Plumbing installation

Level-II

Learning Guide-25

Unit of Competence: Read plans and calculate plumbing quantities

Module Title: Reading plans and calculating plumbing quantities

LG Code: EISPLI2 M07 LO1-LG-25

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LO1: Prepare for work

Instruction Sheet	Prepare for work – LG - 25

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying drawings ,specifications and standards for quantity calculations
- Adhering sanitary drawings, Safety ***(***OHS***)*** requirements and Workplace environment for calculating plumbing requirements***.***
- Identifying and adhering Quality assurance requirements
- Preparing Work area and to support the efficient reading of plans and the calculation of plumbing

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:

- Identify drawings ,specifications and standards for quantity calculations
- Adhere to sanitary drawings, Safety ***(***OHS***)*** requirements and Workplace environment for calculating plumbing requirements***.***
- Identify and adhering Quality assurance requirements
- Prepare Work area and to support the efficient reading of plans and the calculation of plumbing

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet.
6. Do the “LAP test” (if you are ready).

Information Sheet-1	Identifying drawings , specifications and standards for quantity calculations

1.1 Basic plumbing principles

Founding of Principles is founded upon basic principles which hold that public health, environmental sanitation, and safety can only be achieved through properly designed, acceptably installed, and adequately maintained plumbing systems.

- No. 1 Principle of All Occupied Premises Must Have Potable Water.

All habitable buildings must be provided with a supply of potable water. Such a water supply shall not be connected with unsafe or questionable water sources, nor shall it be subject to the hazards of backflow, backpressure, or back-siphonage.

- No. 2 Principle of Adequate Water Required.

Plumbing fixtures, devices, and appurtenances must be supplied with water in sufficient volume and at pressures adequate to enable them to function properly under normal conditions of use.

- No. 3 Principle of Hot Water Required.

Hot water must be supplied in all habitable buildings for plumbing fixtures which utilize hot water for sanitary or hygienic purposes.

- No. 4 Principle of Water Conservation.

Plumbing must be designed and installed to meet the water conservation requirements of while using the minimum quantity of water necessary to function properly under normal conditions of use.

- No. 5 Principle of Dangers of Explosion or Overheating.

Devices and appliances for heating and storing water must be so designed and installed as to guard against dangers from explosion or overheating.

- No. 6 Principle of Required Plumbing Fixtures.

a. To meet the basic prerequisites of sanitation and personal hygiene each dwelling shall include the following:

   ~ At least one toilet;

   ~ At least one lavatory;

   ~ At least one kitchen style sink;

   ~ At least one bathtub or shower compartment or shower unit;

   ~ Laundry Facility Requirements.

b. Plumbing fixtures must be constructed of durable, smooth, nonabsorbent, and corrosion resistant material and must be free of concealed fouling surfaces.

- No. 7 Principle of Protection of Drainage Systems.

The plumbing drainage system must be installed, designed, arranged, constructed, and maintained to protect against fouling, deposit of solids, and stoppages. Additionally, adequate cleanouts must be incorporated to ensure the system may be readily cleaned.

- No. 8 Principle of Durable Materials and Good Workmanship.

The piping and other components of the plumbing system must be manufactured of durable material, free from defective workmanship, and designed and constructed to provide satisfactory service for its reasonable expected life.

- No. 9 Principle of Need for Traps in the Plumbing Drainage System.

Every fixture directly connected to the drainage system must be equipped with a liquid-seal trap. The drainage and associated vent system must be designed to provide adequate circulation of air in and throughout all piping. Trap seals shall be protected

from the dangers of siphonage, leakage, aspiration, momentum, oscillation, back pressure, evaporation, and capillary action under conditions of normal ordinary use.

- No. 10 Principle of special Precautions for Oily and/or Flammable Liquid Wastes.

Oily and/or flammable liquid wastes pose a public health and safety danger if not properly disposed of. Accordingly, all commercial buildings and garages which are used to store or repair motor vehicles must have separators installed to ensure that all oil, grease, and other flammable wastes are discharged before emptying into the building drainage system or other point of disposal.

- No. 11 Principle of Need for Venting in the Plumbing System.

Vent terminals shall extend to the outer air above the roof line and be installed to prohibit the possibility of vent obstruction and the return of sewage gases into the building.

- No. 12 Principle of Plumbing Systems must Be Tested.

The plumbing system must be subjected to such tests as mandated by 248 CMR 10.00 to effectively disclose all leaks and defects in the work or the materials.

- No. 13 Principle of Harmful Substances must be excluded from the Plumbing System.

No substance that will cause or exacerbate clogs or stoppages in pipes, produce explosive mixtures, destroy the pipes or their joints, or interfere unduly with the sewage disposal process shall enter the sanitary drainage system. Special waste water discharges containing such hazards must be collected and disposed of or treated prior to entering the sanitary drainage system.

- No. 14 Principle of need for Indirect Waste Piping in the Plumbing Drainage System.

Indirect waste piping shall be provided to prevent backflow of sewage or the contamination of food, water, ice, sterile goods, and other similar products. When the

potential of a backflow of sewage event is possible, the fixture, device, or appliance shall be connected indirectly with the building sanitary or storm drainage system.

- No. 15 Principle of Light and Ventilation.

No toilets, urinals, bathtubs, or shower facilities shall be installed into a new or renovated room, space, or compartment that does not incorporate proper illumination and mechanical exhaust to the exterior of the building.

- No. 16 Principle of Need for Disposal of Sewage.

All habitable buildings must be provided with a means of disposing of sewage. If toilets or other plumbing fixtures are to be installed in buildings where there is no sewer within a reasonable distance, suitable provisions shall be made for disposing of the sewage.

- No. 17 Principal of Prevent Sewer Flooding.

Where a plumbing drainage system is subject to back-flow of sewage from the public sewer system suitable provision shall be incorporated to prevent the potential of overflow into the building.

- No. 18 Principle of Proper Maintenance.

Plumbing systems shall be maintained in a safe and serviceable condition from the standpoint of both mechanics and health.

- No. 19 Principle of Fixtures Shall Be Accessible.

All plumbing fixtures shall be installed in a manner with respect to clearances for spacing and accessibility for their intended use and cleansing.

- No. 20 Principle of Structural Integrity.

The performance of plumbing work shall not impact the structural integrity of building components

- No. 21 Principle of Protect Ground and Surface Water.

All discharges to ground or surface water must meet all local, state, and federal water quality discharge standards.

- No. 22 Principle of Piping and Treatment of Hazardous Wastes.

All waste discharge materials that may become detrimental to the health and welfare of the general public, that enter the sanitary drainage system of any building, shall be carried within hazardous waste piping systems. The hazardous waste shall be collected and disposed of or treated prior to entering the sanitary drainage system.

- No. 23 Principle of Need for Privacy.

In a room that accommodates more than one toilet, or that incorporates a urinal and a toilet, each toilet shall be enclosed and each urinal shall be side shielded for privacy.

- No. 24 Principle of Drinking Fountain.

Drinking fountains shall be installed in safe, clean, and hazard-free areas. The installation of a drinking fountain in a restroom that incorporates toilets or urinals is prohibited.

1.2 Plumbing drawing

1.1.1 Installation Drawings

In accordance with the provisions of this General Specification and as stated elsewhere in the Contract, the installation drawings must incorporate details of the actual plant and equipment items as approved by the Architect. Installation drawings are accurate representation of the Installations shall be fully dimensioned and suitably scaled showing construction, sizes, weights, arrangements, operating clearances and performance characteristics.

a. "Installation drawings" shall generally include, but not limited to, the following:-
   - Symbols and notations same as and compatible with the drawings' standard;
   - Complete layout/assemblies including all necessary minor items and accessories;
   - Positions of all fixings, hangers and supports;

- Maintenance spaces for all with drawable items, such as coils, heater elements, thermometers, thermostats, fan shafts and fan blowers, cleaning and replacement of tubes, removal of guards, etc.;
- Positions & sizes of all test holes, test pockets, thermostat pockets, thermometer pockets, bends and fittings, clearances to allow for the removal of inserted equipment where applicable;
- Outline of insulation and clearances to allow for application thereof;
- Outline of valve and similar insulation boxes and the clearances to be allowed for their removal thereof; and
- Lifting points and safe working weights of each item. Note: These may be shown on separate drawings, if necessary, to avoid confusion.

b. Pipe work Installation Drawings

Prior to the commencement of any manufacture, fabrication, or installation for technical appraisal installation drawings for the pipe work installation. Generally,

- The drawings shall be drawn to a scale of not less than 1:50. Subject to the Architect's approval a scale of 1:100 may be adopted where the installation is a simple one.
- The drawings shall indicate the location, with dimensions given, of all pipe work in relation to the building structure and other pipe work and equipment.
- The position of all valves, strainers, check valves, etc. shall be shown together with clearances necessary for removal of strainer baskets, internal parts of all valves, motors for motorized valves, solenoids, etc.
- Positions and details of all hangers and supports shall be shown and the positions dimensioned.
- Positions of thermostats, thermometers, test pockets and similar devices shall be shown and dimensioned including clearances required for their removal.
- Details and outline of insulation and insulation boxes shall be shown including clearances required for removal of the boxes.

c. Special Plant Rooms Co-ordination Work

Plant room where the equipment constitutes the major item involved (i.e. as in the case of pump room) for taking effective responsibility for the coordination of other services/building details within these specific areas. Where necessary, the foregoing

plant room co-ordination requirement shall include the preparation of plant room coordination drawings which involved in the plant room are to comply with.

1.2.2 Builder's Work Drawings

Drawings showing details of all builders' work required e.g. the weight and the load on each support of equipment. Such drawings shall clearly indicate the details and positions of all openings, trenches, ducts, drain and cutting required and construction details for plinths and equipment bases. Checking Drawings of Other Trades, The design intent of the Drawings in planning and carrying out the work and shall cross check with other trades in order to verify the line, level, space and sequence in which the Installations is to be installed.

1.2.3 **Manufacturer's Shop Drawings**

The manufacturer's shop drawings are drawings for equipment or plant to be manufactured by a specialist manufacturing supplier in their own workshops and places away from the Site. The drawings shall show detailed construction, principal dimensions, weights and clearances for maintenance, etc. No work shall proceed on or off Site unless drawings requiring approval are so approved in writing by the Architect.

1.2.4 As-built drawings

As built drawings are accurate representation of the Installations shall include, but not limited to the following:-

- Plumbing and drainage layout plans such as pipe arrangement, valve arrangement, sanitary fitments arrangement, etc.;
- System schematic diagrams; and
- Installation details and assembly drawings such as pipe work, sanitary fitments, etc.

"As-built" drawings shall complete with all details to be used for commissioning purposes. Any amendments noted on these drawings during the commissioning and test stage shall subsequently be transferred to the original "As-built" drawings once the amendments have been accepted by the Architect.

1.2.5 Framed Drawings

Provide and install in the relevant major plant room glass-framed, non-fading prints of the following:-

- Valve chart consisting of schematic diagrams showing the layouts and positions and identification of all valves with record of final settings/adjustment for regulating devices; and
- Plant room record drawings showing all plant items, pipe work and equipment.

Glazing shall be polished plate of not less than 6 mm thickness mounted in natural finish, extruded and anodized aluminum frames with the prints mounted on acid free mounting board and the whole backed with marine grade plywood not less than 8 mm thick.

1.3 Plumbing drawing specification

The specifications for different items of work are to be decided before the estimates are prepared and specifications are to be laid down with due regard to functional utility, safety, durability and aesthetics. The specifications, standard of construction and quality of materials depend on the type of structures, the life and the utility value. Richer the specifications, more is the estimated cost and therefore justifications for adopting richer specifications are to be laid down. For example:

- All contractors and subcontractors shall maintain (at the job site) and refer to copies of the written specifications as part of drawings. Refer to the written specifications in conjunction with the plans for full project scope. In all cases of discrepancy between plans and specifications, the more stringent requirements shall govern and where it is unclear, such cases shall be referred to the engineer for adjudication.

- The plumbing contractor shall review these plans and specifications, as well as the related HVACs, electrical, architectural, interior decor and site engineering drawings to become familiar with the full project scope. During the course of Construction coordination and actual construction, the plumbing contractor shall cooperate with all other contractors and trades on this project to ensure a smooth running and carefully coordinated installation.

- If any conditions arise that are not identified on drawings, immediate notification shall be provided to the Engineer or owner. No work shall proceed without approvals from engineer or Owner.

- Drawings are diagrammatic in nature and may have to be adapted to comply with existing building conditions. Contractor shall submit plumbing shop drawings, Indicating locations, and routing of ducts, piping, and wiring.

- Piping shown on drawings show the general run and connections and may or may not in all parts be shown in its exact position. Contractor shall be responsible for erecting the piping suitable in every respect for the work. Piping shall be installed so that access, clearance, headroom and pitch are maintained. Contractors of the various trades shall coordinate the installation.

1.3 Plumbing work Standards

Standards are sets of rules that outline specification of dimensions, design of operation, materials and performance, or describe quality of materials, products or systems. These standards should cover the performance expectations of the product for particular applications, as well as, in the case of drinking-water contact, the chemicals that may be leached from the product into the water. The intent of standards is to provide at least minimum quality, safety or performance specifications so as to ensure relatively uniform products and performance, and to remove ambiguity as to the suitability of certain commercial products for particular applications.

They reduce the risk of error by installers, and also provide assurance to the plumbing system owners. Standards also provide direction to manufacturers in respect to the expectations of the products that they produce.

Internationally accepted standards provide economies to both the manufacturer and the user by reducing the number of products of the same type that must be produced. Standards may be developed by industry, non-profit organizations or trade associations, as well as national or international bodies. The existence of credible standards and certifiers relieves the regulatory authority of the need to develop its own case-by-case standards and product assessment system.

Plumbing Codes generally:

- Protect health and safety of community
- Reduce potential for widespread disease
- Provide rules and regulations for installing drinking water or sewer facilities
- Identify required methods for installing plumbing systems
- Provide permits and inspections

Codes of practice attempt to minimize risk by specifying technical standards of design, materials, workmanship and maintenance for plumbing systems. The primary aims of a plumbing code of practice are to ensure the following:

- That planners, administrators and plumbers develop the required competency so these codes are respected and applied;
- That standards are set to ensure that plumbing assemblies, materials and technologies are safe and effective;
- That plumbing installations meet these standards;
- That plumbing installations are maintained to ensure continuous safety and effectiveness.

1.4.1 Plumbing drawing standard

Drawings accompanying estimates should be legible and clear. This should be prepared in a manner so that drawings are easily readable to save time and efforts. Drawing should comply with the following requirements:-

- Scale and size of the drawings should be properly selected according to the object to be shown/ drawn.
- Too many objects should not be incorporated in one sheet so that it becomes clumsy. Size and writing of the figures and letters should be proper and clear.

- Drawings should be made in standard sizes and when more than one drawing is required for one work; all the sheets in one set of drawings should preferably be of same size for easy handling at site.
- The notes should be very clear and explicit leaving no chance for misunderstanding or ambiguity.
- An arrow indicating north direction should be given for quick orientation of the drawing. Preferably the north direction should be towards the top of the sheet.
- Only standard symbols and abbreviations should be used.
- Drawings should be duly authenticated and all subsequent revisions should be recorded.
- Drawings should be numbered as per standard practice and documentation/ recording should be done.

1.4.2 Plumbing materials standard

Materials used in everyday plumbing work are required to meet minimum standards of performance. It is also important that there is standardisation for the sizes and dimensions of fittings and components. Imagine what it would be like if you could buy a range of 15 mm fittings that all had a slightly different internal diameter to the external diameter of a 15 mm pipe!

1.4.3 Plumbing measurement standard

A method of measurement:

- Provides a structure for the information that should make up the descriptions.
- Defines the unit of measurement for each item - m, m2, m3, number, tones, and so on.
- Provides rules as to what is included within each item.
- Defines the terms used to avoid disputes.

- Allows familiarity to develop, so measurement becomes easier and quicker.
- Provides a clear system for structuring other project information and cross-referencing specification information with bill of quantity information.

There are two main systems of measurements:

a. Metric system (SI = System International)

The SI was developed in 1960 from the old meter-kilogram-second system, rather than the centimeter-gram-second system, which, in turn, had a few variants. International System of Units (abbreviated SI from the French le Système International d'unités) is the modern form of the metric system and is generally a system devised around seven base units(i.e. meter, kilogram, second, ampere, kelvin, candela, and mole) and the convenience of the number ten. It is the world's most widely used system of measurement, both in everyday commerce and in science. The older metric system included several groups of units. Because the SI is not static, units are created and a definition is modified through international agreement among many nations as the technology of measurement progresses, and as the precision of measurements improves. Metric unit system is easy to handle because everything is a multiple or a fraction of ten.

Name/unit	Unit symbol	Quantity	Symbol
Meter	M	Length	l
Kilogram	Kg	Mass	m
Second	S	Time	t
Ampere	A	Electric current	I
Kelvin	K	Thermodynamic temperature	T
Candela	Cd	Luminous intensity	Iv
Mole	Mol	Amount of substance	n

Table - The Seven SI base Units

b. British (Imperial) system

The imperial system is one of many systems of English or foot-pound-second units, so named because of the base units of length, mass and time. Although most of the units are defined in more than one system, some subsidiary units were used to a much greater extent, or for different purposes, in one area rather than the other.

SI Units of different Units of measurement;

a. The unit of length is the base unit meter (m)

- 1 Decameter = 10^{1}m = 1dam
- 1 Hectometer = 10^{2}m = 1hm
- 1 Kilometer = 10^{3}m = 1km
- 1 Mega meter = 10^{6}m = 1Mm
- 1 Giga meter = 10^{9}m = 1Gm
- 1 Tetrameter = 10^{12}m = 1Tm
- 1 Decimeter = 10^{-1}m = 1dm
- 1 centimeter = 10^{-2}m = 1cm
- 1 Millimeter = 10^{-3}m = 1mn
- 1 micrometer = 10^{-6}m = 1Mm
- 1 Nano meter = 10^{-9}m = 1nm
- 1 Pico meter = 10^{-12}m = 1pm

b. The SI unit for area, is the derived units meter square

- 1 hectare = $10^{4}m^{2}$ = 100 X 100 m = 1 ha
- 1 square kilometer = 10^{6} m^{2} = 1000m X 1000m = $1km^{2}$ = 100 ha

c. The SI unit for volume is the derived unit cubic meter (m^{3})

- 1000 Cu millimeter = 1 cubic centimeter meter
- 1000 Cu centimeter = 1 cubic decimeter
- 1000 Cu decimeters = 1 cubic meter

1.5 Conversion of Units

We can convert measurements from one unit to another unit within the same system (English or Metric) or between the two systems. To convert measurements, it is necessary to know conversion factors between measurements. A conversion factor is a clever way of writing 1 as a fraction in which the numerator is equal to the denominator but the numerator and the denominator have different units.

a. .....Conversion of length

- 1 inch = 2.54 cm
- 1 foot = 0.30 48m
- 1mile = 1.6093 km

b. .....Conversion of area

- 1 sq. in = 6.4516 sq.cm
- 1 sq. Ft = 0.0929 sq. cm
- 1 sq. mile = 2.59 sq. km

c. Conversion of volume

- 1 cu. In = 16.387 cu.cm
- 1cu ft = 0.0283

Self-Check - 1	Written Test

Directions: Match the construction element with its related job description for all the questions listed below. Use the Answer sheet provided in this page.

1. You only really need either Drawings or Specifications; not both.
   A. True B. False C. Not both

2. All information is always shown on the drawings.
   A. True B. False C. Not both

3. All drawings are done to the same scale.
   A. True B. False C. Not both
4. Building codes were written to ensure protection of property and life.
   A. True B. False C. Not both

Note: **Satisfactory rating - 2 and 4 points** **Unsatisfactory - below 2 and 4 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Name: _____ **Date:** _____

Answer sheet

1. _____ **2.** _____ **3.** _____ **4.** _____

Information Sheet- 2	Adhering sanitary drawings, Safety ***(***OHS***)*** requirements and Workplace environment for calculating plumbing requirements***.***

2.1 Sanitary drawing requirement

- Elevation of storm and sanitary sewers to determine that gravity flow is feasible or if lift stations are needed. Determine that storm and sanitary drain pipes do not conflict. Consider backwater valves where appropriate.

- Utility regulations and provide water-service requirements. Provide an approved back flow preventer where required.

- Fire protection standards and local requirements, including class of standpipes and classification of occupancy. Determine water demand, including flow at required residual pressure. Provide service with an approved back flow preventer or other approved cross-connection control. Select wet, dry, or anti-freeze type sprinkler system. Special extinguishing systems may be required.

- Coordinate fire department connection location and fire hydrant requirements with the architect, site civil engineer, and landscape designer.

- The code-minimum rainfall rate and whether a higher rate should be considered. Size roof drains, conductors, and storm drain accordingly. Review secondary drainage requirements and coordinate them with the architect.

- Determine size and extent of subsoil drainage based on soils report and wall structural requirements.

- Send electrical-control and power requirements of plumbing and fire-protection equipment to the electrical engineer. These requirements may include pumps, air compressors, water heaters, water coolers, heat tracing, solenoids, high-water

alarms, medical gas alarms and manifolds, fire sprinkler switches, and fire-alarm bells. Among various pumps consider fi re pumps, domestic boosters, circulation pumps, vacuum pumps, sump pumps, and sewage ejectors.

- Storm-water management issues. Clear water disposal restrictions.

- Hot-water-demand requirements. Select and size water heater, mixing valve, and circulation pump. Provide hot water system with a circulating return unless the distance between the heater and the farthest fixture is relatively short.

- Water treatment requirements. Select and size treatment equipment for anticipated occupancy demand and client preferences.
- Selection of pipe material for each part of the plumbing system from supply systems to drain systems. Consider purity requirements, corrosion issues, fluid temperature, fluid pressure, joining methods, hanger spacing, code issues, and physical protection.
- Coordinate drawing details with specifications.
- Pipe insulation requirements thermally and acoustically.
- Noise and vibration considerations of piping systems and plumbing equipment. Review water-hammer requirements.
- Review noise concerns from rotary vacuum pumps and similar equipment.
- Consider building expansion requirements and design concerns that affect tenant occupancy changes. Coordinate plumbing-system locations with architect.
- Arrange plumbing piping logically while considering obstructions, occupancy restrictions, accessibility, control, future expansion, designer's preferences, other building systems, existing or new, and economics. In general, run piping clear of structural beams. Where necessary, in consultation with the structural engineer, penetrate through the web of steel beams and the middle third of wood or concrete beams. Keep piping out of elevator shafts, electric and data communication rooms, similar restricted rooms, as well as stairs and exit discharge corridors. Size piping for required supply and drainage fixture units.
- Provide pipe expansion loops or expansion joints where required.

- Provide valves on distribution branches, on branches off supply risers, and at the base of supply risers. Provide drain valves with hose threads at the base of risers and in the low portions of piping.
- Provide hose bibs around the building. Select frost-proof hose bibs if required. Review landscape Irrigation connection point where required. Confirm if hose bibs are to be key-operated.
- Note piping elevation changes on plans. Pipes rising within a story should be noted as “rise”. Pipes rising to another story should be noted as “up”. Pipes dropping to another story should be noted as “down”. Pipes at ceiling should be noted as “at ceiling” when exposed and “above ceiling” when concealed. Pipes under the floor, other than obvious fixture drain pipes, should be noted as “below floor,” “at ceiling below,” or “above ceiling below.”
- Review and coordinate water supply connection and drain requirements for:

- Back flow preventers (adequate drain for relief port)
- Beverage machines
- Boilers
- Chillers
- Compressors
- Cooling towers
- Cooling coils
- Emergency eyewash/shower
- Fire sprinklers and fi re pumps
- Food service areas, including dishwashers, walk-in refrigerators and freezers, steam kettles, scullery sinks
- High efficiency burners
- Humidifiers
- Ice machines
- Laboratory equipment
- Laundry
- Pressure relief valves (drain only)
- Sterilizers
- Vacuum pumps
- Other equipment

2.2 Safety (OHS) and Workplace environment for calculating plumbing requirements

2.2.1 Safety requirements

Health and Safety safe work practices and procedures, and creating an understanding of what is required for a healthy work environment, are absolutely essential. The following is help to establish a safe environment:

- Recognize safety equipment
- Follow established rules and routines
- Recognize hazards in work areas.

2.2.2 Environmental requirement

a. The nature of the work

To understand the nature of the work activities and the type of hazards involved, the Following questions should be considered:

- Does the work involve exposure to infectious material or contaminants? If so, workers may need access to shower facilities before they leave the workplace.
- Do workers need to change out of their clothes? If so, they may need change rooms and appropriate personal storage.
- Is the work mostly conducted standing or seated? If so, floor coverings and seats should be considered.
- Is the work sedentary or physically active? If so, this may affect the ideal comfortable air temperature.
- Is the work done in shifts? If so, cleaning and maintenance schedules may need to take into account the times when the facilities are used.

Workers undertaking different work within the same workplace may also have different Requirements for facilities depending on the work they do and the equipment they use.

b.Maintaining the work environment and facilities

The work environment should be maintained so that it remains in a clean and safe condition. Broken or damaged furniture, fixtures and fittings, including chairs, plumbing, air conditioning and lighting should be repaired promptly.

Facilities should be clean, safe, accessible and in good working order. Consumable items, including soap and toilet paper, should be replenished regularly. Equipment and furniture such as toasters, fridges, lockers or seating should be maintained in good working order.

Workplaces and facilities should be cleaned regularly, usually on a daily or weekly basis. The cleaning schedule of facilities such as dining areas, toilets, hand basins and showers should take into account shift work, the type of work performed, the likelihood of contamination and the number of workers using them.

c. Regulation for work environment

A plumber undertaking plumbing work must ensure, so far as is reasonably practicable, that:

- The layout of the workplace allows, and is maintained to allow, persons to enter and exit the workplace and move within it safely, both under normal working conditions and in an emergency
- Work areas have space for work to be carried out safely
- Floors and other surfaces are designed, installed and maintained to allow work to be carried out safely
- Lighting enables each worker to carry out work safely, persons to move around safely and safe evacuation in an emergency
- Ventilation enables workers to carry out their work without risk to their health and safety
- Workers exposed to extremes of heat or cold are able to carry out work without risk to their health and safety
- Work in relation to or near essential services (such as gas, electricity, water, sewerage and telecommunications) do not affect the health and safety of persons at the workplace.

Self-Check - 2	Written Test

Directions: Match the construction element with its related job description for all the questions listed below. Use the Answer sheet provided in this page.

1. Not include in hot-water-demand requirements.

   A. Size water heater B. Mixing valve C. Circulation pump D. None

2. A water-hammer requirement is noise and vibration considerations of piping systems and plumbing equipment in drawing.

   A. True B. False C. Not both

3. Which is not establish a safe environment:

A. Recognize safety equipment B. Follow established rules and routines

B. Recognize hazards in work areas D. Negligence

4. Pipe insulation requirements mechanical, thermally and acoustically

   A. False B. True C. Not both

Note: **Satisfactory rating - 2 and 4 points** **Unsatisfactory - below 2 and 4 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Name: _____ **Date:** _____

Answer sheet

1. _____ **2.** _____ **3.** _____ **4.** _____

Information Sheet- 3	Identifying and adhering Quality assurance requirements

3.1 Quality assurance

Quality assurance encompasses all the measures that are necessary to achieve the quality of a product. Specifically for Civil Engineering construction it implies that there are standards of construction for all works which must be achieved. Knowledge/consciousness about quality is therefore the first pre requisite of quality assurance. Various aspects of civil engineering constructions are must be followed for quality assurance.

- To start with specifications covering materials and workmanships should be clearly drawn and laid down as per Codes.
- Drawings should support the specifications in the form of notes, sketches etc. as far as practicable.
- Workmanship should be similarly covered to the possible extent in the form of acceptable limits of tolerance for any work.

The well designed quality assurance system will provide confidence that the project outputs will fulfill all the requirements for which it is being planned. The quality assurance system should have the following basic parameters.

- Site documents
- Mandatory and optional testing
- Availability of field and departmental laboratories
- Manufacturing test certificates
- Departmental team inspections
- Checklist guide for works
- Site inspections

- Post quality testing of finished works
- Quality certification
- Monthly reporting and review meetings

Quality assurance has two important aspects:

- Preventive aspect.

The preventive aspect should consist of an organized Quality Control program with clear standards and guidelines so that everyone knows exactly what he is responsible for.

- Corrective aspect.

The corrective aspect is basically based on the complaints and Corrective Quality assurance therefore includes taking immediate action to correct flaws, dealing with whatever other problems they may have caused and putting things back normal. Steps must also be taken to see that the same trouble does not recur.
For plumbing quality assurance is a major strategy for risk minimization in the supply of water and disposal of wastewater. A major component of quality assurance programs in plumbing is the use of codes of good practice that specify the requirements to be met to assure conformance with norms. These codes are usually supported by legislation or by local government regulations and are therefore referred to as codes of practice or mandatory codes of practice.

Record accuracy and maintains copies of all quality-related documentation. This includes, but may not be limited to:

- Daily construction QA logs and records;
- Inspection checklists and reports;
- Surveillance reports;
- Non-conformance reports;

- Material receiving reports; and
- Monitoring and test data.

These records will be stored in files maintained in the project document control files. All original documents pertaining to project information will be maintained in the project file located at the project office. All records shall be available for inspection and audit, at any time

Self-Check - 3	Written Test

Directions: Match the construction element with its related job description for all the questions listed below. Use the Answer sheet provided in this page.

1. Plumbing quality assurance system includes Civil engineering work.
   A. True B. False C. Not both

2. All original documents should be located at the project office.
   A. False B. True C. Not both

3. Corrective aspect of quality Control program is that everyone knows exactly what responsible for.
   A. False B. True C. Not both

4. The specifications should support drawings in the form of notes, sketches etc. as far as practicable.
   A. True B. False C. Not both

Note: **Satisfactory rating - 3 and 4 points** **Unsatisfactory - below 3 and 4 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Answer sheet

Name: _____ Date: _____

Short Answer Questions

Information Sheet- 4	Preparing Work area and to support the efficient reading of plans and the calculation of plumbing

4.1 Preparing Work area

- Identify relevant codes and standards (EBCS 9), including local amendments and date of issue. Relevant issues include:
  - Energy and water conservation
  - Hot-water production and maintenance
  - Cross-connection control
  - Interceptors
  - Clearwater disposal
  - Fuel gas code
  - Rainfall rates
  - drainage
  - Storm-water management
  - Fire sprinklers and standpipes (occupancy class)
  - Medical gases and other healthcare matters

- Contact the plumbing code official and fire protection authority having jurisdiction.
- Contact water, sewer, and gas utilities, and establish connection requirements.
- Identify phasing issues and whether there will be concurrent occupancy.
- Review survey and other documents for size, location, and depth of sanitary and storm sewers, water mains, and gas mains. Work with civil engineer as well.

- Obtain water flow and pressure data (static and residual) at given elevation. Determine if a fire pump and a domestic booster pump are required. Select and size pumps as required.

- For building alteration or addition, check if existing plumbing services, distribution, and equipment are adequate (capacity and life of systems or equipment), including water heaters, water-treatment equipment, pumps, compressors, water meter, backflow preventers, and interceptors.

- Identify the energy source: gas, electric, steam, hydronic.

- Determine if water treatment is required. Obtain water-quality analysis.

- Determine if there are unusual occupancy related plumbing requirements.

- Within the limits of the code, determine the architect's preferred method of cleanout design.

- Establish and coordinate electrical voltages and phases for motors and controls with the electrical engineer.

- Determine the need for other systems, such as compressed air, vacuum, deionized water, acid waste, fuel oil, and steam.

- Review the cost estimate and time estimate against recent project developments.

4.2 Duties and responsibilities of estimating officer/ estimator

- He will prepare/ update schedule of rates including analysis of rates.

- He is responsible for the following in respect of the office, he is attached to :

  - Preparation and revision of standard estimates, checking of estimates/ revised estimates received from projects/ areas/ units/ HQ unit and processing the same for sanction

  - Action for call of tenders, preparation and sale of tender documents

- Scrutiny of tenders received and preparation of comparative statement and placing the same before Tender Committee, preparation of work order etc.

- Preparation of bill of quantities for the agreements, preparation/ scrutiny of draft agreements.

- Responsible for proper accountal & recording of various documents such as tender documents, drawings and other papers. He will maintain the following registers as far as practicable:-

  - Register of standard estimates/revision thereof.
  - Register of other estimates/revision thereof.
  - Register of tender documents prepared & sold.
  - Register for tender opening.
  - Register of accounts for "Application form for registration of contractors".
  - Register of applications received regarding registration of contractors.
  - Register of approved suppliers/manufacturers.
  - Register regarding performance of contractors.
  - Register of contractors registered under different contracts.

- He should assist in arbitration and other cases pertaining to the department.

- He should scrutinise claims, rate analysis etc.

- He is responsible for collection and compilation of different statistics of buildings, roads etc.

Directions:	Self-Check - 4	Written Test

Match the construction element with its related job description for all the questions listed below. Use the Answer sheet provided in this page.

1. Ethiopian relevant codes and standards on plumbing work is:

   A. EBCS 2 B. EBCS 1 C. EBCS 9 D. EBCS 6

2. Duty and responsibility of estimator in the preparation of work area are/is

   A. Accounting & recording of various documents B. assist in arbitration
   C.Preparation of bill of quantities D. All

3. Estimator review the cost estimate and time estimate against recent project developments.

   A. False B. True C. Not both

4. Not relevant for preparation of plumbing work area

   A. Energy and water conservation B. Cross-connection control

   C, Medical gases and other healthcare matters D. None

Note: **Satisfactory rating - 2 and 4 points** **Unsatisfactory - below 2 and 4 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____ 2. _____ 3. _____ 4. _____

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary sanitary drawing, templates, tools and materials you are required to perform the following tasks within 4 hours.

Task 1: Identify specifications and standards used in this sanitary drawing for quantity calculations.

Task 2: Identify adhered requirements of Safety ***(***OHS***)*** and workplace environment of this sanitary drawing for calculating plumbing work***.***

Task 3: Identify and adhering Quality assurance requirements for this drawing.

Task 4: Prepare Work area for reading of selected drawing and the calculation of plumbing work.

List of Reference Materials

- Seeley IH. (1998). *Building Quantities Explained* 5th Revised edition, Macmillan ISBN 978-0-333-71972-5
- Seeley IH. (1997). *Quantity Surveying Practice*, 2nd Revised Macmillan; ISBN 978-0-333-68907-3
- Lee S. Trench W. Willis A. (2005) *Elements of Quantity Surveying*. 10th Edition WileyBlackwell; ISBN 978-1-4051-2563-5
- Ashworth A. Hogg K. (2007). *Willis's Elements of Quantity Surveying* 12 Rev Ed edition Blackwell Publishing. ISBN 978-1-4051-4578-7
- OHS Insider | www.ohsinsider.com
- Clean and maintain industrial work area and equipment , D1.HHK.CL3.07 , Trainee Manual

No	Name of trainer	Qualification	Region	E-mail
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