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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – I - Construction Management -SAR1404

CONSTRUCTION MANAGEMENT AND STAKEHOLDERS

Objectives

The construction management typically include the following: Specifying project objectives and plans including delineation of scope, budgeting, scheduling, setting performance requirements, and selecting project participants.

Scope of Construction Management

The main purpose of CM is to control project time, cost and quality. CM is compatible with all project delivery systems. Reduce overall project costs, contract negotiation, reducing change orders, orders reduction in time and elimination of unnecessary scope and cost

Stakeholder

A stakeholder is anyone who has an interest in the process or outcome of a project. In a typical construction project, any or all of the following may be a stakeholder:

- the client
- the main contractor
- designers
- subcontractors
- people employed in any capacity in the project
- local authorities
- the end users
- professional bodies
- local residents
- local business owners
- politicians
- lobby groups
- and many more...

Client

The client, he is the potential owner of the construction facility. It is he who sponsors the work, finances their construction and utilizes the facility constructed. Client may be a govt. body, a public or private enterprises. Construction work can be executed through clients own organization or through contractors

Consultants

Consultants are rendering certain services on contract basis. Generally task assigned includes –

- (a) Project feasibility study, including cost estimates.
- (b) Site survey and soil investigation.
- (c) Estimating, initial planning and budgeting
- (d) Scrutiny and coordination of design and drawing work .
- (e) Processing prequalification of construction agencies, tendering and awarding contracts to the successful bidder.
- (f)Designing project organization for executing works and developing standard operating procedures and systems. (g)Developing detailed construction plans, project schedules and performance measuring standards.
- (h)Supervising works, including administration of contract and controlling of project time, cost and quality objectives.

Contractors

Construction contractors form the backbone of the construction business as they execute most of the construction work. In the competitive construction business, the contractor generally tends to specialize in particular area of construction.

Contractor classification

- General contractors
- Building contractors
- Specialist contractors for various types of heavy infrastructure construction work like highways, bridges, dams etc.
- Specialist contractors for various categories of industrial works like power plants, process industries, etc.
- Specialist utility services contractors. These include electrical contractors, water supply and sewage disposal contractors, HVAC(heating, ventilation and air conditioning) contractors.

Financial institutions

Infrastructure are normally financed on project basis. This refers to financing in which lenders look to the cash flows of an investment for repayment, without recourse to either equity sponsors or the public sector to make up any shortfall. This arrangement has several advantages: reduces the financial risk of the investors; may allow more debt in the financing structure; results in limited liability on project sponsors and more careful project screening.

Money is

Most important resource

All other resources depends on availability of funds.

So financial resources should be planned very carefully.

REGULATORY

There is a need to regulate a service provider to ensure that services provided reflect the adequate level and meet the desired standard or quality. Several risks are involved in the absence of a regulatory system.

The main risks are:

• Excessive tariff

• Inadequate service level and quality

• Non-compliance of contractual obligations to users, government or other parties

• Low efficiency in production and in the provision of goods and services

• Inadequate level of investment in the sector, and

• Frequent discontent between the parties involved.

In order to eliminate or minimise these risks, an appropriate regulatory system needs to be in place and should be considered at the planning stage of a project. The powers to regulate are provided in the relevant legal instruments, statutory rules, concession/contract agreements, and other applicable documents. The structure of the regulatory authority varies from one country to another and may also vary by sector within a country. There can also be various institutional arrangements with respect to regulatory authorities that may include: the concerned ministry, a special cell within the ministry, regulation by contract, and an independent regulator with discretionary powers. Often, PPPs rely mainly on regulation by contract, particularly in the early years of PPP development. This is also a common form of regulatory arrangement in the roads sector. In such a case, a contract administrator monitors compliance with the contract agreement. Investors may often prefer such arrangements because of low discretionary powers on the part of the regulator. However, the major disadvantage of regulation by contract is that such contracts may be difficult to adjust or renegotiate, if such a necessity arises.

What is public-private partnership in infrastructure projects ?

Governments in most developing countries face the challenge to meet the growing demand for new and better infrastructure services. As available funding from the traditional sources and capacity in the public sector to implement many projects at one time remain limited, governments have found that partnership with the private sector is an attractive alternative to increase and improve the supply of infrastructure services. The partners in a PPP, usually through a legally binding contract or some other mechanism, agree to share responsibilities related to implementation and/or operation and management of an infrastructure project.

This collaboration or partnership is built on the expertise of each partner that meets clearly defined public needs through the appropriate allocation of1 :

• Resources

• Risks

• Responsibilities,

• Rewards

IMPORTANT CHARACTERISTICS OF PPP PROJECTS

Promise of better project structure and design.

• Allows better screening of projects. A bad project is a bad project no matter whether it is implemented by the public or the private sector.

• Better choice of technology based on life-cycle costing.

• Better service delivery, especially if performance based payment is considered.

• Better chances of completion on time and within the budget.

− Risk of default.

− Project risks can easily turn into government risks.

− Various liabilities on government (direct and indirect).

− A long-term contract management system needs to be in place.

− An administrative mechanism and special skills in the government are required to develop and implement PPP projects.

Social and environmental impacts and mitigation measures

The likely social and environmental impacts of the project and their possible mitigation measures need to be assessed early on in the project planning phase. Many countries have special laws on environment, which stipulate the requirements for environmental impact studies.

These requirements need to be carefully assessed. Large tracts of land may be required for many infrastructure projects. In such cases, resettlement and rehabilitation of the affected people and compensation for the acquired land/property may become major issues in project development and implementation. The problem may become of a serious nature in the absence of fair policies, and necessary legal measures to deal with such complex social issues.

These issues also have deep financial as well as political implications. Some governments have formulated clear policies on these matters. The social, legal, administrative and financial implications of these issues need to be carefully considered during the project planning stage.

Environmental impact assessment

Purpose of Environmental Impact Assessment of Construction Projects

- The purpose of the Environmental Impact Assessment study is to establish existing baseline conditions in the project area and to proactively assess the potential impacts and associated impacts of the proposed project on the project area.

The main objectives of the EIA are to:

- Establish the existing bio-geo-physical and socio-economic conditions of the project area.
- Identify the resultant impacts (positive and negative) associated with the installation and operation of the project.
- Make recommendations to eliminate/mitigate/control the magnitude and significance of the identified impacts.
- Recommend plan and procedures to manage the consequences and
- To integrate the views and opinions of stakeholders, National and International environmental regulations, codes and conventions relevant to the proposed dam activities into the final project design from the EIA report Review.

Environmental protections

Storm water pollution: As a result of construction, the soil is displaced from its original location which can possibly cause environmental problems in the future. Runoff can occur during storms which can possibly transfer harmful pollutants through the soil to rivers, lakes, wetlands, and coastal waters.

Endangered species: If endangered species have been found on the construction site, the site must be shut down for some time. The construction site must be shut down for as long as it takes for authorities to make a decision on the situation. Once the situation has been assessed, the contractor makes the appropriate accommodations to not disturb the species.

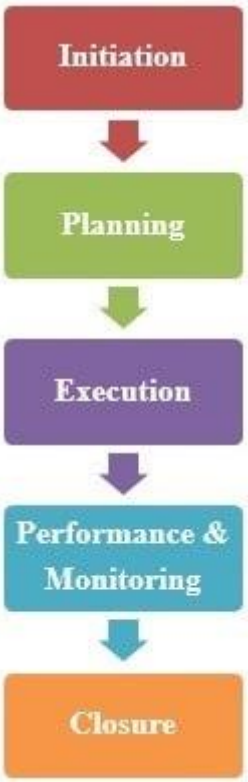
Vegetation: There may often be particular trees or other vegetation that must be protected on the job site. This may require fences or security tape to warn builders that they must not be harmed.

Wetlands: The contractor must make accommodations so that erosion and water flow are not affected by construction. Any liquid spills must be maintained due to contaminants that may enter the wetland.

Historical or cultural artifacts: Artifacts may include arrowheads, pottery shards, and bones. All work comes to a halt if any artifacts are found and will not resume until they can be properly examined and removed from the area.

Life Cycle Phases in Construction Project

- A standard construction project, in general, has following five major life cycle phases:
- Initiation
- Planning
- Execution
- Performance and monitoring
- Closure



1. Initiation Phase of Construction Project

- We have to create and evaluate the project in order to determine if it is feasible and if it should be undertaken, at the beginning of the project. Here the project objective or need is identified; this can be a business problem or opportunity.
- A suitable response to the need is documented in a business case with recommended solution options. A feasibility study is conducted to examine whether each option clearly identifies the project objective and a final recommended solution is determined.
- Many questions related to the issues of feasibility i.e. “can we do the project?” and justification like “should we do the project?” are mentioned and faced.
- When a solution is approved, a project is initiated to implement the approved solution. For this, a project manager is appointed. At this stage, the major deliverables and the participating work groups are identified.

2. Planning Phase of Construction Project

- The planning phase involves further development of the project in detail to meet the project's objective. The team identifies all of the work to be done. The project's tasks and resource requirements are identified, along with the strategy for producing them.
- In a broader sense identification of each activity as well as their resource allocation is also carried out. A project plan outlining the activities, tasks, dependencies, and timeframes is created.
- The project manager is the one who coordinates the preparation of a project budget by providing cost estimates for the labor, equipment, and materials costs. This is mainly carried out by project scheduling software like MS project or PRIMAVERA. This scheduling charts would help us to track the stages of our project as time passes. This is also referred to as "**scope management**."
- The budget of the project already estimated is used to monitor and control cost expenditures during project implementation.
- Finally, we require a document to show the quality plan, providing quality targets, assurance, and control measures, along with an acceptance plan, listing the criteria to be met to gain customer acceptance. At this point, the project would have been planned in detail and is ready to be executed.

3. Execution Phase of Construction Project

- This is the implementation phase, where the project plan is put into motion and the work of the project is performed practically on site. It is essential to maintain control and communicate as needed during each implementation stages.
- Progress should be continuously monitored and appropriate adjustments are made and recorded as variances from the original plan. A project manager is the one who spends most of the time in this step. Throughout the project implementation, people carry out the tasks, and progress information is being reported through regular project team meetings.
- The project manager uses this information to preserve control over the direction of the project by comparing the progress reports with the project plan to measure the performance of the project activities. If any deviation is found from the already defined plan corrective measures are made.
- The first option of action should always be to bring the project back to the original plan. If that cannot happen, the team should record variations from the original plan and record and publish modifications to the plan. all through this step, project sponsors, and other key stakeholders are kept informed about the project's status as per the agreed rate and format of communication. The plan should be updated and available on a regular basis.
- Status reports should always highlight the probable end point in terms of cost, schedule, and quality of deliverables. Each project deliverable produced should be reviewed for quality and measured against the acceptance criteria.
- When deliverables have been produced and the customer has agreed on the final solution, the project is said to be ready for closure.

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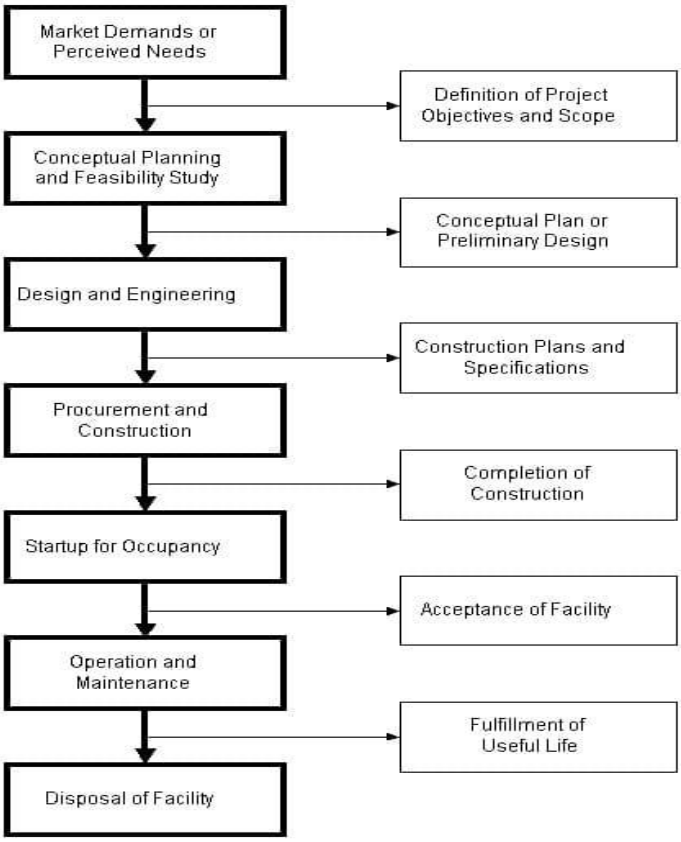
4. Performance and Monitoring Phase of Construction Project

- This stage is all related to the measurement of progress and performance to make sure that items are tracking with the project management scheduling. This phase regularly happens at the same time as the execution phase.

5. Closure Phase of Construction Project

- During the final closure, the importance is on providing the final deliverables to the customer, that is:
- Handing over project documentation to the business
- Termination of supplier contracts
- Releasing project resources
- Communicate the closure of the project to all stakeholders.
- Last and final is to conduct lessons-learned studies to examine what went well and what didn't.

This type of analysis would make the knowledge of experience to be transferred back to the project organization, which will help future project teams.



Types of Construction

Seven types of construction

- **Agricultural:** Typically economical buildings, and other improvements, for agricultural purposes. Examples include barns, equipment and animal sheds, specialized fencing, storage silos and elevators , and water supply and drains such as wells, tanks, and ditches.
- **Residential:** Residential construction includes houses, apartments, townhouses, and other smaller, low-rise housing, small office types.
- **Commercial:** This refers to construction for the needs of private commerce, trade, and services. Examples include office buildings, "big box" stores, shopping centers and malls, warehouses, banks, theaters, casinos, resorts, golf courses, and larger residential structures such as high-rise hotels and condominiums.
- **Institutional:** This category is for the needs of government and other public organizations. Examples include schools, fire and police stations, libraries, museums, dormitories, research buildings, hospitals, transportation terminals, some military facilities, and governmental buildings.
- **Industrial:** Buildings and other constructed items used for storage and product production, including chemical and power plants, steel mills, oil refineries and platforms, manufacturing plants, pipelines, and seaports.
- **Heavy civil:** The construction of transportation infrastructure such as roads, bridges, railroads, tunnels, airports, and fortified military facilities. Dams are also included, but most other water-related infrastructure is considered environmental.
- **Environmental:** Environmental construction was part of heavy civil, but is now separate, dealing with projects that improve the environment. Some examples are water and wastewater treatment plants, sanitary and storm sewers, solid waste management, and air pollution control.

The stages of a typical construction project have been define as **feasibility**, **design**, **construction** and **operation**, each stage relating to the project life cycle.

Feasibility and design

Feasibility and design involves four steps: programming and feasibility, schematic design, design development, and contract documents. It is the responsibility of the design team to ensure that the design meets all building codes and regulations. It is during the design stage that the bidding process takes place.

- **Conceptual/Programming and feasibility:** The needs, goals, and objectives must be determined for the building. Decisions must be made on the building size, number of rooms, how the space will be used, and who will be using the space. This must all be considered to begin the actual designing of the building. This phase is normally a written list of each room or space, the critical information about those spaces, and the approximate square footage of each area.

- **Schematic design:** Schematic designs are sketches used to identify spaces, shapes, and patterns. Materials, sizes, colors, and textures must be considered in the sketches. This phase usually involves developing the floor plan, elevations, a site plan, and possibly a few details.
- **Design development (DD):** This step requires research and investigation into what materials and equipment will be used as well as their cost. During this phase, the drawings are refined with information from structural, plumbing, mechanical, and electrical engineers. It also involves a more rigorous evaluation how the applicable building codes will impact the project.
- **Contract documents (CDs):** Contract documents are the final drawings and specifications of the construction project. They are used by contractors to determine their bid while builders use them for the construction process. Contract documents can also be called working drawings.

Pre-construction

The pre-construction stage begins when the owner gives a notice to proceed to the contractor that they have chosen through the bidding process. A notice to proceed is when the owner gives permission to the contractor to begin their work on the project. The first step is to assign the project team which includes the project manager (PM), contract administrator, superintendent, and field engineer.

- **Project manager**: The project manager is in charge of the project team.
- **Contract administrator**: The contract administrator assists the project manager as well as the superintendent with the details of the construction contract.
- **Superintendent**: It is the superintendent's job to make sure everything is on schedule including flow of materials, deliveries, and equipment. They are also in charge of coordinating on-site construction activities.
- **Field engineer**: A field engineer is considered an entry-level position and is responsible for paperwork.
- During the pre-construction stage, a site investigation must take place. A site investigation takes place to discover if any steps need to be implemented on the job site. This is in order to get the site ready before the actual construction begins. This also includes any unforeseen conditions such as historical artifacts or environment problems. A soil test must be done to determine if the soil is in good condition to be built upon.

Procurement

- The procurement stage is when labor, materials and equipment needed to complete the project are purchased. This can be done by the general contractor if the company does all their own construction work. If the contractor does not do their own work, they obtain it through subcontractors. Subcontractors are contractors who specialize in one particular aspect of the construction work such as concrete, welding, glass, or carpentry. Subcontractors are hired the same way a general contractor would be, which is through the bidding process. Purchase orders are also part of the procurement stage.

- **Purchase orders:** A purchase order is used in various types of businesses. In this case, a purchase order is an agreement between a buyer and seller that the products purchased meet the required specifications for the agreed price.

Construction

- The construction stage begins with a pre-construction meeting brought together by the superintendent (on an American project). The pre-construction meeting is meant to make decisions dealing with work hours, material storage, quality control, and site access. The next step is to move everything onto the construction site and set it all up.
- A **Contractor progress payment schedule** is a schedule of when (according to project milestones or specified dates) contractors and suppliers will be paid for the current progress of installed work.
- **Progress payments** are partial payments for work completed during a portion, usually a month, during a construction period. Progress payments are made to general contractors, subcontractors, and suppliers as construction projects progress. Payments are typically made on a monthly basis but could be modified to meet certain milestones. Progress payments are an important part of contract administration for the contractor. Proper preparation of the information necessary for payment processing can help the contractor financially complete the project.

Owner occupancy

- Once the owner moves into the building, a warranty period begins. This is to ensure that all materials, equipment, and quality meet the expectations of the owner that are included within the contract.

Construction project planning

Construction project planning is like creating a roadmap that leads everyone through all the phases of the project. It's a formal document that requires approval from the client or stakeholder, and shows how the project will be executed and controlled.

- Business Benefits: what is the return on investment of the project.
- Planning Permission: you must get approval and adhere to building and municipal codes.
- Project Description: outline what the project is and how you're planning to execute it.
- PM and Team: who is leading the project and who will make up the teams executing the plan.
- Project Design: the plans, blueprints and other drawings detailing the build.
- Bid and Contract: there are a couple of different bidding methods, which should be detailed here, also the details of the contract.
- Construction Process: identifying activities and resources required to make the design a physical reality.
- Occupation and Defects Liability Period: outlining the process the client takes once possessing the development to occupy it.

Schedule

The schedule is created by collating the thoughts of many people; the specialist Planning, Scheduling, Monitoring and Control planner's role is to form these thoughts into a coherent schedule, and then to communicate it effectively. This will include:

• developing logistical plans;

• setting up the schedule in planning software;

• deciding how the plan is to be presented and communicated.

Monitoring and Control Processes

Monitoring and Control Processes

- Monitoring and Control processes include:

1. Monitoring and Controlling Project Work

The Monitoring and Controlling Project Work process collects, measures and disseminates performance information, and assesses measures and trends to forecast potential items requiring corrective action. This includes monitoring project risks and ensuring that they are being managed according to the project's risk plans.

- Outputs include:
- Recommended corrective actions
- Recommended preventive actions
- Forecasts
- Recommended defect repair
- Requested changes

2. Integrated Change Control

The Integrated Change Control process ensures that changes as a result of project corrective actions and other controlling factors are managed across the project knowledge areas. *Integrated change control takes place throughout the project, from project initiation through project closure*.

- Outputs include:
- Approved change requests
- Rejected change requests
- Updates to the Project Management Plan
- Updates to the Project Scope Statement (and requirements)
- Approved corrective and preventive actions
- Approved defect repair
- Validated defect repair
- Deliverables

3. Scope Verification

The scope verification process ensures that project deliverables are formally accepted.

- Outputs include:
- Accepted deliverables
- Requested changes
- Recommended corrective actions

4. Scope Control

The Scope Control process ensures that changes to project scope are controlled.

- Outputs include:
- Updates to the Project Scope Statement and Scope baseline (this includes requirements)
- Updates to the Work Breakdown Structure (WBS) and the WBS Dictionary
- Requested changes
- Recommended corrective actions
- Updates to organizational process assets
- Updates to the Project Management Plan

5. Schedule Control

The Schedule Control process monitors and controls changes to the project schedule.

- Outputs include:
- Updates to the schedule model data and baseline
- Performance measurements
- Requested changes
- Recommended corrective actions
- Updates to organizational process assets
- Activity list and activity attribute updates
- Updates to the Project Management Plan

6. Cost Control

The Cost Control process monitors and controls costs and changes to the project budget.

- Outputs include:
- Cost estimate updates
- Cost baseline updates
- Performance measurements
- Forecasted completion
- Requested changes
- Recommended corrective actions
- Updates to organizational process assets
- Updates to the Project Management Plan

7. Performing Quality Control

The quality control performance process measures specific project results to determine whether the project is meeting quality standards.

- Outputs include:
- Quality control measurements
- Validated defect repair
- Updates to the quality baseline
- Recommended corrective and preventive actions
- Requested changes
- Recommended defect repair
- Updates to organizational process assets
- Validated deliverables
- Updates to the Project Management Plan

8. Managing the Project Team

This process tracks team member performance, provides feedback, resolves issues and coordinates changes to maintain and improve project performance.

- Outputs include:
- Requested changes
- Recommended corrective and preventive actions
- Updates to organizational process assets
- Updates to the Project Management Plan

9. Performance Reporting

The Performance Reporting process collects and distributes performance information — including status reports, progress reports and forecasts.

- Outputs include:
- Performance reports
- Forecasts
- Requested changes
- Recommended corrective actions
- Updates to organizational process assets

10. Managing Stakeholders

This process manages stakeholder communications and works with stakeholders to ensure that requirements are satisfied and issues are proactively resolved.

- Outputs include:
- Resolved issues
- Approved change requests
- Approved corrective actions
- Updates to organizational process assets
- Updates to the Project Management Plan

What is a Construction Project Schedule?

When it comes to construction management, maintaining a construction project schedule is one of the most important parts of a project. A well-planned schedule helps minimize downtime and ensures that all parts of the project are completed on-time and on-budget.

The lifecycle of a construction project begins when an owner identifies a market need and ends when the project is completed and turned over to the owner. A well-executed construction project schedule outlines each step and provides dates for completion.

Keeping Construction Projects On-Time and On-Budget

- Construction schedules are the basis of many financial outcomes. The development of early schedules can be useful for forecasting completion and milestones that can affect financial decisions.
- Baseline schedules are crucial to keeping construction projects on-time and on-budget. It's never too early to have a plan and know your timeline. Understanding the basics of scheduling is a necessary part of the development and management of construction projects.

Planning a Construction Project Schedule

- There are a number of things that should be considered when planning a construction project schedule. Design, necessary permits and cost must all be taken into consideration. The scheduling process forces the contractor to imagine how they will complete the project. It provides a thorough planning process and helps create a clear plan that can be shared with everyone else involved.
- Construction schedules typically focus on two major aspects; determining how long each activity will take to complete and determining who is responsible for completing each activity.

Benefits of a Well-Planned Construction Schedule

- A properly executed construction schedule can help manage materials, labor and equipment. It also allows for adjustments to accommodate unexpected events. This allows construction management to complete projects on-time and on-budget.
- Construction schedules help identify and manage the activities necessary to complete each task as well as the order in which each task must be completed.

Quality Construction Scheduling and Management

- Spire Consulting Group provides quality construction project scheduling and management. Spire utilizes standard industry scheduling methods and software to develop, monitor and report progression of construction projects. This allows us to alert our clients of potential problems and corrective actions.

Construction Contract Documents

- Contract drawings and specifications
- Priced bill of quantities
- Construction programme
- Project quality management plan
- Project health and safety plan
- Conditions of contract
- Risk insurance

1. Contract Drawings and Specifications

- The contract drawings include the architectural drawings, the structural/geotechnical engineering drawings, and the building services engineering drawings. These drawings provide information regarding the arrangement of spaces, structural components, electrical, mechanical and plumbing installations etc.
- Specifications simply amplif the information given in the contract drawings and bill of quantities. It describes in details the work to be executed under the contract and the nature and quality of materials, components, and workmanship.

2. Priced Bill of Quantities

- A priced Bill of quantities is a required document of contract that has its rate and amount column filled by a contractor. A bill of quantities consists of a schedule of items of work to be carried out under the contract with quantities entered against each item, prepared in accordance with the Standard Method of Measurement of Building Works

3. Construction Programme

- This is a document that is prepared in order to provide the project participants a thorough appreciation of the work involved, to allow the site production team to sort out its main constituent and decide how, in what order and at what time to do them, and to ensure adequate coordination of the labor, materials and machinery requirements

4. Project Quality Management Plan

- The Project Quality Management Plan defines the various quality related activities and procedures which will be implemented on the project. It sets down requirements, gives guidelines, provides information and indicates to appropriate personnel, the procedures to be followed with respect to the Project Quality Management Plan. A sample outline of the Project Quality Management Plan is referred to in the appendix.

5. Project Health and Safety Plan

- The Project Health and Safety Plan is a document developed to secure the health, safety and welfare of persons who will work or visit the site. It was also developed to control the emission of toxic substances into the atmosphere and control the keeping and use of substances that might be hazardous to health. An outline of the Project Health and Safety Plan is delineated in the appendix.

6. Conditions of Contract

- The conditions of contract define the terms, under which the work is to be undertaken, the relationship between the client, architect and contractor, the duties of the architect and contractors, and the terms of payment.

7. Risk Insurance

- This is a contract document which shows that all the personnel and equipment associated with a construction project have been insured against loss or damage. By insurance, all the risks associated with personnel and equipment in a construction project is transferred to a third party.

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SCHEDULING AND PROJECT COSTING

Why use a Work Breakdown Structure?

The WBS is a method for getting a complex, multi-step project done. It's a way to divide and conquer large projects so you can get things done faster and more efficiently. Work breakdown structure (or WBS) is a hierarchical tree structure that outlines your project and breaks it down into smaller, more manageable portions. In Wrike, you can build a WBS by creating folders and subfolders, and can even go further to divide individual tasks into subtasks. The goal of a WBS is to make a large project more manageable. Breaking it down into smaller chunks means work can be done simultaneously by different team members, leading to better team productivity and easier project management overall.

Project work breakdown structures can also be used to identify potential risks in a given project. If a work breakdown structure has a branch that is not well defined then it represents a scope definition risk. These risks should be tracked in a project log and reviewed as the project executes. By integrating the work breakdown structure with an organizational breakdown structure, the project manager can also identify communication points and formulate a communication plan across the project organization.

When a project is falling behind, referring the work breakdown structure will quickly identify the major deliverables impacted by a failing work package or late sub- deliverable. The work breakdown structure can also be color coded to represent sub- deliverable status. Assigning colors of red for late, yellow for at risk, green for on-target, and blue for completed deliverables is an effective way to produce a heat-map of project progress and draw management's attention to key areas of the work breakdown structure

Schedule

What Is Scheduling in Project Management

- Scheduling in project management is the listing of activities, deliverables, and milestones within a project. A schedule also usually includes the planned start and finish date, duration, and resources assigned to each activity. Effective project scheduling is a critical component of successful time management.

In fact, when people discuss the processes for building a schedule, they are usually referring to the first six processes of time management:

- Plan schedule management.
- Define project activities.
- Sequence activities.
- Estimate resources.
- Estimate durations.
- Develop the project schedule.

Schedule Inputs

types of inputs to create a project schedule:

- Personal and project calendars – Understanding working days, shifts, and resource availability is critical to completing a project schedule.
- Description of project scope – From this, you can determine key start and end dates, major assumptions behind the plan, and key constraints and restrictions. You can also include stakeholder expectations, which will often determine project milestones.
- Project risks – You need to understand these to make sure there's enough extra time to deal with identified risks – and with unidentified risks (risks are identified with thorough Risk Analysis).
- Lists of activities and resource requirements – Again, it's important to determine if there are other constraints to consider when developing the schedule. Understanding the resource capabilities and experience you have available – as well as company holidays and staff vacations – will affect the schedule.

Scheduling Tools

Tools and techniques for combining these inputs to develop the schedule:

- Schedule Network Analysis – This is a graphic representation of the project's activities, the time it takes to complete them, and the sequence in which they must be done. Project management software is typically used to create these analyses – Gantt charts and PERT Charts are common formats.
- Critical Path Analysis – This is the process of looking at all of the activities that must be completed, and calculating the "best line" – or critical path – to take so that you'll complete the project in the minimum amount of time. The method calculates the earliest and latest possible start and finish times for project activities, and it estimates the dependencies among them to create a schedule of critical activities and dates. Learn more about Critical Path Analysis.
- Schedule Compression – This tool helps shorten the total duration of a project by decreasing the time allotted for certain activities. It's done so that you can meet time constraints, and still keep the original scope of the project. You can use two methods here:
  - Crashing – This is where you assign more resources to an activity, thus decreasing the time it takes to complete it. This is based on the assumption that the time you save will offset the added resource costs.
  - Fast-Tracking – This involves rearranging activities to allow more parallel work. This means that things you would normally do one after another are now done at the same time. However, do bear in mind that this approach increases the risk that you'll miss things, or fail to address changes.

Benefits of project scheduling in project management

- Project scheduling provides the following benefits:
- Assists with tracking, reporting on, and communicating progress.
- Ensures everyone is on the same page as far as tasks, dependencies, and deadlines.
- Helps highlight issues and concerns, such as a lack of resources.
- Helps identify task relationships.
- Can be used to monitor progress and identify issues early.

TIME MANAGEMENT

time management is the process of planning and exercising conscious control of time spent on specific activities, especially to increase effectiveness, efficiency, and productivity.

The key here is **increasing effectiveness**, **efficiency,** and **productivity**

Six effective time management strategies

- **Know** what your goals are. Stay on top of everything you need to execute.
- **Plan** your resources efficiently. Knowing where and how your resources are spending their time will help you delegate better.
- **Assess** dependencies, risks, and deliverables periodically. Re-evaluate and fix issues as and when you come across them.
- **Track** the time spent on your core tasks and projects. This will show you how you spend your time daily.
- **Automate** complex and time-consuming tasks. Use this time to spend on the more important tasks.
- **Evaluate** the post-project impact and learnings.

The 3 points of estimates are as below:

- **Optimistic estimate –** Estimate when all favourable things will happen (all opportunities happen and no threats take place)
- **Pessimistic estimate –** Estimate when all unfavourable conditions happen (all threats happen and no opportunities take place)
- **Most Likely estimate –** Estimate when both favourable and unfavourable conditions will happen

Precedence Diagramming Method (PDM)

With many complex responsibilities involved in handling a project, Project Management as a task has become even more challenging. With tools to assist that helps accomplish the project and executing the duties and supporting software, the widely used network techniques are more than half a century old. Thus, project managers should consider techniques or methods that best suit their management style.

A strategy for scheduling activities in a project plan, the **Precedence Diagramming Method (PDM)** is a strategy for developing a project schedule network diagram that utilizes nodes to represent activities and associates them with projectiles that illustrate the dependencies. This method is likewise called the activity-on-node (AON). Alluding to a particular project management technique, the project team utilizes a schedule network diagramming procedure to graphically represent any acknowledged and preexisting schedule activities through the utilization of nodes.

- The most significant advantage of using the Precedence Diagramming Method is that it quickly allows the project team to understand all the scheduled activities and its affiliates with each other.

Types of Precedence Diagramming Method Relationships

The significant output in the Sequence Activities process is the Network Diagram. Amidst the sequence activities process, the activities that are explained in the define activities process is sequenced as specific activities that rely upon another. While the network diagram shows the project activities and presents the interrelationships of activities, the Precedence Diagramming Method (PDM) is the most widely-recognized strategy to draw network diagrams. So it is normal for certain affiliates and dependencies between the activities in Precedence Diagramming Method.

- **Finish-to-Start (FS)** is the most common dependency type used between activities. Activity can't begin before a predecessor activity completes. At that point, a Finish-to-Start dependency needs to be present between these exercises.
- **Start-to-Start (SS)** is a kind of dependency shows that two activities determine to start together.
- **Finish-to-Finish (FF)** in a project illustrates that two activities in a project determine to finish together.
- **Start-to-Finish (SF)**, a unique type of dependency on projects, it can be utilized instantly along with the supply chain materials for instance. In this type of dependency, Activity B can finish only after Activity A starts.

Line of balance (LOB)

Line of balance (LOB) is a management control process used in construction where the project contains blocks of repetitive work activities, such as roads, pipelines, tunnels, railways and high-rise buildings. LOB collects, measures and presents information relating to time, cost and completion, and presents it against a specific plan.

LOB assists project management by:

- Comparing a formal objective against actual progress.
- Examining the extent of any deviations from specific plans, in terms of knock-on effects.
- Identifying in advance problematic areas where corrective action may be required.
- Forecasting future performance.

The advantages of LOB include

- Allowing a clearer understanding of the amount of work taking place at a certain time in a specific place.
- Resources can be optimised for a large number of repeated work activities.
- As all information is available for each activity, it allows easier cost and time optimisation analysis.
- It is relatively easy to modify, update and change the schedule.
- It allows better management of subcontractors and resources.
- It allows problem areas to be identified in advance.

Maturity of Project Financial Management

- Financial management includes the processes of acquiring and managing the financial resources for the project. Compared to project cost management, project financial management is more concerned with revenue sources and monitoring net cash flows for the construction project than with managing day-to-day costs. The major processes involved in financial management are Financial Planning, Financial Control, Administration and Records

Benefits of Good Financial Management

- Good financial management will help your organization to:
- Make effective and efficient use of resources
- Achieve objectives and fulfill commitments to stakeholders
- Become more accountable to donors and other stakeholders
- Gain the respect and confidence of funding agencies, partners and beneficiaries
- Gain advantage in competition for increasingly scarce resources
- Prepare for long-term financial sustainability.

This assessment might consider:

- Budget.
- Draw-down facilities.
- Approvals and consents.
- Tax and grants.
- Loan size and term.
- Land and site value.
- Building costs.
- End valuation.
- Stage payments.
- Planning risk.
- Profit on cost.
- Collateral or guarantor.

SOURCE

Sources of funding might include:

- Construction and development loans from a specialist property funder or senior debt lender (such as a commercial or high street bank).
- Mezzanine finance.
- Bridging finance.
- Project finance with special project vehicle (equity) and syndicated non-recourse loans and /or limited recourse finance.

For the public sector, funding options might also include:

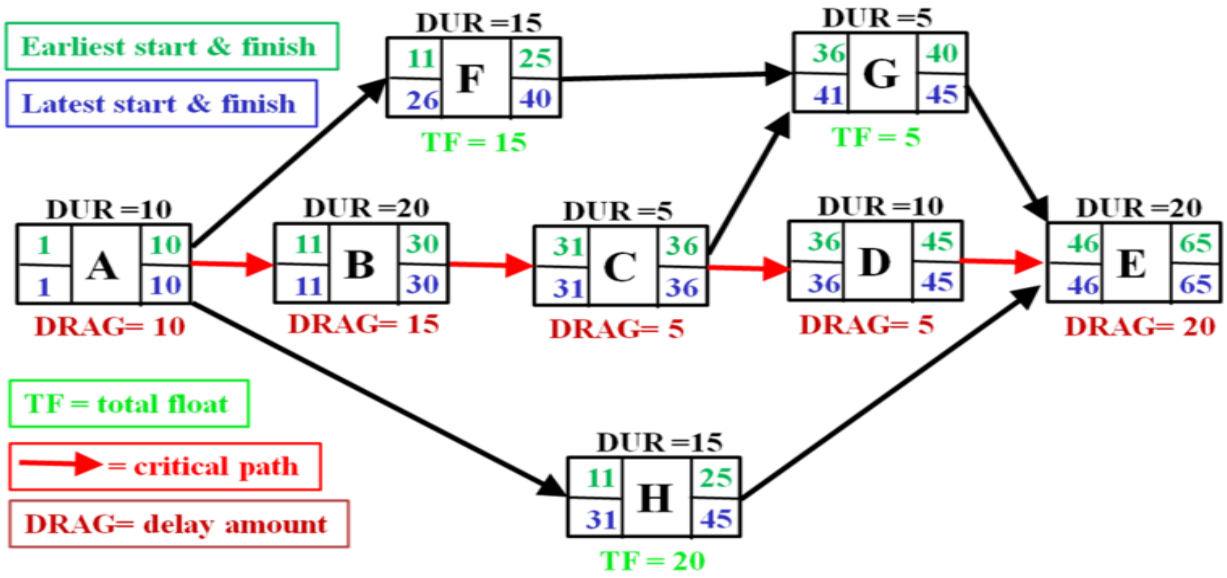
- Private developer scheme(PDS).
- Leasehold.
- Crown build.

CPM

The critical path method (CPM) is a staple of construction schedulers. Owners often require a critical path analysis. Construction management programs have taught CPM for decades, and courts use critical path schedules as evidence in construction disputes.

- However, CPM intimidates many people because they find it complex and time consuming. Some construction superintendents and foremen view critical path as a theoretical abstraction that is irrelevant to their work. They believe that construction realities in the field should drive the schedule — with this approach, however, efficiency generally suffers.
- The critical path method is a staple of project scheduling used across many industries where time is money. Construction stakeholders can use it to visualize and determine a project's duration, and also use it as a shorthand for talking about how duration is affected when project variables change.
- Construction project managers everywhere recognize a CPM chart since they have to study the method to obtain Project Management Professional (PMP) certification. In project-related disputes, the CPM is a legal standard for measuring project delays, and it is often used in court cases as the basis of financial claims.
- The critical path method was developed in the 1950s by Morgan R. Walker at DuPont and James E. Kelley Jr. at Remington Rand. It was first used in a skyscraper construction project in the 1966 building of the World Trade Center's Twin Towers. After a 1993 bombing, the team that oversaw repairs to the facility, who were working on a very tight schedule, turned to CPM to organize the work.
- CPM enables project managers to calculate the time and resources needed to complete a project. With good data, critical path can prevent scheduling problems and coordinate timely task performance by letting project managers know what needs to be done when. It allows supervisors to optimally schedule procurement and equipment usage and avoid overcrowding at the construction site. So-called stacking of trades, when too many specialty tradespeople are working simultaneously in a single area, hurts productivity and increases labor costs. So, good scheduling saves the project sponsors money in many ways.
- The CPM chart reads from left to right.

1. List all the activities from your work breakdown structure on the left side of your page.
2. The horizontal orientation of your page represents time. Mark off intervals such as days.
3. Know the precedence relationships of your activities (e.g., first you need to excavate before you can pour the foundation).
4. Draw a horizontal bar on your chart for each task. Start the bar in line with the project day when the task will begin, and make the length coincide with the number of days it will take. (Since this is only an exercise, you can pick a single duration and not worry about the range of potential late/early starts/finishes.)
5. For tasks with precedence relationships, draw the first activity's bar, then draw the dependent activity's bar farther to the right so that the bar does not begin until after the first activity's bar ends. This represents that the dependent activity begins later in time. You can draw a vertical line between the ending of the first activity and the start of the second activity to make this more noticeable.
6. For activities that can occur simultaneously, stack their bars in parallel above one another.
7. You can now find the critical path by identifying the longest sequence of activities in terms of duration. To be sure, you can add up the activity durations on each path.



In this diagram, Activities A, B, C, D, and E comprise the critical or longest path, while Activities F, G, and H are off the critical path with floats of 15 days, 5 days, and 20 days respectively. Whereas activities that are off the critical path have float and are therefore not delaying completion of the project, those on the critical path will usually have critical path drag, i.e., they delay project completion. The drag of a critical path activity can be computed using the following formula:

- If a critical path activity has nothing in parallel, its drag is equal to its duration. Thus A and E have drags of 10 days and 20 days respectively.
- If a critical path activity has another activity in parallel, its drag is equal to whichever is less: its duration or the total float of the parallel activity with the least total float. Thus since B and C are both parallel to F (float of 15) and H (float of 20), B has a duration of 20 and drag of 15 (equal to F's float), while C has a duration of only 5 days and thus drag of only 5. Activity D, with a duration of 10 days, is parallel to G (float of 5) and H (float of 20) and therefore its drag is equal to 5, the float of G.
- These results, including the drag computations, allow managers to prioritize activities for the effective management of project, and to shorten the planned critical path of a project by pruning critical path activities, by "fast tracking" (i.e., performing more activities in parallel), and/or by "crashing the critical path" (i.e., shortening the durations of critical path activities by adding resources).
- Critical path drag analysis has also been used to optimize schedules in processes outside of strict project-oriented contexts, such as to increase manufacturing throughput by using the technique and metrics to identify and alleviate delaying factors and thus reduce assembly lead time.

Program Evaluation and Review Technique (PERT)

Program Evaluation and Review Technique (PERT) is a project network analysis technique used to plan and control large construction projects.

- PERT focuses on the relationship between the time each activity takes, the costs for each activity and the resulting time and cost for the expected completion of the entire construction project. This helps in understanding the performance of the work throughout the course of the project.
- PERT is an event oriented project scheduling techniques. The method does not show any kind of inter-dependencies. It only shows an event, which is represented in terms of the time and the resources that are necessary for the completion of that event. It does not possess any historic chain.
- PERT gains a lot of benefits, that facilitates the project management team. But it also shows certain disadvantages that must be taken into consideration by the project managers. The pros and cons of PERT techniques are mentioned in the following section.

Advantages of PERT in Construction Management

Use of PERT in construction project has following advantages:

- Facilitate planning of large projects
- Critical Path of construction project is visible
- Helps in activity Analysis
- Better coordination
- What-if Analysis

Disadvantages of PERT in Construction Management

Subjective Analysis

- For a new project, the method requires data to identify the activities. This is found to be difficult because the new project chosen are not repetitive in nature. It would be a rare or fresh project idea. This makes the data collection to be subjective in nature showing lesser accuracy in the time or cost estimated.
- The source of data obtained, have chances of biasing and are found unreliable. As mentioned, because of the not repetitive nature of the project, there is no guaranty in bringing information from a past historic record with similar cases in certain situations and implementing it.

Time Focused

- PERT is a time oriented method. It just makes use of the time that is required to complete the activity. Hence the determination of time for each activity and its allocation is of great importance. It's based on an assumption and will work well if it is right. Else problems arise.
- PERT technique is labor intensive in nature
- When two or more projects share available resources, the technique won't work good or makes it complicated.
- Any change in the precedence and sequential relationships of project activities will result in the failure of this method.
- With the increase in project activities, it makes the chart complicated with hundreds of task dependencies.
- Expensive in nature
- Prediction Inaccuracy

When a project with no past records or assistance exists, predictions play a role in the movement of the project. Inaccurate decisions and predictions would make the overall project to a total loss. This cannot be done by trial and error with the assumptions.

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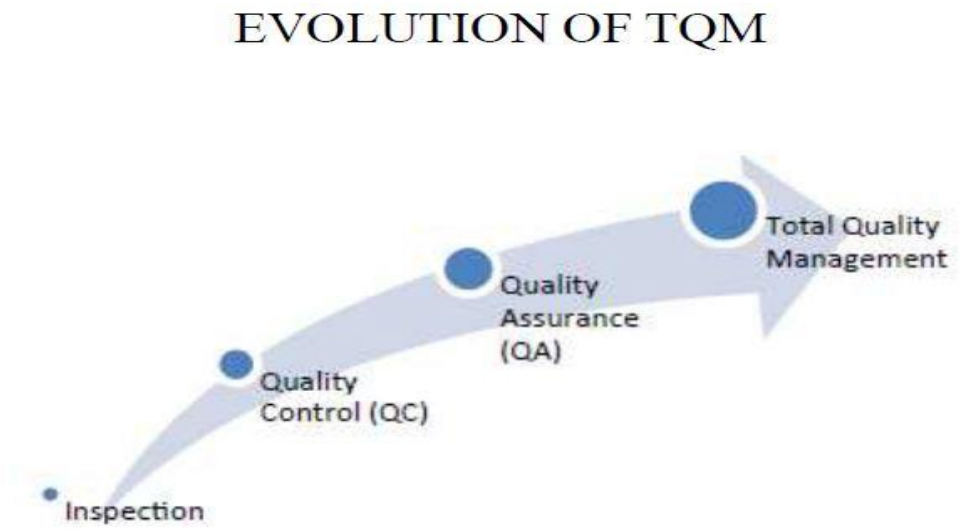
DEPARTMENT OF ARCHITECTURE

UNIT –III - Construction Management -SAR1404

QUALITY AND RESOURCE MANAGEMENT



Quality circles

A QC Circle is a small group of frontline employees who meet regularly to try to improve the quality of their work. In general their approach is problem-based. ... Through the QC activities, they develop quality consciousness, problem consciousness, a willingness to make improvements, and a sense of quality management

Project quality plan

A project quality plan is a written plan that details how you will manage quality on a specific construction project.

- This is different from a company quality manual, which explains your quality policies and procedures in general, but not with information specific to each project.
- Clients may ask for project quality plans in different ways. One way may be that your contract says you need to submit a quality control plan. Another way may be that your client comes out and asks for a project quality plan.
- In most cases, everyone wants the same thing: your project quality plan, company quality manual, and standard operating procedures.

Project Quality Plan

- Who's on the project quality management team? A Project Organization Chart
- What makes them qualified to be there? Appointment Letters defining the responsibility and authority for each team member's position
- Personnel Qualification Form verifying the capabilities of each team member and who approved them
- Resume for each team member
- What training will you provide to make sure your people have the necessary skills and knowledge for this project? Will you train your customer on operations and maintenance? This should include quality system, quality procedures, and the technical training.Training Plan indicating the training and who has received it
- Who are the points of contact for the project?Point of Contact List
- How will you make sure all quality-related information gets to the people that need it?Project Quality Communications Plan
- What documents, reports, and records will you submit, by when, and to whom?Project Submittals Schedule and Log

Project-Specific Standards

- What regulatory codes and industry standards apply to this project?
- Project Regulatory Codes and Industry Standards Form

Project-Specific Inspections and Tests

- What inspections and tests will you conduct for this project? How will you record each inspection and test?
- Inspection and Test Plan Form
- Quality Controlled Construction Task Form
- What measuring devices need calibration and how often?
- Measuring Devices Calibration Form

Poject Purchasing

- What credential and resources do your key subcontractors need such as licenses, insurance, production capacity? Also, how do their quality programs meet your requirements? Subcontractor and Supplier Qualification Form
- Who are your qualified suppliers and what materials will they supply?
- Source of Supply Form
- In Conclusion
- Clients are concerned about how you will manage quality on their projects. Addressing project-specific, site-specific and contract-specific requirements in your project quality plan is how you will comply with their requirements.

RESOURCE MANAGEMENT

- **All the resources necessary to complete the project.** That's everything from people to machines and even any office space you'll need. Spend a good amount of time with this list, the more complete it is, the more accurate your schedule will be.
- **Timeframes for the planned effort of each resource.** By noting the duration of time needed for each resource, you have a clearer picture of how it will fit into your overall schedule.
- **Number of each resources you'll need per day/week/month.** Again, you want to break your resource needs out on a daily, weekly and monthly rotation to better grasp what you'll need and when.
- **Quantity of resource *hours* required per day/week/month**. You've figured how what you need, but how many hours for each of those resources are you going to allocate over time?
- **Identify assumptions and constraints.** An assumption is what you think might be true, while the constraints are the schedule, cost and scope of your project. So, you want to know what they are and how they'll potentially impact your plan. Think strategically. Are you assuming a team will be available in 3 months? Do you know for a fact they won't get assigned by another group leader for a separate project? Have you taken into account holidays and scheduling shifts? Identifying all your assumptions is a critical component to planning your resources wisely.

Definition of Construction Material Management:

Material management is defined as planning, identification, procuring, storage, receiving and distribution of materials. The purpose of material management is to assure that the right materials are in the right place, in the right quantise when needed. The responsibility of material management department for the flow of materials from the time the materials are ordered, received, and stored until they are used in the basis of material management.

Classification of Construction Material

Material Type	Details	Example
Bulk materials	Materials that are delivered in mass and are deposited in a container.	Sand,Gravel,Topsoil,Cement, Concrete
Bagged materials	Materials delivered in bags for ease of handling and controlled use.	Cement
Palleted materials	Bagged materials that are placed in pallets for delivery	Cement, Doors
Packaged materials	Materials that are packaged together to prevent damage during transportation and deterioration when they are stored.	Pipes,Tiles,Electrical Fitting

Process of Construction Material Management

Materials Management

- Materials management is an important element in project planning and control. Materials represent a major expense in construction, so minimizing *procurement* or *purchase* costs presents important opportunities for reducing costs. Poor materials management can also result in large and avoidable costs during construction. First, if materials are purchased early, capital may be tied up and interest charges incurred on the excess *inventory* of materials. Even worse, materials may deteriorate during storage or be stolen unless special care is taken. For example, electrical equipment often must be stored in waterproof locations. Second, delays and extra expenses may be incurred if materials required for particular activities are not available. Accordingly, insuring a timely flow of material is an important concern of project managers.

- Materials management is not just a concern during the monitoring stage in which construction is taking place. Decisions about material procurement may also be required during the initial planning and scheduling stages. For example, activities can be inserted in the project schedule to represent purchasing of major items such as elevators for buildings. The availability of materials may greatly influence the schedule in projects with a *fast track* or very tight time schedule: sufficient time for obtaining the necessary materials must be allowed. In some case, more expensive suppliers or shippers may be employed to save time.

Material Procurement and Delivery

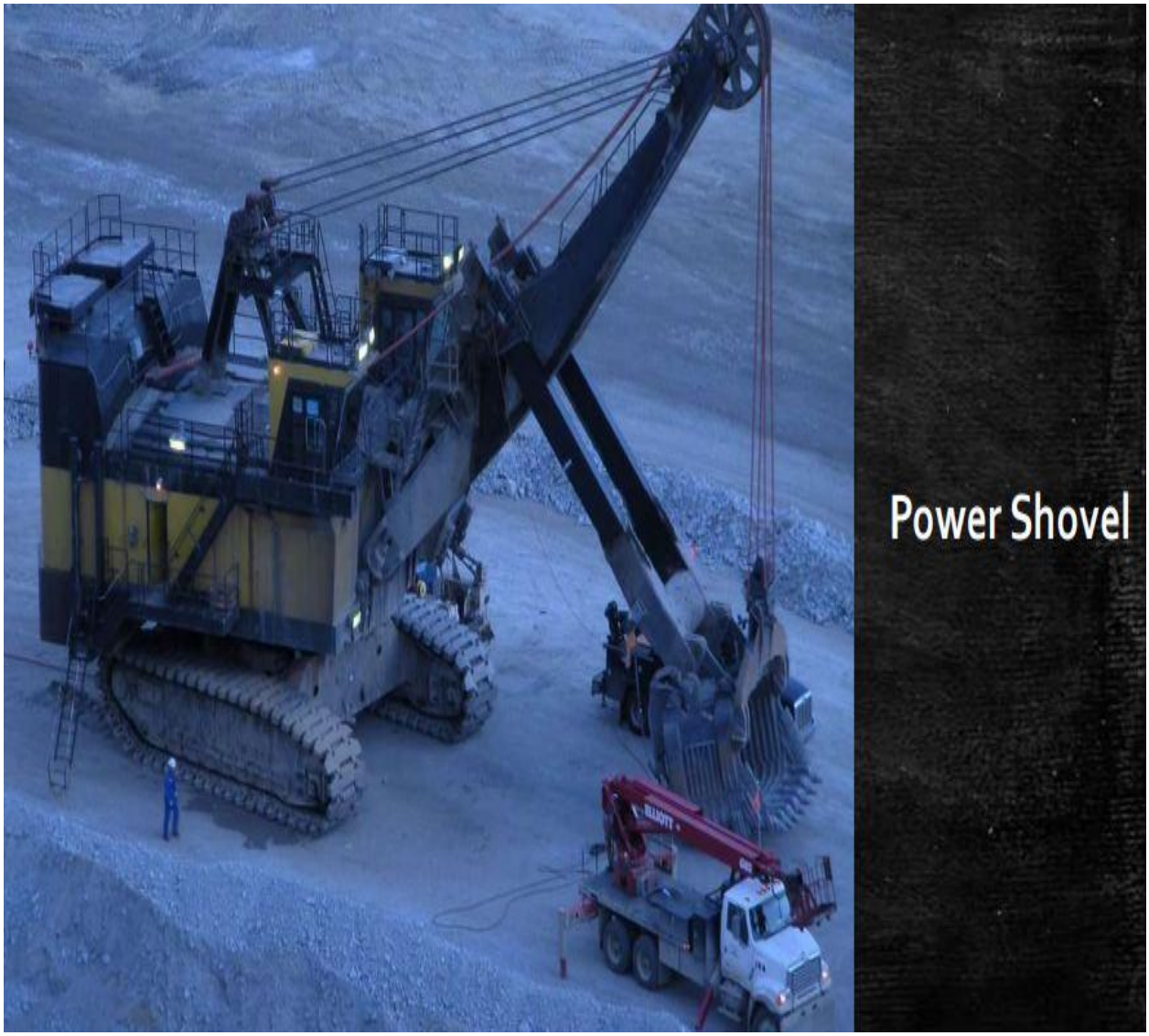
- The main sources of information for feedback and control of material procurement are requisitions, bids and quotations, purchase orders and subcontracts, shipping and receiving documents, and invoices. For projects involving the large scale use of critical resources, the owner may initiate the procurement procedure even before the selection of a constructor in order to avoid shortages and delays. Under ordinary circumstances, the constructor will handle the procurement to shop for materials with the best price/performance characteristics specified by the designer. Some overlapping and rehandling in the procurement process is unavoidable, but it should be minimized to insure timely delivery of the materials in good condition.

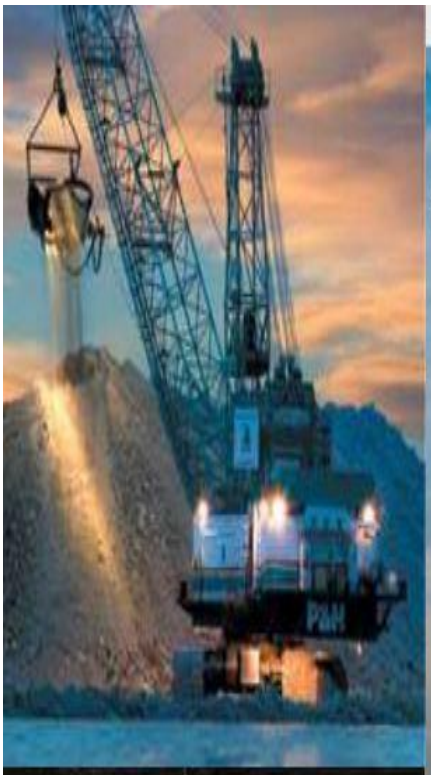
- The materials for delivery to and from a construction site may be broadly classified as : (1) bulk materials, (2) standard off-the-shelf materials, and (3) fabricated members or units. The process of delivery, including transportation, field storage and installation will be different for these classes of materials. The equipment needed to handle and haul these classes of materials will also be different.

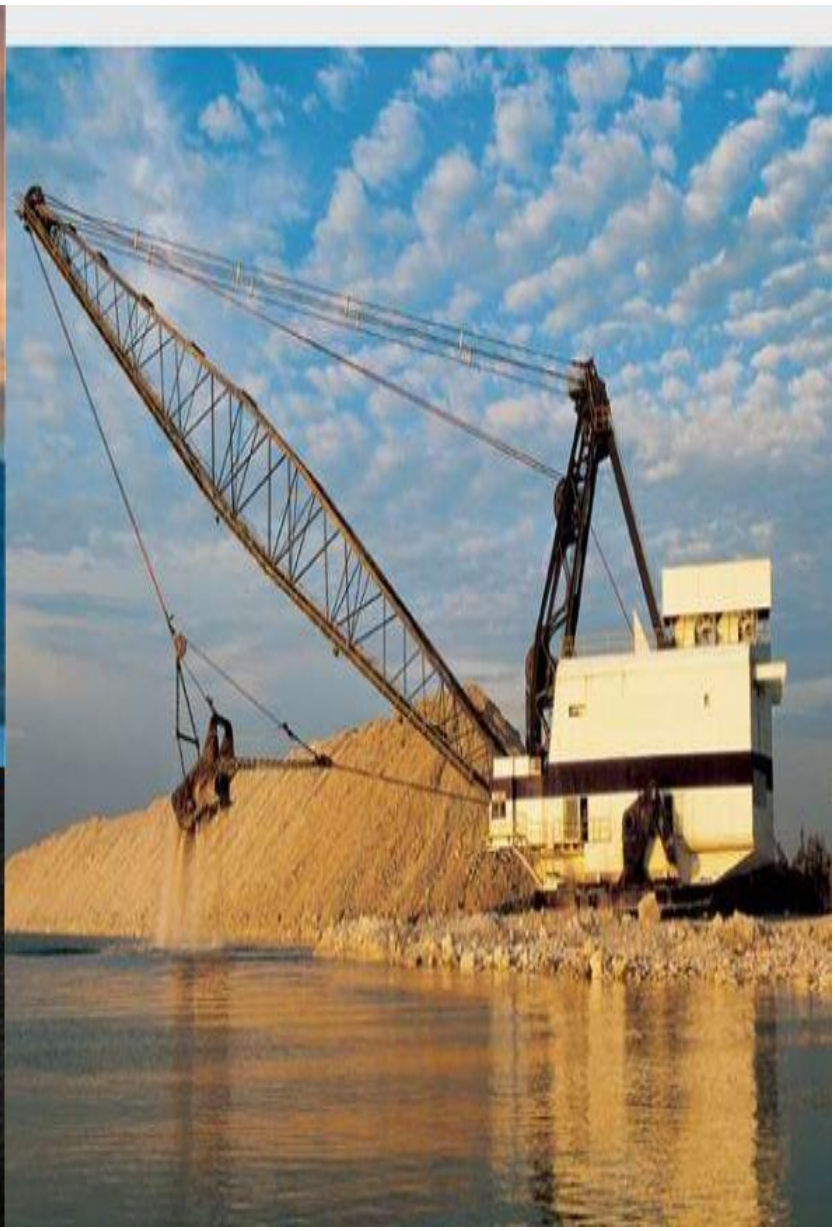
- Bulk materials refer to materials in their natural or semi-processed state, such as earthwork to be excavated, wet concrete mix, etc. which are usually encountered in large quantities in construction. Some bulk materials such as earthwork or gravels may be measured in bank (solid in situ) volume. Obviously, the quantities of materials for delivery may be substantially different when expressed in different measures of volume, depending on the characteristics of such materials.

- Standard piping and valves are typical examples of standard off-the-shelf materials which are used extensively in the chemical processing industry. Since standard off-the-shelf materials can easily be stockpiled, the delivery process is relatively simple.

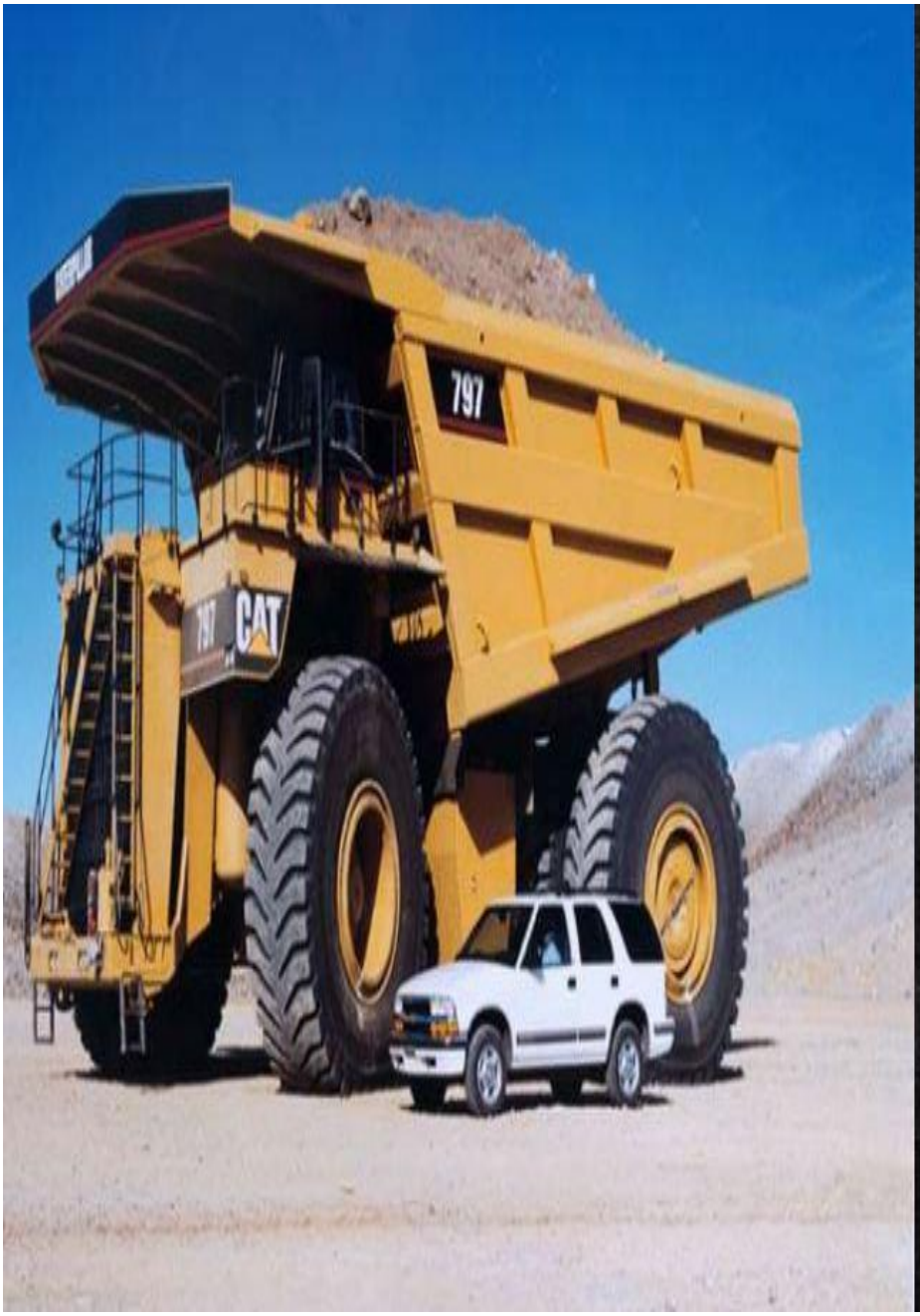
- Fabricated members such as steel beams and columns for buildings are pre-processed in a shop to simplify the field erection procedures. Welded or bolted connections are attached partially to the members which are cut to precise dimensions for adequate fit. Similarly, steel tanks and pressure vessels are often partly or fully fabricated before shipping to the field. In general, if the work can be done in the shop where working conditions can better be controlled, it is advisable to do so, provided that the fabricated members or units can be shipped to the construction site in a satisfactory manner at a reasonable cost.


Power Shovel





Dragline



Dumper

Labor Productivity

Productivity in construction is often broadly defined as output per labor hour. Since labor constitutes a large part of the construction cost and the quantity of labor hours in performing a task in construction is more susceptible to the influence of management than are materials or capital, this productivity measure is often referred to as *labor productivity*. However, it is important to note that labor productivity is a measure of the overall effectiveness of an operating system in utilizing labor, equipment and capital to convert labor efforts into useful output, and is not a measure of the capabilities of labor alone. For example, by investing in a piece of new equipment to perform certain tasks in construction, output may be increased for the same number of labor hours, thus resulting in higher labor productivity.

Construction output may be expressed in terms of functional units or constant dollars. In the former case, labor productivity is associated with units of product per labor hour, such as cubic yards of concrete placed per hour or miles of highway paved per hour. In the latter case, labor productivity is identified with value of construction (in constant dollars) per labor hour. The value of construction in this regard is not measured by the benefit of constructed facilities, but by construction cost. Labor productivity measured in this way requires considerable care in interpretation. For example, wage rates in construction have been declining in the US during the period 1970 to 1990, and since wages are an important component in construction costs, the value of construction put in place per hour of work will decline as a result, suggesting lower productivity.

Productivity at the Job Site

- Contractors and owners are often concerned with the labor activity at job sites. For this purpose, it is convenient to express labor productivity as functional units per labor hour for each type of construction task. However, even for such specific purposes, different levels of measure may be used. For example, cubic yards of concrete placed per hour is a lower level of measure than miles of highway paved per hour. Lower-level measures are more useful for monitoring individual activities, while higher-level measures may be more convenient for developing industry-wide standards of performance.
- While each contractor or owner is free to use its own system to measure labor productivity at a site, it is a good practice to set up a system which can be used to track productivity trends over time and in varied locations. Considerable efforts are required to collect information regionally or nationally over a number of years to produce such results. The productivity indices compiled from statistical data should include parameters such as the performance of major crafts, effects of project size, type and location, and other major project influences.

- In order to develop industry-wide standards of performance, there must be a general agreement on the measures to be useful for compiling data. Then, the job site productivity data collected by various contractors and owners can be correlated and analyzed to develop certain measures for each of the major segment of the construction industry. Thus, a contractor or owner can compare its performance with that of the industry average.

Factors Affecting Job-Site Productivity

Job-site productivity is influenced by many factors which can be characterized either as labor characteristics, project work conditions or as non-productive activities. The labor characteristics include:

- age, skill and experience of workforce
- leadership and motivation of workforce
- The project work conditions include among other factors:Job size and complexity.
- Job site accessibility.
- Labor availability.
- Equipment utilization.
- Contractual agreements.
- Local climate.
- Local cultural characteristics, particularly in foreign operations.

The non-productive activities associated with a project may or may not be paid by the owner, but they nevertheless take up potential labor resources which can otherwise be directed to the project. The non-productive activities include among other factors:

- Indirect labor required to maintain the progress of the project
- Rework for correcting unsatisfactory work
- Temporary work stoppage due to inclement weather or material shortage
- Time off for union activities
- Absentee time, including late start and early quits
- Non-working holidays
- Strikes

Each category of factors affects the productive labor available to a project as well as the on-site labor efficiency.

Labor Characteristics

- Performance analysis is a common tool for assessing worker quality and contribution. Factors that might be evaluated include:
- Quality of Work - caliber of work produced or accomplished.
- Quantity of Work - volume of acceptable work
- Job Knowledge - demonstrated knowledge of requirements, methods, techniques and skills involved in doing the job and in applying these to increase productivity.
- Related Work Knowledge - knowledge of effects of work upon other areas and knowledge of related areas which have influence on assigned work.
- Judgment - soundness of conclusions, decisions and actions.
- Initiative - ability to take effective action without being told.
- Resource Utilization - ability to delineate project needs and locate, plan and effectively use all resources available.
- Dependability - reliability in assuming and carrying out commitments and obligations.
- Analytical Ability - effectiveness in thinking through a problem and reaching sound conclusions.
- Communicative Ability - effectiveness in using orgal and written communications and in keeping subordinates, associates, superiors and others adequately informed.
- Interpersonal Skills - effectiveness in relating in an appropriate and productive manner to others.
- Ability to Work Under Pressure - ability to meet tight deadlines and adapt to changes.
- Security Sensitivity - ability to handle confidential information appropriately and to exercise care in safeguarding sensitive information.
- Safety Consciousness - has knowledge of good safety practices and demonstrates awareness of own personal safety and the safety of others.
- Profit and Cost Sensitivity - ability to seek out, generate and implement profit-making ideas.
- Planning Effectiveness - ability to anticipate needs, forecast conditions, set goals and standards, plan and schedule work and measure results.
- Leadership - ability to develop in others the willingenss and desire to work towards common objectives.
- Delegating - effectiveness in delegating work appropriately.
- Development People - ability to select, train and appraise personnel, set standards of performance, and provide motivation to grow in their capacity.

Labor Relations in Construction

- The market demand in construction fluctuates greatly, often within short periods and with uneven distributions among geographical regions. Even when the volume of construction is relatively steady, some types of work may decline in importance while other types gain. Under an unstable economic environment, employers in the construction industry place great value on flexibility in hiring and laying off workers as their volumes of work wax and wane. On the other hand, construction workers sense their insecurity under such circumstances and attempt to limit the impacts of changing economic conditions through labor organizations.
- There are many crafts in the construction labor forces, but most contractors hire from only a few of these crafts to satisfy their specialized needs. Because of the peculiar characteristics of employment conditions, employers and workers are placed in a more intimate relationship than in many other industries. Labor and management arrangements in the construction industry include both unionized and non-unionized operations which compete for future dominance. Dramatic shifts in unionization can occur. For example, the fraction of trade union members in the construction industry declined from 42% in 1992 to 26% in 2000 in Australia, a 40% decline in 8 years.

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UNIT –IV - Construction Management -SAR1404

SAFETY PLANNING AND MANAGEMENT

Construction work is a hazardous land-based job. Some construction site jobs include: building houses, roads, tree forts, workplaces and repair and maintain infrastructures. This work includes many hazardous task and conditions such as working with height, excavation, noise, dust, power tools and equipment. The most common fatalities are caused by the fatal four: falls, being struck by an object, electrocutions, and being caught in between two objects. Construction work has been increasing in developing and undeveloped countries over the past few years. With an increase in this type of work occupational fatalities have increased. Occupational fatalities are individuals who die while on the job or performing work related tasks. Within the field of construction it is important to have safe construction sites.

Why Are Construction Safety Programs Important?

There are many mitigating factors supporting the need for effective construction safety programs today. Generally they fall into humanitarian and economic categories. The hard-nosed economic factors of safety have forced even the most inhumanitarian managements into taking a more humanitarian stance on construction safety. I say this because of the construction industry's widespread macho image, which tends to play down present-day management's general trend toward a humanistic approach toward employees. Present-day construction safety programs must also stress accountability for safety throughout the organization. Owners' and contractors' managements must initiate the need for safety, and the resulting system must be clear as to who is accountable for carrying out the program. Because CMs have sole responsibility for delivering the project goals, they are held accountable for the success or failure of the site-safety performance.

Humanitarian factors in safety

The humanitarian factors in safety are quite straightforward. No one connected with the industry wants to see coworkers killed or injured on the job. Everyone working on the job must make a personal commitment to perform in a manner that doesn't endanger the lives and property of others. This is especially true for the various management groups involved in the construction project because they are responsible for managing the safety environment.

CMs are especially sensitive to safety's humanitarian side because they are customarily responsible for delivering the sad news of an accident to the next-of-kin. As leaders of their field organizations, most CMs feel a personal responsibility for an accident that happened on their watch

Although the accident rate among CMs is relatively low, I have had a CM experience a serious lost-time accident on one of my projects. Considering a CM's overall project-performance rating, having a personal lost-time accident on one's record is probably the worst thing that can happen. No one on the project is outside the safety program's umbrella or immune from accidents.

Who Are the Main Players in Construction Safety?

The contributors to a successful construction safety program fall into two groups divided into line and staff functions as follows:

Owner managements	Field safety engineers
Contractor managements	Home office safety groups
Construction managers	Government
Contractor field supervisor's	Trade unions
Field foremen	Trade associations
Craft labor	Academia

The line functions are responsible for implementing and applying the safety regulations that are developed by the staff organizations. The line people are directly responsible for the execution of and results from the safety program at the job site. The corporate staff functions are responsible for formulating, maintaining, and supporting the safety programs at the site. The corporate safety groups (CSGs) act as intermediaries between upper management and the field organization as well as outside safety-oriented organizations. The outside groups are the government, trade unions, trade associations, and academia. We will look in more detail at the typical responsibilities and contributions of each group.

Scope of Safety Management

Safety management during construction phase covers:

- Planning of work to avoid personal injury and property damage
- Monitoring of work to provide early detection and correction of unsafe practices and conditions
- Protecting adjacent public and private properties to provide for the safety of the public
- Providing safety education and incentive programs

Roles of the Agency in Safety Management

The Agency's role is to establish awareness that the prevention of accidents and protection of employees, the public, and property is a top priority. The Agency should have a safety management plan which can be a sub section of the PMP or on larger projects a separate subsidiary planning document. The requirements of the safety management plan should be incorporated as part of the contract documents. The Agency through their CM monitors individual contractor safety performance for compliance with the above contractual safety requirements and conducts regular contractor safety audits and loss control surveys. When a violation of job safety is observed the CM will advise the Agency to notify the contractor in writing to correct the violation.

Education

Contractors give newly employed, promoted, and/or transferred personnel comprehensive safety indoctrination on topics such as: workplace hazards, required protective equipment, procedures for reporting unsafe job conditions, procedures for reporting accidents, contractor job rules, location of first-aid and medical facilities, and tool box safety meeting requirements. Safety should be a standing item at site meetings. Foremen or shift supervisors should also hold regular crew training (toolbox) meetings to cover specific safety procedures pertinent to the crew's on-going activity.

Incentives

Contractors should display signs and posters at the job site to reinforce safety training and as an incentive to maintain interest in job safety with the changing work assignments and jobsite conditions. The Agency should encourage contractors to introduce employee incentive programs that reward safe work performance through personal recognition and prizes such as belt buckles, pins, or lunch boxes.

Audits

The Agency through the CM monitors and conducts regular audits of contractor safety performance and notifies the contractor in writing of unsafe practices observed. Should a contractor fail to correct an unsafe condition or practice, the CM may recommend that the Agency issue a stop work order until the condition is corrected.

Accident Investigation and Record Keeping

Accidents should be investigated without delay by the contractor and the investigation should generate recommendations for corrective actions to prevent recurrence of similar accidents. The contractor's accident report, project records, progress reports, and daily time reports may become important evidential material in any ensuing legal action. The contractor prepares monthly accident summary reports for submission to the CM. These reports will allow the CM to assess contractor safety performance as measured by recordable and lost time accident frequency rates and the type and cause of accidents. The federal and state regulations mandate reporting of certain injury accidents to the authorities.

Salient Points of Safety Management

- It is the responsibility of the construction manager to create safety programs that will prevent these accidents.
- The philosophy of the company must be that all accidents are prevented and the actions expected to accomplish that goal must be clearly stated to the employees.
- Without a safety plan , a project cannot be described as a successful construction project . The safety should be the highest priority of the company. The company must be committed to the improvement of safety.
- The safety code of conduct should be communicated to the employees in the company , who should also be made aware of the pros and cons of the accidents.
- A company with a better culture of safety attracts the right kinds of employees and builds a good , consistent safety record .
- During the project planning in the beginning of the work, a unique job-specific safety plan must be developed .
- Task specific hazard should be addressed daily.

Contract Requirement

The role of the owner in the safety management is vital . The cost and time is also dependent on the safely management . In India , large infrastructure construction is carried out by the government agencies . Safely should be included in the contracts and pre-qualification . It has been observed that construction is carried out by many small constructors , and they do not follow the safely rules properly . That is why the owner and the government agencies can enforce the safety .Their safety plan should be included in the contract i.e. it is a part of the contract and safety performance should be measured against the owner's plan

Safety guidelines for Personnel Conduct

- Employees should always wear hard hats , safety shoes , eye protection , ear protection , in noisy areas .
- Equipment operator should have the license and training with the equipment operation and safety norms .
- Stay out of dangerous places .
- One should not work alone on the site , when other employees are not on the site.

New employees should make themselves conversant with safety norms from senior persons of the department.

Safety and health management, are as much a part of an efficient project planning and management as the minimizing the cost of project, completing the project on schedule and maintaining the high quality of construction.

Safety and health, cost of the project, schedule and quality are interrelated . They are an integral part of effective project management.

Reasons for safety management

a. Humanitarian side :

Construction industry in any country is comparatively highly accident prone . The number of fatal accidents , as well as injuries in which workers become disabled or reduced in efficiency ,is higher as compared to other industries . The death of a worker , creates a vacuum in the family earning as well as psychological and emotional disruption of the family .

The main purpose of improved safely is to minimize human pain and suffering , to the worker's family or to the worker , that results due to accident or work induced illness .

Loss of a skilled worker is a damage to the construction industry . Skilled workers are scarce and considerable time as well as money is spent on their training .

b. Economics of safety :

The premiums for insurance for equipments and manpower depends upon the past safety record of the company . If the accident rate is high , the insurance company has more risk . Thus , there will be higher premiums . If a good safety record is maintained , less premiums has to be paid .

Second point is regarding compensation , to the family of the worker or to the worker himself . If the accident rate is higher , the company has to pay more money .

In advanced countries , the owner also looks into the contractors insurance costs and safety record .

When the indirect as well as the direct costs of accidents and illness are examined , costs associated with insurance premiums and claims settlements are only a small part of the whole . Indirect and impact costs resulting from disrupted production , reduced morale of employee , lower productivity or worker and ripple effects on the interrupted project schedule can be several times the direct costs associated with hospitalization , disability pay , spoiled materials and damaged equipment .

An improved safety management plan reduces these direct and indirect costs incurred due to accidents . It has been pointed out that the expenses in improved safety and health is an investment .

c. Legal aspect of accident :

In India , there is not a no separate law regarding the safety of construction workers . But it falls under the labour laws and criminal laws . After accidents , it is reported to the concerned police station . There are a lot of problems due to investigation , regarding the cause of accident , and the compensation demanded to the contractor , owner and even co-workers .

d. Organization problems :

Past safety records of the construction company plays a very important role in the employment of workers , getting contracts , pride among peers . It inculcates high productivity , high morale and stronger loyalty of the worker to the organization .

e. Health hazards :

Health hazards include those activities which cause problems to life , in long such - head radiation , noise , dust , shocks and vibrations , toxic chemical .

Implementation Guidelines

Company should prepare comprehensive guideline for different personnel and processes . Following guidelines can be prepared .

Behavioral approaches to safety and health –

Guidelines for top managers .

Guidelines for superintendents of project .

Guidelines for foreman manager .

Guidelines for workers .

Physical approaches to safety and health -

Education and training in correct methods and procedures.

Utilization of safety certified tools in well condition.

Use of equipment for personal protection such as hard hats, seat belt , ear plugs , etc .

Good housekeeping on job sites.

Frequent and thorough job site inspections by knowledgeable and objective professionals.

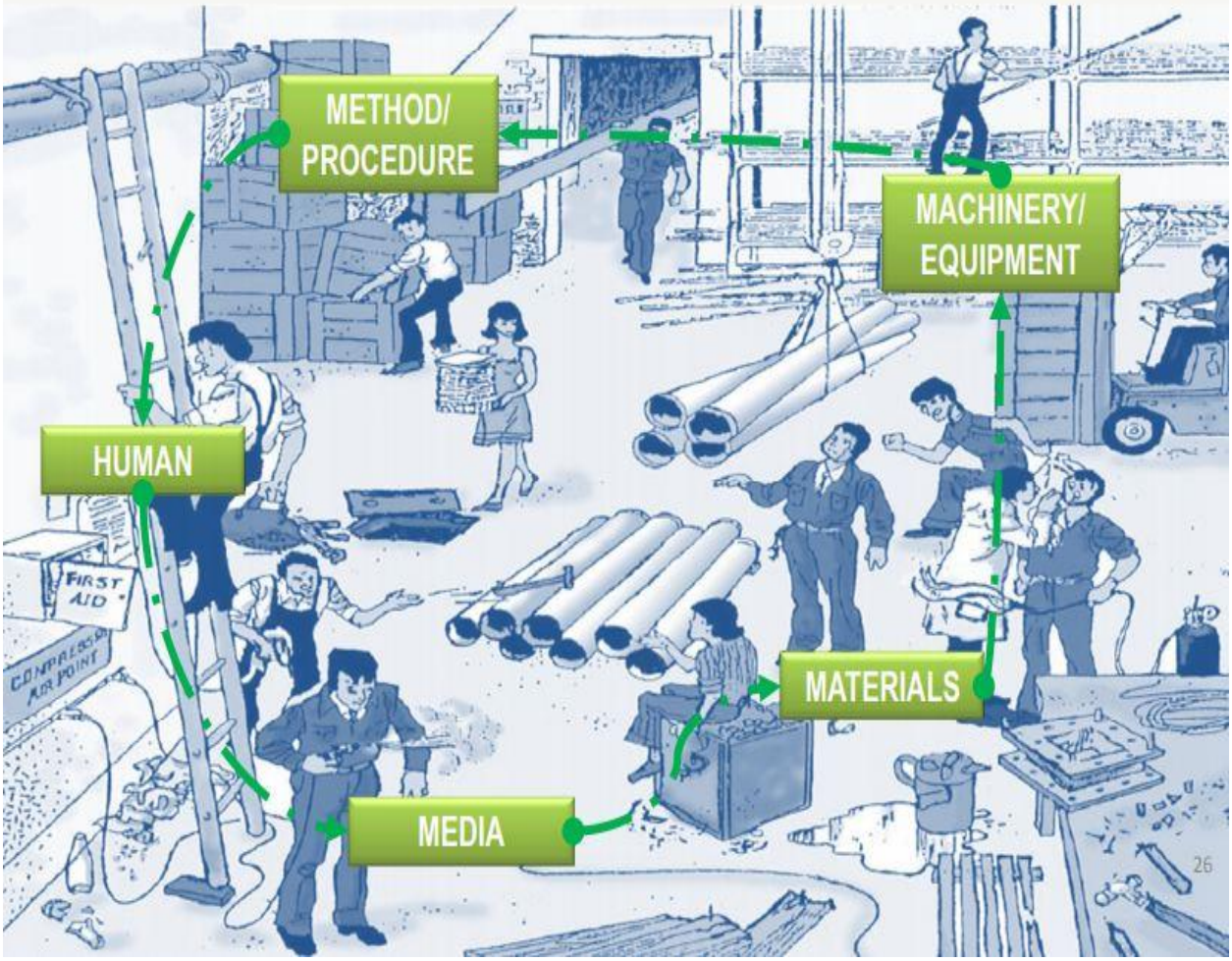
Incorporation of safety review.

Example of Risks

Scope of work	Hazard	Risk
Grinding	Eyes hit by flying debris	Eye injury or blind
Welding	Radiation from the welding arc	Eye inflammation/ kataraks/blind
Working at height	Fall from height	Injury/Death

SIGNAGE	MEANING THAT -
	DANGER HIGH RISK SITUATION
	WARNING MEDIUM RISK SITUATION
	CAUTION LOW RISK SITUATION

Source of accident



Alteration and Demolition works

Demolition is the dismantling, razing, destroying or wrecking of any building or structure or any part thereof. Demolition work involves many of the hazards associated with construction. However, demolition involves additional hazards due to unknown factors which makes demolition work particularly dangerous. These may include:

Changes from the structure's design introduced during construction;

- Approved or unapproved modifications that altered the original design;
- Materials hidden within structural members, such as lead, asbestos, silica, and other chemicals or heavy metals requiring special material handling;
- Unknown strengths or weaknesses of construction materials, such as post-tensioned concrete;
- Hazards created by the demolition methods used.

To combat these, everyone at a demolition worksite must be fully aware of the hazards they may encounter and the safety precautions they must take to protect themselves and their employees.

Demolition hazards are addressed in specific standards for the construction industry.

Hazards

PLAN ahead to get the job done safely

Proper planning is essential to ensure a demolition operation is conducted with no accidents or injuries. This includes, but is not limited to:

- An engineering survey completed by a competent person before any demolition work takes place. This should include the condition of the structure and the possibility of an unplanned collapse.
- Locating, securing, and/or relocating any nearby utilities. For help, call 811 before you dig.
- Fire prevention and evacuation plan.
- First Aid and Emergency Medical Services.
- An assessment of health hazards completed before any demolition work takes place.

PROVIDE the right protection and equipment

The employer must determine what Personal Protective Equipment (PPE) will be required. In demolition operations, PPE may include:

- Eye, face, head, hand, foot protection
- Respiratory protection
- Hearing protection
- Personal Fall Arrest Systems (PFAS)
- Other protective clothing (for example, cutting or welding operations)

Life saving equipment's

Personal protective equipment (PPE) is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals.

Protective equipment may be worn for job-related occupational safety.

Personal Protective Equipment (PPE) for Construction

- Protective gloves.
- Hearing protection.
- Full face shields when cutting, grinding, or chipping.
- Chemical splash goggles.
- Respiratory protection.
- Fall protection equipment when working above 6 feet.
- Specific protective clothing such as welding leathers when welding or FR clothing when working with live electric.

Employee Hazard & Safety Training

Employee Hazard & Safety Training
A formal training program to allow employees to recognize and avoid materials handling hazards is recommended. Instructors should be well-versed in matters that pertain to safety engineering and materials handling and storing. The content of the training should emphasize those factors that will contribute to reducing workplace hazards including the following:
• Alerting the employee to the dangers of lifting without proper training.
• Showing the employee how to avoid unnecessary physical stress and strain.
• Teaching workers to become aware of what they can comfortably handle without undue strain.
• Instructing workers on the proper use of equipment.
• Teaching workers to recognize potential hazards and how to prevent or correct them.
• Awareness of health risks to improper lifting.
• Knowledge of the basic anatomy of the spine, the muscles, and the joints of the trunk, and the contributions of intra-abdominal pressure while lifting.
• Awareness of individual body strengths and weaknesses— determining one's own lifting capacity.
• Recognition of the physical factors that might contribute to an accident and how to avoid the unexpected.
• Use of safe lifting postures and timing for smooth, easy lifting and the ability to minimize the load-moment effects.
• Use of handling aids such as stages, platforms, or steps, trestles, shoulder pads, and handles.
• Knowledge of body responses—warning signals—to be aware of when lifting.

When do employers need to compensate an injured employee?

The Act requires employers to compensate an employee who has suffered an accident while performing his/her duties during work hours, resulting into

- Permanent total disability,
- Permanent partial disability,
- Temporary disability, or
- Death.

Permanent Total Disability

- Permanent total disability is relevant when a worker can no longer perform any of their previous duties due to an on-the-job injury. This injury must be assessed to permanently affect the employee's ability to perform their duties.
- In this case, the worker is entitled to a minimum compensation of INR 140,000 (US$2,004) or 60 percent of his/her monthly wage multiplied by a factor based on the employee's potential future earnings. The total payment can be significantly larger based on the age of the injured employee.

Permanent Partial Disability

- When an employee has sustained an injury that renders them unable to perform their role at the same capacity for the rest of their career, the employee is entitled to permanent partial disablement compensation.
- For partial permanent disability, compensation is dependent upon the nature of the injury and the employee's loss of earning capacity. The Act includes a schedule of possible permanent disability injuries and lists the loss of earning capacity. For example, an arm amputated at the shoulder is assessed as a 90 percent loss of earning capacity, while the loss of an entire index finger is considered a 14 percent loss of earning capacity.
- In cases that the worker's injury is not included in the given schedule, employers must provide a medical doctor to perform an evaluation of the injured employee and calculate the loss of earning capacity. The compensation for the injured worker is then established based on the percent of lost earning capacity multiplied by the monthly wage multiplied by a factor based on the employee's potential future earnings.

Temporary Disability

- Employees that sustain injuries that render them disabled, permanently or partially, for a temporary period are compensated through temporary disability.

- In cases of temporary disability, an injured worker will be paid 25 percent of their salary every two weeks, making monthly compensation fifty percent of total earned wages. In cases of temporary injury, a medical doctor is required to examine the injured employee and determine necessary leave. A worker on temporary disability leave must undergo a physical examination twice in the month following the injury and once during the following months if they are still claiming disability.

Death

- In the unfortunate case of a death, the worker's immediate dependents are entitled to compensation. The compensation payable on death is INR 120,000 (US$1,717), or half the worker's monthly wage multiplied by a factor based on the employee's potential future earnings.

- In all cases, it is the employer's duty to ensure that the workers receive these medical evaluations without incurring personal expenses.

Safety measures

- Before you operate a machine, ensure that the dangerous part of the machine has been installed with a guard.
- Avoid going to any area with insufficient lighting as there may be some dangerous places which have not been provided with fencing.
- Keep vigilant all the time and watch out for moving cranes, hooks or other lifting equipment.
- Before you use any electrical installation or tool, check the condition of its electric cables.
- Avoid dragging electric cables on the ground or allowing the cables to come into contact with water.
- Use electrical tools installed with an earth leakage circuit breaker.
- Use and handle chemicals with care.

Personal Safety

- Wear protective equipment.
- Do not drink or take drugs while working.
- Pay attention to personal hygiene.
- Do not play in the workplace.
- Report to your supervisor immediately if you notice any unsafe condition.

Falsework If you are engaged in falsework operation, you should:

- Check whether the falsework is erected in accordance with the design.
- Make sure that the falsework is securely erected.
- Check whether the struts of the falsework are secure.
- Ensure that the props are erected vertically and arranged at a suitable distance in a row.
- Report to your supervisor when any unsafe situation is found.

Scaffold

- Do not use scaffolds unless they have been erected by trained workmen and under the supervision of a competent person.
- Do not use a scaffold unless it has been inspected and certified safe by a competent person before use.
- Strictly follow the instructions of a competent person.
- Do not alter the scaffold unless authorized to do so. Do not work on an unfinished scaffold.
- When it is necessary to work on a mobile scaffold, lock the wheels of the scaffold before you start working.
- Do not work on a scaffold unless it has been provided with a suitable working platform.

Fencing

- Do not work in a dangerous place unless its floor edges and openings have been installed with secure fencing.
- If you notice any dangerous places that have not been installed with fencing or the fencing has been damaged, reinstall or repair the fencing. If this is beyond your capability, inform your supervisor at once.

Ladder

- Use a ladder which is of good construction, sound material and adequate strength.
- Examine the ladder before using it and inspect it at regular intervals.
- Place the ladder on a level and firm footing.
- Place the ladder at an appropriate angle.
- Ensure that the ladder has a sufficient length. The upper end of the ladder should be at least 1 metre above the landing against which the ladder leans.
- Do not use a ladder unless its upper or lower end has been securely fixed or secured by another worker.
- If there are electrical installations nearby, do not use metal ladders.
- If work is carried out 2 metres or more above the floor, use a suitable working platform.

Lifting Appliance and Gear

- Do not operate a lifting appliance unless trained. In the case of a crane, a certificate is required.
- Before using lifting gear such as hook, shackle or chain sling, check whether there is any wear and tear.
- Check the weight of the load to be lifted.
- Do not exceed the safe working load of a lifting appliance or lifting gear.
- Adopt the correct lifting method.
- Do not use a lifting appliance or lifting gear unless it has been examined and certified safe by a competent examiner.
- Do not use a lifting appliance unless it has been regularly repaired and maintained by a competent person. No unauthorized repair is allowed.
- Follow the safe working instructions of the manufacturer of a lifting appliance.
- Do not work beneath any suspended load

Material Hoist

- Do not ride on a material hoist.
- Do not operate a material hoist without prior proper training.
- Do not exceed the safe working load of a material hoist.
- Do not use a material hoist unless it has been examined and certified safe by a competent examiner.
- Do not use a material hoist unless its gates have been installed with an effective interlocking safety system. The hoist is only operable after all the gates have been closed.
- Do not use a material hoist unless it has been repaired and maintained by a competent person. No unauthorized repair is allowed.
- Do not put loose materials into receptacles unless properly secured.
- Ensure good communication with the operator of a material hoist. All signals should be understood and followed.

Fire Risk

There is always a fire risk. However, the chances of fire can be reduced, and you will know what to do when a fire breaks out if you:

- Always keep the workplace clean and tidy.
- Handle machinery and tools that may generate sparks or heat carefully.
- Do not smoke or use naked flames in any area where flammable and explosive substances are stored.
- Know where fire extinguishers are located and how they are used.
- Know the place of assembly for fire evacuation.

Public Safety

- Pay attention to public safety. Members of the public are often unaware of or do not understand the work carried out on construction sites and the risks involved.
- Take great care to prevent the fall of materials from height.
- Do not stack materials on floor edges or on scaffolds.

Safety Supervisors

- Their responsibility is to assist others to work smoothly and safely.
- They have received specific safety training and are important members of the construction team.
- They have legal responsibility or liability for the overall safety of the construction site.
- You should get to know your safety supervisor.

Personal Safety

Eye Protection

- A wise worker will certainly take good care of his eyesight.
- A small fragment may cause serious consequences if it enters one's eyes.
- When there is a risk of eye injury, such as in concrete breaking or using abrasive wheels, you should wear suitable eye protectors.
- Take proper care of the eye protectors provided to you.
- Replace damaged or defective eye protectors immediately.
- Ensure that eye protectors are comfortable to wear, and keep clean.
- Use eye protectors for eye protection ─ do not put it on your head or hang it on your neck.
- Bear in mind that eye protectors are replaceable, but not your eyes.

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Personal Protective Equipment

- For your own safety and interest, use the personal protective equipment provided by your employer.
- Wear gloves when handling or contacting chemicals.
- Remember to wear a mask when working in a dusty environment.
- Wear eye and ear protectors whenever necessary.
- Wear a safety harness and secure it to a safe anchorage point when working at height. A bamboo scaffold is not a safe anchorage point, so do not fasten the safety harness to it.
- Wear safety shoes to prevent foot injury.
- Consult your supervisor if in doubt.

First Aid

- If you sustain an injury or feel not well while at work, even if it is minor, go to the first aid room right away for medical treatment and notify your supervisor.
- Put the case on record.

Manual Handling Operations

- Avoid manual handling operations as far as possible to minimize the risk of injury.
- Estimate the weight of the load.
- Lift an object with a correct posture.
- Wear suitable protective equipment. Put on gloves as far as possible to protect your hands from any cut, scratch or puncture, and wear safety boots or shoes to prevent injury to toes by heavy falling objects.
- Seek assistance from someone in lifting a load if necessary.

Construction safety check list

A - Jobsite General

1. Posters and safety signs/warnings?
2. Safety meetings held periodically?
3. First aid kit available and adequately stocked?
4. Job related safety training completed?
5. Accident reporting procedure established?
6. Substance abuse policy in place?
7. Injury records being kept?
8. Emergency telephone numbers posted?
9. Traffic routes identified?

B - Housekeeping and Sanitation

1. General neatness of work area(s)?
2. Regular disposal of waste and trash?
3. Procedures to handle hazardous waste?
4. Passageways and walkways clear?
5. Adequate lighting?
6. Waste containers provided and used?
7. Sanitary facilities adequate and clean?
8. Adequate potable water supply?
9. Adequate drinking cups?
10. Nails, boards, debris removed?
11. Eye flushing facilities available?
12. Emergency showers available?

C - Construction Area - Secured Access/After Hours

1. Warning signs in place?
2. Open ditches protected?

3. Drop-offs protected?
4. Ladders lowered?
5. Hazard lights utilized?
6. Equipment secured?
7. Utility ditches flagged or barricaded?

D - Hazard Communication

1. Written program?
2. Employees trained?
3. MSDS's on file and available?
4. Control and disposal measure(s) established?
5. Material properly stored and labeled?
6. Log of all chemicals on site available?
7. Labels legible?

E - Fire Prevention

1. Adequate number and type of fire extinguisher(s) available?
2. Fire prevention/extinguisher training accomplished?
3. Fire extinguisher inspections accomplished (monthly/periodically)?
4. Phone number of fire department posted?
5. Fire extinguisher(s) provided on appropriate equipment?
6. Are flammable liquids in approved containers and correctly labeled?
7. Are flammable liquids properly stored?
8. Fire alarm available/fire evacuation plan established?
9. Fuel supplies protected from accidental impact?
10. Fire training given to appropriate personnel?
11. Is equipment shut down prior to refueling?
12. Is equipment properly grounded to fuel trucks before refueling
13. "No smoking" signs posted and enforced?
14. Hydrants clear, access to public thoroughfare open?

F - Flammable Liquids/Materials

1. Empty containers removed?
2. Only approved containers being used?
3. Containers stored in approved and appropriate area(s)?
4. Outside storage bermed for containment?
5. Storage tanks properly grounded, bonded & pressure relief provided?
6. Cylinders stored/secured in upright position?

G - Electrical

1. Electrical devices have current inspection and coding?
2. Electrical equipment properly maintained?
3. Equipment properly grounded?
4. Assured equipment grounding program established?
5. GFCI used and tested where required?
6. Fuses provided?
7. Electrical dangers posted?
8. Proper fire extinguisher(s) provided?
9. Are terminal boxes equipped with required covers (cover used)?
10. Are circuits labeled in terminal boxes?

H - Personal Protective Equipment

1. Hazard evaluation accomplished and certified?
2. Protective equipment adequate for exposure?
3. Employees issued PPE where needed?
4. Is PPE being used?
5. Employees trained in the use of PPE?
6. Are inspections being accomplished periodically/before and after use?
7. Adequate maintenance and sanitary storage available/utilized?
8. Adequate fall protection provided?
9. Eye protection?

10. Face protection (glasses, goggles, shields)?

11. Hearing protection?

12. Respirators and masks?

13. Respirators used for harmful dust, asbestos, sand blasting, welding (lead, paint and galvanized zinc or cadmium)?

14. Head protection?

15. Hand and foot protection?

16. Physicals accomplished as required?

I - Hand Tools

1. Proper tool used for the job?

2. Handles free of cracks and attached to tool properly?

3. Inspections and proper maintenance accomplished prior to use?

4. Neatly stored, safely carried?

J - Power Tools

1. Good housekeeping where tools are used?

2. Inspections and proper maintenance accomplished?

3. Tools grounded properly or double insulated?

4. Guards in place and used correctly?

5. Damaged or malfunctioning tools tagged out until repaired or replaced?

6. Local laws and ordinance compliance?

7. All operators qualified?

8. Tools protected from unauthorized use?

9. Competent instruction and supervision?

10. Cords included in electrical inspection?

K - Ladders

1. Ladders inspected and in good condition?

2. Ladders used properly for type of exposure?

3. Ladders secured to prevent slipping, sliding, or falling?

4. Do siderails extend 36" above top of landing?

5. Are ladders spliced?

6. Rungs or cleats not over 12" on center?
7. Proper maintenance and storage?
8. Are ladders painted?
9. Do fixed ladders in excess of 20 feet have fall protection?
10. Are aluminim ladders of sufficient strength for the task?

L - Scaffolds

1. Erection properly supervised?
2. All structural members free from defects and meet safety factor?
3. Are all connections secure?
4. Are scaffolds erected on solid footing?
5. Is scaffold tied to structure?
6. Are working areas free of dirt, debris, snow, ice, grease, etc.?
7. Are workers protected from falling objects?
8. Is scaffold plumb and square, with cross-bracing?
9. Are guard rails, intermediate rails, and toeboards in place?
10. Are ropes and cables in good condition?
11. Fall protection available and in use?

M - Excavation and Shoring

1. Are holes, trenches, and cuts over 5 feet deep shored, sloped or trench boxes used?
2. Operation supervised by competent person?
3. Spoil banks at least 2 feet from edges of cut?
4. Ladders placed to ensure no greater than 25 feet of lateral travel by worker?
5. Ladder properly secured?
6. Are adjacent structures properly shored?
7. Is shoring and sheathing correct for soil and depth?
8. Are roads and sidewalks supported and protected?
9. Excavation barricaded and lighting provided?
10. Are equipment ramps adequate?
11. Have underground utility installations been identified?

12. Registered professional engineer design/approval accomplished?

13. Confined space entry permit required plan established?

14. Are daily inspections completed by a competent person?

N - Tunneling

1. Testing of atmosphere accomplished?

2. Adequate ventilation?

3. Electrical approved for hazardous locations?

4. Adequate fire prevention?

5. Rescue plan?

6. Confined space entry permit program?

O - Hoists, Cranes and Derricks

1. Are annual inspections completed?

2. Are operators properly tested and physical exams current?

3. Are daily inspections completed by operators?

4. Outriggers used?

5. Power lines deactivated, removed, or warning signs posted warning of at least 10 foot clearance from overhead power lines (voltages 50,000 volts or below)?

6. Hoists designed by a competent professional engineer?

7. Proper loading for capacity at lifting radius?

8. Operation in accordance with manufacturer's instruction?

9. Competent person inspecting crane?

10. Equipment properly lubricated and maintained?

11. Load testing accomplished?

12. Signalmen where needed?

13. Alarms working and audible?

P - Heavy Equipment

1. Regular inspection and maintenance?
2. Seat belts provided and used in equipment with ROPS?
3. Backup alarms working and audible?
4. Slow moving vehicle emblem attached to rear of equipment operating at less than 25 mph?
5. No employees riding equipment without proper seating?
6. Lights, brakes, warning signals operative?
7. Wheels chocked when necessary?
8. Haul roads well maintained and laid out properly?
9. Equipment properly secured when not in use?
10. Noise arresters used?
11. Spark arresters used as necessary?

Q - Motor Vehicles

1. Regular inspection and maintenance?
2. Qualified operators?
3. Local and state laws observed?
4. Brakes, lights, warning devices operative?
5. Weight limits and load stress controlled?
6. Personnel carried in correct manner?
7. All glass in good condition?
8. Backup signals provided?
9. Fire extinguisher(s) installed?
10. Seat belts worn?
11. Tie down straps or chains inspected?
12. Are all vehicles checked at the beginning of each shift?

R - Garages and Repair Shops

1. Fire hazards controlled?
2. Oily rag containers used and emptied daily?

3. Good housekeeping?

4. Adequate lighting?

5. Adequate ventilation?

6. Are fuels and lubricants in proper containers?

7. Are fire extinguisher(s) provided, proper type and rating?

8. Ample absorbent materials available and in use

S.Barricades

1. Floor openings planked over or barricaded?

2. Roadways and sidewalks protected?

3. Adequate lighting provided?

4. Barricades or covers installed (shafts, wall openings, stairways, stairwells, trenches, outriggers, etc.)?

T - Handling and Storage of Materials

1. Materials properly stored or stacked?

2. Are shelves, racks, and overhead storage load rated?

3. Are passageways clear?

4. Sufficient employees to do the job?

5. Lifting correctly?

6. Materials protected from weather?

7. Employees protected from falling into hoppers and bins?

8. Is dust protection used?

9. Correct type of fire extinguisher(s) and other fire protection available?

10. Traffic controlled through the storage area?

11. Rigging inspected prior to use?

12. Competent person responsible?

U - Demolition

1. Engineering survey in writing?

2. Are material chutes provided and used?

3. Are operations planned ahead?
4. Is there shoring of adjacent structures?
5. Utilities shut off?
6. Hazardous materials/chemicals removed from any pipes, tanks, or equipment?
7. Chutes provided for disposing of material above 20 feet?

V - Blasting

1. Contractor qualifications and credentials checked?
2. Explosive inventory completed and accounted for at all times?
3. Stray electrical currents checked?
4. Blasting mats used when required?
5. All signs, warning signals, and protective equipment in place?
6. Non-essentials removed from area?
7. Radio transmissions limited?
8. Procedures for handling misfires in place?
9. Explosives properly stored?
10. Is black powder prohibited?
11. Experienced and trained personnel handling explosives?
12. Detonators tested before each shot?
13. Area inspection after each shot?
14. Proper disposal of wrappings, waste, and scrap?
15. Operations suspended during electrical storms or when lightning is within 10 miles?
16. Explosives and related materials properly stored?
17. All blasting operations conducted between sun-up and sun-down

W - Welding and Cutting

1. Are operators qualified?
2. Screens and shields in place?

3. Are oxygen and acetylene stored properly?

4. Are bottles not in use secured with caps in place?

5. Proper eye protection and PPE used?

6. Fire extinguisher located near operations?

7. "Hot work" permit completed and posted in areas requiring such permit?

8. Are valves shut-off and regulators backed off each night?

9. Flashback arresters placed on hoses (O2 and fuel gas)?

10. Electrical equipment grounded?

11. Area inspected for fire hazards?

12. Gas lines and power cables protected and in good condition?

13. Proper ventilation?

14. Welding permit program?

X - Steel Erection

1. Safety nets or planked floors?
2. Hard hats, safety shoes, gloves and other PPE used?
3. Taglines for controlling loads?
4. Fire hazards covered and barricaded?
5. Floor openings covered and barricaded?
6. Hoisting apparatus checked?
7. Adequate fall protection?
8. Christmas treeing used correctly?

Y - Concrete Construction

1. Forms properly installed and braced?
2. Adequate shoring, plumbed, and crossbraced?
3. Proper curing period and procedures used?
4. Adequate PPE?
5. Caps on rebar?
6. Automatic shutoff on power operated trowels?
7. Nails and stripped form material removed from area?

Z - Masonry

1. Proper scaffolding?
2. Masonry saws properly equipped, dust protection provided?
3. Safe hoisting equipment?
4. Are limited access zones established as required?

AA - Highway Construction

1. Competent flagmen properly dressed, trained, and posted?
2. Adequate warning signs and markers?
3. Equipment not blocking right-of-way?
4. Traffic control through construction site?
5. Adequate marking and maintenance of detours?
6. Dust control used?
7. Adequate lighting?
8. Are barricades erected with correct directional stripes?

AB - Asbestos

1. If unexpected presence detected, is stop work procedure established?
2. Owner been notified?
3. Area secured?

AC - Work Permits

1. Safe work permit procedures followed?
2. "Hot work" permit procedures followed?
3. Excavation permit procedures followed?
4. Control of hazardous energy (lockout/tagout) procedures being used?
5. Confined space entry permit procedures followed?
6. Are emergency rescue plans established and available?

SAFETY SIGNS

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