

# Plumbing Skills and Maintenance in Mosques



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## 1. Introduction to Plumbing Skills:

Sanitary skills and plumbing works are the most important handicrafts that cannot be dispensed in homes and places of worships, because water is the main element in all daily activities of persons inside and outside the home, workplaces and public places.

This means we need to transport water and for this purpose we need good pipes networks, faucets and valves. The processes of installation and maintaining these facilities are known as "plumbing works".

## 2. Equipment and tools:

Before starting to explain the method of work, it is necessary to identify the equipment and tools which are used during work, and to know the purpose of each tool as well as how and why to use it. The following is a description of the work tools:

### 1. Screwdrivers (Slot head and Phillips head)



### 2. Pliers



**3. Bubble level tools**



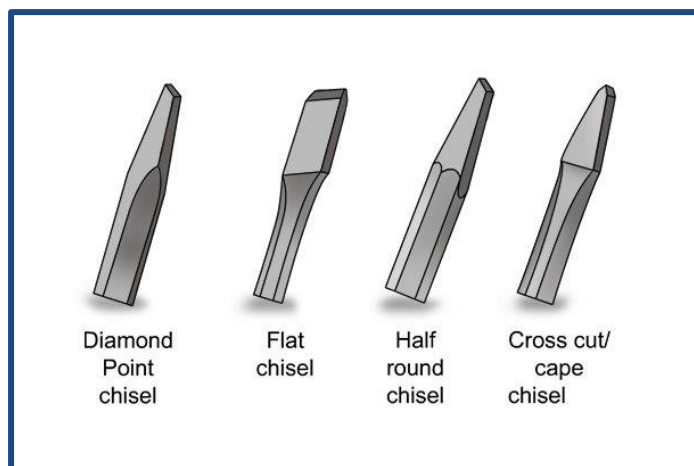
**4. Measure tape**



**5. Hammer**



**6. Chisel**



**7. Pipe vise**



**8. Die heads set for steel pipes**



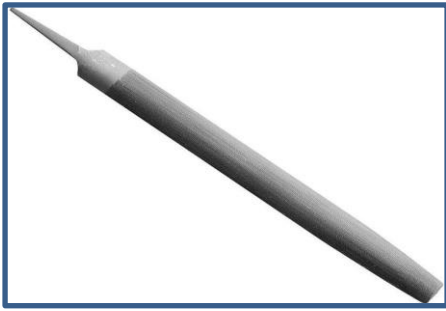
**9. Steel pipe cutter**



**10. Steel saw**



**11. Metal grater: Used to the adjustment the steel and plastic pipe edges**



**12. Teflon tape**



**13. PEX pipe cutter**



**14. Plumbing Snake**



## 3. Pipe types

Types of pipes vary in use, for example there are water pipes and sewage pipes. Each type differs from the other in the thickness of the pipe wall, diameter and the material used in the manufacture. The pipes of the potable water pipes have relatively small diameters, whereas the sewage pipes diameter is larger and has special specification materials to make it suitable for of sewage water, which contains many organic and chemical components. There are many types of pipes, depending on the type of material used to fabricate the pipe, for example:

- 1- Iron pipe
- 2- Galvanized iron pipes
- 3- Copper pipes
- 4- Plastic pipes
- 5- Concrete pipes

Here we will mention the characteristics of iron pipes and plastic pipes:

### 3.1 Iron Pipe

This type of pipes is used in the following cases:

- 1 - If pipes need to be installed in a place which pose difficult conditions, such as heavy pressure under traffic roads or other heavy mechanisms, or if it installed in deep depths under the surface of the earth.
- 2 - When pipes with large diameters (more than 200 mm) are necessary.

### 3.2 Galvanized Iron Pipes

This type is made from steel and the outer pipe surface is covered with a zinc or tin layer to resist corrosion and the surrounding environment. It is used in sanitary plumbing systems in houses. It is worth mentioning that the use of metal pipes is more difficult than plastic pipes.

### 3.3 Plastic Pipes:

Demand for plastic pipes has recently increased and the type comes with following advantages and disadvantages:

#### Advantages:

- Anti-corrosive characteristics
- Low weight of pipes
- No sediments or deposition on the inner walls of the tube
- Resistant to many chemical compounds
- Poor heat conduction

#### Disadvantages:

- Some types are affected by direct sunlight
- might not withstand heavy weights or heavy pressure
- it cannot be used it in fire extinguishing systems

#### Uses:

- ❖ Used in agricultural irrigation systems
- ❖ Used in Sewage networks inside houses
- ❖ Used in chemical factories
- ❖ Used in industrial and chemical installations
- ❖ Used for cable protection and insulation

### 3.3.1 Plastic Pipe Types:

#### 3.3.1.1 PVC Pipes:

This type of pipe is cheap and resistant to many difficult conditions. The most outstanding feature of PVC pipes, which revolutionized the plumbing world, compared to cast iron or copper pipes is the simplicity of joining two pipes. Whereas copper pipes need welding or teething operations, which are still prevalent today, PVC pipes are glued together. The most important uses of PVC pipes are undoubtedly in sanitary installations, as all buildings rely on the existence of sewage pipes and those are usually made from PVC.

**It is worth mentioning that these pipes are not recommended for drinking water systems because of their interaction with the chlorine residual in water which was used for disinfection. Toxic substances might be formed inside the water especially at hot temperatures.**

#### 3.3.1.2 High Density Polyethylene Pipes (HDPE):

It is used for water transport inside or outside the house. It is also used for public purposes such as drinking water distribution networks (Municipal water network), because it does not affect water quality and does not interact with chlorine residuals in the drinking water in the long term.

#### 3.3.1.3 Polypropylene Pipes (thermal):

Thermal pipes, polypropylene, or PPR is also a plastic pipe made from basic carbon material called polypropylene. Sometimes these pipes are colored green for commercially purposes , although there are many thermal pipes in the market that are not green but gray, blue, white, milky, and golden.

#### 3.3.1.4 PEX Pipes:

Polyethylene tubing provides an excellent option for plumbing, heating systems and other fluids like oil or fuel in both residential and commercial plumbing applications. When combined with push-fit fittings, manifolds, valves and other supplies, PEX pipe offers the fastest way to plumb any project. PEX pipe is made from a cross-linked HDPE (high density polyethylene). The HDPE is melted and continuously extruded into a tube to form a high-performing pipe suitable for a variety of potable and non-potable plumbing applications.

PEX pipe is easier to install than a rigid pipe, and it is available in long coils which can eliminate the need for extra fittings. PEX pipe is flexible and can be navigated around obstacles. PEX pipe doesn't require the use of glue or cement, can be air tested and can be installed in wet or dry conditions. Additionally, PEX pipe is freeze-damage resistant whereas CPVC pipe is susceptible to cracking at temperatures below -50°.

PEX pipe as part of a water supply piping system has several benefits over metal pipe or rigid plastic pipe systems. It is flexible, resistant to high pressures and chlorine. PEX pipe does not corrode or develop pinholes. Plus, it is faster to install than metal or rigid plastic and requires fewer connections and fittings.

### **Advantages**

- Safety of potable water and long-term reliability
- Resistance to corrosion and deposits
- Chlorine and chloramine resistance
- Flexibility of pipe speeds installations
- Freeze-break resistance
- Lightweight, easy to transport
- Noise and water hammer resistance
- No scrap value, avoiding jobsite theft
- Durability and toughness to survive jobsite installations
- No flame required for joining, with many fittings and joining options



## 4. Installation, Welding of Pipes and Fittings:

When installing pipelines, we need various types of joint fittings to connect these pipes to each other. Following pictures show some types of fittings:



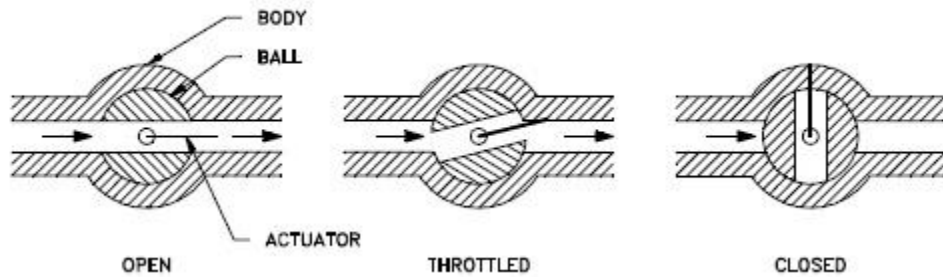
## 5. Valves

Valves are used to control fluid flow in the pipe, in other words to open and close the pipelines. There are many types and we can mention the following types:

### 5.1 Ball Valve (Spherical valves)

The Ball Valve functions as following: the sphere at the side of the valve rotates around the center line of the valve body to open and close.

The open-close disc (sphere) of the spherical valve is derived by the valve hand and rotates round the axial line of the valve hand. It is mainly used for cutting off or start the water flow or any other fluid inside the pipeline.

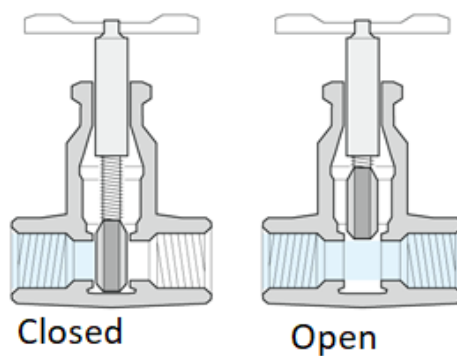


### Advantages of spherical valve

1. Small fluid resistance, the resistance coefficient is equal to the pipe sections with same length
2. Simple structure, small size and light weight
3. Easy operation, quick open and close
4. Convenient maintenance, simple structure, easy to dismantle and change

## 5.2 Gate Valve

Gate valves are designed for fully open or fully closed service. They are installed in pipelines as isolating valves and should not be used as control or regulating valves.



Gate valve work method

### 5.3 Flow Control Valves

This type can control the flow rate of water in the pipes. But it causes a significant reduction of pressure in the water flowing through it (high resistance to flow). Some examples of this type are presented below:

- **Angle valves**

This type changes flow direction by 90°

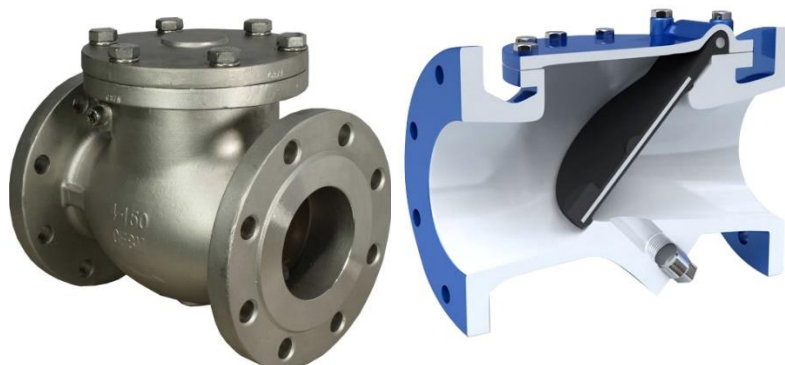


- **Butterfly valves**



- **Check Valve (One-way directional valve)**

This type only works with pressurized water, and does not allow water to flow opposite direction



- **water altitude control valve**



## 6. Plumbing Works

The plumbing and sanitary works include the main activities to supply drinking water and drain waste water in any building but are not limited to the installation of water faucets and pipes but also include the installation and maintenance of sanitary equipment and all other necessary accessories.

Plumbing works require high skills for installing pipes networks to guarantee performance of installation and proper arrangement. Careless work leads to worst results for public health of people in the building, also might even cause damage to the building itself.

A poor execution of installation works reduces the lifetime of the building because leakage of water on concrete or under the tiles leads to the destruction of concrete and damages ground and wall tiles. It also damages paints of various kinds. It is very important to study the architecture of the building and its sanitary facilities previous to an technical intervention especially if no architectural sketches and plans are given.

### 6.1. Methods of detecting Water Leakage from Pipes

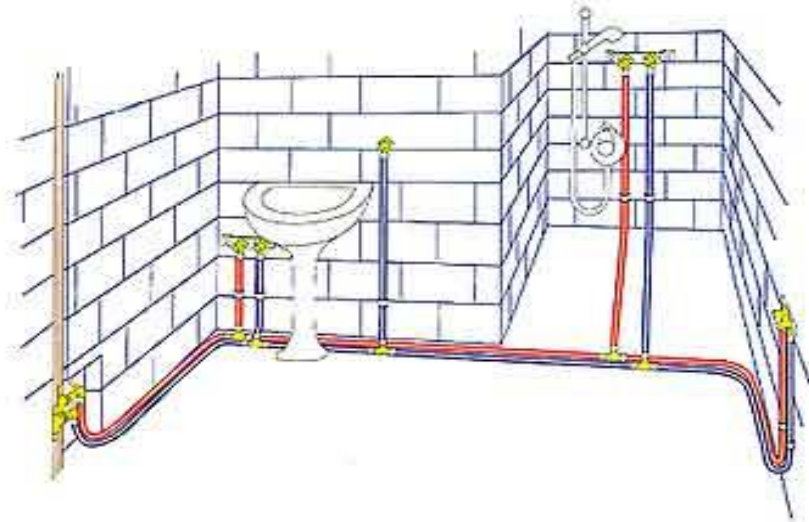
Indicators of a leak in water networks in houses are:

- water appears on the walls, ceilings or floors as a result of the leakage of water from the exposed parts of the pipes
- Mold stains (Black spots) on walls or wet spots
- Different color appears on walls' paint or peeling paint from walls
- High water consumption bill
- Appearance of cracks in some parts of the building.

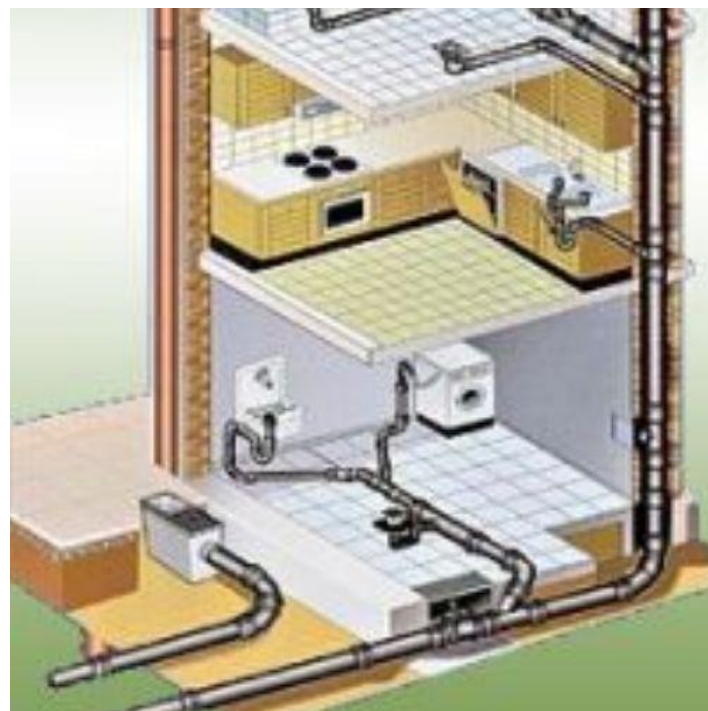


Plumbing works in generally are divided into the following topics:

1. Networks for municipal water



2. Wastewater networks



## 7. Pipe Installation Stages

### 7.1. Vertical Supply Pipes on Walls

Installed on walls for the supply of water to the roof tanks for example. They should have an appropriate diameter and there should be left a 5 cm space between them and the wall by installing the joints at sufficient distance to the wall. By using the water bubble device is made sure that the pipe is oriented vertically.



### 7.2. Water Supply Pipes inside Walls

The pipes pass through walls to arrive to taps for water supply in houses. The pipes must be covered with cement to withstand pressures from furniture or inhabitants. Gypsum is inadequate to protect the pipes and might even lead to an enhanced corrosion.



### 7.3. Wastewater Discharge Pipes

Sewage works are divided into the following points:

1. Install drainage pipes under the floors of toilets and kitchens in houses. In public buildings the drainage pipes should be installed outside of the walls of bathrooms and kitchens for easy maintenance works later.
2. Vertical drainage collection pipes inside or outside of buildings are usually installed on and not in walls. They collect the sewer from toilets, bathrooms and discharge it to the ground floor. The system consists of plastic pipes with relatively large diameters (4 inches).
3. Prepare the ground siphons and drainages points. Prepare the pipes to collect the wastewater drainage from wash facilities to connect them with the main drainage pipe.
4. Rainfall drainage gutters are to be connected to reach the rainwater drainage system or are supposed to drain to the sidewalks outside the building.
5. Horizontal drainage pipes are buried inside the floor of the ground floor or are suspended under the roofs of the ground floors. All pipes discharge to the public sewer and must have appropriate diameters.
6. Construct manholes for public buildings or large buildings and inspection openings for pipes in houses. Determine the location, dimensions and depth as specified by the executive plans and technical drawing. Manholes must be placed at each point of change in direction of horizontal pipes, before each entry line below the building, after the exit line from the bottom of the building, and also after every 20 meters of a straight pipe.

The manholes are always built from concrete or brick and has a covered hole in the top. It must have enough space to allow a person to access it. The manhole dimensions must not be less than 60 × 60 cm and if the depth exceeds 120 cm a ladder must be installed at one of the sides of the manhole.

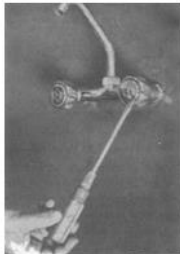
## 8. Maintenance of Water Faucets

To maintain faucets, follow these steps:

Firstly, the main pipe valve must be closed, then choose an appropriate pipe wrench, remove the nut from the faucet body and replace the old rubber ring inside the faucet with a new one, because water leakages usually results from damage of the rubber ring inside the faucet. The next picture shows the faucet parts:



The following pictures summarize the steps:



1- Remove cover on the valve



2-Remove screw by using appropriate screwdriver



3-Remove the internal part of valve by using appropriate wrench



4-Replace old rubber ring inside faucet and reinstall all parts

If there is a leakage of water from the faucet when it is closed, it means that there is a need to change the rubber O-ring inside. Therefore, the faucet should be dismantled to replace the old rubber ring.



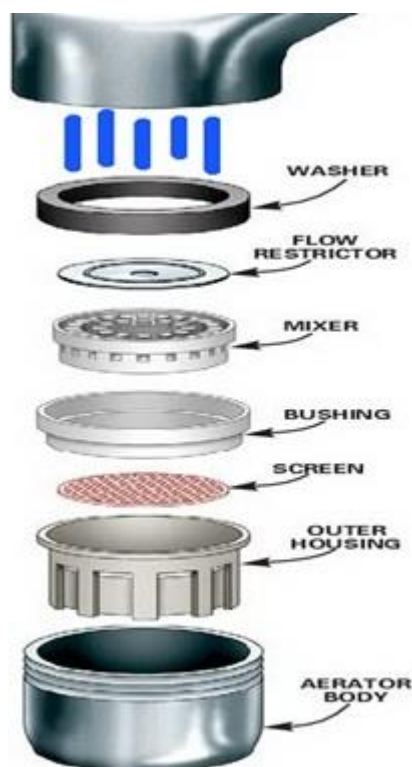
## 9. Water saving Device (Faucet aerators)

### 9.1. Water saving Aerator Description and Aerator Work Method

To reduce water consumption during daily activities many water saving devices can be installed in your home to reduce the amount of water consumed. Some of them can be self-installed, others need professional installation. These devices deliver a strong spray but help to control water consumption. They can be self-installed in all your home's faucets and showerheads to increase spray velocity and reduce water consumption.

Tap aerators are also known as flow regulators. The aerator is a small attachment that either fits onto the end of the tap or can be inserted inside of the existing spout. These water saving devices will control the amount of water that flows through the tap without affecting the water pressure as they mix the water with air.

The aerator acts as a sieve, separating a single flow of water into many tiny streams which introduces the air in to the water flow. Also, as there is less space for the water to flow through, the water flow is reduced, resulting in water savings. As the water pressure is maintained, most people don't notice a difference in the amount of water coming out of an aerated faucet yet benefit from the water efficiency. Next picture shows aerator's parts:



### 9.2. Installation of water saving Device on the faucet

You can install the aerators yourself. They are cheap and easy to fix. If you need to replace an aerator, just unscrew the old one and put the new one in. If you do not have one already, check inside the tap to see what kind you will need. If the threads are on the inside, you need a male aerator, and if they're on the outside you need a female aerator.

Next the detailed steps to install the aerator:

- Use the wrench to loosen the nut that is holding the old shower head onto the pipe then finish unscrewing it with your fingers and remove the head.
- Wipe down the pipe's threads (the ones that were just exposed by removing the head) to ensure that there isn't any mildew or rust or other bits of gunk that could bind the threading.
- Wrap a thin layer of plumber's tape over the threads to ensure a watertight seal with the shower head, then screw on the new head until finger tight before use the wrench.

## 10. Irrigation in Mosques' Gardens

Many mosques have planted gardens, and most trees are irrigated manually by using a water hose. This practice is water inefficient because it consumes large quantities of water above the plant's need and simply increases evaporation. Therefore, it is recommended to use drip irrigation for high water savings which may reduce water consumption by 85%, also the material cost is little.

Drip irrigation networks consist of following:

- Irrigation pipes: Polyethylene pipes with a diameter of 16mm or 20mm, preferably using good types made of environment- friendly materials
- Water Drippers: These are located on the irrigation pipes so that they are near the plants. Water Drippers have different outflows per hours (e.g. 2 liters, 4 liters, 8 liters, or they can be adjusted in their water discharge).
- Rubber ring: Installed before dripper device to prevent water leakage and maintain water pressure



## 11. Water filtering in Mosques for Drinking Water

Mosques depend on either purchasing water bottles or installing drinking water filters (RO systems) to provide drinking water. Here, we will talk about drinking water filters (RO systems):

Reverse Osmosis Filtration has consistently proven to be one of the best ways to filter and provide water for mosques and houses because of the following reasons:

- Improves taste: RO filtration improves taste, remove odor and reduce turbidity of water by removing contaminants that cause taste and odor and other problems.
- Simple maintenance: RO systems have very few moving or replaceable parts making RO systems easy to clean and maintain.

### How Does Reverse Osmosis Work?

Reverse Osmosis is a process in which dissolved inorganic solids (such as salts) are removed from a solution (such as water). This is accomplished by household water pressure pushing the tap water through a semipermeable membrane.

When pressure pushes water through the RO membrane and additional filters, such as sediment or carbon filters, the impurities are filtered out and subsequently flushed down the drain. What is left, is clean-tasting drinking water. Note that many RO units incorporate a 4-5 stage process for optimal water quality.

You may be interested to know that Reverse Osmosis technology is not new. In fact, RO processes began being utilized by municipalities back in 1977. Since then, Reverse Osmosis has become increasingly popular because it is safe, cost-effective, and easy to maintain.

Some contaminants found in tap water can be removed with Reverse Osmosis filtration technology such as fluoride, lead, chlorine and chloramine, pesticides, detergents, nitrates & sulfates

The next picture shows a RO filter device:



## 12. Water Supply and increasing Hygiene Levels

Most sanitary units and public facilities such as toilets in schools or mosques suffer from lack of maintenance and lack of cleaning work within them, which leads to increased spread of rodents, insects and odors, and leads to increased spread of pathogens. Therefore, a general maintenance for water networks and faucets must be conducted in these public facilities to raise awareness of its importance and reduce the spread of rodents and pathogens in public facilities.

The presence of means of sterilization and cleaning liquids in these sanitary units is one of the most important measures as well and a way to raise the levels of hygiene for the users of these facilities. Additionally, written awareness messages must be written inside sanitary facilities to raise the user's awareness of health. This can also be accomplished by holding training courses.

### 12.1. Hygiene at the Mosque

Cleanliness is one of the most important behaviors of civilized people in all fields of life. The value of cleanliness is considered one of the most important Islamic values.

To ensure the cleanliness of sanitary units in mosques, work should be done on:

- Ensure that a clean water source is provided inside the bathrooms
- Bathrooms should be equipped with toilets flushing system
- Provide a waste basket inside the bathrooms
- Provide soap at the hand wash basin
- Provide cleaning materials and tools to clean bathrooms, floors, hand wash basin and places of ablution
- Clean bathrooms and hand wash basin more than once a day
- Ensure the closing of manholes and make sure to prevent dumping of solid waste and tissues inside it
- Provide good ventilation in the bathrooms and install fans that can ensure the removal of odors
- Wastewater streams shall be in closed pipes and connected to the septic tank or public sewer

## 13. Hausmeister(Facility Manager)

It is a German word referring to the person responsible for the management of a particular building and the follow up of its affairs of maintenance. He or she is responsible for all different matters to ensure the preservation of the building in the form required and ideal to achieve the purpose for which it is built for. These buildings may be public or private, such as schools and mosques.

## 14. Solar Water Heater

A solar water heater is a device that can be used to capture sunlight in order to heat the water used for baths, showers, etc.

It enables substantial energy savings, as the sun shining on 1m<sup>2</sup> of roof replaces 100 l of heating oil or 100 m<sup>3</sup> of natural gas (approximately 1 000 kWh) a year. Generally speaking, it is possible to heat 50 to 70 % of the water used in the kitchen and the bathroom in this way.

It consists mainly of:

- a thermal panel (solar collector) installed on the roof
- a tank to store hot water
- accessories, such as a pump to carry the water from the collector to the tank, and
- a thermal regulator.

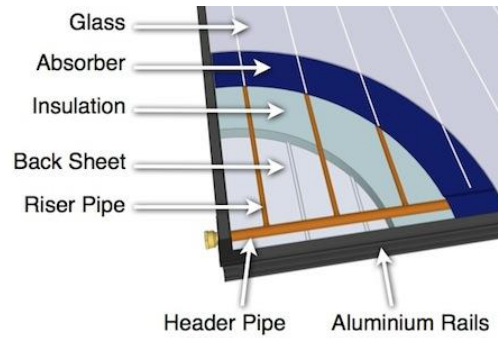
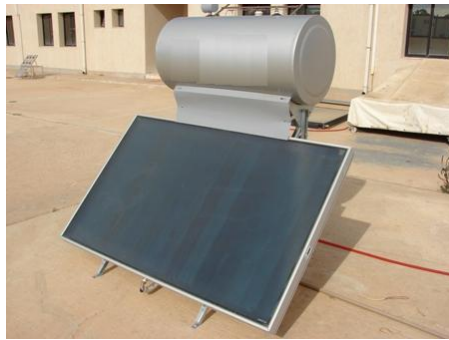
### 14.1. Benefits and features of water solar heaters

1. You are using free energy: solar energy is free and abundant (even in cloudy weather).
2. High efficiency: About 80 % of the sun's radiation is turned into heat energy needed to obtain hot water at home.
3. Cost savings: The cost of two or three panels is cheaper than larger domestic installations. You also save on fuel bills for supplying gas heating systems.
4. Low maintenance: After installation, little maintenance is required, and a solar water heater can run for up to 20 years.
5. Lower carbon footprint: A home can be eco-friendlier

### 14.2. Types of solar water heater

A typical flat-plate collector is a metal box with a glass or plastic cover (glazing) on top and a dark-colored absorber plate on the bottom. The sides and bottom of the collector are usually insulated to minimize heat loss.

Sunlight passes through the glazing and strikes the absorber plate, which heats up, transforming solar energy into heat energy. The heat is transferred to a liquid passing through pipes attached to the absorber plate. Absorber plates are commonly painted with "selective coatings," which absorb and retain heat better than ordinary black paint. Absorber plates are usually made of metal—typically copper or aluminum because the metal is a good heat conductor. Copper is more expensive but is a better conductor and less prone to corrosion than aluminum. In locations with average available solar energy, flat plate collectors are sized approximately one-half- to one-square foot per gallon of one-day's hot water use.



### 14.3. Vacuum Tubes technique

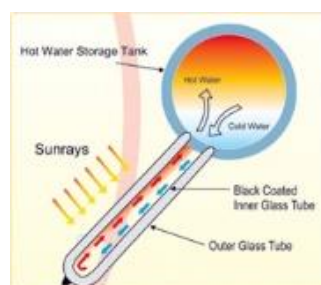
Vacuum or Evacuated Tubes are made from glass – typically ultra-strong and heat resistant Pyrex with a double wall construction. The glass on the inner tube is coated on its outer surface with an absorbent coating, and on its inner surface with a reflective coating. Inside each tube all air is removed making a vacuum and a copper heat pipe is run through the center of the tubes. Most of the infra-red radiation (i.e heat) from the sun is absorbed by this sealed heat pipe which contains an anti-freeze type liquid.

As heat rises, hot vapors from the heat transfer fluid rise up to the top of the heat pipe where its copper tip connects with a header pipe through which more fluid flows. This hot fluid is then pumped through a coil of pipe inside the hot water tank (acting as a heat exchanger) with the result that the water gets hotter

The heat transfer fluid then continues its journey around the system and back out to the solar water heater to be reheated.

The copper at the tip of the heat tube can reach well over 200 degrees easily, heating water to 90°C on hot days and to 60°C even in the winter. This simple system is completely sealed and needs minimal maintenance over its 20+ years life.

The advantage of using evacuated tubes is that they will work even during the coldest winter months unlike old style Flat Plate Solar Collectors. The vacuum insulates the heat tube from being cooled by the ambient temperature which could be well below freezing. Winter sun can easily heat water to 50+ degrees even in the depths of the coldest season. Even if it is very cloudy and very cold, enough sunlight gets through to keep the tubes well above freezing and so they will still be pre-heating the water which can then be heated further by a standard immersion heater or gas burner reducing the costs of heating the water.



#### 14.4. Heat Pipes Technique

The heating pipe consists of a copper pipe which is placed inside a glass pipe under vacuum. In this case, however, inside the copper pipe is also air to adjust the water pressure inside the copper tube.

At sea level the water evaporates at 100°C, while in mountain areas the evaporation point will be lower due to the difference in atmospheric pressure between the two regions. The water can be evaporated at lower temperatures, if atmospheric pressure can be reduced.

This idea is used here to get a rapid evaporation of water at low temperatures like 30°C for example, so if the heating pipe's temperature is higher than 30°C, the water will evaporate, and this steam flows up to the top of the pipe and conveys heat. When it reaches the top, the steam loses its temperature, causing it to condense and return to its liquid state, and then returns to the bottom of the heating pipes again, thus repeating the process.

The heating pipes are a very easy and uncomplicated technology but at the same time require sophisticated industrial technology with precise quality. They are copper tubes that are empty of air and have a small amount of water. When producing these high-quality pipes, the type of metal made of the pipe must be considered. The presence of impurities inside it affects the efficiency and performance of the pipes. Therefore, high quality copper should be used, which is why this technology is not widespread.

#### 14.5. Solar water heater parts

- **Solar collectors**

The solar collectors absorb sunlight to collect heat.

- **Storage tank**

The storage tank holds the hot water. The tank can be a modified water heater, but it is usually larger and very well-insulated. Systems that use fluids other than water usually heat the water by passing it through a coil of tubing in the tank, which is full of hot fluid.

- **Water pipes**

Used to transfer water through system parts.

- **System Framework**

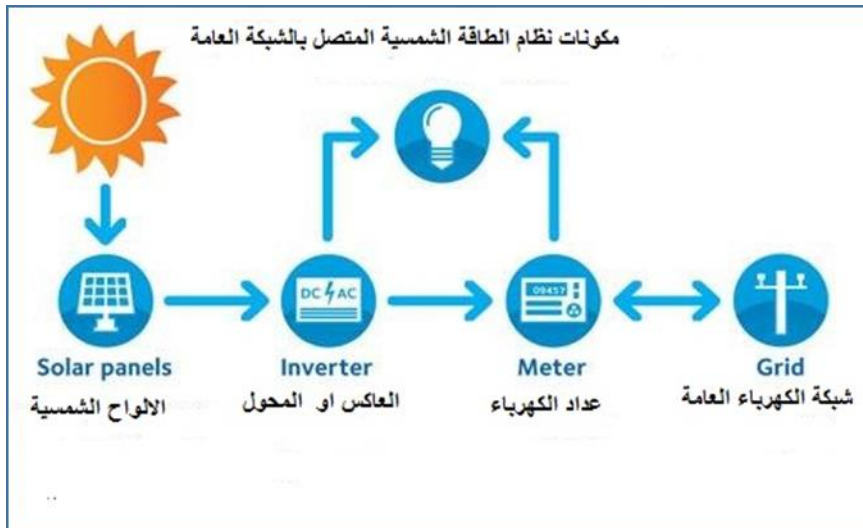
Used to carry all system parts, often made from aluminum or steel

### 15. Photovoltaic System in Mosques

A Photovoltaic (PV) system consists of one or more solar panels connected with an inverter and other electrical hardware that use rays from the sun to generate electricity. PV systems can vary greatly in size from small system on houses to big-scale plants.

## 15.1. System Components

- Solar Panel
- Inverters
- Framework



## 15.2. How do Photovoltaics Work?

### Step 1: Solar panels collect the energy from sun ray

Every solar panel contains cells called photovoltaic or PV cells. PV cells take light (called photons) and turn the light into electricity (voltage).

When sunlight arrive to the solar panel, PV cells start to work by producing direct current (DC) electricity, but DC electricity cannot power your electrical devices. That is where some other pieces of equipment come into the picture.

### Step 2: Inverters convert the solar power to usable electricity

On the back of each solar panel is an inverter. The most important thing to know about the inverter is that it converts DC electricity (the unusable kind of electricity) to alternating current (AC) electricity (the usable kind of electricity)

### Step 3: Electricity flows into net meter

AC electricity flows from the solar panels through efficient cables into your electricity meter. Your net meter measures both the electricity from the grid and the excess electricity your solar panels are go back onto the grid.

So, if your solar panels do not produce enough energy to cover all your needs, do not worry. You are still connected to the public electricity grid, so you can automatically get enough electricity whenever you need.



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