LEVEL(S) APPROACH TO ANALYSIS OF SUSTAINABILITY IN BUILDINGS AN EXPLORATORY STUDY OF LEVEL(S) FRAMEWORK ON A RESIDENTIAL PROJECT

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1. INTRODUCTION

In recent years, sustainable building practices have gained significant attention due to the increasing global concern for environmental preservation and resource efficiency. As a result, various assessment tools have been developed to evaluate the sustainable performance of buildings. This paper presents part of an analysis of the sustainability of a residential building using the Level(s) tool, a comprehensive framework developed by the European Commission [1].

2. METHODS AND RESULTS

2.1 Understanding Level(s)

Level(s) is the common EU framework of core sustainability parameters for buildings. The framework provides a set of indicators and common metrics for measuring the sustainability performance of buildings along their life cycle, assessing the following aspects: environmental performance; health and comfort; life cycle cost and value, and potential risks to future performance. It provides a standardized methodology, which enables the identification of key sustainability indicators and performance parameters for different stages of a building's development, from design and construction to operation and renovation, [2].

2.2 Case Study: Residential Building

To conduct the analysis, a case study of a single-family residential building, located in Alcanena, Portugal, was selected. The Level(s) tool was applied to evaluate its performance in areas such as energy efficiency, resource use, indoor environmental quality, and circular economy principles. The analysis included the gathering of relevant data on the building's materials, energy consumption, water usage and occupancy comfort and applying it to assess Level(s) performance indicators. The structure will be a mixture of reinforced concrete and wood panels type X-LAM with other specified materials for ceilings, wall and floor finishes including insulation, weather proofing and differentiation of materials for load bearing and non-load bearing elements. The house has a Gross Area of 238.98 m^2 (ground floor 182.14 m^2 and 1st floor 56.84 m^2) and has two floors with a total height of 6.05 m. Here only Life Cycle Global Warming Potential is presented.

2.3 Results

Macro-objective 1: Greenhouse gas and air pollutant emissions along a building's life cycle

Level(s) indicator 1.2: Life Cycle Global Warming Potential (GWP) - **Level 1: Conceptual Design Assessment.** a) Purpose of the level: To assess and incorporate design concepts that will help reduce the carbon impact to nearly zero of the building by optimising the use of materials, reducing waste; promoting circularity, ensuring minimum use of energy and maximising renewable energy. It also takes into consideration the construction, design form and the structural system of the building specific to its site context. b) Life cycle design concept: 1. Efficient building shape and form: The footprint of the assessed building is 238.98 m^2, the height of the building is made up of 2 floors totalling to 6.05 m (with a clear height of 2.75 m each floor, kept to minimum required) and the building plan is rectangular aligned to best fit the shape of the available land. The total exposed surface area has been reduced as much as possible. There is a small Surface area/Volume ratio (less exposed surface area) which minimises heat gain and heat loss as the surface- volume ratio is optimised. 2. Optimised NZEB construction: The major material palette, 'wood materials' used have an Environment Product Declaration (EPD) and the building is designed to reduce CO2 emissions through façade by providing insulation on walls which reduces heating and cooling loads, windows with glazed glass provided with curtains from inside. Use of renewable energy (solar powered systems for sanitary hot water). 3. Optimised material utilisation and circular value: Use of insulating materials contribute to reduction in energy loads. Optimum usage and minimal waste during production of construction materials. Use of concrete limited to structural requirements, insulation materials and false ceiling provided where necessary. 4. Extending building and component service lives: The proposal of the building complies with accessibility to sanitary installations, flooring and coverings. The components can be maintained/replaced without having to demolish the structural system. 5. Design for adaptability: The structural elements are of standard sizes and may be adapted as per future generation needs. There is also possibility of more efficient use of space if need arises. 6. Design for deconstruction: Not applicable. **Level 2: Detailed Design Construction** a) The purpose of this level is to assess the carbon emissions in terms of kg CO2eq. of the life cycle of a building from 'cradle to grave' process. This boundary includes both the assessment of use stage greenhouse gas emissions (those directly associated with the energy used for heating, cooling and supplying electricity to a building), and 'embodied' greenhouse gas emissions (those that are indirectly the result of the construction, repair, maintenance, renovation and eventual deconstruction of a building). The calculations are made using a software tool that is pre-programmed with calculation routines from the EN 15978 standard. Hence, OneClick LCA software [oneclicklca.com] has been chosen to perform LCA for this indicator. It offers a simplified and an interactive structure for Level(s) assessments and comes with extensive built-in LCA material database. Figure 1 shows the global warming potential. The production stage (A1-A3) contributes to 77% of the emissions produced throughout its life cycle.

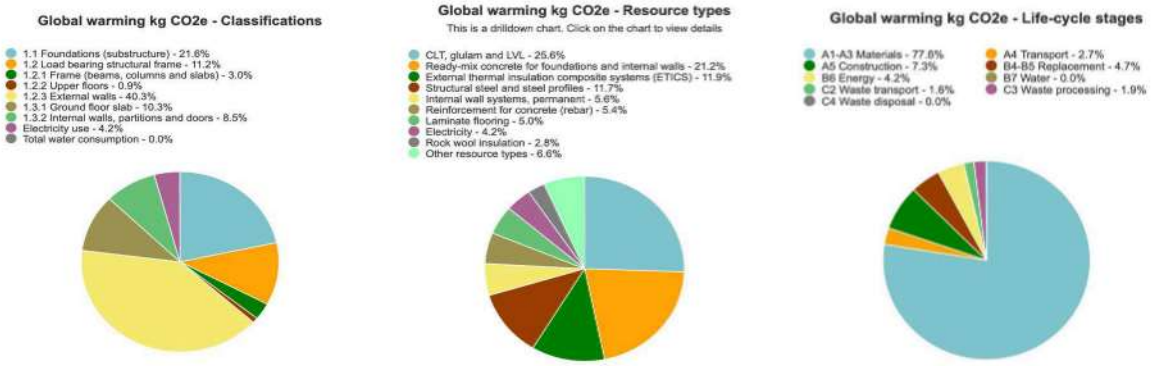

Figure 1 – Global warming potential according the life cycle stages, resource types and elements type.

3. CONCLUSIONS

The results suggest that the production stage (A1-A3) emits most kg CO2 eq. emissions, which is in line with the inference obtained from [3]. Concerning the elements of the building, it shows that the external walls contribute to 40% of the global emissions followed by the substructure. This paper contributes to the growing body of knowledge on sustainable building design by demonstrating the practical application of the Level(s) tool in evaluating the performance of a residential building.

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