School of Architecture, Civil and Environmental Engineering, ENAC
Environmental Engineering Institute, IEE
Laboratory on Human-Environment Relations in Urban Systems, HERUS

Master thesis project

Title: Feasibility of Lausanne's building renovation targets: Construction materials and circularity potentials.

Description of research:

As cities transition toward low-carbon and circular futures, understanding the material dynamics of the built environment is crucial. In Switzerland, the building stock represents a major share of material consumption and embodied greenhouse gas emissions, especially in structural components like concrete, steel, insulation, windows, and facades. Planned energy-efficiency renovations over the coming decades will generate substantial material inflows (new materials) and outflows (waste and potential secondary materials).

This thesis focuses on **quantifying material flows and circularity opportunities** arising from building renovations in Lausanne. Using:

- **Swiss Federal Statistical Office (FSO)** building data (age, type, floor area, energy label, etc.)
- **Material intensity data** from literature and WSP (BG Ingénieurs)
- **Existing renovation scenario models** from previous theses

In close collaboration with HERUS and WSP, the student will develop a **dynamic building material flow model** to 2050. The analysis will identify **renovation-driven material outflows**, estimate **reuse and recycling potential**, and assess **environmental payback** (gray energy and CO_2 break-even points).

The ultimate goal is to provide a **buildings' systems-level perspective** on how circular renovation strategies could reduce environmental impacts in Lausanne.

Objectives

1. **Quantify baseline material stocks** in Lausanne's building archetypes.
2. **Model dynamic material flows** from renovation scenarios to 2050, including inflows and outflows.
3. **Evaluate circularity potential and environmental payback**, e.g.:
    - Which materials are easier to reuse/recycle?
    - Under which conditions can renovation achieve CO_2/energy break-even?
4. **Compare circularity strategies** (reuse vs. recycling) and identify the most impactful interventions.

Data available for the student

- Building inventory (FSO) with age, typology, floor area, and energy label
- Material intensity datasets (WSP + literature)
- Renovation scenario data (previous MSc thesis, Lausanne case)
- KBOB and SIA benchmarks for materials and environmental impacts

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If you are interested, please send your CV and a short letter describing your motivations and future plans to the email: **francisco.felixmartindelcampo@epfl.ch**