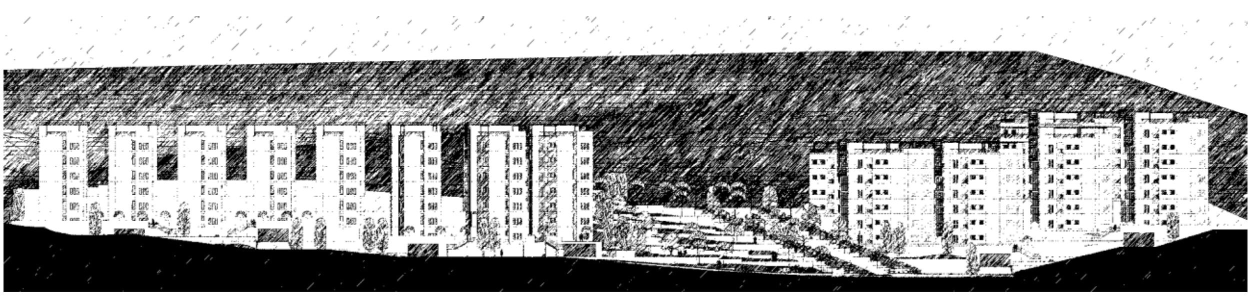
Abu Alanda Housing Competition



The following outlines the method utilized in developing the concept design of the 'Model Water- and Energy-Efficient Low-Income Apartment Building in Abu Alanda':

The Energy Concept

The procedure adopted in designing for energy efficiency can be broken down to an analytical part (boundary conditions), and a process oriented part (concept development) and finally a quantitative part (evaluation) [i]. The third part is beyond the scope of this report.

1. The starting point for developing an energy concept was **analysing the most important boundary conditions**; namely the climate and solar geometry:
    a. The software *Climate Consultant* was utilized to perform a bioclimatic analysis and generate a bio-climatic design chart (see appendix A). The outcome was a list of prioritized passive and conventional design strategies that are relevant to the local climate; recorded as hourly weather data averaged over twenty years (TMY data) . Due to the lack of such data for Amman in a digital format that is compatible with such software, the weather-file for Jerusalem was used instead keeping in mind that the purpose is to set a climate-relevant direction for the design strategies. Jerusalem's climate is very close enough to that of Amman for this purpose. An early study of the
    b. An early study of the solar trajectory over the site's geometry easily revealed the challenging nature of the orientation of the site (North-South) which when combined with the inevitable multi-storey arrangement of the dwelling units result in little or no solar exposure to many of the units. However, solar collection for purposes of water and space heating could still happen on the roof level, which later became a design strategy for this project.
2. Developing the energy concept embraces two complementary objectives: **Minimization of energy requirements** and **optimization of energy supplies**:
    a. In order to keep energy consumption to a minimum:
        i. It was early decided to utilize thermal insulation to the outside of thermally massive materials, the economical wall construction is mainly comprised of rendered solid concrete masonry blocks with external insulation outside the structure, and an external finish of synthetic rendering.
        ii. The building form was driven by the provision of potential daylight and natural ventilation to each and every regularly occupied space. Furthermore, the staggering of the building blocks came to maximise the solar exposure (before or afternoon) for the maximum number of units.
        iii. The buildings fenestration mainly face north and south away from the East and West sun which are absent when most needed in Winter and available when most undesired in Summer, except for the deep windows of the master bedrooms that were chosen to face the East or West views through vertical deep windows.

iv. facing the prevailing winds (westerly) with the short side of the building maintains most of the horizontal flow of air flowing in between the building blocks to reach other windows.
v. The green roofs shall positively contribute to thermal performance of the roof

b. In order to optimize the energy supplies:
    i. The proposed system for heating the spaces is a 'low operating temperature' radiant slab heating (lower operating temperature translates to larger radiating areas). This system enhances both energy efficiency and human thermal comfort. Heat would be collected through vacuum tubes at the roof level which double function as pergolas to shade the roof. This system shall utilize seasonal storage of heated water to make it available during consequent cloudy days. When serving a large number of units (as in this project's case), the system can centrally (economically) cover 50% of the space and water heating requirements based on preliminary sizing of 0.14-0.20 sqm/1 sqm of floor space, and a 1.5-2.25 cubic m/ 1 sqm collector area.
    ii. Backing up the solar collector system would utilize high efficient electrically driven heat pumps. It is important to state at this point that any building that is being designed or even built at this point will mostly live longer than availability of oil as source of energy (20-30 years at best according to various current figures). Electricity in Jordan will be generated by cleaner and ever-cheaper sources of energy in the near future in contrast to oil which will continue to rise in cost and drop in availability. Heat pumps in this regard make a more sensible choice than fossil fuel fired furnaces on the longer run. An energy change to renewable resources is inevitable and is in fact happening on a global scale.

The Water Efficiency Concept

Water Efficiency is mainly approached through collection and use of rain water and grey water, as well as through constructional and technical measures such as water saving fixtures. Furthermore, This project is proposed to spread knowledge about Water Efficiency through the park area which is designed to showcase water efficient strategies to educate the public about water efficiency in buildings and the landscape. Hardscape features and and softscape elements are proposed to be tagged with brief information. For example, water management systems or the watering requirements for selected species of plant material can be explained through fixed signage or printed on to hardened concrete surfaces.

1. Collection of rain and grain water
    a. Observing the rain water patter in Jordan indicates that although it does not rain very frequently, but when it rains it brings a huge quantity of water that is wasted if not properly collected in huge tanks. This has been evidently understood by earlier civilizations and vernacular settlements. Collection of rain water shall utilize:

i. lower podium levels through direct surface drainage above hard surfaces and permeable 'pebble gardens' at the lower podium levels
ii. roof green surfaces which are proposed to become shallow soil vegetable gardens.
iii. Storage of rain water and grey water would be in tanks concealed under apartment blocks and intentionally exposed (in part or full) in the park area.

2. Grey Water Systems shall be central to the development and shall be used for purposes of irrigation.

On the Architectural Aesthetics and Rationale

The buildings form break-down came a response to the challenging North-South orientation of the site as previously discussed. The building was then designed inside out, the apartment spaces were designed for potential natural ventilation and daylight. Smaller building blocks also enhance a sense of security through relating to fewer neighbours in the one building.

Cars are parked underground strictly from the lower street (East), elevated podiums provide for communal areas. Privacy of residents at podium level apartments is enhanced through planter edges around buildings. The upper street side (West) shall be dedicated for pedestrian drop off and enclosed (relatively more private) family and children play areas. Building cores (lift and stairs) link between all levels and between buildings at the parking and podium levels.

The roof shall be accessible at one of its two 'wings'. While one shall accommodate water tanks and other utilities, the other side is proposed to be utilized as ground cover and/or vegetable gardens. This would positively contribute to the life style, identity and economics of low-income families.

The solar collectors on the roof also provide for a unique sense of identity. Manipulators of wind, sun and light (external window shutters) are proposed to be utilized to enhance the human comfort. From an aesthetical point of view, operable shutters that respond to orientation and time of day shall grant a dynamic appearance to an otherwise repetitive look of identical buildings. Such unique elements can be color coded according to the building, and this color code can be carried down to the parking basements for an enhanced sense of direction. Color also adds vibrancy to the project.

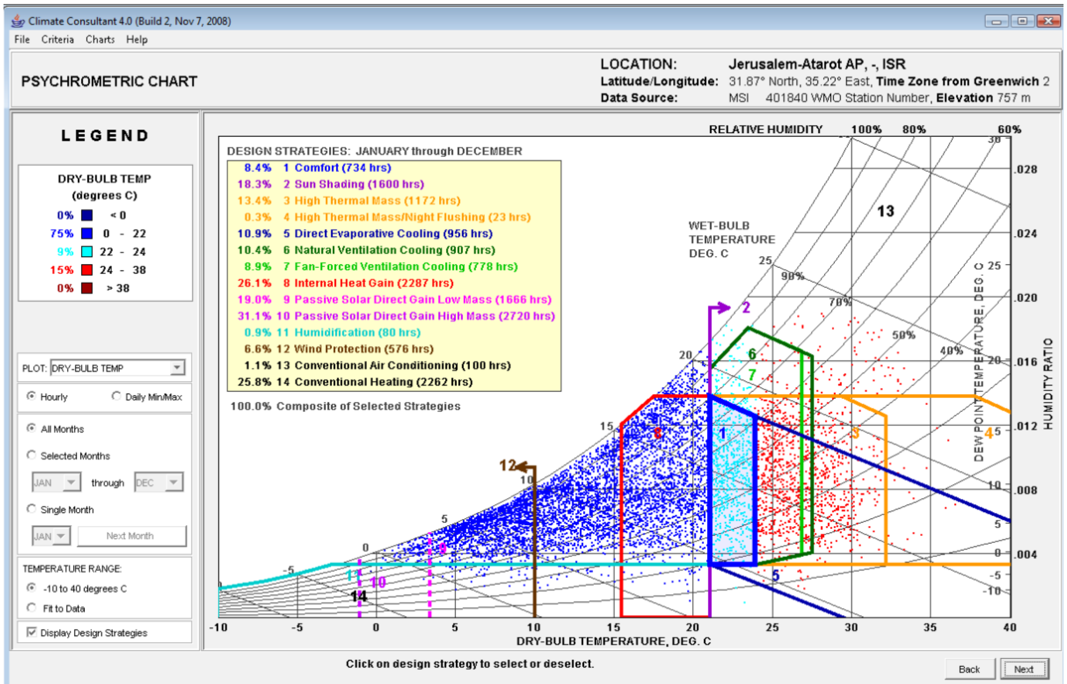


Fig .1 Bio Climatic Chart

Building 1	10		
Building 2	10		
Building 3	10		
Building 4	10		
Building 5	10		
Building 6	10		
Building 7	10		
Building 8	10		
Building 9	10		
Building 10	10		
Building 11	12		
Building 12	12		
Building 13	12		
Building 14	12		
Building 15	12		
Building 16	12		
Total	**172**	FAR	1.751441

Table 1: Breakdown of apartments (119.8 sqm each, while each building footprint is 280.72 sqm) and resultant design FAR ratio

Table 3: Estimated Breakdown of cost of one apartment building was made available with the generous help of a local contractor, figures describe cost only, and not contracting profits:

- Substructure: JOD 50,800
- Finishes: 96,500
- Electr Mechanical works: JOD 96,700
- Landscaping: JOD 39,800

This totals to JOD 610,100, bringing the cost estimate per-square-meter for the apartment building to meet the target of JOD 240.0.

Regarding the Life-Cycle-Cost Analysis (which can be defined as the sum of the building and site cost, maintenance and repair cost and operation cost), the author – regretfully- did not find reliable data on time to perform a realistic analysis.

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[i] (Hegger, Fuchs, Stark and Zuemer, Energy Manual)