

ABSTRACT

Title of Thesis: PAPER RECYCLING MILL: A SUSTAINABLE EDUCATION
CENTER IN SAN JUAN, PUERTO RICO

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By the 1960's a sub-urban lifestyle had taken over the island of Puerto Rico, bringing with it cars for everyone and a culture of consumption. Today the population has grown with such rapidity that an uncontrollable amount of garbage is being generated. This is an overwhelming concern for an island that measures only 35 by 110 miles.

The goal of this thesis is to design an industrial building that tackles the need for proper waste management on the island. The premise is to recycle at three scales landscape, building, and material.

This project seeks to transform the former foundry, commonly known as *Fundición Abarca* in San Juan, Puerto Rico into a paper recycling mill. By studying the correlation between "recyclable" buildings, cultural landscapes, and the recycling process of solid waste, a paradigm for a new sustainable culture can be created before it is too late.

PAPER RECYCLING MILL: A SUSTAINABLE EDUCATION CENTER
IN SAN JUAN, PUERTO RICO

by

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DEDICATION

To all the people who ride the bus

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Introduction

[“Yes, they tore down yet another mountain”. “But why mom?” “It is for new developments, new big houses, they will have air conditioning, glass windows and flat roofs”. “But what will happen to the trees, that were there mom, what will happen to the birds, the animals and the ‘coquies’ that were there mom?” The little girl looked puzzled out the window of the air conditioned car wondering why they had to be stuck in traffic when they where only going a short distance.]



Figure 1 New development sequence.

Top- Untouched land, Naguabo, Puerto Rico. Middle- Housing project under construction, Ceiba, Puerto Rico.

Bottom- Strip Mall and parking lot with housing project in the background, Carolina, Puerto Rico.

This is a typical sequence of any new development constructed at the outskirts of a city in Puerto Rico. *Photos taken by Arturo Bird-Carmona*

The focus of this thesis is to address through architecture one of the current most critical environmental problems occurring in the tropical island of Puerto Rico. This problem is the excess of garbage. What to do with it, where to put it, and how to manage it. As the quantity of waste increases and urban sprawl rapidly takes over the island's natural resources, urban centers become uncared for, increasing the number of abandoned buildings. More and more undisturbed land is being developed in a greedy, foreign, and inharmonious manner; while buildings in cities are left forsaken, to rot and become dangerous areas. Meanwhile the culture of consumption increases, which is dictated by fashion and the image of progress.

The intent of this thesis is to create environmental awareness, to demonstrate to the community of Puerto Rico a conscientious solution of recycling and sustainability. By designing a paper recycling mill on a neglected site that holds an ignored historic building of valuable heritage for the island; real issues of recycling will be addressed. In this thesis recycling is presented at three different scales, the smallest scale is based on materials, the second revises buildings, and the third scale studies sites or cultural landscapes.

Chapter 1: The Truth about Recycling

Recycling

“Recycling” has become a common term used more and more everyday. It is a term used both in households and communities, by professionals and nonprofessionals, for education and as well as for economy, but has it really been justly used given its significance. What is the significance of recycling? What does the act to recycle imply? What does the word “recycle” mean?

The *McGraw Hill Recycling Handbook* defines recycle as “to separate a given material from waste and process it so that it can be used again in form similar to its original use; for example, newspapers recycled into newspapers or cardboard.”¹ It defines recycling as “the act of extracting materials from the waste stream and reusing them”.² In the book *Big and Green: Toward Sustainable Architecture in the 21st Century* recycling is defined as “a series of processes (including collection, separation, and processing) by which products and raw materials are recovered and reused in lieu of disposal as solid or liquid wastes.”³

What is important to note and understand is that recycling is compromised by a full cycle, as the word itself suggests. To [re]cycle is to submit to a cycle once again. A cycle is “a period of time occupied by a series of events that repeat themselves regularly and in the same order”⁴. The process of [re]cycling starts off with the recollection of materials prior to reaching the waste dump. The materials collected are sent to what is commonly known as a Recycling Center. Here materials such as paper, plastics, and metals are divided and put into categories. After materials have been properly grouped

they are then sent off to Recycling Mills or Recycling Plants. These are the facilities where materials will be transformed into a new product.

There are three different categories of recycling. “Primary recycling” refers to the remaking of a material into the same material, for example remaking a glass container into a new glass container; it is a process that can be repeated. “Secondary recycling” refers to the process of remaking a material into a new different but related material, for example a newspaper can be recycled into cardboard, which can again be recycled into another material of lesser quality. “Tertiary recycling” employs the act of recycling only once, where for example paper can be recycled into tissue paper.

The history of recycling is long and straightforward. If followed closely, a logical sequence can be discovered starting with the concern of where to dispose of waste and how to manage it, to the present in which there exists a variety of institutionalized recycling and collection programs. Why does the process of recycling take so long, from when it is disposed by the consumer’s hand to when it is put on the shelf for selling? Is there a way to facilitate this process? Can this time consuming process become life threatening if not stopped and treated urgently?

The modern day recycling movement in America started only 34 years ago on April 22nd 1970 with the creation of Earth Day when the concept of recycling was introduced to the general public. The Environmental Protection Agency was also created that year, an organization dedicated to the protection of the natural and built environment.

Today a wide variety of materials can be and are recycled. The most common recycled materials are paper, cardboard, plastics, aluminum, steel, and glass. It is no coincidence that these materials are the most recycled because they indeed are the most

wasted. Other materials that are currently recycled are electronic devices such as computers, also carpets, textiles, tires, batteries, and construction and demolition remains.

Recycling in Puerto Rico

The history of recycling in Puerto Rico has generally followed that of the United States. No real consciousness occurred till the decade of the 70's. The first important fact to be mentioned is that Puerto Rico is an island of only 3,300 square miles. The population is nearing four million people, approximately 1,100 people per square mile⁵ which makes Puerto Rico one of the most densely populated countries in the world. Puerto Rico fits sixteen times in the State of New York and nineteen times in the State of Florida.

A second essential fact to mention is that in Puerto Rico 8,100 tons of waste is generated per day⁶ of which one person can generate around 4.9 pounds of waste per day. From the amount of waste generated 81% can be recycled, reused or reclaimed. How did Puerto Rico become a country in which enough garbage is created that could potentially fill up a fifth of the island in six years⁷? How can this "culture" of waste generation be stopped?

The management of waste is similar to that of a country that has a population density of 76 people per square mile⁸, the United States. Should Puerto Rico's waste management be treated in the same fashion as in the United States? What is the relationship and what are the consequences between a very densely populated island and the amount of garbage created by its people?

During the last sixty years Puerto Rico has gone through a series of sweeping changes that have left little remains of what the island once was. From an island surrounded by abundant clean beaches, covered with a wide variety of flora and fauna, and a rich culture of leisure and agriculture it has morphed into an industrial high technological society. The population doubled from just over two million in 1950 to almost 4 million in the year 2004⁹. During the 1970's with the introduction of Levittowns¹⁰ the suburb was created. The construction of highways and streets sponsored by US agencies, facilitated interconnection in the island in a way never possible before. There was now a car for every two people.

The culture was and is changing imitating more and more the culture of the United States with all of its inherent problems, but at the same time it is losing the uniqueness that identifies it. The significance of growing up and living on an island is strongly tied to images and thoughts of safety, of being untouchable, and disassociated from the rest of the world. It is not a surprise that the everyday Puerto Rican refers to the world and specifically the United States as "allá afuera", meaning "out there", as in not "in here".

The progressive movement that the island has gone through has made its residents think and believe that they are living in a highly developed country, feeling free to consume as desired. Thus a culture of uncontrollable consumption was formed. What does this mean for an island so small? Is it possible to consume and dispose freely without consequences? The following chart offers insight on what this means.

Waste Generation vs. Country Size			
Country	Waste (Kg/ person/year)	Area Square miles	Percentage %
Puerto Rico	812	3,435	24
United States	701	3,618,770	0.02
Canada	646	3,831,033	0.02
Norwich	512	125,182	0.4
Netherlands	484	15,770	3
Luxemburg	436	998	44
Germany	417	137,857	0.3
Switzerland	406	15,941	3
Japan	400	145,875	0.3
Austria	367	32,377	1
Belgium	358	11,783	3
Denmark	351	16,638	2

Figure 2 Waste Generation vs. Country Size Table

Source: La Isla Desechable: El Problema de la Basura en Puerto Rico p. 10 Percentage column added by author.

By looking at the percentages presented one possible conclusion may be deducted. The first countries that will suffer the consequences of extreme waste generation will be those that are smaller in area. Possible consequences are shortage of livable necessity of land, natural resource contamination and extinction, cultural resource elimination, human health pollution, and scarce sources of food. In other words something must be done sooner than later.

In order to help change this “culture” of disposable things the first thing the people of Puerto Rico have to realize is that the island is small, very small, there is a very limited amount of land and space. The second thing to realize is that the island is not big enough for its three “most important” components, people, cars, and garbage. Importance in this case is defined by the rapidly growing majority. Indirectly this fact

indicates that garbage is more important than the environment itself. This is a real problem, the number one environmental problem which not only affects the well being of the environment but also the health of people and culture. This relationship of “importance” should be reversed.

Recycling Paper in Puerto Rico

The waste generated in Puerto Rico is composed by five main materials. These are paper and cardboard with 40.2%, food and garden waste 27%, glass 11.5%, metals 10%, plastics 9.2%, and others 2.1% ¹¹. Paper is used on a daily basis in many forms, newspaper, for office use, for educational purposes, for commercial purposes, and various forms of cardboard are mainly used for packaging. In Puerto Rico more than 1,800 tons of waste paper is generated per day, from which 500 tons is newsprint. ¹² Paper is created from trees, 24 trees can produce one ton of office paper, 12 trees can produce one tone of newsprint; inversely one ton of recycled paper can save up to seventeen trees. ¹³ If 100% of the waste paper generated is recycled then approximately 28,900 trees can be saved per day, which is equal to 20,230 acres of land.. Where does the paper in Puerto Rico come from? How does the generation of waste in Puerto Rico affect other countries?

Only nine paper recycling center currently exist in Puerto Rico. These are dedicated to shredding, sorting, and packaging paper. Eight of them are located in the San Juan-Carolina-Bayamón Metropolitan Area, cities where the majority of the population resides, and five are in the municipality of San Juan.



Figure 3 Map of Puerto Rico showing location of recycling centers.

The majority are located in the San Juan-Carolina-Bayamón Metropolitan area. Municipalities with dots indicate a paper recycling center.



Figure 4 Location of Recycling Centers in the center of San Juan.

Black dots indicate Recycling Centers; grey dots indicate Paper Recycling Centers.

But none of these process

the paper in order to produce a new material. Instead the recycling centers are dedicated to the recollection and sorting process of paper, it is then packaged and shipped to Venezuela and the United States to be recycled. Similar procedures occur with plastics, metals, and glass. None of these materials are recycled in the island, the reason being that there are no recycling mills in Puerto Rico.

	Bayamón	Caguas	Carolina	Cataño	Guaynabo	Hatillo	Ponce	San Juan	Toa Baja	Trujillo Alto
Paper, Metals, Glass	Industrial Fibers Corp; Pronatura; Scorpio Recycling; Waste Disposal Management	Industrial Fibers Corp; Onyx Environmental Services LCC	Landfill Technologies; Multi Recycling System Corp; Southern Recycling Inc.; Universal Recycling	ARB Recycling		Recyclaje del Norte		EAC of PR; Industrial Fibers Corp.; Island Festival Recycling; Peoples's Recycling Peninsula Canter Inc		Sani Plant Co Inc
Paper		Federal Land Bank Associates; Papiro Inc.	Cartonera de Puerto Rico Inc					Confidential Data Destroyer; Shred-it		
Metals		Borinquen Metals Scrap Corp	Isla Bonita Metal							
Fuel/Oils			Southern Recycling Inc		GSI Environ. Services		Ponce Saftey Oil Cleaners	Alternatives Fuels Inc.	Grasas Sevilla Inc	
Asphalt			Better Recycling Corp							
Medical			Caribbean Polimedics DBA					Santurce Metal & Bag Co Inc		
Structure	Estructuras Ambientales (PV)									
Luminaires	Lamp Recycling Company									

Figure 5 Table of existing Recycling Centers in Puerto Rico.

There are three recycling programs in Puerto Rico. The Bluebag Program which depends on household individual sorting their waste and putting them into bluebags, leaving them in the front lawn to be collected by a municipal truck. Currently there are 219 communities in 64 out of the 78 municipalities that participate in the Bluebag

program¹⁴. Unfortunately most municipalities do not have where to deposit the Bluebags, which sometimes end up in clandestine waste dumps. The second program is known as Deposit Centers. Individuals personally deposit their recyclables into deposit center located at shopping mall parking lots. 67 municipalities participate in this program, but only 33 are permanent centers¹⁵. The third program is the Collecting or Recycling Centers, this is where waste is sorted and packaged.



Figure 6 Deposit Center Bins

This proposal responds directly to the largest component of waste materials, paper; and suggests that it can create a new level of environmental consciousness, a new recycling industry for Puerto Rico. Can a small island take care of the waste it generates without having the need to export its problems and responsibilities to other countries? Is there a place in the economy for recycling mills?

The Process of Recycling Paper

The process of recycling paper is composed of essentially five steps after being recollected, sorted, and transported to the recycling mill. It is first deposited into a hydropulper or “giant blender” from a conveyor belt. In the pulper, paper is mixed with extremely hot water. In the second step the pulp passes through a series of filters that extract scrap such as tape, staples, glues, and biodegradable waste unfiltered at the sorting

center. Third the pulp which is now 99% water and 1% stock is dropped on a moving wire screen belt which drains the water leaving only the fibers. The fourth step before being put into rolls consists of a number of inline steel drums that act as steaming heaters. The steam evaporates the water in the fiber until there is only six percent of water in the new paper stock¹⁶. Finally the paper is put into rolls and packaged for a new use.

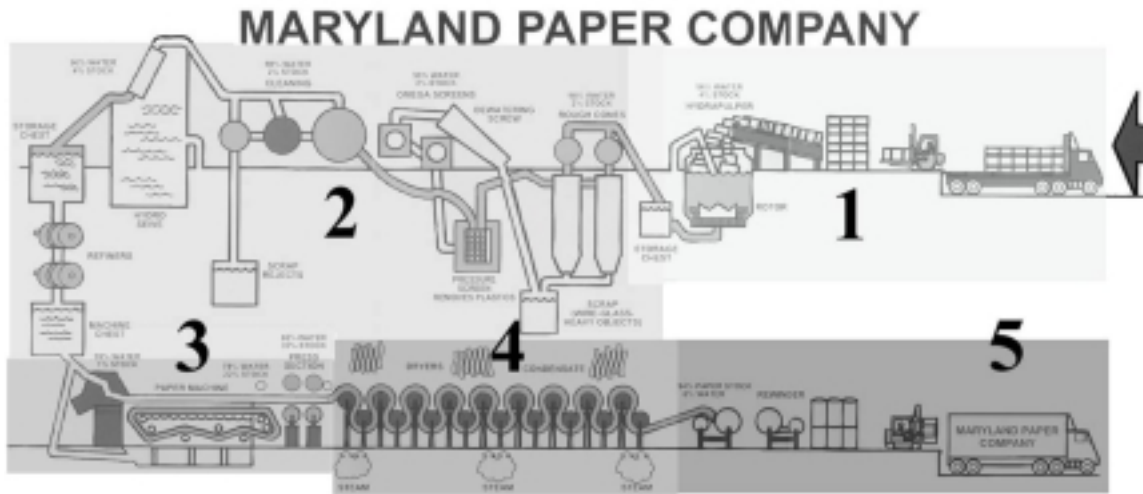


Figure 7 Diagram of recycling paper process.

Five main steps of recycling paper. 1- “blending”, 2- filtering, 3- draining of water, 4- drying by heat, 5- rolling and packaging. Diagram provided by Maryland Paper Co.



Figure 8 Waste paper bales

Corrugated cardboard, newspaper, magazines, and others are ready to be deposited onto the conveyor belt for recycling. (MD Paper Co. Photo taken by author).



Figure 9 Hydropulper

First step of recycling waste paper, consisting of 96% water blended with 4% waste paper. (MD Paper Co. Photo taken by author).



Figure 10 Filtering machine.

Because corrugated cardboard contains glue, the waste paper stock goes through a glue filtering machine.

(MD Paper Co. Photo taken by author).



Figure 11 Flat screen drainer.

The new fiber stock now 99% fresh water and 1% stock is ready to be made into paper. It is deposited onto a flat screen that drains the water. This is known as the paper making machine. (MD Paper Co. Photo taken by author).



Figure 12 Reel of new paper product.

After moving through a series of metal drum rollers that dry the paper using a steaming method it is ready to be wound onto a reel. The final product is 94% paper stock and 6% water. The roll in this image is five miles in length. (MD Paper Co.)

Maryland Paper Co. receives 30 trucks of waste paper per day from a 400 mile radius including the states of Virginia, Pennsylvania, Delaware, New York, and Maryland. This is equivalent to a capacity for recycling 400 tons of waste paper per day. The mill is inside a warehouse structure of 118,000 square feet. “Maryland Paper both recognizes and understands the environmental problems of solid waste pollution. We are making a strong contribution to the solution of these problems with the recycling of virtually all forms of paper in our mill.”¹⁷



Figure 13 400 mile radius around Puerto Rico.

If a mill with the capacity of Maryland Paper Co. is constructed in Puerto Rico, it would be able to not only take care of its own waste paper but potentially recycle waste paper from neighboring countries.

The first recorded recycled paper was in Japan in 1031. The color was grayish until the process of de-inking was invented around World War I. During World War II

recovered recycled paper was again in use, reaching its peak around the 1950's mainly used for office paper.

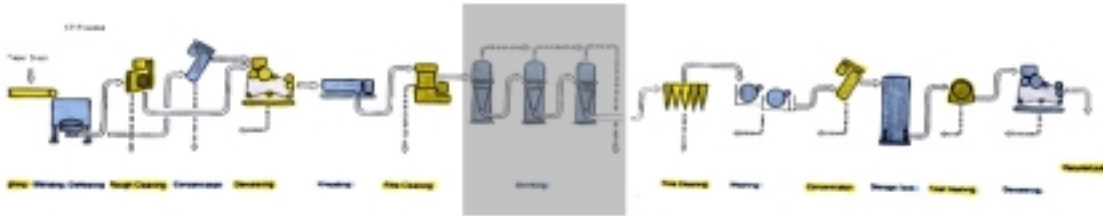


Figure 14 De-inking diagram.

The area shaded in grey indicates an additional step in the recycling paper process. This step is realized when newsprint or office paper will be recycled into new paper.

Today most of the recycled paper is used for corrugated cardboard packaging. Other current uses for recycled paper are newsprint, various tissue papers such as napkins, paper towels, toilet paper, printing and writing paper, and it is also used as a component for manufacturing roof shingles as is done by Maryland Paper Co. What else can be made from recycled paper? Are there any construction qualities in recycled paper?

Chapter 2: Recycling at Three Scales

Recycled Materials

Today recycled materials are not only used for their original purpose, they can also be used for construction. Employing this idea unwanted construction materials can be reused in other constructions. Concrete rubble can be reused for construction. Construction sites are full of unwanted materials, but so are cities. Abandoned buildings are scattered throughout urban and rural landscapes. Can materials be extracted from abandoned buildings to be used in new building designs? If so what would happen to the old building? Can the building itself be recycled?

Samuel Mockbee, architect and professor, formally introduced unwanted scrap materials into the architecture world. With the Rural Studio, an educational program with the mission of education citizen architects to become an integral part of the communities arose the opportunity to create architecture with existing resources thus engaging in an act of conservation instead of consumption. Not only was he salvaging materials but they were also introducing into neighborhoods a culture of sustainability through recycling. What was once seen as garbage was now seen as vibrant, useful, vernacular architecture. Because these materials belonged to the place of construction opportunities for defining its contemporary identity awakened.

Shigeru Ban is a Japanese architect who has mastered the art of “paper architecture”. By using cardboard columns made out of recycled paper Ban has been able to create large open structures, roofs, walls, houses, and furniture.



Figure 15 Paper Dome, interior view and detail.



Figure 16 Odawara Hall and East Gate.
View of outdoor structure and interior wall partitions.

Recycling Buildings/ Adaptive Re-use

Large components of inner city waste are buildings themselves. Throughout cities abandoned building can become dangerous, useless, undesirable places. When a building is destroyed to become a parking lot or an abandoned lot, the space is wasted. The idea of recycling buildings is not new; it has been around since the beginning of the 20th century through historic preservation.

Historic Preservation is “the act or process of applying measures to sustain the existing form, integrity, and material of a building or structure and the existing form and vegetative cover of a site.” It comprises an act of restoration, conservation, or rehabilitation through research and study of value of a given building or landscape. Historically preservation in the United States has been focused on houses. But in the past twenty years the definition of preservation has been constantly reevaluated. Where now it is not enough to choose and select what is to be preserved, instead a broader scope begins to reach for other significant pieces of history. An example of what preservation is focusing on today includes office buildings, vernacular architecture, non-elite architecture, and industrial buildings.

But what about the building that has no historic value and significance, should this be a justification for tearing it down? No, this is not a just reason for this building to become a blank space, a nameless space in the city. It can be reused, stripped of unwanted material (which can be taken to other construction sites or recycling centers), filtered like paper to become part of a new usable structure. All these buildings together in conjunction with the existing form part of city landscapes. Parks, street art, light fixtures, facades, and vegetation, fast food restaurant, gas stations all form part of the

existing cultural landscape. As the cities change over time so does the culture. If the cities improve, can the culture improve? If a strong movement for recycling buildings begins can the direction of the culture turn to a less consumption more conservation driven society? Can an island learn through architecture, to become sustainable?

Another way to look at recycling buildings is through adaptive use. It is defined as “the process of converting a building to a use other than that for which it was designed, e.g., changing a factory into housing. Such a conversion is accomplished with varying alterations to the building.”¹⁸ All cities contain buildings that have potential for adaptive use, some more obvious than others. Urban centers in Puerto Rico are perfect laboratories for this kind of development, where many buildings are abandoned or semi-abandoned but still have the potential for rehabilitation, “the act or process of returning a property to a state of utility through repair or alteration which makes possible an efficient contemporary use while preserving those portions or features of the property which are significant to its historical, architectural, and cultural values.”¹⁹



Figure 17 Abandoned buildings on Ave. Ponce de Leon in Santurce.

Top left, Spanish revival; top right, Art Deco; bottom, 70's Modern.

Recycling City Landscapes

The problem of urban sprawl in Puerto Rico is becoming larger and larger every year. Currently new developments have become a mortal threat to the natural environment. More species are becoming endangered, water source contamination is increasing, and communities suffer from flooding and land slides. These new developments do not take into consideration any environmental factors that might be forever altered. How can a country that is in constant need for growth, expand in a limited amount of space? How can this ‘constant need for growth’ be controlled?

One solution can be to build on brown-field sites, abandoned or underused industrial and commercial properties, instead of taking over more natural green space. Allen Hershkowitz²⁰, scientist who was involved in the development of a recycling paper mill states “along with the choice to use recycled raw materials, locating an industrial project in an urban brown-field is one of the two most important environmental decisions any industrial developer can make.”²¹ Following this line of thought portions of cities once abandoned can be recycled, reused, and given a new identity that then would serve a purpose in a given contemporary society.

Chapter 3: Industry and Sustainability

Industrial Typology

Industries today form a large part of brown-fields. Since the 1960's they have been under the eye of rehabilitation for new developments. The architectural value that industries possess is one of specialized function and unique architectural typology. Most industrial buildings are characterized by a large nave or space, a shell that covers its main program. This sheltered, well lit open plan permits a variety of uses, ideal for adaptive use and preservation. What environmental issues are involved in recycling an industrial site? What values can a neglected industrial building offer to the heritage of a place?

Industry Iron/Steel

Iron and steel industries in America were developed around the 1850's with the boom of the Industrial Revolution. The location depended on the ore deposits, large open areas, waterway access and railways. Thus convenient locations were along maritime ports, that where themselves connected with dense urban settings. Iron and steel industries have an important role in Puerto Rico as well as the US. It is one of the first signs of progress and technology, which a society can identify with.

Industrial Ecology

Industrial ecology “focuses not only on analyzing and enhancing material flows and energy use, but on reducing life-sciences-habitat, biodiversity-ecological impacts as well.”²² The purpose is to rethink how consumer products are made and used. The first steps were taken by environmental scientists and engineers near the end of the 1980's.

Their work was directed towards promoting recycling businesses and adequate waste management. Some disciplines that address industrial ecology are material flow analysis, supply-chain management, pollution prevention, ecologically integrated urban planning, and ecological design, among others.

This concept of industrial ecology is still at an early stage, two pioneering examples are worth looking at, the eco-industrial park in Kalundborg, Denmark and the eco-industrial park in Santa Perpetua de Modoga city near Barcelona. The focus is concentrated on a symbiotic relationship between the companies in the industrial park, where the waste produced by one is needed by the other, and the land and resources are shared, as well as the energy exchanged. There is a large disjunction between recycling values cultures may have, and the driving force of corporate worlds. What industrial ecology attempts to achieve is infiltration of sustainable values into the corporate world.



Figure 18 Aerial view of Kalundborg, Denmark.

Kalundborg is an example of a working industrial ecosystem that engages in a relationship known as industrial symbiosis.
www.uneptie.org/pc/ind-estates/graphics/Cases/kalundborg

The eco-industrial park at Kalundborg²³ began in 1961 with the effort to save water used in a new oil refinery. By 1980 few industries had joined forming a network that efficiently used the limited supply of water. Today Kalundborg is comprised of six partners. These are a power station that produces electricity for Denmark, an oil refinery,

a biotechnology company that produces insulin and enzymes, a building company that produces plasterboard, a soil remediation company, and the town of Kalundborg which uses the excess heat produced by the power station for residential heating. This industrial ecosystem has not only managed to save water but also to reduce consumption of resources, and reduce waste emissions.

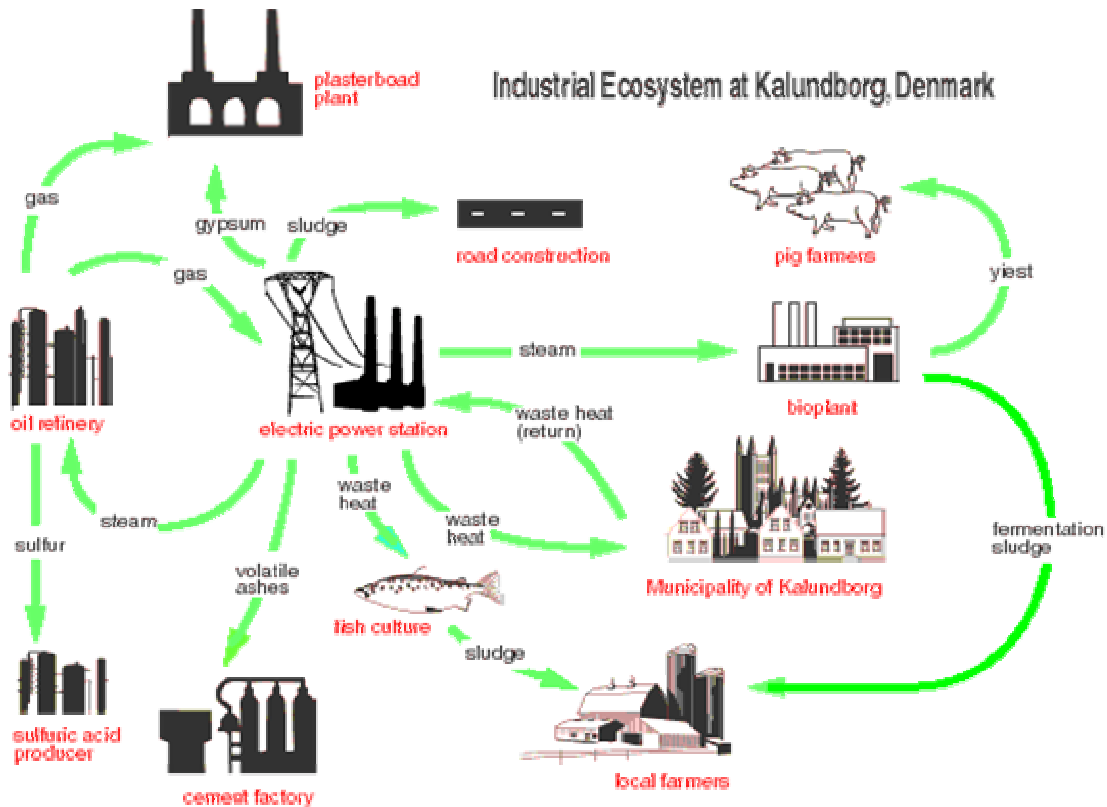


Figure 19 Diagram of Industrial Ecosystem at Kalundborg, Denmark.

This diagram demonstrates the industrial symbiosis of this eco-industrial park.

<http://newcity.ca/Media/Kalundborg.gif&imgrefurl>

Sustainability

What is sustainability? Why has it become such an urgent issue in the last twenty years? Sustainable development as defined by the United Nations World Commission on Environment and Development states that sustainability “meets the needs of the present without compromising the ability of future generations to meet their own needs.”²⁴

Sustainable as defined by the *McGraw-Hill Recycling Handbook* is “the ability to support, endure or keep up; meeting present needs without compromising future resources. In order for recycling to be sustainable, it is essential for the public to buy products made with recycled materials.”²⁵

One of the main concerns that ecologically aware present generations have is the consequences that consumption driven behavior of today will have on future generations. Powerful countries have a flaw, the flaw of abundance, while fragile countries lack essential resources. Sustainability’s outreach cries for a balanced world, a balance between the natural environment, its resources, and its inhabitants. Historically humans have been a threat to this balance; today it is reaching its limits. How can architects contribute to the restoration of this balance? How can architects influence communities to acquire sustainable conscience?

William McDonough has defined in practical terms how an ecologically aware architect would design buildings, “she would immerse herself in the life of each place, tapping into natural and cultural history, investigating local energy source, the availability of sunlight, shade, and water, the vernacular architecture of the region, the lives of local birds, trees and grasses. Her intention would be to design a building that creates aesthetic, economic, social and ecological values for the surrounding human and natural communities-- more positive effects, not fewer negative ones.”²⁶

“Recycling is among the most basic activities in the natural world, and every vision of sustainability includes recycling as a fundamental, essential component.”²⁷

Chapter 4: The Site

Site History

In the year 1625 the land of Cangrejos (Santurce) was dedicated to sugar plantations and cattle farms. In 1776 it contained a population of 648. By the year 1864 it was declared to fall under the jurisdiction of San Juan, the capital of Puerto Rico.

Santurce was the rural area of San Juan, a country escape for people that lived in the dense capital.



Figure 20 1892 topography conditions of Santurce.

Santurce began on the highest region between the Laguna del Condado and the San Juan Bay.

The urban development of Santurce during the end of the 19th century was slow and disorganized. Two projects helped organize and create density in Santurce: Calle Central (Ave. Ponce de León), which connected San Juan with the rest of the island; and the electric trolley system, which interconnected the seventeen, sectors of Santurce.



Figure 21 1914 View of Ave. Ponce de León.



Figure 22 1891, 1917, 1975 Figure ground of Ave. Ponce de León

Figure ground of Ave. Ponce de León demonstrates augmentation in urban density.

The Calle Central became the main retail and commercial street of the city, heavily transited by vehicles as well as pedestrians. During the first half of the 20th century the community relished from twelve movie theaters along the commercial avenue, of which only two are still in function. This reduction has been a direct result of big commercial center developments at the outskirts of the city. Although today mass transit serves the avenue, the bustling street lifestyle it once received its character from is gone.



Figure 23 Districts and main streets



Figure 24 1917 plan of site, by *Puerto Rico fire Underwriters*.

The site is bordered by the *American Railroad* train tracks from the Sector Miramar to the north, and the facilities of *Puerto Rico Gas Co.* to the east.

The sector Isla Grande is located at the southwest corner of Santurce. This area remained as marshlands containing few Spanish military installations until the beginning of the 20th century, when the new sovereign country took possession over the island.²⁸ As the population grew from 5,840 in 1899 to 17,338 in 1910, an industrial sector developed. By 1917 Isla Grande accommodated the U.S. military and civic airport (today the Rivas Dominici Regional Airport), military housing, the *Puerto Rico American Tobacco Co.*, the *Puerto Rico Gas Co.*, and the *American Railroad Co.*, among others.



Figure 25 1961 Map of Sector Isla Grande, San Juan.

Map shows what was the US Military and Civic Airport, the US Coast Guard Military residence, and the Sector Miramar. (Topography map Planning Department).

The site of this thesis is located next to the *Puerto Rico Gas Co.*, the only remaining functioning company in the area. The *American Railroad* train tracks (1880) ran parallel to the front of the site, connecting San Juan to the rest of the island. It was substituted by Ave. Muñoz Rivera which defines the north border of the site separating it from Miramar, a wealthy residential sector dating back to the origins of Santurce. In 1924 *Sucesores de Abarca Inc.*, first foundry in Puerto Rico moved to the site, where it remains, it ceased operations in 1980 and has been adopted by *West Indies Machinery Co.*²⁹

Site Physical Description

The site is located in an industrial zone on the sector Isla Grande in the district Santurce of the municipality San Juan, Puerto Rico. It includes 14 acres (609,840 square feet) and is bounded to the north by the heavy transited Avenida Muñoz Rivera and to the south by the San Juan Bay. It is oriented facing northeast, from where the prevailing winds come year round.



Figure 26 Aerial view of site and surrounding context.

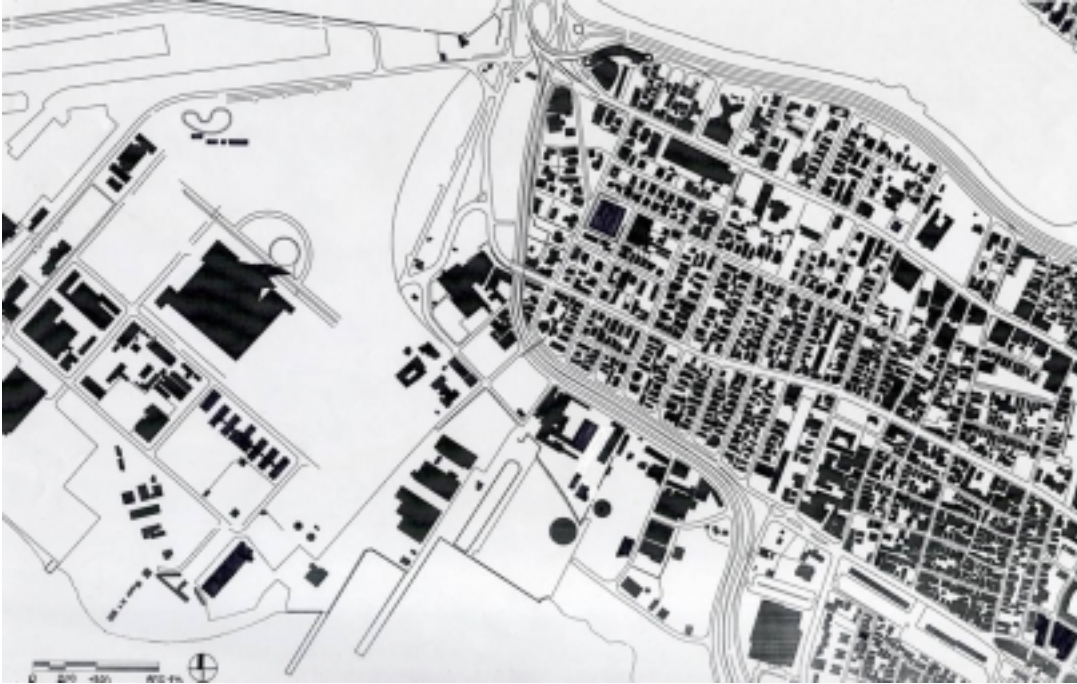


Figure 27 Existing figure ground

This diagram shows the dense residential fabric to the north east, the construction site of the new Puerto Rico Convention Center to the west, and the proposed site of this thesis to the central south along with the existing industrial buildings.

Across Ave. Muñoz Rivera a secondary boundary made up of a tree liner separates the site from Miramar, a wealthy residential neighborhood of historic houses dating from the 19th century. This boundary is made up of live oaks, palm trees, and local shrubbery that sit along the residential marginal street. Direct access to the site is limited to either an exit off the avenue to the marginal street or directly onto the marginal street situated between the avenue and the site.



Figure 28 Vegetation plan.

Plan shows tree liner that further divides the neighborhood Miramar from the industrial area.

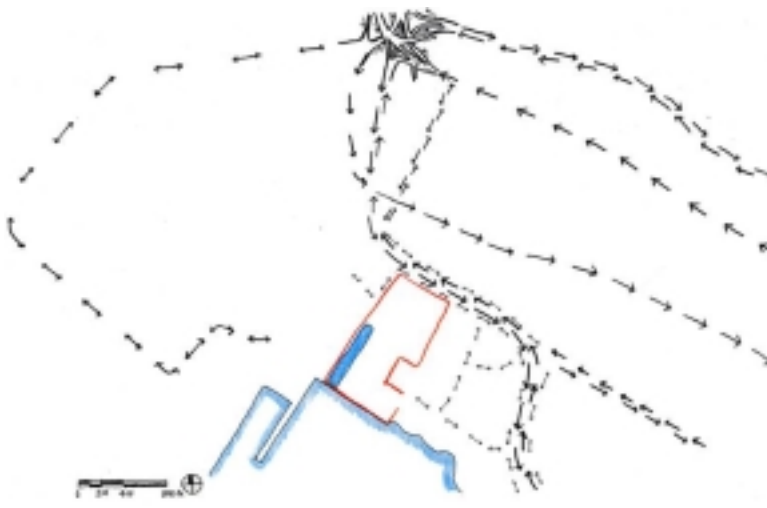


Figure 29 Street directions

At the north central portion of the diagram is the existing intersection of seven streets that serve as the main vehicular entrance to Old San Juan.

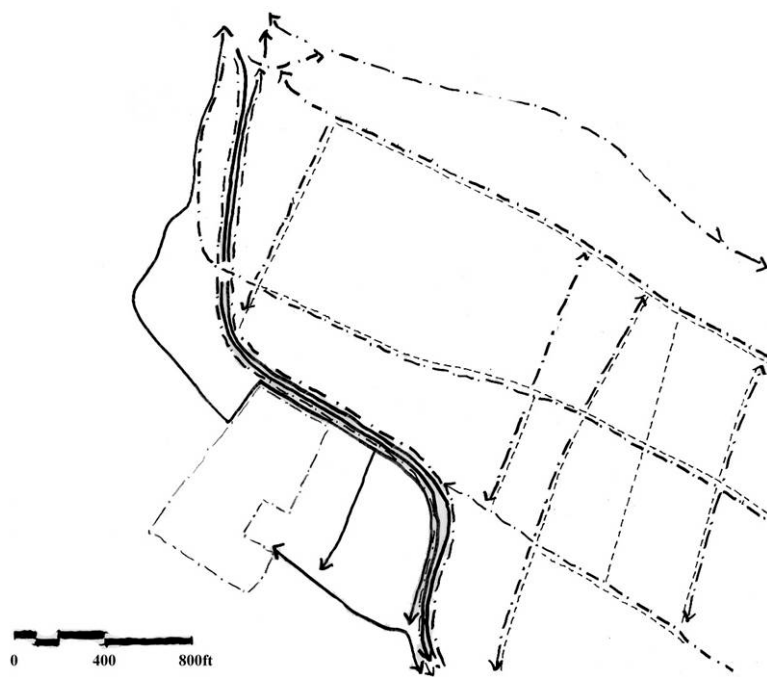


Figure 30 Main truck, car, and pedestrian circulation.

Truck-continuous line; car-dash dot line; pedestrian- dashed line.

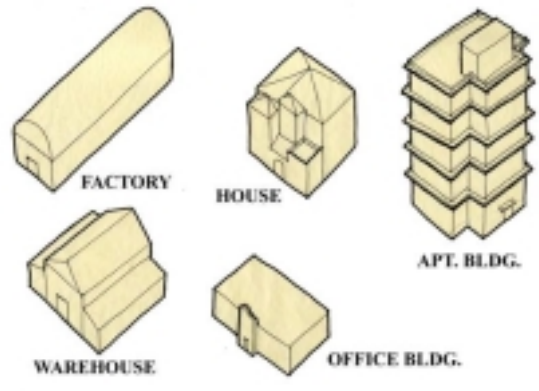


Figure 31 Blocks and building typologies

The residential blocks to the northeast contain mostly Spanish Revival style houses and a few 1960-70's apartment buildings along the perimeter. The industrial blocks to the southwest contain warehouses and factories from the first half of the 20th century, and a few 1950-60's office buildings.

Ave. Muñoz Rivera runs parallel to the front of the site and continues southeast for 800ft before turning south, limiting the industrial zone to the east. Four lanes compose the avenue; two in each direction which are separated by a median.

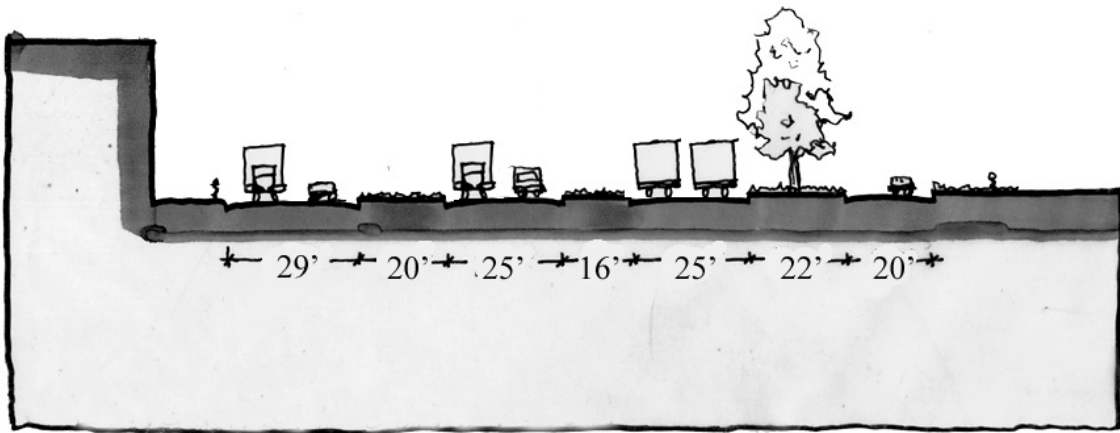


Figure 32 Section of existing conditions of Ave. Munoz Rivera.

A liner of trees serves as a secondary boundary between the industrial zone and the residential neighborhood, Miramar.



Figure 33 Images of Ave. Muñoz Rivera

Left, view towards southwest with Fundación Abarca building and Puerto Rico Convention Center in the background. Right, view towards northwest with tree liner.



Figure 34 Existing southwest façade of Ave. Muñoz Rivera.



Figure 35 Existing northeast façade of Ave. Muñoz Rivera.

The maximum speed limit is 50 miles per hour. To the west of the site a cluster of torn down warehouses await removal for new developments, next to them is the construction of the new Puerto Rico Convention Center.



Figure 36 Soft site diagram.

Buildings shaded in white will remain. Buildings shaded in light grey can be considered for recycling. Buildings shaded in dark grey are part of the 15 year soft site and buildings shaded in black are part of the 30 year soft site.



Figure 37 Diagram showing surface parking.

The Puerto Rico Convention Center is located on what was the site of the US Coast Guard Navy Base. This development encompasses 113 acres dedicated to, retail, commerce, hotels, housing, and amenities. “The Puerto Rico Convention Center is certain to make Puerto Rico the meeting hub of the Americas. It will create a singular destination for conventions, tradeshow, consumer shows and conferences fostering competition in North America, Latin America and Caribbean convention markets.”³⁰ The goal of this project is to create the largest convention facility in the Caribbean, a major

tourist attraction and business site. Adjacent to the building are over 950 parking spaces. The first phase of the project is the Convention Center Building which is expected to be completed within the next two years. The second phase is the commercial district, it is expected to be completed by the year 2015. The district of Isla Grande will be changed from industrial to commercial, with the intention of addressing adjacent neighborhoods and districts such as Miramar, El Condado, and Old San Juan.



Figure 38 Tourist areas in San Juan
Northeast- Old San Juan; Northwest- El Condado; Center- new Puerto Rico Convention Center.



Figure 39 Puerto Rico Convention Center under construction.



Figure 40 Rendering of proposed Puerto Rico Convention Center including phase one and two.



Figure 41 Projected figure ground including the new Puerto Rico Convention Center.

What environmental impact can a project of this magnitude have on a small island? How much waste will it generate? What can be done to minimize its impact and the impact of other large corporations on the island? Can the Puerto Rico Convention Center engage in an industrial symbiotic relationship with the new proposed project?

Immediately to the south of the site are a collection of untouched trees and greenery. Following these is a domed concrete mixer and the *Puerto Rico Dry Dock*, at the waterfront of the San Juan Bay.



Figure 42 Water taxi

The San Juan Municipal Waste Dump is located immediately to the south of the Hato Rey-Old San Juan line.

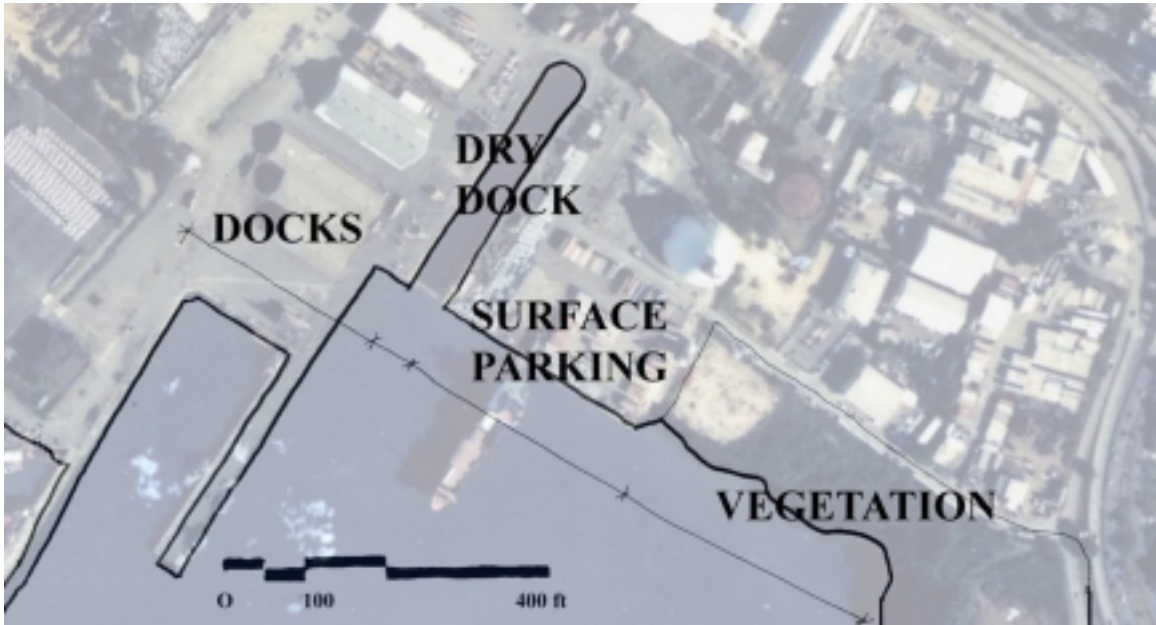


Figure 43 Waterfront conditions.



Figure 44 Existing view of waterfront.

The site itself houses five buildings originally built for *Sucesores de Abarca Inc.* (1924-1980). Only three continue to be use, two are completely abandoned, and all five have been altered. This company held the first foundry of Puerto Rico and was the only foundry on the island that could turn iron into steel. Today the remaining buildings house a window manufacturer and a machinery warehouse. This thesis proposes to recycle what once were the buildings of the foundry by integrating them with the new paper recycling mill.

Fundición Abarca History

Fundición Abarca, name given to the foundry, was not always located in the Isla Grande sector. Its first location which dates back to 1850 was in the district of La Puntilla, outside the city walls of San Juan. There, the foundry was dedicated to metal forging and machinery. The foundry worked mainly for prosperous sugar industries in the island, shipping industries, and small factories belonging to both the government and private sectors. In 1924 the foundry moved to its current location where it benefited from the *American Railroad Company* located on what was known as the “Avenida del Sud” (today Avenida Muñoz Rivera) for transportation of its work in the island.



Figure 45 Aerial perspective of Fundición Abarca, 1944.

(Image courtesy of Architect Joaquín Berdasco-Paz)



Figure 46 1955 and 1975 aerial view of Fundición Abarca.

(Source: *La Gran Enciclopedia de Puerto Rico*. v. 13 Municipios. P. 336)

Fundición Abarca constructed sugar refineries for countries in the Caribbean such as Colombia, Dominican Republic, Venezuela, Honduras, Costa Rica, Panamá and the

State of Florida. Domestic projects included construction and assembling of the *Central Guamaní* sugar mill, and repairing a total of seven sugar mills. Of these, the sugar mill *La Plata* was acquired by Fundición Abarca and used as a laboratory for sugar mill machinery and as exhibition space for other sugar mills.

The following statement regarding Fundición Abarca was published in an article of the *Boletín Oficial de la Cámara de Comercio* in 1934.

“...the largest and best equipped in the West Indies... identified largely with the sugar business... at one time or another, designed, built and completely equipped entire sugar mills, importing practically nothing but the steel shapes and plates from outside sources...

Sucesores de Abarca are equipped to manufacture any and all machinery used in sugar mills and also can handle any other construction work requiring the services of a foundry, machine shop or boiler works...

*The facilities which Sucesores de Abarca afford today have been of the greatest value to the sugar industry as all repairs and new work can be handled and there is no necessity for holding the mills idle for long periods while waiting for spare parts from abroad.”*³¹

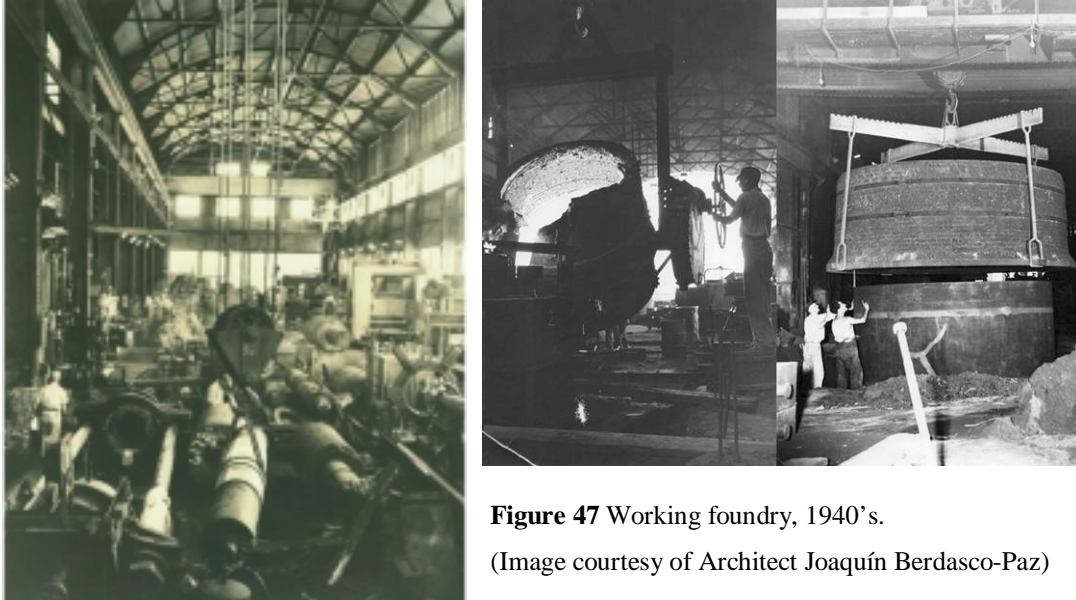


Figure 47 Working foundry, 1940's.

(Image courtesy of Architect Joaquín Berdasco-Paz)

Figure 48 Interior view of foundry, 1940's.

(Image courtesy of Architect Joaquín Berdasco-Paz)

Directly to the south of the Foundry's site was a Dry-dock constructed by the local government. As recorded by engineer Rafael Pumarada,³² during the Spanish-American War the foundry repaired Spanish Navy boats damaged by the United States Navy. During the 1920's and 1930's the foundry was in charge of repairing ships. The United State's navy expropriates the Dry-dock in order to repair ships damaged during the Second World War. After the War ends in 1947 the United States Government sells the Dry-dock to the Foundry and is given the name *Abarca Drydock Inc*³³. Other activities that were realized by the foundry were recollection, sorting and selling of scrap metals.

By 1955 the industrial complex of Abarca was dedicated to forging of iron, steel, bronze, and aluminum, fabrication of steel structures, maintenance and repair of ships and vessels and sugar production. During its time of operation the Foundry designed and constructed three bridges on the island. [poner info de puentes] The Foundry ceased

operations in 1980 after having sold its sugar interests in 1976. In 1989 Hurricane Hugo demolished great part of the remaining structures.

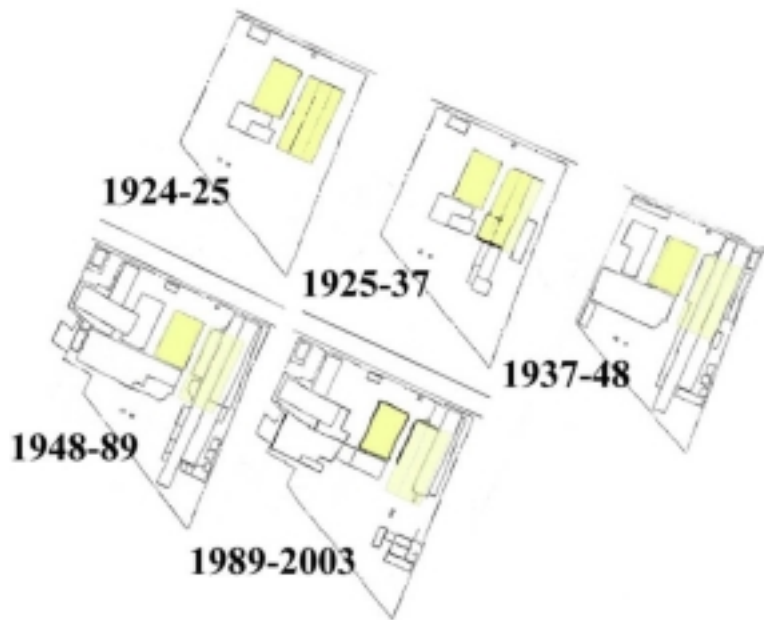


Figure 49 Fundación Abarca morphological sequence over time.

(Source: Del Cueto, Pantel & Associates. *Documentación y Evaluación de La Fundación Abarca Santurce*, p. 25)

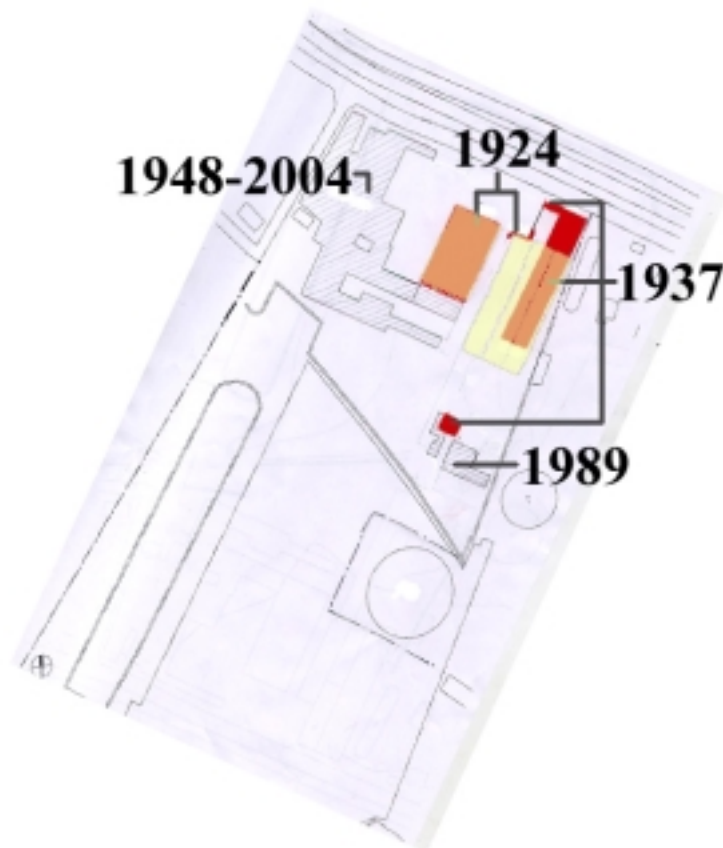


Figure 50 Fundación Abarca existing conditions, 2004.

Proposed buildings for recycling are in shaded in red.

Fundición Abarca Existing Conditions

The neglected buildings of Fundición Abarca sit on a property that includes 25,921 square meters. There are seven structures on the site; these can be seen in the diagram above. Starting in clockwise order the structures will be referred to as buildings, A, B, C, D, E, F, and G.

Buildings A and F are simple shed warehouses, of which only A is in use as storage and F is completely abandoned. Building G is a surviving portion of building D, which was torn down by Hurricane Hugo. Building G has been stripped down to its bare structure, composed of five structural barrel shaped steel trusses and supporting columns.



Figure 51 Fundición Abarca remaining structures A and G.

Buildings C and D are characterized by the lack of an actual building, the corresponding principal facade is the only remaining evidence of the building C. Building D holds its principal facade plus one structural bay made out of the same components of building G.



Figure 52 Fundición Abarca remaining structures C and D.

Buildings B and E are currently in use. Building B houses the company West India Machinery which is used for storage and renting of machinery. Building E houses the company Condado Window Manufacturing.



Figure 53 Fundición Abarca remaining structures B and E.

Chapter 5: *Fundición Abarca*: Adaptive Transformation from Foundry to Recycling Paper Mill

This project seeks to transform the former foundry, commonly known as *Fundición Abarca* in San Juan, Puerto Rico into a paper recycling mill. The goal is to design an industrial building that tackles the need for proper waste management on the island. The premise is to recycle at three scales landscape, building, and material.

The focus of this chapter relies on the exploration and meaning of transformation. The ultimate goal is to offer an answer to a persistent question in preservation today. Is adaptive re-use an effective tool of preservation? What are the limits to adaptive use before affecting the integrity of the historical building? Or can adaptive use be realized without affecting integrity?

Underlying these broader issues of preservation are the inevitable concerns of cultural identity, industrial heritage, and conservation of the environment. This research will attempt to redefine adaptive use, to propose that the discourse of preservation has to include a search for sustainability, a marriage between finding and asserting significance within an object, building, landscape, place, or culture, and the vitality of the environment in a given community.

The major preservation issue that will be explored in this chapter is the relationship between adaptive re-use and preservation. This project proposes that preservation—to sustain the existing form, integrity, and material of a building or structure and the existing form and vegetative cover of a site—runs parallel with conservation of the environment, in which one can benefit from the other. Thus, how can preservation and sustainability—to keep in existence, to maintain—work together in order to result in healthy and integral communities?

Historic Preservation Terms and Definitions

In the rapidly changing society that exists today, culture is constantly being reevaluated, altered, and reinvented. The term culture can be defined in many ways such as “the process of cultivation... that is intangible, comprising a mental and spiritual system established and nurtured by human society,”³⁴ “that which is created and purposefully and decidedly by... the human hand or mind,”³⁵ and “patterns, traits, and products considered as the expression of a particular period, class, community, or population.”³⁶ It is important to stress the intangible aspect of culture which is not defined by the physical object but by the expression communicated by what is tangible.

One way to witness cultural change is through modifications to the built environment, to cultural landscapes³⁷—the inherent relationship between humans, artifacts, and nature. Buildings and landscapes are evidence of this change. This change can be called new construction, abandonment, neglect, demolition, or possibly adaptive use. Adaptive use, commonly known as adaptive re-use, as defined by William Murtagh in *Keeping Time: the History and Theory of Preservation in America*, is “the process of converting a building to a use other than that for which it was designed, e.g., changing a factory into housing. Such conversions are accomplished with varying alterations to the building.”³⁸

This essay will explore a possible new definition for adaptive re-use as well as its relationship to preservation. The common denominator between these two subjects is integrity. The adaptive “transformation” or “marked change in appearance or character usually for the better”³⁹ of the foundry *Fundición Abarca* in San Juan, Puerto Rico, into a sustainable paper recycling mill will serve as the basis for this exploration. This project

will be studied and with the assistance of the Secretary of Interior Standards for Rehabilitation an attempt will be made to preserve the property's significance as expressed by its historic features.

Key words need to be defined in order to understand the goal of this research. What are preservation, conservation and rehabilitation? Most importantly what is integrity and how is it defined from a preservationist point of view? Preservation is "to sustain the existing *form, integrity, and material* of a building or structure and the existing form and vegetative cover of a site."⁴⁰ Rehabilitation as defined by the Secretary of Interior Standard for Rehabilitation is "the process of returning a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural, and cultural values." And conservation is "the action taken to prevent decay and manage change dynamically... it embraces all acts that prolong the life of our cultural and natural heritage... to present to those who use and look at historic buildings with wonder the artistic and human message that such buildings possess."⁴¹

Preservation is thus an act of maintenance, of keeping in existence. In this act what is to be sustained are the form, integrity, *and* material of a structure, site, place and or culture. On the other hand rehabilitation is the *process* employed to return a structure or site to a contemporary usable state. As implied by the word returning in the definition of rehabilitation, it is understood that there is no use of the property prior to rehabilitation. In addition rehabilitation includes preservation in its definition, stating that preservation should be employed on features of historic, architectural and cultural significance that remain on the property. Conservation aspires to prevent decay, manage

change, and prolong life; preservation aspires to maintain the existing. The similarities between conservation and preservation are the subject and the reason; the difference is the means by which the goal is achieved. While the former employs foreign treatments in order to protect the message of a structure, the later only controls the amount of damage inflicted on a structure or site. This structure can be named an historic building. An historic building is “one that gives us a sense of wonder and makes us want to know more about the people and culture that produce it... it is a symbol of our cultural identity and continuity—a part of our heritage.”⁴²

Historical Significance of *Fundición Abarca*

Commonly known as *Fundición Abarca*, the foundry Sucesores de Abarca was established in 1850⁴³ to construct mainly machinery for the sugar factories on the island. The sugar industry of Puerto Rico dates back to the beginning of the nineteenth century when it surpassed Haiti, the number one sugar producer at the time.⁴⁴ Sugar rapidly became the number one export of the island and the base for its economy. This growth only lasted a few decades from the 1810’s to the 1840’s⁴⁵ due to the lack of an organized system to export, control output, and the conditions of hard, unpaid labor.

The first formally organized sugar *central* –factory or building complex where sugar cane was ground into unrefined sugar—in Puerto Rico was Central San Vicente, established in 1873,⁴⁶ the same year slavery was abolished. The new technology employed in San Vicente resulted in great accomplishments for the sugar industry. This new technology consisted of a sophisticated production and spatial system with powerful machines and housing and dining spaces for employees.⁴⁷ In 1898 the Spanish-

American War decided Puerto Rico's new future changing from a Spanish regime to a colony of the United States. By 1910, 108 working *centrals* had been established on the island.⁴⁸ The three larger centrals established by the United States were, Central Fajardo, Central Aguirre, and Central Guánica.

Problems with stabilizing the economy persisted; Puerto Rico was still dependant on monocultures, farming of only one product. Labor conditions, although now paid, were still very harsh, and wages were low. The sugar industry provided a seasonal input for the economy, with harvesting lasting roughly from January to June. *Jornaleros*—day laborers—were subject to an unstable source of income, and thus obligated to look for alternative jobs during the off seasons.⁴⁹ A new system of quotas established in 1920 controlled the entrance of unrefined sugar into the United States which resulted in a decline in sugar production, thus new alternatives such as farming of coffee and tobacco were needed to sustain the economy.⁵⁰ The ups and downs of sugar production have slowly come to a halt; today sugar cane is no longer planted on the island and not one *central* remains in operation.

The role that *Fundición Abarca* played in Puerto Rico's long history of sugar production has much to do with the design and construction of machinery needed to run the sugar mills. The Spanish blacksmith Don Isidro Abarca Poo founded *Abarca* in the district of La Puntilla in Old San Juan.⁵¹ Here the small factory dedicated to metal working and machinery began an industry that was soon to include two of the best known foundries in the history of Puerto Rico, Ponce Iron Works being the other foundry. *Abarca* housed the only metallurgic laboratory in Puerto Rico; in addition the facilities included an iron, steel, bronze, and aluminum smelting factory, a kettle for construction

of evaporation machines, a design and drafting area, molding factory, storage warehouses and a factory for maritime reparations.⁵²

During the first half of the twentieth century, *Abarca's* success depended mainly on the proliferation of the sugar *centrals*. The third decade of the twentieth century witnessed the second boom in the sugar industry, and it is no coincidence that in 1924 Abarca ran out of space and moved to its current location in the district of Isla Grande, still in the capital of Puerto Rico.



Figure 54 Sites of Fundición Abarca

Diagram indicates with dots the first site of Abarca in La Puntilla (1850), and the current site where transportation was facilitated by the train tracks of

the American Railroad Co. (Author)

With engineering and technical knowledge Abarca intelligently supplied the constant demand for new machines and technology in the sugar industry. Among the sugar *centrals* that Abarca served were Central La Plata, constructed by Abarca, Central Cambalache also owned by Abarca, Central San Vicente, Central Mercedita-Ponce, Central Fajardo, Central Cayey, and Central Guamaní.⁵³

During the second half of the twentieth century the sugar industry began to decline. Abarca, which had already begun to export machinery to countries in Central America and Florida, dedicated its service to dismantling of *centrals* on the island and transportation of these pieces to other countries. Another type of production engaged in by Abarca was bridge fabrication. In 1975 the bridge Pedro Avila-Cercadillo was

awarded honorific mention by the *American Institute of Steel Construction*. Abarca was in charge of constructing the pieces at the foundry and mounting the bridge on site.⁵⁴ *Fundición Abarca* ended operations with 130 years of industrial service to the economy of Puerto Rico in 1980.

Throughout the years of the foundry's existence many workers, craftsmen and designers made possible the technological advances achieved. The *jornaleros* or working class in the sugar plantations and centrals were directly affected by the sugar industry and indirectly affected by Abarca. Who was directly affected by Abarca? Who were the workers? What relationship existed between Abarca and its surrounding communities?

An article published in the journal *Puerto Rico Ilustrado*, December 3, 1949, titled "Sucrs. De Abarca Inc.: Un Siglo Entero al Servicio de la Industria Boricua" (Successors of Abarca Inc.: An Entire Century Dedicated to *Boricua* Industrial Service") affirms,

"The house Abarca is a solid company in the industrial development of the country and in its factory 500 family fathers develop its activities, it (the company) pays individual contributions to the public State Treasury and avoids through its progressive industry the migration of millions of dollars from inside the country to the exterior by investing on foreign machinery."⁵⁵

Further on the article establishes that Abarca's employees were the base of its success. According to the article Abarca always demonstrated to its employees the highest humanitarian spirit, insuring protection and special attention to injuries and family misfortunes. But who were these "500 fathers"?



Figure 55 Communities surrounding Abarca
(Author)

Three very distinct communities surrounded Abarca immediately to the north, east and west. To the south a plot of land sits between Abarca and the San Juan Bay. To the west on Isla Grande, U.S. Coast Guard Military housing was established during the beginning of the twentieth century, its duration lasted over 40 years. The “500” working men could not have been from this community. To the north across Avenida Muñoz Rivera, originally the railroad track of the American Railroad Co. dating from the 1880’s, is the neighborhood Miramar. Miramar was and still is an affluent community. It was shaped during the late eighteenth and beginning of the nineteenth century by wealthy residents of Old San Juan looking for a country retreat from the busy city lifestyle.⁵⁶ The plots of land were large and thus the houses were of a grand scale. The metal and wood working men of Abarca did not come from this community either.

This leaves only the communities that existed to the far east of Abarca. Immediately to the east was the Porto Rico Gas Co. followed by the factory of the American Railroad Co. established c.1910 and today is public housing. Surrounding this Company was the sector still known as *Tras Talleres* or literally translated to Behind

Factories. To the south of this sector and to the southeast of Abarca, a series of sectors known as *El Fanguito* (The Muddy Area), *Buenos Aires* and *Marruecos*⁵⁷ existed.



Figure 56 Aerial photograph, 1937

(Department of Transportation and Public Services. Photography Office, San Juan.)

Figure 57 El Fanguito, 1952

Aerial view looking east over El Fanguito community and Canal Martín Peña. (Sepúlveda Rivera, Aníbal. *Cangrejos-Santurce : historia ilustrada de su desarrollo urbano (1519-1950)*. Puerto Rico: Centro de Investigaciones CARIMAR, Oficina Estatal de Preservación Histórica, 1988. p. 59)

These sectors were developed by low income families during the 1930's on marshlands that ran parallel to the Canal Martín Peña, a body of water that ends at the San Juan Bay. The impoverished houses that characterized these sectors were displaced throughout the second half of the twentieth century due to the construction of road systems including Avenida Muñoz Rivera and Avenida John F. Kennedy, which now delineate the edge of the city.⁵⁸ Today on what was *El Fanguito* are the structures of *Parque Central*, a sports and recreational area used by citizens of the capital. Sectors *Buenos Aires* and *Marruecos* are again marshlands. It would be reasonable to hypothesize that the working men of Abarca lived in poor conditions and thus resided in the communities just described.



Figure 58 Working men of Abarca during the 1940's.

(Courtesy of Architect Juagquin Berdasco-Paz).

Defining Integrity and Cultural Identity

UNESCO's 2003 [*Convention for the Safeguarding of the Intangible Cultural Heritage*](#)⁵⁹ defines intangible cultural heritage as “the practices, representations, and expressions, as well as the associated knowledge and the necessary skills, that communities, groups and, in some cases, individuals recognize as part of their cultural heritage.”

The intangible cultural heritage that surrounded Abarca was of working class men, of metal and wood working crafts, of sugar plantations and sugar *centrals*. There is not much left in Puerto Rico that can testify to this past culture, many sugar centrals are abandoned and find themselves rapidly deteriorating. The heritage—something that is passed down from preceding generations; a tradition⁶⁰—that Abarca can bestow on the generations of today are only the physical structures of the remaining buildings. The

historical integrity—the relationship between their actual content and what originally existed⁶¹—is blurred. These iron and steel structures with concrete facades are but mere shells that have been adopted by modern commercial companies. The companies locate themselves inside the only two remaining buildings or shells of Abarca. *West India Machinery Supply Co.* is housed by the original foundry and storage building built in 1924, and *Condado Window Manufacturing* is housed by the last building of Abarca to turn iron into metal built during the 1940's. The powerful machines that once gave life to Abarca are gone. The only evidence remaining of these machines are plans and documents unavailable to the public collected by the *Archive of Architecture and Construction of the University of Puerto Rico* (AACUPR), in 1995. What will happen to Abarca as these companies adapt the structures in order to comply with their needs? How is the integrity of the buildings affected?

Integrity as defined by the National Register of Historic Places (NRHP) is “the ability of a property to convey its significance.” In June of 2003 a local firm of historic preservation consultants Pantel del Cueto and Associates prepared a document in order to establish the potential for Fundicion Abarca’s eligibility for listing on the NRHP. *Documentación y Evaluación de La Fundición Abarca Santurce, Puerto Rico* presents the historical background of Abarca, a description of the existing physical conditions of the buildings, and discusses the seven aspects defined by the NRHP in order for a property to retain integrity.⁶² Pantel del Cueto concludes that Abarca does possess these seven aspects, location, design, setting, materials, workmanship, feeling, and association,⁶³ therefore it does retain integrity and can convey its significance. The firm believes that Abarca has the potential to be eligible for listing on the NRHP but affirms “the integrity

of its structure and the setting of its elements has been modified, and in a certain way has diminished through time.”⁶⁴

It is important to indicate what these buildings offer to the Puerto Rican community. Although not an architectural jewel, the presence of Fundicion Abarca offers a clue to help define the island’s cultural identity. Cultural identity as defined by UNESCO “denotes the *correspondence* which exists between a community (national, ethnic, linguistic, etc.) and its cultural life, as well as the right of each community to its own culture.”⁶⁵ Due to the fact of improper maintenance and deterioration not only of Abarca, but also of the sugar centrals, a vital piece of Puerto Rico’s history is being lost and quickly forgotten. Thus a possible connection through history between the community and its own culture becomes ever more difficult to achieve. As a result of dereliction, the “right of the community to its own culture” presented by the built fabric is being negated. Therefore the answer offered in this essay is preservation. It is to preserve culture by means of adaptive re-use. Adaptive re-use offers a chance of life, not only to preserve but to be used for contemporary needs of a given community.

Puerto Rico as noted in previous chapters is an island of small dimensions in which its community suffers from uncontrollable consumption of disposable things. This results in large generation of waste in excess of what the island can handle. It is a phenomenon that has come to define the contemporary culture of the island. Therefore the island is in need of proper waste management, but more so a reevaluation of the consumerist culture.

The proposed alternative is of sustainability and conservation of the environment. An ecologically sensitive agenda is offered in this essay, a building that properly

manages waste and reuses an existing, neglected site and building. This project looks to serve as an example of adaptive re-use where the historical industrial buildings of Fundicion Abarca are transformed into a paper recycling mill. This project contains a receiving and sorting center as well as an educational area for learning about recycling and sustainability but most importantly about culture, history and identity.

Chapter 6: Program

Goals and Approach

With the implementation of the Paper Recycling Mill in the capital of Puerto Rico a prototype of recycling mills on the island would be created. This prototype would function as proof that recycling can achieve its full cycle within the island. This project would serve as a catalyst for recycling in the island. Proving that environmentalists, architects, engineers, professional, the community and politicians are not only concerned but can act for a better future.

The goals of this project would be:

- ❖ To promote, facilitate, and build an environmentally aware community.
- ❖ To not only create consciousness of the negative impacts of consumption; but to start to eliminate the “culture” for consumption.
- ❖ To change from a culture of disposable things to a culture of conservation.
- ❖ To change the market system, less packaging more reusing and recycling.
- ❖ Education by demonstration, demonstrate what can be done with recycled paper and its environmental importance.
- ❖ Sustainability for the future—that is it.
- ❖ To promote by demonstration, recycling of buildings in cities, preventing urban sprawl and contamination of natural resources.
- ❖ To promote reevaluation of city landscapes for urban renewal.
- ❖ Respect for the natural environment, cultural heritage, and the well being of future generations.

- ❖ To save the trees, not only worldwide but internally on the island, by developing and promoting construction inside cities more open spaces of green will be protected.
- ❖ To promote the development of other recycling mills on the island (i.e. plastic, metal, glass, tires, electrical equipment, etc).
- ❖ To create an example of sustainability for other countries in similar situations as well as neighboring American countries.
- ❖ The mill or parts of it should be flexible for recycling.

Problems and Issues

How to harmoniously locate the building (design of site plan) so it can have a positive relationship with surrounding context: residential neighborhood, Convention Center, San Juan Bay waterfront, and Ave. Muñoz Rivera.

Given the fact that the site is amongst neglected industrial buildings, what is its relationship to these, will they play a roll in the design, or will they be eliminated?

Can a positive relationship be formed between the Recycling Paper Mill and the new Puerto Rico Convention Center in order to demonstrate proper waste management? Can it bring conservation awareness to the Convention Center achieving less consumption and less consumption of disposable thing by the people who visit it? Can the message travel through the corporation up to marketing designers in order to change packaging, material flow, and the supply-chain?

The *Department of Engineering and Professional Development of the College of Engineers*, University of Wisconsin has defined a set of criteria for choosing a site for a

recycling facility, these are: one, the site should be near a waste dump or waste managing center; two, it should be accessible to receive and embark or export; three, it should be compatible with adjacent land uses; four, it should have good topography conditions; and five, it should be on route with its final destination. Where is the waste coming from? What and where is the final destination for the end product? Can the topography and landscape be used in favor of the sustainable design? How can the avenue be used in favor for the transportation of materials to site? Given the variety of context what positive and negative effects can the Paper Recycling Mill have?

How to convince the government and private corporations that such a development is needed?

How can architecture and design influence this project, using the relationship between industrial sites and architecture, and sustainability and architecture?

What is the cultural identity of the site? How can this project help define it? By studying vernacular materials and their possibility to be recycled, what design or architectural vocabulary can be formed?

What role does Fundición Abarca have, architectonically, programmatically, and environmentally? If the building is used through adaptive use, how can it maintain its heritage? To what degree of preservation is the foundry going to be taken? What relationship can develop between the former foundry and the recycling paper mill?

The recycling paper mill will need large quantities of water and will produce a lot of steam, where will the water come from and what will happen with the steam expelled?

Precedents

Bronx Community Paper Company

Architect: Maya Lin. **Location:** Bronx, New York. **Dates:** not constructed

The goal of this project was to “create a humanistic center whose purpose is not just to recycle waste paper, but to create a positive environment for the people that work there, the community it is placed in, and the people who will tour the facilities.”⁶⁶ The main design issues were focused on paths and their interconnections. These were: the path of people, vehicles, paper, and water. The buildings and the landscape were to be in harmonious balance, not letting the vehicle access take over the design considerations.

The capacity of the plant was to be 1800 tons of waste paper per day.

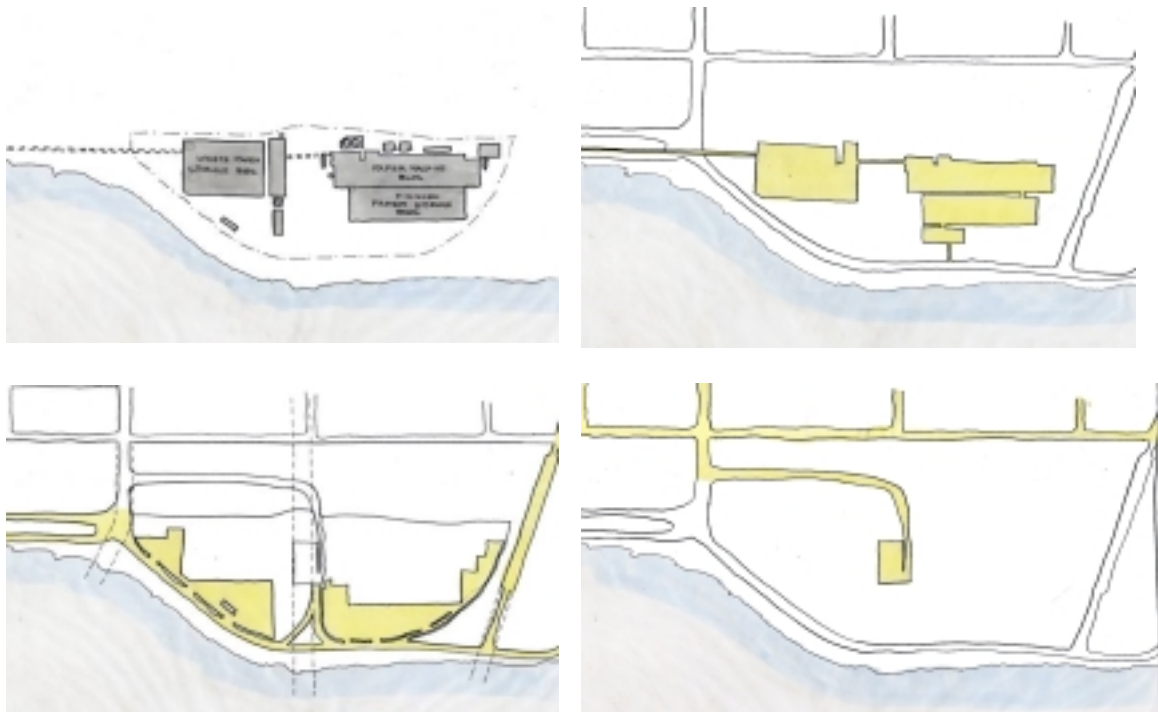


Figure 59 Path circulation diagrams of Bronx Community Paper Co.

Top left, Site Plan including Waste Paper Storage Buildings, Paper Machine Building, and Finished Paper Storage Building. Top right, Paper circulation, coming from a recycling sorting plant adjacent to the site. Bottom left, truck circulation. Bottom right, visitor vehicle circulation.

New Recycling Plant for Urban Waste

Architects: Abalos & Herreros. Location: Madrid, Spain. Dates: 1996-1999

The contemporary city of Madrid was used as a laboratory for the realization of different projects that searched for the connection between recycling, architecture, and the role of the architect. The project incorporates a system of management and recycling waste which is conceived inside a structure that is wrapped with recycled polycarbonate panels. This translucent material allows for vast diffusion of daylight while unifying the interior components of the recycling plant. The design takes advantage of the topography for the production line. As an industrial building this precedent offers an example of a large shed structure with a free plan in the interior.

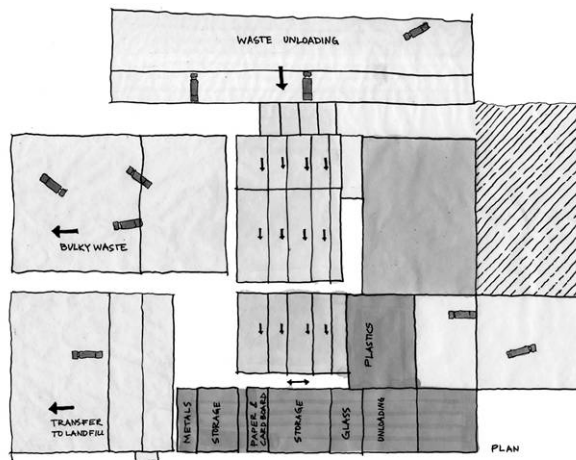


Figure 60 Madrid Recycling Plant waste circulation diagram plan and section.

Left, Waste Circulation Diagram, starting from top to bottom, the sorted material is loaded onto trucks for transportation to recycling mills.

Bottom, Section of Waste Circulation Diagram, showing how the waste process takes advantage of the topography.

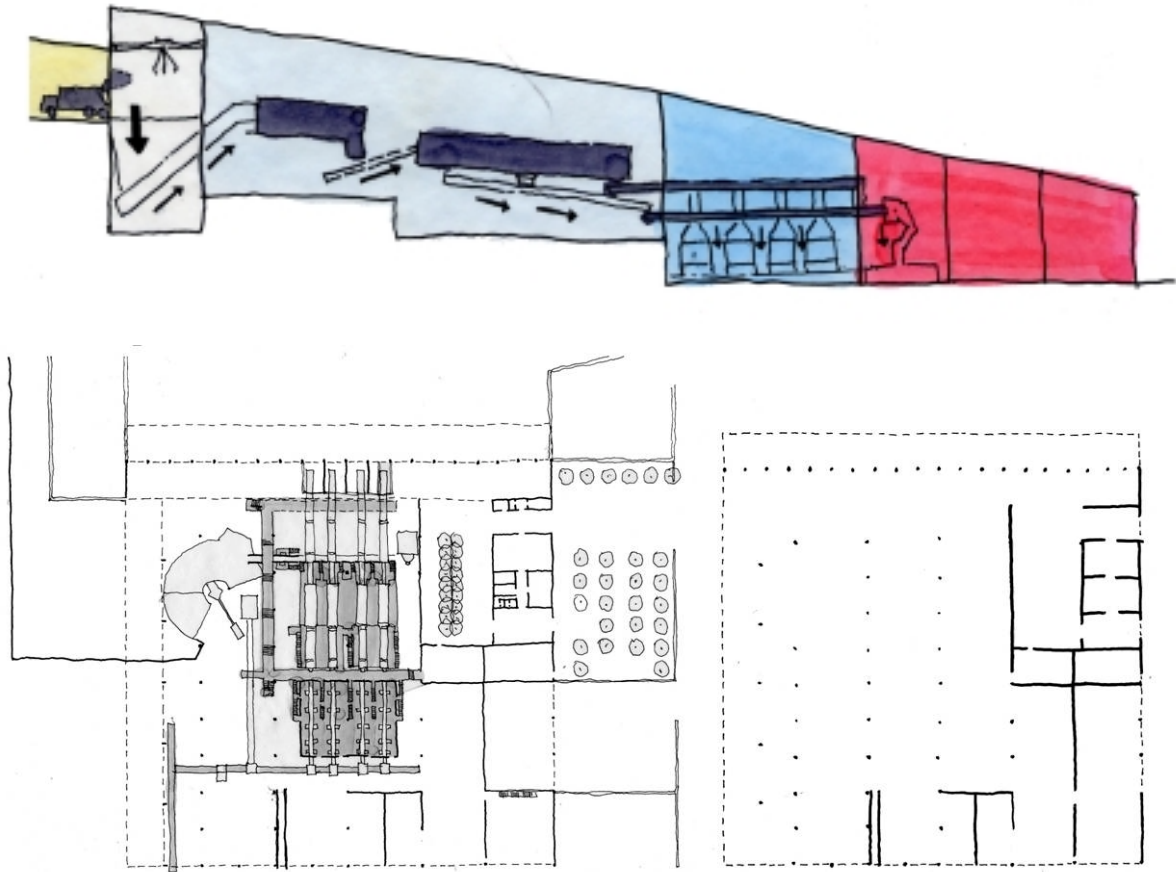


Figure 61 Waste processing machine plan and structural plan of Madrid Recycling Plant



Figure 62 Madrid Recycling Plant

Top, truck unloading platform. Middle, view of mechanical waste selection area. Bottom, view of enclosed final selection area.

Waste Transferal Station

Architects: UN Studio. Location: Delft, Netherlands. Dates 2000 Area: 10,997 sq ft.

“The building symbolizes a general change in attitude towards waste, enforced through contemporary environmental awareness”.⁶⁷

The scheme responds to the circulation of vehicles and waste, thus resulting in a fluid and dynamic form. This complex which appears as a gigantic machine coming out of the earth accommodates a recycling waste facility and a compression facility for non-recyclable waste that is transferred to an incinerator. The system includes delivering, processing and shipping of waste. A blue glazing closes one side of the building, allowing for views of the internal workings.

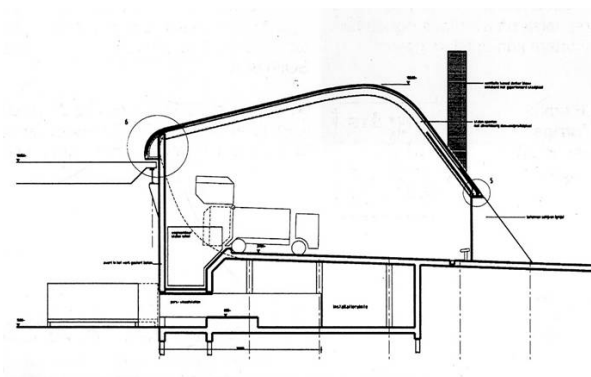


Figure 63 Delft Waste Transferal Station, exterior view and section.

(Source: *The Phaidon Atlas of Contemporary World Architecture*. London: Phaidon, 2004. p. 335)

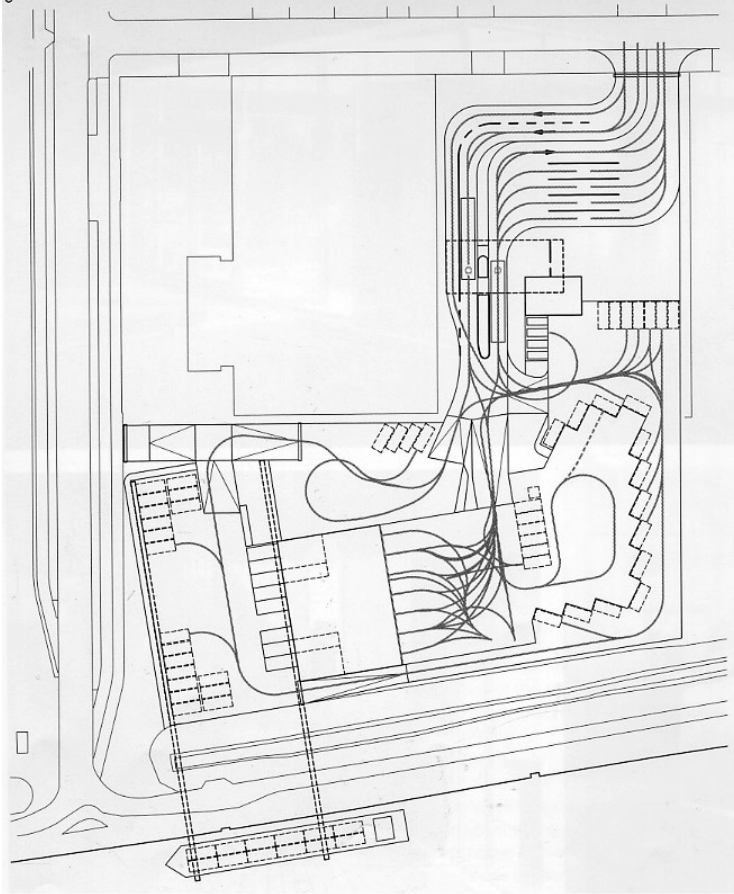


Figure 64 Delft Waste Transferal site plan and circulation diagram.

(Source: *The Phaidon Atlas of Contemporary World Architecture*. London: Phaidon, 2004. p. 335)

MS&R Offices

Architects: MS&R. Location: Minneapolis, Minnesota. Dates 2003 Area: 25,00 sq ft.

This adaptive re-use project integrates an abandoned mill with new office space. The mill known as Washburn A Mill is a National Historic Landmark, but was an architectural ruin until MS&R architects transformed this industrial building into the Mill City Museum and MS&R central offices.



Figure 65 MS&R Offices

Left, diagram showing existing and new intervention. Bottom left, exterior view. Bottom right, view of interior courtyard formed by the overlapping of the old and new structure.



Program

“The general public’s perception of what recycling is remains largely limited to those visible elements.”⁶⁸

The fact that no recycling plant exists in Puerto Rico has a great impact on the community’s conception of recycling. To the community recycling is just the mere act of collecting and separating waste into bins then taking them to the respective drop-off sites, generally located at shopping center parking lots. There is no promotion for or involvement between the community and the existing recycling sorting centers. These facts call for a place that visually demonstrates to the community what happens to the so called “recycled materials”. A place that serves as an education center, with exhibition halls and participation areas can help in transforming the current culture of consumption to an environmentally aware culture of recycling. Thus this project proposes a program that includes:

Waste paper sorting plant/ Receiving and sorting facility 7780 sqft

Recycling paper mill	Total 117780 sqft
Wastepaper de-inking plant	6000 sqft
Waste paper storage building	24890 sqft
Sludge dryer building	1300 sqft
Electrical equipment building	780 sqft
Paper machine building	23110 sqft
Finished paper storage building	21720 sqft
Control room	900 sqft
Overlooking corridor for visitors	
Toilet/ washing facilities	
Changing rooms/ lockers	890 sqft
Machinery:	
Steam boiler	1670 sqft
Soak tank	650 sqft
Broke storage tank	560 sqft
Plume reduction system	1110 sqft
White water storage tank	560 sqft

Newsprint paper making machine
Conveyer system

Vehicle circulation components:

Paved truck access area	6320 sqft
Truck loading ramp	5560 sqft
Roll loading area	4170 sqft
Weighing area	950 sqft
Parking areas	21560 sqft

Exterior program:

Green landscape
Water recollection
Waste water natural wetlands marsh

*Square footage based on a capacity of 1,800 tons of newsprint per day, calculated for a capacity of **400 ton per day**

Museum

Entrance lobby/reception	7750 sqft
Recycled materials exhibition room	1500 sqft
Open air exhibition rooms	2000 sqft
Conference/lecture hall	2000 sqft
Restoration/ storage/ curator	1000 sqft
Café/restaurant	750 sqft
Gift shop	100 sqft
	500 sqft

Education Center

Research facility/library	3750 sqft
Administration office	1000 sqft
Projection room	750 sqft
Laboratory	1000 sqft

Fundición Abarca

Building B	15,700 sqft
Building E	14,400 sqft
Dry dock with capacity for 20,000 ton ships	
Floating dock with capacity to serve 1,500 ton ships	

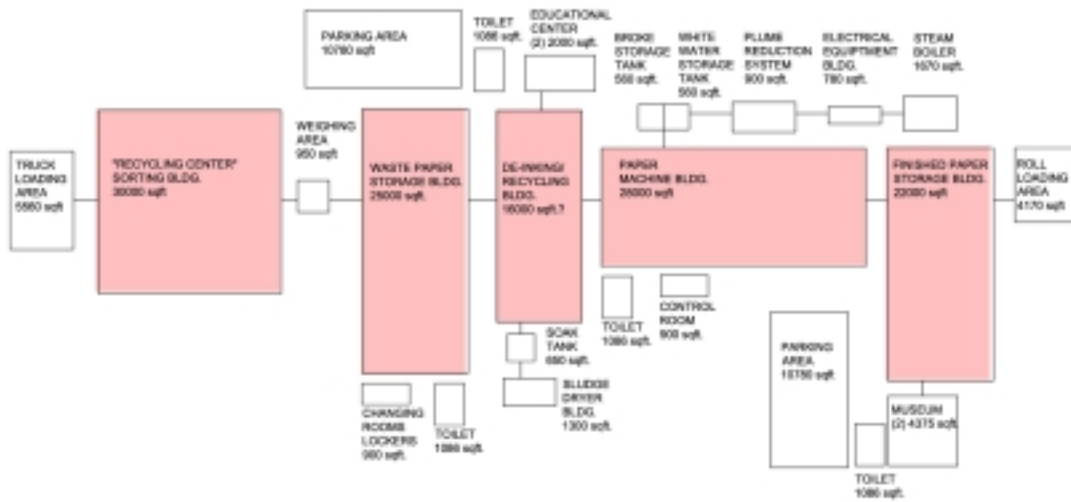


Figure 66 Program

Blocks shaded in gray indicate the five main buildings of a paper recycling mill.

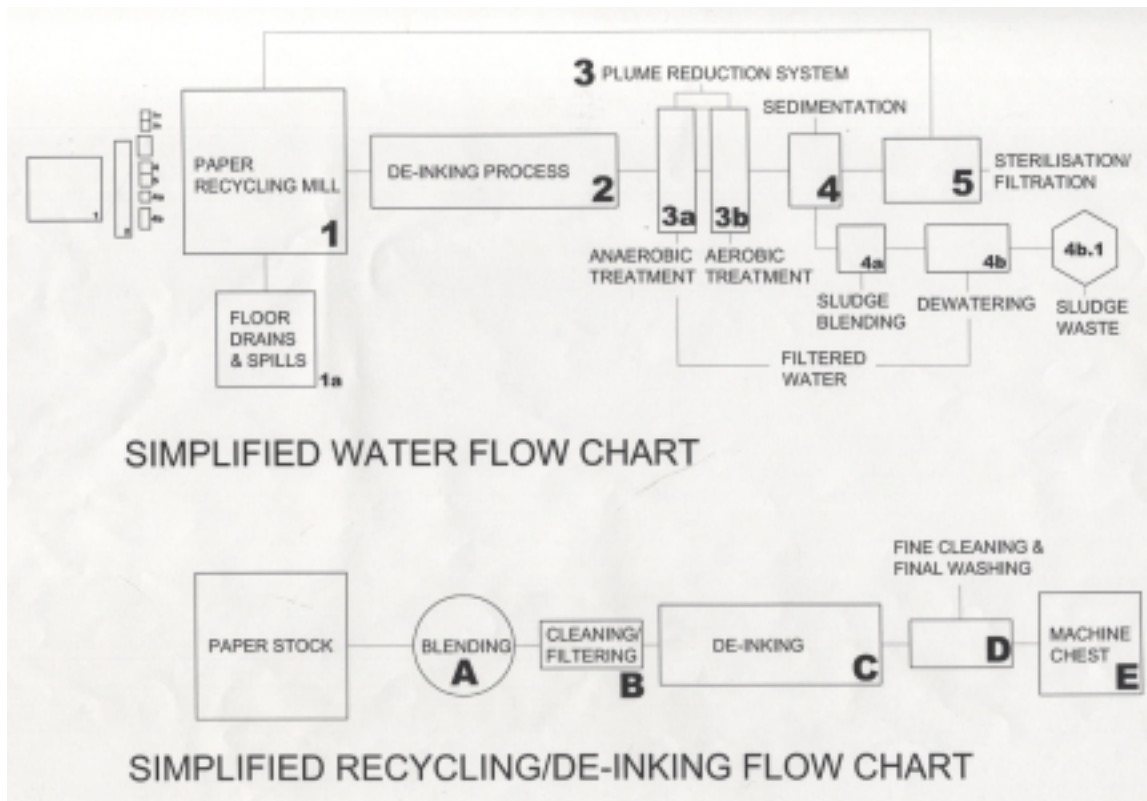


Figure 67 Water Circulation Diagrams

Chapter 7: Intervention and *Partis*

Interventions

The following interventions address three main site design problems. These are street direction and site access, truck and visitor circulation, and use of existing and adjacent blocks. The overall goal is the search for facilitating access to the site while keeping a harmonious balance between the industrial, residential and new commercial areas. The treatment of Ave. Muñoz Rivera has been identified as a key element that will play a very important roll in the ultimate design solution. The waterfront is an element second to the Avenue but nonetheless needs a formal definition. Other considerations addressed in the interventions are the placement of a traffic circle at the intersection of the seven streets entering Old San Juan, and a five mile radius around the schools in the vicinity.

Intervention #1 Connecting neighborhoods with bridges

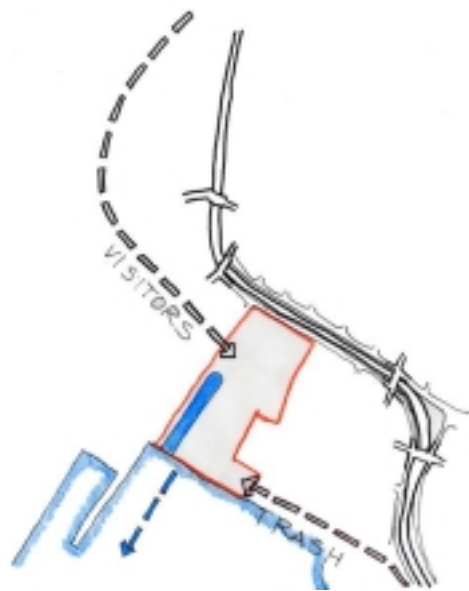


Figure 68 Intervention #1

Top, use diagram. A residential neighborhood is added to the southeast of the site. This new neighborhood imitates the block sizes of the Convention Center. It is connected to Miramar by a series of vehicular bridges, and enjoys access to the waterfront.

Middle, circulation diagram. Trucks and visitor path to site.

Bottom, new section of Ave. Muñoz Rivera. In this intervention the Avenue leads to the circle which becomes the main access to the site.

Intervention #2 Extending the Miramar Grid

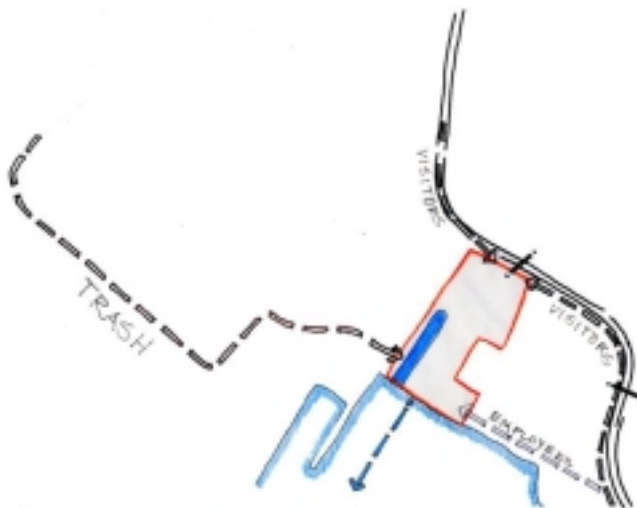
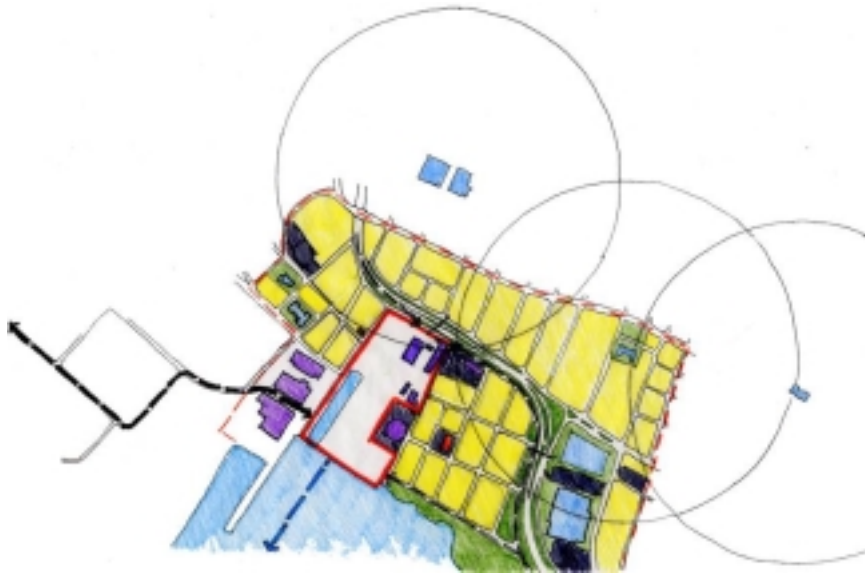


Figure 69 Intervention #2

Top, use diagram. The grid of Miramar has been extended to create a new residential neighborhood southeast of the site.

Middle, circulation diagram.

Bottom, the Avenue remains intact, with the addition of pedestrian bridges that connect the new and old neighborhoods.

Intervention # 3 Fusion of Neighborhoods



Figure 70 Intervention #3

Top, use diagram. A complete fusion of neighborhoods has been achieved by relocating the Avenue at the extreme south of the site.

Middle, circulation diagram.

Bottom, the Avenue is now elevated to accommodate the passage of ships using the dry dock underneath. The waterfront becomes part of the Avenue.

Intervention # 4 New Ecological Industries

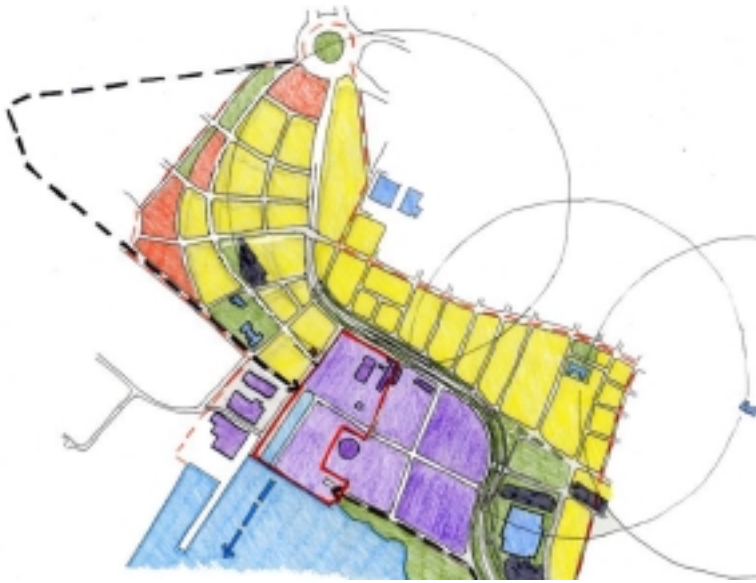


Figure 71 Intervention #4

Following Kalundborg's site strategy of industrial symbiosis, the proposed site is dedicated to new industries. The opportunity of reusing the brown field site in a similar manner to its original use is the main focus of this intervention. A reinterpretation of industry can now take place. A new cross street is added through the middle of the site, this allows for direct access from the southern most part of the Avenue and a direct connection the new Convention Center.

Initial *Partis*

The *partis* are focused on organizational strategies of architecture, preservation, and circulation. The following diagram chart best explains the ideas behind each *parti*.

	1	2	3
ARCHITECTURE			
PRESERVATION	FOUNDRY AS MUSEUM	FOUNDRY AS RECREATION/INDUSTRY	FOUNDRY AS INDUSTRY
TRUCK CIRCULATION			
VISITOR CIRCULATION			
EMPLOYEE CIRCULATION			
PAPER CIRCULATION			
AVENUE TREATMENT			
AVENUE SECTION			
FRONTS VS. BACKS			
DRY DOCK TREATMENT			
RELATION TO CONVENTION CENTER			
OPEN GREEN AREAS			
ROLE OF WATERFRONT			

Figure 72 Parti chart.

Parti #1 Paper at the Water's Edge

Following intervention number four, this parti accommodates the paper mill south of the new street. A direct relationship between the paper mill and the Convention Center is achieved. Any participation between the former foundry and the new mill is limited, thus turning the foundry into a museum of industry becomes a viable option. In this parti the waterfront and the dry dock belong only to the paper mill.

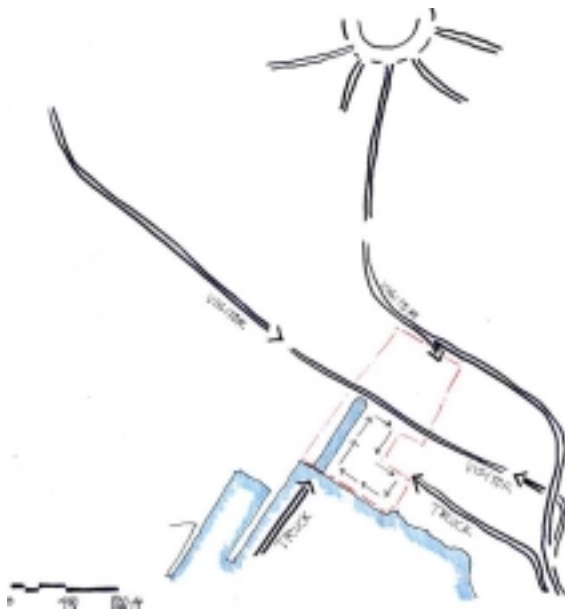


Figure 73 Parti #1

Top, site plan. Bottom, circulation diagram.

Parti #2 “Molding” iron and paper

This parti activates a relationship between the former foundry and the new paper mill. The new building functions as a connecting piece, a mediator between history and future. Special attention must be given to the new use of the foundry and how it will reinforce the objective of the paper mill. The avenue contains two major interventions, one is the proposed exit by the Convention Center and two is the introduction of a traffic circle. Here the traffic circle serves as the entrance path to the new industrial sites and

paper mill.

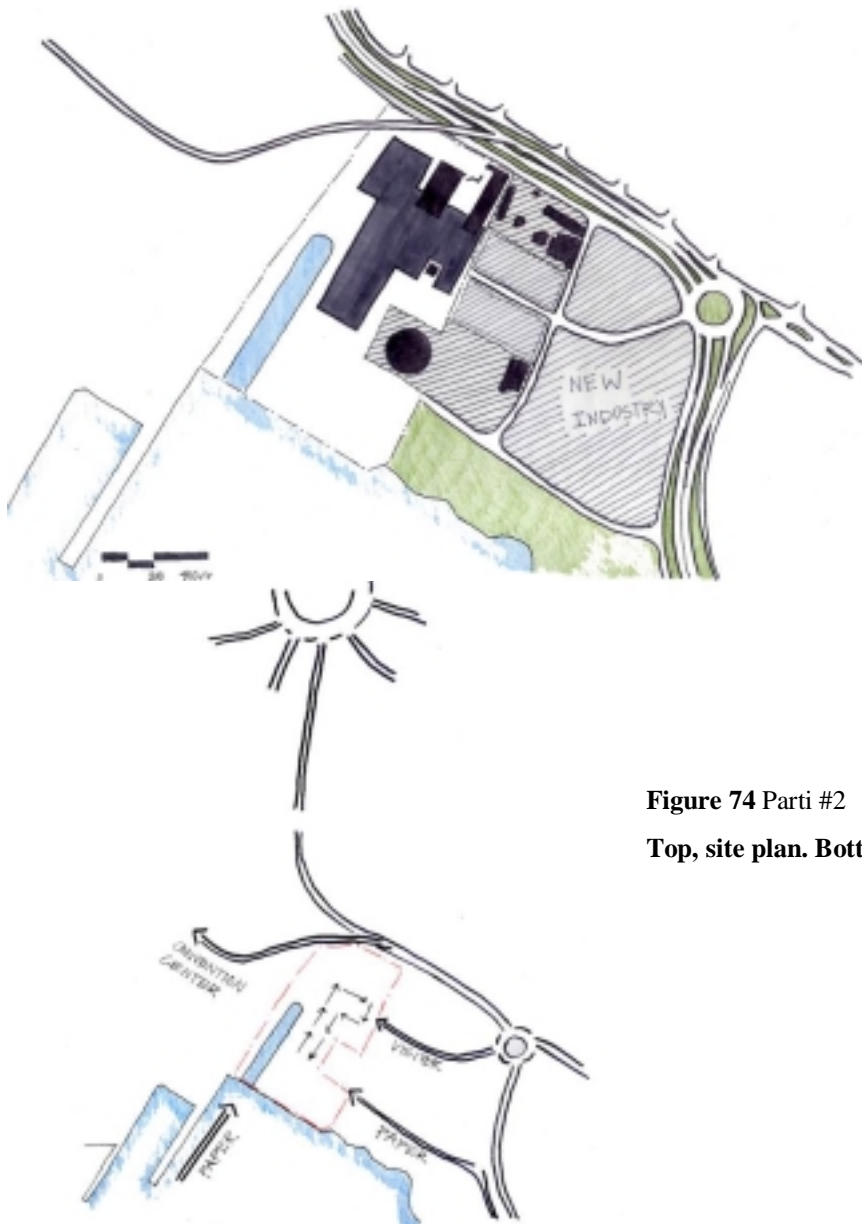


Figure 74 Parti #2

Top, site plan. Bottom, circulation diagram.

Parti # 3 Traditional Shed

This exploration brings into play the traditional shed structure of industrial buildings with the existing buildings of Fundición Abarca. A series of overlaps characterize this parti. One is the physical overlap of a roof hovering over another, in essence a shelter. A second overlap is the internal use of the building, where portions of the program are given to the foundry's structures through adaptive re-use. And the third overlap is the most evident, which can be defined as a double use of land, reducing

physical contact
with the
environment.

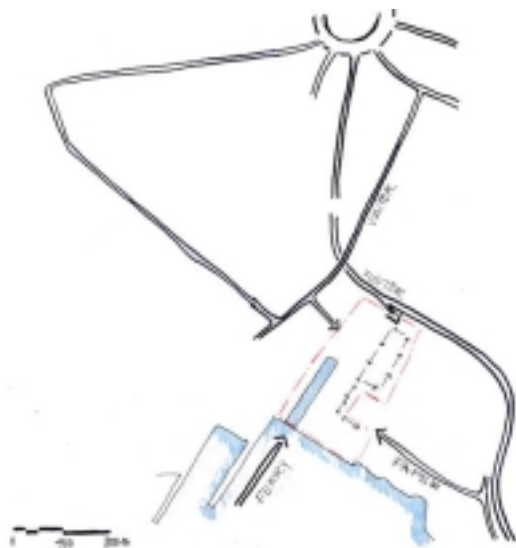


Figure 75 Parti #3

Top, site plan. Bottom, circulation plan.

Parti #4

By combining street and avenue strategies of parti numbers one and two, the architectural parti of number three can be accomplished. Again adaptive reuse plays an important role. The waterfront is not forgotten but incorporated into the industrial sequence. The street and the circle become one, a formal entrance piece to not only the new paper mill but also to the new Convention Center.



Figure 76 Parti #4.

Chapter 8: Design Conclusions

Transformation

In order to successfully transform the former foundry into a paper recycling mill, an acute study of the site and structures has been conducted as well as the compatibility between the two. Several aspects have been singled out as vital to maintaining integrity; these are the existing condition of the structures, the exterior facades, the interior qualities of light, the industrial use, and its setting on the site. The basic preservation strategy is to stop deterioration of the structures of Abarca and offer supplementary visual means for education and communication of its significance.

In this project the Secretary of Interior Standards for Rehabilitation will be used as a guideline to ensure that the historic character of Abarca is minimally affected. There are ten Standards to take into consideration, which “encompass the exterior and the interior, related landscape features and the building's site and environment as well as attached, adjacent, or related new construction.”⁶⁹ Of the ten Standards two are critical for the realization of this project. These are Standards numbers one, and nine, which include the use of the historical buildings, and new additions. These read as follow

“1. A property shall be used for its historic purpose or be placed in a new use that requires minimal change to the defining characteristics of the building and its site and environment.

9. New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with

the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.”⁷⁰

Standards two through eight refer to treatment of materials, historic features, and archaeological artifacts. Standard ten refers to removal of new additions.

As mentioned earlier the transformation of Abarca starts with the study of site, location, and the needs of space required for a paper recycling mill in relation to the historical buildings dedicated to metal foundry work. A paper recycling mill is composed of four main buildings plus a sorting center. The sorting center is the building that receives recyclables such as plastic, metal, glass, and paper, and separates these materials into bales to be taken to corresponding recycling mills. The four main buildings of a paper recycling mill are an initial paper bale storage building, where paper is stored before going through the recycling process. A de-inking machine building, this machine turns paper into pulp which then goes through a filtering and cleaning process. A paper machine building, here pulp is steamed into paper, and a final finished paper storage building where the finished product is stored. Also included in the program of this project is an area dedicated to commemorate Abarca as well as an area for education and communication of the new sustainable agenda.

The study of compatibility between foundry and paper recycling mill indicates the similarity between the area of the process line of turning iron into steel and the area of a paper machine. Both engage in a linear process thus both, need to be contained inside a long narrow building such as what the 1940’s Abarca building offers. The original 1924 building of Abarca is now designated as the heart of the new complex. This building will include a commemoration area, classrooms, a conference room, a materials research area,

office space, an eating area, and the machine control room of the new complex. This structure will be referred to as the visitor's center. The new structures needed to accommodate the functions of the paper recycling mill have been placed accordingly to respect the ninety-two feet building set back from the property line of the original 1924 building. The sorting center building is located to the west of the visitor center. Directly south is the initial storage building which is connected by a conveyor belt to the de-inking building located between the 1924 and the 1940's building. The 1940's building now holds the paper machine and south the final storage building is located. The new buildings have been carefully placed to fit the needs of the recycling process and most importantly result in "...minimal change to the defining characteristics of the building and its site and environment."⁷¹

The new fabric is designed with materials that respond to the vocabulary of a paper recycling mill and are "differentiated from the old,"⁷² an important distinction required by the Secretary of Interior Standards. Recycled paper tube columns and recycled polycarbonate panels are used for the enclosure or exterior walls of the mill buildings, exposed Corten steel is used as the main structural material. Its rusted quality requires less maintenance and creates a dialogue between paper architecture and iron architecture. An elevated walkway weaves its way between old and new allowing for visitors to tour and comprehend the process of recycling paper.

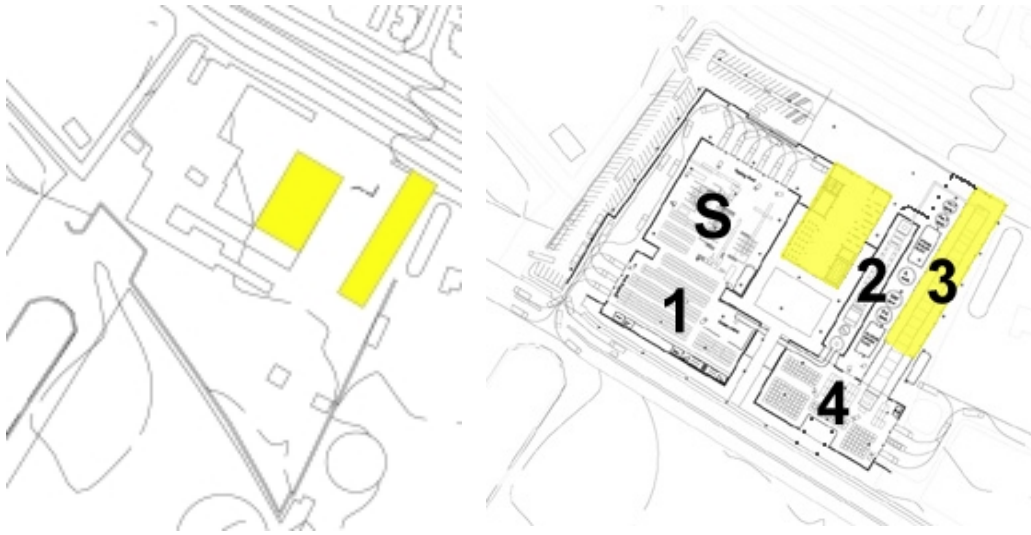


Figure 77 Location of buildings, before and after.

Shaded in gray from left to right are Abarca’s original 1924 building and 140’s building. S indicates location of sorting center, one is the initial storage building, two is the recycling/de-inking building, three includes the paper machine inside the 1940’s building, and four is the final storage building.

Visible elements of the sustainable agenda include generation of energy by a photovoltaic array which hovers over the complex like a large tree canopy giving shade to the revived landscape; this component will be referred to as the sun canopy. The scale of the sun canopy is noticeably larger than the existing and new fabric. Its transparent characteristic as well as the location and size of opaque elements present a translucent massing appearance. A balance is created between scale and mass in order to meet the challenge of “the new work shall... be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.”⁷³

Green roofs or vegetation roofs are designed for the new buildings which in combination of the sun canopy assist in cooling the interior of the buildings. Breathing space between the buildings allow for deliberate infiltration of vegetation or gardens into

the built fabric. South of the complex a new landscape is developed. The premise of the landscape design is regeneration of nature, where the built fabric is once again dominated by flora which is inversely penetrated by the “city.” The “city” is seen as paths and hard surfaces. Both path and garden work together as interlaced fingers creating a balance between nature and building.

Conclusions

It is clear that the ultimate goal is to balance nature and construction by means of adaptive re-use, and to communicate the importance of conserving the environment. How this has affected Abarca’s integrity is a delicate matter. Going back to the seven aspects of integrity defined by the NRHP three would be questionably altered in the proposed scheme. These are setting, feeling, and association.

The surroundings that define the setting of Abarca of which much was already lost, have been transformed from a complex of foundry buildings to a complex of paper recycling mill buildings. The industrial use is maintained but the footprints and the spatial relationship between buildings have changed. The feeling of metal works that responded to a past agricultural life has also been transformed to a feeling of recycling that responds to contemporary needs for a sustainable life. The fact that the machines of the foundry do not exist and in their place are paper recycling machines and uses dedicated to visitors, changes the association; however the complex remains industrial. The ability to convey to the observer the relationship of activities realized in the foundry has changed, leaving only the structures and the area of remembrance to communicate association.

It is fair to assert that adaptive re-use is an appropriate practice of preservation as long as integrity is maintained. Preservation by means of adaptive re-use is presented here as an example to the community of regeneration possibilities. This project has been designed to demonstrate and to prove that existing sites can be reused in an effective manner, that historical buildings can be saved and can serve current needs, that sustainable projects can be realized to benefit the community, and that within a specific community the environment can be conserved.

Therefore preservation, the reuse of buildings, and environmental conservation can be combined to form a powerful method that can result in healthy, integral and historical and culturally cognizant communities. This method can be called sustainable preservation made possible by adaptive re-use. In the case of Abarca five components define sustainable preservation. These are re-use of a neglected site, preservation of a historical building, sustainable design, conservation of the environment, and conservation of a culture. Adaptive re-use can now be redefined as the process of preserving buildings, sites or landscapes employing a sustainable agenda by facilitating a new use in order to maintain environmental health, integrity, and culture in a given community.

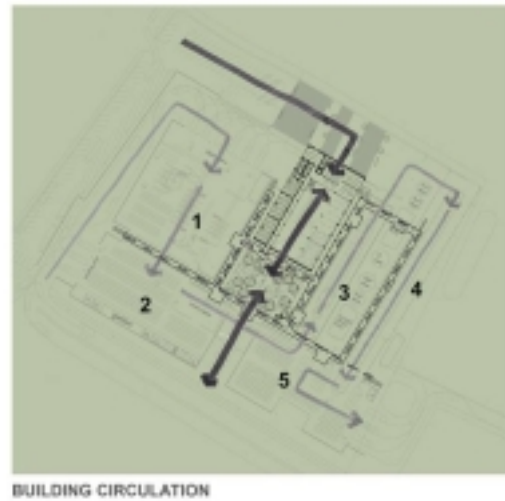
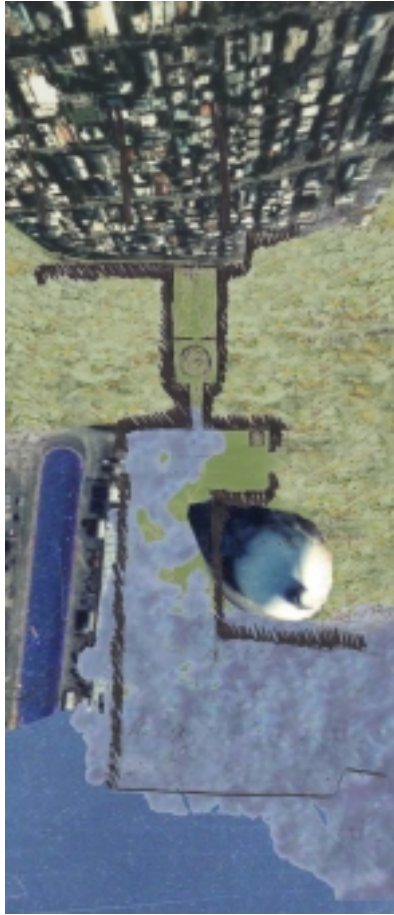


Figure 78 Conceptual Diagram

This diagram shows the idea of the city being pulled into the heart of the sustainable education center and coming out transformed into nature.

Figure 79 Paper and visitors' movement diagram

The sequence of arrival to departure is shown for paper in gray and for visitors' in black both at urban and building scale.



Figure 80 Location Diagram

The act of reclaiming the water front is seen through the extension of the green and the boardwalk at the water's edge which connects to the Paper Recycling Mill and the new Convention Center.



Figure 81 Master Plan

The master plan shows the proposed symbiotic relationship for the new industrial ecological zone.



Figure 82 Transformation 1: Existing Condition



Figure 83 Transformation 2: Horizontal Plane 1



Figure 84 Transformation 3: Vertical Plane



Figure 85 Transformation 4: Horizontal Plane 3

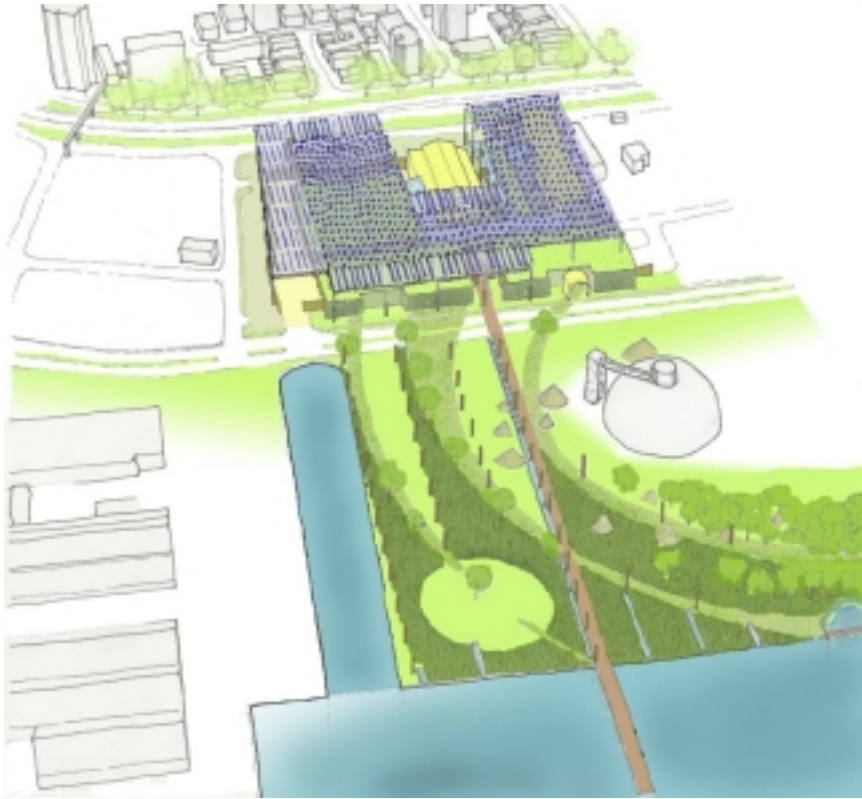
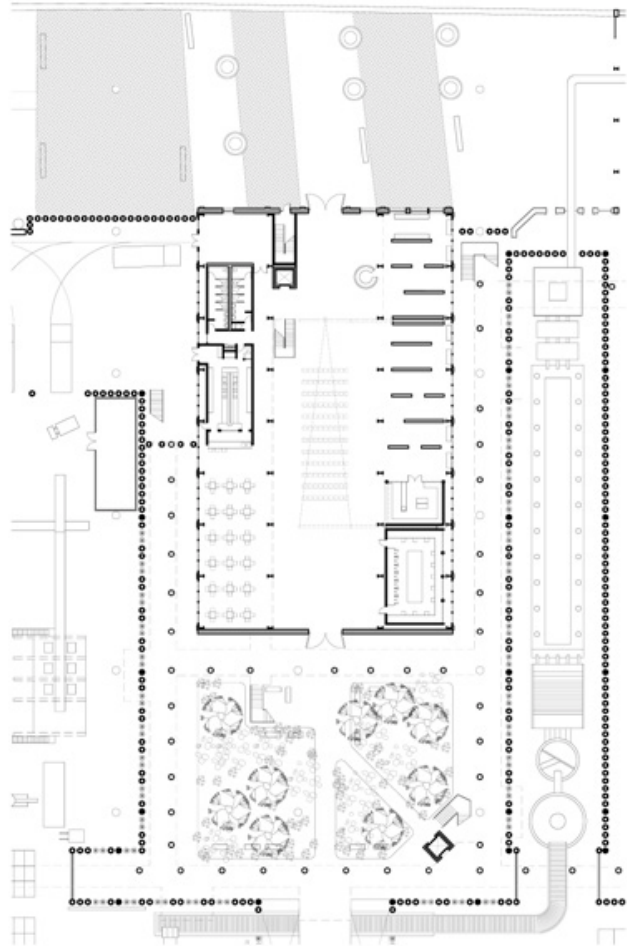


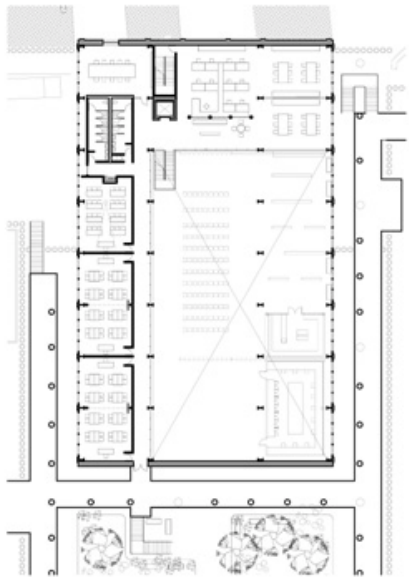
Figure 86 Transformation 5: Horizontal Plan 3



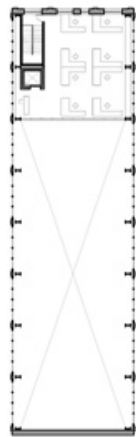
Figure 87 Ground Floor Plan



VISITORS' BUILDING
GROUND FLOOR
PLAN



SECOND FLOOR
PLAN



THIRD FLOOR
PLAN



Figure 88 Longitudinal Section from city to water



Figure 89 Longitudinal section through building



Figure 90 Cross section

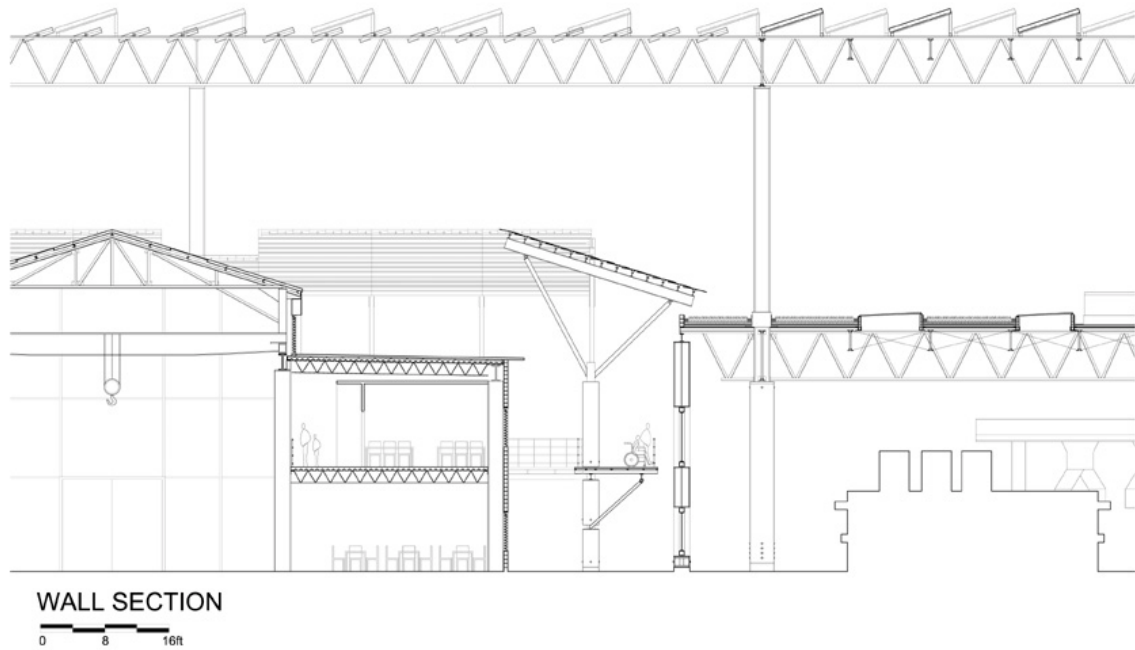


Figure 91 Wall section

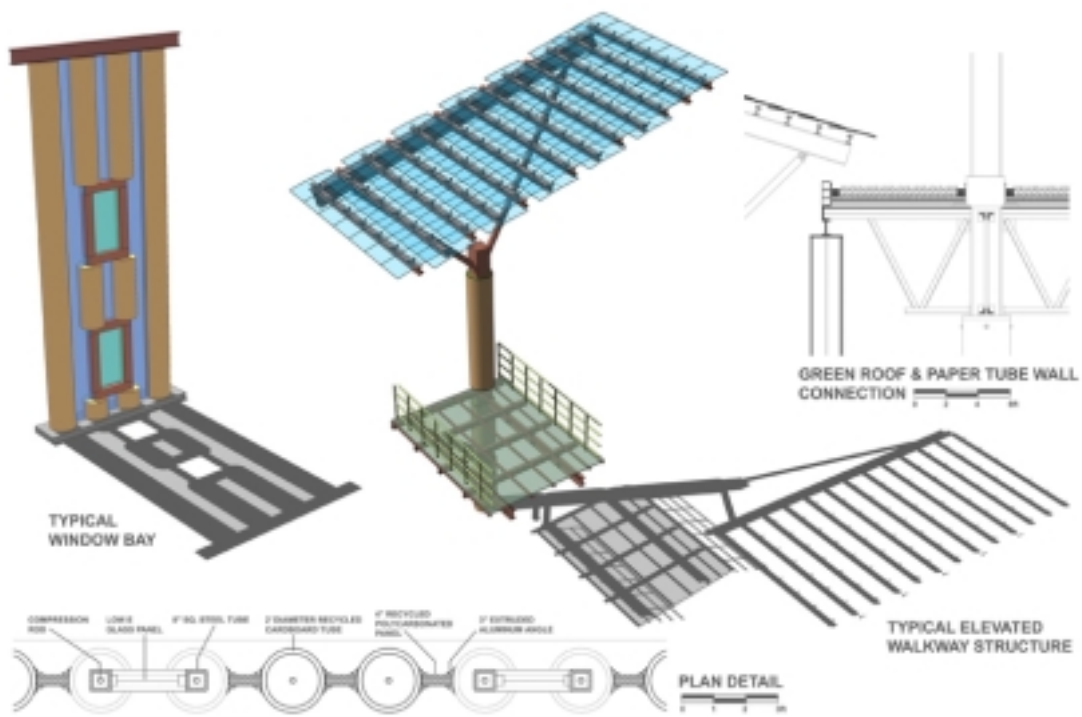


Figure 92 Details



Figure 93 Interior view of visitors' building

Figure 94 View of courtyard



PAPER RECYCLING MILL: SUSTAINABLE EDUCATION CENTER IN SAN JUAN, PUERTO RICO

Figure 95 Visitors' sequence plan

Visitors can tour the complex on an elevated walkway. There are eight stages, six are shown here. There are five main buildings and six including the visitors' center.



Figure 96 View into sorting center and tipping floor.



Figure 97 View into paper storage building



Figure 98 View of landscape from elevated walkway

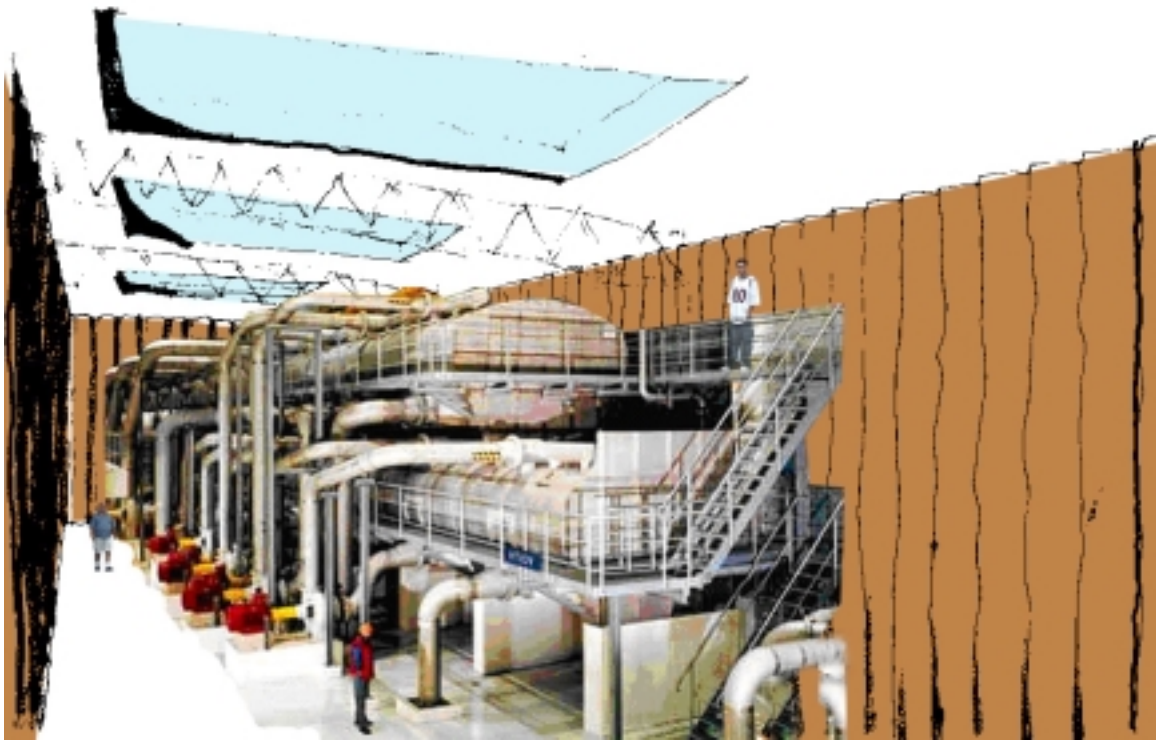


Figure 99 View into de-inking building

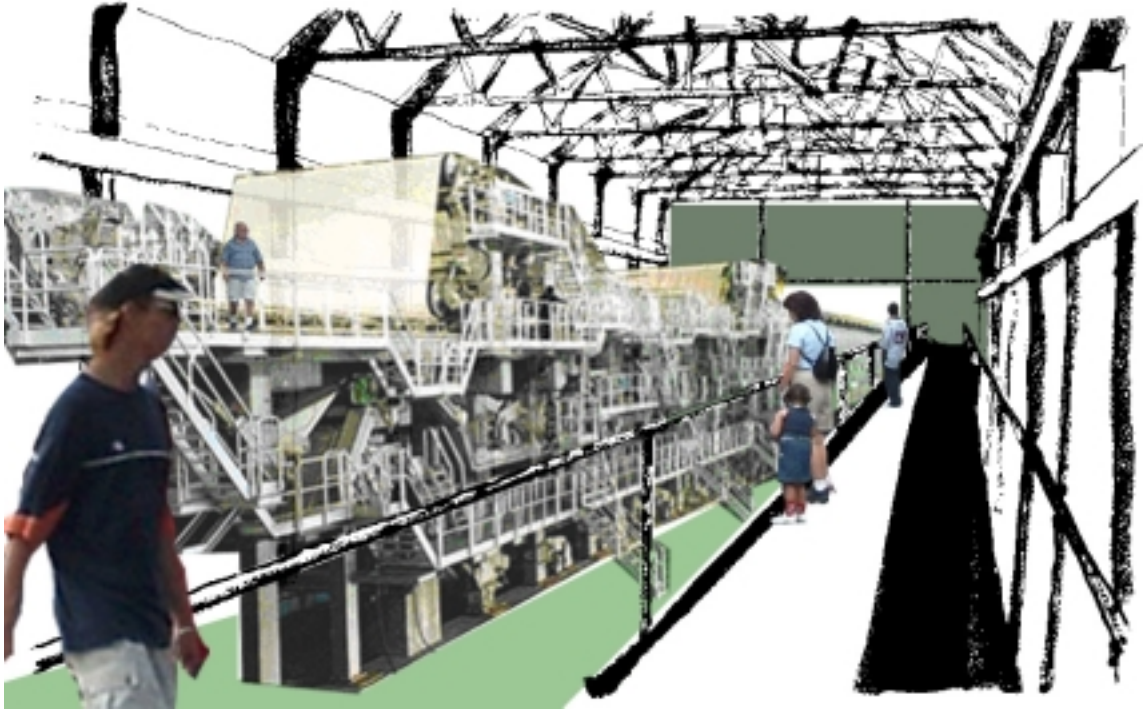


Figure 100 Paper machine building in 1938 Abarca building.



Figure 101 Final storage building

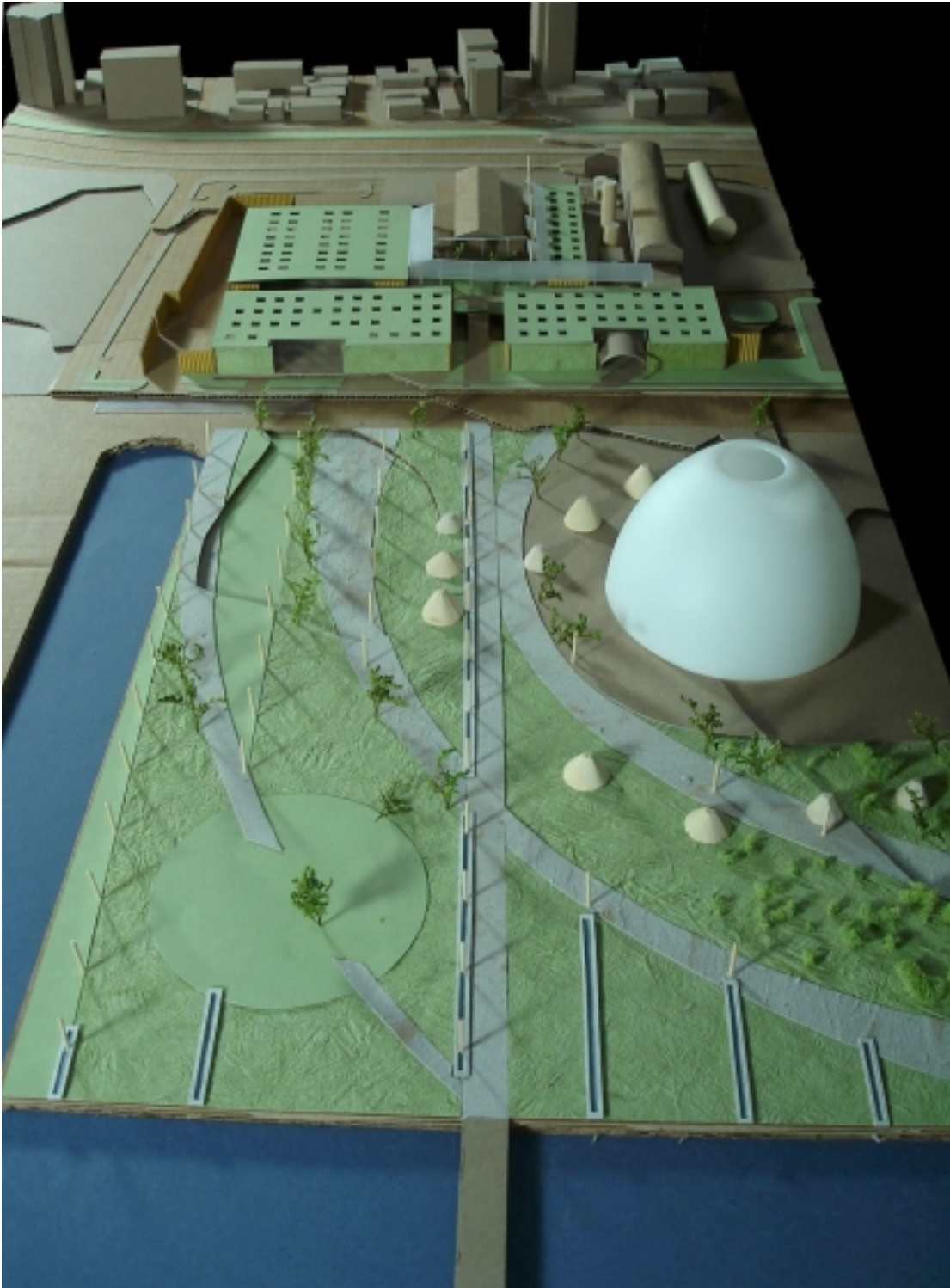


Figure 102 Site model

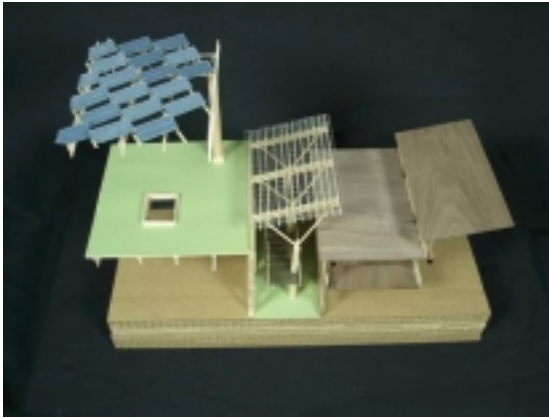


Figure 103 Detail model

This model shows the interaction between the historical building and the new building. It also shows part of the sustainable agenda: PV panels, green roof, recycled cardboard columns and recycled polycarbonated panels.

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- ¹ Lund, Herbert F. *The McGraw-Hill Recycling Handbook: Second Edition*. United States of America: McGraw-Hill. 2000 p.27
- ² Ibid
- ³ Gissen, David. *Big & Green: Toward Sustainable Architecture in the 21st Century*. New York: Princeton Architectural Press. 2003 p.185
- ⁴ Webster Dictionary. P.195
- ⁵ <http://welcome.topuertorico.org/people.shtml>
- ⁶ *La Isla Desechable: El Problema de la Basura en Puerto Rico*. Sala de Exhibiciones Rafael Carrión Pacheco. Noviembre de 1995 p. Introduction
- ⁷ Math calculation done by author. (8,100 tons per year = 324000 cubic feet = 324000 square feet. 1839975 square feet of the island divided by 324000 square feet per year = 6 years.)
- ⁸ <http://216.239.41.104/search?q=cache:ELDEoE9JrmoJ:geography.about.com/library/weekly/aa012599.htm+population+density+united+states&hl=en>
- ⁹ <http://prehco.rcm.upr.edu/docs/census00.pdf> There was a population of 2,210703 in the year 1950.
- ¹⁰ Suburban planned community, composed of single family houses, designed to full fill the American Dream, half acre lot for everyone. <http://server1.fandm.edu/levittown/default.html>
- ¹¹ *La Isla Desechable: El Problema de la Basura en Puerto Rico*. Sala de Exhibiciones Rafael Carrión Pacheco. Noviembre de 1995
- ¹² Ibid. p 20-21
- ¹³ Lund, Herbert F. *The McGraw-Hill Recycling Handbook* p
- ¹⁴ *Informes Anuales a la Legislatura de la Autoridad de Desperdicios Sólidos*. 1997
- ¹⁵ Ibid.
- ¹⁶ Maryland Paper Co.
- ¹⁷ Maryland Paper Company Brochure.
- ¹⁸ Murtagh, William J. *Keeping Time: The History and Theory of Preservation in America*. United States of America: John Wiley & Sons, Inc. 1997 p. 215
- ¹⁹ Ibid. p. 218
- ²⁰ Allen Hershkowitz is a senior scientist at the Natural Resource Defense Council, who specializes in issues related to sustainable development, industrial ecology, solid-waste management, recycling, the paper industry, among others.
- ²¹ Hershkowitz, Allen. *Bronx Ecology: Blueprint for a New Environmentalism*. Washington: Island Press. 2002 p 97
- ²² Hershkowitz, Allen. *Bronx Ecology: Blueprint for a New Environmentalism*. Washington: Island Press. 2002 p. 43
- ²³ www.uneptie.org/pc/ind-estates/graphics/Cases/kalundborg
- ²⁴ Gissen, David. *Big & Green: Toward Sustainable Architecture in the 21st Century*. New York: Princeton Architectural Press. 2003. p. 185
- ²⁵ Lund, Herbert F. *The McGraw-Hill Recycling Handbook: Second Edition*. United States of America: McGraw-Hill. 2000 p. P.B. 35
- ²⁶ Gissen, David. *Big & Green: Toward Sustainable Architecture in the 21st Century*. New York: Princeton Architectural Press. 2003. p. 9
- ²⁷ Hershkowitz, Allen. *Bronx Ecology: Blueprint for a New Environmentalism*. Washington: Island Press. 2002 p. 44
- ²⁸ The United States invaded and occupied Puerto Rico in 1898. The Paris Treaty put an end to the war between the United States and Spain which required Spain to give up its political rights over Puerto Rico and the Philippines to its adversary. Picó, Fernando. *Historia General de Puerto Rico*. Río Piedras, Puerto Rico: Ediciones Huracán. 1986. p.223 translated by the author
- ²⁹ Company dedicated to machinery and truck storage and renting
- ³⁰ <http://www.prconvention.com>

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- ³¹ Cited in, Del Cueto, Pantel & Associates. *Documentación y Evaluación de La Fundación Abarca Santurce, Puerto Rico*. Guaynabo, Puerto Rico: Historic Preservation Consultants. 2003 p 13-14
- ³² Engineer who published the *Curriculum Vitae de Sucesores de Abarca, Inc. S/ Snp.* in 1978, cited in Del Cueto, Pantel & Associates. *Documentación y Evaluación de La Fundación Abarca Santurce, Puerto Rico*. Guaynabo, Puerto Rico: Historic Preservation Consultants. 2003 p 8
- ³³ Cueto, Pantel & Associates. *Documentación y Evaluación de La Fundación Abarca Santurce, Puerto Rico*. Guaynabo, Puerto Rico: Historic Preservation Consultants. 2003 p 16
- ³⁴ Robert E Stipe, *A Richer Heritage: Historic Preservation in the Twenty-First Century* (Chapel Hill: University of North Carolina Press, 2003 p. 442)
- ³⁵ Alanen, Arnold R. and Robert Z. Melnick,. *Preserving Cultural Landscapes in America* (Baltimore: The Johns Hopkins University Press, 2000 p. 24)
- ³⁶ <http://dictionary.reference.com>
- ³⁷ Jeremy Korr, "A Proposed Model for Cultural Landscape Study." *Material Culture* Vol. 29 No. 3 (1997):1.
- ³⁸ William J. Murtagh, *Keeping Time: The History and Theory of Preservation in America* (United States of America: John Wiley & Sons, Inc., 1997 p. 116)
- ³⁹ <http://dictionary.reference.com>
- ⁴⁰ Murtagh, 218.
- ⁴¹ Bernard M Feilden, *Conservation of Historic Buildings* (Amsterdam: Architectural Press, 2003 p. 3)
- ⁴² *Ibid*, 1
- ⁴³ "Sucrs. De Abarca Inc. Un Siglo Entero al Servicio de la Industria Boricua," *Puerto Rico Ilustrado* (December 3, 1949): 106.
- ⁴⁴ Teresita Martínez-Vergne, *Capitalism in Colonial Puerto Rico: Central San Vicente in the Late Nineteenth Century* (Florida: University Press of Florida, 1992 p. 4)
- ⁴⁵ *Ibid*, 4-6.
- ⁴⁶ *Ibid*, 38.
- ⁴⁷ *Ibid*, 42.
- ⁴⁸ Thomas Hibben, *Industrial Development of Puerto Rico and the Virgin Islands of the United States*. (Puerto Rico: Caribbean Commission Puerto Rico Planning, Urbanizing and Zoning Board, July 1948 p. 3)
- ⁴⁹ Fernando Picó, *Historia General de Puerto Rico* (Río Piedras, Puerto Rico: Ediciones Huracán, 1986 p. 197-8)
- ⁵⁰ *Ibid*, 238.
- ⁵¹ "Sucrs. De Abarca Inc. Un Siglo Entero al Servicio de la Industria Boricua," 106.
- ⁵² *Ibid*, 106.
- ⁵³ *Ibid*, 108-109.
- ⁵⁴ Edgar Morell, "La Colección Abarca en AACUPR." *Heliografía*, Vol 2, No. 4 (August 1995): 7.
- ⁵⁵ "Sucrs. De Abarca Inc. Un Siglo Entero al Servicio de la Industria Boricua," 106.
- ⁵⁶ Aníbal Sepúlveda Rivera, *Cangrejos-Santurce: Historia Ilustrada de su Desarrollo Urbano (1519-1950)*, (Puerto Rico: Centro de Investigaciones CARIMAR, Oficina Estatal de Preservación Histórica, 1988 p. 14)
- ⁵⁷ *Ibid*, 59.
- ⁵⁸ *Ibid*, 59.
- ⁵⁹ This Convention was adopted by the thirty-second session of the UNESCO General Conference on 17 October 2003. It was designed in order to safeguard cultural heritage and strengthen solidarity at regional and international levels. <http://portal.unesco.org/culture>
- ⁶⁰ <http://dictionary.reference.com>
- ⁶¹ Stipe, 440.
- ⁶² Pantel Del Cueto & Associates. *Documentación y Evaluación de La Fundación Abarca Santurce, Puerto Rico*. (Guaynabo, Puerto Rico: Historic Preservation Consultants, 2003 p. 31-35)
- ⁶³ http://www.cr.nps.gov/nr/publications/bulletins/nrb15/nrb15_8.htm#seven%20aspects
- ⁶⁴ Del Cueto, p.38.
- ⁶⁵ <http://www.ibe.unesco.org/International/DocServices/Thesaurus/00003681.htm>
- ⁶⁶ Concept Design for the Bronx Community Paper Co., Maya Lin, Feb. 1, 1994

⁶⁷ *The Phaidon Atlas of Contemporary World Architecture*. London: Phaidon, 2004. p. 335

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⁶⁹ <http://www.cr.nps.gov/hps/tps/tax/rhb/stand.htm>

⁷⁰ Ibid.

⁷¹ Ibid, Standard 1.

⁷² Ibid, Standard 9.

⁷³ Ibid.

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