

Comparing Two Zero Energy Touristic Accommodations Located In Cold Climate Regions to Find Solutions for Designing a Zero Energy Hotel

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Abstract— One of the humanities biggest concerns today is the environmental pollution and its consequences for the future. Since one of the main sources of this problem is the building industry so more attention in designing process will cause an impressive difference in measures of pollution arising from this industry so it is architects, as designers and owners of buildings, responsibility to reduce the amount of energy used by the buildings and following that the amount of pollution produced by the energy usage. One of the ways to recommend solutions for designing a zero energy hotel is to compare the buildings that have been implemented and evaluate the solutions that each one have applied in order to reduce the energy consumption . The method that was used in this article was case study method using internet references and also data collected from published articles about zero energy touristic accommodations. This case study is pursuing architectural approaches for restricting energy uses. Since solutions for cold climates are desirable by comparing these two accommodations which were both placed in cold climates, many beneficial methods for designing an energy efficient building was earned.

Index Terms— Case study, Cold climate, Touristic accommodation, Zero energy

I. INTRODUCTION

With increasing human attention to environmental health the need for green accommodations including touristic accommodations creating the lowest contamination, had become one of the basic needs of mankind. This trend towards green hotels not only addresses environmental concerns by saving energy, water, and resources, but it also expected to improve guest satisfaction and comfort [1]. In this article each aspect of zero energy buildings about the two selected accommodations will be investigated and be compared to each other. Each one of these two will get points from zero to four that zero point means less superiority and four points indicates excellence in that section. At the end by adding all these points together the accommodation which has the best design for energy efficiency with highest points will be determined. One of these accommodations is ION hotel which is located in Switzerland in the south western town of Selfoss. The unique landscape plays a pivotal role in the rich design of the hotel which leans heavily on sustainable practices and the natural features of the island. Ion adventure hotel has 21 standard rooms and 24 deluxe rooms. “changing rooms lead out into the biting Icelandic air to shallow 10 meter hot pool. There is a good choice of double or twin rooms“, second sample is Rocksresort Laax located in Switzerland which “won the 2010 design award in

the best new ski resort category by wall paper magazine”. “Laax is quite possibly the most sustainable ski resort in the world“. It has 2-5 floor high buildings host shops, bars and restaurants on their ground floors and 4-8 bed apartments above with a number of 130 furnished flats and 1000 beds in total. Data from the two cases were compared for each aspect to highlight the similarities and differences in the approaches adopted by these two hotels. The data collected was compiled and analyzed in order to identify commonalities and differences across the two case studies and to identify strategies that appeared to work well in each case. These commonalities were then assembled as a set of possible strategies to be considered for future zero energy hotel projects to increase their sustainability.

II. LOCATION OF THE BUILDING ON THE SITE

Studying both accommodations shows that both in a way are seamlessly located in order to make lowest changes in the natural environment. Somehow that they are also a part of the nature which this integration could be by the means of indigenous materials or otherwise by buildings form. “ In RocksResort cube shaped buildings, houses furnished holiday apartments, shops, restaurants and bars all arranged around a central square combined with its environment and bold design statement several of the eleven structures are arranged

around a central square at the bottom of a ski slope, while others nestle up to the edge of a nearby forest. The Rocksresort touches the mountain as lightly as possible. It is in harmony with the landscape Ion hotel also “jutting out from the base of a long –dormant volcano, affords striking views of the other – worldly landscape” according to the above both these accommodations will gain the highest point for this section.

III. BUILDING FORM AND PLAN

It is obvious that in cold climate regions compact buildings and not widespread ones are accepted because in buildings with cubical shapes and spherical forms less cold will be penetrating to the inside of the building instead buildings with more sides or adjacent walls have more extent in touch with outsides cold weather and this will cause more insulation and for more walls which will increase building costs and also won't be optimal. In ION hotel oblong-shaped building has a elongation from east to west which the reason for this elongation is for benefit of sunlight that is an advantage for this building but from the aspect of heat exchange length to width ratio is a disadvantage two long sides of the building should be armed with insulation so that less heat will be going out and also less cold will impact the inner spaces way of arranging spaces in a building has an impressive impact on the amount of the sunlight that every space will get and also on heat exchange. An intelligently done space arrangement determines access paths. In hotel Ion as is showing in figure 1 rooms are located along the northern and southern sides so they can use the sunlight and even sun heat. Rocks Resort with eight slate-clad cubic buildings and putting the rooms around the building will provide spaces required lighting. But there will be less heat gain from the windows. So it could be said that cubical form of Rocks Resort is more suitable for zero energy building design.

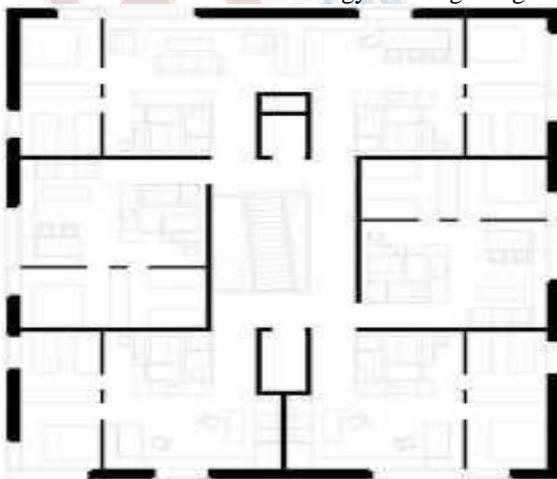


Figure 1: Arrangement of spaces in RocksResort.

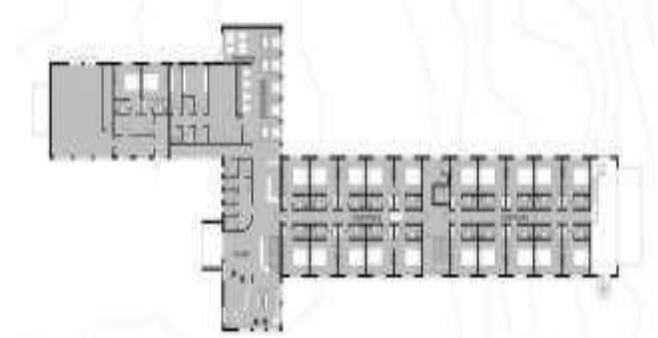


Figure 2: Arrangement of spaces in Ion hotel. [2]
Table 1: Comparing Building Form and Plan

Hotel	Plan	Figure	Ranking
ION Hotel	oblong-shaped		2
Rocks Resort	cubical		4



Figure3:Rocks Resort



Figure4: ION Hotel

IV. BUILDING MATERIALS

Using every regions indigenous materials will reduce energy use during constructions because it will limit the transportation so it will result less pollution for the environment. Since indigenous materials in an area are suitable for its weather conditions and have been formed over the years. They can be better responders for that areas low temperature. In hotel Ion the mnm MOD prefabricated panelized building system used for both the new extension and original structure achieves both aesthetic and environmental objectives. Beneath its stark appearance which could easily be mistaken for part of the evolving land scape, is a high –performance system that maximizes energy efficiency with a reduced carbon footprint. Exposed concrete walls and wooden furniture. A mellow mix of concrete chic and earthy ambiance, combined with the warm accents of locally salvaged drift wood and lava.



Figure 5: hotel Ion the mnm MOD prefabricated panelized building system.

Icelandic rock and locally sourced, repurposed wood fill Ion’s interiors, which were designed to echo and integrate with the environment. Recycled materials were also used in Ion hotel. In Rocksresort natural materials from the local region have been used. Finished in rough-hewn stone, the cubic exterior of this hotel complex succeeds at blending in with its environment. Quartzite stone was used in kitchen and bathroom and concrete and lime stone was used in open plan living area. Interiors reflect the cubic format of the buildings and feature lighter materials to contrast with the aw-inspiring landscape where bedrooms feature untreated light finished wood. 500 tons of 40 million year old quartzite stone was used the stone mined from a local quarry, has been cut and stacked bricklike, to create the resorts free standing cubist structures. The use of local materials is a major feature of the project. The slate comes from boulders that were strewn

through the region by a colossal land slide 10000 years ago – supposed by the biggest in the history of the world which shaped the valley in which Laax sits. “The researchers developed several green material technology programs, which maintain or improve current practices in construction engineering and ensures green products or methods arising from these programs would be cost effective and would confer benefits on society, the economy and the environment.” [3] Utilization of recycled and waste materials in various construction applications have many benefits such as” enhancing sustainability of the construction industry while reducing cost, providing solutions to environmental pollution and reducing the need for natural resources.” [4] It seems that both Ion hotel and Rocks Resort have made the best use of indigenous materials and this is what is important in zero energy design, to reduce the buildings embodied energy.

V. ELECTRICITY PRODUCTION

There are many different ways for producing buildings electricity by itself with no need to use fossil fuels and only using clean and renewable energy sources which need an investigation on the landscape to choose the best energy source that works better for every individual building. Both of the accommodations in this study have their own ways of producing their electricity need. Rocksresort is powered entirely by hydro electricity and have solar powered chair lifts. Hydro power electricity is one of the renewable energy sources that has many advantages and disadvantages. “In fact, hydropower is the cheapest way to generate power with today’s technology”,also “water power is also very reliable, making it an excellent base load power source- meaning that it can provide the energy needed all the time, not just during high demand periods such as intervals of very hot or very cold weather” [5]. Hydro electricity causes some destructions too. The results of hydroelectric development are somewhat unique to specific projects; landscape destruction differs depending on the types of landforms involved [6]. “Both the methane emitted from turbines and spillways and the carbon dioxide from above-water decay of standing trees contribute to emissions and pollution” [7]. From the studies that had been done it seems that the advantages of hydro electricity is more than its disadvantages and its defects are negligible. Ion hotel has an ambitious green energy project that allows electricity to be generated through the cooling of volcanic waters sourced beneath the sprawling geothermal parkland on which Ion is located. From the comparison of these two individual solutions used by Ion hotel and Rocks resort both are clean energy generators that has economical advantages. So they both earn equally highest points.

VI. WINDOWS

Windows are responsible for about 25-30% of the heat loss in a building because window glazing is a poor insulator [8]. In Ion hotel a major amount of inner spaces lighting is supported by floor to ceiling windows which also has an impact on space heating. This kind of using direct sun light is one of the best passive systems and window scales are suitable for receiving the most sunlight. All rooms offer floor to ceiling windows so guests can fully appreciate the magnificent view of the unique Nesjavellir geothermal power plant or across the lava fields towards Thingvellir national park. The extensive use of oversized windows throughout the hotel captures the natural daylight reducing the need for artificial lighting while providing unobstructed views of the natural wonders beyond. Windows in Rocks Resort are in various sizes and are located on all around the building, so while some of the windows get direct sunlight others don't and this may cause problems in space lighting and heating. According to the above Ion hotels windows are more suitable for a zero energy building.

Table 2: Comparing windows

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Hotel	Windows	Window shape	Ranking
ION Hotel	Floor to ceiling windows		4
RocksResort	Windows with various sizes		2

VII. BUILDING HEATING

Space heating for buildings located in cold regions is an important issue in providing comfort of buildings occupants. Massive windows towards south expresses that Ion hotel design was successful finding the best solutions for providing heat comfort for the guests. Also in Rocksresort under floor heating and block stone buildings are heated with entirely renewable biomass energy. An abundance of natural hot springs surrounding the hotel provide guestrooms with clean energy efficient geothermal heating and hot water. To find out which one of the heating solutions are more optimal at the following each ones features will be raised. Many researches were done to study the effects of under heating system and one of them was the research has been done by Joakim Larsson using design builder software which to

compare under floor heating system and radiators differences for a house . According to the results “ the under floor heating system would only need 87% for a well insulated house and about 81% for a badly-insulated house of the energy that is needed for the radiator system.” The study also shows that “ under floor heating heats a larger volume of potential heat storage.”[9]. The two main applications of geothermal energy are electric power generation and direct use of heat. Benefits of geothermal energy can be described as “1- not depending ,directly or indirectly on sun , geothermal may produce 24 hours per day. 2- a base – load energy like fossil and nuclear sources. 3- the total cost of geothermal power production is cheap if compared to those of other renewables.”[10] “Biomass energy does not contribute to the forcing of climate change with greenhouse gases. A plant used for biomass energy grows by removing carbon dioxide from the air through photosynthesis. Using that plant as biomass energy returns the carbon dioxide to the atmosphere, with no net change in the amount of carbon in the atmosphere, plants, or soils.” [11] “The production of biomass energy almost always entails the use of fossil energy for the farming, transportation and manufacturing stages of the process “[12]. “Changes in the carbon content of the site. Deforestation typically releases a large fraction of the tree and soil carbon to the atmosphere” [13]

VIII. SUMMARY

In order to find out the best solution for designing a zero energy hotel two zero energy touristic accommodations were analyzed and solutions for every aspect of designing that has been evaluated was indicated in the table3 below.

Table 3: Summary

Aspect	ION hotel	RocksResort
Location of the building on the site	Integration with the nature	Integration with the nature
Building form and Plan	Oblong-shaped	Cubical
Building Materials	Mm MOD prefabricated panelized building system, Exposed concrete walls, wooden furniture,	natural materials from the local region, Quartzite stone, concrete and lime stone, untreated light

	locally salvaged drift wood and lava recycled materials	finished wood
Electricity Production	Geothermal	Hydro power electricity, solar panel
Windows	Floor to ceiling windows, extensive use of oversized windows	Windows with various sizes
Building Heating	Geothermal Heating	Biomass energy
Total	18	18

IX. CONCLUSION

In comparing two case studies this can be deduced that both Ion hotel and Rocks Resort have their individual solutions of providing the buildings energy use which both have been successful to achieve, But from some aspects according to factors that should be taken into consideration, essentials of zero energy design were ignored, which these two accommodations success will show itself by compensation in other aspects.

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