University: Université de Sherbrooke, Department of civil and building engineering
Professors leading the project: Liya Li, Sébastien Langlois, Charles-Philippe Lamarche
Collaborators : University of Waterloo, AluQuébec, ALU MC3, MTMD
Program launch: Automn 2024
Recruitment: 2 Ph.D. students

PhD positions available in structural engineering:
Study on the fatigue resistance of aluminum highway accessory supports

The Department of Civil and Building Engineering at the University of Sherbrooke (UdeS) is looking for highly motivated PhD candidates to join our structural engineering research group. This project, under the guidance of three UdeS professors, aims to address the knowledge gap in fatigue analysis of aluminum highway accessory supports.

The project involves collaboration with several key organizations: Prof. Scott Walbridge's team at the University of Waterloo, the non-profit organization AluQuébec, the light pole and sign structure manufacturer ALU MC3, and the Ministère de la Mobilité et des Transports du Québec (MTMD). As part of this PhD program, candidates will have the opportunity to enhance their research experience by spending a semester at the University of Waterloo.

Figure 1: Sign structures (https://www.alumc3.com/en/)

Why this project?

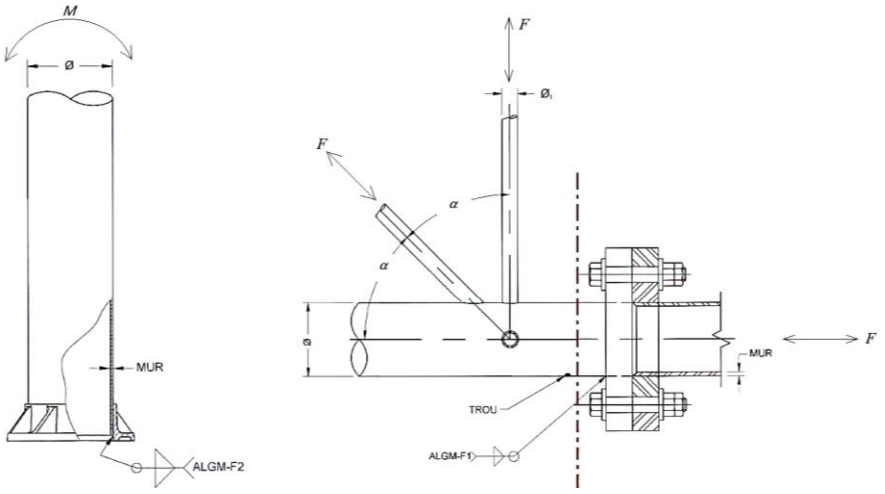
Aluminum plays a crucial role in structural engineering, particularly in highway accessory supports. However, there's a notable knowledge gap in understanding its fatigue limits. While the Canadian Highway Bridge Design Code CSA S6 offers comprehensive guidelines for steel, the specifics for aluminum, especially regarding fatigue, are either limited or non-existent. This lack of detailed information challenges engineers in making informed decisions for aluminum components.

Objectives:

- Experimental Investigation: Conduct a series of experimental tests specifically targeting the fatigue assessment of various aluminum structural details and configurations not covered by CSA S6, but frequently encountered in practice. This includes the study of plate socket connections and K-joints (see Figure 2). These connections are often used in highway accessory supports to effectively transmit forces such as axial loads, bending moments and shear forces between connected elements.
- Numerical Analysis: This step will make use of the fatigue test results collected in experimental test.

Various approaches will be used to predict these results, including but not limited to finite element (FE) analysis to obtain local stresses and stress intensity factors (SIFs) at critical locations in the connections, in conjunction with hotspot stress, notch stress, and linear elastic fracture mechanics (LEFM) methods.

- The obtained experimental and numerical results will be used to enhance the fatigue performance of highway accessory supports and the associated standards. Recommendations will be made regarding the application of the methodology used for categorizing the investigated unclassified details. This approach will facilitate its future adoption by code writers as new unclassified fatigue details are identified.



a) b)

Figure 2: Experimental tests - a) plate socket connections - b) K-joints

Required Skills:

The position requires a proactive researcher with a well-established publication record. The preferred candidate should demonstrate evidence of the followings:

- A Master's degree in Structural Engineering, demonstrating a strong theoretical foundation along with practical experience;
- Proficiency in numerical analysis techniques and finite element analysis;
- Excellent communication and writing skills in English, with the ability to effectively communicate in an international academic environment and produce high-quality research reports and papers;
- The ability to conduct scientific research independently, along with a strong spirit of teamwork.

Preferred Skills:

- A background in fatigue research, with an understanding of how fatigue phenomena affect structural safety;
- Hands-on experience in conducting experimental projects in structural engineering. This includes proficiency in experimental design, execution, and data analysis;
- Proficiency in high-level programming languages such as MATLAB, Python, and VBA. Capable of using these tools for complex data processing, modeling, and simulation analysis, supporting numerical analyses and research in projects.

How to Apply:

To apply for this position, interested candidates should submit their application to Prof. Li via email at liya.li@usherbrooke.ca. The email subject should be formatted as “PhD application_Fatigue_first name_last name”. The application must include the following documents:

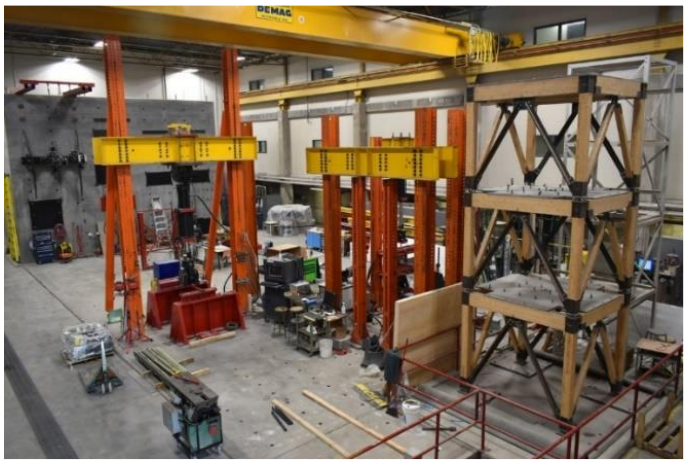
1. **Motivation Letter**: A one-page letter outlining your research areas and future plans. The file should be named “1. Motivation letter_first name_last name”.
2. **Comprehensive CV**: This should include a minimum of three references. The file should be named

"2. CV_first name_last name".

3. **Academic Transcripts and Degrees**: Copies of all academic transcripts and degrees. The file should be named "3. Transcripts & degrees_first name_last name".
4. **Research Summary**: Your master's thesis or a summary of previous research, between 3-5 pages. The file should be named "4. Research summary_first name_last name".
5. **English or French Language Certificate**: If your previous studies were in a language other than English or French, include a language certificate with your test scores. The file should be named "5. Language test_first name_last name". The required tests and scores are:
   a) English Test: IELTS (6.5 and above) or TOEFL (90 and above)
   b) French Test: TCF (C1 and above for all four tests) or DALF (C1 and above)

The UdeS and the Department of Civil and Building Engineering

The Université de Sherbrooke (UdeS) in Quebec, Canada, founded in 1954, is a prominent French-speaking institution renowned for its dynamic approach to education and research, particularly in engineering. The Department of Civil and Building Engineering at UdeS offers comprehensive programs in structural, geotechnical, environmental, and building engineering. Known for its commitment to practical and hands-on learning, the department prepares students thoroughly for professional careers in engineering, emphasizing collaboration with industry partners and other academic institutions. A standout feature of the department is its Structural Engineering Laboratory, a state-of-the-art facility equipped with advanced technology for research in earthquake engineering, structural dynamics, material testing, and sustainable construction practices. This laboratory not only supports innovative student projects and faculty research but also contributes significantly to technological advancements in civil engineering, aligning with UdeS's overall focus on community engagement and addressing contemporary challenges in the field.



https://www.usherbrooke.ca/genie/partenariats/partenr/plateformes/laboratoire-de-structures-de-universite-de-sherbrooke-labs