

TECHNICAL SOLUTIONS

Structural System:

- The project mainly consists of production halls and a multi-storey administration building in addition to a number of service buildings (workshops, boiler room...).
- Various construction systems have been used to suit the requirements of each part.
- Structural systems (steel, concrete) were used.

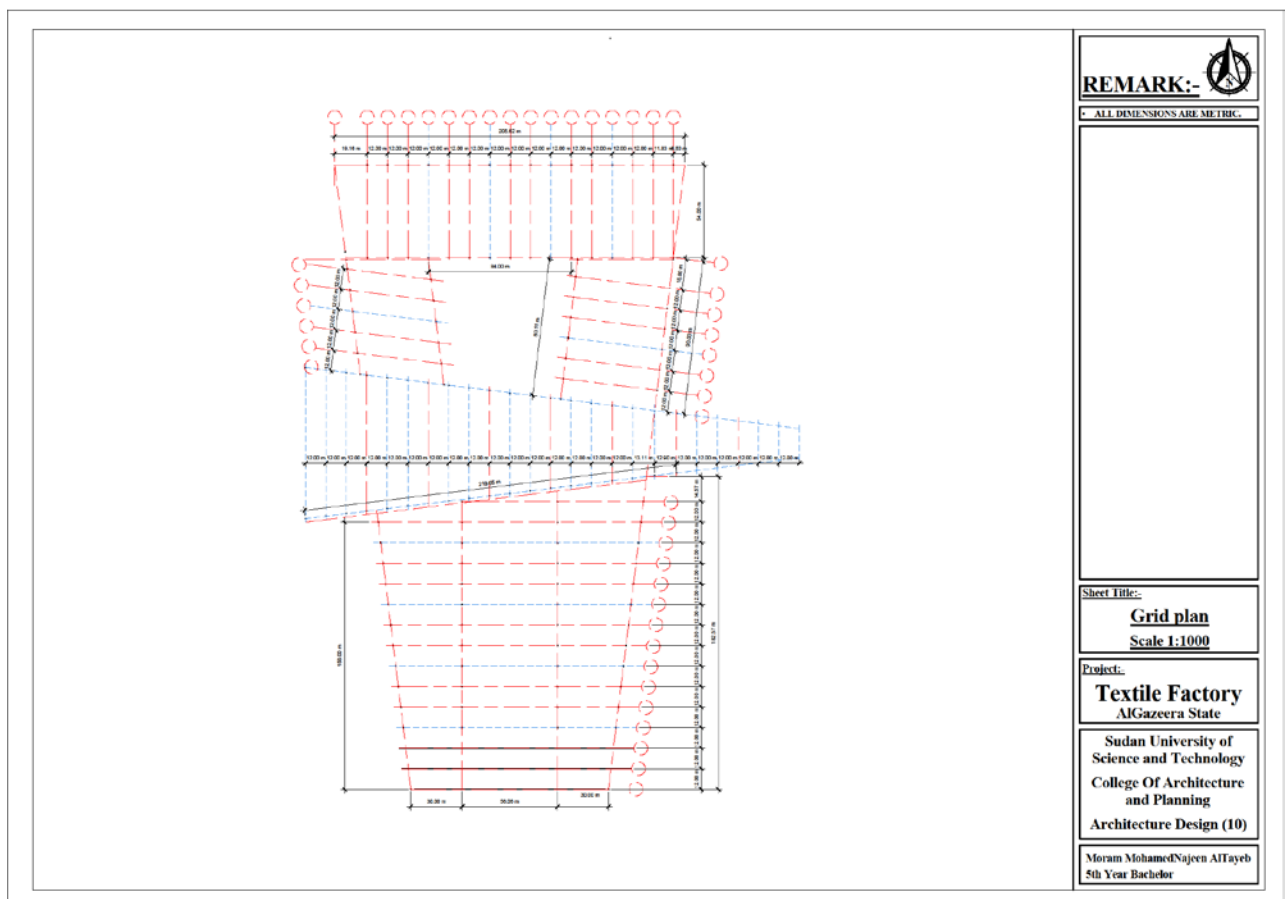
The main structural system used for production halls is:

3d Trusses -Prismatic Truss Frame:-

- A three dimensional (3D) truss is a type of frame work used to give extra strength and support to structures such as bridges and buildings.
- Sometimes called a prismatic truss, it is made up of triangles that are arranged into three dimensional triangular shapes (prisms) such as tetrahedrons.
- These trusses are extremely strong and are able to withstand a great deal of force without changing shape or breaking.
- Like other trusses, the 3D truss is made up of a series of triangular shapes; which gives it the ability to withstand a great deal more force than structures made of other shapes and will not lose their shape when subjected to stress.
- Given enough force, a truss can break apart, but the triangular sections are not subject to angular changes the way that other shapes, such as quadrilaterals, are the most commonly used shape in a 3D truss is a tetrahedron.
- This three dimensional shape is made up of four triangles, arranged so that one triangle forms the shape's base and the other three attach to each edge of the base, meeting in a point at the top. A similar structure, a pyramid, which has a square base and four triangular sides that meet at a point, can also be used.

Reasons for choosing 3d Trusses -Prismatic Truss:

- Covers large spans in an elegant way.
- They are extremely strong and are able to withstand a great deal of force without changing shape or breaking.
- They are light, structurally efficient and use materials optimally.
- They allow great flexibility in designing layout and positioning of end supports..
- Services such as lighting, air conditioning, etc., can be integrated with structures.
- They can be built from simple , prefabricated units.
- They can be assembled easily and quickly at the site using semi-skilled labor.



(5-) Grid Sheet

The flat slab concrete structure was used in the administrative building for the following reasons:

- The span is relatively small.
- Economic considerations.
- Flexibility in interior design and division.

Foundations: -

- Pile Foundation foundations were used in the project, due to the location of the project in the island area (with clay soil and near the Blue Nile) and the existence of soils that can be established at a deep depth.
- The Raft Foundation was used for underground tunnels because of soil weakness.

Joints:-

- As for the large area of the building, the difference of loads and the nature of the site's clay soil, the following joints should be used:-

Expansion Joints: -

- They are used to control cracks in the concrete, and to reduce expansion and shrinkage resistance due to nature and environmental impact factors.
- they start from above the foundations, go from the bottom to the top of the building.
- The expansion joints used are (2 cm) wide, filled with a water-resistant, moisture-proof material (tropi-cool polyurethane) with (40m) spacing.
- In the fence; horizontal spacing between the expansion joints is 12m.

Control Joints: -

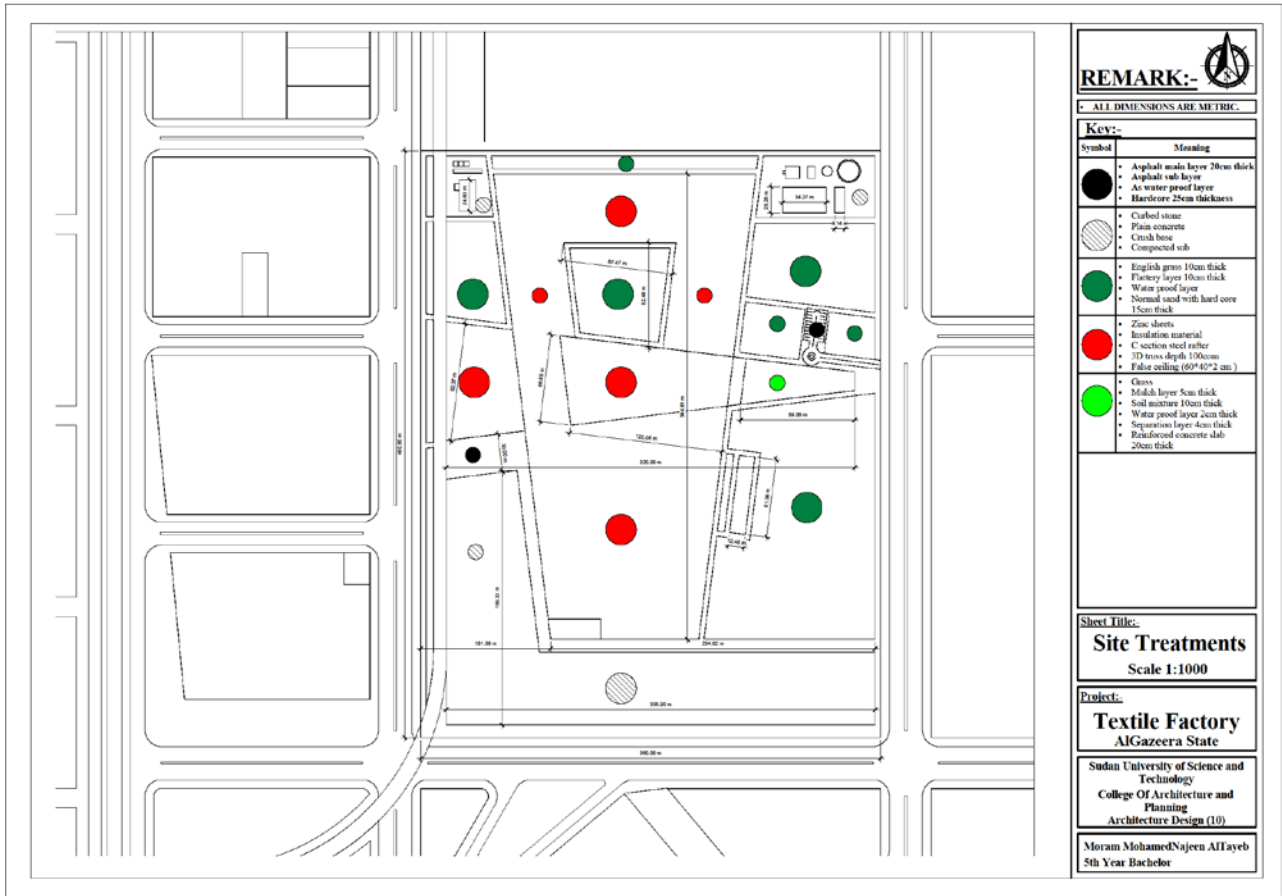
- They are used in the floors of the production halls, warehouses and workshops to resist high weight and high mobility; by covering the floors with concrete slabs (9 * 6*.15 m).
- The spaces between the tiles are (1.5 cm) filled with a flexible material (tropi-cool polyurethane) which has high movement capacity.
- Control joints allow stretching or shrinkage in the tiles without fractures, and do not permit a relative drop between the adjacent tiles.

Settlement Joints: -

- They are used to allow an irregular drop in the building without cracks or damage to the building.
- Are used in the administration building because of the different heights and loads.
- Start from the foundations up to the highest top of the building.
- They are used with a width of (2 cm), filled with a water-resistant and moisture-resistant material (tropi-cool polyurethane) at (30m) spacing.

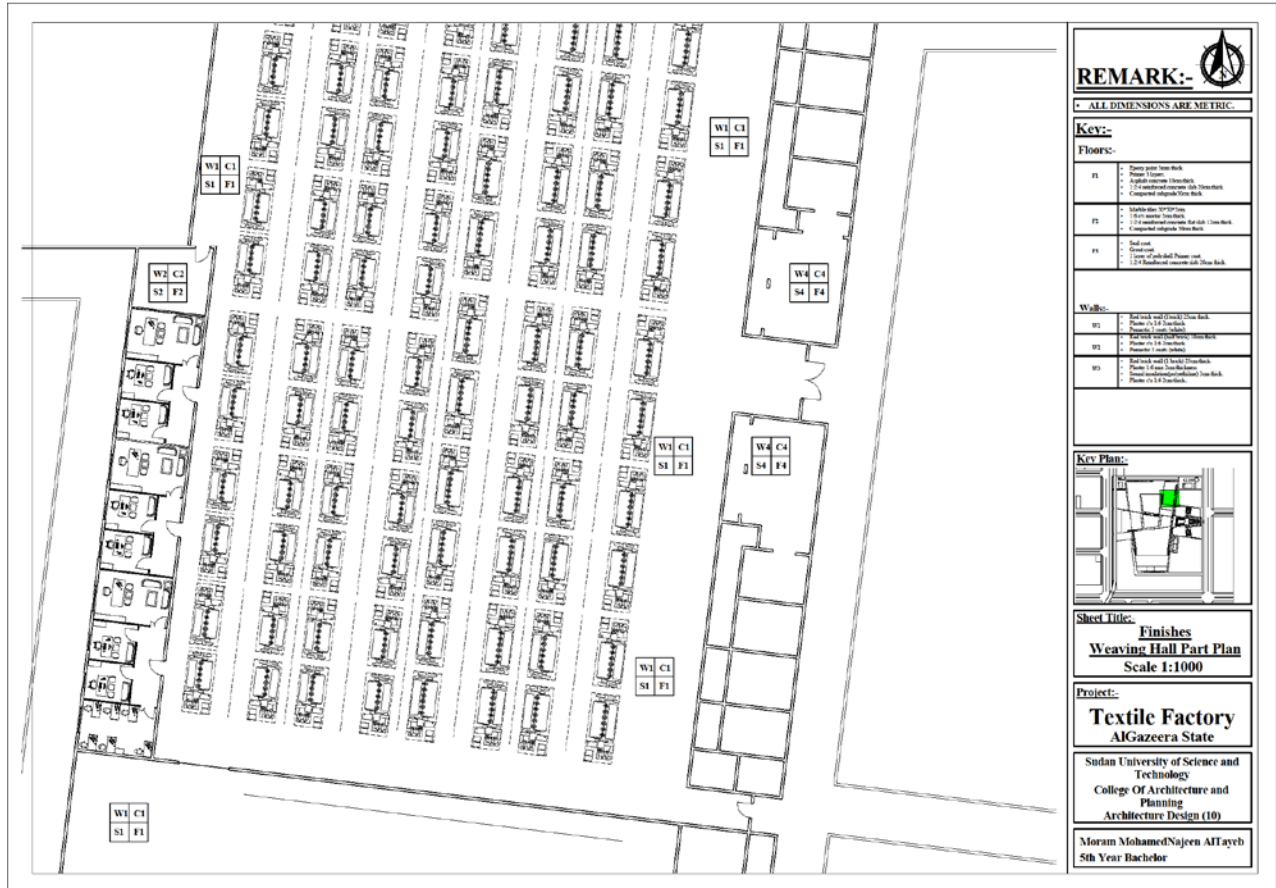
Treatments and Finishing:-

Site treatments:



(5-) Site Treatments Sheet

Finishes;



(5-) Finishes (weaving hall) Sheet

Services (Infrastructure):-

HVAC systems: -

Clarification of building specifications (production halls): -

Type of functional space		The basic need of the air conditioning system		The most important requirements		Less important requirements		Air conditioning system control		Sizes of spaces	
Large main space	√	Cooling or heating		Temperature	√	Temperature		Central	√	Large	√
Multiple spaces		Cooling or heating In large quantities	√	Air renewal	√	Air renewal		From each space		small	
		Temperature variation		Quiet voice		Quiet voice	√				
				Humidity	√	Humidity					
				Air sterilization		Air sterilization	√				

Table (5-): Clarification of building specifications (production halls)

- From the table above, the air conditioning system which has similar conditions of use to the building's specifications is: **All Air System.**

All Air System: -

Working principle:-

- Uses air only in cooling or heating.
- Exhausted air is sucked from the spaces and fresh air is added from outside of the building.
- The system then provides the most important requirements of the air properties and disburse it back to the internal spaces.

Parts: -

- **Air Handling:** Includes: -
 - Suction fan.
 - Cooling and moisture removing coil or heating coil.
 - Supplying fan.
 - Filter.
 - Hydration unit.
- **Supply Air Outlet (diffusers):**
 - Mounted to the false-ceilings of the internal spaces.
- **Return Air Outlet:**
 - High-floor slots that sucks out exhausted air and volatile cotton fibers from production.
- **Air Ducts:** has two types:
 - Supply air ducts: Take the shortest path possible between the air handling unit and the conditioned air diffusers.
 - Return tunnel: are underground tunnels with the shortest path between the return air outlets and the air handling unit.

Clarification of building specifications (administration building):

Type of functional space		The basic need of the air conditioning system		The most important requirements		Less important requirements		Air conditioning system control		Sizes of spaces	
Large main space		Cooling or heating		Temperature	√	Temperature		Central		Large	
Multiple spaces	√	Cooling or heating In large quantities		Air renewal		Air renewal	√	From each space	√	small	√
		Temperature variation	√	Quiet voice	√	Quiet voice					
				Humidity		Humidity	√				
				Air sterilization	√	Air sterilization					

Table (5-): Clarification of building specifications (administration building)

- From the table above, the air conditioning system which has similar conditions of use to the building's specifications is: **Variable Refrigerant Volume System (VRV)**

Variable Refrigerant Volume System (VRV System):-

Working principle:-

- It is a large external central unit with distributed small internal units.
- The ability of reversing the gas cycle in the internal units makes the system capable of cooling and heating.

Parts: -

- The central unit (external unit):** placed at the top of the ceiling.
- Internal Units:** Installed with the false-ceilings of the internal spaces.
- Gas pipes:** takes the shortest pass between the external and internal units.

Fire Fighting Systems: -

- Fire of textile factories is considered a medium-risk fire.

Building study:

Determining the building's function and the seriousness of its combustion:

space	Category Classification	Main Category	building
Production halls	Industrial buildings (F)	(F-1)	Industrial buildings or parts of them which are not classified as low risk factories (F-2)
Warehouses	Warehouse buildings (S)	(S-1)	Buildings or parts of them which were prepared for medium-risk materials' storage
Administration buildings	Office buildings for business owners (B)	(B)	Building or part of it used as business management offices, services or archives and documents storage
Labs, colors' kitchens	High-risk buildings (H)	(H-5)	Buildings or parts of them used for research, development and electrical conductors installation
electricity's workshops	High-risk buildings (H)	(H-5)	Buildings or parts of them used for research, development and electrical conductors installation

Table (5-): Determining the building's function and the seriousness of its combustion

- Fire extinguishing technology is done by removing the three sides of the fire (heat, oxygen, fuel).

space	Fire classification	Type of fire alarm and detectors	The average sound intensity (dB) of sirens	Fire extinguishing technique	Type of hand extinguishers in the space
Production halls	A, C	Flame (F.D.) + manual (M.D.)	80	Cooling flames, Immerse with CO2 or Powder	Water (M.F.E), CO2 (C.F.E.) , Powder (P.F.E)
Warehouses	A	Smoke (S.D.) + manual (M.D.)	30	Cooling flames	Water (M.F.E.)
Admin. buildings	A	Smoke (S.D.) + manual (M.D.)	55	Cooling flames	Water (M.F.E.)
Labs, colors' kitchens,	B, D	Heat (H.D.) + manual (M.D.)	40	Throttle the flames by a layer of foam or powder	Foam (F.F.E.), Powder (P.F.E)
electricity's workshops	C	Flame (F.D.) + manual (M.D.)	80	Immerse with CO2 or Powder	CO2 (C.F.E.) , Powder (P.F.E)

Table (5-): Fire extinguishing technology

- The powder fire extinguisher (P.F.E.) used in production hall are fire extinguishing balls made of rubber, filled with mono-ammonium phosphate, hanged over the machines, so they'll deploy automatically if a fire develops, being triggered by heat.

(5-): fire extinguishing ball

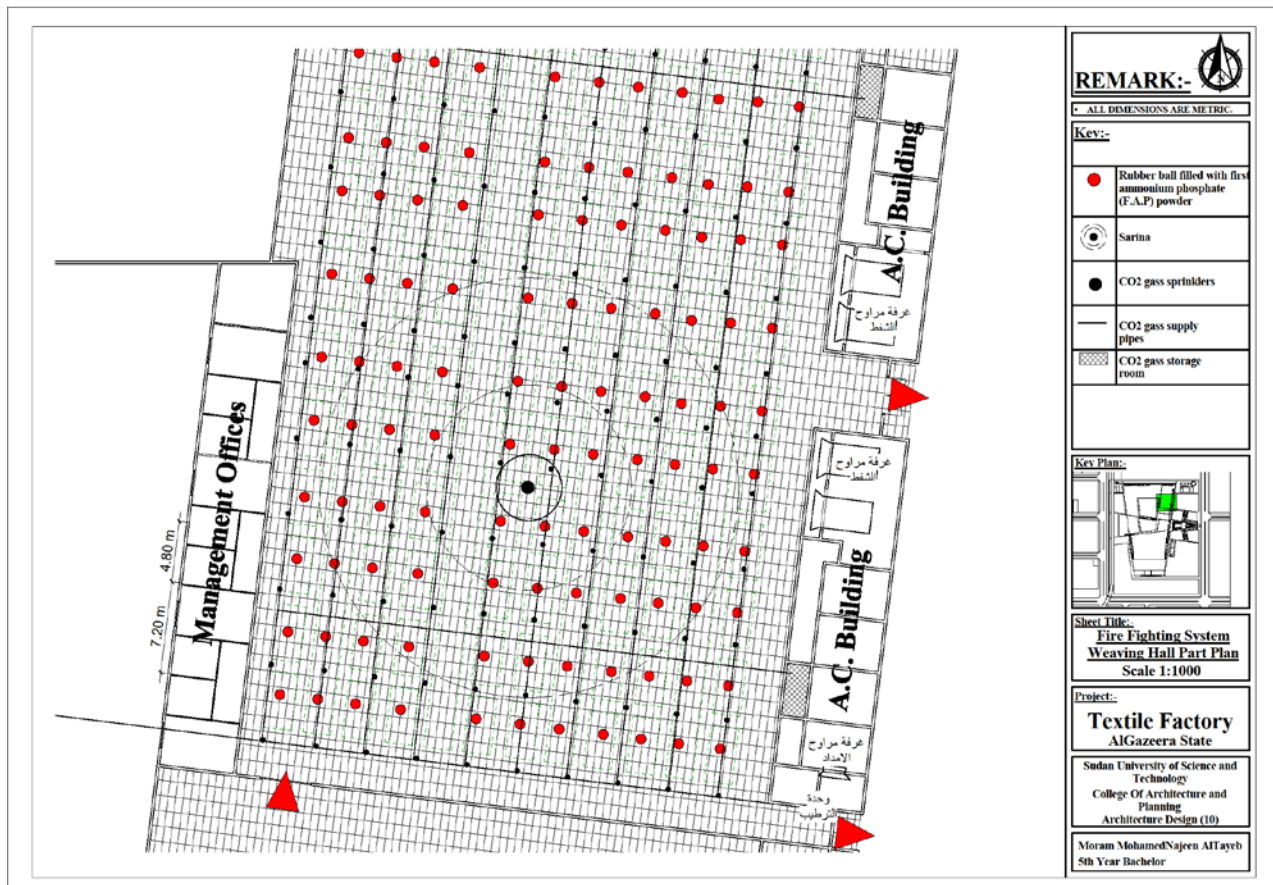


Once fire alarms are detected, the following processes are performed automatically:

- Turning on the fire alarms and sirens and evacuate users.
- Activating fire doors (closed not locked).
- Switching off the air conditioning systems and closing the air ducts.
- Operating the fire extinguishing system in the building.
- Informing the fire department.

Specifications of fire doors: -

- Open outside the space.
- Equipped with a mechanical and manual closures and electronic locks operated with fire alarms.
- Manufactured at the rate of fire time resistance (3 hours).
- The space between the fixed frame and the moving cage is closed to prevent smoke from passing.
- Have transparent glass at the height of visibility reinforced with wires to reduce the possibility of fire explosion.



(5-) Fire Fighting System (weaving hall) Sheet

Water Supply Systems:

- The site is supplied by public network water via a 2-inch pipe.
- For industrial use it is supplied from a well at the site via pumps to the ground tank then to the upper tank, which is distributed by ring system to the production spaces.

supply system:-

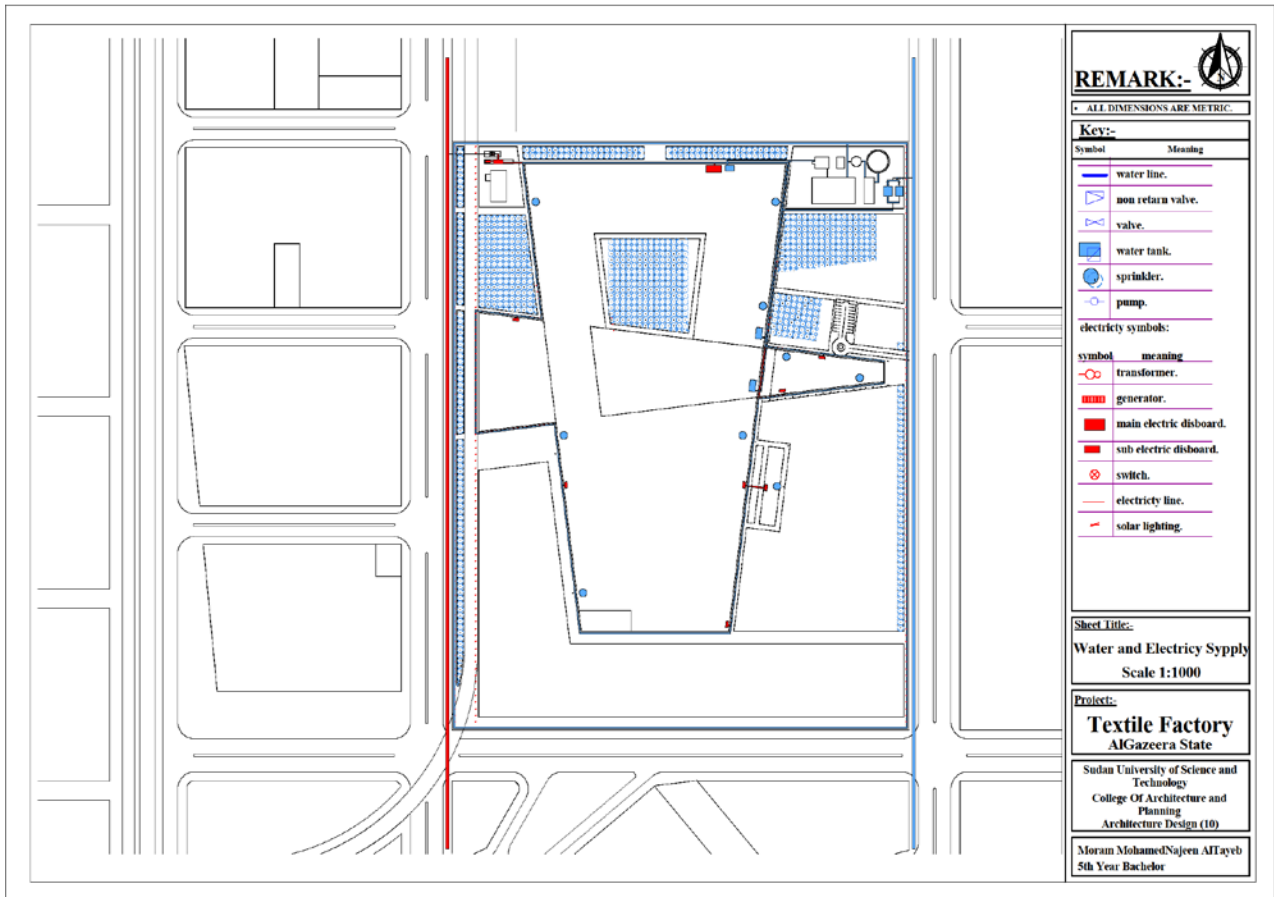
- Ring system is used because it provides continuous water supply and it doesn't get affected by maintenance in any part of the supply net.

Buildings' water supply: -

- The fall gravity system has been used; placing a top tank close to the most used areas (W.C.s, kitchens).
- The choice of this system was because of the uncontinuous and strong water pressure, as that the height of the buildings is suitable for the direct capacity of the pumps (Motors).
- Non-lighted multi-layer plastic water tanks have been used, which's considered the best, with an overhead sunshade.
- Water tanks capacity was calculated by calculating the daily consumption rate based on the number of users and the type of building.

Calculation of the the water tank capacity for the weaving production hall W.C.s: -

- Number of users = 150 people
- Daily consumption rate per user = 15 gallons
- Total consumption rate = $150 * 15 = 2,250$ gallons
- Total consumption rate per liter = $2,250 * 3.8 = 8,550$ liters
- So the tank capacity = **8,550 liters**



(5-) Electricity and Water Supply System Sheet

Sewage Systems: -

- The system used is **the fully ventilated two pipes system.**

Reasons to choose the system: -

- Reducing the pressure on the pipes by allocating a pipe to sinks' sewage and another pipe to toilets', with ventilation pipes that prevent smell of toilets from leaking to the sinks' pipes.
- Sewage pipes and accessories are made of (PVC).

Working principle:-

- This system allocates a sewage pipe for sinks' and basins' sewage (sewage column), and another pipe for toilets' sewage (work column).
- It also allocates a separate ventilation pipe for sinks and another ventilation pipe for toilets.
- The sinks' pipe meets the toilets' pipe in the manholes.
- In order to prevent the leakage of toilets' smells to the sinks' pipe, the sinks' pipe is isolated with a large Gully trap before it reaches the Manhole.

Surface drainage systems: -

Drainage of roofs: -

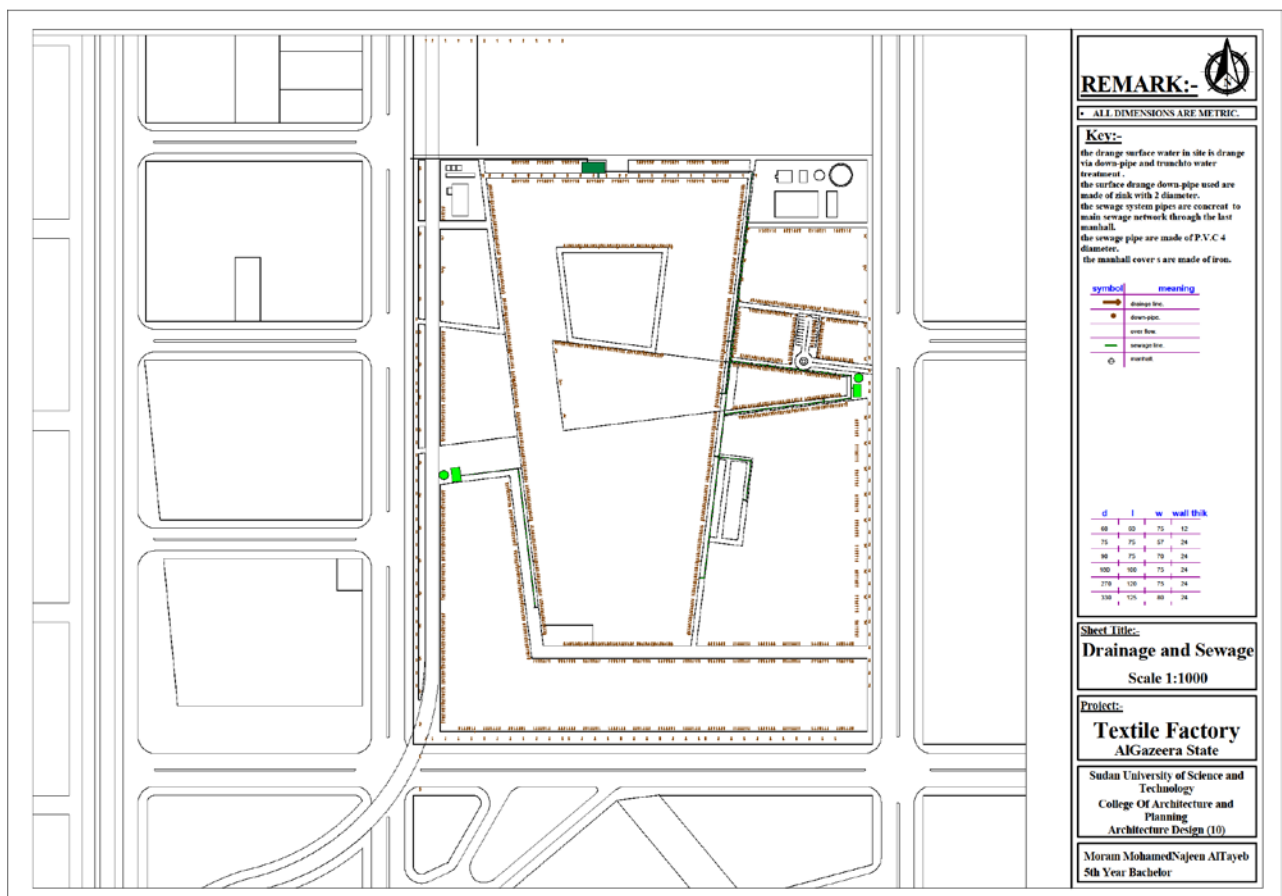
- The rainwater is drained from buildings by dividing it into sections (every 15 m) with 1: 100 slope.
- in each section, the water is collected in a down-stream that ends with a down-pipe to drain the water.

Drainage of corridors: -

- due to the length of the distance within the site, the site's slope is divided in two with opposite slope directions (1: 200).

Drainage of green ares and parkings: -

- Green areas' and parkings' slope is (1: 200) in the direction of trunch, which discharges the water in the direction of the site's slope.



(5-) Drainage and Sewage system sheet