PART-I

MONITORING AND EVALUATION (M&E) MANUAL ON CONSTRUCTION WORKS (BUILDINGS)

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EXECUTIVE SUMMARY

The role of IMED was limited to only monitoring of projects till 1982 when project evaluation responsibility was added to its portfolio. IMED made a humble effort in this direction by initially evaluating few completed projects. Within a short period, it started evaluating all the completed projects during a particular fiscal year. Of late, it has started outsourcing consultants every year to carry out evaluation of few important completed projects/programs and this policy is continuing till date.

Encadrement of IMED's posts in 1982 in the BCS Economic Cadre is considered as a milestone, when its door was opened up with an objective to bring more agility and dynamism in its function through continuous induction of new blood in the system. IMED's job being a bit different than the job of the other Ministries and Divisions, it demands a bit different training and attitude to accomplish it professionally. Monitoring and Evaluation being two very important functions of IMED, each one of it requires special attention and treatment.

So long, on the basis of 'learning by doing', newly posted or recruited officers have been carrying out their responsibilities of monitoring and evaluation. Of course, a small 05 page inspection guideline followed by a 06 page format of Project Inspection Report was prepared in 1995 and was practiced till 2004 when Project Inspection Report format was revised and reduced to a 02 page format and was named as IMED 06/2003. Both these guidelines contain number of instructions to the intending field inspecting officials. These instructions cover almost all aspects of project activities. It directs only what to be inspected, and not how to be inspected and check quality of construction work. Therefore, necessity of a comprehensive manual/guideline on monitoring & evaluation is felt by everybody including the newcomers in the IMED. To facilitate and enhance skill of the officers and to strengthen the capability of the organization, Monitoring & Evaluation Manual for Civil Works (Buildings, Roads, Bridges and Culverts) is prepared. The manual is prepared in two parts. Part-I consists of Building construction related works and Part-II deals with construction of Roads, Bridges and Culverts.

The manual is based on less theoretical deliberations but more practical oriented questions in the form of checklists on various aspects of project implementation. The checklists are supposed to lessen the burden of inspecting officials of going through various documents like DPP/TPP, procurement etc. this will help save valuable time and concentrate more on collecting useful data/information from the field.

There are as many as 28 Checklists (Part-I contains 23 nos. and Part-II contains 5nos.) in this manual. Some are quite elaborate and some are short. These checklists are basically divided into 2 categories. One category relates to the DPP/TPP and Public Procurement Rules and Acts and the others belong to quality checks for civil construction work in the field. As many of the checklists of Part-I cover the construction areas of the Part-II, these are not annexed with the Part-II of the report.

The checklists in the form of questionnaires are given for the purpose of strengthening an inquisitiveness related to the technical subject and also develop confidence in oneself. The questionnaires will help know and learn the technicalities involved in checking the quality and workmanship in the construction works.

Delay in procurement of goods, works and services is nationally identified as a major cause in project execution. To overcome the situation, government, with the assistance of the World Bank has initiated many steps through CPTU of IMED. One of them being, developing PPA-2006 and PPR-2008. Recently CPTU has developed 45 key indicators for monitoring procurement contracts of few selected organizations for monitoring their procurement performances.

However, the Consultant has developed a comprehensive checklists for procurement of construction works appended as **Annexure**-3 in the manual, where 45 key indicators mentioned in the above paragraph have also been taken care of. This Annexure will help IMED officials to analyse various contracts thoroughly, pin point specific steps where inordinate delays have occurred and suggest measures to contain them effectively.

Checklists of the manual are quite exhaustive and have covered almost all areas of construction that an IMED official would be interested to look into.

ABBREVIATION AND ACRONYMS

AA	**Approving Authority**
ACV	**Aggregate Crushing Value**
BCR	**Benefit Cost Ratio**
BCS	**Bangladesh Civil Service**
C.C.	**Cement Concrete**
C.B.R. Test	**California Bearing Ratio Test**
CONTASA	**Convertible Taka Special Account**
CPTU	**Central Procurement Technical Unit**
DOSA	**Dollar Special Account**
DP	**Development Partner**
DoFP	**Delegation of Financial Power**
DPP	**Development Project Proforma**
ECNEC	**Executive Committee for National Economic Council**
EOI	**Expression of Interest**
FDD	**Field Dry Density**
GCC	**General Conditions of Contract**
HOPE	**Head of Procuring Entity**
HRD	**Human Resource Development**
IFB	**Invitation for BID**
IFT	**Invitation for Tender**
IMED	**Implementation Monitoring and Evaluation Division**
IRR	**Internal Rate of Return**
LD	**Liquidated Damage**
LOI	**Letter of Intent**
LTM	**Letter Tender Method**
MDD	**Maximum Dry Density**
MDG	**Millennium Development Goal**
M&E	**Monitoring and Evaluation**
NA	**Not Applicable**
NOA	**Number of Application**

NPV	**Net Present Value**
NEC	**National Economic Council**
OMC	**Optimum Moisture Content**
OTM	**Open Tender Method**
PCC	**Particular Conditions of Contract**
PC Girder	**Pre-stressed Concrete Girder**
PE	**Procuring Entity / Project Engineer**
PEC	**Project Evaluation Committee**
PIB	**Project Implementation Bureau**
PO	**Purchase Order**
PPA	**Public Procurement Act**
PPR	**Public Procurement Rules**
PIC	**Project Implementation Committee**
PRS	**Poverty Reduction Strategy**
PWD	**Public Works Department**
RHD	**Roads and Highways Department**
R.C.C.	**Reinforcement Cement concrete**
REOI	**Request for Expression of Interest**
RPA	**Reimbursable Project Aid**
RFP	**Request for Proposal**
PSC	**Project Steering Committee**
SAFE	**Special Account for Foreign Exchange**
SMECI	**Strengthening Monitoring and Evaluation Capabilities of IMED**
STD	**Standard Tender Document**
SPD	**Standard Prequalification Document**
SRFQ	**Standard Request for Quotation**
TFV	**Ten Percent Fine Value**
TEC	**Tender Evaluation Committee**
TOC	**Tender Opening Committee**
TPP	**Technical Project Proforma**
TEC	**Technical Evaluation Committee**

1. Background:

As background to the work an overview of the existing system of project planning and approval, monitoring and evaluation in Bangladesh is given in the diagram below that in general illustrates the main steps of the project cycle. Under this study 5th and 7th stage of the project cycle, namely 'Project Monitoring/Ongoing Evaluation and Post-Project Evaluation' is covered.

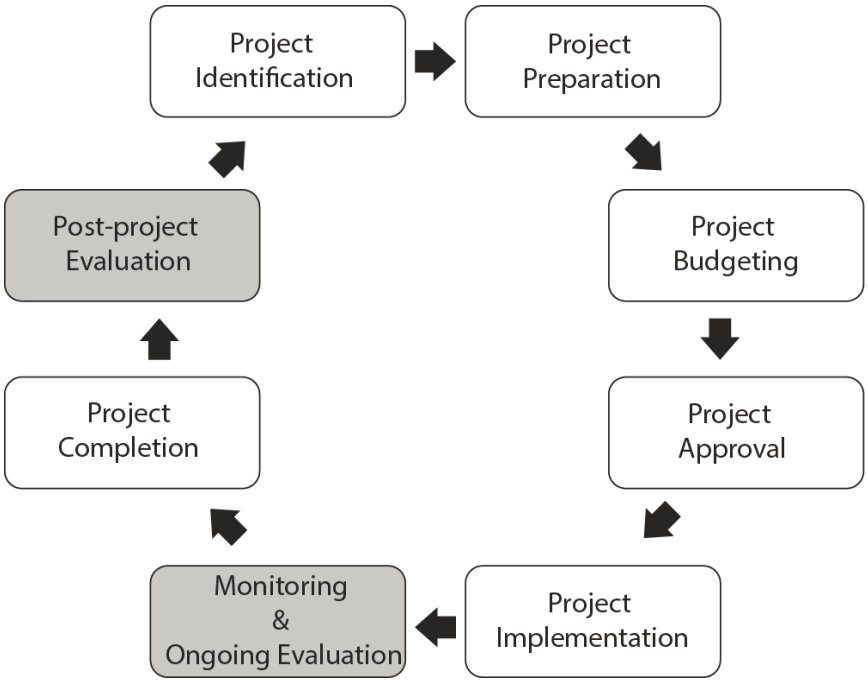


Fig. Project Cycle

1.1 Monitoring is defined as collection of data prior to and during the project implementation. These data, when analyzed, pinpoint progress or constraints as early as possible, allowing project managers to adjust project activities as needed. It also provides basis for undertaking evaluation.

The primary objectives of monitoring are to:

- Reveal if there is any impending problem to avoid disaster/delay;
- Assess the progress of the project with respect to the proposed timeline;
- Make necessary adjustments in resources, if necessary;
- Ensure quality of the ongoing work;
- Learn weakness and strength of the project management.

- Redesign or readjust project implementation strategies or project components to achieve desired objective.

1.2 Evaluation is also defined as a structured process of assessing the success of a project in meeting its goal and to reflect on the lessons learned. It is carried out mostly at the end of a project work. Evaluation is not just about demonstrating success, it is also about learning why things don't work. As such, identifying and learning from mistakes is one of the key aspects of evaluation.

The primary objectives of evaluation are to:

- Understand how the project has achieved its intended purpose, or why it may not have done so;
- Identify how efficient the project was in converting resources into activities, objectives and goals;
- Assess how sustainable and meaningful the project was;
- Inform decision-makers on how to build on or improve a project.

The key difference between monitoring and evaluation is that evaluation is about placing a value judgment on the information gathered during a project, including the monitoring data. The assessment of a project's success (its evaluation) can be different based on whose value judgment is used. For example, a project manager's evaluation may be different to that of the project's participants, or other stakeholders.

2. Why is monitoring and evaluation important?

Monitoring and evaluation are critical tools for identifying and documenting successful projects and approaches and tracking their progress. This is especially more relevant and essential in resource poor countries like Bangladesh, where difficult decisions need to be made with respect to resource allocation priorities.

At the program level, the purpose of monitoring and evaluation is to track implementation and outputs systematically. Monitoring and evaluation forms the basis for modification and interventions and assessing the quality of work done.

Monitoring and evaluation can be used to demonstrate whether project has achieved the expected outcomes or not. It is essential in helping managers, planners, implementers, policy

makers and funding agencies acquire the information and generate informed decisions about project implementation.

Monitoring and evaluation helps identify the most efficient use of resources and provide the necessary information to guide strategic planning, design and implementation of projects, and to allocate, and re-allocate resources in better ways.

3. Monitoring and Evaluation practice in Bangladesh:

Project Implementation Bureau (PIB) was created in 1975 through an executive order of the government as a central project monitoring organization of the Government of Bangladesh. The PIB latter upgraded and renamed Implementation Monitoring and Evaluation Division (IMED) started its journey in 1982 in a modest way. Initially, its project monitoring activities were mostly limited to financial performance reporting of projects. Although, physical progress reporting formats were also in place, IMED's data analysis activities and reports were limited mostly to observations. The reports based on those observations were made on the (project) reports received from the ministries/agencies.

According to The Rules of Business of the government, allocated functions or activities to the IMED are as follows:

- Monitoring and Evaluation of the implementation of development projects included in the Annual Development Program.
- Collection and compilation of project-wise data for preparing quarterly, annual and periodical progress reports for information of the President, NEC, ECNEC, Ministries and other concerned.
- Rendering such advisory or consultancy services to Ministries/Agencies concerned on implementation of projects as and when necessary.
- **Field inspection** of projects for on the spot verification of implementation status and such other Co-ordination works as may be necessary for the removal of implementation problems, if any, with the assistance of related ministries/ agencies.
- Submission of project inspection reports to the President and Ministers concerned when attentions at such levels are considered necessary.
- Matters relating to Central Procurement Technical Unit (CPTU).
- Matters relating to The Public Procurement Rules (PPR), 2008.

- Such other functions as may be assigned to the Division by the Prime Minister from time to time.

4. Emphasis on field/site inspection:

Field inspection is one of the important tools of monitoring and evaluation, and that is being carried out by the IMED in Bangladesh with the available resources. Field inspection of the projects is one of the duties and responsibilities of the IMED enshrined in its Rules of Business. And it is being religiously executed by the organization from its very beginning to fulfil its obligation.

Emphasis given on the field inspection by the IMED can be understood by the fact that every officer of the organization is required to visit at least 3 projects every month and submit its inspection reports to the government for necessary action. This practice was made mandatory for every officer, including the DGs through an internal order and that is being followed by the organization for about 25 years.

IMED also involves itself in investigative inspection reporting, whenever and wherever it is necessary or it is desired by the higher authority to do so for the benefit of the project implementation.

5. Site inspection of civil works (bldg.) related projects:

Field inspection gives an on the spot impression of project performance in its implementation phase. Since most of the investment projects have civil construction/ physical work component, the overall physical progress of work of any project can only be assessed properly through site visits. Site visits gives an opportunity to see whether the works are being carried out as per the approved plan document or there are deviations from the approved DPP. Besides, the rate of progress of work vis-a-vis the utilization of funds can also be assessed as to whether there are possibilities of time and cost overruns. Through project inspection early forecast of the likely impending problems/hazards in the implementation phase can be made in advance and the remedial/corrective measures can be suggested.

Inspection and quality assurance of project implementation is the ultimate responsibility of the respective Ministry/Agency, though it is contractor’s responsibility to guarantee quality of works as per terms of the contract. However, in order to have an impartial/unbiased view of

the project performance inspection by an independent and higher body like IMED becomes pertinent. Field inspection gives an opportunity to see whether the works are being carried out as per the approved plan and design standards/specifications or there are deviations from the approved DPP. Besides the rate of progress of work vis-a-vis the utilization of funds can also be assessed as to whether there are possibility of time and cost overruns. These findings and recommendations form the core of the report.

There was a time when all the construction materials (like bricks, cement, MS rod, sanitary fittings etc.) used to be supplied by the Public Works Department (PWD) and the contractor has to take delivery of the materials from the store, carry it to specific site/s and complete the job in time. This practice was inherited from the then East Pakistan PWD. But in late seventies, the flaw in the whole system was detected by an investigating teams constituted by the government. It was revealed that construction materials and construction related equipment worth millions of Taka were lying in different PWD stores scattered all over Bangladesh. Some of the equipment and materials were even continuing in the inventory of the store from Pakistan days. In some cases these materials and equipment were purchased to block funds allocated to the departments each Fiscal Year. In those days PWD used to do all the civil works of all the government departments, and huge fund were placed at its disposal every Fiscal Year. This led to corruption and misuse of fund as well.

However, this position changed dramatically after revelation and government decided to put the responsibility of supplying the needed construction materials and equipment, for constructing building and other civil works etc., on the shoulder of the contractor, leaving only the supervisory role to be played by the indenting agency. In short, the agency required to look intensely to ensure quality of material supplied by the contractor and supervise the construction work to ensure quality of work done by him (the contractor) as per specifications of the contract and also determine its completion within the specified time frame.

5.1 Attitude/approach of the inspector:

The inspecting officer may or may not be an engineer but the person sitting in front of him/her (Project Director) probably is; who is also likely to be senior in age and is supposed to know his job well. Therefore, approach of the visiting official has to be nice, positive and friendly with him. The visitor should not hurt him by his behavior. Because an inspector needs his/her office's 100% cooperation for collecting project information from the field. His/her non-cooperation may lead to unproductive visit, resulting in wastage of time, money and energy.

Achievement of project's target is attributed to a team efforts and not to an individual, therefore a Project Director (PD) alone should not be put in the dock for failure to achieve the target of project. A Project Director does not live in isolation. He does not have absolute control on the entire risk and assumptions of the project activities.

An inspector should encourage PD to speak freely about the impediments, project is encountering in its implementation. Negative attitude of an inspector towards PD may discourage PD to divulge any information that may, in his perception, harm him or his superior in hierarchy. In short, the atmosphere of collecting information from the field should be kept lively and cool to the extent it is possible from inspecting official's side.

As this manual/guideline deals with the highly technical engineering subjects, it would be advisable to IMED officials in general, whether engineer or non-engineer, to avoid entering into debate or arguments on the matter of 'design', whether it is a building design or bridge design or any other structural design. Because, it is a specialized area and the matter should always be left to those who have specialization in the subject. Debate or arguments on the subject may not be helpful rather it can prove to be counterproductive.

6. M&E Manual for civil works:

This M&E manual is a reference document which provides— step-by-step guidance on how to perform a specific task. It contains many sets of instructions containing DOs and DON'Ts. This M&E manual includes specific steps/ instructions to be followed by the inspecting/investigating officials of the IMED.

The purpose of the manual is as follows:

- To provide an operational framework for achieving the IMED's M&E goals.
- To explain its working procedures
- To provide clear inspection/investigation guidance for the IMED's officials
- To establish standard internal reporting system
- To improve quality of project monitoring and evaluation
- To ensure consistency in M&E within the sectors/sub-sectors
- To enhance inspection skill of the IMED's official
- To improve quality of reporting.

This manual will require periodic updating for keeping pace with the development strategy of the government as well as the monitoring and evaluation policy of the IMED.

7. Preparation for project inspection by using M& E Manual:

Before embarking on project inspection a number of preparatory works are necessary to be taken to make it more effective and meaningful. In brief, these steps are:

- Having knowledge of the stages of construction of a building will be helpful in understanding the project activities and its efficient management.
- Holding a pre-inspection meeting with the Project Director/Project Management, preferably in the IMED, to get an overall impression of the project progress and the impediments centering round the project implementation.
- Preparing inspection schedule in consultation with the project officials, so that inspection is completed within a reasonable time period.
- Studying procurement plan provided in the DPP in the light of PPA-2006 and PPR-2008
- Studying Development Project Proforma (DPP)
- Studying yearly, quarterly and monthly reports (IMED's 01/2003, 02/2003, 03/200304/2003 and 05/2003 formats or newly developed two formats, 2015) of the project received in the IMED and filling in part of the inspection report with static data/information before going to the field or by using online PMIS.

8. Inspection of building construction work:

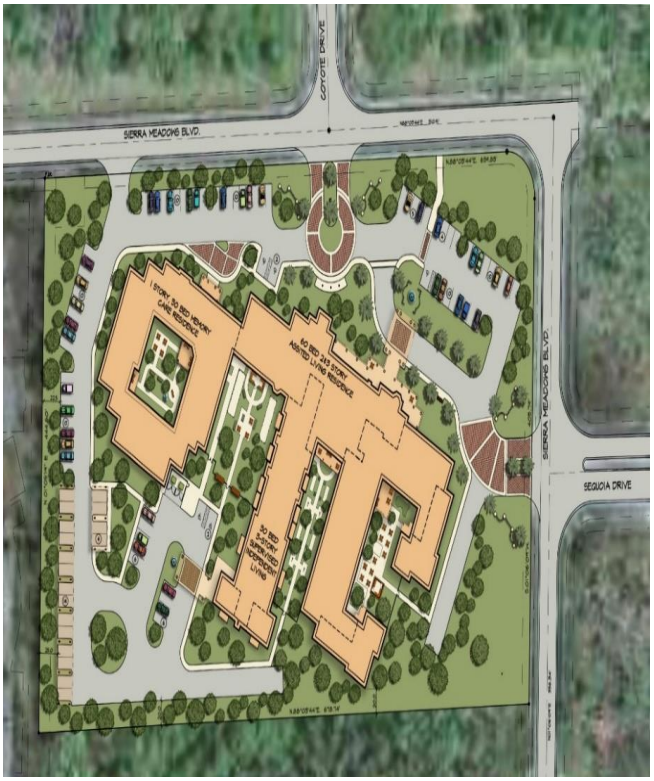
There are number of steps in construction of building that are required to be followed systematically during its construction. As a preliminary to the construction work, some important in-house jobs like-preparation of tender with technical specifications, estimation of cost, invitation of tender and award of contract is completed. Actual physical work starts from handing over the site, and providing with layout and design/drawings of a building to the contractor.

This is being a purely technical subject, it requires a monitor to have some acquaintance with technical terminologies of civil construction work and some basic knowledge of the subject. This manual is prepared with that purpose. It tries to provide a monitor with knowledge and knowhow of construction of different stages of a building.

9. Construction Stages of a building

There are as many as 34 stages of building construction that are elaborated here. Acquaintances with these stages of construction work will help in understanding the nature of work, its complicacies, technicalities and systematic approach to building construction work.

I. Site preparation/ design phase

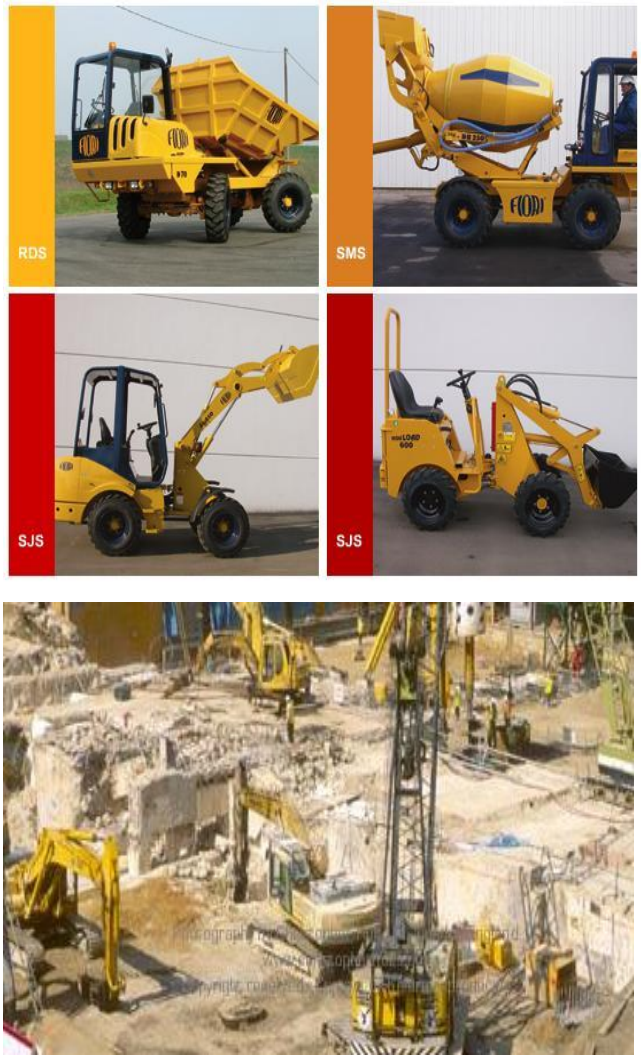
Sl.	Activities	Images
1.	**Selection of site:** There are many factors that taken into account while selecting a site for a commercial/residential buildings. Some of these factors are given below. 1. **Shape of the plot:** It should be such that the building can be constructed with low cost, and it can be expanded in future. 2. **Location of the plot:** It should be near the main road, shall have less polluting environment, shall have less development cost and surrounding area has aesthetic look. 3. **Availability of amenities:** The area may have availability of number of amenities, such as electricity, Telephone, fast transport system etc. and proper **sewerage system** at the site of residential plots. So that, the extra water of houses can easily be drawn out especially in rains and floods.	 ***Fig.*** *Construction site of a building*

Sl.	Activities	Images
2.	***Preparation of design:*** Architectural design and drawings shall be prepared at the outset and that will follow preparation of structural design and drawings of a building. Electrical, sanitary and plumbing design and drawings shall also be completed simultaneously. Building design refers to the broadly based architectural, engineering and technical applications to the design of buildings. All building projects require the services of a building designer, a licensed architect or structural engineer. Cost estimate of the structure (building) shall be made based on structural design/drawings and tender shall be floated IMED may check the time bound plan prepared for delivery, approval and supply of design and its sequence, and take stock of the supply situation at project site. If consultant/s is appointed for preparation of drawings/ designs etc. IMED may examine the activities of the consultant/s and note areas of failure. ***See checklist for building design no. M, Page-61.***	 ***Fig.*** *Preparation of design*

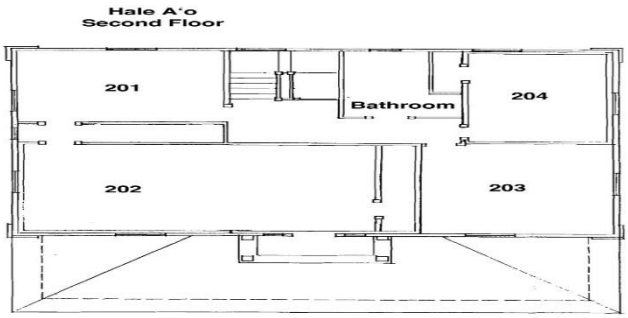
Sl.	Activities	Images
3.	**Selection of contractor:** The evaluation and selection of contractor leading to the award of construction contracts is a vital part of the construction process. In the light of PPA-2006 and PPR-2008 tender shall be invited for selection of contractor through competitive bidding process. **See checklist for procurement of construction work-Annexure-3, page-47-50.**	 ***Fig.*** *Selection of contractor*
4.	**Mobilization:** **a) Handing over site:** After signing the contract, clear site of the project is handed over to the contractor and if necessary lay out is provided on the ground by the Executive Engineer or his representative. **b) Construction of site office:** To fulfill the conditions of the contract and facilitate smooth construction activities, normally a contractor builds a site office nearest to the project location. At the site contractor's essential men and construction material and equipment are located. He is also required to maintain a 'site inspection register/book' on the site, and also preserve a copy of the 'Work Order' along with it, so that visiting project officials and other related officials can write their observations /instructions in it regarding progress of work, quality of materials as well quality of work performed (workmanship) by the contractor. He is also required to keep a copy of the	 ***Fig****: Handing over site*

Sl.	Activities	Images
	approved construction schedule (Bar Chart) at the site for quick reference and observations. Setting up a material and quality testing laboratory at site with trained qualified personnel also lies under purview of the contractor's responsibility. The above arrangements at site are considered a pre-requisite for the start of construction work. Therefore, when visiting a site, take a look into these arrangements. Site register/book will give first-hand information about the frequency of visits of the senior officials at site, instructions given to the contractor for compliance and its follow up etc. IMED's official can also record its comments/ observations in the register/book regarding visit and other issues that deem worth mentioning. **See checklist for site documents no. H, page-67 and also See checklist for testing facilities at site no. K, page-60.**	 ***Fig.*** *Construction of site office*

Sl.	Activities	Images
	c) Arrangement of water and electricity: Making arrangements of electricity and water at the project site before the start of construction work. These facilities are essential to ensure security at site, operating equipment, cleaning construction materials, carryout material and other tests and ensure timely castings of CC and RCC work, proper curing and curing of masonry work and plastering work of the building.	  ***Fig.*** *Arrangement of water and electricity*
	d) Construction material: Mobilization of construction material at site by the contractor as per approved sequence is necessary for timely start of construction work. All materials are required to meet the standard quality tests as per technical specifications of the contract document. The material test result is also need to be approved by the project authority. Procurement of materials is a gigantic task and that often constitutes a major part of construction work. Therefore, mobilization of materials at site will reflect, to some extent,	 ***Fig.*** *Mobilization of construction material*

Sl.	Activities	Images
	seriousness of the contractor in meeting the construction deadlines of the schedule. **See checklist for mobilization of materials and equipment (Annexer-4) nos. N & O , Page-62 and also see checklist for ensuring overall quality test and management of building construction (Annexer-5) no. C, Page-64.**	
	e) Construction Equipment: Mobilization construction equipment at site is necessary before the start of work. Depending on the complexity and nature of work to be performed, the construction equipment are identified and entered into the contract document. IMED may have a look in the list of construction equipment well as other auxiliary and ancillary equipment and check whether these are brought at site as per contract document. **See checklist (Annexer-4) no. O, page-62**	 ***Fig.*** *Deployment of construction equipment*

II. Implementation phase

Sl.	Activities	Images
5.	**Handing over site and provide layout to the contractor**: Handing over layout to the contractor is the first step towards start of construction work on the ground. As per layout plan, component of the building are set out on the ground and execution of building plan starts.	 ***Fig:*** *Layout of a building*   ***Fig:*** *Preparation of site* *Clearing of site*
6.	**Foundation:** Broadly speaking, all foundations are divided into two categories: Shallow Foundations and Deep Foundations. The word Shallow and Deep refer to the depth of the soil in which foundation is made. Shallow and Deep foundations are made as per requirement of the conditions of the soil and the type of structure to be built. **a. Trench cutting:** After setting out the lay out on the ground, trench cutting for foundation is done. Length, breadth and depth of the trench is kept as per provision made in the structural drawings. If it is a	 ***Fig:*** *Trench Cutting*

	shallow foundation, then excavation is carried out as per size of the footing **b. Foundation Casting:** As a first step towards casting foundation is to do Brick Flat Soling. On the top of it CC casting is done as per design requirement to consolidate the ground. Over this smooth and stable concrete bed, reinforcement is placed as per requirement of the design/drawings and reinforcement of column are also vertically placed and tied to the rods of the bed as per requirement. After completion of this process RCC casting of bed is done as a preliminary to the casting of the columns. IMED may consult the expert/ consultant of the project regarding design know the details of it and check whether size of the footing, diameter of reinforcement (RI), covering of RI has been provided as per design/drawings. Quality of materials like chips, bricks, cement, sand and RI and shuttering materials are provided as per specifications. Inspecting IMED official may also check if the foundation casting is done as per drawings/design. **See checklist C, Page-64. Annexer-5 for overall quality test and management of building construction.**	 ***Fig**: Foundation casting*

Sl.	Activities	Images
7.	**Colum casting:** Column casting is an important work of the building. Before the start of actual casting, there are some auxiliary works like tying of the columns with GI wire after placing rings of specific diameter at specified distances around it, making overlapping of reinforcements and fixing the shutters around the column, covering of the RI etc. as requirement of the drawings/design or as per instruction of the engineer are done. IMED may check whether the instructions of the engineer have been properly followed. It may also check if the no. of RI and its diameter, quality of shuttering materials and other casting materials are provided as per specifications. Generally, concrete covering of columns below ground level is higher than the columns above ground level. **See checklist E Page-55 Annexer-3 for casting floor slabs, beams and columns and also checklist J, Page-59.-Annexer-4 for quality control of R.C.C work**	 ***Fig.*** *Colum casting up to grade beam*  ***Fig.*** *Column casting*

Sl.	Activities	Images
9.	**Grade beam casting :** As mentioned earlier, some similar important axillary works are to be performed by the contractor before the commencement of the casting of the grade beam to ensure better quality of work. Apart from many other precautions, use of vibrator machine in all castings has to be used to facilitate proper compaction and setting of concrete. **See checklist E Page-55 Annexer-3 for casting floor slabs, beams and columns and also checklist J, Page-59.-Annexer-4 for quality control of R.C.C work**	 ***Fig:*** *Grade beam casting*
10.	**Stair casting:** In this case, utmost care is taken to ensure that riser and tread (step) of the stair confirm to the design /drawings and shutters are properly fixed before commencement of the casting, so that water of the concrete mix does not leak through the gaps weakening the structure. **See checklist E Page-55 Annexer-3 for casting floor slabs, beams and columns and also checklist J, Page-59.-Annexer-4 for quality control of R.C.C work**	 ***Fig:*** *Stair casting*
11.	**Column casting (ground floor):** It is mentioned in the previous columns about the necessity of fixing the shutters	

Sl.	Activities	Images
	around the columns properly as per design/drawings and pouring of the cement and sand mix in specified ratio as per instruction of the engineer. Test of C. C. mix is carried out as per specifications of the contract before it is poured. IMED may see the test reports of the concrete. **See checklist E Page-55 Annexer-3 for casting floor slabs, beams and columns and also checklist J, Page-59.-Annexer-4 for quality control of R.C.C work**	 ***Fig:*** *Column casting (ground floor)*
12.	**Floor beam and slab casting:** Before casting of floor and beam is started, following steps shall be ensured: i. Leveling and placing of shutters are done. ii. RI are properly placed and tied. iii. Blocks/chairs of proper size are placed below the RI for covering. iv. Placement of electrical ducts in right places are completed. v. Provision for sanitary fittings is made. vi. Quality checks of materials-cement, sand, chips, water and RI are carried out. It is a monolithic structure and has to be cast in one go without interruption. It requires lot of preparation before start of pouring concrete. First of all floor beam is cast and then floor slab is cast continuously until it is finished. Fixing of shuttering and centering material properly as per requirement of working drawings before pouring of concrete is necessary part of the total	

Sl.	Activities	Images
	process. As mentioned earlier gaps in the shutters should be covered to avoid leakage of water of concrete mix, and de-bonding material should also be used for better result. Use of vibrator machine for proper compaction and concrete mixer machine for mixing the aggregates properly is a must to achieve quality work. After rod bindings, electrical ducts laying and making sanitary fittings provisions pouring of concrete is done with the approval of the engineer at site. **See checklist E Page-55 Annexer-3 for casting floor slabs, beams and columns and also checklist J, Page-59.-Annexer-4 for quality control of R.C.C work**	 ***Fig:*** *Floor beam and slab casting*

III. Construction of column

Sl.	Activities	Images
13.	**Rod binding:** During rod binding process, following steps shall be taken to ensure quality of work: **i.** Number of rods placed are as per design **ii.** Placement of rods and its diameter are as per specifications **iii.** Spacing between the rods are as per drawings. **iv.** Tying and covering of RI are done as per design. **v.** Rods are vertically placed as per design. **vi.** Water tight shutters are used as per design. **See checklist J, Page-59.-Annexer-4 of quality control of R.C.C work.**	 ***Fig:*** *Rod binding from foundation level*
14.	**Shuttering arrangements:** Good quality shuttering materials shall be used for achieving quality castings. Following measures shall be necessary: i. Spacing of props should be as per drawings; ii. For columns, shutter support is given from different sides to keep it vertical; iii. For slabs and beam, vertical support is provided from below; iv. In case of stairs, inclined shutters and vertical support is given; Good quality shuttering material in the process ensure sturdy construction and ability to bear inconsiderable forces generated by wet concrete. Contractor is	

supposed to make arrangements of the shutters required for construction as per contract agreement.

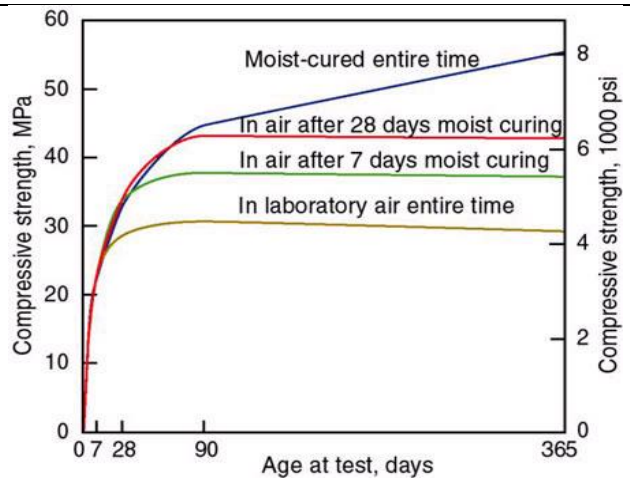
Steel shuttering plate is the best type of shuttering because this is water tight shuttering which can bear the load of cement concrete placed on it. This shuttering gives good appearance and pattern work according to architectural drawings. If the plaster is required, the thickness of plaster will be less. Being water tight shuttering, the strength of concrete with steel shuttering is comparatively higher.

Contractors are supposed to use steel shutters in every construction. Quality of shuttering and centering materials and its proper fixing greatly influences the quality of the casted structure. If the gaps and cracks shutters are not plugged with care and adequate attention is not given during concrete pouring, concrete water often leaks through the shutters and other places leaving honeycomb and sometime exposing rod in the structure, thus weakening the structure itself. In some cases bulging or sagging in the column, roof, and beam etc. is also observed due to defective fixing of shuttering and centering materials.

Fig: *Shuttering arrangements*

Fig : *Use of steel as shuttering materials*

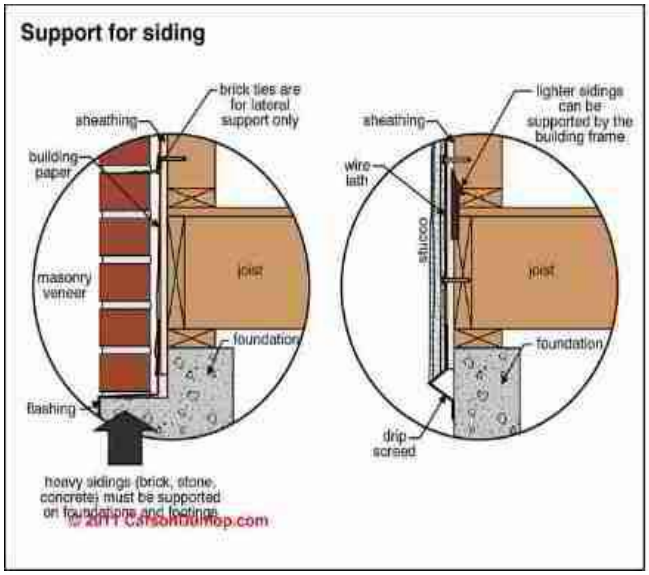
Sl.	Activities	Images
15.	**Concrete pouring:** Before start of pouring of concrete following steps are followed to ensure quality work: **i.** Mixing is done as per approved Mix Design; **ii.** Quality of aggregates (cement, sand chips and water) is properly checked; **iii.** Mixer Machine or Batching Plant is made available at site depending on the volume of work; **iv.** Calibrated steel or wooden bucket is used for measuring aggregates (cement, sand and chips); **v.** Vibrator Machine is made available at construction site; For small volume of concreting work, concrete pouring is done by hopper connected to Mixer Machine and in case of large volume of concreting work Batching Plant is used. Batching plant delivers the mix concrete with proper proportion automatically as per design mix. Vibrator machine is used during pouring of concrete to achieve desired level of compaction. To ensure proper proportion of aggregates in the Mixer Machine as per specifications, steel or wooden calibrated buckets shall be used for measuring the volume of the aggregates. **See checklist E Page-55 Annexer-3 for casting floor slabs, beams and columns and also checklist J, Page-59.–Annexer-4 for quality control of R.C.C work**	 ***Fig:*** *Pouring concrete and proper compaction*

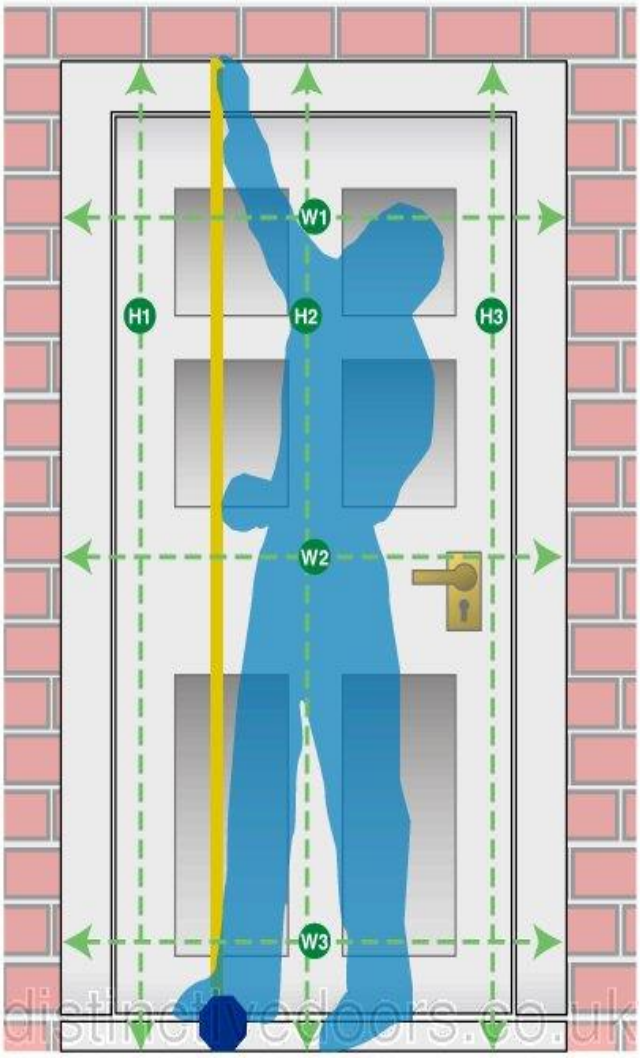
16.	**Curing:** Water plays a critical role in building construction. It is needed for workability and hydration reaction in the concrete. — Time is an important factor in determining concrete strength. Curing of concrete as well as masonry work is an important aspect of the whole process of construction of a building. Proper attention should be given for Curing to ensure durability and longevity of a building. Availability of potable adequate water, at the project site for curing shall be ensured. All R.C.C. castings shall be kept wept continuously for at least 28 days to achieve desired strength of the structures. Masonry and Plaster work shall be kept wet for at least 07 days to ensure desired level of strength. **See checklist E Page-55 Annexer-3 for casting floor slabs, beams and columns and also checklist J, Page-59.–Annexer-4 for quality control of R.C.C work**	  ***Fig:*** *Curing to be ensured for 28 days*

IV. Construction of Lintels

Sl.	Activities	Images
17.	**Centering of lintels, sunshade, drop wall etc.:** The activity of construction of lintels, sunshade, drop wall etc. follow the same principle of shuttering, binding of rods, pouring of concrete and curing the structure for a specified time period as in other structures mentioned before.	 ***Fig:*** *Centering of lintels, sunshade, drop wall etc.*
18.	**Laying electrical duct and keeping provision for sanitary fittings:** As per electrical design, electrical conduits are laid on the floor before pouring of concrete. Provisions for electrical conduits for electrical wiring is made in the walls after masonry work is completed. Provisions for sanitary fittings are also kept before start of casting of slab.	 ***Fig:*** *Laying electrical duct*  ***Fig:*** *Making provision for Sanitary wares*

V. Completion of Curing

Sl.	Activities	Images
19.	**Removal of shuttering and defects repair :** After completion of curing for 28 days centering and shuttering is removed cautiously without damaging the structure and avoiding causing injury to the working laborers or people living close to the building. Honey comb and other defects often appear in the structure after removal of the centering and shuttering material. These problems are supposed to be taken care of immediately as per instruction of the site engineer to avoid permanent damage and weakening the structure. **See checklist E Page-55 Annexer-3 for casting floor slabs, beams and columns and also checklist J, Page-59.–Annexer-4 for quality control of R.C.C work**	 ***Fig:*** *Centering and shuttering removal*
20.	**Wall construction:** Masonry work of walls is done by 1st class bricks. All bricks to be used in masonry work should be uniform in shape and size, free from lumps, cracks and spongy matter. There are crude methods for testing 1st class bricks. When two 1st class bricks are struck with each other, it emits ringing sound. When 'T' test is applied for testing 1st class bricks, two bricks are held in 'T' position and dropped from 4/5 feet above the ground, the one above will break if it is not 1st class.	

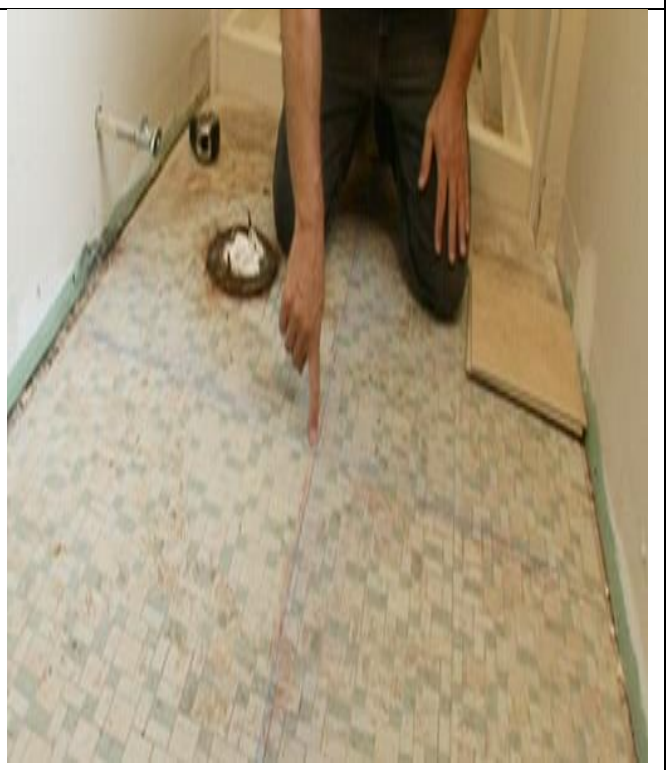
Sl.	Activities	Images
	Anyhow in the laboratory 'Compressive Strength' test is done to determine the quality of the bricks for masonry work. Compressive Strength test of 1st class bricks comes to around 1000 kg/sq.cm. It is ~~also~~ important to note that mortar that is used for bonding the bricks is mixed in right proportion and buttering of one side of the brick is done properly before its placement. During wall construction mortar should be used as specified in the contract document. **See checklist- B, page-63. Annexer-5 for testing construction materials.**	 ***Fig:*** *Wall construction*
21.	**Doors, window frames and accessories:** Normally wood is used in door frames, door shutters and stair railings of a building. Contractor is required to supply and fix these works as per specifications mentioned in the contract document or as allowed by the Engineer in writing. Contractor shall supply sample of door frames and shutters. The engineer shall verify if these are properly seasoned and meet specifications of the contract. After that, the engineer will allow the contractor to supply and fix the door frames and shutters. It shall also be ensured that Hinges, Tower Bolts, Haze Bolts, Clamps etc. are supplied and fixed as per specifications. — **See check list B, page-52. Annexer-4 for wood works.**	

Sl.	Activities	Images
	Flat Bar, Square Bar, MS bar, Iron Angle, GI/MS Pipe, SS Pipe etc. is mostly used in window grills and other places of the building for security reasons, and in some cases as requirement of the architectural design and also for enhancing aesthetic look of a building. Therefore, it is desirable that all these materials are supplied and used as mentioned in the schedule of works. Therefore, to be sure that the flat bars used in the grills are of right specification, one can check if all joints are welded properly. It is commonly found that joints are welded by 'spot welding' instead of running welding. Therefore, in all cases running welding joints shall be ensured. **See checklist C, page-53. Annexer-4 for metal works (Iron/Aluminum).**	 ***Fig:*** *Fittings of doors and window frames*
22.	**Plastering:** Wall, ceiling, column, beam surfaces are cleaned and soaked with water before applying plaster on it. Sand, cement and water is mixed in specified proportion before application. After application of the mortar on the wall, surface is rubbed to smoothen the surface. When plastering walls, plaster must be applied in such a way that it sticks to the support wall surface, bears its weight load without cracking, and exhibits a smooth, hard, finished surface suitable for painting or papering.	 ***Fig:*** *Plastering of walls*

Sl.	Activities	Images
	After plastering, curing of wall is supposed be done for 7 days to allow complete bonding. **See checklist A, page-51. Annexer-4 for plastering work.**	
23.	**Construction of sanitary pits and laying of underground R.C.C pipe:** Following steps are necessarily taken before construction of pits and laying underground RCC pipes: a. Sewage, sanitary and kitchen disposal pipes are first fixed as per drawings/ design b. Pipes mentioned in above 'a' are connected with sewage and drainage system through another bigger size pipe laid on the ground c. Some pits are provided on the ground to clean the lines, if chocked The above facilities have to be created as per construction drawing/design of the building. Its quality of workmanship and the quality of the materials used has to be ensured by the contractor and the supervisory officials of the project. **See checklist D, page-64. Annexer-5 of completed building.**	 ***Fig:*** *Construction of sanitary pits and laying of underground R.C.C pipe*

VI. Ground floor preparation

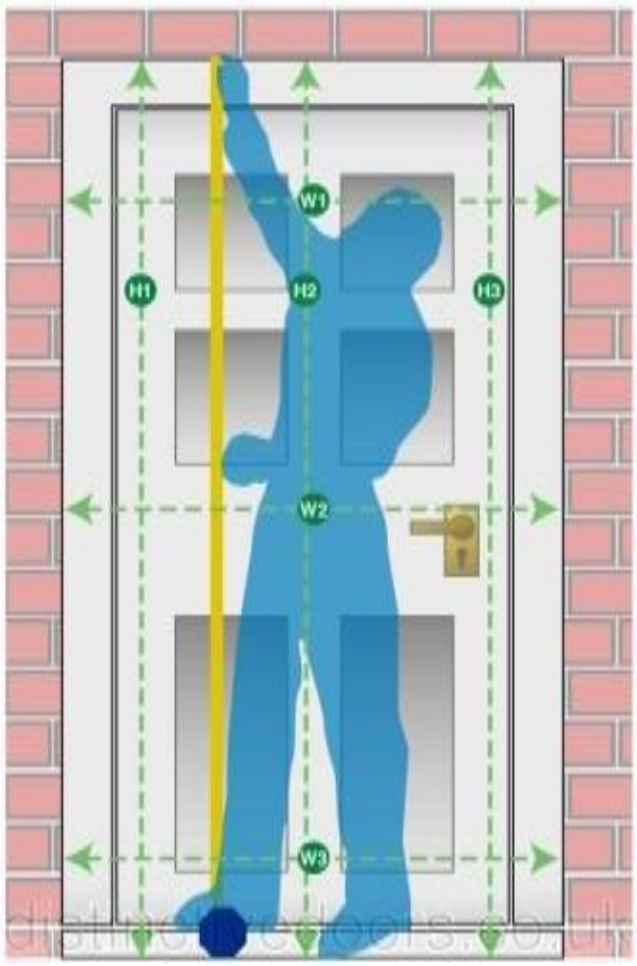
Sl.	Activities	Images
24.	**Soling is prepared upon compacted sand filled trenches for ground floor:** Following steps shall be taken to accomplish the work: 1. Sand filling shall be done in the trenches and also on the floor up to specified level and compacted in layers 2. Brick soling shall be done above it. CC shall be done above the flat soling as per specifications. 3. Water damp proof work in the ground floor shall be ensured as per specifications This work has to be performed by the contractor as per approved construction drawings/design. The assurance of the quality of work lies with the contractor and the project engineer	 ***Fig:*** *Soling upon compacted sand filled trenches*

Sl.	Activities	Images
25.	**Tiles laying:** Samples of floor tiles and wall tiles are supplied, approved and finally approved tiles shall be laid on the floor and walls. Workmanship of laying the tiles, maintaining tile joints line accurately, putting specified material in the joints properly shall be ensured by the contractor as per specifications and conditions of the contract. Anyhow, workmanship of wall tiles and floor tiles can be tested by hitting the wall tiles or the floor tiles with a stick or something similar to that. If the floor or the wall is not properly wet with water and sand and cement mixture is not properly spread before placing the tiles, its hitting sound will be hollow one, as if there was no contact between the tile and the mixture placed below it. **See checklist -F, page-56. Annexer-4 for tiles laying and mosaic.**	 ***Fig:*** *Tiles laying in the bath room*
26.	**Construction of boundary wall:** Boundary wall is constructed to protect the property from encroachment or trespassing. Its construction procedure/method is similar to that of construction of foundation footing, grade beam, column, brick wall, plaster etc. Construction of boundary wall shall be done as per drawings/ design and as per instruction of the engineer.	 ***Fig:*** *Construction of boundary wall*
27.	**Construction of entrance road and collapsible gate fitting:**	

Sl.	Activities	Images
	Entrance road is required to get easy excess to the nearby service road. The road pavement may be either flexible or rigid. In case of flexible pavement, box cutting, Sand filling, filling with sub-base/base material and finally carpeting of the pavement shall be done as per design specifications of the road. Proper compaction at different stages of construction of road shall be done as per requirement of the contract. Rigid pavement is made of R.C.C or C.C depending on the design requirement of the road. Collapsible gate shall be fabricated and fixed as per specifications laid down in the contract document. IMED may check if the conditions of the contract have been well taken care of. **See check list -C, page-53. Annexer-4 for metalwork (Iron & aluminum).**	 ***Fig:*** *Casting of entrance road and collapsible gate fitting*

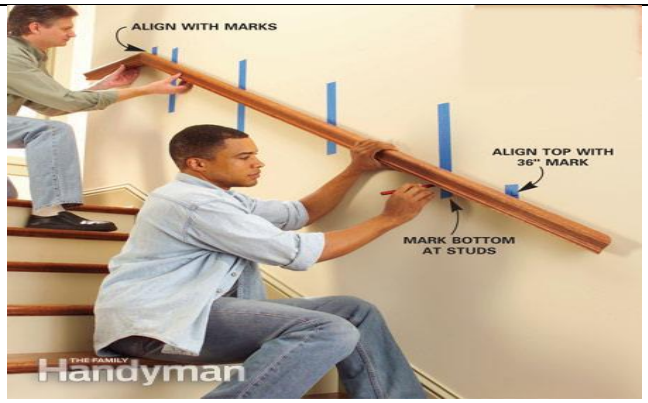
VII. Finishing work

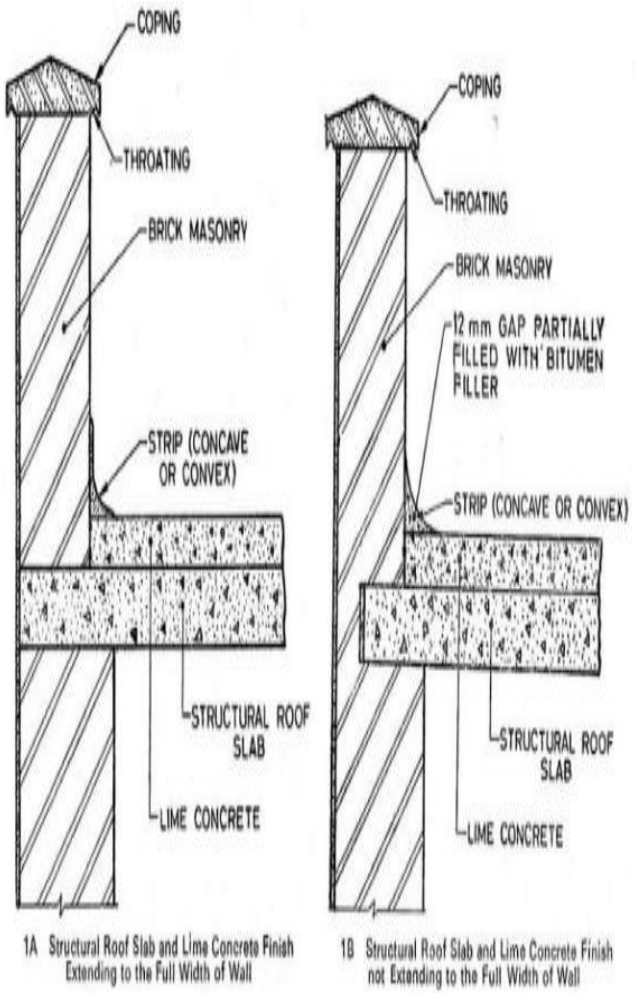
Sl.	Activities	Images
28.	**Fittings of kitchen:** Fittings & finishing work of kitchen has to be fully completed as prescribed in the contract document and as per specifications and instruction of the Project Engineer. Workability and quality assurance of the fittings and fixtures is the prime responsibility of the contractor.	 ***Fig:*** *Fittings of kitchen*
29.	**Windows and door fittings:** Normally wood is used in door frames, door shutters and stair railings of a building. Contractor is required to supply samples of these materials, get it approved by the engineer and then fix them as per specifications mentioned in the contract document or as allowed by the Engineer in writing. If wooden doors and windows are fixed and painted, there is no way one can ascertain that what wood it is made of or what is its quality. Therefore, a chisel or something sharp instrument can be used to open the surface to see if the wood and its quality matches with the specifications of the tender. See if door frame fittings like-	

Sl.	Activities	Images
	clamp, shutter (Palla) fittings like-hinge, tower bolt, haze bolt, handle, lock and buffer block are supplied, approved and fixed by the contractor as per specifications of the contract. Also see if door's and window shutters are properly shut, leaving no gaps between them, bolts, locks and other door and window fittings work properly. In case of Thai Aluminum window, its frame thickness and size, shutter thickness, thickness of the glass, wheels and other accessories shall be as per design and specifications. **See check list B, page-52. Annexer-4 for wood works.** Flat Bar, Square Bar, MS bar, Iron Angle, GI/MS Pipe, SS Pipe etc. is mostly used in window grills and other places of the building for security reasons. These are fabricated and shall be fixed by the contractor as per specifications of the contract. It is desirable that all these materials are supplied and used as mentioned in the schedule of works. It is a tendency of the contractors in general to fix undersize materials in the building, particularly flat bars in window grills etc. Therefore, to be sure that the flat bars used in the grills are of right specification, gauge/slide caliper may be used to measure them. Apart from it, one can check, if the flat bars are welded properly. It	  ***Fig:*** *Windows and door fittings*

Sl.	Activities	Images
	is commonly found that flat bars are joined by what is called 'spot welding' rather than 'running welding'. Therefore, inspecting officer should check if the welding of joints conform to the specifications of the contract. **See checklist -C, page-53. Annexer-4 for metalwork (Iron & aluminum).**	
30.	**Fitting pan/commode, shower and basin in the bathroom:** Layout for the fittings has to be set on the floor and walls as per drawings and the contractor shall fix those accordingly. Supervisory officials have to ensure that the supplied and approved fittings and fixtures are as specified in the contract document and the contractor has fixed them in right places properly as per instructions of the Engineer. IMED may check whether quality of fittings and fixtures and their fixation works confirms to the specifications of the contract.	 ***Fig:*** *Fitting pan/commode, shower and basin in the bathroom*
31.	**Setting up electrical ducts, wires and cables and fixing electrical fittings:** i) Electrical ducts are placed as per layout provided in the drawings. After sample supply by the contractor, cables and wires are tested and approved by the engineer to confirm to the specifications of the contract document. The contractor is given go ahead signal to lay the cables and wires in the duct as per specifications.	 ***Fig:*** *Setting up electric wires and cables*

Sl.	Activities	Images
	ii) Samples of electrical fittings like-sockets, switches, etc. are supplied, tested and approved by the engineer in the light of the contract agreement and then contractor is allowed to fix them in designated places. Since, it is a very sensitive and hazard prone work of a building, it is ensured that electrical ducts are properly placed; cables and wires are installed, electrical fittings are fixed as per design specifications. After energizing the line, the system has to be tested and certified by the authorized person to ensure its safety and safety of the users of the building. IMED may check whether the installation of the electrical system confirms to the specifications standard of the contract. **See checklist -G, page-57. Annexer-4 for electrical works.**	 ***Fig:*** *Fixing electrical fittings*
32.	**Fitting of hand rails of stairs:** Hand rail of stair may be made of wood, G.I. Pipe or SS Pipe etc. depending on the nature of the contract. Samples of specified material in the contract are supplied by the contractor and its approval is accorded by the engineer. Getting approval of the authority, contractor makes/fabricates hand rails and fixes it. Method of fixation and treatment of hand rail shall depend on the nature of material being used.	

Sl.	Activities	Images
	Anyhow, contractor has to follow the design and conditions of the contract and fix the hand rail accordingly. IMED may see if design specifications have been properly followed. **See checklist - B, page-52. Annexer-4 for wood works. and checklist – C. page-53. Annexer-4 for metal works.**	 ***Fig:*** *Fixing of hand rails of stairs*
33.	**Whitewash or distempering the wall:** Surface of the interior walls are thoroughly rubbed to ensure a smooth surface. Afterwards, a prime coat and under coat is given to the surface before plastic paint/ distemper is applied on it. In a similar manner, surface of the exterior wall is rubbed thoroughly to ensure smooth surface. After that snowcem or weather coat is applied on it.	
	Painting of interior and exterior wall of a building is done to maintain durability of the building, increase its life, give an aesthetic look and prevent from untimely wear and tear. Normally synthetic paints of different brands are used for painting exterior and interior walls. Durability of the color of the building greatly depends on the finishing work of the building. Better finished plaster work ensures better smooth surface resulting into better quality finished interior and exterior painted walls. **See checklist D, page-54. Annexer-4 for interior and exterior paintings of walls.**	 ***Fig:*** *Whitewash or distempering the wall*

Sl.	Activities	Images
34.	**Varnishing of wooden frames:** Varnishing work of wooden frames etc. has to be done as per principles laid down in the contract documents. Initially, surface of the wood is rubbed to bring smoothness in the esurface. On the smooth surface first prime coat is applied. Afterward, varnish is applied on it. The contractor shall follow the dictates of the engineer to perform the job as per specification of the contract. **See checklist - B, page-52. Annexer-4 for wood works.**	 ***Fig:*** *Varnishing of wooden frames*
35.	**Lime terracing of top roof:** Lime terracing on the top of the roof of a building is an old practice. But climatic condition of our country still suggests following this practice. When lime, *surkhi* and brick chips in 7:2:2 proportions is mixed and spread in specified thickness on the RCC roof, it is known as Lime terracing. The lime terracing of the roof protects the roof from wear and tear, stops water leakage and controls heat to keep the roof top cool. Normally for 100 mm thick finished lime terracing on the roof top, 20 mm downgraded brick chips and *surkhi* from 1st class bricks with minimum lime content of 500 kg. per 2.83 cu. m in the proportion of 7:2:2 is required. Stone lime is slaked for 03 days and then mixed with brick chips and su*rkhi* in the proportion mentioned above	 ***Fig:*** *Lime terracing of top roof*

Sl.	Activities	Images
	on a suitable platform under the shade of polythene to protect it from sun and rain. Cutting the mix twice daily with lime water for 7 days is done until the mix achieves desired consistency. The mix so made is then spread on the roof with proper slope and making ghoondie. The roof is beaten for 7days and curing is done for another 21 days. **See checklist- I, page-58. Annexer-4 for lime terracing.**	

10. Study of Project Documents:

An approved Development Project Proforma (DPP) is considered to be the Bible to be followed by everybody in its letter and spirit. It is the document that contains the physical and non-physical items of works along with its budgetary provisions and also its execution plan to be carried out over the project implementation period. An inspector shall also have comprehensive knowledge of this approved government document as to what are the physical activities to be taken up for implementation by the project management. Study of the project document thoroughly, particularly the work components that are planned to be inspected with reference to previous inspection/progress report (See ***Annexure-1*** and ***Annexure -2***, page- 41-43/44-45 for DPP/TPP Checklist) is necessary.

11. Study of procurement discipline:

Beside other documents, it is advisable to study in depth on the PPA 2006 and the PPR 2008 (Revised/Updated) (See ***Annexure-3***, page-46-49; procurement discipline Checklist).Without having comprehensive knowledge of this aforesaid Acts and Rules with checklists one may be misguided while visiting the project site. The documents and the checklists will give officers an insight into the detail of the work awarded to the contractor.

12. Study of building related technical discipline:

Before investigation of building related projects which purely known as civil works, one should remember the basic engineering roles item by item. For example Schedule of rate of all kind of materials. See ***Annexure-3*** page- 46-49**;** building related technical discipline **Checklists of *Annexure-4*, page**-50-59).

13. Study of Project implementation arrangements:

All the project documents have an approved provision of required number of, different categories of project personnel for execution of the project as well as for its operation after its completion. IMED's inspecting official should take stock of the whole arrangement and

see whether these positions are filled up. Organizations like PWD, PDB, WDB, R & H D etc. government and autonomous bodies normally do not recruit new personnel for the project from outside; rather it depute project personnel including PD, from within the organization. If project execution personnel are appointed from outside through open advertisement, IMED may see whether procedures for recruitment of manpower were properly followed and recruited personnel possessed requisite qualifications and experience as stipulated in the DPP/TAPP.

Appointment of full time PD, though very important for timely project implementation, but government decision in this respect is often overlooked/neglected by the ministry/agency and part time PD is appointed. IMED's inspecting official may obtain detail information about the appointment of the PD and also note whether project progress or quality of work in anyway suffered due to appointment of a part time PD or shortage of manpower in this project**.**

See Checklist for project manpower for execution and operation no.-F, page- 63.

14. Checking quality of work:

Basic responsibility of ensuring quality of work lies with the contractor. The contractor has to ensure supply of construction materials as per specifications of the contract and also to ensure its use and workmanship as mentioned in the contract document. The indenting agency/ministry has to ensure that whatever was specified in the contract document is being delivered by the contractor. IMED as an outsider can do little to ensure quality of work from the contractor, but it can certainly help agency/ministry in extracting quality work and better workmanship through regular visits to the project sites. But in most cases IMED's field inspection takes place after completion of the work, that won't help ensure quality of work. Therefore, depending on the stage of progress of work in the field IMED's visits need has to be planned.

Suppose that when IMED is visiting a particular project site where construction work is 100% complete. In this case to what extent will one can go to check the quality of works of the building. At this stage of work there is no way one can check whether cement, sand and water was used in right proportions or columns, beams and roofs etc. were cast using correct proportion of cement, chips with specific quantity of M.S. bar of correct dimensions and quality as specified in the tender document. Of course naked eye observations of the

construction work from different angles may throw some light on the overall construction quality of the work. That may generate some query and need explanations/comments from the PD or his representatives. Apart from getting comments/ explanation of the project authority a request can also be made to supply some documentary evidences and also carry out some on-site checks for record.

See check list for completed buildings no. D, page-61-62, and also see checklist for handing and taking over of building no E, page-63.

14.1. Establishing site office and on-site testing facilities:

To fulfill the conditions of the contract and facilitate smooth construction activities, a contractor is required to builds a site office nearest to the project location. Creation of material and quality testing facilities at site at the cost of contractor also remains part of the contract.

Site office is built by the contractor in a way that it accommodates PD's office and his staff as well. Provision of electricity and water supply is also ensured by the contractor to smoothen activities of the project without interruption. At the site office, contractor's essential men and construction materials and equipment are also located.

14.2. Maintenance of site inspection register/book:

Contractor is also required to maintain a 'site inspection register/book' on the site, and also preserve a copy of the 'Work Order' along with it, so that visiting project officials and other related officials can write their observations/instructions in it regarding progress of work, mobilization of equipment and materials, quality of material as well quality of work performed (workmanship) by the contractor. He is also required to supply construction schedule and keep a copy of it at the site for quick reference and observations. These are considered prerequisite steps for the start of construction work. Therefore, when visiting a site, take a look into this 'book'. That will give first-hand information about the frequency of visits of the senior project officials at site, instructions given to the contractor for compliance and its follow up etc. IMED official should also record his comments/observations in the 'book' regarding his visit and other issues that deem worth mentioning and can desire to be on record for future ready reference.

See checklist for site office documents no. H, page-64.

14.3. Use of visual aid during inspection:

Visual aid like Camera or Video Recorder may be used for recording images of project activities. These images will always be helpful in better understanding the project situation in the field. In many cases, it will complement comments/observations of the officials and confirm reliability of information and data collected from the field. Therefore, wherever possible, help of visual aid should be sought for explaining views/comments/observations. Photographs of the buildings from different angles and the photographs of the construction defects like hair cracks or larger cracks in wall or floor, subsidence in the floor, defective window grills, defective wooden doors, windows and other fittings etc. will strongly complement inspecting official's views and comments.

15. Conclusion:

The quality achievement is not an easy outcome or an accident; it is the product of determined effort. The PD/PE is the key person who must play an important role to get the work done true to the standards and specifications so as to ensure desired quality of work. The contractor is obligated under the contract for testing of the quality of work to ensure compliance as stipulated in the specifications. It is the standard practice for the engineer's site staff to supervise and witness such testing of the works. However, the site engineer should also carry out some testing separately, for the purpose of validation of tests done by the contractor as well as for the auditing purposes.

The inspecting officials from the Ministry/Department and the IMED may verify whether or not the contractual obligations of the contract have been fulfilled with proper documentation of the test results and comments of the site/Project Engineer there on. This must be carefully noted and reported at the decision making level of the government.

Annexure-1

CHECKLIST FOR DPP

1. Project Title:

2. Objectives of the project:

3. Estimated cost of the project total GoB PA (RPA):

4. Mode of financing:

5. Components of the project:

Sl.	**Aspects to be answered/covered**	**Yes/No**	**Remarks**
6.	Whether log frame in the DPP is correctly drawn to achieve the objective of the project		
7a.	Whether required manpower as mentioned in the DPP has been deputed from existing setup, recruited directly or recruited by outsourcing		
7b.	Whether recruitment of personnel has been made following government recruitment rules and regulations		
7c.	Whether recruited/deputed personnel have requisite qualification and experience as mentioned in the DPP		
8.	Whether there is a Project Steering Committee (PSC) and Project Implementation Committee (PIC) for reviewing the progress of project (monthly/quarterly/half yearly)		
9.	Whether procurement plan of goods, works and services as mentioned in the Annex III (a), III (b) and III(c) are being executed following the PPA-2006 and PPR-2008. Make analysis of the individual contracts in the Checklist for Procurement of Construction (Building) Work --**Annexure—3,page-44**		

Sl.	Aspects to be answered/covered	Yes/No	Remarks
10a.	Whether item wise physical components as approved in the project document, differ from those being executed in the field.		
10b.	Whether physical components targets and progress as reported in the 02, 03 IMED formats are consistent with the field up to last quarter.		
10c.	Whether year wise financial phasing as approved in the DPP matches with the yearly ADP allocation.		
10d.	Whether year wise fund release and expenditure are consistent with the reported figures in the IMED formats.		
11a.	Whether project authority has clearly identified the RPA expenditure items of the project and is making the RPA claims from DOSA, CONTASA, SAFE, Impressed, etc. accounts properly and timely		
11b.	Whether claims of RPA expenditures are being submitted quickly for reimbursement.		
12.	Whether benefit-cost ratio (BCR), net present value (NPV) and internal rate of return (IRR) figures provided in the approved project document are inconsistent with the present figures (for completed profit earning industries).		
13a.	Whether mitigation programs for environmental impact has been taken care of by the project authority as mentioned in the DPP.		
13b.	Whether the project in anyway is contributing to the poverty alleviation, empowerment of women and regional disparity as mentioned in the DPP.		
14.	Whether the project is contributing to the PRS and MDGs as mentioned in the DPP.		
15.	Whether any project aid conditionality mentioned in the DPP is affecting implementation of the project.		

Sl.	Aspects to be answered/covered	Yes/No	Remarks
16a.	Whether rehabilitation/resettlement of affected persons/families program is taken up by the project authority.		
16b.	Whether the cost involvement as mentioned in the DPP for rehabilitation/resettlement will remain within the approved estimate.		
17.	Whether project implementation period is likely to be extended		
18.	Whether there is a possibility of time over run and cost over run		
19.	Whether internal and external audits are being carried out. When last internal and external audit was done.		
20.	Whether site register/book is being maintained at project site and visiting supervisory officials are recording their observations on progress and quality of work etc.		
21.	Whether Annual Work Plan has been prepared by the project authority/PD.		
22.	Whether CPM/ Bar Chart, for smooth execution of the project, has been prepared and being followed.		

Annexure -2

CHECKLIST FOR TPP

1. Project Title:
2. Objectives of the project:
3. Estimated cost of the project total GoB PA (RPA):
4. Mode of financing:
5. Components of the project:

Sl.	Aspects to be answered/covered	Yes/No	Remarks
6.	Whether there is a possibility for cost and time overrun.		
7.	Whether PD/NPD is a full time or a part time appointee.		
8.	Whether financing arrangement has been finalized.		
9.	Whether loan/credit/grant and other amounts as approved in the TPP is the same		
10.	Whether TOR of the consultants adequately covers the areas related to the objective of the TPP		
11.	Whether PPR 2008 has been followed in selecting consultants		
12.	Whether adequate step have been taken by the project authority to ensure transfer of technology.		
13.	Whether consultant's performance is being monitored regularly		
14.	Whether educational qualifications and experience of the consultants are relevant to the assignments they have been engaged.		
15.	Whether the counter-part personnel attached to the consultants have required educational qualifications and experience as mentioned in the approved TPP.		
16.	Whether educational qualification and experience of the support staff matches with information provided in the approved TPP.		
17.	Whether letter of agreement with implementing agency and the development partner has been signed.		
18.	Whether project steering committee has been formed to review the progress of work.		

Sl.	Aspects to be answered/covered	Yes/No	Remarks
19.	Whether auditing of the project is being carried out. When the last audit was done?		
20.	Whether project work is progressing as per approved implementation works schedule provided in the TPP.		
21.	Whether total procurement plan as envisaged in the approved TPP is being implemented in the light of PPR 2008. Individual contracts should be analyzed in the Checklist for Procurement of Construction (Building) Work --Annexure-3.		
22.	Whether approving authority is exercising financial authority as per Delegation of Financial Power published by ministry of finance.		
23.	Whether CPM/ Bar Chart, for smooth execution of the project, has been prepared and being followed.		

Annexure -3

CHECKLIST FOR PROCUREMENT OF CONSTRUCTION WORKS (BUILDING)

<table>
<tr><th colspan="4">PART-A PROCURING ENTITY AND DESCRIPTION OF PROCUREMENT</th></tr>
<tr><td>1. Ministry/Division</td><td colspan="3"></td></tr>
<tr><td>2. Agency</td><td colspan="3"></td></tr>
<tr><td>3. Procuring Entity</td><td colspan="3"></td></tr>
<tr><td>4. Name of the Project</td><td colspan="3">(if applicable)</td></tr>
<tr><td rowspan="2">5. Source of Funds
(Tick relevant boxes)</td><td>Government ☐</td><td>Development ☐</td><td>Revenue ☐</td></tr>
<tr><td>Project Aid ☐</td><td>Own Funds ☐</td><td></td></tr>
<tr><td rowspan="3">6. Procurement Plan</td><td colspan="3">Status of Annual Procurement Plan (APP)</td></tr>
<tr><td colspan="2">Approved ☐</td><td>Unapproved ☐</td></tr>
<tr><td colspan="3">Short Description (If necessary):</td></tr>
<tr><td>7. Brief Description of Works</td><td colspan="3"></td></tr>
<tr><td>8. Procurement Method
(as in DPP or otherwise)</td><td colspan="3"></td></tr>
<tr><td>9. Procurement Value
(Estimated Cost)</td><td colspan="3"></td></tr>
<tr><td>10. Type of Tender Document
(Tick relevant one)</td><td colspan="3">• SRFQ (PW 1)
• STD (PW 2/PW 3/PW 4/PW 5)
• SPD (PQW 4/ PQW 5)</td></tr>
<tr><td>11. Formation of TOC/POC and TEC/PEC</td><td colspan="3">• No of members in TOC/POC
• No of member from TEC/PEC
• No of members in TEC/PEC
• No of external members in TEC/PEC
• Authority approved TEC/PEC</td></tr>
</table>

PART-B SCHEDULE OF ACTIVITIES (Pre-Qualification)				
Sl.	**Activity** (If not applicable indicate N/A**)**	**Planned Date** (As per procurement plan/ Flow Chart)	**Actual Date**	**Remarks**
1.	**PRE-QUALIFICATION**			
1.1	Date of Advertisement of Invitation 1.1.1 Advertisement in Newspaper Published 1.1.2 Advertisement in CPTU Website Published 1.1.3 Advertisement published in own website, 1.1.4 Tenders/Proposals followed PPA-2006/PPR, 2008 1.1.5 Tenders/Proposals followed DP's Guidelines			
	1.1.6 No of Sale/Issuance of Tender/ Proposal Documents 1.1.7 No of Tenderer/Consultant participated 1.1.8 Days allowed per Rule for preparation and Submission 1.1.9 Date of Submission of Tender Doc./Applications			
1.2	Date of Pre-Qualification Meeting (if any)			
2.	**Tenders/Proposals Evaluation**			
	2.1 Days allowed per Rule between opening and completion/submission of evaluation 2.2 Days actual between opening and completion/submission of evaluation 2.3 Responsiveness of Tender/Proposal 2.4 Re-invitation of Tenders/Proposals recommended by TEC/PEC 2.5 Procurement proceedings annulled/cancelled 2.6 Date of Submission of Evaluation Report with Recommended List			
	2.7 Approving Authority (AA) as per Delegation of Financial Power (DoFP) 2.8 Date of Approval of List 2.9 Authority approval date 2.10 Evaluation report was sent directly to the AA			

PART-C	SCHEDULE OF ACTIVITIES			
Sl.	**Activity** (If not applicable indicate N/A**)**	**Planned Date** (As per procurement plan/ Flow Chart)	**Actual Date**	**Remarks**
1.	**TENDER FOR WORKS**			
1.1	Date of Advertisement of Invitation for Tenders 1.1.1 Advertisement in Newspaper Published 1.1.2 Advertisement in CPTU Website Published 1.1.3 Advertisement published in agency's own website, 1.1.4 Tenders/Proposals followed PPA-2006, PPR-2008 1.1.5 Tenders/Proposals followed Dev. Partner's Guidelines			
1.2	Date of Issue of Tender Document 1.2.1 No of Sale/Issuance of Tender/Proposal Documents 1.2.2 No of Tenderer/Consultant participated			
1.3	Date of Pre-Tender (Pre-Bid) meeting			
	1.3.1 Days allowed as per rules for preparation and Submission 1.3.2 Date of Submission of Tenders			
1.4	Date of Opening of Tenders			
1.5	Date of Submission of Technical Sub-Committee Report (if applicable)			
1.6	Date of Submission of Evaluation Report			
1.7	Procurement processing lead-time i.e. days actual between opening and issuance of NOA/PO/Contract signing/LOI			
1.8	Days actual between IFT/RFP and issuance of NOA/PO/Contract signing/LOI			
1.9	Publication of award in CPTUs website/PE's website/others			
1.10	Contract award made within the initial Tender/Proposal validity period			
1.11	Date of Approval for Award of Contract			

Part-D	Individual Contract Review			
1.	**Contract Implementation:**		**Planned Date** (As per procurement plan/ Flow Chart)	**Actual Date**
1.1	Contract Reference			
1.2	Contract Amount/ Value			
1.3	Contract Signing Date			
1.4	General Conditions of Contract (GCC) should be specific			
1.5	Particular Conditions Contract (PCC) should be specific			
1.6	Terms of Reference/ Activities (Item by item)			
1.7	Work plan			
2.	**Completion of Contract**			
2.1	Days per original contract time specified for supply/Execution/Delivery	:		
2.2	Days actual for Supply/Execution/Delivery	:		
2.3	Amount of LD imposed	:		
3.	**Complaints and Appeal**			
3.1	Complaint, if any, lodged and reasons thereof	:		
3.2	Resolution of complaints per Rules	:		
3.3	Modifications resulting from resolution of complaints	:		
3.4	Appeal of Independent Review Panel	:		
3.5	Review Panel's decision and follow-on	:		
4.	**Contract Amendment**			
4.1	No of times contract time extended and days	:		
4.2	Variation/Extra Work/Repeat/Addl. Delivery Orders etc. made	:		
4.3	No and amount of such orders	:		
5.	**Contract Disputes unresolved**			
6.	**Fraudulence and Corruption**			
7.	**Procurement Management Capacity**			
7.1	HRD facilities	:		
7.2	No. of Staff trained in procurement	:		

Annexure -4

CHECKLISTS FOR INSPECTING QUALITY OF CONSTRUCTION (BUILDINGS)

A. Checklist for plastering works*

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether fine sand (F.M.-1.2 or as per specifications) is free from silt and other foreign materials and organic impurities		
2.	Whether correct proportion (1:4 or 1:6 or as per specifications)of cement and sand is used		
3.	Whether wall plaster's thickness is as per specifications (12mm thickness)		
4.	Whether plaster surface is smooth		
5.	Whether plaster is done on properly wet wall		
6.	Whether curing is done for at least 7 days		
7.	Whether potable water for mixing cement and sand is available		
8.	Whether cement and sand were mixed properly before use		

In some cases there are design requirement for doing Pointing Works rather than doing plaster on the brick wall. In that case, cement and sand mix of 1:2 ratio is used for pointing works.

*This is applicable for on-going construction work.

B. Checklist for wood works:

Nowadays, normally wood are used in door frame, door shutter and stair railing.

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether wood used meets the specification in the tender schedule		
2.	Whether matured wood of specified thickness is used (if it is specified as 1.5 inch solid door shutter, then it is 1.5 inch solid door shutter after finishing)		
3.	Whether sap wood is supplied or used		
4.	Whether wood is mechanically seasoned before use		
5.	Whether wood having knot is used		
6.	Whether hole/cavity in the door shutter or door frame is properly filled with same wood dust (mixed with glue) or putty		
7.	Whether surface of the wood is smooth finished		
8.	Whether wood Varnish is used for polishing		
9.	Whether wooden fiber is exposed after polishing		
10.	Whether Enamel Paint is used for wood that is likely to come in contact with water		

C. Checklist of metal (Iron/Aluminum) works:

Flat Bar, Square Bar, MS Bar, MS Angle, GI/MS pipe, SS pipe etc. is mostly used in the building for security reasons and also in some cases as requirement of the architectural design and in some cases for enhancing aesthetic beauty of a building. Therefore, it is desirable that all these materials are supplied and used as mentioned in the schedule of works. To ensure quality of works following steps should be taken:

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether Anti-corrosive paint and anti-rust prime coat are used on all MS grills etc. or works like it		
2.	Whether Aluminum shutter and frame's thickness meet the requirement of the contract		
3.	Whether Flat bars, Angles, MS pipes, GI pipes etc. thickness used in the building are as per specifications of the contract		
4.	Whether joints in the Flat bars, Angles, MS pipe, GI pipe etc. are welded as per technical specifications (spot welding or running welding) mentioned in the contract		

D. Checklist for painting interior and exterior walls:

Painting of interior and exterior wall of building is done to maintain durability of the building, increase its life, give an aesthetic look and prevent from untimely wear and tear. Normally synthetic paints of different brands are used for painting exterior and interior walls. In this case, before application of the paints on the wall, proper treatment of the wall surface is necessary to get better result.

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether walls are completely dry before painting		
2.	Whether walls are properly cleaned with water (if necessary)		
3.	Whether wall surfaces are made smooth		
4.	Whether paints are done uniformly all over the surface		
5.	Whether 'Damp' prevention measure(if any) are taken		
6.	Whether paint is - applied on the wall as per specifications/instruction of the manufacturer		

E. Checklist for casting floor slab, beam and column

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether the rings around the reinforcement of beams and columns are placed and tied by G.I wire properly as per construction drawing/design		
2.	Whether MS bars in the columns are overlapped as per working construction drawings/design		
3.	Whether vibrator machine is used during casting of floor slab, beams and columns		
4.	Whether Coarse Sand (of Sylhet or Dinajpur) is used for C.C &R.C.C work		
5.	Whether MS bars of same strength (60 grade or 40 grade) are used as per construction drawings/design		
6.	Whether diameter of the bars meet the specification of the contract		
7.	Whether quality shuttering materials have been used as per specifications		

F. Checklist for tiles and mosaic

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether water absorption test result of tiles meet the specification of the contract		
2.	Whether floor and walls are properly wet before tiles placement work is started to ensure bonding between floor and tiles		
3.	Whether tiles are properly placed in straight lines and joints are correctly maintained		
4.	Whether striking sound on the floor or wall tiles emits ringing sound		
5.	Whether tile joints have been filled with putty properly		
6.	Whether mosaic chips quality and size meet the specifications of the contract		
7.	Whether mosaic chips is properly cleaned and washed to remove dust and foreign particles before use		
8.	Whether mosaic mound is prepared and spread on the floor properly as per instruction of the engineer		
9.	Whether floor is properly wet before spreading the mosaic mound to ensure bonding between mosaic mound and the floor		
10.	Whether mosaic cutting work and polishing etc. has been done as per specifications of the contract or as per written instruction of the project engineer		
11.	Whether striking sound on the mosaic floor emits ringing sound		

G. Checklist for electrical works

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether electrical system of the building is installed by the contractor as per approved electrical drawing/design		
2.	Whether earthing of electrical installation is done in a way it is mentioned in the contract document with the approval of the engineer		
3.	Whether all electrical cables and wires are supplied by the contractor as per specifications and Brand mentioned in the contract.		
4.	Whether electrical safety issue has been adequately taken care of in the building.		
5.	Whether power points are kept in the right position throughout the building as per design or instruction of the engineer		
6.	Whether concealed wiring has been done as specified in the contract		
7.	Whether light, fan etc. points are correctly positioned in the rooms and outside it		
8.	Whether meter box , switch boards etc. are fixed as per specification of the contract		

H. Checklist for cleaning of materials

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether stone chips/brick chips are cleaned at site before use to ensure removal of foreign material		
2.	Whether Sieves of different size are used at site to separate materials for use in construction as per specifications		
3.	Whether rust is removed from the rod before concreting is done		
4.	Whether foreign material and silt is removed from the sand before use		

I. Checklist for roof lime terracing

Following steps can be useful to check the quality of works of lime terracing of roof:

Sl.	Aspects to be answered/covered	Yes/ No	Remarks
1.	Whether lime used is from lime stone		
2.	Whether Surkhi being used is from 1st class brick		
3.	Whether brick chips are 20 mm down grade of 1st class bricks or as per specifications		
4.	Whether lime terracing thickness of 75 mm to 100 mm on an average is maintained or it is as per specifications		
5.	Whether proper slope is maintained to allow rain water to pass ‘Rain water down pipe’		

J. Checklist for Quality Control of R.C.C work

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether aggregates contain dust, earth or any other foreign matter		
2.	Whether potable water is used for mixing and curing		
3.	Whether slump tests are carried out at regular intervals to ensure proper workability		
4.	Whether adequate number of cube/cylinder tests at 7 and 28 days are carried out		
5.	Whether adequate number of cover blocks and chairs are made for clear cover		
6.	Whether binding wires are adequately used for tying up reinforcements		
7.	Whether overlaps are done as per construction design		
8.	Whether adequate spacing for inserting vibrator is kept		
9.	Whether curing is done for 28 days		
10.	Whether expansion/contraction joints are properly made and at correct locations as per drawings		
11.	Whether availability of cement, aggregate, sand, water has been ensured before commencing concreting		
12.	Whether de-bonding compound/material is used in shuttering		
13.	Whether construction materials have been tested as per requirement of the contract or as per instruction of the engineer.		

K. Checklist for testing facilities at site

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether contractor has setup laboratory testing facility at site		
2.	Whether laboratory facilities are created in conformity with the contract agreement		
3.	Whether contractor has the right type of people/qualified engineers and the technicians for supervision of the work		
4.	Whether contractor has qualified and experienced personnel to carry out different tests		
5.	Whether contractor has deployed trained manpower to collect different sample as per requirement of the contract		
6.	Whether system of routine on the spot checking /testing for materials at site set up		
7.	Whether system /facility established for in-situ testing and approval of test results in each stage of work available		
8.	Whether proper construction materials procured and samples sent for laboratory testing;		
9.	Whether the system of routine on the spot checking/testing for materials at site set up;		

L. Checklist for soil test:

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether soil test of the place is conducted by a competent firm		
2.	Whether building design consultant has taken into cognizance the result of the soil test		

M. Checklist for building design

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Has 'Bangladesh National Building Code (BNBC)' been followed (earthquake, cyclone, flood level, landslides etc. are taken care of in design preparation)?		
2.	Has adequate fire safety measure been put into place?		
3.	Has the water supply arrangement been made as per requirement?		
4.	Has the sanitation arrangement been made as per requirement?		
5.	Has electrical system design plan been incorporated in the total plan building design?		
6.	Has the building design/drawings been made available to the contractor for the start of the work?		
7.	Is the availability of the drawings/design being made to the contractor following sequence of construction activities?		
8.	Whether firefighting equipment installation provision has been kept in the building		

N. Checklist for mobilization of material

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether contractor has mobilized construction material at site as per technical specification of the contract		
2.	Whether samples of the materials have been tested in the laboratory by the contractor and have been approved by the competent authority		
3.	Whether inventory of supplied materials matches the mobilization schedule submitted by the contractor		
4.	Whether tested sample's reports are preserved at site for cross references		

O. Checklist for mobilization of construction equipment

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether contractor has mobilized construction equipment at site as per of contract agreement		

Annexure-5

MISCELLANEOUS CHECKLISTS FOR CIVIL WORKS INSPECTION

A. Checklist for Audit

Sl.	Aspects to be answered/covered	YES/NO	Remarks
1.	Whether internal and external audits are being carried out.		
2.	When last internal and external audit was done?		

B. Checklist for testing construction materials

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether organic impurities are removed from sand before use		
2.	Whether there is silt content in the sand		
3.	Whether 'fineness' test of the cement is done		
4.	whether 'setting time' test of cement is done as per requirement		
5.	Whether 'compressive strength' of cement is done		
6.	Whether stone/brick chips (aggregate) 'crushing strength' test is done		
7.	Whether 'slump test ' of concrete has been carried out		
8.	Whether 'cube/cylinder test' of concrete has been carried out		
9.	Whether 'tensile strength test', 'Elongation test' and 'Bend Test' of reinforcement has been done		
10.	Whether 'compressive strength' test of brick has been done		
11.	Whether 'water absorption' test of bricks has been done		

C. Checklist for overall management of construction and quality control

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Does the contractor has the right people/qualified engineers for supervision& testing;		
2.	Does the contractor has the necessary field drawings/designs to prepare for the work;		
3.	Are there the right type of people in the Department/Project office for checking the quality of work;		
4.	Does the Department has contractor's approved quality control program;		
5.	Whether necessary construction equipment are available with the department/ contractor;		
6.	Has the department set up implementation monitoring/inspection recording system at site		

D. Checklist for completed building

Sl.	Aspects to be answered/covered	Yes/ No	Remarks
1.	Whether electrical points are properly located		
2.	Whether proper number of quality electrical sockets for equipment and machineries are provided.		
3.	Whether provision of Fire-Fighting equipment is made.		
4.	Whether water points, wash basins, sinks etc. are suitably provided.		
5.	Whether proper drains and drain pipes have been provided for disposal of waste water.		
6.	Whether there are cracks in the walls. If yes, point out the location, nature and magnitude (vertical/horizontal/inclined etc.). Take picture of the defective area.		
7.	Whether there are any sign of dampness/leakage/seepage. If yes, point out the location, nature and magnitude. Take picture of the defective area.		

Sl.	Aspects to be answered/covered	Yes/ No	Remarks
8.	Whether there are any cracks on the floor/skirting or nearby area. If yes, point out the location, nature and magnitude. Take picture of the defective area.		
9.	Whether there is any subsidence in the ground floor. Is there any stagnation of water in washing corner, bath and veranda? If yes, point out the location, nature and magnitude. Take picture of the defective area.		
10.	Whether there are any leakages in roofs? If yes, point out the location, nature and magnitude. Take picture of the defective area.		
11.	Whether all the fittings viz locking arrangements, tower bolts, pull bolts, door stoppers, hooks, hinges etc. working smoothly. If no, point out the individual item location and nature problem. Take picture of the defective item.		
12.	Whether plastering of walls and ceilings are satisfactory, smooth and free from cracks and other defects. If no, point out the location, nature and magnitude. Take picture of the defective area.		
13.	Whether painting of the walls, doors and windows are properly done. If no, point out the location and nature of defects. Take picture of the defective area.		
14.	Whether there is any leakage in the sewerage lines, drainage pipes. If yes, point out the location.		
15.	Whether flushing system, wash basins etc. are correctly fitted and working properly. If no, indicate location and nature of problem.		
Some other related issues of completed buildings			
16.	Whether the building being put to the planned use. If not, why?		
17.	Whether the building was handed over for occupation. If not- was a list of defects prepared? Were all the defects been		

Sl.	Aspects to be answered/covered	Yes/ No	Remarks
	rectified by the contractor before the building was finally taken over?		
18.	Whether “As built drawing” has been handed over to the indenting agency.		

E. Checklist for handing & taking over of building

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether a committee was formed to take over the completed work of the contractor.		
2.	Whether formation of the committee was in line with normal practice of the department		
3.	Whether committee’s report was accepted by the authority?		
4.	Whether contractor corrected/rectified the defects as per recommendations of the committee within the ‘defects and liability period’		
5.	Whether building is formally handed over by the contractor and taken over by the project authority.		
6.	Whether performance guarantee money has been released by the project authority		

F. Checklist of deployment of manpower for execution and operation

Following information about the project implementation arrangement may be collected from the PD’s office and analyzed to see their impact on the project progress and quality of works:

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether necessary personnel of different category as approved in the DPP are placed		
2.	Whether PD has been timely appointed		
3.	Whether PD’s appointment is for full time or half time		
4.	Whether PD stays at the project site permanently		
5.	Whether necessary trained manpower has been deputed for overseeing quality control and other aspect		
6.	whether proper arrangement for physical and financial reporting has been made		

Sl.	Aspects to be answered/covered	Yes/No	Remarks
7.	Whether consultant/s has been appointed to provide technical supports		
8.	Whether PD holds regular meetings at site to review the progress of day today work etc.		
9.	Whether a committee has been formed to oversee the work of the contractor and consultant		
10.	Whether project logistics as approved in DPP/TPP are in place and are being used properly		
11.	Whether necessary steps have been initiated to recruit/depute manpower for operation after its completion		

G. Checklist for testing other relevant kits

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether flat bar or metal sheet measuring gauge is available		
2.	Whether camera/ video is available		
3.	Necessary testing kits to be identified and made available during site inspection		

H. Checklist of site documents

Sl.	Aspects to be answered/covered	Yes/No	Remarks
1.	Whether site register or inspection book is maintained		
2.	Whether material register record is maintained		
3.	Whether daily progress report file is at site		
4.	Whether design& drawing record is maintained		
5.	Whether test records of materials are maintained		

Annexure -6

Glossary of civil works related terminologies

A

Abrasion Test of Stones: The life of stones, used as a paving material, is measured by the resistance offered by the stoned against abrading action of the traffic. Dorry's Abrasion testing machine, sieves and a balance are required to perform test for the co-efficient of hardness of paving materials

Abutment: a support of an arch or bridge. When there is a series of arches, the end supports are called abutments.

Abutment Wall: A wall at the abutment, extending beyond the bridge or culvert to retain the earth behind the abutment.

Abutment Pier: A pier to a wall supporting one end of a bridge or a culvert.

Acoustic Construction: A construction aiming at reducing the sound entering or leaving a room i.e., to make it sound-proof...

Aeration of Water: Odorous gases and tastes that are present in water can be removed by the process of aeration.

Aerobic Bacteria: The aerobic bacteria flourish and nourish in presence of air. With the aid of oxygen from air, they produce nitrification of dead organic matters without creating any offensive odor.

Alignment: Marking off points on the ground in correct line of direction for setting out a road, railway, transmission line, etc.

Aluminum Foil: Aluminum sheets thinner than 0.15 mm, which reflects visible light as well as infra-red (heat) rays. It is a good insulator.

Anchor Bolt: A holding down bolt or foundation bolt is used to hold down machines or building frames against vibration or wind loads.

Anchor Plate: A base plate for the anchor bolt embedded in concrete.

Anchor Tower: A part of the staging or support derrick tower gantry. The leg of the derrick **crane is used for shifting materials on site.**

Apartment: A dwelling for one family in a building.

Apron: A hard surface on a pavement to the bed of a canal stream or river to prevent scour

Aqueduct: A duct or conduit made of brick or stone masonry o concrete for conveying water over long distances.

Aquifer: A reservoir of ground water.

Arcade: A roofed passage with shops on both sides.

Arch: This may be considered as a beam curved in a vertical plane required to carry heavy load on a large span. Prior to introduction of steel and RCC in construction works, arch construction was extensively used.
Arch Centering: A timber frame required for construction of an arch.
Arterial Road: A main road to which the tributary roads meet.
Artesian Well: A bore hole through which water comes out without pumping
Asbestos: A mineral silicate comprising thin and tough fibrous crystals found in veins of rocks. This can withstand very high temperature. This is used as a heat insulator.
Asbestos Roofing: Plain, corrugated or patterned asbestos-cement sheets used for wall cladding or roofing.
Asphalt: Mineral hydrocarbons, black in color, containing bituminous substances which are essentially products of petroleum decomposition. These are naturally found beneath the ground surface where petroleum deposits occur.
Asphaltic concrete: Road surfacing by using rolled asphalt.

B

Back Drop or Drop Manhole: Used to make connection from a high level sewer at a lower level**.**
Back Fill or Back Filling: Earth, cinder, moorum, rubbish or stone chips used to fill the foundation trench after the foundation have been laid.
Bag Work: A kind of revetment work to protect the river banks from erosion. Dry concrete or gravels sewn in bags are tamped against the bank and held together by dowel roads driven through the bags.
Bank Protection: Protectionary measures adopted for river or sea embankments against scour by use of revetments, groynes, mattresses, turfing with sods, etc.
Bar: Around square or rectangular steel bar used in construction.
Barrage: A low height dam with sluice gates, constructed across a river to raise the water level for irrigation or navigation.
Barrier Pillar: A pillar of coal left uncut to protect mine from inrush of water and to support the structure.
Barrow Run: A narrow path made of scaffold boards for wheeling loaded barrows to the building site for construction.
Base Course: The surfacing layer below the wearing course of road.
Base Line: The starting line for calculations in a triangulation survey.
Basement: A storey whose major portion is below ground level. This may be used as storage place, garage or a living room.
Base Plate: The plate on which a machine rests. This holds the machine and distributes load over a larger area.

Batch: One measured box of mixed concrete or mortar.
Batch Box: a gauge box for measuring dry ingredients for proportioning a concrete mix.
Batching Plant: A mechanical equipment for measuring different ingredients by weight or volume.
Batch Mixer: A concrete mixer for mixing concrete batches.
Beam: A structural member, usually horizontal, to support a floor or roof slab. The load on a slab is carried by the beam. A beam is usually made of Timber, steel and reinforced concrete.
Bearing Bar: A wrought iron bar instead of a wall plate placed on a brickwork to support the beams or joists at level.
Bearing Capacity: The bearing power or stress of a material to withstand a load without causing any sinkage to the member from which the load is coming over it. It is given by the load per unit area.
Bearing Pile: A pile that carries load and transfers to soil either through its end or by skin friction.
Bearing Wall: A wall that bears a load.
Bearing Test: A test, usually the load bearing test conducted to determine the carrying capacity of a soil.
Bench Mark: A fixed point having known level with reference to the mean sea level. This point is used as datum or reference point in a level survey.
Bend Test: A test to verify the ductility of a flat steel bar by bending the bar through 180^{o}, when cold. If no crack is found, the piece is considered ductile.
Berm: A horizontal ledge at the bottom of an embankment or at the top of a cutting.
Berth: A place where a ship is moored for loading and unfolding.
Berthing Impact: The forces on jetties and piers from the Kinetic energy of a vessel during its berthing.
Bib Cock: A water tap connected to a horizontal pipe line for drawing water.
Billet: A product obtained in forging or hot rolling wrought iron or steel.
Bill of Quantities: Quantity surveying, speaking of items of work with description/specification and the quantity of work involved in each item of work.
Binder: A binding material like cement, lime, gypsum plaster, bitumen, tar, etc.
Binding Wire: Annealed wire (black wire) used in binding reinforcement bars.
Bio-Gas Plant: A plant used for generation of gas from human waste and cattle dung.
Bitumen: Non-crystalline solid or viscous material derived from petroleum. It consists of petrolene and asphaltene, used in making road pavements. It contains 87% carbon, 11% hydrogen and 2% oxygen by weight.
Bitumen Emulsion: A bituminous emulsion, made of water and bitumen, which is used to roads in damp cold water. Also, known as ‘bitumen road emulsion’.

Bituminous Carpet: The wearing course of a road, using bitumen as binding under the flooring.
Bituminous Felt: An underlining felt used for roof covering, lining damp walls and under the flooring.
Blasting: Breaking or dislodging rocks and coals in mining operation with the help of explosives.
Bleaching: Removal of colour by chemical action.
Blinding: Spreading of sand to fill the voids in a road wearing course.
Blow Out: In working with compressed air, a sudden loss of compressed air from a caisson that may cause disaster.
Boiler: A plant for steam generation.
Borrow Pit: Pit formed due to excavation of soil from a place to fill other site.
Box Culvert: A box like culvert of square or rectangular section constructed for drainage of water.
Box Drain: A drain of box shape, square or rectangular section constructed for drainage of water.
Breaking Strength: Rupture strength or ultimate strength.
Breaking Stress: The maximum strength developed in a material at the point of its breaking.
Break Joint: A structural joint to break the continuity, with a view to giving allowance for expansion and contraction.
Bricklayer: Mason; A tradesman skilled in laying bricks for different works in civil engineering.
Brick Masonry: Brickwork.
Brick Mattress: A type of brick lining.
Brick Work: Masonry work with bricks.
Bridge: A structure usually horizontal, across a stream, river, canal, or railway.
Bridge Cap: The top most part of a bridge pier, on which the bridge bearing is placed.
Bridge Deck: The bridge floor that carries the load and transfers to the bridge girder.
Brick Pier: The intermediate support of a long bridge of continuous beam type.
Bridge Truss: A truss or glider used for carrying bridge loads.
Broad Gauge: A widest gauge used in a railway track. It is 4′- 8 ½″ in some countries and 5′-6″ in some other countries.
Buffer Stop: A fixture made of old rails and sleepers which is fixed at the end of a railway track to take the impact load of a moving wagon, if needed to stop it.
Buttering: Spreading of mortar on vertical face of a brick, prior to laying.

C

Cable: A collection of ropes or conductors, insulated and protected where needed.

Cable Duct: A hole cast in concrete through which electric cables or pre-stressing cables are pulled.
Camber: A cross fall in a road curvature (across the road width) to premi9t water to run-off a road. It is also the hog provided in a girder to counter balance the effect of deflection.
Canal: A channel to carry water for navigation, irrigation and other purposes.
Cantilever: An overhanging beam from a wall.
Cantilever Arm: The arm projected from a fixed support.
Cantilever Bridge: In a cantilever bridge, the outer span of the cantilever arm is anchored down at either end and overhangs into the central span.
Capillary Pressure: The seepage force of water.
Cast-In-Situ: Cast at site or cast in place.
Cast Iron: This is obtained by purifying foundry pig iron. Cast iron contains2 to 5% of carbon with other impurities. There are varieties of C.I used for different purposes.
Catalyst: A substance that hastens a chemical reaction. This is an accelerator.
Caterpillar Gate: A heavy duty steel gate used to control flow of water through a spillway.
Cat Eye: A pin knot in timber.
Cat Walk: A gangway of restricted width provided to give access for inspection and repair.
C.B.R Test: California Bearing Ratio (C.B.R) test developed by California State Highways Department for evaluation of subgrade strengths required in design of road pavements. The test can be done on all soils.
Cement Concrete: A concrete made of cement, sand and stone chips or khowa (brick ballasts) with adequate quantum of water.
Cement Grout: A thin paste of cement and sand applied by a spray gun to fill in the cracks and crevices found in a concrete or masonry structures.
Cement Mortar: A mortar prepared by mixing cement, sand and water in required proportion. This is required for brick work, Plastering and preparation of concrete.
Cement Paint: A cement slurry made of cement and water, is applied as a paint to make a surface water-proof.
Cement Slurry: A very thin mixture of cement and water that can be used as a wash over the wall.
Centering: A curved framework made of timber, required for construction of an arch or a dome.
Centre Of Gravity: A point in a body at which its weight acts and it will remain in a balanced state if supported at that point.
Centrifugal Pump: A pump in which the impeller blades rotating at a high speed throw water outwards and discharges to the required head.

Check Valve: A valve having controlling device to regulate the flow of a fluid through it.
Chisel: A sharp beveled-edge cutting tool of various form with a wooden handle used by carpenter and masons**.**
Chute: A vertical or inclined duct provided in a multi-storied building for disposal of garbage/ solid wastes.
Cleavage: A fracture in wood or stone or any other material.
Coarse Aggregate: The larger size aggregates used in making concrete. These are usually stone chips and broken brick bats (khowa).
Coat: A thin layer or film of any material over another.
Coated Macadam: Tar macadam.
Cock: A valve to control flow of a fluid through a pipeline. There are various types of cocks for specific requirements.
Column: A post or a vertical member in a structure.
Compaction: Increasing dry density of a granular soil artificially by mechanical means.
Compact Soil: A granular soil with a relative compaction of 90% or more.
Compost: Humus obtained by decomposition of organic wastes, which can be used as a god soil-conditioner. It has the required nutrients for the growth of plants.
Compression Test: Test carried out to determine the crushing strength of bricks, stones, concrete, mortar, etc. Unconfined compression test and triaxial compression test are carried out for soil.
Compressive Strength: The strength of a material to withstand the compressive force acted on it.
Concrete: A mixture of cement, fine aggregate and coarse aggregate with adequate quantum of water to form a homogeneous mass. When set and cured, it resembles stone. This is extensively used in Civil Engineering constructions. There are various types of concrete to meet the specific needs.
Concrete Blocks: Blocks made of concrete. Hollow blocks are used in building construction. Solid blocks of heavy type are used in protection of river banks and also in construction of breakwater.
Concrete Mixer: A concrete mixing machine comprising essentially a rotating drum into which the ingredients and water are fed for through mixing.
Concrete Paver: A concrete mixer with arrangement for spreading concrete, mounted on a crawler track, used in construction of concrete roads and pavements.
Concrete Piles: Precast or cast-in-situ reinforced concrete piles which are driven into ground to increasing the bearing power of soil and to support a structure above ground.
Conduit: A pipe; An encasement for cables.
Connection Pit: A pit or manhole to facilitate connection of incoming sewers with the outgoing sewers.

Contraction Joint: A break in continuity of a structure to allow shrinkage of concrete or masonry.

Conveyor: An equipment with a moving flat belt used for transportation of coal, ore, sand, etc. continuously over a short distance. This is chiefly used in industries.

Cracks:

i.) Cracks may develop in a long continuous structure due to expansion and contraction of the materials with the variation in temperature as well as due to unequal settlement of the structure.

ii.) Hair cracks may develop on a plastered surface due to shrinkage of plaster on drying.

iii.) Cracks are likely to occur in concrete due to shrinkage, poor curing, inadequate reinforcement, excessive loading etc.

iv.) Cracks may develop due to poor bonding of brickwork or stone masonry.

v.) In a wall, cracks are sometimes found under a beam due to sharing action of the load transmitted by the beam.

Crane: A power driven lifting device with a jib commonly used in loading and unloading cargos. Also used in massive civil engineering constructions for lifting and transporting materials over a horizontal distance from the work site.

Crane Gantry: A gantry having rails, over which the overhead crane travels in a factory.

Crushing Strength: The compressive strength of a material.

Crushing Test: A cube test for mortar or concrete. A test to determine the compressive **strength of a material.** A test to observe the failure of a very short column by increasing gradually the direct load over it.

Cube Strength: The strength of a mortar or concrete cube at the point of its crushing.

Cube Test: A test to determine the crushing strength of a mortar cube or concrete cube.

Culvert: An underpass provided in a road or railway to facilitate the natural drainage of a land area. A small bridge over a narrow stream or watercourse for crossing it.

Curing: A process of maturing mortar or concrete to attain its strength, by sprinkling water or keeping wet sacks over it for about seven days after setting of the mortar or concrete.

Cusec: A unit of quantum of flow of a fluid. One cubic foot per second.

Cushion: A layer of sand, gravel or any other granular material in a foundation bedding.

Cylinder Test: This test is carried out to determine the compressive strength of a concrete. A concrete cylinder of 150 mm diameter and 30 mm length is tested under compression instead of using a concrete cube of 150 mm size. The cylinder test shows 0.75 times the strength of the same concrete crushed in cube test.

D

Dado: A panel of neat cement finish or any other ornamental finish around the inner walls starting from skirting level to a height of 30 cm to 60 cm.

Dam: A massive wall across a flowing stream or river to hold water at the upstream side.

Dam Proof Course: A layer of strong mix of cement concrete or any other water-repelling material laid LL long the top of the walls at plinth level to prevent the ground moisture coming up the walls.

Datum: A point having a level of reference which serves as a permanent bench mark from which a level surveying is carried out. Temporary bench marks, are established from the permanent bench mark.

Deck: A platform, a floor without any covering at top, a bridge floor, a jetty, etc.

Deck Bridge: A bridge with a deck carried by the top chord of the girder.

Degree Of Compaction: In soil mechanics, it is a measure of compactness of a soil sample.

Density: Weight per unit volume of a material.

Depressed Gutter: A street gutter is sometimes depressed where a street inlet is provided for entry of storm water into the sewer.

Derrick Crane: A 'scotch derrick' of stiff legs having no guy rope, used as a stationary derrick. A permanent structure holds the mast in vertical position, the base of the mast being tied with two horizontal legs (sleepers). The legs are held down by counter weights (kentledge).The top end of the boom is hung from the top of the mast and it can swing through an angel of 240^{o}.

Detonator: A container having explosive mixture, used for blasting purpose.

Dewatering:

i.) Lowering ground water table by pumping.

ii.) Bailing out water from a foundation trench or any other excavation by pumping.

Diagonal Bond: 'Raking bond' or 'herring-bone bond'. The bricks are laid at 45^{o} to the face. It is used in flooring

Dike: An earthen embankment built on either side of the river at a distance away from the river banks, the height being kept about 1.5 m to 2 m above the H.F.L, with a view to controlling flood.

Discharge: The quantum of fluid following through a pipe or channel per unit time. It is usually denoted by 'Q'.

Discharge Valve: A control valve which regulates the discharge.

Distemper: Distemper: A sort of matt paint with appreciable quantum of pigment which is thinned with water. The washable distempers or oil-bound distempers have drying oils. In washable distempers, the binder used is casein of glue.

Distribution Box: A box or chamber which gives access to the branch lines.

Diversion Dam: A dam built across a stream to divert some water into a by-pass channel.
Dolomite: A basic refractory material.
Drainage Excavator: An excavator used for digging purpose below the level of its tracks, which works by dragging or pulling a bucket hung from the end of a long jib.
Dredger: A vessel fitted with a bucket ladder or grab machinery for mining operation or under-water excavation.
Dry Dock: A graving dock into which a ship to be repaired/overhauled is taken in, lock gate is closed and the water is pumped out. The ship rets on the docking blocks.

E

Earthen Dam: A dam made of compacted earth with a core of puddled clay or any other impervious material.
Earth Moving Plant: Machinery like bull-dozers, excavators, loading shovels, graders, etc., required for shifting mucks and leveling a surface by removing spoils.
Earth Work: Digging earth or raising the ground with soil.
Elastic Rail Spike: A rail fastening provided with a steel spring and a specially shaped head.
Electrode: A conductor leading electric current in an electrolytic cell or electric furnace.
Electrolysis: Flow of electric current through electrolytes, which deposit metal on cathode and oxygen or acid radicals are liberated at anode.
Electroplating: The deposition of a thin film of a noble metal like nickel, chromium, copper or cadmium on another metal by the process of electrolysis.
Elevated Railway: A railroad carried on a bridge supported on columns above the road level.
Elevation: Normally it is the front view of an object. However it may be a rear elevation or end elevation. This is required to show the object in orthographic view.
Elevator: A mechanism by which passengers or goods are elevated from a lower level to a higher level. A lift used in a multi-storied building.
Embankment: A mound of earth, rock or composite material forming a trapezoidal section used for a roadway or railway. This is also built along a banks of a river or stream to protect the surrounding areas from flood due to high water level in the river/stream.
Enclosure: A space covered by walls or fence.
Engineering Brick: A brick having uniform colour, shape and size with standard crushing strength and other properties suitable for constructional works.
Erection: Placement, positioning and fixing of precast concrete frames or fabricated steel frames.

Erosion: Wearing away of a surface due to abrasive action.
Excavation: Digging and removing earth.
Excavator: A power-driven excavation machine mounted on tracks, used for quick excavation in soil or rock.
Expansion Joint: I) A rail joint with a gap for expansion of rails. II) A joint provided in a structure to prevent cracks due to expansion.

F

Fabrication: Preparation of members of a structural frame in workshop such that the framed structure can be built easily in a short time by making assembly of the parts at site.
Factor Of Safety: The ratio of ultimate strength of a material to the maximum allowable strength.
False Ceiling: A decorative or pleasant ceiling built under a roof with a gap in between. It also provided space for running cables and pipes.
Fastener: Nails, screws, bolt-nut, rivets, dowel pins, spikes and dogs are used as fasteners required in different types of jobs.
Feeder: A channel to feed water to canal or reservoir.
Feed Pump: A pump used for feeding water to a boiler.
Feed Water: The water that is treated, pre-heated to boiler-temperature and pumped for feeding a boiler.
Fender: Wooden block with rope mat or rubber block or old rubber tyre fastened to a wall or piles to protect a water vessel from impact.
Fender Pile: A vertical wooden pile to absorb the impact of vessels with a view to protecting the berth.
Fender Wall: A dwarf wall to carry the hearth slab for a fireplace.
Filler: Finally powdered minerals added to bitumen and tar for making them stiff for use in road pavement.
Filter: A strainer or straining medium to arrest fine flocs and bacteria present in a water.
Final Grade: The formation level of a roadway.
Fine Aggregate: Sand, crushed stone, cinder, etc. are called fine aggregates which are used in making concrete or mortar.
Fine Cold Asphalt: A road wearing course made of fine aggregates and bitumen which is spread evenly and rolled when cold.
Fineness Modulus: A number indicating the fitness of material like cement, sand, pigment etc.
Fine-Textured Wood: A wood having fine texture which does not require the use of filler prior to varnishing.

Finish: i) Finishing coat of paint. ii) Final coat of plaster. iii) Completed work with final touch up.
Fire Bricks: Refractory bricks used in lining furnaces. These bricks can withstand a very high temperature.
Fire Extinguisher: Fire extinguishing foam sprayers, gas gun, emulsifiers, water sprinklers, drenchers and hydrants.
Fire Hydrant: An outlet from a water main into which a hose pipe is fitted hydrant and the other end is provided with a nozzle.
Fishing Tools: Recovery tools used in exploratory oil-well drilling to take out broken tools.
Fish Ladder: A suitable pass for fish to travel from upstream to downstream side of a weir. It is provided with baffles having openings to allow water to flow and fish pass.
Fish Pass: A fish ladder.
Fish Plate: A steel plate of special shape used for joining the ends of two rails by means of bolts-nuts as shown in illustration.
Flanks: The sides of a metaled road.
Flank Wall: A wall built at one side or end of a building.
Flash Point: The minimum temperature needed by a material to ignite momentarily when a flame is put to it.
Flexible pavement: A pavement for roads, air strips or runways made of a waterproof bituminous wearing course over a base course.
Float Glass: A thick glass sheet made by floating molten glass over a molten metal. This produces a smooth surface of the glass sheet.
Floating Berths: Berths having floating arrangement used in small craft harbors. Floats are made of wood, fiber glass, polyurethane and light-weight concrete.
Floating Caisson: A caisson sunk by filling it with water so that it remains hydrostatically stable at each stage. The floatation is achieved by producing caisson with sufficient buoyancy and hydrostatic ability**.**
Floating Dock: A floating dry dock that consists of a floating steel structure which sinks beneath a water vessel (required for under water repairs) and makes itself buoyant when the water ballast is pumped out. Thus, the vessel is raised above the water level and is repaired in the dry condition.
Floor Tiles: Tiles used in making a finished floor. Such tiles are made of various materials.
Flush: To pour an adequate quantum of water at a time at a high velocity.
Flush Door: A door having a smooth surface without any panel and built of commercial boards either solid or with a hollow core.

Fly-Ash: The ash particles from pulverized coal that pass through the chimney. This can be used as an admixture to cement or as pozzolana. Fly –ash is also used in making light-weight aggregate and bricks.
Foil: A very thin sheet of a material.
Footing: A wall or column foundation which is widened to distribute the load to a large area.
Fork Lift Truck: A power-driven truck provided with a projected steel fork at its front by which materials are picked from the ground level, lifted up band transported to the desired location.
Formation Level: The dressed level surface of a ground or an embankment.
Foundation: The sub-structure or the part of a structure built underground for transfer of load to soil and to hold the structure.
Friction: A force that oppose a motion.

G

Gang: A group of workmen/laborers.
Gangway: A narrow approach way for men to walk on for inspection and repair work.
Gate Valve: A valve used in pipeline to close or control the flow of a liquid by closing or partly opening the gate.
Gauge: i) Measuring sheet thickness or wire diameter by a number. ii) Measuring device to indicate the quantum of rainfall. iii) Water level measuring device.
Gauging Station: A station point where a stream gauge or a rain gauge is installed.
Gauntlet Track: A railway track, when a double line f same or different gauge is narrowed over a short distance.
Geological Map: A map showing the geological formation and underground strata of an area on earth.
Geophysical Survey: The survey conducted for search of mineral deposits. Maps are prepared with variations of elastic properties of earth, gravitational field, magnetic field, radio activity, etc.
Ghoondie: The rounded surface at the junction of roof and parapet wall.
Girder: A large size beam of timber, steel or concrete to which the secondary beams may be connected.
Girder Bridge: A bridge supported by girders.
Glass Paper: Also known as sand paper, emery paper and garnet paper. This is an abrasive paper made from powdered glass, sand, flint, garnet and corundum glued to paper. The quality of such paper depends on the degree of fineness.
Glazed Tile: Wall tiles made of earthenware may be glazed with decorations for interior use.
Graded Aggregate: Classified aggregate having different particle sizes.

Graded Sand: A sand sample containing coarse, medium and fine sand.
Gravity Dam: A dam of massive construction which prevents its overturning by its self-weight alone. This type of dam is to be built quite heavy and high enough.
Gravity Water: Water flow by gravity.
Grille: A grating through which air passes for ventilation.
Groyne: This may be of 'fending', 'repelling' or 'attracting' type.
Ground Beam: A reinforced concrete beam placed near ground level over piles which acts as a foundation walls. This may also act as a strip foundation.
Ground Water Recession: The variation of base flow with time during periods of no rainfall over a basin. It is a measure of drainage rate of ground water storage from a basin.
Grout: Cement-sand slurry made of equal volumes which injected into the joints of brick work, stone masonry or fissures in rocks.
Grouted Macadam: A macadam road built with coarse aggregates, the voids being filled with cement grout or bituminous grout.
Guide Bank: Also known as 'Bell Bundh' named after J.R Bell. It is constructed at a bridge site to protect the bridge ends by guiding the water flow in stream.
Guy: A rope with holds mast, chimney derrick, shear legs, etc.

H

Hangar: A covered shelter for aircrafts.
Harbour: A water area close to a land for giving shelter to ships, loading and loading materials and men.
Hard Core: Hard Materials like lumps of stone, bricks and old concrete introduced into a soft ground in foundation or used for filling a soft soil for making a road.
Hessian: Also known as 'burlap'. Coarse material woven from jute or hemp for making sacks.
Highway: A roadway of standard width, meant for all sorts of traffic.
Hoist: A device to lift or lower a material.
Horse Power Hour: The work done by spending one h.p for one hour which is equal to 0.746 kilowatt hour. In other words, 1 kWh = 1.34 hp hour.
Hot-Air Seasoning: Seasoning of timber in a closed chamber by pressing hot air.
Humus: Dark brown or blackish fertile material obtained from decomposition of organic wastes, which may be used as a good soil-conditioner.
Hydrant: A connection to street water main from which water is drawn during street washing and firefighting.
Hydraulic Excavation: Excavation by injection water jets at a very high pressure to loosen the materials to be taken out. Thus water carries mud, stiff sand and loose gravel and flows in a channel.

Hygrometer: A measuring device to determine the relative humidity of air.

I

Impeller: The curved blades of a centrifugal pump or blower, which rotate.
Incinerator: A special furnace for burning combustible solid wastes.
Initial Setting Time: Time required by a cement paste, mortar or matrix for initial setting. This is measured by a vicat needle apparatus.
In-Situ: Fabricated or cast at site.
In-Situ Concrete: Concrete mix prepared and cast at site.
In-Situ Soil Test: Soul tests conducted in field such as load test, vane test, dynamic penetration test, permeability test, etc.
Irrigable Area: The area which is low enough to be irrigated.

J

Japanese Lacquer: It is the most durable glossy varnish prepared from the sap of the Japanese Varnish tree '*Rhus vernicifera'*
Jim Crow: This is a railway tool used in bending rails manually.

K

Kiln: A furnace for burning bricks, tiles, lime, and lime stones in cement manufacturing.
Knot: The location in a tree trunk wherefrom branch came out. In timber dead knots are harmful.

L

Lacquer: Like varnish a glossy finish is produced either for decoration purpose or for coating metal surfaces by using cellulose-based compounds.
Lagoon: A ditch, pond or low-lying are used for treatment of sewage or sludge.
Land Accretion: Land reclamation from marshy lands, low-lying areas, rivers and sea by siltation or by dumping waste materials, garbage, rubbish, etc.
Latch: A locking arrangement provided in doors.
Layout: A general concept or arrangement for a proposed construction or installation.
Leach: Removal of salts from a soil by passing water through it.
Levee: An embankment constructed to prevent flooding in flood-prone areas which are low-lying lands.
Light House: A structure constructed on the sea-rock with arrangement of flash-light for cautioning the ships.
Link: One hundredth of an engineer's chain or Gunter's chain.

Lintel: A small beam placed over the door or window to support the masonry built over it.

Load Test: This test often carried out to determine the bearing capacity and settlement characteristics of a soil at site by applying and increasing loads in stages and nothing the stress-strain and consolidation or settlement.

Location Plan: A site plan which shows the dimensions of the location of the proposed construction site.

Lock Gate: A gate that separates water of upper reach from the lower reach.

Locomotive: A railway engine which draws the coaches.

Locomotive Crane: A heavy mobile crane which travels on the railway track, required for the purpose of construction and maintenance of railway bridges and also for loading and unloading heavy massive units.

Log: A tree trunk after trimming.

Lump Sum Contract: A contract made for execution of a work as per specification at a fixed price (total value).

M

Macadam: The most common road metal. The macadam surface may be water-bound or bitumen-coated or cement-bound.

Macadam Spreader: A machine to spread macadam uniformly to form a road surface.

Main beam: A beam that rests directly over walls or columns and support the subsidiary beams or rafters.

Main Canal: A canal that delivers water to its branches for the purpose of irrigation.

Main Drain: A major drain that receives waste water from its branches and laterals and leads to the outfall.

Main Holes: Relief holes used in mining.

Man-day: The quantum of work done by a man in a day.

Manhole: An access hole to a tank or a sewer junction chamber, so that a man can enter into the tank or chamber through this hole for inspection and repair work.

Man-hour: The quantum of work done by a man in on hour.

Manometer: A gauge in form of a U-tube filled with mercury or any other liquid to measure the pressure difference.

Marble: A type of limestone which is valuable for its beauty and durability.

Member: A part of a structure or a building.

Membrane: A skin-like thin film or layer.

Mensuration: A subject dealing with measurement and calculation of lengths, angels, areas and volumes.

Microbes: Microscopic organism.

Mild Steel: Basically it is an alloy of iron having low carbon content which makes it ductile.

Mix: The mixture of ingredients (dry or wet) to form a paste or concrete. The term is normally used for making a mortar or concrete.
Mixer: A mixing machine for making mortar or concrete or a puddling machine for clay.
Moisture Barrier: Damp proof course.
Monolithic: A jointless construction as a whole reinforced concrete structure. For example, a column, a beam and a slab are cast in one operation at a time.
Mortar: Usually a mixture of cement and sand or lime and surki with adequate volume of water to form a paste.
Mosaic: A course or layer made of colored stone chips of small size laid in cement.
Mosaic Cutting: The cutting of top surface of a mosaic carpet by rubbing it with pumice stone.
Movable Dam: A dam having removable part to allow the flood water to flow through it.

N

Narrow gauge: This is a railway gauge (2'-6") which is narrower than the standard gauge of 4'-8.5".
Natural Seasoning: The driving out of a sap from a freshly cut timber by keeping it under a shade, but exposed to atmospheric air and temperature.

O

Open Caisson: A caisson, either a cylinder or a drop shaft with both top and bottom being open
Open Cut: An excavation in the open.
Open Hearth Process: Also known as Siemen's-Martin process used in manufacturing steel. In this process, pig iron, scrap steel and iron are melted together by regenerative gases to produce better quality steel with the removal of C, Si and P.
Organic Silt: A silt of animal and plant origins, having dark black colour and obnoxious odor. This silt is highly compressible.
Overhead Ropeway: An aerial ropeway.

P

Paneled Door: A door shutter made of panels set in a frame.
Parapet: A low-height wall provided round the edge of a roof, bridge, culvert, balcony, etc. for safety.
Patent Stone: A cast stone with cement, sand and colored stone chips.
Pavement: A hard floor on platform or footway made of wood blocks, stone sets, bricks, tiles or concrete.

Peat: Gelatinous dead vegetable matters of dark brown colour preserved by humic acid in ground.

Penetration Test: i) A field test that indicates the load-bearing capacity of a soil. The test may be either static or dynamic. ii) An important test to measures the hardness or consistency of asphalt and bitumen for use in road making.

Percolation: The movement of fluid through the pore spaces in soil or any other porous material.

Pier: An intermediate support in a continuous span bridge, usually made of concrete, brickwork or stonework.

Pier Cap: A thick slab or plate provided at the top of a pier for distribution of load coming over a pier.

pH Meter: A measuring instrument to determine the acidity or alkalinity of a solution.

Pile Driver: A frame with a hoist and a monkey required for pile driving as shown in.

Pile Shoe: The conical tip of a pile made of good quality cast iron which helps in penetrating the pile into the ground.

Pit: An excavation for exploration of the ground or for obtaining soil, sand, etc. or for verification of the underground utility lines.

Pitching: Setting bricks or stone blocks on the sloping bank of a river or canal or tank to protect from scouring action.

Pivot Bridge: A swing bridge which swings about its pivot to allow passing of vehicles.

Plank: Timber board of 20 mm to 80 mm thickness obtained by sawing squared log.

Plasticity: In soil science, it is a characteristic of clays which can be determined in field.

Plinth Level: The ground floor level.

Plugging: Closing a hole in masonry by inserting a plug into it.

Plywood: Sheets of veneers or wood piles are glued together by heat and pressure to obtain a thick board, which is called plywood.

Pneumatic caisson: It is used for construction of a pier and its foundation below water level. Compressed air used prevents mud and water from entering into the chamber. The use of this type of caisson permit removal of boulders, logs etc. encountered by the cutting edge and placing of concrete in dry.

Pointing: The mortar joints are raked out from the surface of a masonry work and these are finished with a strong mortar to resist weathering action as well as to improve the appearance of the surface.

Polder: Reclaimed land area from the sea by constructing dykes and filling with boulders.

Pontoon: A flat bottomed vessel which is sometimes used to carry a crane or to support the end of a floating bridge or to carry plants and material.

Pontoon Bridge: A floating bridge of temporary or permanent nature which is supported by R.C.C pontoon moored to the river.

Porch: A cantilever hood without any prop at the free end, provided at the entrance to a building.

Portico: It is similar to porch having supports at the extended end. It is made larger than a porch.

Precast Concrete: Concrete blocks, slabs, posts, lintels and parts of a concrete frame, which are precast and cured in a factory.

Prefabricated Structure: A structure whose component are prefabricated in a factory and are assembled at construction site.

Pre-stressed Concrete: This is more advantageous compared to ordinary concrete, when long spans, shallow depth and light self-loads are desired. Pre-stressed concrete structure require about 25% less concrete than standard design of ordinary concrete.

Primary Coat: The base coat on a wooden surface. For iron and steel surfaces, it is a coat with a base of red lead, baryta or iron oxide.

Primer: i) A priming coat applied on a surface prior to painting. ii) A bituminous spray in soil stabilization.

Putty: A material used to fill cracks and crevices, holes, depressions and gaps. These are white lead putty, mason's putty, lime putty, glaziers' putty etc.

Q

Quarry: An open pit from which sand, building stone or minerals is taken off.

R

Raft Foundation: Mat foundation. A reinforced concrete foundation slab designed to act as a mat foundation to support the total structure above it.

Ranking Pile: A batter pile, a pile driven inclined to vertical.

Reconnaissance Survey: Survey-ing an area from observations in field and without use of any instrument/apparatus.

Recording Gauge: An automatic gauge that records the water level or velocity of flow in stream, channel or river.

Red Oxide: Iron oxide in colour, used as a pigment which does not inhibit corrosion. This is chiefly used for primary coat on iron and steel.

Refractory: Materials that can withstand very high temperatures. These are used in lining furnaces, boilers, converters, crucibles and pyrometer tubes.

Reinforced Concrete: A concrete which is reinforced with mild steel rods or wire mesh. In a reinforced concrete member, concrete takes compression and reinforcement steel is in tension. Reinforced concrete is extensively used in Civil Engineering constructions.

Relief Well: A borehole made at the toe of a massive dam to relieve high pour water pressure...

Representative Sample: A sample that represents the whole. To prepare such a sample, proportionate sampling is done from various parts of the whole and thoroughly blended.

Retaining Wall: A wall to retain earth, water or any other material.

Retiring Embankment: These are constructed similar to dykes, but away from the natural bank of a river as shown. They provide a large area for carrying flood water which helps in keeping down the H.F.L.

Revetment: A protective covering or lining given to a sloping bank of a river, stream or channel to protect the slope from scouring action due to wash water or due to water waves.

Rigidity: The resistance to shearing, bending or twisting.

Rigid Pavement: A pavement made of concrete slabs.

Riparian: The bank area of a stream or canal.

Road Roller: A power-driven roller weighing from ½ to 12 tons, used in rolling the road surface.

Road Surface: The wearing course or road carpet, the topmost layer of a road.

Rotary Drilling: A method of drilling deep holes of 150 mm to 450 mm diameter for oil or water. Hollow shafts are screwed together to form the length, with the cutting bit rotating at the tip. The drilled material is taken out through the shaft.

Round About: A circular traffic island provided at the center of a road junction where four or more roads meet. The facilitates in guiding traffic flow.

Run-Off: The overland flow of water derived from precipitation. This is also known as surface run-off, storm run-off or flood run-off.

S

Safety Belt: A belt to be worn by a worker for his safety while working at a height more than one meter.

Safety Valve: a spring-loaded valve used to release steam pressure in a boiler for safety.

Sagging: Bending with concavity upwards.

Sand Blast: Throwing sand particles on to surface through a compressed air jet to make a surface clean and smooth or to etch a surface for decorative work.

Sand Dry Surface: A dry surface to which no sand stick, which is suitable for painting.

Sand Paper: An abrasive paper used for cleaning or smoothing a surface by rubbing.

Sap Wood: The wood in the outer part of a tree which is normally weaker than the heartwood (core), light in colour and prone to decay more easily.

Scaffold: A temporary frame made of timber or steel to support men and materials during a constructions.

Scour Protection: For protection of river bank scouring due to wave action and high velocity of flow, there are many devices that can be adopted.
Seal: i) A tight joint to prevent flow of fluid through it. ii) An air-tight cover to preserve a material.
Sealant: A compound of plastic consistency spread over a surface to fill up the pores, cracks, crevices and gaps in joints so that the surface will not permit the penetration of water.
Sealing Coat: A thin coat of bitumen, tar or an emulsion applied to a road surface.
Seasoning: Driving out moisture content or sap from a freshly cut timber tree. It is either 'Natural-seasoning' or kiln-seasoning'. Natural-seasoning may be air-seasoning or water-seasoning.
Septic Tank: A tank with compartments and piping arrangement for inflow, outflow and ventilation, is used in treating domestic sewage from individual house, by gasification and liquefaction and sedimentation of sludge at the bottom.
Service Pipe: The pipeline from a street water main or gas main to house premises for supply of water or gas.
Setting coat: The finishing coat of a plaster.
Settling Tank: A tank either rectangular or circular, in which suspended particles settle down and the clarified liquid flows out from top.
Sewage: Foul water carrying human excreta and filthy matters.
Shaking Test: A simple and quick field test to determine whether a fine-grained soil sample is silt or clay without use of any apparatus.
Shear Plate: A connecting plate held by bolts.
Sheep foot Roller: A cylindrical roller projections in form of sheep's foot arranged in rows round the cylinder. This is used in compacting soil.
Sheet Piles: Piles made of thin sheets of steel, concrete slabs, wooden planks, etc. closely set and driven underground to retain earth or water.
Sheet Pile Wall: A wall made of sheet piles to withstand the thrust of water and earth.
Short Blasting: Cleaning a steel surface by throwing steel shorts on to it with the help of steel impellers prior to metal coating or painting.
Shuttering: A formwork for moulding or casting concrete.
Sieve: A screen to separate grain sizes.
Sieve Analysis: A screen analysis to determine grain-size distribution.
Silo: A tall tower of cylindrical shape or other forms used for storage of fine-grained materials.
Silt: A fine-grained soil whose individual particles cannot be differentiated by the naked eye.
Simple Beam: A beam simply supported at its end.
Slab: A flat piece of timber or concrete or stone.

Slag: The glass- like molten impurities flowing off above the molten metal in furnace. It is used in making slag cement, expanding cement, supersulphated cement and slag bricks or slag concrete.
Slaked Lime: Hydrated lime made by slaking quick lime with water.
Sludge: The solid matters obtained by settling a sewage. It may be inert or organic.
Sluice Gate: A gate is used to open or close openings into walls of a water reservoir. This is operated either manually or by hydraulic pressure. A light type of sluice gate is used to control flow in open conduits.
Slump Test: A common and popular test which gives a measure of consistency of concrete. A sample of mixed concrete is poured into the slump cone (mould) full to the brim and the cone is gently lifted up. The subsidence of the concrete cone in height is the slump.
Slurry: Very thin paste or semi-fluid state of a material.
Soil Stripping: These are used to carry the effluent of septic tank and also the waste water from pour flash toilets in high density slums having no sewerage system.
Solid Door: A single leaf flush door with a solid core. This door is sometimes plated with metal sheets.
Soling: Laying a single or double layers of brick or stone in a foundation trench over which concrete is cast.
Specification: A detailed description of material, a machine, a mechanical or electrical unit, or an item of work speaking of activities and procedure of work.
Spillway: Waste weir or waste way or an overflow weir over a dam to allow passing of excess water.
Spray Painting: Painting surface by means of a sprayer, which facilitates uniform painting by ejecting a fine mist of powder on a hot surface or a mist of paint on a surface at normal temperature.
Spread Footing: A column or wall footing gradually widened towards its base for distribution of load over a large area.
Standard Specifications: Descriptions of standard materials and workmanship.
Stem Curing: Curing of precast concrete products in a steam bath under pressure for hastening the maturation.
Steam Roller: A road roller driven by a steam engine which is now obsolete. Now-a-days, diesel engines are used.
Steam Turbine: A turbine operated by the force of high-pressure steam onto the vanes for generation of electrical power.
Steel Pile: Steel pipe piles filled with concrete and steel H-piles are used, when extremely long piles with high bearing capacity are required for the foundation of a bridge or a tall building.

Stone Block Pavement: A pavement made by setting blocks of stones cut to rectangular shape and more or less of uniform size.
Storage Reservoir: A reservoir used for storage of a liquid.
Strainer: A perforated or slotted pipe with or without copper wire mesh is fitted at the bottom of a tube well pipe so that only water will enter into the pipe excluding sand, silt, moorum and mud.
Structural Design: The design of structure based on the structural analysis such that each member is capable of taking the loads and moments coming on it and on the whole the structure is made stable against bending, sway, overturning, subsidence etc.
Structure: A frame or skeleton work for a building, bridge, trestles etc.
Sub-base: A course of material laid under a road base and over the sub-grade.
Sub-grade: The formation level or ground surface below a road.
Submersible Pump: A centrifugal pump which remain submerged under water and is driven by an electric motor from top. This is used for pumping water or sewage.
Subsidence: Settlement or downward movement of the ground surface due to consolidation.
Sub-soil: The soil below the formation level or the top soil.
Subway: An underground passage for pedestrians in a busy area with a view to avoiding congestion on surface.
Suction-cutter Dredger: A suction-type dredger with a rotating cutter provided at the end of a suction pipe. This is used in digging stiff clay.
Suction Dredger: A heavy-duty suction-type dredger without any excavating buckets. It dredges out mud and water mixture by suction pumps.
Super Structure: The part of a structure above ground.
Surface Dressing: Dressing of ground surface during site preparation.
Suspension Cable: A steel wire stranded rope strong enough to carry a suspension road bridge. Two such ropes are needed for a bridge.

T

Tack Coat: A thin coat of tar or bitumen applied on a road surface to increase the adhesion of the top course (chipping carpet or wearing course).
Tack Weld: A spot weld to gold the two edges together, which are to be welded afterwards as per requirement.
Tar: A deep black viscous liquid. It may be coal tar, wood tar or mineral tar.
Template: A wooden or metal pattern used to form the shape of a moulding. Plaster or concrete member.

Tensile strength: The internal force developed in a member under tension to resist the tensile force applied externally on the member.
Tensile stress: The stress i.e., the internal force per unit area of the section of the member developed due to application of a tensile force.
Tensile Test: A test carried out on a standard specimen to find out the tensile strength of the specimen.
Tension: A member is said to be in tension when it is subjected to a tensile road.
Terrace: A flat roof surface or a raised platform.
Terra Cotta: A strong and durable earth ware made from refractory brick clay or from selected clay mixed with ground glass, pottery and sand.
Testing Machine: There are a number of testing machines to determine the various properties of engineering materials. In a universal testing machine quite a number of tests can be carried out. These tests are for tension, compression, torque, impact and fatigue.
Texture: A face, fine-grained or coarse –grained, distributed or at random, smooth or rough, even or uneven and with or without designs.
Thinner: A solvent of volatile liquid which is used in a paint or varnish to lower the viscosity so that it can flow easily.
Tidal Dock: A dock having no lock gate. Therefore, the water level inside and outside the dock is always same.
Tie Beam: A beam which acts as a tie between two members.
Tie Rod: A steel rod used as a tie.
Toe Wall: A vertically downward wall built at the toe of a remaining wall.
Topographical Surveying: The land survey plotting the natural features of a country, such as hills, woods, streams, rivers, lakes and artificial features like roads, railways, channels, canals, housing, etc.
Top Soil: The soil layer of 6” to 12” thickness at the ground surface that supports vegetation. This soil is usually composed of silt and humus.
Tower Bolt: A large size barrel bolt made of steel or brass, used in doors and windows.
Training Wall: A wall built to guide the flow path of a river.
Training Works: Spurs, groynes and dykes are examples of training works for a flowing stream or river.
Trimming: Final dressing up of a surface.
Truss: A frame of timber or steel used in roofing, bridging and making partitions.
Tube Railway: An underground railway through a cylindrical tunnel. This is built either by cut and cover method or by tunneling.
Tunnel: An underground passage.
Turbine: A prime mover by gas, steam under high pressure or falling water.

Turfing: Covering a ground with growing grass taken out along with soil from another site. This helps to prevent erosion in slopes of earthen embankments.

U

U-abutment: This type of abutment is required sometimes to support a bridge at its end.
Undistributed Soil Sample: A sample of cohesive soil from a bore hole or trial pit obtained by driving soil sampler into the ground.

V

Varnish: A solution of resin in either oil, turpentine or alcohol.
Venetian Window: A window provided with Venetian shutter.
Viaduct: Just like an Aqueduct, a road or railway bridge over a valley.
Vibrated Concrete: Concrete compacted and made homogeneous by means of vibration.
Vibrating Pile Drive: A device for driving piles was originated in U.S.S.R and first used in 1949. On the top of a pile to be driven, two powerful motors rotate in opposite directions and thus, strong vibration takes place. This pile driving is rapid and noiseless.
Vibration Roller: A roller with a vibrated roll. The roller is self-propelled.
Void: The spaces between the particles in a mass of granular material.

W

Walk Way: A permanent gangway provided with handrails, so that safe access may be given along a roof.
Wash Out Closet: A closet so shaped that a small quantum of water remains in it into which excreta falls and is flushed out over the edge of the basin into a trap below.
Water Bound Macadam: A road surface formed of gravel or broken stones bound by soil and sand particles or hogging by sprinkling water and rolling.
Water-logging: Submergence under water due to inadequate facility of draining out water.
Water Seasoning: A method of seasoning timber by immersing fresh cut logs under water for a fortnight or so and drying them afterwards in atmospheric air under a shed.
Well Foundation: Well foundation is used in soft loose soil. The well with the curb sinks under its own weight and the soil within the well is excavated.
Wing Wall: A projected or extended wall from an abutment wall.