World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:19, No:02, 2025

A Validated Estimation Method to Predict the Interior Wall of Residential Buildings Based on Easy to Collect Variables

Authors : B. Gepts, E. Meex, E. Nuyts, E. Knaepen, G. Verbeeck

Abstract : The importance of resource efficiency and environmental impact assessment has raised the interest in knowing the amount of materials used in buildings. If no BIM model or energy performance certificate is available, material quantities can be obtained through an estimation or time-consuming calculation. For the interior wall area, no validated estimation method exists. However, in the case of environmental impact assessment or evaluating the existing building stock as future material banks, knowledge of the material quantities used in interior walls is indispensable. This paper presents a validated method for the estimation of the interior wall area for dwellings based on easy-to-collect building characteristics. A database of 4963 residential buildings spread all over Belgium is used. The data are collected through onsite measurements of the buildings during the construction phase (between mid-2010 and mid-2017). The interior wall area refers to the area of all interior walls in the building, including the inner leaf of exterior (party) walls, minus the area of windows and doors, unless mentioned otherwise. The two predictive modelling techniques used are 1) a (stepwise) linear regression and 2) a decision tree. The best estimation method is selected based on the best R^2 k-fold (5) fit. The research shows that the building volume is by far the most important variable to estimate the interior wall area. A stepwise regression based on building volume per building, building typology, and type of house provides the best fit, with R^2 k-fold (5) = 0.88. Although the best R^2 k-fold value is obtained when the other parameters 'building typology' and 'type of house' are included, the contribution of these variables can be seen as statistically significant but practically irrelevant. Thus, if these parameters are not available, a simplified estimation method based on only the volume of the building can also be applied (R^2 k-fold = 0.87). The robustness and precision of the method (output) are validated three times. Firstly, the prediction of the interior wall area is checked by means of alternative calculations of the building volume and of the interior wall area; thus, other definitions are applied to the same data. Secondly, the output is tested on an extension of the database, so it has the same definitions but on other data. Thirdly, the output is checked on an unrelated database with other definitions and other data. The validation of the estimation methods demonstrates that the methods remain accurate when underlying data are changed. The method can support environmental as well as economic dimensions of impact assessment, as it can be used in early design. As it allows the prediction of the amount of interior wall materials to be produced in the future or that might become available after demolition, the presented estimation method can be part of material flow analyses on input and on output.

Keywords : buildings as material banks, building stock, estimation method, interior wall area
Conference Title : ICACC 2025 : International Conference on Architecture, Construction and Conservation
Conference Location : New York, United States
Conference Dates : February 17-18, 2025