# Contingency Planning for Construction Project to Accommodate Delay Caused by Surprised Situations

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**An undergraduate thesis submitted to the Department of Civil & Environmental Engineering of Islamic University of Technology, Board Bazar, Gazipur in partial fulfillment of the requirements for the degree**

**Of**

**BACHELOR OF SCIENCE IN CIVIL ENGINEERING**

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# DECLARATION

We hereby declared that the undergraduate project work reported in this thesis has been performed by us and this work has not been submitted elsewhere for any purpose (except for publication).

**October, 2012**

TanzimAlam

Md. Ali Ishtiak

Shofiul Bashar Himon

Dedicated

To

Our Beloved Parents.

## ABSTRACT

Construction industry is flourishing in Bangladesh day by day. It is very important to complete a project on time and with limited budget. However, people are having difficulties in the accomplishment of the project. Projects are often failed in terms of budget and time. Project planning is done prior to start of the project but it is hardly maintained in Bangladesh because many constraints and surprise situation arise in the implementation stage. These are the reasons of frequent failure of construction project in Bangladesh. To make a project planning fruitful there should be some backup planning which is known as contingency planning or a provision in the project management plan to mitigate cost and/or schedule risk.

Contingency planning is a systematic approach to identify what can go wrong in a situation. Rather than hoping that constrains will be constant, a planner should try to identify contingency events and be prepared with plans, strategies and approaches for avoiding, coping or even exploiting them. Various constrains may arise in case of a project. Regarding that a ranking of common constrains are made by their weightage value.

In this study schedules for two projects has been made by Microsoft project. In those time schedule how downstream activities are affected due to delay of an activity has been demonstrated by different constrains scenario. Use of squeezing & overlapping as mitigation measure to overcome delay, compatibility of those tools for real project has also been shown. It is found that proper overlapping & squeezing of selected activities is adequate to overcome delay.

# ACKNOWLEDGEMENT

At first we want to pay our gratitude to our thesis supervisor,DR. Md. AslamHossainfor providing us his continuous support and guideline to perform this research work and to preparethis concerted dissertation. His consistent inspiration helped us to work diligently throughout thecompletion of this research work and also contributed to our ability to approach and solve manyproblems.

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# CHAPTER ONE

# INTRUDUCTION

## 1.1GENERAL

This Chapter describes the importance of the contingency planning, objective and scope of the study.

## 1.2 BACKGROUND

Construction industry is flourishing in Bangladesh day by day. It is very important to complete a project on time and with limited budget. However, people are having difficulties in the accomplishment of the project. Projects are often failed in terms of budget and time. Project planning is done prior to start of the project but it is hardly maintained in Bangladesh because many constraints and surprise situation arise in the implementation stage. These are the reasons of frequent failure of construction project in Bangladesh. To make a project planning fruitful there should be some backup planning which is known as contingency planning or a provision in the project management plan to mitigate cost and/or schedule risk. Often used with a modifier (e.g., management reserve, contingency reserve) to provide further detail on what types of risk are meant to be mitigated. The specific meaning of the modified term varies by application area. Emergency preparedness or contingency plan helps to minimize the human suffering and economic losses that can result from emergencies.

# Chapter One: Introduction

It should be understood that the size and complexity of projects, as well as their access and location, have a bearing on the degree of planning necessary for emergencies. To maintain time schedule and budget and to ensure successful implementation of project tasks, identification of emergency conditions, and preparation and development of contingency plan according to conditions are mandatory. But this approach of considering surprise situations and initiating contingency plan is not a common practice in Bangladesh. So it has encouraged us to evaluate different effects of not taking different surprise conditions under consideration and suggest different measures to handle these conditions, focusing mainly on maintaining the given project duration by application of some methods.

## 1.3 OBJECTIVE

- To examine the current practice of project planning for construction in Bangladesh.
- To find out the different constrains / surprise situation that delays the project's completion time.
- To propose contingency planning in order to mitigate / minimize the delay in project completion.

## 1.4 SCOPE

Contingency planning enables us to analyze the productivity of a project as well as cost analysis of the total project, it also helps to manage the resources .In this thesis we are going to focus on the time duration of the project i.e .propose the how to overcome the delay by analyzing the project.

## 1.5 ORGANIZATION OF THE THESIS

Rest of the thesis has been organized as follows:

- LITERATURE REVIEW

  This section describes the definition of project planning, different surprise situations causing poor project planning execution, preparation and development of contingency plan and different mitigation measures.

- METHODOLOGY

  Brief discussion on tools to overcome delays.

- MODEL DEVELOPMENT AND DATA ANALYSIS

  Contains Model development & analysis for different scenarios.

- CONCLUSION

  Describes effectiveness of study and recommendations to enhance the study.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 GENERAL

This section mainly focuses on definition of project planning, different surprise situations causing poor project planning execution, preparation and development of contingency plan and different mitigation measures.

## 2.2 CONSTRUCTION PROJECT PLANNING

Construction planning is a fundamental and challenging activity in the management and execution of construction projects. It involves the choice of technology, the definition of work tasks, the estimation of the required resources and durations for individual tasks, and the identification of any interactions among the different work tasks. A good construction plan is the basis for developing the budget and the schedule for work. Developing the construction plan is a critical task in the management of construction, even if the plan is not written or otherwise formally recorded. In addition to these technical aspects of construction planning, it may also be necessary to make organizational decisions about the relationships between project participants and even which organizations to include in a project.

# Chapter Two: Literature Review

## 2.3 FACTORS LEADING TO POOR PROJECT PLANNING EXECUTION

Every project has its own characteristics, that is its type, its size, it geographic location, personnel involved in the project etc. Depending on the characteristic of the project,Planning procedure is adopted. Hence, Execution of the planning is the main challenge which includes a lot of risks and the lack of appropriate approach to addressing these risks has led to a lot of undesirable results in project execution in the construction industry of most developing countries. Traditionally, this is seen in the failure of the project to achieve its cost, time, quality and other

targets due to inefficiencies in the execution process.

A common problem that affects project performance in the industry is lowproductivity. For example, Makulwasawatudom et al (2003), identifies 23 criticalfactors influencing the construction productivity in Thailand. Ten of these were foundto be critical*:* lack of material, incomplete drawing, incompetent supervisors, lack oftools and equipment, absenteeism, poor communication, instruction time, poor sitelayout, inspection delay, and rework. A research by Mutijwaa and Rwelamila (2007)showed that the South Africa Infrastructural Department (SAID) is under pressure toimprove performance, that is, to deliver projects on time, on budget and to higherstandard of quality. They attributed the problem to lack of skilled workers in these infrastructure departments (ID) and called for the need for a project manager in all these offices to coordinate the many on-going projects. Further, they observe that theinfrastructural departments do not know whether they are (i) achieving desired results(ii) meeting their customer's success criteria and (iii) achieving their desired return oninvestment. Hence, they propose a means of assessment to evaluate progress

as ameans of addressing these questions. Secondly, they recommend such IDs to beproject-oriented organizations (POO). Other project-related challenges have to do with the twin chronic problems of cost and time overruns. These problems are not limited to developing countries alone. According to "Benchmarking the Government Client stage 2 study (1999)", UK, benchmarking study conducted in 1999 of 66 central government departments' construction projects with a total value of £500 million showed that three quarters of the projects exceeded their budgets by up to 50% and two thirds had exceeded their original completion date by 63%.

According to Yisa and Edwards (2002) despite thedevelopment of new alternative and less adversarial contractual arrangements, theindustry continues to be affected by problems of project time and cost overruns andconsequently, client dissatisfaction (drawing from Latham, 1994; Egan, 1998). Different countries identify different factors as critical in this regard. In Botswana, Chimwaso (2000) research into the factors of cost overrun and came out with four

Related factors: vari*ations, re-measurement of provisional works, fluctuation in the cost of labor and materials and contractual claims, that is, claims for extension of time with cost.* In the case of time overruns, Zhang et al. (2003) identify 8 factors that cause delay in project executions in China: factors related to the contractor, the design team, the project, labor, client, material, equipment, and other factors. In the midst of the booming infrastructure development and urbanization in Vietnam, Le-Hoai et al (2008) established that cost and time overruns top the list of problems of project implementation. Using factor analysis techniques, they obtained 5 main factors out of a list of 21, namely: poor site management and supervision, poor project management

assistance, financial difficulties of owner, financial difficulties of contractor, design changes. Significantly, they compared their results with results of similar research from 8 other countries as shown in table.

**Table 2.1: COMPARISON OF FACTORS CAUSING TIME AND COST OVERRUNS FROM EIGHT COUNTRIES (Le-Hoai et al, 2008)**

| Countries | Major cause | Major cause | Major cause | Major cause | Major cause |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Vietnam (Le-Hoai et al., 2007) (1) | Poor site management and supervision | Poor project management assistance | Financial difficulties of owner | Financial difficulties of contractor | Design changes |
| Malaysia (Sambasi and Soon, 2007) (2) | Improper planning | Site management | Inadequate contractor experience | Finance and payments of completed work | Subcontractors |
| South Korea (Acharya | Public interruptions | Changed site conditions | Failure to provide site | Unrealistic time estimation | Design errors |

| | | | | | |
|---|---|---|---|---|---|
| et al., 2006) (2) | | | | | |
| Hong Kong (Lo et al., 2006) (2) | Inadequate resources due to contractor/lack of capital | Unforeseen ground conditions | Exceptionally low bids | Inexperienced contractor | Works in conflict with existing utilities |
| UAE (Faridian d El-Sayegh, 2006) (2) | Preparation and approval of drawings | Inadequate early planning of the project | Slowness of the owner's decision-making process | Shortage of manpower | Poor supervision and poor site management |
| Jordan (Sweis et al., 2007) (2) | Financial difficulties faced by the contractor | Too many change orders from owner | Poor planning and scheduling of the project by the contractor | Presence of unskilled labor | Shortage of technical professionals in the contractor's organization |

| | | | | | |
|---|---|---|---|---|---|
| Kuwait (Koushki et al., 2005) (2) | Change orders | Financial constraints | Owner's lack of experience | Materials | Weather |
| Ghana (Frimpong et al, 2003) (1) | Monthly payment difficulties | Poor contract management | Material procurement | Inflation | Contractor's financial difficulties |
| Nigeria (Aibinu and Odeyinka, 2006) (2) | Contractors' financial difficulties | Clients' cash flow problem | Architects' incomplete drawing | Subcontractor's slow mobilization | Equipment breakdown and maintenance problem |

**(Continuation of Table 2.1)**

most of the factors that cause delay also cause cost overruns. In addition, it is also found that the same factors were ranked differently in different countries. In a related development, another dimension was provided another to the delay factor issue. In Nigeria, it is found out that depending on whether a contractor is using quantitative techniques (for example, bar chart, Critical Path Network or Pert analysis) or not, different rankings of the same identifiable delay factors emerged, that is, from the

contractors' point of view (Table 2). These differences in the rankings of the same factors in different countries, and even in the same country, shows that these factors are themselves, moderated by other factors. It suggests that the factors that affect the efficient execution of construction project everywhere are themselves impacted on by other external and, sometimes, intermediate factors prevailing in those countries and during the cause of project implementation. It also shows that each factor should be taken seriously and treated as of equal relevance. They are, thus, contingency factors and what may be the most important factor today may not necessary be a critical one on the next project or in the near future. Therefore, the perceived importance attached to a factor by contractors, consultants, clients or even the public should be considered in such a way as to reflect the specific circumstances of the project

**Table 2.2: DIFFERENT RANKINGS OF DELAY FACTORS DUE TO DIFFERENCES IN THE TECHNOLOGY**

| **Delay Factor** | **Ranking (Severity Index)** | |
|---|---|---|
| | **Contractors using quantitative planning techniques** | **Contractors not using quantitative planning techniques** |
| Finance | 1(100) | 3(60) |
| Weather | 2(85.7) | 1(80) |
| Design changes | 3(71.50 | 9(40) |
| Equipment failure | 4(71.5) | 5(60) |
| Sub-contractors | 5(71.5) | 6(60) |
| Material shortage | 6(71.5) | 2(80) |
| Labour supply | 7(527.2) | 4(60) |
| Contractual dispute | 8(42.9) | 11(40) |
| construction errors | 9(42.9) | 11(40) |
| Industrial disputes | 10(28.6) | 7(40) |
| Off-site fabrication | 11(14.3) | 10(40) |

## 2.4 CONTINGENCY PLANNING AND RISK MANAGEMENT

Contingency Plan describes the various specific actions that will be taken if the risk occurs and these actions are carried out at the time of risk occurrence. Contingency Plan is developed in Planning Process for the identified risks and it clearly defined the specific actions to be taken when the risk is about to happen or has happened. Contingency planning is a part of risk management or mitigation. Risk mitigation mainly involves two steps**:**

- Identifying the various activities, or steps, to reduce the probability and/or impact of an adverse risk.
- Creation of a Contingency Plan to deal with the risk should it occur**.**

Taking early steps to reduce the probability of an adverse risk occurring may be more effective and less costly than repairing the damage after a risk has occurred. some risk mitigation options may simply be too costly in time or money to consider. Mitigation activities should be documented in the Risk Register, and reviewed on a regular basis. They include:

- Identification of potential failure points for each risk mitigation solution.
- For each failure point, document the event that would raise a "flag" indicating that the event or factor has occurred or reached a critical condition.
- For each failure point, provide alternatives for correcting the failure

As foregoing suggests that Contingency planning is the act of preparing a plan, or a series of activities, should an adverse risk occur. Having a contingency plan in place

forces the project team to think in advance as to a course of action if a risk event takes place.

• Identify the contingency plan tasks (or steps) that can be performed to implement the mitigation strategy.

• Identify the necessary resources such as money, equipment and labor.

• Develop a contingency plan schedule. Since the date the plan will be implemented is unknown, this schedule will be in the format of day 1, day 2, day 3, etc., rather than containing specific start and end dates.

• Define emergency notification and escalation procedures, if appropriate.

• Develop contingency plan training materials, if appropriate.

• Review and update contingency plans if necessary.

• Publish the plan(s) and distribute the plan(s) to management and those directly involved in executing the plan(s).

Contingency may also be reflected in the project budget, as a line item to cover Unexpected expenses. The amount to budget for contingency may be limited to just the high probability risks. This is normally determined by estimating the cost if a risk occurs, and multiplying it by the probability. For example, assume a risk is estimated to result in an additional cost of $50,000, and the probability of occurring is 80%. The amount that should be included in the budget for this one item is $40,000. Associated with a contingency plan, are start triggers and stop triggers. A start trigger is an event that would activate the contingency plan, while a stop trigger is the criteria to resume

normal operations. Both should be identified in the Risk Register. The only difference between a contingency plan and a problem solution is the order of events: the plan precedes the occurrence of the problem, whereas the solution follows it.

## 2.5 HOW TO DEVELOP A CONTINGENCY PLAN/EMERGENCY RESPONSE PLANNING

According to Construction Safety Association of ONTARIO, Development of contingency plan should include the following considerations:

1) Hazard identification/assessment
2) Emergency resources
3) Communication systems
4) Administration of the plan
5) Emergency response procedure
6) Communication of the procedure
7) Debriefing and post-traumatic stress procedure.

Each of these points is explained in the following sections.

### 2.6 HAZARD IDENTIFICATION/ASSESSMENT

The process of hazard identification and assessment involves a thorough review that should include, but not be limited to, the following points:

- transportation, materials handling, hoisting, equipment or product installation, temporary structures, material storage, start-up, and commissioning activities
- environmental concerns
- consultation with the client regarding potential hazards when working in or adjacent to operating facilities
- resources such as material safety data sheets (MSDSs) to determine potential hazards from on-site materials
- proximity to traffic and public ways

Because construction sites are frequently fast-changing, the process of hazard assessment must be ongoing to accommodate the dynamic environment. Once hazards are identified, the next task is to assess the potential or risk involved in each. For each hazard identified, ask:

- What can go wrong?
- What are the consequences?

For each potential hazard it is important to identify resources necessary for an appropriate emergency response. For most events in construction, a simple analysis based on the experience of the people involved on the project is likely sufficient.

## 2.7 EMERGENCY RESOURCES

It is important to identify which resources are available and have contingency plans in place to make up for any deficiencies. The most important resource on most projects will be a 911 system. It is essential to verify that 911 is in effect in the area. Most Ontario communities have a 911 system in place, but it is important to know the facilities or limitations available in that location. Is a high-reach rescue team available? What is the response time? What must site personnel do in the meantime? Other on-site resources such as fire extinguishers, spills containment equipment, and first aid kits must be maintained and clearly identified. Construction equipment may be included among potential emergency resources. Personnel, especially on-site medical staff or workers trained in first aid, should be included in the plan. There may be situations where outside resources are so far away that an adequate response is not possible. In these situations, resources may have to be obtained and kept on site. Examples would include fire protection or ambulance/medical resources in remote areas. Whatever the situation may be, people, equipment, facilities, and materials are needed for emergency response. Where they will come from must be determined in advance. Moreover, the people supplying these resources must be made aware of their role in the plan.

## 2.8 COMMUNICATION SYSTEMS

An important key to effective emergency response is a communications system that can relay accurate information quickly. To do this, reliable communications equipment must be used, procedures developed, and personnel trained. It is a good

idea to have a backup system in place, in case the system is rendered useless by the emergency. For example, telephone lines may be cut. The type and location of emergency communication systems must be posted on the project. This will include location of telephones, a list of site personnel with cellular phones or two-way radios, and any other equipment available. Emergency phone numbers and the site address/location should be posted beside all site phones. A communication system must be made up of strategically placed equipment and properly defined responsibilities. The emergency response plan posted in a conspicuous place on the project must identify the designated equipment and the people to operate it.

## 2.9 ADMINISTRATION OF THE PLAN

The task of administering and organizing the plan is vital to its effectiveness. The person who has this task will normally be the person in charge of the emergency response operation. It is their task to ensure

• That everyone clearly understands their roles and responsibilities within the emergency response plan (a chart may be helpful in this regard)

• That emergency resources, whether people or equipment, are kept at adequate levels in step with the progress of the project.

It is very important to review the emergency plan on a regular basis and especially after an emergency has occurred. Changes may be necessary where deficiencies became apparent as the plan went into operation.

## 2.10 EMERGENCY RESPONSE PROCEDURE

An emergency can be reported from any source—a worker on site, an outside agency, or the public. Remember that circumstances may change during the course of an emergency. Any procedures you develop must be able to respond to the ongoing situation.

The following list covers basic actions to take in an emergency. These steps apply to almost any emergency and should be followed in sequence.

- Stay calm.
- Assess the situation.
- Take command.
- Provide protection.
- Aid and manage.
- Maintain contacts.
- Guide emergency services.

## 2.11 COMMUNICATION OF THE PROCEDURE

To be effective, an Emergency Response Procedure must be clearly communicated to all site personnel. The following activities should be considered:

- Review the procedure with new site subcontractors and new workers to ensure that it covers their activities adequately.
- Review the procedure with suppliers to ensure that it covers any hazards that the storage or delivery of their materials might create.
- Review new work areas in operating plants with owner/client to ensure that new hazards are identified and covered in the procedure.
- Review the procedure with the Joint Health and Safety Committee or Health and Safety Representative on a regular basis to address new hazards or significant changes in site conditions.
- Post the procedure in a conspicuous location.

The Emergency Response Procedure for a construction project must continually undergo review and revision to meet changing conditions.

## 2.12 DEBRIEFING AND POST-TRAUMATIC STRESS PROCEDURE

The recovery process, or what happens after the emergency response has been completed, is a critical step in the plan. Many emergency tasks may be handled by

people who are not accustomed to dealing with emergencies. People may have seen their work partners and friends badly injured and suffering great pain. Once the emergency is over, the attitude should not be “Okay, let’s get back to work” or “Let’s go home.” Some of the people involved may need assistance in order to recover. In some cases professional counseling may be needed. As part of site emergency planning, construction companies should have measures in place to deal with post-traumatic stressDebriefing is necessary to review how well the plan worked in the emergency and to correct any deficiencies that were identified. Debriefing is critical to the success of future emergency response planning

## 2.13 SUMMARY

The above discussions have shown that various types of surprise situations may arise at the implementation stage of construction project. To handle these situations, construction industry everywhere needs to take a deliberate effort to prepare an effective contingency plan.

Although there may be little time between the award of the contract and the start of the project, a good emergency response plan can be generic and, with some minor changes, can be easily adapted to specific sites and readily implemented. Later, different considerations to prepare a contingency plan have also been discussed. Different surveys have shown that absence of contingency plan causes different problems like failure to maintain project schedule, cost overruns, poor resource allocation etc which may ultimately lead to total project failure. So the position of thesis is that general project schedule could be better maintained or implemented more flawlessly, if efforts are made to identify various surprise conditions and prepare emergency response planning or contingency planning in response to the conditions.

# CHAPTER THREE

# METHODOLOGY

## 3.1 GENERAL

In this portion methods and tools for overcoming delay due to constrains will be discussed. Alongside development of model for project's task schedule is also discussed. A brief discussion about Microsoft Project software is also included. Simulations of different scenarios & data analysis for different scenarios are described briefly.

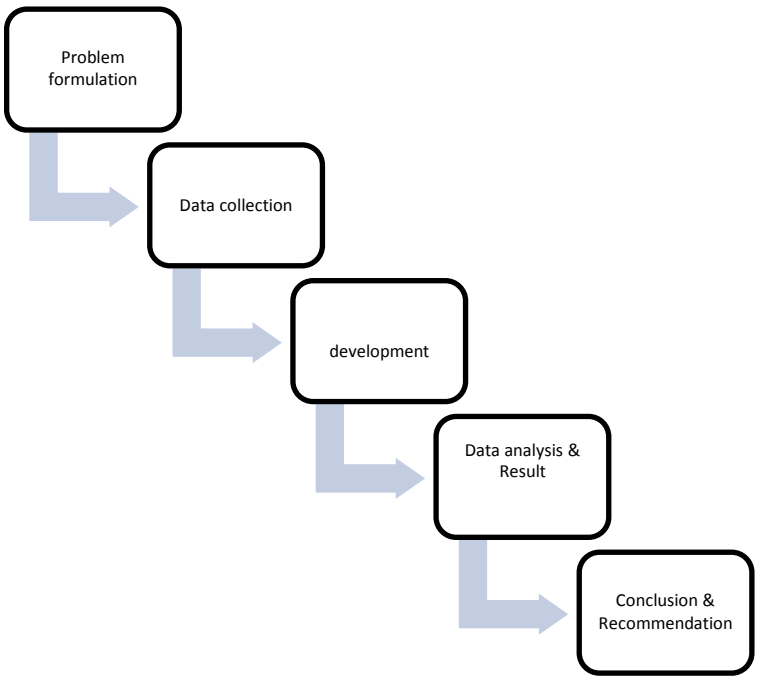



Figure 3.1:Methodology Flow Chart

## 3.2 PROBLEM FORMULATION

When a component task of a project is delayed, it's affect on other tasks depends on certain things. Such as if the task is critical or not, how much free float does the task have, what is the condition(critical non critical) of it'ssuccessor activities.

Depending upon the condition of the task we need to select the right tool to mitigate the project delay. The tools/method for reduce the delay of the project are:-

**3.2.1 SCHEDULE COMPRESSION:** This tool helps shorten the total duration of a project by decreasing the time allotted for certain activities. It's done to meet time constraints, and still keep the original scope of the project. This is where more resources assigned to an activity, thus decreasing the time it takes to complete it. This is based on the assumption that the save time will offset the added resource costs.

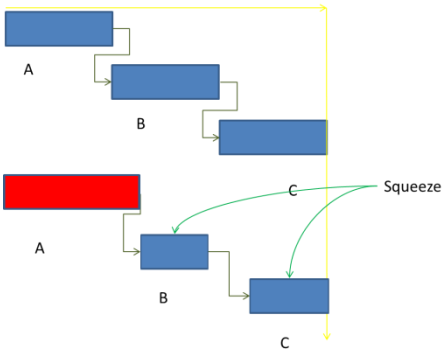



**Figure3.2: Schedule Compression**

**3.2.2 Fast-Tracking/Overlapping**– This involves rearranging activities to allow more parallel work. This means that tasksare normally done one after another are now done at the same time. However, do bear in mind that this approach increases

the risk of missing things, or fail to address changes. This tool incorporates with finish start relationship, resource leveling etc.

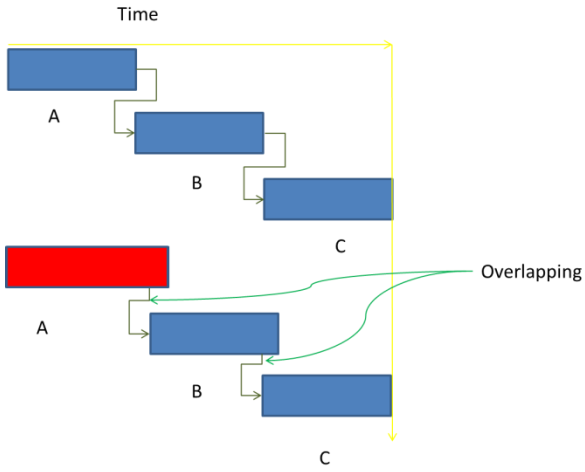



**Figure 3.3:Fast-Tracking/Overlapping**

## 3.3 DATA COLLECTION

Different projects consist of different types of activity. Depending upon place, project type, time constrains also varies. So, critical constrains for every type of projects cannot be specified. As, earlier we said we have taken Zoom In approach to identify critical constrains of the project. According to this approach we are going to select a project and study it to find out which tasks are critical.

To find out those critical constrains several construction sites were visited. While visiting those sites project managers were asked what type of problem they

might encounter during the construction phase of the project. These problems are used as input in case of scenario simulation.

## 3.4 MODEL DEVELOPMENT

Microsoft project (MS project) is used to develop the schedule of the project. Shipping Tower Constriction Project's schedule & illustrative case example schedule is developed through this software. MS project is very user friendly software. With MS project projects schedule can be presented as Gantt chart, network diagram, relationship diagram, resource graph etc. This software also enables to find out critical tasks as well as free float of the task & total float of the project. In that software input is mainly tasks name, duration, predecessors, Starting & finishing time.

## 3.5 DATA ANALYSIS & RESULT

Data analysis is done by creating various scenarios that might occur in the construction phase of the project. The scenarios are created based on interview with the project manager & assuming several unforeseen constrains.

The model of the project's schedule is taken as base line in MS project. In baseline scenario which works are critical & non critical were notedin a spread sheet. After that according to scenario tasks were delayed & again critical & non critical tasks are noted in the spread sheet for the scenarios.

After the simulation every task is observed, in case of observation zoom in approach was taken i.e. focusing on a critical segment or a subproject rather than

reviewing the entire project. Depending upon task Schedule Compression & overlapping method is used to complete the project in time or to reduce the delay. After that again critical & non critical tasks were noted down in a spread sheet.

## 3.6 CONCLUSION

In this study most important stages are data collection & model development. If the desired data are collected than model development can be done accurately. That will give more realistic results for real life scenario cases.

# CHAPTER FOUR

# MODEL DEVELOPMENT AND DATA ANALYSIS

## 4.1 GENERAL

In this chapter basis of model development is briefly discussed. A short discussion about illustrative case example & real life project is also included. Detailed Gantt chart of projects and different scenarios are elaborately discussed. At the end of the scenario probable mitigation measures are also suggested.

## 4.2 MODEL DEVELOPMENT

To realize the delay causes &affect of delay a time schedule needs to be developed. Based on the Bangladeshi construction tradition duration of different activity is estimated. An activity can be delayed by two possible ways: firstly, delay at activity starting; secondly, delay at implementation stage. Activity duration, probable causes of delay, probable delay& mitigation measures are the key input for the development of the model. Using Microsoft project software time schedule of projects are is developed. For this thesis, Two time schedules are developed. First schedule made for an illustrative case example of 30 activities & another one is based on real life case study. Those schedules are analyzed for different scenarios.

# Chapter Four: Model Development and Data Analysis

The analyzed data and mitigation measures gives an overview how delayed projects can be finished within it's duration & acts as a model for other projects for different scenario.

Before model development several papers were studied on project management & constrains. One; "Delay and Cost Overruns in Vietnam Large Construction Projects: A Comparison with Other Selected Countries"( Long Le-Hoai, Young Dai Lee, and Jun Yong Lee, July 16, 2008), this paper showed a comparison of delay causes among Asian countries. The table is shown below.

**Table 4.1:A COMPARISON OF DELAY CAUSES AMONG ASIAN COUNTRIES**

| | Major causes | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Vietnam (This study, 2007) (1) | Poor site management and supervision | Poor project management assistance | Financial difficulties of owner | Financial difficulties of contractor | Design changes |
| Malaysia (Sambasivan, 2007) (2) | Improper planning | Site management | Inadequate contractor experience | Finance and payments of completed work | Subcontractors |
| South Korea (Acharya *et al.*, 2006) (2) | Public interruptions | Changed site conditions | Failure to provide site | Unrealistic time estimation | Design errors |
| Hong Kong (Lo, 2006) (2) | Inadequate resources due to contractor/lack of capital | Unforeseen ground conditions | Exceptionally low bids | Inexperienced contractor | Works in conflict with existing utilities |
| UAE (Faridi, 2006) (2) | Preparation and approval of drawings | Inadequate early planning of the project | Slowness of the owner's decision-making process | Shortage of manpower | Poor supervision and poor site management |
| Jordan (Sweis, 2007) (2) | Financial difficulties faced by the contractor | Too many change orders from owner | Poor planning and scheduling of the project by the contractor | Presence of unskilled labor | Shortage of technical professionals in the contractor's organization |
| Kuwait (Koushki, 2005) (2) | Change orders | Financial constraints | Owner's lack of experience | Materials | Weather |
| (3) | Contractor | Materials | Financial constraints | Change orders | Weather |
| Ghana (Frimpong, 2003) (1) | Monthly payment difficulties | Poor contract management | Material procurement | Inflation | Contractor's financial difficulties |
| Nigeria (Aibinu, 2006) (2) | Contractors' financial difficulties | Clients' cash flow problem | Architects' incomplete drawing | Subcontractor's slow mobilization | Equipment breakdown and maintenance problem |

From this comparison a ranking of constrains are made. The ranking is made on the basis of Weightage& frequency. According to the table above the constrain which is ranked No.1 for a individual country is given weightage value 5, No.2 ranked constrain is given weightage value 4 similarly No. 3, 4, 5 ranked constrains were given weightage value 3,2,1 respectively.

Frequency refers to the number of presence of constrains on the table. The ranking is given below:

## Table 4.2:RANK ,CAUSE, WEIGHTAGE OF DIFFERENT CONSTRAINS

| Rank | Cause | Weightage |
|---|---|---|
| 1 | Cash flow problem | 28 |
| 2 | change in orders | 19 |
| 3 | Improper planning | 17 |
| 4 | Financial difficulties faced by contractor | 17 |
| 5<br>6 | Poor site management & supervision | 11<br>10 |
| 7 | Changed site condition | 9 |

| | | |
|---|---|---|
| 8 | Preparation & approval of drawing | 9 |
| 9 | Poor design | 6 |
| 10 | Exceptionally low bids | 6 |
| 11 | slowness of owners decision making | 6 |
| 12 | shortage of man power | 6 |
| 13 | Public interruptions | 5 |
| 14 | Inadequate contractor experience | 5 |
| 15 | Weather | 5 |
| 16 | Failure to provide site | 3 |
| 17 | Architects incomplete drawing | 3 |
| 18 | Presence of unskilled labor | 3 |
| 19 | Sub-contractors slow mobilization | 3 |
| 20 | Inflation/cost of material changes | 2 |

| | | |
|---|---|---|
| 21 | Equipment breakdown & maintenance | 1 |

For real life case study, several ongoing projects have been visited. During these visits, project managers were asked about the critical constrains that they usually face during construction period. To determine the type of scenario, construction sites were observed. For urban construction site in Bangladesh, the critical constrains are

1. change in orders
2. Improper planning
3. Changed site condition
4. Preparation & approval of drawing
5. Material procurement
6. Public interruptions
7. Presence of unskilled labor
8. Inflation/cost of material changes

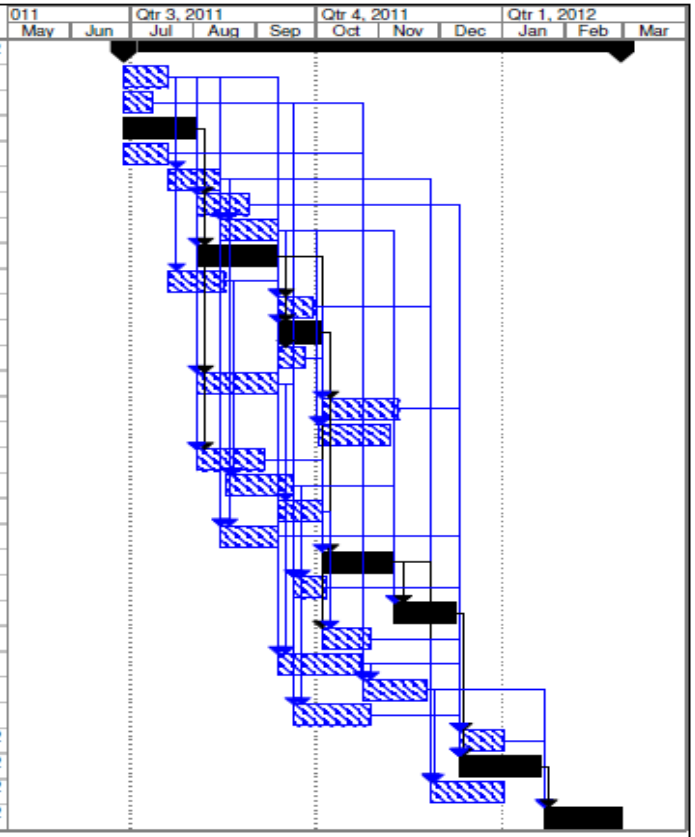
## 4.3 ILLUSTRATIVE CASE EXAMPLE

Illustrative case example is developed for 30 imaginary activities & predecessor relationship. This case example will help to understand, how any delay in an activity affects the downstream activities, how the state of an activity changes i.e. a non criticalactivit becomes critical or a critical activity becomes non critical. This will provide the basis of remedy measures to overcome the adverse effect on downstream activities through squeezing and/or overlapping of these activities.

# Chapter Four: Model Development and Data Analysis

The Gantt Chart of 30 activity model is given in Figure-4.1. As the model is an illustrative case example, no specific cause for the delay of the activity has been shown in the analysis. Thus, some activities have been randomly selected in order to demonstrate the impact of the delay and their remedy measures.

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **project start** | **176 days** | **Tue 6/28/11** | **Tue 2/28/12** |
| 2 | 1 | 16 days | Tue 6/28/11 | Tue 7/19/11 |
| 3 | 2 | 10 days | Tue 6/28/11 | Mon 7/11/11 |
| 4 | 3 | 26 days | Tue 6/28/11 | Tue 8/2/11 |
| 5 | 4 | 16 days | Tue 6/28/11 | Tue 7/19/11 |
| 6 | 5 | 18 days | Wed 7/20/11 | Sun 8/14/11 |
| 7 | 6 | 18 days | Wed 8/3/11 | Sun 8/28/11 |
| 8 | 7 | 20 days | Mon 8/15/11 | Sun 9/11/11 |
| 9 | 8 | 28 days | Wed 8/3/11 | Sun 9/11/11 |
| 10 | 9 | 20 days | Wed 7/20/11 | Tue 8/16/11 |
| 11 | 10 | 14 days | Mon 9/12/11 | Thu 9/29/11 |
| 12 | 11 | 16 days | Mon 9/12/11 | Mon 10/3/11 |
| 13 | 12 | 10 days | Mon 9/12/11 | Sun 9/25/11 |
| 14 | 13 | 28 days | Wed 8/3/11 | Sun 9/11/11 |
| 15 | 14 | 28 days | Tue 10/4/11 | Thu 11/10/11 |
| 16 | 15 | 26 days | Sun 10/2/11 | Sun 11/6/11 |
| 17 | 16 | 24 days | Wed 8/3/11 | Mon 9/5/11 |
| 18 | 17 | 24 days | Wed 8/17/11 | Mon 9/19/11 |
| 19 | 18 | 16 days | Mon 9/12/11 | Mon 10/3/11 |
| 20 | 19 | 20 days | Mon 8/15/11 | Sun 9/11/11 |
| 21 | 20 | 26 days | Tue 10/4/11 | Tue 11/8/11 |
| 22 | 21 | 12 days | Tue 9/20/11 | Wed 10/5/11 |
| 23 | 22 | 22 days | Wed 11/9/11 | Thu 12/8/11 |
| 24 | 23 | 18 days | Tue 10/4/11 | Thu 10/27/11 |
| 25 | 24 | 30 days | Mon 9/12/11 | Sun 10/23/11 |
| 26 | 25 | 24 days | Mon 10/24/11 | Thu 11/24/11 |
| 27 | 26 | 28 days | Tue 9/20/11 | Thu 10/27/11 |
| 28 | 27 | 16 days | Sun 12/11/11 | Sun 1/1/12 |
| 29 | 28 | 30 days | Sun 12/11/11 | Thu 1/19/12 |
| 30 | 29 | 26 days | Sun 11/27/11 | Sun 1/1/12 |
| 31 | 30 | 28 days | Sun 1/22/12 | Tue 2/28/12 |




Project: 3D.mpp
Date: Sat 9/8/12

Task
Project Guide: Critical Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

Page 1

Figure:4.1:scheduleofIllustrative Case Example

### 4.3.1 Scenario 1

In scenario1, Activity 5 is delayed up to it's float. (figure 4.2) The duration of the task was 18 days &it's float is 26 days. So, due to delay up to it's float total duration became 44 days. For that the work became critical but the total duration of the project remained unchanged.

Due to this delay, the total duration of the project is not affected but there are some considerable changes affecting the other tasks, some of the activities became critical. For that scenario Activity 4,5,7,12,14 became new critical activity. That means the flexibility of those activity became restricted.

So, for that kind of situation delay in new critical tasks would make the project delayed. To prevent delay precautionary measures need to be taken to avoid delay on those new critical tasks.

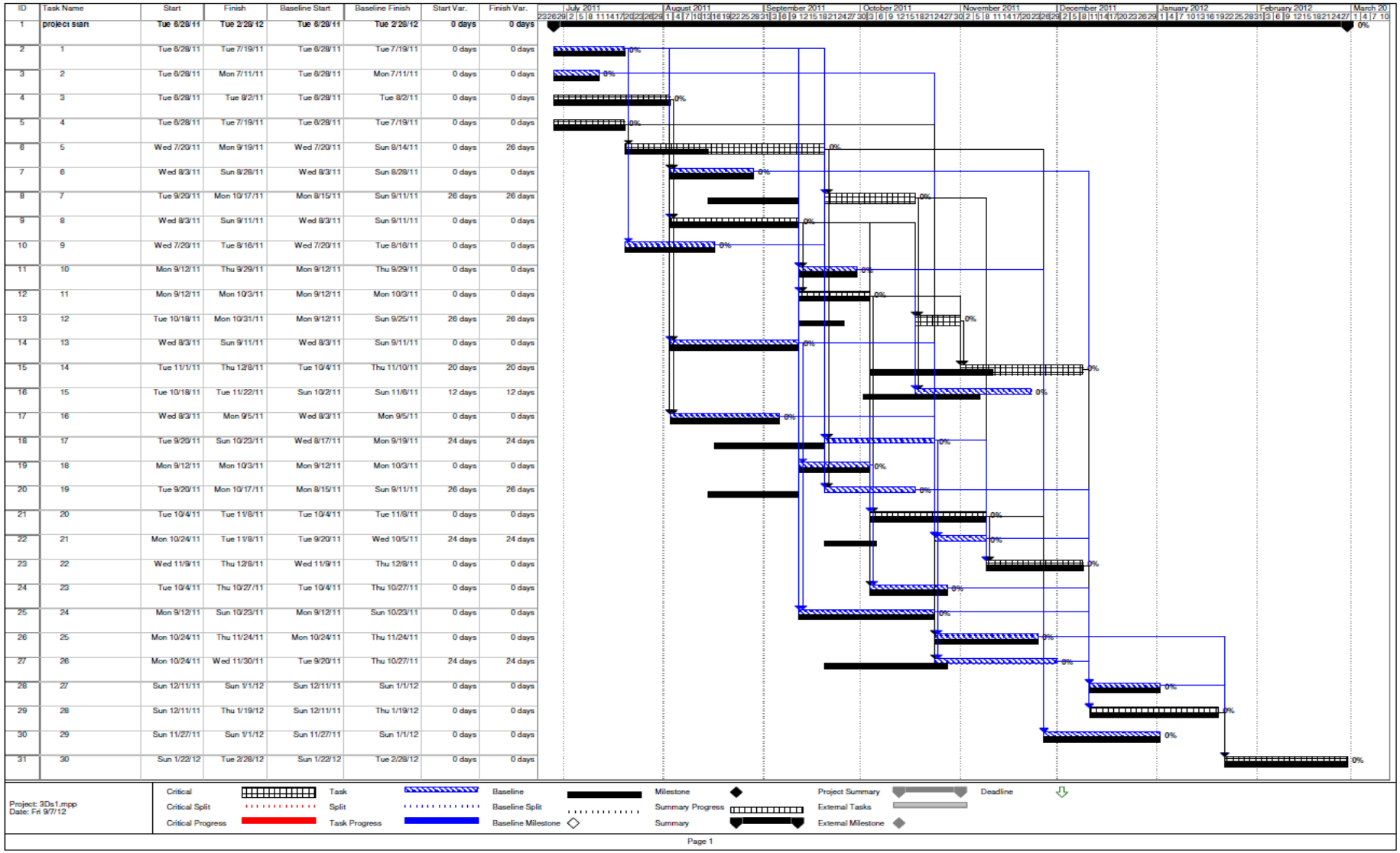
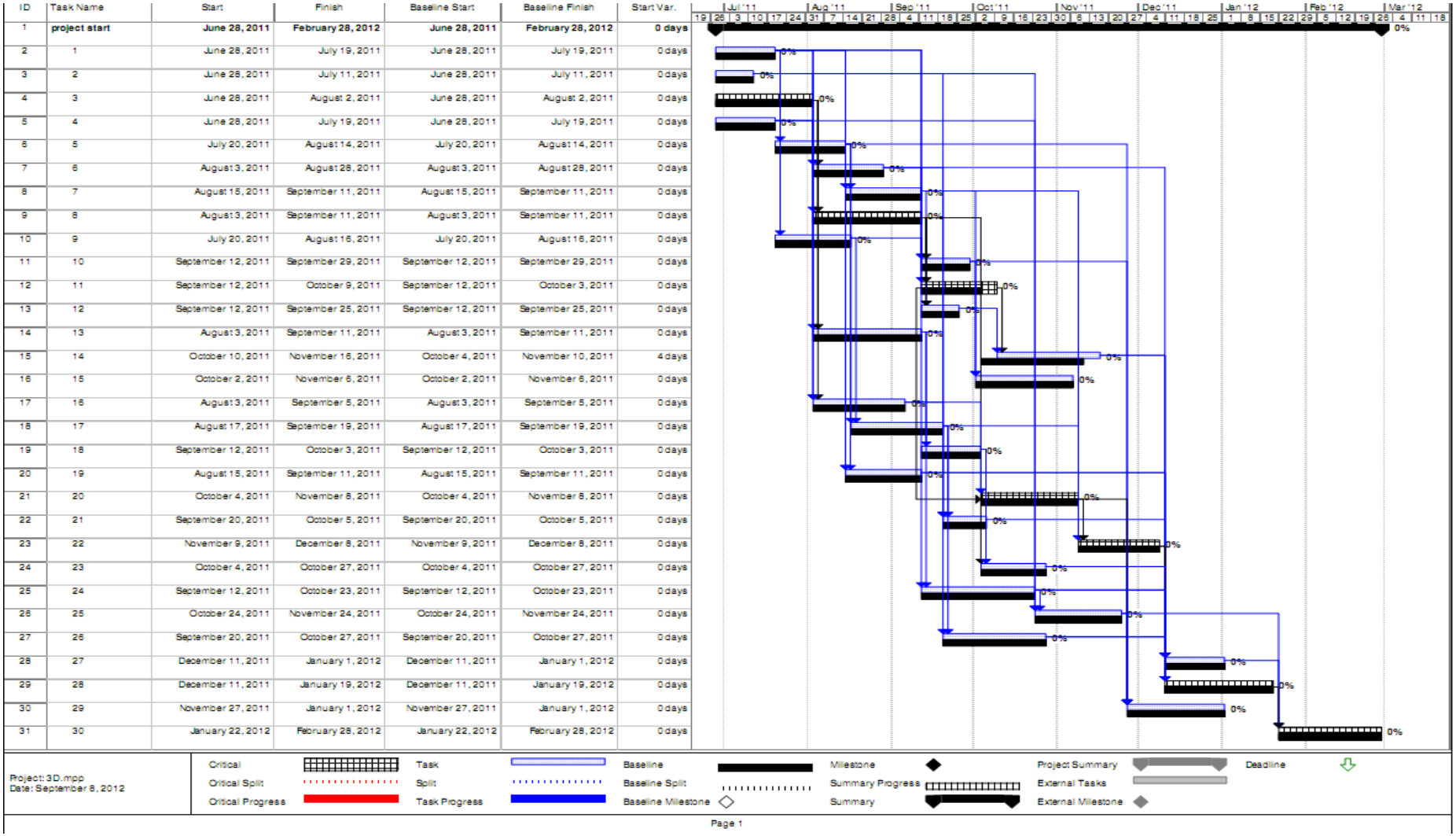



Figure : 4.2 Name : Base line comparison of scenario 1(Illustrative case example)

### 4.3.2 Scenario 2

This illustrative case example contains 3 activities which do not have any successor activity. They are activity 15, 29& 30. Two of them are non-critical. No successor activity means no downstream activity. So, there is no chance of delaying other activity.

But due to delay of that kind of activity the total project duration might change. Such as, if the activity 30 is delayed for 1 day, the total duration of project increases by 1 day. This happened because the activity 30 is critical. On the other hand if we delay the activity 29 for 39 days than it will become critical. Up to this the duration of the project will not increase. If the activity 29 is delayed more than 39 days, the duration of the project will increase.



| ID | Task Name | Start | Finish | Baseline Start | Baseline Finish | Start Var. |
|---|---|---|---|---|---|---|
| 1 | **project start** | **June 28, 2011** | **February 28, 2012** | **June 28, 2011** | **February 28, 2012** | **0 days** |
| 2 | 1 | June 28, 2011 | July 19, 2011 | June 28, 2011 | July 19, 2011 | 0 days |
| 3 | 2 | June 28, 2011 | July 11, 2011 | June 28, 2011 | July 11, 2011 | 0 days |
| 4 | 3 | June 28, 2011 | August 2, 2011 | June 28, 2011 | August 2, 2011 | 0 days |
| 5 | 4 | June 28, 2011 | July 19, 2011 | June 28, 2011 | July 19, 2011 | 0 days |
| 6 | 5 | July 20, 2011 | August 14, 2011 | July 20, 2011 | August 14, 2011 | 0 days |
| 7 | 6 | August 3, 2011 | August 28, 2011 | August 3, 2011 | August 28, 2011 | 0 days |
| 8 | 7 | August 15, 2011 | September 11, 2011 | August 15, 2011 | September 11, 2011 | 0 days |
| 9 | 8 | August 3, 2011 | September 11, 2011 | August 3, 2011 | September 11, 2011 | 0 days |
| 10 | 9 | July 20, 2011 | August 16, 2011 | July 20, 2011 | August 16, 2011 | 0 days |
| 11 | 10 | September 12, 2011 | September 29, 2011 | September 12, 2011 | September 29, 2011 | 0 days |
| 12 | 11 | September 12, 2011 | October 9, 2011 | September 12, 2011 | October 3, 2011 | 0 days |
| 13 | 12 | September 12, 2011 | September 25, 2011 | September 12, 2011 | September 25, 2011 | 0 days |
| 14 | 13 | August 3, 2011 | September 11, 2011 | August 3, 2011 | September 11, 2011 | 0 days |
| 15 | 14 | October 10, 2011 | November 16, 2011 | October 4, 2011 | November 10, 2011 | 4 days |
| 16 | 15 | October 2, 2011 | November 6, 2011 | October 2, 2011 | November 6, 2011 | 0 days |
| 17 | 16 | August 3, 2011 | September 5, 2011 | August 3, 2011 | September 5, 2011 | 0 days |
| 18 | 17 | August 17, 2011 | September 19, 2011 | August 17, 2011 | September 19, 2011 | 0 days |
| 19 | 18 | September 12, 2011 | October 3, 2011 | September 12, 2011 | October 3, 2011 | 0 days |
| 20 | 19 | August 15, 2011 | September 11, 2011 | August 15, 2011 | September 11, 2011 | 0 days |
| 21 | 20 | October 4, 2011 | November 8, 2011 | October 4, 2011 | November 8, 2011 | 0 days |
| 22 | 21 | September 20, 2011 | October 5, 2011 | September 20, 2011 | October 5, 2011 | 0 days |
| 23 | 22 | November 9, 2011 | December 8, 2011 | November 9, 2011 | December 8, 2011 | 0 days |
| 24 | 23 | October 4, 2011 | October 27, 2011 | October 4, 2011 | October 27, 2011 | 0 days |
| 25 | 24 | September 12, 2011 | October 23, 2011 | September 12, 2011 | October 23, 2011 | 0 days |
| 26 | 25 | October 24, 2011 | November 24, 2011 | October 24, 2011 | November 24, 2011 | 0 days |
| 27 | 26 | September 20, 2011 | October 27, 2011 | September 20, 2011 | October 27, 2011 | 0 days |
| 28 | 27 | December 11, 2011 | January 1, 2012 | December 11, 2011 | January 1, 2012 | 0 days |
| 29 | 28 | December 11, 2011 | January 19, 2012 | December 11, 2011 | January 19, 2012 | 0 days |
| 30 | 29 | November 27, 2011 | January 1, 2012 | November 27, 2011 | January 1, 2012 | 0 days |
| 31 | 30 | January 22, 2012 | February 28, 2012 | January 22, 2012 | February 28, 2012 | 0 days |



Figure : 4.3 : Base line comparison of scenario 2(Illustrative case example)

### 4.3.3 Scenario 3

There are 7 critical activities(activity no. 3, 8,11, 20,22,28,30) in this case example. Critical activities refer that there is no float for the activity. If somehow the activity gets delayed, then the total project will be delayed.

To improvise the situation, project manager needs to be cautious about those critical activities; due to some unforeseen condition, this critical activity might get delayed. To overcome this situation, squeezing or overlapping of activities is needed.

For example, if activity 11 is delayed by 4 days, the total project duration will become 180 days. If we overlap activity 20 by making a start start relation with its predecessor activity 12 by 16 days, then project duration again will become 176 days (FIG-3).On the other hand if activities 20 & 22 are squeezed by 2 days, again the project duration will become 176 days.(figure-4.4 )

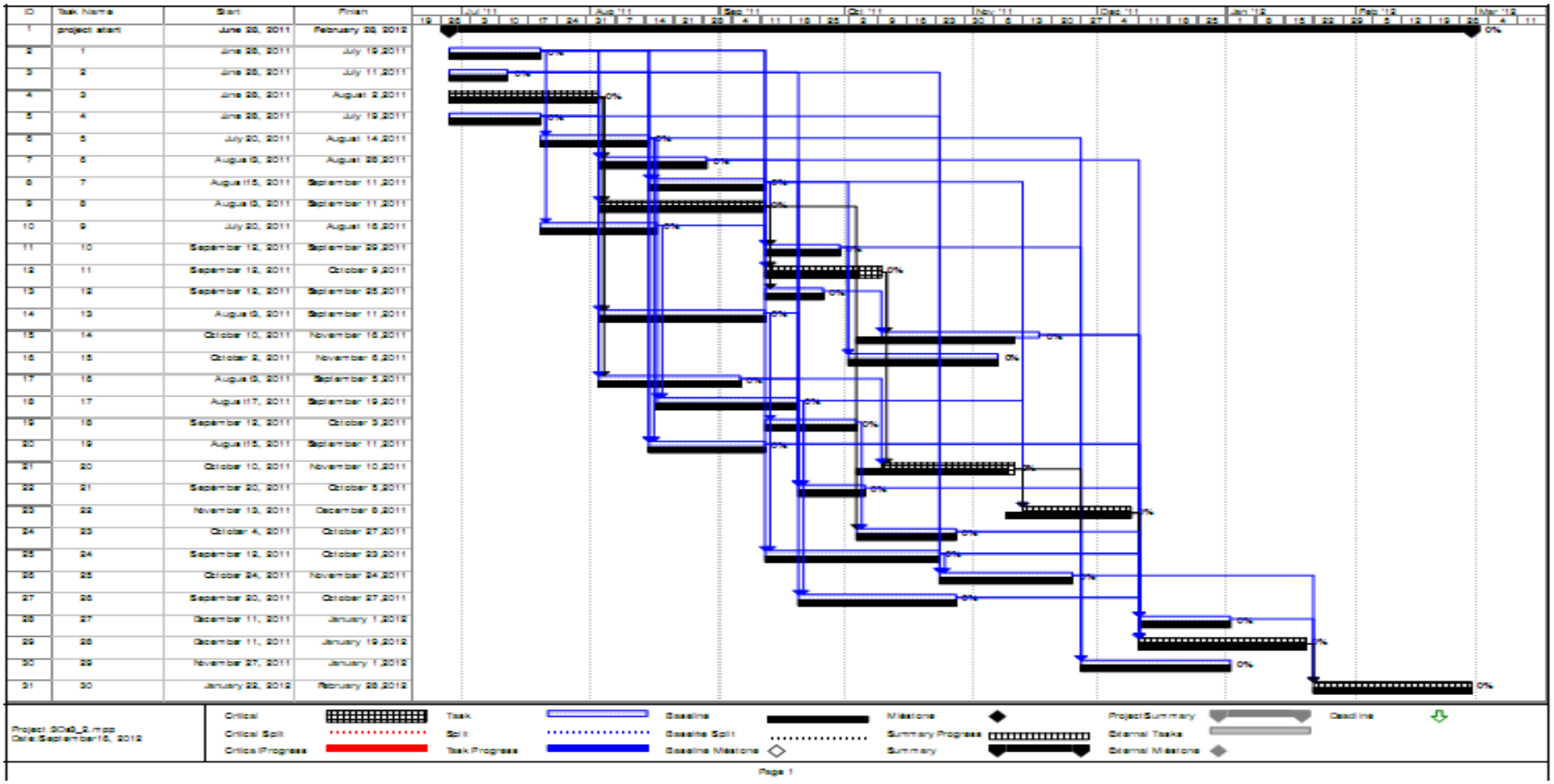



Figure : 4.4 Name : Base line comparison of scenario 3 (Illustrative case example)

## 4.4 CASE STUDY

### 4.4.1 Data Collection

To make real life model, a construction project named Shipping Tower is selected. This is a 25 story building including 3 basements. This construction site is situated in a very busy commercial area named Motijhil across a busy road. The owner of the building is Bangladesh Shipping Corporation. Planning and design are done by Department of Architecture & Public Works Department respectively. The total construction activity sequence & duration were noted down. Based on this data real life model is developed & several scenarios were created.

The detail Gantt chart of the project is given below.

According to scenarios mentioned in the previous section, activities were delayed and their possible impacts on project duration have been observed & possible solutions to overcome the delay have been suggested accordingly.

## 4.5 SCENARIOS

### 4.5.1 Scenario 1

In scenario 1, a critical work named "Earth excavation up to 11'-0" depth" is delayed by 39 days for which total project duration is increased from 1095 days to 1134 days, i.e. a total delay of 39 days. The reason for delay in task “Earth excavation up to 11'-0" depth” might be unforeseen ground condition such as seepage, lateral load due to surcharge load, ground water level as well as weather condition & machine related problems.

To complete the task in time overlapping method is adopted. Two sets of activities have been overlapped. Firstly, activity no 32-51 (R.C.C works of 5th to 25 th floor) were overlapped by 15 days with start- start relation, because concrete would get enough strength to bear the load of upper floor by 15 days. Secondly, activity 107 named **Installation all kind of electrical fixtures** is overlapped by 22 days with activity 106 named **Electrical Wiring** with start-start relation. This is done because, after completion of Electrical wiring of several floors, it is possible to start installation of electrical fixtures. This kind of overlapping may require extra man power as well as extra cost. Detail analysis for extra cost is beyond the scope of this study. Here no task has been squeezed.

The base line comparison is shown in figure-4.5.

In this figure, it can be observed that due to delay in task 13 named **Earth excavation up to 11'-0" depth,** the downstream tasks also became delayed as a result, total project duration increased. However, from RCC works (task no 32-51) of floors above the sixth story were overlapped with each other by 15 days as a result

RCC works have been completed several months earlier. Due to early finish of RCC works, brick works are also finished within the scheduled date.

Afterwards, finishing works began; the finishing tasks were delayed because the task cannot be started until the brick works of $6^{th}$ floor is completed. From base line comparison it can be seen that total brick work is completed within schedule but the individually their starting times were delayed. As a result the starts of successor activities' such as **plastering work-1**, **Floor finishin-1** were delayed. But other Finishing works were started ahead of schedule because their predecessors are completed before schedule time.

In case of Electrical works, the related sub task named Installation of all kind of electrical fixtures is overlapped with its predecessor by 22 days. This overlapping can eventually helps to complete the electrical works within its scheduled time.

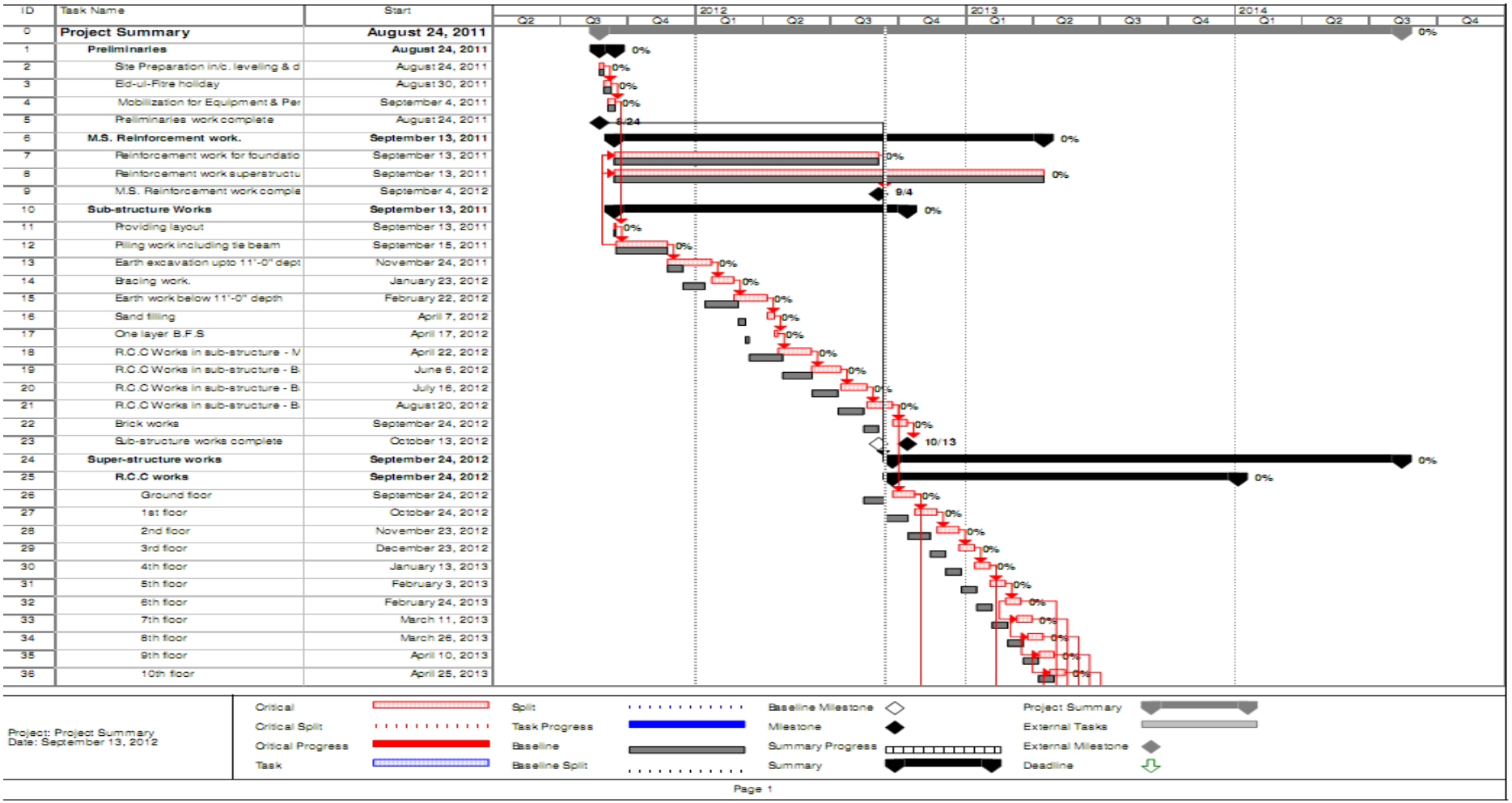
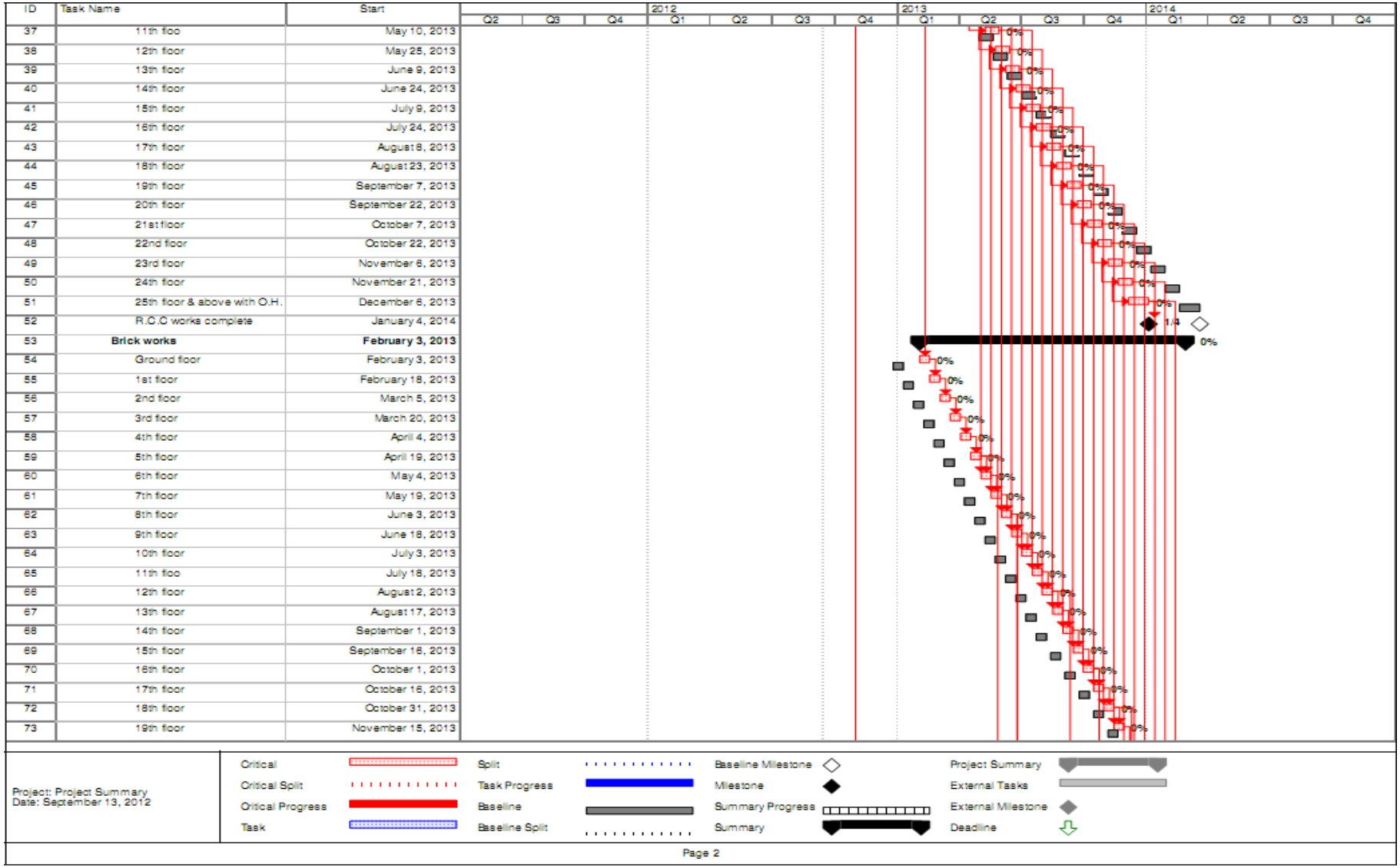


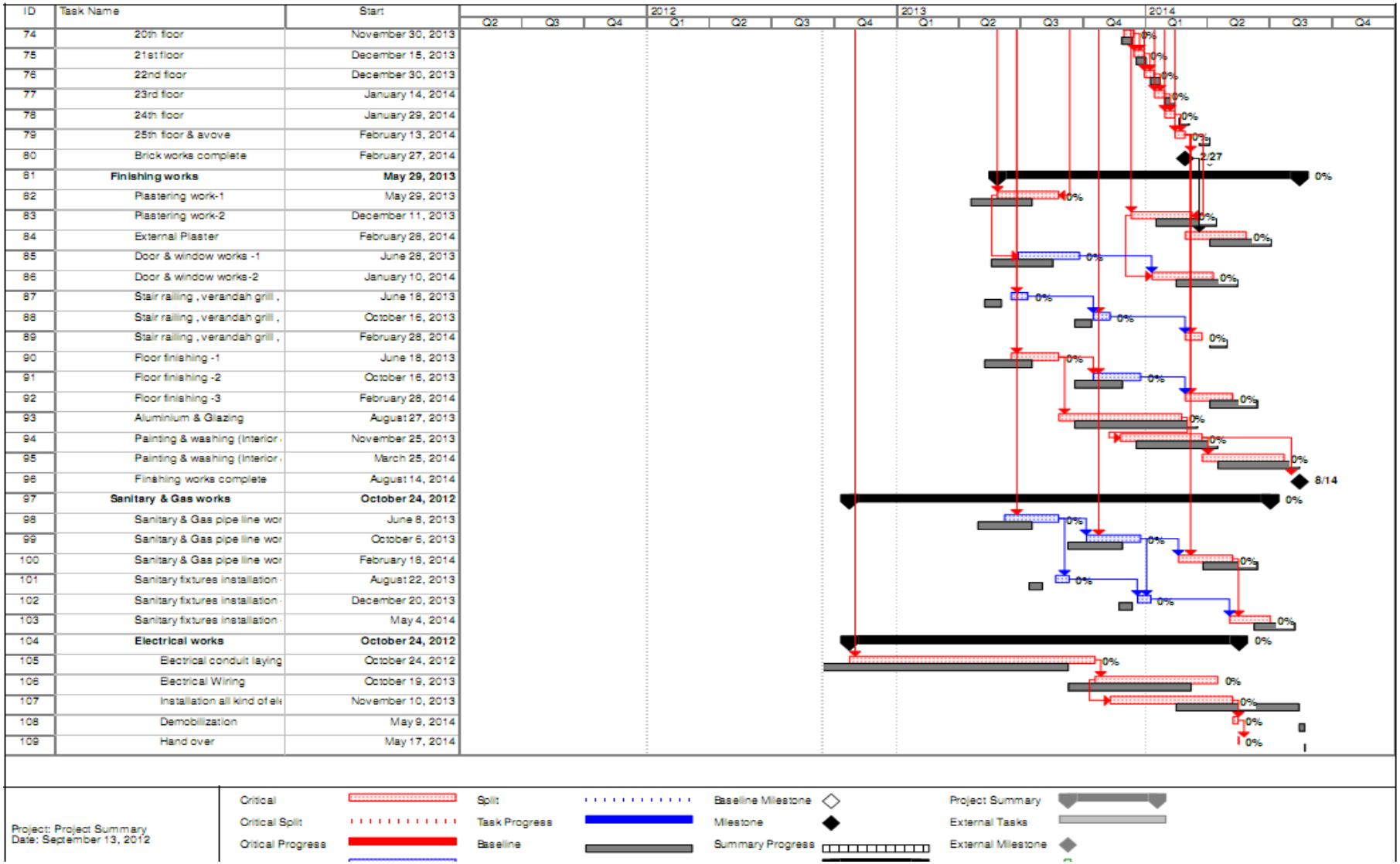

Figure : 4.5 : Base line comparison of scenario 1 (real life model )



| ID | Task Name | Start |
|---|---|---|
| 37 | 11th floo | May 10, 2013 |
| 38 | 12th floor | May 25, 2013 |
| 39 | 13th floor | June 9, 2013 |
| 40 | 14th floor | June 24, 2013 |
| 41 | 15th floor | July 9, 2013 |
| 42 | 16th floor | July 24, 2013 |
| 43 | 17th floor | August 8, 2013 |
| 44 | 18th floor | August 23, 2013 |
| 45 | 19th floor | September 7, 2013 |
| 46 | 20th floor | September 22, 2013 |
| 47 | 21st floor | October 7, 2013 |
| 48 | 22nd floor | October 22, 2013 |
| 49 | 23rd floor | November 6, 2013 |
| 50 | 24th floor | November 21, 2013 |
| 51 | 25th floor & above with O.H. | December 6, 2013 |
| 52 | R.C.C works complete | January 4, 2014 |
| 53 | **Brick works** | **February 3, 2013** |
| 54 | Ground floor | February 3, 2013 |
| 55 | 1st floor | February 18, 2013 |
| 56 | 2nd floor | March 5, 2013 |
| 57 | 3rd floor | March 20, 2013 |
| 58 | 4th floor | April 4, 2013 |
| 59 | 5th floor | April 19, 2013 |
| 60 | 6th floor | May 4, 2013 |
| 61 | 7th floor | May 19, 2013 |
| 62 | 8th floor | June 3, 2013 |
| 63 | 9th floor | June 18, 2013 |
| 64 | 10th floor | July 3, 2013 |
| 65 | 11th floo | July 18, 2013 |
| 66 | 12th floor | August 2, 2013 |
| 67 | 13th floor | August 17, 2013 |
| 68 | 14th floor | September 1, 2013 |
| 69 | 15th floor | September 16, 2013 |
| 70 | 16th floor | October 1, 2013 |
| 71 | 17th floor | October 16, 2013 |
| 72 | 18th floor | October 31, 2013 |
| 73 | 19th floor | November 15, 2013 |



Figure: 4.5(continue)



| ID | Task Name | Start |
|---|---|---|
| 74 | 20th floor | November 30, 2013 |
| 75 | 21st floor | December 15, 2013 |
| 76 | 22nd floor | December 30, 2013 |
| 77 | 23rd floor | January 14, 2014 |
| 78 | 24th floor | January 29, 2014 |
| 79 | 25th floor & avove | February 13, 2014 |
| 80 | Brick works complete | February 27, 2014 |
| 81 | **Finishing works** | **May 29, 2013** |
| 82 | Plastering work-1 | May 29, 2013 |
| 83 | Plastering work-2 | December 11, 2013 |
| 84 | External Plaster | February 28, 2014 |
| 85 | Door & window works -1 | June 28, 2013 |
| 86 | Door & window works-2 | January 10, 2014 |
| 87 | Stair railing , verandah grill , | June 18, 2013 |
| 88 | Stair railing , verandah grill , | October 16, 2013 |
| 89 | Stair railing , verandah grill , | February 28, 2014 |
| 90 | Floor finishing -1 | June 18, 2013 |
| 91 | Floor finishing -2 | October 16, 2013 |
| 92 | Floor finishing -3 | February 28, 2014 |
| 93 | Aluminium & Glazing | August 27, 2013 |
| 94 | Painting & washing (Interior | November 25, 2013 |
| 95 | Painting & washing (Interior | March 25, 2014 |
| 96 | Finishing works complete | August 14, 2014 |
| 97 | **Sanitary & Gas works** | **October 24, 2012** |
| 98 | Sanitary & Gas pipe line wor | June 8, 2013 |
| 99 | Sanitary & Gas pipe line wor | October 6, 2013 |
| 100 | Sanitary & Gas pipe line wor | February 18, 2014 |
| 101 | Sanitary fixtures installation | August 22, 2013 |
| 102 | Sanitary fixtures installation | December 20, 2013 |
| 103 | Sanitary fixtures installation | May 4, 2014 |
| 104 | **Electrical works** | **October 24, 2012** |
| 105 | Electrical conduit laying | October 24, 2012 |
| 106 | Electrical Wiring | October 19, 2013 |
| 107 | Installation all kind of ele | November 10, 2013 |
| 108 | Demobilization | May 9, 2014 |
| 109 | Hand over | May 17, 2014 |



Figure: 4.5(continue)

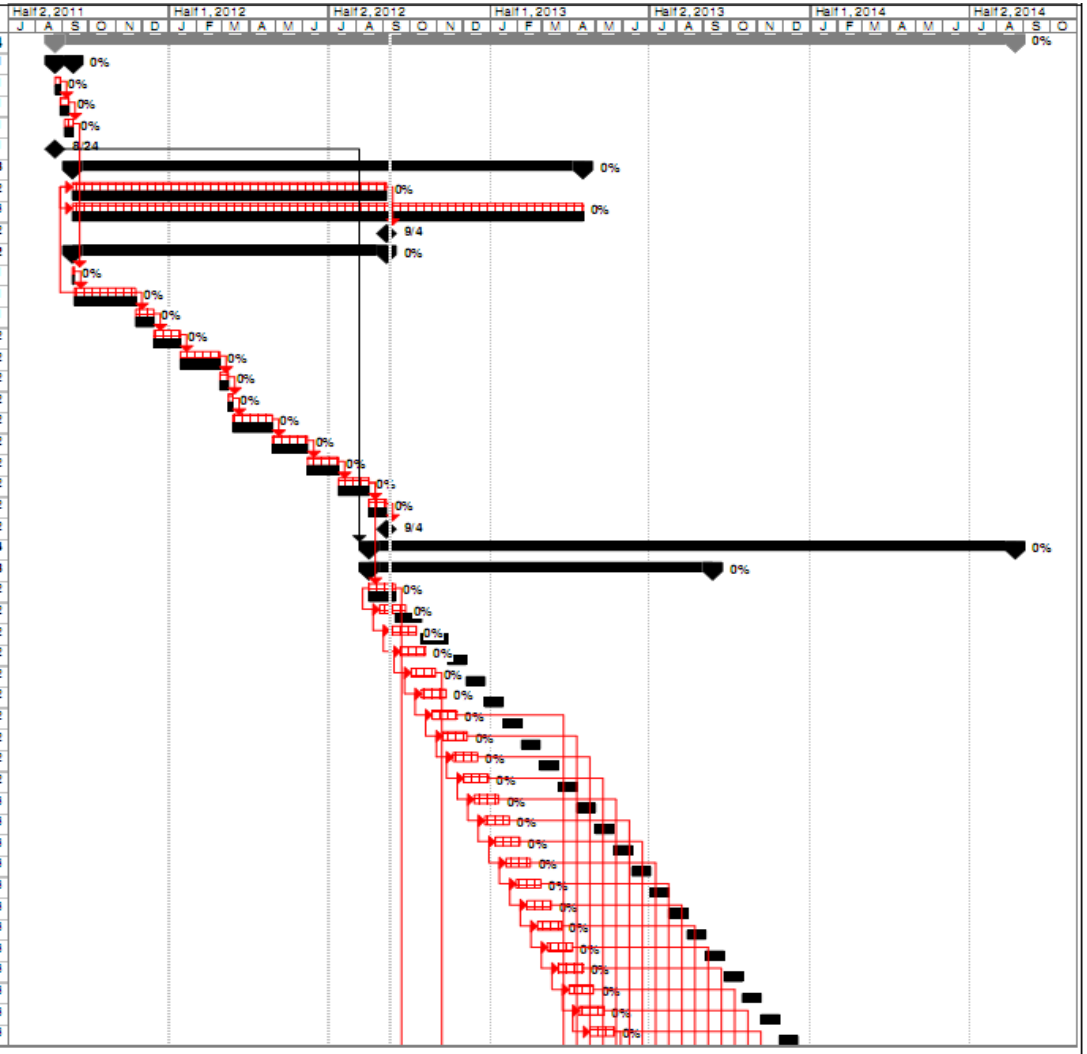
### 4.5.2 Scenario 2

In this scenario, the RCC work of super structure is delayed due to lack of concrete mixing place, for that ready mix concrete is used but the project site is situated in the busiest place of Dhaka city. For that, the roads around the project site are always busy, besides there is not enough space to accommodate those ready mix concrete carrier trucks & reinforcement bars. For that, every day ,5-8 working hours are lost in transportation of ready mix concrete & reinforcement bars. On the other hand it is impossible to carry on tasks at night time due to objection of neighborhood. Due to those problems mentioned above, RCC work of every floor is delayed 6-8 days that, for that project might get delayed for 137 days, to get rid of this problem, the RCC works of super structure are over lapped. The shuttering work of every floor is started after 15 days of concreting work at floor below it.

The base line comparison is shown in figure 4.6.

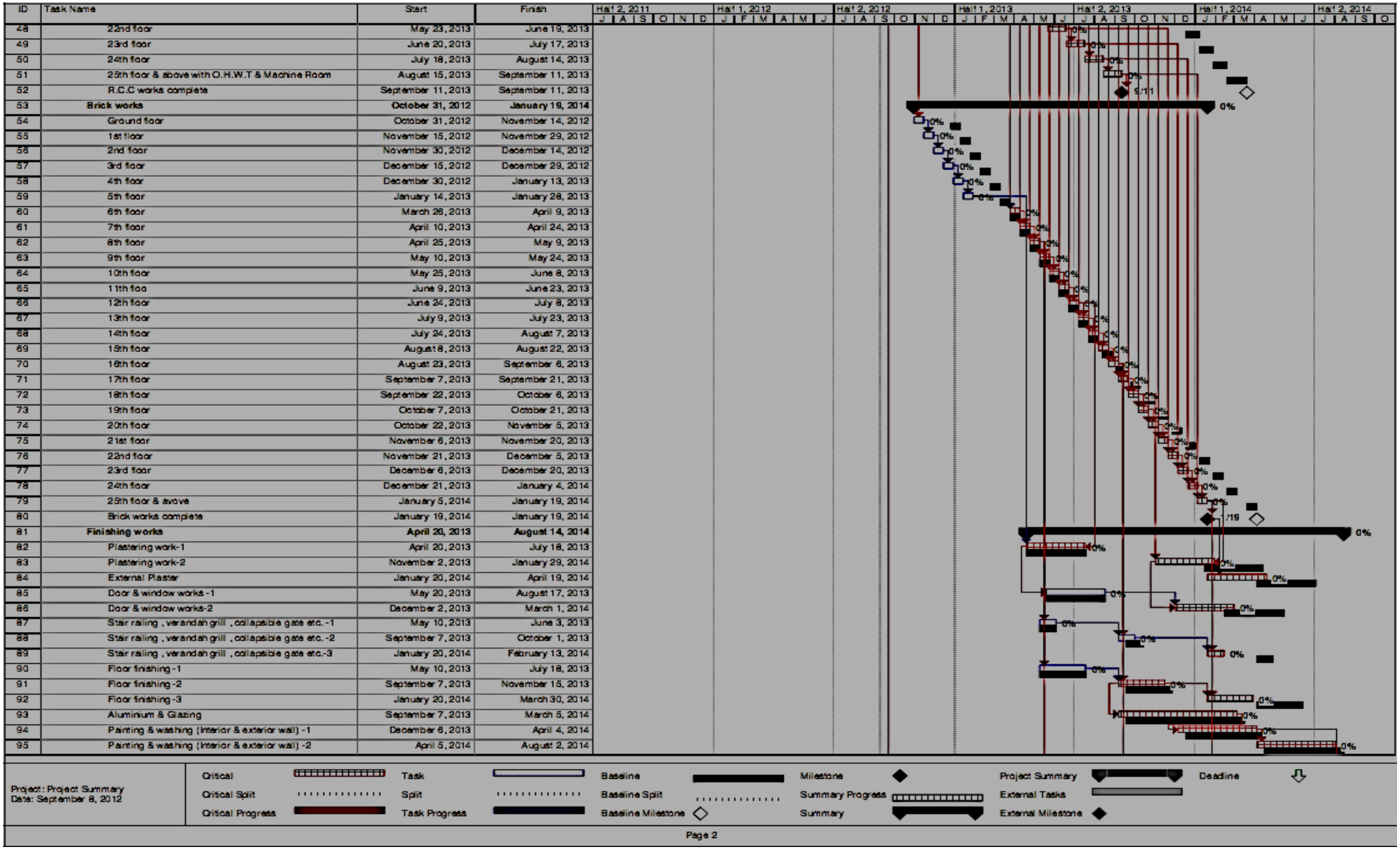
The figure shows that due to overlapping of RCC works, the total RCC works gets completed ahead of schedule. For that, other downstream tasks such as Brick works, Finishing works, Sanitary& Gas works & Electrical works are completed within schedule date

| ID | Task Name | Start | Finish |
|---|---|---|---|
| 0 | **Project Summary** | **August 24, 2011** | **August 22, 2014** |
| 1 | **Preliminaries** | **August 24, 2011** | **September 13, 2011** |
| 2 | Site Preparation in/c. leveling & dressing. | August 24, 2011 | August 29, 2011 |
| 3 | Eid-ul-Fitre holiday | August 30, 2011 | September 8, 2011 |
| 4 | Mobilization for Equipment & Personnel | September 4, 2011 | September 13, 2011 |
| 5 | Preliminaries work complete | August 24, 2011 | August 24, 2011 |
| 6 | **M.S. Reinforcement work.** | **September 13, 2011** | **April 16, 2013** |
| 7 | Reinforcement work for foundation & superstructure | September 13, 2011 | September 4, 2012 |
| 8 | Reinforcement work superstructure | September 13, 2011 | April 16, 2013 |
| 9 | M.S. Reinforcement work complete | September 4, 2012 | September 4, 2012 |
| 10 | **Sub-structure Works** | **September 13, 2011** | **September 4, 2012** |
| 11 | Providing layout | September 13, 2011 | September 14, 2011 |
| 12 | Piling work including tie beam | September 15, 2011 | November 23, 2011 |
| 13 | Earth excavation upto 11'-0" depth | November 24, 2011 | December 14, 2011 |
| 14 | Bracing work. | December 15, 2011 | January 13, 2012 |
| 15 | Earth work below 11'-0" depth | January 14, 2012 | February 27, 2012 |
| 16 | Sand filling | February 28, 2012 | March 8, 2012 |
| 17 | One layer B.F.S | March 9, 2012 | March 13, 2012 |
| 18 | R.C.C Works in sub-structure - Mat/Raft Foundation | March 14, 2012 | April 27, 2012 |
| 19 | R.C.C Works in sub-structure - Basement - 3 | April 28, 2012 | June 6, 2012 |
| 20 | R.C.C Works in sub-structure - Basement - 2 | June 7, 2012 | July 11, 2012 |
| 21 | R.C.C Works in sub-structure - Basement - 1 | July 12, 2012 | August 15, 2012 |
| 22 | Brick works | August 16, 2012 | September 4, 2012 |
| 23 | Sub-structure works complete | September 4, 2012 | September 4, 2012 |
| 24 | **Super-structure works** | **August 16, 2012** | **August 22, 2014** |
| 25 | **R.C.C works** | **August 16, 2012** | **September 11, 2013** |
| 26 | Ground floor | August 16, 2012 | September 14, 2012 |
| 27 | 1st floor | August 28, 2012 | September 26, 2012 |
| 28 | 2nd floor | September 9, 2012 | October 8, 2012 |
| 29 | 3rd floor | September 21, 2012 | October 18, 2012 |
| 30 | 4th floor | October 3, 2012 | October 30, 2012 |
| 31 | 5th floor | October 15, 2012 | November 11, 2012 |
| 32 | 6th floor | October 27, 2012 | November 23, 2012 |
| 33 | 7th floor | November 8, 2012 | December 5, 2012 |
| 34 | 8th floor | November 20, 2012 | December 17, 2012 |
| 35 | 9th floor | December 2, 2012 | December 29, 2012 |
| 36 | 10th floor | December 14, 2012 | January 10, 2013 |
| 37 | 11th floo | December 26, 2012 | January 22, 2013 |
| 38 | 12th floor | January 7, 2013 | February 3, 2013 |
| 39 | 13th floor | January 19, 2013 | February 15, 2013 |
| 40 | 14th floor | January 31, 2013 | February 27, 2013 |
| 41 | 15th floor | February 12, 2013 | March 11, 2013 |
| 42 | 16th floor | February 24, 2013 | March 23, 2013 |
| 43 | 17th floor | March 8, 2013 | April 4, 2013 |
| 44 | 18th floor | March 20, 2013 | April 16, 2013 |
| 45 | 19th floor | April 1, 2013 | April 28, 2013 |
| 46 | 20th floor | April 13, 2013 | May 10, 2013 |
| 47 | 21st floor | April 25, 2013 | May 22, 2013 |

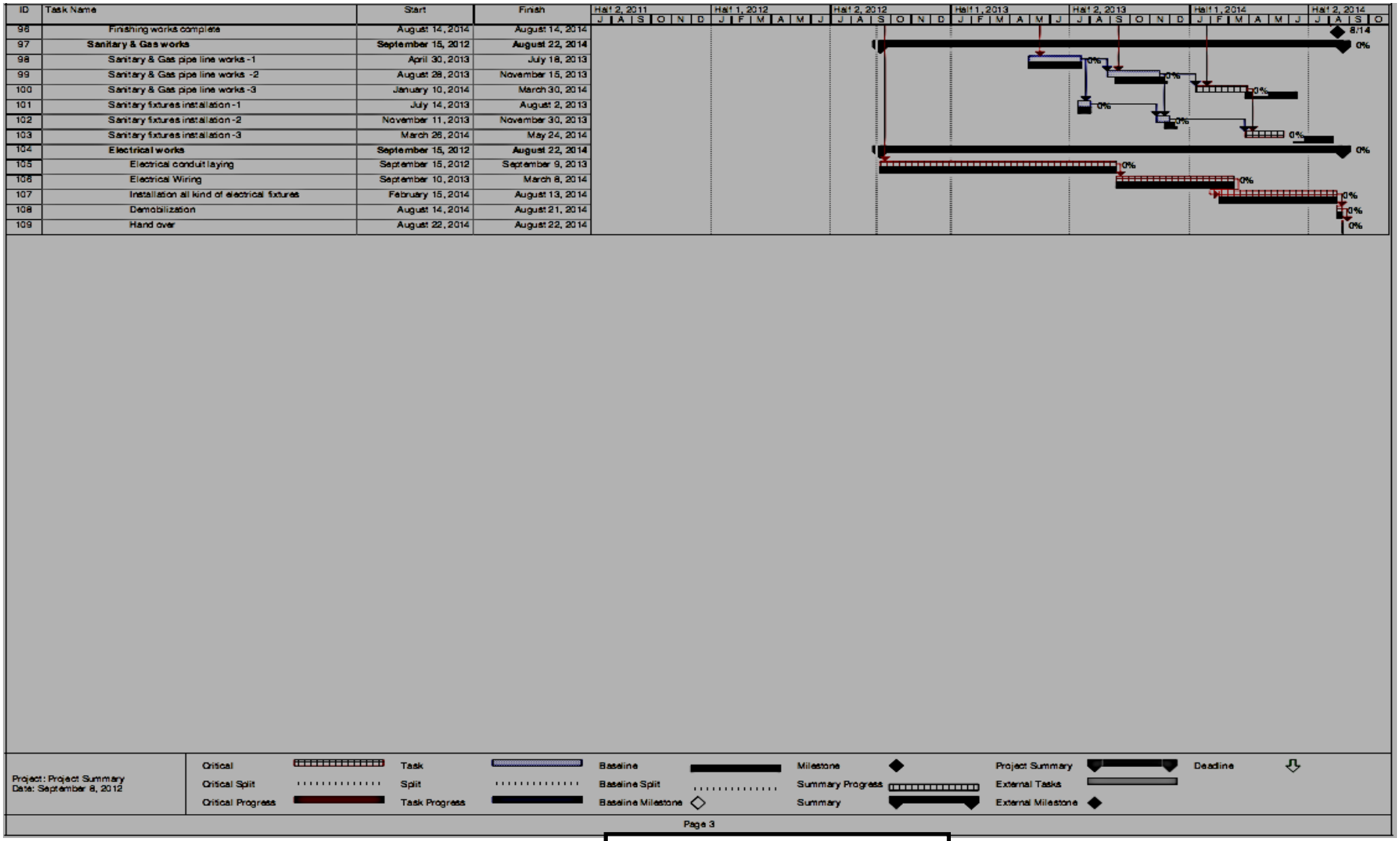



Project: Project Summary
Date: September 8, 2012

Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Project Summary
External Tasks
External Milestone
Deadline



| ID | Task Name | Start | Finish |
|---|---|---|---|
| 48 | 22nd floor | May 23, 2013 | June 19, 2013 |
| 49 | 23rd floor | June 20, 2013 | July 17, 2013 |
| 50 | 24th floor | July 18, 2013 | August 14, 2013 |
| 51 | 25th floor & above with O.H.W.T & Machine Room | August 15, 2013 | September 11, 2013 |
| 52 | R.C.C works complete | September 11, 2013 | September 11, 2013 |
| 53 | **Brick works** | **October 31, 2012** | **January 19, 2014** |
| 54 | Ground floor | October 31, 2012 | November 14, 2012 |
| 55 | 1st floor | November 15, 2012 | November 29, 2012 |
| 56 | 2nd floor | November 30, 2012 | December 14, 2012 |
| 57 | 3rd floor | December 15, 2012 | December 29, 2012 |
| 58 | 4th floor | December 30, 2012 | January 13, 2013 |
| 59 | 5th floor | January 14, 2013 | January 28, 2013 |
| 60 | 6th floor | March 28, 2013 | April 9, 2013 |
| 61 | 7th floor | April 10, 2013 | April 24, 2013 |
| 62 | 8th floor | April 25, 2013 | May 9, 2013 |
| 63 | 9th floor | May 10, 2013 | May 24, 2013 |
| 64 | 10th floor | May 25, 2013 | June 8, 2013 |
| 65 | 11th floo | June 9, 2013 | June 23, 2013 |
| 66 | 12th floor | June 24, 2013 | July 8, 2013 |
| 67 | 13th floor | July 9, 2013 | July 23, 2013 |
| 68 | 14th floor | July 24, 2013 | August 7, 2013 |
| 69 | 15th floor | August 8, 2013 | August 22, 2013 |
| 70 | 16th floor | August 23, 2013 | September 6, 2013 |
| 71 | 17th floor | September 7, 2013 | September 21, 2013 |
| 72 | 18th floor | September 22, 2013 | October 6, 2013 |
| 73 | 19th floor | October 7, 2013 | October 21, 2013 |
| 74 | 20th floor | October 22, 2013 | November 5, 2013 |
| 75 | 21st floor | November 6, 2013 | November 20, 2013 |
| 76 | 22nd floor | November 21, 2013 | December 5, 2013 |
| 77 | 23rd floor | December 6, 2013 | December 20, 2013 |
| 78 | 24th floor | December 21, 2013 | January 4, 2014 |
| 79 | 25th floor & avove | January 5, 2014 | January 19, 2014 |
| 80 | Brick works complete | January 19, 2014 | January 19, 2014 |
| 81 | **Finishing works** | **April 20, 2013** | **August 14, 2014** |
| 82 | Plastering work-1 | April 20, 2013 | July 18, 2013 |
| 83 | Plastering work-2 | November 2, 2013 | January 29, 2014 |
| 84 | External Plaster | January 20, 2014 | April 19, 2014 |
| 85 | Door & window works -1 | May 20, 2013 | August 17, 2013 |
| 86 | Door & window works-2 | December 2, 2013 | March 1, 2014 |
| 87 | Stair railing , verandah grill , collapsible gate etc.-1 | May 10, 2013 | June 3, 2013 |
| 88 | Stair railing , verandah grill , collapsible gate etc.-2 | September 7, 2013 | October 1, 2013 |
| 89 | Stair railing , verandah grill , collapsible gate etc.-3 | January 20, 2014 | February 13, 2014 |
| 90 | Floor finishing -1 | May 10, 2013 | July 18, 2013 |
| 91 | Floor finishing -2 | September 7, 2013 | November 15, 2013 |
| 92 | Floor finishing -3 | January 20, 2014 | March 30, 2014 |
| 93 | Aluminium & Glazing | September 7, 2013 | March 5, 2014 |
| 94 | Painting & washing (Interior & exterior wall) -1 | December 6, 2013 | April 4, 2014 |
| 95 | Painting & washing (Interior & exterior wall) -2 | April 5, 2014 | August 2, 2014 |



| ID | Task Name | Start | Finish |
|---|---|---|---|
| 96 | Finishing works complete | August 14, 2014 | August 14, 2014 |
| 97 | **Sanitary & Gas works** | **September 15, 2012** | **August 22, 2014** |
| 98 | Sanitary & Gas pipe line works -1 | April 30, 2013 | July 18, 2013 |
| 99 | Sanitary & Gas pipe line works -2 | August 28, 2013 | November 15, 2013 |
| 100 | Sanitary & Gas pipe line works -3 | January 10, 2014 | March 30, 2014 |
| 101 | Sanitary fixtures installation -1 | July 14, 2013 | August 2, 2013 |
| 102 | Sanitary fixtures installation -2 | November 11, 2013 | November 30, 2013 |
| 103 | Sanitary fixtures installation -3 | March 26, 2014 | May 24, 2014 |
| 104 | **Electrical works** | **September 15, 2012** | **August 22, 2014** |
| 105 | Electrical conduit laying | September 15, 2012 | September 9, 2013 |
| 106 | Electrical Wiring | September 10, 2013 | March 8, 2014 |
| 107 | Installation all kind of electrical fixtures | February 15, 2014 | August 13, 2014 |
| 108 | Demobilization | August 14, 2014 | August 21, 2014 |
| 109 | Hand over | August 22, 2014 | August 22, 2014 |

### 4.5.3 Scenario 3

In Bangladesh, change in order is one of the major causes to delay projects. In scenario 3, there are multiple problems that are taken into consideration which might occur simultaneously. Here the task 11 named "Providing layout" is delayed by 28 days. Most likely, cause of this delay is owner's decision change, for that change in layout plans, sometimes delays are obvious. If there is major change in orders sometimes layout plan needs to be completely checked.

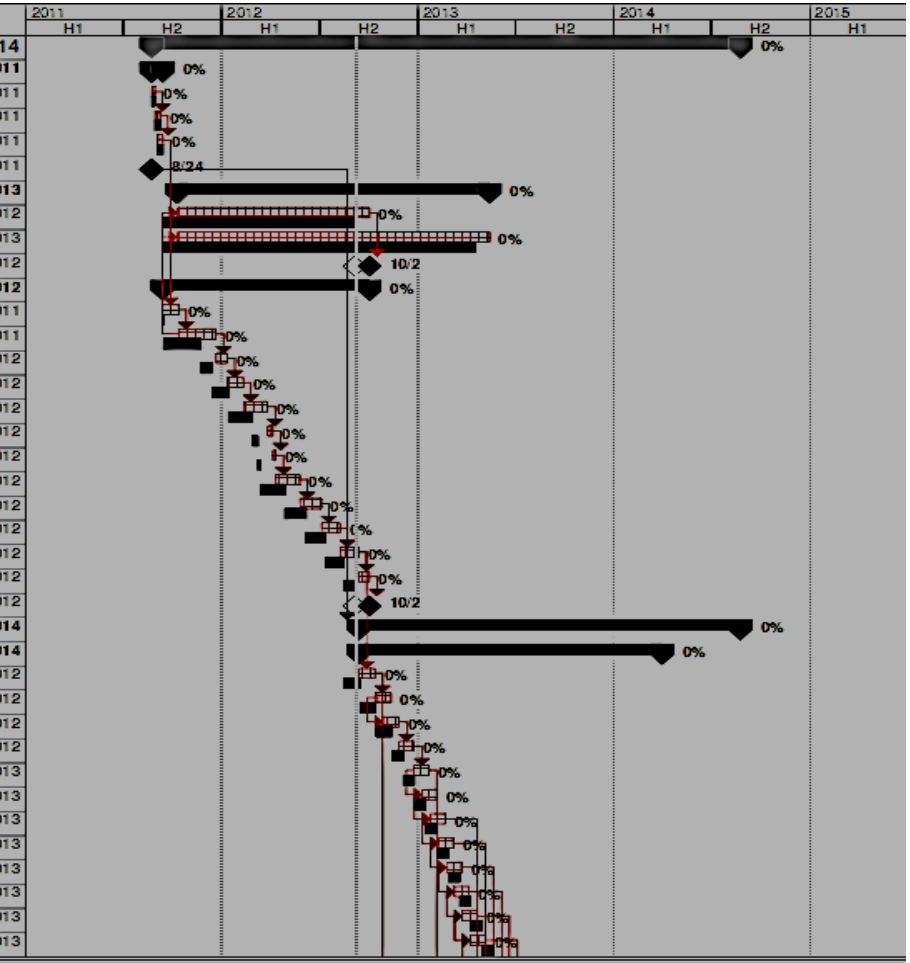
Another specialty of scenario 3 is problem of scenario 2 that is taken into consideration simultaneously. For that total project might get delayed for 167 days.

To resolve that delay problem, the RCC work of super structure is overlapped by 15days with start-start relation. On the other hand, Painting & washing (Interior & exterior wall) -1, Painting & washing (Interior & exterior wall) -2, Electrical Wiring, Installation of all kind of electrical fixtures are squeezed by 4, 3, 20, 15 days respectively.

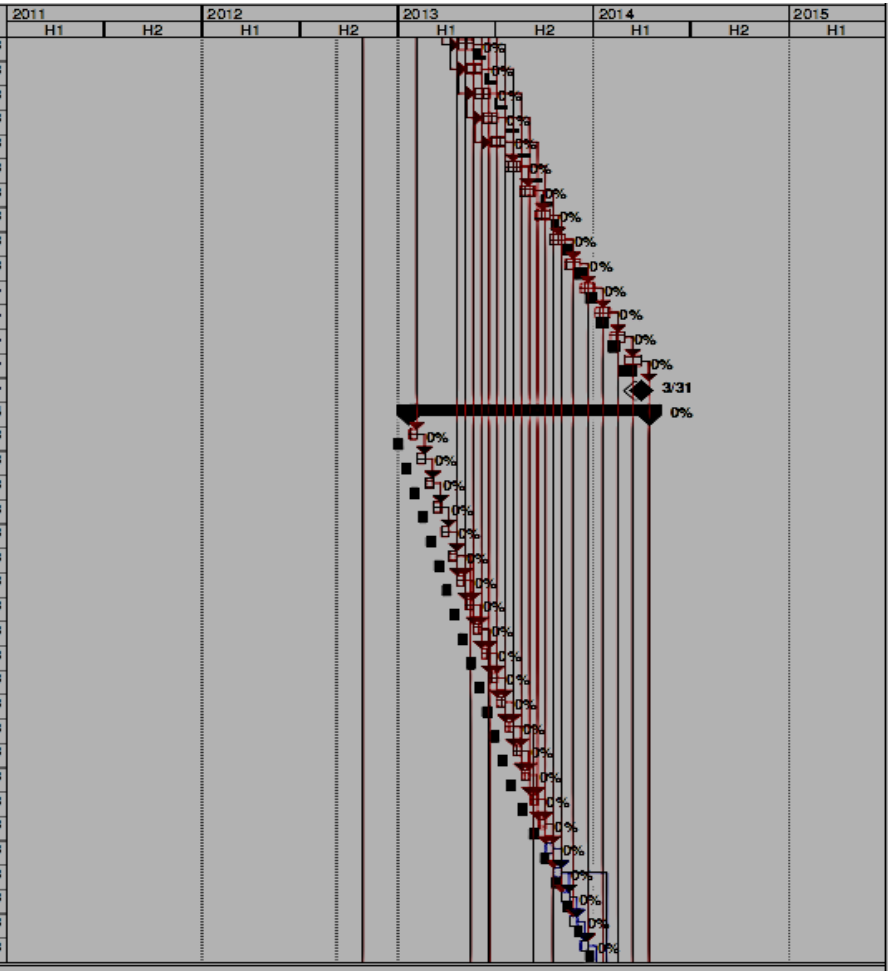
Base line comparison is given in fig 4.7.

The noticeable fact from the figure is that due to delay providing layout, the successor activities such as M.S. Reinforcement work get delayed. For that, all project activities are affected like a chain reaction. On the other hand, the duration of RCC works increases resulting increase of project duration. When the RCC works of each floor are overlapped, then the total task is finished within schedule time & its direct successor Brick works also get finished in time. But other activities such as Finishing works, Sanitary & Gas works, Electrical works are behind the schedule. When they are squeezed using more resources than total project's duration again becomes 1095 days.

| ID | Task Name | Start | Finish |
|---|---|---|---|
| 0 | **Project Summary** | **August 24, 2011** | **August 25, 2014** |
| 1 | **Preliminaries** | **August 24, 2011** | **September 13, 2011** |
| 2 | Site Preparation inlc. leveling & dressing. | August 24, 2011 | August 29, 2011 |
| 3 | Eid-ul-Fitre holiday | August 30, 2011 | September 8, 2011 |
| 4 | Mobilization for Equipment & Personnel | September 4, 2011 | September 13, 2011 |
| 5 | Preliminaries work complete | August 24, 2011 | August 24, 2011 |
| 6 | **M.S. Reinforcement work.** | **October 11, 2011** | **May 14, 2013** |
| 7 | Reinforcement work for foundation & superstructure | October 11, 2011 | October 2, 2012 |
| 8 | Reinforcement work superstructure | October 11, 2011 | May 14, 2013 |
| 9 | M.S. Reinforcement work complete | October 2, 2012 | October 2, 2012 |
| 10 | **Sub-structure Works** | **September 13, 2011** | **October 2, 2012** |
| 11 | Providing layout | September 13, 2011 | October 12, 2011 |
| 12 | Piling work including tie beam | October 13, 2011 | December 21, 2011 |
| 13 | Earth excavation upto 11'-0" depth | December 22, 2011 | January 11, 2012 |
| 14 | Bracing work. | January 12, 2012 | February 10, 2012 |
| 15 | Earth work below 11'-0" depth | February 11, 2012 | March 26, 2012 |
| 16 | Sand filling | March 27, 2012 | April 5, 2012 |
| 17 | One layer B.F.S | April 6, 2012 | April 10, 2012 |
| 18 | R.C.C Works in sub-structure - Mat/Raft Foundation | April 11, 2012 | May 25, 2012 |
| 19 | R.C.C Works in sub-structure - Basement - 3 | May 26, 2012 | July 4, 2012 |
| 20 | R.C.C Works in sub-structure - Basement - 2 | July 5, 2012 | August 8, 2012 |
| 21 | R.C.C Works in sub-structure - Basement - 1 | August 9, 2012 | September 12, 2012 |
| 22 | Brick works | September 13, 2012 | October 2, 2012 |
| 23 | Sub-structure works complete | October 2, 2012 | October 2, 2012 |
| 24 | **Super-structure works** | **September 13, 2012** | **August 25, 2014** |
| 25 | **R.C.C works** | **September 13, 2012** | **March 31, 2014** |
| 26 | Ground floor | September 13, 2012 | October 12, 2012 |
| 27 | 1st floor | October 13, 2012 | November 11, 2012 |
| 28 | 2nd floor | October 28, 2012 | November 26, 2012 |
| 29 | 3rd floor | November 27, 2012 | December 24, 2012 |
| 30 | 4th floor | December 25, 2012 | January 21, 2013 |
| 31 | 5th floor | January 9, 2013 | February 5, 2013 |
| 32 | 6th floor | January 24, 2013 | February 20, 2013 |
| 33 | 7th floor | February 8, 2013 | March 7, 2013 |
| 34 | 8th floor | February 23, 2013 | March 22, 2013 |
| 35 | 9th floor | March 10, 2013 | April 6, 2013 |
| 36 | 10th floor | March 25, 2013 | April 21, 2013 |
| 37 | 11th floo | April 9, 2013 | May 6, 2013 |



| ID | Task Name | Start | Finish |
|---|---|---|---|
| 38 | 12th floor | April 24, 2013 | May 21, 2013 |
| 39 | 13th floor | May 9, 2013 | June 5, 2013 |
| 40 | 14th floor | May 24, 2013 | June 20, 2013 |
| 41 | 15th floor | June 8, 2013 | July 5, 2013 |
| 42 | 16th floor | June 23, 2013 | July 20, 2013 |
| 43 | 17th floor | July 21, 2013 | August 17, 2013 |
| 44 | 18th floor | August 18, 2013 | September 14, 2013 |
| 45 | 19th floor | September 15, 2013 | October 12, 2013 |
| 46 | 20th floor | October 13, 2013 | November 9, 2013 |
| 47 | 21st floor | November 10, 2013 | December 7, 2013 |
| 48 | 22nd floor | December 8, 2013 | January 4, 2014 |
| 49 | 23rd floor | January 5, 2014 | February 1, 2014 |
| 50 | 24th floor | February 2, 2014 | March 1, 2014 |
| 51 | 25th floor & above with O.H.W.T & Machine Room | March 2, 2014 | March 31, 2014 |
| 52 | R.C.C works complete | March 31, 2014 | March 31, 2014 |
| 53 | **Brick works** | **January 22, 2013** | **April 15, 2014** |
| 54 | Ground floor | January 22, 2013 | February 5, 2013 |
| 55 | 1st floor | February 6, 2013 | February 20, 2013 |
| 56 | 2nd floor | February 21, 2013 | March 7, 2013 |
| 57 | 3rd floor | March 8, 2013 | March 22, 2013 |
| 58 | 4th floor | March 23, 2013 | April 6, 2013 |
| 59 | 5th floor | April 7, 2013 | April 21, 2013 |
| 60 | 6th floor | April 22, 2013 | May 6, 2013 |
| 61 | 7th floor | May 7, 2013 | May 21, 2013 |
| 62 | 8th floor | May 22, 2013 | June 5, 2013 |
| 63 | 9th floor | June 6, 2013 | June 20, 2013 |
| 64 | 10th floor | June 21, 2013 | July 5, 2013 |
| 65 | 11th floo | July 6, 2013 | July 20, 2013 |
| 66 | 12th floor | July 21, 2013 | August 4, 2013 |
| 67 | 13th floor | August 5, 2013 | August 19, 2013 |
| 68 | 14th floor | August 20, 2013 | September 3, 2013 |
| 69 | 15th floor | September 4, 2013 | September 18, 2013 |
| 70 | 16th floor | September 19, 2013 | October 3, 2013 |
| 71 | 17th floor | October 4, 2013 | October 18, 2013 |
| 72 | 18th floor | October 19, 2013 | November 2, 2013 |
| 73 | 19th floor | November 3, 2013 | November 17, 2013 |
| 74 | 20th floor | November 18, 2013 | December 2, 2013 |
| 75 | 21st floor | December 8, 2013 | December 22, 2013 |

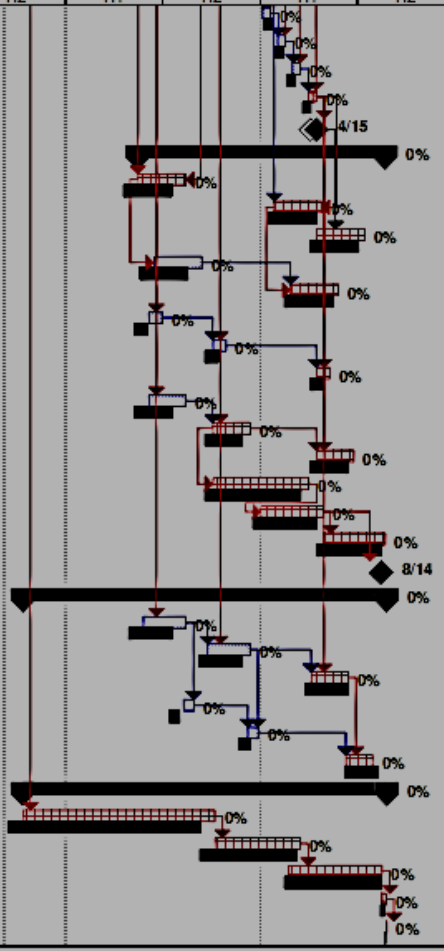



Project: Project Summary
Date: September 8, 2012

Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Project Summary
External Tasks
External Milestone
Deadline

Page 2

| ID | Task Name | Start | Finish |
|---|---|---|---|
| 76 | 22nd floor | January 5, 2014 | January 19, 2014 |
| 77 | 23rd floor | February 2, 2014 | February 16, 2014 |
| 78 | 24th floor | March 2, 2014 | March 16, 2014 |
| 79 | 25th floor & avove | April 1, 2014 | April 15, 2014 |
| 80 | Brick works complete | April 15, 2014 | April 15, 2014 |
| 81 | **Finishing works** | **May 17, 2013** | **August 22, 2014** |
| 82 | Plastering work-1 | May 17, 2013 | August 14, 2013 |
| 83 | Plastering work-2 | January 27, 2014 | April 25, 2014 |
| 84 | External Plaster | April 16, 2014 | July 14, 2014 |
| 85 | Door & window works -1 | June 16, 2013 | September 13, 2013 |
| 86 | Door & window works-2 | February 26, 2014 | May 26, 2014 |
| 87 | Stair railing , verandah grill , collapsible gate etc. -1 | June 6, 2013 | June 30, 2013 |
| 88 | Stair railing , verandah grill , collapsible gate etc. -2 | October 4, 2013 | October 28, 2013 |
| 89 | Stair railing , verandah grill , collapsible gate etc.-3 | April 16, 2014 | May 10, 2014 |
| 90 | Floor finishing -1 | June 6, 2013 | August 14, 2013 |
| 91 | Floor finishing -2 | October 4, 2013 | December 12, 2013 |
| 92 | Floor finishing -3 | April 16, 2014 | June 24, 2014 |
| 93 | Aluminium & Glazing | October 4, 2013 | April 1, 2014 |
| 94 | Painting & washing (Interior & exterior wall) -1 | January 2, 2014 | April 27, 2014 |
| 95 | Painting & washing (Interior & exterior wall) -2 | April 28, 2014 | August 22, 2014 |
| 96 | Finishing works complete | August 14, 2014 | August 14, 2014 |
| 97 | **Sanitary & Gas works** | **October 13, 2012** | **August 25, 2014** |
| 98 | Sanitary & Gas pipe line works -1 | May 27, 2013 | August 14, 2013 |
| 99 | Sanitary & Gas pipe line works -2 | September 24, 2013 | December 12, 2013 |
| 100 | Sanitary & Gas pipe line works -3 | April 6, 2014 | June 14, 2014 |
| 101 | Sanitary fixtures installation -1 | August 10, 2013 | August 29, 2013 |
| 102 | Sanitary fixtures installation -2 | December 8, 2013 | December 27, 2013 |
| 103 | Sanitary fixtures installation -3 | June 10, 2014 | July 29, 2014 |
| 104 | **Electrical works** | **October 13, 2012** | **August 25, 2014** |
| 105 | Electrical conduit laying | October 13, 2012 | October 7, 2013 |
| 106 | Electrical Wiring | October 8, 2013 | March 16, 2014 |
| 107 | Installation all kind of electrical fixtures | February 23, 2014 | August 16, 2014 |
| 108 | Demobilization | August 17, 2014 | August 24, 2014 |
| 109 | Hand over | August 25, 2014 | August 25, 2014 |




Project: Project Summary
Date: September 8, 2012

Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Baseline
Baseline Split
Baseline Milestone
Project Summary
External Tasks
External Milestone
Deadline

## 4.6 CONCLUSION

From the analysis, it can be seen that by squeezing and overlapping a delayed project can be finished within time limit. Proper contingency planning will ensure proper allocation of resources.

# CHAPTER FIVE

# CONCLUSION

## 5.1 GENERAL

This section includes the total summery of the study, effectiveness & a brief recommendation how this study can be enhanced.

## 5.2 CONTINGENCY PLANNING TO OVERCOME PROJECT DELAY

Most of the construction projects suffer due to lack of proper planning. This study is done to increase the effectiveness of the project planning. The objectives of the study were to examine the current practice of project planning for construction in Bangladesh, to find out the different constrains / surprise situation that delays the project's completion time, to propose contingency planning in order to mitigate / minimize the delay in project completion.

Four construction sites named Shipping Tower construction project, Police head Quarter construction project, Airport to Mirpur flyover & Overpass at Bonani Rail crossing construction project, Kuril Flyover construction project. In those construction sites it is noticed that they make project plan but they cannot follow the schedule due to many constrains and surprises situation. Most of the projects cannot carry out their activity with their proposed timeline; on the other hand these projects cannot recover the delay because no contingency plan is adopted. So project duration increases.

However, every construction project is unique; so there might be unique constrains related to the construction project. But in general there are certain constrains that are common to

the most of the construction project. The constrains/ surprise situations are identified and ranked according to their intensity & importance in Chapter 4. Afterwards time schedule of illustrative case example of 30 activities and a real life project named Construction of 25 story building (including 3 basements) at Motijhil is developed by Microsoft Project. Then those time schedules is analyzed for forthcoming constrains / scenarios. These scenarios are created based on interview with the project manager & assuming several unforeseen constrains. In the analysis amount of delay and proposals for mitigation to overcome the delay is included.

From the scenario analysis of the study it has been found that proper selection of task for overlapping or squeezing is important. The project needs to be properly analyzed to identify which task can be squeezed or overlapped. Again overlapping or squeezing time selection also important, after analyzing the task with proper judgment squeezing or overlapping time needs to be selected, If key tasks are selected and squeezed or overlapped according to need that will result in a finished project within scheduled time.

## 5.3 EFFECTIVENESS OF THE STUDY

In Bangladesh, completions of most of the projects are delayed for various reasons. Before starting any construction project, if proper planning and contingency planning are done, chance of delay will be minimized significantly. Thus, very seldom a project will come to a stagnant condition. The study mainly focuses on selecting which tasks can be squeezed or overlapped to overcome the delay in a construction process for different kind of constrains scenario. Contingency planning with more detailed way will also ensure proper utilization of resources. With the contingency planning the

trend of following time schedule will be more popular, because with this kind of study a delayed project can be turned back on its track. A contingency is the planned allotment of time and cost or other resources for unforeseeable elements with a project, Because allotment of resource are not that easy within a short notice and without proper contingency planning there will be some risk for overlapping task (as many jobs are done in parallel rather sequentially) and lot cash involvement for squeezing(extra resources are required). Hence, a proper contingency plan will lead to scheduling of activities and the resources required by those activities, so that predetermined constraints of resource availability and/or project time are not exceeded, as far as the definition of resource allocation is concerned. As a result, in different constrains scenario unavailability of resource, misallocation of resources will not occur. This will ensure smooth working flow during implementation phase of the project.

## 5.4 RECOMMENDATION

This study mainly focuses on how delay of a construction project can be mitigated. But this study does not involve cost analysis of contingency planning; a further study on cost analysis would help to increase the precision of the budget. Because when a task is squeezed or overlapped it requires increased amount of resources that will increase the cost of the project as well. So, a cost analysis of contingency planning is required to ensure the proper prediction of budget. On the other hand, extensive survey work on construction project can be done to identify more construction constrains, that will increase the accuracy of the constrain ranking.

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