

# Keagan Hudson Rankin

1 (506) 461-5211 | [keagan.rankin@gmail.com](mailto:keagan.rankin@gmail.com) [keagan.rankin@mail.utoronto.ca](mailto:keagan.rankin@mail.utoronto.ca)

## Education

**University of Toronto**, Faculty of Applied Science & Engineering *Sept 2021- present*

MASc (Environmental Engineering), GPA: 4.0 (4.0 scale)

Thesis: *Material Efficiency Strategies for Building More Housing with Less Embodied Greenhouse Gas.*

Supervisor: Shoshanna Saxe

**University of New Brunswick**, Faculty of Engineering *Sept 2017–June 2021*

BSc Eng (Structural Engineering), GPA: 4.2 (4.3 scale) – First Division, Dean’s List

Thesis: *A Review of Canadian Highway Bridge Inspection Demand and Technology.*

## Research Interests

- Industrial ecology and sustainable urban/human systems. Material efficiency and low-carbon energy.
- Applications of data science and computational methods to sustainability problems.
- Economics of and policy making for technologies. Existential technological risk.

## Research Experience

**Mitacs Accelerate Intern** *Sept 2022-present*

City Planning Division, City of Toronto (Toronto, ON).

- I collaborated with city planners to find ways of decoupling Toronto’s housing growth from climate impacts. I quantified the embodied GHG of buildings, used data analysis to find drivers of material GHG, modelled future pathways of Toronto’s housing emissions, and found the best incentives for reducing emissions. Our work was used by policy makers in new municipal housing bylaws.

**Research Assistant** *Apr 2021-Aug 2021*

Offsite Construction Research Centre (OCRC), University of New Brunswick (Fredericton, NB).

- The OCRC works on developing technologies and private partnerships to further the offsite construction industry. Working under Professor Zhen Lei, I created a novel supply chain model and discrete event simulation for a company shipping housing modules to remote communities in Northern Canada. Our paper won second best paper award the 2022 Canadian Society for Civil Engineering Annual Conference.

**Undergraduate Researcher** *Apr 2020-Apr 2021*

Smart Structures Research Group (SSRG), University of New Brunswick (Fredericton, NB).

- The SSRG is led by Professor Kaveh Arjomandi and focuses on technology and automation in structural health monitoring. Over the summer, I helped create a data pipeline using Python and SQL for the group’s projects. I also collected and processed waveform data from a sensor setup for drive-by inspection of roads and bridges. I completed my undergraduate thesis with the same group; It explored scenarios where autonomous inspection technologies might change Canada’s policies and spending on highway infrastructure maintenance.

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## Undergraduate Researcher

Apr 2019-Aug 2019

Department of Civil Engineering, University of Victoria (Victoria, BC).

- Working with Professor Thomas Froese, I helped develop a new sustainability and design-focused undergraduate curriculum for the department's undergraduate program. My research included a comprehensive look at teaching sustainable construction theory.

## Undergraduate Researcher

Apr 2018-Aug 2018

Mactaquac Aquatic Ecosystems Study (MAES), University of New Brunswick (Fredericton, NB).

- MAES is a multi-disciplinary study assessing the impacts of a hydroelectric stations on the longest river in Eastern Canada. Under the supervision of Professor Katy Haralampides, I developed a linear model for quickly assessing passing suspended solids at the hydroelectric station. The linear model informed the station's policy on passing solids limits during construction. I also gathered 3D flow data around the station.

## Teaching Experience

### Graduate Teaching Assistant

Sept 2021-present

University of Toronto, Toronto, ON

- I have held three assistantships for the 1<sup>st</sup> year engineering mechanics class (CIV100). My role involves leading lecture-style tutorials, holding office hours, and marking exams for 100+ undergraduate students.

## Publications

### Conference Papers:

- **Rankin KH**, Zhuo, Lei, Rizaee, Searle, Ene, Amuno, (2022) Pull-based simulation modeling for modular construction supply chain analysis: A case study in Northern Canada. *Proceedings of the Canadian Society of Civil Engineering Annual Conference 2022*. – Awarded 2<sup>nd</sup> best paper out of ~300 submissions.
- Froese, Bristow, **Rankin K**, (2021). Towards a sustainability-centred design curriculum in civil engineering. *EESD 2020/2021 Conference Proceedings*. Engineering Education for Sustainable Development (EESD2020/2021).

### Non-Peer Reviewed:

- Hudgins, Haralampides, Dolan, **Rankin K**, Yamazaki (2019). Results and analysis of the 2018 suspended solids field program in the Mactaquac headpond, Saint John River, NB. *University of New Brunswick*.

### Forthcoming/In Preparation Papers:

- **Rankin KH**, Arceo, Isin, Saxe. Embodied GHG of missing middle: residential building form and strategies for more efficient housing. *Journal of Industrial Ecology*. In Review
- **Rankin K.H.**, Arceo, A., Yoffe, H., Isin, K., Saxe, S. Forecasting embodied housing emissions and material efficiency scenarios to 2030 in Ontario, Canada. *ISIE 2023*. Submitted
- **Rankin K.H.**, Arceo, A., Yoffe, H., Isin, K., Saxe, S. The potential for missing middle to provide more housing with less embodied emissions: quantifying and optimizing material efficiency in low-rise, multi-unit housing. *ISIE 2023*. Submitted
- Yoffe, H., **Rankin, K.H.**, Bachmann, C., Posen, D., Saxe, S. A Top-Down approach for downscaling sectoral emission budgets. A case study of Canada's construction sector. *ISIE 2023*. Submitted

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## Recognitions and Awards

### National

- Esch Foundation Scholarship; \$6,000 (Transportation Association Canada) *Sept 2020*
- Undergraduate Student Research Award (NSERC) \$6,000  
awarded twice at UNB and once at University of Victoria *Apr 2018-Aug 2020*

### University of Toronto

- QEII: Graduate Scholarship in Science and Technology Award; \$15,000 *Sept 2022-Sept 2023*
- C.W. Bowman Graduate Scholarship in Energy Research; \$4,400 *April 2022*
- NSERC Alexander Graham Bell Award, CGS M; \$17,500 *Sept 2021-Sept 2022*
- CIVMIN Graduate Merit-Based Entrance Scholarship; \$5,000  
awarded to top 5 incoming CIVMIN graduate students. *Sept 2021-Sept 2022*
- Ontario Graduate Scholarship; \$15,000 *declined* *Sept 2021*

### University of New Brunswick

- NSERC CGS M; \$17,500 *declined* *Sept 2021*
- Lieutenant Governor of New Brunswick Silver Medal;  
Civil Engineering Nominee. Awarded to most outstanding  
graduating student in the faculty of engineering. *Apr 2021*
- D. Malcolm Jeffrey Memorial Prize.  
Awarded for highest departmental GPA over 4 years. *Apr 2021*
- Best capstone design report; team nominated for national CSCE  
student poster design competition *Apr 2021*
- Rudy and Theresa Esterbauer Research Fund; \$5,000 *Sept 2020-Apr 2021*
- Merit Based Scholarships; \$20,000  
total awarded by the university over course of degree. *Sept 2017-Apr 2021*

## Selected Presentations

“Spongy dams and superintelligence: the unknowable consequences of engineering new technologies”.  
*Massey College Junior Fellow Lecture Series*. Toronto, Ontario. *Oct 2022*

“Evaluating the Material Intensity of Missing Middle Housing”. *2022 Industrial Ecology Gordon Research Conference*. Newry, Maine. *Jun 2022*

“Providing more housing with less embodied GHG: housing form and beyond”. *UofT Centre for Sustainable Built Environment*. Toronto, Ontario. *Jan 2023*

## Projects and Media

“Using Machine Learning to Classify the Cycling Accessibility of Roads” *April 2022*  
Primary Author and co-contributor. Responsible for concept, data collection, cleaning, modelling, visualizations.

<https://github.com/KeaganHRankin/1498-ML-Project>

## Affiliations and Service

### **Board of Directors: Campus Cooperative Residence Inc**

*Jan 2023-present*

CCRI is the Canada's oldest housing co-operative, owning 20+ properties and serving ~200 student members in Toronto's downtown core. As a board member, I lead the co-op in strategic planning, policy making, and a multimillion-dollar budget ratification.

### **Junior Fellow: Massey College**

*Jun 2022-present*

Massey College is a Canadian society and charity focused on addressing interdisciplinary problems. It provides junior fellowships to a select few graduate students at University of Toronto "who show an exceptional promise and engagement within academia and the world beyond it." I am editor-in-chief of the literary journal, participant in the Technology X Society group, and a junior fellow lecturer.

### **Member: International Society for Industrial Ecology**

*May 2022-present*

"The ISIE facilitates communication among scientists, engineers, policymakers, managers, and advocates who are interested in better integrating environmental concerns with economic activities."

### **Academic Director: U of T CIVMIN Graduate Society**

*Sept 2021-present*

I attended student panels and helped organize events for engineering graduate students.

### **Engineering in Training: APEGNB**

*May 2021-present*

(Association for Professional Engineers and Geoscientists New Brunswick)

### **Member/Volunteer: Canadian Society for Civil Engineering**

*Sept 2018-present*

Volunteer at the 2018 CSCE annual conference.

### **Shad Mentor**

*Jul 2021*

Shad is a Canadian program that exposes secondary students to university learning. I was volunteer mentor for grade 10/11 students in the program at UNB as they completed a design project on freshwater sustainability.

### **Member: Fredericton Rowing Club**

*Jan 2014 – Dec 2018*

I helped with fundraising, community events, and volunteer/paid coaching over my tenure.

## Skills

### **Programming/Markup Languages (in order of experience)**

Python (Scikit-Learn, Pandas, Matplotlib), R, MATLAB, SQL, HTML + CSS, VB.

### **Engineering Software**

REVIT, SAP2000, AutoCAD, Civil3D, EPANET, LabView, OnScreenTakeoff, ArcGIS.

### **Languages**

English (native), French (proficient)

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**Rowing/Crew***2017-2019*

- Eastern Canadian champion in open 4x, finalist at 2017 Canada Games (Team NB Rowing)
- Three-time annual “top male rower” (Fredericton Rowing Club).
- High performance team member (Victoria City Rowing Club)
- Three-time Atlantic Canadian University champion (Lwt Men’s 1x, Men’s 2x twice) (UNB Rowing)