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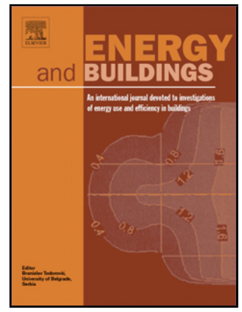

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Authors: Tudor Baracu, Viorel Badescu, Catalin Teodosiu, Mircea Degeratu, Monica Patrascu, Constantin Streche

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Consideration of a new extended power law of air infiltration through the building's envelope providing estimations of the leakage area

Tudor Baracu[a,*], Viorel Badescu[a,b], Catalin Teodosiu[c], Mircea Degeratu[c,d], Monica Patrascu[a], Constantin Streche[a]

[a]University Politehnica of Bucharest, Romania
[b]Romanian Academy, Romania
[c] Technical University of Civil Engineering Bucharest, Romania
[d]Academy of Romanian Scientists, Romania

[*]Corresponding author: tbaracu@yahoo.co.uk

Highlights

- It is proposed a new extended power law (EPL) for the air infiltration through the building's envelope;
- EPL is validated through comparison with other laws by using four statistical indicators;
- It is proposed the correlation leakage area of the cracks in linear-perimetral and circular-compact formulations;
- Evaluation of the air leakage at low pressure difference through linear extrapolation;
- It is provided an application for the passive house Politehnica of Bucharest.

This paper proposes a new ***extended power law (EPL)*** *of air infiltration in buildings as an alternative in certain cases to the widely used power law (PL) and quadratic law (QL). Specifics: it separates the airflow rates in laminar and turbulent components; improves the estimation of the leakage area; new evaluation of the airflow rate at low pressure differences. In various numerical comparisons several advantages of EPL are revealed and we appreciate that will raise interest and adoption by the software platforms that evaluate the airflow in buildings.*

Based on the measurement data (MD) of the Passive House Politehnica from Bucharest (Romania), EPL is validated and compared with other laws of infiltration. Four statistical indicators (PCC, RMSE, MBE and MAE) show that EPL has the best fit to MD. *A generalized function of air leakage is developed and may serve in certain cases for a higher level of processing the MD for improved evaluations.*

An ***inverse problem*** *approach finds the* ***leakage area*** *of the cracks in linear-perimetral and in circular-compact distributions respectively. They are alternative to the consecrated notions ELA and EqLA. The leakage areas are estimated to be from 5 cm^2 (the case of LFCorrLA*[1] in circular-compact formulation) up to 2085.7 cm^2 (the case of LFCorrLA at in linear-perimetral formulation). Among the surveyed leakage areas we appreciate that CorrLA offered the most realistic result.*

Through linear extrapolation of the laws of infiltration at low pressure difference EPL is compared with PL and QL and the differences are discussed.

Keywords: Air infiltration, Air leakage, Extended power law, Correlation leakage area, Low pressure difference, Airflow in buildings

Nomenclature

A- area, [m^2]	R- resistance, [$m^{-1}s^{-1}$]
AC- Average Curve	Re- Reynolds number [-]
ACSD- Average Curve Standard Deviation	RMSE- Root Mean Squared Error
a-index of air infiltration, [-]	root- square root
B- width [m]; coefficient of airflow	RQL- Reduced Quadratic Law
c- constant;	S- area, [m^2]
C- flow coefficient; constant of a law	SR- similitude ratio
CFD- computational fluid dynamics	t- Student's t test variable
CL- Cubic Law	TFCorrLA- Turb. Flow Corr. Leak. Area, [cm^2]
CorrLA- Correlation Leakage Area, [cm^2]	TFCorrLA*- Turb. Fl. Corr. Leak. Area (circ. formul.), [cm^2]
CorrLA*- Correl. Leakage Area (circ. formulation), [cm^2]	TS- Total Score
CPL- coefficient of pressure loss	$\dot{V}$- airflow rate, [m^3/h]
CQL- complete quadratic law	w- speed, [m/s]
D- diameter [m]; Darcy	x- variable
DOF- degrees of freedom	y- variable
EAHX- Earth to Air Heat Exchanger	
EAR- Electrical Analogy Resistance	**Non-latin symbols**
EL- Exponential Law	α- level of significance
ELA- Effective Leakage Area, [cm^2]	ε- error
EPL- Extended Power Law	δ- width [mm]
EqLA- Equivaent Leakage Area, [cm^2]	Δ- difference

[1] The symbol "*" is used for the circular-compact formulation of the crack's area.