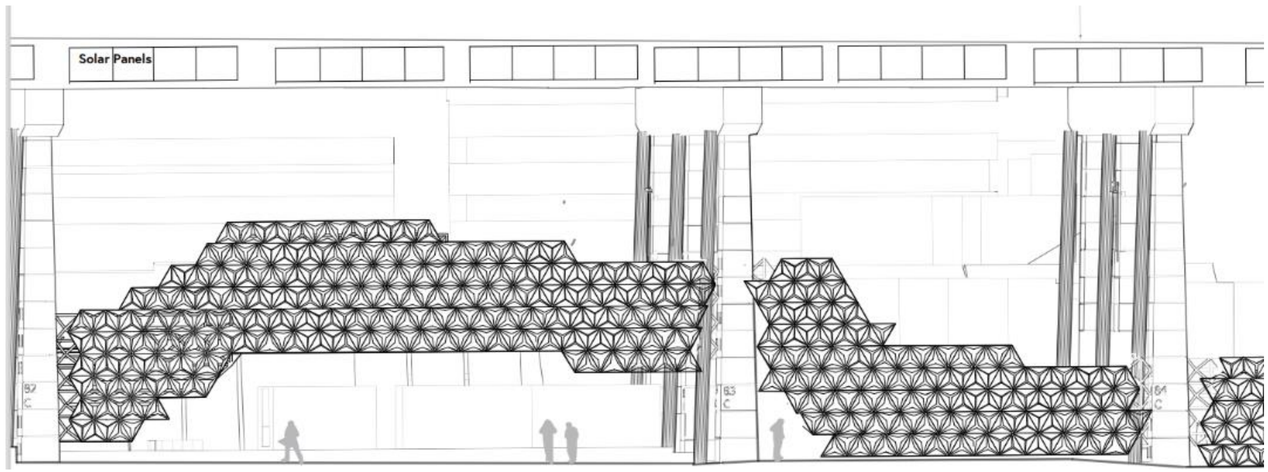
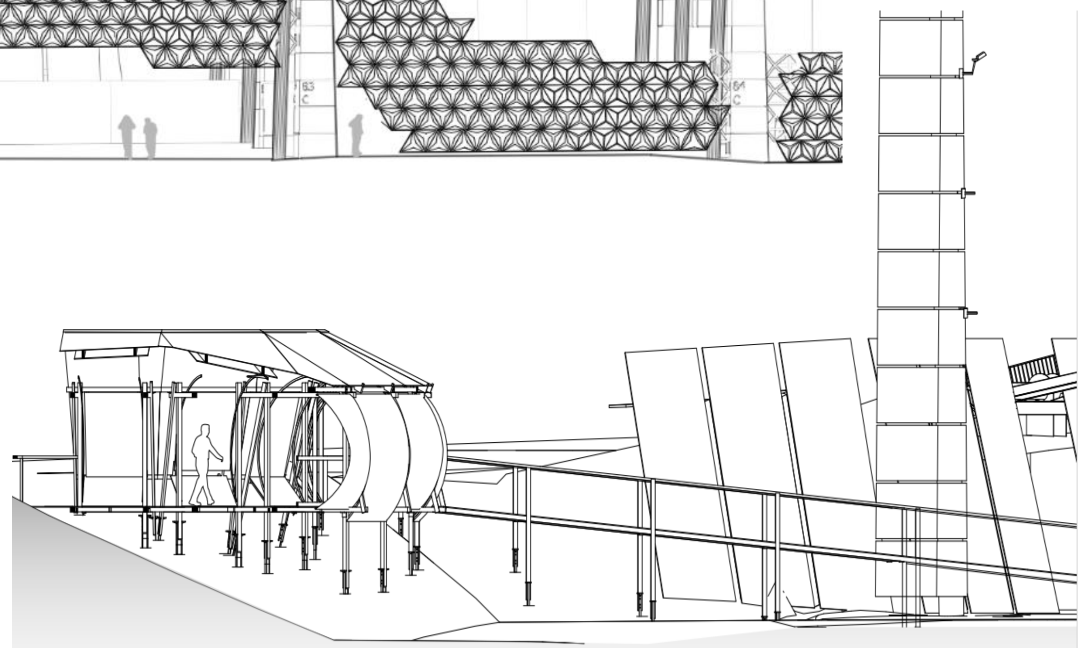
Microclimate of winter public spaces.
Passive design directives for The Bentway Skate Trail in Toronto

by Celeste Meledath





Design concepts from Toronto Metropolitan University students, presented at the Bentway. [1]

Image 1: The Bentway Skate Trail in winter 2022. Artwork: Beacons by Toronto artist Shellie Zhang.

INTRODUCTION

Winter cities

Winter cities, often nestled within the higher latitudes, are characterized by snowy landscapes, shorter daylight hours, and chilly temperatures that can dip below freezing. The characterization of a winter city extends beyond merely climatic and geographical attributes. It encapsulates a broader sociocultural context, inherently intertwining with the regional lifestyle, traditions, and infrastructural adaptations designed to utilize all seasons effectively.

The story of winter varies dramatically across the globe, profoundly shaping the lives of those who reside in these winter cities. In Stockholm, Sweden, the arrival of winter signals a shift to cozy 'fika' breaks, with residents retreating to the warmth of coffee shops against the Scandinavian cold, thus fostering a sense of community amid the chill.

Image 2: Ulaanbaatar/Kuala Lumpur, 12 January 2021 – Red Cross provides relief ahead of extreme winter season in Mongolia.

Meanwhile, in Ulaanbaatar, Mongolia, one of the global coldest capitals, winter calls for resilience as residents navigate icy winds and freezing temperatures. Winter in Yellowknife, Canada, sees residents embracing the outdoors, with ice fishing, snowmobiling, and viewing the breathtaking Northern Lights as part of daily life.

The dynamic interplay of climate and season within urban environments over time has spurred the emergence of organizations' interest in public programming to accommodate the shifting rhythm of urban life.

City of Sapporo [Hokkaido, Japan] organized the first-ever Snow Festival in 1950, the infamous creation of full-scale snow sculptures, which still attracts many crowds today.

Image 3: Sapporo Snow Festival, Japan. February 2015 © JTB

Five years later, in 1955, the Quebec City Winter Carnival was established as an annual event. During the 1960s, 1970s, and 1980s, a host of other Canadian cities, such as Sault Ste. Marie, Gatineau (Hull), Ottawa, Winnipeg, and St. Boniface followed suit, creating events that embraced and celebrated winter. *Pressman, 2004* [2]
To improve the quality of life in winter cities, it is necessary to reduce inconvenience, offer protection from the excessive negative stressors associated with winter, and optimize exposure to its beneficial aspects. For urban design professionals, winter is a time that offers a challenge for sensitive design to create safe, comfortable, and memorable places for life to thrive in the city.

The Bentway Skate Trail, Toronto.

'Genius Loci' occurs when a common space is elevated in the minds of citizens, to a sense of place, with universally appreciated attributes. [2]

Under the Gardiner Expressway in Toronto, a highway constructed in the 1950s-60s that spans over seven neighborhoods, a remarkable example of genius loci can be found - The Bentway Skate Trail. This once-underutilized space has been transformed into a vibrant year-round public space that has captured the imagination and appreciation of citizens. The Bentway has become a hub for diverse communities, cultures, and experiences, creating a sense of place that resonates with people from all walks of life.

With art installations, community events, and a highly regarded winter skating season from December to February, The Bentway continuously offers new and exciting experiences for newcomers and residents. By actively planning and curating public realm opportunities in the 1.6 km space beneath the Gardiner Expressway, The Bentway remains a dynamic and ever-evolving destination.
The organization's commitment to innovative and inclusive winter programming has embodied the common perception of Toronto- a vibrant winter city.

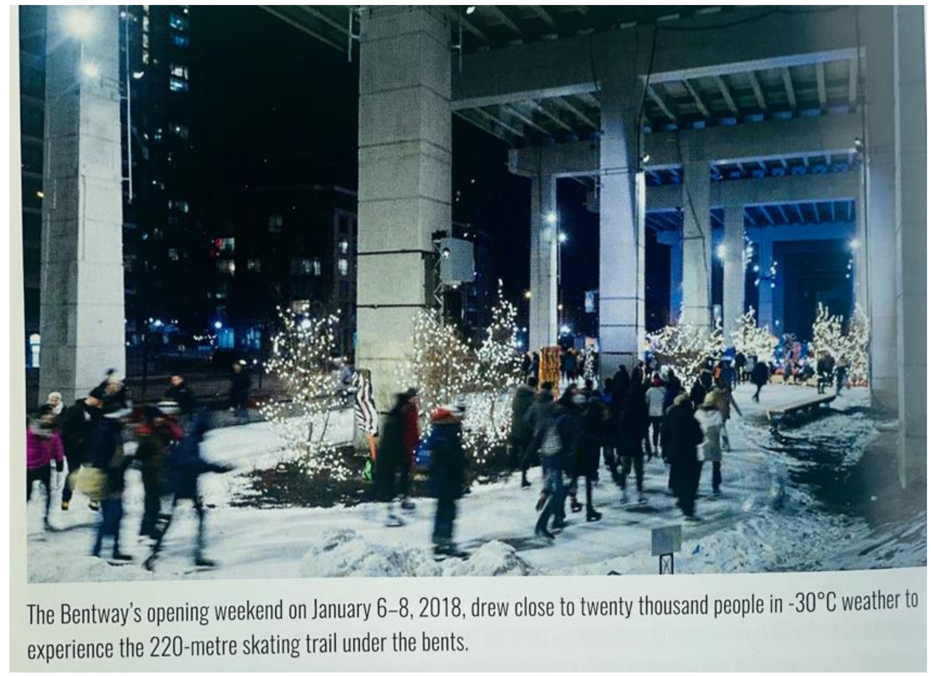


Image 4: Feature from the book- Toronto Reborn [3]

Microclimates and public spaces.

A microclimate pertains to the distinct and localized weather conditions within a specific area, deviating from the general climate of the surrounding region. These unique conditions are shaped by factors such as topography, bodies of water, human-made structures, and vegetation. The microclimate of a particular space plays a crucial role in attracting or deterring people from spending time in that area. For example, an exposed plaza lacking proper lighting and transitional infrastructure between shops and parking lots would likely have fewer users compared to a thoughtfully designed civic space featuring adequate lighting, shelter, and protection.

The Köppen climate classification [4] currently classifies Toronto as Dfa (Continental with hot summers) bordering on Dfb (Continental with warm summers). An article by Scientific Data [5] predicts Toronto to fall under Dfc (Subarctic climate, currently experienced by Siberia, The Pyrenees, Southern Nunavik, etc.) in the next 50 years. The Climate Atlas' models [6] projections for 2051-2080 show that Canadian urban centers will see at least four times as many +30°C days per year on average (assuming a continual ride of global greenhouse gas emissions). Climate change introduces a greater degree of variability and unpredictability to weather patterns. This means Toronto might see more extreme weather swings, including sudden cold snaps, heat waves, or unusually harsh winters, even as the overall climate warms.
While there have been numerous efforts to regulate the microclimate of public spaces in hot and humid cities, research on winter cities has been relatively limited. However, there has been a growing interest in this area in recent years to support and sustain ‘winter programming.’

Norman Pressman, a renowned scholar, and Professor Emeritus at the University of Waterloo’s School of Urban and Regional Planning has played a pivotal role in advocating climate-conscious urban design, particularly in winter cities. With his profound knowledge and expertise, Pressman has contributed significantly to the understanding and development of winter cities worldwide. Notably, he serves as the founding president of the International Winter Cities Association, an organization dedicated to promoting livability and sustainability in cold climate regions. His exploration of the "grammar of the north" in his influential works "Shaping Cities for Winter: Climatic Comfort and Sustainable Design (2004)" [2] and "Sustainable Winter Cities: Future Directions for Planning, Policy, and Design (1996)" [7] has provided invaluable guidance that significantly inform this piece.
In "Developing Climate-responsive Winter Cities" (1988), [8] Norman Pressman identifies a disconnect between Canada's severe winter climates and the existing urban design principles. He points out the lack of awareness and action in using design and planning strategies to mitigate winter's challenges among urban professionals. Moreover, he noted a significant need for more research and real-world examples related to urban planning and policies for cold climates, while most attention has been on warmer regions.

Inhabited by over half the world's population, urban regions depend on open and semi-open spaces for routine activities. Within the dense forest of high-rise buildings that typify many neighborhoods, The Bentway emerges as a communal oasis, functioning like a shared backyard. This site provides an essential haven for social and recreational engagement, serving as a vital communal asset for the diverse population that calls this urban expanse home.

Thermal comfort

Thermal comfort is defined as a "condition of mind," few studies have tried to establish a link between physiological indicators and outdoor thermal comfort [9]. Weather reports often provide a "feels like" temperature, which considers factors such as air temperature, wind speed, and humidity to approximate how weather conditions might be experienced by individuals. However, 'thermal comfort,' a few steps further, involves a broader range of variables, such as clothing insulation, metabolic rate, and personal preferences. The existing models on Outdoor Thermal Comfort [OTC] depend on direct factors (air temperature, radiation, wind, and humidity) and indirect influences (behavioral, social, cultural, and personal factors).

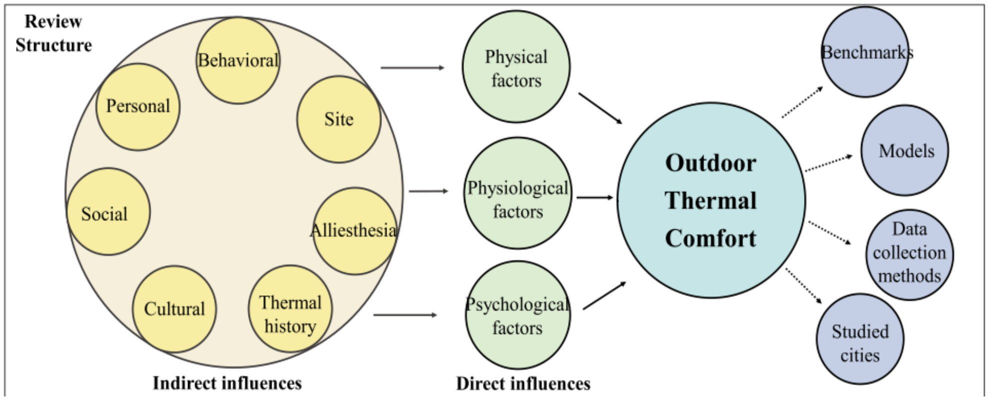


Image 5: Factors influencing OTC from: "A comprehensive review of thermal comfort studies in urban open spaces" 2020, [9]

Multiple studies in the last decade tried to find the effect of the different direct factors on thermal comfort and found conflicting results [Tabulated below]. [10]

City	No. of samples	Type of test	Influence on thermal sensation	Reference
Athens	2313	Logistic Regression	Solar radiation > wind speed.	Tseliou et al., 2015
Changsha	7851	Standardized Linear Regression	Globe temperature > wind speed	Liu et al., 2016
Taiwan	8077	Analysis of variance	Operative temperature 75% variance.	Lin et al., 2011
Curitiba	1654	Comparative	Effect of wind = temperature	Krüger and Rossi, 2011
Birmingham	451	Comparative	Change in wind speed > solar radiation.	Metje et al., 2008

Therefore, studying the weather data specific to each site and considering the surrounding infrastructure to develop practical guidelines for public spaces is crucial. Tailoring the choice of OTC models and indices to the site's climate zone and cultural context while also prioritizing operational sustainability is essential.

A study conducted by Transsolar | Klima Engineering [15], focusing on Bents 121-133 (located west of The Bentway Skate Trail, which lies between Bents 81-87), employed the Standard Effective Temperature (SET) as a metric to evaluate the Outdoor Thermal Comfort (OTC) in areas beneath the Gardiner. This metric, which considers Mean Radiant Temperature, Air Velocity, Relative Humidity, Metabolism, and Clothing Level, is well-suited for semi-outdoor or partially covered spaces with a low sky view factor. The study aimed to scrutinize weather patterns and devise strategies to align with urban climate objectives.
Such studies hold significant importance. In winter cities, prolonged exposure to extreme cold, wind-chill effects, and icy or snow-covered surfaces pose more than just sensory discomfort; they can pose severe and stress-inducing hazards. Ensuring thermal comfort in outdoor public spaces is crucial to maintaining the vitality and character of cities, particularly in the context of the changing climate and its potential impact on the livability and vibrancy of urban areas.

The Bentway Phase 1 presents a paradox of urban microclimates in the winter/cold city: how can we effectively improve the performance of winter infrastructure while enabling a level of comfort for users of the space?

Transsolar Study Area **Bentway Phase 1**

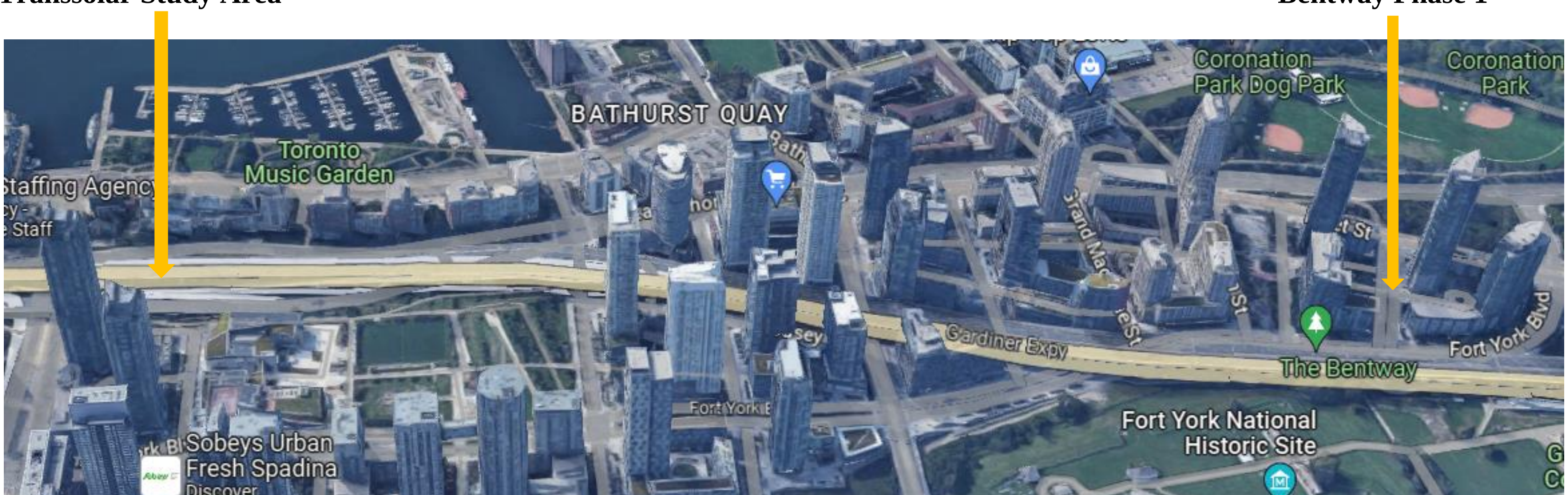


Image 6: Google grab showing the Transsolar study site at a 1km distance from The Skate Trail.

DESIGN DIRECTIVES

Climate adaptation projects at the urban tissue level — the connective fabric of neighborhoods comprising buildings, streets, parks, and so on — can typically prioritize interventions across three primary aspects: physical, social, and economic. [Tabulated]

The physical influence is important among the three as the physical environment, or the microclimatic environment, **can be modified through design**. [Pressman, 2]

Physical

- Optimizing accessibility through improved infrastructure
- Integrating climate adaptation within existing urban forms
- Building pilot projects and conducting research experiments to continuously learn and improve design approaches

Social

- Public education on winter safety
- Community snow removal assistance for the elderly
- Fostering positivity through winter festivities
- Creating inclusive and protected public spaces

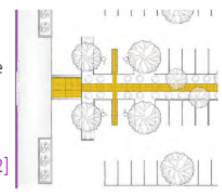
Economic

- Transit fare-reduction to promote winter mobility
- Winter subsidy programs for low-income groups
- Support for seasonal markets and local businesses
- Promoting winter tourism opportunities

Image 7: Winter activations at The Bentway Skate Trail.

"What is important is the recognition that explicit winter-induced discomforts exist and that they be acknowledged in planning practice. Once this occurs, our cities and residential precincts can function in a more satisfactory manner reducing the negative impacts of winter and enhancing its beneficial qualities."- Pressman, "Sustainable winter cities" [7]

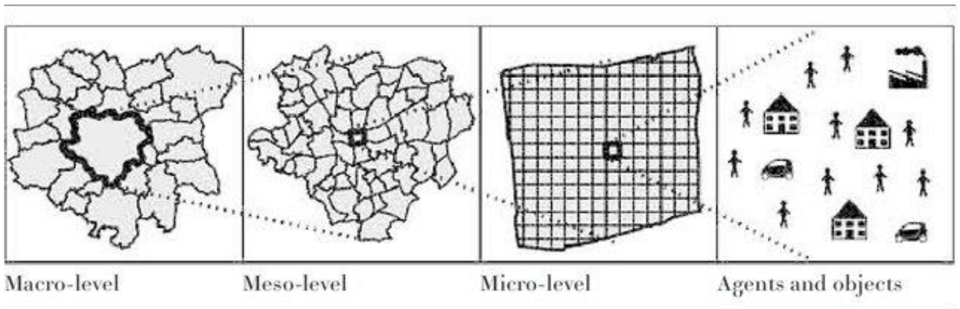
Inspired by Pressman's work, physical interventions of climate-adaptive design in present-day public spaces can follow the below framework. The aim is to develop effective design directives to enhance winter public spaces.

Analysis Areas	Processes	Examples
Micro climate of the space	• Assessing the interaction of the site with weather conditions (wind, snow, temperature, radiation, daylight hours, Sky View factor, humidity, pressure etc.). • Reviewing historic data and researching practices from similar climate regions. • Identifying an outdoor thermal comfort model and setting practical targets for improvement. • Conduct subject tests and collect weather data based on the chosen thermal comfort model. • Determine nature of intervention needed- permanent, seasonal, adaptive etc.	A case study of public space in Nanjing (1990s-2010s) assessing wind patterns and comfort. [11]  The 3D model of the Drum Tower area, 2010s (Source: Authors)
Users of the space	• Understanding the diverse diaspora of space users (age, metabolic rate, presence of pets etc.). • Considering preferred behaviors of thermal adaptation based on cultural associations and relevant studies. • Developing a Human Comfort success level to define the desired thermal comfort experience. • Pinpointing the main physical elements of weather to be addressed to achieve the desired comfort levels.	Subject test with microclimate monitoring and perception survey[10]  8 subjects sitting  8 subjects walking
Use of the space	• Determining the primary purpose of the space (transit, socializing, community programming, etc.). • Evaluating the visitor footprint, potential for community engagement. • Incorporating ideas for visual stimulation through art, color, lighting, and appropriate furniture. • Explore available amenities and considering strategies for extending the outdoor season.	City of Edmonton designing parking lots with pathway to minimize pedestrian-vehicular interaction as well as plantations for absorbing snowmelts. [12] 
Sustainable Ethic of Intervention	• Ecological considerations: Using low embodied carbon materials and sustainable design practices, • Social considerations: Incorporating inclusive design principles for equitable access. • Economic considerations: Promoting economic viability and regional identity in materials.	"Vegas Atlas Envelope" in Spain adheres to climatic conditions with ropes made from different materials. [13] 

Create a map of goals emerging from the analysis. → Balance trade-off in priorities, identify mandatory goals. → Develop design detail for the intervention.

While many principles of energy-efficient planning focus predominantly on macro and meso-level urban patterns, the underpinnings of climate-responsive landscape planning depend largely on micro-level factors addressing two primary concerns:

- modifying the natural environment, for instance, through solar orientation, use of vegetation, site selection, and placement of buildings; and
- creating interventions via built forms such as "wind gates," fences, walls to redirect wind and snow, overhead project features like atriums and galleria-style developments, integrated bus shelters, arcades above sidewalks, courtyard dwelling designs that offer microclimate protection, and interconnected buildings. [8]



These micro-level design interventions should aim to transform public spaces to achieve the following:

- Encourage longer outdoor stays of residents by tackling the negative stresses of winter.
- Offer accessible and thoughtfully designed amenities and furniture.
- Shape the city's social spaces' unique character.

The conclusion must be that the outdoor social space has to be located, designed, and equipped to extend the outdoor season and to support social activity during the cold part of the year, even if not necessarily with the same intensity or in the same way. *Climate-responsive social space: a Scandinavian perspective.* [14]

Attention to cold climate design can yield greater levels of comfort and accessibility throughout the year and effectively extend the outdoor season by six weeks each year (Pressman, 2005). The subsequent section dives into a practical exploration, applying these design directives to The Bentway Skate Trail. The objective is to extend and enhance the comfort of this public space throughout winter, putting theory into action through site microclimate analysis and an interactive design exercise resulting in climate-adaptive solutions.

SITE MICROCLIMATE ANALYSIS

Image 8: Weather stations used on site by Adaptive Artifacts

Image 9: Site Map [The Bentway Skate Trail Sketch up]

Weather data: In 2022, The Bentway initiated Adaptive Artifacts which was a collaboration with the Public Visualization Lab/Studio to study the impact of weather on site. The project involved setting up sensory weather stations on-site for an entire year.

This table shows the averaged winter data on site from the Adaptive Artifacts' weather stations across the Skate Trail at different periods of the day.

Time	9 AM-12 PM	12 PM – 3 PM	3 PM-6 PM	6 PM-9 PM
Temp C	0	1	0	-2
Wind speed m/s	26	24	27	30
Humidity %	80%	76%	75%	79%
SET	Cold Stress	Moderate cold Stress	Cold stress	Extreme cold stress

Thermal Comfort Levels calculated by the Transsolar [15] study show low SET levels during winter. Since the two sites are close enough, the results can be applied to the skate trail.

Individuals using the space who aren't engaged in physical activities such as sports and are primarily standing or sitting experience 'icy' conditions 85% of the winter days due to their low metabolic rate.
On the other hand, those with a higher metabolic rate, who are partaking in activities like skating, running, or exercising, fall into the 'cold to very cold' category 42% of the time, averaged across varying weather conditions.

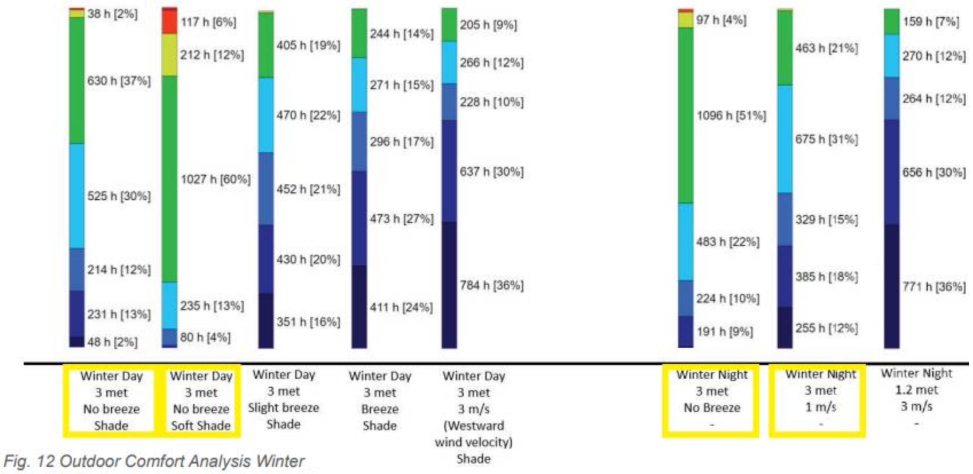
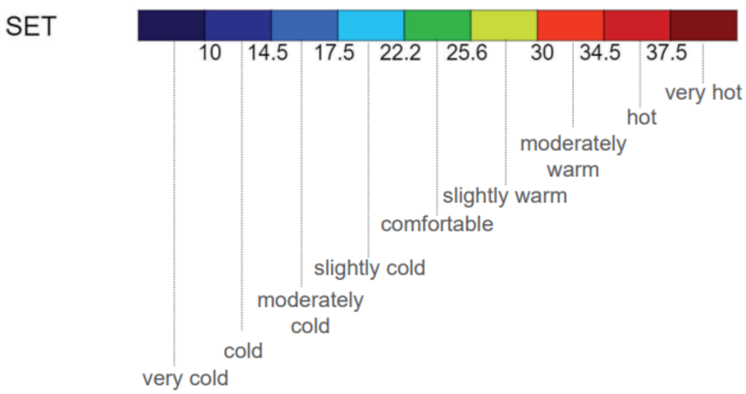


Fig. 12 Outdoor Comfort Analysis Winter
High Metabolic Rate Programming (met 3)
Highlighted scenarios are recommended to maximize comfortable hours which include: increasing light intake and blocking/minimizing cold winds.



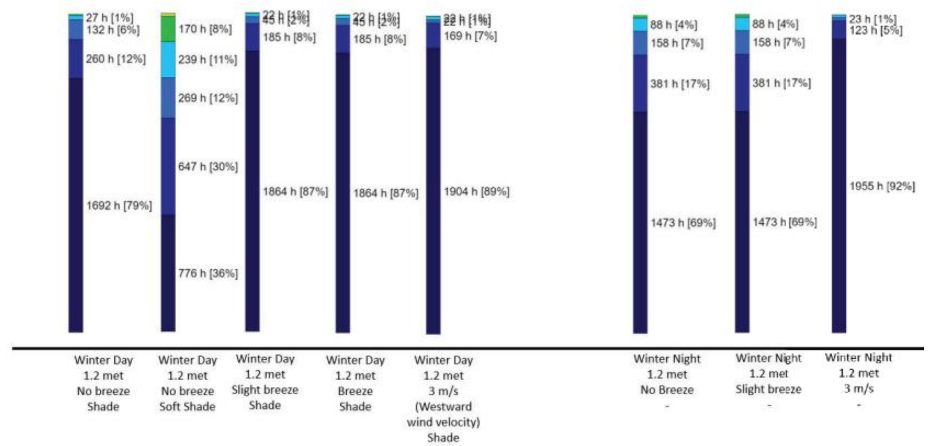


Fig. 13 Outdoor Comfort Analysis Winter
Low Metabolic Rate Programming (met 1.2)
Conditions are cold and require active intervention to gain enough comfortable hours for programming.

Examining the site's interaction with weather patterns unveiled three primary factors.

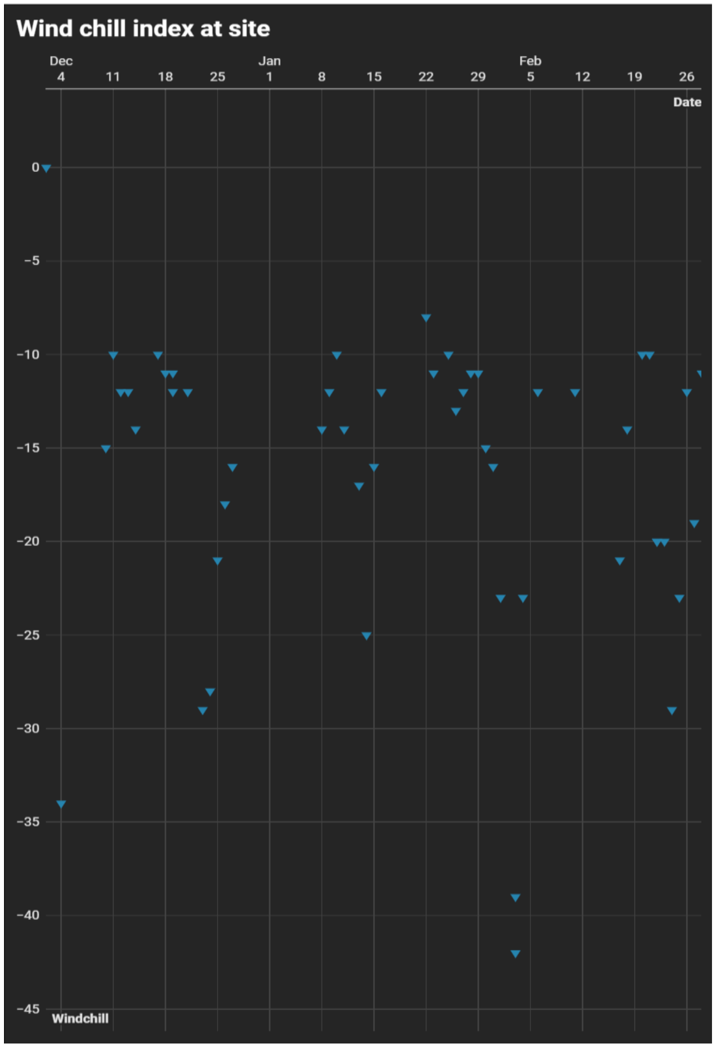
A. West winds [>30km/hr.]: The site experiences strong winds emerging from the west, which has the following impacts:

a) Negatively affects the Thermal comfort levels at the site.

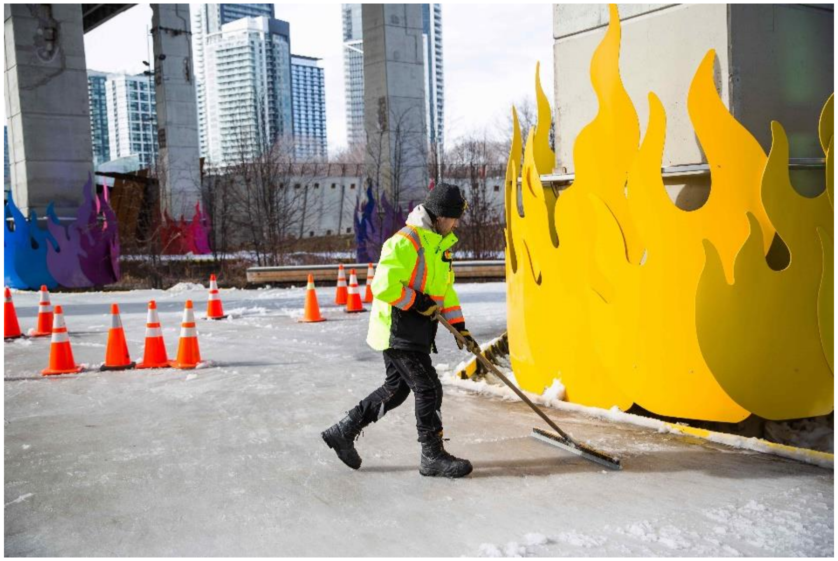
b) Positively affects the flow of ventilation across the site.

The Canadian Wind Chill Index [17] is a weather measurement that quantifies the combined effect of cold temperatures and wind on human perception. It provides a numerical value that represents the equivalent cooling rate on exposed skin due to the combination of temperature and wind speed. The index is used to assess the potential risks and discomfort associated with cold and windy conditions, helping individuals and authorities make informed decisions regarding outdoor activities, clothing choices, and safety measures. By considering both temperature and wind speed, the Canadian Wind Chill Index offers a more accurate representation of how cold it feels to the human body in different weather conditions.

Out of the 52 Days that recorded temperatures below 0°C in the 2022 winter season, wind chill index calculations show that: Two days fell under extremely high risk, seven days touched a Wind chill between -28°C to -39 °C, which falls under High-risk Category, and forty-five days fell under -10 to -27 which Moderate risk category.

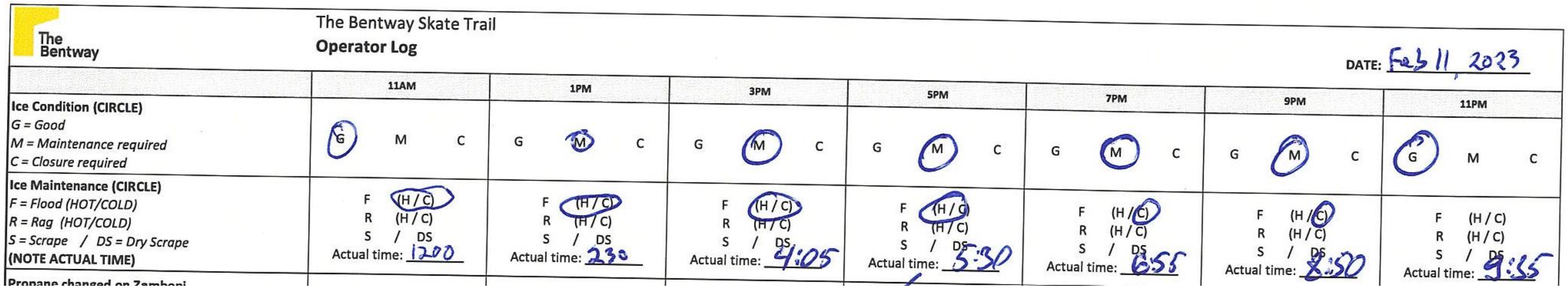


B. Solar Radiation



a) Positively affects the Thermal comfort levels at the site.
b) Negatively affects skating rink ice conditions.
c) Provides photo-voltaic opportunity.

While management/redirection of solar radiation can create pockets of sun and enhance thermal comfort, the effect of the south-side radiation on the skate trail's ice makes it essential to develop barriers/ redirect the radiation.
The maintenance operators' log is a document followed by Bentway's facilities staff to record maintenance runs by the Zamboni, hazards on site, and ice conditions. Most of the 'Maintenance required' recordings were done when the skate trial was exposed to solar radiation. The solar radiation on site is present on the south side of the trial. The rapidly melting ice results in poor ice conditions, which need to be maintained more often to avoid slip hazards.



The Bentway

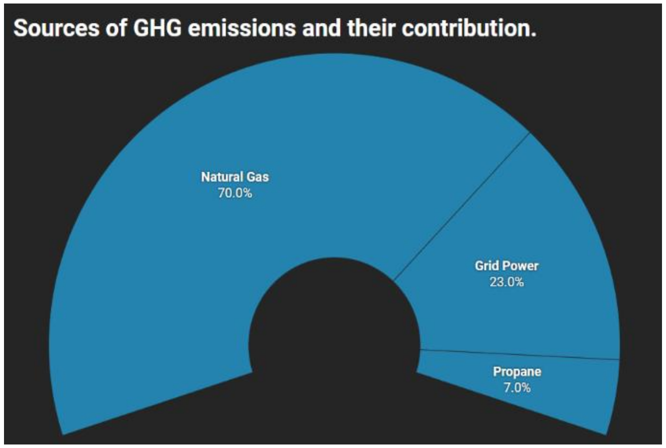
The Bentway Skate Trail
Operator Log

DATE: Feb 11, 2023

	11AM	1PM	3PM	5PM	7PM	9PM	11PM
Ice Condition (CIRCLE) *G = Good* *M = Maintenance required* *C = Closure required*	G M C	G M C	G M C	G M C	G M C	G M C	G M C
Ice Maintenance (CIRCLE) *F = Flood (HOT/COLD)* *R = Rag (HOT/COLD)* *S = Scrape / DS = Dry Scrape* **(NOTE ACTUAL TIME)**	F (H / C) R (H / C) S / DS Actual time: 1200	F (H / C) R (H / C) S / DS Actual time: 230	F (H / C) R (H / C) S / DS Actual time: 4:05	F (H / C) R (H / C) S / DS Actual time: 5:30	F (H / C) R (H / C) S / DS Actual time: 6:55	F (H / C) R (H / C) S / DS Actual time: 8:50	F (H / C) R (H / C) S / DS Actual time: 9:55

Image 10: Ice maintenance log from the Bentway Facilities team.

C. Rising Temperatures towards the end of the winter season:



a) Negatively affects operating emissions.
b) Positively affects thermal comfort.

The emissions from the operation of the skate trail originate from the refrigeration plant, which cools the trail by circulating a heat exchange brine (ethylene glycol) through tubes beneath the ice rink's concrete slab. The grid powers the refrigeration plant. Additionally, the skate trail maintenance involves using an ice resurfacer, specifically the [Model] Zamboni, which currently operates on propane and utilizes gas power to heat water.

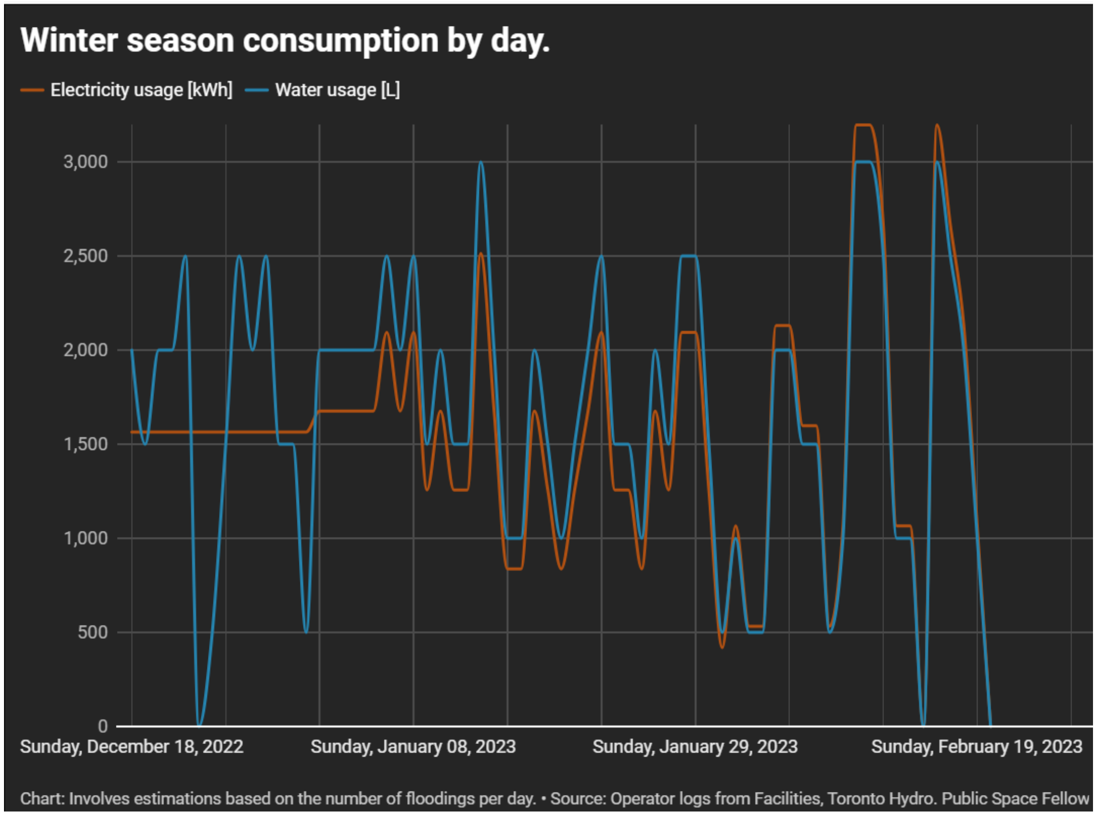
It is important to note that the estimated emissions in the table assume perfect efficiency of equipment and do not account for water consumption or any potential leakage or losses within the refrigeration system. In reality, refrigeration systems may experience some degree of leakage, which can contribute to overall greenhouse gas emissions.

Sources*			GHG Gases			
Natural Gas [m^3]	6524	Carbondioxide	Methane	Nitrous Oxide		
	Emission Factor [g/ m3]	1879	0.037	0.033		
	Global Warming Potential	1	25	298		
	CO2e [CO2 Equivalent] in tonnes	12.258596	0.0060347	0.064157016	12.33	t of CO2e
Propane [L]	805	Carbondioxide	Methane	Nitrous Oxide		
	Emission Factor [g/L]	1515	0.024	0.108		
	Global Warming Potential	1	25	298		
	CO2e in tonnes	1.219575	0.000483	0.02590812	1.25	t of CO2e
Grid Power [kWh]	148418.975	Carbondioxide	Methane	Nitrous Oxide		
	Electricity consumption intensity factor [g CO2e/kWh]	28	0	0		
	Emissions in grams	4155731.3	0	0		
	CO2e in tonnes	4.1557313	0	0	4.16	t of CO2e
				Total Emissions=	**17.73**	**t of CO2e**

The estimated total is approximately equivalent to yearly emissions generated by three American homes / four passenger vehicles.

Calculated using emission factors from Canada's National Inventory Report 1990-2020: Greenhouse Gas Sources and Sinks in Canada, Part 2, Table A6.1-3, "CH4 and N2O Emission Factors."

Illustrating the impact of warmer days on skate trail operations, the graph demonstrates a noticeable increase in water usage and electricity consumption. As temperatures rise, the demand for cooling intensifies, leading to higher power requirements for the refrigeration plant. Consequently, electricity consumption increases accordingly. Additionally, the graph highlights the corresponding surge in water usage needed to sustain the cooling process during warmer periods. These findings underscore the importance of mitigating these effects, such as creating barriers to solar radiation, enhancing insulation techniques, and adopting strategies to minimize heat absorption. By doing so, it is possible to reduce resource strain, extend the winter season, and enhance the overall sustainability of skate trail operations.



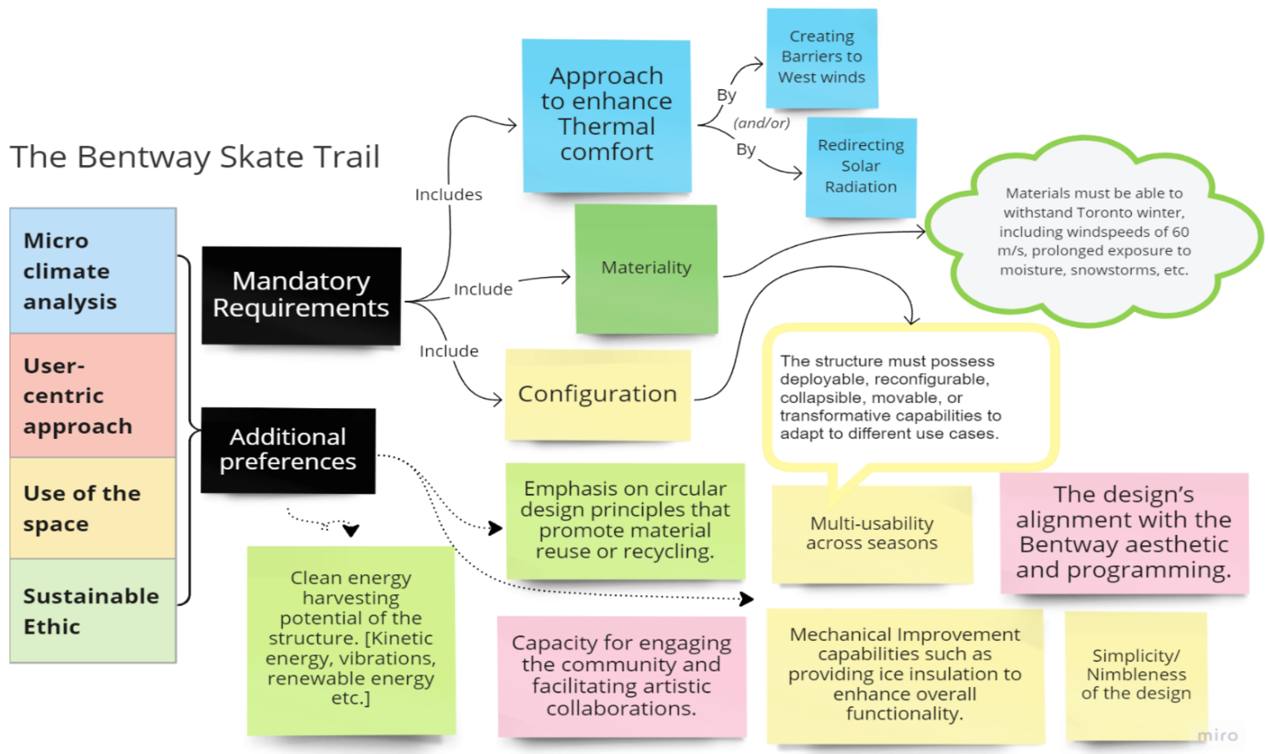
ADAPTIVE DESIGN EXERCISE WITH STUDENTS

Established on the principles of radical accessibility, The Bentway serves as a vital public space. The permanence of the Skate Trail and the anticipated intensification of weather challenges necessitate the formulation of robust and innovative solutions.
Norman asserts that **"The accurate measure of a livable city is its adaptability to the shifting weather patterns across different seasons."** This adaptability is crucial in public spaces; fluctuating weather conditions can significantly affect this. Accordingly, architectural solutions must be as flexible and adaptable as the climates they intend to mitigate.

The feature of transformability in the case of architectural use can arise from two different motivations.

- The first motivation is to create a fast and/or safe construction method, and in some cases, it can also be the need for a quick demounting process and the possibility of reusability.
- The second motivation is to adapt the structure to external excitations like functionality requirements or weather conditions. *Investigation of highly flexible, deployable structures, Friedman* [16]

As a part of this research, a design exercise was conducted at The Bentway aimed to explore innovative solutions for improving the microclimate of the Skate Trail. Five teams of students from the Department of Architectural Sciences at the Toronto Metropolitan University were sent a design brief created using the following priorities.



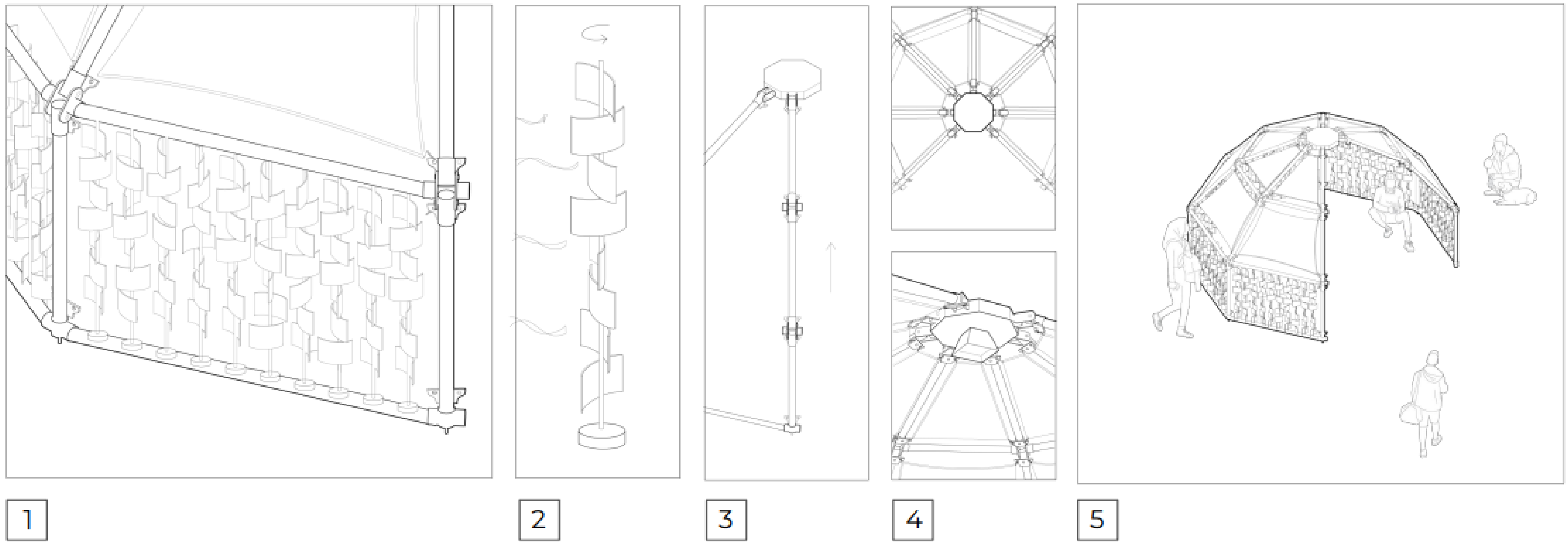
The primary objective was to develop adaptive design concepts that would enhance the performance of the winter infrastructure while ensuring optimal thermal comfort for users of the skate trail. The exercise focused on creating responsive and resilient design concepts that could withstand the challenging weather conditions of the city.
The prompt stressed aspects of reconfigurability and ‘ease of install’ to support the site’s versatile use case and avoid storage issues during periods of unuse. Additionally, the use of recycled and sustainable materials was encouraged by the design brief to ensure environmental responsibility and longevity.

The design exercise culminated in presentations by the student groups, where they showcased their concepts and received feedback from panelists and peers in the design community. The evaluation criteria included factors such as creativity, problem analysis, site-specificity, sustainability, feasibility, and presentation quality.
Overall, the design exercise urged the students to explore innovative approaches to improve the microclimate of The Bentway Skate Trail. By combining architectural design principles, material selection, and adaptability considerations, the students aimed to enhance the microclimate at the site while improving user experience, fostering community engagement, and contributing to the sustainable development of The Bentway Skate Trail as a vibrant public space.

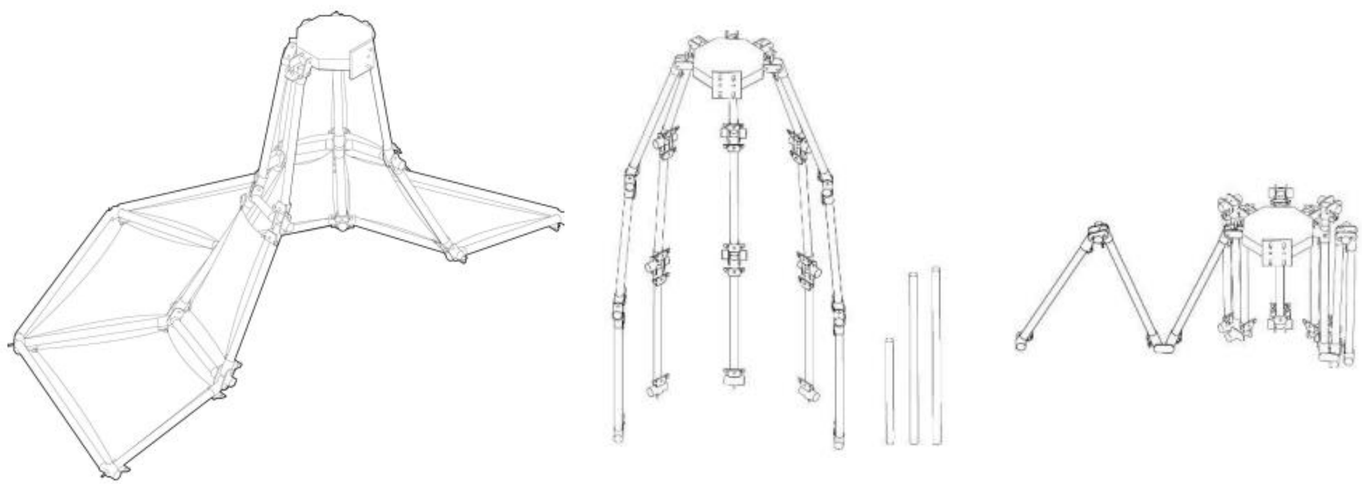
ILLUSTRATION OF RESULTS [TOP 2 CONCEPTS]

COVES by Samiha Ali and Mei Li

COVES is a project that aims to enhance the user experience at The Bentway's skate trail by providing shelter and interactive seating options. The design incorporates wind-blocking mechanisms and renewable wind energy to ensure thermal comfort and sustainability throughout the year. The structure takes the form of an adaptable octagonal hut, allowing for easy collapse and reconfiguration. It features both passive and active systems, with fabric modules to block wind and wind collectors that generate electricity for heating. The reconfigurable design enables convenient storage and deployment, while recycled materials like PVC piping and PTFE glass membrane ensure sustainability. COVES also incorporates bright and joyful colors to capture The Bentway's aesthetics and create an enjoyable atmosphere. Overall, COVES demonstrates the potential of innovative design in creating environmentally conscious public spaces.



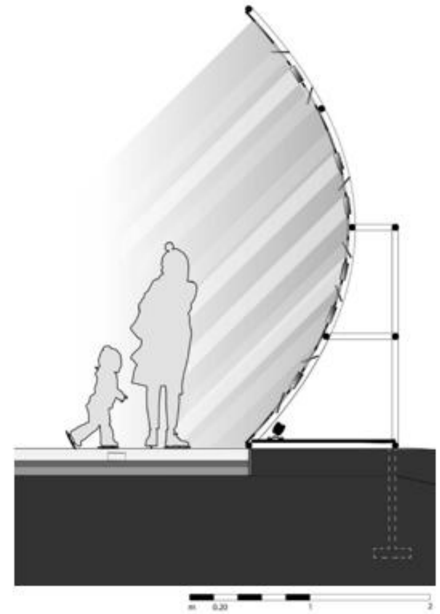
Wind energy harvesting.



Collapsibility and seating opportunities with COVES.

<u>FUSION by Jake Levy and Emily Lensin</u>

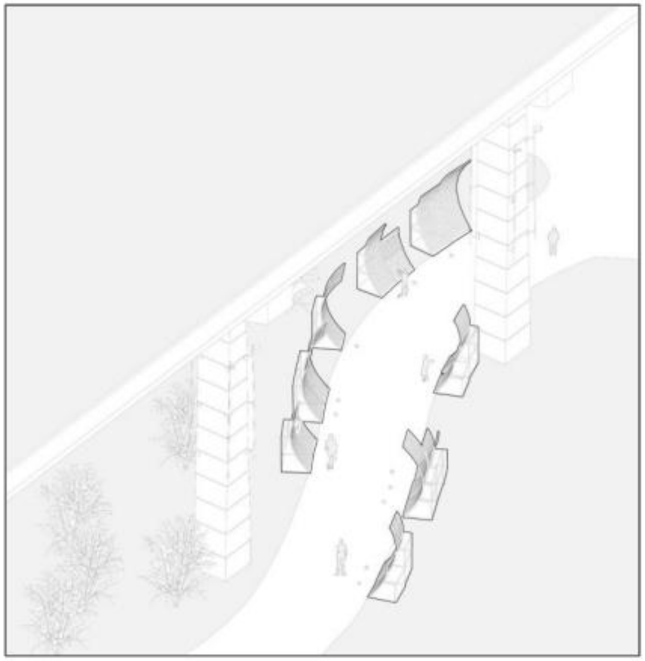
Winter Skating Condition

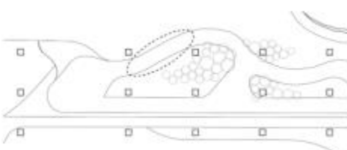


Section

"Fusion" is a conceptual design proposal that aims to create a visually captivating experience while highlighting the hidden spaces of The Bentway and responding to climate conditions. The design focused on key goals, including fast assembly and disassembly, configurability, community engagement, minimal use of materials, emphasizing hidden spaces, and mitigating wind patterns. Precedent studies were analyzed to explore engaging outdoor displays, incorporating artificial lighting, kinetic design, and sensory elements. The chosen design combines these ideas while addressing wind patterns. Fusion features a perforated aluminum concave sheet supported by a steel pipe scaffolding system, with reflective metallic tiles threaded into the perforated spaces. The tiles can rotate or remain stationary, creating a collision with the wind and producing moving light rays. The concave form allows reflections to be portrayed on the underside of the Gardiner expressway or on the pavement and ice, creating a visual spectacle. Natural and artificial light sources, including LED lights activated by sensors, enhance the display. Fusion aims to engage the public, highlight The Bentway's structure and hidden spaces, and mitigate climate challenges through a simple yet effective design.

Configurations





In a zone with minimal wind barriers, the structures mitigate the wind patterns while providing a visual spectacle, emphasizing the beautiful nature of The Bentway and its hidden spaces.

Toronto Metropolitan University The Bentway

Read more about COVES, FUSION, and all other TMU student presentations from the event here-

https://drive.google.com/drive/folders/1dTeHfZ37AMavl0fHpJXY-4G1Tvori-ex?usp=drive_link

CONCLUSION

Through the expansive lens of this analysis, we find ourselves standing at a crucial crossroads where necessity spurs innovation. The evolving realities of our climate necessitate a paradigm shift in our interaction with public spaces. This shift underscores the importance of adaptability, thermal comfort, and sustainable design.

In this landscape of change, public spaces like The Bentway are more than mere locations; they are year-round ecosystems synergizing with nature's rhythm, embodying resilience, sustainability, and active community engagement.

One of the key themes from this study is that rather than viewing winter as an adversary, we must revolutionize our perspective, seeing it as an ally in our quest to create engaging, dynamic spaces. To truly flourish as a community, we must embrace the frost, the wind, and the chill.

This report underlines the potential of creative thinking. The design exercise with students demonstrates how adaptive and flexible designs can help cope with our ever-fluctuating weather patterns. These designs not only allow us to respond to environmental changes swiftly but also ensure the functionality and usability of public spaces across all seasons. The framework for physical interventions, site analysis, and goal selection examples can benefit and encourage neighboring Skate Trail operators and winter programmers in Toronto (Harbor Front Skating Rink, Evergreen Brickworks Skating Rink, Toronto City Hall, etc.) to explore the unique microclimates of their sites and foster initiatives aimed at enhancing user experiences and creating safer, more resilient public spaces.

In conclusion, it's crucial to remember that this report is not just a case study but a clarion call to architects, designers, and stakeholders to shape a future where our interaction with public spaces is not dictated by the weather but instead, where the weather becomes a tool that enhances our collective experience. The challenges posed by our changing climate represent not an endpoint but a starting line for continuous innovation and exploration. Our journey towards creating climate-responsive public spaces has only just begun.

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