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Development of a Smart Modular Heat Recovery Unit Adaptable into a Ventilated Façade

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Abstract

This paper presents the designing aspects and first experimental characterization of an adaptable Smart Modular Heat Recovery Unit (SMHRU) developed under the scope of the E2VENT Project. This SMHRU is being designed as a part of an adaptable renovation module for the retrofitting of multi-storey residential building from the *60*'s, *70*'s across Europe that embeds the SMHRU and an energy storage system based on a phase change material. This heat recovery unit will be adjustable to be integrated into the ventilated façade cavity, and able to recover heat from ventilation air, preheating the ventilation air in winter and precooling it in summer. This will allow an efficient combination of consumption reduction and acceptable air indoor quality.

The first part of the paper presents designing considerations and thermal stationary analysis of the heat recovery unit, which is based on experimental correlations obtained for air-to-air compact offset-strip-fin plate heat exchangers. Secondly CFD analysis of the distributor of the SMHRU is presented. Finally prototype first performance estimation based on experimental results is presented.

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Keywords: Air-recovery; Air-quality; Compact-heat-exchangers; Offset-strip-fin-plates; Ventilated-façade; CFD Analysis.

1. Introduction

The air renewal ensures the indoor air quality and prevents the occupants from health issue. In the case of existing buildings, the low air tightness allows natural ventilation through the façades, but when the building is retrofitted,

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Nomenclature

COP	Coefficient of performance
ε	efficiency
EES	Engineering Equation Solver
f	friction factor
j	Colburn j-factor
NTU	Number of transfer units
OFS	Offset Strip fins
p	pressure
SMHRU	Smart Modular Heat Recovery Unit
T	Temperature
v	velocity

Subscripts

in	inlet
c	cold
h	hot
in	inlet
out	outlet

the thermal losses through the façade are limited by adding a layer of insulation (either internal or external), and the windows are classically changed in order to have a more efficient glazing. Those aspects of the renovation have impact on the air tightness of the building and the leaks through the façades are highly limited and thus the air tightness is higher, making the natural air renewal lower and therefore the indoor air quality can be drastically reduced.

E2VENT Project develops an adaptable Smart Modular Heat Recovery Unit (SMHRU) which is combined with a system based on phase change material energy storage system. This heat recovery unit will be adjustable to work into the ventilated façade cavity, and able to recover heat from ventilation air, preheating the ventilation air in winter and precooling it in summer. This will allow an efficient combination of consumption reduction and acceptable indoor air quality.

2. SMHRU Design

Heat recovery or air-to-air heat recovery systems are made in so a lot of different types, sizes, configurations and flow arrangements. Most common types of heat recovery units are: fixed-plate, heat-pipes, thermal wheel and round around systems. The SMHRU must fit within the E2VENT module, and thus must be placed between the wall and the cladding. Consequently fixed plate heat exchangers as they are thinner are the most favourable type of heat exchangers. Plate fin heat exchanger are characterized by high effectiveness, compactness, low weight and moderate cost.

Offset strip fin (OSF) plates have been considered for the SMHRU design. OSF are widely used to enhance fin geometries in large variety of industrial processes. This is because they are considered as one of the best heat transfer geometries' relatively to friction factor; and large analytical, numerical and experimental investigations have been performed over the last *50* years. Main characteristics of the plates selected are described below together with the scheme (see Fig. 1):

Fin type: *1/8* Lanced OSF
Lanced length: *3.175* mm.
Material: Aluminium *3003*.

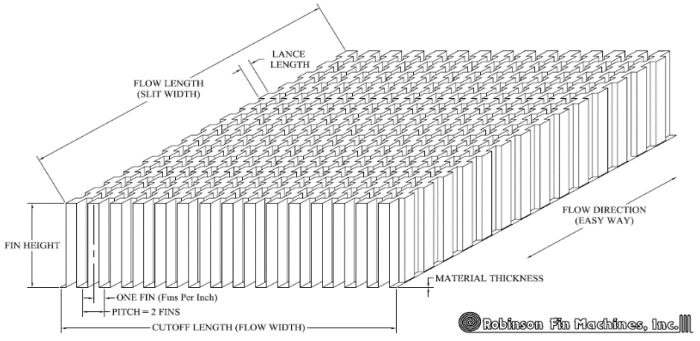

Fig. 1. OFS Plates scheme and terminology. http://www.robfin.com/