ABU ALANDA HOUSING COMPETITION

DESIGN METHODOLOGY and COST ANALYSIS

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SITE PLANNING

-The site was designed into two main zones; Part 1 and Part 2, which are connected by the park.

- The site is designed to create a continuous pedestrian spine through the connected courtyards. Each residential unit is mirrored identifying a courtyard which creates an introverted experience giving the neighbors the chance to meet and interact.

-The central pedestrian spine in part 1 is linear because the land goes with North-South orientation.

-The spine in part 2 is shifted through a zigzag line to keep the North-South orientation. Through this shift in masses, the design provided the masses with long south elevations. See figure (1)

Figure(1): Site planning concept

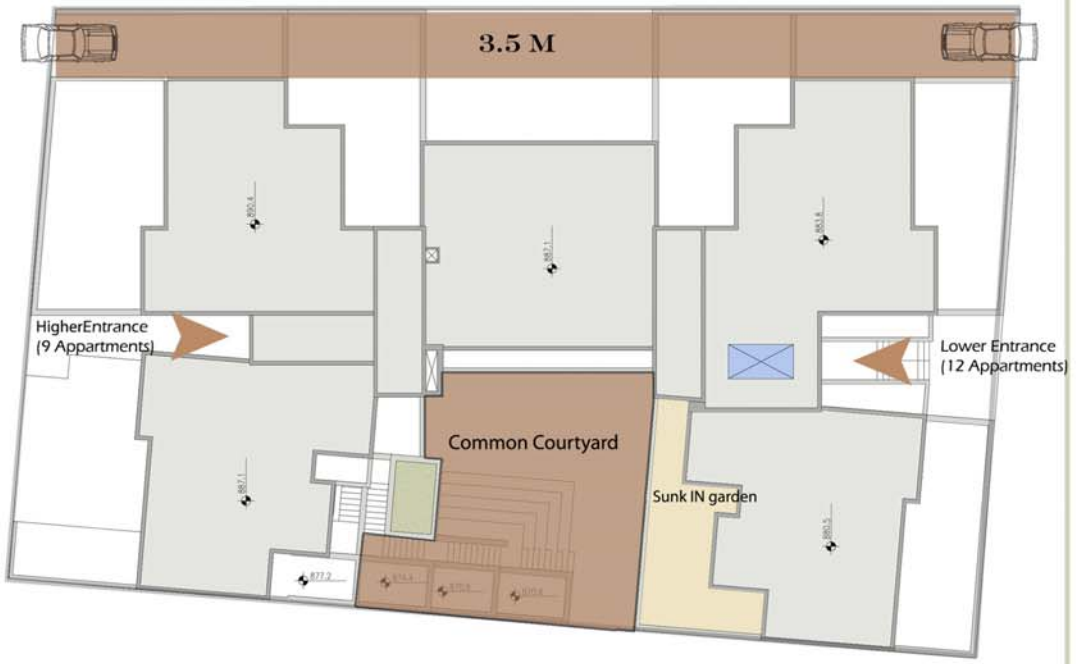
- A side setback of three and a half meters is reserved for car entrance to the parking level.

- Two entrances are identified; one from the lower street serving 12 apartments and the other one is from the upper street serving the rest 9 apartments.

- Sunk in gardens are introduced for the apartments of level 1 and 2;
First: to allow the sun into the rooms and offer a nice landscaping experience for the occupants.

Second: to separate these apartments from the common courtyard to provide them privacy and security. See figure (2)

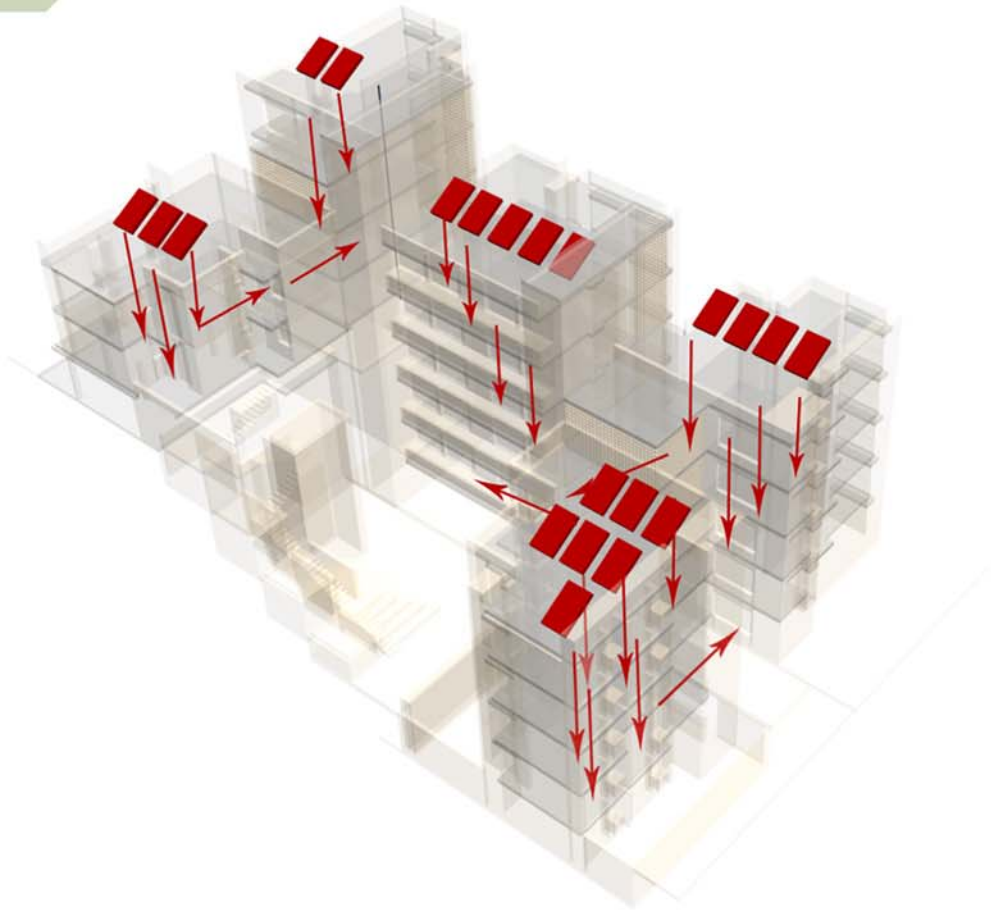
- families are encouraged to design their courtyard the way they find suitable , some may choose to reserve it for children to play and others may choose to landscape it, this will give each apartment building its individuality .



Figure(2): Conceptual plan showing the proposed setback, the entrances and the courtyard

- The stepped massing of each building creates stepped terraces and offers the apartments the chance to shade each other and to shade their courtyard.

- The stepped massing of the building prevents the heat loss of the Solar Thermal System. The stepping supports the Solar System to heat the closest apartments attached to it, by this the length of the pipes are reasonable to keep the heat in the pipes. See figure (3).



Figure(3): stepping of masses reduces the heat loss of the Solar system

ENERGY EFFICIENCY

Energy Efficiency is achieved through the following passive indigenous responses to the environment:

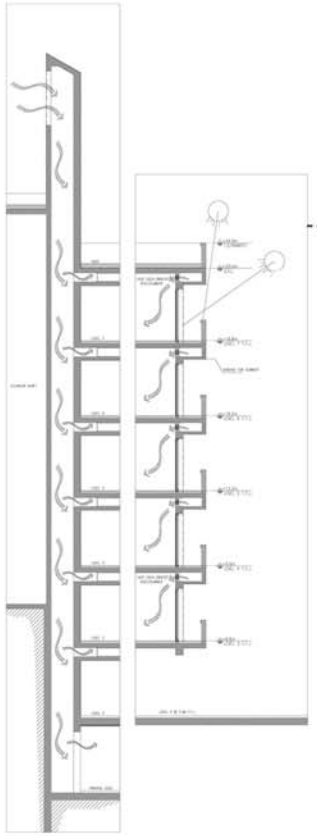
- Apartments are arranged to maximize the amount of natural day light entering the rooms, 70 % of the living rooms and the kitchens of the apartments are facing southern sun, and this will also maximize solar gain in winter.

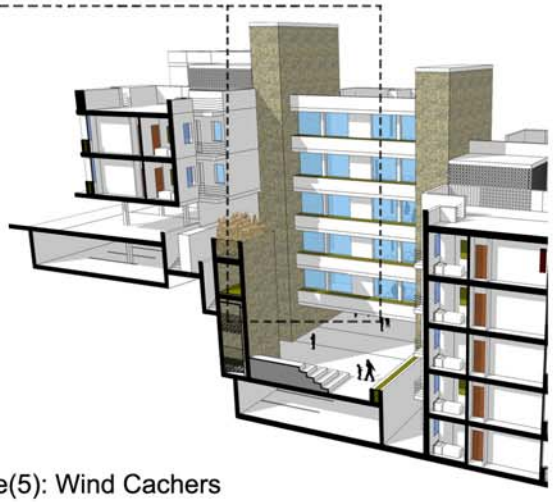
- Southern facing windows are treated with overhangs to prevent the solar heating in summer.

- Western and eastern windows are treated with vertical windows to avoid heat input from a low-angle sun. See figure (4).

- Wind catchers are directed to receive the western prevailing winds and to pump the air into the spaces that receive less air than others. -Straw is used in the Courtyard balcony to create Desert AC. When wind goes through the wet straw, it gets heavier and gets down to the lower apartment through a grilled unit. See Figure (5)

Figure(4): Virtical Windows to aviod Low Angle Sun Heat





Figure(5): Wind Cachers

- Collestra Façades are used in the western and eastern staircase elevations to reduce the heat of the low angle sun. See figure (10)

Saving energy depends on the first level on people themselves. Accordingly, the project advises to add the water and electricity counters in the apartments. By this residents can calculate their level of energy consumption. Psychologically, it helps to increase awareness for people and pay attention to their Energy saving

Figure(10): collestra on the wastrel and eastern facades

Insulation

- The building is insulated to minimize the possibility of thermal bridges. Both ceilings and parking roofs are thermally insulated. 5 cm of expanded polystyrene is used to give the exterior walls a low U value and thermal resistance. See figure (8)
- Double glazed windows will be employed to also reduce future cost obligations.

Heating System

-The Central Heating system is a two pipe system which means every radiator gets a hot feed in and a separate cold feed back to the boiler. This allows to turn any radiator off and set all radiators at different temperatures.
The boiler normally turns on and heats the radiators approximately every 40 minutes when the house looses 5 degrees, if the temperature in any room drops quicker for any reason the thermostate on the radiator will open, this will lower the pressure on the boiler which will then turn the boiler on sending hot water to the open radiator the rest will not heat up until it is necessary.
Each radiator has a Thermostat which actually saves money.

The radiators we use have fins on the back this cuts down heat loss into the walls and will save more money.

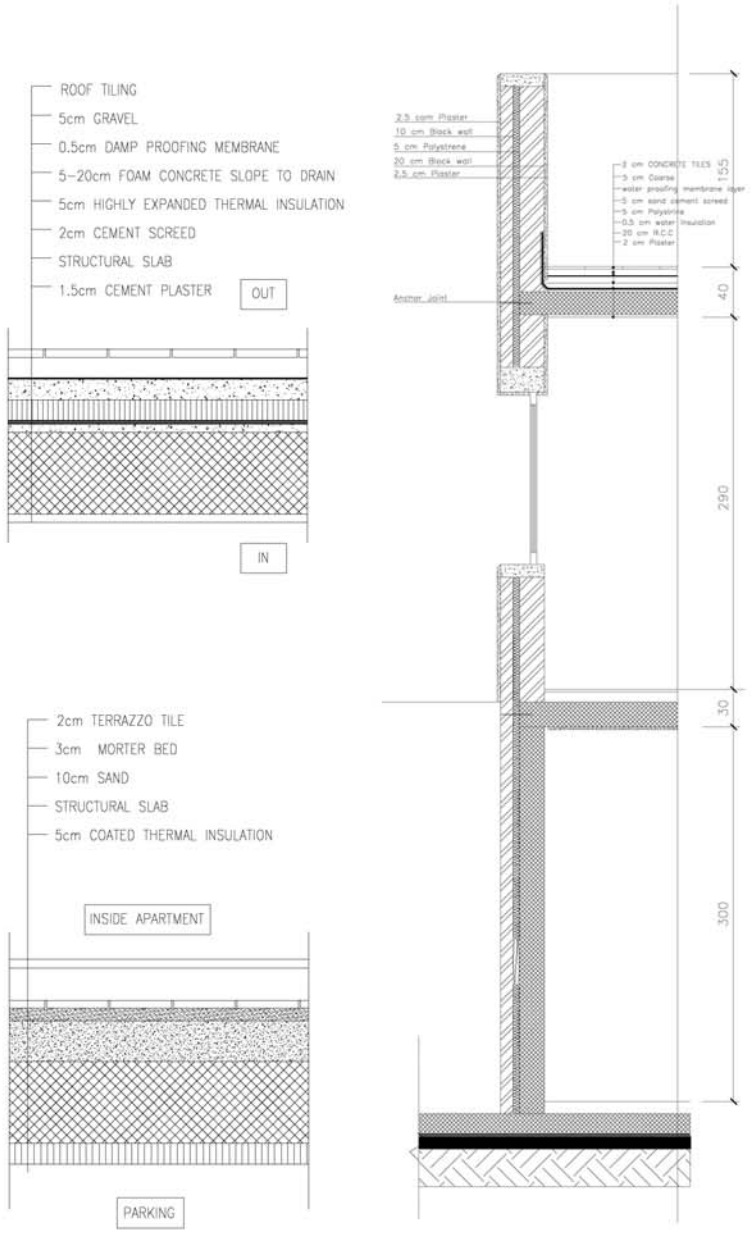


Figure (8): Wall and Ceiling Sections

Hot Water Supply

- Each apartment has its own heating and hot water system .Thermosiphon System with Boiler is used for hot water supply. Solar panels are placed to face South on the building stepping roofs with an inclined angle 30°.

-The cold water moves into the hot water tank. Water moves in a close circuit from the solar panel to the hot water tank and transfers the heat to the cold water by a heat exchanger .

- A sensor, valve and pump exist close to the apartment. When ever water temperature is less than 30° C the pump allows water to go back into the hot water tank, to minimize the water loss in waiting the hot water.

-The Passive water system is linked to an active bioler system activated when ever necessary.

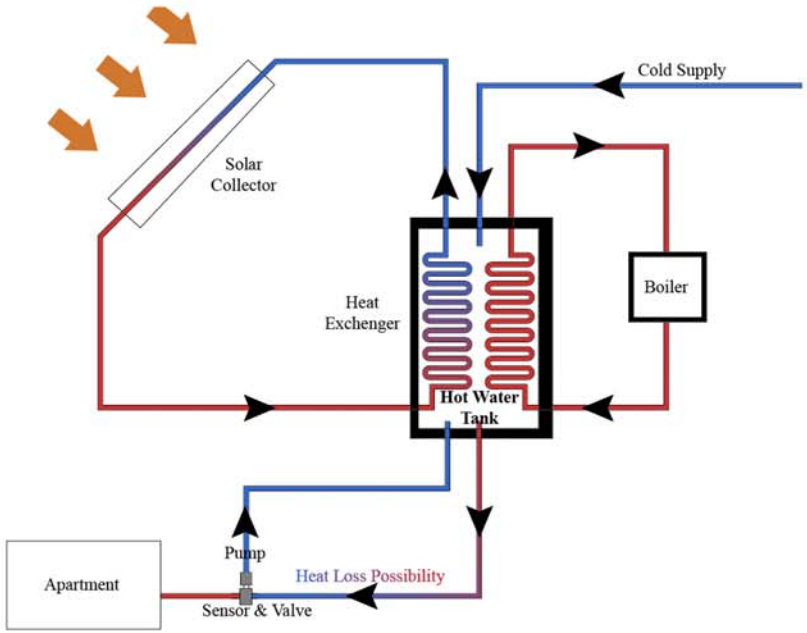


Figure (9): Thermosiphon and Boiler water Heating System

Cooling and Ventilation

- The apartments on the upper streets are elevated on columns so that they do not obstruct the air moving into the courtyard. The air will pass above a Bamboo Planting.The structure of the Bamboo acts as a grill that can allow air to penetrate through it. In Summer time it will be sprinkled in order to keep it's surface wet.When ever air passes through it, the bamboo cools it. then the air becomes heavy and goes down to cool the courtyard.See figure (6).

- Trombe-michel wall is introduced. It incorporates vent openings near the floor and near the ceiling. As the heated air rises, it would enter the room through the top vent, drawing in cooler air from the room near the floor level. Thus the outer wall surface and cavity air temperatures are lowered; thereby the heat loss is reduced. See figure (7).

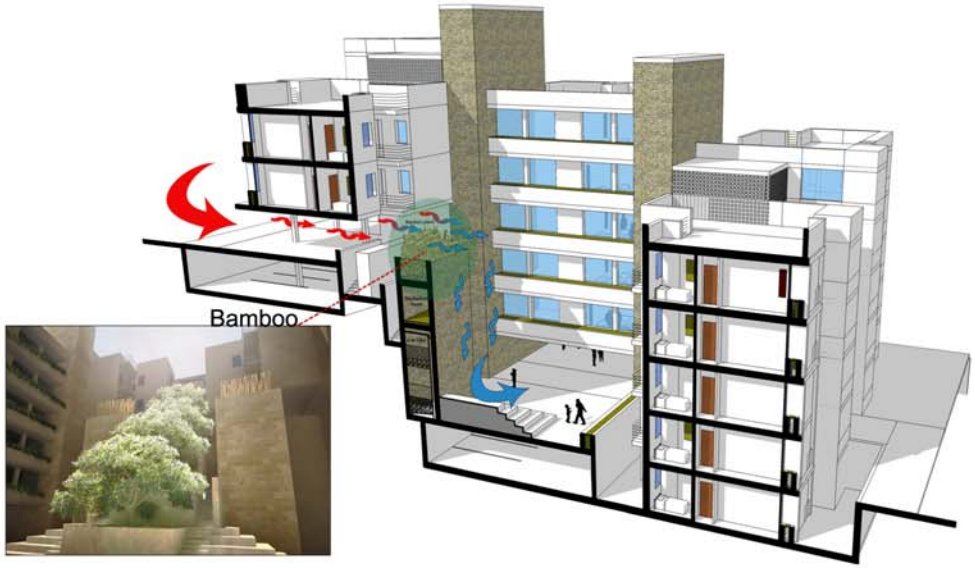


Figure (5): Bamboo Plant in Cooling the Courtyard

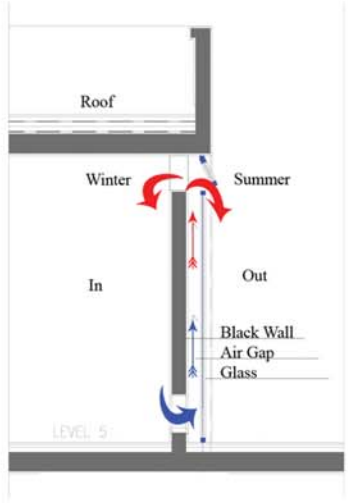
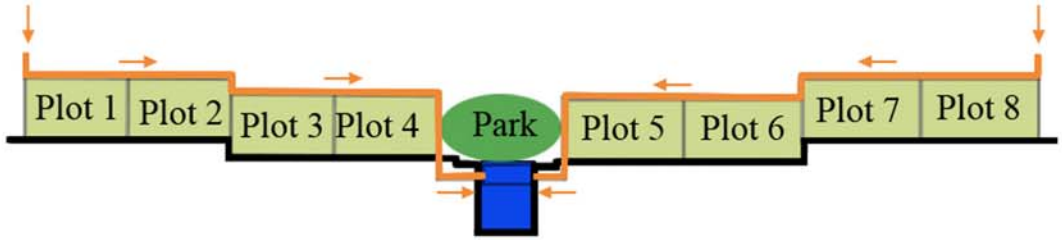


Figure (7): Trombe- Wall Mechanism

Rainwater harvesting tank is located on the lowest point of the site under the designated park. The water is collected from the terraces of the eight plots through pipes. The collected water will be used to irrigate the garden of the park. See figure (11).



Figure(11): Rain Water Harvesting Tank below the Park

GRAY WATER TREATMENT

The used water from bathtubs, showers, sinks, floor drains, and washing machines will be collected in a tank of 5m3 volume in the basement. The collected water will be filtered through a Gray Water filter. A stainless steel screen mesh at the beginning filters water from hair and solid materials. Then it passes through many layers of wood, sand, stone courses, and cement. Then it will be collected again in a tank that will pump to upper tank. This tank will be connected into 22 tanks; 21 for the residents to use it (through special pipes) as toilet flush and for cleaning issues. And one to water plants in the common courtyard through dripped irrigation to keep GW out reach of kids. All the tanks have valve to get rid of water when necessary. The screen mesh should be cleaned periodically through the Mechanical room.
The GW filter should be very well covered, and should be vented appropriately to allow odors to escape to the atmosphere by an exhaust up to the roof. See Figure (12)

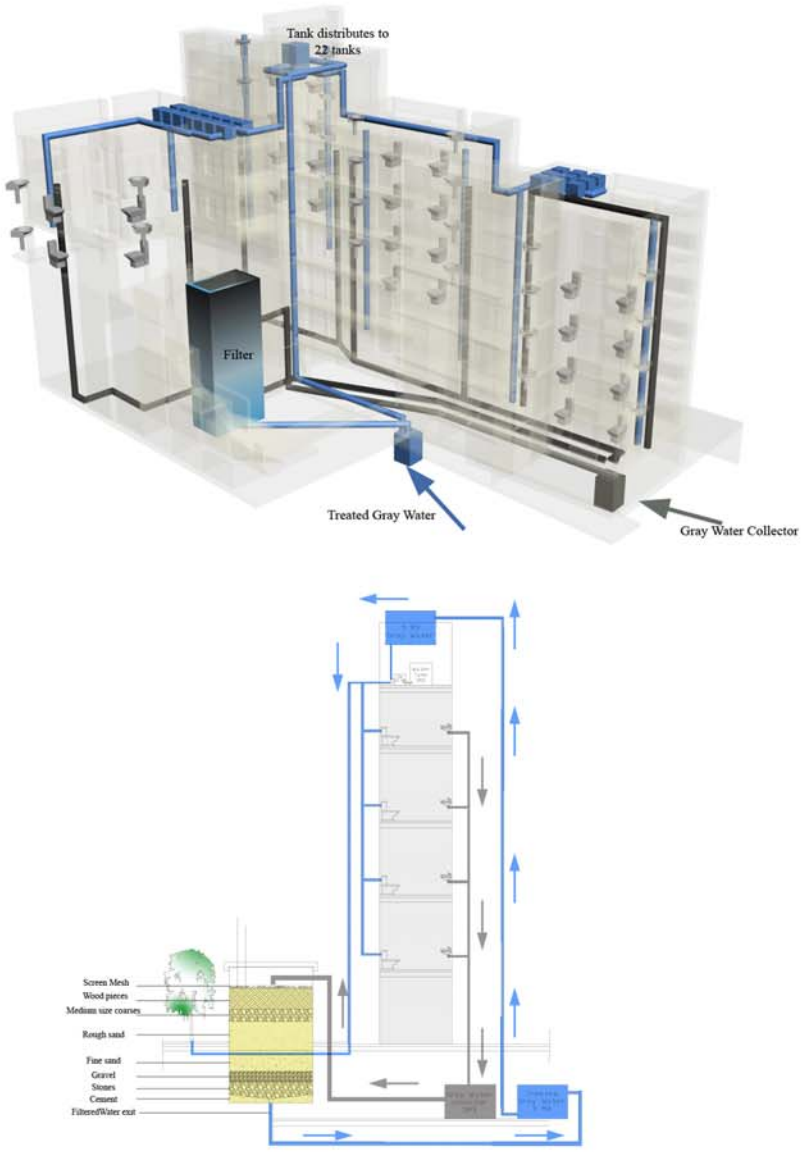


Figure (12): The process of Gray Water Filtering

Environmental friendly materials employed are:

1. Concrete (local cement/ local aggregates/ local reinforcement): concrete is a friend of the environment in all stages of its life span. It builds durable, long lasting structures. Building with concrete is energy efficient because the building will take advantage of its thermal mass or its ability to absorb and retain heat. It is produced in quantities needed for each project, reducing waste; it can also be crushed and recycled after the building has served its original purpose.

2. Ceramic tile (local ceramic tile for services and porcelain for floor tile): the ceramic tile is made of natural clay and raw materials, with a manufacturing process utilizes regional materials

3. Painting (pure acrylic emulsion high quality paint): pure acrylic is biodegradable and has very low toxicity rating. It has near zero VOC (volatile organic compounds)

4. Alluminum doors and frames (double glazing): aluminum strength, recycability and light weight makes it good for building; it offers an advantage through its ability to be repeatedly recycled without loss of quality and with only five percent of the original process energy use and emissions.

The park is designed to keep the courtyard spine of all 8 plots connected.

- The design respected the original levels of the intermediate plot.
- An underground tank is designed to collect storm water from the eight plots
- A promenade for children playgrounds and family seating areas is connected with the courtyard spine and is dispersed within a strong landscape character.
- In general the park is designed to have a variety of evergreen and deciduous trees that are dense with colors and change with seasons.
- For plant selection, the following was taken into consideration:

1. facing west , trees like populneus is used , because it gives a beautiful voice whenever the wind passes through it , in addition it allows the air to pass and filters it, rosemary and lavender are also used to give out a good smell for the rest of the park .
2. Facing north, different plants were selected but ones that do not need direct light to grow, just like agars.
3. Deciduous trees were selected for east and south.

The following is a table of the plants selected for the design of the park:

Carob ceratonia siliqua
Kuarrajong – brachychiton populneus
Purple – jacaranda acutifolia
Crape myrtle –lagerstroemia indica
Italian stone pine –pinus pinea
Creeping junipers- junipeurs horizantalis
Rosemary –rosemarinus officinals
Lavender – lavendula angustifolia
Stripped agava- agave Americana varigata
Scarlet firethorn-pyracantha coccinea
Silver falls- dichondra

Figure (12): Central Designated Park

COST ESTIMATE

Item No.	Description	Unit	Quantity	Unit Price (JOD)	Total Price (JOD)
1	**Substructure**				**156,800.00**
1.1	Excavation & Earth Works To reduced level, to footings & ground beams	m3	3,800.00	3.00	11,400.00
1.2	Backfilling Around & above foundations	m3	200.00	3.00	600.00
1.3	Plain Concrete For blinding under slab on grade & foundations	m3	100.00	69.00	6,900.00
1.4	Reinforced Concrete For slab on grade, wall & column necks & foundations	m3	1,210.00	100.00	121,000.00
1.5	Bitumen Waterproofing For underground works, horizontally & vertically	m2	2,600.00	6.50	16,900.00
2	**Superstructure**				**130,000.00**
2.1	Reinforced Concrete For columns, stairs, beams & slabs	m3	700.00	100.00	70,000.00
2.2	Concrete Masonry Unit				48,000.00
	100mm thick, for inner partitions & outer walls		3,750.00	8.00	30,000.00
	150mm thick, for partitions between apartments & outer walls	m2	1,800.00	10.00	18,000.00
2.3	Thermal Insulation Expanded polystyrene 50mm thick to cavity walls & parking ceiling	m2	3,000.00	4.00	12,000.00
3	**Finishing**				**164,750.00**
3.1	Internal Plastering Portland cement plaster to walls & ceilings	m2	7,000.00	6.00	42,000.00
3.2	Ceramic Tiles For bathrooms & kitchens, walls & floors	m2	1,650.00	16.00	26,400.00
3.3	Terrazzo Tiles Portland cement terrazzo tiles to dry areas floors	m2	1,530.00	10.00	15,300.00
3.4	Aluminum Works Anodized aluminum windows & doors	m2	400.00	97.00	38,800.00
3.5	Wooden Doors Painted hollow-core doors with frames	m2	250.00	71.00	17,750.00
3.6	Paint Emulsion paint to walls & ceilings	m2	7,000.00	3.50	24,500.00

Item No.	Description	Unit	Quantity	Unit Price (JOD)	Total Price (JOD)
4	**Façades**				**22,400.00**
4.1	Plastering Portland cement plaster to elevations, soffits & parapets	m2	1,800.00	6.00	10,800.00
4.2	Paint Weatherproof paint to elevations, soffits & parapets	m2	1,800.00	5.00	9,000.00
4.3	Metal Works Vertical & horizontal louvers	m2	52.00	50.00	2,600.00
5	**Roof Works** Rigid thermal insulation, foam concrete to slope, screed, bitumen membrane, protection board & concrete tiles	**m2**	**600.00**	**31.00**	**18,600.00**
6	**External Works & Landscaping**				**7,600.00**
6.1	Paving Interlocking concrete tiles	m2	600.00	11.00	6,600.00
6.2	Agricultural Soil & Plantation	L.S.	1.00	1,000.00	1,000.00
7	**Mechanical Works**				**68,250.00**
7.1	Thermosiphon System				45,465.00
	Solar auxiliary system Solar panels, tanks & heat exchangers	Apt.	21.00	405.00	8,505.00
	Boilers & radiators system	Apt.	21.00	1,760.00	36,960.00
7.2	Bathrooms Fixtures	Apt.	21.00	270.00	5,670.00
7.3	Grey Water Filtration System	Apt.	21.00	290.00	6,090.00
7.3	Networks Plumping pipes & fittings for all systems	Apt.	21.00	525.00	11,025.00
8	**Electrical Works**				**48,300.00**
8.1	Power Fixtures Electrical panels & boards, sockets & plugs	Apt.	21.00	1,030.00	21,630.00
8.2	Lighting Fixtures	Apt.	21.00	360.00	7,560.00
7.3	Low-Current Systems Fixtures for data & telephone systems	Apt.	21.00	250.00	5,250.00
7.3	Conduits, Cabling & Wiring For all systems	Apt.	21.00	660.00	13,860.00
	Total				**616,700.00**

LCCA = Initial cost + Replacement cost - Residential value + 20 (total operating and repair costs)

Initial cost =616,700.00 JOD

Replacement cost equals Replacement cost for any system that isn't expected to last the full time period = zero

Residual value equals any remaining value the resident can recover at the end the twenty years = 1,000,000 JOD

Total operating and repair cost= (10+20+10) *12* 20*21= 201,600 JOD as follows:

- 10 JDs water bill monthly per apartment
- 25 JDs electricity bill per apartment
- 10 JDs is the monthly maintenance cost
- 21 is the number of apartments
- 20 is the time for which the analysis is requested

LCCA= 616,700.00+0-1,000,000+201,600
LCCA= -181,700 JD

PERSPECTIVES

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