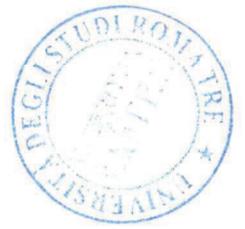




- 1) TECNICHE EDILIZIE E STRATEGIE
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- 2) LE FUNZIONI TECNICHE NELLE
UNIVERSITA'
- 3) I VANTAGGI DELLA PROIEZIONE
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- 2) IL RUOLO DEL DIRIGENTE TECNICO NELLA PROGRAMMAZIONE DELLO SVILUPPO EDILIZIO NELLE UNIVERSITÀ
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1 Towards an improved Thermometric method: convective and radiative heat 2 transfer for heat flux measurement through an indirect approach

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10 **Abstract** - Actual thermal performance of building walls need to be assessed through on-site tests. Several
11 measurement procedures have been proposed during the last decades. Nonetheless, among them the
12 Thermometric (THM) method has been poorly explored in literature, hence opportunities for improvements
13 can be highlighted. The THM technique is a quite a new and non-standardized procedure for wall thermal
14 characterization, based on the well-known Newton's law of cooling. This law needs the heat transfer coefficient
15 knowledge and there is no agreement about the value to apply when the THM method is used. In this work, a
16 low-cost experimental apparatus characterized by a heated wooden sample was realized. Sensors were installed
17 to measure heat fluxes through a common heat flux plate. The obtained values were compared with the heat
18 flows achieved via the THM method, where dimensionless groups analysis was performed for computing
19 suitable heat transfer coefficients obtained from real time data processing. The aim of this work is to lay the
20 groundwork for overcoming the disagreement related to the value of the total heat transfer coefficient in the
21 THM method by proposing and consolidating an alternative approach. The results show that the proposed data
22 processing for the THM method can provide satisfying results in terms of indirect heat flux measurements,
23 showing extremely low percentage differences (ranging from +1.16% to +3.56%) if compared with the HFM
24 method.

25 **Keywords:** Heat flux measurement; Heat-flow meter; Thermometric method; Nondestructive test; Data post-
26 processing.

27 1. Introduction

28 It is well known that every building during all phases of the entire life cycle consumes significant amounts of
29 energy [1]. The building stock is responsible for around 35% of energy needs globally and 40% in Europe [2].
30 Nowadays the ever-growing urbanization has made the concept of sustainable building more and more
31 widespread [3]. The new sustainable buildings are designed applying careful planning that has energy saving
32 as one of its main objectives [4]. It is evident how the energy performance is a central topic with the aim to
33 reduce the environmental impact of new constructions and built heritage [5]. Investing in sustainable building
34 techniques and technologies leads to an increase in the thermal performance of the building envelope [6].
35 The thermal characterization of buildings is carried out using thermal resistance (R-value) or thermal
36 transmittance (U-value) as quantitative parameters [7]. In order to obtain a low energy impact building, it is
37 necessary to consider R-value or U-value of walls as a key parameter [8]. The U-value represents the heat flow
38 that crosses a building component per unit area divided by the difference of temperature across the structural
39 element. The assessment of the thermal performance of buildings varies according to the case of new buildings
40 or existing structures.
41 In the first case both the geometry and the materials of the walls are known. According to the Standard ISO
42 6946 [9], the heat flux through a wall, characterized by a certain number of layers of known thickness and
43 material, can be calculated as the ratio between the temperature difference across the wall and the thermal
44 resistance. The R-value of each layer is defined as the ratio between the thickness of the layer and the thermal
45 conductivity of the material.