Harpak House, Carmiel (Israel)

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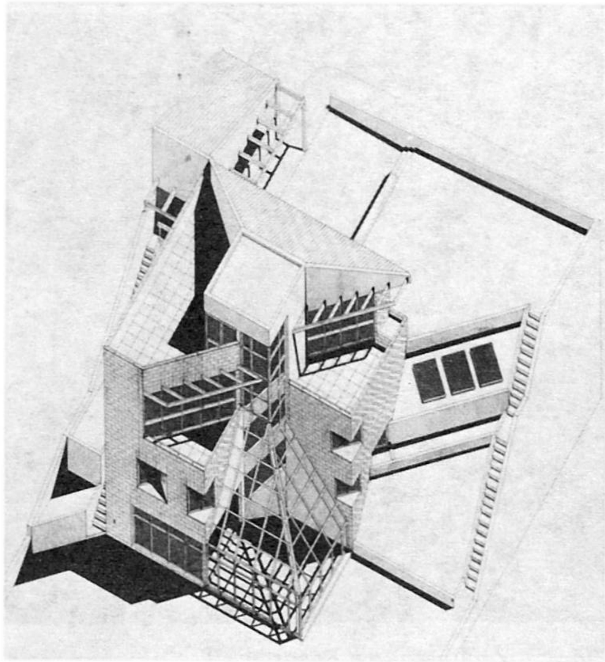
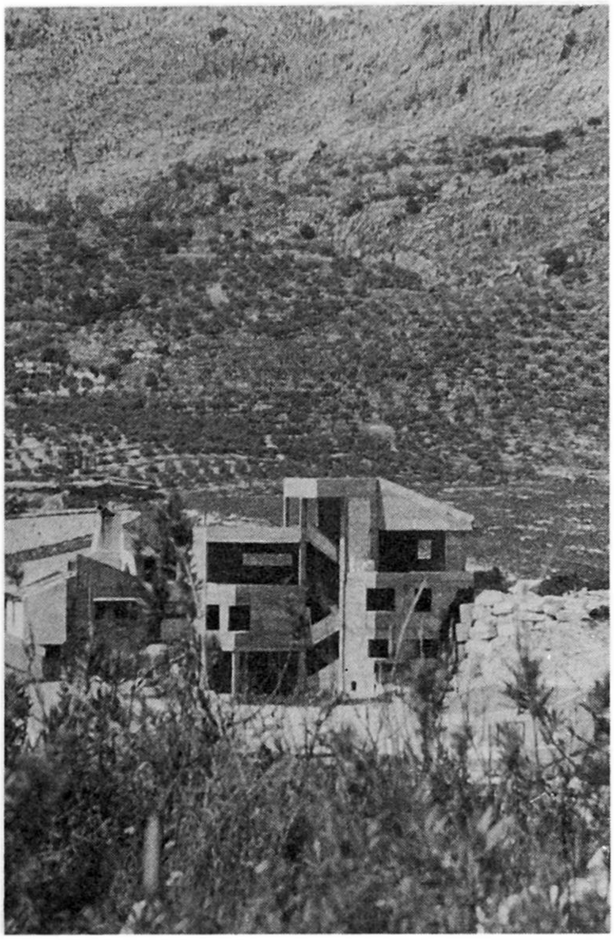
Owner: *Dana and Yuval Harpak*
Architect: *Goldschmidt Associates, Gabriela Goldschmidt, Principal*
Strucutre: *Avi Li'or, Civil Engineers*
HVAC: *Advanced Energy Systems, Amos Halfon, Principal*
General Contractor: *Yuval Harpak*

This single family house is being built on a small lot (640 m^2, with restrictive building lines) in Carmiel, a small town situated 20 km east of the Mediterranean coast. The site has a 45 % down slope towards west and it is approached from the top. The area is exposed to strong western winds. The program calls for a total floor area of about 250 m^2; thermal comfort was a major design guideline. The design temperatures are 33°C in summer and 2°C in winter. Heating degree days (based on 18°C) amount to about 900 DD°C.

Soon after design was undertaken, it became clear that the main challenge was basically geometrical: to design a structure whose architecture consolidates the needs for varying orientations, both in plans and in sections.



Harpak House

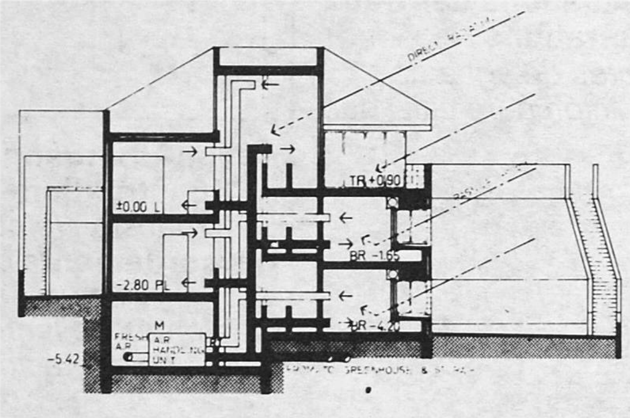


View

Complementary passive and hybrid solar design strategies which accentuate the geometric characteristics and provide maximum climatic comfort both in winter and in summer were used in the design of the house.

Architectural solution

The need to fit an extensive program into a very limited and steep building site suggested a multi-level house, partially underground. Three levels best accomodate the program. Each level is split in two in order to best adjust to the topography. A central stair was designed to minimize circulation and by turning it 45° relative to the rest of the layout, vertical spaces were gained which serve as air-shafts. Regulating openings at the top enable natural ventilation of the whole house in summer, when the rising hot air is sucked out. Space under the shelter was selected for rock-bed storage, after it was decided to store hot and cold air in this manner. The heating system of the house is based largely on direct gain and therefore all major spaces have openings facing south (with the exception of the family room). In order to obtain south-facing windows, 45° cuts were made at bedroom corners and the entire top floor, with the major living-dining spaces, was "chopped" diagonally for the same reason. Overhangs provide summer shading. A greenhouse, adjacent to the family room, was designed to complete the missing corner of the basic 11.80 m cube in which the house is enclosed. Of the two roofs, the one facing north-west is flat, so it can serve as a terrace, because it will be the only place in the house high enough to command a magnificent view, over the



Section

top of the roof of the neighbour's house. The roof over the other half of the house slopes down toward the front yard, thus creating a small-scale image compatible with the rest of the houses on the street. On the north-eastern side of the house and under ground level, are spaces which do not require view or direct heat gain such as bathrooms, storage, shelter etc. There are minimum openings to the est, as a protective measure against the strong winds.

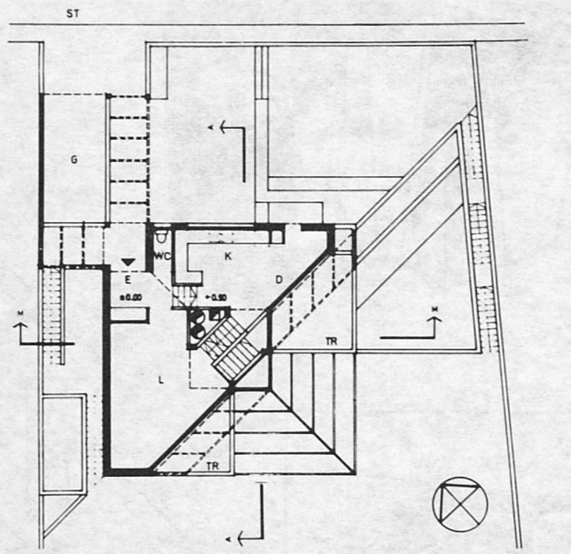
The structural material is concrete (15 cm load bearing walls), which is insulated on the exterior with 5 cm styrofoam sheets and clad with concrete blocks (with few exceptions where the styrofoam is stuccoed).

Energy System

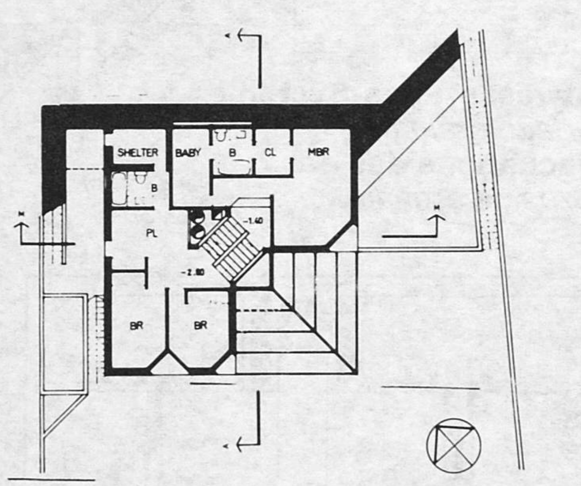
Heating and cooling are largely reversal operations in this house, as the rock-bed storage is charged with hot air during the daytime in winter, to be released at night, and with cold air during the night in summer, to be released during the day. The greenhouse, apart from being a pleasant living area, is where hot/cold air is accumulated. It streams into the house or is pumped into the rock-bed storage; a door between the greenhouse and the house makes it possible to control air circulation into the house. The storage releases hot or cold air to the various spaces of the house through a duct system connected to an air handling unit. The ducts are exposed and run in the vertical shaft next to the stairs.

The energy balance of the house was carefully calculated and the computations show that in addition to year-round comfort, overall savings in energy consumption amount to about 60%. The greatest contributions to savings are achieved through the improved envelope (thermal mass and insulation), direct gain (winter), good through ventilation and shading (summer). Operation of the greenhouse/storage combination is therefore postponed: preparations are being made, but they will be finished as per need at a later stage. The heating and cooling requirements of this house are 12500 (kWhT)[a], versus 20675 (KWhT)[a] in a comparable regular house. The annual solar contribution is 4135 in a standard house, 10570 in this house without the greenhouse and storage and 11800 when this auxiliary system operates.

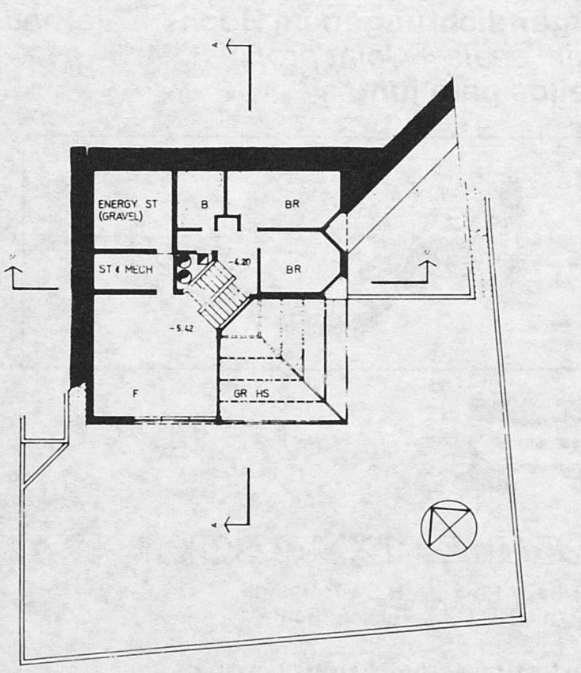
(G. Goldschmidt)



Upper Levels



Intermediate Levels



Lower Levels