Combining green and smart elements in a new idea of design of an ecological house

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Abstract: Aim of this work is this paper is giving guidelines for the design of a house which combines the positive elements of both intelligent and green buildings, thereby it shows much better environmental- and also energy behavior. In the particular work there are presented all the theoretical elements which should be known as definitions for the comprehension of the results, in general, and also more concrete elements are given to distinguish the contribution of the two categories, namely the intelligent buildings and the green buildings. After having dealt with all the essential elements in the categories of buildings, the current thesis is completed with the design of the building. The external as well as the internal building characteristics will be chosen having in mind the climate condition of Greece . For easier understanding, specific examples (not hard guidelines) are given. Lastly, this paper exhibits the design of the building applying the AUTOCAD software, following the data and specification results given in the relevant diploma thesis of one of us, i.e. of Martha Demertz[i].

Keywords: green buildings, smart buildings, ecological house, AUTOCAD design, intelligent design

1 Introduction

The well being of the Mankind the past six decades, or so, has been based on a wrong concept of of environmental exploitation. The manners in the primary and mainly in the secondary production (industry) were blamed for this.

But also the heart of our Habitat, the house, is often a forgotten factor in our relationship with the Environment. Therefore in any eventual Environmental contract, echoing the Social contract of the age of the Illumination [2,3], should to our opinion start with the House, where we spend at least 1/3 of our living time.

Viewing the previous literature on the subject we encounter the “concept house” idea by Jacques Ferrier, also the attempts by Jose Baure, Montrendon, France, the “Passiv Haus” in Swiss and the “Thermos Haus” in Germany [4-7]. Individuals are also reported in the media to have built environment friendly houses.

The concern about a ‘correct’ house is twofold:

1. how to save energy consumption, this due to the worry of the conventional energy sources shortage headache
2. how to hinder a further deterioration of the surroundings (Environment) of the house
The measures to apply for the first concern involve the so-called smart elements, while for the second concern are the so called green elements.

The Diploma Thesis of one of us, Martha Demertzi, is of a synthetic character, i.e. combining the smart and green elements in order to design the ‘correct’ house fulfilling the two criteria mentioned above. The Thesis has been proposed for an award by the Hellenic Center of Environment and the Sustainable Development (EKPAA) under the auspices of the Ministry of the Environment of Greece.

2. Green Elements
Those elements correspond to criteria such as the viability of the place where to build, the atmospheric quality and the possibilities of the existence of renewable energy sources in the area. Materials and resources should fulfill the environmental requirements, for example the possibility of recycling, like in the case of impregnated wood to be used as a building material.

The design as far as the water use is concerned implies the reasonable, non excessive, consumption of both potable and cleaning/irrigation water. In-door environmental good quality is also a must. The in-door quality includes healthy inner atmosphere conditions, optimal illumination and comfort temperature ranges.

The above elements should not be just summed up, but they have to in, a holistic way, be synthesized so that a better design could be emerged. The final output isn’t simply the sum in an additive manner but new elements can appear, such as low particle emission building, painting, finishing materials. Elements of control and surveillance, too, belong to this category.

3. Smart Elements
Smart elements are mostly controlling elements aiming at reducing energy needs and (in parallel) at increasing safety. Already in the phase of the house construction the criteria imply application of correct management strategies.

In the functioning of the built house, there is the need to control the switching on and off of the internal and external lamps. Surveillance and distribution remote mechanisms is another aspect.

HVAC aims at controlling pressure, temperature and relative humidity of the various places in the house. HVAC control consists of the necessary instrumentation to collect the necessary physical properties data. Other smart elements include sound or voice management (VoIP or IP) cabling, infrastructure, wireless systems, audio/visual (AV) signaling, f.ex, plasma screens at the walls.

As far as safety is concerned, simple ways of access control is very helpful (Fig.2).

Very important are the Energy Management systems, aiming at reducing the electric power consumption costs without compromising with the comfort status of the house (Fig.3).
At last but not at least, of crucial importance is an overall datanet structure of the smart building, due to the fact that the basic data structure is always increasing in size: this is the very kernel of the smart building design!

4. Combining the green and smart elements

This combination is shown in Fig. 4, in the cross section of the two circles showing the green, respectively the smart elements:

5. Design of the House

5.1 External area

The orientation should be towards south, for obvious reasons. In the southern part deciduous trees such as mulberries (Fig. 5) are recommended, in order to avoid superheating during summer in a Mediterranean area to be planted whereas in the northern part the trees are good to be evergreen such as tuya (Fig.6) in order to obtain the shadowing during the entire year.

Additional elements of thermo-insulation is external thermo-insulation materials. An example of energy saving systems is the following (Fig.7)

The color of the walls will be white in order to avoid overheating. As far as the building materials are concerned some examples are given below:
• for the parking facility: porous layer of 100% recycled HPDE (High Density Poly Ethylene)
• for the balconies: synthetic wood material made of 50% thermoplastic and 50% wooden fiber, which is suitable for external areas
• for the walls: composite cement, sand and cellulose fibers, against moisture and fire, with a life duration of up to 50 years

Other elements include grass natural or artificial, a facility for the collection of rain waters (Fig.8). In our designed house the capacity will be of 50000L since the stored water will be used for irrigation, toilet and general cleaning purposes.

For a better thermo-insulation the installation of a green roof is recommended (Figs.9-10).

Solar water heating system are essential to be installed on the roof. Additionally, autonomous photovoltaic systems such as in Fig.11 will be utilized.
5.2 Internal area
Examples of environmentally friendly material for the interior of the house are:

- for the kitchen: recycled glass for the bench (fig.12)

- for the walls: composite made of recycled wood, stone powder and hoe
- For the tables: recycled vinyl material (Fig.13)

Of particular attention are the windows to be considered of a double glass to enable heat and energy savings, this is valid both for warm and cold weather.

Besides the above, energy saving wood boiler is a necessity (Figs14-15)
Water economizers also are needed both in the WCs and in the kitchen. As for an example see Fig.16 above. In Fig.17 a smart RFID (Radio Frequency Identification) element is demonstrated to enable energy saving in the electricity consumption of the house. Smart design to maximize light inlet in the house is shown in Fig.18.

![Figure 17. RFID tag.](image1.png)

![Figure 18. Smart design to enable light inlet in the house.](image2.png)

The design should be completed with elements for the openings, doors and windows, for protection from fire and, at last, not at least, for overall inspection and control. Finally the Auto-cad figure is exhibited here below. The economical factor is estimated in a first attempt giving a cost figure of 1190 Euro/m² of a 120 m² building.

6. Concluding Remarks

In this paper we have summarized in a synthesis existing smart and green technologies in order to propose a design of a building with a number of obvious environmental advantages. Not only the environment but also the health of the habitants will be benefited from such a design.

![Figure 19. Aspect of the building.](image3.png)

![Figure 20. Ground plan of the building.](image4.png)

References