



SMART MANAGEMENT OF CONSTRUCTION WASTE

Meeting Minutes

Event organized by Concordia University's Centre for Innovation in Construction and Infrastructure Engineering & Management (CICIEM), Concordia's Next Generation Cities Institute and 4th Space

May 20th 4:00 - 5:30 pm EST

Agenda

Introduction and overview of 4th Space, Anna Wacławek, Manager 4th Space

Moderator, Dr. Rebecca Dziedzic

Opening remarks, Dr. Osama Moselhi

- A special welcome to industry representatives & faculty members from the [Centre for Innovation in Construction and Infrastructure Engineering and Management \(CICIEM\)](#)

Presentation of the research center, Dr. Ursula Eicker

- Welcome from the [Next Generation Cities Institute](#)
- CICIEM is one of 14 Concordia University Research Centers associated with the Institute
- The Center and Institute seek collaboration with industry and municipal partners

Panel Presentations

1. Nicolas Bellerose, Récyc-Québec
2. Abdu Lotfy, PhD, PEng, LafargeHolcim
3. Stephanie Dalo, PEng, MEL, Dialog
4. Michel Bouchard, Devimco
5. Ahmed Soliman, PhD, PEng, Concordia University

General Discussion

Breakout Room Specialized Discussions and Networking

1. Design, maintenance, rehabilitation and deconstruction
Dr. Moselhi, Dr. Nik-Bakht, Dr. Hammad, Dr. Han
2. Recycling & reuse at the material level
Dr. Soliman, Dr. Ouf
3. Environmental impacts and management of construction, renovation and demolition (CRD) waste
Dr. Nasiri, Dr. An, Dr. Eicker

Panelist Highlights

1. Nicolas Bellerose, Récyc-Québec

Récyc-Québec's mission is to lead Quebec to reduce, reuse, recycle and recover residual materials to promote a circular economy and mitigate climate change.

Main strategies for smart construction waste management include:

- Material reuse (deconstruction instead of demolition);
- Mindful planning to minimize or avoid waste;
- Dealing with reputable CRD waste sorting centers, Récyc-Québec has implemented a recognition program to promote industry best practices; and
- Material selection considering potential markets and uses at the end of the building's life, motivating a circular economy.

2. Abdu Lotfy, PhD, PEng, LafargeHolcim

An increasing number of sustainability focused initiatives from the public and private sectors are being developed to minimize environmental impacts (i.e. low to zero Co2 building requirements). However, environmental policies and discrepancies between provincial and municipal levels pose an additional challenge. Some regulations prohibit the re-use of CRD materials. In the case of recycled concrete aggregates, the inclusion of "contaminants", such as asphalt, gypsum and glass, is a major obstacle to wider adoption. Smart sourcing and segregation are key to minimizing contamination.

3. Stephanie Dalo, PEng, MEL, Dialog

Over the last few decades, environmental impacts of built facilities have reduced at the operational level due largely to gains in energy efficiency. Now the trend is shifting to material use and a focus on circular design, design for disassembly (DfD) and life cycle assessments. However, current databases do not generally account for the end of life phase of materials, which constitute a major obstacle in demonstrating the benefits of material reuse.

Some current initiatives that motivate material reuse include the LEED certification, the Envision sustainable infrastructure rating system, the application of material passports, and the newly created ISO 20887:2020 Standards for Sustainability in buildings and civil engineering works - Design for disassembly and adaptability.

4. Michel Bouchard, Devimco

Devimco is a Quebec real estate developer involved in large real estate projects, in particular lifestyle and TOD (transit-oriented development) complexes. Unfortunately, little is done in the real estate field with regards to the reuse of CRD materials. The cost of smarter construction waste management cannot be passed on to the end user, the sector is very competitive and implementing additional initiatives is not perceived as economically viable. This change needs to be initiated by either a demand from the customers, or via modification and improvements of government regulations.

5. Ahmed Soliman, PhD, PEng Concordia

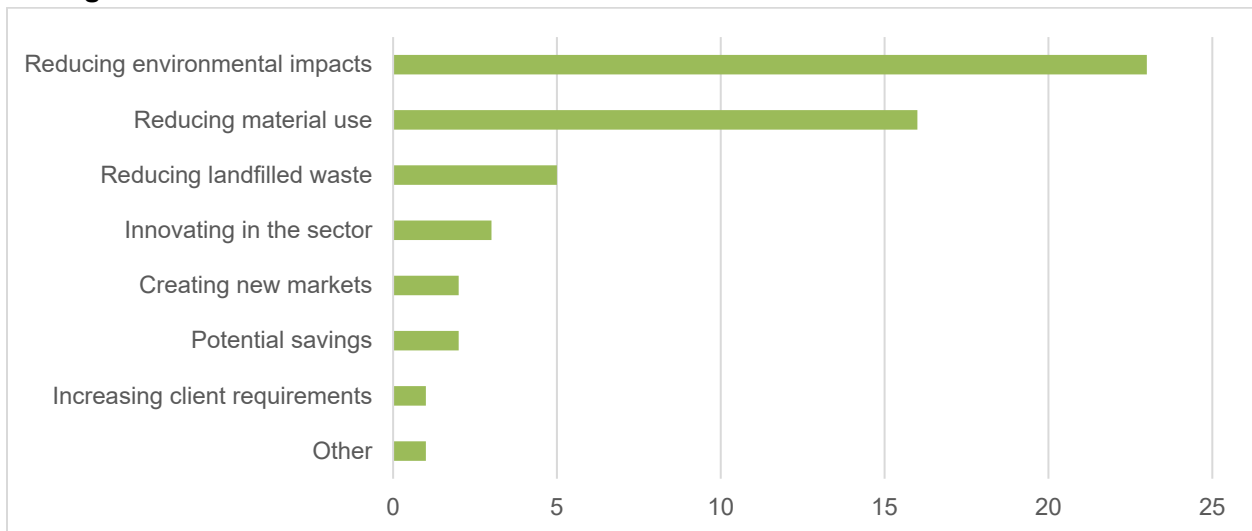
There is an increasing awareness of the scarcity and depletion of natural resources. The “3R-Concept”: Recover, Recycle and Reuse should be expanded to include a 4th “R”, reduce, related to reducing the use of CRD materials. At Concordia, research in new approaches to serve the current and future needs for sustainability is ongoing. Focus areas include closed loop lifecycles for material and multi generation waste, waste valorization and negative emission strategies (i.e. carbon sequestration).

Discussion Highlights

Four zoom polls were conducted with participants to gather information on motivations and barriers for smarter solutions for construction waste management. Results of the polls and related remarks are summarized below.

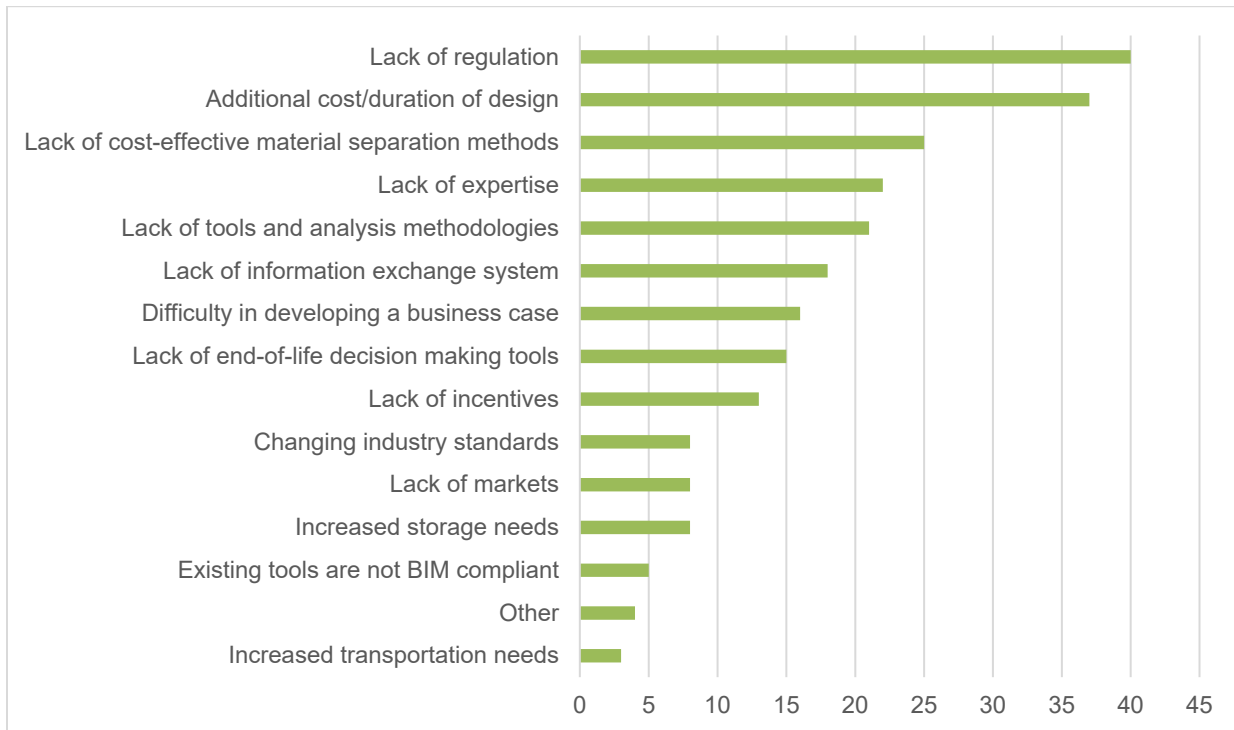
The first poll, opening the workshop was related to the motivation for seeking smarter solutions to construction waste management. Fifty-three participants answered and generally identified environmental impacts and material use as the most important drivers, as seen below.

What is your motivation for seeking smarter solutions for construction waste management?



Each of the following polls concentrated on the barriers to improving construction management in different areas and phases of the material lifecycle. The second poll focused on design for disassembly and deconstruction. Lack of regulation and additional cost/duration of design were clearly selected as the top two barriers by the 56 respondents.

What are the 3 top barriers to designing and maintaining for disassembly and deconstruction?



Remarks:

Stephanie Dalo, Dialog: At an individual level, it's the engineer's responsibility to incorporate sustainability into design, with a special focus on resilience and safety. At term, better management for construction waste won't result in additional costs, it will be integrated into the cost of design. Smarter management of C&D waste will also result in job creation.

Responding to how engineers can impact policies, organizations such as the Canadian Society for Civil Engineering are connecting industry practitioners with academia and governance leaders. Ways to improve policies include incremental changes in standards and inclusion of new initiatives in city action plans.

Nicolas Bellerose, RECYC-QUEBEC: Some materials used in the past have a longer lifespan compared to newer materials being used. Decisions taken today will have an impact in 50 years. The city of Vancouver is a good example of enforcing regulations for the dismantlement instead of demolition of buildings built prior to the 1950s.

It is difficult to have and enforce province-wide regulations in regards to design for disassembly and C&D waste management. Strategies for local regulations and bylaws can be more effective at times.

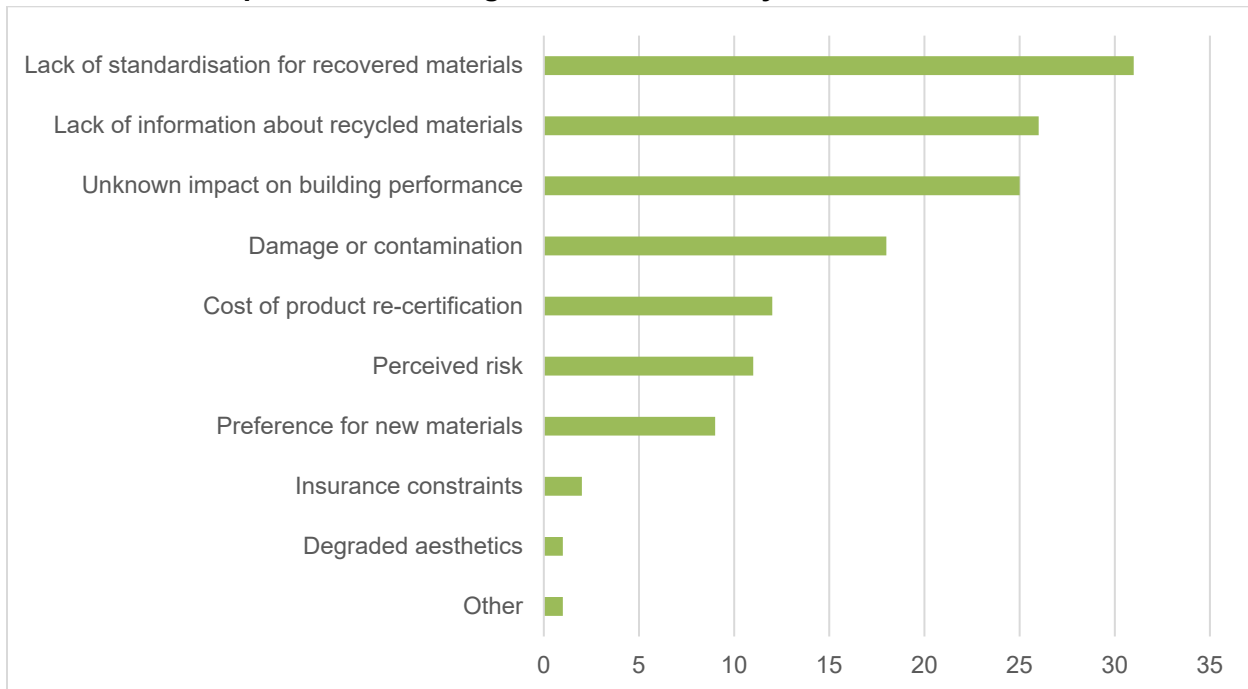
Rebecca Dzedzic, PhD, Concordia: Some lifecycle costs and potential savings are not initially apparent. Environment impacts and other externalities are to be considered when supporting initiatives in better CRD waste management.

Michel Bouchard, Devimco: The construction and development industry will react and change from either pressure from the consumers or change in legislature. Quebec is behind compared to other provinces with regards CRD waste management regulations.

Ahmed Soliman, Concordia: Integrated material design - requires planning from sourcing the raw materials until the end of life and further use.

The third poll focused on barriers at the material level. Fifty-one respondents identified a lack of standardization, lack of information and unknown performance impacts as the top 3 barriers, as shown below.

What are the 3 top barriers to using recovered and recycled materials?



Remarks:

Gilles Bernardin, 3R MCDQ: The province of Quebec is lagging with regards to waste management. C&D materials are considered waste and need approval to be reused. Asphalt shingles are allowed to be reused in the USA, whereas 3R MCDQ have been trying to obtain approvals from Quebec authorities for the past 8 years.

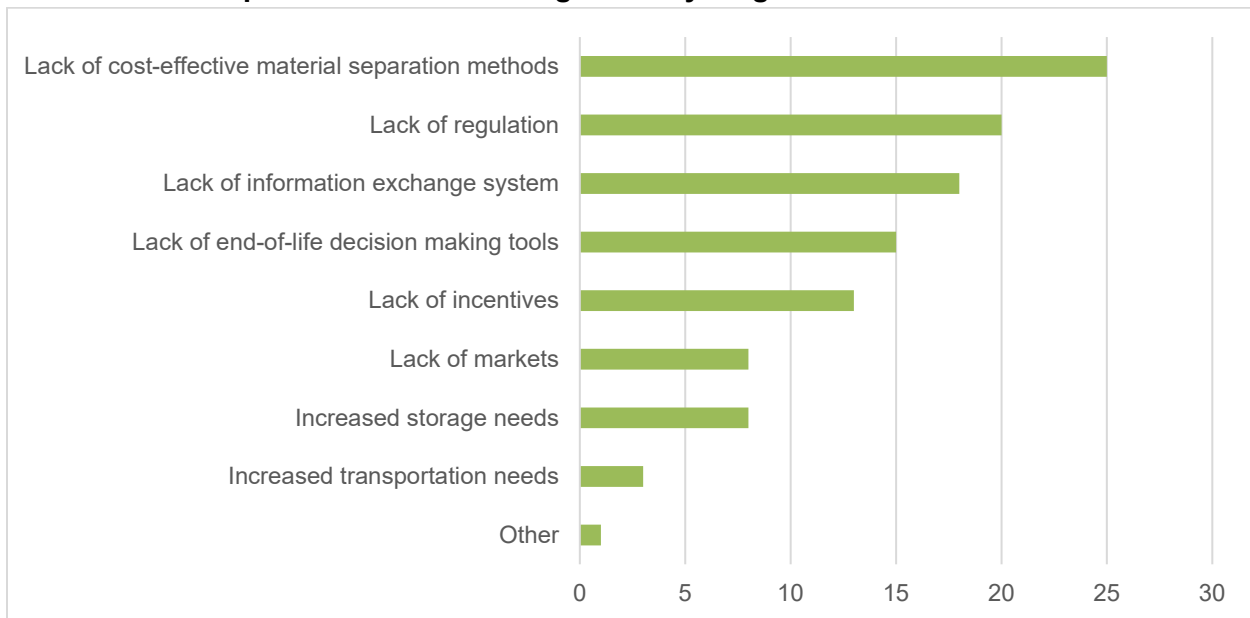
Abdu Lotfy, LafargeHolcim: Two major barriers to using waste materials in concrete; technical standards & variability across provinces (Ontario vs. Quebec vs. Atlantic) and the environmental

regulations. The use of recycled concrete is not mandated at a provincial level. Montreal uses some recycled concrete aggregate in subbase applications, whereas other municipalities don't (where it is perceived as an increased risk).

Discrepancies in the regulations, for example the MTQ (Quebec's transport ministry) allows the reuse of waste products as long as it remains on site. When these waste materials are collected and transported to another external site, they are treated differently and can no longer be used. Another example is blending recycled aggregate, allowed in Ontario but not in Quebec (even if only 1% of the material is recycled). Standards and specifications need to be consistent with other leading provincial standards and global standards.

The last poll asked participants about barriers to closing cycles and connecting potential stakeholders in smart waste management. Once more, costs and regulation were identified as top barriers by the 41 respondents.

What are the 3 top barriers to recovering and recycling materials?



Ahmed Soliman, Concordia: The lack of information is a great barrier to getting better industry acceptance for material recovery and recycling. Even if recycled materials are meeting specifications, decision makers are hesitant to use them as there is limited availability of data on the material lifespan. Current regulation is making data collection for recycled material difficult.

Specialized Discussions

1. Design, maintenance, rehabilitation and deconstruction

Dr. Moselhi, Dr. Nik-Bakht, Dr. Hammad, Dr. Han

For Metro Vancouver, about one third of all waste is CRD and 70% of that from wood. Recyclability can vary significantly for different materials, components, and conditions in built facilities. There is a need for investing in procurement strategies and project delivery methods which are better compliant with design for disassembly (rather than prescriptive design). Thinking can then shift from material-level to component/product/sub-system and even system-level reuse and recycling. Applications of value engineering can also be updated and better adjusted to accommodate sustainability and recyclability.

Modern technologies that can help in this area include:

- BIM (Building Information Modeling can not only help with design for disassembly in new buildings/infrastructure; but also for deconstructability analyses of existing facilities)
- MOC (Modular and Offsite Construction, that includes in-factory manufacturing, shipment to the site, and onsite installation can better fit the dismantling, deconstruction and reuse, in comparison to conventional construction, by reversing the procedure.
- Traceability through technologies such as RFID (Radio Frequency Identification), barcodes, and other IoT (Internet of Things) technologies (dismantling at the End of Life, particularly in complex facilities, will require accurately knowing 'what component is where').

2. Recycling & reuse at the material level

Dr. Soliman, Dr. Amador, Dr. Ouf

Dr. Abdu Lotfy from LafargeHolcim provided further insights on recycling and reuse at the material level, as described below.

- There is a growing desire to recycle CRD material. 10 years ago it was a new trend when LEED started giving points for recycled content. Now it's much more advanced and in 10-15 years zero or net zero carbon emissions form construction is aimed for. The desire is there, but the problem is there is no mandate.
- We need regulations, specs to allow users to be more comfortable with the use of recycled materials. That way, people will also be more aware of the programs, and what's needed. This can also lead to more sharing of information. Currently there are almost no technical specifications.
- Recycled concrete is acceptable for low-risk applications and even in structural components in Ontario. However, in Québec it cannot be used. According to the MTQ it can technically be used on site, but generally isn't because of the lack of regulation.
- Success stories with early adopters can help build stakeholder confidence.

- Not all suppliers use the same specifications. Actually, recycled materials have no specifications, anyone can call anything recycled concrete. This has given recycled concrete a bad reputation.
- There are many potential low-risk applications that do not affect stakeholder image. Examples include sidewalk and backfill application in the cities of Mississauga and Kingston, ON. A 5-10 year warranty is provided to show confidence in the product.
- A change in name might be another strategy to improve marketability. Price of recycled concrete is lower or equivalent. Additional cost is attributed to processing, sorting, etc.

Dr. Ahmed Soliman from Concordia also noted regulations should allow more recycled content. However, there is still hesitance from owners and contractors.

3. Environmental impacts and management of CRD waste

Dr. Nasiri, Dr. Chen, Dr. An, Dr. Eicker

A key challenge with waste recovery efforts in the construction sector is the trade-off between the potential environmental benefits of materials recovery and the costs of recovery. As an example, cement has a vast potential (and a relatively easy process) for recovery within the construction sector. One process is to crush it and use it as a base surface for roads in mixture with other materials. In contrast, metals have a lower potential for reuse and recovery within the construction sector. Depending on the age and deterioration of the material, other solutions would have to be provided in other sectors, such as in recycling facilities. These differences have resulted in the recovery of 80% of cement/concrete in construction sector in Quebec while most other types of waste (metals, plastics, woods) still largely end up in landfills.

The Quebec Environmental Quality Act has set targets for waste recovery (including construction waste), however, there are not direct incentives or monitoring indicators for each specific type of waste. The targets are weight-based and account for the whole sector waste stream. As such, with significant recovery of concrete and asphalt in Quebec, the construction sector is surpassing those targets even without recovery efforts for other materials.

Conclusions

The workshop welcomed panelists and participants from academia and industry, representing different types of stakeholders involved in the management of construction waste. The discussions centered around three main areas:

- Design, maintenance, rehabilitation and deconstruction for recycling and reuse;
- Recycling and reuse at the material level; and
- Environmental impacts and management of CRD waste.

Participant surveys and discussions identified the following key barriers to the smarter management of CRD materials:

- Lack of regulations and material standardization,
- Lack of information on long-term performance and impacts of recycled materials; and
- Perceived higher cost of design for disassembly and material separation methods.

Concordia's Centre for Innovation in Construction and Infrastructure Engineering and Management (CICIEM) is committed to forwarding knowledge in the smart management of CRD materials and addressing these barriers. Information on members of the Asset Management & Policy research cluster who organized this workshop are provided in the appendix. To learn more about our research and opportunities for collaboration, please contact CICIEM Director, Dr. Osama Moselhi, moselhi@encs.concordia.ca.

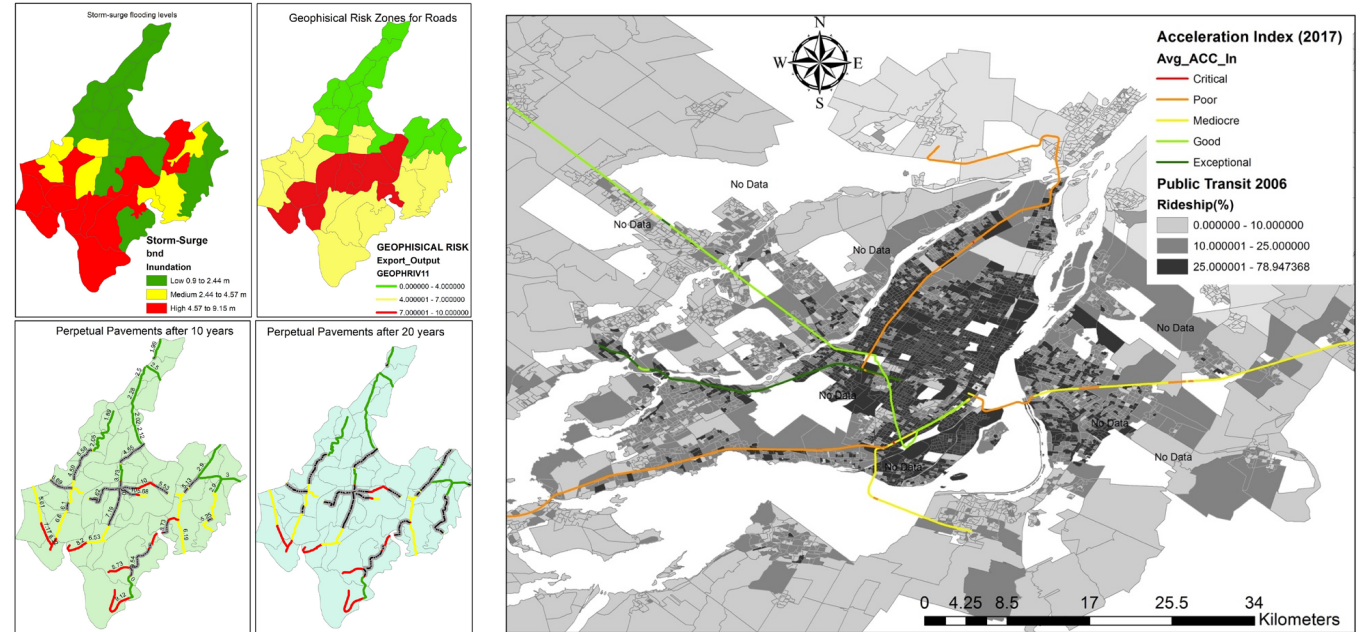


ASSET MANAGEMENT & POLICY RESEARCH CLUSTER MEMBERS AND INTERESTS



Dr. Luis Amador
Assoc. Prof. and UGPD

Email: luis.amador@concordia.ca



Teaching

Undergraduate

- CIVI 471 – Highway and Pavement Design
- BCEE 371 - Surveying

Graduate

- CIVI 6461 Pavement Management Systems
- CIVI 6451 Pavement Design

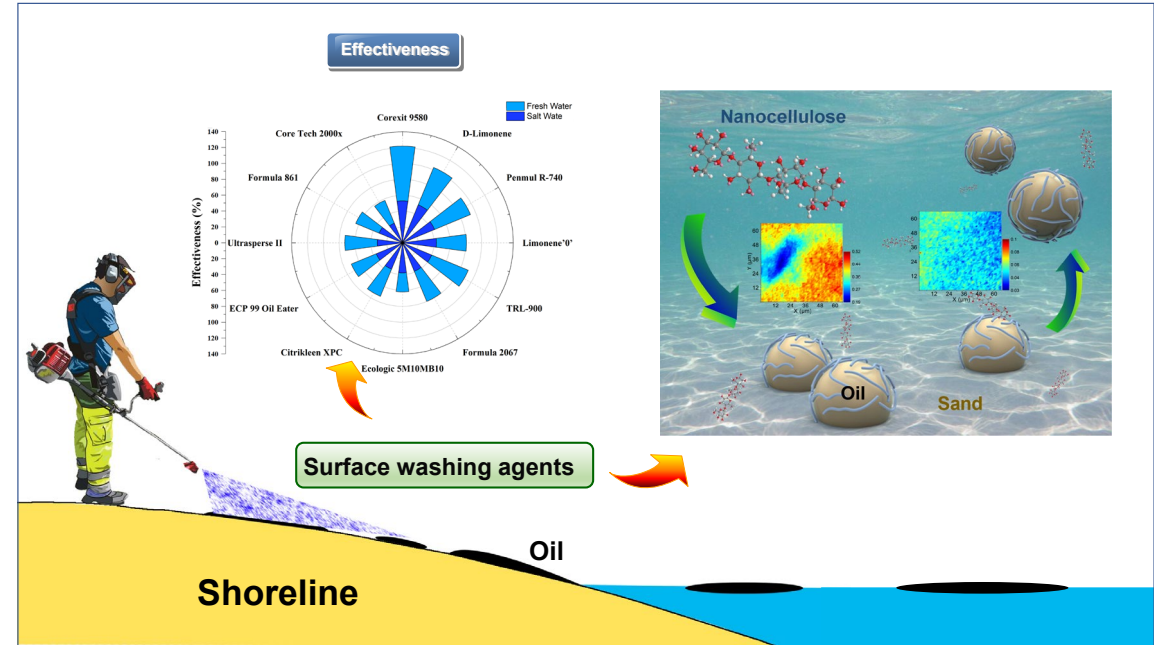
Research Interests

- Pavement Deterioration Modeling
- Pavement Management Systems
- Roadway Artificial Illumination
- Public Transit Accessibility and Comfort
- Trip Generation and Parking Rates



Chunjiang An
Ph.D., P.Eng.
Assistant Professor

S-EV 6237
(514) 848-2424 ext. 7857
chunjiang.an@concordia.ca



Teaching

Undergraduate

- CIVI 468 - Waste Management
- ENGR 202 - Sustainable Development and Environmental Stewardship

Graduate

- CIVI 6481 - Hazardous Waste Management
- CIVI 6641 - Unit Operations in Environmental Engineering

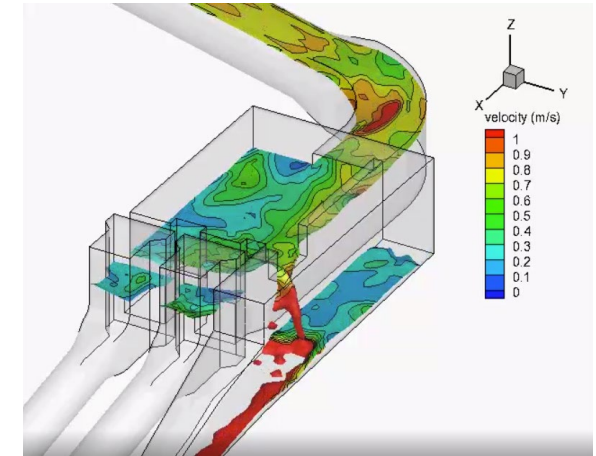
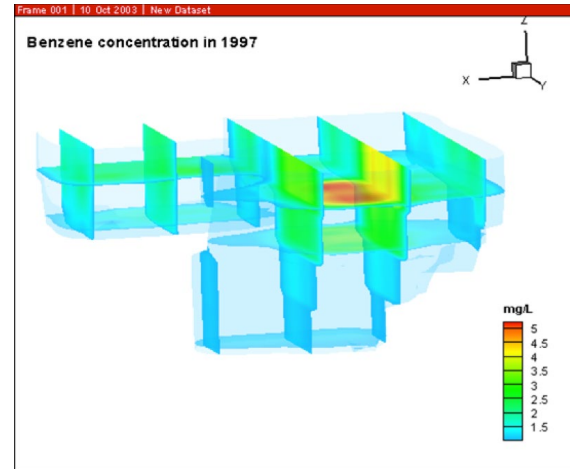
Research Interests

- Waste Management and Resource Recovery
- Spill Response and Remediation
- Contaminant Transport in Multiphase
- Advanced Physiochemical and Biological Treatment
- Environmental Risk Assessment and Management
- Environmental Sustainability



Zhi Chen
Ph.D., P.Eng.
Professor

S-EV 6169
(514) 848-2424 ext. 8775
Zhi.chen@concordia.ca



Teaching

Undergraduate

- CIVI 382 Water Supply and Wastewater Engineering
- CIVI 464 Environmental Impact Assessment
- CIVI 467 Air Pollution and Emission Control

Graduate

- CIVI 6661 Environmental Impact Assessment
- CIVI 6671 Fate and Transport of Contaminants in the Environment

Research Interests

- Modelling of Pollutant's Fate and Transport in the Environment
- Risk Assessment
- Air Pollution
- Environmental Application of Systems Analysis
- Information Technology Applications to EIA

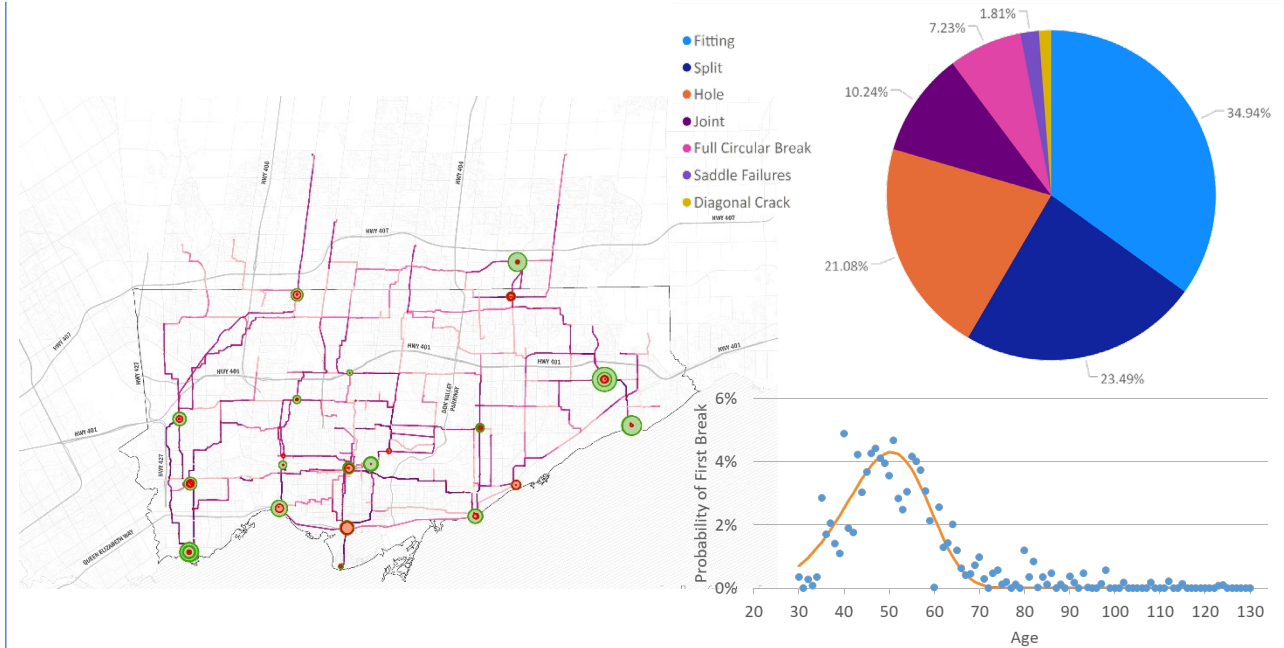


Dr. Rebecca Dziezic
Assistant Professor

Rebecca.Dziezic@Concordia.ca
(514) 848-2424 ext. 3012

Teaching

- ENGR 301 - Engineering Management Principles and Economics
- CIVI 6711 - Asset Management for Sustainable Civil Infrastructure
- BLDG 6571 - Project Management



Research Interests

- Predicting infrastructure failure
- Optimization of water systems
- Resilience of interdependent urban systems
- Lifecycle asset management
- Sustainable policies for asset management planning
- Decision support tools for circular economies



Prof. Dr. habil. Ursula Eicker
Canada Excellence Research Chair
Next-Generation Cities
ursula.eicker@concordia.ca



Next-Generation Cities

Teaching

Urban energy systems and sustainable district design and operation (ENCS 691)

“Next-Gen City concepts should not only allow the optimization of the design and functioning of a city, but focus on the quality of life of its inhabitant’s and the types of relationships they maintain with one another. “

Research Interests

- next-generation smart and sustainable cities
- zero-carbon neighborhoods
- urban data analytics, urban modeling and digital twins
- innovative and sustainable energy systems
- multi scale urban energy management
- game changing real-world projects
- university-city collaboration

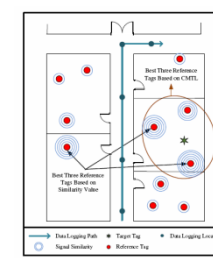
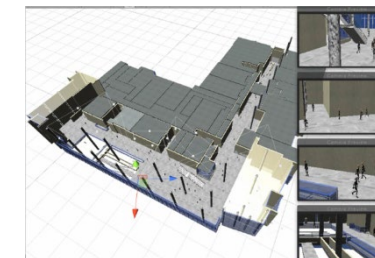
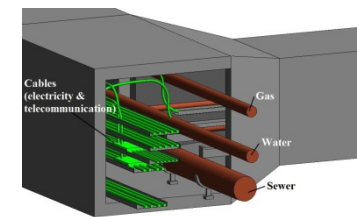
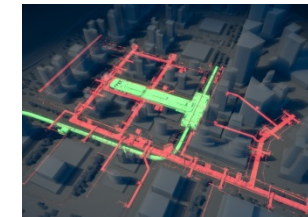
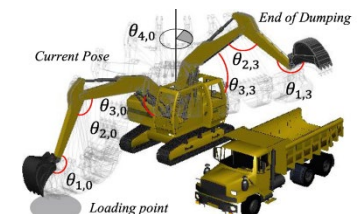
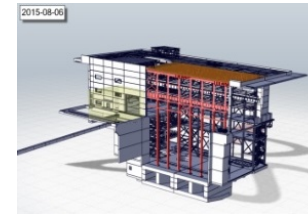


Amin Hammad
Professor
amin.hammad@concordia.ca

- **Automation in construction**
 - Modeling, simulation and visualization
 - Robotic construction
 - Cyber-physical construction systems

- **Smart infrastructure systems**
 - Smart multi-purpose utility tunnels
 - Infrastructure monitoring and management

- **Smart buildings**
 - Optimizing energy consumption in shared spaces considering occupants' locations and preferences
 - IoT applications for enhanced building safety and security
 - Recourse tracking for asset management

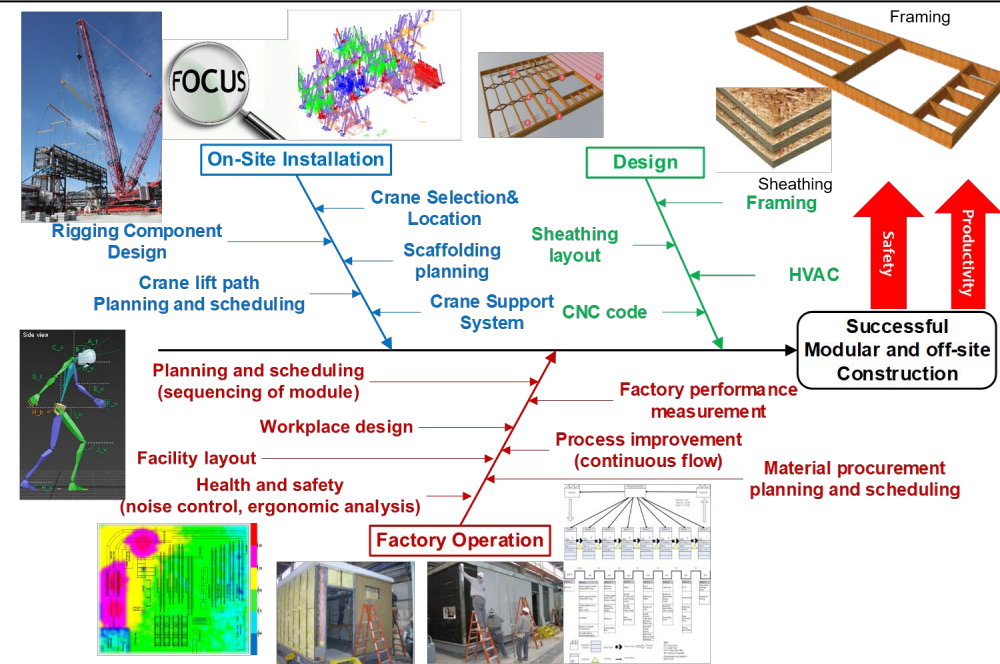




Sang Hyeok Han
Assistant Professor,
Department of Building,
Civil and Environmental
Engineering

Contact Information

Email: sanghyeok.han@concordia.ca



Teaching

Graduate

- BLDG 6571 Project Management
- BLDG 7871 Construction Equipment Management
- BLDG 691K Modular and Off-site Construction

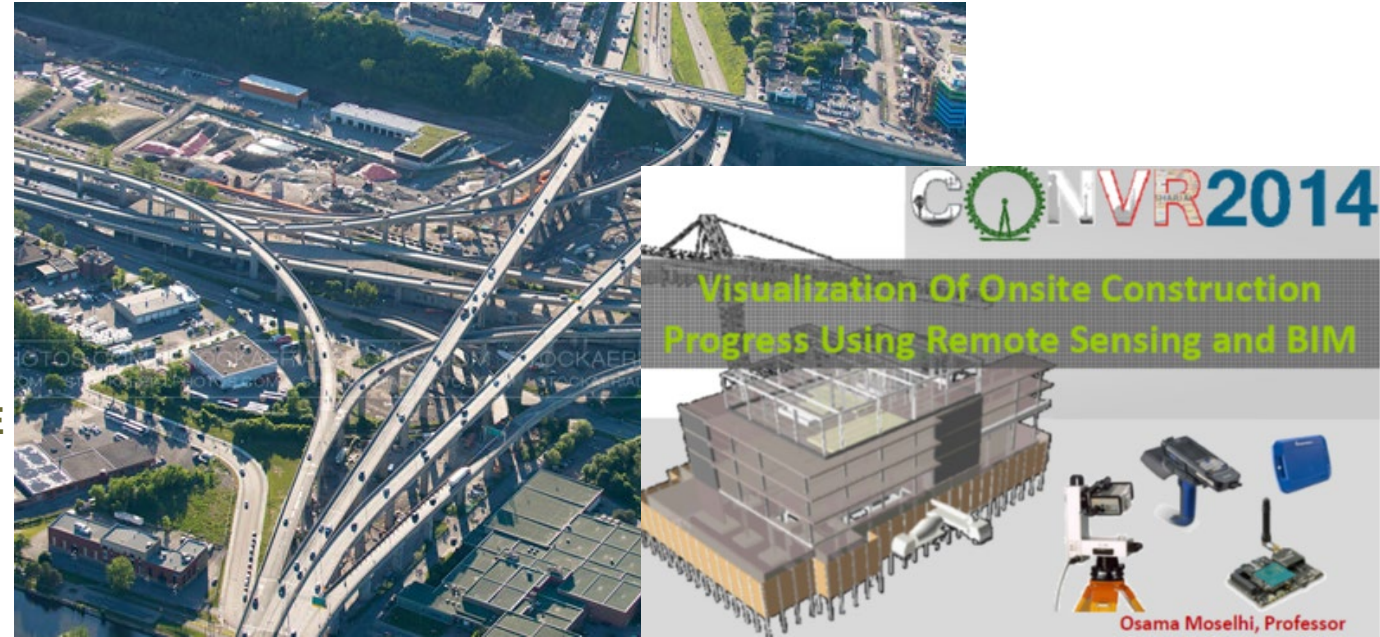
Research Interests

- Optimization for construction equipment operation, facility layout, and planning and scheduling in construction manufacturing process.
- Automated design processes for modularization and Parameterized modular design
- Process-oriented performance analysis
- Minimization of material wastes
- Physical-driven design for construction methods and workplaces



Osama Moselhi, Ph.D., P.Eng.,
F.ASCE., FCSCE, F.AACE, F.CAE
Professor

moselhi@encs.concordia.ca



Teaching

Graduate

- BLDG 7811 Project Acquisition and Control

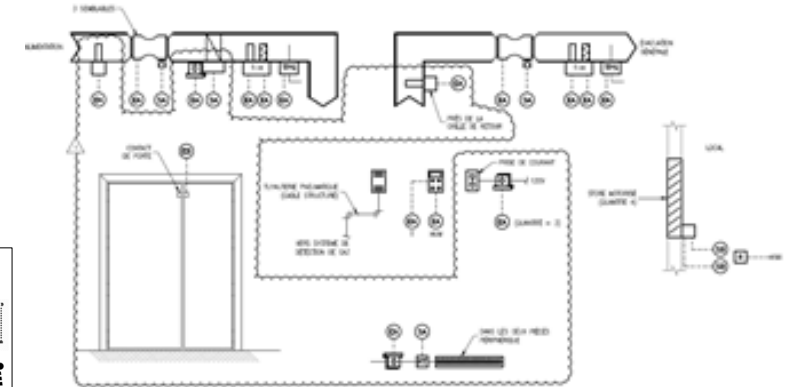
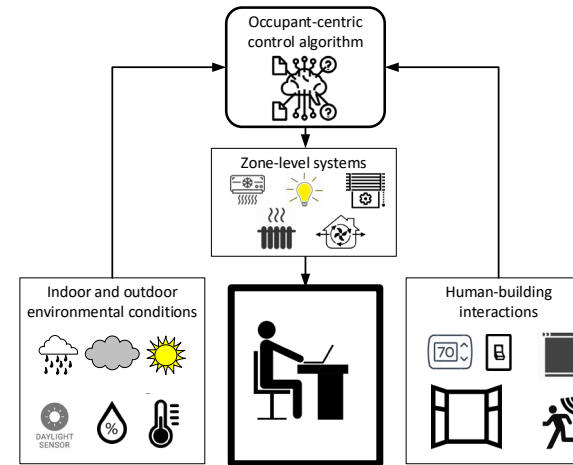
Research Interests

- Automation in construction
- Management methods for sustainable and resilient civil infrastructure
- Risk management
- Procurement & project delivery methods
- Digitized delivery of constructed facilities



Mohamed Ouf
Ph.D., P.Eng.
Assistant Professor

S-EV 6251
(514) 848-2424 ext. 7046



Schematic of Living Lab

Teaching

- BLDG 371: Building Service Systems
- BCEE 478: Project Management for Construction
- BLDG 6851: Project Cost Estimating
- ENGR 251: Thermodynamics

Research Interests

- Smart occupant-centric building controls
- Optimization of building operations
- Urban-scale energy modelling
- Building performance simulation
- Occupant behaviour modelling
- Indoor environmental quality

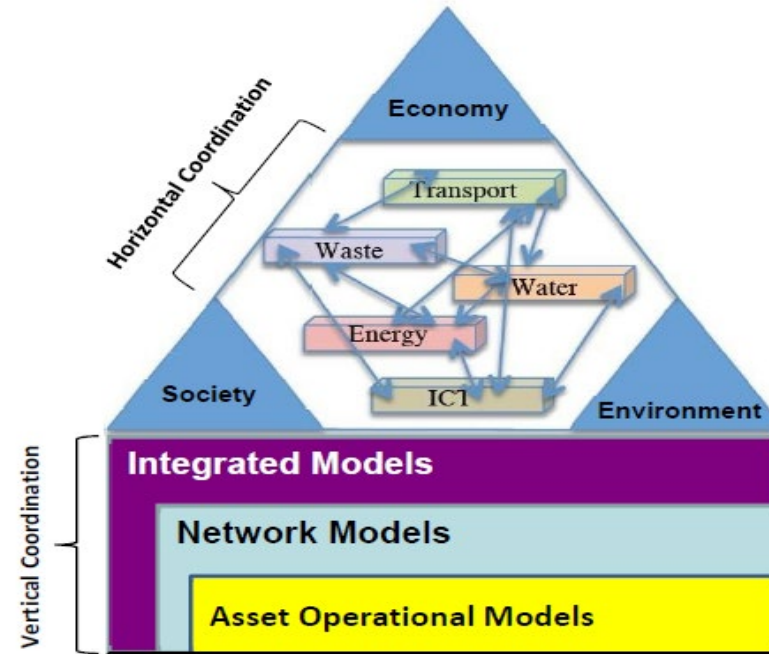


Dr. Fuzhan Nasiri
Associate Professor

fuzhan.nasiri@concordia.ca

Teaching

- ENGR 301 - Engineering Management Principles & Economics
- BLDG 6631 & 481 - Fundamentals of Facility Management
- CIVI 6721 - Infrastructure Systems Modeling & Simulation
- BLDG 6231 - Applications of Artificial Intelligence in Building and Civil Engineering



Research Interests

- Facilities Management
- Environmental Engineering
- Energy Systems Engineering
- Risk, Resilience & Reliability Analysis
- Critical Infrastructure Management
- Smart & Sustainable Cities & Communities
- Life Cycle Analysis



A.M. Soliman,
PhD, P.Eng
Associate Professor

Room: EV 6.124

ahmed.soliman@concordia.ca

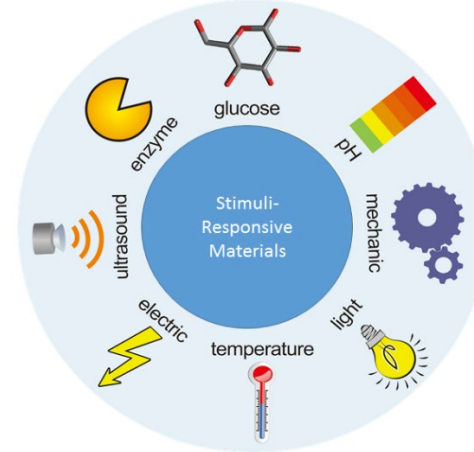
Teaching Undergraduate

- CIVI 321 **Engineering Materials**
- BCEE 342 **Structure Analysis**
- ENGR 244 **Mechanics of Material**

Graduate

- BLDG 6931 **Infrastructure Rehabilitation**
- BLDG 6621 **Modern Building Materials**

Smart Building Technologies & Infrastructure

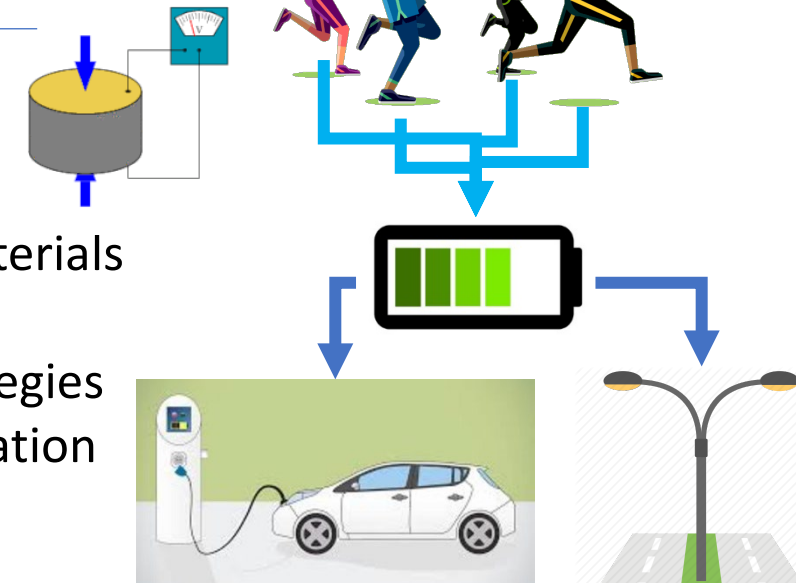


Construction Building Materials (CBM)

Smart Responsive Materials

Research Interests

- Green Construction Materials
- Responsive composite
- Negative Emission Strategies
- Infrastructure Rehabilitation
- Valorizing waste





GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

Department of Building, Civil and
Environmental Engineering



CONCORDIA.CA

