

**B.Sc Civil
Engineering**

CONTRACT



Project & Contract Management CE 206

Engr. Omer Altaf

**Department of Civil Engineering
UET LAHORE**

Lecture # 6 & 7

Preparations of Tender Documents



Technical specifications:

- It is a part of tendering process and it is supposed to be prepared by design consultant. Technical specifications used in civil engineering are of two types:
- General Specifications
- Detailed Specifications

General Specifications:

- These specifications are normally provided in drawings in which very brief information regarding the quality of materials or finished product is described. No detailed description is given. These general specifications are referring to detailed specifications which are the part of tender document.

e-g **Product**

- Concrete
- In foundation

Material

1 Cement :2 sand: 3 crush
Brick and mortar

Detailed Specifications:

- These specifications are always in the form of thick booklet as the part of tender document. The detailed specifications address all the major and minor materials and products, quantity and usage requirement for any specific construction project.
- Detailed technical specifications should be properly noted by contractor for evaluation of rates of project. Without the understanding of detailed specifications, contractors are unable to provide their rates in BOQ. Detail technical specification for any construction comprises of following items.

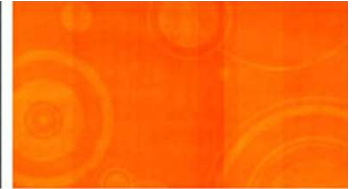
Civil Works : Concrete

- Detail specifications of concrete include.
- Mixing of concrete by volume or by weight.
- Concreting by manual method or concrete mixer or concrete plant.
- Grade of concrete.
- Grades of concrete are normally referring to the concrete class; mostly used classes include A,B,C,B1,B2,C1,C2 etc. These classes are based on compressive strengths of concrete i-e (A=12000 psi, C2=3000 psi)
- Curing requirements of concrete. (Ponding, jute bags, chemicals).
- Admixtures of concrete (admixtures are modern chemicals added in concrete to improve its physical and chemical properties).
- Formwork or shuttering of concrete.
- Vibration or compaction requirement.

Civil Works : Steel

- Detailed specifications of steel include.
- Yield and ultimate strength of steel.
- Hot rolled deformed bars (mild steel) or cold formed steel.
- Tor or Cold twisted re-bars / deformed steel
- Lap splice length requirement.
- Bending and cutting reinforcement. (Manual : Less costly and quality, Mechanical: Costly but quality)
- Brand of steel. (i.e.Prime steel, Mughal steel,Ambreli steel,Ittefaq steel, Malik steel etc.) to be checked

Civil Works : Bricks



Detail specifications of bricks include.

- 1st brick (Water absorption=12-15%, faces are regular, First class bricks are recommended for pointing, exposed face work in masonry structures, flooring and reinforced brick work.),
- 2nd class (Strength not less than 7MPa, water absorption = 16-20%, edges may not be regular, Second class bricks are recommended for all important or unimportant hidden masonry works and centering of reinforced brick and reinforced cement concrete (RCC) structures),
- 3rd class (may be under burnt. They are soft and light-coloured producing a dull sound when struck against each other. Water absorption is about 25 per cent of dry weight. Uses : It is used for building temporary structures), Under-burnt (Pilla Brick) (Higher water absorption and lesser compressive strength)and over-burnt brick (Khinger brick)(not used for construction)

Civil Works : Bricks

- Porosity of brick.
- Efflorescence of brick: When bricks come in contact with moisture, water is absorbed and the alkalis crystallize. On drying, the moisture evaporates, leaving behind grey or white powder deposits on the brick which spoil the appearance. This phenomenon is called efflorescence. If bricks become saturated before the work is completed, the probability of subsequent efflorescence is increased, brick stacks should, therefore be protected from rain at all times. During laying, the bricks should be moistened only to the extent that is found absolutely essential to obtain adequate bond between bricks and mortar; newly built brickwork should be protected from rain. The specifications limit the efflorescence to be not more than moderate (10–50%) up to class 12.5 and not more than slight (< 10 per cent) for higher classes.

Civil Works : Bricks

- Compressive strength of brick.
- For testing bricks for compressive strength from a sample the two bed faces of bricks are ground to provide smooth, even and parallel faces. The bricks are then immersed in water at room temperature for 24 hours. These are then taken out of water and surplus water on the surfaces is wiped off with cotton or a cloth. The frog of the brick is flushed level with cement mortar and the brick is stored under damp jute bags for 24 hours followed by its immersion in water at room temperature for three days. The specimen is placed in the compression testing machine with flat faces horizontal and mortar filled face being upwards. Load is applied at a uniform rate of 14 N/m^2 per minute till failure. The maximum load at failure divided by the average area of bed face gives the compressive strength.

Civil Works : Cement

Detail specifications of cement include.

- Brand of cement (i.e. DG cement, Maple leaf cement, Askari cement, Pioneer cement, White (40kg-600rs/bag) or grey cement(50kg-350rs/bag) for decorative purpose.
- Physical and chemical properties of cement including compressive strength, soundness and durability.

Civil Works : Cement

- **Initial setting time** : The initial setting time may be defined as the time taken by the paste to stiffen to such an extent that the Vicat's needle is not permitted to move down through the paste to within 5 ± 0.5 mm measured from the bottom of the mould
- **Final setting time of cement**: The final setting time is the time after which the paste becomes so hard that the needle, under standard weight, fails to leave any mark on the hardened concrete. It is important to know the initial setting time, because of loss of useful properties of cement if the cement mortar or concrete is placed in moulds after this time. The importance of final setting time lies in the fact that the moulds can be removed after this time. The former defines the limit of handling and the latter defines the beginning of development of mechanical strength

Civil Works : Cement

- Water-cement ratio
- Mixing water: Mixing water is the water in freshly mixed sand-cement grout, mortar, or concrete exclusive of any previously absorbed by the aggregate.
- Slump requirement.
- mix of cement (ratio of cement).

Civil Works : Sand

Detail specifications of sand include:

- Type of sand. (i.e. Ravi FM(2.8),Chenab FM(2.5-2.6), Lawrencepur FM(2.4-2.5))
- Gradation requirement sand :Fine sand passing from No.100 retained on No.200,
- Medium passing sieve no.40 retained on no.100
- Coarse passing sieve No.4
- Specific gravity.
- Shear strength.
- Angle of internal friction.

Civil Works : Sand

- Compaction requirement (Optimum moisture content–max dry density) (With addition of water to sand, the moisture acts as a lubricant and allows particles to consolidate up to a certain moisture content known as Optimum moisture Content (OMC) , and at that mc the density becomes maximum , however, once the mc is increased from OMC the moisture starts to penetrate the particle voids and cause the soil structure to become a suspension causing its compressive strength to reduce)
- Permeability requirement.

Civil Works : Crush

- Detail specifications of crush include.
- Sources of crush. (i.e. Margalla crush (Islamabad), Sargodha crush, Dena crush(roads , lean concrete) (Near Mangla towards Rawalpindi,SakhiSarwar (DG Khan)
- Specific gravity and water absorption.

Specific Gravity (G_s) of solid particles of a material is the ratio of weight/mass of a given volume of solids to the weight/mass of an equal volume of water at 4°C.

$$G_s = \frac{\gamma_s}{\gamma_w} = \frac{\rho_s}{\rho_w}$$

$$\text{At } 4^\circ \text{C } \gamma_w = 1 \text{ g/cc or } 9.8 \text{ kN/m}^3$$

Civil Works : Crush

Soundness requirement:

- Soundness of aggregates is the ability of aggregates to resist change of volume due to change of physical condition. These physical conditions include freezing and thawing, temperature change, alternative change of drying and wetting in normal condition and alternative change of drying and wetting in salt water. The aggregates which are weak, porous and containing undesirable materials undergo large volume change in change of those physical conditions.

Civil Works : Crush

- Los Angeles abrasion value. (ABRASION DEFINITION)
- Optimum Moisture Content and maximum dry density (σ_d).
- Gradation.
- Chemical test values including alkali silica reactivity etc

Civil Works : Crush

- Physical test values:
- Crushing value.(The apparatus, with the test sample and plunger in position is placed between the platens of the testing machine and loaded at a uniform rate as possible, so that the total load is reached in 10 minutes.)
- Impact Value:
Aggregate Toughness , lower Impact value means tougher the aggregate and vice versa,
< 10% Exceptionally strong, 10–20% Strong, 20–30% Satisfactory for road surfacing & > 35% Weak for road surfacing.)

Civil Works : Crush

Flakiness index

- Flaky particles: The particles whose least lateral dimension(thickness) is less than 0.6 times of their mean size,
- Elongated particles are those particles whose 1 dimension is greater 1.8 times of their mean size.
- Flakiness index: Percentage of coarse aggregate which shows how many particles are flaky or elongated is flakiness index or elongated index respectively/ Elongation index.

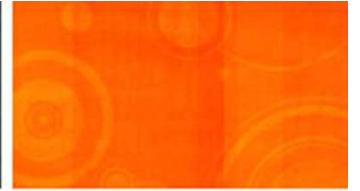
CBR (California bearing ratio) value.

Architectural work

Flooring: Detail specifications of flooring include.

- Type of floor.
- Marble, Terrazzo or chip, Tiles, cement floor(cheapest))
- Fixing of marble or tiles or laying of white or grey floor (by the type of cement).
- Pigment or color requirements.
- Size of tiles or marbles.(Standard size of tile/marble is 1' x 1'. Other sizes available are 2'x2', 3'x3', 4'x4' and so on. Further bigger sizes are also available in the market. The per square foot cost of small tiles is less than the per sq.ft. cost of larger sized tiles.)
- Skirting Requirements. (Type , size)

Flooring



Skirting



Architectural work

- Borders.
- Brands of marble includes: Boticena, China Verona, Indian green, Ziarat white, Ziarat grey etc.
- Brands of tiles include (Master, Sonex, Forte, Emco)
- Majority of imported tiles comes from China however the best imported tiles are from Spain and France (costlier).
- For cemented floor or terrazzo floor or chips floor :the ratio of cement and sand.
- Floor with chips or without chips
- Floor with or without marble or glass strips .
- Grinding requirements of floor.
- Use of chemical polish (only for grinding floor) or wax polish.

Wood

- Detail specifications of wood include.

- Type of wood

- **Natural Wood**

- Teak(Tali)

- Shisham

- Diar(common)

- Partal(min cost)

- **Artificial wood**

Formica, Winboard.

Lasani wood, Malaysian wood

Plywood

Winboard, Chipboard.

- Treatment of wood. (Painting, Polishing and termite proofing).

- Hollow wood finishing frame or solid wood finishing frame.

Architectural Steel work:

Detail specifications of steel works include.

- Architectural steel is used for railing, doors, grills, stands etc. All architectural steel is in the form of sheet. The steel sheet of steel work is based on thickness which is represented by gauge. (Market : 24 gauge-No.6 Gauge (from lesser to larger thicknesses))
- Protection of steel sheet from corrosion or rusting through painting, oiling and greasing.
- Dimensions required of steel sheet in window, door and other installation.
- Punching and Impact value of steel.
- **Aluminum sheets are also used to avoid rust or corrosion.**

Painting:

Detail specifications of painting works includes:

- Types of paint includes (Distemper, Varnish, Oil paint, Emulsion, Water paint, Weather shield, Emulsion, Liquo paint, deco paint)
- Brand of paints (Berger, ICI, Black horse, Master)
- Solvent for Paints (oil based or water based)
- Pigment requirement of paints. (Are used to hide the surface imperfections and to impart the desired color. They protect the paint film by reflecting the destructive ultra violet light, which acts as a catalytic agent for the destructive oxidation of the film.)
- Surface preparation requirement.(Level the wall, Apply plaster of paint, do grinding, apply first layer of paint, small grinding again, apply 2nd coat of paint)

Plumbing, water supply and sewage work:

Detail specifications of plumbing, Water supply and sewage work includes:

- Source of water (WASA, Bore underground water, Water tank(storage))
- Gate valve requirement for pipes.
- Water supply requirements for pipes (Galvanized iron pipe, polypropylene pipe)
- Grades of pipes (High pressure grade(used in power plant), Low pressure grade(used in residential plant), Medium Pressure grade(used in tube-wells))
- Accessories of water supply system(Elbows, valves, bents, corks, tees, reducers)
- Protection of pipes against rusting and corrosion.(for galvanized iron pipes)
- Geyser Requirements (Types of geyser: Instageyser(wall mounted), traditional, solar)

Sewage work:

- Sewerage pipes can be of R.C.C or PVC or cast iron.
- Manhole requirement (bricks or concrete)
- Manhole covers.
- Storm water drain pipes (PVC or CI , clamped or unclamped)
- Septic tank requirements
- Connection of sewerage system of pipes.
- Surface protection of CI pipes.

Electrical works:

- Detail specifications of electrical works include.
 - Electric cable
 - Electric switch
 - Circuit breakers
 - Distribution boards
 - Lights, fans and AC requirements.
 - Electric conduit pipe etc
 - Earthing system

Mechanical Works

Detail specifications of Mechanical works include.

- Type of motor or pumps
- Capacity of motor or pump in terms of horsepower or kW
- Escalators.
- Electrical requirements for its running.
- Maintenance requirement

HVAC (heating ventilating and air conditioning)

Works:

- Capacity, brand and location for placement of HVAC system.
- Ducting requirement.