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Aero-Architecture “Visualizing to 2nd life of Commercial Airliners”

Recommissioning, Reclaiming, Redesigning Commercial Airliners into Resilient Spaces

Introduction

Hidden and forgotten in the southwest deserts of the United States, away from public view and discourse, are the anonymous airplane graveyards, with their expanding area and ever-growing numbers of obsolete airplanes dating back to the Second World War. The once majestic and most advanced technological inventions of mankind are discarded to decades of slow erosion by the sun and the wind. Last year, an interesting article titled “The Boneyard - - Old jets are retired to the New Mexico desert” appeared in the 05/13/16 issue of USA Today by journalist Ben Mutzabaugh in which he eloquently describes the boneyard adjacent to the Roswell local airport. The article presents an exhibit of retired airplanes from the Boeing 777 to the 727 and other planes, like “the red 1962 Lockheed Jet Star JT 12-5 that once flew Elvis”. Ben continues to describe the site as a popular tourist destination for observing the decaying and exposed airplanes as an airplane cemetery museum that brings back “lot of memories” of our aviation history. For architects, this junkyard is an untapped resource ready to be reshaped, reused, and brought back to life. A potential refuge, a new line of furniture, a new housing typology, and many other visions are possible second lives to be created from these obsolete airliners.

It has also been 15 years since Architect William McDonough’s visionary book “Cradle to Cradle” introduced a new model and approach to existing manufacturing and design. He produced the Hanover Principles, “a set of statements about **designing** buildings and objects with forethought about their environmental impact, their effect on the **sustainability** of growth, and their overall impact on society”. Professor Paul Laseau’s books, “Visual Notes” and “Architectural Drawing”, on visual thinking, studies the subject of visual acuity, the ability to see more in what we experience or observe, and the methodology to integrate that process clearly and accurately for others to understand. So the process and value of reusing and recycling become important components in architecture as we design new environments, in combination with our ability to visualize and communicate these concepts. Also embedded in this sustainable second life concept is another challenge: resiliency.

Excessively violent storms are becoming a more frequent occurrence in our weather patterns, and our architecture is not up to the task of combating their damaging forces. Buildings are swept away in floods and hurricanes, blown apart in tornadoes and straight winds, crumbled by earthquakes, and torched in forest fires. Resilient architecture needs to be investigated, created, and built in order to live safely in our climate-change environment.

These are the two challenges that have been the mainstay of the Aero-Architecture studios conducted at Ball State University’s College of Architecture and Planning. The studios were able to build a design vocabulary of using airline parts as primary building materials in creating innovative and resilient architectural spaces, and finding a variety of reuses for these forgotten airliners. The resultant student projects were first informally introduced to a group of young aeronautical engineers working at Boeing, as well as the chief engineer of the 747- 800. They encouraged us in the continuation of these projects, and invited our students to visit the assembly plant in Everett, Washington, where they were introduced to aero technology, airplane components, assembly logistics, new materials, and integral design methodologies. The plant tour also allowed students to see the process of manufacturing commercial airliners, and gave them close-up opportunities to examine the scale of the components that make up the aircraft.

The paper will present five years of aero-architecture through graphic communications of the graduate studios that utilized the airplane bone yards to reinvent the obsolete into state-of-the-art living environments and create a second life for the Boeing Commercial Airliners. The communication challenges were to illustrate the continuous value of aeronautical engineering, to demonstrate the endless opportunities of the second life of airplanes, and to visually address the resilient challenges of future climate-change environments.

The Studio Brief

The architecture graduate studio design challenge was to invent a second life for the Boeing Commercial Airliners. The studio engaged in the challenge to program, develop and design contemporary sustainable habitats by utilizing the components of the decommissioned commercial airliners as primary material for the projects.

The Program

The design studio began with a visit, via Google, to airline graveyards in Arizona, during which they investigated particular models and then reinvented the obsolete into state of the art habitats and created a second life for the Boeing Commercial airliners. The challenge was to define and redefine these once majestic ships of the sky and transform them into sustainable living spaces on earth. The projects began in the research stage (team process), with the analysis and the investigation of airplanes, and terminated with individual design solution of architectural form, space, and technology.

The other design research component was the analysis and understanding of extreme weather patterns, environmental forces and the destructive effect they have on architecture.

Fig 01 Airplane Boneyards

The First Project

The first project was to utilize, reinvent, and reform the fuselage into a new urban architectural environment, integrated with layers of sustainable architectural concepts for contemporary urban living patterns of working, living and playing. These projects were then presented and critiqued by Aeronautical engineers at the Boeing Assembly Plant and in the Future of Flight Museum in Everett, Washington.

The studio then received a plant tour in order to gain more understanding of the scale, technology, and assembly of the planes for their second studio project. (Plant photographs by Boeing) The tour allowed students to see the process of manufacturing commercial airliners, and gave them up-close opportunities to examine the components that make up the aircraft.

The Second Project

The second project is to respond to the gained knowledge and experience of the tour and engagement from the Boeing Plant visit and the Boeing presentation and discourse. Student then design more integrated systems of the utilization of airplane components.

Below are a few examples of the students’ projects and the added value they incorporated into their designs.

Fig 02 proposed disassembbly plant and design studios

Aeronautical Disassembly and Research Facility by Joshua Stowers

Have you ever wondered what happens to a retired aircraft, especially the commercial airliners? Well, many end up in the desert, useless and abandoned. But why? Few facilities exist to disassemble an aircraft, but those that do rip and shred the airplane into useless chunks of scrap material. Why not recycle parts just the way they are?

Commercial airliners are assembled similarly to cars, right on an assembly line, albeit a slightly bigger one. With all their pre-made component technologies integrated into the construction of an aircraft, why not simply reverse-construct the plane? The Aircraft Fleet Recycling Association has already set goals and standards for aircraft disassembly, but why not go further?

In business, money is everything, and an aircraft’s scrap value alone does not justify the cost of cutting it apart. So how does one overcome this? By producing an environment that encourages the creative reuse of airplane parts and materials for manufacturing products and incorporating them into architectural design, decommissioned aircraft would have enough value to economically justify their disassembly.

A zero-waste disassembly plant would provide refurbished airworthy parts back to the airlines, provide raw materials for an on-site manufacturing facility, and ensure every scrap is recycled. Attached to the facility, an education, training, and research facility would incubate entrepreneurs, provide a platform of opportunity to researchers, and be the center of the discussion for spearheading efforts of sustainability after the useful life of aircraft.

By establishing added value to the process, this facility makes possible the tools, space, and leadership needed to create and establish new uses for aerospace technologies. The aim of this facility is to be a platform where all the other projects in this paper become possible, by providing the opportunity and means for their construction.

Fig 03 a rescue and medical module

Extreme Environmental Medical Response Module by Lucas Holwerda

Past research has shown that disaster response times and relief housing alleviate fears and concerns about safety and health in post disaster scenarios. While the relationship between housing and physical health has been the focus of considerable research, healthcare design and deployment—which are especially necessary in mitigating long term injury—have received much less attention. This study examines the issues of disaster response and deployment design through research of healthcare response in real disaster scenarios. I believe the findings will show that thoughtful design through empirical evidence, interviews, and working knowledge of healthcare programming can result in shorter response times and better health services immediately following catastrophes. In addition, only a handful of agencies currently have programs that target the health and security needs of disaster victims. This research suggests that there is a significant mismatch between healthcare knowledge and healthcare design response in disaster settings, which perhaps require exceptional response the most.

Utilizing case studies of organizations providing medical response in Haiti such as the United Nations Educational, Scientific and Cultural Organizations (UNESCO), The Red Cross, AmeriCares, and the United States Military, we can begin to gain insight into how response times for adequate medical care may affect social justice in post-disaster communities. In addition, a site visit to Haiti in March of 2013, three years following the earthquake disaster, provided opportunities of conducting observational research, as well as the implementation of interviews with local citizens and organizations such as the aforementioned case studies.

Through the use of Post Disaster Response Evaluations (PDREs) and literature reviews, policies and resulting designs appear, which inform how a responsive design may provide adequate medical response, and supports facilitating and alleviating concerns of inadequate social justice while generating a means of mitigating medical response that place citizens into categories (i.e., amputees) that root social stigma.

This design initiates the real-life concern that simply a quick response in catastrophic scenarios is not enough. An empirical approach towards medical response design, coupled with an understanding of local social belief systems, provides a framework for drastically improving the lives of the vulnerable stakeholders in disasters.

Global disaster search and rescue module by Daniel Potash

The Global Disaster Search and Rescue Module is a new alternative to traditional search and rescue operations. Utilizing existing aviation technology and products, these modules provide search and rescue teams with everything they need to operate in post-disaster situations. Due to the existing engineering capabilities, these modules are designed to withstand extreme conditions including the potential after-effects of a disaster. With the frequency of natural disasters increasing, these modules would be stationed around the world to be ready at a moment’s notice. The Global Disaster Search and Rescue Modules will make the jobs of rescuers easier, therefore saving more lives faster.

Fig 04 coastal resilient housing

Aero BLOC, Resilient coastal housing, by David Smith

The Aero Bloc is a modular community, designed for a new breed of urban dweller. Recycled 737 fuselages provide the container for the modules, which can provide shelter for living, growing, retail, and many other uses including outdoor green space. Each module is designed to be entirely self-sufficient. Through the incorporation of efficient and smart systems the modules gather their own energy, collect water, and provide a dynamic pod for occupation. The entire complex grows organically based on need and input from the client and environment. Basic cellular rules for growth, architectural guidelines, and client needs determine the placement of the module in the Bloc.

The modules are prefabricated in a facility off-site, and delivered via barge or truck to the site. Before delivery the modules are completely finished according to client and engineering specifications, and upon arrival the integral crane automatically lifts the pod into place before a small team easily installs them into the superstructure. What is created is a complex network - a hive - of urban communal space. The superstructure provides a “quick connection,” or a port where the modules can be plugged in and unplugged easily. This design allows for the easy mobility, high quality and efficient production, and flexibility of the structure. The pods are made to be able to be relocated if needed with simple means, and the 737-fuselage size allows it to be transported with most means.

The modular system and self-sufficiency also allow the Bloc to perform well in times of disaster. The Bloc is meant to resist the damages caused by flooding. The modules can be lifted to a higher placement as waters rise, and their on-board energy harvesting and water systems allow them to sustain themselves when infrastructure fails. The module itself is strong and resilient, and can resist the damages caused by high winds and water damage, and if the modules are damaged, they can easily be replicated and replaced.

Fig 05 tornado responsive architecture

Tornado Refuge by Glen Cramer

Every year, many people are killed or injured by tornados. Building collapse and flying debris are to blame. Suburban communities located in tornado alley are at a high risk of such destruction.

After being devastated multiple times in the past decade, Moore, Oklahoma is in desperate need of a stronger and more robust school to resist the next storm.

This school and community center sits next to a large suburban neighborhood with little or no protection. In the event of a likely storm this building will serve as a tornado shelter for those residents as well as a safe haven for the students and staff.

Fig 06 inserting and folding plane components

Inserting and folding of airplane components by Tara Murphy and Alexis Flowers

On March 2, 2012 an F3 tornado ripped through the small Indiana town of Henryville and destroyed their K-12 school. The storm caused considerable damage and left the educational facility in disrepair. The project inserts resilient airplane components into the redesign of the school that would create a more protective environment against future storms and create a unique educational environment.

By folding airplane parts, an exterior multi functional community facility is developed in an inner city neighborhood. The folded spatial composition allows for seasonal festivities, public markets, evening venues, and a variety public play.

Fig 07 aero architecture housing

Aero-Architecture Housing by Eric Bearman and Miguel Ramirez

New suburban and urban housing topology are designed by utilizing airplane parts in a variety of methods that result in more integrated systems and have the capacity to weather more violent storms. The parts of the fuselage will function as a safe room and the wings as a roof and water collection/storage system. The wings can also become aerodynamic structural walls to divert winds and collect energy. The concept is to convert a typical static house into a dynamic energy-producing facility for contemporary suburban and urban living environments.

Fig 08 fire resistance

Fire Resistant Habitats by Morganne Walker

Wildfires, whether caused by nature or man, have destroyed millions of acres of forest, wildlife, and human dwellings and will continue on that path for years to come. This project looks into the possibility of being able to design a habitat that can survive a wildfire. By using the three-layered structure of the airplane engine as a main refuge against the heat of a forest fire and wrapping and extending the living unit with a sacrificial outer core of a recycled fuselage, one would be able to survive the fire and rebuild the dwelling after a major fire.