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Review on recently use of VRF technology

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Abstract

This paper reviews the recent technology development of multiple VRF (Variable refrigerant flow) air conditioning system. The VRF heat pump system provides heating and cooling for all indoor at a specific time. Heat recovery system provides simultaneous cooling and heating as well as heat recovery, transferring the energy from cooling zone to heating zones of the building. Modern VRF system provide some major advantages, such as zoning, individual temperature control, minimize duct work etc.

Keywords: variable refrigerant system, HVAC (heating, ventilation, and air conditioning).

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Introduction

variable refrigerant flow (VRF), also known as variable refrigerant volume (VRV), is an HVAC technology invented by Daikin industries, Ltd.in 1982. In which one outdoor unit is connected with multiple indoor units, and the flow of refrigerant is automatically shifted from one zone to another to efficiently transfer heat away from areas needing heating. VRF system are available either as heat pump system or as heat recovery system for those applications where simultaneous heating and cooling is required. In addition to providing superior comfort, VRF system offer design flexibility, energy savings, and cost effective installation.

This paper will outline the benefits of a typical VRF system, describe the advantages offered by the most advanced outdoor units available, and provide general guideline for selecting a heat pump system versus a heat recovery system.

Similar to other system use air-cooled condenser, thermal environment of outdoor units of VRV system must be considered for proper operating and energy efficiency. In summer, outdoor condenser will warm up the air around and form a “mini thermal island”, which could increase the working temperature of itself or units around. Situation will become worse if many outdoor units set closely or in high-rise buildings.

VRF technology:

In a VRF system, multiple indoor fan coil units may be connected to one outdoor unit. The outdoor unit has one or more compressor that are inverted driven, so their speed can be varied by changing the frequency of the power supply to the compressor. As the compressor speed changes, so does the amount of refrigerant delivered by the compressor.

Each indoor fan coil unit its own metering device that is controlled by the indoor unit itself, or by the outdoor unit. As each indoor unit sends a demand to the outdoor unit, the outdoor unit delivers the amount of refrigerant needed to meet the individual requirements of each indoor unit.

These features make the VRF system ideally suited for all applications that have part load requirements based on usage or building orientation, as well as applications that require zoning. (Fig.1).

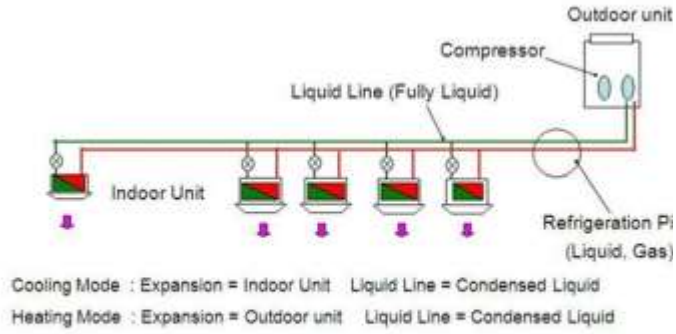

Figure 1 – Typical VRF Heat Pump System

Advantages of VRF system:

Variable refrigerant flow (VRF) system may be a particularly good option for building with multiple zones or wide variance heating/cooling l0ads across many different internal zones. These systems provide individual control and are the most versatile of the multi-split system. Hotels, schools and office buildings are good examples.

The key to providing comfort is to supply heating or cooling when and where it is required without swings in room temperature.

In conventional system, the compressor is either on or off, so even space that have individual controls experience fluctuation in room temperature as the compressor stops and then starts again to maintain the thermostat setting (Fig.2).

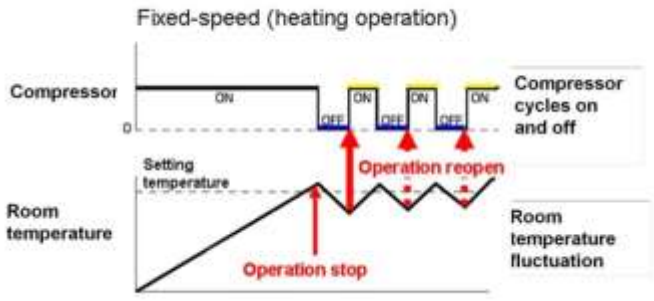

Figure 2 – Traditional Fixed-Speed Compressor Operation

In a VRF system, since the speed of the compressor can be varied, the compressor does not cycle on and off, but operates continuously for longer periods (Fig.3). The required refrigerant flow is supplied to the indoor fan coil and once the set point is reached, the refrigerant flow is adjusted to maintain the room temperature smoothly without fluctuation.

In addition to having distinct set points, the indoor unit fan speeds and lower positions can be changed to provide additional comfort in the

Space.

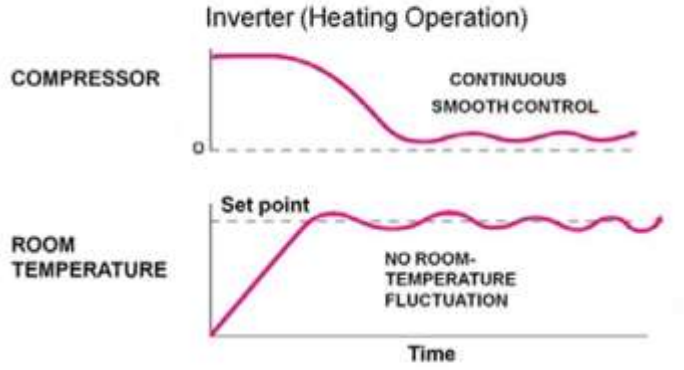

Figure 3 – VRF System Inverter-Driven Compressor Operation

VRF system are generally best suited to buildings with diverse, multiple zones requiring individual control, such as office buildings, hospitals, or hotels. A VRF system does not complete well with rooftop systems in a large-rise building such as a big box retail store. although VRF heat pumps operate at ambient temperature as low as -18 degree Celsius as in all heat pumps, their efficiency drips off considerably at low temperatures, so they are less cost effective compared to gas heating in very cold climates.

Compressor's functions:

The compressor is heart of the cooling cycle the cycle beings when the compressor draws in cool low pressure refrigerant gas from the indoors. The motor driven compressor's sole function is to "squeeze" the refrigerant, rising its temperature and pressure so that it exits the compressor as a hot, high pressure gas.

Heat transfer: The compressor pusses the hot gas to the finned condenser coil in the outdoor side of the air conditioner where fans blow cool outside air over the coil and throw the fins, extracting the heat from the refrigerant and transferring it to the outside air.

Turns liquid:

When enough heat has been extracted from the refrigerant, it condenses into a warm liquid that passes under high pressure to an expansion valve that turns the refrigerant into a cool, low- pressure. The refrigerant goes from the expansion valve to the finned evaporator coil located in the indoor are room side of the air conditioner unit.

Absorbs heat:

When the refrigerant inters the evaporator coil where the pressure is much lower, it is chemically compelled to evaporator into a gas. This proses requires heat, which comes from the room's warm air being blown over the evaporator coil by another fan. As room heat is transferred to the evaporating refrigerant, the room's air grows cooler. The refrigerant, the room's air grows cooler, the refrigerant, now back to a cool, low-pressure gas, is drawn back into the compressor to continue the cycle.

Design considerations:

Space layout:

The design of a VRF system being with understanding the space layout. The orientation of the and the seasons during which peak loads occurs must be considered. The type of load (heating or cooling) and the distribution of loads into zones will depend on the intended use of the space. In turn, these factors will determine whether a heat pump system or heat recovery system will be the most efficient choice.

Figure show a typical space layout, with zones specified as requiring heating or cooling and the load reflected in the size and type of the indoor units shown.

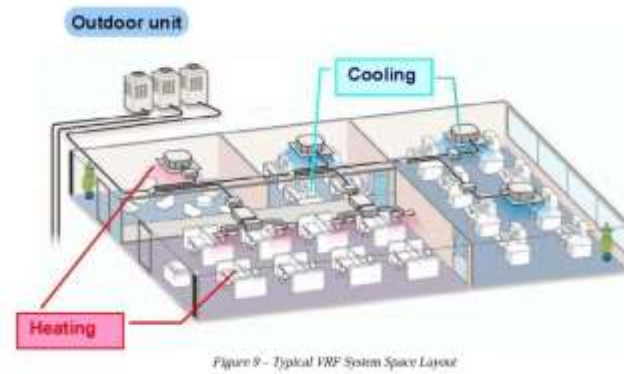

Figure 9 – Typical VRF System Space Layout

Conclusion:

VRF technology is relatively new in India and gained the momentum after 2007. So this is relatively new and efficient way to design HVAC system with VRF technology. VRF technology use smart integrated controls, variable speed drives, refrigerant piping, and heat recovery to provide products with attributes that include high energy efficiency and energy saving depends on many variables which controls heat load of the building. So energy saving from VRF technology many vary from 10% to 40%.

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