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Faculty of Engineering and Information Technology

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كلية الهندسة و تكنولوجيا المعلومات

Graduation Project Report II

Quantity Survey and Cost Estimate For Tulkarem Health Directorate

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بسم الله الرحمن الرحيم

كل الشكر لله سبحانه وتعالى الذي ساعدنا على إنجاز هذا المشروع وأعطانا

القوة لتجاوز الصعوبات التي واجهتنا.

نود أن نتقدم بجزيل الشكر لمعلمينا الأعزاء في قسم الهندسة المدنية الذين قدموا لنا مراجع قيمة خلال المشروع ، و نقدم خالص امتناننا لمشرفتنا السيدة ريما نصار لدعمها الثابت وإرشادها وتعليقاتها واقتراحاتها البناءة خلال هذا المشروع. نود أيضًا أن نشكر والدينا الذين قدموا لنا دائمًا الدعم الكامل وكذلك أصدقائنا الذين وقفوا إلى جانبنا.

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ABSTRACT

Every engineer should have a very good experience in engineering management because it has essential part in planning and running every project, also it turns their design ideas into financially viable projects that create shareholder value for the companies they work for and it teaches them to design for commercialization and profitability. Project management is important because it ensures what is being delivered, is right, and will deliver real value against the business opportunity.

In this report we will talk about the construction projects, the constrains that occurred, the relationship between the parties of the project (owner, consultant, and contractor) in addition to the types of the delivery systems and contracts, and about the main issues especially focusing on time and cost issues.

In our graduation project we will recalculate the quantities and costs of the Tulkarem health directorate building project and compare them with the actual quantities, also to estimate the duration for this project and compare it with the actual duration. Check if there is a delay and cost overrun.

This project is a Tulkarem health directorate building, the donor of this project is Italian development cooperation. It is about 2002.9 square meter total area, which consist of the ground floor and three floors, area of ground floor 483.9 square meter, first floor is 493 square meter, second and the third floor are 487 square meter and the staircase is 52 square meter.

We will be using in this project mainly Revit software to calculate quantities, estimate cost, and Primavera p6 will be used for scheduling project.

The main objectives of this project are:

1- Reviewing the main construction design plans and diagrams
2- Calculating quantities, costs and scheduling project time
3- Comparing the calculated time and cost with the actual ones from the contractor of the project.
4- Investigate the reasons for delay and cost overrun

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1. INTRODUCTION

One of the most important foundations of the construction organization is the strategy, as the strategy and the future vision are among the most important things to achieve the goals of this organization. As stakeholders meet their personal needs by putting their money into the project, the project goals are based on their goals, money, and the project's limitations. There may be a conflict in the needs and desires of stakeholders due to the presence of specific resources in the surrounding environment.

There are many stages that are summarized in defining the project, in terms of setting goals, making designs and implementing them on the ground, so that they are compatible with the goals.

A project is a set of information, activities, and objectives through which a product or service is created for a public or private interest. It is a temporary endeavor to reach this product or service, as projects are often constrained by time, resources and current circumstances.

Project management is based on planning, implementing, and measuring progress and performance. By defining project requirements and objectives and taking the needs and expectations of the key stakeholders into consideration.

1.1 Construction Industry

1.1.1 Definition of Construction Industry

> Construction industry. Sector of national economy engaged in preparation of land and construction, alteration, and repair of buildings, structures, and other real property. (Dang & Low, 2015)

1.1.2 Types of Construction Industry

The construction industry is divided into two parts: the residential sector and the non-residential sector, as the non-residential sector consists of three sub-sectors (industrial, commercial and engineering). There are three types of construction: buildings, infrastructure and industrial.

1.1.3 Importance of Construction Industry

One of the most important factors contributing to increasing the economic growth of society is construction, through the development of infrastructure related to the health, transport and education sectors, the construction of buildings segment includes contractors, usually called general contractors, who build residential, industrial, commercial, and other buildings. ... They obtain orders for their work from general contractors, architects, or property owners.

1.2 Project description

We will address the building of the Health Directorate in Tulkarm, where a calculation of specifications and quantities for the building will be made, and a cost calculation will be made for all parts and activities of the building and the final cost will be calculated.

1.3 Objectives

The objectives of this project are:

1. Identifying all types of project plans and how to read them.

2. Work on calculating specifications and quantities of raw materials needed to build the project.

3. Work on calculating the project costs of materials, machines, workers, contracts, etc.

4. Coming up with results similar to those of the engineers supervising the project.

1.4 Significant of study

Estimation helps in determining the approximate cost of works before they are carried out; thus, we can see if the work can be completed according to certain specifications within a specified budget.

2 LITERATURE REVIEW

2.1 Project

The project is defined as “A temporary endeavor undertaken to create a unique product or service”.

2.2 Project Management

The establishment of any construction project needs a management and mastermind, as the establishment of the project without management will lead to the failure of this project.

2.2.1 Definition

Project management can be defined as the sum of all activities such as Planning, organizing, implementing and controlling a project in order to meet the client’s expectation from start to finish within the planned period, budget and quality.

2.2.2 Project management functions

The planning stage is one of the most important stages of project management, whereby the definition of what is the project that must be implemented, and through which our objectives are determined through this project, the development of programs of activities, time scheduling, forecasting the costs of each project activity, setting the time period for the activities, and finally predicting what will be The project must be completed after the completion of its construction period.

The stage of organization is the second stage of the project management, it reflects how the organization tries to create the plan and arrange the activities according to its reliability, where the tasks are assigned and grouped on Departments, allocate resources to the project.

The implementation stage is the phase of implementing the planned plans, specifications and arrangement of activities.

Finally, the control stage, as it is one of the important matters in project management and monitoring of implementation work according to what was planned and according to the specifications and time given to each of the project activities.

Therefore, we can say that project management is the head of the project, and without it, the project is not suitable.

2.2.3 Project Management Phases

1. Initiation phase

Project initiation is the first stage of a project's life cycle. A project is formally launched here. It has a name and a wide strategy. The project's constraints, hazards, and stakeholders are all recognized, as well as the project's goals. Shareholders must now determine whether or not to invest in the project.

Studies may be undertaken to determine the project's feasibility, depending on the project.

2. Planning phase

A roadmap that will guide teams from creating a project plan throughout the project's execution and closure phases is developed comprehensively during the planning stage. Deadlines must be set, and resources must be allotted. Breaking down tasks into smaller, manageable activities makes it easier to manage project risks, costs, quality, time, and so on.

At the same time, breaking tasks down into smaller parts will help everyone involved complete the project on schedule and on budget.

3. Design phase

Project design is an early phase of the project where a project's key features, structure, criteria for success, and major deliverables are all planned out. The aim is to develop one or more designs that can be used to achieve the desired project goals. Stakeholders can then choose the best design to use for the execution of the project. The project design phase might generate a variety of different outputs, including sketches, flowcharts, site trees, HTML screen designs, prototypes, photo impressions, and more.

4. Execution phase

During the project execution phase, the project plan is implemented. Teams will work on the deliverables at this time to ensure that the project satisfies the requirements.

Everyone normally comes for a meeting to mark the project's official start, where teams can get to know one another and discuss their roles in the project's success. Before the project plan is implemented, communication modes and project management tools are identified.

Furthermore, team members become familiar with the required status meetings and reports that will be held during this phase to collect project data. The project execution phase is an important part of the project life cycle since it determines whether or not everyone's efforts will be successful.

5. Closing phase

The project closure step of the project management life cycle is more complicated than simply delivering the output. During the project closing phase, project managers must record all deliverables, consolidate documentation in a centralized area, and hand over the project to the client or the team in charge of managing its operations.

Furthermore, teams gather together for a final meeting to review the lessons they've learned and to recognize each member's hard work.

2.3 Constrains

The triple constraints of project management (also known as the project management triangle or the iron triangle) are quality, cost, and time. You'll need to balance these three elements in every project, and doing so can be challenging because they all affect one another.

2.4 Parties

All building contractors and building industry participants (within the meaning of the Building Code) who execute work in relation to the Project are referred to as the Project Parties.

Project key participants consists of the following:

- The owner
- Architect/designer
- Contractor

2.5 Delivery System

What is meant by project delivery system?

Traditionally project delivery system is defined as the process by which a project is designed and constructed for an owner, but these days PDS covers financing, planning, design, construction, operation, management, and maintenance of the project which have been delved into in this chapter.

Types of Project Delivery Methods

1. Traditional

Also known as Design-Bid-Build, in this approach the owner hires a design professional who prepares a complete set of contract documents for the owner for a design fee.

The general contractor is totally responsible for delivering the completed project as spelled out in the contract documents, and he may subcontract out parts of the project, with each subcontractor reporting directly to the general contractor.

There is no direct, formal contact between the designer and the builder in this delivery technique. They only converse with each other through the owner.

There is two approaches in this method:

a) Design-Bid-Build with prime contractor
b) Design-Bid-Build with multiple primes/GC (separate contracting)

2. Design-Build

In this approach, a single organization is responsible for performing both design and construction, and parts of the design may be subcontracted to specialist consultants.

3. Professional Construction Management (PCM)

In this approach, the owner appoints construction management organization to manage and coordinate the design and construction phases of a project using a teamwork design approach.

4. BOT (Build Operate Transfer)

BOT is a system in which a private entity, usually a consortium is responsible for financing, construction, operation and maintenance of the facility for agreed duration known as Concession period and at the end of the period transfers the ownership of the facility to the government.

2.6 Contracts

What is a Contract?

A contract is an agreement that is executed between two or more parties that can include terms such as payments, marketing reporting requirements, proposals and procurement statement of work. A contract agreement also defines the roles and responsibilities that both parties share, and they have to abide by the terms and conditions mentioned in the contract agreement. If any of the parties mentioned in the contract agreement wants to make changes or add new clauses in the agreement, then it has to be done with the concern of the other party as well. If both parties agree then they can include these changes, which has to be written formally by the legal experts. A legal contract includes an offer, acceptance of that offer, consideration, legal capacity and legal purpose.

Types of construction contracts are determined by the ways in which the contractor is paid for the work carried out.

The types of construction contracts are

a) **Lump sum**

   It used when quantity and quality are known.

b) **Unit price**

   It used when quality is known but not quantity.

c) **Negotiated Cost-plus**

   It used when scope (plans & specs) cannot be defined before the construction starts

d) **Guaranteed maximum price (GMP)**

   In this type of contract the contractor agrees for a fixed fee and profit at a cost not to exceed pre-established maximum price.

2.7 Time Management

2.7.1 Time schedule

The contractor is asked to provide a timetable for different work items to ensure that he is able to complete the work within the time limits set in the contract. And the time schedule gives us the payments schedule. The contractor will submit a comprehensive Work Schedule within 28 days of the beginning of the job. And the work program includes (A Blinder, ERD Canetti, DE Lebow, JB Rudd - 1998):

Work plan, Time schedule for work items, Subcontracted work, Time schedule for tests and Resource profiles.

2.7.2 Planning and scheduling

Planning and scheduling are two terms that are often thought of as synonymous. However, they are not. Scheduling is just one part of the planning effort.

Scheduling is the determination of the timing and sequence of operations in the project and their assembly to give the overall completion time. As mentioned previously, scheduling focuses on one part of the planning effort (A Baldwin, D Bordoli - 2014)

Why schedule project?

1. To calculate the project completion date.

2. To calculate the start or end of a specific activity.

3. To expose and adjust conflicts between trades or subcontractors.

4. To predict and calculate the cash flow.

5. To evaluate the effects of changes.

6. To improve work efficiency.

7. To resolve delay claims.

8. To serve as an effective project control tool.

2.7.3 Duration

Forecasting construction duration in a project can be achieved by many means and depends on the stage of construction planning. Forecasting construction duration informs the project owner to allow the contractor to complete the work within given time. On the other hand, the contractor could prepare realistic and practical detailed schedule at the minimum costs within the limited time frame. (KK Chitkara - 1998)

2.7.3.1 Definitions

Construction duration can be defined as one or a combination of the following:

1) The construction duration arising from critical path in which duration for items of work or activity in sequence cannot be reduced further

2) Duration means the time required to complete a specified task or activity. And, construction duration is the time determined by the owner's needs to occupy, utilize, or rent the completed space of the project

3) Construction duration is a duration resulting from an examination of one or more methods of carrying out the works on the basis of minimum cost, it is usually estimated in the first instance for normal condition

4) Construction duration refers to a given time to execute and complete items of work using all project information and resources within an estimated or predicted cost

5) Construction time can be defined as the elapsed period from the commencement of site works to the completion time of building to the client. It is usually specified prior to the commencement of construction (SS Leu, AT Chen, CH Yang - International Journal of Project Management, 2001)

Construction duration is defined as the time frame given by the owner for the contractor to complete the project under normal work conditions, normal practice of construction, and based on the minimum costs. It starts when the contractor receives the instruction to proceed and ends at the completion of construction works on site. It also includes delays caused by unanticipated circumstances, e.g. alteration of works (changed conditions and change orders), extra works, and supply of materials, location, weather, and site work conditions. Major changes that after the scope of work significantly are not included. (EC Lim, J Alum - International journal of project management, 1995)

2.7.3.2 Factors Affecting Construction Duration

The following are some factors affecting construction duration and its estimate.

1. Size of project

Size of the project can be represented in terms of functional or floor area, i.e. in ft2, or m2. The larger the building size, the more complex the construction, thus needing longer duration to complete (F Jalaei, A Jrade - Sustainable Cities and Society, 2015)

2. Function

Function implies type of building and required engineering systems, e.g. plumbing, firefighting, and lighting it is an important facet in designing of construction project. Function of a building implies business target that the building serves. It can be considered as qualitative variables, e.g. office, retail, and other buildings.(GC Foliente - Forest Products Journal, 2000)

3. Height

Height of building, represented by number of floors (or storeys) affects the construction duration. The height of building indicates construction technique, major equipment used, and construction sequence. (E Allen, J Iano - 2019)

4. Complexity

Complexity implies unfamiliarity with work. The complexity of building impacts the form of construction, i.e. building frame, foundation, and systems. Complexity can be represented in form of construction equipment, method and sequence.(CW Johnson - Reliability Engineering and System Safety, 2006)

5. Quality

Quality can be classified by variables or attributes, i.e. appearance, strength, stability, materials used, performance finish. Appearance of the building, e.g. external facing is one aspect of quality. Considered number of major finishing works in duration forecasting instead of a defined quality index.(LF Chen - Omega, 2012)

6. Location

The location of the building has a significant effect on the construction duration (Chan and It reflects restrictions or easements that exist and availability of services, It effects supply of resources, e.g. materials, and equipment. Consequently, it also effects the use of major equipment, and productivity on site.(1995 - Taylor & Francis)

2.7.4 Productivity rate

Many terms are used to describe productivity in the construction industry: performance factor, production rate, unit person-hour (p-h) rate and others. Traditionally, productivity has been defined as the ratio of input/output, i.e., the ratio of the input of an associated resource (usually, but not necessarily, expressed in p-hs) to real output (in creating economic value). To restate this definition for use in the construction industry: labor productivity is the physical progress achieved per p-h, e.g., p-hs per linear meter of conduit laid or p-hs per cubic meter of concrete poured. The two most important measures of labor productivity are: (TD Oesterreich, F Teuteberg - Computers in industry, 2016)

• The effectiveness with which labor is used in the construction process.

• The relative efficiency of labor doing what it is required to do at a given time and place.

Examples of the first measure are the labor dollars required to produce a square meter or square foot of living area, or the labor cost of providing one bed in a hospital. Another example is the labor content required, per barrel of output, to build an oil refinery. In these cases, technological innovations or design improvements have the most significant impact because it is the effectiveness with which labor is used in the building process that is being measured.

Contractors and organized labor are, however, more interested in the second measure, the relative efficiency of labor. Examples include the number of square meters of formwork or linear meters of conduit that can be installed per p-h at a given time and place. Labor efficiency is the basis of most tender estimates, as well as the yardstick by which performance is measured and monitored. For example, it was reported that 837.4 p-hs were required to construct a house in 1930. By 1965, the requirement was reduced to 283.2 person-hours. The reduction in p-hs is equal to an impressive average annual growth rate of 3.2%. It is not surprising that some analysts have tried to explain this as the result of steadily improving labor efficiency. The real improvement, however, had little to do with improved efficiency but was due to such technological changes as improved construction excavating equipment and the introduction of drywall to replace wet plaster. When relative growth in labor productivity was equated with real improvement in labor efficiency, the construction industry was led to believe that no problem in declining productivity existed. Apparently lack of motivation is not seen as a problem, and the ever frequent financial losses were blamed either on poor estimating or on the impact of accelerated schedule performance. Construction supervisors eventually had to face up to reality and admit that labor efficiency has been steadily declining for some time. By accepting the reality and trying to understand both the magnitude of and the causes behind this decline, the construction industry is making strides toward improving productivity. (M Goldfield - 1989).

2.7.5 Critical path method (CPM):

The critical path method (CPM) keep the project on track by scheduling many things like it helps you to identify the activities that must be done on time in order to finish the whole project on time, shows you which one of the tasks you can delay and for how long without impacting the project schedule, you can calculate the minimum time to complete the project. The heart of the (CPM) method is the (network) which is a model consisting of nodes and links connecting between nodes. There are two basic methods of analysis which are:

2.7.6 Arrow Diagramming Method (ADM)

Activities are represented by two nodes and one link.

2.7.7 Precedence Diagramming Method (PDM)

Activities are represented by nodes and links represent the relationship.

This method has four key elements which are:

1. Critical path analysis
2. Float determination
3. Early start & early finish calculation
4. Late start &late finish calculation

2.7.8 Delay classification

Delay is an event or a condition that results in finishing the project later than stipulated in the contract.

2.7.8.1 Types of delay:

1. Excusable delays: an excusable delay entitles the contractor to additional time to complete the contract work. Excusable delays usually stem from reasons beyond the contractor's control. These delays can be further classified as follows (MR Finke - Cost Engineering, 1997)

A. No compensable delays: these delays are beyond the control, and not the fault, of the owner- such as unusual weather conditions, natural disasters (earthquakes, floods, hurricanes, etc.), wars or national crises, and labor strikes. Most likely, these delays entitle the contractor to a time extension but not monetary compensation. (TJ Trauner - 2009)

B. compensable delays: these delays are caused by the owner or the designer (architect or engineer). They usually entitle the contractor to a time extension, recovery of the costs associated with the delay, or both. (MR Finke - Journal of Construction Engineering and Management, 1999)

2. No excusable delays: by definition a no excusable delay does not entitle the contractor to either time extension or monetary compensation. Typically, a no excusable delay is any delay that is either caused by contractor or not caused by the contractor but should have been anticipated by the contractor under normal conditions. Example of first include slow mobilization, contractor cash flow problems. (JG Zack Jr - Cost Engineering, 2000)

3. Concurrent delays: involves a combination of two or more independent causes of delay during the same period. Often, a concurrent delay involves excusable delay and no excusable delay. For example, the one case the author was involved in, the contractor was working slowly and increasingly falling behind schedule. (D Arditi, MA Robinson - Cost Engineering, 1995).

2.7.8.2 Liquidated damage

Liquidated damages are a sum of money negotiated by the parties at the time of signing the contract which sets out the damages that can be claimed in the event that a party violates the contract. When the parties sign the contract, the amount will represent the best estimate of the possible damages. These typically apply to a specific form of violation, and in building, the failure to complete work on time is often the outcome

(B Eggleston - 2009).

There are many benefits of including the liquidated damages in the contract and the most important one which is predictability. When the both parties already predetermined amount of damages, it allows the both parties to negotiate the number which feels that is not fair for him. In the viewpoint of the owner, this is serving as a cheap form of protection against the contractors. And he can assess the damages without having to go through the trouble of proving real damages. In the viewpoint of the contractor, it helps them to assess the level of risk involved from the owner and he had a chance to restrict the owner's claims for damages. (RA Hillman - Cornell L. Rev., 1999)

Some of them are simple and general and should consider the circumstances at time of contract, and some of them are precise and require certain language. It kind of hard to apply in the court and it different from country to another. And the court should take into consideration that (AB Hill - 1965)

1) True losses are hard to measure

2) The amount has to be fair

3) Amount shall be used as reward, not as a punishment

And we calculate them by:

Total Contract Price – [(X amount of $ per day) x (number of days late)] (2.1)

2.7.8.3 Construction delay claims

Construction delay claims and their resolution is a complicated subject. Many attorneys retain consulting engineers and other experts to assist them in understanding the technical issues in construction related cases. (N Braimah - Journal of Management in Engineering, 2014)

The simplest definition of a delay is an event or condition that results in finishing the project later than stipulated in the contract. A delay may also pertain to starting or finishing a specific activity later than planned. A claim is request from one contracting party to another party for additional compensation, a time extension, or both. If we put the two terms together, a delay claim simply means a claim related to delay. (AH Al-Momani - International journal of project management, 2000)

Delay claims and change orders:

A delay claim may ask for a time extension, monetary compensation, or both.

Delay that results in claims are classified as excusable, non-excusable, and concurrent,

A claim for only monetary compensation often forms the basis for change order (CO). A CO may be initiated at the request of the owner, contractor, subcontractor, and so on. For example, an owner may want to change the color of the brick, the type of floor tile, or the type of light fixtures from that specified in the contract. Such a CO may be initiated by the owner's submitting a request for quotation(RFQ).This request could be an owner's decision or a" what if" inquiry. In this later case the owner sends an RFQ along with relevant architectural or engineering details (drawings or specifications), if necessary, to the contractor. The contractor evaluates the new changes, including their impact on the schedule .In response, the owner accepts, rejects, or negotiate this quotation. Once the owner and the contractor agree on the price or schedule change, the owner issues a CO.

The CO signals the owner's acceptance of the cost and other terms already agreed on with the contractor, and it authorizes the contractor to do the work. ACO can be for an addition to, a deletion from, or a substitution to the original contract. An example of a deletion from, or a substitution to the original contract. An example of a deletion CO is owner's deleting a swimming pool from a contract to build a house. In such cases, most contractors issue partial credit that is less than the amount originally estimated in the contract for the item. (AN Goldhaber, G Fitts - US Patent 5,794,210, 1998)

2.7.8.4 Reasons for delay claims

Claims usually occur because of unexpected events or developments, regardless of who is at fault. Unlike projects in other industries, no two construction projects are the same. Even when two projects have the same design and are performed by the same company, they may differ with regard to site conditions, climate, regulations, subcontractors, market conditions, and team members. Consequently, anticipating every event that will affect a construction project is difficult, even when the projects are substantially similar. A claim may arise during any construction project for several reasons. (TA Birkland - 1997)

2.8 Cost Management

Throughout the project life cycle, project cost management is the process of estimating, planning, and controlling expenses with the goal of staying within the agreed budget.

It is necessary for a project to be considered successful if it meets the specifications and scope; its execution quality is excellent; it is completed on time and on budget.

As a result, project cost management is an important pillar of project management that applies to every industry, including manufacturing, retail, technology, and construction. It aids in the creation of a financial baseline against which project managers may assess the current state of their project costs and, if necessary, realign the course.

The main four steps in Project Cost Management:

1. Project Resource Planning
2. Cost Estimation
3. Cost Budgeting
4. Cost Control

2.9 Quantity Surveying:

The action or profession of a person who estimates the cost of the materials and labour necessary for a construction job

• **Consultant QS**: deal with benefit of a client association, frequently known as a "proficient amount assessor", "client's amount assessor" to guarantee an incentive for cash and actually look at the exactness of the pertinent project workers applications for instalment

• **Contractor QS**: work for development organizations, frequently known as a

"Principal project worker's amount assessor". The structure project workers amount assessor will be liable for the arrangement of sub project workers accounts and guaranteeing that there applications for instalment are sensible and exact and furthermore managing any varieties that happen. Likewise the project workers QS should submit applications for instalment to the client in accordance with the dates concurred in the first agreement.

• Bill of Quantity

A bill of quantities is a document used in tendering in the construction industry in which materials, parts, and labor (and their costs) are itemized. It also (ideally) details the terms and conditions of the construction or repair contract and itemizes all work to

enable a contractor to price the work for which he or she is bidding. The quantities may be measured in number, area, volume, weight or time. Preparing a bill of quantities requires that the design is complete and a specification has been prepared.

The bill of quantities is issued to tenderers for them to prepare a price for carrying out the construction work. The bill of quantities assists tenderers in the calculation of construction costs for their tender, and, as it means all tendering contractors will be pricing the same quantities (rather than taking-off quantities from the drawings and specifications themselves), it also provides a fair and accurate system for tendering

2.10 2.10 Estimating Construction Cost

Construction Cost is divided to

a) Direct Cost: and it includes:

1) Materials costs.

2) Labor costs.

3) Equipment costs.

4) Subcontract.

b) Indirect Cost: and it includes:

1) Overhead costs:

- Job overhead costs.
- Operating overhead costs.

2) Profit.

Direct Cost

1. Materials costs:

- The interaction of supply and demand determines a market equilibrium in which both buyers and sellers are price-takers, called a competitive equilibrium.
- Competition can constrain buyers and sellers to be price-takers.
- Prices and quantities in competitive equilibrium change in response to supply and demand shocks.
- Real-world markets are typically not perfectly competitive, but some policy problems can be analysed using this demand and supply model
- Material price is highly affected by quality and quantity of material

Material Taxes: The charges rate for materials will differ contingent upon the area.

2. Labor Costs:

Most persons involved in construction agree that people are the most important resources on a project.

Labor cost is the total of wages, benefits, and payroll taxes paid to and for all employees. It's divided into two categories: direct and indirect labor costs.

Direct labor costs are the wages paid to the employees that produce products or services. Indirect labor costs are costs that facilitate that production. The wage of a worker who maintains production equipment is a good example of an indirect labor cost.

3. Equipment Costs:

A business that is dependent on the use of heavy equipment has a few decisions to make about how they'll acquire the equipment that is vital to completing a project properly, efficiently and on time. Your specific situation will be different than another construction or excavating business so it's not easy to just get the needed insights from a fellow business owner on what they do. You need to take into account a few different factors that will contribute to making the right choice for the vitality and management of your company.

Consider the main factors that will help you decide to buy or rent your construction equipment:

- Your current financial state
- The resources and skills available within your company for inventory control and fleet management
- The costs associated with buying and how they compare to renting
- Your need to have equipment that's available at a moment's notice
- If the owned or rented equipment will be used for the appropriate length of time

Indirect Cost

- Overhead costs

Job Overhead Costs

Expenses that cannot be attributed to a specific work item, but can be attributed to a specific project.

Operating overhead costs.

Overhead costs, often referred to as overhead or operating expenses, refer to those expenses associated with running a business that can't be linked to creating or producing a product or service. They are the expenses the business incurs to stay in business, regardless of its success level.

- Profit

In its simplest form, it's the amount left after subtracting your total expenses from your total revenue. The money remaining, your profits, can either be kept in the business and re-invested to finance future growth, or distributed as a draw or dividends to stakeholders.

3 METHODOLOGY

In this part of the project we talked about a lot of topics in the administrative construction project, as well as how to manage and regulate it in general. We also discussed how to get started and select the delivery system needed to complete the task to the owner's specifications with the highest quality and the least amount of time and money.

Then we looked for a project that had already been established to examine and adapt in the second part of the Project.

In project 2, we will examine the plans and perform quantity calculations using REVIT software, then using PRIMAVERA software to establish the project's duration.

Finally, we obtain the Bill of Quantities that we prepared, compute the project's price in the end, and compare the original Bill of Quantities to the one we prepared, identifying any differences, and explaining the reasons for the differences.

3.1 REVIT SOFTWARE

Revit is an Autodesk 3D design program that is very important in the collaboration between engineers from various disciplines of construction, architecture, mechanical, electrical, and sanitary, and thus a high level of coordination in work and fewer errors due to cooperation in the early stages of the project. It is a sophisticated way to create models from Buildings and structures that are very similar to reality.

Figure 1: Revit Interface.

3.1.1 Project preconception

Do you want to install a door in a room? With Revit, you may construct a basic plan for your project utilizing a selection of predefined parts. Simply select the sort of door you want, and the software will include it into the project, complete with all of the door's, window's, load-bearing walls, columns, and other features.

Designers may create a basic project layout fast and correctly with Revit, and design revisions can be performed easily and flexibly, allowing clients to preview and visualize their homes and future projects. Designers can experiment with different design ideas and arrange their design selections earlier in the process using 3D views.

3.1.2 Flexibility

Revit combines the design, drafting, construction, and change management processes in a single platform, allowing all project owners to stay informed about changes and their roles, resulting in better overall coordination. The BIM approach has proven to be more effective than the old approach focused on manual labor and manual modifications since everyone understands what is going on. This avoids design dispute and reduces risks.

3.1.3 Phasing

Engineers and designers can analyze the model at a precise point in the construction timetable using phasing, which takes the fourth dimension of the project, time. By tracking the construction and demolition of elements, for example, in a particular project, the doors table usually lists all of the doors that were built in the project; however, in a building with hundreds of doors, working with the table can be difficult, because the doors that were demolished will be listed with doors after the renovation, and it can be confusing. Scaffolding, hoists, delivery, and storage of materials and equipment are all practical aspects of construction that can be considered with phasing.

3.2 Primavera P6 SOFTWARE

Oracle Primavera P6 is a project, program, and portfolio management software that helps you plan, manage, and execute your projects. It's built to handle large and small projects in a variety of industries, including construction, manufacturing, energy, and information technology. It has been doing so in projects all across the world for more than 30 years.

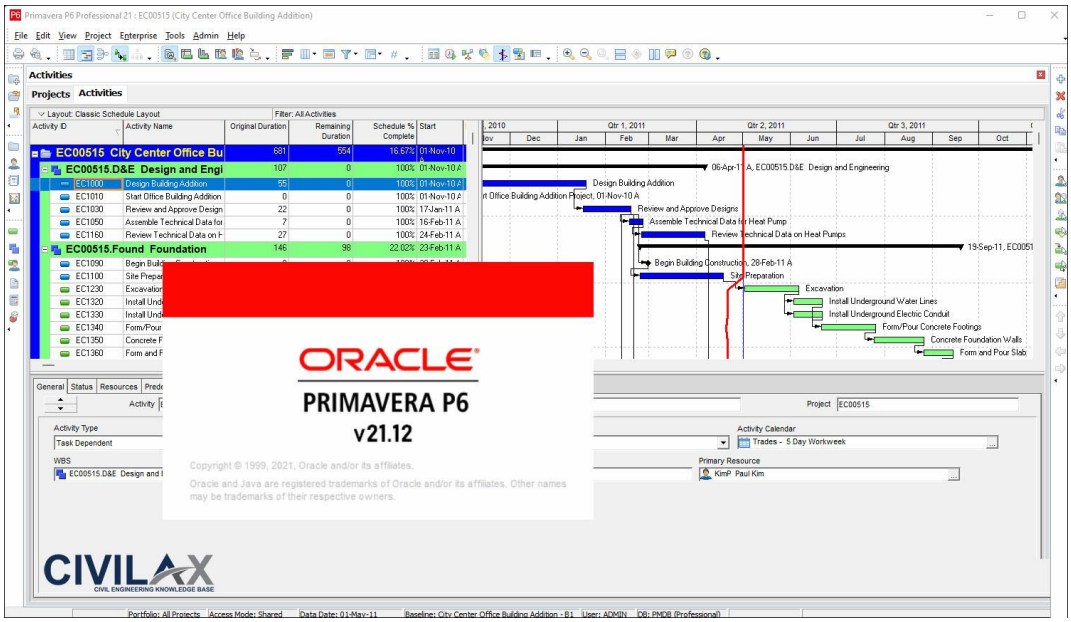

Figure 2: Primavera Interface.

Primavera P6 Features

Let’s zoom in closer on Primavera P6. First, it’s a tool that works on an enterprise structure. That means it goes from the highest level of management down the line of project members. In terms of the key features, they are as follows.

- Timelines: A traditional gant chart to schedule tasks on a bar graph
- Risk Management: Identify, track and resolve risks before they become issues
- Information Dashboard: A dashboard to track key project metrics
- Reporting & Analytics: Ability to generate status reports for stakeholders
- Resource Analysis & Allocation: Keep track and reallocate resources as needed
- Calendar & Activity Views: View project tasks set over a calendar view
- Portfolio & Program Management: Able to manage multiple projects in a program or portfolio at once
- Contract Management: Manage multiple projects, get info from database fast
- Scheduling Alerts: Keep the project on track by always knowing what’s due when

4 RESULT

4.1 Quantities using Autodesk Revit

Revit program was used to perform 3D model for the Tulkarem health directorate building in order to estimate the quantities. Below there are some pictures showing the building model.

Figure 3: 3D Architectural view for the building using Revit.

Figure 4: 3D Architectural view for the building using Revit.

Figure 5: 3D Architectural view for the building using Revit.

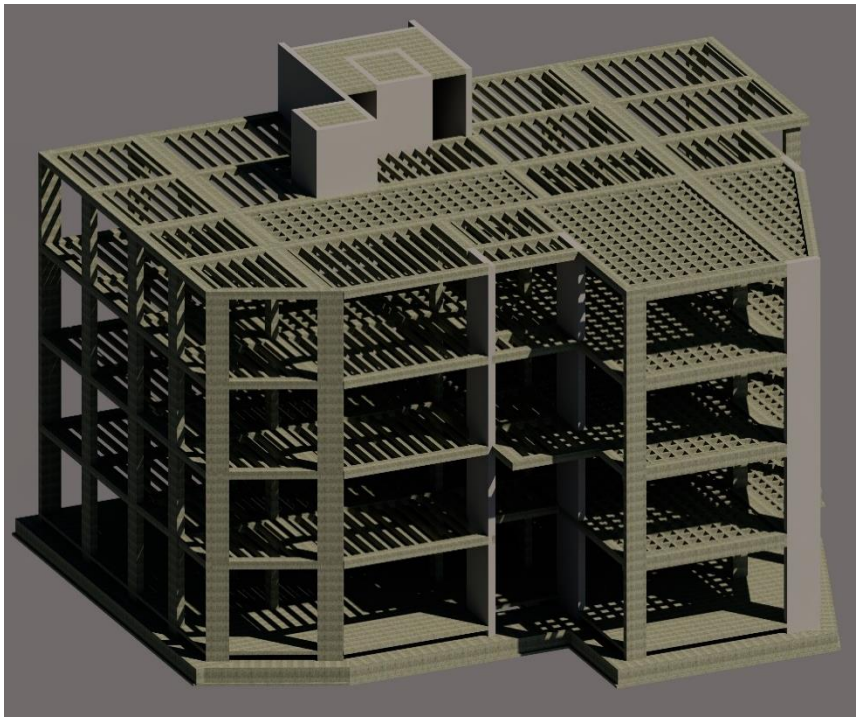

Figure 6: 3D structural view for the building using Revit

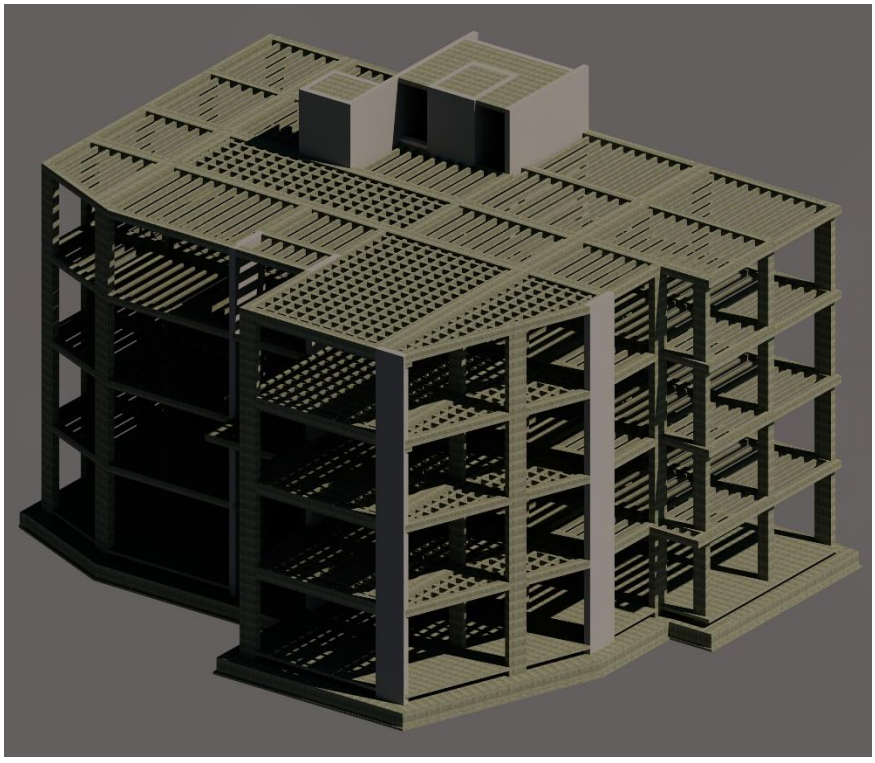

Figure 7: 3D structural view for the building using Revit

4.1.1 Sub structure works:

1. Blinding concrete B300

For The blinding concrete (B300), the amount of concrete is equal to 35.15 m³ and the total price is 16000 ₪ as listed in the table below:

Blinding Concrete Volume			
Type	**Area**	**Volume**	**Total Price**
Blinding 10cm	351 m²	35.15 m³	16000 ₪

Table 1: The amount of concrete for the blinding

2. Foundation work

Foundation Concrete Volume	
Total Volume	193.59 m³
Foundation Steel Weight	
Total Weight	13.592 Ton
Total Price	
200000 ₪	

Table 2: The amount of concrete and steel for foundation

From the previous table, the total amount of concrete (B300) and steel are 193.59 m^3 and 13.592 tons respectively and the total price is 200000 ₪.

3. Slab on Grade

For the slab on grade the thickness is 0.12 m the total volume of concrete is 54.72 m^3

The total price for the slab 63840 ₪

Type	Area	Volume	Unit Price	Total Price
Ground Floor Slab 12cm	456 m²	54.72m³	140	63840 ₪

Table 3: Slab on Grade Area and Volume

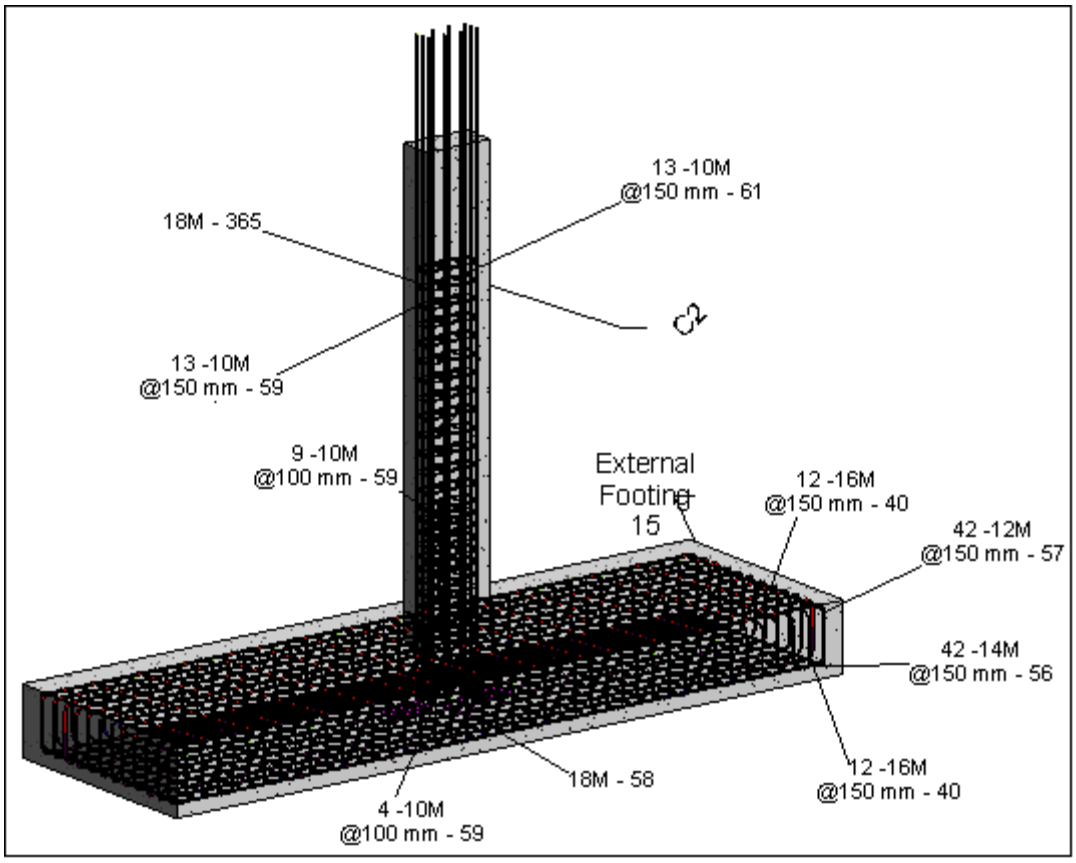

Figure 8: Footing and column details using Revit

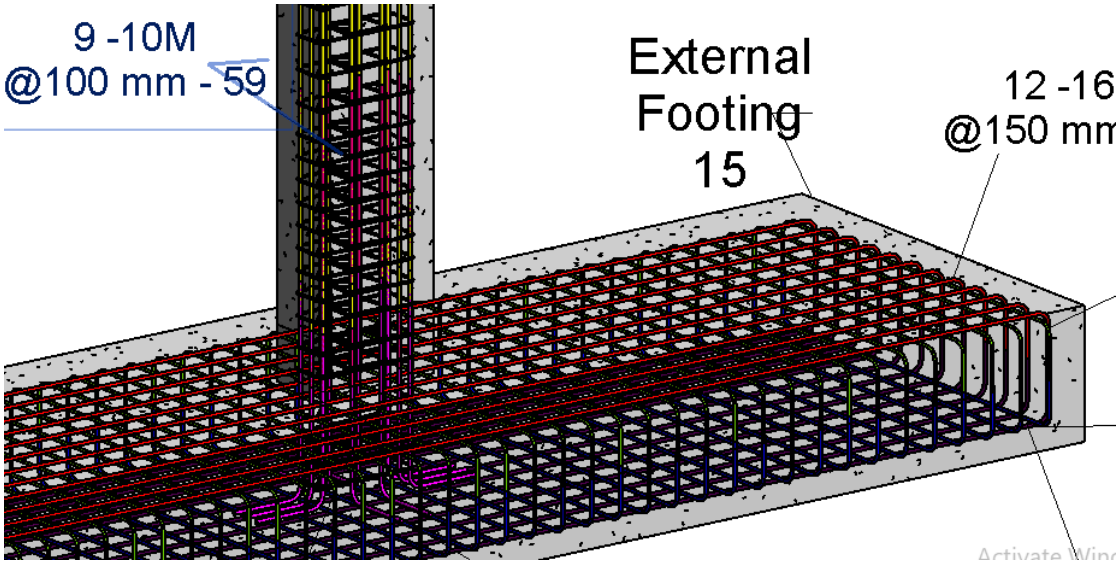

Figure 9: Footing and column details using Revit

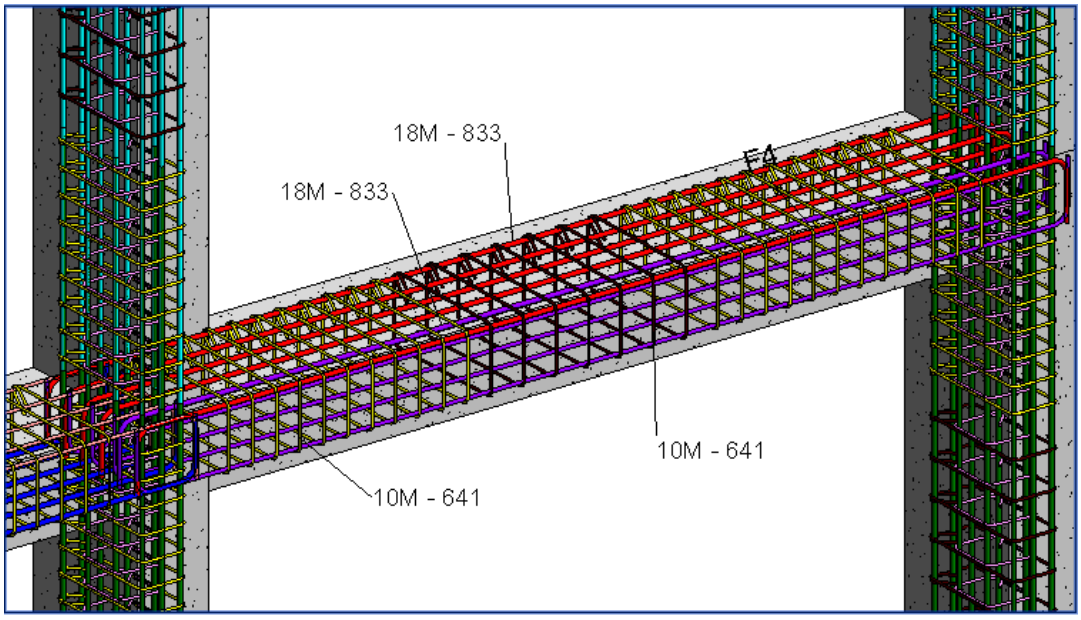

Figure 10: Beam details using Revit

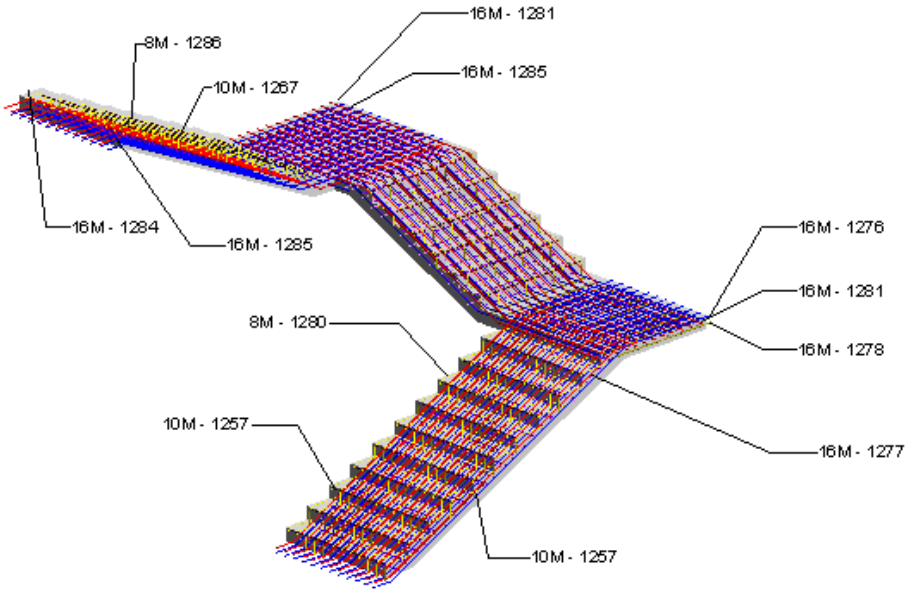

Figure 11: Stairs details using Revit

4.1.2 Super Structure work:

In the super structural works the full quantities were calculated through Revit, then the price of each activity was calculated, taking into consideration the profitability of the contractor and the operating expenses.

Section	Unit	Quantity
Number of Blocks in Ceiling	Each	10364
Columns Concrete Volume	MC	76.53
Walls Concrete Volume	MC	184.76
Beams Concrete Without Joists	MC	135.33
Joists Concrete Volume	MC	218.699
Slabs Concrete Volume	MC	182.61
Columns Steel Bars Weight	Ton	14.181
Walls Steel Bars Weight	Ton	24.085
Beams and Joists Bars Weight	Ton	50.486
Stair Concrete Volume	MC	10.248
Stair Steel Bars Weight	Ton	2.985
Total concrete used in the sections above		**808.2**
Total steel used in the sections above		**91.74**

Table 4: Structural Quantities

4.1.2.1 Ground Floor Bill of Quantity:

For The Ground Floor, each activity in this floor is shown in the following table with their quantities and prices, the total price 766628 ₪ as listed in the table below:

Ground Floor				
Activity	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Columns	20.1	MC	1921	38612.1
Shearwalls	43.47	MC	1623	70551.8
Stairs	2.75	MC	1910	5252.5
Stairs Slab	6.25	MS	400	2500
Ceiling Slab	338	MS	314	106132
Stone Walls	303	MS	450	136350
Concrete 10cm	50.15	MS	58	2910
Concrete 15cm	333.5	MS	76	25500
Wall Plastring	1109.5	MS	40	44380
Ceiling Plastring	401.75	MS	40	16070
Staircase Walls Plastring	36.59	MS	40	1463.6
Marble for Windows	25.63	ML	60	1538
Doors	23	EACH	-	57500
Windows	44.64	MS	600	26784
Curtain Panels	16	MS	500	8000
Glass Partitions	34.08	MS	500	17040
Porcelain Tiles (Corridores ,Waiting Areas ,Administration …etc)	372.2	MS	213	79278.6
Porcelain Tiles (Bathrooms and Kitchens)	34.415	MS	213	7330.395
Glazed Ceramic (Corridores and Waiting Room walls)	52.98	MS	145	7682.1
Glazed Ceramic (Bathroom Walls)	104.75	MS	195	20426.25
Perlato Marble for Staircase Walls	17.715	MS	476	8432.34
Stair Landing	8.75	MS	426	3727.5
Wall Painting	1109.5	MS	20	22190
Ceiling Painting	401.75	MS	20	8035
Staircase Walls painting	36.59	MS	20	731.8
Fallceiling	401.75	MS	120	48210
Net Total Price (₪)			766627.99	

Table 5: Ground Floor B.O.Q

4.1.2.2 First Floor Bill of Quantity:

For The First Floor, each activity in this floor is shown in the following table with their quantities and prices, the total price 749386 ₪ as listed in the table below:

First Floor				
Activity	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Columns	18.81	MC	1921.00	36134.01
Shearwalls	39.20	MC	1623.00	63621.60
Stairs	2.75	MC	1910.00	5252.50
Stairs Slab	6.25	MS	400.00	2500.00
Ceiling Slab	347.00	MS	314.00	108958.00
stone walls	306.00	MS	450.00	137700.00
Concrete 10cm	20.56	MS	58.00	1190.00
Concrete 15cm	363.00	MS	76.00	27600.00
Wall Plastring	1164.93	MS	40.00	46597.20
Ceiling Plastring	402.62	MS	40.00	16104.80
Staircase Walls Plastring	36.59	MS	40.00	1463.60
Marble for Windows	46.99	ML	60.00	2819.66
Doors	22.00	EACH	-	44000.00
Windows	81.84	MS	600.00	49104.00
Curtain Panels	16.00	MS	500.00	8000.00
Porcelain Tiles (Corridores ,Waiting Areas ,Administration …etc)	348.50	MS	213.00	74230.50
Porcelain Tiles (Bathrooms and Kitchens)	14.96	MS	213.00	3185.84
Glazed Ceramic (Corridores and Waiting Room walls)	90.31	MS	145.00	13094.95
Glazed Ceramic (Bathroom Walls)	78.32	MS	195.00	15272.40
Perlato Marble for Staircase Walls	17.72	MS	476.00	8432.34
Stair Landing	8.75	MS	426.00	3727.50
Wall Painting	1164.93	MS	20.00	23298.60
Ceiling Painting	402.62	MS	20.00	8052.40
Staircase Walls painting	36.59	MS	20.00	731.80
Fallceiling	402.62	MS	120.00	48314.40
Net Total Price (₪)			749386.10	

Table 6: First Floor B.O.Q

4.1.2.3 Second Floor Bill of Quantity:

For The Second Floor, each activity in this floor is shown in the following table with their quantities and prices, the total price 738954 ₪ as listed in the table below:

Second Floor				
Activity	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Columns	18.81	MC	1921.00	36134.01
Shearwalls	39.20	MC	1623.00	63621.60
Stairs	2.75	MC	1910.00	5252.50
Stairs Slab	6.25	MS	400.00	2500.00
Ceiling Slab	341.00	MS	314.00	107074.00
stone walls	282.00	MS	450.00	126900.00
Concrete 10cm	23.74	MS	58.00	1380.00
Concrete 15cm	376.50	MS	76.00	28900.00
Wall Plastring	1163.95	MS	40.00	46558.00
Ceiling Plastring	409.35	MS	40.00	16374.00
Staircase Walls Plastring	36.59	MS	40.00	1463.60
Marble for Windows	26.99	ML	60.00	1619.44
Doors	21.00	EACH	-	44000.00
Windows	47.00	MS	600.00	28202.40
Curtain Panels	32.50	MS	500.00	16250.00
Glass Partitions	9.63	MS	500.00	4816.00
Porcelain Tiles (Corridores ,Waiting Areas ,Administration …etc)	385.00	MS	213.00	82005.00
Porcelain Tiles (Bathrooms and Kitchens)	21.93	MS	213.00	4670.88
Glazed Ceramic (Corridores and Waiting Room walls)	117.82	MS	145.00	17083.90
Glazed Ceramic (Bathroom Walls)	75.52	MS	195.00	14726.40
Perlato Marble for Staircase Walls	10.88	MS	476.00	5176.50
Stair Landing	8.75	MS	426.00	3727.50
Wall Painting	1163.95	MS	20.00	23279.00
Ceiling Painting	409.35	MS	20.00	8187.00
Staircase Walls painting	36.59	MS	20.00	731.80
Fallceiling	402.67	MS	120.00	48320.40
Net Total Price (₪)			738953.93	

Table 7: Second Floor B.O.Q

4.1.2.4 Third Floor Bill of Quantity

For The Third Floor, each activity in this floor is shown in the following table with their quantities and prices, the total price 740450.82 ₪ as listed in the table below:

Third Floor				
Activity	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Columns	18.81	MC	1921	36134.01
Shearwalls	39.2	MC	1623	63621.6
Stairs	2.75	MC	1910	5252.5
Stairs Slab	6.25	MS	400	2500
Ceiling Slab	341	MS	314	107074
stone walls	285	MS	450	128250
Concrete 10cm	49.48	MS	58	2870
Concrete 15cm	302	MS	76	23000
Double Hollow Block 10cm	13.76	MS	400	5504
Wall Plastring	1119.62	MS	40	44784.8
Ceiling Plastring	407.76	MS	40	16310.4
Staircase Walls Plastring	36.59	MS	40	1463.6
Marble for Windows	24.1816	ML	60	1450.8986
Doors	23	EACH	0	54500
Windows	42.112	MS	600	25267.2
Curtain Panels	24.5	MS	500	12250
Porcelain Tiles (Corridores ,Waiting Areas ,Administration …etc)	386.5	MS	213	82324.5
Porcelain Tiles (Bathrooms and Kitchens)	21.44	MS	213	4566.72
Glazed Ceramic (Corridores and Waiting Room walls)	101.45	MS	145	14710.25
Glazed Ceramic (Bathroom Walls)	89.72	MS	195	17495.4
Perlato Marble for Staircase Walls	15.09	MS	476	7182.84
Stair Landing	8.75	MS	426	3727.5
Wall Painting	1119.62	MS	20	22392.4
Ceiling Painting	407.76	MS	20	8155.2
Staircase Walls painting	36.59	MS	20	731.8
Fallceiling	407.76	MS	120	48931.2
Net Total Price (₪)			740450.82	

Table 8: Third Floor B.O.Q

4.1.2.5 Roof Bill of Quantity

For The Roof, each activity in this floor is shown in the following table with their quantities and prices, the total price 180702 ₪ as listed in the table below:

Roof Floor				
Activity	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Shearwalls	23.78	MC	1623	38594.94
Stone Walls	90	MS	450	40500
Ceiling Slab	25	MS	314	7850
Perlato Marble for Staircase Walls	49.335	MS	476	23483.46
Staircase Walls Plastring	95.62	MS	40	3824.8
Ceiling Plastring	47.27	MS	40	1890.8
Staircase Walls painting	95.62	MS	20	1912.4
Ceiling Painting	47.27	MS	20	945.4
Doors	1	EACH	-	4000
Parapet	131	ML	440.46	57700
Net Total Price (₪)			180701.80	

4.2 Time Calculation using Primavera P6

- Objective

In this project, the Oracle Primavera P6 software will be used only for scheduling the time, knowing the schedule of all the activities that will be carried out in this project and knowing the types of relationships between the activities.

- Primavera input:

1. Activity of project.
2. Activity relation.
3. Duration for each activity.

- Primavera Output:

1. Bar Chart
2. Time schedule
3. Budgeted cost
4. S-curve

- **Project Definition:**

Figure 12: Project ID and Project Name

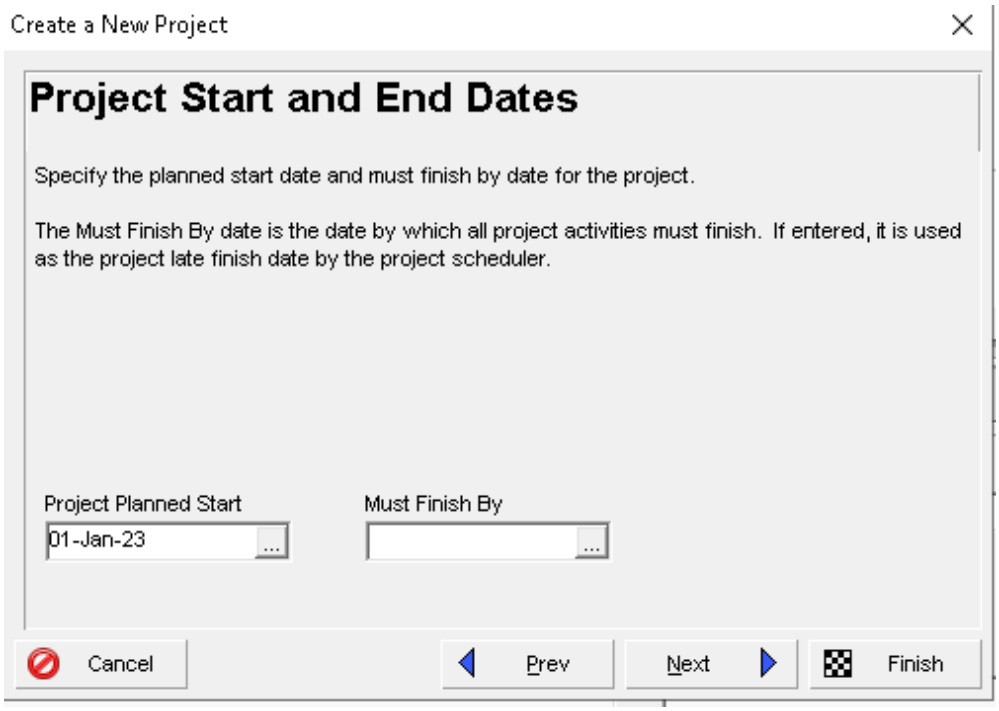

Figure 13: Project planned start

Input Data:

1- Enterprise project structure (EPS)

The enterprise project structure constitutes the hierarchical structure of the database in projects.

This is Hierarchal structure that identifies the company wide projects and enables organizing and management of those projects.

2- Organizational breakdown structure (OBS):

It is a global hierarchy that represents the managers responsible for the projects that the organization implements.

It represents management responsible at the EPS/ Project. Each Manager in the OBS is associated with our area of the EPS.

3- Calendar

The scheduling calendar is used to schedule activities in construction projects, as this project was carried out on the basis of six days a week, with 8 working hours per day, in addition to the fact that Friday is always a holiday

- Calendar Definition

The parameters needed to define the calendar in Primavera software:

- Work Hours per Day: 8.0 hr/d.
- Calendar Weekly Hours: 8.0 hours for all week's days when Friday is holiday.
- Hours per Time – Period:
  - 8.0 hr/day.
  - 48.0 hr/ week.
  - 206.0 hr/month.
  - 2496 hr/year

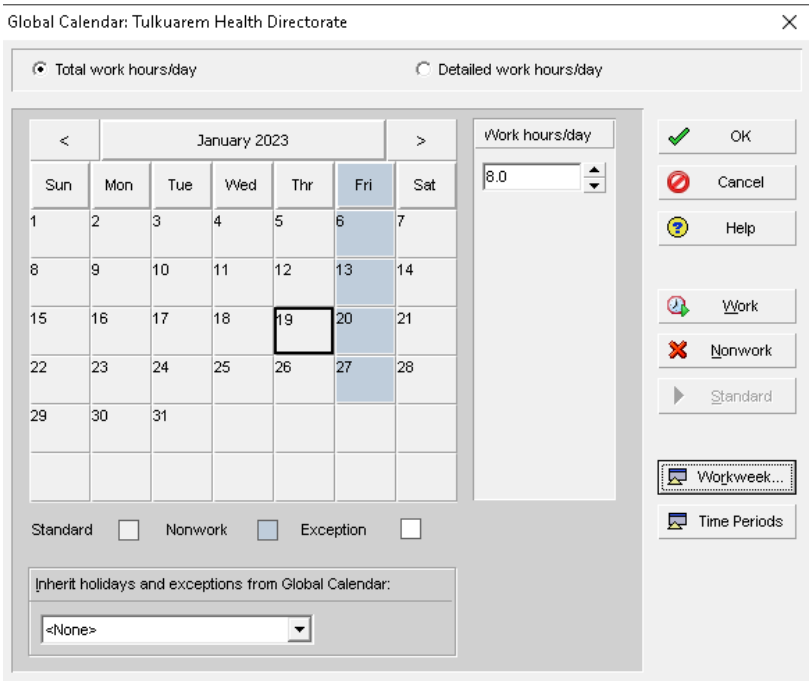

Figure 14: Calendar Details

4- Work Breakdown Structure (WBS)

A work breakdown structure is an arrangement of services and activities that are performed during the implementation of a project.

Layout: WBS

WBS Code	WBS Name	Total Activities
T.H.D	Tulkarem health directorate	117
T.H.D.sub	sub structure	3
T.H.D.super	super structure	114
T.H.D.super.GF	Ground Floor	27
T.H.D.super.GF.1	concrete works	6
T.H.D.super.GF.2	finishing works	21
T.H.D.super.1st	first floor	25
T.H.D.super.1st.1	concrete works	6
T.H.D.super.1st.2	finishing works	19
T.H.D.super.2nd	second floor	26
T.H.D.super.2nd.1	concrete works	6
T.H.D.super.2nd.2	finishing works	20
T.H.D.super.3rd	third floor	26
T.H.D.super.3rd.1	concrete works	6
T.H.D.super.3rd.2	finishing works	20
T.H.D.super.roof	Roof	10
T.H.D.super.roof.1	concrete works	3
T.H.D.super.roof.2	finishing works	7

Figure 15: WBS

5- Activity:

There is some information that must be entered into the activities, which is:

- Name of the activity:

A description associated with WPS is a description of construction activities that gives the reader information related to the work.

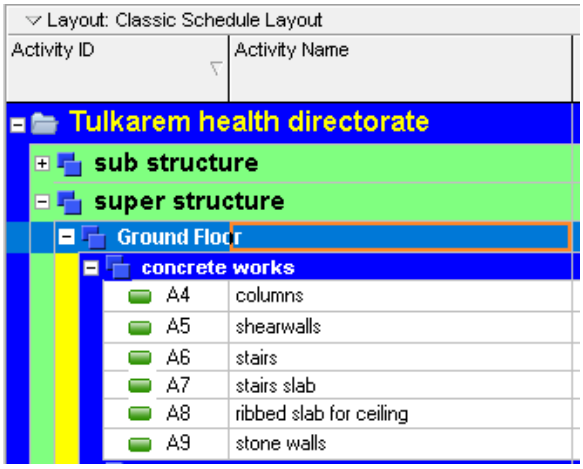

Figure 16: Activities name

- Original Duration:

Each activity implemented in the project requires a different period of time from the other activity, as this period depends on the productivity of work and the amount of work assigned to this activity.

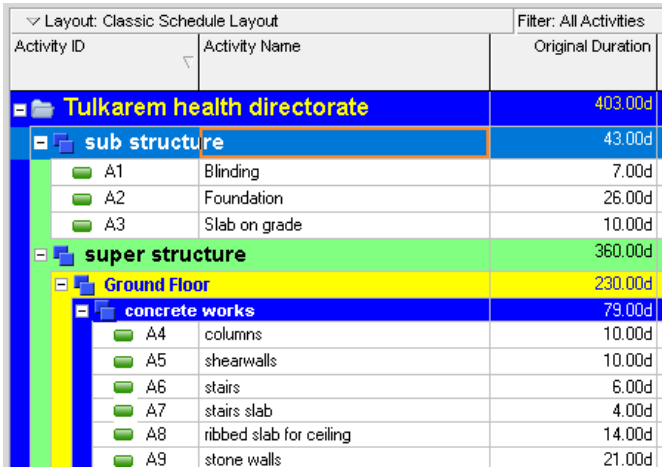

Figure 17: Activities original time

- Relationship type:

There are four types of relationships that link activities. These relationships are determined by knowing the sequence of activities and through which the type of relationship between activities is selected.

- Finish to start (FS).
- Finish to finish (FF).
- Start to start (SS).
- Star to finish (SF).

- Resources:

In the project, the resources are divided into three main groups:

1- Materials: All materials needed and required to implement the project, such as: bricks, steel, stone, wood, and other materials.

2- Human Resources such as: steel fixer.

3- Non-human resources such as: excavator.

But we will not use the Primavera program in calculating the total cost, so we will not need to enter these resources.

- Quantities:

The quantities are entered into the Primavera program in order to find the total cost of the project. But in this project, the total cost of the project will be calculated in another way, so we will not need to enter the quantities into the Primavera program.

Output data:

1. Time scheduling:

The project is started on 1/June/2023 and will finished on 14-Apr-2024 with a planned duration equals 403 for working days and 470 for calendar days.

2. Gant chart:

One of the best ways to display the activities that will be implemented, as it provides a graphic table showing the activities and their relationship to each other, and also shows the start and end dates for each activity, and includes all the activities contained in the project.

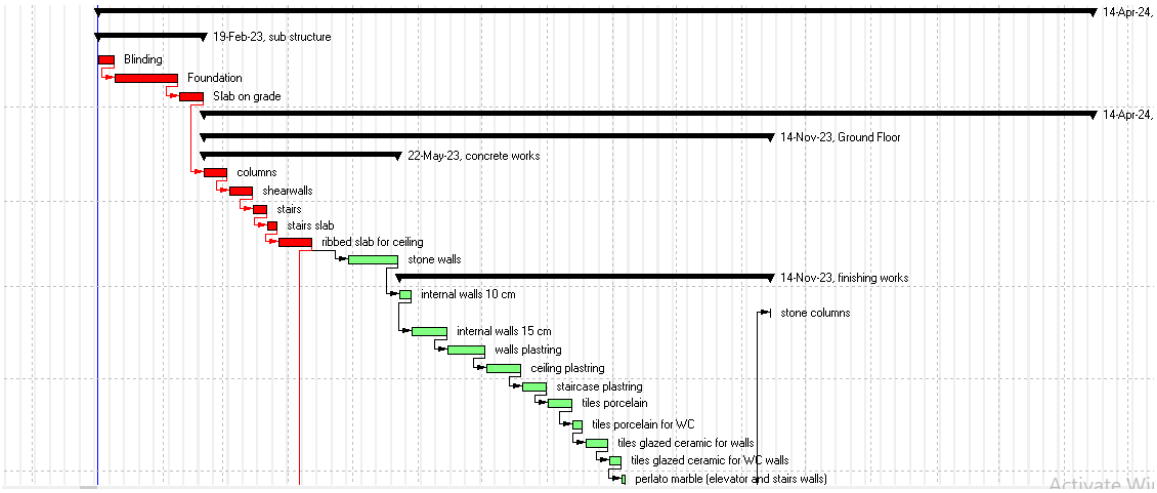

Figure 18: Gant chart of project

3. Critical activities

The critical path is called those activities that must start and end at a specific time in order to ensure the completion of the project at the agreed time, and any delay in those activities may lead to delaying the delivery of the entire project, as the critical path can be identified through the total float, which equals zero. Or through the longest path in the project.

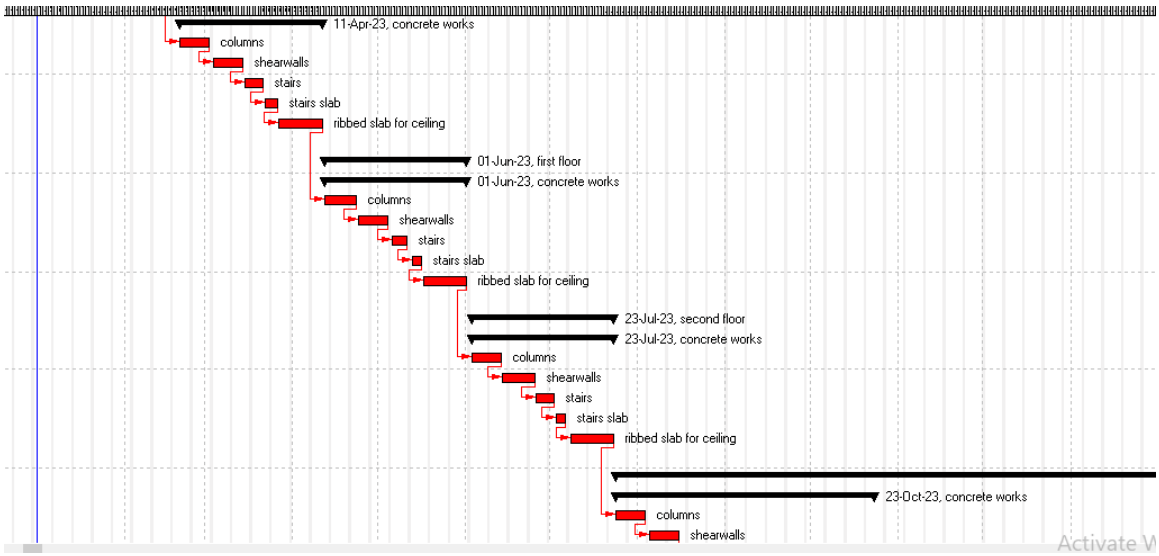

Figure 19: Critical activities.

4. Cost estimate:

It is the process of forecasting the financial requirements and any matters necessary to complete the project within a specific scope, where everything is estimated in the project, whether (materials, workers) in order to calculate the total amount for the whole project. Where this information is entered into the Primavera program to calculate the total cost of the project

5. S-Curve:

It represents the cumulative man-hours (units) against time. S-Curve represents the cumulative Scope (Time & Cost) related to EVM. In primavera, you can display the s-curve by first assigning resources which will cause variable costs and man-hours for each activity in a certain period.

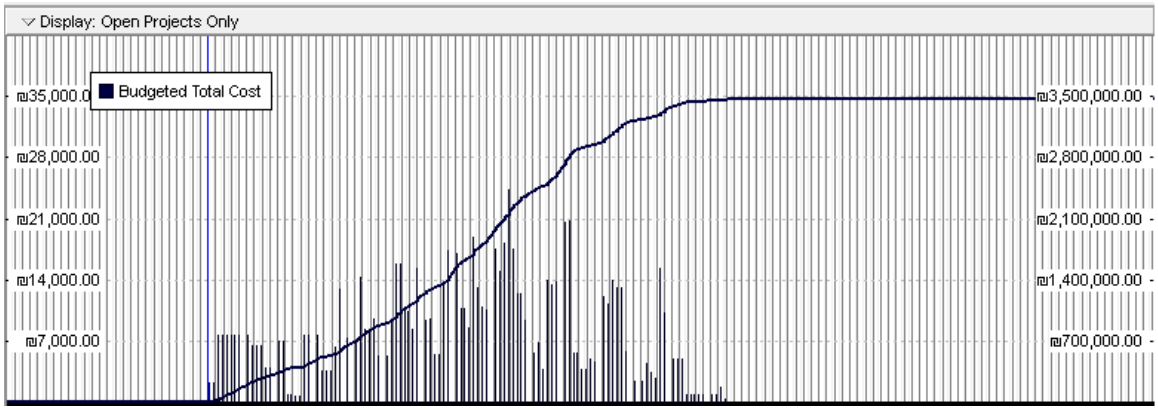

Figure 20: S-Curve

4.3 Bill of Quantity (BOQ)

Activity	Quantity	Unit	Unit Cost	Total Price
Blinding Concrete	351	MS	45.58	16000
Foundation	194	MC	1030.93	200000
Slab on Grade	456	MS	140	63840
Columns	76.53	MC	1921	147014.1
Shearwalls	184.85	MC	1623	300011.6
Stairs	11	MC	1910	21010
Stairs Slab	25	MS	400	10000
Ceiling Slab	1392	MS	314	437088
stone walls	1266	MS	450	569700
Concrete 10cm	143.93	MS	58	8347.94
Concrete 15cm	1375	MS	76	104500
Double Hollow Block 10cm	13.76	MS	400	5504
Wall Plastring	4558	MS	40	182320
Ceiling Plastring	1668.8	MS	40	66750
Staircase Walls Plastring	241.98	MS	40	9679.2
Marble for Windows	123.8	ML	60	7428
Doors	90	Each	-	204000
Windows	215.6	MS	600	129357.6
Curtain Panels	89	MS	500	44500
Glass Partitions	43.712	MS	500	21856
Porcelain Tiles (Corridores ,Waiting Areas ,Administration …etc)	1492.2	MS	213	317838.6
Porcelain Tiles (Bathrooms and Kitchens)	92.741	MS	213	19753.83
Glazed Ceramic (Corridores and Waiting Room walls)	362.56	MS	145	52571.2
Glazed Ceramic (Bathroom Walls)	348.31	MS	195	67920.45
Perlato Marble for Staircase Walls	110.73	MS	476	52707.48
Stair Landing	35	MS	426	14910
Wall Painting	4558	MS	20	91160
Ceiling Painting	1668.8	MS	20	33375
Staircase Walls painting	241.98	MS	20	4839.6
Fallceiling	1614.8	MS	120	193776
Parapet	131	ML	440.46	57700
stone columns	2	Each	3000	6000
Net Total Price (₪)			3461458.58	

Table 9: BOQ

5 CONCLUSION AND RECOMMENDATION:

5.1 Conclusion:

The main aim of this graduation project is to estimate the total quantities of steel and concrete and all other materials that needed to construct Tulkarem health directorate using Revit software.

These quantities divided on the productivity rate for each activity to estimate the time needed for each one of them. These productivity rates can be known by asking the contractor. Also, the relation between these activities is determined, so the total duration to perform the work will be known. The resources for each activity and their costs are determined, so the total cost for each activity is estimated and also the total cost for the whole project is estimated.

The main conclusions from this graduation project are:

1. The working days for the building was estimated to be (403) days.

2. The calendar days for the building was estimated to be (470) days.

3. The total quantities and cost for concrete were estimated to be 1026.7 m^3, the price of 1 cubic meter is equal to (350)₪ .

4. The total budgeted quantities of steel were estimated to be (113.34) Tons, the price of 1 ton is equal to (3700)₪ .

5. The total price for this school project was estimated to be (3,461,458.6)₪ .

5.2 Recommendation:

There are many issues that can be recommended which are:

1. Preparing the equipment and agreeing on when to come to the site must be done before the specified time of each activity.

2. The request for materials must be performed in a previous specific time so that there is no delay in the completion of any activity.

3. The costs required for each activity must be paid on time to the contractor without any delay in their payment by the bidder.

4. Executing each activity at the time specified for it so that there is no delay in the delivery and completion of the project within the period agreed upon in the bid.

5. There must be a permanent follow-up of the implementation of the project within the required standards regarding time and cost for each activity in the project.

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