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**PROJECT NARRATIVE**

**Design concept**

*Dig/Dug City* is conceived of as a vast eco-city formed by casting thin shells into sculpted holes in the ground. The construction process will start by digging a field of mirrored concave holes, ranging from 4-10 feet deep. These holes will then be cast with either concrete or paper. Next, the casts will be removed from their respective holes and flipped over to form duplicate, bulbous shells. Finally, the shells will be moved on top of their matching formwork, letting the inverted form of one hole become a paraboloid cap to the other that encloses the structure.

Together, the holes, matched with their respective shells, create a series of semi-subterranean structures in which the negative and positive expressions of a series of excavated forms take on a reciprocal relationship to create multiple habitable spaces. The result of this process is a formal and phenomenal experience derived from the earth itself.

**Technology**

The design seamlessly integrates old-wisdom of building and vernacular techniques with cutting-edge sustainable technology to create an environmentally sustainable project from construction to habitation. The structure builds off a history and practice in the desert of earth casting, a process that involves casting thin shells in sculpted holes in the ground. However, whereas typically the earthen formwork is filled in after casts are created, our concept instead proposes to utilize the subterranean holes that the shells are cast in as part of the design—creating a closed-loop construction process in which nothing is wasted, and the scale of construction and material use is cut in half.

Furthermore, the project proposes to not only condition the site with a field of environmentally-sensitive, thermally-temperate paper and concrete interior spaces, but to convert the entire exterior of this large architectural array into a performative landscape for sustainable energy generation. The project proposes to deploy Paper Photovoltaics, an emerging technology of solar power generation, on a massive scale; layering lightweight, flexible solar energy cells as a coating in the terminal step of the fiber-forming construction process of *Dig Dug City*. The Paper Photovoltaic, which has been developed by engineers at MIT's Photovoltaics Research Lab, is a low-cost, high-sustainability energy generation solution which eliminates much of the weight, material and transportation cost of traditional PV panels by simply swapping out the conventional substrate of the voltaic cell from glass to paper. The flexible paper cells can be easily folded, rolled, and packaged, making them easily transported and installed in remote locations. In ambient light, a 7cm x 7cm array of pvs printed on paper can generate 50volts a day, or enough to power a personal device. With close to 50million cm2 of exposed roof surface area, the *Dig Dug City* Paper PV Array will produce enough energy to provide conveniently for the power needs of its inhabitants sheltered locally, as well as share power with future projects or developing infrastructure at the Fly ranch site.

**Materials, dimensions, and supported activities**

The *Dig/Dug City* program is composed of two building types, housing units and multipurpose community centers that will each be cast from varying materials at different scales.

The larger aspect of the program, the community centers, will be cast from concrete so as to maximize structural efficiency while simultaneously reducing the amount of resources spent. A conventionally designed concrete structure of this scale would typically use over twice the amount of material that is used in Dig/Dug City. Through the utilization of the earthen formwork as part of the building structure and the geometry of the shells (domed shells are some of the most efficient structures in the world, both in terms of tectonics and material use), we are able to build the structures with approximately one third the material of a typical concrete building. The three community centers will each be formed by two mirrored holes measuring approximately 10 feet deep and 50 feet long with an average footprint of 3,000 square feet.

The smaller—but collectively more vast—aspects of the program, the housing units, will be cast out of a fiber-based material we have been developing over the last year that consists mostly of recycled paper products (see board 3). The 30 housing units will be arranged by a mix of one to three holes combined with their respective shells and will range in occupancy from one bedroom (average 800 square feet) to two bedrooms (average 1,200 square feet).

**System inputs and outputs**

The design is conceived as a closed-loop system in which no waste is generated. The structures utilize vernacular techniques, including thermal mass and geothermal energy, to maintain comfort levels. Half of the building volume is submerged underground, using the earth's consistent temperature to passively cool the building in the summer and warm it in the winter. Other passive systems such as self-contained sewage and rainwater collection likewise reduce environmental impact. Daily maintenance will be upheld by those dwelling in the structures, carrying on a Burning Man tradition of personal responsibility for waste disposal and general cleanliness.

The most significant innovation of the project comes from the implementation of imaginative material and construction technologies. All of the community centers will be cast from concrete through a process that actively cuts the typical material usage for buildings of a similar size by two thirds. By casting the top portion of the houses in the semi-subterranean basements of their neighbors, it allows us to cut material use while also keeping construction at a manageable scale without the need for industrial equipment. Additionally, all housing units will be constructed with recycled paper products as the primary structural and formal material. This way, the buildings are not just sustainable but regenerative in the sense that they will remove excess material from circulation in an unsustainable economy of waste. What's more, all of the excavated dirt displaced by the digging of the holes will be used to engage community involvement with the masterplan by either; one: mixing the dirt with mineral-rich soil in order to recondition the site to host small-medium sized plants, and to facilitate the conditions for community gardens; or two: educating residents in the art of earth-cast ceramics so as to generate a small trade of crafts to be circulated internally and exported as goods.

**Conceptual cost estimate**

Preliminary material tests of the fiber domes placed estimated costs for a fully serviced two-bedroom housing unit at approximately $60,000, not including labor. Preliminary estimates for one fully serviced community center place costs at $76,000 each. With these estimates, we anticipate the total cost for the project, as specified in the design package, at around 2.5 million dollars. However, the nature of the design lends itself to a flexible construction process executable at myriad scales. We see the design as something that could grow over many years as the scale of the Fly ranch project expands in the coming decades—starting with one prototype, and growing over time into a lively neighborhood of houses and communal spaces.

**Strategy for on-site prototype development**

If chosen, we propose prototypal construction to focus on the technological development of the first community center, central to the organization of the larger urban plan. We will plan and build a one-third scale version of the community center with limited services to show the viability of cast-in-place concrete construction. The end result of the prototyping will be a fully functioning community space that could tie into the larger master plan.

**Environmental impact summary**

The goal of *Dig/Dug City* is to transcend “sustainable design” in its goal to achieve neutral environmental impact and to actually give back to an environment that has already undertaken a massive negative impact. With the project, we want to ask the question: how can humans start to reverse the damage we have done to the environment, not just by making better buildings, but by fostering a situation to encourage people to live more sustainable lives. The worth of the planet is not measured in money but in all our lives, and the lives of our children and grandchildren. Thus, the onus is on the generation of humans living now to create cities and environments that can coexist with natural systems long-term.

Dig/Dug City works to achieve these goals by implementing multiple innovative construction, material, and formal techniques. The implementation of recycled materials into the design is one critical aspect of this. With our methods we plan on building over eighty percent of the masterplan infrastructure using recycled products as a primary structural and formal materials. Furthermore, the nature of the design allows us to use less than half the material of a normal plan of this scale—simultaneously reducing the amount of labor, material, and money required to undergo the project. Finally, the formal language and passive systems used in the design encourage people to reimagine how they live out their lives on a day to day basis—going beyond sustainability in a technical sense to also one of lifestyle and spirit.