Master of Science in Architecture (Construction)
### *Honors theses*

From a sustainable design approach to parametric modeling and design tools: landscape art competition in the UAE
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The aim with this study was to make the integration possible between energetical and environmental sustainability aspects to digital design, using parametric design tools. The decision to deal with a thesis project related to engineering insights is gained by choosing a free participation contest, aimed at architects, designers, artists, which set a goal rather paradoxical, both for the requests and the context. The project site is located in the hinterland of the city of Dubai, UAE, nestled in the only protected natural area of the country: the pool of Ras Al Khor. All around stretches of concrete casting are irrevocably changing the morphology of this city grew up and started from scratch. The goal is the creation of a Landscape Art off-grid, while respecting the surrounding nature and its ecosystem. After a careful analysis of the site I moved to a concept phase that served to identify what was an original proposal for the area. The UAE is one of the countries in the world with the highest proportion of imported food, and this makes it necessary study the possibility of alternative cultivation, even in a climate so difficult. The idea was to create aeroponic intensive greenhouses, spread over a hilly terrain consisting of mild elevations that would promote the expansion of Wetlands and desert Sabka, as well as, in a longer time, even the vegetation of the mangrove in the natural reserve.
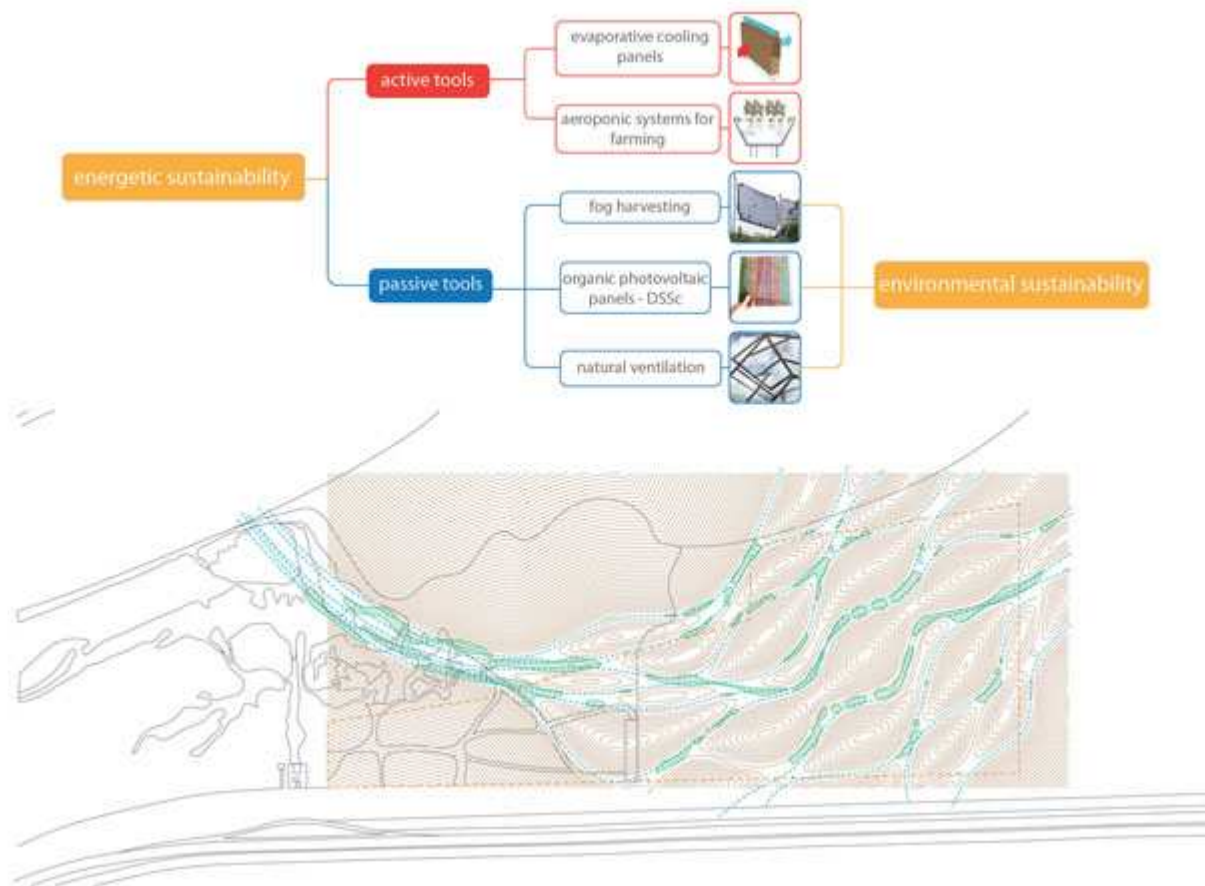
After deciding on the concept of the program, we have moved to the stage of calculation and dimensioning of a greenhouse type. Studying the climatic characteristics of the city it has become evident as the amount of the annual phenomena of fog was quite often to justify the use of this meteorological phenomenon to produce water by using the "Fog Harvesting" system. Having defined the necessary water requirements for two food rounds of aeroponic growing, thanks to some literature data, it was possible to trace a hypothetical profile of the gain of water from fog in Dubai and size the system for Fog Harvesting. At the level of air-conditioning, an evaporative cooling system was chosed and sized, because it is more economic and uses water for cooling. The power efficiency of the greenhouse is provided by solar panels and organic type DSSC, always with respect for the environment in terms of CO_2 emissions and environmental protection, as these cells are more environmentally friendly than silicon and has better aesthetic features that best suited the project concept.

solar panels DSSc
1003,37 m²
20,20 KW
panels efficiency 8%

23% aeroponic sys
77% cooling

natural ventilation
openings tot. 300 m²
(30% of coltivated area)

ETFE protective film
924 m²

evaporative cooling panels
73,86 m³
water consumption : 60,18 m³/day

underground water storage
6285,24 m³
18% aeroponic sys
82% cooling
(one year, 2 crop cycles)

aeroponic coltivations
1000 m²

fog harvesting mesh
250 m²

Based on these data, important considerations about the orientation came to promote the natural cooling (depending on the origin of winds) and the provision of more greenhouses within the boundaries of the site, with position and distance tested graphically and with CFD software. The landscape was generated from these studies, and it is the result of an algorithm that models the flat mesh building turning it into some mounds, where the greenhouses are located. The penultimate step was the construction of the parametric model of the greenhouse, which allows to have a single ranging model depending on the parameters obtained in the previous section dedicated to the calculations.

Further discussion was held regarding the construction phase of the greenhouse, in particular, attention was focused on the study of planarization of photovoltaic solar panels in a structure initially characterized by a double-curved surfaces, again thanks to the use of parametric discretization methods. Finally it was conceived the project of a tourist reception center, integrated into the landscape, which includes a museum dedicated to the natural reserve and a central outlet for greenhouses products.

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