**Pre-Construction Works: Planning &Preparing for Successful Building Projects**

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***Abstract: This paper provides a comprehensive overview of pre-construction works - the critical planning and preparation activities that occur before actual construction begins on a building project. It covers key aspects including project design phases, site investigations, procurement processes, environmental considerations, and site preparation. The paper emphasizes the importance of thorough pre-construction planning to define project scope, schedule, and costs; identify potential issues; and set up projects for success. It outlines specific steps and best practices for activities like geotechnical studies, construction paper preparation, contractor selection, site layout planning, and environmental mitigation. Overall, it serves as a guide for project owners, managers, and contractors on effectively executing the pre-construction phase to enable smooth project implementation.***

***Background****:* ***Buildings are essential spaces where humans spend most of their lives. Pre-construction work is critical for setting up any project for success. It involves preliminary planning and engineering to define project objectives, identify potential issues, and analyze cost impacts. The pre-construction phase aims to determine project scope, schedule, and cost as early as possible for efficient use of resources. It helps owners determine project viability and avoid common pitfalls. The process involves developing conceptual cost estimates, preliminary schedules, and evaluating constructability. Pre-construction efforts result in a firm project scope, schedule, and approximate cost estimate. The process takes out many unknowns and reduces risk to the client. It also allows for identification of cost-saving opportunities and evaluation of different scenarios before funding approval.***

***Methods****: The pre-construction process involves several key steps. First, professional services are engaged for pre-design work to develop the project program and scope. Next, the schematic design phase translates the program into initial physical drawings and defines building systems. This is followed by the design development phase, where plans are further refined and detailed. Construction documents are then prepared, including detailed drawings and specifications. The procurement process selects a contractor, typically through competitive bidding. Site information is gathered through visits and surveys. Groundwater and geotechnical investigations are conducted to understand subsurface conditions. A pre-construction meeting is held to align responsibilities among team members. Site management plans are developed, including layout plans and temporary works. Environmental impact mitigation measures are identified. The site is prepared by clearing, leveling, and establishing benchmarks. Finally, the building layout is marked on the site using surveying techniques to accurately transfer the design to the ground.*

***Conclusion:*** *Pre-construction work is essential for project success, providing a solid foundation for efficient execution. It allows for thorough planning, risk mitigation and optimization before significant resources are committed. The process results in clearly defined project parameters and execution strategies. While requiring upfront time and effort, pre-construction work ultimately saves costs and reduces uncertainties during construction. It is a critical phase that owners and project teams should prioritize to maximize project outcomes.*

***Key Words****:**Pre-construction, planning, design, procurement, site investigation, risk mitigation, constructability.*

1. **Introduction**

Humans spend 90% of their lives indoors, and there is no place where humans spend more time in their lives than in a building. So buildings are far more than just four walls, they are the places where we are born, learn the first lessons of life, where we meet the personalities who shape our future. Buildings are the places where we spend time with the people we love. And at the end of it all: they are our homes, our places of work. As our lives start at a perfect place, (the mother’s womb) why shouldn’t all our lives be lived in perfect places, a place perfectly designed for its purpose, a place to learn, a place to develop, a place to grow, a place to succeed. Such a building should be energy efficient, well digitized, safe from fire, secured, comfortable. First step for this is preparation for construction, regardless of the scope and purpose of the building. To set any project up for success, an effective and efficient pre-construction phase is critical. Traditionally, pre-construction involves performing preliminary planning and engineering in order to define the project objective, identify potential issues and analyze cost impact. 1,2,3 Planning aspects evolve out of the objectives of the project and requirements of the final completed construction facility. In other words, pre-construction work is to define project scope, schedule, and cost as early as possible for efficient use of resources, money and time. Pre-construction process helps the owner to determine if the project is viable or not. By making a proper pre-construction assessment, it is possible to avoid common pitfalls of a project. In the pre-construction phase, a conceptual cost estimate is developed and subsequently updated as the design progresses and additional information become available. A preliminary master schedule is developed to modify it with the availability of information provided by the consultant and the owner.

1. **Methods**

**Outcome of Pre-Construction Efforts**

The main outcome of pre-construction efforts is a firm project scope, schedule and approximate cost estimate for the owner. The cost estimate depends on the level of accuracy needed by the owner. The pre-construction process is useful to evaluate the constructability (Note1) of the project and identify opportunity for value engineering (Note2). Followings are some of the outcomes of pre-construction works:

* Project scope
* Site plan and site evaluation
* Execution plan
* Risk management (Note 3)
* Constructability
* Project schedule
* Engineering
* Basis of design
* Procurement plan
* Equipment requirements
* Electrical loads
* Availability of construction materials and manpower
* Availability of utility services etc.

Note 1--- Constructability (or buildability) is a project management technique to review construction process from start to finish during pre-construction phase. It is to identify obstacles before a project is actually built to prevent errors, delays, and cost overrun. The term “constructability” defines the ease and efficiency with which structures can be built. The more constructible a structure is, the more economical it will be.

Note 2 – Value engineering is a systematic and organized approach to provide the necessary functions in a project at the lowest cost. Value engineering promotes alternate design solution, the substitution of materials and methods with less expensive alternatives without sacrificing functionality which includes performance, quality, reliability, and safety.

Note 3 --- Risk management is activity process about defining sources of uncertainty (risk identification), estimating the consequences of uncertain events/conditions (risk analysis), generating response strategies in the light of expected outcomes and finally carrying out response generation steps to ensure that project objectives are met. The risk may be political, economic, social, weather, cost, time, resource etc.

**Benefits**

There are a number of benefits and significant impact on the project due to pre-construction works. Pre-construction work is the basis for project appropriation process. 7,9,12 It reduces the number of changes, unexpected cost and variations of schedule during the project. Most importantly the client has a defined basis to make a decision whether to implement the project or abandon it. Pre-construction process takes out many of the unknowns of a project and reduces risk to the client. Through pre-construction process it is also possible to identify areas where there is scope for cost savings. Pre-construction work evaluates the different scenarios upfront and identifies a defined path for construction of the project prior to funding approval of the project.

**Issues to be Resolved during Pre-Construction Process**

There is a whole range of issues that can be resolved during pre-construction process. Some of the most common include:

* Professional services
* Site selection and requirements
* Evaluation of utilities and connection permits with utility providers
* Evaluation of soil condition (review soil analysis with consultant – ensure foundation design is adequate)
* Identify permitting requirements including site plan approval and building permit
* Construction in busy localities of city
* Fire precautions
* Health hazards, like asbestos, contaminated land, storage of hazardous materials etc.
* Risk management
* Adjacent land and existing structures
* Construction in corrosive atmosphere like coastal areas
* Construction in hilly region
* Value engineering options and building material analysis
* Cost saving options
* Equipment selection
* Project feasibility etc.

In the preconstruction phase, special emphasis can be given on the following situation:

* Construction in busy localities of cities needs special considerations and meticulous planning due to restricted space, adjoining structures, underground utilities, traffic restrictions, noise and other environmental pollution and other specific site constraints;
* Construction practices in hilly regions need to take into considerations the problems of landslide, slope stability, drainage etc., besides ensuring on adverse impact on the fragile environmental conditions;
* Durability of construction in corrosive atmospheric condition like coastal region and aggressive ground situation with high chlorides and sulphates should also be taken care of with appropriate practices;
* Constructional practices in disaster prone areas need specific planning. The type of construction, use of materials, construction techniques requires special consideration in such areas;
* Adverse weather conditions have strong bearing on construction phases. Accordingly, suitable design and field operations should be adopted or redefined in anticipation of these aspects.

In addition to these, in areas where accessibility is limited only for certain period of the year (due to adverse weather conditions and inadequate transport system) for transporting labor force and materials, special pre-construction planning is required.

**Project Design Phase**

Project design phase contains four major components:

* **Pre-design phases (Professional services):** Every construction work contains a service element e.g. consultancy or design. The consultancy services are either provided in-house or procured externally using a variety of professional services arrangements which differ from agency to agency. Normally the design and construction stages are undertaken completely separately, with the project owner preparing the design either in-house or using consultants and a contractor subsequently being engaged to construct the works in line with an agreed program, pre-existing design and other project paperations. At this stage a project program shall have to be developed which shall define scope and budget of the project, i.e., the needs and function of the user. After the project program is finalized, it is recommended that a pre-design conference be held to confirm that all issues have been addressed in the program. All interested parties should participate in the pre-design conference.
* **Schematic design:** Schematic design is the first phase of the basic services for project design. The schematic design phase is concerned with:
* Building systems (structural, mechanical, HVAC, electrical and plumbing);
* Interior and exterior finishes;
* Building site

The purpose of the schematic design is to translate the project program into physical drawing of space. In the schematic design phase, the project team determines the areas, physical requirements and the relationship of all the required building spaces and components, confirms or revises the total building square footage, the total project budget, project schedule and occupancy dates. It provides control strategies for all equipment and system related to building services such as security, fire alarms and defines the technical requirements for phones, data, cable and audio/visual needs. The schematic drawings–floor plan, site plan, and building elevations are reviewed and refined for functionality, usability, code compliance, security, safety and aesthetics. The plans are shared and discussed with others such as maintenance services, logistics, information technology, and public safety to identify possible problems and coordinate with the needs and practices in these areas. At this stage in a project, the design professionals describe the project three dimensionally. A range of alternative design concepts are explored to define the character of the completed project and an optimum realization of the project program. As a part of the schematic design phase, applicable environmental paper will be completed. It is recommended that value engineering begin early, preferably in the program phase of a project. Modification and changes due to value engineering and design review sessions must be incorporated into the schematic design papers before the client’s approval to proceed with the design development phase.

* **Design development:** During the design development phase, the schematic plans and elevations are reviewed, revised and expanded and the project design is further refined. Plan arrangements, specific space accommodation, equipment and furnishing, building design, materials and color, and complete definition of all systems serving the project are developed. A clear and coordinated description of all aspects of design including Architectural, Structural, Mechanical, Electrical, Plumbing and Fire Protection system is worked out providing a basis for preparation of construction paper. Project components are looked at to the smallest details. At this stage, issues often come to light that affect constructability or are critical to satisfying the project program and that may require change to the project program or to the budget, or both. Construction Manager assists Client and architects in determining potential cost saving, energy efficiency, and constructability improvements All design decisions are completed during this phase in order to prepare the subsequent construction paper. At the end of design development phase, the architect will provide the client with drafted to-scale drawings that will illustrate the project as it would look when it is constructed. These drawings will very specifically define the site plan, floor plans, external elevation and sections needed for the structural designer. It is important that the client provide input to the architect at this stage as the design development drawings are used as the basis for construction drawings

At the end of design development stage, the project may again go for value engineering review. Modification or changes from value engineering and design review sessions must be incorporated into schematic as well as design development papers before approval of the client.

* **Construction papers:**

The construction paper phase is concerned with the following:

* Compliance with all local and national codes and statutes;
* Compliance with the standards of the clients;
* Verification of the building site conditions;
* Quality control during the construction phase;
* Estimate of all associated costs.

Construction paper phase consists of preparation of drawings and specifications establishing the requirements for the construction of the project. Drawings are the illustrative component of construction papers, whereas specifications are written requirements pertaining to building materials, equipment, and construction system that outline the standard to be met in the construction of the project. The Technical Specifications call for specific test of materials, testing methods, and Standards. In addition to Bangladesh Standards (BDS), other equivalent International Standards are normally mentioned in the Specification for the convenience of the Contractor. Materials and other testing methods which are not available in BDS, other equivalent international Standards like ACI, ASTM, EURO Standards, and AASHTO are normally followed. 4,5

The construction papers describe the quality, configuration, size, and relationship of all components to be incorporated into the project. Construction papers must be consistent with the project program, the construction budget, and project schedule. Construction papers are the basis of bid papers and the construction contract. While preparing the construction papers the estimated project cost is updated to reflect current construction cost which is compared with project budget to see whether the project can be completed within approved budget. Design professionals submit construction papers for review by the client and others as deemed necessary by the client and for final feedback after all correction are made. Design professional must incorporate all resulting changes into the 100% papers prior to submitting the final back check set.

Construction drawings shall normally consist of the following:

* General and Site Plan Drawings
* Detail Architectural Drawings
* Detail Structural Drawings
* Detail MEP (Mechanical, Electrical and Plumbing) Drawings
* **Procurement Process**

A major component of pre-construction work is to select a contractor who shall execute the work. Normally the selection is done through a procurement process. Procurement is the act of finding, acquiring, buying goods services or works from an external source, often via a tendering or competitive bidding process. A comprehensive procurement strategy that demonstrates careful consideration and analysis of all available options will enable project owners to identify the procurement method most suitable for the project in question. By using the appropriate procurement method, project owners can expect to attain improved value–for-money outcomes as risks will be most effectively managed and the incidence of contractual disputes, cost and time overruns is likely to be reduced. After preparation of construction papers the first stage of procurement process is the preparation of bidding or tender paper. There are several methods by which a contractor can be selected. Followings are some of these methods as per The Public Procurement Rules :( National Procurement)

* Open Tendering
* Limiting Tendering Method
* Two-stage Tendering Method
* Request for Quotation Method

There is also International Procurement. International organizations have also introduced Single -Stage Two Envelope procedure. It is the wish of the client to decide the procuring method.

During the procurement process the client addresses its specific needs through the information provided in the Tender Data Sheet and Particular Condition of Contract of the tender papers. Detail requirements are provided in the Bills of Quantities, specifications and drawings. Bill of quantities and specifications are prepared on the basis of construction drawings.

Normally following are the papers that forms a contract:

* Notice Inviting Tender
* Instruction to Tenderer
* Tender Data Sheet
* Evaluation and Qualification Criteria
* Tender Forms
* Eligible Countries
* Employers Requirements
* General Conditions of Contract
* Particular Conditions of Contract
* Contract Forms
* Specifications (General and Particular)
* Bill of Quantities
* Contract Drawings

**Site Information**

Before submitting the bid, the Contractor should visit the site and by his own independent observation and enquiry, acquaint himself fully with the local conditions, accuracy of the local records, accessibility of the site (including working areas) and full extent and nature of the operations necessary for the full and proper execution of the contract including, but not limited to the following:

* Availability of potable water and electricity,
* Space for construction of temporary works, labor accommodation,
* The character of soil, water table, extremes of weather and other natural conditions,
* The supply and use of labors, transportation of materials, equipment and plants,
* All other things necessary for the proper construction, completion and maintenance of the works according to Conditions of Contract, Specifications and drawings
* Labor law or any other law (tax law, VAT law etc.) that may affect the Contractor.
* Underground service lines in the area such as electric cable, water line, sewer line, gas line, telephone cables etc.

**Groundwater Investigation**

A general appreciation of the pattern of the groundwater flow can be of considerable value when considering such aspects as the location of the structure, the layout of the groundwater lowering installations, the penetration of sheet piling, secant piles and composition of grout curtain. The object of such study is to establish the source of water and deduce the way in which it flows in the region of the site and the possible influence of the engineering works and completed structure on this flow system. It should be recognized that ground water flow may be very different from theoretical patterns because of ground variation.

Ground water in a pervious soil stratum may be replenished directly from rain falling on the ground surface or by percolation from run-offs, streams or nearby rivers. The water pressure in pervious layers will usually change as a result of variations in seasonal rainfall, river and sea level in cases where there is direct connection between the pervious stratums and these sources.

Owing to low permeability of many soils, the water levels in boreholes or observation wells may take a considerable time to reach equilibrium with the ground water. Spot readings of the water level in boreholes may therefore give an erroneous impression of the true ground water level. Readings should be made in piezometer (Note 4) or simple standpipes over a sufficient period of time in order to obtain a proper assessment of fluctuation in the ground water level.

Seasonal variation in the level of ground water table may also be important. Where deep excavation is required, levels of water bearing strata should be determined with particular care and the water level and pressure in each stratum should be observed so that necessary precautions may be taken during excavation.

On sites liable to be waterlogged in wet weather, it is desirable to determine the contour of the water table relative to the ground surface in order to indicate the direction of the natural drainage. This will facilitate the design of intercepting drains to prevent the influx of groundwater into the site from higher ground.

Note 4 – Piezometer is an instrument for measuring the pressure of a liquid or gas, or something related to pressure (such as compressibility of liquid). Piezometers are often placed in boreholes to monitor the pressure or depth of ground water. Origin comes from Greek word ‘piezein’ meaning press, squeeze and English word ‘meter’)

**Geotechnical Site Investigation**

A geotechnical site investigation is the process of collecting information based on either preliminary site review of the past geotechnical investigation of nearby sites or actual test of the soil at site by standard testing methods and evaluating the condition of the site for the purpose of designing and constructing the foundation for a structure. Through geotechnical soil investigation, composition of the soil is known so as to examine the ability of the soil to withstand the load of the structure. If the soil at the proposed site is not suitable for the project, it might be necessary to select alternate site where the soil is suitable for the project. It is also probable that due to bad soil condition resulting in excess expenditure in the foundation might make the project not viable economically. Normally following are the stages of geotechnical soil investigation:

* Preliminary site evaluation by the geological consultant. The exploration of a site for an important structure requires the exploration and sampling of all strata likely to be significantly affected by the structural load. The extent of this exploration will vary with the site and structure. In built-up areas where experience of similar structures and sufficient quantitative information is available for a satisfactory design exploration may be limited to checking that the ground conditions are those expected in the neighborhood. It consists of preliminary site review of the past geotechnical investigations of the nearby sites and a selection of likely foundation design based on published literature and the geotechnical consultant’s knowledge of the site. It would include a preliminary site visit by a geotechnical engineer to collect visible data and performance information of existing buildings in order to complete the office phase of the evaluation and discuss the findings with the owner and structural engineer. If existing information is not sufficient or is inconclusive, the site should be explored in detail to obtain knowledge of the type, consistency, thickness, sequence, discontinuities, depth of strata and knowledge of the ground water condition.
* Geotechnical site investigation (test holes and sampling) and laboratory testing for soil characteristics. For examination of fairly shallow depths, where conditions are suitable, trial pits have the advantage that the sides of the pits can be inspected at all levels. Where “made” ground is encountered, trial pits enable it to be identified and may enable its probable bearing capacity to be assessed. For deeper explorations where the ground is unsuitable for trial pit, bore holes or drill holes are required.
* Geotechnical report preparation with recommendation for foundation type options.

The scope of these guidelines is to plan a geotechnical site investigation of the soil, report the results from field investigation and laboratory testing in terms of internationally recognized classified systems, and provide foundation design and construction recommendations that addresses the requirements of the building.

**Pre-construction Meeting**

Prior to starting a project, a preconstruction conference should be held a few days or a week before the work starts to define and allocate responsibility of the entire construction team. It is imperative that all members of the team including owner, project manager, architect, structural engineer, MEP engineers, general contractors, sub-contractor, if any, inspectors etc. shall be present in the meeting. This meeting should be held well in advance of the starting of the project to ensure that sufficient time is ensured for all parties to be absolutely clear on what their responsibility would be in the implementation of the project. 6,8,11

Every construction project brings different companies, personnel, and procedure and as two jobs are never the same, it is always necessary to realign individual responsibilities. Pre-construction conferences are needed to sort out the details of how a project shall be executed, identify the authorized contacts for various aspects, and what should be done if some things do not go as planned. In many cases projects are started without a clear understanding of assigned responsibilities resulting in extra work, lost time, and major expenses.

The pre-construction conference agenda should contain the following to ensure that all details are addressed prior to starting of the project:

* Project information and schedule
* Project participants with their responsibilities
* Construction sequences and processes
* Site access
* Power, light, water
* Formwork and scaffolding
* Specification requirements for concrete and steel
* Quality control/quality assurance
* Job site environmental management
* Job site safety and security
* Adverse weather precautions for concreting
* Material storage
* Test specimen storage, transportation and testing
* Ready-mix concrete plant inspection, scheduling and delivery
* Responsibility for inspection of forms, re-bar placing prior to concrete placing
* Test of in-place concrete, (method) if necessary.

Agenda should be sent to all invited parties with the notice of the meeting. There will be some items that the contractor will be asked to prepare for this meeting, so it is important to give the contractor reasonable advance notice in order for them to prepare. Complexity of the project shall determine the information to be covered in a pre-construction meeting.

**Project with Basement**

For a project with basement, preconstruction meeting is a must if the project requires de-watering. The meeting should include project manager, client or his representative, contractor, geotechnical engineer, sub-contractor doing the excavation work, construction supervisor, representative from statutory body etc.

The contractor shall take excavation permission before starting the excavation work.

During pre-construction meeting, soil report shall be reviewed for shoring of basement excavation requirements.

If required, a de-watering plan must be prepared and submitted for approval.

**Site Management**

Construction site management involves managing construction works. Construction managers must oversee a variety of resources including labor, equipment, materials and capital. They must also deal with numerous local and national regulations, as well as coordination with contractors, architects, structural designers, MEP designers’ workers, suppliers, engineers etc.

**Sitemanager**

Site manager is the senior construction company representative. The site manager’s role is the supervision and management of all site based staff employed by the company/contractor to ensure that the project is delivered within their contractual obligation. The major responsibilities of site manager are:

* Advise and assist in overall planning;
* Planning and coordinating resources;
* Monitor and control progress and quality;
* Communicate with the consultant team;
* Provide feedback and report to the Project Manager;
* Ensure that all aspects of the project are carried out in accordance with statutory requirements;
* Ensure that all aspects of the project are carried out as per design.

**Site layout plans**

Site layout plans are prepared by contractors as part of their mobilization activities before work on the site commences. Site layout plan is a crucial part of pre-construction plan as it involves the co-ordination and movement of large quantities of materials as well as high value products, plants and people. Effectively and accurately laying out a site can help ensure that the works are undertaken efficiently and safely. Careful sizing and positioning of temporary facilities can help reduce travel times congestion and so on and help the site a more effective workplace with better worker morale.

Site layout plan involves four basic processes:

* Identifying the site facilities that will be required;
* Determining the sizes, and other constraints of those facilities;
* Establishing inter-relationship between the facilities;
* Optimizing the layout of the facilities on the site.

Site layout plans might include locations for and sizes of:

* Site office;
* Off-loading, temporary storage and storage areas;
* Access, entrances, security and access control, temporary roads;
* Waste management and recycling areas;
* Site hoarding and existing boundaries;
* Protection for trees, existing buildings, neighboring buildings and so on;
* Adequate yard lighting and lighting of night shift;
* Crane location with radii and capacity;
* Fabrication facility area for reinforcement work;
* Testing facilities areas
* Labor sheds with toilet and emergency medical facilities.

As sites will change in nature during the course of works, there may be a number of different site layout plans for different phases of construction.

**Temporary works**

Permanent works are the parts of construction project that will be used and remain in position for long time, say 60 to 70 years. These include buildings and other structures such as bridges, road retaining walls etc. The construction of most types of permanent works will require the use of some form of temporary works. Temporary works (TW) are the parts of construction project that are needed to enable the permanent works to be built. Usually the TW are removed after use–e.g. work sheds temporary field office, labor sheds, material storage facilities, formworks, scaffolds etc. Normally temporary works are the responsibility of the contractor. The party responsible for temporary work should carry out the work in a manner that does not create unacceptable risk or harm to the workers, neighbors and members of the public.

**Contractor’s field office**

Before starting the construction of the project, it is necessary that field office be constructed for the contractor and his staff members with proper electricity, water and sanitary facilities.

It is recommended that the Contractor shall submit to the Project Manager necessary plan and drawings showing proposed details and site location including foundation, electrical, sanitary, water supply system etc.for approval before construction. The Project Manager may require revision of the drawings prior to approval for construction. The Contractor shall also submit details of furniture, fittings and equipment to the Project Manager for approval.

The Contractor shall provide standard sanitation and refuse collection facilities for the site office complying with the regulations of City Corporation and sewerage authority.

**Pre-construction photographs**

Before starting the construction work the Contactor shall take digital photographs of site and surrounding properties from different points of view as selected by the Project Manager. Photographs in sufficient numbers shall be taken to show existing conditions of the properties adjacent to the site before starting the work. Photographs of existing structures either on or adjacent to the site should be in sufficient details to record accurately the physical condition before starting the construction.

**Remedial measures for environmental impact**

The project shall be planned, organized and implemented in such a way that the environment is least affected. Normally, it is the responsibility of the contractor to undertake the construction works observing all environmental mitigation measures and follow standard papers. The Contractor shall take reasonable steps to protect the environment on and off the site and to avoid any damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operations. During continuance of the contract, the contractor shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bylaws of the Government nor local authorities and any other law, by-law, regulations that may be passed or notification that may be issued in this respect in future by the Government or the local authority. It is the responsibility of the contractor to take all measures for the prevention and control of pollution of the ground and surface water from oil and waste oil spills, sanitary facilities, construction wastes, paints and any other chemicals used in the construction. Stagnation of water within or outside the project area from the project activities should be avoided to prevent mosquito breeding and other vector borne diseases.

The construction activities shall bring forth several issues concerning the environment. Some of these along with the actions required are shown in Table 1.

**Table no 1:** Mitigation measures required on environmental issues.

|  |  |  |
| --- | --- | --- |
| Sl.No. | Activity/ Concern | Action Required |
| 1.0 | Operation of stationary plants like concrete mixer machine, generators, crusher etc. | To be located in a place where neighbors are least disturbed. The plants should have noise silencers and dust arresters. |
| 2.0 | Transport of loose natural materials like soil, sand etc. | To carry the materials in moist conditions or wet the top layers by water spray. On windy days sand trucks shall be covered over by tarpaulin or similar other materials. |
| 3.0 | Disposal of excavated unsuitable materials/waste materials /debris/rubbish | Should be at locations approved by the Project Manager/City Corporation |
| 3.0 | Storage of fuel and chemicals | Shall be in properly fenced protective location with firefighting equipment. All precaution against leakage, pilferage, or unauthorized use of the materials shall be taken. |
| 5.0 | Water quality | The operations shall not pollute surface or underground water or cause flooding of the area. Drinking water supplied to the workman shall be pure drinking water free from any harmful or injurious materials. |
| 6.0 | Air quality | Construction vehicles and machines shall be kept well-tuned and in good working conditions. The engines should be switched off while not in use. Dust generating operations shall not be taken up during high wind periods. |
| 7.0 | Noise | The vehicles and machinery shall have internationally accepted silencers and noise abating measures. |
| 8.0 | Healthcare of workman | The contractor’s workman shall be provided with first aid and other healthcare facilities. For all workmen in his labor camp, the contractor shall have health check-up carried out to ensure that none of his workers have communicable and deadly diseases like AIDS etc. |
| 9.0 | Sanitary facilities for labor camps | Where a camp for stay of the workman is established, the contractor shall ensure supply of potable water and provide necessary facilities for the disposal of solid and human waste satisfying the requirements of local public health authorities. |
| 10. | Dust | All surfaces creating a significant amount of dust in the atmosphere shall be watered regularly by the Contractor. |
| 11. | Accumulation of waste, debris and rubbish | Throughout the construction period, the Contractor shall keep the site free from accumulation of waste, unsuitable materials, debris and rubbish. |

**Site preparation**

Preparation of site is the first task before construction can be started. To start a project in a site that is unfriendly shall hinder the project activity and delay the project implementation. As such site preparation activity should be undertaken with right earnest before any building project can be started. Preparation of site properly means much safer and productive working environment.

* **Steps of site preparation**

The following factors are considered for the construction site preparation:

* The first step of site preparation work is to remove all scrubs or jungles, removal of trees, demolishing buildings and removal of any or all old underground infrastructure, and any other obstacles that might affect the construction process in future. The roots of the trees should be totally uprooted.
* The whole area will be roughly leveled provided the site is not much uneven for contractor to spend substantial amount of money. For an uneven or undulated site it is advisable to undertake pre-construction contour survey for calculation of amount of cutting and filling.
* Permanent bench mark shall be established at a suitable point in the construction site with the help of a surveyor.
* Surveyor shall be engaged to lay orientation and trench lines or center lines of the columns and walls as well as boundary lines of the building in the construction site.
* Location of storage and stacking of materials shall be set on the ground in the site.
* Location of field office, go downs, guard and labor shed, access and exit roads for trucks and carts shall be set.
* Site shall be properly fenced for safety of the people working at the construction site and the public. Proper safety lights shall be installed for night time safety as per requirements of local bodies.
* **Layout of the Building**

The process of laying out (or setting out) a building is an important part of surveying as it enables the works to proceed on site exactly according to the prepared design. Accurately setting out is the most important part of the construction and errors can be very expensive and time consuming to correct it. It should only be undertaken by competent persons and all works should be thoroughly checked by different personnel. Setting out usually undertaken once the site has been subject to conditioning survey and desk study, and has been cleared of any debris or obstructions. Works necessary to create required levels may also have been completed before the layout process begins. The position and orientation of the structure is generally described in architects or engineer’s drawings defining precisely how the layout should be done. The controlling points of the structure can then be marked so that the construction team is able to easily identify them. This usually consists of marking the buildings re-entrant corners, grid lines, horizontal and vertical positions, using stakes, temporary pillars with string lines and other methods.

**Contour Survey –** If the site is significantly undulated and requires cutting and filling to make it fairly level with the proposed ground level, a pre-construction contour survey should be undertaken to ascertain the quantity of earth cutting/filling.

**Baseline –** A baseline is a straight reference line with respect to which corners of the building are located on the ground. It may be outer boundary of a road, or boundary of the area or simply a line joining two points.

**Temporary Bench Mark (TBM) –** The temporary bench mark (TBM) is fixed on a site to which all levels are related and should be established at an early stage. Where possible the bench mark should be fixed in relation to a national bench mark considering highest flood level, road top or other important infrastructure. On the site, it could relate to any permanent fixture such as road top, permanently driven post etc.

**Horizontal Controls –** These are the points that have known coordinates with respect to specific points. Other points such a layout corners can then be located. Sufficient number of control points should be used so that each point of the plan can be precisely located on the ground.

**Vertical Controls –**In order that design points on the works can be positioned at their correct levels, the vertical points are established relative to specified vertical datum – often a timber post set on brick work or concrete.

Horizontal or vertical controls are generally established during the leveling phase using a total station/theodolite or similar instrument.

**Plinth Level –** Plinth is defined as the portion of the building between the surface of the surrounding ground and the surface of the floor, immediately above the ground. The level of the floor is usually known as the plinth level. The built-up covered area measured at the floor level is known as plinth area. While giving the layout of the building the plinth level shall have to be fixed based on architectural drawings.

**Building Layout**

For a simple building layout, such as a rectangle, the outline of the building is marked by cord fixed to corner posts. A theodolite or builders square is used to turn-off 900 angles for the remaining corners. Ranging rods may be required to establish a straight line between corner posts. Corner posts are usually 50x50mm timber posts driven firmly into the ground with a nail in the post’s center. The outline may be marked on the ground with dry lime or similar powder. If space is available corner posts may be driven at an off-set to avoid its removal from the point during excavation work. In such case the corner point may be established by threads perpendicular to each other and a plumb bob.

When the outline of the building is more complicated than a simple rectangle, it may be necessary to establish a range of points in the same way as for laying out a simple rectangle. However, great care is required, as small errors are more likely to be introduced as more points are positioned. For a building with a series of grid lines in both directions, individual grid lines should be established from the base line by means of total station/ theodolite. The intersections of grid lines mark the center point for columns as well as isolated or mat foundation. Once the grids have been set out, offset pegs can be fixed clear of any subsequent excavation work. Control of excavation depth can be by achieved by level and staff related to a site datum.

1. **Discussion**

Pre-construction work results in a comprehensive set of documents and plans to guide project execution. These include detailed architectural, structural, and MEP drawings and specifications. A procurement strategy and contract documents are developed. Site conditions are fully characterized through investigations. Project budgets and schedules are refined based on developed designs. Constructability and value engineering reviews identify optimization opportunities. Risk assessments highlight key project challenges. Site logistics and management plans ensure efficient operations. Environmental mitigation strategies are established. The physical site is prepared and building layout is accurately marked, allowing construction to commence with confidence.

In this prospective according to study, recommendations can be summarized –

* Conduct comprehensive geotechnical site investigations to fully understand soil conditions.
* Develop detailed project designs through schematic, design development, and construction paper phases.
* Utilize value engineering to identify cost-saving opportunities without sacrificing functionality.
* Hold pre-construction meetings with all key stakeholders to align on responsibilities and processes.
* Create thorough site layout plans to optimize efficiency and safety during construction.
* Implement environmental mitigation measures to minimize negative impacts.
* Carefully prepare the construction site by removing obstacles and establishing survey controls.
* Accurately lay out the building footprint and key reference points on site.
* Establish clear quality control and inspection processes before construction begins.
* Develop a detailed procurement strategy and contractor selection process.

1. **Conclusion**

Pre-construction works form a critical foundation for successful building projects. By thoroughly planning and preparing before breaking ground, project teams can identify and mitigate potential issues, optimize designs and processes, and set realistic budgets and schedules. Key activities like geotechnical investigations, detailed design development, contractor selection, and site preparation enable smoother project execution and help avoid costly changes or delays during construction. Environmental considerations and mitigation measures should be integrated from the start. Careful layout and establishment of survey controls ensures accuracy in translating designs to reality on site. While pre-construction planning requires significant upfront time and resources, it ultimately facilitates more efficient, cost-effective, and high-quality project delivery. By following the best practices and recommendations outlined in this paper, project owners and managers can maximize the benefits of the pre-construction phase and position their building projects for success.

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