

Carbon Budget Zero. Climate Positive

Iteration 1st Reimagining an affordable neighborhood as a carbon bank

Course Syllabus and Information Instructor: Assistant Professor Sonsoles Vela

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Credits: (6) semester credit hours | Meeting Place: Nochi Atrium. | Reg Meeting Time: MWF 1:00-5.00 PM



Research Studio: Carbon Budget Zero. Climate Positive Fall 24. Prof. Sonsoles Vela. Strategic Approach _REIMAGINING our neighborhoods as a metabolic system, Circular processes. Undergraduate student: Sofia M Vladimir

01_CONTEXT

The built environment is a major contributor to global carbon emissions, with the construction industry accounting for 40% of emissions and 32% of natural resource consumption. This highlights the urgent need for change, especially as we approach the UN's 2030 targets. Housing is essential, yet it contributes 21% of global energy use and 17% of CO2 emissions. With 3 billion people needing suitable housing by 2030, there is an opportunity to improve housing while minimizing environmental impact. Current environmental policies focus on energy efficiency but often overlook material efficiency and the carbon storage potential of various construction materials. The "Carbon Bank" concept aims to create low-carbon neighborhoods that sequester more carbon than they emit. This requires thoughtful site planning and leveraging natural landscapes to offset construction emissions. The industry often follows a linear "take, make, use, dispose" model, which hinders material reusability and fails to consider the total environmental impact of materials from extraction to construction. Addressing embodied emissions is crucial, making material selection and future reuse key to reducing the sector's carbon footprint.

02_COURSE DESCRIPTION:

The research studio sets out with a bold aim: to use embodied and operational carbon as design parameters in the new or stock-built environment through three iterations, paving the way for constructing buildings and cities with a zero-carbon footprint. This approach integrates carbon footprint as the primary performance measure and promises a sustainable future. The research studio is guided by a pivotal question: "How can a design be developed to achieve a zero-carbon budget?" This inquiry shapes the research agenda and envisions a future where carbon neutrality is the standard. The exploration is twofold, allowing for a comprehensive investigation of the topic. On one side, the studio focuses on operational carbon actions, examining both passive and active strategies along with renewable energy systems to enhance efficiency and reduce operational emissions. Conversely, the research delves into embodied carbon actions, emphasizing low-carbon materials and innovative methods that align with the natural carbon cycle. This involves reimagining design approaches by prioritizing the principles of reuse, reduction, and sequestration and considering materials as strategies for carbon storage while exploring alternatives to conventional building materials.

Other questions will arise during the exploration:

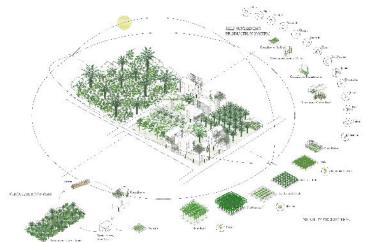
-Can healthy and environmentally friendly buildings be constructed using the current material palette?

-What is the impact of materials in the construction industry, and how are architects accountable?

-What are the possibilities for using bio-based materials harvested in a hot climate/tropical region as building materials, and how can they be utilized throughout their lifecycle?

-What criteria and methods are necessary to evaluate the benefits of these materials in terms of carbon emissions and storage? -How do we transition to a circular model in construction?

The research studio will investigate these questions related to climate adaptation over three iterations, each centered on a distinct climate zone. The first iteration will focus on the southeast climate, followed by the northeast climate in the second iteration, and concluding with the Pacific Southwest climate in the third. Each phase will identify a specific location where new development opportunities, adaptations, or hybrid models can be explored, demonstrating the practical application of the research in real-world contexts.



Research Studio: Carbon Budget Zero. Climate Positive Fall 24. Prof. Sonsoles Vela. Strategic Approach _Nurturing City Neighborhood Close-To Nature Forestry. Undergraduate student: Claire R Fisher

The Research Studio will be structured as follows: **Interaction #1:**

Reimagining an affordable neighborhood as a carbon bank

Hot Climate FL_ New Development (Typology. Neighborhood > Residential /mix used)

Interaction #2:

Limitations of adaptive reuse. Human-Centric Design

Cold Climate NY_ Retrofit, Adaptative Reuse on existing Construction. (Typology. Residential / mix used) Selected projects.

- -.1 The Refinery at Domino Brooklyn, Kings County, NY
- -.2 Tabacco warehouse, Brooklyn, NY.From shipping to sheltering,
- -.3 Renwick Smallpox Hospital on Roosevelt Island, NY,
- -.4 Neponsit Beach Hospital at Jacob Riis Park Beach NY,

Interaction #3:

Adaptive reuse and new additions in targeted areas Improvise, Adapt, Overcome

Moderate Climate CA. _Hybrid. New addition + retrofitting on existing construction (Typology. Residential/mix used)



Research Studio: Carbon Budget Zero. Climate Positive Fall 24. Prof. Sonsoles Vela. Strategic Approach _BIODIVER-CITY. Recycling Existing footprints. Undergraduate student: Mary Lawson Bring

2.1 Iteration #1 Little River Neighborhood, Miami, Florida

The project aims to progress from a conceptual framework to an urban strategy and ultimately to a detailed proposal that prioritizes a climate-positive approach for both landscapes and built environments, with the main goal of reducing greenhouse gas emissions. Specifically, it envisions the creation of a carbon sink neighborhood by introducing a new biogenic affordable housing concept focused on sustainability.

Site selection: The Little River neighborhood in Miami, recognized for its heightened vulnerability to climate impacts, has catalyzed the development of the Little River Adaptation Action Area (AAA) plan, which was launched in January 2022 as part of Miami-Dade County's initiatives to combat sea level rise. This comprehensive plan outlines both immediate and long-term challenges posed by rising sea levels and proposes strategies for adaptation, including resilience projects and policy recommendations. The AAA plan identifies affordable housing as a critical focus area, with Miami-Dade Public Housing & Community Development (PHCD) playing an essential role in executing resilience initiatives. Key to this initiative is the redevelopment of three public properties—Kline Nunn, Little River Plaza, and Little River Terraces-under the Rental Assistance Demonstration (RAD) Program, ensuring they meet modern standards for resilience and sustainability. This research studio adopts Little River Terraces as the practical setting for this research studio, which involves addressing the housing crisis with a specific focus on achieving carbon budget zero in the new neighborhood.

The approach taken by the research studio follows a chronological design process, beginning with an exploration of the context and background regarding building decarbonization. This phase involves an extensive literature review focused on strategies suitable for hot-humid tropical climates. It emphasizes passive design elements and explores biobased materials for their potential in carbon storage and environmental impact. The research aims to evolve material strategies to incorporate biobased approaches for future demounting and reuse. It includes an analysis of market materials and an inspirational case study review of global projects. A thorough examination of detailing with biobased materials seeks to deepen the understanding of their intrinsic qualities, minimizing

reliance on limited natural resources and fossil fuels while aiming to capture carbon in building layers. Ultimately, the project aspires to achieve carbon neutrality, hinging on a comprehensive understanding of the lifecycle of biobased and sink materials within the design process. The implementation phase relies heavily on Life Cycle Assessment (LCA) tools, which inform the design choices to lower both embodied and operational carbon emissions, reducing environmental impact from construction and facilitating paths toward carbon-neutral designs.

2.2 Work plan and implementation

Outline Calendar: The 16-week, 6-credit research studio is divided into the following modules/sections to build course concepts progressively:

Interaction #1: Hot Climate FL

Reimagining an affordable neighborhood as a carbon bank

MODULE 0. INTRO Strategies for Building Decarbonization M0 Carbon exploration.

Considerations for Building Decarbonization

Introduction to Embodied and Operational Carbon

Measuring Embodied and Operational Carbon

Carbon Reduction Strategies

MODULE 1. Material Strategy Circular economy

M1 Material Exploration.

material pallet material, ID card, material life cycle analysis. Product Stage A1-A3 case study and implementation

MODULE 2. Design Strategy Circular economy. Redefine affordable suburban housing.

M2.1 Urban Strategy.

Re-imagining zoning to formulate carbon-neutral neighborhoods. Carbon Sequestration and energy production on-site

M2.2 Design Exploration

Operational Carbon Strategies.

Embodies Carbon Strategies. Carbon sink layers

LCA Module D. Reuse-Recovery-Recycling potential

Emissions Calculations (embodied & operational)

M2.3Design Implementation

Circular Economy: Beyond the Life span -disassembly Measuring embodied carbon: LCA and GWP Analysis: Tools for quantifying energy usage and carbon accounting One Click LCA plugin & cloud. Sefaira– app/climate studio: operational emissions -renewables Visualization data: Carbon budget dashboard

Interaction #2 & 3. Cold Climate NY, Moderate Climate CA. Adaptive reuse transformations.

MODULE 0. INTRO Strategies for Building Decarbonization M0 Carbon exploration.

MODULE 1. Material Strategy Circular economy M1.1 Material Exploration. M1.2 Material Sourcing /Production On-site – VS Off-site MODULE 2. Design Strategy Circular economy. Redefine a new

use for sheltering.

M2.1 Deconstruction, Salvage, and Reuse Policies M2.2 Design Exploration M2.3 Design Implementation

04_READINGS & SOURCES

Books and essays

Designing Zero Carbon Buildings. Embodied and Operational Emissions in Achieving True Zero, by Ljubomir Jankovic **Carbon: A Field Manual for Building Designers** by Alan Organschi, Andrew Ruff, and Matti Kuittinen

Designing the Forest and other Mass Timber Futures by L.Wikstrom **Manual of Biogenic House Sections** by Lewis Paul Lewis, Marc Tsurumaki, David J. Lewis (Authors)

Energy and Design: Making Architecture between Metrics and Narratives, Columbia University GSAPP, David Benjamin (eds.)

Renovating carbon: Re-imagining the carbon form, by Erik L'heureux and Giovanni Cossu

Ending Fossil Fuels: Why Net Zero is not enough' by Holly Jean Buck Build Beyond Zero: New Ideas for Carbon-Smart Architecture by B. King and C. Magwood

The New Carbon Architecture: Building to Cool the Climate by B. King Emerging Ecologies: Architecture and the Rise of Environmentalism by Carson Chan

Landscape Design for Carbon Sequestration Thesis. by Deanna Lynn Digital sources

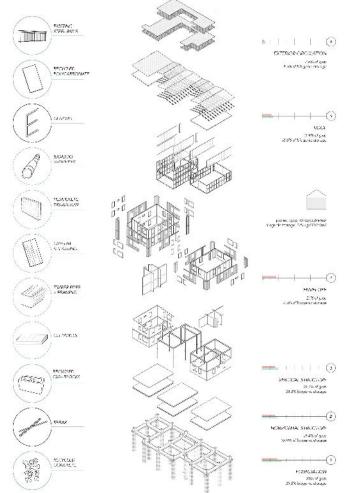
Architecture 2030. https://www.architecture2030.org/ 2030 Palette https://2030palette.org/

Carbon Smart Materials Palette. https://www.materialspalette.org/ Carbon Leadership Forum https://carbonleadershipforum.org/ IStructE https://www.istructe.org/

LETI https://www.leti.uk/wlcwebinarseries

Software tools

I tree & Pathfinder Software _ Sequestration on site. Sefaira software Energy consumption & Operational emissions One Click LCA plugin measures and reduces embodied carbon from predesign to practical completion. Stages A1-A5, B1-B7, C1-C4, and D.



Research Studio: Carbon Budget Zero. Climate Positive Fall 24. Prof. Sonsoles Vela. EXPLOTED AXONOMETRIC ASSEMBLY: LCA analysis. Undergraduate student: Sofia M Vladimir