ECOVILLAE: AN INTEGRATED ECOLOGICAL VILLAGE

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Keywords: sustainable planning, ecological building, energy saving building strategies and technologies

Summary

Ecovillae is an integrated ecological village in Fiano Romano, 30 km far from Rome, made up of 100 houses for 300 inhabitants. Urban layout has been modelled studying main winds and sun, in order to ensure natural ventilation and passive cooling during summer, daylight and free solar gains during winter. Each typology changes with seasons adapting to the climate: during winter energy needs are very little (less than 30 kWh/m²y, “A Class” for Casaclima calculation method), thanks to the use of green houses, solar atria, and high values of thermal insulation of envelope. During summer natural ventilation, thermal mass and solar shadings allow to have little conditioning charges. There is a cogeneration plant which uses woods from the maintenance of about 500 ha of wood and produce electrical and thermal energy for the whole village. Ecovillae philosophy is to provide everyone of passive systems, to let people choose active systems and to experiment very innovative technologies, as organic solar panels and electric wire in low tension in direct current. Inhabitants are strongly involved in the design and management. Ecovillae is a real project: construction will start before summer 2007, the first part will be completed before the end of 2009.

1. Urban layout

Ecovillae is an integrated ecological village in in the country side 30 km far from Rome. The project is developed by Avventura Urbana, on behalf of Euroaedifica, an international real estate group based in Rome, in partnership with its technical branch, Aengineering. The site is easily reachable by car from the A1 motorway. The village saves the ground: it is made up of 100 houses for 300 inhabitants only on 2 ha: 0,7 m² built for 1 m² of ground (for the surroundings it is about 0,2). Urban layout has been modelled studying main winds and the exposure to the sun, in order to ensure natural ventilation and passive cooling during summer, daylight and free solar gains during winter. During summer, when solar height is maximum, solar shadings, which equip each building, allow to avoid overheating.
Figure 1  Urban density of Ecovillae (on the right) compared with the density of the surroundings (on the left).

Figure 2  Solar position and shadows on the 21st of December, at 12:00 (on the left) and on the 21st of June, at 12:00 (on the right).
2. **Energetic sustainability approach**

Energetic sustainability approach in Ecovillae is based on the difference between what is incorporated in the project and building and what can be added according to inhabitants needs. So because Ecovillae is not a prototype village, but it’s real and repeatable. All the incorporated technologies are passive technologies and systems (high insulation, high thermal mass, openings layout to improve natural ventilation, solar shadings) and active ones (floor radiant panels for winter heating), which allow, by moderate extra costs to strongly improve performances using existing components that are affordable for everyone. At the same time people, interested to the environment, can customize their house introducing passive systems (greenroofs) and active technologies and systems (solar collectors, PV panels, active envelopes), which not only ensure energy saving, but also allow to produce energy.

![Environmental strategies in winter (above) and in summer (below).](image)

**2.1 Winter heating strategies**

First strategy for winter energy saving is an high value of thermal insulation of opaque and transparent envelope systems. The main U values of opaque and transparent envelope systems are: $U = 0.27\, \text{W/m}^2\,\text{K}$ for the garden roof, $U = 0.28\, \text{W/m}^2\,\text{K}$ for the outside wall, $U = 1.2\, \text{W/m}^2\,\text{K}$ for the curtain wall. These requirements are lower than the limits fixed for the 2010 by the D.L. 29/2006 n° 311. Heating energy requirements are less than 50% of common houses: less than 30 kWh/m²y (“A Class” for Casaclima calculation method). Radiant floor heating system will be installed in each building and the users could combine it with biomass-burning stove or bio-fuel fireplace. Energy savings of up to 40% can be achieved compared to conventional heating systems. A cogeneration plant of about 1MW (powered by bio-gas and biomass from the surrounding woods) in the village will produce electricity and simultaneously provide hot water for each house. If inhabitants choose the highest efficiency type of solar thermal collectors in order to integrate heating system, they can spare up to 80% of energy.

**2.2 Summer cooling strategies**

The first strategy for summer energy saving is the reduction of conditioning charges, which are reduced up to 80% by using natural ventilation, thermal mass of opaque structures and solar shadings. These strategies are used in order not to have the need of conditioning plants, and give users good thermal comfort conditions only with passive cooling systems. To improve thermal comfort is possible to use the radiant floor system with flow the cold fluid from the cogeneration plant.
2.3 Innovative technologies

Each house is designed to have PV panels faced to the sun. Each family may produce up to 2kWp that, added to the cogeneration plant, provide to the ordinary energy demand of the village. The use of energy from the public net is reduced from 60% to 100% according to the panels installed. Moreover home owner can experiment very innovative technologies, as organic solar panels and electric wire in low tension in direct current for technologies which use it (as pc, phones, hi-fi, tv, ecc.). This technologies are developed in association with Freenergy Association - Unversity of Rome "Tor Vergata". Some houses may have an individual connection for electric cars.
3. **Ground and water saving**

In spite of its density, the village maintains an elevate level of permeability of the ground by using discontinuous flooring materials (stones) and permeable ones (steady ground). Manoeuvre areas, very little in the urban layout, are covered with half-permeable materials (permeable asphalt or levocell). Green roofs guarantee a natural temporary absorption of meteoric water, in order to avoid problems during major rains or storms. Ground permeability preservation (medium run-off coefficient calculated following R.I.E. method by Bolzano autonomous province is $\Psi = 0.27$), reduce superficial run-off, which can be easily drained. Ecovillae uses strategies for water saving, by the storage of about 4000 m$^3$/year of rain water, which can be used for cars washing, gardens watering, wc. Users may spend a little more to have systems as special water taps and WC which reduce drinking water consumptions of about 30 l/day for each inhabitant.

![Figure 6 Strategies for ground permeability and water saving.](image)

4. **Life-cycle**

Ecovillae uses innovative technologies and natural materials, from certified production cycles, recycled and recyclable materials: copper for the roofs, aluminium for curtain walls structures, cellulose for insulation, plastic for loose stone foundations. No toxic material is used in construction and there is a great attention for electromagnetic pollution reduction. Construction cycle is optimized, in order to minimize rejects and waste, and to make demolition and reuse operations easier.

![Figure 7 Main important recycled and recyclable materials used.](image)
5. Social sustainability: users’ participation

Users are involved in the first phases of construction, in an innovative cohousing process, which consider their active participation in open spaces design, building design, technological choices, making of a manager of common services. On of these services is a car-pooling system which links Ecovillae to railway station of Settebagni, and to Rome railway system itself, in order to support new kinds of mobility instead of individual cars.

6. Sustainability evaluation

Sustainability evaluation is one of the instrument used by designer during each phase of the planning process. This evaluation following ITACA method, which includes some indications of international evaluation method Green Building Challenge. Ecovillae score is 4 (0 is the minimum performance and 5 is the best performances reached using experimental technologies). Ecovillae footprint is 2,5 ha for each inhabitant, the half of a village which uses traditional technologies in Italy.

![Figure 8 Ecological footprint for Ecovillae compared with a traditional village in Italy.](image)

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