81	1	1.72	2
3	Water Supply & Sanitary System	26	3	2,034,599.76	1	48.96	5
4	Electrical and Telecommunication	62	7	53,826,992.55	6	62.71	6
5	Air-Conditioning System	28	3	57,393,146.58	6	48.96	5
6	Miscellaneous	23	3	5,672,591.00	1	43.80	4
7	Interior Work	33	4	89,134,386.64	9	100.31	8

Table 4.10

The severity rating analysis of detail of change from requirment that change in the project

No	Description	Frequency of Variation Order		Cost Impact (Baht)		Schedule Impact (Days)	
		Total	Rating	Total	Rating	Total	Rating
1	User change drawing	117	10	232,410,123.34	10	300.05	10
2	User Change System	6	1	0	1	49.08	5
3	User Adding System	3	1	192,763.13	1	30.83	4
4	User Change Material	6	1	17,121,256.44	2	39.77	4
5	User adding work	6	1	45,682,539.98	5	16.28	3

From Table 4.9 and 4.10, the analysis of severity and frequency rating in term of types of work and detail of change from the requirement can be demonstrate the RPN result as Table 4.11 and Table 4.12

Table 4.11

The RPN rating analysis of work's type that change in the project

No	Description	Frequency of Variation Order Rating	Cost Impact Rating	Schedule Impact Rating	RPN
1	Architecture	8	7	9	504
2	Civil	1	1	2	2
3	Water Supply & Sanitary System	3	1	5	15
4	Electrical and Telecommunication	7	6	6	252
5	Air-Conditioning System	3	6	5	90
6	Miscellaneous	3	1	4	12
7	Interior Work	4	9	8	288

Table 4.12

The RPN rating analysis of detail of change from requirment that change in the project

No	Description	Frequency of Variation Order Rating	Cost Impact Rating	Schedule Impact Rating	RPN
1	User change drawing	10	10	10	1000
2	User Change System	1	1	5	5
3	User Adding System	1	1	4	4
4	User Change Material	1	2	4	8
5	User adding work	1	5	3	15

To identify the root cause, the fish bone analysis and fault tree analysis will be applied. The tools will find the cause of each problem before finding the solution. The model in each problem can be analyzed as

4.2.1 Risk of architecture works

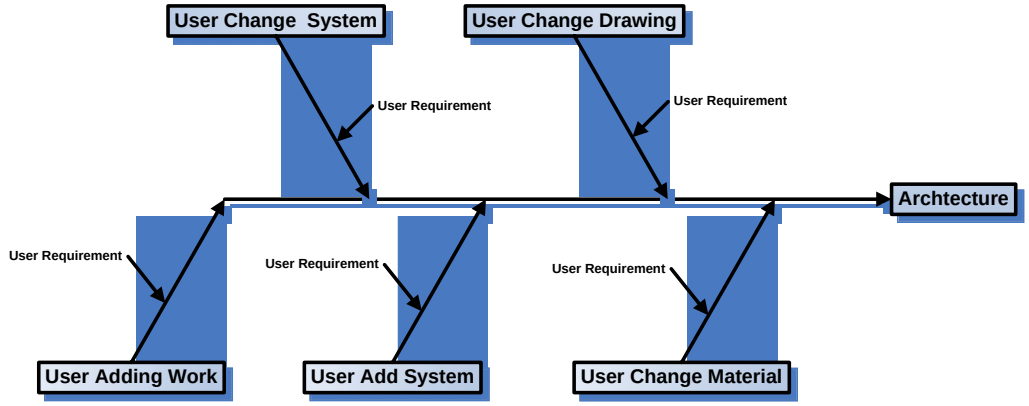


Figure 4.10 Fish bone analysis of architecture works

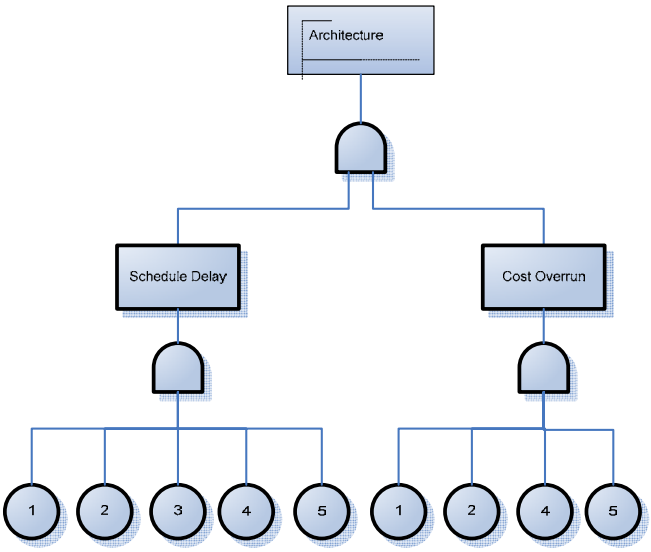


Figure 4.11 Fault tree analyses of architecture works

1 = User change drawing

2 = User change system

3 = User adds system

4 = User change material

5 = User adds work

There are five main causes impact the cost and 4 main causes impact the schedule of architecture work in this construction project as Figure 4.10 and Figure 4.11. All impacts are come from the user requirement.

4.2.2 Risk of civil works

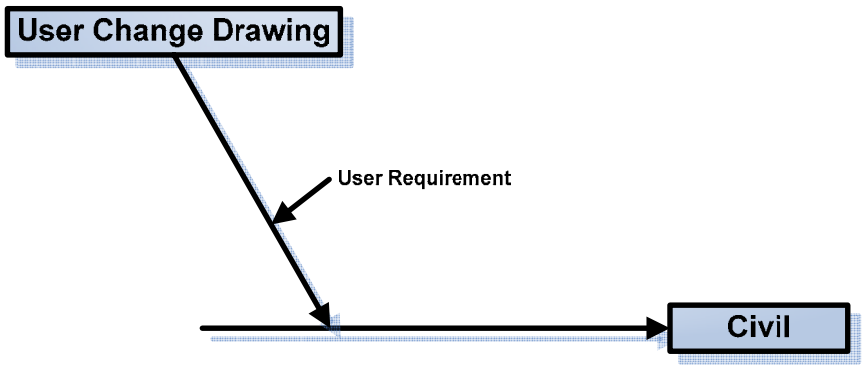


Figure 4.12 Fish bone analysis of civil works

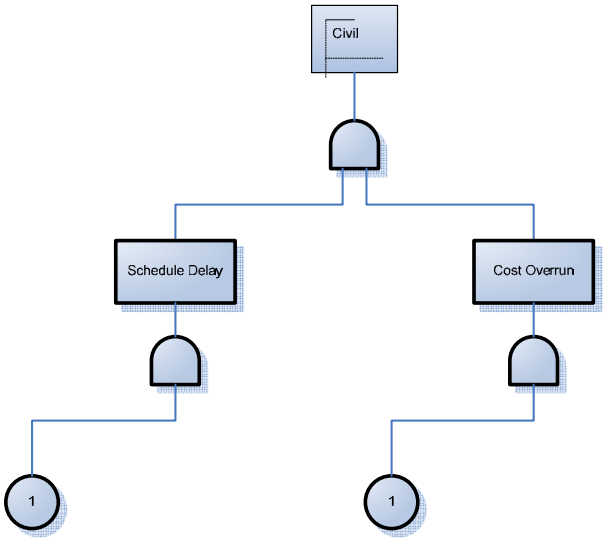


Figure 4.13 Fault tree analyses of civil works

There is only user change drawing cause impact the cost and the schedule of civil work in this construction project as Figure 4.12 and Figure 4.13. All impacts are come from the user requirement.

4.2.3 Risk of water supply and sanitary system work

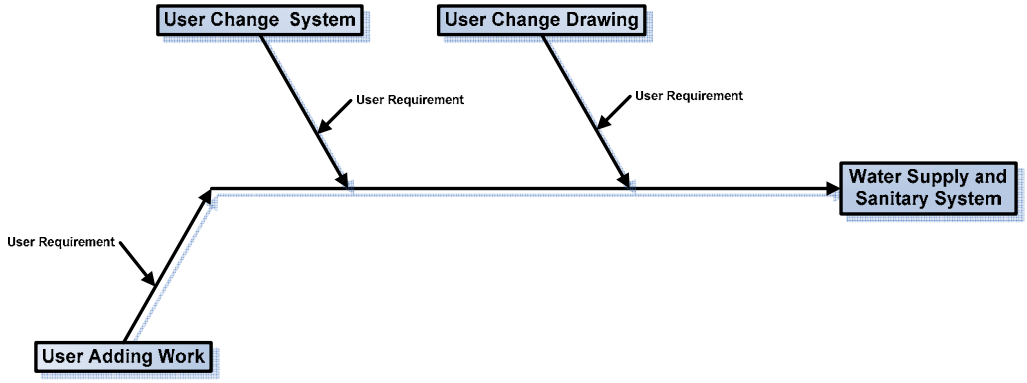


Figure 4.14 Fish bone analysis of water supply and sanitary system works

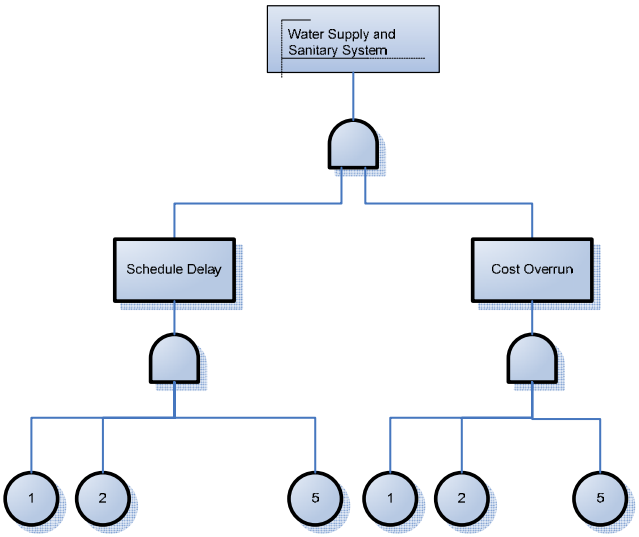


Figure 4.15 Fault tree analyses of water supply and sanitary system works

There is only user change drawing cause impact the cost and the schedule of water supply and sanitary system works in this construction project as Figure 4.14 and Figure 4.15. All impacts are come from the user requirement.

4.2.4 Risk of Electrical and Telecommunication works

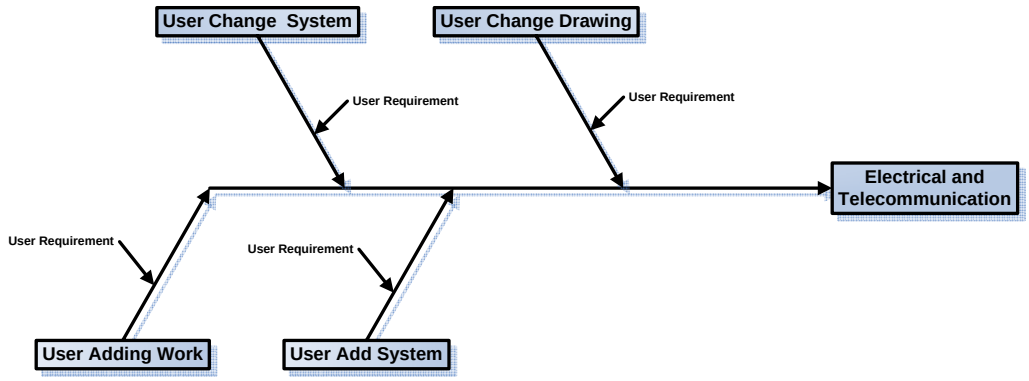


Figure 4.16 Fish bone analysis of electrical and telecommunication works

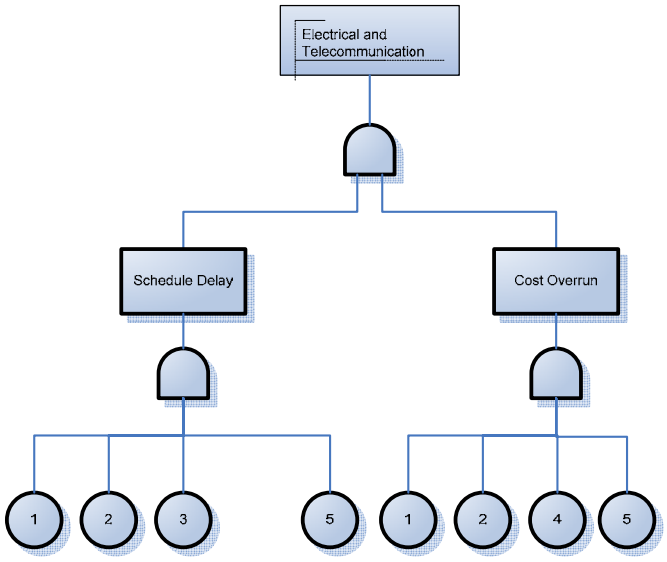


Figure 4.17 Fault tree analyses of electrical and telecommunication works

There are four main causes impact the cost and four main causes impact the schedule of electrical and telecommunication works in this construction project as Figure 4.16 and Figure 4.17. All impacts are come from the user requirement.

4.2.5 Risk of air conditioning system works

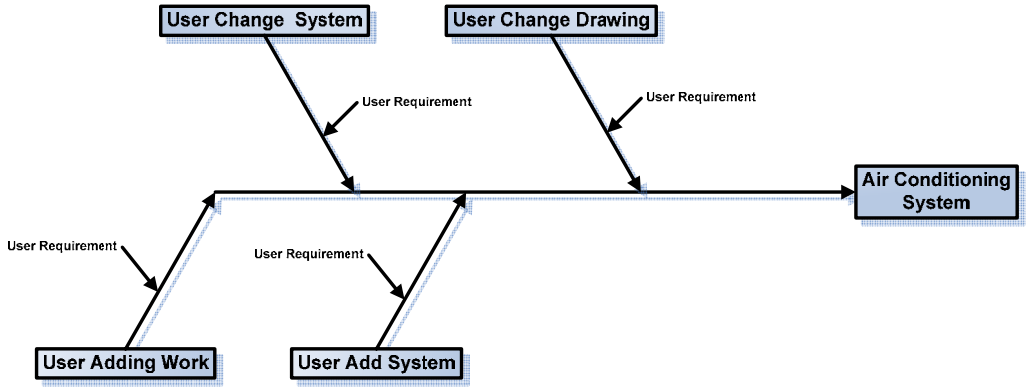


Figure 4.18 Fish bone analysis of air conditioning system works

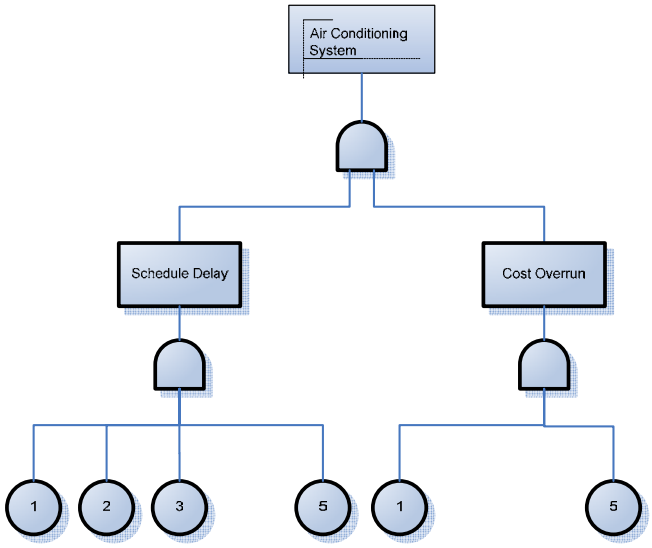


Figure 4.19 Fault tree analyses of air conditioning system works

There are four main causes impact the cost and two main causes impact the schedule of air conditioning system works in this construction project as Figure 4.18 and Figure 4.19. All impacts are come from the user requirement.

4.2.6 Risk of Miscellaneous works

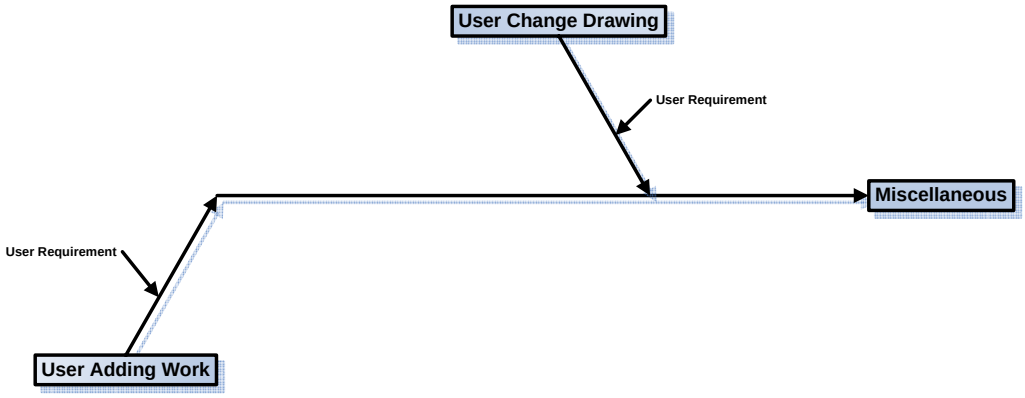


Figure 4.20 Fish bone analysis of miscellaneous works

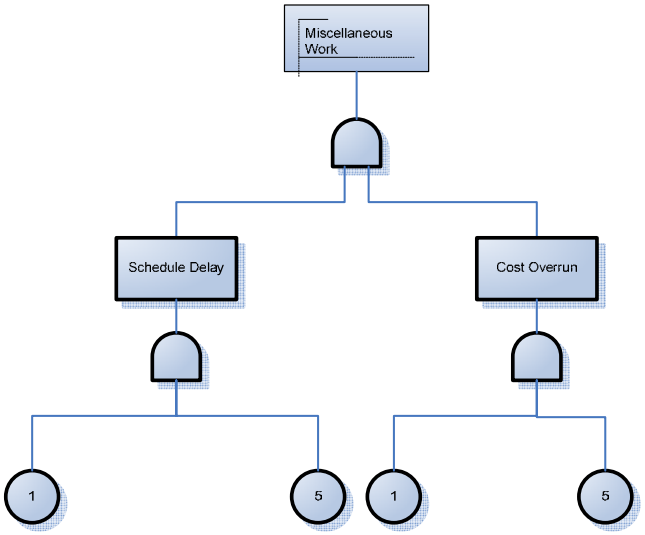


Figure 4.21 Fault tree analyses of miscellaneous works

There are two main causes impact the cost and two main causes impact the schedule of miscellaneous works in this construction project as Figure 4.20 and Figure 4.21. All impacts are come from the user requirement.

4.2.7 Risk of interior works

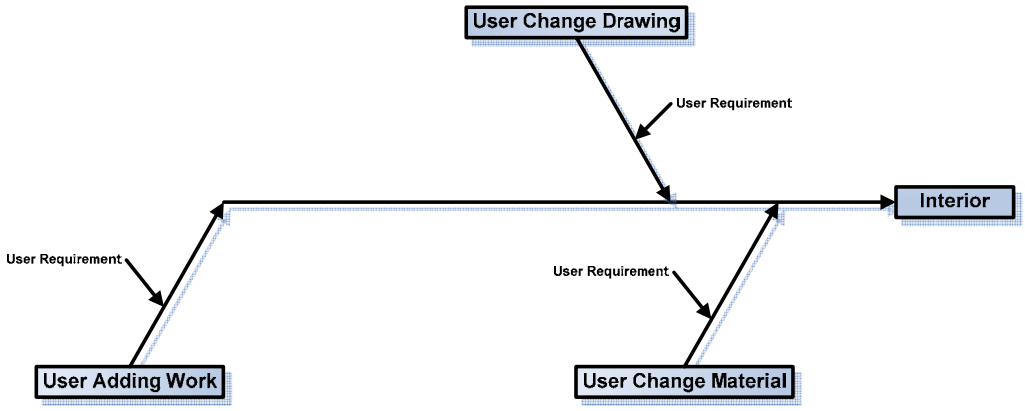


Figure 4.22 Fish bone analysis of interior works

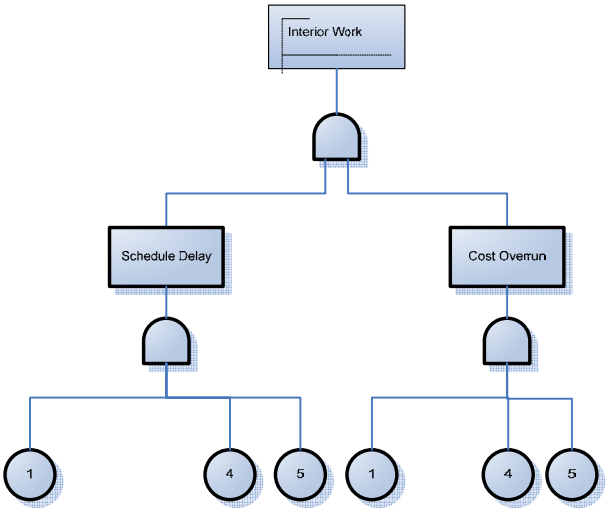


Figure 4.23 Fault tree analyses of interior works

There are three main causes impact the cost and three main causes impact the schedule of interior works in this construction project as Figure 4.22 and Figure 4.23. All impacts are come from the user requirement.

4.2.8 Risk of special cost

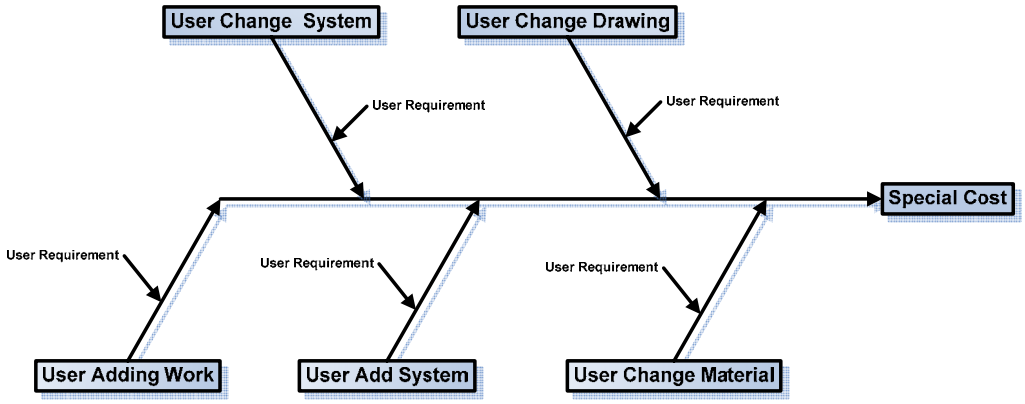


Figure 4.24 Fish bone analysis of special cost

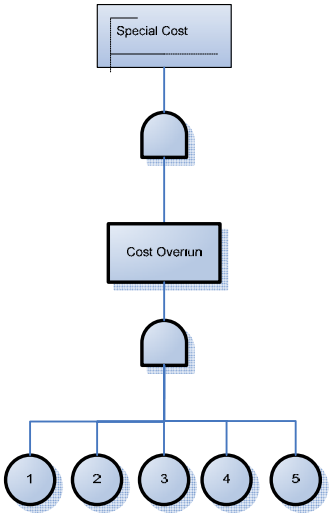


Figure 4.25 Fault tree analyses of special cost

The risk of special cost is come from the delay of schedule and impact to the cost of operation during the construction. The reason of schedule delay is come from all factors. However the special cost did not affect to the project schedule at all. There are five main causes impact the cost from special cost in this construction project as Figure 4.22 and Figure 4.23. All impacts are come from the user requirement which delay the schedule.

4.3 Risk Response and Control

Client of this project hired the project management and construction supervision consultant to respond and control the risk during the construction project including stating the condition in contract document to reduce the impact of risk and transferring to other organizations.

The consideration of PMSC for negotiation with the contractor can be summarized as the following:

First Addendum

PMSC and client have considered the baseline program which contractor proposed to extend the contract for 333 days. The result of negotiation is the reduction of the schedule delay for 49 days to 284 days (reduce for 17.25%) which is stated in first addendum.

Third Addendum

PMSC and client have considered the baseline program which contractor proposed to extend the contract for 240 days. The result of negotiation is reduction of the delay of schedule for 87 days to 153 days (reduce for 56.86%) that is stated in second addendum.

For the negotiation on cost of construction, the result can be categorized into:

1. Architecture from 56,348,783.34 baht to 49,425,916.14 baht (before vat and overhead from contract) reducing for 6,922,867.20 baht (12.29%)

2. Civil from 548,989.03 baht to 351,563.31 baht (before vat and overhead from contract) reducing for 197,425.72 baht (35.96%)

3. Mechanical and Electrical Work from 71,343,716.22 baht to 61,285,162.60 baht (before vat and overhead from contract) reducing for 10,058,553.62 baht (14.10%)

3.1 Water Supply and Sanitary System: no reduction of cost

3.2 Electrical and Telecommunication from 24,240,221.57 baht to 20,460,533.97 baht (before vat and overhead from contract) reducing for 3,779,687.60 baht (15.59%)

3.3 Air-Conditioning System from 43,044,757.22 baht to 37,116,870.89 baht (before vat and overhead from contract) reducing for 5,927,886.66 baht (15.97%)

3.4 Miscellaneous Work from 2,761,200.00 baht to 2,410,220.64 baht (before vat and overhead from contract) reducing for 350,979.36 baht (14.56%)

4. Interior Work from 68,690,000.00 to 64,892,250.36 baht (before vat and overhead from contract) reducing for 3,997,740.64 baht (6.16%)

5. Special Cost 12,571,929.21 for 284 days: no reduction of cost

The total reduction cost due to the negotiation between PMSC and contractor is 24,353,075.26 baht which is 11.83% of total variation order cost in third addendum (205,808,168.73 baht).

In forth addendum PMSC checks the overall variation cost and negotiates with the contractor before the contractor proposes the variation order cost.

4.4 Preventive Action and Implementation

Recommended preventive action which is categorized in term of work's type can be summarized as

1. Architecture work (RPN rating is 504) Frequency of variation orders are equal to 77, cost impact are 67,713,264.42 baht and schedule impact are 129.53 days. The variation orders are mainly come from user changes drawing. User changes the function of usage area and specification of the material of work which affect the cost and schedule to construction project.

2. Civil work (RPN rating is 2) Frequency of variation order is equal to 1, cost impact are 404,297.81 baht and schedule impact are 1.72 days. The variation order is come from user changes drawing. User did not need to changes the civil work due to the user did not interest to change in technical change or structure change.

3. Water supply and sanitary system (RPN rating is 15) Frequency of variation orders are equal to 26, cost impact are 2,054,599.76 baht and schedule impact are 48.96 days. The variation order is come from user changes drawing. User did not need to changes the water supply and sanitary system due to the user did not interest to change in technical change.

4. Electrical and telecommunication system (RPN rating is 252) Frequency of variation orders are equal to 62, cost impact are 53,826,992.55 baht and schedule impact are 62.71 days. The variation orders are come from user changes drawing. User need to changes the requirement and function of electrical and telecommunication system including change system from analog system to digital system which affect to the cost and project schedule a lot.

5. Air conditioning system (RPN rating is 90) Frequency of variation orders are equal to 28, cost impact are 57,393,146.58 baht and schedule impact are 48.96 days. The variation orders are come from user changes drawing. User need to changes the requirement and function of usage area which affects to the cost and project schedule.
6. Miscellaneous (RPN rating is 12) Frequency of variation orders are equal to 23, cost impact are 5,672,591.00 baht and schedule impact are 43.80 days. The variation orders are come from user changes drawing. User need to changes the finished work so, the re-preparation process will affects to the cost and project schedule.
7. Interior work (RPN rating is 288) Frequency of variation orders are equal to 33, cost impact are 89,134,386.64 baht and schedule impact are 100.31 days. The variation orders are come from user changes drawing. User need to changes the requirement of interior work and specification of interior work from the changing of usage area and function of the usage area which affects to the cost and project schedule a lot.

The preventive action will be focused on the user changes drawing which has RPN is equal to 1,000 comparing to the other factor which are 5, 4, 8 and 15 is much lower than user change drawing. The preventive action due to user changes drawing can be summarized as

1. The drawing must be finish before construction start.

The essential reason of cost overrun and project delays is the drawing was not approved by the user in documentation. The process of the solution is providing meeting weekly during the design stage between Client, User, Designer and consultant especially the architecture and interior design. This process will fulfill the all requirement of the user before the construction start. Client and consultant have to consider the detail of drawing not to over the budget and schedule of project can finish on target. The communication process before and after solution can be derived as Figure 4.26 and Figure 4.27.

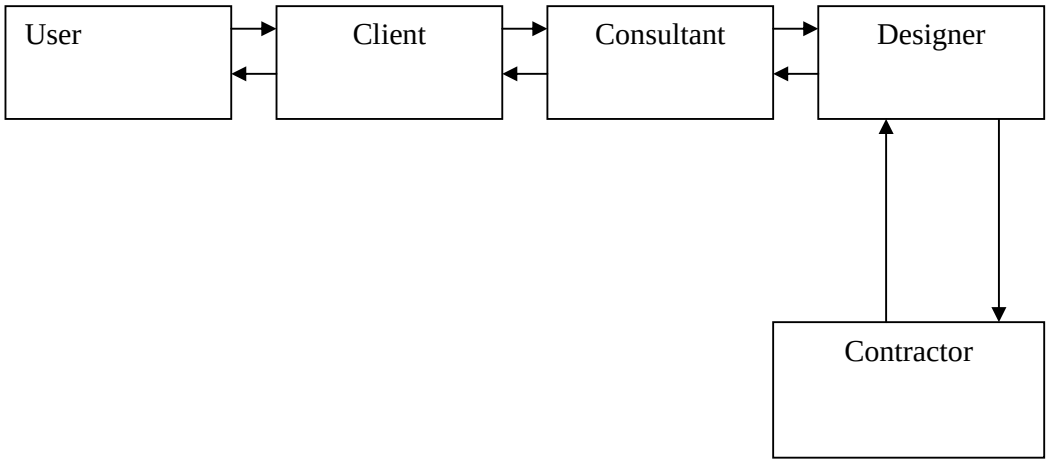


Figure 4.26 Communication flow chart before solution

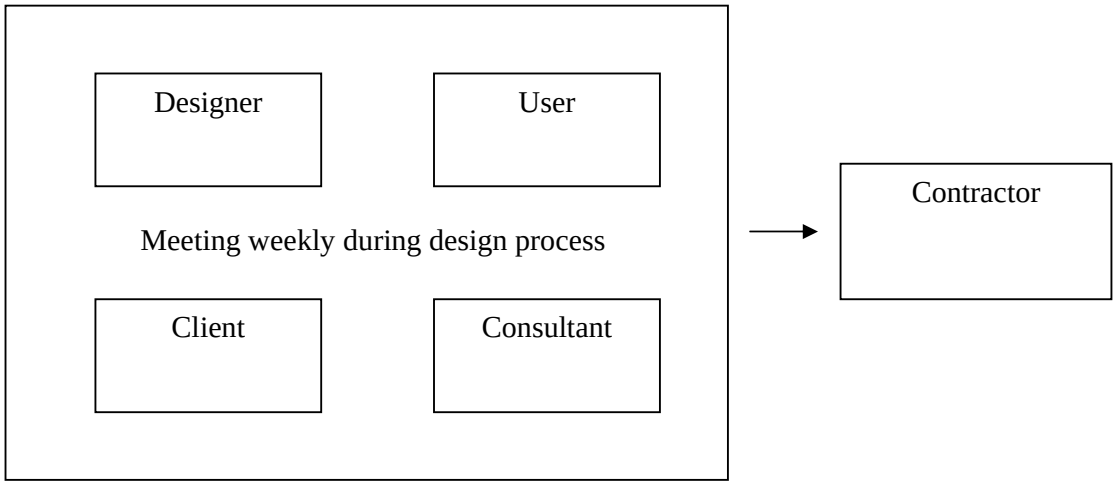


Figure 4.27 Communication flow chart after solution

The drawing and specification before construction start will fulfill all requirement before construction start. However the change after construction start does not be solve yet. The result of this process is the changing of drawing during the construction project which causes the cost and schedule by 40% for architecture, electrical and communication, air conditioning system and interior work (the number is come from the stakeholder meeting).

2. Applied memorandum of understanding (MOU)

The main problem of this construction project is fluctuation requirement of building user. The improvement of coordination between designer, user and contractor must be implemented. The memorandum of understanding must be applied to prevent the change after construction work start.

If not the change of user's requirement will affect to the schedule and project budget and get the problem as case.

The MOU of this research can be demonstrated as

The memorandum of understanding of drawing and specification for administrative court office building construction project.

- The user of this building (Administrative Court) approved and accepted the all drawing and specification (enclosing in this MOU). The client (Dhanarak Asset Development Co., Ltd) will use drawing and specification (enclosing in this MOU) to construct the administrative court office building which fulfill all user requirement.

If user need to change the drawing or specification (enclosing this MOU), user has to follow the contents as

- If the change of the user not increase the cost and project duration (must be approved by client and contractor), the change can be constructed.
- If user's requirement is to cancel or reduce the work which come from drawing and specification (enclosing this MOU). The change must not increase the cost of construction and construction duration (must be approved by client and contractor, then this change can be construct.

- If user's requirement is to change the drawing and specification (enclosing this MOU) and increase the construction cost and construction duration, user has to send the documentation to the client. Client has right to not to construct follow the change that impact to the construction cost and project duration and follow the drawing and specification (enclosing this MOU).
- User can hired the own contractor to construct for the adding requirement, however the drawing, specification and construction schedule must be approved by client and contractor.
- This MOU must have the signature of representation of user, client and witness.

This MOU will prevent the change after construction start which comes from additional user's requirement. However the change that come from mistake or missing item in the drawing and specification (enclosing the MOU) which can not fulfill the requirement of the user, client has to absorb the additional cost and delay of schedule. The result of the solution will decrease the controllable cost and schedule by 30% for architecture, electrical and communication, air conditioning system and interior work (the number is come from the stakeholder meeting).

The change that come from the requirement of client itself, the cost and the delay must be absorbed by client.

Form the Table 4.6, Table 4.7 and Table 4.8 the analysis of new severity and new frequency rating in term of types of work from the requirement can be demonstrate the RPN result as Table 4.13 and Table 4.14.

Table 4.13

The new severity rating analysis of work's type that change in the project

No	Description	Frequency of Variation Order		Cost Impact (Baht)		Schedule Impact (Days)	
		Total	Rating	Total	Rating	Total	Rating
1	Architecture	23.1	3	20,313,979.33	3	38.86	4
2	Civil	0.3	1	121,289.34	1	0.52	1
3	Water Supply & Sanitary System	7.8	1	610,379.93	1	14.69	2
4	Electrical and Telecommunication	18.6	2	16,148,097.77	2	18.81	3
5	Air-Conditioning System	8.4	1	17,217,943.97	2	14.69	2
6	Miscellaneous	6.9	1	1,701,777.30	1	13.14	1
7	Interior Work	9.9	1	26,740,315.99	3	30.09	4

Table 4.14

The new RPN rating analysis of work's type that change in the project

No	Description	Frequency of Variation Order Rating	Cost Impact Rating	Schedule Impact Rating	New-RPN	Old-RPN	Diff (%)
1	Architecture	3	3	4	36	504	92.857143
2	Civil	1	1	1	1	2	50
3	Water Supply & Sanitary System	1	1	2	2	15	86.666667
4	Electrical and Telecommunication	2	2	3	12	252	95.238095
5	Air-Conditioning System	1	2	2	4	90	95.555556
6	Miscellaneous	1	1	1	1	12	91.666667
7	Interior Work	1	3	4	12	288	95.833333

4.5 Conclusion

In the process of the analysis and evaluation, this research came up with the actual schedule delay and budget over run in existing project. It can be clearly seen that the addition cost from variation order is 295,406,682.89 baht referring to the initial construction cost of 1,813,000,000.00 baths over 10% of the initial construction cost. Moreover, the construction project schedule is delay by 436 days referring to the initial schedule that client set the schedule to finish the construction project by 730 days is over 50%.

The main reason of the delay and the cost overrun is the requirement of the user of the building and client. From the result of analyzing this type of work, it can be seen that the architecture work and the interior work are the main additional cost (around 150 million baht) and main influence on the schedule (230 days)

In the analysis of change detail in the requirement cause, it can be seen that the mainly additional cost and delay of schedule come from user changing of drawing (232 million baht of 295 million baht and 300 of 436 days).

In the response and control process, this case is the negotiation of the unit price, quantity of work and the schedule after changing the work. For the preventive action will reduce the RPN rating up to 90%.

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Introduction

The project risk management in massive construction project approach and considers in time and cost factors which are essential factors in construction project management. This research will focus the views of client and project management as well as construction supervision consultant (PMSC) basing on the actual contract document between client and contractor in constructing and designing stages. The whole basic methodology implemented in this research can be illustrated in Figure 5.1.

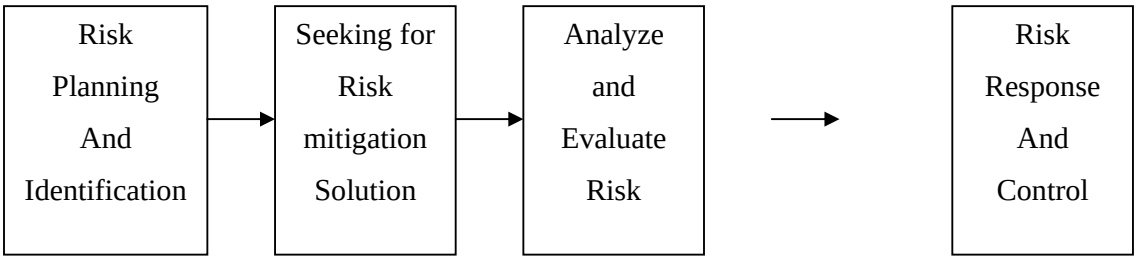


Figure 5.1: The process of project risk management in massive construction project

The first process is risk planning and risk identification. Check list is the tools that usually applied in this process. The check list is developed from the experience and the previous similar construction projects. The essential part in this process is to set the framework of application based on realistic situation and document. In this research, the check list is developed from the actual contract document between client and contractor at the initial state and the 4 addendum of contract during construction until project is finished. The sources of data used in this research are the variation orders of the client to the contractor that affect the construction cost, project schedule and the payment process between client and contractor. The risk in the construction project can be identified as:

Design stage

1. Requirement of client and user of the building
2. Environment and traffic concern
3. Design management
4. Designer qualification
5. Time and budget control

Construction stage

1. Requirement of client and user of the building
2. External factors
3. Environment and traffic concern
4. Construction method
5. Contractor qualification
6. Construction management
7. Re-design
8. Time and budget control

After the identification of the risk is finished, the planning process is the next essential process. This process will be based on the actual document that was stated in the contract document to reduce, mitigate and transfer the risk to other parties such as contractor.

The essential factor in this case of construction project is the requirement risk. The client has already stated in the contract document to respond the risk in any risk that can happen except the requirement and external factors which are cannot be controlled by the client and PMSC.

In the process of the analysis and evaluation, this research came up with the actual schedule delay and budget over run in existing project. It can be clearly seen that the addition cost from variation order is 295,406,682.89 baht referring to the initial construction cost of 1,813,000,000.00 baths over 10% of the initial construction cost. Moreover, the construction project schedule is delay by 436 days referring to the initial schedule that client set the schedule to finish the construction project by 730 days is over 50%.

The main reason of the delay and the cost overrun is the requirement of the user of the building and client. From the result of analyzing this type of work, it can be seen that the architecture work and the interior work are the main additional cost (around 150 million baht) and main influence on the schedule (230 days) because the requirement of the user of the building mainly coming from the layout the design at initial state does not belong to the requirement of actual usage of the user in this building. The technical requirement of the user does not have the main impact on this project but the technical and system additional cost mainly came from the changing of the layout and function of the drawing. It can be seen that the structure cost is very low because the user and client were not interested in changing any technical engineering term at all.

In the analysis of change detail in the requirement cause, it can be seen that the mainly additional cost and delay of schedule come from user changing of drawing (232 million baht of 295 million baht and 300 of 436 days). This implies that requirement of the user coming from the layout and function of the architecture and interior work are not in building facilities system or civil work.

In the response and control process, this case is the negotiation of the unit price, quantity of work and the schedule after changing the work. Client has already hired the PMSC to be involved with the process. The result is acceptable and the additional cost and the delay of the schedule are reasonable referring to the quantity of work.

Table 5.1 Roles and responsibility in design and construction process of stakeholder which are the main causes of the delay and budget overrun

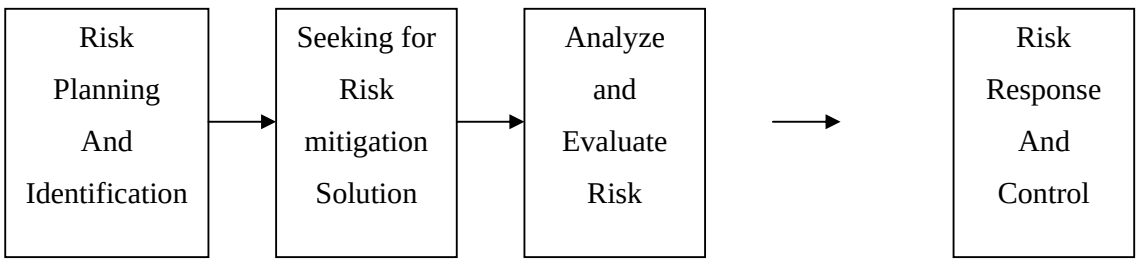
	Design Process	Construction Process
Client	Requirement Time and Budget Control Environment and Traffic Concern	Requirement Time and Budget Control External Factor Environment and Traffic Concern
PMSC	Designer Qualification Design Management Time and Budget Control	Contractor Qualification Construction Management Time and Budget Control
Designer	Design Qualification Design	Re-Design Construction
Contractor		Contractor Qualification Construction Method

5.2 Conclusion

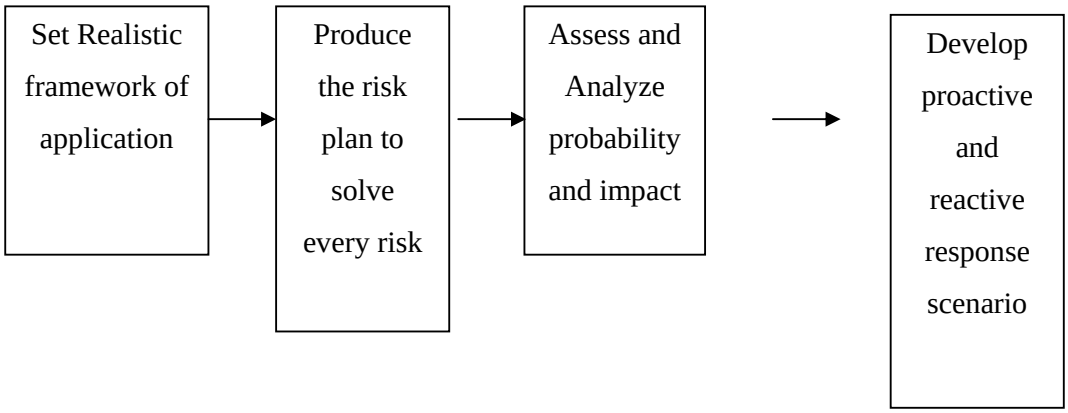
In conclusion, in case of the construction project which has the similarity like this research can simulate the framework as the figure 5.3

Figure 5.2 the process and the output in project risk management process in construction project

Project risk management process



Output of the process



The mitigating strategies in time and cost factor for planning and scheduling are used to control the project with the time frame of each activity by using work brake down structure or other software tools to help with documentary system. The client or consultant has to plan the baseline program with floatation and realistic project schedule for contractor to catch up with the schedule. Providing the milestone and penalty helps to control the contractor to be not too late to catch up with the project baseline program and to finish the project on target date. They also develop the realistic and reasonable ceiling prices referred to the market price.

The mitigating strategies in monitoring and controlling strategies for time and cost factors are to develop the payment process with realistic unit cost and quantity to control the progress of construction and the payment between the client and the contractor. This also helps to provide the weekly and monthly report for each party as contractors, consultants and designers to monitor the progress within each party.

5.3 Recommended Preventive Action

Recommended preventive action which is categorized in term of work's type will be focused on the user changes drawing which has RPN is equal to 1,000 comparing to the other factor which are 5, 4, 8 and 15 is much lower than user change drawing which can reduce the RPN rating up to 90%. The preventive action due to user changes drawing can be summarized as

1. The drawing must be finish before construction start. The essential reason of cost overrun and project delays is the drawing was not approved by the user in documentation. The result of this process is the changing of drawing during the construction project which causes the cost and schedule.
2. The main problem of this construction project is fluctuation requirement of building user. The improvement of coordination between designer, user and contractor must be implemented. The memorandum of understanding before construction start between client and user must be applied to prevent the change after construction work start.

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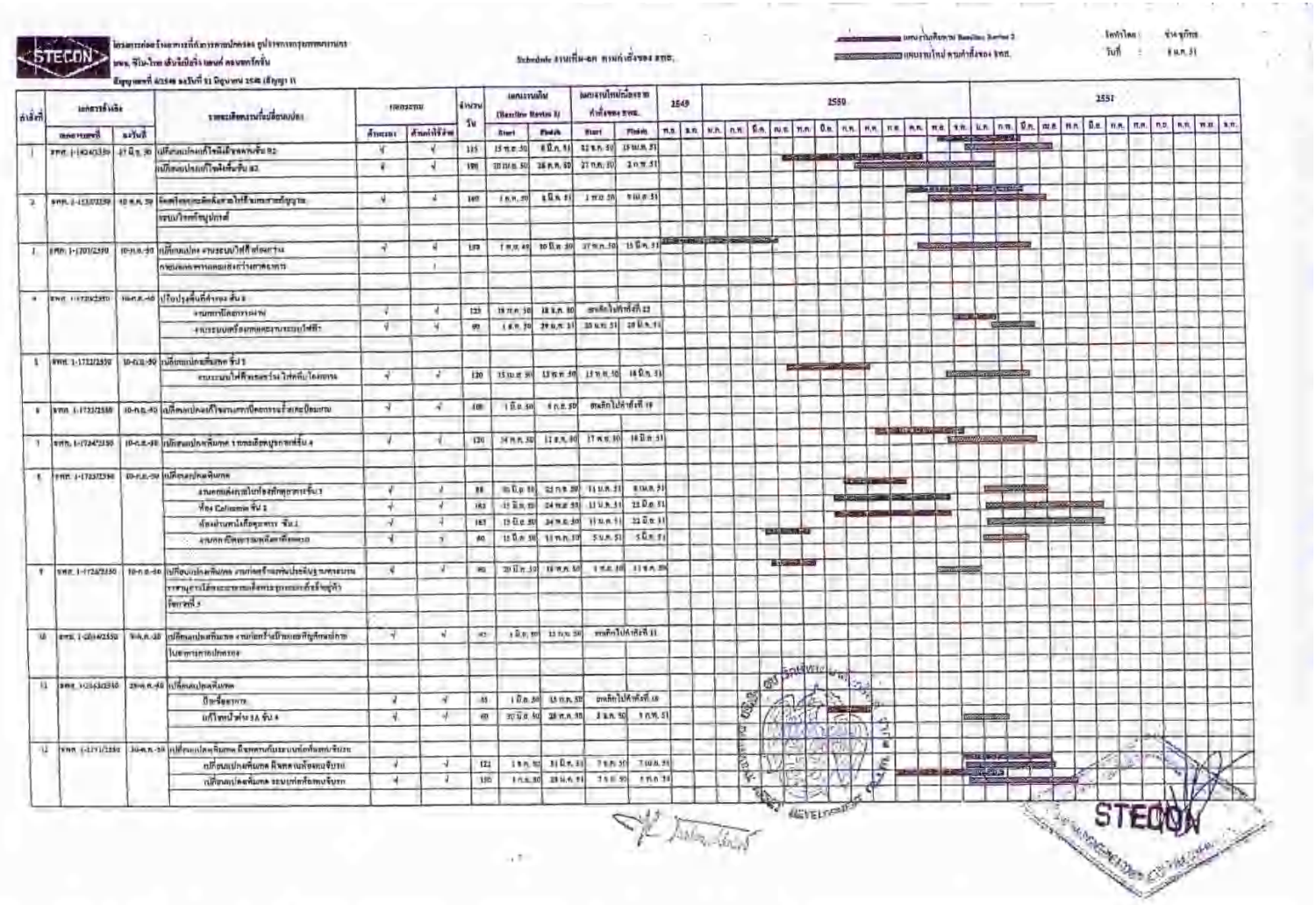
APPENDIXE

The backup sheet of project schedule and Cost calculation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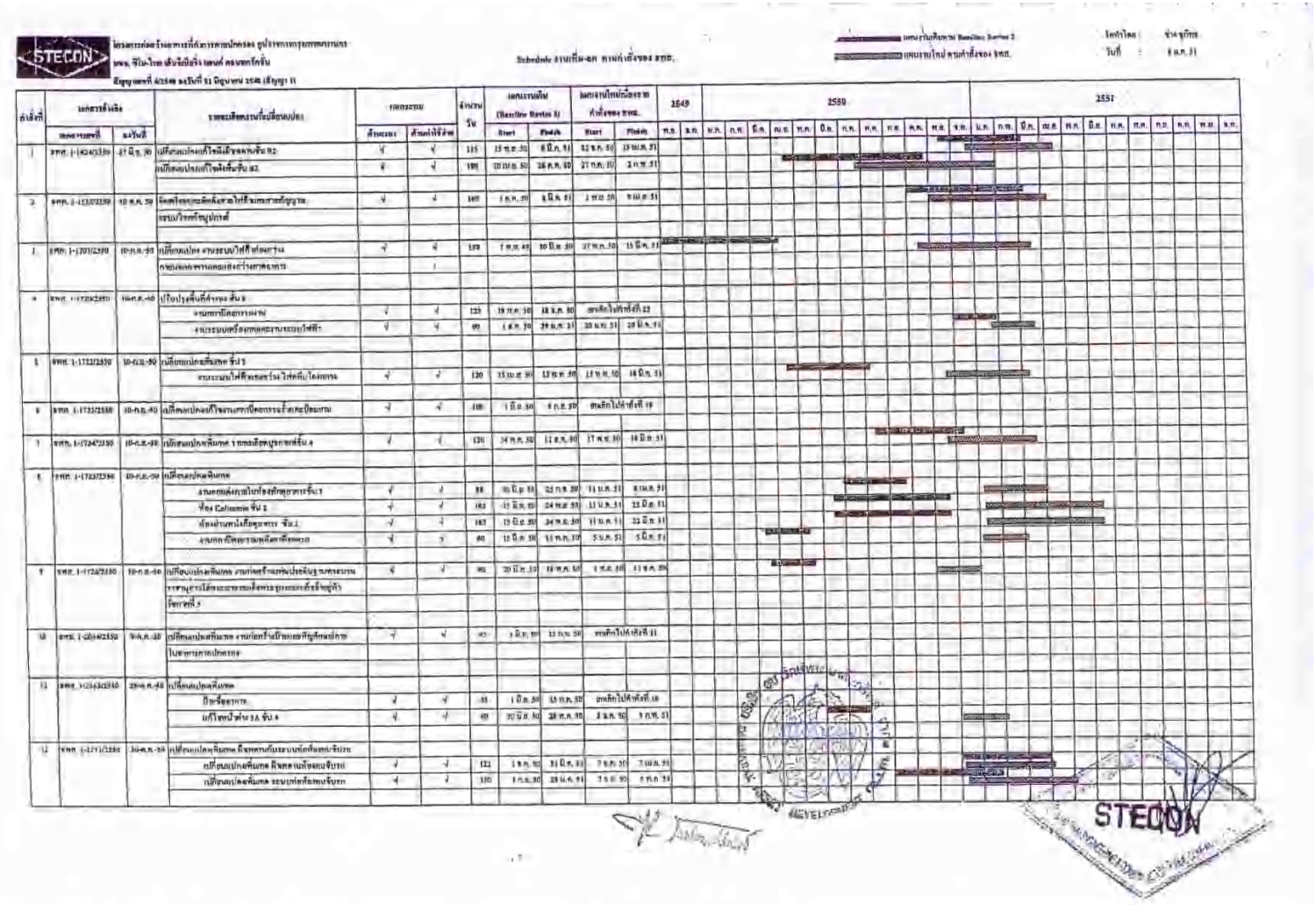
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แผนงานที่เหลือ ครั้งก่อนของ ขนส.
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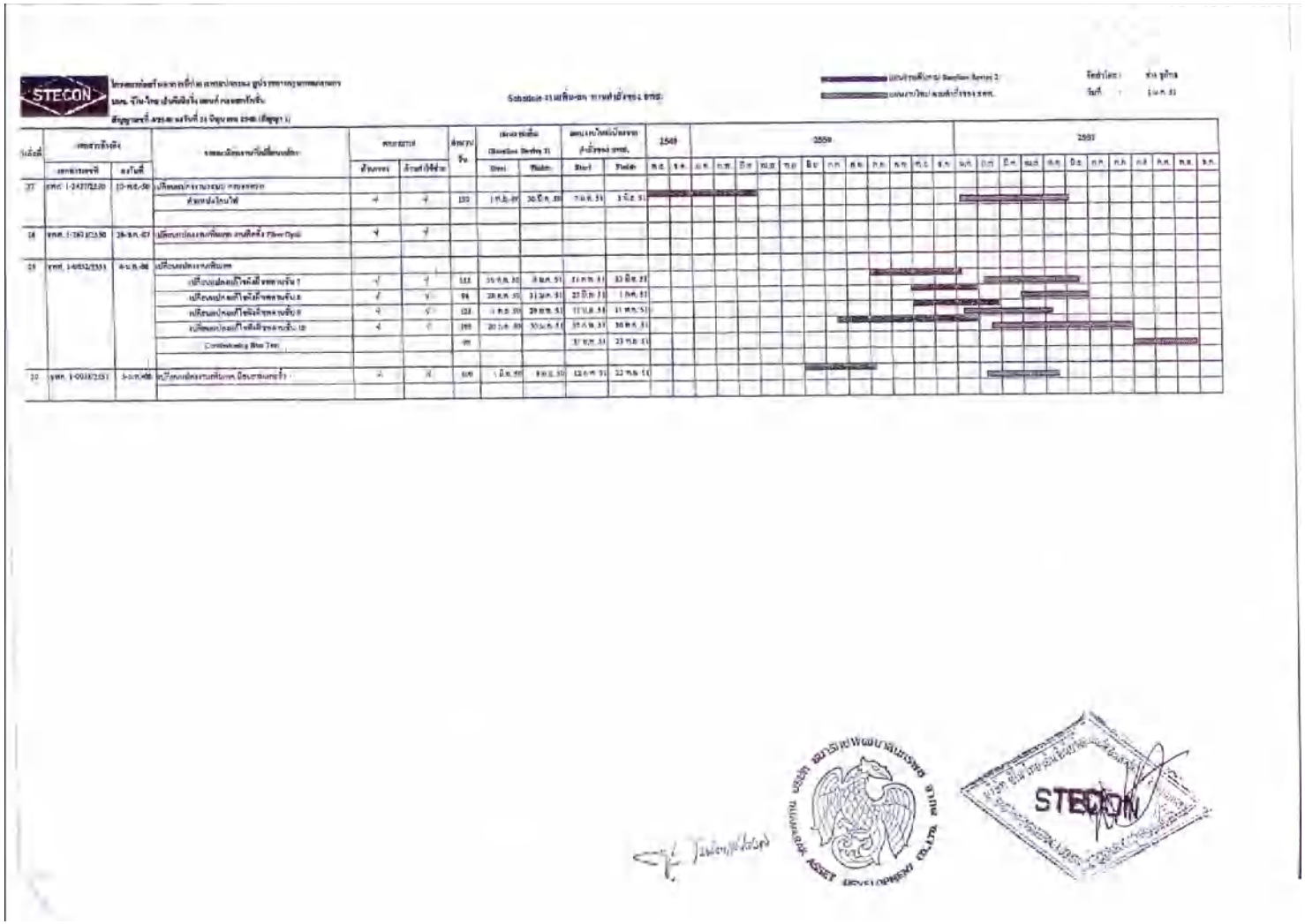

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PMSC

PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION CONSULTANT TEAM AITSO INTEGRAL DR NOCCO

ที่ PMSC 52241/08752

21 มีนาคม 2551

เรื่อง ส่งรายเพิ่ม-ลด เนื่องจากการเปลี่ยนแปลงงาน จำนวน 14 คำสั่ง
งานก่อสร้างอาคารที่จำการทางยกระดับ (สัญญา 1)
โครงการศูนย์ราชการกรุงเทพมหานคร ถนนแจ้งวัฒนะ

เรียน กรรมการผู้จัดการ บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด
ผ่าน ผู้อำนวยการฝ่ายควบคุมงานก่อสร้าง

อ้างถึง 1. สัญญาจ้างก่อสร้าง เลขที่ 4/2548 ลงวันที่ 21 มิถุนายน 2548
2. บันทึกข้อตกลงแก้ไขเพิ่มเติมสัญญา ครั้งที่ 1 ลงวันที่ 19 มิถุนายน 2550
3. หนังสือ ธพส. ที่ ธพส.1-1654/2549 ลงวันที่ 17 กรกฎาคม 2549
4. หนังสือ ธพส. ที่ ธพส.1-3824/2549 ลงวันที่ 22 ธันวาคม 2549
5. หนังสือ ธพส. ที่ ธพส.1-3968/2549 ลงวันที่ 29 ธันวาคม 2549
6. หนังสือ ธพส. ที่ ธพส.1-101/2550 ลงวันที่ 26 มกราคม 2550
7. หนังสือ ธพส. ที่ ธพส.1-142/2550 ลงวันที่ 2 กุมภาพันธ์ 2550
8. หนังสือ ธพส. ที่ ธพส.1-266/2550 ลงวันที่ 2 มีนาคม 2550
9. หนังสือ ธพส. ที่ ธพส.1-276/2550 ลงวันที่ 2 มีนาคม 2550
10. หนังสือ ธพส. ที่ ธพส.1-549/2550 ลงวันที่ 4 เมษายน 2550
11. หนังสือ ธพส. ที่ ธพส.1-598/2550 ลงวันที่ 11 เมษายน 2550
12. หนังสือ ธพส. ที่ ธพส.1-599/2550 ลงวันที่ 11 เมษายน 2550
13. หนังสือ ธพส. ที่ ธพส.1-991/2550 ลงวันที่ 11 มิถุนายน 2550
14. หนังสือ ธพส. ที่ ธพส.1-1181/2550 ลงวันที่ 27 มิถุนายน 2550
15. หนังสือ ธพส. ที่ ธพส.1-1315/2550 ลงวันที่ 16 กรกฎาคม 2550
16. หนังสือ ธพส. ที่ ธพส.1-1533/2550 ลงวันที่ 10 สิงหาคม 2550

สิ่งที่ส่งมาด้วย 1. หนังสือบริษัท ซิโน-ไทยฯ ที่ STECON/C01/LTR/51-004/VO/R1 ลงวันที่ 5 กุมภาพันธ์ 2551
2. หนังสือบริษัท ซิโน-ไทยฯ ที่ STECON/C01/LTR/51-005/VO/R2 ลงวันที่ 1 มีนาคม 2551
3. หนังสือบริษัท ซิโน-ไทยฯ ที่ STECON/C01/LTR/51-006/VO/R1 ลงวันที่ 6 มีนาคม 2551
4. หนังสือบริษัท ซิโน-ไทยฯ ที่ STECON/PMSC/C01/LTR/51-0139/R1 ลงวันที่ 3 มีนาคม 2551

STECON

ที่ ...

ที่ ... เอกสารรายละเอียดงานเปลี่ยนแปลง เพิ่ม-ลด จำนวน 4 เล่ม ประกอบด้วย
เล่มที่ 1 รายละเอียดงานเปลี่ยนแปลง เพิ่ม-ลด หมวดงานโครงสร้าง และสถาปัตยกรรม
เล่มที่ 2 รายละเอียดงานเปลี่ยนแปลง เพิ่ม-ลด หมวดงานระบบประกอบอาคาร
เล่มที่ 3 รายละเอียดงานเปลี่ยนแปลง เพิ่ม-ลด หมวดงานตกแต่งภายใน
เล่มที่ 4 รายละเอียดงานเปลี่ยนแปลง เพิ่ม-ลด หมวดค่าใช้จ่ายพิเศษตามข้อกำหนด

ตามที่ บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด (ธพส.) ได้ว่าจ้าง บริษัท ซิโน-ไทย เอ็นจีเนียริ่ง แอนด์ คอนสตรัคชั่น จำกัด (มหาชน) เป็นผู้รับจ้างงานก่อสร้างอาคารที่ทำการสำนักงาน (สัญญา1) ตามสัญญาจ้าง อ้างถึง 1. และบันทึกข้อตกลงแก้ไขเพิ่มเติมสัญญา ตามอ้างถึง 2. และในระหว่างที่ผู้รับจ้างดำเนินการก่อสร้างตามสัญญา สำนักงานตรวจสอบราชการ ซึ่งเป็นผู้ใช้ประโยชน์ในพื้นที่ และเป็นผู้กำหนดรูปแบบและรายการประกอบแบบมีความประสงค์ให้ปรับปรุง และพัฒนาแบบก่อสร้าง งานสถาปัตยกรรม งานวิศวกรรมระบบ และงานตกแต่งภายใน เพื่อให้สอดคล้องกับบุคลากรตามโครงสร้างองค์กร จึงได้ขอเปลี่ยนแปลงแก้ไขรูปและรายละเอียดประกอบแบบ โดยมีหนังสือแจ้ง ธพส. ให้ดำเนินการ ซึ่ง ธพส. ได้มีคำสั่งให้ผู้รับจ้างดำเนินการก่อสร้างตามแบบเปลี่ยนแปลงเป็นระยะๆ โดยคำสั่งดังกล่าวเป็นการเปลี่ยนแปลง เพิ่ม ลดงาน และมีผลกระทบต่อระยะเวลาปฏิบัติงานและค่าจ้างตามสัญญา ผู้รับจ้างจึงได้ยื่นหนังสือตามสิ่งที่ส่งมาด้วย 1 - 4 แจ้งการเปลี่ยนแปลงราคาค่าก่อสร้าง โดยแยกเป็นส่วนของงานโครงสร้าง และสถาปัตยกรรม งานระบบประกอบอาคาร งานตกแต่งภายใน และค่าใช้จ่ายพิเศษตามข้อกำหนด ที่ได้รับผลกระทบจากคำสั่งเปลี่ยนแปลงงานของ ธพส. จำนวน 14 คำสั่ง ตามอ้างถึง 3-16. โดยมีผลสรุปเป็นค่างานเพิ่ม ดังนี้

1.	หมวดงานโครงสร้าง และสถาปัตยกรรม	จำนวนเงิน	77,522,855.28 บาท
2.	หมวดงานระบบประกอบอาคาร	จำนวนเงิน	70,821,133.90 บาท
3.	หมวดงานตกแต่งภายใน	จำนวนเงิน	64,892,250.36 บาท
4.	หมวดค่าใช้จ่ายพิเศษตามข้อกำหนด	จำนวนเงิน	12,571,929.21 บาท
	รวมเป็นเงิน		305,808,158.73 บาท

(สองร้อยห้าล้านแปดแสนแปดพันหนึ่งร้อยห้าสิบแปดบาทเจ็ดสิบสามสตางค์) รวมภาษีมูลค่าเพิ่ม

ที่ปรึกษา PMSC ได้ตรวจสอบเอกสารประกอบการเจรจาการเปลี่ยนแปลงราคาค่าก่อสร้างของผู้รับจ้างแล้ว พบว่าถูกต้อง มีความเหมาะสม เป็นไปตามเงื่อนไขของสัญญาจ้าง และเป็นอัตราที่ต่ำ ธพส. จึงได้รวบรวมจัดทำเป็นเอกสารรายงานผลการตรวจสอบ รายละเอียดตามสิ่งที่ส่งมาด้วย 5 ส่งให้ ธพส. เพื่อพิจารณาอนุมัติต่างงานเพิ่มให้กับผู้รับจ้าง

บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด DHANARAK ASSET DEVELOPMENT COMPANY LIMITED

STECON

ALS/P0681/CSC1/5224/LT5103/LT793

อนึ่ง การพิจารณาการเปลี่ยนแปลงราคางาน เพิ่ม-ลด ในครั้งนี้ยังไม่ได้รวมกับผลกระทบของราคางานก่อสร้างสืบเนื่องจากคำสั่งเปลี่ยนแปลงงานของ ธพส. ฉบับที่ 15 จนถึงปัจจุบัน คือฉบับที่ 73 ซึ่งผู้รับจ้างได้ทยอยส่งให้ที่ปรึกษา PMSC เป็นระยะๆ และอยู่ในระหว่างการพิจารณาตรวจสอบของที่ปรึกษา PMSC ซึ่งเมื่อได้ข้อสรุปประการใด จะได้นำเสนอ ธพส. พิจารณาอีกครั้งต่อไป

จึงเรียนมาเพื่อโปรดพิจารณาดำเนินการต่อไป

ขอแสดงความนับถือ

(นายยุทธ กิ่งมาตุ)
ผู้จัดการโครงการ

สำเนาเวียน: รองกรรมการผู้จัดการ ฝ่ายปฏิบัติการ
สว/อส

บริษัท ซิโน-ไทย เอ็นจีเนียริ่ง แอนด์ คอนสตรัคชั่น จำกัด (มหาชน)
SINO-THAI ENGINEERING & CONSTRUCTION PUBLIC COMPANY LIMITED

ที่ STECON/COM.TP/SI-004/ VO/R1

วันที่ 5 กุมภาพันธ์ 2551

เรื่อง ขออนุมัติวิศวกรงานเพิ่ม-ลด ครั้งที่ 1 (ส่วนงานโครงสร้างและสถาปัตยกรรม) Revise 1 ที่ผ่านการพิจารณาล่าสุดท้าย จากที่ปรึกษา PMSC

เรียน ผู้จัดการโครงการ ที่ปรึกษาโครงการ PMSC
โครงการก่อสร้างอาคารที่ทำการศาลปกครอง

อ้างถึง 1. เอกสารเลขที่ STECON/COM.TP/SI-004/VO/R0

สิ่งที่ส่งมาด้วย 1. บัญชีแสดงราคางานเพิ่ม-ลด ส่วนงานโครงสร้างและสถาปัตยกรรม จำนวน 1 เล่ม (9 แผ่น)
2. บัญชีแสดงปริมาณงานเพิ่ม-ลด ส่วนงานโครงสร้างและสถาปัตยกรรม จำนวน 1 เล่ม (132 แผ่น)
3. รายละเอียดการเสนอราคาต่อหน่วยใหม่ งานโครงสร้างและสถาปัตยกรรม จำนวน 1 เล่ม (80 แผ่น)
4. แบบก่อสร้างโครงสร้างและสถาปัตยกรรม จำนวน 1 เล่ม (195 แผ่น)

ตามที่บจก. ซิโน-ไทย เอ็นจีเนียริ่ง แอนด์ คอนสตรัคชั่น ได้รับหวังไว้วางใจจาก องค์การ ในการว่าจ้างให้เป็นผู้รับจ้างในโครงการก่อสร้างอาคารที่ทำการศาลปกครองตามสัญญาเลขที่ 4/2548 ลงวันที่ 21/6/2548 และบันทึกข้อตกลงแก้ไขเพิ่มเติมสัญญาจ้าง ครั้งที่ 1 ลงวันที่ 19/6/2550 นั้น

และจากการที่บจก.ธนารักษ์พัฒนาสินทรัพย์ จำกัด ได้มีคำสั่งเปลี่ยนแปลงรูปแบบของโครงการในส่วนของงานโครงสร้างและงานสถาปัตยกรรมตามเอกสารที่อ้างถึง ซึ่งเป็นงานส่วนหนึ่งในเอกสารแนบท้ายของบันทึกข้อตกลงแก้ไขเพิ่มเติมสัญญาจ้าง ครั้งที่ 1 นั้นนี้งานการตรวจสอบปริมาณงานและต้องรองราคาที่เปลี่ยนแปลงร่วมกันระหว่าง ผู้ควบคุมงาน PMSC และผู้รับจ้างได้แล้วเสร็จลงแล้วในส่วนของงานโครงสร้าง & งานสถาปัตยกรรม ตามรายละเอียดในสิ่งที่ส่งมาด้วย 1 ผู้รับจ้างจึงใคร่ขอเสนอราคางานเพิ่ม-ลด ครั้งที่ 1 (Revise 1) ส่วนงานโครงสร้างและงานสถาปัตยกรรมให้ที่ปรึกษา PMSC ได้พิจารณาเพื่อขออนุมัติดังรายละเอียดต่อไปนี้

งานเพิ่มส่วนงานโครงสร้างและงานสถาปัตยกรรม	=	49,727,479.45 บาท
ค่าดำเนินการและกำไร 8%	=	3,982,198.36 บาท
รวมเป็นเงินก่อน VAT	=	53,759,677.81 บาท
ภาษีมูลค่าเพิ่ม 7%	=	3,763,177.45 บาท
จำนวนงานเพิ่ม	=	57,522,855.26 บาท

(ห้าสิบเจ็ดล้านห้าแสนสองหมื่นห้าร้อยห้าสิบห้าบาทยี่สิบหกสตางค์)

สิ่ง

บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด

STECON

ชั้น 27 ซิโน-ไทย ทาวเวอร์ 32/69-70 ถนนสุขุมวิท 21 กรุงเทพฯ 10
27th FL. SINO-THAI TOWER, 32/69-70 SUKHUMVIT 21 RD., BANGKOK 10110 THAILA
Tel. 0-2610-4930 FAX. 0-2260-

บริษัท ซิโน-ไทย เอ็นจีเนียริ่ง แอนด์ คอนสตรัคชั่น จำกัด (มหาชน)
SINO-THAI ENGINEERING & CONSTRUCTION PUBLIC COMPANY LIMITED

-2-

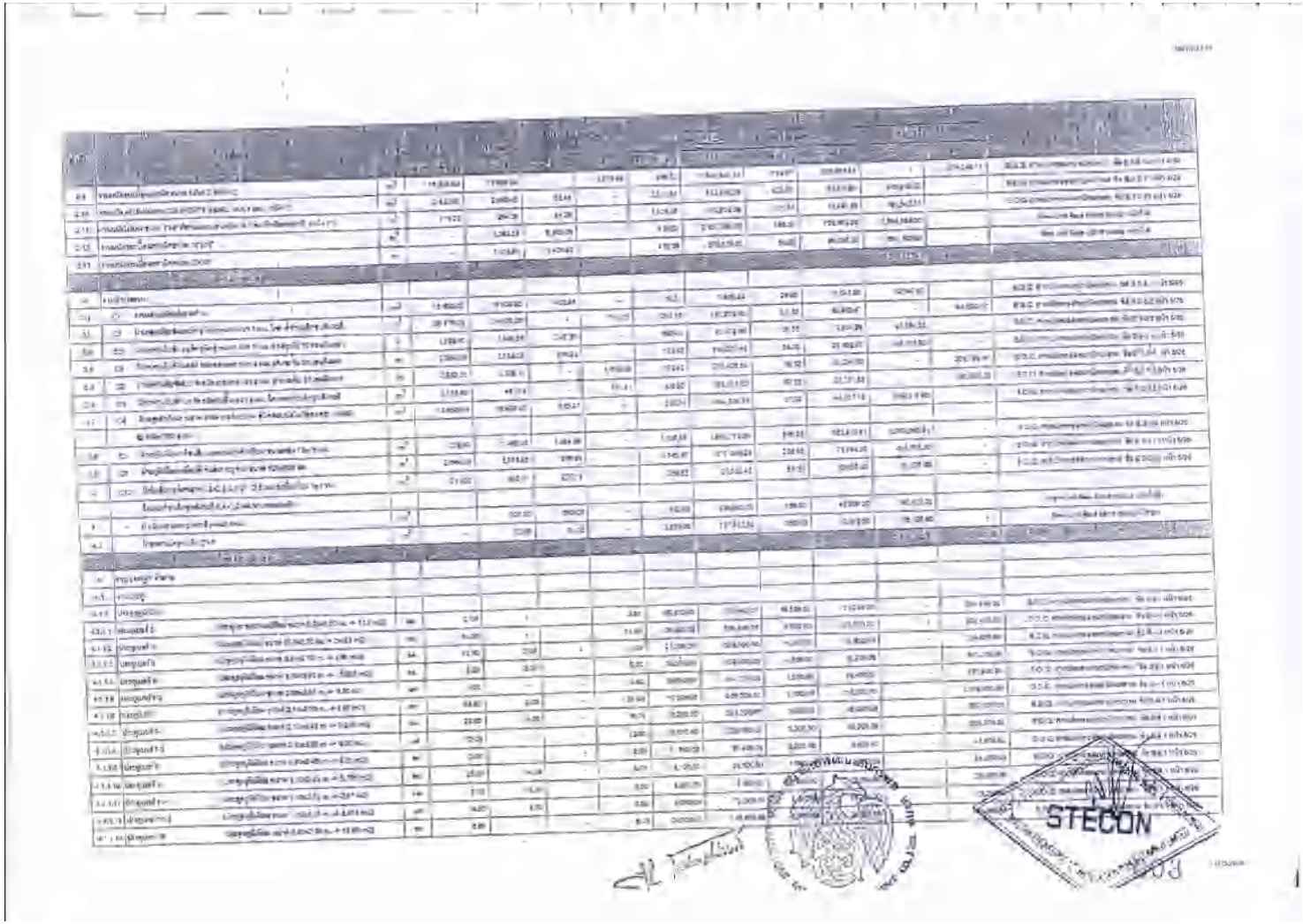
จึงขอเรียนมาเพื่อโปรดพิจารณาอนุมัติและพิจารณาแก้ไขเพิ่มเติมสัญญาจ้างเพื่อให้บริษัทฯ สามารถเบิกเงินส่วนเพิ่มเติมที่ทำงานไปแล้วเกือบทั้งหมดด้วยจักเป็นพระคุณอย่างยิ่ง

ขอแสดงความนับถือ

(นายพีระ นาเวิบล)
ผู้อำนวยการโครงการ

รับเอกสารโดย : .....
วันที่ : ...../...../.....

STECON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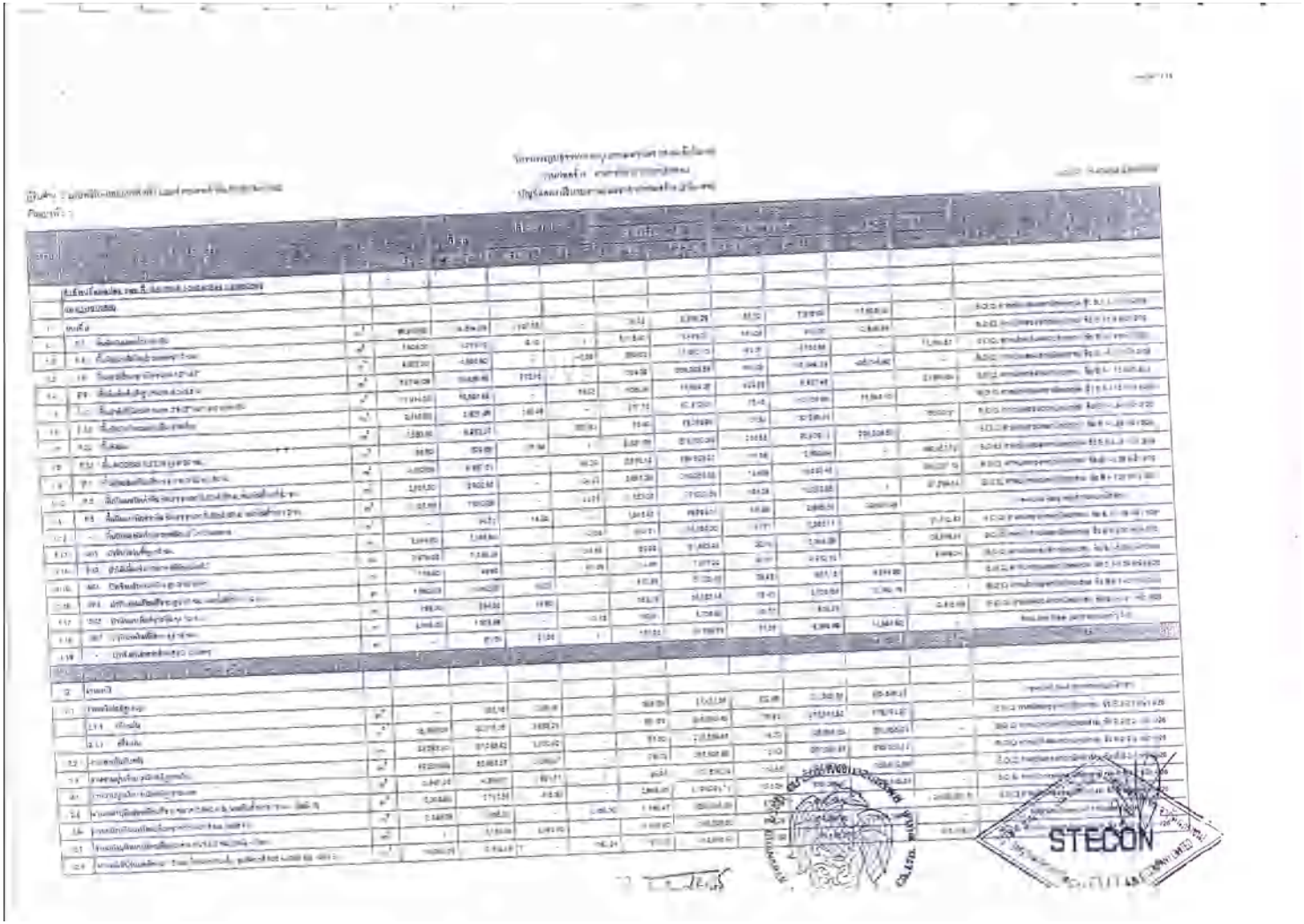
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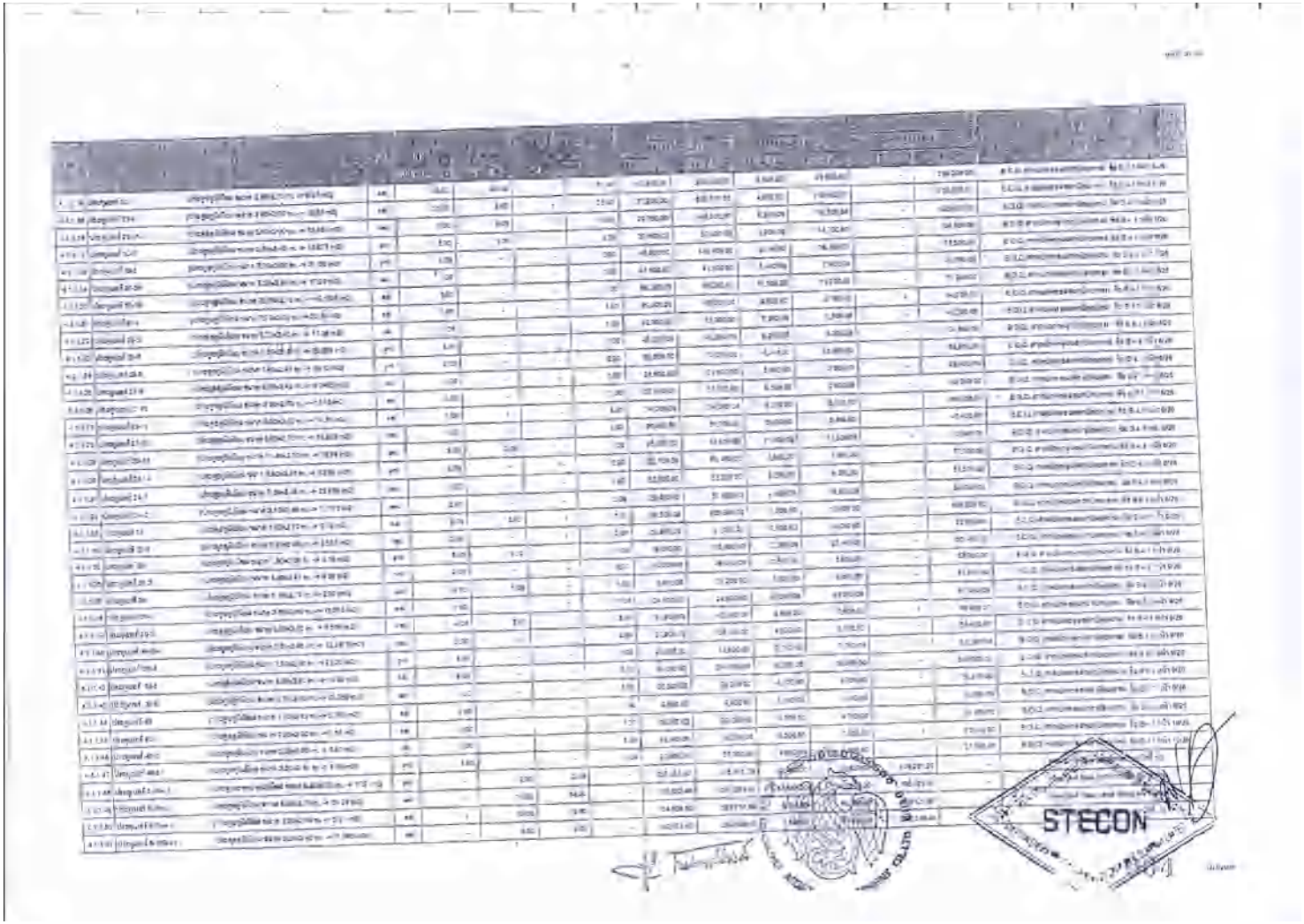
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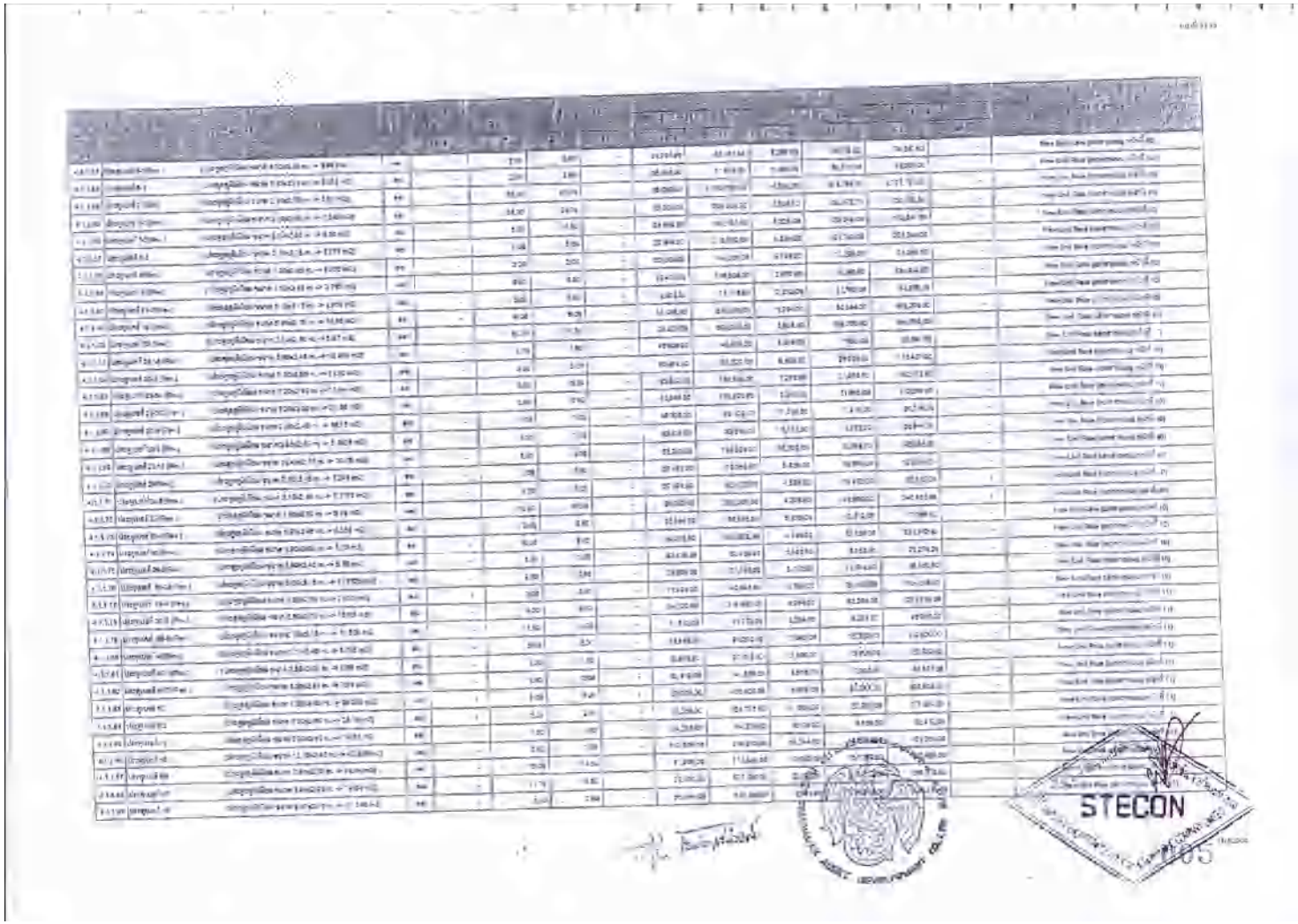
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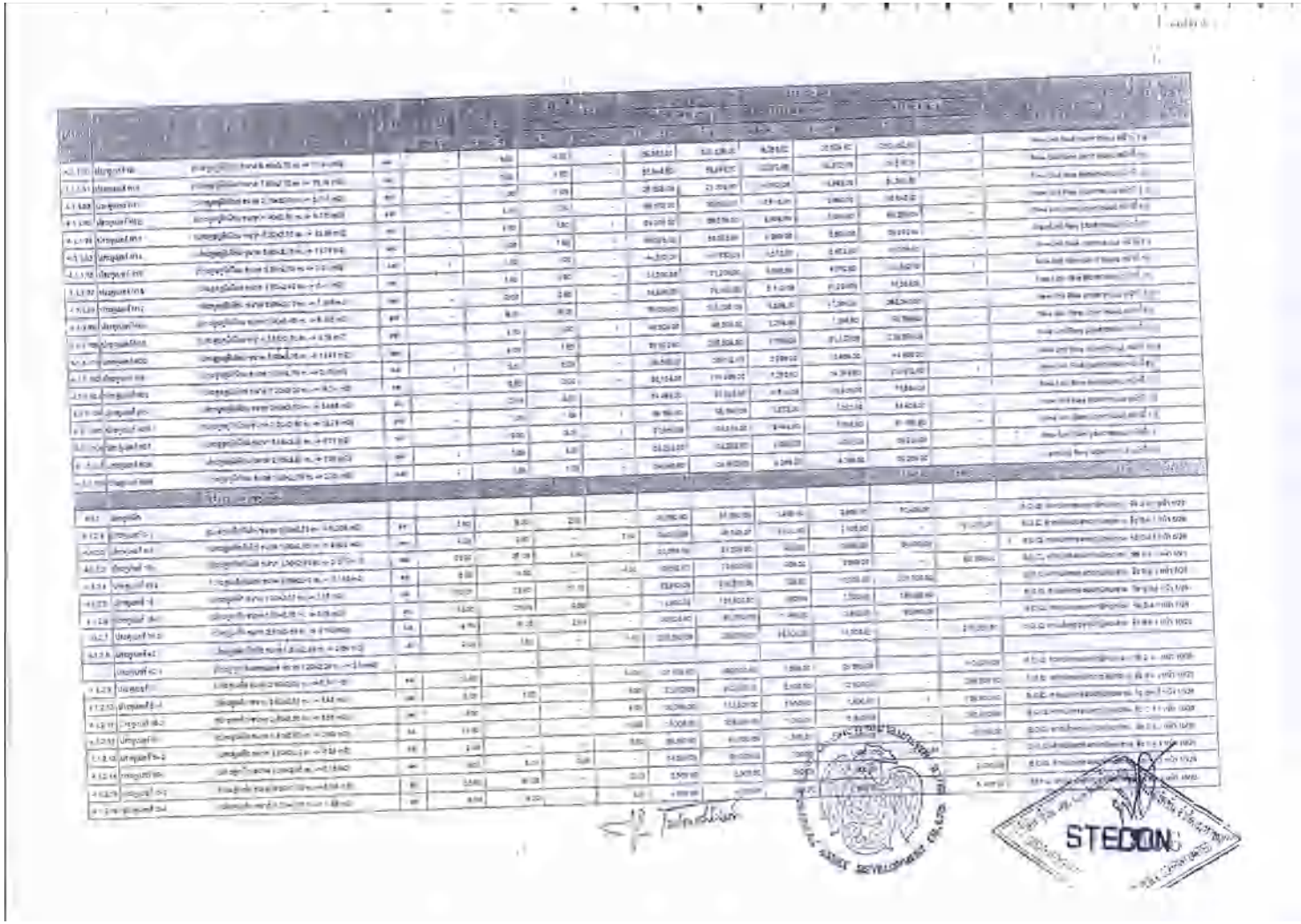

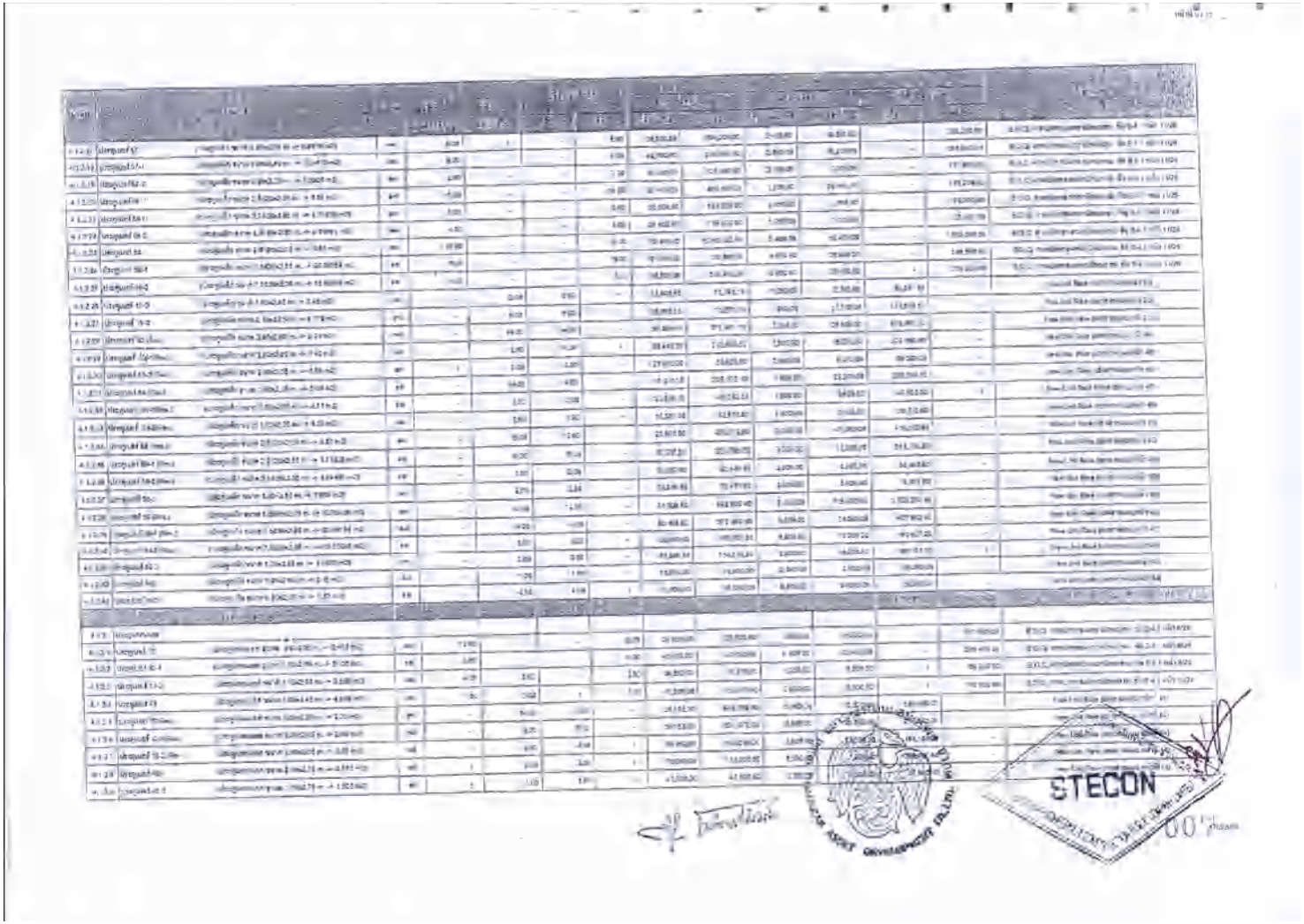
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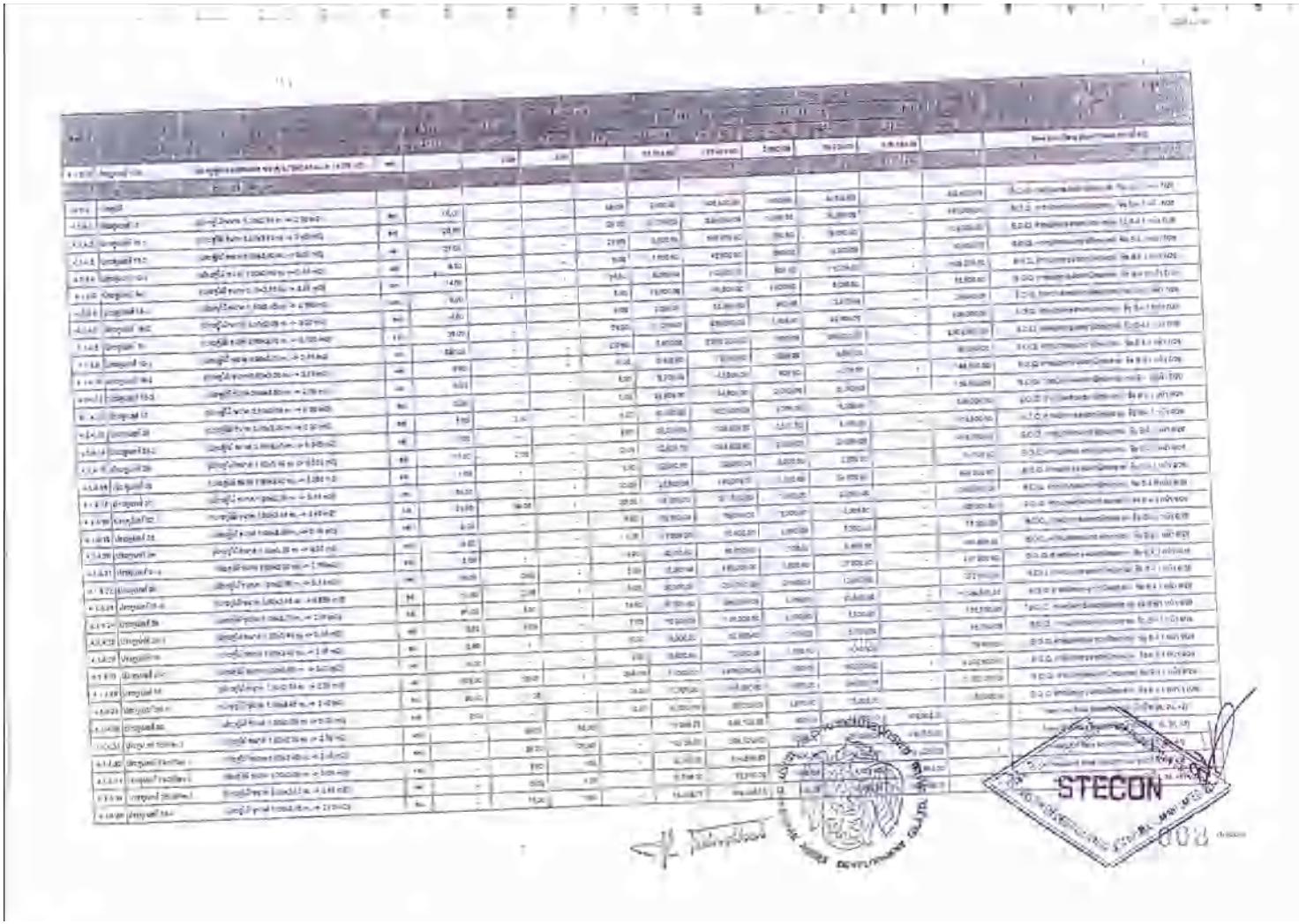
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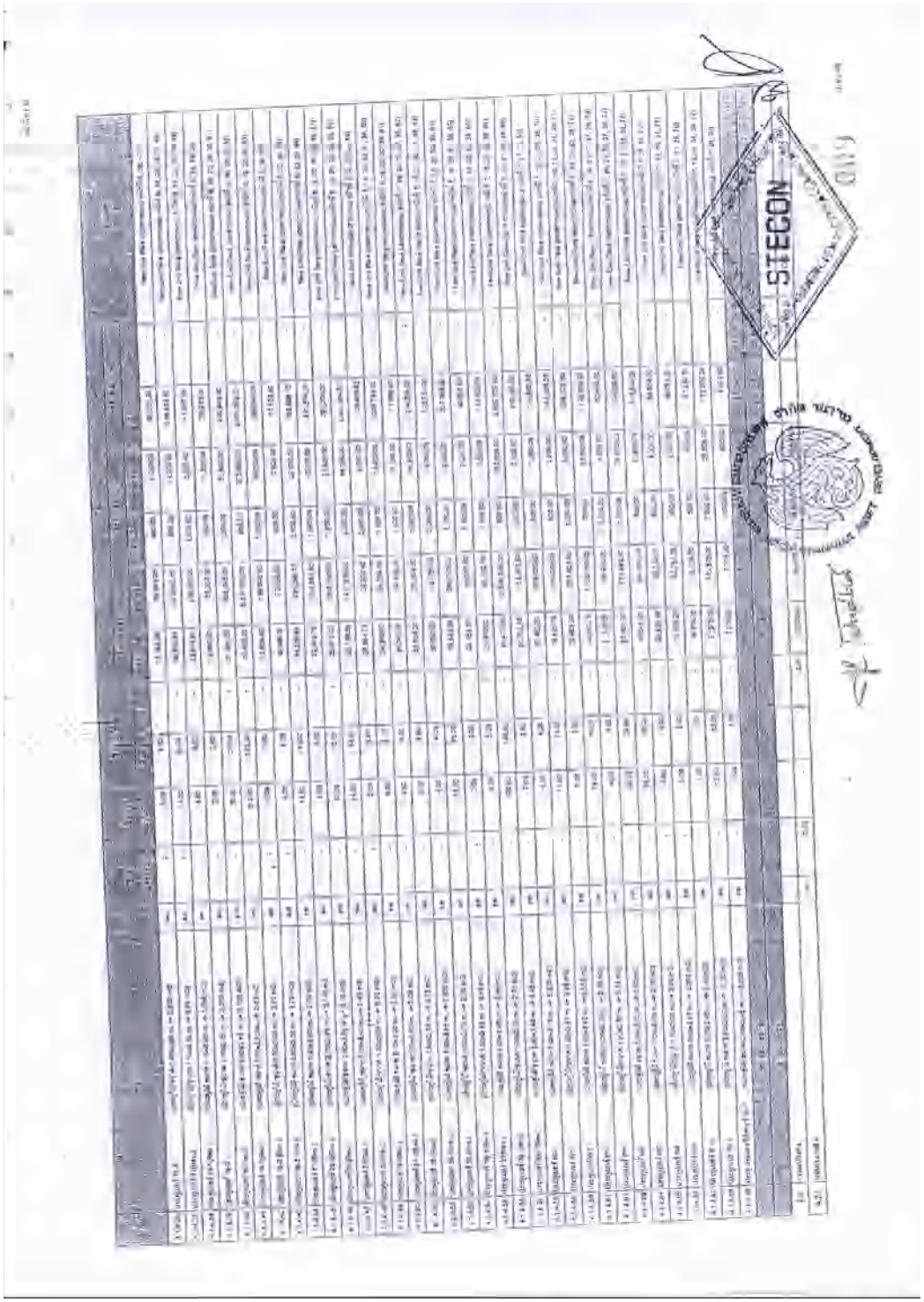
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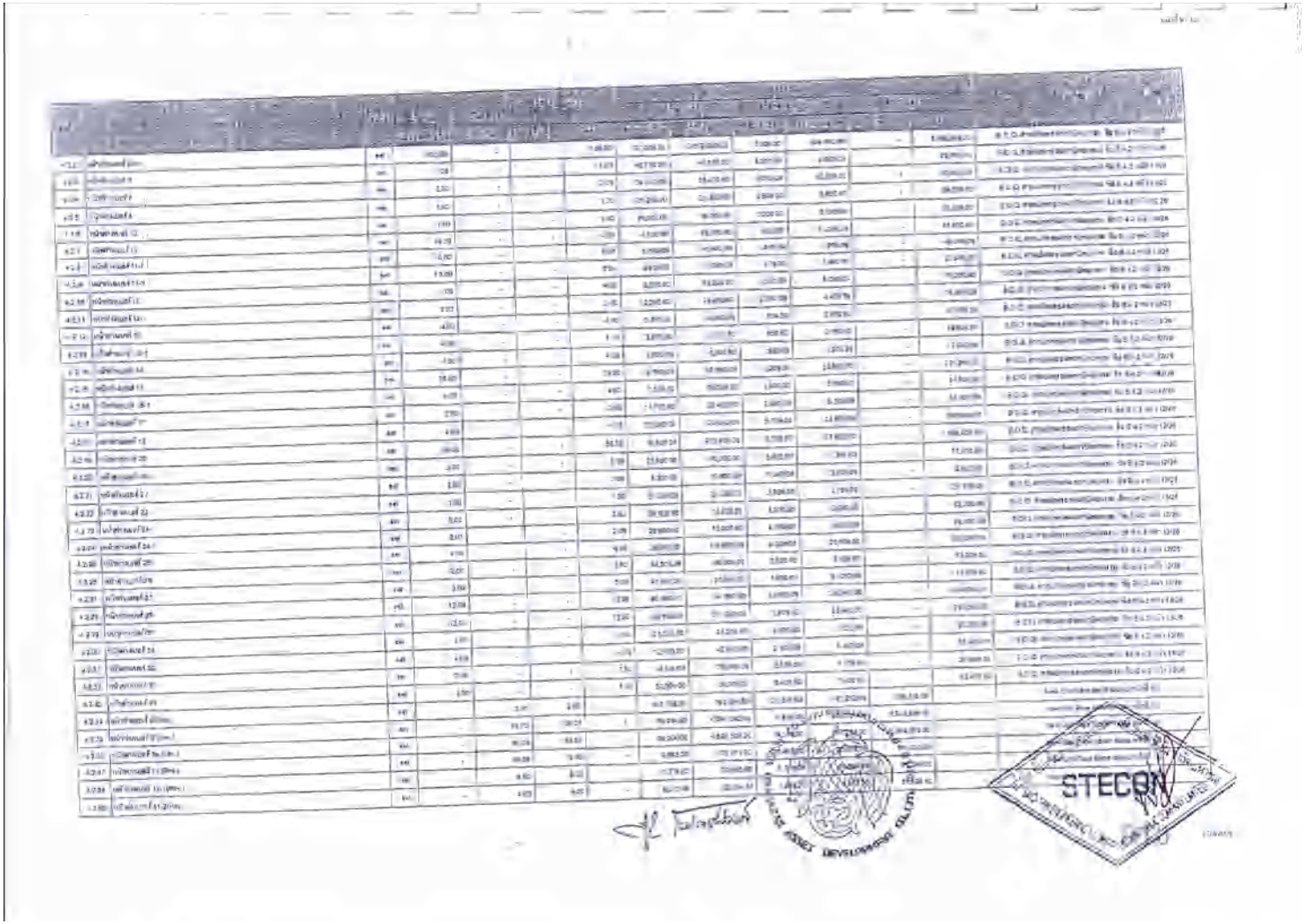
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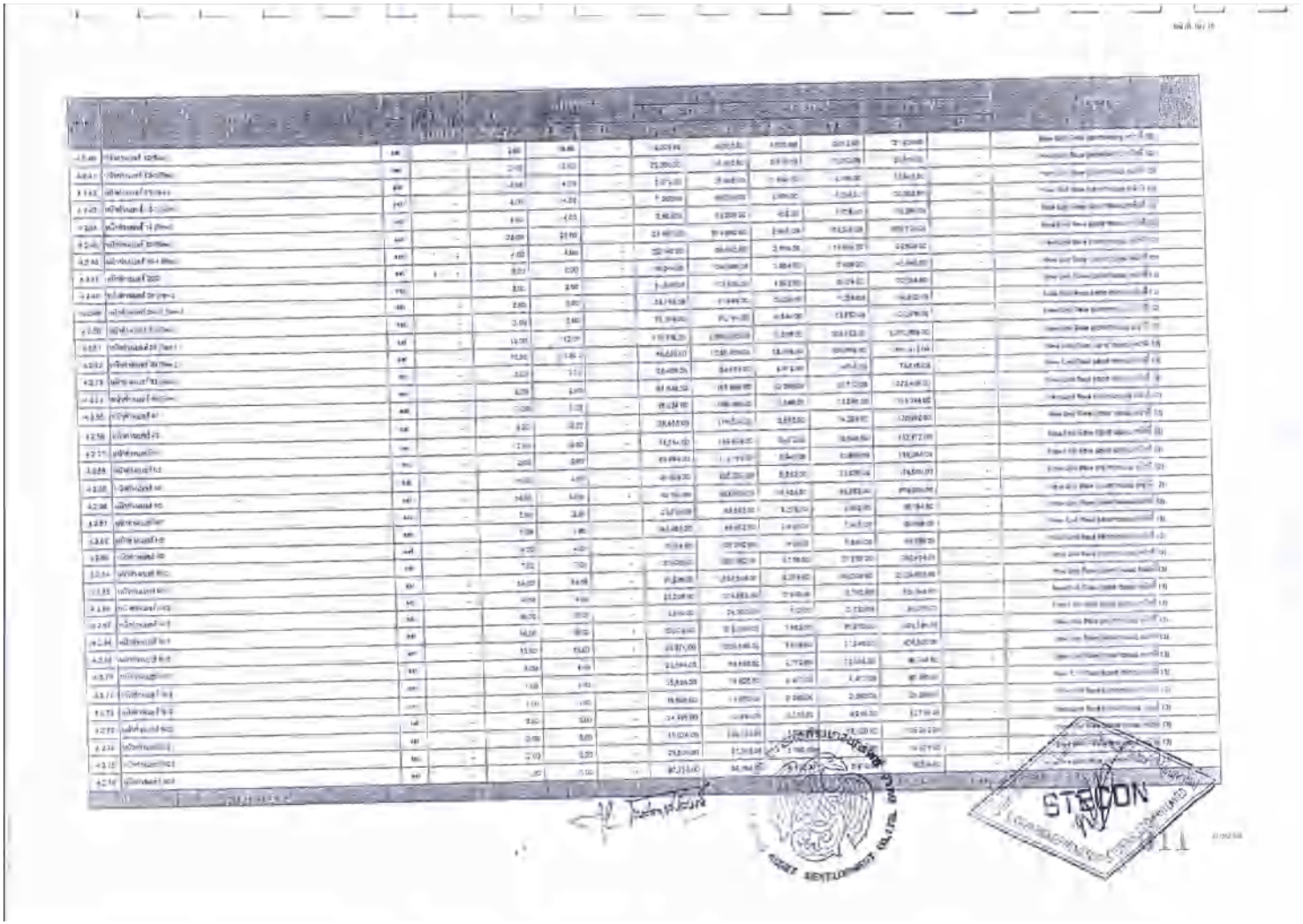

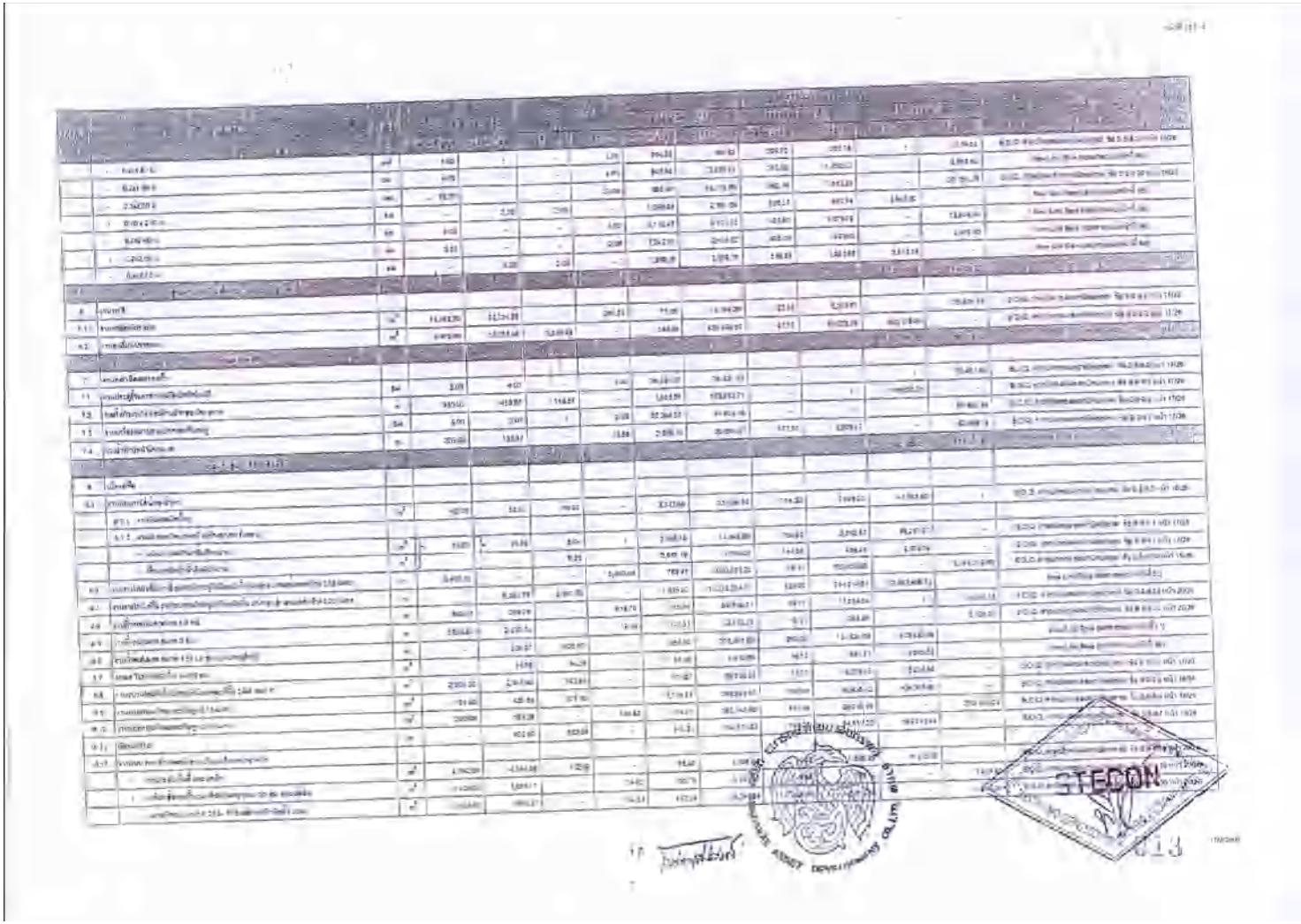

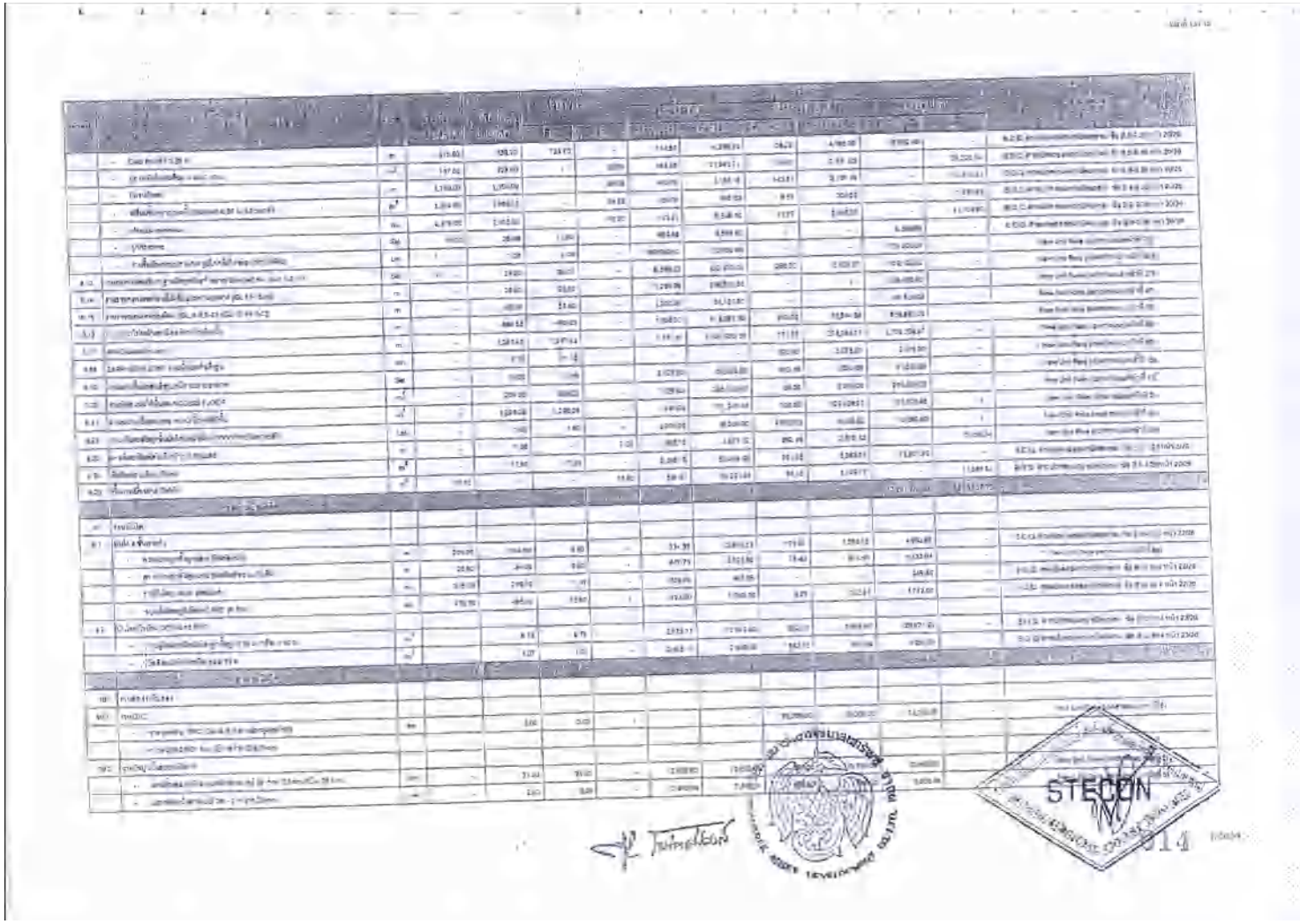

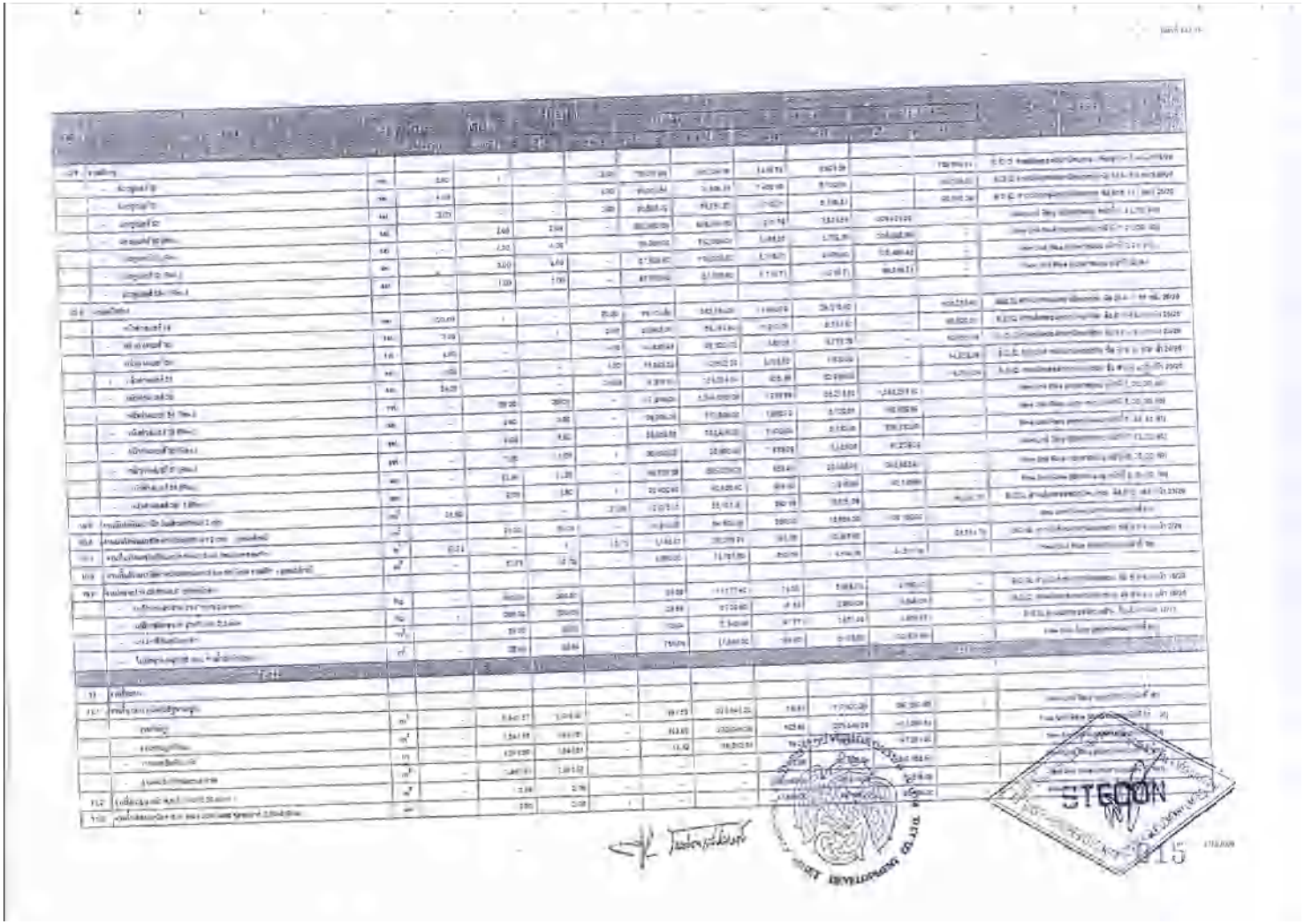

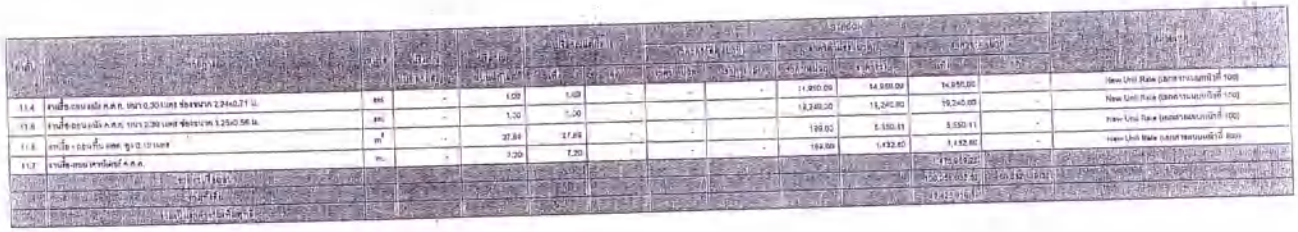

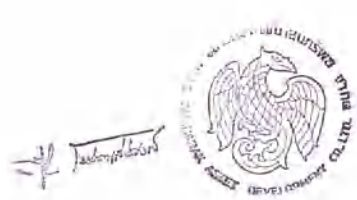

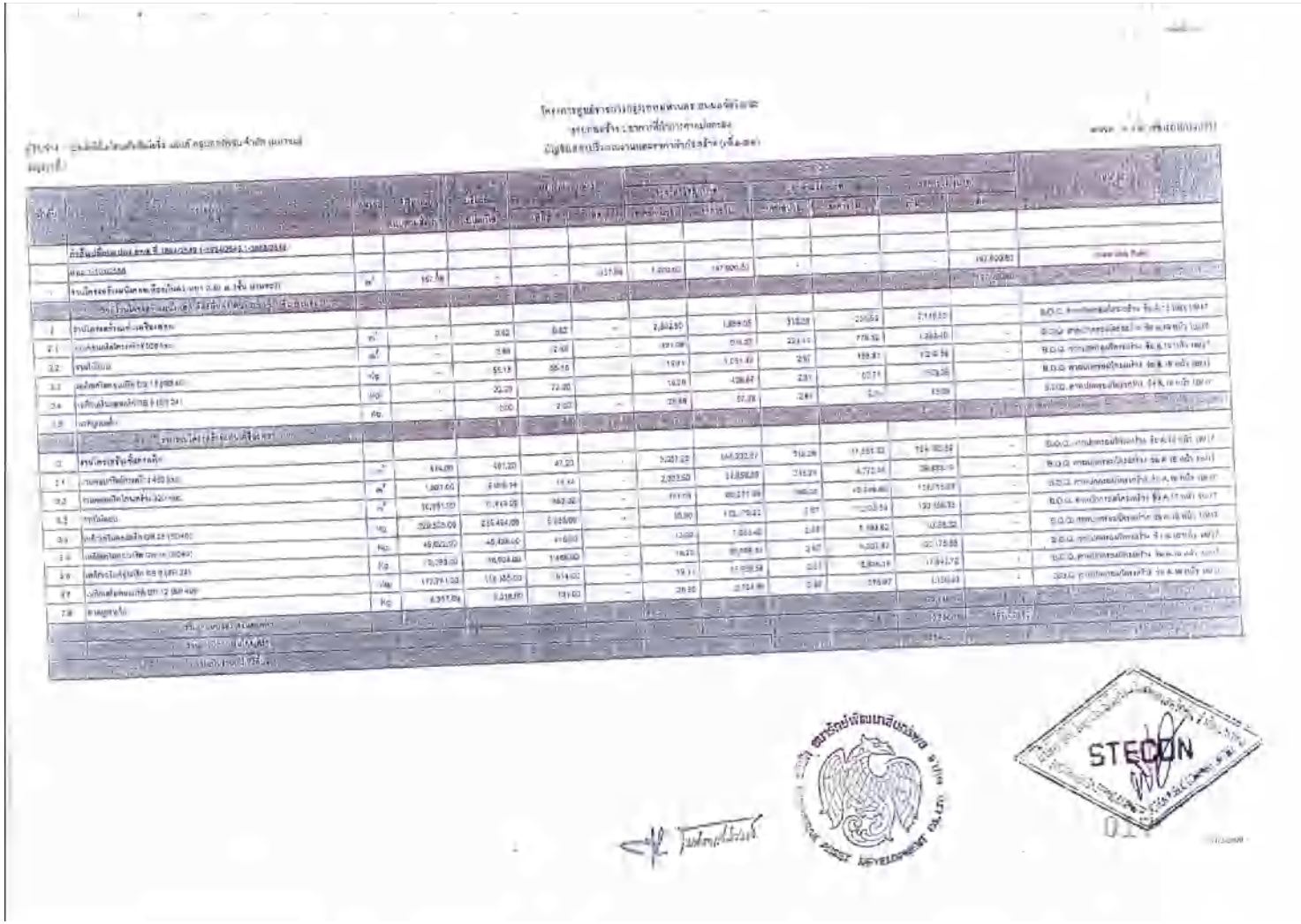

โครงการถนนพระยาสุเรนทร์ ถนนรังสิตนครนายก

งานก่อสร้าง : งานที่ทำการทางปกติ(ต่อ)

บัญชีแสดงปริมาณงานและราคาค่าก่อสร้าง (ที่ประมูล)

ผู้รับจ้าง : บริษัทสตีนโคน อินฟินิตี้ จอยท์ เวนเจอร์ส จำกัด (มหาชน)

สัญญาที่ : 1

ลำดับที่	รายการ	หน่วย	ปริมาณงานตามสัญญา	ราคาต่อหน่วย (บาท)	ปริมาณงานที่ทำได้ (งวดนี้)		ปริมาณงานที่ทำได้ (สะสม)		จำนวนเงิน (งวดนี้)		จำนวนเงิน (สะสม)		หมายเหตุ
					เพิ่ม	ลด	เพิ่ม	ลด	เพิ่ม	ลด	เพิ่ม	ลด	
	ค่าจ้างเปลี่ยนแปลง ตาม ก.ร.ว. 13(ง)(2)(ข) 1-3624/2548 1-3958/2549												
	และ 1-1032/2550												
	ข้อตกลงคืนดี ระหว่าง กรมทางหลวง กระทรวงคมนาคม และ กรม												
	ค่าก่อสร้างผิวทางที่ 1 สำหรับช่องจราจรนำปูนกลางหรือเสริมเหล็ก												
	- ขนาด Dia 600mm	m	606.00	499.00	34.00	-	612.67	13,657.58	710.59	24,333.79	38,331.58	-	ป.ร.ว. ตามบันทึกตรวจสอบงานที่ลง ที่ ร.ว.ง.1 เล่มที่ 6/22
	- ขนาด Dia 800 mm.	m	79.00	50.00	-	30.00	1,148.17	22,929.40	1,092.18	20,065.20		+3,982.00	ป.ร.ว. ตามบันทึกตรวจสอบงานที่ลง ที่ ร.ว.ง.1 เล่มที่ 6/22
2	ข้อต่อและอุปกรณ์ต่อท่อคอนกรีตเสริมเหล็ก สำหรับท่อระบายน้ำ ตามแบบ												
	เหล็กรูปพรรณและอุปกรณ์ Kn, Dip Galvanized												
	- ขนาดกว้าง 400 mm.	กก.	31.00	40.00	9.00	-	9,440.88	8,460.27	1,400.00	8,280.27	23,788.14	-	ป.ร.ว. ตามบันทึกตรวจสอบงานที่ลง ที่ ร.ว.ง.1 เล่มที่ 6/22
	รวมเงินค่างานก่อสร้างทั้งสิ้น										1,375.02		
	จำนวนเงินที่ขอรับ												

STECON

016

บริษัท ซิโน-ไทย เอ็นจีเนียริ่ง แอนด์ คอนสตรัคชั่น จำกัด (มหาชน)
SINO-THAI ENGINEERING & CONSTRUCTION PUBLIC COMPANY LIMITED

ที่ STECON/C01/LTR/51-078/ VO/R0

วันที่ 22 กรกฎาคม 2551

เรื่อง ขออนุมัติรายงานเพิ่ม-ลด ครั้งที่ 2 ที่ผ่านการพิจารณาต่อรองสุดท้ายจากที่ปรึกษา PMSC

เรียน ผู้จัดการโครงการ ที่ปรึกษาโครงการ PMSC
โครงการก่อสร้างอาคารที่ทำการศาลปกครอง

อ้างถึง เอกสารเลขที่ STECON/C01/LTR/51-008/VO/R0 ลงวันที่ STECON/C01/LTR/51-077/VO/R0

สิ่งที่ส่งมาด้วย รายละเอียดการเสนอราคางานเพิ่ม-ลด ครั้งที่ 2 ประกอบด้วย

1. ตารางสรุปรายการยอดรวมงานเพิ่ม-ลด ครั้งที่ 2 จำนวน 4 แผ่น
2. บัญชีแสดงปริมาณงานเพิ่ม-ลด ครั้งที่ 2 จำนวน 163 แผ่น
3. เอกสารประกอบใบเสนอราคางานเปลี่ยนแปลง จำนวน 189 แผ่น

ตามที่บมจ. ซิโน-ไทย เอ็นจีเนียริ่ง แอนด์ คอนสตรัคชั่น ได้รับความไว้วางใจจาก สพส.ในการว่าจ้างให้เป็นผู้รับจ้างในโครงการก่อสร้างอาคารที่ทำการศาลปกครองตามสัญญาฉบับที่ 4/2548 ลงวันที่ 21/6/2548 และบันทึกข้อตกลงแก้ไขเพิ่มเติมสัญญาจ้างครั้งที่ 1 ลงวันที่ 19/6/2550; ครั้งที่ 2 ลงวันที่ 5/9/2550; ครั้งที่ 3 ลงวันที่ 28/4/2551

และจากการที่บจก.ธนารักษ์พัฒนาสินทรัพย์ จำกัด ได้มีคำสั่งเปลี่ยนแปลงรูปแบบของโครงการ ซึ่งปัจจุบันมีคำสั่งที่ สพจ. 1-2175/2551 ลงวันที่ 3/7/2551 นั้น ทางบริษัทฯ ได้ทำการคำนวณราคางานเปลี่ยนแปลงเพิ่ม-ลด ดังกล่าวให้ที่ปรึกษาพิจารณาต่อรองตามเอกสารที่อ้างถึงเรียบร้อยแล้ว

บัดนี้การตรวจสอบปริมาณงานและต่อรองราคาที่เปลี่ยนแปลงร่วมกันระหว่างที่ปรึกษาโครงการ PMSC และผู้รับจ้างได้แล้วเสร็จลงตามรายละเอียดในสิ่งที่ส่งมาด้วย 1, 2, 3 บริษัทฯ จึงขอเสนอราคางานเพิ่ม-ลด ครั้งที่ 2 ให้ที่ปรึกษา PMSC ได้พิจารณาและขออนุมัติดังรายละเอียดต่อไปนี้

งานเปลี่ยนแปลงเพิ่ม-ลด ครั้งที่ 2		71,774,869.54	บาท
ค่าดำเนินการและกำไร 8%		5,741,989.56	บาท
รวมเป็นเงินก่อน VAT		77,516,859.10	บาท
ค่าใช้จ่ายพิเศษตามข้อกำหนดในข้อที่ปรึกษาโครงการครั้งที่ 2	=	6,220,070.02	บาท
รวมค่าก่อสร้างก่อนภาษี	=	83,736,929.12	บาท
ภาษีมูลค่าเพิ่ม 7%	=	5,861,585.04	บาท
รวมราคางานเพิ่มทั้งสิ้น	=	89,598,514.16	บาท

(แปดสิบเก้าล้านห้าแสนเก้าหมื่นแปดพันห้าร้อยสิบสี่บาทสิบหกสตางค์)

บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด ASSET DEVELOPMENT CO.,LTD.

STECON

บริษัท ซิโน-ไทย เอ็นจีเนียริ่ง แอนด์ คอนสตรัคชั่น จำกัด (มหาชน)
SINO-THAI ENGINEERING & CONSTRUCTION PUBLIC COMPANY LIMITED

โดยมูลค่างานดังกล่าวไม่รวมค่าแร่งรัดงานที่ทำให้แล้วเสร็จก่อนสัญญาสิ้นสุด 50 วัน ซึ่งจะได้รวบรวมค่าใช้จ่ายดังกล่าวให้ทราบอีกครั้งหนึ่ง

จึงขอเรียนมาเพื่อโปรดพิจารณาอนุมัติและพิจารณาแก้ไขเพิ่มเติมสัญญาจ้างเพื่อให้บริษัทฯ สามารถเบิกเงินส่วนเพิ่มเติมที่ทำงานไปแล้วเกือบทั้งหมดด้วยครับเป็นพระคุณอย่างยิ่ง

ขอแสดงความนับถือ

(นายพีระ นาควัฒน)
ผู้อำนวยการโครงการ

STECON

รับเอกสารโดย : .....
วันที่ : ...../...../.....

บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด
DHANARAK ASSET DEVELOPMENT CO.,LTD.

ผู้รับจ้าง : บริษัท เทสารอโคน์ เทคนิคัลคัน์ซัลท์ (ประเทศไทย)

โครงการศูนย์ราชการกรุงเทพมหานคร ถนนแจ้งวัฒนะ

หน้าที่ 1 / 1

สัญญาที่ : ราคารวม (ไม่มีภาษี)

งานก่อสร้าง : งานการที่ทำการปรับปรุงอาคาร

บัญชีแสดงปริมาณงานและราคาค่าก่อสร้าง (เพิ่ม-ลด)

ลำดับ	รายการ	หน่วย	ปริมาณ (ตามสัญญา)	ปริมาณ (ตามแก้ไข)	ปริมาณเพิ่ม/ลด		ราคาค่าวัสดุ/อุปกรณ์		ราคาค่าแรง (บาท)		จำนวนเงิน (บาท)		หมายเหตุ
					เพิ่ม	ลด	ราคาหน่วย	จำนวน	ราคาหน่วย	จำนวน	เพิ่ม	ลด	
D.12	งานเปลี่ยนแปลง LIGHTING FIXTURES ตามคำสั่งเปลี่ยนแปลงงาน ช.ม.ร ฉบับที่ 5 ลงวันที่ 5 ม.ค. 54 LIGHTING FIXTURES - 2 x 36 W. Wall Mounting Fixture (โคมไฟส่องทำโครงกระจกด้านข้างขนาด 40 วัตต์) - Accessories - WMS 090-20TCT-EL Fixture - งานรื้อโคมไฟ 2 x 36 W. Wall Mounting Fixture - ค่าเปลี่ยนงานหน้าจั่ว, พื้น และสี ที่ดำเนินการหลังจากรื้อโคมเก่า - Accessories	ea Lot ea ea ea Lot	72.00 - - - - -	40.00 1.00 72.00 40.00 40.00 1.00	- - 72.00 40.00 40.00 1.00	(32) (1) - - - -	1,329.59 559.86 2,340.00 625.00 29,022.00	(39,546.88) (559.86) 168,480.00 25,000.00 29,022.00	200.63 89.24 210.00 200.63 250.00 4,300.00	(6,420.16) (89.24) 15,120.00 8,025.20 10,000.00 4,300.00	- - 183,600.00 8,025.20 25,000.00 33,322.00	(45,767.04) (648.74) - - -	D.12 P.14/22 D.12 P.14/22 New Item New Item D.12 P.14/22 New Item
	Sub Total for D.12										259,947.20	(46,407.78)	
	Grand Total											213,539.42	

STECON/C01/LTR/51-008/VO/01

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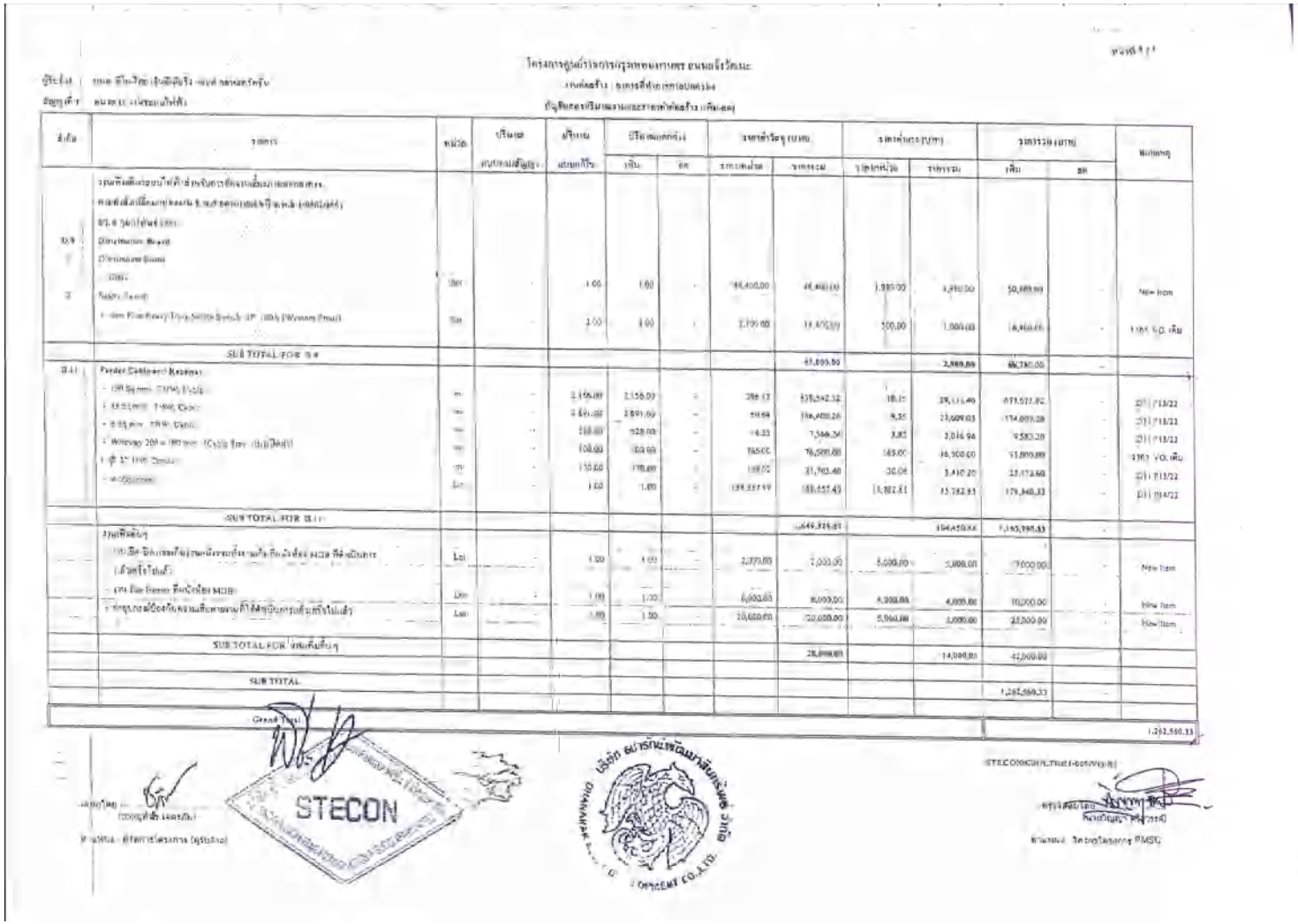
ตำแหน่ง : ผู้จัดการโครงการ (ผู้รับจ้าง)

ตำแหน่ง : วิศวกรโครงการ PMSC

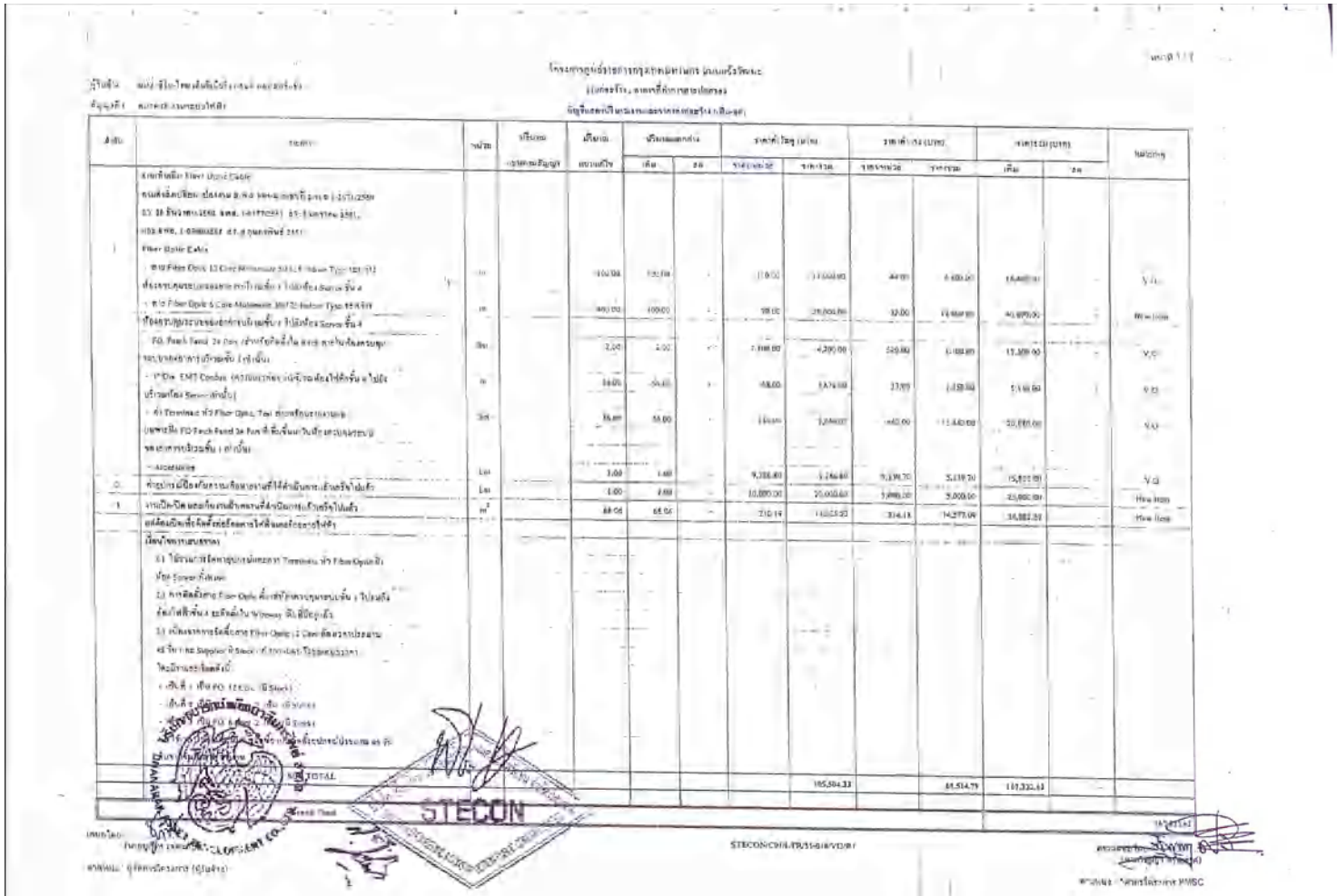


โครงการปรับปรุงระบบจำหน่ายและสถานีไฟฟ้าย่อย ...

ลำดับ	รายการ	หน่วย	ปริมาณ (ตามสัญญา)	ปริมาณ (แบบก่อสร้าง)	ปริมาณงานแต่ละงวด เพิ่ม	ปริมาณงานแต่ละงวด ลด	ราคาต่อหน่วย (บาท) ราคาเดิมตามสัญญา	ราคาต่อหน่วย (บาท) ราคาเพิ่ม	ราคาต่อหน่วย (บาท) ราคาต่อหน่วย	ราคาต่อหน่วย (บาท) ราคารวม	ราคารวม (บาท) เพิ่ม	ราคารวม (บาท) ลด	หมายเหตุ
10.9	งานติดตั้งระบบไฟฟ้าส่องสว่างบริเวณถนนเลี่ยงเมืองและทางแยกต่างระดับ ตอนที่ 1 ตั้งแต่ กม.ที่ 0+000 ถึง กม.ที่ 4+000 (ฝั่งขาเข้า)												
	Direction Board												
	Diversion Board												
	Total	Set	-	1.00	1.00	-	48,400.00	48,400.00	1,950.00	1,950.00	50,350.00	-	New Item
2	Public Sound												
	1 - 3ø Fire Rated Type Servo Switch 3P 100A (Wiring Free)	Set	-	3.00	3.00	-	2,790.00	13,470.00	500.00	1,500.00	16,470.00	-	1 ชุด V.O. เพิ่ม
	SUB TOTAL FOR 10.9							61,870.00		2,950.00	66,820.00	-	
10.11	Feeder Cantilever Recovery												
	- 150 Sq.mm. CWW, XLPE	m	-	2,156.00	2,156.00	-	288.13	621,042.32	18.15	39,131.40	673,673.72	-	ปี 13/22
	- 95 Sq.mm. CWW, Cable	m	-	2,891.00	2,891.00	-	58.68	196,400.28	8.35	23,609.03	154,009.28	-	ปี 13/22
	- 50 Sq.mm. CWW, Cable	m	-	528.00	528.00	-	14.33	7,566.24	3.85	2,046.96	9,580.20	-	ปี 13/22
	- Wireway 200 x 100 mm. (Cable Tray ประเภทมีฝาปิด)	m	-	100.00	100.00	-	765.00	76,500.00	165.00	16,500.00	93,000.00	-	1 ชุด V.O. เพิ่ม
	- ø 1" UPVC Conduit	m	-	170.00	170.00	-	168.00	31,703.40	30.06	3,410.20	35,113.60	-	ปี 13/22
	- Miscellaneous	Lot	-	1.00	1.00	-	139,337.19	139,337.19	13,782.81	13,782.81	179,840.33	-	ปี 13/22
	SUB TOTAL FOR 10.11							1,049,329.69		104,450.64	1,153,780.33	-	
	งานเพิ่มเติมๆ												
	- ชุด อุปกรณ์ป้องกันฟ้าผ่าแรงสูงชนิดเส้นสายล่อฟ้าพร้อมสายนำลงดิน ... (ตัวครึ่งโซนนี้)	Lot	-	1.00	1.00	-	2,370.00	2,000.00	5,000.00	5,000.00	7,000.00	-	New Item
	- งาน Bus Frame ที่หม้อไฟฟ้า MCB	Lot	-	1.00	1.00	-	6,000.00	8,000.00	4,000.00	4,000.00	10,000.00	-	New Item
	- ท่อสูบกลมป้องกันรอยเสียดสีของสายที่ใส่ลงในกรุและเครื่องไม้เสา	Lot	-	1.00	1.00	-	20,600.00	20,000.00	5,000.00	5,000.00	25,000.00	-	New Item
	SUB TOTAL FOR งานเพิ่มเติมๆ							28,000.00		14,000.00	42,000.00		
	SUB TOTAL										1,262,560.33	-	
	Grand Total												1,262,560.33

STECON

STECON/CHOW/LTHAI (JOINT VENTURE)



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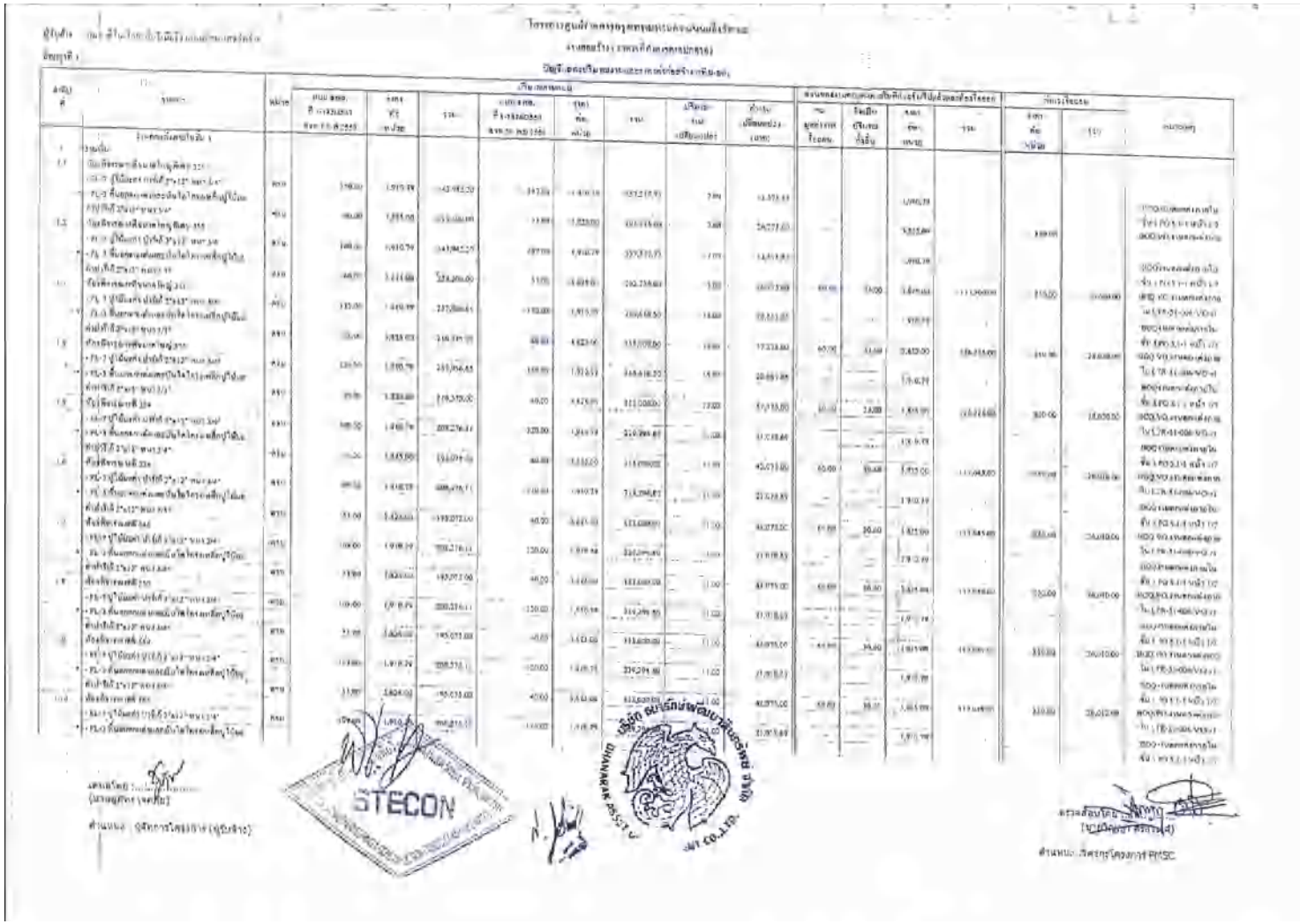
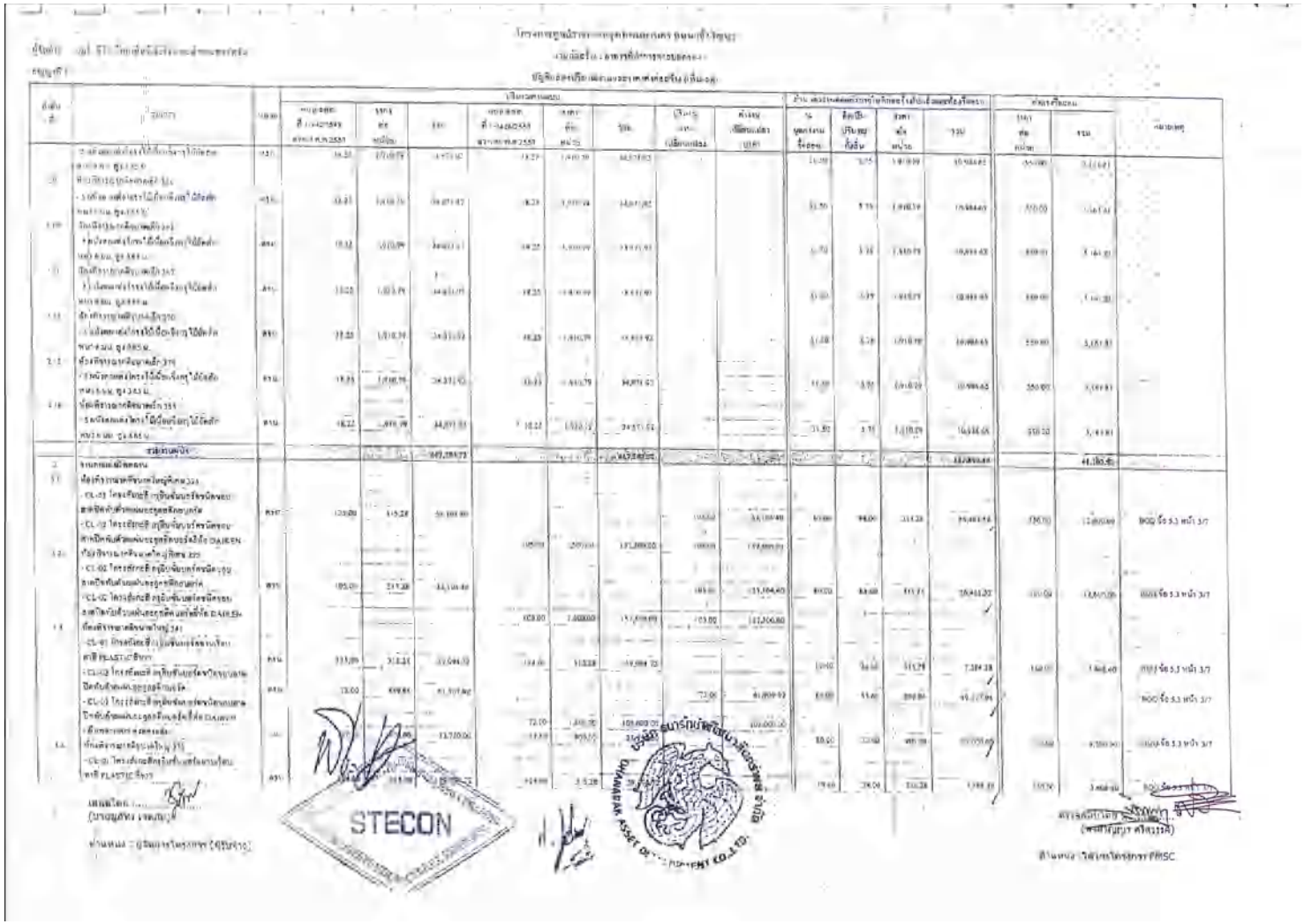
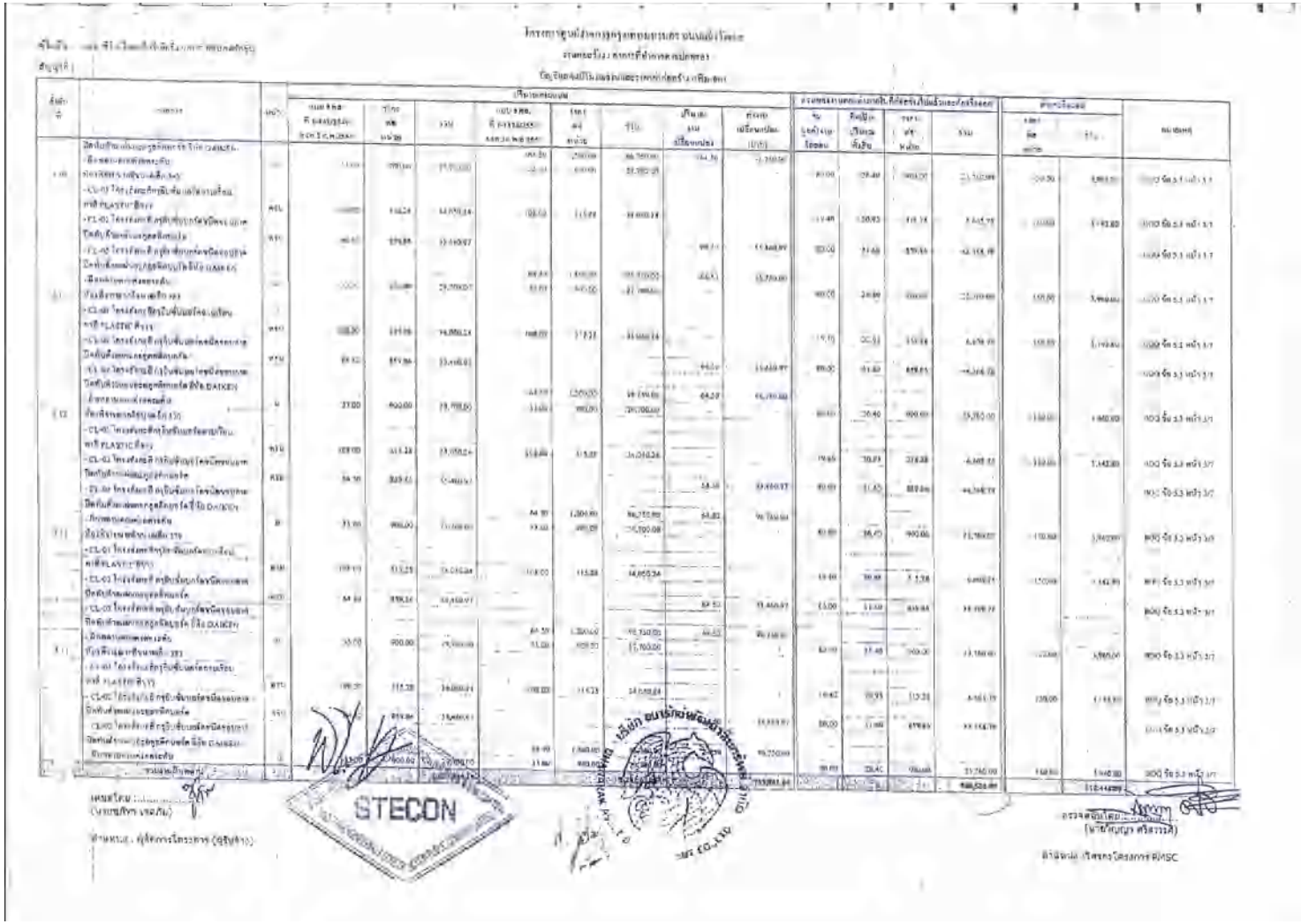
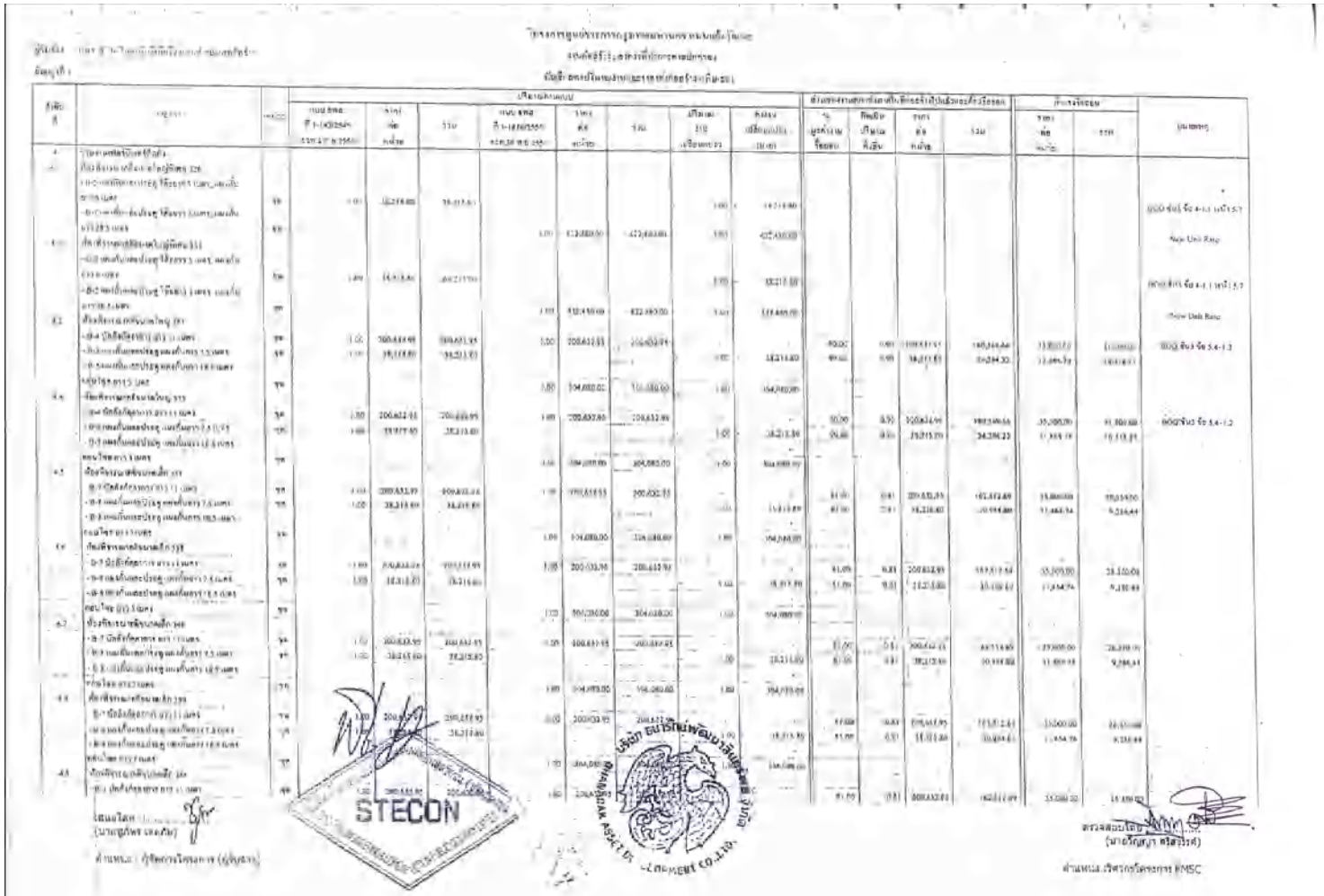
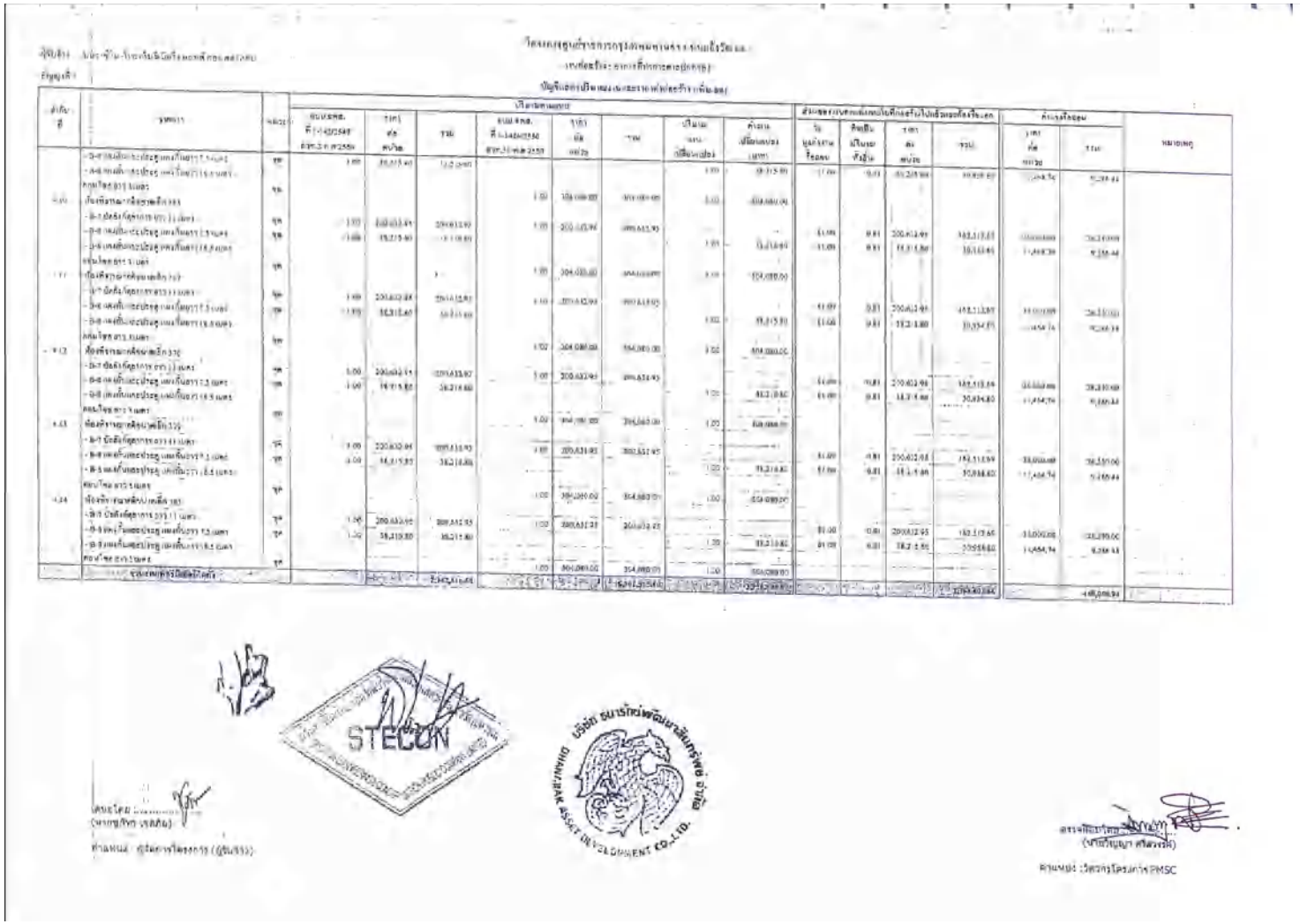




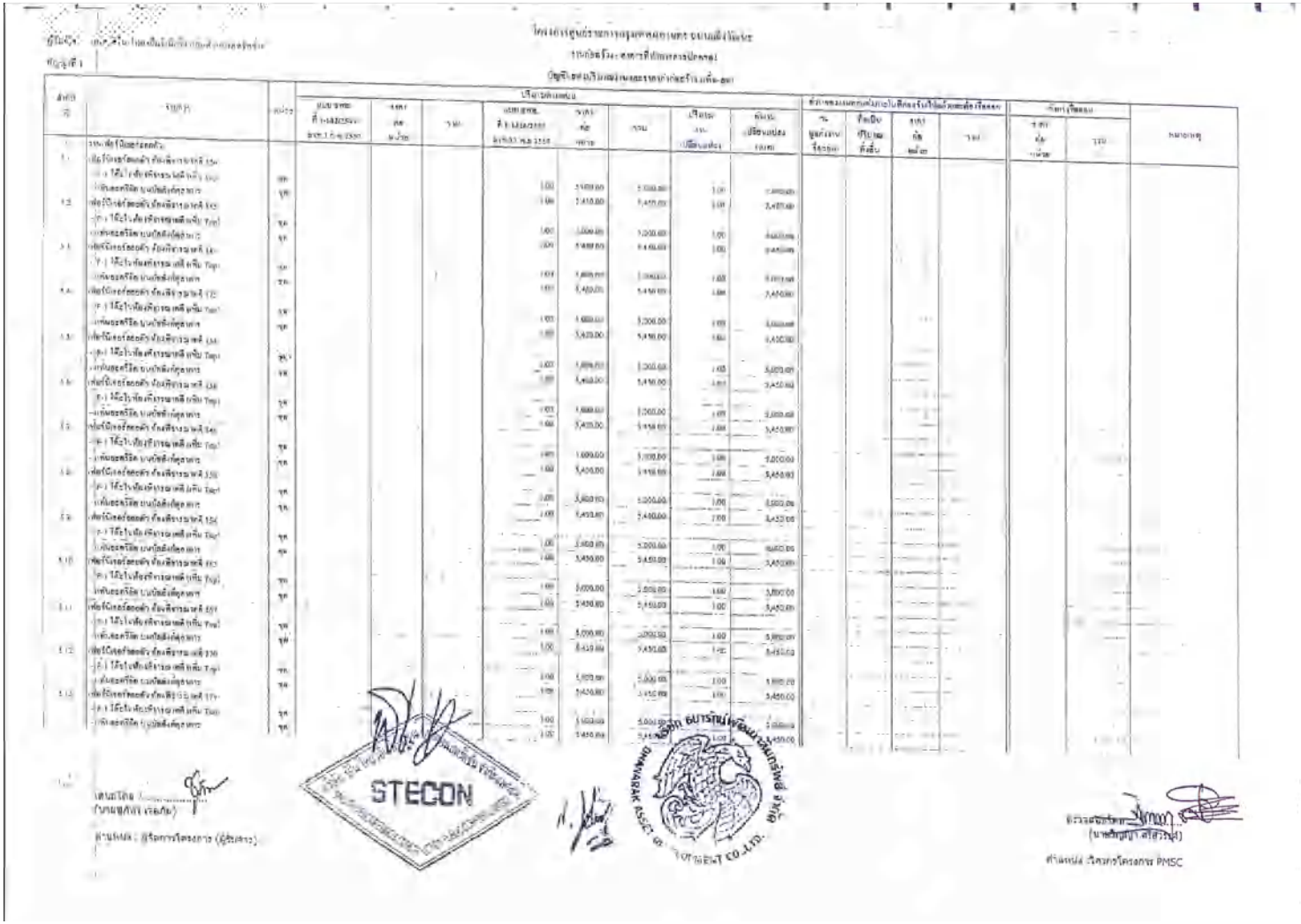






STECON

บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด
DHANARAK ASSET DEVELOPMENT CO.,LTD.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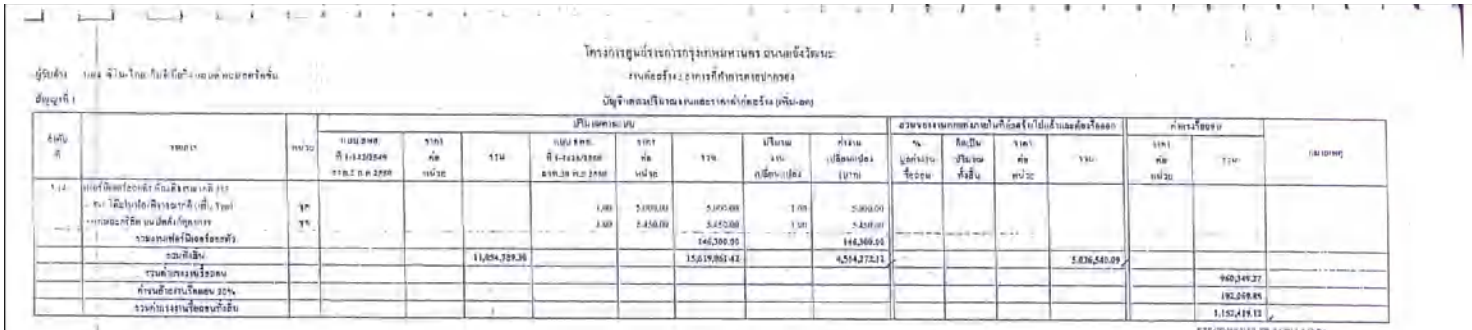

ค่างานเปลี่ยนแปลง	4,564,272.12	บาท
มูลค่างานตกแต่งภายในที่ก่อสร้างไปแล้วและต้องรื้อถอนออก	5,036,540.09	บาท
ค่าแรงในการรื้อถอนและขนย้ายออก	1,152,419.12	บาท
รวมเป็นมูลค่างานเพิ่ม	**10,753,231.33**	บาท

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]												
	[illegible] I-2230/2530 [illegible]												
	[illegible]												
	[illegible] Shop [illegible]												
E.10	[illegible]												
10.1	[illegible]												
	- # 20	[illegible]	-	3,256.00	3,256.00	-	30.57	99,535.92	76.75	97,098.00	196,633.92		New Unit Rate
	- # 22	[illegible]	-	10,143.00	10,143.00	-	36.75	271,433.25	[illegible]	232,670.71	504,102.96		New Unit Rate
	- # 33	[illegible]	-	5,919.00	5,919.00	-	21.97	130,040.43	19.11	113,112.09	243,152.52		New Unit Rate
10.9	[illegible]	[illegible]	-	1.00	1.00	-	110,550.00	110,550.00	39,710.00	39,710.00	150,260.00		
10.10	[illegible]	[illegible]	-	1.00	1.00	-	27,500.00	27,500.00	11,110.00	11,110.00	38,610.00		
10.11	[illegible]												
	- Duct insulation [illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	12.00	115,494.00	[illegible]	74,832.08	[illegible]		New Item
	- [illegible]												
	[illegible]	[illegible]	-	1.00	1.00	-	2,260.00	2,260.00	[illegible]	[illegible]	[illegible]		New Item
	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		New Item
	Total E.10												
E.14	Other										2,326,[illegible]	-	
	- [illegible]	[illegible]		19,829.00	19,829.00		[illegible]	[illegible]	[illegible]	[illegible]	177,[illegible]		New Item
	- [illegible]	[illegible]	-	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		New Item
	- [illegible]	[illegible]	-	1.00	1.00				[illegible]	[illegible]	[illegible]		New Item
	Total E.14									177,[illegible]	311,[illegible]	-	
	Sub Total										[illegible]	-	
	Grand Total										1,551,[illegible].78		

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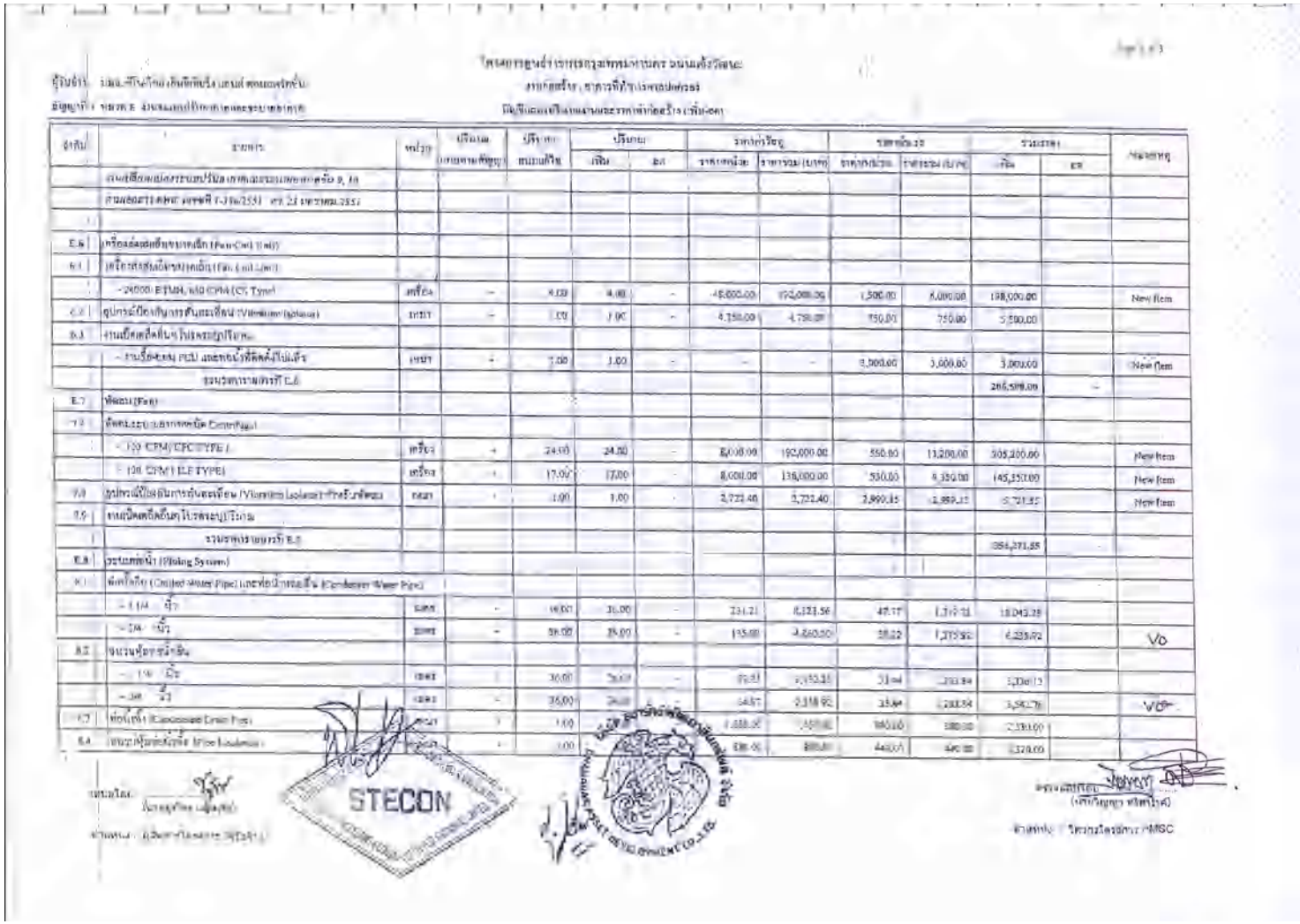


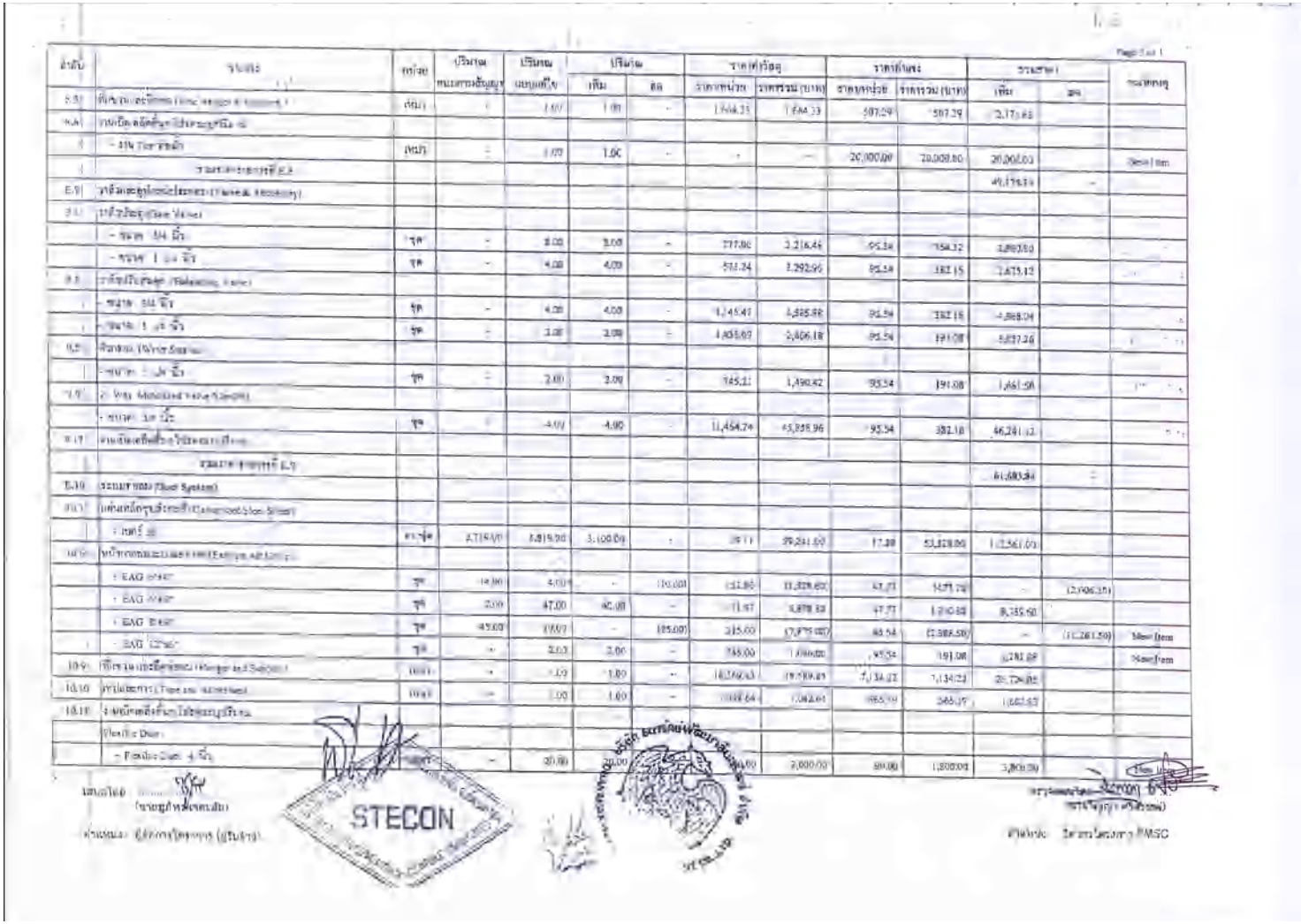
โครงการอาคารสำนักงานและที่พักอาศัย ขนาดใหญ่พิเศษ
งานก่อสร้าง , ติดตั้งระบบปรับอากาศ
ปรับปรุงแบบและรายการครั้งที่ 2 (เพิ่ม-ลด)

ลำดับ	รายการ	หน่วย	ปริมาณ (ตามสัญญา)	ปริมาณ ณ ปัจจุบัน	ปริมาณ เพิ่ม	ปริมาณ ลด	ราคาต่อหน่วย	ราคารวม (บาท)	ราคาต่อหน่วย	ราคารวม (บาท) เพิ่ม	ราคารวม (บาท) ลด	หมายเหตุ
	ค่าแก้ไขแบบและรายการครั้งที่ 9, 10											
	ตามหนังสือ ลงวันที่ 1-316/2551 ลว. 23 เมษายน 2551											
E.6	เครื่องส่งลมเย็นชนิดแขวนเพดาน (Fan Coil Unit)											
6.1	เครื่องส่งลมเย็นชนิดแขวนเพดาน (Fan Coil Unit)											
	- 24000 BTUH, 600 CFM (CC Type)	เครื่อง	-	8.00	8.00	-	45,000.00	360,000.00	1,500.00	6,000.00	138,000.00	New Item
6.2	ชุดกรองฝุ่นพร้อมกรอบ (Filter Set)	ชุด	-	1.00	1.00	-	4,750.00	4,750.00	750.00	750.00	5,500.00	
6.3	งานเปลี่ยนสีพื้นผิวโครงสร้าง											
	- งานปรับผิวและ PCU และทาสีใหม่ทั้งหมด	เหมา	-	1.00	1.00	-	-	-	3,000.00	3,000.00	3,000.00	New Item
	รวมราคาหมวดที่ E.6										265,598.00	
E.7	พัดลม (Fan)											
7.1	พัดลมระบายอากาศชนิด Centrifugal											
	- 120 CFM (CPC TYPE)	เครื่อง	-	24.00	24.00	-	8,000.00	192,000.00	550.00	13,200.00	205,200.00	New Item
	- 130 CFM (ELE TYPE)	เครื่อง	-	17.00	17.00	-	8,000.00	136,000.00	550.00	9,350.00	145,350.00	New Item
7.2	ชุดกรองฝุ่นพร้อมกรอบกันสะเทือน (Vibration Isolator) กำลังลดลง	ชุด	-	1.00	1.00	-	3,722.40	3,722.40	3,990.15	3,959.15	8,731.55	New Item
7.3	งานเปลี่ยนสีพื้นผิวโครงสร้าง											
	รวมราคาหมวดที่ E.7										354,281.55	
E.8	ระบบท่อน้ำ (Piping System)											
8.1	ท่อน้ำเย็น (Chilled Water Pipe) และท่อน้ำหล่อเย็น (Condenser Water Pipe)											
	- 1 1/4 นิ้ว	เมตร	-	40.00	36.00	-	231.21	8,323.56	421.17	1,717.32	10,040.88	
	- 2นิ้ว	เมตร	-	59.00	35.00	-	135.00	4,860.00	58.22	1,275.92	6,135.92	Vo
8.2	ฉนวนหุ้มท่อน้ำ											
	- 1 นิ้ว	เมตร		36.00	36.00	-	97.91	3,524.76	31.94	1,150.13	4,674.89	
	- 2 นิ้ว	เมตร	-	36.00	36.00	-	54.57	1,964.52	35.64	1,283.04	3,247.56	Vo
8.3	ท่อน้ำทิ้ง (Condensate Drain Pipe)	เมตร		1.00	1.00	-	1,888.00	1,888.00	880.00	880.00	2,768.00	
8.4	อุปกรณ์ปรับแรงดันน้ำ (Flow Regulator)	ชุด		1.00	1.00	-	880.00	880.00	440.00	440.00	1,320.00	

STECON

ผู้ควบคุมงาน
(วิศวกรโยธา)

ตำแหน่ง วิศวกรโครงการ / MSC



ลำดับ	รายการ	หน่วย	ปริมาณตามแบบสัญญา	ปริมาณแบบแก้ไข	ปริมาณ เพิ่ม	ปริมาณ ลด	ราคาต่อหน่วย	ราคารวม (บาท)	ราคาต่อหน่วย	ราคารวม (บาท)	เพิ่ม	ลด	หมายเหตุ
9.5	ที่ดักตะกอนชนิดกรวย (Sand Trap)	ชุด	1	1.00	1.00	-	1,944.33	1,944.33	587.29	587.29	2,177.62		
9.6	วาล์วปิดเปิดชนิดประตูน้ำ												
	- ขนาด 150 มิลลิเมตร	ชุด	-	1.00	1.00	-	-	-	20,000.00	20,000.00	20,000.00		New Item
	รวมราคาหมวดที่ 9										49,179.91	-	
9.9	วาล์วตะกุยน้ำกลับ (Foot Valve)												
9.10	วาล์วกันกลับ (Check Valve)												
	- ขนาด 3/4 นิ้ว	ชุด	-	3.00	3.00	-	777.00	3,216.48	95.54	154.32	3,893.80		
	- ขนาด 1 1/4 นิ้ว	ชุด	-	4.00	4.00	-	511.24	1,292.96	95.54	382.16	1,675.12		
9.11	วาล์วปิดเปิดชนิดลูกบอล (Ball Valve)												
	- ขนาด 3/4 นิ้ว	ชุด	-	4.00	4.00	-	1,145.47	4,585.88	95.54	382.16	4,968.04		
	- ขนาด 1 1/4 นิ้ว	ชุด	-	2.00	2.00	-	1,655.69	3,406.18	95.54	191.08	3,597.26		
9.12	ข้อต่อสวม (Water Saddle)												
	- ขนาด 1 1/4 นิ้ว	ชุด	-	2.00	2.00	-	965.21	1,490.42	95.54	191.08	1,681.50		
9.13	2 Way Motorized Valve 3/4inch												
	- ขนาด 3/4 นิ้ว	ชุด	-	4.00	4.00	-	11,454.74	45,858.96	95.54	382.16	46,241.12		
9.14	ตามมิเตอร์ที่ติดตั้งใช้งานอยู่												
	รวมราคาหมวดที่ 9										61,680.34	-	
9.10	ระบบราง (Rail System)												
9.11	แผ่นเหล็กรูปตัวซี (Galvanized Iron Sheet)												
	- เกรด B	ตัน/ม	2.719.00	5,819.00	3,100.00	-	39.11	99,231.00	17.88	53,818.80	1,12,561.00		
10.6	หน้าแปลนและน็อตยึดแผ่นเหล็กรูปตัวซี (Flange and Bolt)												
	- EAG 6"x6"	ชุด	14.00	4.00	-	(10.00)	1,181.85	11,828.60	47.77	1,911.08	-	(2,706.35)	
	- EAG 4"x4"	ชุด	2.00	47.00	45.00	-	1,181.85	5,878.33	47.77	2,150.88	8,355.50		
	- EAG 8"x8"	ชุด	45.00	10.00	-	(35.00)	335.00	17,875.00	95.54	(3,346.90)	-	(17,281.50)	New Item
	- EAG 12"x12"	ชุด	-	2.00	2.00	-	765.00	1,530.00	95.54	191.08	1,721.08		New Item
10.9	ที่ยึดรางประกอบสำเร็จ (Flange and Bolt)	ชุด	-	1.00	1.00	-	18,742.43	19,789.85	7,134.22	7,134.22	26,924.06		
10.10	ฝาปิดรางระบาย (Top Cover)	ชุด	-	1.00	1.00	-	1,117.64	1,082.64	565.19	565.19	1,647.83		
10.11	งานติดตั้งเสร็จสิ้นใช้งานอยู่												
	Flexible Duct												
	- Flexible Duct 4 นิ้ว		-	20.00	20.00		2,000.00	2,000.00	90.00	1,800.00	3,800.00		

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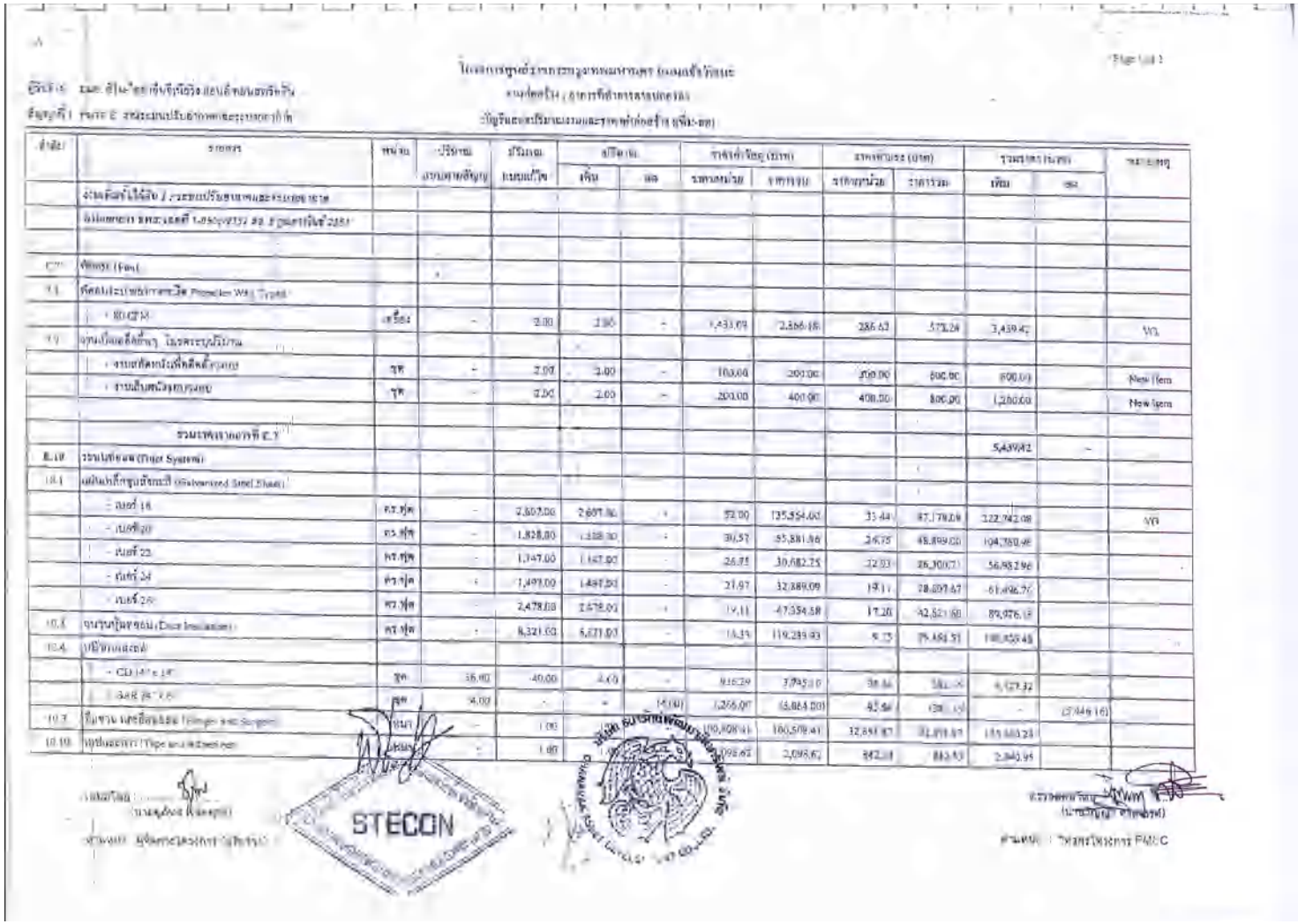
ลำดับ	รายการ	หน่วย	ปริมาณ (ตามสัญญา)	ปริมาณ (แบบแก้ไข)	ต้นทุน		ราคาต่อหน่วย		ราคาเสนอ		รวมทั้งสิ้น		หมายเหตุ
					เพิ่ม	ลด	ของผู้รับจ้าง	ราคากลาง	ราคาต่อหน่วย	ราคารวม(บาท)	เพิ่ม	ลด	
	งานติดตั้งระบบ [illegible]												
	- ปั๊ม 5"	เครื่อง	-	120.00	[illegible]		268.53	49,050.40	114.65	[illegible]	64,560.60		New Item
	- Fire Hydrant & Siamese	ตัว	-	1.00	[illegible]	-	5,593.42	5,593.42	2,496.02	2,496.02	2,996.04		New Item
	- Pressure Gauge [illegible]	ชุด	-	41.00	41.00	-	1,250.00	51,250.00	140.00	5,740.00	56,010.00		New Item
	- งานเจาะยึดติดตั้งอุปกรณ์ยึดหิ้วท่อและอุปกรณ์ประกอบ	ชุด	-	60.00	60.00	-	100.00	6,000.00	306.00	18,360.00	24,000.00		New Item
	- งานเก็บปูนกระบอกและก่อหลุมพร้อมฝา	ชุด	-	60.00	60.00	-	300.00	18,000.00	400.00	24,000.00	36,000.00		New Item
	รวมรายการงานที่ E.10										346,956.50	(13,265.50)	
E.13	ระบบไฟฟ้า (Electrical System)												
E.13.4	Room Thermostat	ชุด	-	6.00	6.00	-	1,464.24	45,538.90	191.08	994.32	66,625.28		
E.13.7	Fan Switch (ปิด-เปิด) + Fan, Plate + Switch	ชุด	-	123.00	123.00	-	57.54	17,251.42	47.77	5,875.71	17,627.13		
	รวมรายการงานที่ E.13										84,252.41	-	
E.14	งานติดตั้งเครื่องดักจับเศษผงและน้ำมัน												
E.14.1	ที่ดักไขมัน 2 เมตร												
	- 1 1/4 นิ้ว	ท่อน	-	18.00	18.00	-	-	-	47.27	851.58	851.58		New Item
	- 3/4 นิ้ว	ท่อน	-	18.00	18.00	-	-	-	38.22	687.96	687.96		New Item
E.14.2	แผ่นกรองในถาดรอง												
	- 1 1/4 นิ้ว	ชิ้น	-	122.04	122.04	-	-	-	4.80	488.16	488.16		New Item
	- 3/4 นิ้ว	ชิ้น	-	60.84	60.84	-	-	-	6.01	243.36	243.36		New Item
E.14.3	แผ่นปิดมาพร้อมชิ้น												
	- 1 1/4 นิ้ว	ชุดเปลี่ยน	-	12.00	12.00	-		-	116.00	1,392.00	1,392.00		VO
	- 3/4 นิ้ว	ชุดเปลี่ยน	-	12.00	12.00	-		-	93.00	1,116.00	1,116.00		VO
E.14.4	แรงงานในการติดตั้ง	งาน	-	1.00	1.00	-	-	-	6,500.00	6,500.00	6,500.00		New Item
E.14.5	แรงงานในการขนย้าย	ครั้ง	2,715.00	3,819.00	3,100.00	-	-	-	4.00	12,400.00	12,400.00		New Item
	รวมรายการงานที่ E.14										33,680.24	-	
	Sub Total										3,108,449.34	(13,265.50)	
	Grand Total										3,095,183.84		

STECON/CV1/LTR/61-013/รายงาน



ลำดับ	รายการ	หน่วย	ปริมาณ (งบประมาณสัญญา)	ปริมาณ (แบบแก้ไข)	เพิ่ม	ลด	ราคาต่อหน่วย (บาท)		ราคาเพิ่มเติม (บาท)		จำนวนเงิน (บาท)		หมายเหตุ
							รวมค่าแรง	รวมค่าวัสดุ	ค่าแรงงาน	ค่าวัสดุ	เพิ่ม	ลด	
	งานติดตั้งไม้ยึด / ระยะปรับแนวและระดับอุปกรณ์												
	ไม้ยึดพลาสติก ขนาด 1.05x0.03x0.03 ม. ยึดด้วยสกรูไม้ 2 ตัว												
C.7	พื้นหญ้า (Turf)												
7.1	พื้นคอนกรีตสำเร็จรูป Precast Wall Panel												
	- 80 ซม.	เหลี่ยม	-	2.00	2.00	-	1,433.09	2,566.16	286.62	573.24	3,439.42		VO.
7.2	งานเบ็ดเตล็ดอื่นๆ ไม่ระบุในรายการ												
	- งานติดตั้งกระเบื้องพื้นสำเร็จรูป	ชุด	-	2.00	2.00	-	100.00	200.00	200.00	600.00	600.00		New Item
	- งานเก็บหน้างานกระเบื้อง	ชุด	-	2.00	2.00	-	200.00	400.00	400.00	800.00	1,200.00		New Item
	รวมราคาหมวดงานที่ E.7										5,439.42	-	
E.10	ระบบท่อลม (Duct System)												
10.1	แผ่นเหล็กชุบสังกะสี (Galvanized Steel Sheet)												
	- เบอร์ 16	ตร.ม.	-	2,807.00	2,807.00	-	52.00	135,554.00	33.44	87,178.04	222,742.08		VO
	- เบอร์ 20	ตร.ม.	-	1,828.00	1,828.00	-	30.57	55,881.96	24.75	45,899.00	104,780.96		
	- เบอร์ 22	ตร.ม.	-	1,747.00	1,747.00	-	26.75	30,682.75	22.93	26,300.71	56,983.46		
	- เบอร์ 24	ตร.ม.	-	1,493.00	1,493.00	-	21.97	32,889.09	19.11	28,607.67	61,496.76		
	- เบอร์ 26	ตร.ม.	-	2,478.00	2,478.00	-	19.11	47,354.58	17.20	42,621.60	89,976.18		
10.3	ฉนวนกันความร้อน (Duct Insulation)	ตร.ม.	-	8,321.00	8,321.00	-	16.35	119,289.93	9.75	79,484.51	198,858.48		
10.4	เบ็ดเตล็ด												
	- CD 24" x 24"	ชุด	36.00	40.00	4.00	-	916.29	3,795.10	38.16	581.06	4,527.32		
	- SAB 24" x 6"	ชุด	4.00	-	-	4.00	1,266.09	6,864.00	42.64	(38.16)	-	(7,446.16)	
10.7	ปั๊มลม เครื่องเป่าลม (Fan & Air Blower)	ชุด	-	1.00	1.00	-	100,808.41	180,509.41	12,851.87	32,851.87	133,660.28		
10.10	อุปกรณ์ควบคุม (Type and Selection)	ชุด	-	1.00	1.00	-	2,098.62	2,098.62	842.34	842.34	2,940.96		

ลำดับ	รายการ	หน่วย	ปริมาณ แบบสัญญา	ปริมาณ แบบแก้ไข	ปริมาณ เพิ่ม	ปริมาณ ลด	ราคาต่อหน่วย	ราคารวม	ราคาต่อหน่วย	ราคารวม	รวมราคา (บาท) เพิ่ม	รวมราคา (บาท) ลด	หมายเหตุ
E.13	งานปิดเสร็จสิ้นอุโมงค์ระบายน้ำ												
	- ค่าขึ้น - ลงบันไดที่ปิดสิ้นสุด (≈ 6,600 FT)	เหมา	-	1.00	1.00	-	-	-	100,320.00	100,320.00	100,320.00		New Item
	- ค่าขนย้ายท่อลงที่รื้อ - ถอน (≈ 6,600 FT)	เหมา	-	1.00	1.00	-	-	-	26,400.00	26,400.00	26,400.00		New Item
	- ค่ารื้อถอนงานฝาและช่องเหล็ก	ตัน	-	54.42	54.42	-	210.19	11,438.54	214.18	11,655.68	23,094.22		New Item
	รวมราคารายการที่ E.13										1,824,967.19	(5,446.16)	
E.14	งานเพิ่มขึ้นเกิดขึ้นเนื่องจากการเปลี่ยนแปลงแบบ												
14.5	แรงงานไทยทางานอิงกฎหมาย	เหมา	-	9,557.00	9,557.00	-	-	-	4.00	38,228.00	38,228.00		New Item
14.6	งานปิดกั้นความเสียหาย, งานสถาปัตยกรรม, พื้น, ผนัง	เหมา	-	1.00	1.00	-	35,000.00	35,000.00	25,000.00	25,000.00	60,000.00		New Item
	และงานตกแต่งภายในที่สำนักการแล้วเสร็จ												
	รวมราคารายการที่ E.14										98,228.00	-	
	Sub Total										1,128,634.61	(5,446.16)	
	Grand Total										1,123,188.45		

STECON/C01/LTR/51-015/VO/R1

ลงนามโดย .....
(นายชูศักดิ์ เฉลยลือ)
ตำแหน่ง : ผู้จัดการโครงการ (ผู้รับจ้าง)

STECON

ตรวจสอบโดย .....
(นายวิญญา ศรีสวัสดิ์)
ตำแหน่ง : วิศวกรโครงการ PMSC

โครงการศูนย์ราชการกรุงเทพมหานคร ถนนแจ้งวัฒนะ

งานก่อสร้าง :ราคาที่ข้าการตกปากระบ

บัญชีแสดงปริมาณงานและราคาค่าก่อสร้าง (เพิ่ม-ลด)

ที่ตั้ง	รายการ	STECON		
		ราคางานเพิ่มรวม (บาท)	ราคางานลดรวม (บาท)	Balance (บาท)
1	[illegible]			
1.1	งานพื้น	1,835,249.77	-	1,835,249.77
1.2	งานผนัง	497,103.77	-	497,103.77
1.3	งานฝ้าเพดาน	813,377.23	-	813,377.23
1.4	งานประตู-หน้าต่าง			
1.4.1	งานประตู	438,477.50	61,592.00	376,885.50
1.4.2	งานหน้าต่าง	902,552.00	-	902,552.00
1.5	งานทาสี	200,788.19	-	200,788.19
1.6	งานเบ็ดเตล็ด	735,575.09	-	735,575.09
1.7	งานชั้วถอน	435,691.70	-	435,691.70
1.8	ค่าแรงงานพิเศษ	812,662.89	-	812,662.89
2	[illegible]			
2.1	คำสั่ง อพท. เลขที่ 1654/254	-	138,268.44	- 138,268.44
2.2	คำสั่งเปลี่ยนแปลง อพท. เลขที่ 1-0170/25	443,152.48	-	443,152.48
2.3	คำสั่งเปลี่ยนแปลง อพท.1-1720/2550	125,808.15	-	125,808.15
3	[illegible]			
3.1	Lighting System	1,701,089.29	-	1,701,089.29

เสนอโดย : .....
(นายสุวิโรจ เจตะกุ)
ตำแหน่ง : ผู้จัดการโครงการ (ผู้รับเหมา)

STECON

STECON [illegible] 01/ Vo/R1

ตรวจสอบโดย : .....
(นายวิญญา ศรีสวรรค์)
ตำแหน่ง : วิศวกรโครงการ PMC

ลำดับ	รายการ	STECON		
		ราคางานเพิ่มรวม (บาท)	ราคางานยกยอดรวม (บาท)	Balance (บาท)
3.2	Switch & Power Outlet System	1,535,612.48	-	1,535,612.48
3.3	Fire Alarm System	230,265.20	-	230,265.20
3.4	Telephone System (IP Phone)	721,203.81	-	721,203.81
3.5	Circuit Breaker ที่เพิ่มในตู้ (LP6FB)	390.00	-	390.00
3.6	Circuit Breaker ที่เพิ่มในตู้ (LP6FA)	1,560.00	-	1,560.00
3.7	Building Automation System (BAS)	1,427,653.22	455,927.85	971,725.37
3.8	ค่าป้องกันความเสียหายจากอัคคีภัยของระบบที่น อนิ	82,500.00	-	82,500.00
	และงานตกแต่งภายใน			-
3.9	งานเปิด/ปิด และเก็บงานโครงสร้างที่ดำเนินการไปแล้ว	41,653.05	-	41,653.05
	แต่ต้องเปิดเพื่อติดตั้งท่อร้อยสายไฟฟ้าและอุปกรณ์ไฟฟ้า			
	(ส่วนที่ Home Run เข้า SE Room)			
4	งานระบบปรับอากาศ	[illegible]	[illegible]	[illegible]
4.1	เครื่องส่งลมเย็นขนาดใหญ่ (Air Handling Unit)	39,807.71	-	39,807.71
4.2	เครื่องส่งลมเย็นขนาดเล็ก (Fan Coil Unit)	487,655.72	34,671.92	452,983.80
4.3	ระบบท่อน้ำ (Piping System)	1,911,205.49	-	1,911,205.49
4.4	วาล์วและอุปกรณ์ประกอบ (Valve & Accessory)	539,427.74	-	539,427.74
4.5	ระบบท่อลม (Duct System)	2,219,760.09	-	2,219,760.09
4.6	ระบบไฟฟ้า (Electrical System)	1,787,265.54	-	1,787,265.54
4.7	งานที่เพิ่มขึ้นเนื่องจากการเปลี่ยนแปลงแบบ	411,653.38	-	
4.8	ค่าป้องกันความเสียหาย งานผนังกันไฟ พื้น ผนัง และ	81,740.00	-	81,740.00
4.9	งานเปิด / ปิด และเก็บงานฝ้าเพดาน ที่ดำเนินการไปแล้ว	84,533.16	-	84,533.16
	แต่ยังต้องเปิดเพื่อติดตั้งท่อน้ำและระบบไฟฟ้า Control			

ผู้ขอเสนอ .....
(นายธนัทกร เจตะเสน)
ตำแหน่ง ผู้จัดการโครงการ (ผู้รับเหมา)

STECON

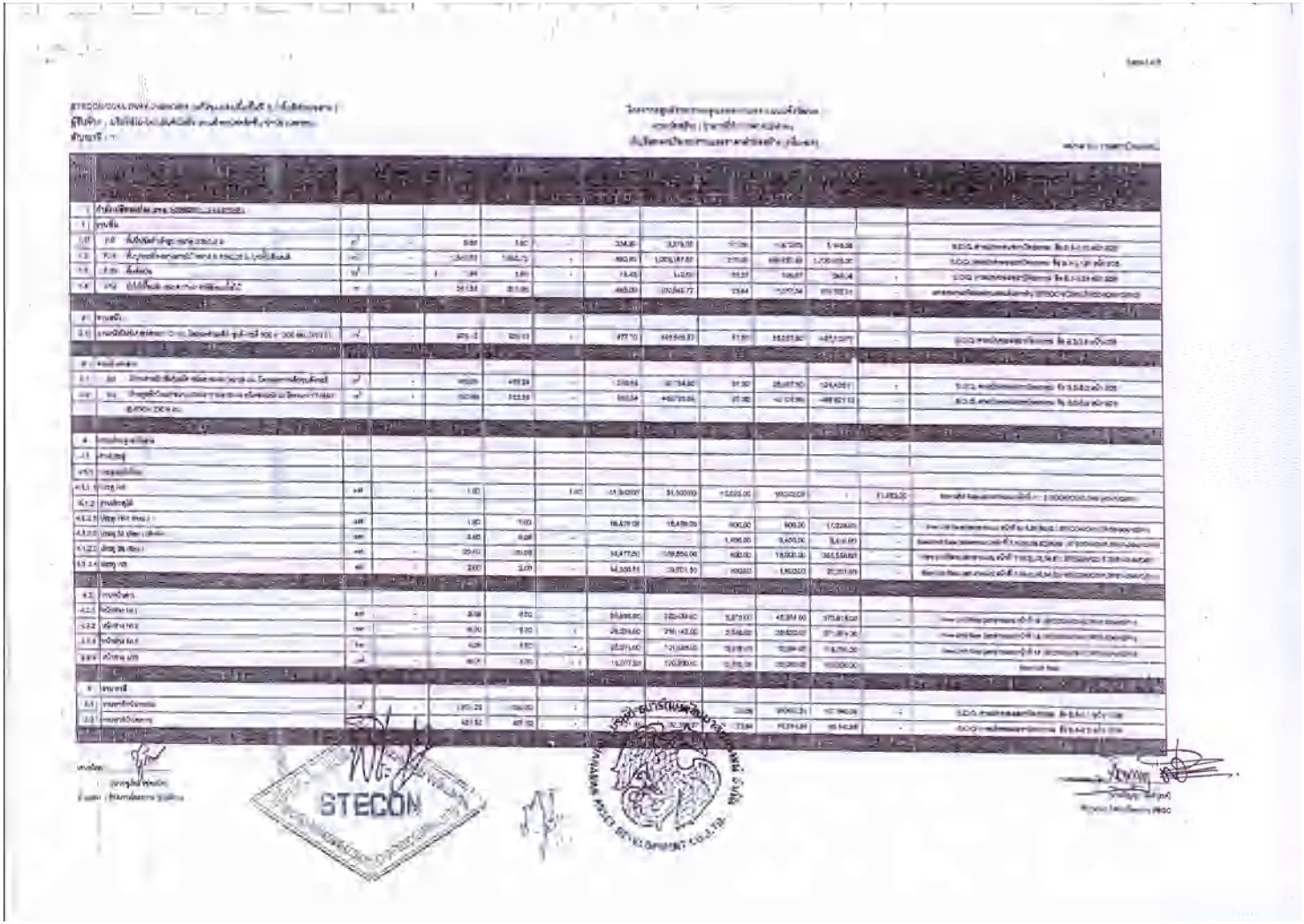
สถาปนิกผู้ออกแบบ .....
(นายนิรันดร์ ศรีทวงศ์)
ตำแหน่ง : วิศวกรโครงการ PMSC

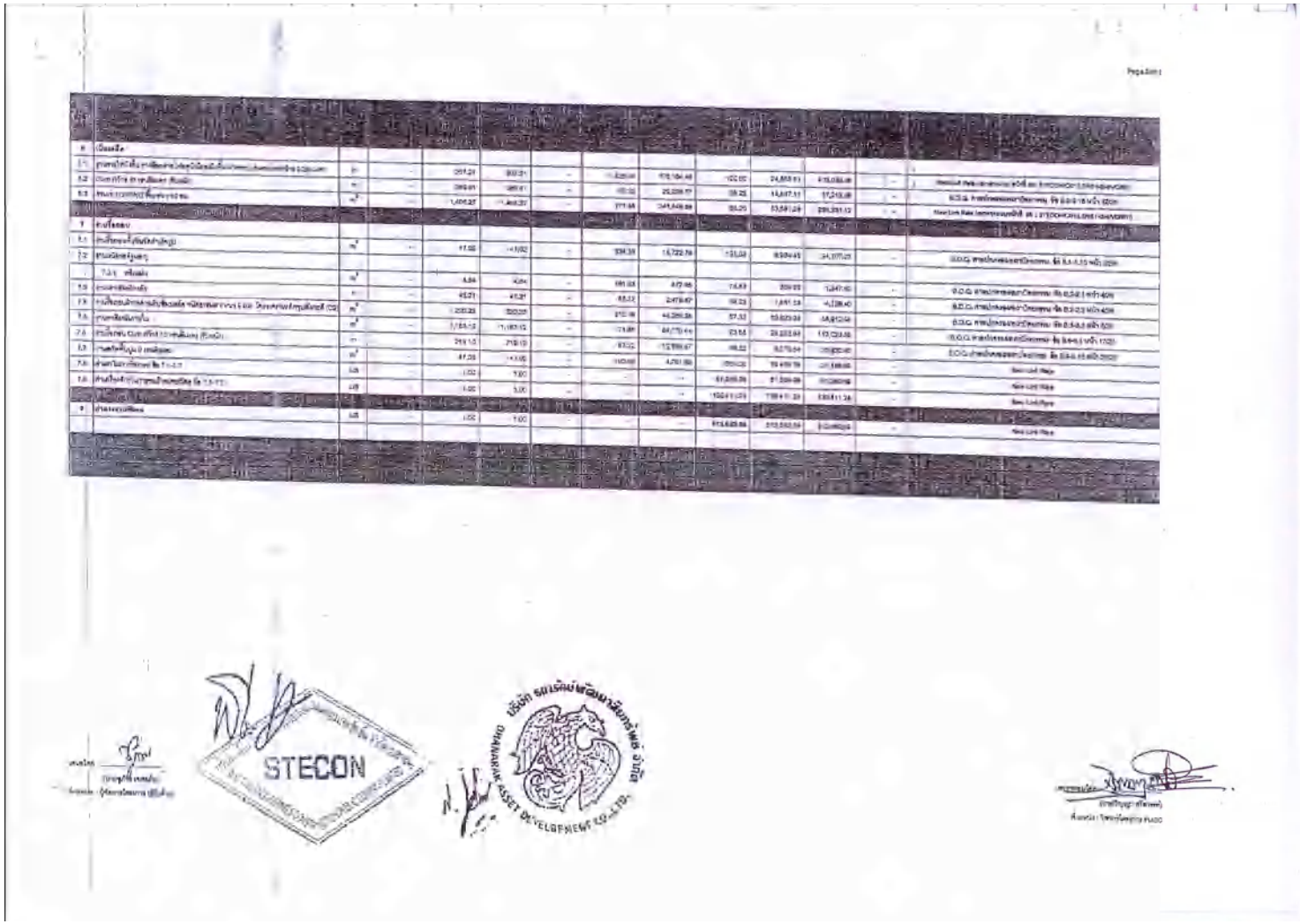
ลำดับ	รายการ	STECON		
		ราคางานเพิ่มรวม (บาท)	ราคางานลดรวม (บาท)	Balance (บาท)
5	[illegible]	[illegible]	[illegible]	[illegible]
5.1	งานตกแต่งผนัง	1,248,403.42	-	1,248,403.42
5.2	งานแต่งผิวพื้นคาน	343,307.92	-	343,307.92
5.3	งานเฟอร์นิเจอร์ติดตั้ง	4,268,877.43	-	4,268,877.43
6	[illegible]	[illegible]	[illegible]	[illegible]
6.1	งานเฟอร์นิเจอร์ลอยตัว	4,010,919.74	-	4,010,919.74
7	[illegible]	[illegible]	[illegible]	[illegible]
7.1	งานเปิดเคลีย	437,857.58	-	437,857.58
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

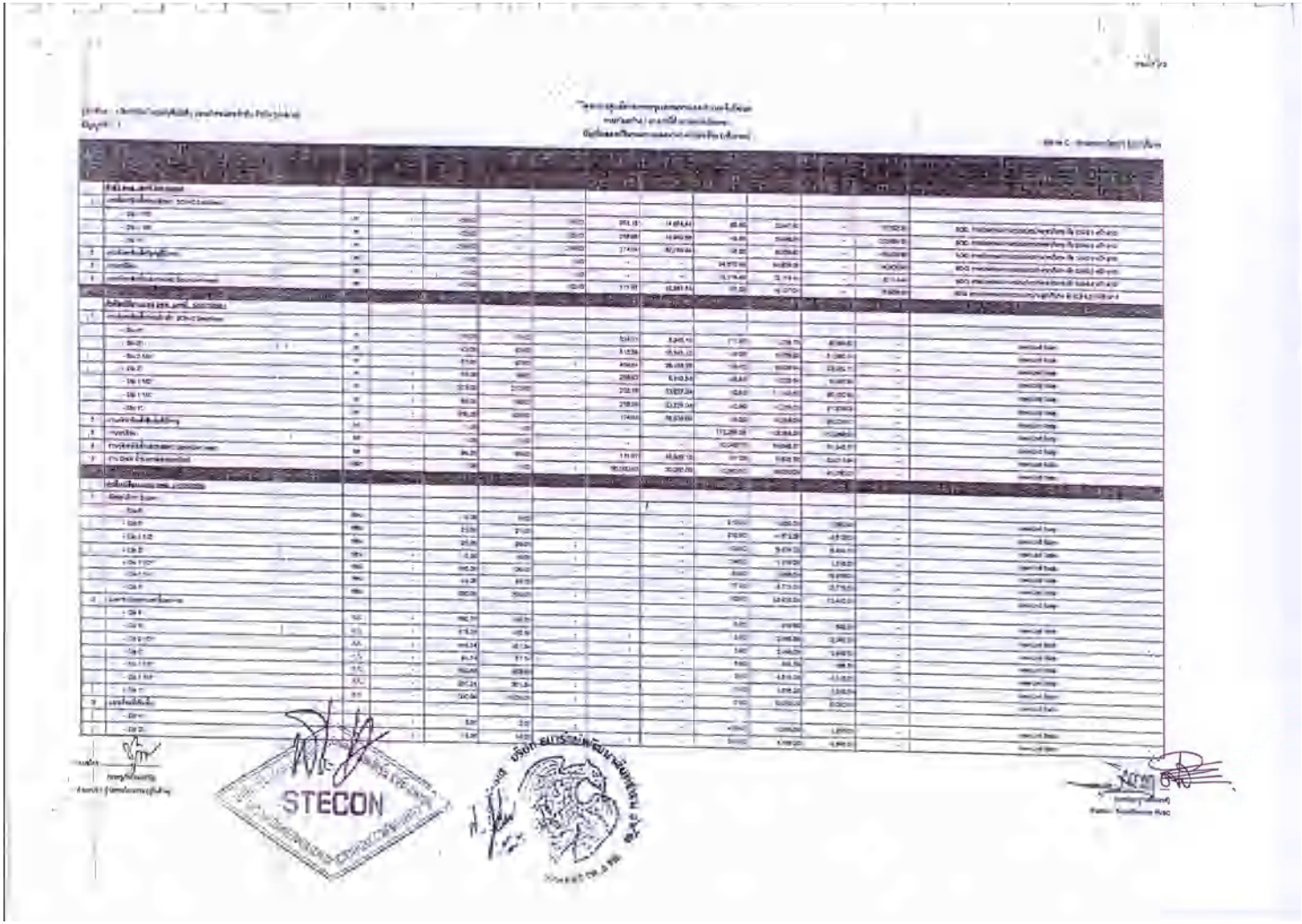
เสนอโดย .....
(นายวุฒิกร เจตอาไว)
ตำแหน่ง : ผู้จัดการโครงการ (ผู้รับเหมา)

STECON

ตรวจสอบโดย .....
(นายวิญญา ศรีสวรรค์)
ตำแหน่ง : วิศวกรโครงการ PMSC




STECON
บริษัท ธนารักษ์พัฒนาสินทรัพย์ จำกัด
THANARAK ASSET DEVELOPMENT CO.,LTD.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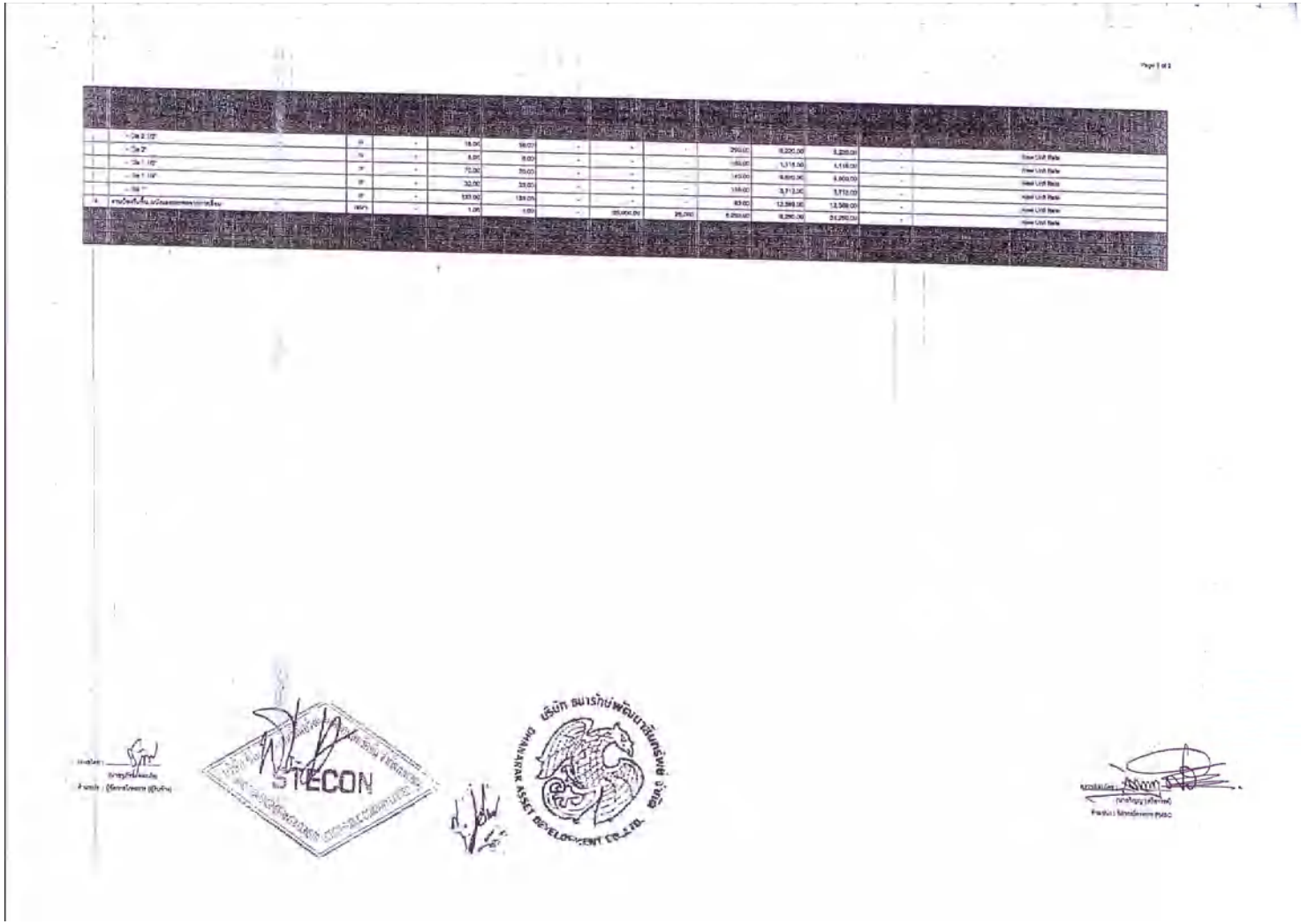

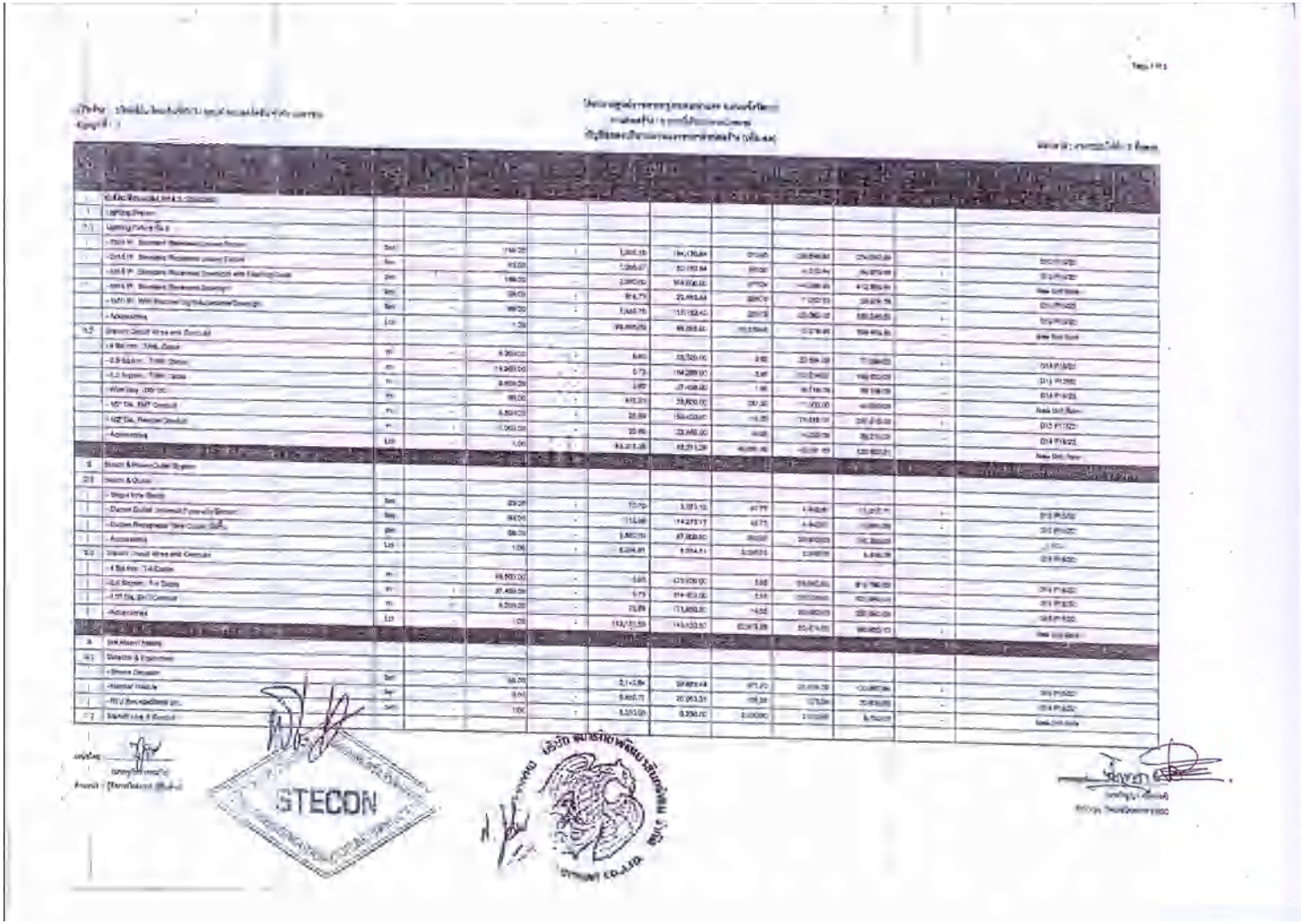
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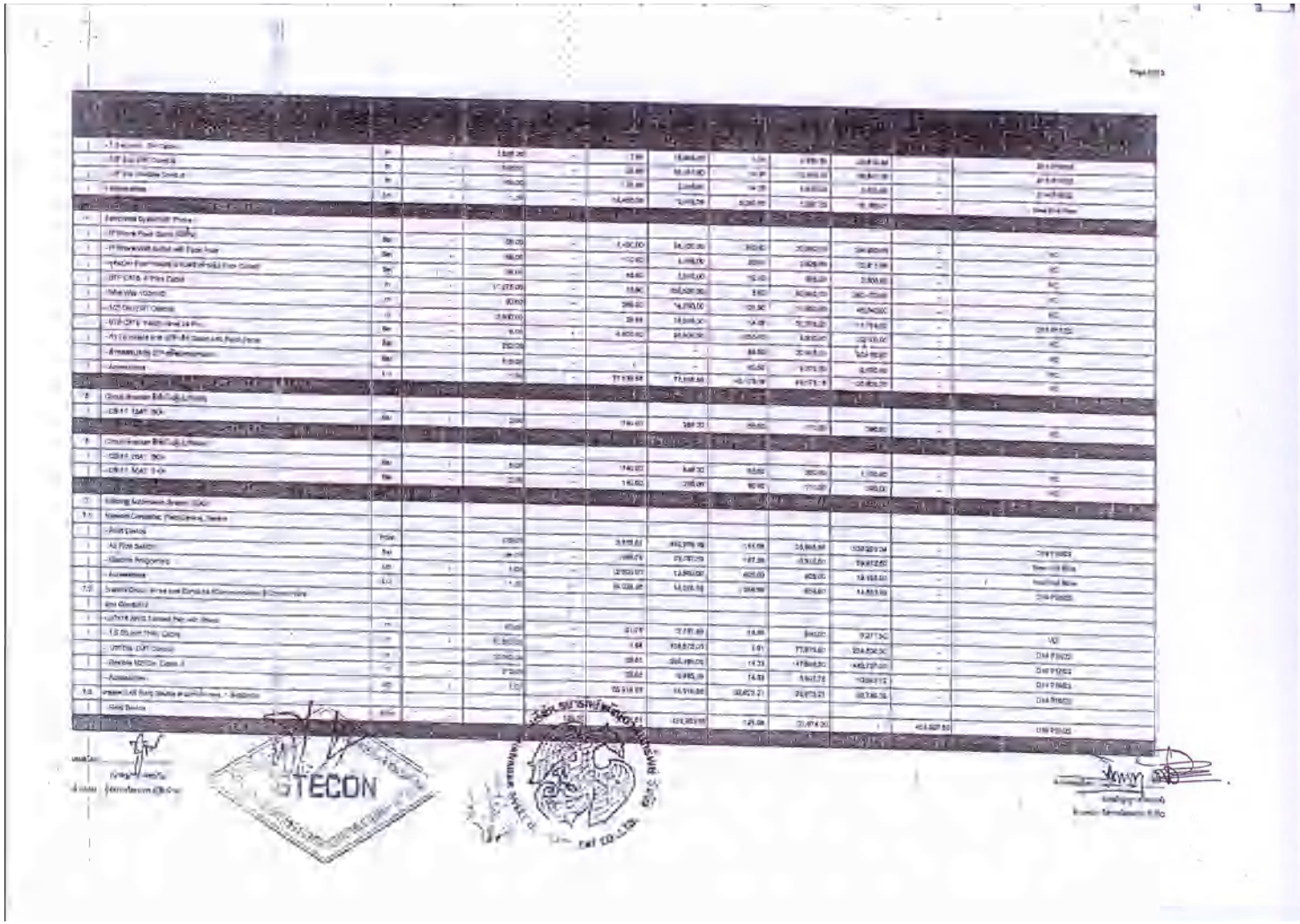
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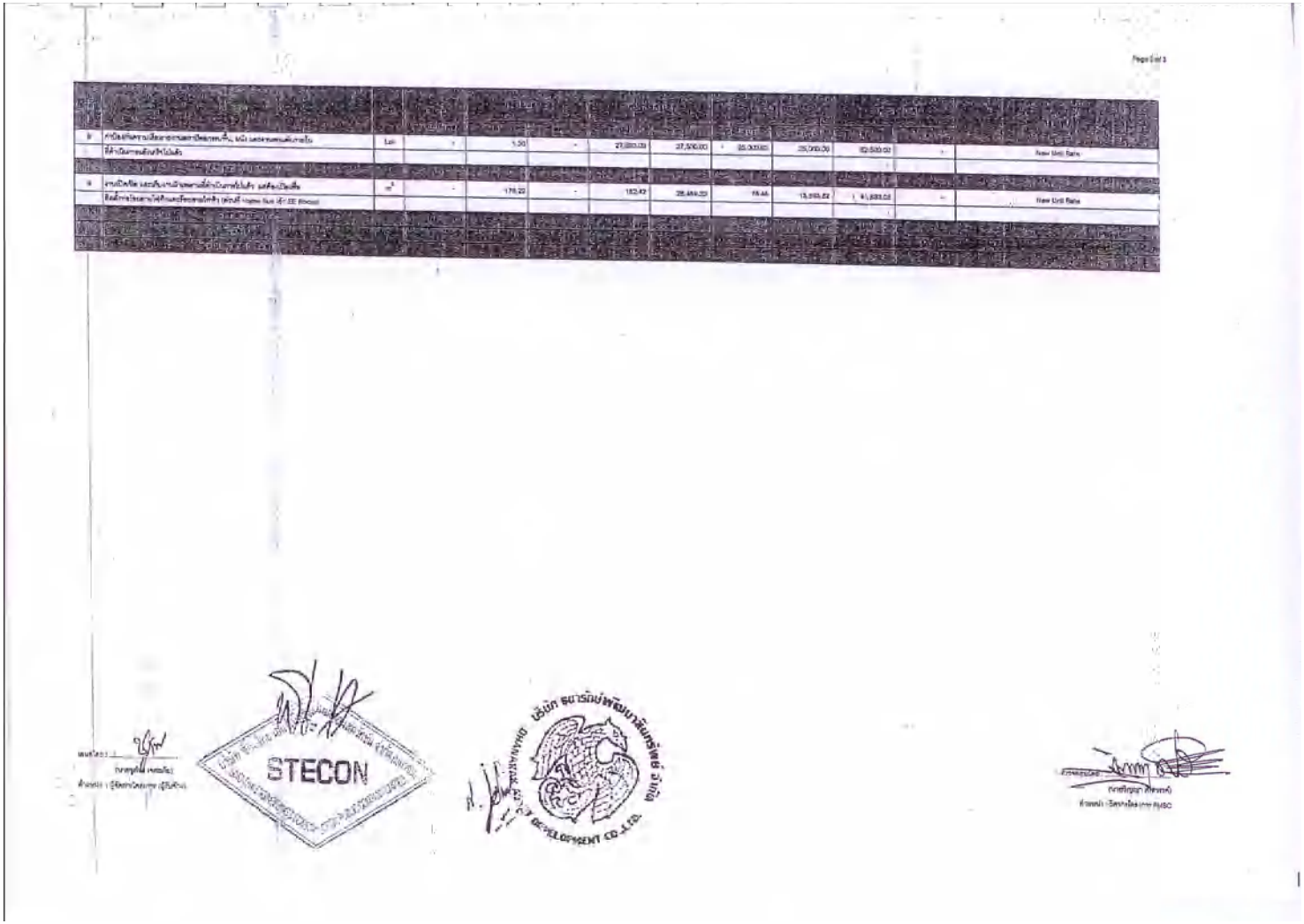
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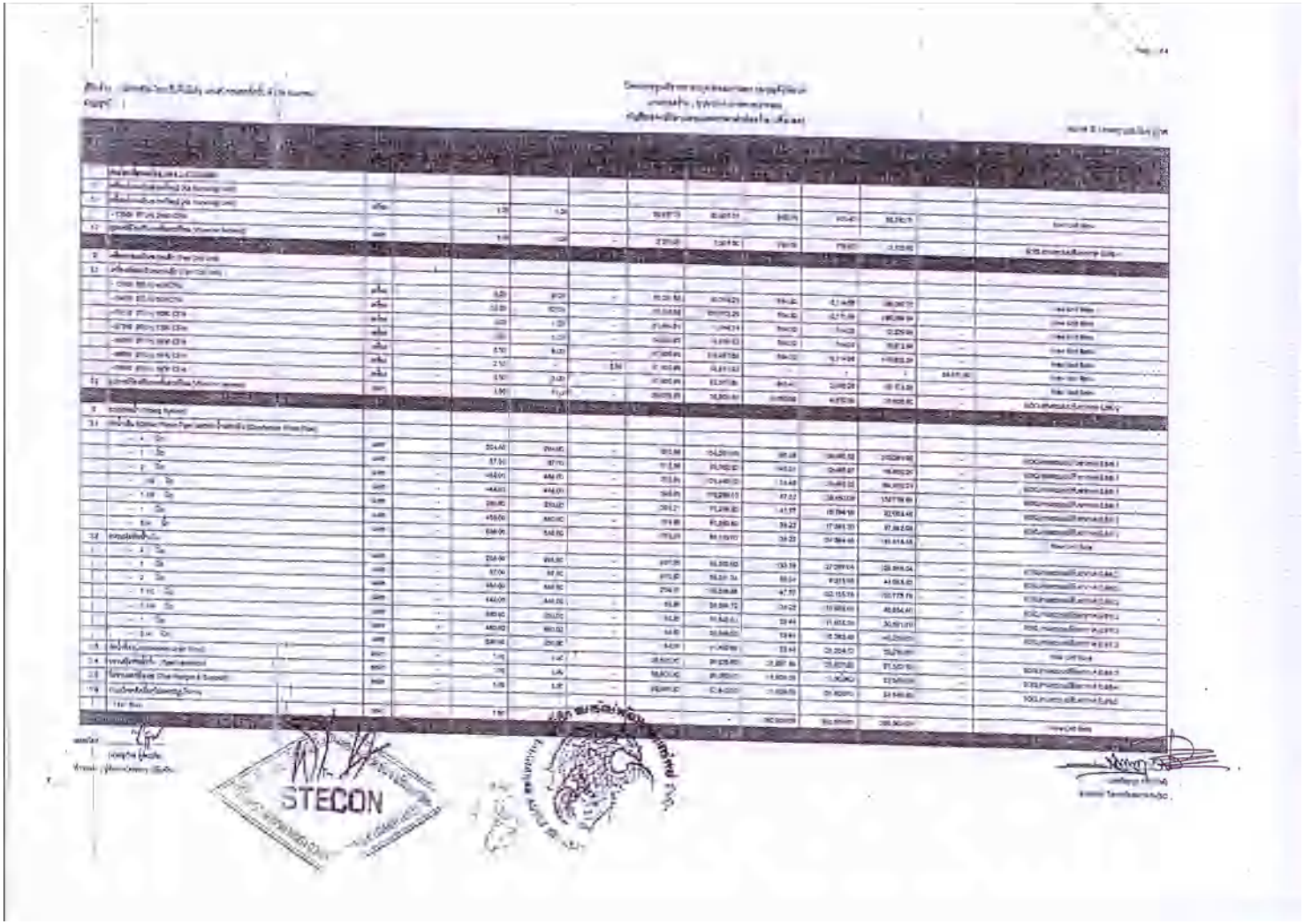
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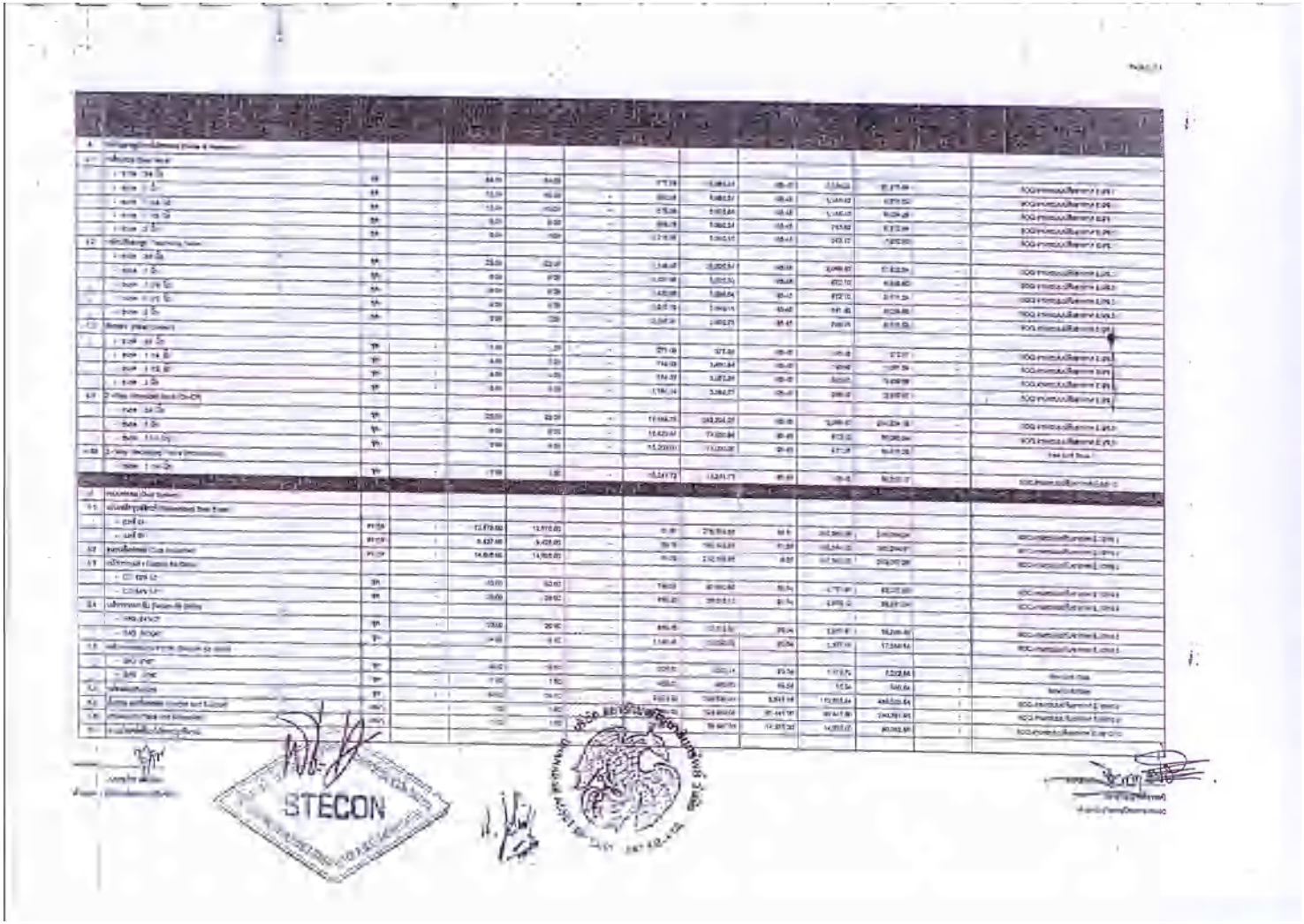
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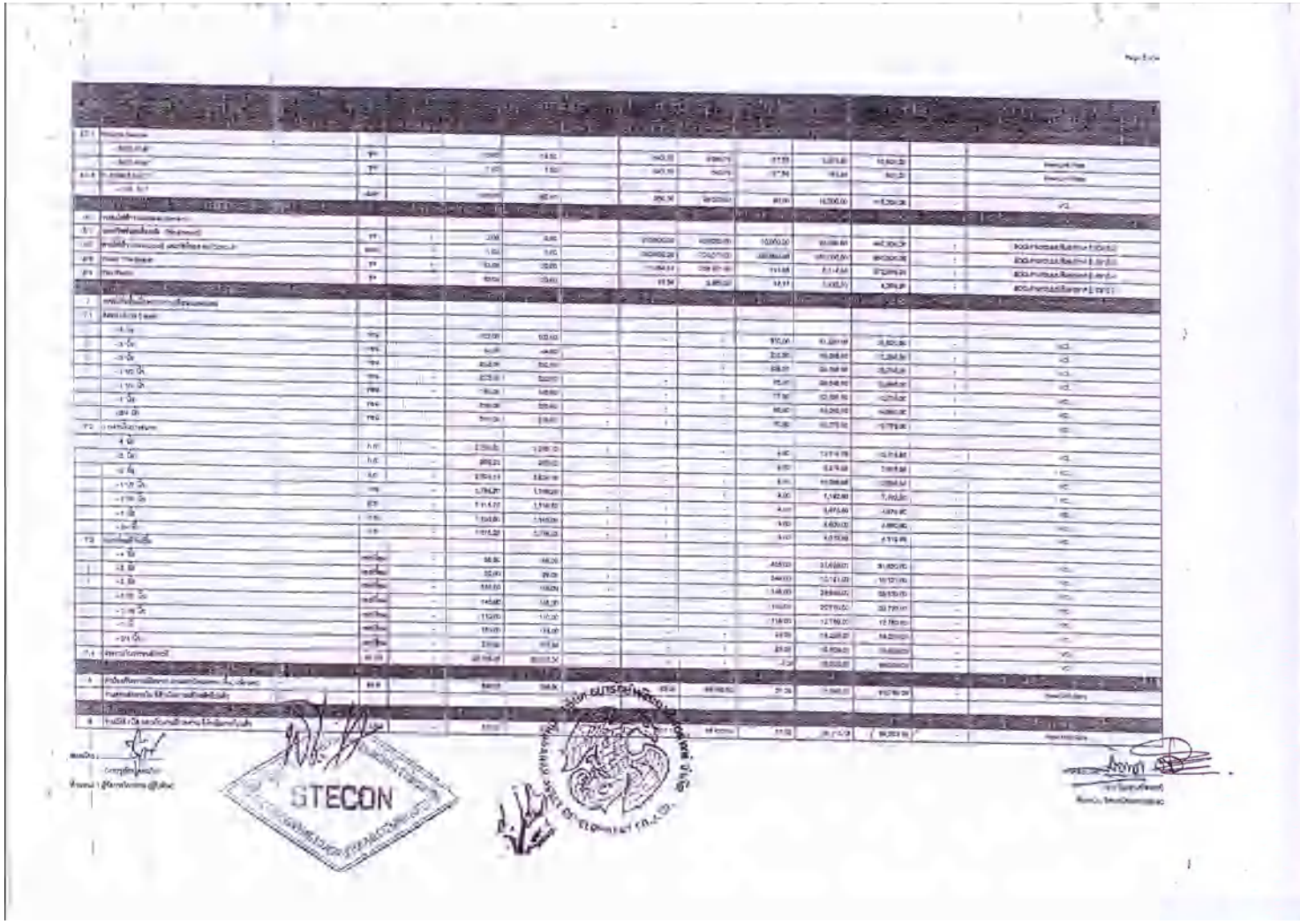
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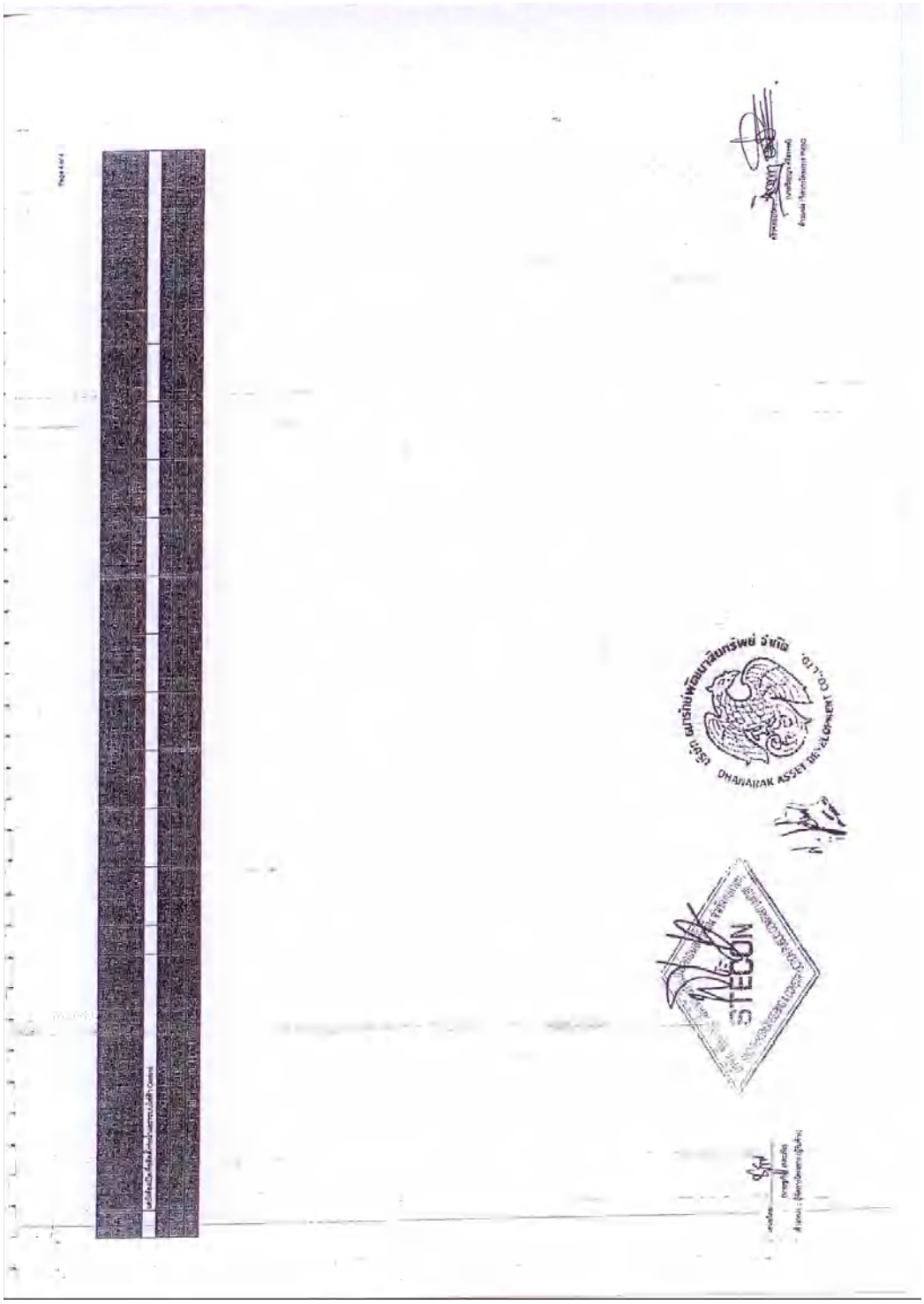

BIOGRAPHY

Varong Tangpraprutgul was born on 30 May 1983 in Bangkok, Thailand. He graduated a Bachelor Degree in Building Facilities Engineering from Thammasat University in 2005. He has worked for Construction Consulting Company for 4 years as Civil Engineer. He continues his Master Degree in Engineering Management at Regional Centre for Manufacturing Systems Engineering (RCMSE), Chulalongkorn University (TH) and University of Warwick (UK).