ARC 5713. Environmental Architecture and Sustainability

Maryam Singery

2025

UTSA The University of Texas at San Antonio
School of Architecture and Planning
SA+P
501 W. Cesar E. Chavez Blvd.
San Antonio, TX 78207
T: 210.458.3010

Mini Ice Box Challenge:

A Hands-On Approach and Using Competition to Accelerate Sustainable Design Knowledge and Application

1.Introduction

The Mini Ice Box Challenge (MIBC) immerses participants in the critical intersections of climate change, environmental justice, and sustainable design, fostering both student learning and public awareness. This team-based, competitive initiative emphasizes passive strategies, innovative material selection, and community collaboration to achieve net-zero design goals while redefining traditional pedagogy through hands-on learning, critical thinking, and meaningful engagement with local stakeholders. By integrating sustainability principles such as energy efficiency, material performance, and carbon reduction, the MIBC highlights the environmental responsibility inherent in design practices. Moreover, it incorporates social justice principles, ensuring equitable solutions that address the needs of diverse communities. Through collaboration with manufacturers, design and construction professionals, and local community leaders, the challenge facilitates a shared journey toward sustainability, empowering participants to create innovative, socially conscious, and more environmentally responsible designs.

2. Methodology:

Students form teams to design and build a 24" x 24" x 24" box with a 12" x 12" x 12" void to house a 15 lb. ice cube. The box must include a 1" air gap between the ice and walls, a 1" drainage block, and a roof with a 3" overhang. After 48 hours, teams weigh the remaining ice, with the heaviest block winning.

3. Course Goals and Learning Outcomes

By the end of this course component, students will be able to:

- **Grasp Sustainable Design:** Understand sustainable design principles and their application in mitigating climate change.
- **Implement Passive Design Strategies:** Utilize passive design strategies and low-tech energy efficiency solutions.
- **Evaluate Material Implication: Evaluate Material Implications**: Analyze building materials for their environmental implications, including energy efficiency, cost, global warming potential, and suitability for sustainable design.
- **Demonstrate Craftmanship in Construction Assemblies:** Gain hands-on building skills for energy-efficient structures, integrating insulation, and evaluating performance.
- **Analyze Real-World Applications:** Investigate sustainable building projects to understand climate resilience and social equity.
- **Utilize Simulation Tools:** Employ software to model design decisions, improving building and passive performance.
- **Collaborate:** Work in teams, engage stakeholders, and present findings clearly and cohesively.
- **Engage with Community:** Incorporate diverse perspectives from local community leaders into the design process.
- **Compare, Contrast, and Refine Designs:** Critically assess design choices through testing and iterate designs based on results and data analysis.

- **Demonstrate Decarbonization:** Show the connection between material choices, building performance, and reduced carbon emissions.

4. Course Structure

The MIBC is structured into the following phases:

Phase I: Foundations:

- Lectures on sustainable design, climate resilience, and passive strategies
- Case studies of high-performance buildings
- Preliminary literature review on passive design and material assemblies

Deliverable: An annotated bibliography and research summary

Phase II: Exploration:

- Research on sustainable materials, with a focus on environmental & cost impacts, and innovative solutions
- Engage with wall and roof assembly manufacturers for insights and potential material donations
- Iterative design development with performance modeling
- Utilize simulation tools for design performance analysis, emphasizing passive design
- Community consultation to align designs with local needs and for feedback

Deliverable: Material research dossier and 3D design models

Phase III: Construction:

- Refine designs, select sustainable materials, and focus on passive design implementation for the competition
- Construct mini-ice box prototypes, focusing on details, the proper integration of sustainable materials and passive strategies, and construction quality
- Meticulously document all designs, steps, and techniques throughout the project to allow others to fully understand the process

Deliverable: Fully constructed prototypes with technical documentation

Phase IX: Performance:

- Conduct controlled tests for thermal efficiency, waterproofing, and wind resistance
- Systematically analyze performance data

Deliverable: Testing results with insights on design efficiency

Phase X: Evaluation & Competition:

- Evaluate design processes and outcomes
- Compete in the Ice Melt Competition to test insulation performance under controlled conditions
- Public showcase with data posters, and project presentations (Fig.1)

Deliverable: Final presentation, competition participation, and public exhibition

5. Assessment and Evaluation

Student performance will be evaluated on:

- **Research & Analysis:** Thoroughness of research, literature review, manufacturer engagement, and understanding of core principles, including passive design, and competitive strategies
- **Design Innovation:** Appropriateness of material choices, and their connection to decarbonization, passive design integration, and performance results within a competitive setting
- **Craftmanship:** Precision assembly of the mini-ice box, proper integration of sustainable systems, and quality of construction, with the outcome taken into consideration
- **Testing & Data:** Data collection, analysis, use of data to inform design, evaluation of passive strategies, and the results of the competitive ice melt test
- **Communication & Teamwork:** Teamwork, engagement, documentation, and the quality of the final presentation, with a focus on the effectiveness of passive design, the ice melt results, and their connection to the competitive aspect of the project
- **Documentation**: The thorough and accurate documentation of all project phases, material integration, design choices, passive strategies, and the effectiveness of the final design

6. Conclusion

The Mini Ice Box Challenge provides a robust approach to engaging students with real-world design challenges and empowering students to lead in sustainable design innovation. Through hands-on building, community collaboration, testing, data analysis, passive design implementation, a competitive ice melt test, and public dissemination of data, this challenge creates a transformative learning experience. This approach enables the next generation of designers to become leaders in sustainable design innovation, by empowering them to work within community-based practices, highlighting social equity issues, promoting effective passive design solutions, and competing to create efficient sustainable designs that perform in a real-world setting.

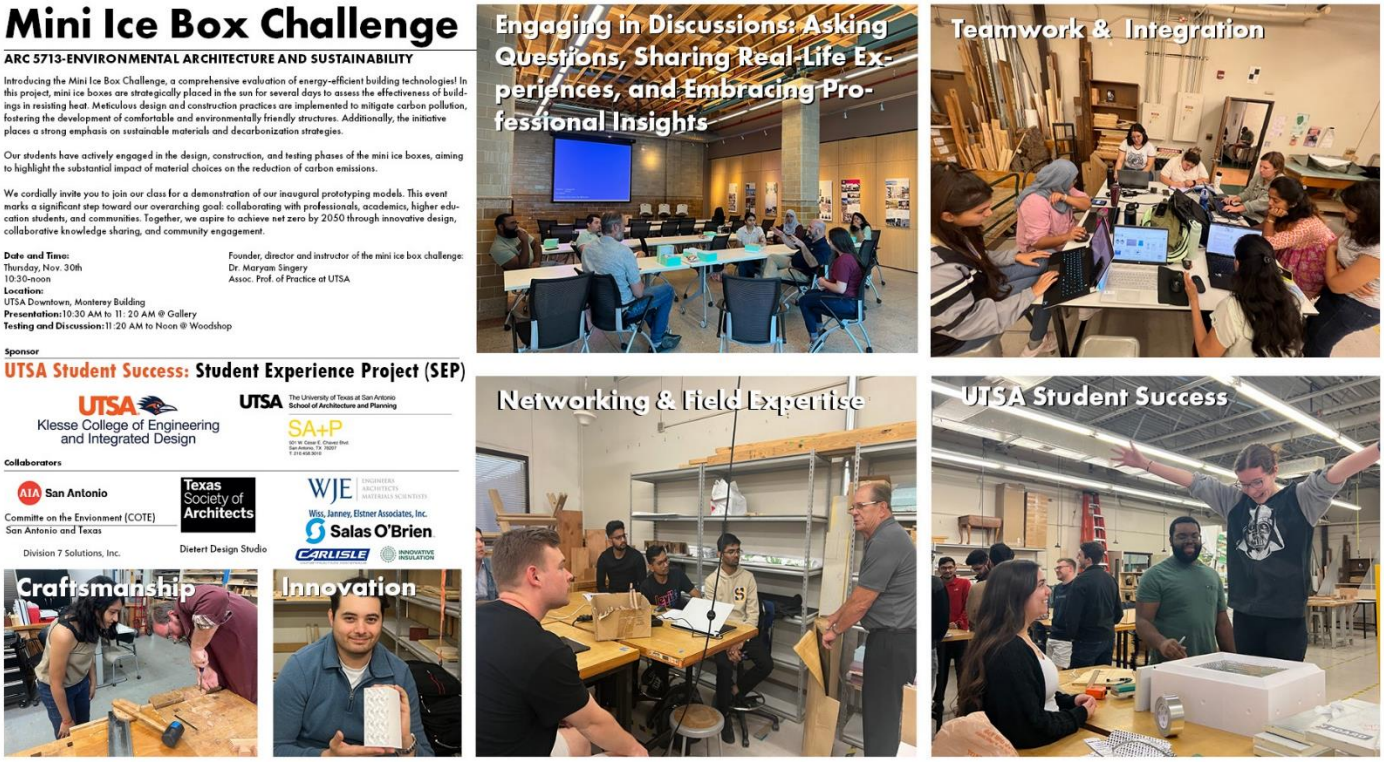

Figure 1: This flyer promotes the Mini Ice Box Challenge event, showcasing the results of the competitive ice melt test, student projects in sustainable design, and a public showcase featuring data posters and presentations. We invite the community to attend.