International Conference on Sustainable Infrastructure (ICSI 2021)

Technical Track Abstracts

Tuesday, December 7, 2021

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Track 1: Healthy Communities and Their Role in Sustainable Infrastructure

Moderated by Theresa Harrison

The Joint Call to Action for Healthy Communities...Its Role in Planning, Designing, and Constructing Sustainable Communities: Panel Discussion for the International Conference on Sustainable Infrastructure (ICSI) 2021

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Keywords: Healthy Communities, Multi-disciplinary Teams for sustainable design

ABSTRACT

ASCE joined the American Public Health Association's Joint call to Action for Healthy Communities (APHA JCTA) in 2018. The APHA JCTA coalition is comprised of eight professional associations, working together to promote multidisciplinary cooperation to plan, design, construct, and implement facilities and programs which enable healthy, sustainable, and thriving communities. The eight signatory organizations of the coalition are (in alphabetical order): American Institute of Architects (AIA), American Planning Association (APA), American Public Health Association (APHA), American Society of Civil Engineers (ASCE), American Society of Landscape Architects (ASLA), National Recreation and Park Association (NRPA), US Green Building Council (USGBC), and the Urban Land Institute (ULI).

The United Nations Sustainable Development Goals (Figure 1) address 17 inextricably linked goals such as health, education, equity, social justice, and collaboration, many of which are paralleled by the APHA JCTA:

"Where we live, work, and play has a major role in shaping our health. Rates of chronic diseases attributable to the design of the built environment–including obesity, diabetes, heart disease, and asthma–are on the rise. The built environment also has direct and indirect impacts on mental health, including depression and anxiety. This is true for everyone, but is felt even more among vulnerable populations, who are less likely to have access to nutritious, affordable food and opportunities for physical activity and are more likely to be exposed to environmental pollutants and circumstances that increase stress.

Addressing growing health challenges and inequities requires new partnerships and collaboration between built environment and public health practitioners, and a health-focused approach to landscapes, buildings, and infrastructure. As signatory organizations to this Joint Call to Action, we encourage our combined 450,000 individual members to embrace collaboration across professions to promote healthier, more equitable communities. When professionals in the fields of the built environment and public health work together, we multiply our potential to improve health."

Figure 1. The 17 UN Sustainable Development Goals

The panel discussion will begin with an overview of ASCE's involvement in the APHA JCTA Coalition. The panelists will be members of the coalition discussing how cross-cutting, multi-disciplinary teams are needed to solve issues in our communities and also illustrating the inextricable connection between healthy communities and sustainability. It is the goal of this discussion to demonstrate how the civil engineering profession is a key player and stakeholder in planning, designing, constructing, operating, and maintaining sustainable infrastructure that will foster and support healthy communities.

References:

The United Nations Sustainable Development Goals. <https://sdgs.un.org/goals>
The American Public Health Association. Healthy Community Design <https://apha.org/topics-and-issues/environmental-health/healthy-community-design>

Track 2: Resilience (Part 1)

Moderated by Liv Haselbach

Integrated Framework for Design and Management of Sustainable and Resilient Infrastructure in a Changing Climate

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Keywords: Adaptation, Infrastructure, Life Cycle Assessment, Mitigation, Resilience, Sustainability

ABSTRACT

In a changing climate, there are a number of growing pressures on Canada's infrastructure such as increasing climatic loads and extreme weather events, aging/deterioration, increasing demand/population growth, greenhouse gas (GHG) reduction/carbon tax, demographic shifts, new technologies (e.g. driverless cars), and limited funding (Bush and Lemmen 2019). The design of current infrastructure and buildings mostly focused on life safety and was driven by low initial cost. There is a lack of integration of mitigation and adaptation actions to address effectively the challenges posed by climate change (Lounis and McAllister 2016). Also, there is a lack of integration of resilience and sustainability performance indicators in the design and management of infrastructure (Bocchini et al. 2014). There is a need for a transition from the standalone concepts of climate change mitigation and adaptation to a concept of integrated mitigation and adaptation in the construction sector. Also, there is a need to bridge the gap between the key performance metrics of resilience and sustainability of infrastructure to enable the move toward sustainable and resilient infrastructure and communities.

The decisions that are made in the design of new infrastructure and management of existing infrastructure are likely to contribute towards or detract from the long-term goals of sustainable and resilient infrastructure. There is a strong correlation between inadequate mitigation and the increasing demand for adaptation activities. Focusing on climate adaptation as a reactive approach, instead of focusing on climate change mitigation as a proactive approach, will lead to increased need for further adaptation in the future as illustrated in Figure 1. Environmental protection, economic effectiveness, and social development, as three pillars of sustainability, are referred to also as Triple Bottom Line (TBL), which should be accounted for in the sustainable design and management of infrastructure.

The adaptive capacity as the commonality of mitigation and adaptation is essential for meeting the goals of long-term sustainability. Figure 1 shows a possible approach presented in the current study to develop a comprehensive framework to consider the interactions between climate change mitigation and climate change adaptation as well as between sustainability and resilience of infrastructure.

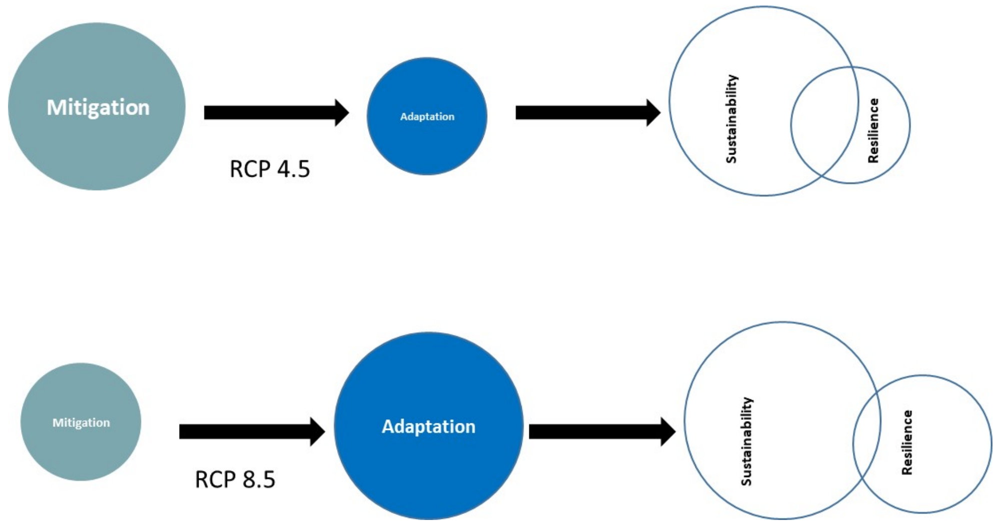

Figure 1. Overview of interactions between mitigation, adaptation, sustainability, and resilience

The integration of sustainability and resilience under a comprehensive framework structure could help to interpret the interactions between the climate change mitigation and adaptation approaches and the final comprehensive framework will support the decision makers to achieve more sustainable and resilient infrastructure. Ensuring both broadness (sustainability, resilience, and climate change impacts) and ease-of-use are the main attributes of the proposed framework to achieve an optimal decision support tool for sustainable and resilient infrastructure. The approach of system thinking has been considered in the proposed framework to address this gap. The proposed integrated framework requires: (i) collection of necessary data; (ii) computation of quantitative performance metrics for sustainability and resilience; (iii) taking into account the impacts of climate change; and (iv) consideration of the significant uncertainty associated with climate change, sustainability and resilience metrics. Applying the life cycle thinking (LCT) methods, such as life cycle performance assessment (LCP), life cycle assessment (LCA), life cycle cost analysis (LCCA), and social life cycle assessment (SLCA) can enable the selection of sustainable and resilient designs of new infrastructure as well as the selection of effective management options for existing infrastructure in a changing climate (Fauré et al. 2017).

In order to cover the mentioned aspects and consider the current needs, Figure 2 shows a simplified schematic representation of the proposed integrated framework for sustainable and resilient infrastructure that takes into account both climate change mitigation and climate change adaptation.

As can been seen, we will basically apply a climate scenario-based assessment to evaluate different possible levels of sustainability and resilience of new and existing infrastructure. It should be stated that improving the performance of new infrastructure can be relatively easy to achieve compared to the improvement of the performance of an existing infrastructure. The focus of the current framework is the relationship between three main blocks, namely: (i) Infrastructure sustainability; (ii) Climate scenarios or representative concentration pathways (RCPs) that predict the GHGs concentration trajectory under various socio-economic scenarios (van Vuuren et al. 2011) and (iii) Infrastructure resilience. Additional sustainable community

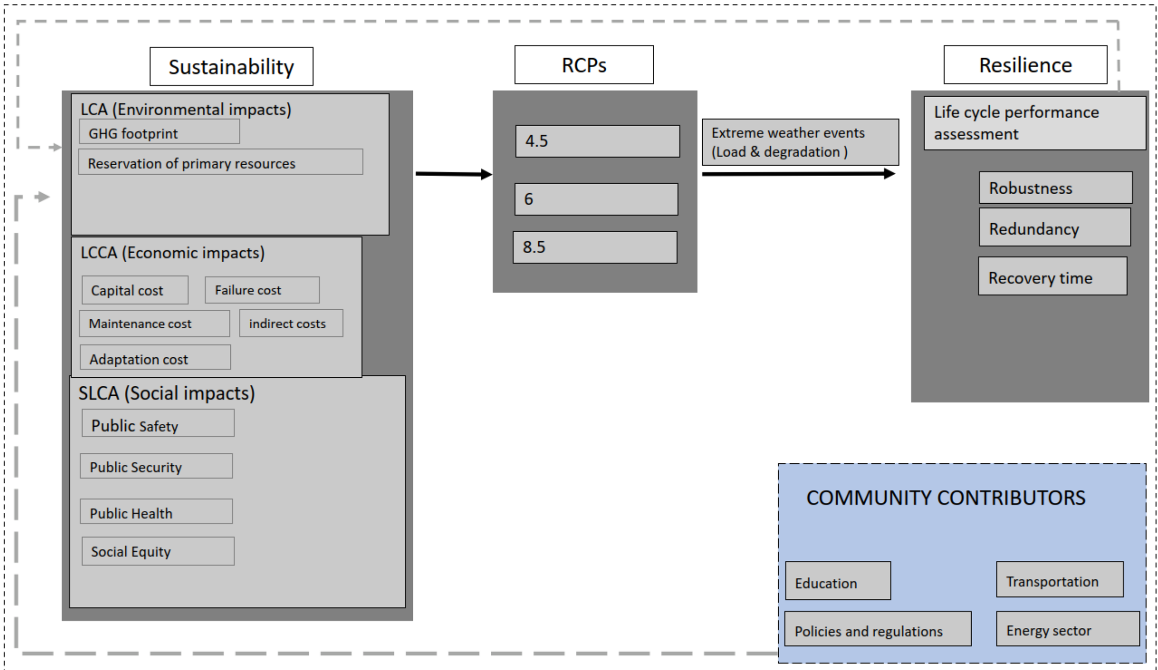

Figure 2. Simplified schematic of proposed scenario-based integrated framework for sustainability and resilience of infrastructure

indicators, such as policy and regulations, sustainable transportation, sustainable energy, education, etc. could be considered in the future.

This is the broader goal of the current integrated framework: to develop a decision support platform that will help achieve a sustainable community which consists of sustainable and resilient infrastructure, including sustainable and resilient bridges, roads, transit, potable water, stormwater and wastewater systems, and buildings, including critical facilities. The implementation of the proposed integrated framework will constitute a considerable piece of the puzzle of sustainable Canadian communities.

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Exploitative and Explorative Learning in Support of Infrastructure Resilience

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ABSTRACT

Infrastructure systems—a combination of physical, institutional, and educational components that help maintain a functioning society through their services—are operating in different conditions than which they were optimized for, but they are being designed and managed with the same rules, norms, and goals that have persisted for the past century. As infrastructure managers imagine opportunities to increase resilience competencies in physical infrastructure design, they must also examine the resilience capacities of their institutions, which relies on the institution's ability to navigate between stability and instability. We reviewed leadership and organizational change literature—with particular focus on Complex Leadership Theory, organizational structure, and ambidexterity—to learn from the field of business management, which often operates in a volatile and aggressive environment. Preliminary results indicate that institutions should 1) be able to navigate smoothly between operational tasks and innovative endeavors and 2) empower decision-makers across the organizational structure, from executives to operators. A flexible organizational structure should innately enable emerging (and similar styles of) leadership and interdisciplinarity (e.g., social-ecological-technological systems) within infrastructure systems because they share the same objective: to respond to complex and uncertain scenarios.

Resilience Dividends and Resilience Windfalls: Narratives that Tie Disaster Resilience Co-Benefits to Long-Term Sustainability

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ABSTRACT

The need for increased disaster resilience planning, especially at the community level, is clear, as is the need to address sustainability; these dual objectives have been deemed a US National Priority (e.g., Exec. Order No. 14008, p. 7619, 2021). The three major global climate agreements, the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015), the Paris Climate Agreement (UN, 2016), and the Sustainable Development Goals (UN, 2015), all emphasize the need to integrate disaster resilience and climate risks with continued sustainable development concerns. Thus, the ways we assess synergies and trade-offs across planning for disaster resilience and sustainability in investment projects that impact communities need to be reconsidered and new ways to express relative categories of co-benefits need to be developed. In recent years, categorizing some co-benefits as contributing to the resilience dividend has helped communication across fields and created bridges from research to practical on-the-ground planning. In parallel, growing focus on the need to recognize the role of narratives in driving decisions about how and where to invest (Shiller, 2017) elucidates the inherent value of archetypes that resonate across stakeholders and disciplines to describe investments that may meet multiple objectives. We introduce the concept of a resilience windfall, as an unexpected or sudden gain or advantage of resilience planning. The potential of resilience windfalls should be conceptualized alongside resilience dividends in community-level resilience planning and evaluation. We recount five narrative vignettes that demonstrate disaster resilience interventions and associated resilience dividends and windfalls. Through this exercise we highlight the utility of categorizing net co-benefits in a manner that evokes understanding from relevant communities. Additionally, this process highlights the need to readily consider the possibilities of resilience dividends and resilience windfalls during the planning, execution, and evaluation phases of disaster resilience projects.

Balancing Trade-Offs Between Efficiency and Resilience in Pursuit of Sustainable and Adaptable Infrastructure Systems

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Keywords: Efficiency, Infrastructure, Resilience, Sustainability, Systems, Variability

ABSTRACT

Infrastructure systems are often faced with a critical tension between efficiency and resilience objectives. Efficiency relates to the optimal use of resources via efforts to minimize wasted time and resources. Conversely, resilience relates to avoiding, mitigating, and managing disruptive changes – often via features that are antithetical to efficiency such as increased redundancy and system diversity. Due to its applicability to "stable" conditions, the operation of many infrastructure systems tends to lean toward efficiency. However, under conditions of rapid change and widespread uncertainty (e.g., a global pandemic, climate change), continued emphasis and reliance on efficiency principles may be misguided. Instead, infrastructure systems would likely benefit from some level of "inefficiency" in the form of additional "slack" and redundancy in the system.

This project seeks to understand the efficiency-resilience tradeoff in the context of infrastructure resilience and sustainability objectives. Through literature review, synthesis, and conceptual framing, two primary questions are explored: 1) What is the state of knowledge regarding the tradeoff between efficiency and resilience in complex urban/infrastructure systems? 2) How does the efficiency-resilience tradeoff hinder (or enhance) broader sustainability/resilience goals? Insights and perspectives from engineering, ecology, and social sciences are examined. Ultimately, this work can help identify whether emphasizing efficiency over resilience (or vice versa) creates barriers to sustainable and resilient infrastructure transformations. It can also set the stage for research and practice aimed at quantifying and reducing these barriers.

Are Resilience, Climate Change Adaptation, and Sustainability Planning Approaches Compatible? Results of a Comprehensive Assessment Across Community-Focused Guidance Literature

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Keywords: Climate Adaptation, Community Planning, Hazard Mitigation, Planning Guidance, Resilience, Sustainability

ABSTRACT

Communities in the United States have the primary responsibility for establishing plans and priorities for a range of objectives, including natural hazard preparedness, adapting to climate change, economic development, and environmental sustainability. Planning processes in resilience, climate-change adaptation, and sustainability are also informed by a variety of planning guidance documents that present differing methodological approaches and information requirements. While it is possible that these approaches may be complementary in many ways, they may also have important differences that need to be understood to advance potential integration of the topics in practice. We conducted a content analysis of community-scale resilience, adaptation, and sustainability guidance products to assess compatibility between their methodological approaches, data requirements, and outputs. By describing the ways in which these interdisciplinary approaches propose materially similar or distinct planning processes, we hope to contribute to efforts to inform and enhance community resilience, adaptation, and sustainability planning.

Track 3: Climate and Society

Moderated by April Lander

Effects of Climate Migration on Town-to-City Transitions in the United States: Proactive Investments in Civil Infrastructure for Resilience and Sustainability

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Keywords: Climate Change, Infrastructure, Migration, Resilience, United States

ABSTRACT

Climate change is a risk amplifier for natural hazards (e.g. floods, droughts, wildfires) and contributes to changing precipitation and temperature patterns that alter an area's risk profile (Xu et al., 2020; Wilbanks and Fernandez, 2014). Existing infrastructure is not designed to handle climate change impacts and is often ill-equipped to absorb shocks associated with increased frequency and severity of these events (Zscheischler et al., 2020; Miller et al., 2018). As climate change progresses, climate change-induced migration is becoming more frequent and more likely, both within and across countries. People relocating to areas with actual or perceived lower risk is expected to add demand for built infrastructure systems and change governance needs as receiving communities grow. Anticipating demand growth can enable proactive rather than reactive investment. To date, although resilient infrastructure is necessary to overcome future climatic extremes and population growth, active measures to implement holistic resilience plans are rare and often limited in scope. Figure 1 presents a framework for considering both these dimensions for adaptive infrastructural investment under climate change—timing relative to disaster events, and location relative to populations. Here we analyze the impact of anticipated climate migration patterns on community growth in the United States (US), leveraging the US Environmental Protection Agency's (EPA) Integrated Climate and Land-Use Scenarios (ICLUS) dataset (https://www.epa.gov/gcx/iclus-downloads#tab-2) to infer possible US climate migration patterns with the goal of identifying opportunities for proactive infrastructural planning. This work expands migration estimates from ICLUS to specifically evaluate "tipping points" where climate migration is likely to contribute to infrastructurally relevant growth: specifically, when towns become cities. Projected 2020-2100 town-to-city rapid urbanization patterns are different from historical (1950-2010) patterns in the US, notably shifting from the Southwest (including California) to the Southern Plains (including Texas) (Figure 2). Climate change is expected to further shift this pattern northwards, contributing to land use change and new demand for civil infrastructure. Proactive investment in civil infrastructure in regions expected to attract climate migration can facilitate resilience and sustainability under climate change, emphasizing safe, sufficient, and equitable infrastructure.

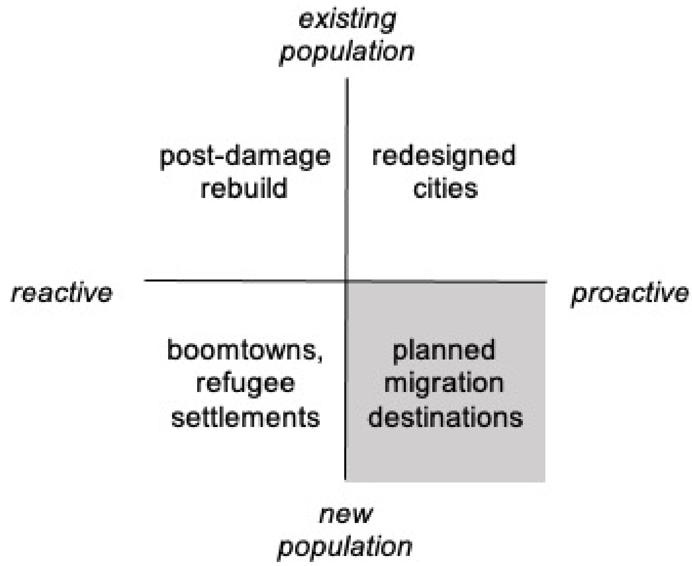

Figure 1. Matrix of infrastructural investment patterns for climate adaptation

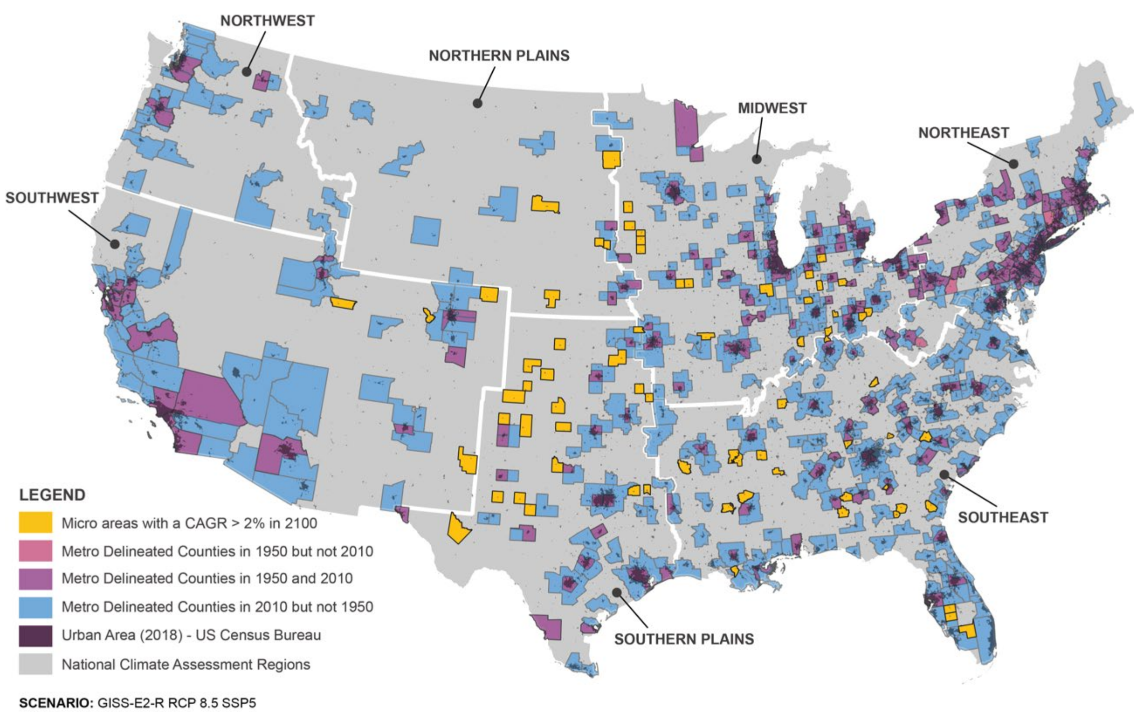

Figure 2. Micro areas with projected 2010-2100 Compound Annual Growth Rate (CAGR) over 2% for the scenario GISS-E2-R – RCP 8.5 – SSP5, where GISS-E2-R is the climate model; RCP: Representation Concentration Pathway and SSP: Shared Socioeconomic Pathway.

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Empowering Communities through Climate Change Engagement and Capacity Building

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Keywords: Adaptation, Capacity Building, Climate Change, Community Engagement, Stakeholder Engagement

ABSTRACT

As the climate changes, communities are faced with a new reality of what it means to be resilient. Extreme events, storms, and flooding are increasing, forcing communities to address climate change impacts by building resilience, often without a clear understanding of what that means. By investing upfront in climate-change education, communities are empowered to play a more informed decision-making role in project planning and development, leading to stronger project outcomes and ultimately more resilient communities.

We share two community engagement and capacity building case studies from across America:

- In the San Francisco Bay Dumbarton Bridge project, a community-based organization developed a 3-week 'parent academy' through which the local community learnt about climate change and its projected impacts on their livelihoods. Through this process the community members were able to teach the project planners, scientists, and engineers about local components that would make for a more robust project design, and were empowered to make more informed decisions about their own long-term resiliency to climate change and teach each other what it means to live resiliently.
- Recognizing that children were heavily impacted by the 2017 hurricanes in Puerto Rico, and that many adults were occupied with meeting families' basic needs following the storms, an innovative outreach strategy engaged 360 schoolchildren in six school districts throughout the island. The students participated in educational modules on resilience and community-based participatory research through photography. Numerous student-proposed recovery actions are reflected in the $20 billion USD CDBG-DR action plan that is guiding the Island's Resilient Recovery.

Monitoring the Stability of a Moraine Dam by Differential Interferometry (DInSAR) to Prevent GLOFs Disasters from Arhuaycocha Lake

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Keywords: Arhuaycocha Lake, Cordillera Blanca, Dinsar, Glacial Lakes, GLOF, Hazard, Moraine-Dammed Lakes

ABSTRACT

The Cordillera Blanca in Peru is the most heavily glaciated tropical mountain range in the world (Emmer et al., 2020), where 800–850 km^2 total glacial area in 1930 decreased to 600 km^2 at the end of the 20th century (Kaser, 1999). The decline has resulted in the formation of moraine-dammed lakes from flow stagnation and recession of glacier tongues (Harrison et al., 2018) affecting 230 glacial lakes in the region, of which 119 were moraine-dammed (Emmer & Vilímek, 2013). The fast growth and formation of lakes caused a dramatic increase in glacial lake outburst flood (GLOF) occurrence from 1930 to 1970. A previous decline (Emmer, 2017) is associated with the Little Ice Age, while GLOF incidence throughout the 21st century as lakes and glaciation respond more dynamically is associated with anthropogenic climate warming (Anacona et al., 2015). Although the GLOF frequency has not fluctuated directly in response to global climate, it will increase as the global climate continues to warm, with hazardous impacts for downstream regions (Harrison et al., 2018). Most of the recorded GLOFs from moraine-dammed lakes in the Cordillera Blanca were caused by slope movements into lakes in which the displaced material was dominated by icefalls, snow avalanches, and rockfall (Emmer & Cochachin, 2013) producing displacement waves, which may overtop, deforming or displacing a lake's moraine dam (Jawaid, 2017). It is also clear that intense rainfall, the extreme variability of air temperature, or snowmelt will lead to a rise in the water level of the lake (Yamada & Sharma, 1993). This causes a deformation that can be identified through interstitial pressure measurements (Corsetti et al., 2018).

DInSAR techniques have been developed to measure the temporal behavior of the displacements or deformation (Toural Dapoza et al., 2019). With ascending and descending DInSAR measurements it is possible to calculate 3D deformation of glaciers at one instance of time (Samsonov, 2019). It is necessary to have two independent acquisition modes from the ascending and descending line of sight (LOS) motions and solve the geometry relationship (incidence angle and satellite tracking heading angle) which are inverted to retrieve the horizontal and vertical components of the displacement. This developed methodology is detailed in Fig. 1 and we call it multi-geometry data LOS fusion.

The multi-geometry data fusion LOS methodology shows that the moraine dam of Arhuaycocha lake suffered subsidence of 17 cm (Fig. 2). The average subsidence zone was concentrated around the drainage channel (Fig. 2), and the zone of greatest subsidence was recorded at the lateral base. The dam shows higher displacement in the greatest rainfall seasons (Fig. 3). We concluded that subsidence in the moraine dam tracked with continued precipitation in wet months, and the loss of storage in dry summer months triggered rebound.

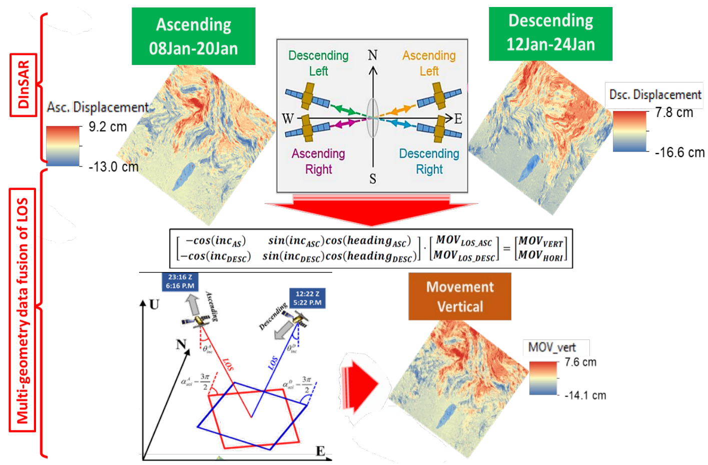

Figure 1. Methodology for multi-geometry fusion of LOS

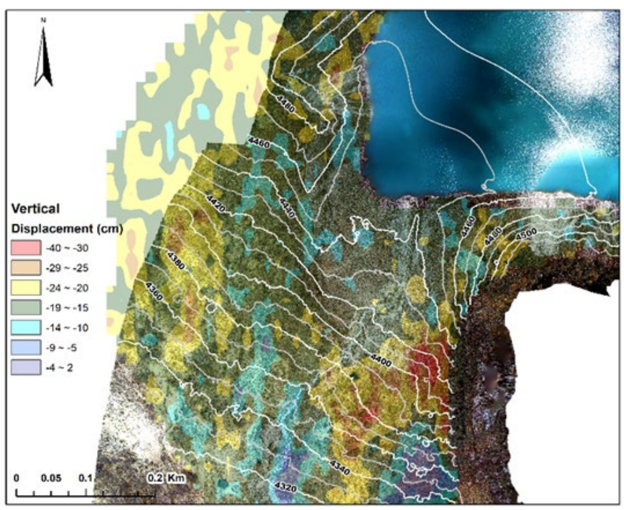

Figure 2. Accumulated vertical displacement for moraine dam Arhuaycocha

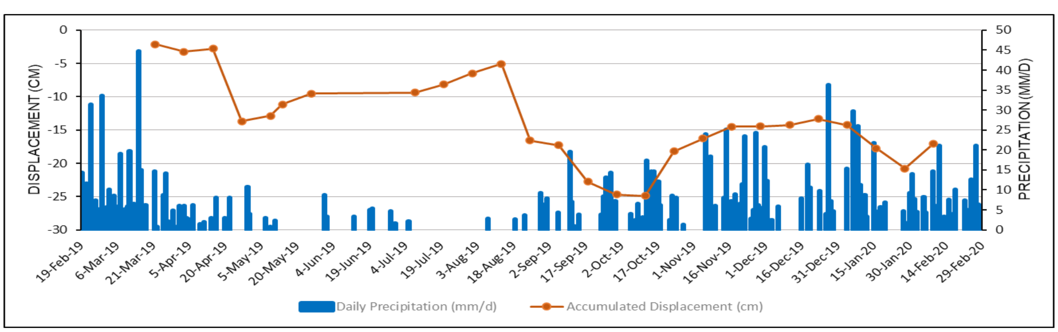

Figure 3. Daily precipitation and accumulated displacement of the moraine dam Arhuaycocha

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Track 4: Flooding and Water Infrastructure

Moderated by Michael Bloom

Houston's Coordinated Approach to Sanitary Sewer Overflow Prevention

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Keywords: Community Outreach, Predictive Modeling, Preventative Maintenance, Sewer Overflows, Wastewater Infrastructure

ABSTRACT

Houston's wastewater collection system has evolved since its founding in 1836. Since its humble beginnings in 1837, Houston's wastewater system has grown exponentially to its current approximately 6,200 miles of sanitary lines, over 381 lift stations, and 39 treatment plants. Today this system serves Houston's 2+ million population, a number which continues to grow, ensuring that wastewater from these homes and businesses is effectively collected, conveyed, and treated to meet water quality standards prior to discharge to the bayous. In addition to rapid and often ad-hoc growth, Houston also claims many unique qualities such as one of the most diverse communities in the nation, a vibrant international restaurant scene, no formal zoning regulations, a relatively flat terrain, and aging infrastructure. These qualities combine to impact Houston's wastewater system, a system currently facing challenges such as sanitary sewer overflows (SSOs). Efforts to address these challenges began with the Greater Houston Wastewater Program. Completed in 1997 this program focused on capacity related to upgrades and improvements for the collection, conveyance and treatment system. In 2005 the Agreed Order with TCEQ accomplished the renewal and rehabilitation and cleaning of millions of feet of pipe and improved the City's management information system for SSO reporting and tracking. This Order ended in 2015 and resulted in the successful completion of the Supplemental Environmental Project and passage of the City's FOG ordinance for fats, oils, and grease.

Most recently, the City of Houston agreed to a Consent Decree (CD) with the Environmental Protection Agency. Effective April 1, 20201 the Decree commits the City to improving its wastewater infrastructure. Programs outlined in the CD include inspection of sewer mains, associated manholes, lift stations and force mains; cleaning of sewer mains to meet Consent Decree goals; and renewal, rehab, replacement or consolidation of lift stations, wastewater treatment plants, force mains and gravity sewer mains. The CD formalizes Houston's forward-thinking plan to improve its wastewater infrastructure and maintenance program, and upgrade assets and facilities to serve its residents while creating a more resilient system. In Houston, approximately 70% of SSOs are caused by clogged pipes from fats, oils and grease poured down residential sinks and wipes flushed down toilets. Through coordination efforts between data collection and analysis, infrastructure maintenance, community outreach, enforcement, and compliance HPW aims to reduce the frequency and volume of these SSOs.

To ensure that SSO prevention efforts are focusing on the appropriate solutions, locations, and problems, HPW conducts rigorous SSO data collection and analysis. When an SSO is reported to Houston's 311 Call Center, a Service Request is created and responded to by Wastewater Inspectors. These inspectors confirm the SSO and input field data into the Infor database. From there the City's Stoppage Crew responds, stopping the SSO and enters additional field data. The Regulatory Compliance Team then conducts QA/QC on this data for reporting, ensuring assets are completely and accurately represented in the City's GIS data clearinghouse. Data is further analyzed for patterns and trends using tools such as Power BI and ArcGIS. Mapping resources are continually improved and streamlined through collaborative partnerships between the field operations team and the IT/GIS team. HPW uses this data to inform its Preventative Maintenance (PM) Program for effective resource allocation. This program was established to lessen the likelihood of failure and to reduce preventable SSOs. It provides the City with an asset management framework to operate and maintain the collection system at an optimum level by identifying the locations, analyzing causes, frequencies, durations, and order of magnitude of SSOs. It assigns sewer lines routine cleaning cycles of 3, 6, 9, 12, and 18 months based on the amount of grease and debris identified on the pre-cleaning CCTV inspection data. The PM Program has evolved by taking advantage of available technology to quickly process large amounts of CCTV inspection data through a customized decision tree and GIS platforms that assign the appropriate cleaning cycle. While routine cleaning goes a long way towards reducing preventable SSOs, it is worth noting that reducing the amount of fat, oil and grease that enters the sanitary system can also reduce the amount of routine cleaning required. To reduce the "source" the City of Houston's GIS system also houses information on grease trap locations, inspection data, and data on the location of high-density housing. This information is analyzed for proximity to sewer lines in the Preventative Maintenance Program to create "Hot Spots" for the City to conduct targeted FOG outreach and enforcement. This allows HPW and the Houston Health Department (HHD) to focus outreach efforts where they are needed.

HHD's FOG Program protects the citizens and the environment from potential hazards that may result from unauthorized waste releases such as SSOs. The FOG Program tracks city regulated waste from cradle: where the waste is being generated and transported, to grave: where the waste is disposed of at a permitted disposal site. At the generation site, the FOG program ensures the waste manifest is obtained and properly filled out by the generator. The FOG program also permits and inspects FOG transporters. The transporter must be permitted by HHD and the vehicle must pass inspection prior operating in the City of Houston. Finally, the FOG Program inspects and audits the disposal site to ensure proper disposal. Each of these: The Generator, Transporter and Disposal Site fill out the waste manifest and submit it to the HHD. Additionally, the FOG Program educates and enforces Chapter 47 Article XI, Chapter 47 Article XII, Section 47-741 and Chapter 10 Section 10-451 of the City of Houston Code of Ordinances. There are approximately 16,000 special waste generators in the current data base system. Investigators are responsible for inspecting all special waste generators as often as needed but not less than once every 3 years. Special Waste Generators have interceptors designed to use differences in specific gravities to separate and retain FOG and settleable solids prior to the wastewater entering the sanitary sewer system. For example, grease trap interceptors are primarily installed in food establishments. The Health Department receives complaints daily from HPW, City Council, Mayors office, other departments, and the public. The FOG Program investigates complaints within 48 hrs. During the investigation Environmental Investigators gather all pertinent information and documentation, educate on better management practices, and collect samples as needed. Public outreach is provided to multi-family residents with repeat sanitary sewer overflows. To ensure compliance the FOG Program issues enforcement that can result in fines up to $2,000 per day. The FOG Program also coordinates joint investigations with groups such as Code Enforcement, Neighborhood Protection, BARC, HPD-Hazmat team and other city departments to obtain assistance on one issue or address several issues at once. Depending on the severity of the case the FOG Program collaborates with HPD Major Offenders Division that may result in Water Pollution Felony Charges. HHD works closely with HPW's Stoppage and Regulatory Compliance teams to respond to SSOs and ensure data accuracy.

HPW also addresses SSOs through outreach and education. SSOs caused by clogged pipes from fats, oils and grease poured down residential sinks and wipes flushed down toilets are preventable if residents just engage in a few simple behaviors. Outreach and Education on this campaign is spearheaded by HPW's "Protect Our Pipes" campaign which asks the community to pour fats, oils and grease in the trash and only flush the 3 P's: Pee, Poo and (toilet) paper. Launched in fall 2020, "Protect Our Pipes" focuses on two primary methods of outreach: citywide brand-recognition and awareness and targeted community engagement. Citywide outreach occurs through strategies such as: social media; tv and radio ads, partnerships with local influencers, publications, and organizations; water bill inserts; and through outreach and presentations at community events and festivals. Through its campaign launch during winter 2020, the campaign achieved over 14.8 million views. HPW's Outreach Team also uses SSO data to conduct targeted outreach around recent SSOs and to identify SSO hotspots for community-specific outreach and engagement. These efforts focus on historically marginalized or underrepresented communities and includes collaborating with community partners to create local community advocates, provide school programming, deliver presentations to HOA and Civic Club meetings, and engage in additional community-driven outreach and education efforts. As Houston's population continues to grow, increased pressure is being placed on its aging infrastructure system, necessitating a further need for collaborative and innovative infrastructure management practices. In addition to collaboration on SSO prevention specifically, these programs and initiatives include partnerships with Houston's resiliency initiatives, such as the Resilient Houston Plan which focuses on building resilience at every scale, and Houston's Complete Communities initiatives which focuses on revitalizing historically underrepresented or marginalized communities. Considering the size and scope of the City of Houston, collaboration amongst so many groups requires intentionality and consistency. Regular meetings between each organization have helped to improve these partnerships, remove silos, and reduce barriers. As Houston continues to address infrastructure and resiliency challenges, this level of coordination will be more and more essential. Our hope is that these current efforts will serve as a framework and starting point for future efforts, creating a strong foundation for Houston to thrive.

Turning Existing Grey Infrastructure Green, a Real Life Cinderella Infrastructure Story

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Keywords: Dual-Purpose, Flooding, Green Infrastructure, Resilient, Sustainability, Triple Bottom Line

ABSTRACT

Today, sustainability is a buzz word in the civil engineering industry. But it can be more than that. In basic terms, sustainable or green infrastructure can be defined as infrastructure that serves its general civil engineering purpose, but is also designed to benefit the community, environment, and economy – the triple bottom line. The Conrad Sauer Basin Revitalization and Mathewson Lane Expansion project in Houston is a great example of this kind of infrastructure.

The Conrad Sauer Basin, located in west Houston, was built in 2000 as a large concrete detention pond to serve as mitigation for a subdivision to the north that was converting its drainage from a ditch system to curb and gutter.

In 2014, a public-private partnership with the City of Houston was formed to extend an adjacent road over the basin and enlarge the basin itself. The basin would also be transformed from the existing concrete surface to lush greenery with walkways throughout. Detention within the new and existing street would be increased and pervious (non-concrete) cover was added to the existing street's fully impervious area. Even the vegetation chosen for this project was designed to be sustainable and resilient, especially considering some of the fluctuating conditions within the basin.

This project provided numerous benefits to all three sectors of the triple bottom line. It truly transformed and redeveloped existing impervious property to a dual-purpose and beautiful asset for the community.

Hydraulic Modelling for Flood Risk Management of Underground Infrastructure Systems

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Keywords: Climate Change, Flood Risk, Infrastructure Resilience, Transit

ABSTRACT

Climate change and sea level rise are poised to significantly increase flood risks to underground infrastructure systems in heavily urbanized coastal cities. While infrastructure managers are cognizant of the increasing flood risks associated with climate change, the existing literature and state of practice lack methods for understanding and conveying these increased risks and the associated impacts to networked underground infrastructure. Addressing this gap, we construct a flood risk assessment framework for a regional rail rapid transit system considering the expected increased frequency and severity of flooding resulting from climate change. Relying on as-built drawings, track charts, and a set of lowest critical locations, we construct a hydraulic model of the interconnected portions of a regional rail rapid transit system and simulate the impacts of a suite of coastal flood events under several sea level rise conditions, demonstrating the propagation of flooding through the rail tunnel network. We further simulate the benefits of a set of flood protection measures, underscoring the importance of a unified and cohesive flood risk management strategy for maximizing system resilience to climate change.

Track 5: Decarbonization and Electrification

Moderated by Anthony Kane

Smart Columbus: Electrifying America's Smart City

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Keywords: Case Studies, Electric Vehicle (EV), Electric Vehicle Supply Equipment (EVSE), Marketing, Municipal Government

ABSTRACT

The three-year Smart Columbus Electrification Program, funded by a grant from the Paul G. Allen Family Foundation and many public and private contributions, was designed to accelerate the transition to a low-carbon future. The City of Columbus, Ohio, and its partners initiated an electrification program with goals of increasing renewable energy sources by almost 1 GW, increasing electric vehicle (EV) adoption by almost 500%, and deploying 925 public, workplace, fleet and residential chargers in the seven-county region. The program effectively increased the EV adoption rate from 0.42% in 2016 to 2.34% in 2019 of new passenger vehicle registrations, surpassing the overall program goal of 1.8%. Columbus has among the highest share of EV registrations of any American city with no zero-emission vehicle (ZEV) regulation or direct incentives to customers from the government.

Decarbonizing the Largest Ferry Fleet in The United States: Washington State Ferries Journey Towards Zero Emissions

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Keywords: Electrification, Emerging Technologies, Emissions Reduction, Ferries, Maritime Sustainability, Transportation

ABSTRACT

Washington State Ferries (WSF) is undertaking an ambitious initiative to electrify their system with plug-in hybrid-electric vessels and terminal enhancements to achieve reduced environmental impact and energy costs. As the largest ferry system in the U.S. – carrying nearly 25 million people each year on 10 routes – WSF is leading the way in the marine industry by outlining and acting on a plan that will allow substantial emissions reductions. As the largest single consumer of diesel fuel in the State Government, implementation of system electrification is vital for Washington State to lead by example to address climate change. The benefits of system electrification extend beyond the government, ferry system, and ferry riders by improving air quality in the Puget Sound region and contributing to the significant greenhouse gas reductions required globally to support a sustainable future.

This presentation will address the overall system electrification program with a focus on the challenges and opportunities presented by this ambitious project. We will discuss the current state of electrification in the maritime industry, the engineering of new hybrid electric vessels as well as retrofitting of existing vessels, the engineering of the supporting charging infrastructure at the terminal facilities, and the partnerships needed with utilities and others to make this project successful. Additionally, the panel will address the necessary planning, financing, and executive support that continue to be key elements in the implementation of this long-term strategy.

Why Standardize Carbon Neutrality in Delivery of Complex Projects?

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Keywords: Carbon Emissions, Carbon Neutrality, Complex Projects, Construction Industry, Standardization, Sustainability

ABSTRACT

The construction industry accounts for approximately a quarter of the global carbon emissions and is the largest consumer of materials and energy (Giesekam et al., 2016; Karlsson et al., 2020). These compelling statistics have engendered an urgency to transform the industry towards serious emission cuts to achieve carbon neutrality by mid-century. Carbon neutrality suggests achieving zero emissions by reducing emissions where practical and compensating for the remaining emissions by investing in carbon offset projects (IPCC, 2018).

This systematic review and meta-analysis sought to assess the extent of carbon emissions throughout the life cycle of complex building projects. This will guide in identifying areas where drastic changes are needed and facilitate decision making on practical decarbonisation opportunities to achieve carbon neutrality. The results of this analysis indicate a need to calibrate the performance of buildings in terms of both operational and embodied carbon emissions to reduce the whole lifecycle emissions. However, the absence of appropriate legislation on embodied emissions, unavailability of accurate and consistent databases, varying scope boundaries, as well as lack of interest in the impacts of embodied carbon emissions by relevant stakeholders make achieving this goal a challenge. There is currently no generally accepted methodology and standards for assessing embodied emissions accurately and reliably (Ibn-Mohammed et al., 2013). It is therefore paramount to streamline the carbon accounting standards and policies along with procurement strategies to address the whole lifecycle emissions of buildings. This will provide a solid reference for developing decarbonisation roadmaps for infrastructure developments; addressing the sustainability agenda.

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Sustainability Approach with Resiliency Planning in Transmission Line Engineering

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Keywords: Climate Change, Grid, Resiliency, Sustainability, Transmission Line

ABSTRACT

Due to evolving public issues relating to global climate change and changing socio-economic values, the traditional methods of transmission line routing, design and engineering are slowly becoming obsolete. There is a perception that electric utility companies are "out of touch" with society. As a result, utility companies are facing an increase in opposition to projects that are proposed. This increased opposition results in delayed permitting and licensing approvals and more public hearings which drive up project costs. To better align utility companies with the current social trends, utility companies need to start including sustainability and grid resiliency values in their projects.

Sustainability is generally defined as development which meets the needs of the present without compromising the ability of future generations to meet their own needs. Generally, sustainability is measured through three action dimensions: economic, environmental and social sustainability. Transmission line engineering needs to play an important role in minimizing adverse environmental impacts, providing economic benefits to shareholders and communities, and delivering electricity in a safe, reliable and efficient manner. Renewable resources and aesthetics are key sustainability concepts.

Grid resiliency is becoming ever more important in modern society. Society is becoming increasingly dependent on reliable power to power the plethora of electronics which are a part of our everyday lives. One of the largest challenges to grid resiliency is global climate change. With climate change the frequency and intensity of wildfires have dramatically increased. Sea level rise is also threatening infrastructure along the coastal areas - areas where a large majority of power generation facilities are located. Protection against adverse factors due to climate change needs to be considered in all grid resiliency discussions to ensure a high level of system reliability into the future.

Following a focused approach to define the importance of sustainability with resiliency planning in transmission line engineering, we have created guidelines and developed case studies. The goal is to help the utility industry to start considering sustainability and grid resiliency concepts in its transmission line engineering processes.