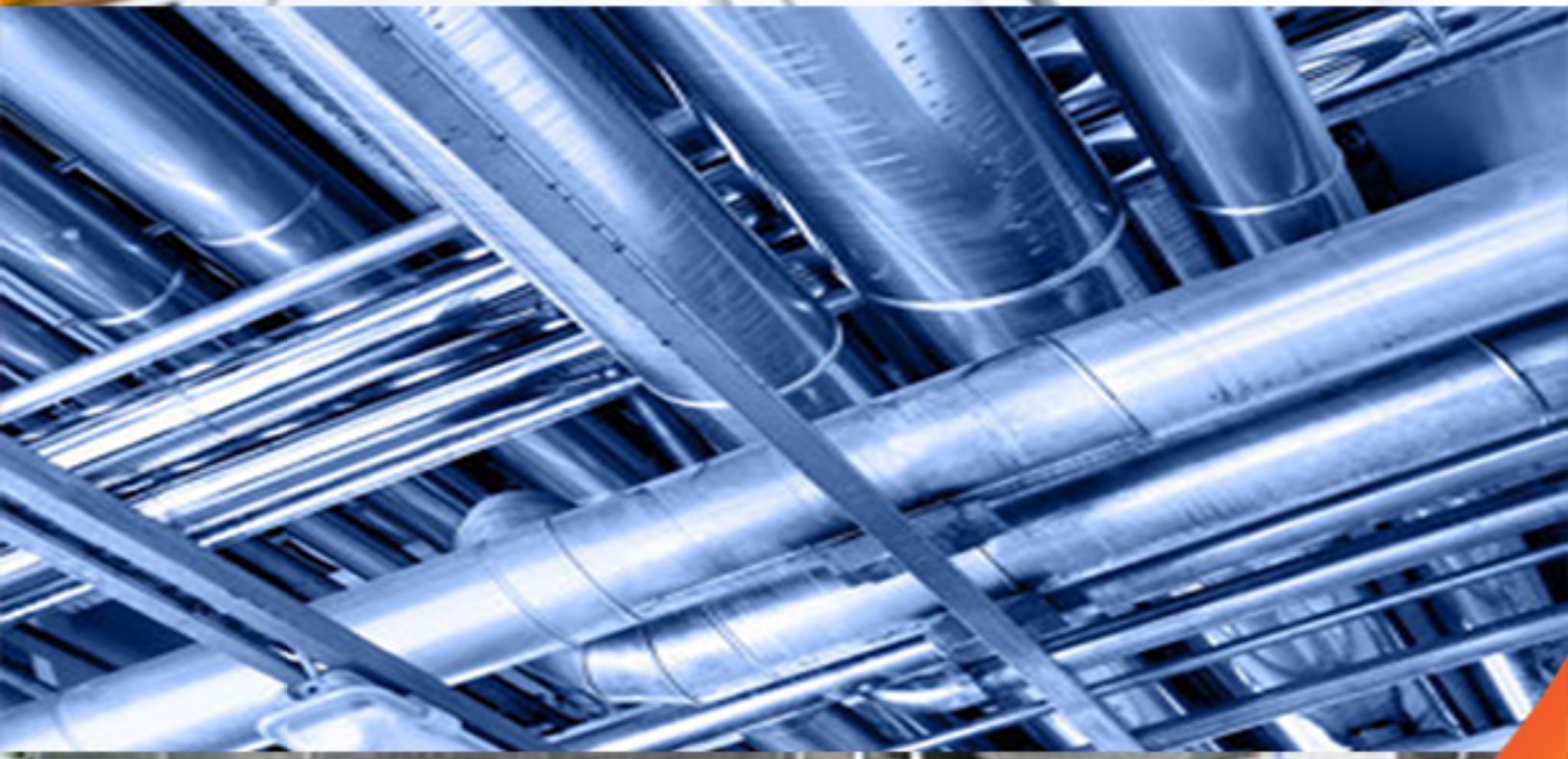
MEP Guide for Planning and Scheduling



PLANNING ENGINEER

Contents

Preface

PlanningEngineer.net is an online project management website, we are a PM Office online simulation aiming to share knowledge, books, several courses as well as online consultancy.

One-size fits all, does not work to project management. You need to learn how to create your own plans as per project conditions and requirements. We share new courses, ideas, approaches, and techniques, which help to increase your project management knowledge to be able to create your own project management plans.

So, All what you may need for enhancing the perfect planning career, you will find it with us, our members is our riches so we work in accordance with your needs and requirements to fit our services to benefit you.

This E-Book was the idea of Eng. Hany Ismael, He is a Civil Engineer BSc, Project Management Professional certified PMP, MSc student at Liverpool University, involved in construction projects since 11 years, and working as a Planning Manager. He likes to share Project Management Information and follow the rabid update of Project Management Tools such as Primavera and Excel.

It was prepared by Eng. Meghdad Hajipour, An experienced SMPE project engineer with strong exposure across end to end project engineering both critical and non-critical portfolios, programs and projects covering all project lifecycle from designing into QA/QC, construction, commissioning and hand over, It was Reviewed and Edited by Eng. Yasmeen Sultan, a Civil Engineer BSc with Four years' experience of Project Management Business Development, for our esteemed members, the book is named " MEP Guide for Planning and Scheduling", Planning career is not a preserve for a specific engineering disciplines, actually any engineer will need planning and scheduling in managing his project.

To make it easier for you, our E-Book will illustrate the planning and the time frame for MEP installations processes. So our book is divided in to 9 chapters which will cover the following topics:

1. Equipment
2. Conveying Systems
3. Fire Suppressions
4. Plumbing
5. Heating Ventilation and Air conditioning
6. Integrated Automation
7. Electrical
8. Electronic Safety and Security
9. Electronic Surveillance

Introduction

Before commencement of any project, the first thing that we need to do is project planning. Any project manager understands importance of planning a project well. Planning and scheduling are the main gear all organizations, Every organization that delivers something, a product or a service, has production requirements and must have the capability to succeed.

Most of Engineers believe that planning is for specific engineering disciplines construction projects, however As Architect, Civil and MEP are the three gears of most Projects, we will be explaining herein by how to plan and put your roper schedule for MEP works, MEP Engineer is a single-level professional classification responsible for planning and design in the areas of mechanical, electrical, and plumbing (MEP) systems including developing polices, standards, inspection procedures, and evaluation tools for MEP matters.

The MEP planning career includes so many duties, such as create master schedule for the execution of the project, Prepare schedule plans to manage mechanical/electrical/plumbing (MEP) work of project, Plan for resource deployment and cash flow to be made available during the project's entire execution phase and Monitor project status for purposes of management and billing information, so we here introduce our EBook to assist all Planning Engineers in their work and career.

Chapter 1: Division 11 - Equipment

1.1. Vehicle and Pedestrian Equipment

1.1.1. Wheel Stops Installation

Wheel stops are typically used to limit Curb overhang which is inconvenient or hazardous for pedestrians, inhibit contact with an end barrier or high Curb and Inhibit encroachment into an opposing parking space.

Figure 1: Wheel Stop General

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Placement and Bolting

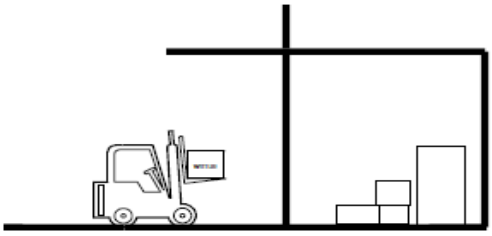


Figure 2: Equipment Storage

MHr/Item	Estimated Hours
Plumber	1
Assistant	1

b) Placement and Bolting: Wheel stops shall be installed in the floor with long bolts. Longer wheel stops may require additional bolts.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Cleaning and using

Figure 3: Bolting to floor

MHr/Item	Estimated Hours
Plumber	1
Assistant	1

1.1.2. Pedestrian barrier/turnstile Card/ticket operated

They Are forms of gates which allows one person to pass at a time and provide safety for pedestrians.

Figure 4: Card/Ticket Pedestrian turnstile

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received materials should be checked against approved lists for any abnormalities
- **Successor activities:**
  Wiring

MHr/Item	Estimated Hours
Electrician	-
Plumber	1
Assistant	1

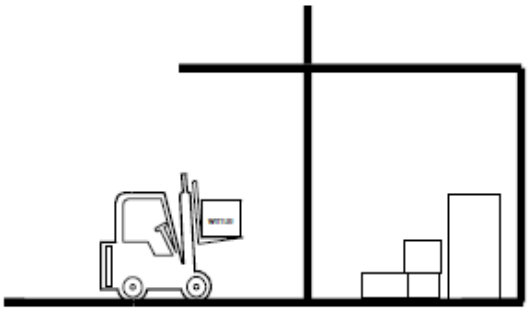


Figure 5: Equipment Storage

b) Wiring: Power cables shall be installed inside the equipment to feed the component.

- **Predecessor activities:**
  Material storage
- **Successor activities:**
  Arrangement and installation

MHr/10meter	Estimated Hours
Electrician	2
Plumber	
Assistant	2

c) Arrangement and installation: equipment components such as rotor and shall be disassembled for installation. After installing of equipment, rotor shall be gently fasten.

- **Predecessor activities:**
  Wiring
- **Successor activities:**
  Ground installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

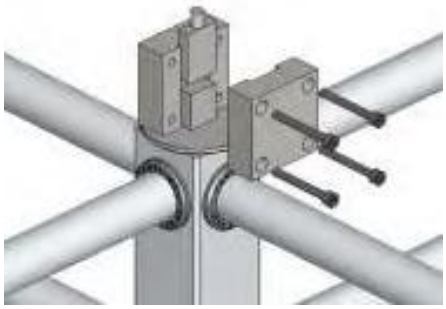


Figure 6: Rotor disassembly

d) Ground Installation: The Equipment shall be placed in drilled holes and holes shall be filled by chemical blended epoxy and mounting rods.

- **Predecessor activities:**
  Arrangement and installation
- **Successor activities:**
  Electric connection and start-up

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

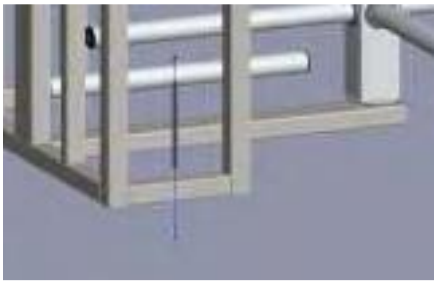


Figure 7: Ground Installation

e) Electric connection and start-up: Power cables shall be connected to the power supply.

- **Predecessor activities:**
  Ground installation
- **Successor activities:**
  Cleaning and usage

MHr/Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

Figure 8: Power board

1.2. Food Service Equipment

Supply and install the following equipment including mixers, traps, flexible, pipes, and pipe connections until wall outlets and inlets regarding the mechanical. Cables, wires, electrical connections until isolating switches, socket outlets and wall outlets, and all associated fittings and accessories complete as per drawings.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Placement and usage

MHr/Item	Estimated Hours
Electrician	1
Plumber	1
Assistant	2

1.3. Kitchen and Pantry Equipment

Main kitchen equipment, Café bar equipment and restaurant equipment and all associated fittings and accessories complete as per drawings.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Placement and usage

Figure 9: Food, Kitchen and pantry

MHr/Item	Estimated Hours
Electrician	1
Plumber	1
Assistant	1

1.4. Entertainment Equipment

Bespoke equipment and auditorium dais are entertaining equipment which shall be installed inside or outside the auditorium.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Placement and usage

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 10: Entertainment Equipment

Chapter 2: Division 14 - Conveying Systems

2.1. Lift Installation

Passenger parking elevator, Service elevator, VIP elevator, Monorail elevator, Exterior WADI elevator

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  The Material shall be distributed to the different floors in the building when required for their assembly

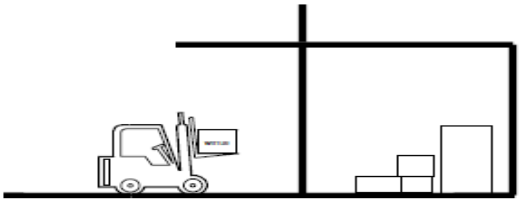


Figure 11: Equipment Storage

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

b) Assembly of guide rails: Guide rails are vertical steel foundation where the lift components such as counterweight and machine room will be installed against them.

- **Predecessor activities:**
  Concrete pit and fixing-plates
- **Successor activities**
  Counterweight installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

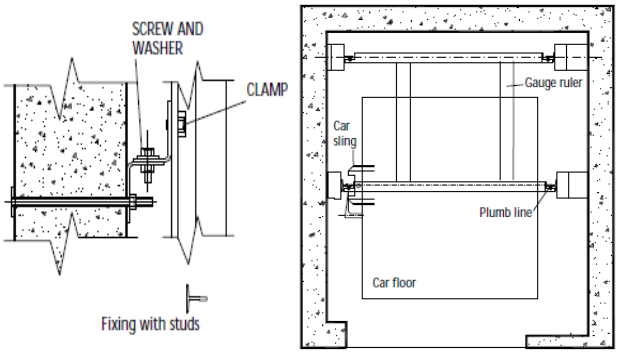


Figure 12: Rail

c) Counterweight Installation: The counterweight is basically made up of a metal frame into which filler weights are inserted.

- **Predecessor activities:**
  Guide rails installed and fixed inside the pit
- **Successor activities**
  Drive Unit installation inside machine room

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

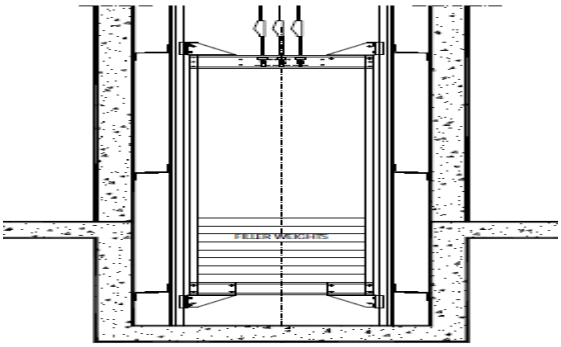


Figure 13: Counterweight Assembly

d) Installation of drive unit inside machine room: The drive unit produces the power for lift movement and is set overhead in the lift enclosure, and is laid on the machine room floor onto a bedplate which is insulated by silent blocks.

- **Predecessor activities:**
  Counterweight Installation
- **Successor activities:**
  Installation of hoisting ropes

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

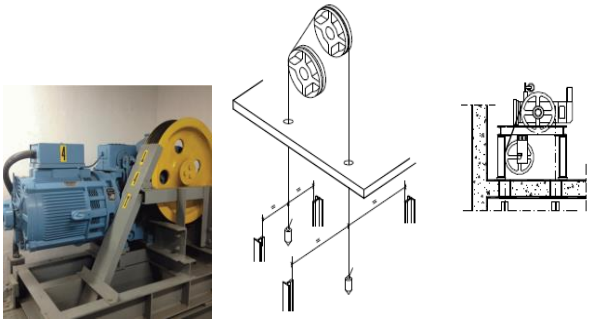


Figure 14: Drive unit inside the

e) Installation of hoisting Ropes: Hoisting ropes are steel cord ropes which connect the counterweight to floor and floor to drive unit in order to transfer the safe tension between mentioned parts of the lift.

- **Predecessor activities:**
  Drive unit installation
- **Successor activities:**
  Installation of over speed governor

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

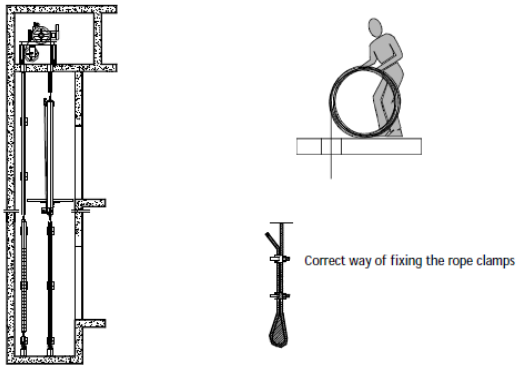


Figure 15: Hoisting

f) Installation of Over Speed Governor: Over Speed governor in a mechanical controller to limit the speed in order to keep the speed in the designed range.

- **Predecessor activities:**
  Hoisting Rope installation
- **Successor activities:**
  Buffer Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

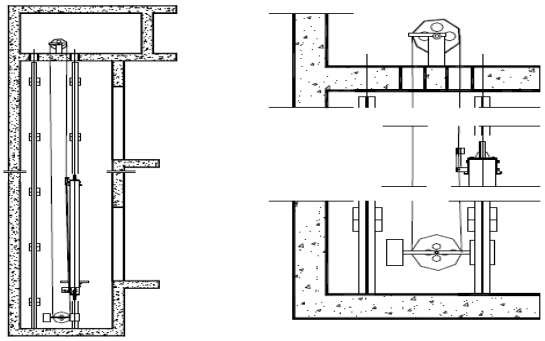


Figure 16: Over Speed

g) Installation of Buffers: Buffers are a mechanical set of springs and steel supports placed in the bottom of pit to maintain the lift safely regarding any failure in hoisting ropes or other parts of lift.

- **Predecessor activities:**
  Over Speed Governor Installation
- **Successor activities:**
  Installation of Swing and sliding landing doors

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

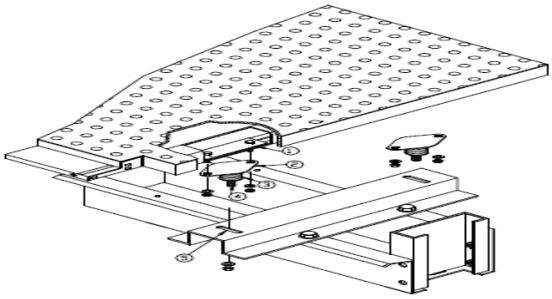


Figure 17: Car and weighing load system

h) Installation of sewing and sliding landing doors: Set of doors need to be installed to enter and exit.

- **Predecessor activities:**
  Buffer Installation
- **Successor activities:**
  Installation of Car and load weighing systems

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

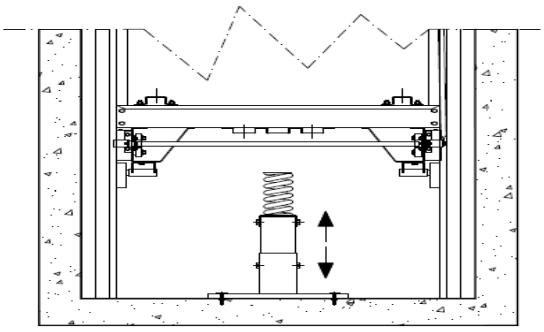


Figure 18: Buffer

i) Installation of Car and load weighing System: Car assembly is actually the room where passengers stand in and weighing system is a mechanical set of loads to be installed with car body to keep the tension in range.

- **Predecessor activities:**
  Sliding and sewing doors
- **Successor activities:**
  Installation of protection screen in the pit

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

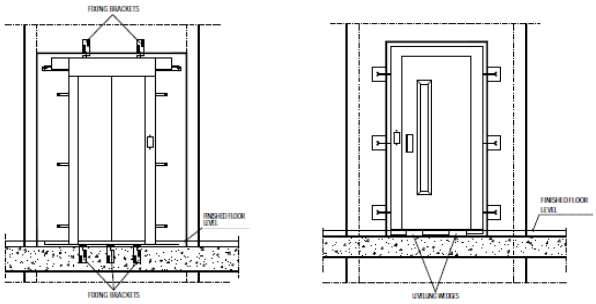


Figure 19: Sliding Door / Sewing Door

j) Installation of protection screen in the pit: Travelling area of counterweight shall be guarded by means of a rigid screen at pit level.

- **Predecessor activities:**
  Car and weighing load installation
- **Successor activities:**
  Electric wiring

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

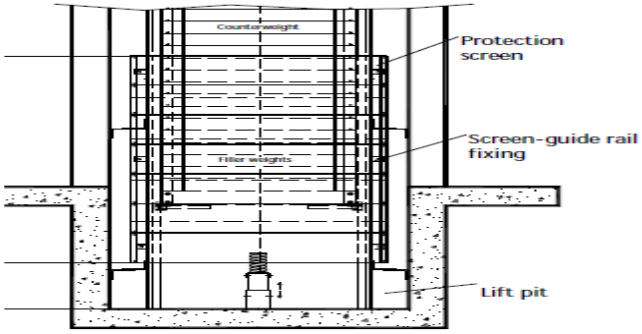


Figure 20: Protection Screen

k) Electric Wiring: Electric controller wiring system is used to control the movement, temperature and generally everything inside and outside the car lift.

- **Predecessor activities:**
  Protection Screen installation
- **Successor activities:**
  Final Adjustment

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

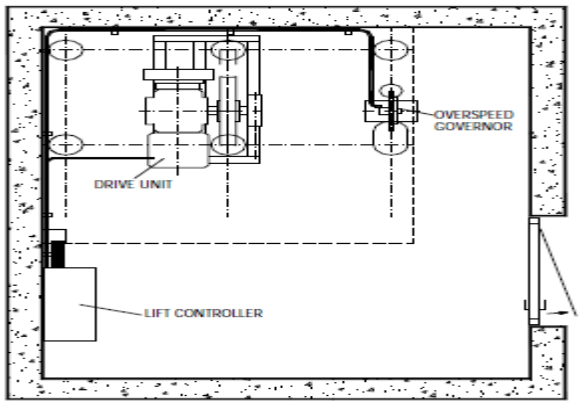


Figure 21: Electric Wiring

l) Final Adjustment: After having carried out all the electric wiring, whole the lift assembly should be cleaned and safety limit switches, buffers, controllers, doors and drive unit should be checked.

- **Predecessor activities:**
  Electric wiring
- **Successor activities:**
  Commissioning and Start-up

MHr/Item	Estimated Hours
Electrician	1
Plumber	1
Assistant	2

2.1.1. Auditorium platform lift, VIP platform lift, Dock platform lift

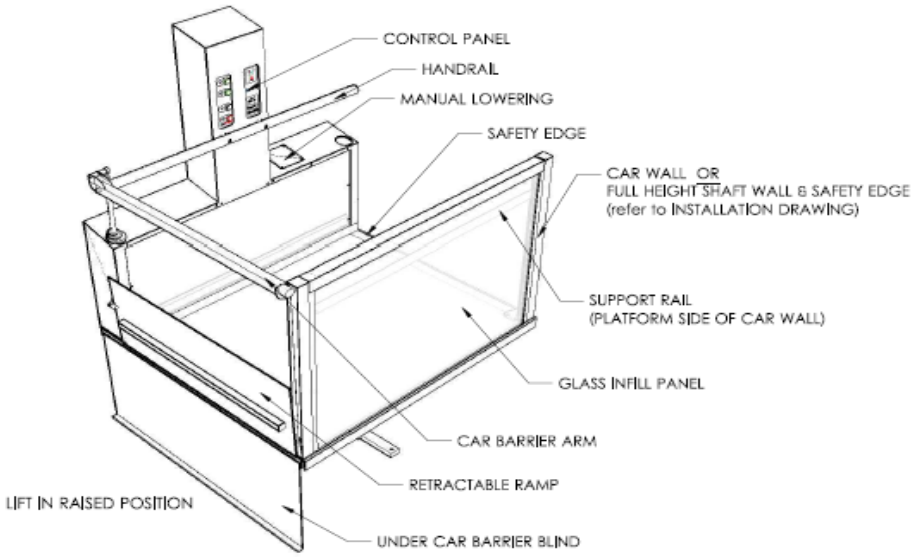


Figure 22: Platform Lift General

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities.
- **Successor activities:**
  Building Concrete pad or steel Structure installed

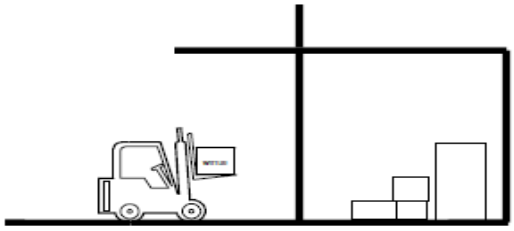


Figure 23: Equipment Storage

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

b) Assembly of guide rails: Guide rails are vertical steel foundation normally L-Beams where following platform lift components such as platform and machine room will be installed inline.

- **Predecessor activities:**
  Building Concrete pad or steel Structure installed
- **Successor activities**
  Drive System Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 24: Guide Rail Assembly

c) Drive System Installation: Drive system is an electromechanical set of motors, pillow blocks, and gearboxes on vibration and acoustic isolators on bed plate and concrete pad that shall be Place on structural supports and bearing plates. Securely fasten to building supports to prevent lateral displacement.

- **Predecessor activities:**
  Guide rail installed
- **Successor activities**
  Platform Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 25: Drive Unit

d) Platform Installation: Platform is a package of equipment including car and surfaces, machine room and etc. where passengers stand in.

- **Predecessor activities:**
  Drive unit installed
- **Successor activities:**
  Platform Control room installation

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

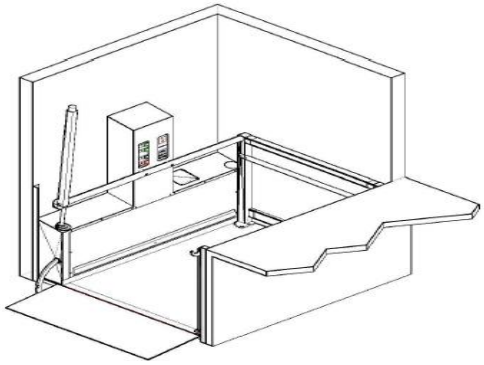


Figure 26: Platform

e) Platform Control Box Installation and Electric wiring: If the control room is not installed with platform, it shall be carefully installed in control room structure placed in platform wall.

- **Predecessor activities:**
  Platform Installation
- **Successor activities:**
  Final Adjustment

MHr/Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

f) Final Adjustment: After having carried out all the electric wiring, whole the lift assembly should be cleaned and safety limit switches, buffers, controllers, doors and drive unit should be checked.

- **Predecessor activities:**
  Control box and electric wiring
- **Successor activities:**
  Commissioning and Start-up

MHr/Item	Estimated Hours
Electrician	1.5
Plumber	1.5
Assistant	3

2.2. Escalator Installation

2.2.1. Interior commercial units (Car park, Monorail, Pre-function, Conference rooms, Wadi)

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities.
- **Successor activities:**
  Framed Operation and Support Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

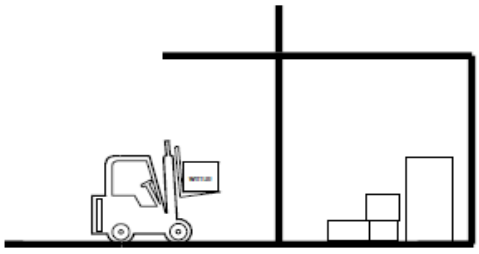


Figure 27: Equipment

b) Support Installation: Supports as they are named, are typically concrete or steel parts which shall be installed in the floor.

- **Predecessor activities:**
  Equipment Storage and distribution
- **Successor activities:**
  Structural Steel Truss Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

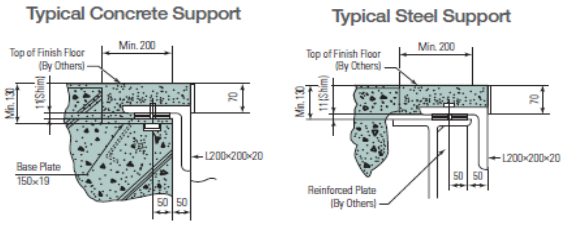


Figure 28: Support

c) Structural steel Installation: The structural steel truss shall be a rigid steel fabricated structure and shall be capable of carrying a full complement of passengers together with mechanism of the escalator, the balustrades and the weight of exterior covering.

- **Predecessor activities:**
  Support Installation
- **Successor activities:**
  Drive Unit Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	4
Assistant	4

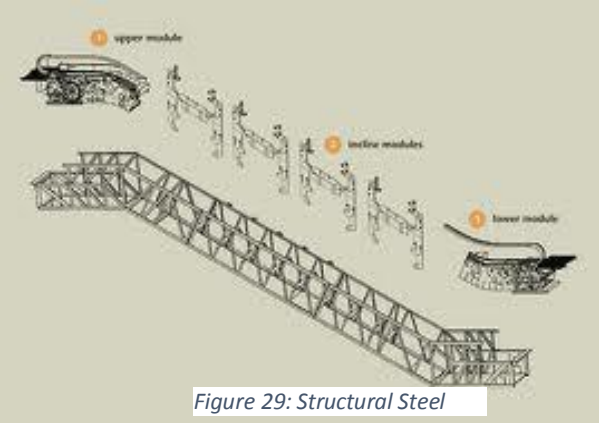


Figure 29: Structural Steel

d) Drive Unit and Tail Assembly: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Structural Steel Assembly
- **Successor activities:**
  Steps and Rollers

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

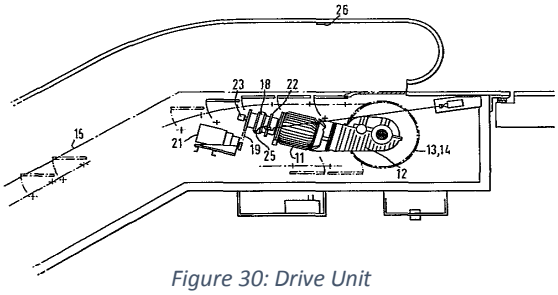


Figure 30: Drive Unit

e) Steps and Rollers: Steps are places where passengers stand during escalator movement. Each step shall be supported by ball bearing rollers to move easily during escalator movement.

- **Predecessor activities:**
  Drive unit and Tail Assembly
- **Successor activities:**
  Step Chain

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

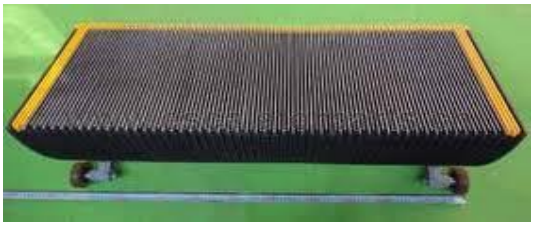


Figure 31:

f) Step Chain: The steps shall be driven by at least 2 steel link chains of which at least one shall be located at each side of the step.

- **Predecessor activities:**
  Step Installation
- **Successor activities:**
  Landing Opening and Landing Plate

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

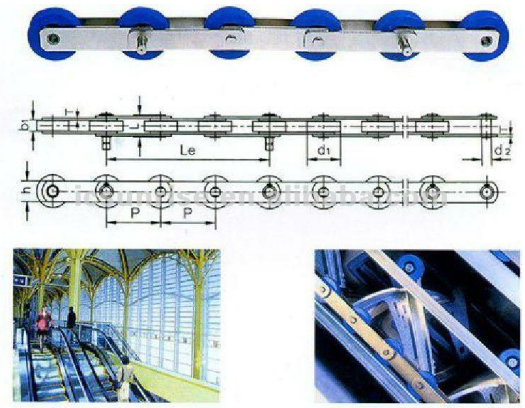


Figure 32: Step Chain

g) Landing Opening and Landing Plate: Landing Opening is specific place where passengers enter or land from/to floor. Landing plate is the plate shall be installed on the landing opening.

- **Predecessor activities:**
  Step chain installation
- **Successor activities:**
  Combs Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 33: Landing Plate

h) Combs Installation: Combs shall be provided at the top and bottom landings and shall be wear resistant aluminium alloy with anti-slip pattern.

- **Predecessor activities:**
  Landing Opening and Landing Plate Installation
- **Successor activities:**
  Balustrades Installation

MHr/Item	**Estimated Hours**
Electrician	
Plumber	.25
Assistant	.25

Figure 34: Comb

i) Balustrades Installation: Solid balustrades shall be installed on each side of the escalator and shall consist of the following components: Skirting, Interior profile, Interior and exterior panelling, Balustrade decking, Extended newel.

- **Predecessor activities:**
  Balustrades Installation
- **Successor activities:**
  Dress Guard and External Cladding Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

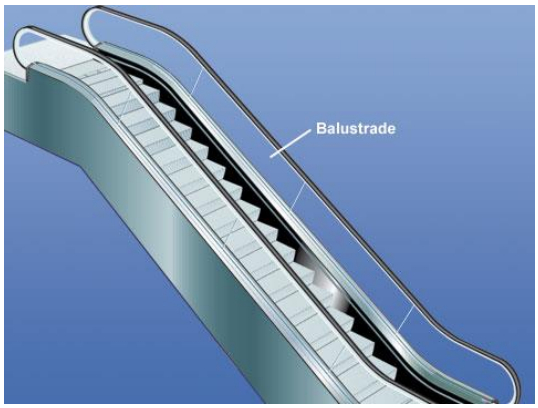


Figure 35: Balustrade

j) Dress guard and external cladding Installation: These Accessories are designed to make a safe place preventing passenger's dress trapping in gaps.

- **Predecessor activities:**
  Balustrades Installation
- **Successor activities:**
  Rubber handrail, safety Guard Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

Figure 36: Dress Guard and External Cladding

k) Rubber handrail, safety Guard Installation: These Accessories are designed to make a safe place preventing passenger's falling during escalator operation.

- **Predecessor activities:**
  Dress Guard and External Cladding
- **Successor activities:**
  Electric wiring and safety Check

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

Figure 37: Handrail

l) Electric Wiring and safety check: These Accessories are designed to make a safe place preventing passenger's falling during escalator operation.

- **Predecessor activities:**
  Dress Guard and External Cladding
- **Successor activities:**
  Electric wiring and safety Check

MHr/Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

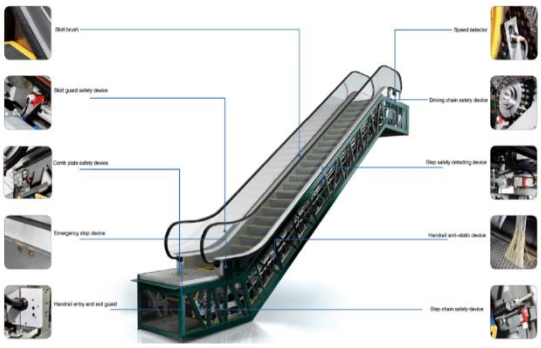


Figure 38: Safety

2.3. Work incidental to conveying systems

2.3.1. Conveying Systems (Coordinating with other engineering installation, document, identification, testing and commissioning, tools and spares)

a) Coordinating with other engineering installation: It is very important to have parallel site management in installing different equipment which work incidentally. I this case, arrangement and coordination of activities shall be planned for safe and prioritised in accordance with project specifications.

- **Predecessor activities:**
  Received material should be arranged in specific places according to site lay out drawings
- **Successor activities:**
  Document preparation

Figure 39: incidental

b) Document Preparation: Project documentations such as drawings, operating instructions and maintenance manuals shall be provided and received by manufacturers and vendors.

- **Predecessor activities:**
  Coordinating with other engineering installations
- **Successor activities:**
  Identifications

c) Identifications: Equipment's identifications such as plates, discs, labels, charts and colour coding shall be implemented to prevent any mistake during commissioning activities.

- **Predecessor activities:**
  Document Preparation
- **Successor activities:**
  Testing and commissioning, Tools and Spares

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	

Figure 40: Equipment

d) Testing and commissioning, Tools and Spares: Equipment shall be tested and commissioned according to project specifications. In the meantime, all required spare parts and tools shall be provided to expedite commissioning progress.

- **Predecessor activities:**
  Identifications
- **Successor activities:**
  Cleaning and Usage

MHr/Item	Estimated Hours
Electrician	2
Plumber	2
Assistant	4

2.4. Conveying Systems Installation

a) Protective painting and decoration: Protecting activities such as removing protective coating, rapping, cleaning, polishing exposed surfaces and painting shall be done.

- **Predecessor activities:**
  Received material should be arranged in specific places according to site lay out drawings.
- **Successor activities:**
  Fittings and outlet preservation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

b) Fittings and outlet preservation: During installation, outlets, fittings and generally weak points of equipment shall be preserved and covered against any damage.

- **Predecessor activities:**
  Protective paintings and decorations
- **Successor activities:**
  -

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

Figure 41: Fitting preservation

Chapter 3: Division 21 - Fire Suppression

3.1. Water Based Fire Suppression Systems

3.1.1. Sprinkler Installation

Sprinkler is an automatic water based fire extinguisher installed in the ceiling of buildings. This equipment includes piping elements, sprinkler head and various valves to control the rate of sprayed water.

Figure 42: Sprinkler

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Sprinkler pipework

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

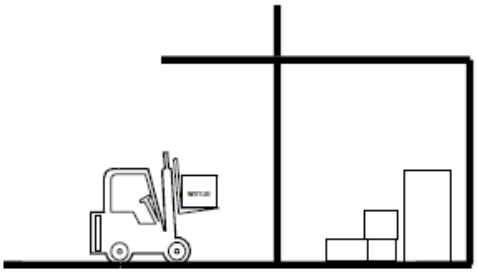


Figure 43: Equipment

b) Sprinkler Pipework: Main sprinkler Siamese connection including fittings, fixings and connections shall be installed according to project drawings.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Sprinkler Head and Valves

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 44: Sprinkler Pipework

c) Sprinkler head and valves installation: As it is obvious in the Figure 46, Sprinkler accessories are including sprinkler head, non-return valve, solenoid valve, needle valve, fire hose valve, OS&Y valve, control valve and anti-vortex plate. These accessories shall be installed according to the sprinkler drawings.

- **Predecessor activities:**
  Sprinkler pipework
- **Successor activities:**
  Touch-Up and Start-up

MHr/Item	Estimated Hours
Electrician	
Plumber	5
Assistant	5

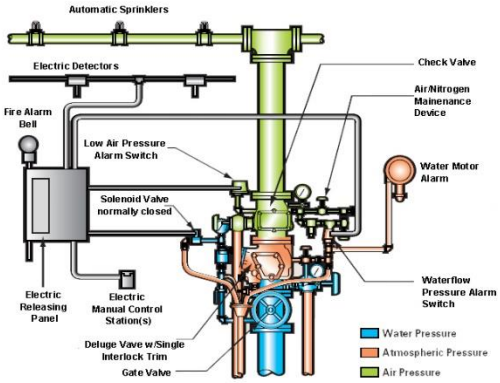


Figure 45: Sprinkler's accessories

Figure 46: Sprinkler's

3.1.2. Fire hose reel Installation:

Fire hose reel equipment is a high-pressure hose that carries water or other fire retardant to a fire to extinguish it. Outdoors, it attaches either to a fire engine or a fire hydrant. Indoors, it can permanently attach to a building's standpipe or plumbing system.

Figure 47: Fire hose reel

a) Fire hose reel Pipework: Including connection including fittings, fixings and connections shall be installed according to project drawings.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Location and mounting

MHr/Item	Estimated Hours
Electrician	
Plumber	4
Assistant	4

Figure 48: Pipe work

b) Location and mounting: Each hose reel shall be located in a readily accessible position and its location shall be clearly indicated. They shall not be installed in fire-isolated exits unless approval is obtained from the Regulatory Authority.

- **Predecessor activities:**
  Pipe work
- **Successor activities:**
  Connect the stop cock to water supply

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

3.1.3. Fire Pumps Installation:

A fire pump is a part of a fire sprinkler system's water supply and can be powered by electric, diesel or steam. The pump intake is either connected to the public underground water supply piping, or a static water source. Fire pumps including duty pumps, standby pumps and jockey pumps.

Figure 49: Fire pump

a) Foundation installation: The foundation for the pump will vary depending on the type of pump installed. Basically foundation designers focus on weight, dimensions and vibrations in their designing calculation.

- **Predecessor activities:**
  Material storage
- **Successor activities:**
  Skid Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 50: Pump Foundation

b) Skid Installation and first grouting: The Skid is normally a steel farming that various parts of a pump such as motor and gear box, couplings, impeller and other components are previously installed on. After installing the skid, first alignment and first grouting shall be done.

- **Predecessor activities:**
  Foundation Installation
- **Successor activities:**
  Drive shaft installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 51: Skid installation

c) Drive shaft Installation: Ensuring that engine and pump are correctly aligned, engine centreline and pump centreline should be measured in accordance with manufacturer's drawings. Then check the drive shaft flanges for parallel standing.

- **Predecessor activities:**
  Material Storage
- **Successor activities:**
  Fuel system installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

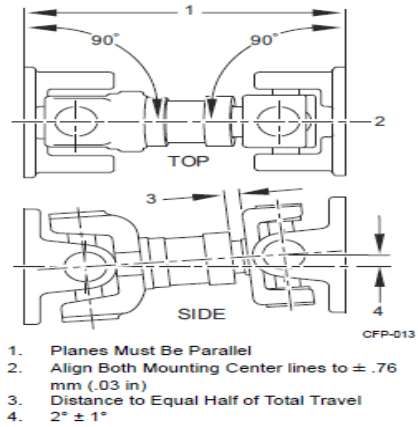


Figure 52: drive shaft installation

d) Fuel system Installation: Fuel system and return piping lines should be installed according to drawings.

- **Predecessor activities:**
  Drive shaft installation
- **Successor activities:**
  Raw water supply installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

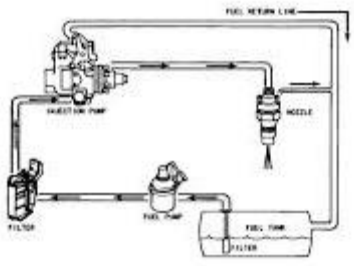


Figure 53: Fuel System

e) Raw water supply system Installation: Raw water circulate through the system cools and engine which must be immediately available when the engine started.

- **Predecessor activities:**
  Fuel system installation
- **Successor activities:**
  Signal control installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

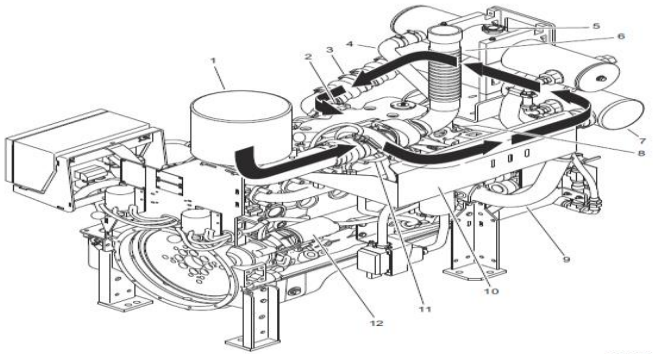


Figure 54: Row water flow diagram

f) Signal control Installation: The connection between the controller wires and terminal blocks which is named by signal control system shall be properly installed.

- **Predecessor activities:**
  Row water system installation
- **Successor activities:**
  Energize and start-up

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

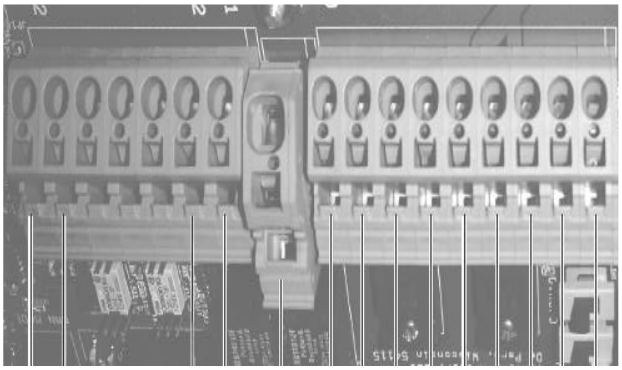


Figure 55: Signal

3.2. FM-200 system

The FM-200 gaseous system uses a regulated greenhouse gas, under the Ozone Depleting Substances & Synthetic Greenhouse Gases. This gaseous system works in seconds and is readily suited to the protection of high value assets. As FM-200 is an agent for Gaseous fire suppression systems, all the installation procedure, follow the procedure below.

3.2.1. Gaseous Fire Suppression Systems

Is a term to describe the use of inert gases and chemical agents to extinguish a fire? Also called Clean Agent Fire Suppression. The system typically consists of the agent, agent storage containers, agent release valves, fire detectors, fire detection system.

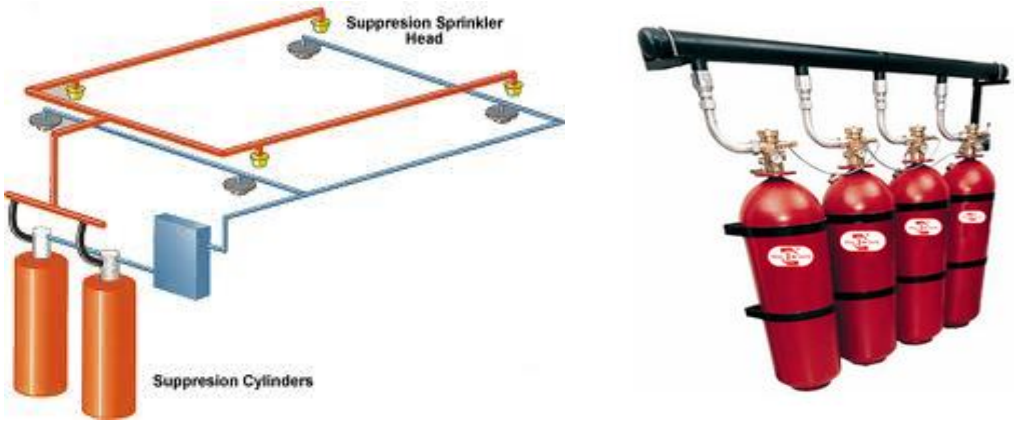


Figure 56: Gas fire suppression system

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Cylinders positioning

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

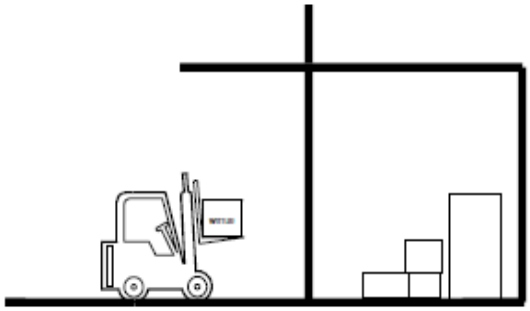


Figure 57: Equipment Storage

b) Cylinders positioning: Gas cylinders shall be positioned before starting the piping works. This makes piping works easier to start and finish.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Pipework installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 58: cylinder positioning

c) Pipework installation: Gaseous fire suppression system piping including fittings, fixings and connections shall be installed according to project drawings.

- **Predecessor activities:**
  Cylinders positioning
- **Successor activities:**
  Nozzles installation

MHr/5 meters	Estimated Hours
Electrician	
Plumber	1.5
Assistant	1.5

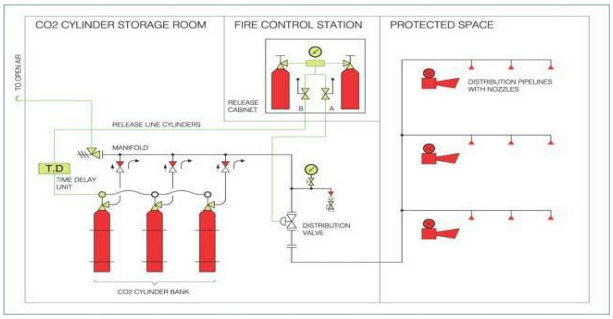


Figure 59: Gas suppression system flow diagram

d) Nozzles installation: Gaseous fire suppression system nozzles are just like sprinkles head in water suppression systems, where the firefighting liquid operates.

- **Predecessor activities:**
  Pipe work installation
- **Successor activities:**
  Cabling, connection and termination

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 60: GSS Nozzle

e) Cabling, connection and termination: After finishing pipe works and installing nozzles, it is time to complete electrical cables, connect them to power source and terminate them.

- **Predecessor activities:**
  Nozzles installation
- **Successor activities:**
  Recommissioning and Start-up

MHr/Item	Estimated Hours
Electrician	
Plumber	4
Assistant	4

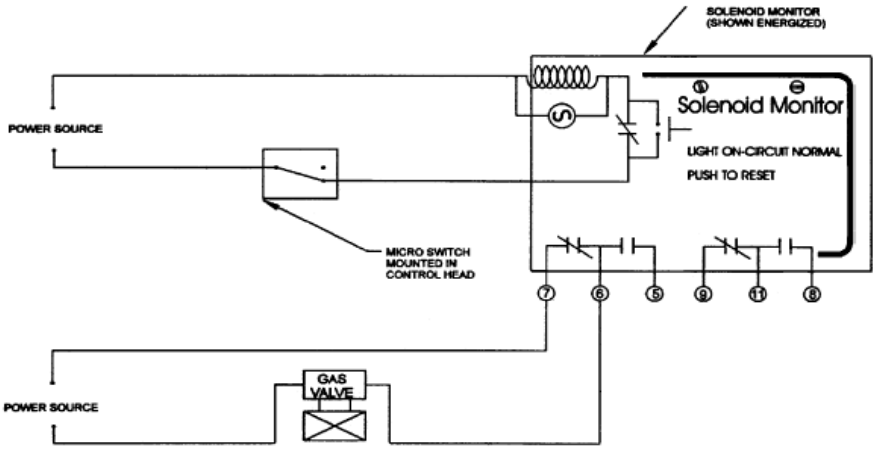


Figure 61: Cabling, connection and termination

3.3. Fire Suppression Water Storage

Automatic fire suppression water storage are used to support needed water for water-based fire suppression systems such as sprinklers, wet risers and mist systems.

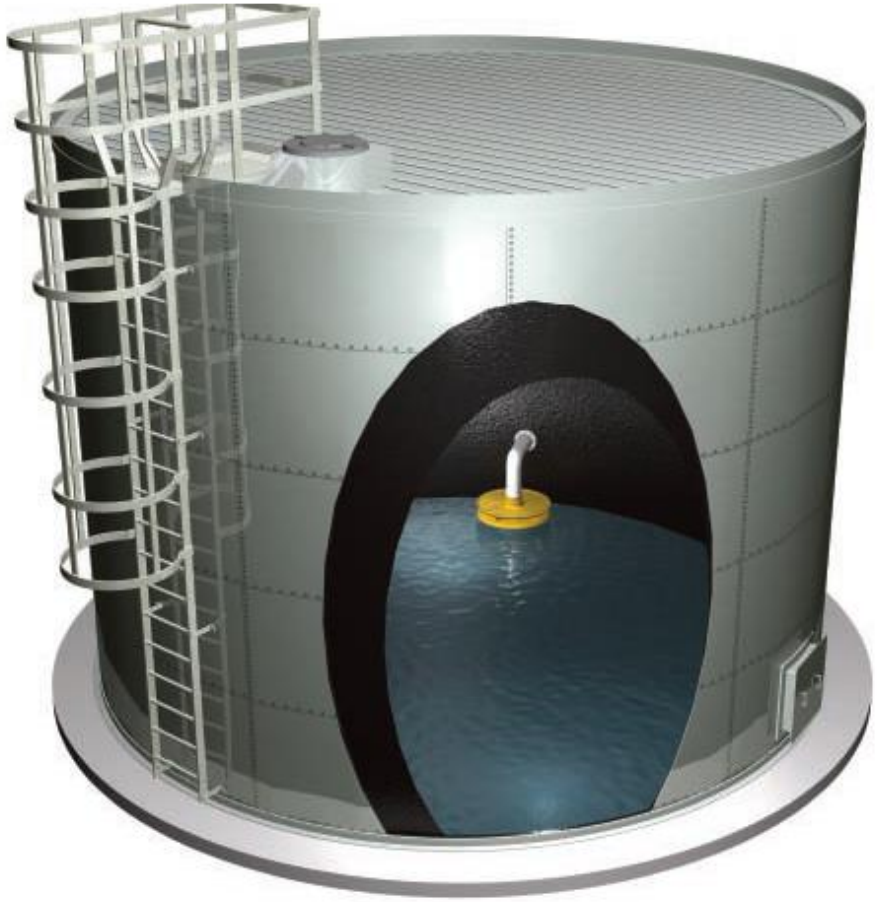


Figure 62: Tank Assembly

a) Support Base installation: The support base for the sprinkler tank will vary depending on the type of tank installed. The most common types are circular or rectangular concrete bases, low level concrete walls or steel beams.

- **Predecessor activities:**
  Material storage
- **Successor activities:**
  Shell and roof installation

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 63: Tank support/foundation

b) Shell, roof and Stair installation: Water storage tanks normally have shell and roof depending on designing they can vary in height and diameter. These components shall be assembled and installed on foundation.

- **Predecessor activities:**
  Support base installation
- **Successor activities:**
  Pipe works

MHr/Item	Estimated Hours
Electrician	
Plumber	5
Assistant	5

Figure 64: shell, roof and stair installation

c) Pipe Works: Piping works normally include GRP, lateral and overall piping lines which shall be installed according to P&ID and piping drawings.

- **Predecessor activities:**
  Shell, roof and Stair installation
- **Successor activities:**
  Valves installation

MHr/Item	Estimated Hours
Electrician	
Plumber	5
Assistant	5

Figure 65: Storage tank piping

d) Valve installation: Water storage tanks need valve to control the rate of inlet and outlet water.

- **Predecessor activities:**
  Piping works
- **Successor activities:**
  Corrosion protection installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 66: Valve installation

e) Corrosion protection installation: To prevent corrosion on steel sheets of tank's body, it is very essential to cover whole components by galvanized protection.

- **Predecessor activities:**
  Valve installation
- **Successor activities:**
  Electrical component installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 67: Corrosion protection

f) Electrical component installation: electrical requirements in connection with mechanical, installation and equipment, including however not limited to control panels, wiring, switches, accessories, final connections and configurations etc.

- **Predecessor activities:**
  Corrosion protection
- **Successor activities:**
  Mechanical and electrical completion

MHr/Item	Estimated Hours
Electrician	1.5
Plumber	
Assistant	1.5

Figure 68: Electrical connections

g) Mechanical and electrical completion: mechanical and electrical completion including : holes/sleeves for cables/conduits/pipe/ducts where passing through structure, cladding, finishes etc. chasing for cables/conduits/pipe/ducts where incidental to structure, cladding, finishes etc. fire stopping around cables/conduits/sleeves/pipes/ducts, where passing through structure.

- **Predecessor activities:**
  Electrical connection
- **Successor activities:**
  Testing and commissioning

MHr/Item	Estimated Hours
Electrician	3
Plumber	3
Assistant	6

Figure 69: Mechanical and Electrical

h) Testing and Commissioning: Testing and commissioning include operating completed installations and providing fuel and power and providing tools and spares, which include loose keys and consumable stores. Documents, which includes drawings, operating instructions and maintenance manuals

- **Predecessor activities:**
  Mechanical and Electrical completion
- **Successor activities:**
  -

MHr/Item	Estimated Hours
Electrician	5
Plumber	5
Assistant	10

Figure 70: Testing and commissioning

Chapter 4: Division 22 - Plumbing

The system of pipes, tanks, fittings, and other apparatus required for the water supply, heating, and sanitation in a building is basically called plumbing.

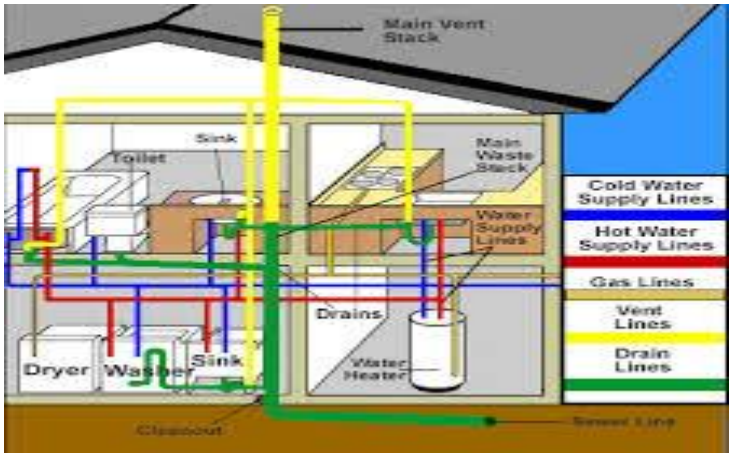


Figure 71: plumbing general layout

4.1. Plumbing piping and pumps

Allowance for main drainage connection, water supplies by main public health authority; to include irrigation and domestic tanker fill point, FDC and hydrant points

4.1.1. Drainage (above ground and underground):

Drainage systems include solvent-weld and push-fit options for both soil & waste drainage; overflow, WC pan connectors and trap systems.

Figure 72: Above Ground Drainage

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Pipe works

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

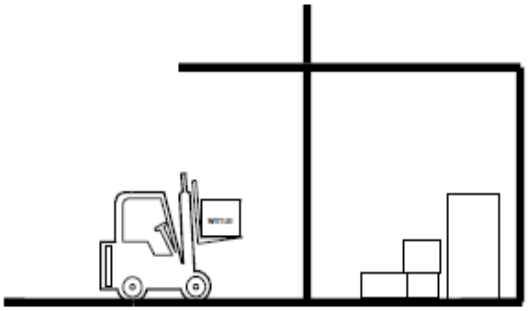


Figure 73: Material Storage

b) Pipe Works: Including lightweight cast iron socket less pipes, U-PVC class IV and Pressure Pipes. Three different piping material which are used in different areas in accordance with designing descriptions and local standards.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Installing Connections, fittings, fixings and integral solder type joints

MHr/Item	Estimated Hours
Electrician	
Plumber	5
Assistant	5

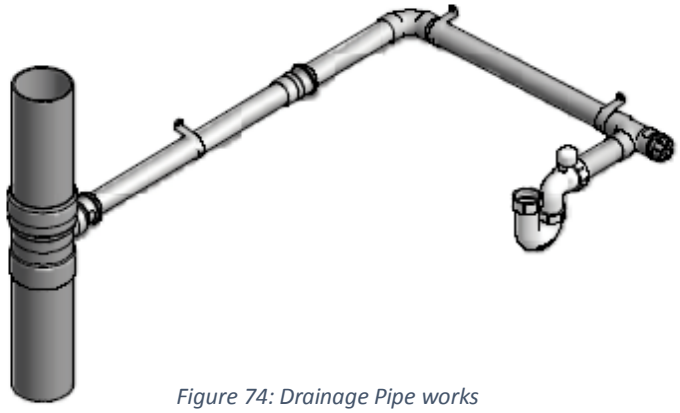


Figure 74: Drainage Pipe works

c) Installing Connections, fittings, fixings and integral solder type joints: Cutting pipes in accordance with drawings and connect to other parts by fittings, connections and joints.

- **Predecessor activities:**
  Pipe Works
- **Successor activities:**
  Sealing and usage

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

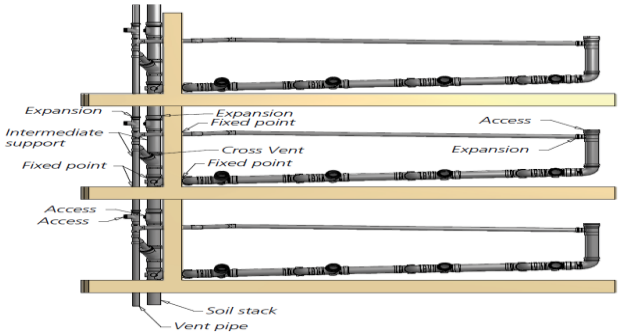


Figure 75: Installing Connections, Expansion joints and etc.

4.1.2. Water Services (Cold, Hot, Grey and Irrigation):

Generally including drinking water and wastewater services to residential, commercial, and industrial sectors of the economy. Cold and Hot water services are provided for drinking usage, in the other hand, grey water and irrigation water are provided by wastewater.

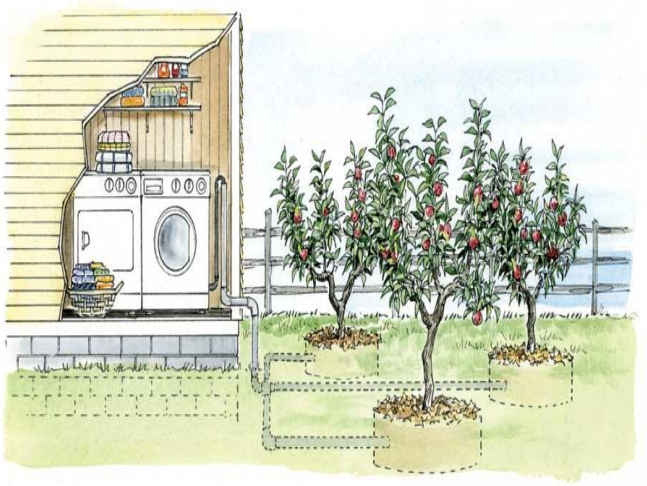


Figure 77: Grey and Irrigation water service

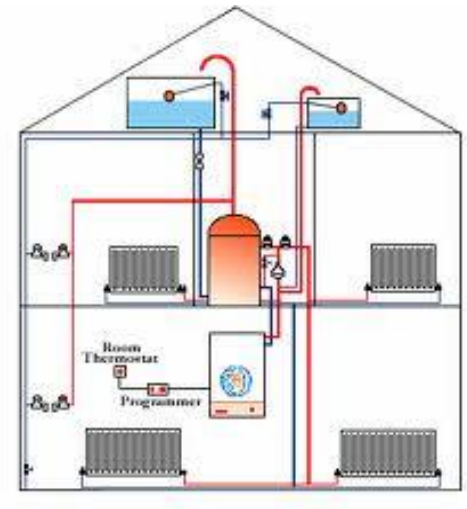


Figure 77: Cold and Hot water service

a) Material Storage: It is very important to check and store the received materials properly in order to prevent any trouble during installation process.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Pipe installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

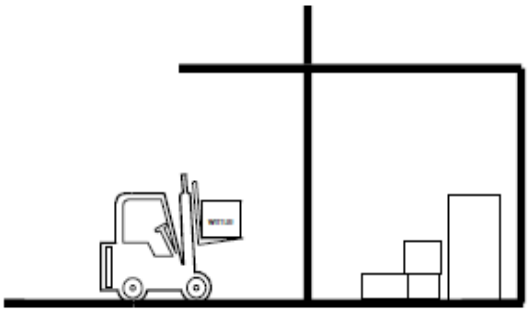


Figure 78: Material Storage

b) Pipe Installation: Including copper pipes, U-PVC class IV and Pressure Pipes. Three different piping material which are used in different water services in accordance with designing descriptions and local standards.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Installing Connections, fittings, fixings and integral solder type joints

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 79: Water Service pipe installation

c) Installing Connections, fittings, fixings and integral solder type joints: Cutting pipes in accordance with drawings and connect to other parts by fittings, connections and joints.

- **Predecessor activities:**
  Pipe installation
- **Successor activities:**
  Plumbing accessories Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 80: Fittings and connections

4.1.3. Water Heater

Is an appliance consisting of a gas or electric heating unit under a tank in which water is heated and stored.

Figure 81: Water heater lay out

a) WATER HEATER installation: This water heater must be installed vertically upright with the water, gas and power connections on the underside, pointing toward the ground. The back of the water heater can be either against a wall or supported by a frame. The water heater must be secured to the wall or frame using suitable mounting screws, two each at the top and bottom of the unit.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Pipe works and connections

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

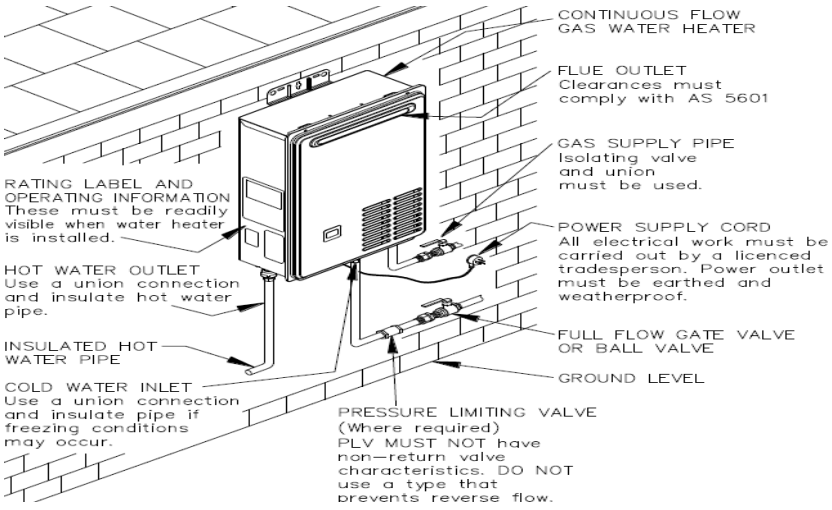


Figure 82: Installing Water heater

b) Pipe works and connections: Including lightweight cast iron socket less pipes, U-PVC class IV and Pressure Pipes. Three different piping material which are used in different areas in accordance with designing descriptions and local standards

- **Predecessor activities:**
  Water heater installation
- **Successor activities:**
  FROST PROTECTION

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

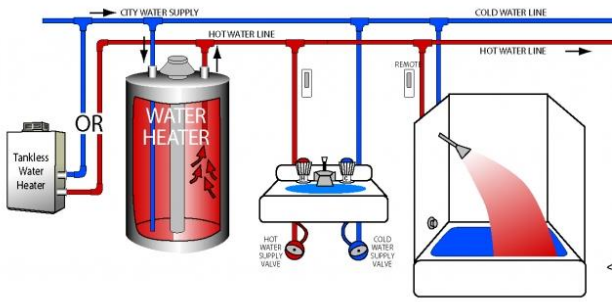


Figure 83: Water heater pipe works

c) FROST PROTECTION: The water heater has a frost protection system. The frost protection system will protect the water heater from damage, by preventing ice forming in the waterways of the water heater, in the event of freezing conditions occurring.

- **Predecessor activities:**
  Pipe work and connection
- **Successor activities:**
  Water Supply connection

MHr/Item	Estimated Hours
Electrician	
Plumber	4
Assistant	4

Figure 84: Water heater frost protection

4.1.4. Plumbing accessories Installation:

Including Valves (Shut-off, OS&Y, non-return and check, float, gate, commissioning set), Strainers, pressure gauge and cock, Shock absorber, water meter and automatic trap primers. Installation procedure for all of above mentioned plumbing accessories are pretty much the same, but for more illumination, each one of them are described as below :

Shut-off Valves: A valve that cuts off water to one or more fixtures, allowing repairs without shutting off the supply system for the entire house.

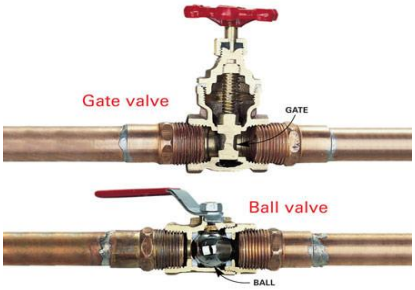


Figure 85: Shut off

OS&Y Valves: Outside Screw and Yoke (OS & Y) which Used mainly in fire prevention.

Figure 86: OS&Y valve

Non-Return Valves: A check valve, clack valve, non-return valve or one-way valve is a valve that normally allows fluid to flow through it in only one direction.

Figure 87: Non-Return Valve

Float Valves: Valve float is an adverse condition which occurs when the poppet valves on an internal combustion engine valve train do not remain in contact with the camshaft lobe during the valve closure phase of the cam lobe profile. This reduces engine efficiency and performance and potentially increases engine emissions.

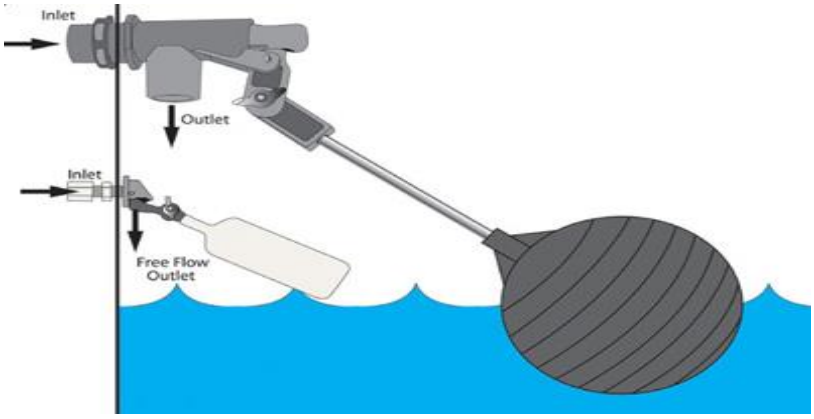


Figure 88: Float valve

Commissioning set: A set of balancing valves can ensure the correct distribution of water.

Figure 89: Commissioning set

Strainers: A device having holes punched in it or made of crossed wires for separating solid matter from a liquid.

Figure 90: Strainer

Shock absorber: A shock absorber is a mechanical device designed to smooth out or damp shock impulse, and convert kinetic energy to another form of energy.

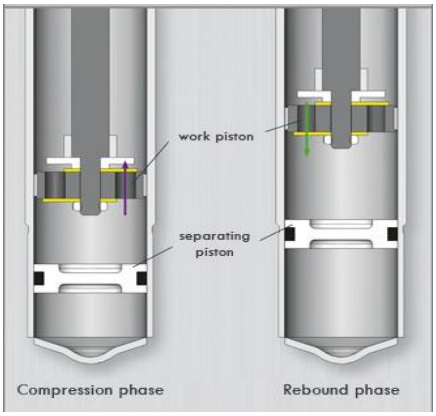


Figure 91: Shock absorber

Water meter: A meter for measuring the quantity of water passing through a particular outlet.

Figure 92: Water

Trap Primer: A trap primer is a plumbing device or valve that adds water to traps.

Figure93: Trap primer

- **Predecessor activities:**
  Material Preparation
- **Successor activities**
  Device Installation and sealing

MHr/Item	Estimated Hours
Electrician	
Plumber	10
Assistant	10

4.1.5. Public Health Equipment

Pumps (Triplex domestic water buster pump, duplex flushing water pump, irrigation water pump, sump pump, sewage ejector pump, dewatering pump), storage tanks (potable cold water tank, grey water tank, flushing tank, treated gray water tank, black water holding tank, irrigation water holding tank and domestic water filter tank): As pump installation breakdown is already described in Here as well as tank installation in here, more explanations about what public health equipment are would be adventures in following:

Buster pump: A Booster pump is a machine which will increase the pressure of a gas. It is similar to a gas compressor, but generally a simpler mechanism which often has only a single stage of compression, and s used to increase pressure of an already pressurized gas. Two-stage boosters are also made.

MHr/Item	Estimated Hours
Electrician	2
Plumber	7
Assistant	9

Figure 93: Buster pump

Sump pump: A pump (as in a basement) to remove accumulations of liquid (as water) from a sump pit.

MHr/Item	Estimated Hours
Electrician	2
Plumber	7
Assistant	9

Figure 94: Sump pump

Sewage ejector pump: An ejector pump is a pump that replaces gravity during the transportation of waste from a plumbing space that is situated underneath the remainder of the system.

MHr/Item	Estimated Hours
Electrician	2
Plumber	7
Assistant	9

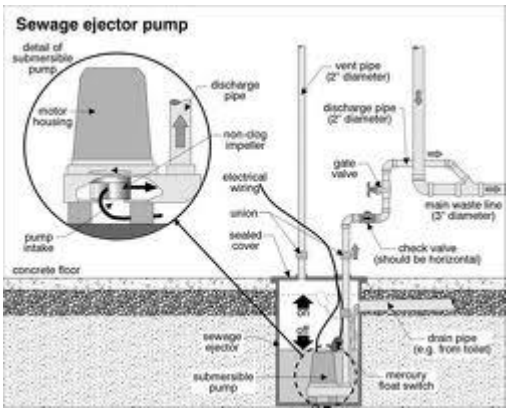


Figure 95: Sewage injector pump

Dewatering pump: Dewatering refers to the removal of groundwater usually by pumping or evaporation, which normally is done by a dewatering pump.

MHr/Item	Estimated Hours
Electrician	2
Plumber	7
Assistant	9

Figure 96: Dewatering Pump

Flushing tank: a tank holding a supply of water or sewage for periodically flushing out a sewer.

MHr/Item	Estimated Hours
Electrician	9.5
Plumber	24.5
Assistant	34

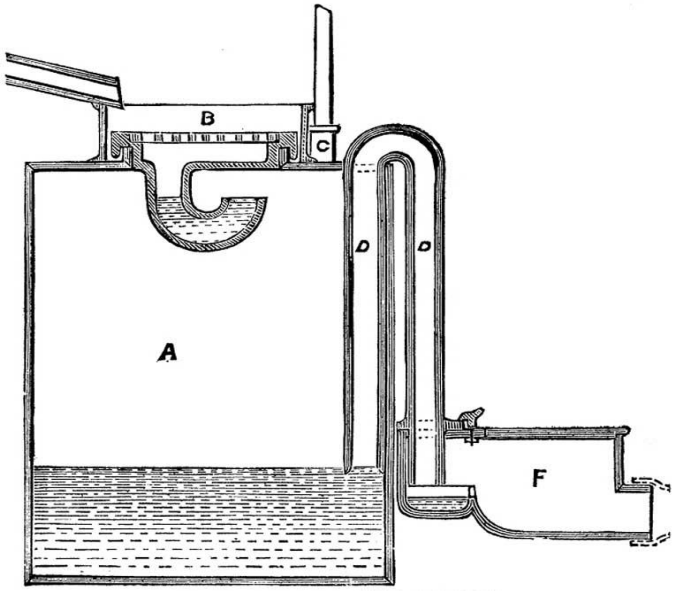


Figure 97: Flashing tank

4.2. Grey Water Treatment Plant:

A Grey water treatment plant or wastewater treatment works is an industrial structure designed to remove biological or chemical waste products from water, thereby permitting the treated water to be used for other purposes.

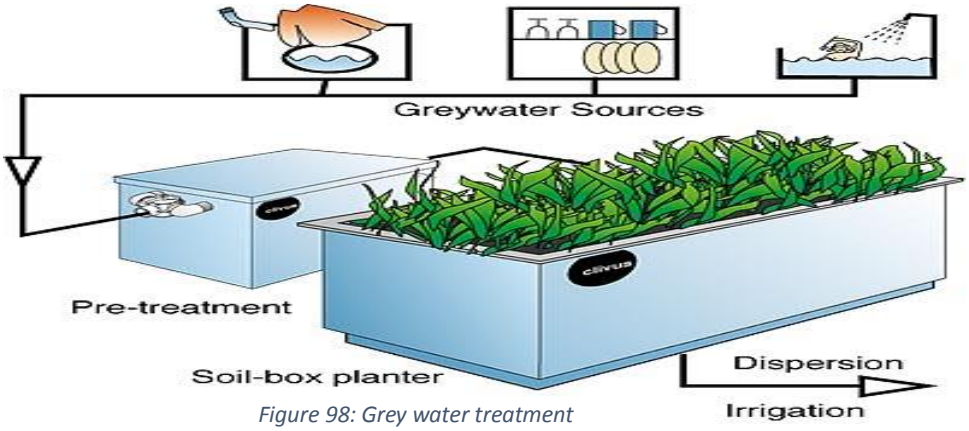


Figure 98: Grey water treatment

a) Equipment Installation and labeled: Including chemical tanks, pumps, tanks and instrument shall be installed in accordance with project and manufacturer's specifications. Equipment installing procedure has been explained in different pages in this document.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Pipe installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 99: Chemical tank, valves and pumps

b) Pipe works: Including pipe installation, fittings and connections to the equipment.

- **Predecessor activities:**
  Equipment installation
- **Successor activities:**
  Electrical equipment installation

MHr/5 meter	Estimated Hours
Electrician	
Plumber	4
Assistant	4

Figure 100: Piping and

c) Electrical equipment Installation and labeled: Including motors, push-button stations, isolating switches, limit and level switches.

- **Predecessor activities:**
  Pipe works
- **Successor activities:**
  Touch-up and start-up

MHr/Item	Estimated Hours
Electrician	3
Plumber	
Assistant	3

Figure 101: Electrical Works

4.3. RO Plant

Reverse osmosis (RO) is a water purification technology that uses a semipermeable membrane. This membrane technology is not properly a filtration method. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property that is driven by chemical potential, a thermodynamic parameter.

Figure 102: RO plant

a) Equipment Installation and labeled: Including water tanks, pumps, instrument shall be installed in accordance with project and manufacturer's specifications. Equipment installing procedure has been explained in different pages in this document.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Pipe installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 103: RO pumps and instrumentation

b) Pipe works: Including pipe installation, fittings and connections to the equipment.

- **Predecessor activities:**
  Equipment installation
- **Successor activities:**
  Electrical equipment installation

MHr/Item	Estimated Hours
Electrician	
Plumber	4
Assistant	4

Figure 104: RO plant pipe works

c) Electrical equipment Installation and labeled: Including motors, push-button stations, isolating switches, limit and level switches.

- **Predecessor activities:**
  Pipe works
- **Successor activities:**
  Touch-up and start-up

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 105: Electrical works

4.4. Grease Interceptor

Grease traps are plumbing devices designed to intercept most greases and solids before they enter a wastewater disposal system.

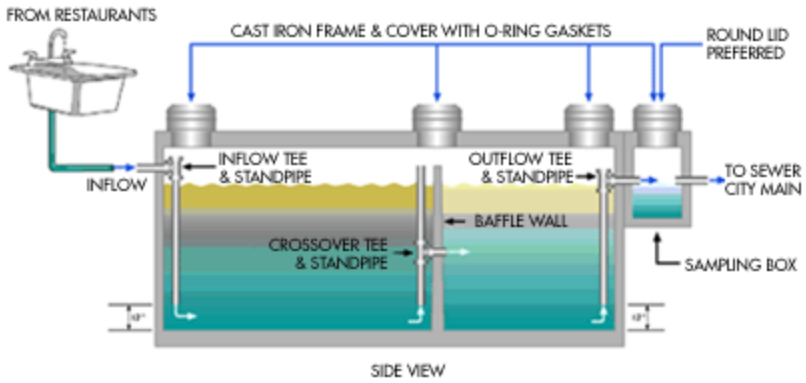


Figure 106: Grease interceptor

a) Equipment Installation and labeled: Grease interceptor will be normally delivered in whole package to site. The only activity to install the equipment is to position it in the floor and between tow pipelines that is already exist in plumbing pipe line.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Inlet and out let connections

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 107: Inlet and outlet connections

4.5. Plumbing Fixtures

Plumbing fixtures are set of fixtures for the distribution and use of water in a building including sanitary fittings, wash hand basin, WC suite and water closet.

Figure 108: Plumbing Fixtures

a) Equipment Installation and labeled: The only activity to install the equipment is to position them and then connect them using waste and tapes.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Cleaning and using

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

4.6. Sanitary fixtures

A receptacle for industrial and fecal sewage that is installed in homes and public and industrial buildings. Sanitary fixtures are attached to the interior systems of water pipes and sewerage systems and constitute the main elements of a building's sanitary engineering equipment.

a) Fit sanitary fixtures: Installing sanitary fixtures including fittings into hoses, connect between pipes and other areas in buildings shall be done in accordance with manufacturer's specifications.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities.
- **Successor activities:**
  Generator base frame installation

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

Figure 109: Installation

b) Sealing: Fixtures shall be sealed against any leakage and from external penetration of dust or other material.

- **Predecessor activities:**
  Fit sanitary fixtures
- **Successor activities:**
  Usage

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

Figure 110: Sealing

4.7. Water Features

Design, supply, installation, testing & commissioning Water Feature Equipment including but not limited to distribution piping, valves, fountain nozzles, fountain pumps, control panel, etc. which are explained for every equipment in this document.

4.8. Irrigation system:

Including Planter Area Internal Irrigation, Green Wall Irrigation, Green Wall Irrigation, Raise Planter Irrigation and Roof Floor Irrigation.

Planter area internal irrigation: internal irrigation system feeds water directly to the plant's roots to limit evaporation and conserve water.

Figure 111: Internal irrigation

d) Bed preparation: every irrigation system like equipment need to be placed in a bed and foundation. A foundation include steel or wooden frame where plants need to be planted and irrigated.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Pipe works and connections

MHr/Item	Estimated Hours
Electrician	
Plumber	4
Assistant	4

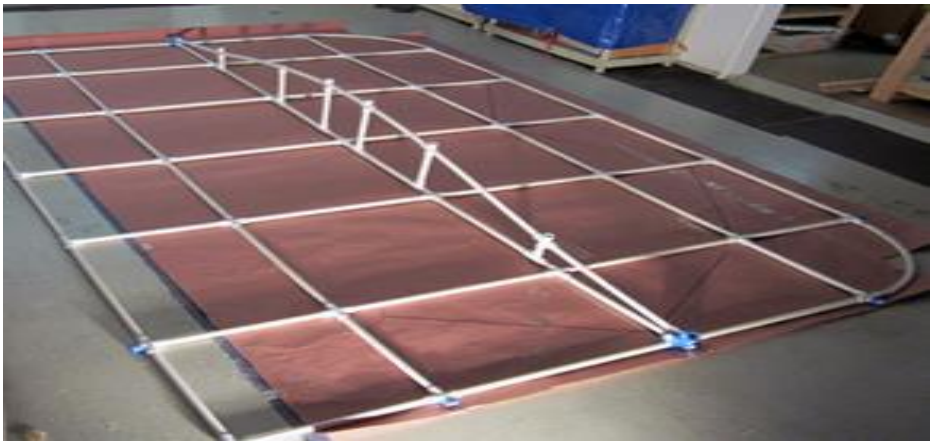


Figure 112: Foundation preparation and pipe works

e) Pipe works and connections: Including lightweight cast iron socket less pipes, U-PVC class IV and Pressure Pipes. Three different piping material which are used in different areas in accordance with designing descriptions and local standards

- **Predecessor activities:**
  Bed preparation
- **Successor activities:**
  Assembling remote valves

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 113: Irrigation pipe works and connections

f) Assembly of remote valves: Including filter, remote control valve and pressure regulating valve assembly, air vacuum relief valve.

- **Predecessor activities:**
  Pipe works and connections
- **Successor activities:**
  Planting

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

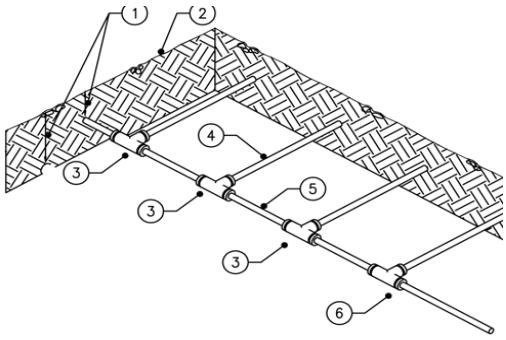


Figure 114: Valve assembly

g) Planting: Plant all plants after installing the drip-line, taking care to pre-cut and tape the open ends of the drip-line when planting the oversized plants. Re-connect the severed drip-line after planting.

- **Predecessor activities:**
  Pipe works and connections
- **Successor activities:**
  -

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

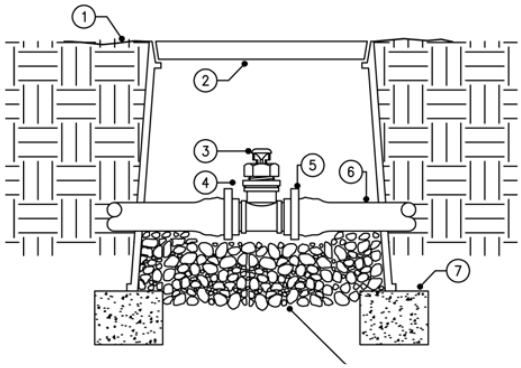


Figure 115: Planting assembly

Green wall internal irrigation: A green wall is comprised of plants grown in supported vertical and inclined systems.

Figure 116: Green Wall internal irrigation

Raise planter irrigation: A raised bed planter includes a planter body having four bed walls with four corners that define a planting area for holding soil and cultivating plants therein.

Figure 117: Raise planter irrigation

Roof floor irrigation: A built-in, nonstructural portion of a roof system. Conventional irrigation system commonly uses pressure to deliver water and distributes it through plants.

Figure 118: Roof irrigation

Chapter 5: Division 23 - Heating Ventilation and Air Conditioning

HVAC is the technology of indoor and vehicular environmental comfort. HVAC system design is a sub discipline of mechanical engineering, based on the principles of thermodynamics, fluid mechanics, and heat transfer.

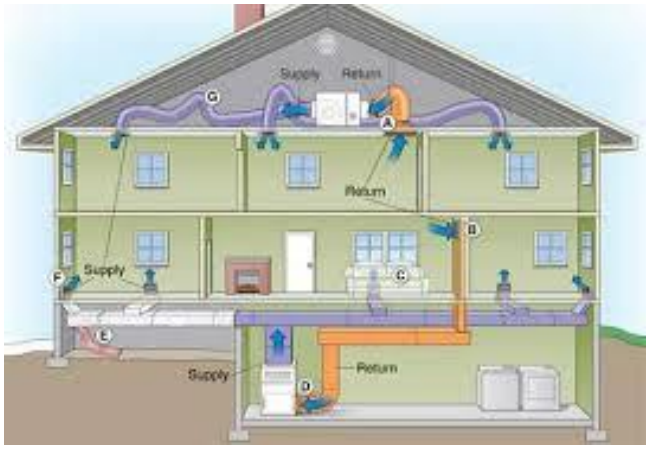


Figure 119: HVAC configuration

5.1. Facility fuel system (Generator)

A dynamic or similar machine for converting mechanical energy into electricity and produce power from fuel for system. There are various fuel systems such as fuel pumps, generators and etc.

Figure 120: Generator layout

c) Set drive unit, switching gear unit, fuel oil transfer pump and tank, control panel in base frame: Normally A generator is delivered to site whilst all mentioned generating parts are assembled in steel base frame. But it is very important to check the received generating set against manufacturer's drawings.

Figure 121: Set of generating machine is assembled in base frame

d) Foundation preparation: Just like every other equipment, generators need steel structure or concrete floor/foundation to be installed.

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities
- **Successor activities:**
  Generator base frame installation

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 122: Generator foundation

e) Generator set installation: Generator base frame shall be lifted to the foundation area and be placed in accordance with drawings. After positioning, generator foundation pockets shall be grouted.

- **Predecessor activities:**
  Generator foundation preparation
- **Successor activities:**
  Pipe works

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

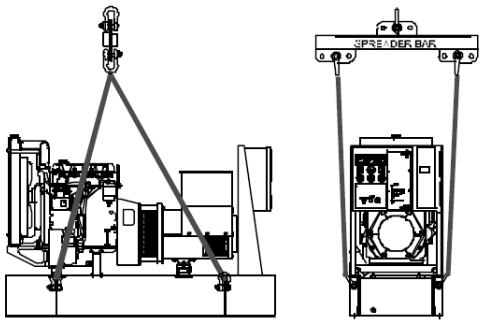


Figure 123: Generator set installation

f) Generator exhaust pipe installation: After installing and grouting the generator set, exhaust pipe shall be installed by using a flexible joint to the generator vent. As it is shown in picture, there is exhaust silencer installed in line with pipe lines to reduce vibration noises.

- **Predecessor activities:**
  Generator set installation
- **Successor activities:**
  Fuel supply installation

MHr/Item	Estimated Hours
Electrician	
Plumber	5
Assistant	5

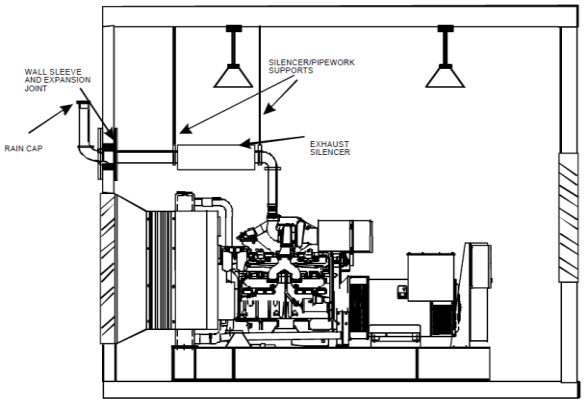


Figure 124: Generator

g) Fuel supply installation: A dependable fuel supply system must assure instant availability of fuel to facilitate starting and to keep the engine operating. This requires, at a minimum, a small day tank (usually incorporated into the generating set base frame - called a base tank) located close to the generating set.

- **Predecessor activities:**
  Generator exhaust pipe assembly installation
- **Successor activities:**
  Fuel Pipe works

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 125: Fuel tank installation

h) Generator Fuel pipe works: Including pipe installation, fittings and connections to the generator.

- **Predecessor activities:**
  Generator set installation
- **Successor activities:**
  Electrical connection and start-up

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 126: Fuel piping

5.2. HVAC piping and pumps

Including condensate pipework, insulation, underfloor radiant cooling, valve, strainer, pressure gauge, flow switch, water meter and air separator installation.

Figure 127: HVAC piping and pumps

5.3. Condensate pipework

No single set of recommendations can cover the layout of condensate pipework. Much depends on the application pressure, the steam trap characteristics, the position of the condensate return main relative to the plant, and the pressure in the condensate return main. But in order to install pipes, basic regulations shall be considered as described in this document earlier.

Figure 128: Condensate pipe works

a) Pipe installation and connections: UPVC class IV pipes including fittings and fixings and connections. Jointing shall be by use of solvent weld sockets; drainage fittings with elastomeric ring-seal joints.

- **Predecessor activities:**
  Preparing pipes and connections
- **Successor activities:**
  Insulation of condensate pipe work

MHr/10meter	Estimated Hours
Electrician	
Plumber	4
Assistant	4

Figure 129: UPVC pipes

b) Insulation of condensate pipe work: Thermal insulation is the reduction of heat transfer (the transfer of thermal energy between objects of differing temperature) between objects in thermal contact or in range of radiative influence. Thermal insulation can be achieved with specially engineered methods or processes, as well as with suitable object shapes and materials such as closed cell elastomeric and black steel tube material.

- **Predecessor activities:**
  Cleaning of surfaces and connections
- **Successor activities:**
  Insulation material installation

MHr/5 meters	Estimated Hours
Electrician	
Plumber	4
Assistant	4

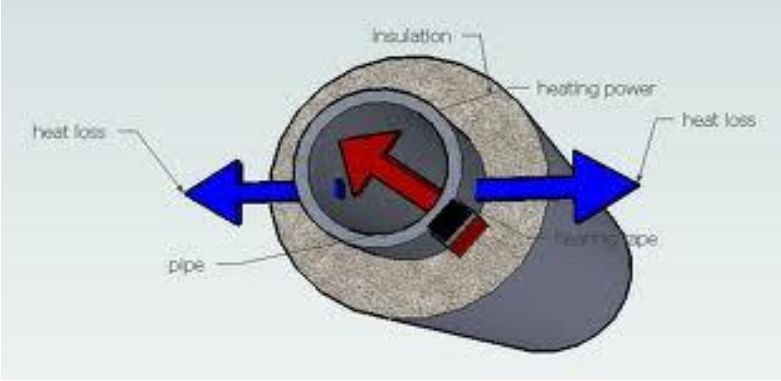


Figure 130: Insulation

c) Insulation material installation: Most tubular insulation products offer easy installation because you can cut the ends and butt them together to make a mitered corner on a variety of pipe configurations. In some cases, mastic is used to secure the insulation material on the pipe either wire or aluminum foil tape can be used.

- **Predecessor activities:**
  Cleaning of surfaces and connections
- **Successor activities:**
  Sealing and curing

MHr/5 meters	Estimated Hours
Electrician	
Plumber	4
Assistant	4

Figure 131: insulation material installation and securing

d) Sealing and curing: sealing shall be carefully executed specially around connections and joints. After sealing, curing time shall be considered before start-up.

- **Predecessor activities:**
  Insulation material installation
- **Successor activities:**
  Start-up

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

Figure 132: Sealing

5.4. Under floor radiant cooling

Radiant floor tubing can be used to cool a house, but presently it is only appropriate for dry climates. The floor temperature is held at 68o F (20oC) by using either a small cooling machine (chiller) connected to the floor tubing or the steady 55o F (13 o C) temperature of the ground by means of an earth loop.

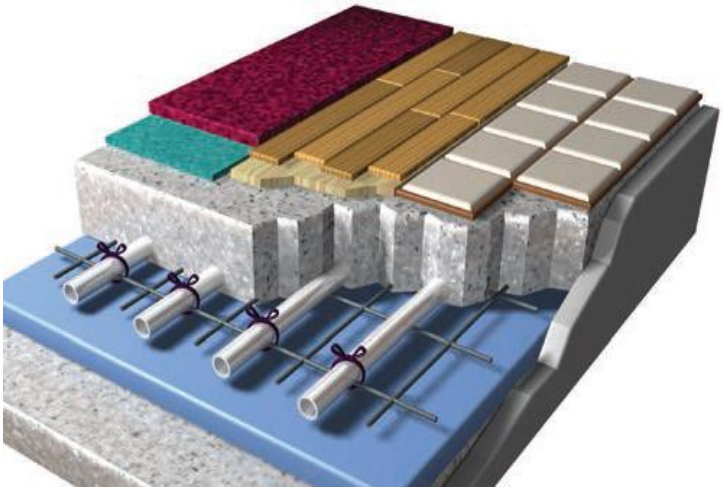


Figure 133: Floor cooling system

a) Floor slab on grade: A vapor barrier, such as high-density polyethylene sheeting, is recommended between the radiant slab and supporting layers. Insulation is crucial for proper and efficient operation of the radiant floor system.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Installing PEX tub

MHr/1 square meter	Estimated Hours
Electrician	
Plumber	2
Assistant	2

b) Installing PEX tubing in structural slab: This method transforms the building structure into a controllable thermal mass. During the construction phase, the mechanical contractor should coordinate with the general contractor to ensure that the manifold locations are properly prepared and that there are no interferences between the PEX-a tubing and any reinforcing steel, post-tension tendons, electrical conduits, etc. In many cases, the PEX-a tubing can be secured with wire ties directly to the rebar.

- **Predecessor activities:**
  Floor slab on grade
- **Successor activities:**
  Pouring underlayment

MHr/1 square meter	Estimated Hours
Electrician	
Plumber	3
Assistant	3

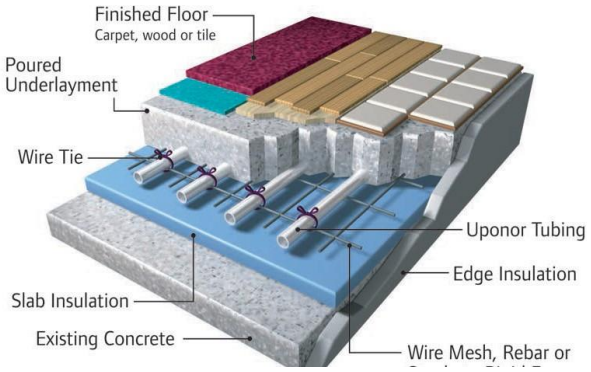


Figure 134: PEX tubing

c) Pouring underlayment: After securing the PEX tubing, concrete underlayment shall be poured.

- **Predecessor activities:**
  PEX tubing installation
- **Successor activities:**
  Sizing and locating manifolds

MHr/1 square meter	Estimated Hours
Electrician	
Plumber	2
Assistant	2

d) Sizing and locating manifolds: Supply and return water connections are made to distribution manifolds, which connect to the floor tubing.

- **Predecessor activities:**
  Poring underlayment
- **Successor activities:**
  Connection to tubing and commissioning

MHr/5Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 135: Sizing and locating

5.5. HVAC Air distribution

Air flow shall be distributed in specific areas by ducting.

Figure 136: Air distribution

5.5.1. Duct Work

A system of ducts used for a particular purpose, as in a ventilation or heating system. Duct is normally made of hot-dip galvanized steel sheets including fittings and connections with secondary steel support. There are two types of duct work here: architectural plenum and under floor air plenum. Since metal is a good thermal conductor, such ducts require thermal insulation, the commonest material for which is glass wool, usually in roll form (known as 'wraps' or 'wrapped insulation'), wrapped around the outer duct wall.

a) Set mounting rings or supports: mounting rings or supports are steel fabricated rings or frames depends on manufacturer's standards.

- **Predecessor activities:**
  Preparing material
- **Successor activities:**
  Duct installation

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

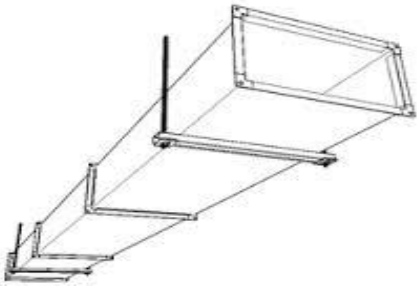


Figure 137: Duct support

b) Duct installation: Connect duct pieces by folding back the insulation and inserting a metal sleeve in between the pieces and using duct tape to keep the sleeves attached.

- **Predecessor activities:**
  Set mounting rings or support
- **Successor activities:**
  Sealing connections

MHr/5 meter	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 138: Duct installation

c) Sealing connections: The longer the distance between your furnace and your room, the more chance there is for the air to escape through tiny holes and cracks along the way. Duct tape will help to minimize heat loss.

- **Predecessor activities:**
  Duct installation
- **Successor activities:**
  Connect to HVAC equipment

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

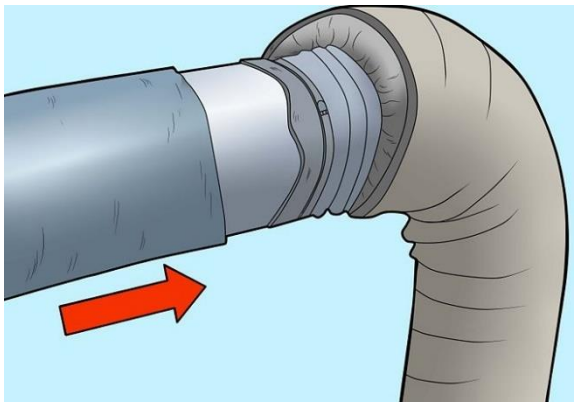


Figure 139: Sealing of connections

5.5.2. Acoustic lining to builders works shafts

Liner Panel is a thick machine made sheet composed of a special processed glass fiber reinforced gypsum core encased in a heavy duty liner board. Shaft Liner Panel is specifically develop to enclose lift shafts, stairwells and service shafts in multistory construction.

Figure 140: Acoustic lining

a) Set mounting supports: mounting supports are steel fabricated frames depends on manufacturer's standards.

- **Predecessor activities:**
  Preparing material
- **Successor activities:**
  Material installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 141: Support installation

b) Material installation: Size and line the acoustic panels inside supports and fix them by fasteners.

- **Predecessor activities:**
  Set supports
- **Successor activities:**
  Jointing and finishing

MHr/5square meter	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 142: Installing

c) Jointing and finishing: different liners shall be joined by plasterboard jointers.

- **Predecessor activities:**
  Material installation
- **Successor activities:**
  Cleaning and usage

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 143: Jointing and finishing

5.5.3. Air diffusers

Diffusers are very common in heating, ventilating, and air-conditioning systems. Diffusers are used on both all-air and air-water HVAC systems, as part of room air distribution subsystems. Air diffusers divided into various types such as linear diffuser, ceiling diffuser and under floor air swirl diffusers.

Figure 146: Under floor air swirl diffuser

Figure 146: linear diffuser

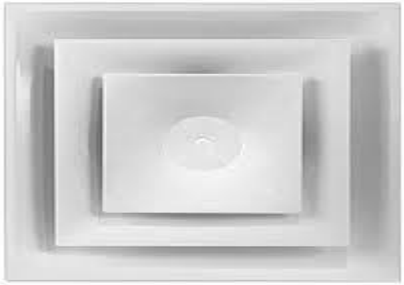


Figure 146: Ceiling diffuser

a) Duct Work: Before installing diffuser, ducts shall be installed as it is instructed.

- **Predecessor activities:**
  Preparing material
- **Successor activities:**
  Installing diffuser

MHr/5 meter	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 147: Diffuser installation

b) Installing diffuser: diffusers in all types shall be installed in position and fixed with screw to the floor, ceil or wall.

- **Predecessor activities:**
  Duct works
- **Successor activities:**
  Cleaning and usage

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

5.5.4. Volume Control Damper (VCD)

Multi-leaf opposed blade type each damper comprising narrow width low profile aero foil blades. A damper is a valve or plate that stops or regulates the flow of air inside a duct, chimney, VAV box, air handler, or other air handling equipment. A damper may be used to cut off central air conditioning (heating or cooling) to an unused room, or to regulate it for room-by-room temperature and climate control.

Figure 148: Multi-leaf opposed blade VCD

a) Duct Work: Before installing VCD, ducts shall be installed as it is instructed.

- **Predecessor activities:**
  Preparing material
- **Successor activities:**
  Installing framing and damper

MHr/5 meters	Estimated Hours
Electrician	
Plumber	2
Assistant	2

b) Installing framing and damper: The ductwork or plenums that the damper is to be attached must be securely supported and diagonally square. The surface that the damper is to be attached must also be flat.

- **Predecessor activities:**
  Duct work
- **Successor activities:**
  Bearing installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 149: framing installation

c) Bearing installation: Blades turn by a shaft and bearing combination. This assembly shall be precisely fit and aligned with framing and blades.

- **Predecessor activities:**
  Framing installation
- **Successor activities:**
  Alignment and start-up

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

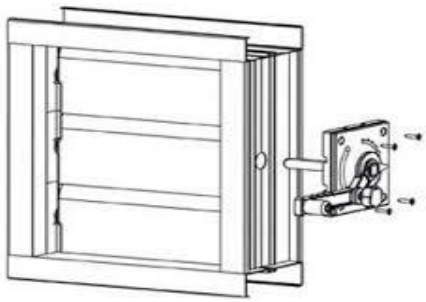


Figure 150: bearing installation

5.5.5. Fire/Smoke Damper (FSD/FD)

Multi-leaf opposed blade type; each damper comprising narrow width low profile aero foil blades. Fire/smoke dampers are similar to fire dampers in fire resistance rating, and also prevent the spread of smoke inside the ducts. When a rise in temperature occurs, the fire damper closes, usually activated by a thermal element which melts at temperatures higher than ambient but low enough to indicate the presence of a fire, allowing springs to close the damper blades.

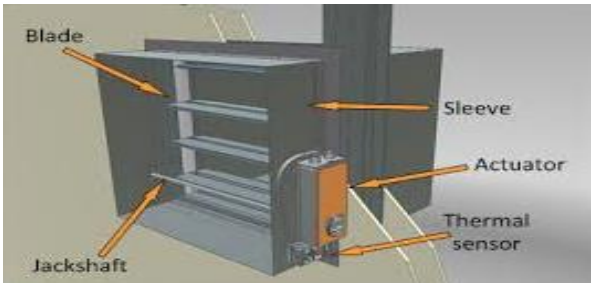


Figure 151: FSD/FD

a) Installation: installation process is completely the same as VCD installation. The last step would be installation of actuator and electric wiring.

- **Predecessor activities:**
  Preparing material
- **Successor activities:**
  Actuator installing and electric connection

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 152: Actuator installation

5.6. HVAC Air cleaning devices

An air purifier is a device which removes contaminants from the air. These devices are commonly marketed as being beneficial to allergy sufferers and asthmatics, and at reducing or eliminating second-hand tobacco smoke. Louvers are common type of ACDs in building.
Louvre: Weather resistant Louvre and Exhaust Air Louver provide good protection to keep rain, leaves and birds from getting into the outdoor and exhaust air openings of ventilation systems.

Figure 153: Louvre installation

a) Installation: installation of Louvre is a simple process including positioning and bolting frame to the masonry frame that would be in wall or other areas of building.

- **Predecessor activities:**
  Preparing material
- **Successor activities:**
  Usage

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

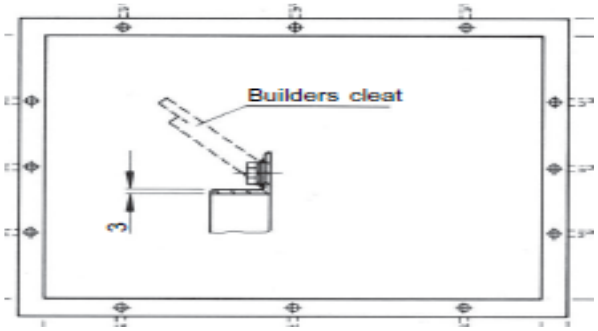


Figure 154: bolting to the wall

5.7. HVAC Equipment

including air separators, plate heat exchangers, chilled water pumps, roof irrigation pumps, radiant cooling pumps, kitchen exhaust precipitators, variable air volume unit, chilled water fan coil unit, air handling units, air movers, Parking exhaust fan, Parking supply fan, Toilet exhaust fan, Return fans, Impulse fan and Sound Attenuators.

5.7.1. Plate heat exchangers

A plate heat exchanger is a type of heat exchanger that uses metal plates to transfer heat between two fluids.

a) Equipment installation: Like every other equipment, heat exchangers need to be installed on foundation which can be a concrete foundation or building floor. Using expansion bolts, chemical bolts or anchor bolts, the set of framing and exchanger plates with other piping spools shall be installed in accordance with drawings.

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 155: plate heat exchanger installation

b) Mechanical completion: including final grouting, anchor bolt tightening and adjusting bolt fixing.

- **Predecessor activities:**
  Equipment installation
- **Successor activities:**
  Pipe works

MHr/Item	Estimated Hours
Electrician	
Plumber	1.5
Assistant	1.5

Figure 156: anchor bolt tightening

c) Pipe works: connecting to piping system and to other processing utilities, inlet and outlet parts of plate heat exchangers shall be connected to pipe lines.

- **Predecessor activities:**
  Mechanical completion
- **Successor activities:**
  Testing and commissioning

MHr/5 meters	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 157: Pipe works

5.7.2. Kitchen exhaust precipitator

Pollution control equipment is being used for other reasons such as kitchens in high-rise buildings to allow the exhaust to discharge out the side of the structure saving the cost of running the duct up many floors to the roof.

a) Equipment installation: kitchen exhaust precipitator shall be installed in masonry framing or by means of supports or hangers depending on designing and engineering drawings. Normally this equipment has brackets or hangers for bolting to the floor or ceil.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Mechanical completion

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 158: installation by hangers

b) Mechanical completion: including connecting to ducts and power supply.

- **Predecessor activities:**
  Equipment installation
- **Successor activities:**
  Testing and commissioning

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

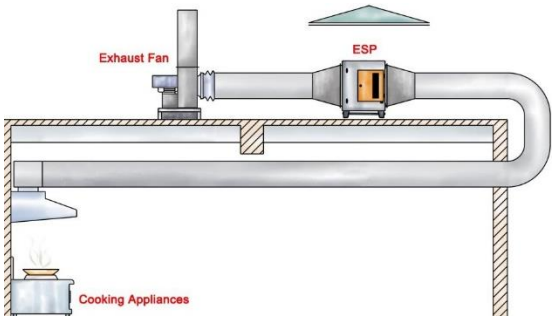


Figure 159: mechanical completion

5.7.3. Variable air volume unit

A variable-air-volume (VAV) air-conditioning system varies the volume of constant temperature air that is supplied to meet the changing load conditions of the space. Installation process id including equipment installation, mechanical completion and commissioning that has been completely described here.

Figure 160: VAV

5.7.4. Chilled water fan coil unit

A fan coil unit (FCU) is a simple device consisting of a heating or cooling coil and fan. It is part of an HVAC system found in residential, commercial, and industrial buildings. Typically a fan coil unit is not connected to ductwork, and is used to control the temperature in the space where it is installed, or serve multiple spaces. It is controlled either by a manual on/off switch or by thermostat.

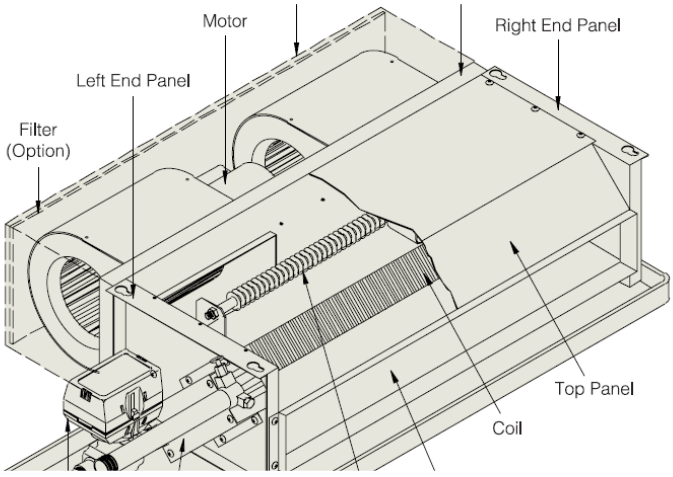


Figure 161: chilled water fan coil unit

5.7.5. Air handling units

An air handler, or air handling unit (often abbreviated to AHU), is a device used to condition and circulate air as part of a heating, ventilating, and air-conditioning (HVAC) system. An air handler is usually a large metal box containing a blower, heating or cooling elements, filter racks or chambers, sound attenuators, and dampers.

Figure 162: Air handling unit

5.7.6. Air movers: (AIR MOVER)

A specialized mechanically operated drying unit that promotes evaporation. Air movers incorporate an electric motor, fan and specially designed housing for use in drying carpet, cushion, and sub floors or structural components (wood floors, walls etc.).

Figure 163: Air mover

Parking exhaust fan, Parking supply fan, Toilet exhaust fan, Return fans, Impulse fan: Any device for producing a current of air by the movement of a broad surface or a number of such surfaces.

Parking exhaust, impulse and return fan: Jet fans are increasingly preferred over traditional ducted systems as a means of ventilating pollutants from large spaces such as car parking buildings. Installation procedure is the same procedure for other ducted equipment.

Figure 164: parking exhaust fan

Parking supply fan: Depending on the ventilation concept of the individual car park and the defined safety standards, supply fans in addition to the exhaust fans may be installed. Installation procedure is the same procedure for other ducted equipment.

Figure 165: parking supply fan

Sound Attenuators: An assembly installed in a duct system to absorb sound. Attenuators are electronic devices that decrease the amplitude or power of a signal without considerably distorting its waveform. They are passive devices that are made from simple voltage divider networks. These equipment are duct inline equipment that shall be bolted to dusts.

Figure 166: Sound Attenuator

5.8. Chiller

A machine for cooling something, especially a cold cabinet or refrigerator for keeping stored food a few degrees above freezing point.

Figure 167: Chiller Assembly

a) Lifting the Unit: Installation, start up and adjustment of this equipment can be dangerous if certain system specific factors are ignored, such as operating pressures, electrical components, location (roofs, terraces and other structures located well above ground level).

- **Predecessor activities:**
  Received material should be checked against approved lists for any abnormalities.
- **Successor activities:**
  LAY-OUT AND INSTALLATION

MHr/Item	Estimated Hours
Electrician	
Plumber	1.5
Assistant	1.5

Figure 168: lifting the chiller unit

b) LAY-OUT AND INSTALLATION: On normal applications, unit rigidity and point load positions enable installation to minimize vibrations. Use of vibration isolators MUST be accompanied by installation of flexible connections in the unit water piping. Vibration isolators must also be fixed to the unit BEFORE being fixed to the ground. The unit must be bolted to the vibration isolators and the latter solidly fixed into the concrete slab.

- **Predecessor activities:**
  Lifting the unit
- **Successor activities:**
  Chilled water piping

MHr/Item	Estimated Hours
Electrician	
Plumber	1.5
Assistant	1.5

Figure 169: lay out

c) Chilled water piping and valves: The water pipes connected to the unit must not transmit any radial or axial force to the heat exchangers or any vibration. It is important to follow non exhaustive recommendations here under:

- Comply with the water inlet and outlet connections shown on the unit.
- Install manual or automatic air purge valves at all high points in the circuit.
- Install a safety valve as well as an expansion tank to maintain the circuit pressure. This option may be included inside the unit.
- Install thermometers in both the entering and leaving water connections.
- Install drain connections at all low points to allow the whole circuit to be drained.
- Install stop valves, close to the entering and leaving water connections.

- **predecessor activities:**
  Lay out and installation
- **Successor activities:**
  Chilled water insulation

MHr/5meters	Estimated Hours
Electrician	
Plumber	5
Assistant	5

Figure 170: Piping and Valves

d) Chilled water insulation: Insulate all pipe work, to reduce thermal leaks and to prevent condensation. If the external water pipes are in an area, where the ambient temperature is likely to fall below 0°C, insulate.

- **Predecessor activities:**
  Chilled water piping and valves
- **Successor activities:**
  ELECTRICAL CONNECTIONS

MHr/5meters	Estimated Hours
Electrician	
Plumber	4
Assistant	4

Figure 171: chilled water insulation

e) ELECTRICAL cabling and connection: First of all, make sure that power supplies from the building to the place where the unit is installed are properly established and that wire gauges are in keeping with the start up and running currents. Check tightness of all electrical connections.

- **Predecessor activities:**
  Chilled water insulation
- **Successor activities:**
  Pre commissioning

MHr/5meters	Estimated Hour
Electrician	2
Plumber	
Assistant	2

Figure 172: Electrical connection

Chapter 6: Division 25 - Integrated Automation

Totally integrated automation (TIA) is a strategy (philosophies/architecture) in the automation technology, which was developed since 1996 by Siemens Automation and Drives. This strategy defines the interaction of extensive single components, tool (SW) and the services (spare part service, etc.) to achieve an Automation solution. The interaction performs integration across the four automation levels of the automation pyramid:

- Management level
- Operator's level
- Controller's level
- Field level

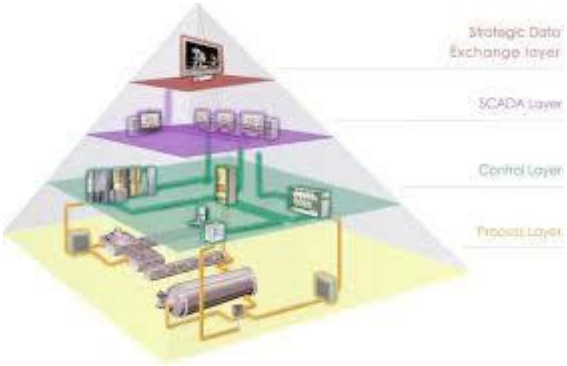


Figure 173: Automation control pyramid

6.1. Building management system and automatic controls (BMS)

Many aspects of control are presented including air handling units, terminal units, chillers, boilers, building airflow, water and steam distribution systems, smoke management, and indoor air quality. Control fundamentals, theory, and types of controls provide background for application of controls to heating, ventilating, and air conditioning systems. Discussions of pneumatic, electric, electronic, and digital controls illustrate that applications may use one or more of several different control methods. Engineering data such as equipment sizing, use of psychometric charts, and conversion formulas supplement and support the control information. To enhance understanding, definitions of terms are provided within individual sections.

Building management systems have evolved into a major consideration for the control engineer when evaluating a total heating, ventilating, and air conditioning system design. In response to this consideration, the basics of building management systems configuration are presented.

The control recommendations in this manual are general in nature and are not the basis for any specific job or installation. Control systems are furnished according to the plans and specifications prepared by the control engineer. In many instances there is more than one control solution. Professional expertise and judgment are required for the design of a control system.

The control system for a commercial building comprises many control loops and can be divided into central system and local- or zone-control loops. For maximum comfort and efficiency, all control loops should be tied together to share information and system commands using a building management system. Refer to the Building Management System.

The basic control loops in a central air handling system can be classified as shown in figure 160. Depending on the system, other controls may be required for optimum performance. Local or zone controls depend on the type of terminal units used.

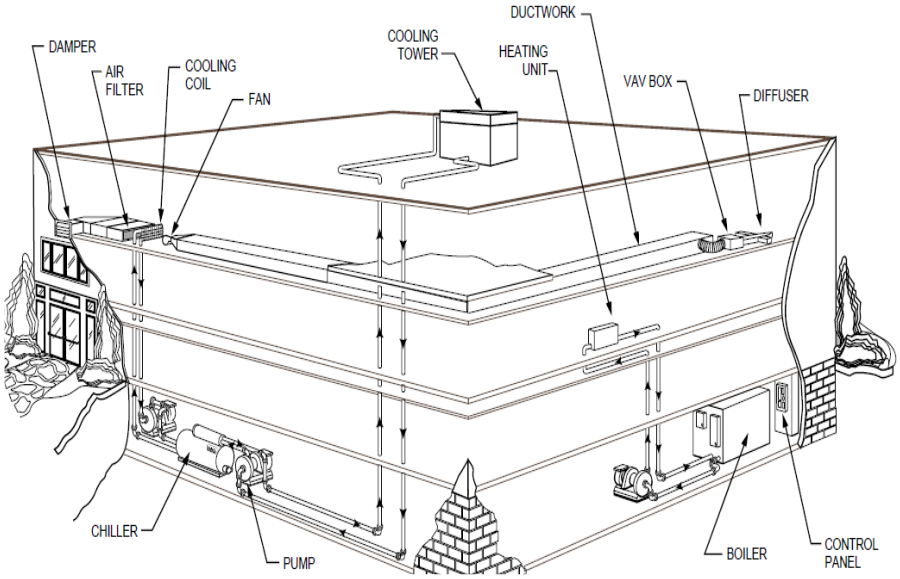


Figure 174: Typical HVAC

a) System Configurations: including hardware configuration, zone level controllers, system level controllers, operation level processors, management-level processors, communication protocols and peer communication protocols.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Set up

MHr/Item	Estimated Hours
Electrician	5
Plumber	5
Assistant	10

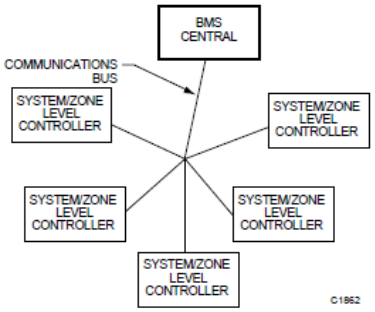


Figure 175: System configuration

b) System Functions: including ZONE-LEVEL CONTROLLER FUNCTIONS, SYSTEM-LEVEL CONTROLLER FUNCTIONS, OPERATIONS-LEVEL FUNCTIONS (SOFTWARE, Standard Software, Communications Software, Server, Security, Reports, Alarm Processing, System Text, System Graphics and Controller Support), OPERATION

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Set up

MHr/Item	Estimated Hours
Electrician	4
Plumber	4

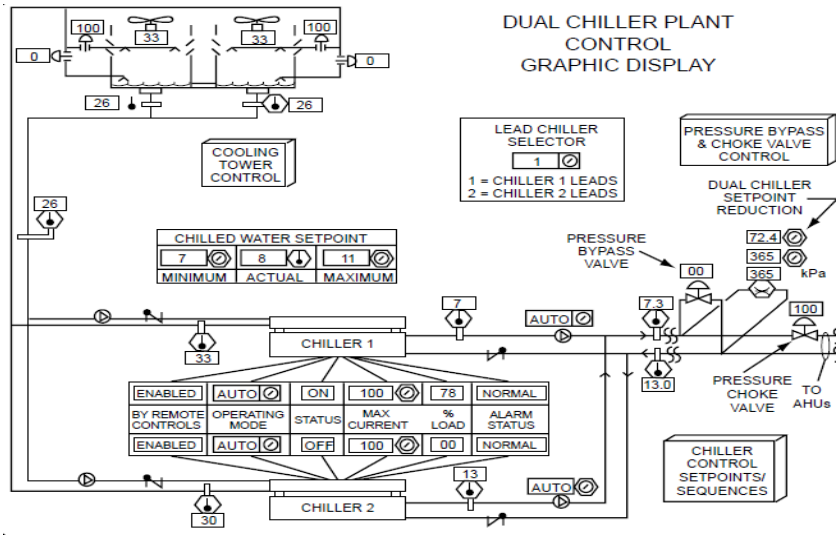


Figure 176: System Functions

c) Integration of Other Systems: including SURFACE INTEGRATION and IN-DEPTH INTEGRATION. A surface integrated subsystem is a stand-alone system which provides certain point information to the BMS.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Set up

MHr/Item	Estimated Hours
Electrician	5
Plumber	5

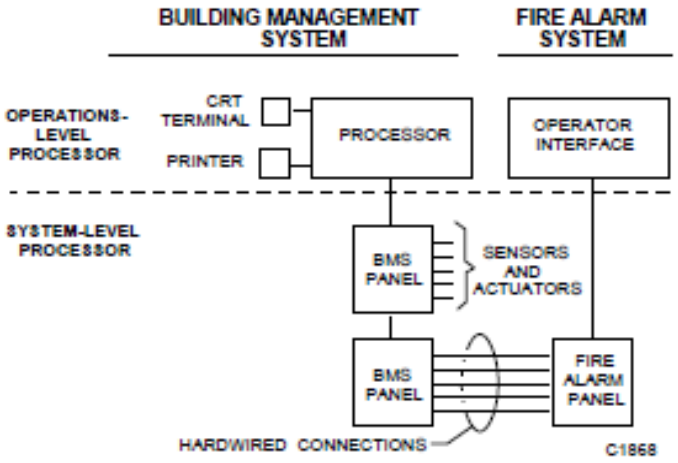


Figure 177: Surface integration

Chapter 7: Division 26 - Electrical

6.2. LV and MV Electrical distribution

Electricity distribution is the final stage in the delivery of electricity to end users. A distribution system's network carries electricity from the transmission system and delivers it to consumers. Typically, the network would include medium-voltage (2kV to 34.5kV)[1] power lines, substations and pole-mounted transformers, low-voltage (less than 1 kV) distribution wiring such as a Service Drop and sometimes meters.

General Activity: Liaise with electrical supply authority SEC and to co-ordinate supply and connection of the main incomer.

The liaison between electrical supply authority and project manager shall be done according to state electrical commission roles and project charter and scope statement.

Figure 178: Electrical supply commission

MV, LV and HV Switchgear: In an electric power system, a switchgear is the combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgears are used both to de-energize equipment to allow work to be done and to clear faults downstream. This type of equipment is directly linked to the reliability of the electricity supply.

Figure 179: switchgear layout

d) Receiving, handling and storage: it is necessary to store the equipment before installation, keep it in a clean, dry location with ample air circulation and heat to prevent condensation. Like all electrical apparatus, these units contain insulation that must be protected against dirt and moisture.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Assembly and installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 180: Receiving, handling and storage

e) Assembly and Installation: Refer to the front view on the switchgear assembly drawing supplied with the switchgear. Beneath this view, shipping splits will be identified in relation to group numbers for each vertical section.

- **Predecessor activities:**
  Receiving, handling and storage
- **Successor activities:**
  Assembly and Installation

MHr/Item	Estimated Hours
Electrician	2
Plumber	2
Assistant	2

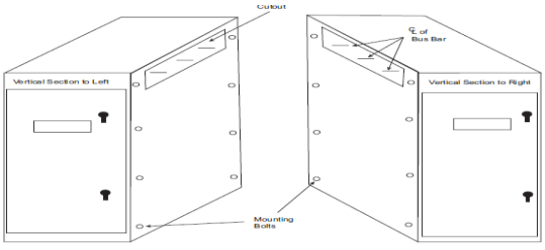


Figure 181: assembly

f) Assembly and Installation: Position the shipping sections next to each other. The holes will match holes in adjacent side sheets. In some cases, it may be necessary to use of an aligning tool such as a punch to move the structures into alignment.

- **Predecessor activities:**
  Assembly and installation
- **Successor activities:**
  Connection of Switchgear to the Transformer

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

g) Connection of Switchgear to the Transformer: Move the switchgear to match the holes on the side that will face the transformer to the matching holes in the transformer case. Minor misalignment may be corrected with a tapered guiding rod of some kind. Insert the hardware and tighten and then cables shall be connected.

- **Predecessor activities:**
  Assembly and installation
- **Successor activities:**
  Connection of motor control center

MHr/Item	Estimated Hours
Electrician	1.5
Plumber	
Assistant	1.5

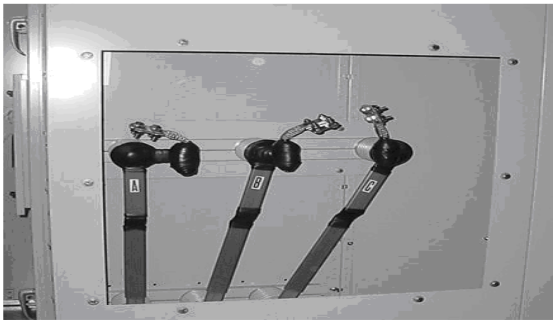


Figure 182: Connection to transformer

h) Connection of motor control center: Holes are pre-drilled in the side of the switchgear structure to match holes provided in the MCC. Bolt the units together using hardware furnished with the switchgear.

- **Predecessor activities:**
  Connection of Switchgear to the Transformer
- **Successor activities:**
  Connections to a Metal Clad Switchgear Assembly

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

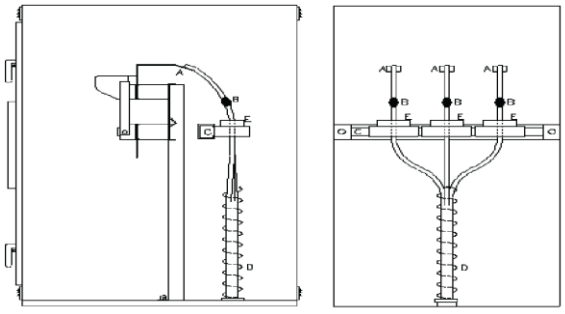


Figure 183: connection to MCC

i) Connections to a Metal Clad Switchgear Assembly: Position the units side by side. The holes in side sheet around bus cutout will match the holes in metal clad switchgear flange. Join the enclosures using the bolts supplied with switchgear. The opposite side of the metal clad switchgear flange has nuts welded in place for ease of connection.

- **Predecessor activities:**
  Connection of motor control center
- **Successor activities:**
  Connection of Customer Power Cables

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

j) Connection of Customer Power Cables: For incoming power, the terminals are usually located at the top of the switch in a vertical section.

- **Predecessor activities:**
  Connections to a Metal Clad Switchgear Assembly
- **Successor activities:**
  Field Insulation

MHr/10meters	Estimated Hours
Electrician	2
Plumber	
Assistant	2

k) Field insulation methods: Clean the area of dirt and foreign matter. Use a clean, dry cloth or, if necessary, dampen slightly with distilled water. Do not use any abrasives or solvents. Place the boot over the joint so it fits in place. Fasten together with plastic wire ties. Cut off excess ends of plastic wire ties.

- **Predecessor activities:**
  Connection of Customer Power Cables
- **Successor activities:**
  Securing Switchgear Assemblies to Foundations

MHr/Item	Estimated Hours
Electrician	
Plumber	5
Assistant	5

Figure 184: Field insulation

l) Securing Switchgear Assemblies to Foundations: It shall be followed the instructions on the specific drawings provided for the switchgear assembly that address the anchoring details. Another drawing addresses the load bearing requirements. Indoor or outdoor vertical sections are secured using clips and foundation bolts. Anchors and lag screws may be used in place of J-bolts if desired.

- **Predecessor activities:**
  Field insulation methods
- **Successor activities:**
  Start-up

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 185: Securing to foundation

6.3. Transformer

A transformer is an electrical device that transfers energy between two circuits through electromagnetic induction. A transformer may be used as a safe and efficient voltage converter to change the AC voltage at its input to a higher or lower voltage at its output without changing the frequency. Other uses include current conversion, isolation with or without changing voltage and impedance conversion.

Figure 186: transformer installation

a) Storage: Liquid filled transformers can be stored for extended periods of time before being placed into service, if properly prepared. Liquid filled transformers may be stored outdoors. It is recommended that the transformer be completely assembled prior to storage. Storage instruction shall be carefully followed in accordance with manufacturer's manual.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Installation location

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

b) Installation location: The installation location of a transformer must be carefully considered. Transformers, as is the case with most electrical equipment, generate a substantial amount of heat during operation. This heat must be removed in order to allow the transformer to maintain its designed maximum temperature limits.

- **Predecessor activities:**
  Storage
- **Successor activities:**
  Assembly

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 187: installation location

c) Assembly: These items should be reassembled in the following order: De-mounted Radiators, Bushings, Pressure Relief Device, Pressure Vacuum Gauge, Fans, Rapid Pressure Rise Relay and Lightning Arrestors.

- **Predecessor activities:**
  Installation location
- **Successor activities:**
  Cooling fans installation

MHr/Item	Estimated Hours
Electrician	
Plumber	6
Assistant	6

Figure 188: transformer site assembly

d) Cooling fans installation: Cooling fans serve to increase the transformer's load capacity and to avoid overheating the windings. The fans are controlled by a "Manual" and "Auto" switch, and by contacts in either the winding or fluid temperature gauges.

- **Predecessor activities:**
  Assembly
- **Successor activities:**
  Installation of Conservator

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 189: Cooling fans installation

e) Installation of Conservator: Install the support structure to install the conservator on the tank, Lift the conservator with the help of lifting eyes/lugs on the top, and place it in position on the support structure and connect the pipe circuit between the conservator and the tank. In case a Buchholz relay is used, check the direction of the oil flow in the relay before mounting.

- **Predecessor activities:**
  Cooling fans installation
- **Successor activities:**
  Cable boxes installation

MHr/Item	Estimated Hours
Electrician	
Plumber	3
Assistant	3

Figure 190: Conservator installation

f) Cable boxes installation: include Compound Filled Cable Box and Air Filled Cable Box. If cable boxes are supplied separately, they should first be fitted on the tank with the proper gasket joints. After making the suitable end-termination and connection with the terminal bushings, the box should be filled up to the correct level with suitable filling medium.

- **Predecessor activities:**
  Conservator installation
- **Successor activities:**
  Closing

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

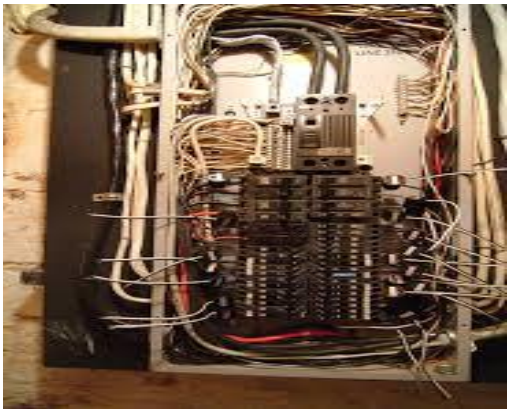


Figure 191: Cable box installation

g) Closing: Lubricate the gasket with petroleum jelly or transformer oil, Place gasket around the manhole opening, making sure the colored dots are facing up, Firmly press the gasket down until stopped by the rim, Place the cover over the gasket and press firmly into position. Verify that the gap between the cover and the manhole rib is equally spaced all around and bolting and Break vacuum with dry nitrogen and apply nitrogen to the gas space.

- **Predecessor activities:**
  Cable box installation
- **Successor activities:**
  Cooling radiator installation

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 192: Closing

h) Cooling radiator installation: If shipped separately, all radiators, pipe work and headers should be inspected & cleaned and flushed with clean, dry oil before fitting, this only the case if contaminated. These should be assembled according to the drawings. After assembly of radiators, the shut off valves provided at the top and bottom should be opened. This will allow the radiators to be filled with clean, dry transformer oil. Air should be released from the top of the header of each radiator.

- **Predecessor activities:**
  Closing
- **Successor activities:**
  Earthing connection and paint work

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 193: Cooling radiant installation

i) Earthing connection and paint work: Earthing connection(s) with a good low resistance are essential for adequate protection against electrical faults. Pain work include the first, which is applied to the clean metal surface, is a primary coat, followed by an intermediate coat, and then a final, finishing coat as per relevant specifications.

- **Predecessor activities:**
  Cooling radiant installation
- **Successor activities:**
  Energizing and commissioning

MHr/Item	Estimated Hours
Electrician	1
Plumber	1
Assistant	1

Figure 194: Earthing

6.4. Cable distribution

Including splicing, connections and terminations, test and commissioning.

a) Cable splicing: A joint in electrical cable is called cable splicing. There are different ways to joint cables that shall be done according to project ITP and P&IDs.

- **Predecessor activities:**
  Cable preparation
- **Successor activities:**
  Connection and termination

MHr/3meter	Estimated Hours
Electrician	2
Plumber	
Assistant	2

Figure 195: Cable splicing

b) Connection and termination: RF frequency signals travelling in coaxial cable will reflect off any impedance that does not match the 75-ohm impedance of the cable. This will cause serious signal distortion. For this reason, the ends of all the trunk and distribution cables are terminated with a 75-ohm load to ground.

- **Predecessor activities:**
  Cable splicing
- **Successor activities:**
  Commissioning

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

Figure 196: Termination

6.5. Pump Control panel

Electrical device consisting of a flat insulated surface that contains switches and dials and meters for controlling other electrical devices. Normally, control panel is installed in pump frame and just need to connect electric cables and termination.

Figure 197: control panel

6.6. Automatic transfer switch

A transfer switch is an electrical switch that switches a load between two sources. Some transfer switches are manual, in that an operator effects the transfer by throwing a switch, while others are automatic and switch when they sense one of the sources has lost or gained power. This equipment shall be simply bolted to the wall or masonry farming. Electrical cables shall be connected and terminated.

Figure 198: transfer switch

6.7. Power distribution Board

The power distribution board distributes power from the battery to the robot components. Some people with acute hearing notice a high-pitched humming coming from the board; this noise is from the circuits that convert the battery's energy to different voltages. It is simply bolted inside the panel.

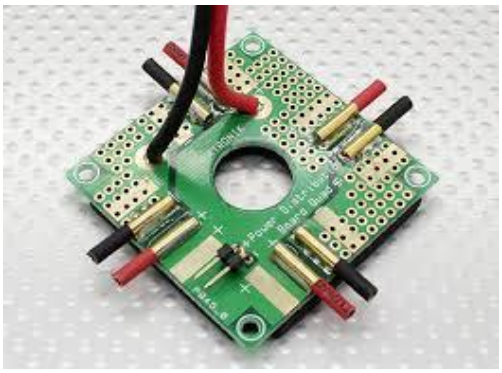


Figure 199: power distribution board

6.8. Isolator and socket outlet points

Lock out, quarantine or other means by which plant and equipment is removed from its source of energy and prevented from being inadvertently operated. A socket for an electric plug that is fixed to a wall and connected to an electricity supply.

Figure 201: Socket outlet

Figure 201: Isolator points

Isolator: including duplex and triplex booster, double and triple isolator, motor connections and etc. All of mentioned devices have a simple procedure to install. There are holes designed in these devices to be bolted to the panel or wall. Connections shall be done according to drawings before start-up.

Socket outlets: including single and double outlets. These devices also have a simple procedure to install. There are holes designed in these devices to be bolted to the panel or wall. Connections shall be done according to drawings before start-up.

6.9. Facility electrical power generation and storing equipment

Electricity generation is the process of generating electric power from other sources of primary energy.

Generator: an electric generator is a device that converts mechanical energy to electrical energy. A generator forces electric current to flow through an external circuit. Installation procedure in here

Central battery system: A battery management system (BMS) is any electronic system that manages a rechargeable battery (cell or battery pack), such as by protecting the battery from operating outside its Safe Operating Area, monitoring its state, calculating secondary data, reporting that data, controlling its environment, authenticating it and / or balancing it.

Figure 202: Central battery system

a) System installation: In the starting phase, the main switch must be in position 0 and the battery fuse must not be connected. The batteries are always placed in a separate battery container. The battery temperature sensor shall be placed between the batteries.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Connecting to main supply

MHr/Item	Estimated Hours
Electrician	.5
Plumber	2
Assistant	2

b) Connecting to main supply: Bring the mains supply cable to the connectors L, PE and N. After this, connect the maintained and non-maintained groups to group cards.

- **Predecessor activities:**
  System installation
- **Successor activities:**
  Implementation

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

c) Implementation: At the factory, the central battery unit and the lights are subjected to voltage withstand test, insulation resistance test and grounding connectivity tests according to the Low Voltage Directive. During the final insulation resistance testing of the installed system, the mains input and group outputs of the unit must be short-circuited.

Predecessor activities:
Connecting to main supply

- **Successor activities:**
  Usage

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

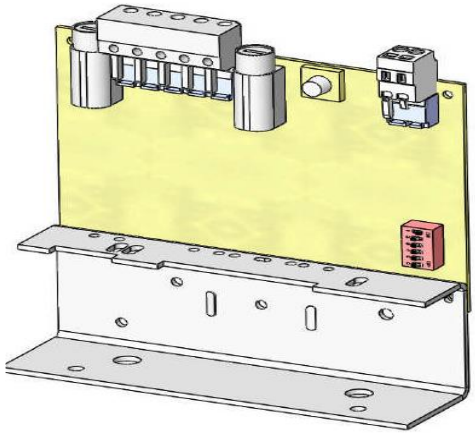


Figure 203: Implementation

6.10. Electrical and CATHODIC protection

CATHODIC Protection (CP) is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell. A simple method of protection connects protected metal to a more easily corroded "sacrificial metal" to act as the anode. The sacrificial metal then corrodes instead of the protected metal. For structures such as long pipelines, where passive galvanic CATHODIC protection is not adequate, an external DC electrical power source is used to provide sufficient current.

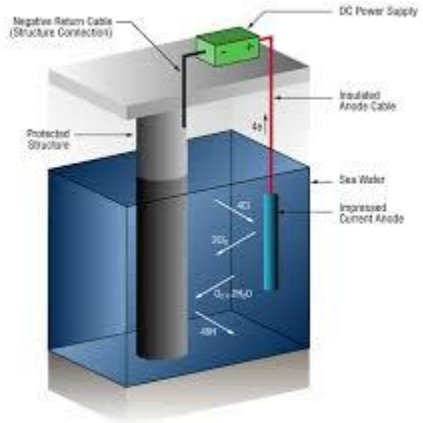


Figure 204: CATHODIC protection

a) Carbon Steel Bracket installation: Various constructions may be used, but some of the main features include:
   - Pigtail wire in air to allow frost heave movement
   - Bracket to protect wire
   - Anti-corrosion paint application to prevent atmospheric corrosion

Figure 205: Bracket installation

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Wire connection

MHr/Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

b) Installation and wiring: CATHODIC protection wire shall be protected from mechanical damage by location. They may be used in the following locations:
   - wellheads and flow lines, with a hole for the flange bolt
   - tanks (welded or bolted)
   - vessels (at the shoe)
   - pipes
   - buildings and structures

- **Predecessor activities:**
  Bracket installation
- **Successor activities:**
  Splicing and termination

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

c) Splicing and termination: Splicing include split bolt or high pressure compression fittings. Termination Terminations (other than underground connections to structures) shall be: above grade or accessible, suitable for the location they are installed in, mechanically reliable and secure.

- **Predecessor activities:**
  Wire connection
- **Successor activities:**
  Splicing and termination

MHr/Item	Estimated Hours
Electrician	
Plumber	1.5
Assistant	1.5

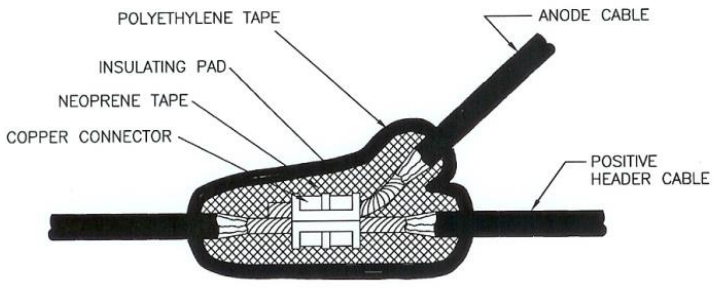


Figure 206: Splicing and termination

6.11. Lighting Installation:

Including occupancy sensors, Luminaires and lighting control system.

Occupancy sensors: An occupancy sensor is a lighting control device that detects occupancy of a space by people and turns the lights on or off automatically, using infrared or ultrasonic technology.

a) Installation Location: for indoor use only and is designed to recess mount into the ceiling with the best location being in the center of the room.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Installation

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

Figure 207: installation location

b) Installation: cut the hole in ceiling and depress the outer ends of the spring clips towards the center of the unit and push the unit through the hole until it rests flat on the ceiling.

- **Predecessor activities:**
  Installation location
- **Successor activities:**
  Network Connection

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

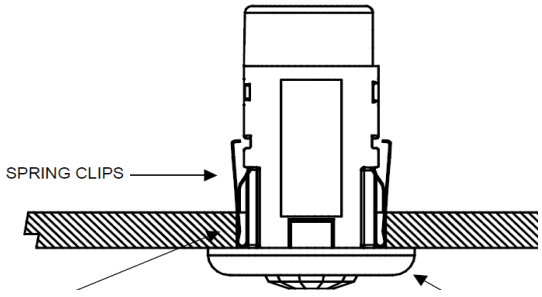


Figure 208: Installation

c) Network connection: It is the responsibility of the installer to ensure that the unit is wired to meet local electrical and building codes.

- **Predecessor activities:**
  Installation
- **Successor activities:**
  Test and commissioning

MHr/Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

6.11.1. Luminaires

Including all lamps, bulbs which shall be simply installed in place.

MHr/10Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

Figure 209: luminaires

6.11.2. Lighting control system

A lighting control system is an intelligent network based lighting control solution that incorporates communication between various system inputs and outputs related to lighting control with the use of one or more central computing devices.

6.11.3. General Knowledge

A building can be compared to a system with a variety of physical processes interacting with each other and with the environment. From the control point of view, it is considered as having multivariate dynamic subsystems showing linear or non-linear behaviors. Environmental and occupancy changes in a building increase the complexity of control operations. Occupants not only impose control goals related to thermal comfort, visual comfort or indoor air quality but also influence the building processes impacting indirectly on the control functions of the different processes (HVAC, lighting, etc.).

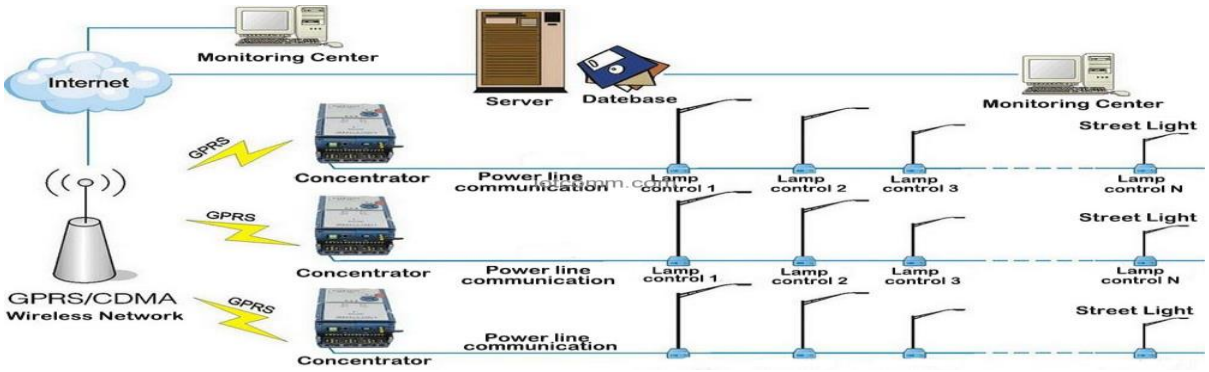


Figure 210: lighting control system

MHr/Item	Estimated Hours
Electrician	10
Network engineer	10
Assistant	10

Chapter 8: Division 27 - Communications

7.1. Communications installation

Including telecommunications cabling, telecommunication conduit system, telecommunication antenna system, telecommunication accessories and telecommunication equipment.

7.1.1. Telecommunication cabling

Including fiber optic cable, voice and data cabling mounting, splicing, and connection and termination activities.

Fiber optic/voice and data cabling: An optical fiber is a flexible, transparent fiber made of high quality extruded glass or plastic, slightly thicker than a human hair. It can function as a waveguide, or "light pipe", to transmit light between the two ends of the fiber.

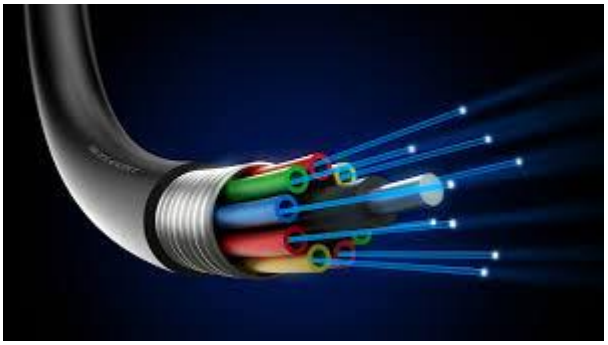


Figure 211: Fibre optic cable

a) Pulling cable: using a cable pulling reel, cables shall be pulled carefully not to exceed the identified pulling tension. Cables shall run into optical patch panel in residential level floor to be spliced and connected.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Splicing

MHr/10meter	Estimated Hours
Electrician	1
Plumber	1
Assistant	1

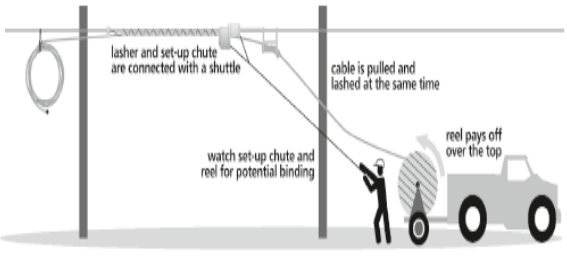


Figure 212: Cable pulling

b) Splicing: The buffer tube must be carefully trimmed to reveal the fibers. Use a buffer tube cutter to score the buffer tube in intervals specific dimensions. Flex the buffer tube back and forth until it snaps, then slide the tube off the fibers. The splice enclosure instruction will tell you how far back to remove the buffer tubes.

- **Predecessor activities:**
  Cable pulling
- **Successor activities:**
  Connection and termination

MHr/Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

Figure 213: Splicing

c) Connection and termination: spliced cables shall be connected to each FTR carefully.

- **Predecessor activities:**
  Splicing
- **Successor activities:**
  -

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

Figure 214: Connection and termination

7.1.2. Telecommunication conduit system

A common method for routing cable through building walls and floors. Specify bushings at the conduit ends to avoid damage to cable sheaths.

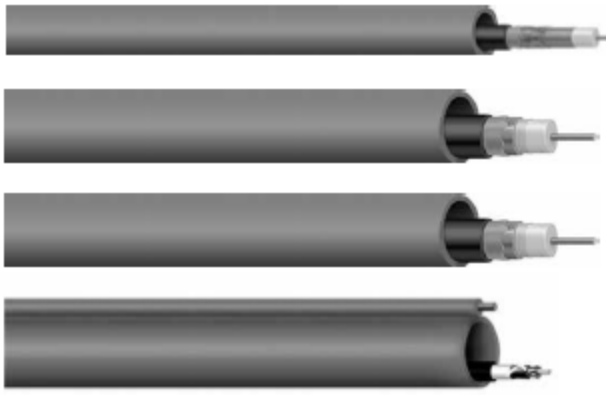


Figure 215: Conduit system

a) Conduit Pay-off: When installing conduit, pay-off the reel from underneath and in as direct a line as possible to the trench to avoid unnecessary bending of the conduit or rubbing of the conduit against the reel flange. When feeding conduit into a manhole, pay-off should occur from the top of the reel with the manhole on the opposite side from the direction of pull.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Conduit cutting

MHr/Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

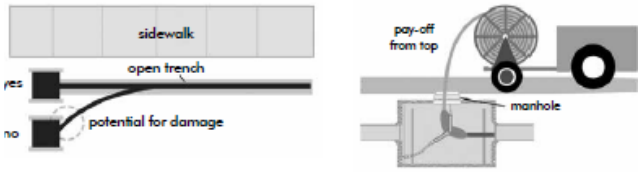


Figure 216: Conduit pay-off

b) Conduit cutting: To cut conduit, open the tool and place it around the conduit at the point where the cut is to be made.

- **Predecessor activities:**
  Conduit pay-off
- **Successor activities:**
  -

MHr/Item	Estimated Hours
Electrician	.5
Plumber	
Assistant	.5

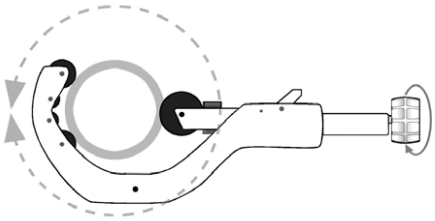


Figure 217: Cutting tool

7.1.3. Telecommunication antenna system

A distributed antenna system, or DAS, is a network of spatially separated antenna nodes connected to a common source via a transport medium that provides wireless service within a geographic area or structure.

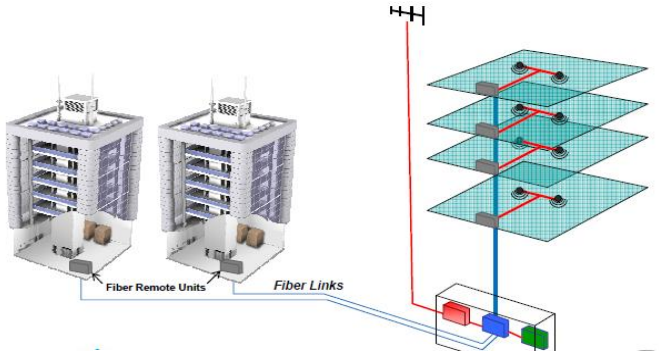


Figure 218: DAS layout

a) Cable pulling: telecommunication cables shall be pulled and brought to nearest place for connecting to in-building antenna system.

Predecessor activities:
Material preparation

- **Successor activities:**
  In-building antenna system installation

MHr/5 meters	Estimated Hours
Electrician	1
Plumber	1
Assistant	1

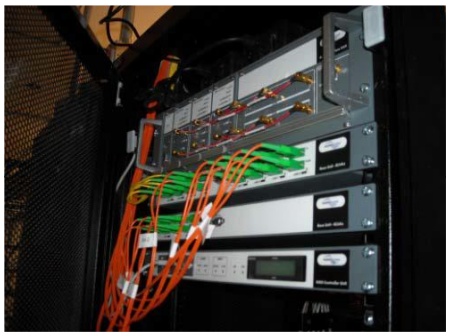


Figure 219: Convection centre

b) In-Building installation: In-Building Distributed Antenna Systems of All Sizes shall be installed including convention centres and distributer head.

- **Predecessor activities:**
  Cable pulling
- **Successor activities:**
  Roof antenna installation

MHr/Item	**Estimated Hours**
Electrician	.5
Plumber	1
Assistant	1

Figure 220: In-building antenna installation

c) Roof antenna installation and connection: floor antenna shall be installed in building floor and cables from convention centers shall be pulled through roof penetrations and connect to the roof antenna.

- **Predecessor activities:**
  In-building installation
- **Successor activities:**
  Commissioning

MHr/Item	Estimated Hours
Electrician	1
Plumber	1
Assistant	1

Figure 221: Roof antenna installation

d) Commissioning: cables shall be tested and all devices shall be commissioned separately.

- **Predecessor activities:**
  In-building installation
- **Successor activities:**
  -

MHr/Item	Estimated Hours
Electrician	1.5
Plumber	
Assistant	1.5

Figure 222: Commissioning

7.1.4. Telecommunication equipment

Including call servers, signal servers, communication racks and fiber patch panels.

a) Call and signal servers: A protocol-specific signalling engine that routes video or voice calls on the network.

MHr/Item	Estimated Hours
Electrician	1.5
Plumber	
Assistant	1.5

Figure 223: Call server

b) Communication racks: A rack server, also called a rack-mounted server, is a computer dedicated to use as a server and designed to be installed in a framework called a rack. These steel framing racks shall be bolted to the floor using expansion bolts.

MHr/Item	Estimated Hours
Electrician	1.5
Plumber	2
Assistant	3

Figure 224: Communication rack

c) Patch panels: a board in a switchboard, computer, or other device with a number of electric sockets that may be connected in various combinations.

MHr/Item	Estimated Hours
Electrician	1
Plumber	
Assistant	1

Figure 225: Patch panel

7.2. Audio-Video Communications Installation

Audio-Video communication cabling: including HDMI, fiber optic cables and voice and data cabling. Installation and operation of these cables match the communication cabling procedure.

Figure 226: Audio video cables

Audio-Video communication accessories: including speakers (ceiling, floor and wall mounted), digital projector, conference equipment (screen, video unit, media receiver and room controller, touch screen panel, presenting mount), cinema equipment, skywalk projector, public address equipment (amplifier, disc player).

a) Pulling cable: By using of conduits or sleeves which shall be drilled in wall, ceiling or floor, relevant cables shall be pulled through and brought into nearest place to connect to equipment. All above equipment shall be installed simply by positioning or bolting to ceiling, wall or floor.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Connecting to power supply

MHr/5 meters	Estimated Hours
Electrician	2
Plumber	2
Assistant	2

Figure 228: conference equipment

Figure 228: Video projector

Chapter 9: Division 28 - Electronic Safety and Security

8.1. Electronic Access Control and Intrusion Detection

The Access Control and Intrusion Detection system is the Software House system which includes a microprocessor based and managed access control system, with options for intrusion detection, and personal protection (duress) security and specifies sensors, detection devices, signal equipment, system controls, and displays.

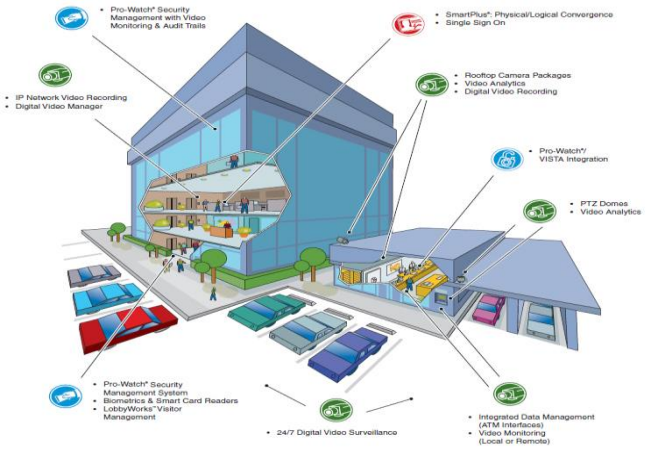


Figure 229: Access Control and Intrusion Detection system

Security and access control cabling: Security and access cabling follows the same instruction which has been described for telecommunication cabling.

Security and access control accessories: including electric door strike, junction box, magnetic lock, panic bar, passive in fared reader and proximity card reader.

8.1.1. Electric door strike and Card reader

An electric strike is an access control device used for doors. It replaces the fixed strike faceplate often used with a latch bar. Like a fixed strike, it normally presents a ramped surface to the locking latch allowing the door to close and latch just like a fixed strike would.

a) Installation and Wiring: electric wiring shall be done between card reader and door striker in line with release switch and supply after installation of equipment which shall be simply screwed to door.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Termination

MHr/Item	Estimated Hours
Electrician	1
Plumber	1
Assistant	1

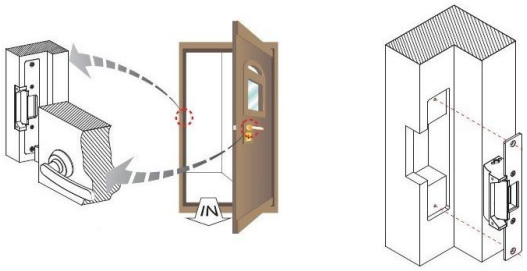


Figure 230: Installation and wiring

8.1.2. Magnetic lock

An electromagnetic lock, magnetic lock, or mag-lock is a locking device that consists of an electromagnet and an armature plate. There are two main types of electric locking devices. Locking devices can be either "fail safe" or "fail secure".

a) Installation: magnetic lock frame shall be bolted top of the door in accordance with engineering drawings.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Wiring

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 231: Magnetic lock

b) Wiring: electric wiring shall be done between equipment and supply system.

- **Predecessor activities:**
  Installation
- **Successor activities:**
  Termination

MHr/Item	Estimated Hours
Electrician	2
Plumber	
Assistant	2

8.1.3. Panic bar

A crash bar is a device for unlocking a door during emergency conditions. The mechanism consists of a spring-loaded metal bar fixed horizontally to the inside of an outward-opening door.

a) Installation: panic bar shall be bolted to the door in accordance with engineering drawings.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**

MHr/Item	Estimated Hours
Electrician	
Plumber	2
Assistant	2

Figure 232: Panic bar

8.2. Electronic Surveillance

Observing or listening to persons, places, or activities—usually in a secretive or unobtrusive manner—with the aid of electronic devices such as cameras, microphones, tape recorders, or wire taps. The objective of electronic surveillance when used in law enforcement is to gather evidence of a crime or to accumulate intelligence about suspected criminal activity.

8.2.1. Electronic Surveillance Cabling

ELECTRONIC SURVEILLANCE cabling follows the same instruction which has been described for telecommunication cabling.

8.2.2. Electronic Surveillance Equipment and Accessories

including CCTV camera, CCTV network PC workstation, CCTV network display monitor, CCTV switch and network video recorder, CCTV equipment rack and CCTV dedicated uninterruptible power supply UPS.

Figure 235: CCTV network PC workstation

Figure 235: CCTV switch and network video recorder

Figure 235: CCTV camera

8.3. Electronic Detection and Alarm

8.3.1. Fire alarm cabling, Fire alarm telephone control cabling, Fire alarm multiple loops:

Fire alarm cabling follows the same instruction which has been described for telecommunication cabling.

8.3.2. ELECTRONIC DETECTION AND ALARM equipment and accessories

Including fire alarm speaker/visual alarm, magnetic door holder, manual call point, smoke detector, fire smoke damper, water flow detector, pressure detector switch, heat detector, fire alarm speaker wall mounted, Fire alarm command center, Fire alarm terminal cabinet, Fire alarm data gathering panel and Firefighting telephone panel.

8.3.3. Fire alarm system

An automatic fire alarm system is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. In general, a fire alarm system is classified as either automatically actuated, manually actuated, or both.

Figure 236: Fire alarm system

a) Alarm initiating devices Installation: including Manual Fire Alarm Boxes, Water flow Initiating Devices, Heat Detectors, Smoke Detectors, Radiant Energy Sensing Fire Detectors. Every single one of them has its own installation procedure including cabling and conduit works, installing fittings and connections.

- **Predecessor activities:**
  Material preparation
- **Successor activities:**
  Notification Appliances

MHr/Item	Estimated Hours
Electrician	
Plumber	1
Assistant	1

Figure 237: Alarm initiating device

b) Notification Appliances Installation: including Bells, Horns, Speakers, Sirens, Strobes and Combination units.

- **Predecessor activities:**
  Alarm initiating devices Installation
- **Successor activities:**
  Fire Alarm Control Units Installation

MHr/Item	Estimated Hours
Electrician	1
Plumber	1
Assistant	1

Figure 238: Notification appliance

c) Fire Alarm Control Units Installation: including System Operating Configuration Conventional fire alarm system, Addressable fire alarm systems and Analog-addressable fire alarm systems.

- **Predecessor activities:**
  Notification Appliances Installation
- **Successor activities:**
  Remote On-Site Annunciation installation

MHr/Item	Estimated Hours
Electrician	3
Plumber	1
Assistant	3

Figure 239: Fire alarm control units

d) Remote On-Site Annunciation Installation: including Point Lighted Alphanumeric, Liquid Crystal Displays (LCD's) and Graphic.

- **Predecessor activities:**
  Fire Alarm Control Units Installation
- **Successor activities:**
  Batteries installation

MHr/Item	Estimated Hours
Electrician	2
Plumber	1
Assistant	3

Figure 240: Remote on-site annunciation

e) Battery Installation: shall be installed for purpose of standby power.

- **Predecessor activities:**
  Remote On-Site Annunciation Installation
- **Successor activities:**
  Commissioning

MHr/Item	Estimated Hours
Electrician	1
Plumber	1
Assistant	1

Figure 241: fire alarm Battery

8.3.4. Magnetic door holder

A magnetic door holder is a hardware fixture which uses a magnet to hold a door open or closed.to install, simply bolt the to both sides.

MHr/Item	Estimated Hours
Electrician	
Plumber	.5
Assistant	.5

Figure 242: Magnetic door holder

8.3.5. Heat and smoke detector:

A heat detector is a fire alarm device designed to respond when the convicted thermal energy of a fire increases the temperature of a heat sensitive element. The thermal mass and conductivity of the element regulate the rate flow of heat into the element.

MHr/Item	Estimated Hours
Electrician	.5
Plumber	.5
Assistant	.5

Figure 243: Heat/smoke detector

We always have more!!

Follow our online store on our website “planningengineer.net”, you may be interested in

- Primavera Online Course
- Excel for Planners Online Course
- Primavera top 50 tips and tricks
- Various E-Books for your Planning Career
- Preparing the Professional Planning Engineer Online Course

Or better then ***join our Premium Membership*** to get the full access for an open sky of E-Books, knowledge and Online Courses.

For Any Inquiries or Information, Please contact us on Info@planningengineer.net

PLANNING ENGINEER

www.planningengineer.net