

Analysis of Mechanical Strategies

This document provides an overview analysis of schemes considered for mechanical systems for the Hirshhorn Revitalize Building and Plaza project. All schemes were considered through Section 106 consultation pursuant to the National Historic Preservation Act. This document is intended to assist Section 106 consulting parties to understand the preferred alternative selected to advance into design and consultation in 2025.

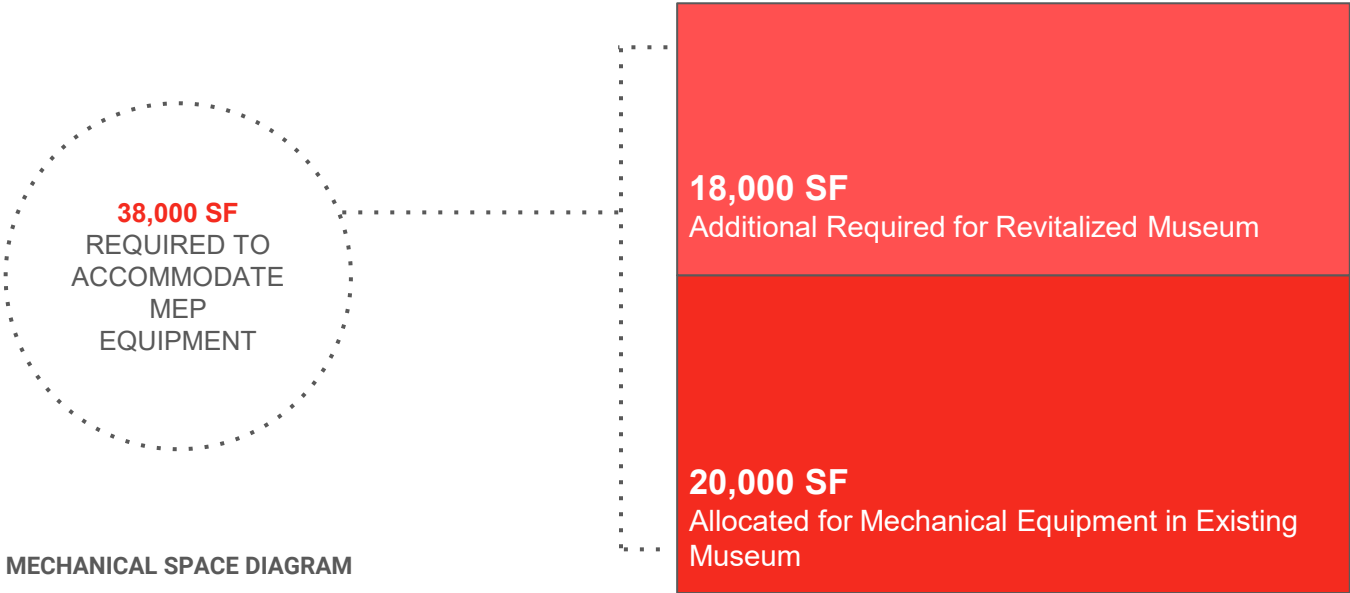
The existing mechanical system of the Hirshhorn building has not been substantially upgraded since 1974. The system is past its life expectancy and does not meet current mechanical, energy, and collection care requirements. This has consistently impeded the Museum’s ability to fulfill its mission. Operations are handicapped by disruptive closures, program cancellations, and compromised thermal conditions. Providing the Museum with sound infrastructure that is safe, functional, efficient, and reliable is a vital component of the building revitalization.

The removal and expansion of the existing system are required to meet the mechanical demands of:

- Energy recovery requirements
- Increased ventilation requirements
- Mechanical zoning requirements for the building’s uses
- Higher occupant load
- Increased building area
- Collection care requirements to maintain temperature and humidity levels
- Security requirements for air intake

The existing building has 20,000 square feet allocated for mechanical equipment. The revitalized museum will require an additional 18,000 square feet. If placed inside the drum, this would occupy an entire floor plate. The challenge is identifying the appropriate location for this equipment.

Strategies considered are included in this document and include locating all the equipment in the Lower Level, utilizing Level 4, and the roof. Due to the building’s unique drum footprint, it is not efficient to layout equipment on a ring-shaped floor plate. Furthermore, the existing historic piers impede the ability to serve the entire building from below.



MECHANICAL SPACE DIAGRAM

MECHANICAL EQUIPMENT SPACE REQUIREMENTS WILL NEARLY DOUBLE IN THE REVITALIZATION TO MEET CURRENT CODE AND PROGRAMMATIC REQUIREMENTS

It is critical to minimize the impact these strategies have on the Museum’s operational requirements. The Museum needs to expand public programming space to meet increased visitation and provide new gallery spaces that facilitate the Museum’s ability to evolve as a platform for the presentation of modern and contemporary art. The Museum strategically plans to move 25,000 sf of staff and collections support off-site to help meet this need. This will unlock Level 4 as a new floor of public space, providing new needed opportunities to exhibit collections currently limited within the historic inner or outer ring floor plans of Levels 2 and 3, an additional opportunity for unique site-specific works, and a location for indoor events that does not interrupt other gallery floors.

## Analysis of Mechanical Strategies

### Existing Mechanical System

The existing building mechanical design utilizes two major mechanical rooms on the Lower Level and equipment on the roof to serve the conservation lab. The air handling units on the Lower Level distribute heating and cooling via ductwork that traverses the building. This ductwork distribution includes supply and return ductwork running up and down the building's four piers via shafts to serve Levels 2, 3, and 4 from the units in the Lower Level.

The mechanical design of the Revitalize Building and Plaza project is unable to replicate this design philosophy due to several factors.

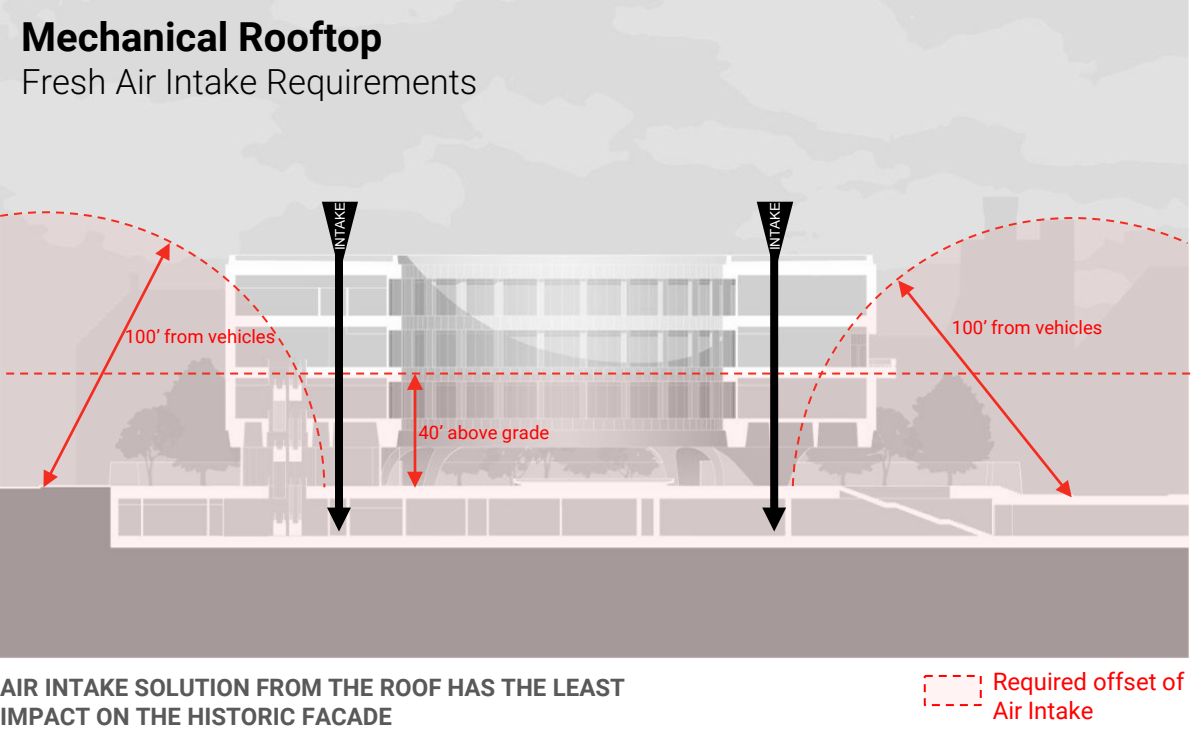
### Modern Systems and Design Goals

- Existing air handling systems (AHUs) are original to the building and do not meet current mechanical/energy code, specifically: ASHRAE 62.1 (Ventilation Standard) and ASHRAE 90.1 (Energy Standard).
- Existing outdoor air intakes are located at grade (via areaways, grates, etc.). They are susceptible to Chemical, Biological, and Radiological (CBR) attacks and are in close proximity to streets and the Plaza (high level of particulates; contaminates from engine exhaust, smoking, etc.).

The diagram to the right illustrates the required air intake offsets per Interagency Security Committee (ISC) Chemical, Biological, and Radiological (CBR) guidelines. The roof is the only location for air intake to meet these requirements without introducing louvers on the drum's facade. Air intakes ducted down from the roof are required to supply the entire building, including the Lower Level air handling units.

### Increased Mechanical Requirements

- Increase in anticipated visitation, resulting in more heating, cooling, and ventilation requirements
- Increased building square footage requires larger equipment
- Increased gallery space requires more total air and ventilation (fresh) air
- Tighter mechanical controls are required to regulate interior environmental conditions for collections



### Increased Mechanical Requirements, continued

- Dedicated food service requires 100% outside air AHUs and accompanying exhaust fans to limit food odor transmission to the building interior
- Smoke evacuation
- Conservation Lab and exhibit production area requirements

### Sustainability Goals

- Individual temperature control for each zone requires more branch ductwork
- Modern ventilation air requirements (ASHRAE 62.1) require more outdoor air
- Energy code requires the design to incorporate energy recovery equipment to harvest energy from waste air, which requires additional space and ductwork
- Sustainability metrics for energy usage heavily incentivize reducing energy consumption that increases duct sizing and equipment requirements

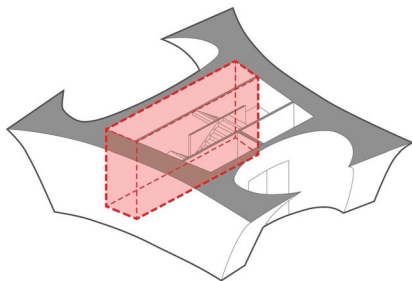
Analysis of Mechanical Strategies

Mechanical Rooftop

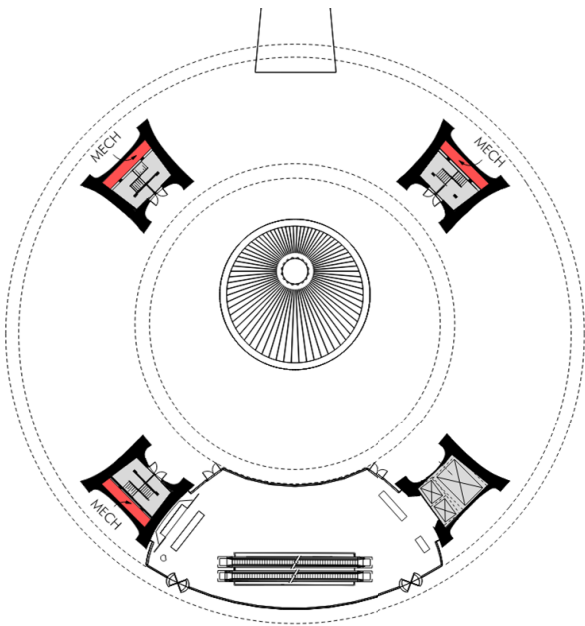
Pinch Point at Piers

Available Shaft Space 285 SF, cumulative for three piers

The majority of available pier space is dedicated to required egress stairs and elevators



AXONOMETRIC OF PIER: LIMITED AVAILABLE SHAFT AREA



PLAZA LEVEL: LIMITED AVAILABLE SHAFT AREA

Pinch Points at Piers

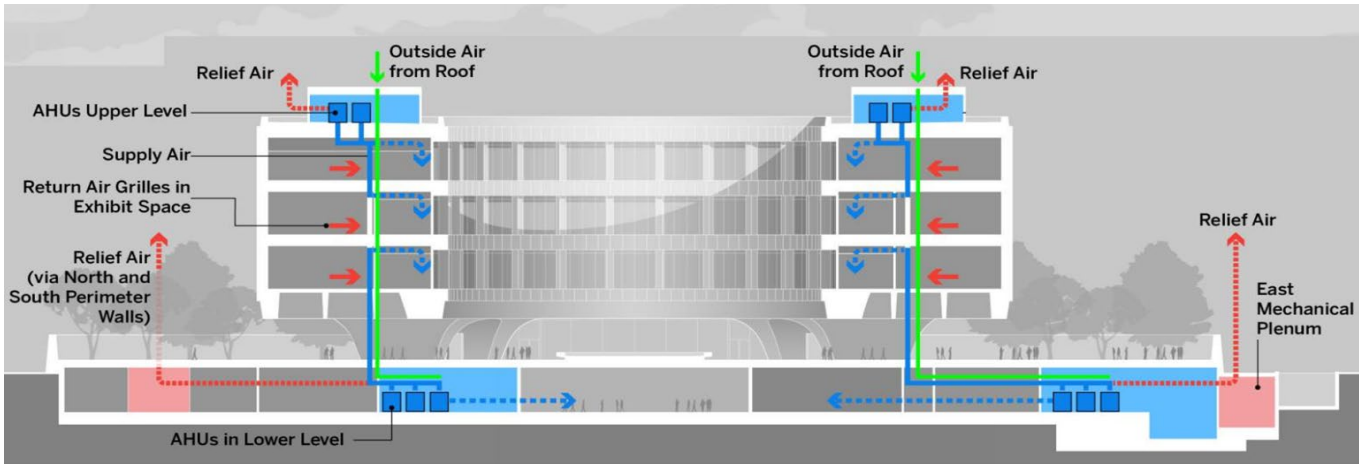
The drum piers are the only points through which the upper levels are connected to the Plaza for egress and to the Lower Level through which air and services are conveyed. The southeast pier is dedicated to elevators. Space within the remaining three historic piers is limited. It will not be possible to serve the upper levels entirely from below without major alterations to the historic piers.

Shaft space within the piers must accommodate the following vertical systems:

- Ductwork between the proposed roof mechanical room and upper levels
- Piping distribution between Lower Level and roof mechanical room
- Electrical conduit between Lower Level, upper levels, and roof
- Security, Telecom, AV/IT, and other low-voltage systems
- Stormwater between roof collection and Lower Level drainage systems
- Domestic water and sanitary systems serving plumbing fixtures

Mechanical Rooftop

Split System Strategy



TO PRESERVE THE HISTORIC FACADE AND PIERS OF THE BUILDING, A SPLIT SYSTEM STRATEGY TO LOCATE A MINIMUM AMOUNT OF EQUIPMENT AT THE TOP OF THE BUILDING IS REQUIRED.

Split System Strategy

A split system strategy to locate a minimum amount of equipment at the top of the building is required due to air intake offset requirements and pier pinch points. This best preserves the historic drum facade and sculptural piers of the building while meeting current code and programmatic requirements.



Analysis of Mechanical Strategies

Scheme 1 | All Equipment on the Lower Level

1 | All Equipment on the Lower Level

Scheme 1 evaluates locating all the mechanical equipment on the Lower Level at the request of the consulting parties. It is not feasible due to code requirements and physical constraints.

Challenges

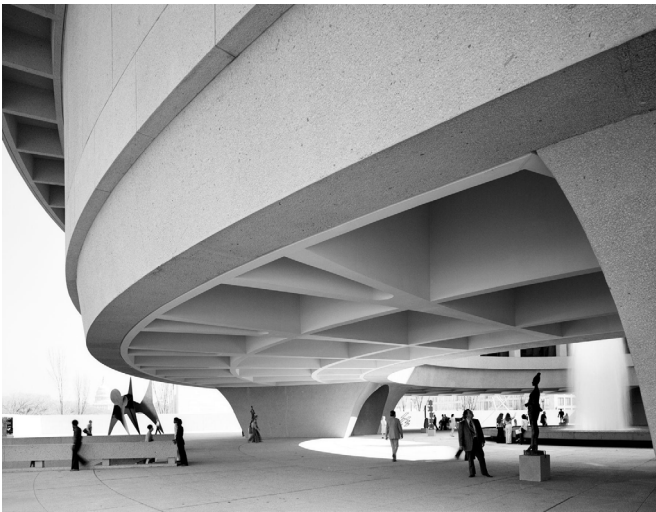
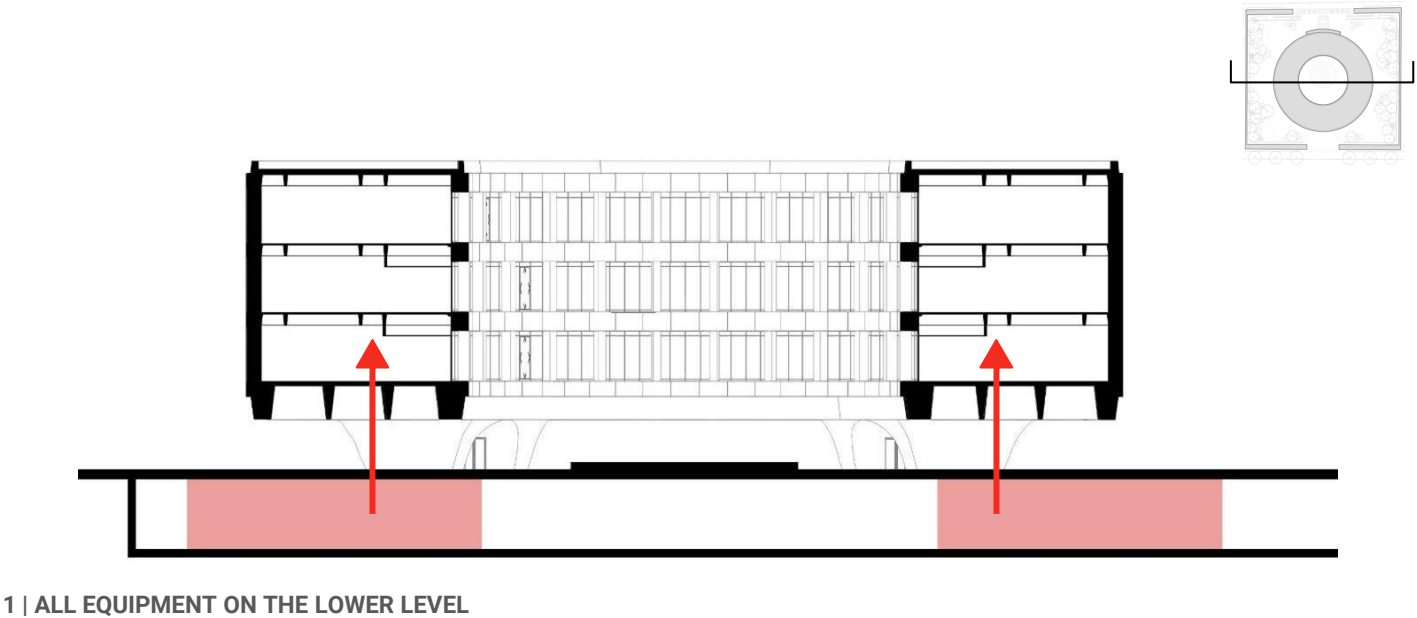
**Fresh Air Intake Requirements:** Placing all equipment on the Lower Level does not meet code requirements for air intake. To limit susceptibility to Chemical, Biological, and Radiological (CBR) attacks, outside air intakes must be located at least 40 feet above grade and 100 feet from vehicle exhaust.

**Pinch Point at Piers:** The historic piers place a physical constraint on the amount of ductwork that can communicate up from the Lower Level.

**Historic Fabric:** If all equipment is located on the Lower Level, the required shaft space will increase more than three-fold and require heavy modifications to the historic piers. The sculptural piers support the elevated drum. This alteration will adversely affect the building form.

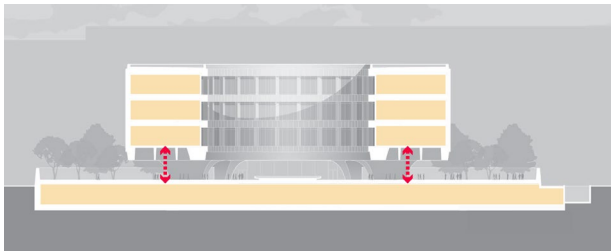
**Program:** Locating equipment on the Lower Level will reduce public space significantly. The Lower Level will have additional equipment and ductwork. Upper levels will be compromised by enlarged shafts needed to convey fresh air down to the Lower Level and supply air back to the upper levels.

**Visible Exterior Alterations:** Fresh air intake will need to be drawn from above grade. This requires louvers in the Museum building facade or equipment on the roof. Pier and facade modifications will result in visible exterior alterations that adversely affect the character-defining building drum.

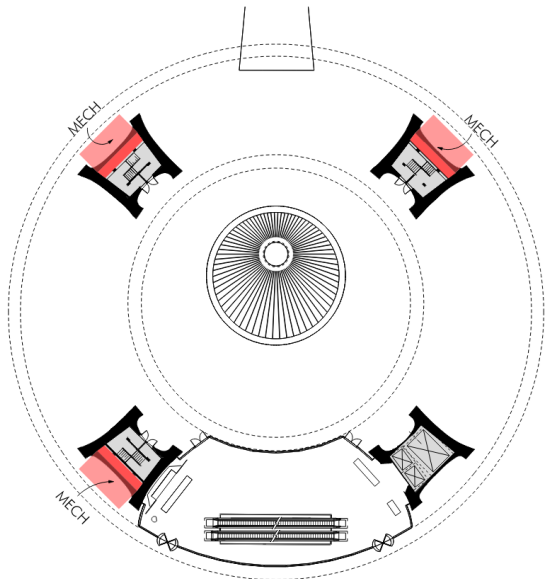


Shaft space required if all MEP equipment remained at the Lower Level: **~1,100 SF**

Shaft space available: **285 SF**  
(cumulative for three piers)



THE HISTORIC PIERS PLACE A PHYSICAL CONSTRAINT ON THE AMOUNT OF DUCTWORK THAT CAN COMMUNICATE UP FROM THE LOWER LEVEL



PLAZA LEVEL SHAFT PLAN SHOWING REQUIRED SHAFT AREA IF ALL MECHANICAL EQUIPMENT IS LOCATED ON THE LOWER LEVEL

Analysis of Mechanical Strategies

Scheme 2 | All Equipment on Level 4

2 | All Equipment on Level 4

Scheme 2 evaluates locating all mechanical equipment on Level 4. The layout, due to the limiting cylindrical floor plan, takes up the entire 25,000 square feet floor plate of the drum and removes 40% of the new public space planned in the building revitalization. This precludes the relocation of staff and collections from Level 4 to allow for public access to a full-depth ring gallery with visible historic coffered ceilings. It is also not desirable due to access limitations, risks associated with exposure to water infiltration, and compromises to gallery and visitor experience at the galleries on Level 3. This scheme has the least impact on visible exterior alterations but does not meet the project’s goal of increasing public space inside the Museum. This scheme is not recommended.

Challenges

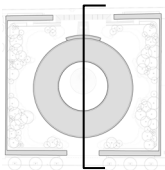
**Access:** Installation, maintenance, and replacement of mechanical equipment on Level 4 restructures the existing roof due to size. The large equipment will require portions of the roof to be removed for installation and future replacement.

**Existing Historic Fabric:** The roof restructuring results in the permanent removal of portions of the existing historic structural coffer ceilings at Level 4.

**Water Infiltration:** Having leak-prone mechanical spaces within the building envelope introduces risk to collections. Required floor penetrations and drainage below units result in potential failure over gallery spaces.

**Acoustics:** Equipment on Level 4 will have a noise impact on gallery levels below. This will limit the types of exhibitions that can be displayed.

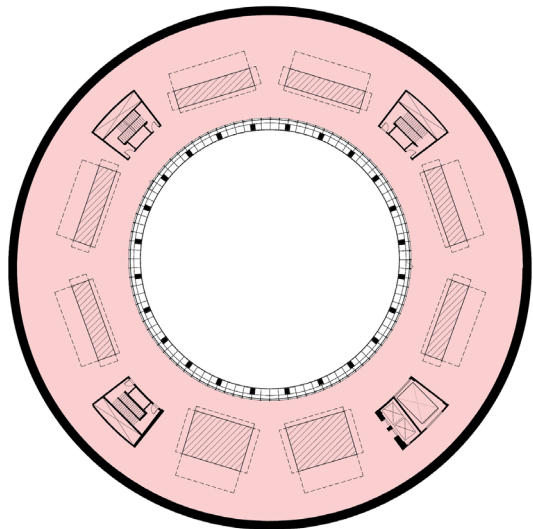
**Visitor Experience:** Dedicating Level 4 to mechanical space will drastically reduce the amount of public space available to the Museum for exhibition and public programming.



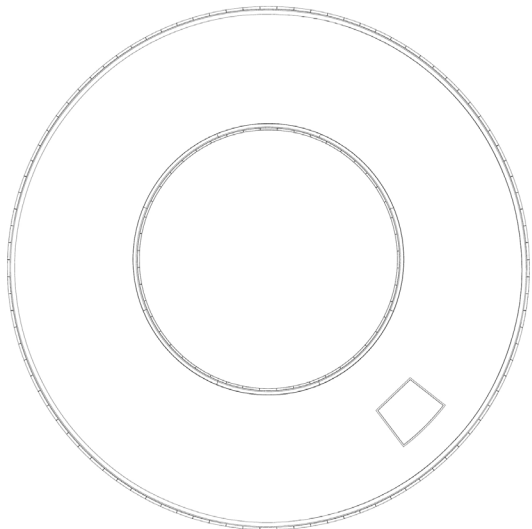
2 | ALL EQUIPMENT ON LEVEL 4



LEVEL 4 FULL-DEPTH RING GALLERY PROPOSED FOR PUBLIC SPACE: USING LEVEL 4 AS A MECHANICAL LEVEL RATHER THAN A NEW GALLERY LEVEL REMOVES 40% OF THE NEW PUBLIC SPACE PLANNED BY THE BUILDING REVITALIZATION



LEVEL 4 MECHANICAL EQUIPMENT OVERLAY



ROOF LEVEL MECHANICAL EQUIPMENT OVERLAY



Analysis of Mechanical Strategies

Scheme 3 | Equipment Partially on Level 4

3 | Equipment Partially on Level 4

Scheme 3 evaluates using part of Level 4 for mechanical equipment. It consolidates the equipment to the north side of the Level 4 floor plate with a mezzanine. Only half of Level 4 will be available for public use, and an addition to the roof will still be necessary to accommodate the stacked equipment and ductwork. Due to access limitations, risks associated with exposure to water infiltration, visible exterior rooftop alterations, and compromises to gallery and visitor experience, this scheme is not recommended.

Challenges

**Access:** Installation, maintenance, and replacement of mechanical equipment on Level 4 restructures the existing roof due to size. The large equipment intended for this area will require portions of the roof to be removed for installation and future replacement.

**Roof Addition:** An addition to the roof is still required for the stacked equipment to the north, ducts feeding the southwest core, and smoke evacuation equipment to the south.

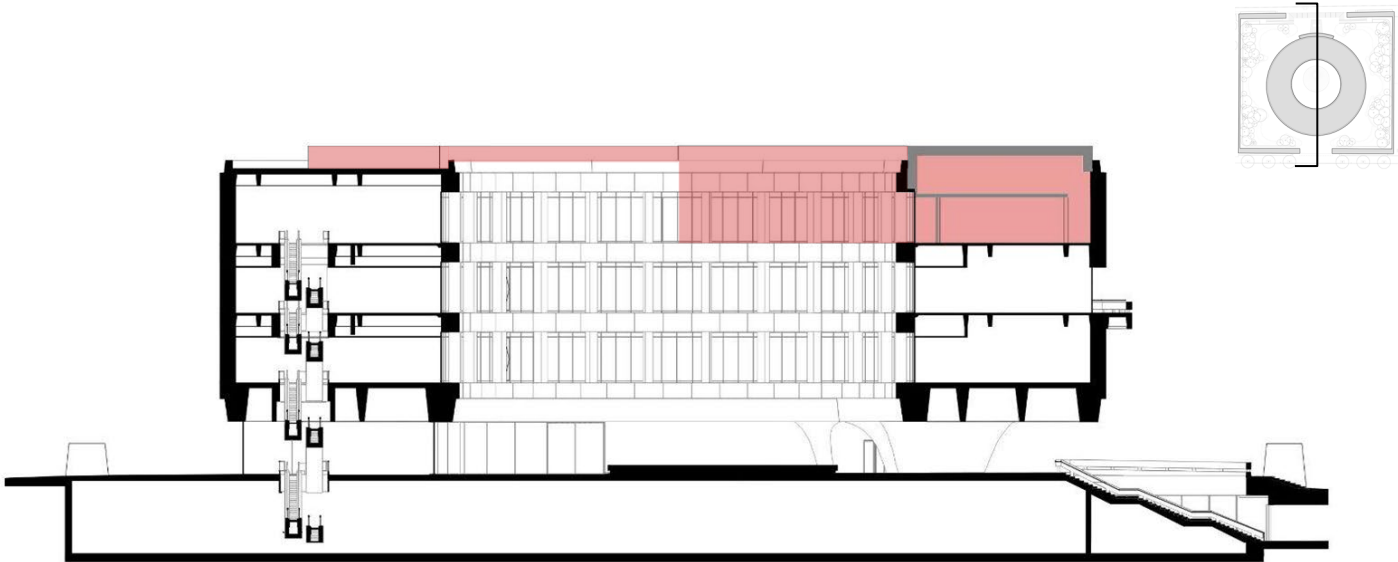
**Existing Historic Fabric & Construction Risks:** The northern half of the roof and historic structural coffered ceiling will be permanently removed. This also exposes the building and site to risks during construction.

**Water Infiltration:** Having leak-prone mechanical spaces within the building envelope introduces risk to collections. Required floor penetrations and drainage below units result in potential failures over gallery spaces.

**Acoustics:** Equipment on Level 4 will have a noise impact on adjacent spaces and below. This will limit the types of exhibitions that can be displayed.

**Visitor Experience:** Placing mechanical equipment on Level 4 will drastically reduce the amount of public space available to the Museum for exhibition and public programming.

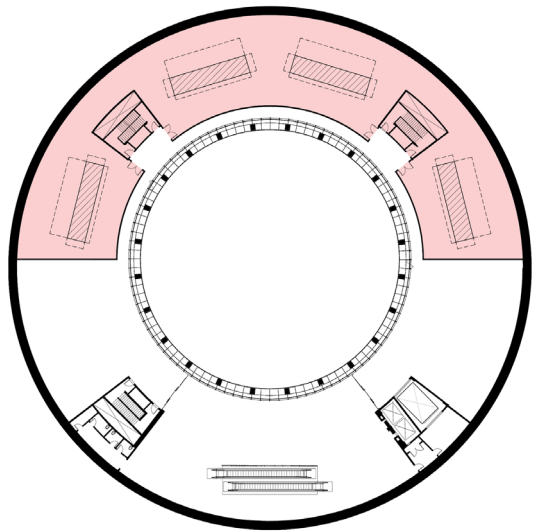
**Visible Exterior Alterations:** This scheme requires visible rooftop mechanical equipment and/or enclosure, visible from multiple public thoroughfares and the National Mall.



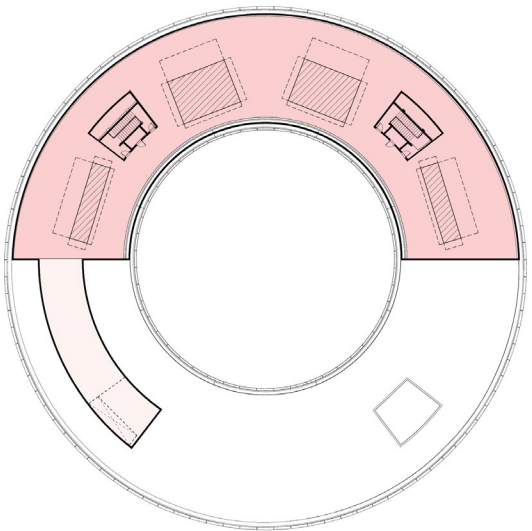
3 | EQUIPMENT PARTIALLY ON LEVEL 4



ROOFTOP EQUIPMENT AND ENCLOSURE WILL BE VISIBLE FROM PUBLIC THOROUGHFARES AND THE NATIONAL MALL



LEVEL 4 MECHANICAL EQUIPMENT OVERLAY



ROOF LEVEL MECHANICAL EQUIPMENT OVERLAY

## Analysis of Mechanical Strategies

### Scheme 4 | All Equipment on a Lowered Roof Structure

#### 4 | All Equipment on a Lowered Roof Structure

Scheme 4 evaluates a new lowered roof structure to minimize the visibility of the rooftop mechanical addition. This strategy removes the historic coffered roof structure. It reduces 1 to 2 feet of height from an addition but significantly alters the building's interior historic character and creates a risk to structural integrity. This scheme is not recommended.

#### Challenges

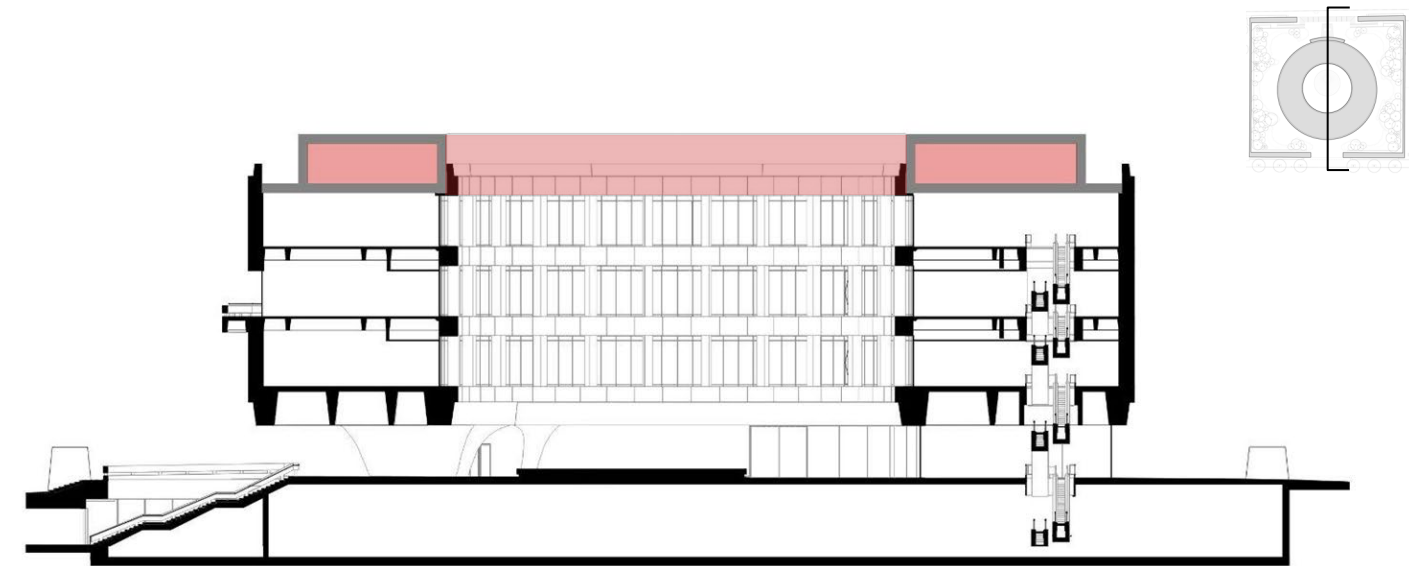
**Existing Historic Fabric:** The entire existing historic structural coffered ceiling will be permanently removed.

**Construction Risks:** Removal of the existing roof exposes the building and site to additional risks during construction. The historic roof structure works as a diaphragm that laterally stiffens the drum structure. Temporary bracing will be required and the remaining building will be more vulnerable to the elements during construction.

**Infrastructure:** There will be less ceiling height to route ductwork and infrastructure on Level 4. Additional floor space may be needed to adequately accommodate ductwork that cannot route within the compressed ceiling. Ductwork and piping will be concealed within added bulkheads, chases, or other visible architectural accommodations.

**Diminished Program:** The compressed ceiling height limits the types of artwork that can be displayed and diminishes public programming.

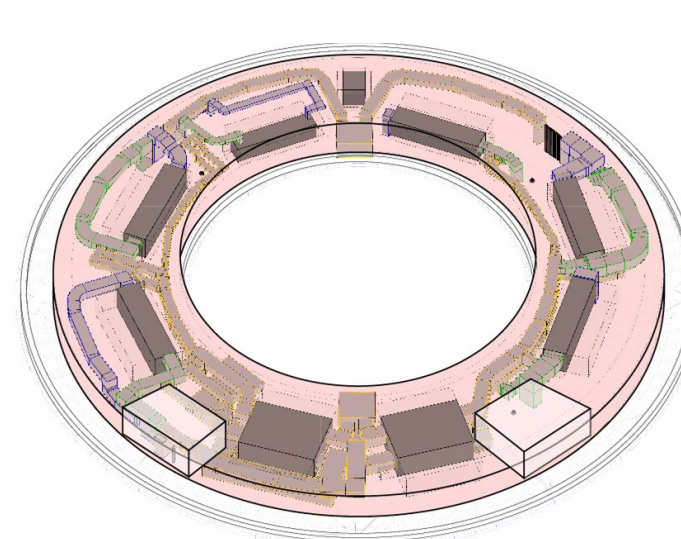
**Visible Exterior Alterations:** This scheme results in rooftop mechanical equipment and/or enclosure visible from multiple public thoroughfares and the National Mall.



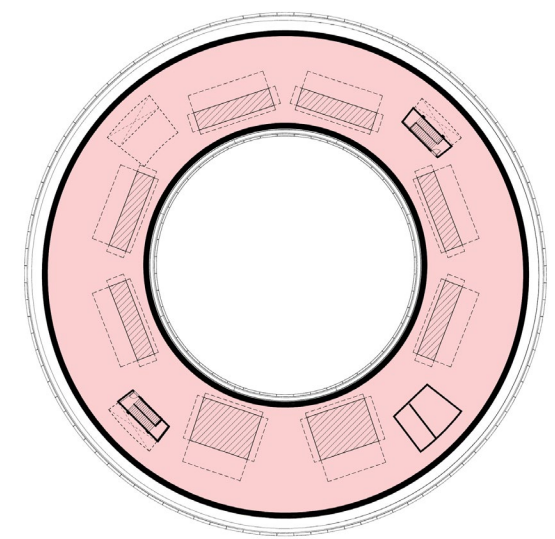
4 | ALL EQUIPMENT ON A LOWERED ROOF STRUCTURE



HISTORIC STRUCTURAL COFFER CEILING WILL BE PERMANENTLY REMOVED AND BE REPLACED WITH A FLAT CEILING



ROOF LEVEL MECHANICAL EQUIPMENT  
DIAGRAM



ROOF LEVEL MECHANICAL EQUIPMENT  
OVERLAY



# Analysis of Mechanical Strategies

## Scheme 5 | Equipment on Open Roof Structure

### 5 | Equipment on Open Roof Structure

Scheme 5 evaluates removing the enclosure over the equipment to minimize the visibility of the rooftop addition. This scheme creates associated water infiltration risks, adds complexities to insulate individual equipment and ductwork, and results in visibility of unsightly equipment from above and from public thoroughfares. This scheme is not recommended.

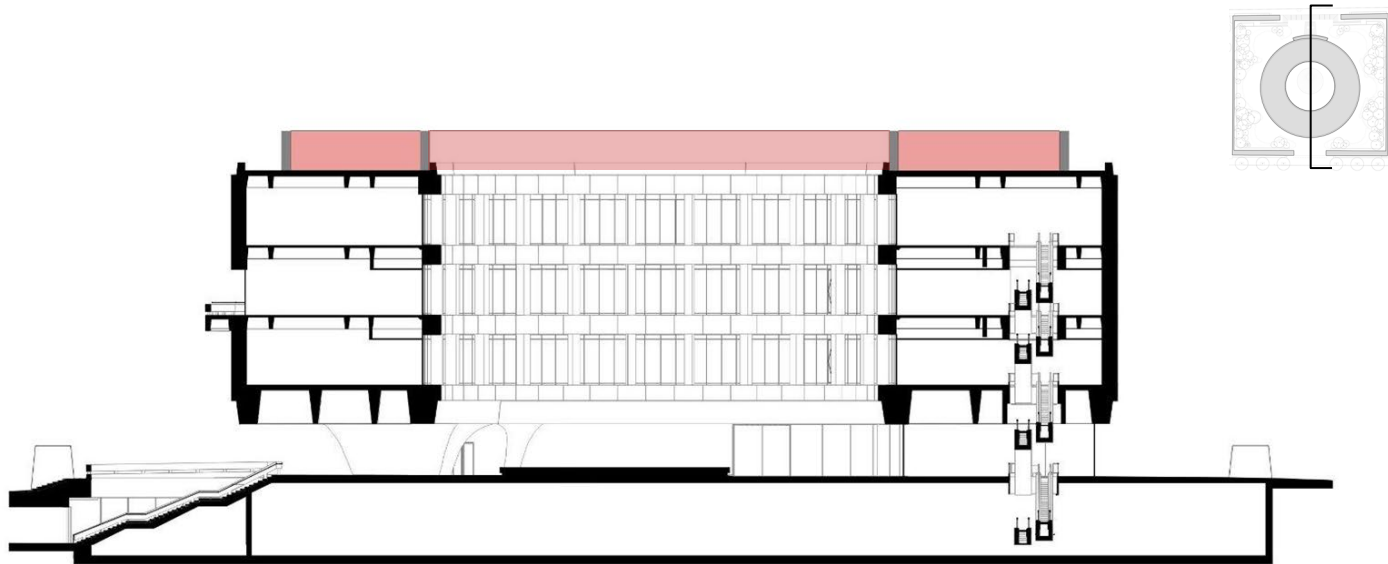
#### Challenges

**Water infiltration:** This scheme greatly increases the risk of waterproofing issues by increasing the number of exposed penetrations and individual points of failure over galleries and collections.

**Maintenance:** Equipment and roofing exposed to the elements are prone to wear and damage, shortening the service life of equipment and ductwork. Equipment and ductwork installed over roofing will make it difficult to maintain and repair the roof.

**Infrastructure:** Mechanical equipment on an open roof requires additional weatherproofing and structure that take up additional area on an already limited footprint. Supports for hanging ductwork and piping will need to be installed to provide adequate pathways for maintenance. This is made more difficult by the circular geometry of the roof.

**Visibility of Equipment:** An open roof does not obscure equipment from all vantage points and neighboring buildings. In particular, the view from the sky (planes, etc.) will be unattractive and highly visible in contrast to the simple building drum. The equipment and enclosure will be visible from above, multiple public thoroughfares, and the National Mall.



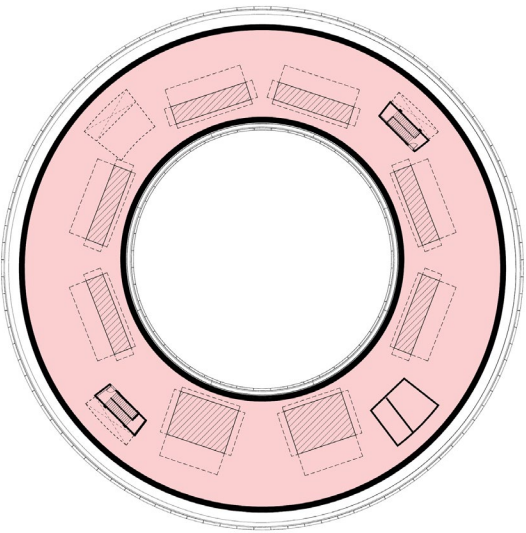
5 | EQUIPMENT ON OPEN ROOF STRUCTURE



REMOVING THE ENCLOSURE OVER THE EQUIPMENT EXPOSES UNSIGHTLY EQUIPMENT FROM ABOVE



HVAC EQUIPMENT ON OPEN ROOF STRUCTURE REQUIRE OVERHEAD STRUCTURE TO SUPPORT DUCTWORK AND PIPING



ROOF LEVEL MECHANICAL EQUIPMENT OVERLAY



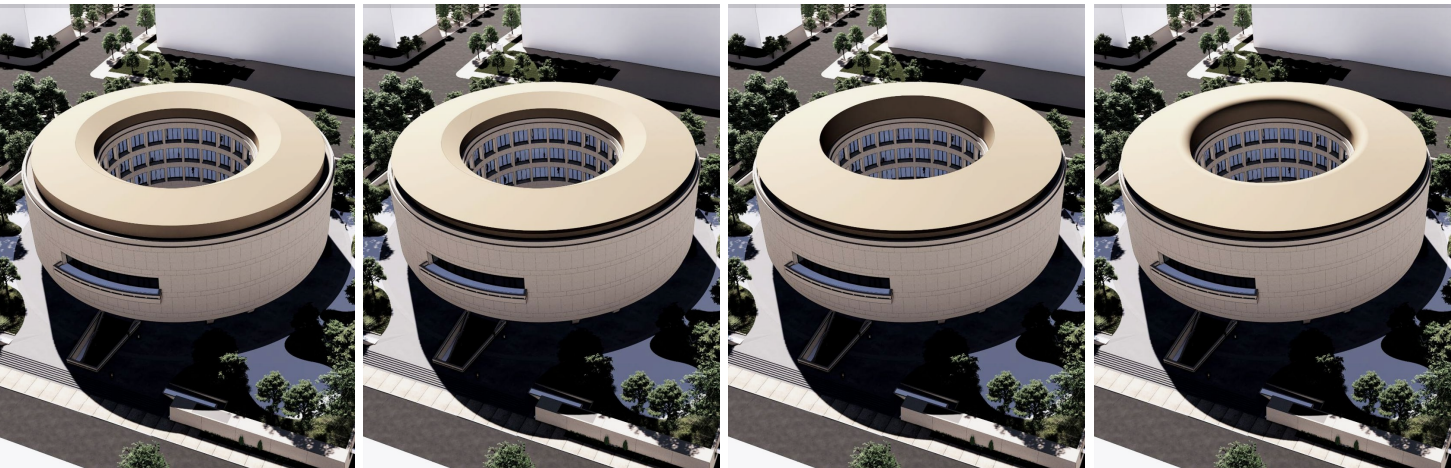
Analysis of Mechanical Strategies

Scheme 6 | Equipment in Enclosure on Roof

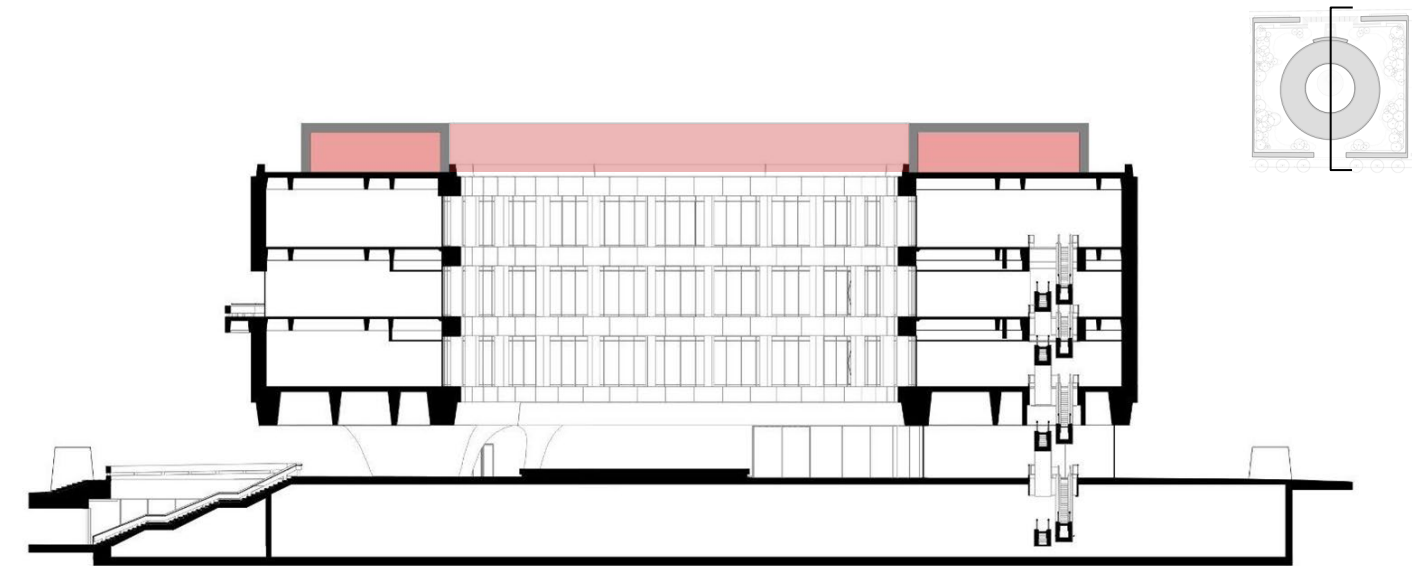
6 | Equipment in Enclosure on Roof

Placing mechanical equipment on the roof is a viable option. It allows the project to meet its public space goals to better serve its visitors and showcase art to support the Hirshhorn’s mission. It provides a mechanical system that is serviceable and resilient: protected from the elements.

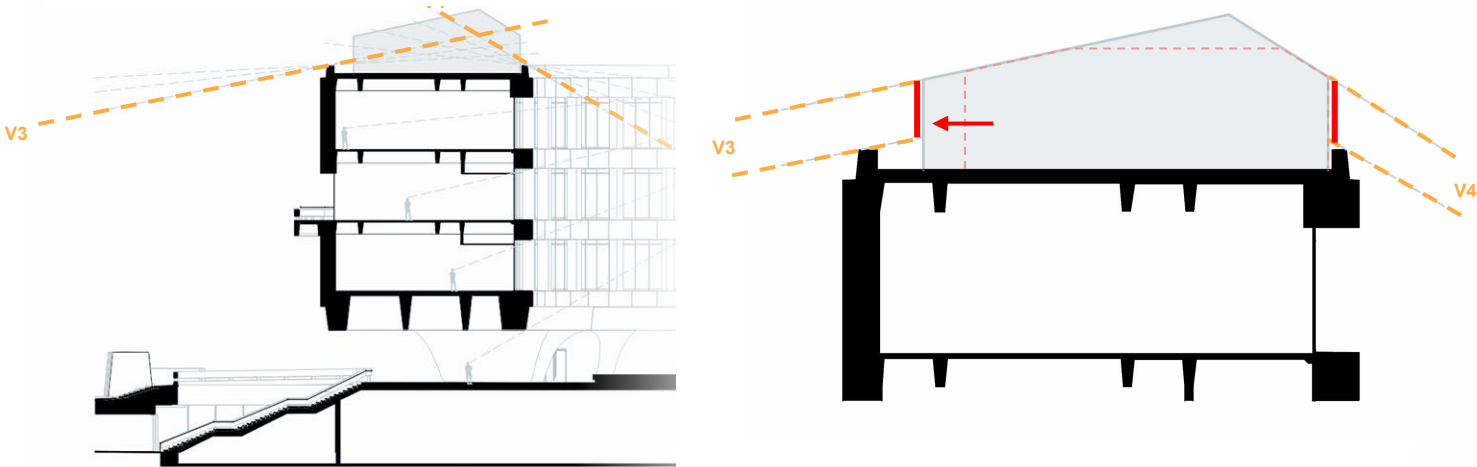
This scheme is recommended, with future design and consultation required on the shaping of the massing and materials. As this proposes an addition to the roof, rigorous study of the form is needed. Careful consideration of sightlines and evaluation of the visible size of the enclosure relative to the drum is required. Analyses will prioritize visibility from the National Mall and public thoroughfares. The design of the envelope and materials will be carefully examined alongside the development of the mechanical systems.



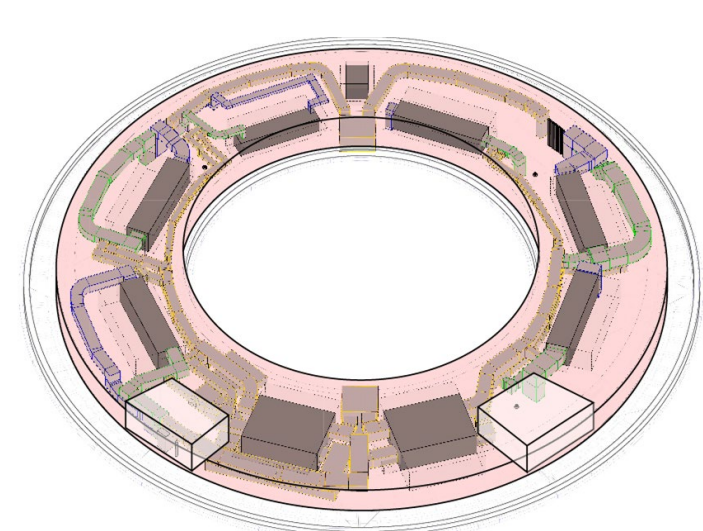
OPTIONS OF FORM, SHAPE, AND MATERIALITY TO BE STUDIED WITH PUBLIC CONSULTATION



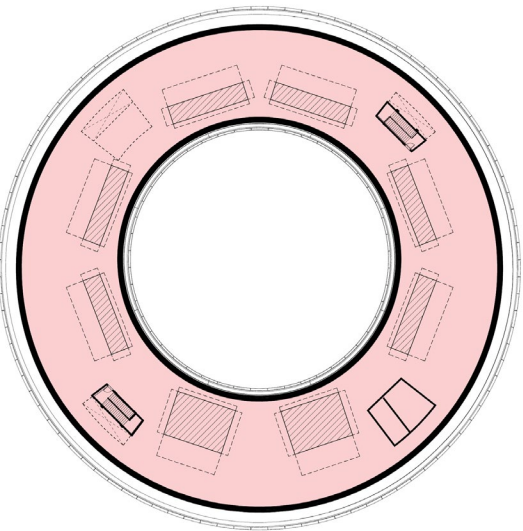
6 | EQUIPMENT IN ENCLOSURE ON ROOF



A STRATEGY TO SHAPE THE ROOFTOP TO VIEWSHEDS TO MINIMIZE HEIGHT AND SCALE



ROOF LEVEL MECHANICAL EQUIPMENT  
DIAGRAM



ROOF LEVEL MECHANICAL EQUIPMENT  
OVERLAY