Full Length NEH White Paper for the project
Planning for a Sustainable Climate Control System and Collection Storage in an Old San Juan Historic Building

La Casa del Libro Museum & Library, San Juan, Puerto Rico.
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What follows is our official White Paper for the National Endowment for the Humanities (NEH) Planning Grant. It represents our final public-facing progress report for the grant and the culmination of the planning phase for the project. La Casa del Libro Museum & Library (La Casa del Libro) principal objective was to conceive a plan that allows the institution to have a properly designed a collection storage that works in combination with sustainable practices. With this, La Casa del Libro prepares to implement an adequate renovation of the main deposit of the museum that turns it into the secure and resilient space the collection needs.

La Casa del Libro in brief

Founded in 1955, La Casa del Libro is the only institution in Puerto Rico devoted to study, teaching and developing the history of the book and book arts. It houses the most important rare book collection on the island and the Caribbean. Elmer Adler (Rochester, New York, 1884 - San Juan, Puerto Rico, 1962), a bibliophile, founding member of Random House, and founder of Pynson Printers, The Colophon magazine, and University of Princeton Graphics Arts Department, was brought to the island by a government dependency formerly known as Fomento Económico with the objective of improving the book industry in Puerto Rico. This idea quickly developed into Puerto Rico’s first nongovernmental, nonprofit museum.

With Adler as its first director, La Casa del Libro was dedicated to educating and inspiring printers, artists, draftsmen and the general public on the history of the book. It did so, using the best tangible examples available, from manuscripts to the finest
contemporary printed books. The collection started with incunabula (books printed between 1450-1501) donated by Adler’s friends. As examples, the collection includes: a first edition of Pope Leo I sermons, printed in 1470 by Sweynheim & Pannartz; a magnificent copy of Pliny’s Natural History by Jenson, printed in 1472; two royal decrees signed by the Catholic Monarchs in 1493, believed to be the oldest existing documents in America related to Cristopher Columbus’ second voyage; and the only extant copy in America of Thomas Aquinas’ *Summa Theologiae Pars Tertia*, printed in 1477.

The collection also houses nearly five hundred 16th century books. Among these, a copy of *Occaeana decas* by Peter Martyr d’Anghiera, containing the first printed map showing Puerto Rico, and the extraordinary Polyglot Bible printed by Arnaldo Guillén de Brocar. In addition, the collection has a copy of Don Quixote second edition, printed in Valencia in 1605, the same year of its publication in Madrid, and another by Juan de la Cuesta in 1608. Likewise, the collection includes a Don Quixote from the Madrid printing press by Joaquin Ibarra in 1780. William Morris’s Chaucer illustrated by Burne-Jones, stands out among the 19th century books. Later examples from the 19th and 20th centuries of fine printing, which stand out for uniqueness, beauty, content, or rarity, are also well represented in our collection. An integral part of La Casa del Libro’s funds are the books and graphic works of a distinguished group of Puerto Rican artists such as Lorenzo Homar, Rafael Tufiño, Jack and Irene Delano, Antonio Martorell and Consuelo Gotay, among others. All these artists came to the institution seeking knowledge and information and left us beautiful and alluring artworks, many inspired by the collection.

In its nearly 67 years of existence, La Casa del Libro’s collection of incunabula and rare books attracts local and international scholars interested in studying the history of the book. They receive information on bibliographic characteristics, first impressions, content, themes, comparison of impressions, and other topics of humanistic relevance contained within the books. Equally, the Museum has placed its collection at the disposal of students, teachers, artists, printmakers, museum professionals and book lovers from all parts of the world that arrive eager to learn about book history. La Casa del Libro emphasizes the appreciation of the book as an artistic object and at the same
time as a repository of human expression, presenting the communion between design, writing, and reading. School programs are free year-round to public schools.

La Casa del Libro hosts three to four exhibitions within a year alternating the collection with artists’ exhibits. These activities allow us to preserve our books and artworks better, spread knowledge about books and book arts, offer opportunities to artists, and increase awareness and reach for La Casa del Libro, thus fulfilling our mission.

**The museum headquarters**

The colonial structure that houses La Casa del Libro, owned by the *Instituto de Cultura Puertorriqueña* (ICP or Institute of Puerto Rican Culture, in English), was originally two multi-family two-story houses. It is located at 255-257 Calle del Santo Cristo, the first paved street in the islet, where several buildings in this street are also the oldest. The 255 wing was the first rehabilitated historic house (1955-1958), in the Old San Juan Historic District, and became the first building on the islet adapted for museum use (a collaboration between Adler and architect Frederik C. Gjessing (St. Louis, 1918 - Martinique, 1997). Although the exact date of construction is not known, its construction in rubblework and brick masonry and the date of nearby buildings such as the Santo Cristo’s Chapel (1753), place it in the 18th century or earlier. Two rehabilitations have been done since its opening as a museum in 1958. The first, in the 1980s, adjoined the adjacent house, 257, that made the museum grow to one building, although with two facades in accordance with ICP’s conservation regulations. It has approximately 12,000 square feet of partially reinforced masonry structure. The latest renovation was completed in 2013 and the building was delivered to La Casa del Libro in late September of 2016.

Upon returning to the renovated building, La Casa del Libro’s Director, Karen Cana-Cruz, M. Arch, started to deliver on her expectations to organize the institution and its collection in its original space. These expectations entailed bringing back the main collection (saved off-site in a bank vault while the building was under rehabilitation),
working on its assessment, and making progressive improvements in handling, processing, and storing collections. La Casa del Libro began the move back to its historic headquarters on September 23, 2016 and finished on July 30, 2017, a few weeks before the hurricanes Irma and Maria of the same year.

As a result of the 2013 rehabilitation, the main deposit (vault) - a 60’ long by 10’ wide, 14’ height closed room - HVAC components were a combination of systems installed during separate periods of renovation over the years. The late 1980’s Liebert units were maintained and repaired six months before the 2017 hurricane season hit. As part of the move, this space was being reconditioned to receive the collection saved on off-site premises. The unusual amount of rain brought by Hurricane Maria, one of the worst hurricanes in the island’s history, left the building with considerable damage. A series of combined factors seriously compromised the roof membrane: severe leaks are all over the building thus provoking unused spaces and drainage from the flat roof surface only happens in three locations. The multiple leaks caused excessive humidity, all of which also accelerated the deterioration of the aging movable compact shelving system. After months without electricity and subsequent power system’s instability, the vault HVAC system broke down. Basically, the deposit was severely affected. Storm exposure weakened the 2013 rehabilitation and revealed weak spots all over the building. The arrangements that started at the beginning of 2017 to bring back the collection saved off-site had since been postponed.

**Objectives, accomplishments and challenges**

In April 2018, thanks to the Conservation Assessment Program (CAP) general conservation assessment awarded by the Foundation of the American Institute of Conservators (FAIC) through an Institute of Museum and Library Services (IMLS) grant, we had the opportunity to analyze how to solve the vault situation. Since our operation is in the colonial building previously described, we needed to find a solution to provide a secure space for the collection. Such a solution had to consider the historic character of the building, the type of collection and programmatic needs, the island weather, our
location in front of an ocean bay, and sustainability. Besides the damage to the building and the vault provoked by Hurricane Maria, the museum's content and on-site collection in a second deposit suffered considerable damage due to the lack of controlled temperature and high humidity. Mold developed in some of the books and artworks located in this deposit. Thanks to an NEH Emergency Grant (2018), we had acquired and installed an electrical generator to be prepared if a new event left us without electricity. Nonetheless, we have to look for other options in case diesel supply is unavailable for weeks or months, as was the case for many institutions across the island during Hurricane Maria. Implementing a “box-within-a-box” solution was initially proposed during the CAP, but the situation presented multiple challenges. With the information gathered we decided to apply for an NEH Planning Grant. This grant brought together an interdisciplinary team of conservation professionals, architects, and engineers to develop a comprehensive plan to re-design La Casa del Libro’s main deposit mechanical system and its whole operation.

**Project team and process**

For La Casa del Libro, the project director Karen Cana-Cruz, Special Collections librarian Rafael Linares and librarian Marie Medina gathered the first phase information using the second deposit data as this deposit has similar conditions to the main deposit and it is currently in use. Among the information gathered were regular temperature and humidity data reports from environmental monitoring data loggers (installed in 2017 previous to the hurricanes), frequency and voltage of electrical fluctuations, damages to contents and photo documentation. The 2018 CAP assessment, the National Heritage Responders (NHR), National Archives and Records Administration, Smithsonian Institution Cultural Rescue Initiative, National Park Service (HENFT) evaluations, and two Library of Congress Conservation assessments, possible thanks to FEMA and the Office of the Interior Department, were all shared with and used to inform the team. Prior to the project, Rare Book librarian Rafael Linares and the Director Cana-Cruz participated in preparedness trainings by crews of NHR, HENTF and FEMA.
Thanks to the extension of the NEH grant due to COVID-19 we could finish the project. Together with La Casa del Libro staff, the team of consultants worked on the project throughout the NEH grant phase. The team engaged in regular Zoom meetings and e-mail correspondence with the project director and librarian. As planned, and when the COVID-19 pandemic allowed it, USA consultants traveled to the island for two days' working sessions.

The team included Director Cana-Cruz, Special Collections librarian Linares, Conservationist and Green Building Architect Fernando Abreuña (Abreuña and Musgrave, Architects), Jeremy Linden (Linden Preservation), Jeremy Linden (Linden Preservation), Ann Frellsen (Frellsen Conservation and Preservation Services), and Architect Jorge Ramirez. Architect Abreuña brought to the project the concept of sustainability and resilience that was adopted as the design philosophy. It nurtured the plan and advocated for the use of layers of resiliency. Jeremy Linden, who was one of the specialists that collaborated with La Casa del Libro in the 2018 CAP, was brought to the project as the mechanical system specialist. His expertise and knowledge in HVAC for different environments was key. Ann Frellsen, a renowned book and paper conservator, ensured solutions were in accordance with the best conservation practices as this deposit will guard rare books and leaves, many of which are more than five hundred years old. Architect Jorge Ramirez, LEED AP, led the group of engineers, composed of Gabriel D., Alcaraz Emmanuelli (Estructuras AE), Rafael Parés (RAP Consulting Engineers), and Juan R. Requena (Juan R. Requena & Associates) who contributed their invaluable experience and knowledge to the project.

The team’s starting point was a “box within a box” solution to provide the main deposit (vault) with a contemporary and reliable HVAC system with humidity-controlled setpoints. They evaluated all the aspects and components that affected the deposit considering the available conditions:

- The “box within a box” solution, not typical to Old San Juan, mostly used in large commercial buildings.
- Weather conditions of Old San Juan, a maritime port, the island winds and the heat load of the building and its incidence on the vault.
• The electrical system and the electrical service to the building, capacity of individual panels and circuits, and the damage caused by wall moisture, saltpeter to the electrical infrastructure and voltage instability after the hurricane.
• Best HVAC system options for the historic building and the collection.
• The compact shelving systems to be replaced in the space.
• Sustainable practices such as reduced energy consumption, as La Casa del Libro is an institution committed to the environmental stewardship.

**Project Philosophy**

The project philosophy advocates using layers of resiliency and redundancy in all aspects of the design to permanently preserve all contents inside the vault space. The project will incorporate four layers of resiliency: 1. normal operations with grid-connected power; 2. backup systems (temporary); 3. secondary backup solution (not equal to normal operating capacity level); and 4. emergency / passive solutions integrated by design when all other options fail (*i.e.*, natural ventilation).

For example, in the case of power, during normal operations, the power grid is used (HVAC system will be designed with redundancy); if the power grid fails, a backup generator already in place will supply power; in the case of generator failure, the design will provide for direct current (DC) fans powered by photovoltaic cells to move moisture and lower temperatures, and, as the last resiliency layer, the design will incorporate operable windows in strategic locations and doors in order to induce natural ventilation in the space.

**Findings, solutions and impact**

**Below is** the renovation plan in detail, divided into two main sections: (I) Architectural / Structural; and (II) Mechanical / Electrical.
I. Architectural / Structural

Architectural:
Before implementing La Casa del Libro’s vault rehabilitation project, the Instituto de Cultura Puertorriqueña (ICP), La Casa del Libro’s headquarters building owner, needs to repair the existing roof membrane. The ICP has obligated funds from FEMA to undertake the repair / replacement of the entire roof in 2022. This is a critical first step; a high-performing roof membrane and insulation system are essential components for the wellbeing of the collection and the institution. La Casa del Libro’s will share with the ICP the findings and solution of this proposal in order to accelerate the implementation of the much-needed repairs.

The team’s preferred and recommended solution to the ICP is for them to replace the entire roof membrane (focusing in the vault area first), the parapet coverings and seams and drainage gratings, and adding high performance eco-friendly insulation. The minimum recommended insulation is an R-30 rigid panel system for the entire roof in order to guarantee optimal thermal transmission protection. A second option would be for the ICP to replace the roof membrane with the same or similar quality as the existing membrane. For the vault rehabilitation project, the proposed new roof / ceiling composition (from exterior to interior) will be:
Roof membrane, R-30+ insulation, historic roof, air gap, a vault “box”: an inclined ceiling waterproof layer (vapor barrier, fiberglass channel skeleton frame and recycled resin panels as box’s interior ceiling surface). The ductwork will be inside the space hanging from the ceiling. To protect the historic character of the building, roof penetration will occur only over the mechanical/storage space for the refrigerant line connection to condensing units on the roof.

The vault “box” inclined ceiling waterproof layer will have a minimum of 2% slope towards the back courtyard in order to provide for emergency leak drainage away from the vault contents in case the roof membrane fails. Any water collected by the inclined
ceiling waterproof layer will be directed via a fiberglass canal and pipe through the wall and towards the exterior of the wall. The recycled resin panels of the ceiling can be easily removed and replaced if damaged by moisture.

The other component of the vault “box” that will aid to provide a near-zero thermal load and moisture transmission inside the vault space is a wall furring over the existing walls. The vault “box” wall/ceiling system components are: vapor barrier on the interior face of the existing walls and ceiling, 3.5” fiberglass channel frame at 2’-0” on center, rigid insulation panels between channels, and recycled resin panels as the finished interior surface. Insulation between channels can also be sprayed with urethane foam, eco-friendly, or recycled materials. All wall and ceiling components should be designed and installed so as to prevent condensation and prevent mold growth. All connectors, fasteners, screws, etc., used in the project shall be stainless steel in order to avoid corrosion and minimize maintenance.

To allow for potential natural ventilation via convection / stack effect during emergency periods, one or more new openings in the upper portion of the north wall structure will be added. These may be equipped with louvres and/or insulated covers for when not in use. The original roof height of the second floor of the building where the vault is located is fourteen feet (14’). To allow heat to rise and aid with air movement in normal operation and in emergency situations when backup power fails and DC-powered fans or when natural ventilation is needed, the proposed ceiling height of the new vault “box” ceiling will be thirteen feet (13’). With this height the warmer air will rise above the supply duct from the air handling units and therefore will help maintain optimal temperatures and humidity at the human and stacks level with much less effort and energy consumption.

One potential drawback of the vault “box” proposal is that it will cover cracks that can form due to seismic movements or wall reverberation due to strong winds on the structural walls. Crack-gauges can be installed at critical points of the structural walls in
order to measure, monitor and take action if needed. Seismic bracing is not a viable solution because the building has adjoining walls to the adjacent buildings.

New aluminum, insulated, thermally broken, double doors with airtight seals will replace the current wooden doors. The doors and windows will have louvers and integrated shutters to allow natural airflow during power failure. During normal operations the shutters will remain closed in order to provide security and protection to the collection. These operable door and window elements are intended to be super-efficient (no air infiltration) during normal and emergency power operation. If the backup generator fails, sealed door and window shutters and louvers can be opened to permit natural air flow. Plastic DC fans (to avoid corrosion) installed on both sides of the space will turn on automatically, providing airflow from the exterior courtyards of the museum into the vault. Power to the DC fans and an emergency light will be provided by photovoltaic panels.

Structural:
While performing the structural assessment of the existing building a concrete slab was found underneath the old wooden platform of the vault space. In order to determine code compliance and structural capacity of this existing concrete slab, a GPR (ground penetrating radar) study is required.

It is most likely that because the last structural intervention to the original / historic building was in the 1990’s, and new building code requirements are more demanding, we will need to build a new, reinforced concrete floor slab will need to be built in order to support the new compact shelving system. The structural engineer’s recommendation is to anchor the new floor slab into the existing / historical walls over the existing floor. The new anchoring into the existing / historical walls (Spanish “cal y canto” - mortar & stone/brick) will consist of closely placed, small diameter reinforcing bars.

The new concrete reinforced floor slab will be another component, along with the new walls and ceiling, of the zero thermal load and moisture transmission space. At the
same time, it will provide for the structural support of the new compact shelving system. Initial projection of new concrete reinforced floor slab considers using the existing concrete slab as the “form” for the new slab, as removing it could damage the historic structure. Other components of the new floor slab include a moisture barrier installed over the existing floor slab, 2” rigid foam insulation panels on top of the moisture barrier and four to six inches of reinforced concrete. The proposed floor finish is a sealed polished concrete or other low-maintenance, high-performance product.

After rigorous analysis and comparison of commercially available options, La Casa del Libro selected for acquisition a new compact shelving system that complies with conservation standards. Ideally, installing museum cabinets with solid doors and operable vents is recommended instead of the regular open cantilever library shelves. Doors should be removable in order to provide for proper ventilation. The new reinforced concrete floor slab will provide adequate support for the proposed compact shelving system, so its weight is not a concern. Composite PET boards with high hardness and rigidity, resistance to wear, chemical resistance, and good thermal properties are proposed for the floor rails’ compact shelving system.

II. **Mechanical / Electrical**

**Mechanical:**
The design of the mechanical system will provide the vault space with the required temperature and moisture control. The design and implementation of passive emergency systems using natural ventilation, DC fans, photovoltaic panels, and batteries will ensure the preservation of vault contents at all times.

The proposed mechanical system which will replace the existing includes the new air handling unit(s) with a direct expansion refrigerant coil, a desiccant wheel, ductwork, grilles, dampers and automatic control system. The desiccant wheel will act as a rotary dehumidifier in which air is dehumidified. This system will provide better humidity control and a more efficient latent load removal, while at the same time reducing high peak
electric demands, which are common in Old San Juan's electrical grid. Whilst a desiccant unit may consume more power on an hourly basis than a compressor unit, they are much more effective at extracting moisture and achieving better results in less time. For La Casa del Libro or any other cultural institution, more efficiency means more savings.

Two air conditioning units will be installed for redundancy in case failure occurs or extended maintenance needs to be performed on any one unit. As designed, each individual unit will have 80% capacity, so if one fails or is undergoing maintenance, the other will be able to maintain the required temperature and humidity levels. Supply ductwork and diffusers of the units will be evenly distributed along the space.

The air-handling units and desiccant wheel will be located in a separate mechanical/storage room adjacent to the vault space to further prevent humidity issues and aid in routine maintenance activities. No return ducts are needed; instead, return grilles will be placed on the wall between the vault space and the mechanical/storage room. This storage space has a unique architectural feature, an oval-shaped “bulls-eye,” an opening in the wall below the wood beams which was traditionally incorporated in buildings built in this era as a method of climate control and ventilation.

The air conditioning and desicant units will include an automatic control system to maintain the required temperature and humidity at all times. The design humidity setpoint range will be between 50% and 60% and the vault temperature set point will be 60 degrees in order to achieve a constant temperature of between 68F and 72F. The setpoint for conservation purposes will be 65 degrees. Condensation could occur on items after removing them from the vault for use. La Casa del Libro personnel will avoid or minimize this potential condensation by placing the consultation area in a room immediately in front of the vault. This consultation room will serve both deposits and it is accessible in under a minute walking distance.
The condensing units will be located on the roof over the mechanical / storage space. An anti-corrosive treatment will be applied prior to installation and they will be anchored to the structure in order for them to sustain 150mph hurricane force winds. A perforated aluminum enclosure will be installed over the units to protect them from the elements, vandalism, and from the many pigeons that live in the park just across the street from La Casa del Libro’s location.

**Electrical:**
The proposed electrical system will replace the existing system and ensure all electrical connections, conduit, cabling, lighting, sensors, access control, and fire protection elements will comply with current codes and be in optimal working condition.

At the implementation phase following this planning phase and the replacement of the roofing system, all exterior and interior electrical components need to be reevaluated and verified, including: MDP, main breaker rating, enclosure integrity, feeders (all need to be installed over current protection and protected as per NEC), grounding system, single-phase loads on panel boards, fire alarm.

Given that the electrical service entrance from the grid is a three-phase system and most of the loads are single phase, the electrical system balance will need to be verified and modified if necessary.

As part of this proposal, electrical system updates include the replacement of the existing roof panel board serving the air conditioning units with a NEMA 3R stainless steel panelboard and a new electrical panelboard at the proposed mechanical / storage room served from building MDP (to be installed through a manual transfer switch). This new panelboard will be dedicated to vault equipment and allow the interconnection of a temporary generator of lesser KW output if the existing onsite generator fails. New electrical system elements to be installed include the required branch circuits for new air conditioning and desiccant units, hardware for exposed branch circuit distribution along the roof, efficient LED lighting, convenience receptacles, access control, mechanical
controls, telecommunications/data, security and audio systems. The two existing chases within the vault, located along the courtyard-side wall, will be used for electrical wiring in opposite corners. A certified fire alarm system technician will install a new fire / heat / smoke alarm and gas fire suppression system. Wet sprinklers are not viable in this application as the goal is to avoid humidity in the vault space to protect its contents.

The existing electric generator (provided by an Emergency NEH Grant, 2018) will be relocated to the roof only after performing a new structural evaluation, since the original structural evaluation was performed in 2018 and is no longer valid. The electric generator has the capacity to provide power to the HVAC system in case of a grid power failure. If the power failure is prolonged or diesel fuel is not available, the passive emergency plan will be activated.

**Conclusion**

Projects whose objective is sustainability, low energy consumption and resiliency have previously been developed in Puerto Rico. However, due to the historical characteristics of La Casa del Libro’s building, the surrounding environment, and what we need to achieve to protect the collection, we understand our proposal could contribute to practical changes in practices in museums and cultural spaces. This proposal combines the historical preservation, architecture, engineering, conservation, preservation, library and museography disciplines to develop a resilient and sustainable solution that uses passive ventilation strategies and redundancy. The plan proposes low energy consumption and simple, commercial equipment that will not harm the historical character of the building. This equipment, plus the implementation of passive ventilation strategies, will provide constant air flow and humidity control inside the vault space to avoid the emergence of fungus. As part of the project a preliminary cost estimate for the future implementation of this plan was presented.

La Casa del Libro’s plan could become a model for other cultural spaces in the Caribbean or those with similar size, conditions and collections, that need to improve their collection spaces.
We are grateful for the support of the NEH on the planning phase of this extremely significant project for the protection of Puerto Rico and the world’s cultural patrimony. We have produced a comprehensive plan with a realistic solution. The process brought the humanities to the front, with each specialist contributing to the institution’s cultural protection and improvement. The project also served as an educational tool for students and emergent professionals who collaborated.

We look forward to sharing this White Paper with the building owner, museum colleagues, students interested in the disciplines involved, and other communities who could benefit from learning about the problems we face and the solutions we have provided. This document, a summary, a PowerPoint presentation, and supporting documents of the process will be posted on La Casa del Libro’s coming website to be published in the summer of 2022. As this is still a project in its planning phase, we acknowledge there is much work ahead of us. We are very excited and look forward to being able to implementing this plan in the very near future; for La Casa del Libro Museum & Library to reach its goal of providing a secure, resilient, and accessible space for its main collection.

**Preliminary drawings follow**
LA CASA DEL LIBRO
Vault Floor Plan