AQABA HOUSING COMPETITION

Design Methodology & Cost Estimate

Aqaba Housing Competition

From the onset, the approach to the design of the Model Water– and Energy–Efficient Low-Income Expandable Housing Unit has been to provide a passive, low-tech, and socially sensitive solution to the requirements set out in the brief.

The primary design concept has been to create a hard protective shell with minimal openings to shelter the unit from the harsh external environment. The resultant inwardly orientated unit would focus around, and derive most of its light and livelihood from, a sheltered and planted private courtyard.

The design allows for 2 units, each of 80m2 gross external area (GEA), to be built on each plot. Each unit may be expanded by building an extension on the upper floor of 56m2 GEA per unit, to reach the plot's maximum gross built-up area of 272m2. The starter unit has a square footprint of 10m x 10m with a central external courtyard of 20m2. Designing the unit around a central courtyard has enlarged the perimeter of the units on site, resulting in narrower and better-shaded spaces between the buildings.

Site Layout

The intention was to avoid the monotony that frequently results from housing projects involving the repetition of a single unit type. A level of articulation was required that would also create usable spaces between the buildings which would play an important role in nurturing a sense of community amongst the residents.

The units have been arranged on site to allow 4 units from 2 neighbouring plots to form a cluster. This affords the units the shared benefits of shading each other and their shared external space; the neighbourhood courtyard. This also aids in creating a community identity through encouraging social interaction between residents of the neighbourhood as well as fostering a sense of communal ownership of these shared facilities.

The layout provides a layering of experience and a hierarchy of spaces leading from the road and culminating in each unit. One enters the site from the public road through one of the semi-public streets between plots. These lead into the more private domains of the neighbourhood courtyards before entering a unit's private courtyard. By the nature of their layout, enclosure and microclimatic variation, each type of space will assume a different function and character and provide the setting for different events.

Plan

All rooms focus around the private courtyard. The layout of the rooms is symmetrical about the courtyard for simplicity, clarity, and interchangeability of functions to suit variations in potential future sites.

The inhabited rooms are located to the sides of the private courtyard with the utilities and circulation located to the front. This designates the private courtyard as the focal point of the unit in addition to acting as a buffer between the public and private zones within the unit.

The unit is split-level with one half of the inhabited rooms raised 1m above the others. This was in response to the topography of the site and as a space saving measure where the horizontal circulation between zones doubles up as part of the vertical circulation for roof access and the potential future extension.

Environment

In designing the units with a protective external shell, the intention was to create minimal external openings in a membrane of high thermal mass. It was also desirable for this membrane to be selectively permeable in order to allow the warm external air to be cooled and introduced into the unit. These requirements provided two main obstacles. The first being that creating a high thermal mass in a conventional manner would affect the budget and that secondly, using minimal openings in a blank façade risks creating buildings with little external visual interest and stimulation.

The solution has been to utilise a 'gabion' cladding system. This entails building up thermal mass by encasing 'off-cut' pieces of stone in a metal wire container, which is supported within a fair-faced reinforced concrete frame. The low cost of this system lies in the fact that the off-cut pieces of stone may be obtained for free from local quarries where one is only required to pay for their transportation to site. There is the additional benefit of encouraging the residents of the unit to participate in the building process themselves by manually filling up the metal wire containers with the stones as a cost saving measure that requires no building experience.

The shaded gaps between the stones in the gabion cladding system allow warm air to be drawn into the air cavity where it is cooled. The cool air sinks and is drawn into the rooms through the low level ventilation gaps due to the buoyancy of the rising warm air in the room which is dissipated through the high level windows. In addition, the plants in the courtyard provide shade and act to humidify the hot, dry external air that enters the rooms through the windows. Air entering from the wind-catcher cools as it travels down the shaded stairwell before entering the rooms and aiding cross ventilation throughout the unit.

Water conservation will be achieved through the incorporation of a Grey Water Re-Use system. The Grey Water may be used to water both the neighbourhood and private courtyard plants. This shall be located directly below the staircase facing the courtyard. Its location below the bathroom level will eliminate the immediate need for a water pump. Maintenance access would be directly off the courtyard.

Private Courtyard

The private courtyard provides microclimatic conditioning at the heart of the unit through shading and evaporative cooling by the plants. It also provides a private open space for household activities to take place in a manner that caters for a traditionally conservative society.

As common to various courtyard house examples in arid regions ranging from the Hijaz to Mexico, the exterior of the units visually blend into the landscape. This, however, is dramatically offset internally with bold colours in the private courtyard as an expression of the inhabitant's individuality. Such colours are not necessarily restricted to those illustrated in the 3d renderings and are subject to vary from unit to unit, depending on the inhabitant's preferences. This individuality may be further expressed in the more subtle variations of stone colours used in the gabion wall systems of each unit, as a result of them being acquired from different quarries.

Category	Description	Description	Description	Quantity	Unit	Rate	Amount
						JD/Fils	JD/Fils
Substructure	Site work	Excavation	For Foundation	65	m3	2	130.00
		Filling	Under Slab on Grade	12	m3	3.5	42.00
	Concrete	Cast-In-Place Concrete (Reinforced Cast In-Situ)	Foundation	11	m3	45	495.00
	Thermal & Moisture Protection	Below Slab on Grade	Bituminous Membrane Waterproofing, 4mm thick	80	m2	2	160.00
Total							**827.00**
Superstructure	Concrete	Concrete Reinforcement	Various Diameters	2200	kg	0.45	990.00
		Cast-In-Place Concrete (Plain)	Blinding	3	m3	30	90.00
			Grade Beams	4	m3	50	200.00
			Hourdi ribbed slabs, 250mm thick	8	m3	55	440.00
			Drop Beams	1	m3	60	60.00
			Columns	2	m3	65	130.00
			Staircases & Steps	2	m3	50	100.00
			Lintels, size 100x200mm	6	m	6	36.00
			Ditto, size 350x200mm	3	m	9	27.00
	Masonry	Concrete Masonry Unit	Walls, 100mm thick	67	m2	4	268.00
			Gabion Walls	85	m2	7	595.00
			Hollow Concrete Hourdi Blocks	480	No	0.24	115.20
			Smooth Troweled Concrete for Sills, Thresholds, Stair Treads & Risers				117.00
	Thermal & Moisture Protection	Laid Vertically	Bituminous Membrane Waterproofing, 4mm thick	80	m2	2	160.00
Total							**3,328.20**
Finishes	Concrete Floor Finishing	Above Slab on Grade	Cement & Sand Levelling Scree	72	m2	3.5	216.00
	Finishes	Portland Cement Plaster		295	m2	2	590.00
	Metals	External Louvres					72.00
		Steel Doors	Single Leaf	3	No	85	255.00
		Wood Doors	Single Leaf	3	No	75	225.00
		Aluminium Windows		11.5	m2	35	402.50
		Ceramic Tiles	size 200mmx200mmx8mm thick	8.5	m2	6	51.00
		Portland Cement Terrazzo	size 300mmx300mmx30mm thick	40	m2	4	160.00
		Painting					380.00
Total							**2,351.50**
Landscaping	External Paving	Including Base Course & Dozing		42	m2	4.7	197.40
	Trees & Plants	Obtained from Ministry of Agriculture Free of Charge					
Total							**197.40**
M & E	Mechanical Installation	Plumbing & Sanitary Installations					700.00
		Grey Water Re-Use System					160.00
	Electrical Installation						600.00
Total							**1,460.00**
Summary							

Summary	
Substructure	827.00
Superstructure	3,328.20
Finishes	2,351.50
Landscaping	197.40
M & E	1,460.00
Total Cost of Starter Unit	**8,164.10**

Total Cost Per Square Meter of Starter Unit	**102.00**
Total Cost Per Square Meter of the Incremental Addition	**83.00**
Total Cost of Fully Expanded Building	**12,812.00**