Designing Urban Hybrids in Miami Beach for the 2020 to 2100 Food-Water-Energy Nexus

Climate Resilient Urban Nexus Choices (CRUNCH)

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Abstract

Miami Beach has already experienced how the comparatively small rise in sea level over the last few decades, combined with increasing precipitation can have dramatic effects on the lives of those living in such vulnerable areas. This submission describes all research design at FIU's Miami Beach Urban Studio exploring the nexus of food, energy, and infrastructure from 2018-2020. The design research focused on a low-lying area of the of Miami Beach, which is prone to sunny day flooding during King Tides. Based on a "living shoreline" strategy of biotechnological, adaptive ecosystems such as mangroves, oysters and coral clusters, projects were developed to combat sea-level rise by raising roads, building seawalls, and improving stormwater management infrastructure. All research design studios were based on approximately 80-year scenarios (2020-2100) in which modelling by NOAA, NASA, and IPCC place much of Miami Beach's existing infrastructure underwater. The study includes envisioning self-sufficient, adaptive, and resilient hybrid structures (both under and above water). All hybrid structures were benchmarked against 100% carbon-neutrality including algae farms for food and protein harnessing mixed and distributed renewable energy such as solar, thermal, and biomass; the conversion of solid and organic waste to energy; the conversion of solid and organic waste to energy; and wastewater to potable water on self-contained live-work hybrids structures. The biomimetic principles and concepts, fitness tests, biotechnological research, and synthetic biology-oriented building systems used in the research focused on carbon-neutrality targets so as not to further burden our planet with the human-produced causes of climate change.

Figure 1. Biology inspired CRUNCH design workflow diagram with open source GIS into Autodesk Infraworks, Civil, ESRI ArcGIS Pro, Revit-BIM, GBS-Insight360, Robotic-Structure, CFD, Fusion360, Dynamo, Grasshopper, Python, Pix2PixHD with Generative Adversarial Neural Network workflows for analyzing, coding, designing, scripting, and optimizations of cities and buildings. This includes carbon-neutral, resilient design studio scenarios from 2018 to 2020. Student work is shown by Sadiel Ojeda, Darren Ockert, Paulina Avendano, Barbara Coppola, Kevin Fernandez, Natalia Llamas, Andrea Ortiz, Patricia Ponce, Fall 2018. (PI Design Studios Prof. Thomas Spiegelhalter, Fall-Spring 2018-2020)

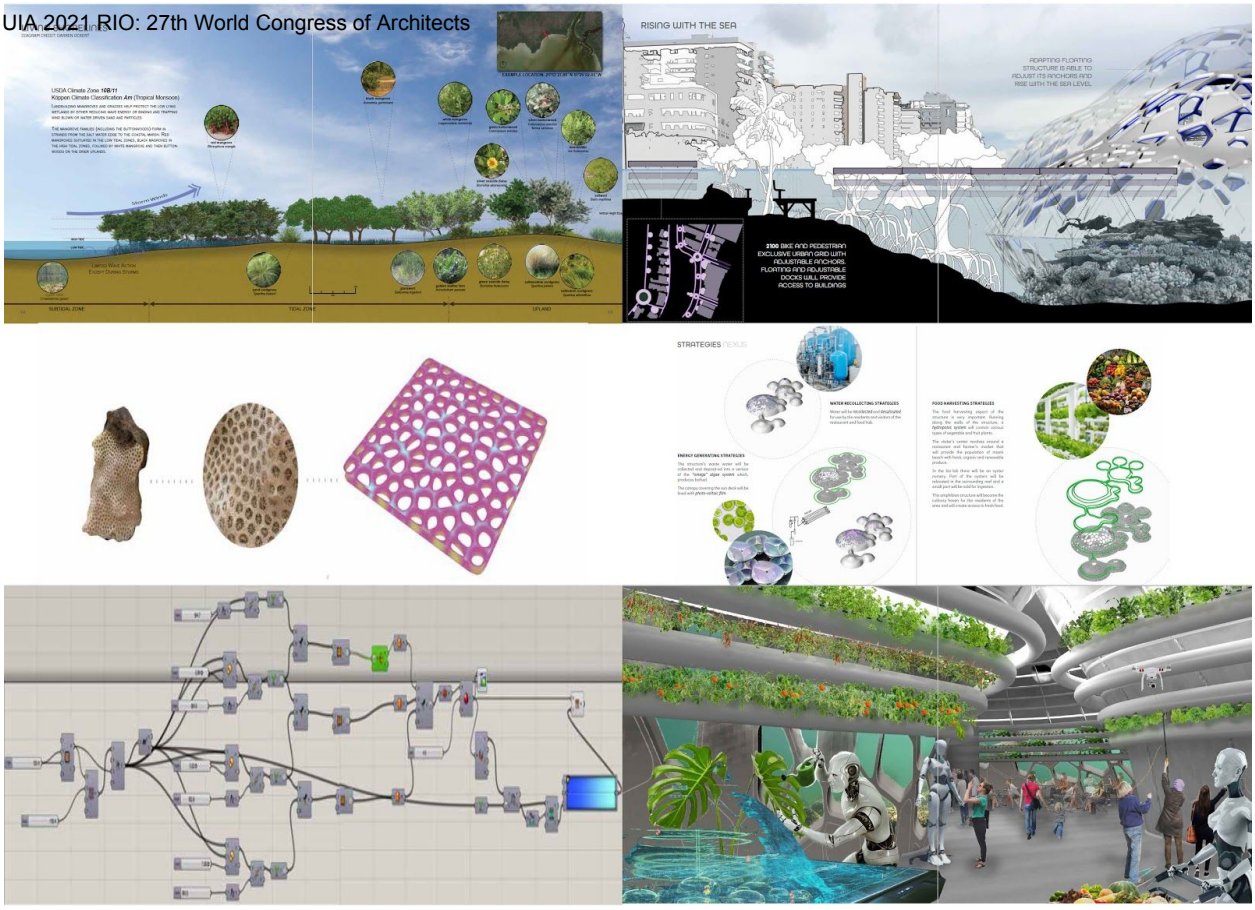

Figure 2. Biology inspired CRUNCH design showing adaptive green-blue infrastructures, living shorelines, hybrid live-work-science hybrids under and above inundated water bodies with food farming and renewable energy harnessing for the carbon-neutral powered floating and interchangeable structures. Student work is shown by Darren Ockert (upper left) and Paulina Avendano (all the other images). (PI Prof. Thomas Spiegelhalter, Fall 2018).

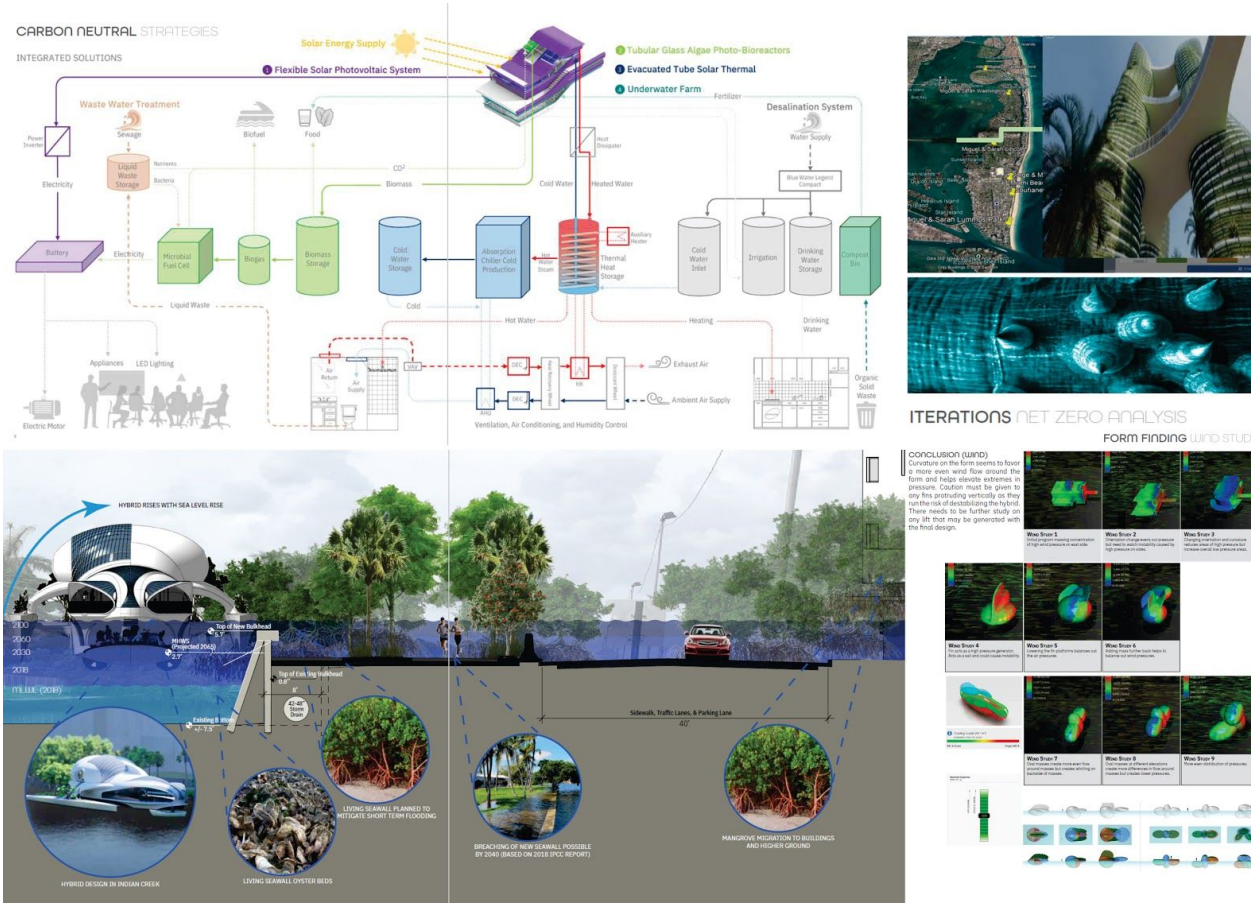

Figure 3. Biology inspired CRUNCH design showing adaptive green-blue infrastructures, living shorelines, hybrid live-work-science hybrids under and above inundated water bodies with food farming by Darren Ockert. and renewable energy harnessing for the carbon-neutral powered floating and interchangeable structures. Student work is shown by Barbara Coppola upper left), Alex Bahenski, Osvaldo Pereyra (upper right), Darren Ockert (bottom). (Design Studio PI Prof. Thomas Spiegelhalter, Fall 2018 and Spring 2020).