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Assessing the energy efficiency improvement potentials of HVAC systems considering economic and environmental aspects at the hospitals

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ABSTRACT

The energy use in the world is increasing significantly owing to increase in per capita consumption of energy and growing population. Due to increased energy demand and the depletion of existing fossil fuel based sources, it is required to use the energy more efficient. Researches show that, hospitals represent approximately 6% of total energy consumption in the utility buildings sector. Heating, Ventilation and Air Conditioning (HVAC) systems are the major part of electrical energy consumption at the hospitals. In this paper, the research papers and practical studies on energy efficiency and energy saving potentials on HVAC systems at the hospitals are presented. Under the following sections, the latest literatures including research articles, conferences, e-books, handbooks and company reports interested in energy efficiency, energy saving and energy management HVAC systems are summarized. Variant Refrigerant Flow (VRF) technology enables greater energy efficiency and cost savings compared with traditional HVAC systems is also introduced. This detailed review also focuses on the payback periods of some projects on HVAC including the installation of cogeneration, trigeneration, chiller, new burners, heat exchangers and steam trap systems.

Contents

1. Introduction

Researches focused on energy efficiency, saving potentials and energy management show that the hospitals represent 6% of total energy consumption at the utility buildings sector [1]. Utility buildings are large space offices, shops, hotels, restaurants, educational establishments and health-care facilities. HVAC system is the single largest energy consumer in these types of buildings. It accounts for almost 60% of total energy cost in a building [2]. The energy consumption distribution of a hospital can be classified by electrical energy consumption types. HVAC (especially cooling and ventilating) systems are the major part of electrical energy consumption. If the absorption chiller is not in use, then the air-conditioning system is responsible for around 70% of total electricity consumption [3].

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Among them, the chillers, the chilled water pumps and the fan of the cooling towers would need 43.94% of the total electricity [3]. The use of energy efficient electric motors and variable speed (frequency) drive (VSD) systems are the best and most cost effective ways to reduce total electrical energy consumption especially in HVAC system at the hospitals. HVAC systems provide conditioned air (cooling, ventilation, thermal comfort and humidity control) to the people and locations in the hospitals, airports, industrial districts and large space buildings. HVAC systems control temperature, humidity and air quality inside the buildings and locations. They are generally used in large office buildings or climate controlled places such as hospitals, offices, hotels and government buildings. In this paper, the central HVAC system with water cooled chiller is focused instead of the individual systems. Central system is an air conditioning system which uses a series of equipment to distribute cooling media to exchange heat and supply conditioned air from one point (e.g. plant room) to more than one room [2]. Central HVAC system consist of heating unit comprise of boiler, ventilation unit comprise of fans and cooling unit comprise of chiller as shown in Fig. 1 [4]. Heating function is commonly used in cold climates and cooling function is commonly used in warm and hot climates. Air conditioning means removal of the indoor air humidity. In the medium or large buildings, central HVAC systems

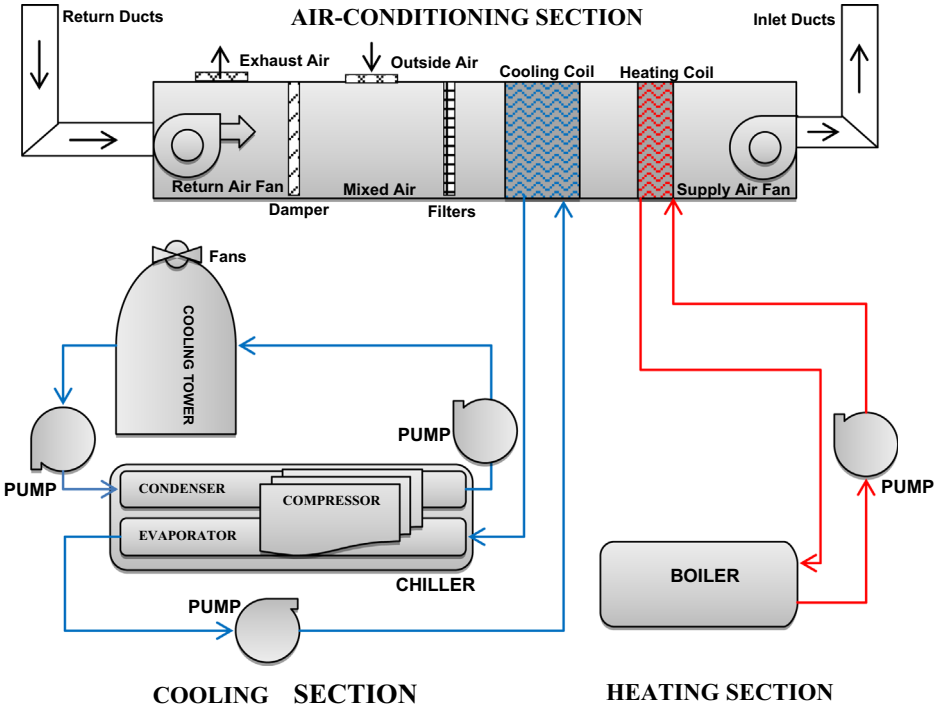

Fig. 1. Schematic diagram of the conventional HVAC system.

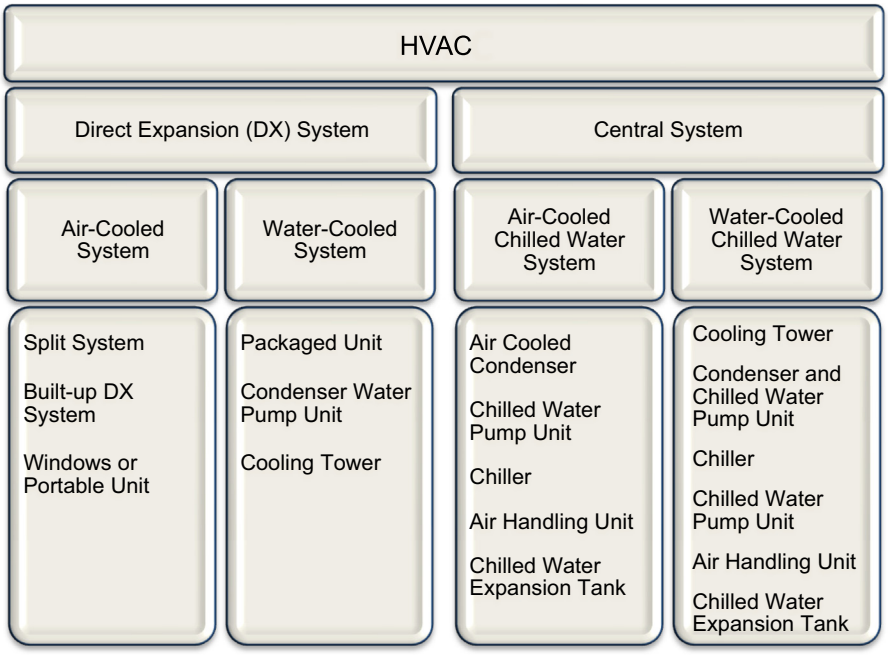

Fig. 2. The classification of HVAC system.