

Design Methodology Towards Near Zero Thermal Energy Residential Villa in Riyadh KSA

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Abstract

The way we are using our global natural resources in order to provide the high increase demand in energy consumption is endangering our survival on Earth. Kingdom of Saudi Arabia is witnessing a huge increase in the electrical consumption which have doubled in the past ten years. Based on the fact that HVAC and DHW systems in villas correspond to 15% of these consumption, the idea was flourished towards investigating a design methodology towards a near zero thermal energy residential villa in Riyadh. First of all, a local typical villa (LTV) - designed based on local thermal standards- was modeled using the “Design Builder” simulation program. The annual hourly thermal and electrical consumption was calculated. Secondly, the three R’s strategy was adopted from materials into energy. Thus starting from reduce strategies which involve the changing the u values of walls, roof, windows, etc... These strategies will reduce the needed thermal loads reaching the first optimized values (OPV1). The second step is designated as re-use strategies which will increase the efficiency of the equipment reaching the second optimized values (OPV2). These strategies include setback temperatures, fresh air cutoff, heat recovery, and economizer. The third step would be introducing the renewable energy. A design mathematical methodology was suggested to find the optimized combination between the area of the evacuated tube solar collectors and phase change material volume. This optimized combination will allow the system to work continuously throughout the year and from year to year without the need of any auxiliary source of energy. After that a user friendly calculator were programed to help other designers easily finding the optimized values based on this methodology. Finally, this system provides more than 90% reduction in terms of energy, economy and environment.

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