

Appendix M : Life Safety and Fire Protection Assessment



STATE OF WYOMING

JOINT LEGISLATIVE AND EXECUTIVE TASK FORCE

DEPARTMENT OF ADMINISTRATION & INFORMATION
CONSTRUCTION MANAGEMENT

WYOMING STATE CAPITOL REHABILITATION & RESTORATION

LEVEL I /LEVEL II LIFE SAFETY AND FIRE PROTECTION ASSESSMENT

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The Wyoming State Capitol, a National Historic Landmark [NHL], is about to undergo a comprehensive rehabilitation to address:

- Long standing issues of deferred maintenance
- Aging and obsolete building infrastructure and systems
- Significant code deficiencies
- Critical space utilization needs

A significant goal of the project is ensuring that the building continues to serve the citizens of Wyoming as the state’s Capitol, as well as protecting its architectural and historic significance for the benefit of future generations.

A careful assessment of the existing conditions revealed the following:

- a. The Capitol, typical of virtually all capitols built around the end of the 19th and early 20th centuries, is **a single volume building**, i.e. all levels and areas of the building are interconnected both horizontally and vertically, comprising a single volume. This condition can have significant risk associated with the spread of fire and smoke.
- b. There are no fire protection and smoke detection systems in place to provide full coverage throughout all areas of the building, from the basement to the attic, that is **there are no smoke detectors nor automatic sprinkler systems**.
- c. Egress does present significant challenges. An attempt was made to address this issue through the installation of open metal stairs along the north façade of the building to provide an alternate means of egress from both Chambers.
- d. Historic railings in the Rotunda and the monumental stairs are well below the code required heights, constituting a life safety risk. Similar conditions exist in the Chambers.

Building Codes in general are written to ensure that new structures that are safe, based on scientific analysis and past case studies. The approach is prescriptive since codes are written to address new construction. Historic buildings, such as the Capitol, were typically designed and built before the introduction of building codes. Applying a prescriptive approach to a historic structure may result in irreversible loss of significant historic building fabric, rare materials, character-defining features and monumental spaces such as the Rotunda.

Fortunately, there is an alternative approach, known as **Performance Based Code Analysis** that is based on scientific analysis of the building, to understand its behavior in the event of a fire. This analysis provides direction in introducing systems that can address all key life safety issues, while ensuring that the architectural and historic integrity of the building is not adversely affected and the goals of life safety and property protection are achieved without compromises.

The report recommends the following:

1. **Introduction of a comprehensive smoke detection system** for all levels of the building, from the basement to the attic, including any interstitial spaces that may be created for the placement of new building infrastructure and systems.
2. **Installation of an automatic sprinkler system throughout the building** to provide full coverage in all areas, from the basement to the attic, including any interstitial spaces that may be created for the placement of new building infrastructure and systems.
3. **Design and insertion of a new standpipe system** to provide coverage to all areas of the building.
4. **Insertion of a fire alarm system** to allow timely response in the event of a fire at the Capitol. The system would be integrated with the rest of the Capitol complex, such as the Connector, the utility tunnels and the Heschler Building.
5. **Enhancements of railings** to ensure that the risk is mitigated in all critical areas without altering the design and character of these elements and adversely impacting the historic spaces of the Rotunda and corridors.
6. **Provision of adequate and fully code compliant restrooms** that meet current requirements and standards, without impacting the primary layout of the building and its historic integrity, as well as ensuring that the piping for all these amenities is placed in carefully planned and designed chases and pathways that will not impact the historic and architectural integrity of the building, even in the event of a pipe failure.

It is important to note the following:

- Electric service to the Capitol will have the capability of being fed from two [2] separate utility feeders as selected by the utility company in the instance of an off-site feeder problem.
- The Capitol will have full generator power back-up that would cover not only the code-required items, but also significant additional loads that would: allow for orderly evacuation of the building and avoid interruption to legislative operations, especially when the Legislature is in session.

All building power and lighting loads will have generator power back-up. Life safety loads, including emergency egress lighting and alarm systems will be served via dedicated equipment and feeders, in accordance with Code requirements.

- The sprinkler system will be fed from two sources with more than adequate pressure, as is the case in most areas of the capital city.

However, the most significant new feature of the proposed code compliance related scope of work is **the introduction of a smoke evacuation system, designed to address the single volume issue**. Several scenarios were developed and tested allowing the Design Team to understand the behavior of the building, including the capacity, design and placement of the key components of this system to ensure optimum effectiveness.

The report presents the results of modeling the various scenarios in *Section 4 : Evaluation of Results*.

Finally, we would like to emphasize that there are two [2] significant dimensions in this code compliance program:

- All new building systems will be fully integrated and will be activated in a specific sequence of operations that would ensure optimum effectiveness and full code compliance for all issues
- The building will be “supervised”, that is there will be a number of individuals that would be fully trained to direct the occupants in the event of an alarm. This is necessary to address both code compliance and security issues.

The report provides details on all of the above items and will be the basis of design for the Level III scope of work.



1. Introduction

The Wyoming State Capitol is a 4-story existing structure, with an approximate gross floor area of **115,000 square feet**. Construction of the building was completed in three [3] phases. Phase I was completed in 1888, with Phase II completed in 1898. The present House and Senate Chamber wings were added to the building in 1917. As most monumental National Historic Landmarks of this type, the net usable area is rather low when compared to modern buildings, due to heavy / thick masonry walls, monumental stairs and corridors, open floor areas, etc.

In the case of the Capitol, the existing net usable space is approximately 60,200 square feet or 46% of the gross area. The proposed net usable space is approximately 50,020 square feet or 39% of the gross area. This further reduction will result with the provision of adequate and code compliant restrooms, properly sized mechanical rooms, electrical rooms and other necessary and required spaces in order to meet contemporary building performance and code requirements.

The Capitol is a National Historic Landmark. As part of the Level I/II building renovation and modernization master-plan / pre-design effort, **a life safety and fire protection assessment was conducted to evaluate the building against the state of Wyoming building and fire codes in order to identify areas of noncompliance and make recommendations to achieve compliance to protect both the occupants and this historic landmark in the event of a fire.** This report summarizes this assessment and the resulting recommendations.



Figure 1-1. Wyoming State Capitol North Elevation.

As part of the Level I / II Study, the **HDR / PDP / Plan1 Team** prepared an “As Found” Conditions set of plans, sections, and elevations. These drawings were generated through a laser scanning process. The floor plans are presented in the following pages and were used for all code related studies contained in this report.





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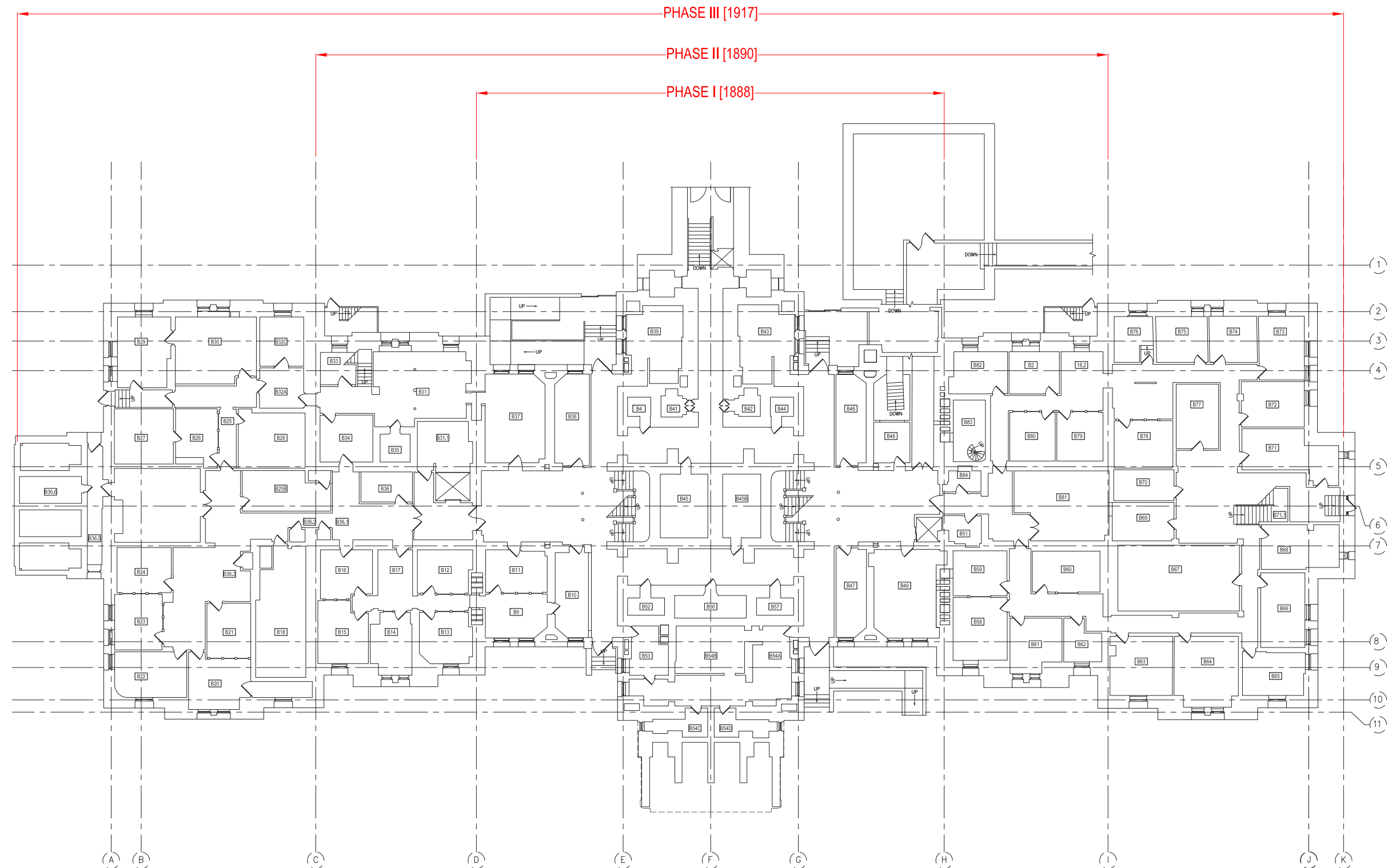
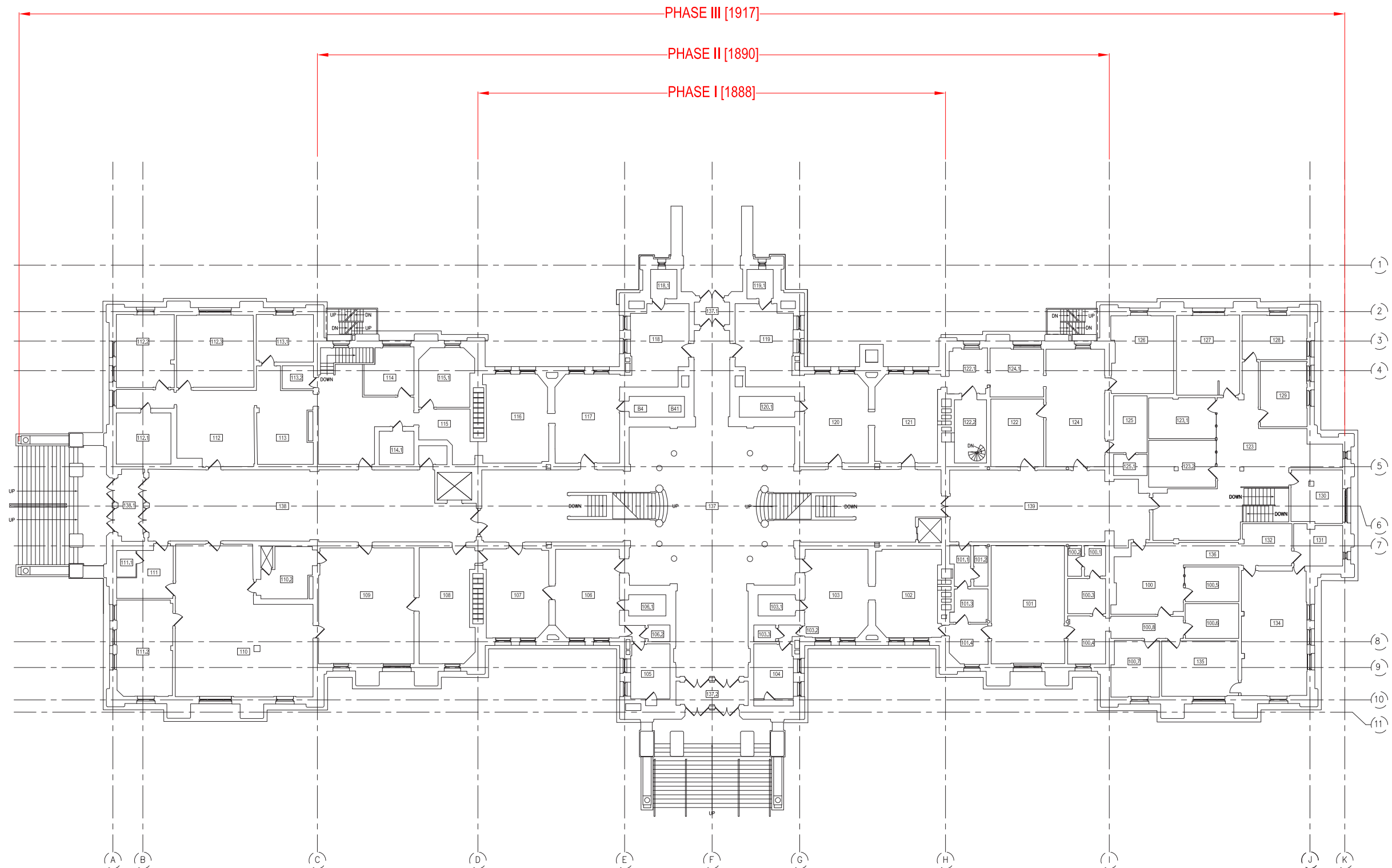


Figure 1-2. “As Found” Basement Level Floorplan.





1 FIRST FLOOR LEVEL PLAN



Figure 1-3. "As Found" First Floor Plan.



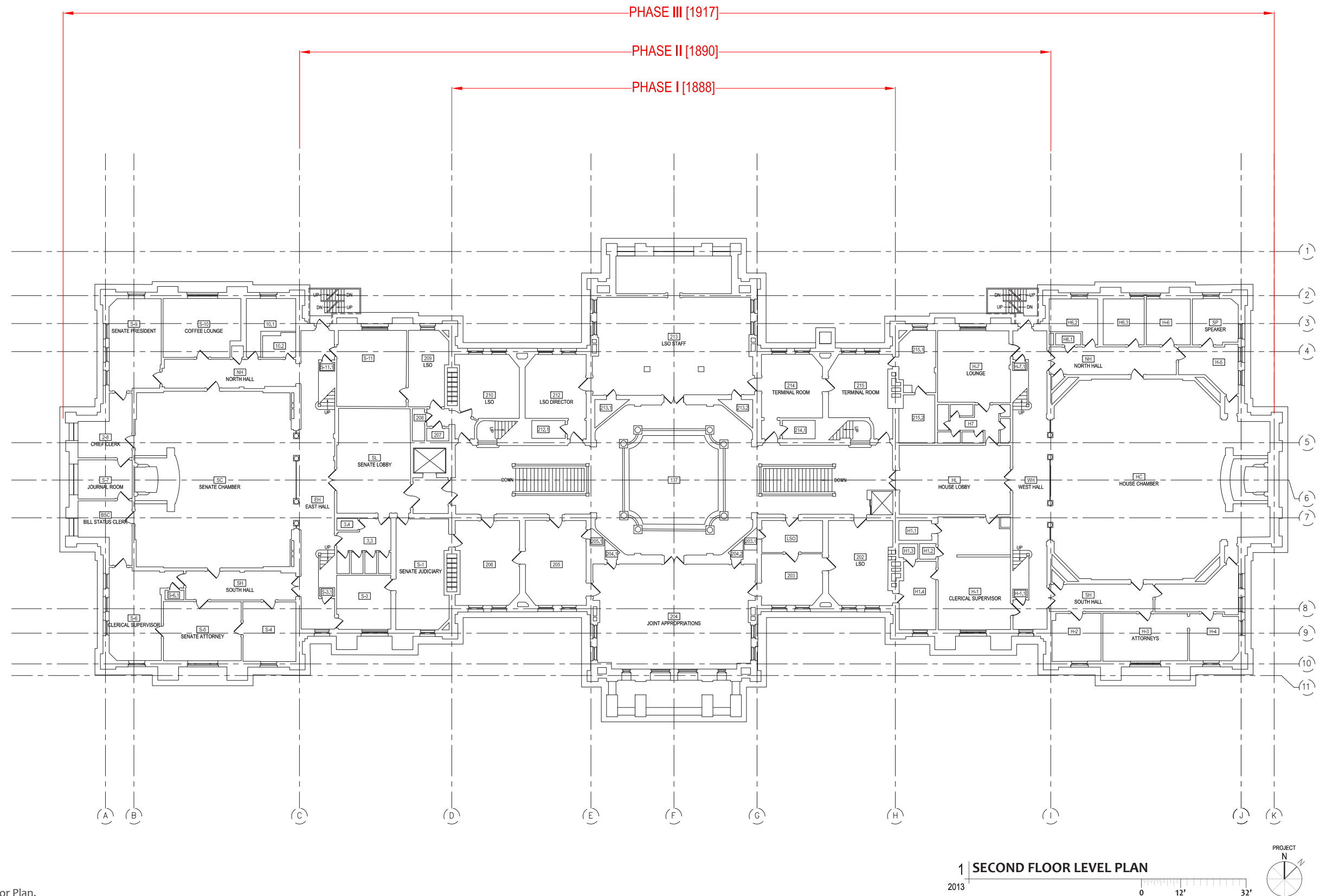


Figure 1-4. “As Found” Second Floor Plan.

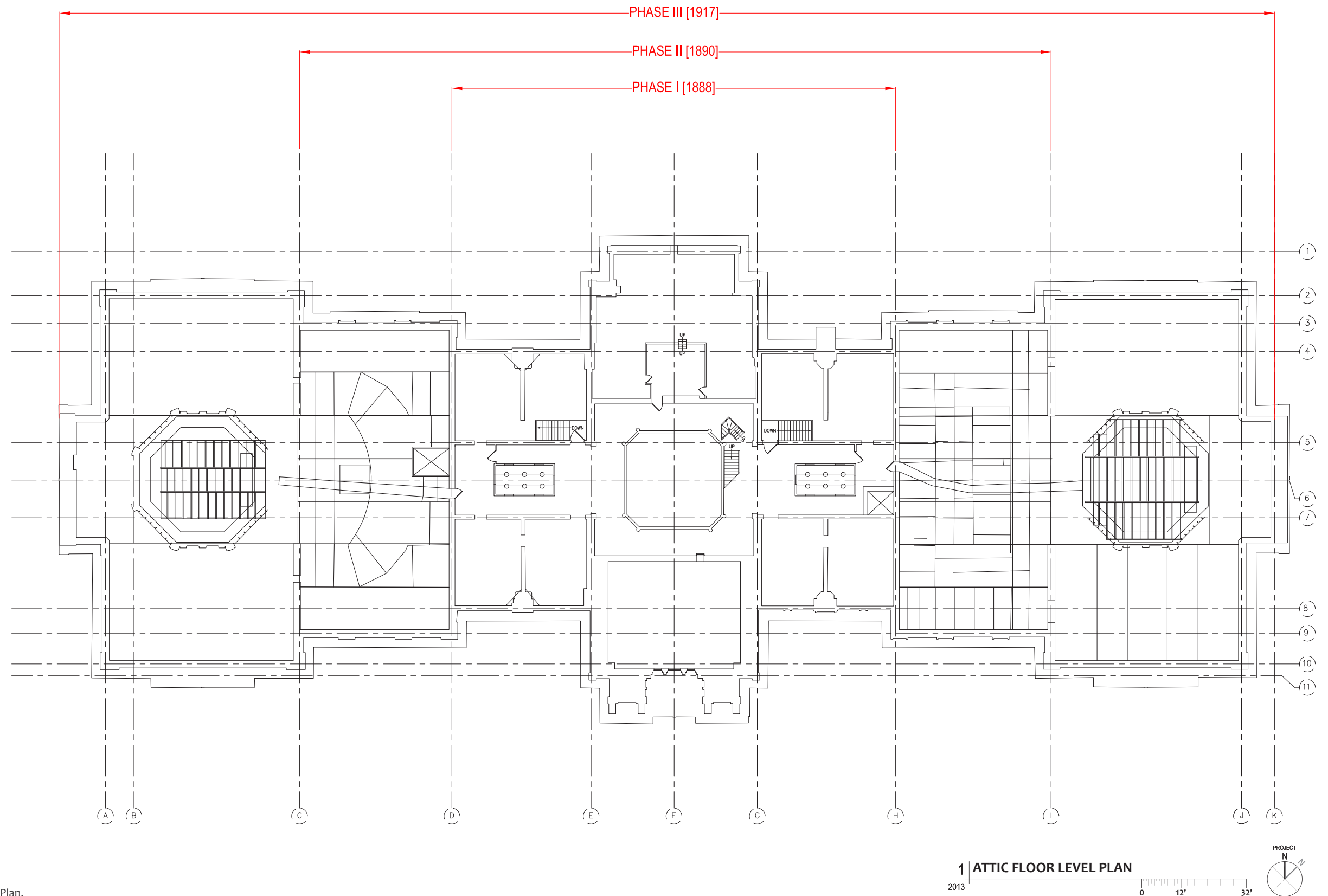


Figure 1-6. "As Found" Attic Level Plan.

2. Fire Protection Engineering Brief

2.1 PROJECT SCOPE

The scope of the Capitol Building renovation and modernization program includes, but is not limited to, the following:

- Restoration of the exterior building envelope;
- Restoration of significant historic spaces;
- Incorporation of new building systems and infrastructure throughout;
- Americans with Disabilities Act [ADA] Compliance;
- New restrooms in new locations that have increased fixture counts and are fully code and ADA compliant.

This code compliance assessment includes identifying areas of nonconformance with the applicable codes and project’s fire safety goals and evaluating alternative means and methods that achieve compliance.

2.2 APPLICABLE CODES

The applicable codes, as adopted by the State of Wyoming to which this assessment was performed, include the following:

- 2012 edition of the ICC International Building Code (IBC).
- 2012 edition of the ICC International Existing Building Code (IEBC).
- 2012 edition of the ICC International Fire Code (IFC).
- 2012 edition of the ICC International Mechanical Code (IMC).

It is important to note that IBC Section 102.4 allows the continuation of a legally occupied structure and does not require retroactive compliance with the current edition of the building code except as specifically required by IBC, the *International Property Maintenance Code* or the *International Fire Code*, or as is deemed necessary by the building official for the general safety and welfare of the occupants and the public.

IBC Chapter 34 applies to existing structures. IBC Section 3401.6 states:

“Work performed in accordance with the International Existing Building Code shall be deemed to comply with the provisions of this chapter.”

The scope of the Capitol renovations is classified as a Level 2 Alteration per IEBC. IEBC requires that any new work be in accordance with the requirements for new construction as stated in the IBC. As such, any upgrades to the building, including life safety systems (i.e., fire protection systems or means of egress) and mechanical and electrical systems, are required to demonstrate compliance with the requirements for new construction.

IBC Section 3409.1 states that:

“The provisions of this code relating to the construction, repair, alteration, addition, restoration and movement of structures, and change of occupancy shall not be mandatory for historic buildings where such buildings are judged by the building official to not constitute a distinct life safety hazard.”

Neither IBC nor IEBC provide minimum requirements for life safety or fire protection for historic buildings. To fill this void, NFPA 914, *Code for Fire Protection of Historic Structures*, will be used for determining the life safety and fire protection strategy. This code prescribes minimum requirements for the protection of historic structures from fire while protecting the elements, spaces, and features that make these structures historically or architecturally significant. This code addresses those construction, protection, operational, and occupancy features that are necessary to minimize danger to life, structures, and the historic fabric from the effects of fire, including smoke, heat, and fumes.

2.3 FIRE SAFETY GOALS

NFPA 914 strategy includes establishing fire safety goals. Four [4] fire safety goals are identified for the Capitol Building:

1. To provide life safety
2. To protect property and heritage
3. To provide for continuity of operations
4. To limit the environmental impact of fire protection measures

The life safety goal is to provide an environment that is reasonably safe from death or injury in fire and similar perils as follows:

- Protection of occupants not proximate to the initial fire development
- Improvement of the survivability of occupants nearby the initial fire development.

The historic preservation goal is to provide a reasonable level of protection against damage to and loss of the building, its unique characteristics, and its contents as follows:

- Minimize damage to materials from fire and fire suppression
- Maintain and preserve original space configurations
- Minimize alteration, destruction, or loss of historic fabric or design while allowing reversibility of alterations





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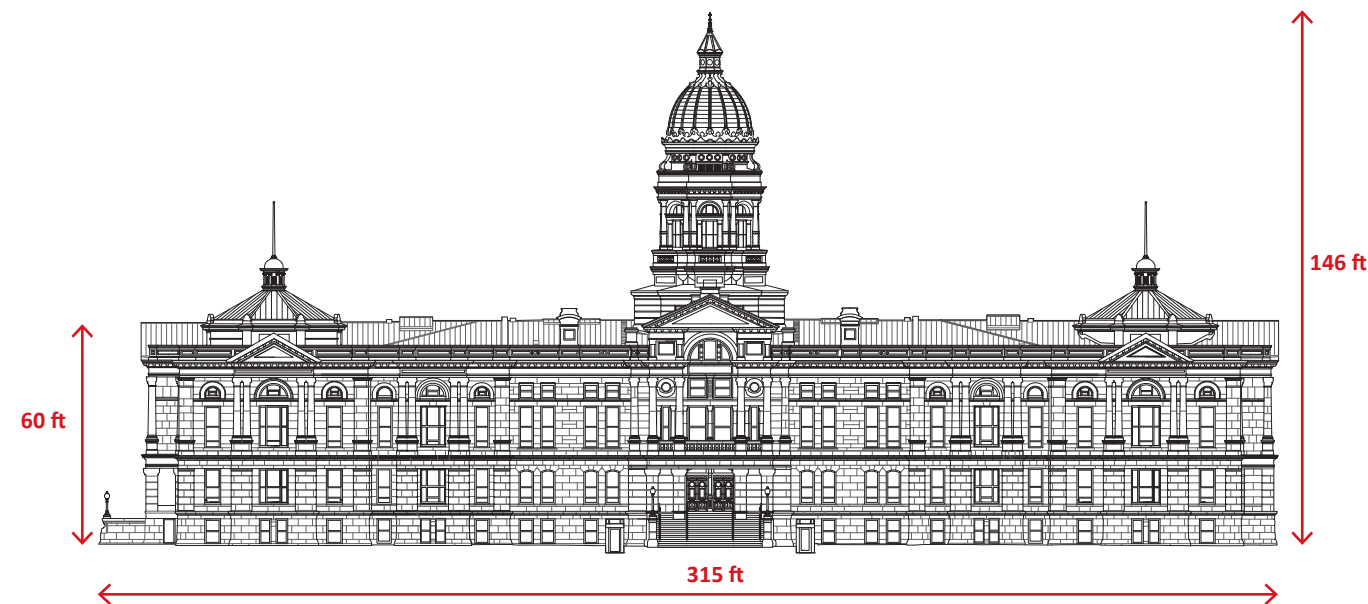


Figure 2-1. Capitol Building South Elevation.

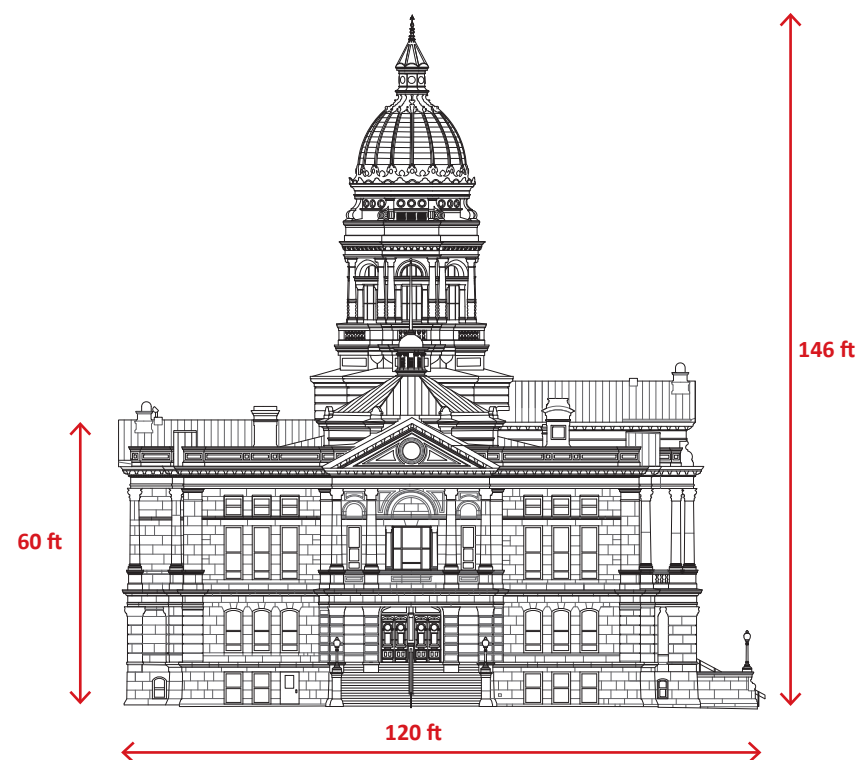


Figure 2-2. Capitol Building West Elevation.

2.4 PRINCIPAL BUILDING CHARACTERISTICS

2.4.1 Overview

The Capitol is four [4] stories above grade including a basement and an attic with access to the dome roof. Utility tunnels connect to the Herschler Building and other structures. The generally symmetrical building has two wings: the West Wing contains the Senate Chamber on the Second and Third Floors and the East Wing has the House Chamber on the Second and Third Floors. The building is approximately 60 feet in height from grade to the main roof and approximately **145** feet in height measured to the top of the cupola. The area of the largest floor plate is approximately **28,800 gross square feet**. See Figures 2-1 and 2-2.

2.4.2 Occupancy Classification

The Capitol Building is classified as a mixed-use occupancy of Use Groups B (Business) and A-3 (Assembly). Incidental uses include storage rooms and mechanical and electrical rooms. Principal assembly occupancy areas currently include the House and Senate Chambers and galleries, committee rooms, and conference rooms.

2.4.3 Construction Type

The Capitol Building is primarily masonry construction with steel framing and concrete floor/ceiling slabs. The building's steel framing is not protected with a fire resistance material. A portion of the attic space, specifically the attic access floors and the cupola, is a combination of steel, concrete, and wood frame construction. Three [3] of the attic's four [4] access floors/levels are constructed entirely of wood, and the fourth level is constructed of wood frame with a concrete deck.

In general, the Capitol Building is classified as **Type IIIB construction (0-hour fire-resistance rating)** due primarily to the unprotected steel structural frame and wood framing and floors within the attic space.

2.4.4 Compartmentalization

The Capitol's floors appear to be subdivided horizontally into **five [5] fire areas on each floor level** (Basement through Third Floor). The compartments on each floor level are created by the masonry walls separating the Phase I construction from the Phase II and Phase III construction to the east and west with substantially thick doors in the openings. The masonry walls and the doors appear to create a minimum 1-hour fire-resistance-rated separation between compartments on the respective floors. See Figure 2-3 through Figure 2-7 on pages M.2.4 to M.2.8.

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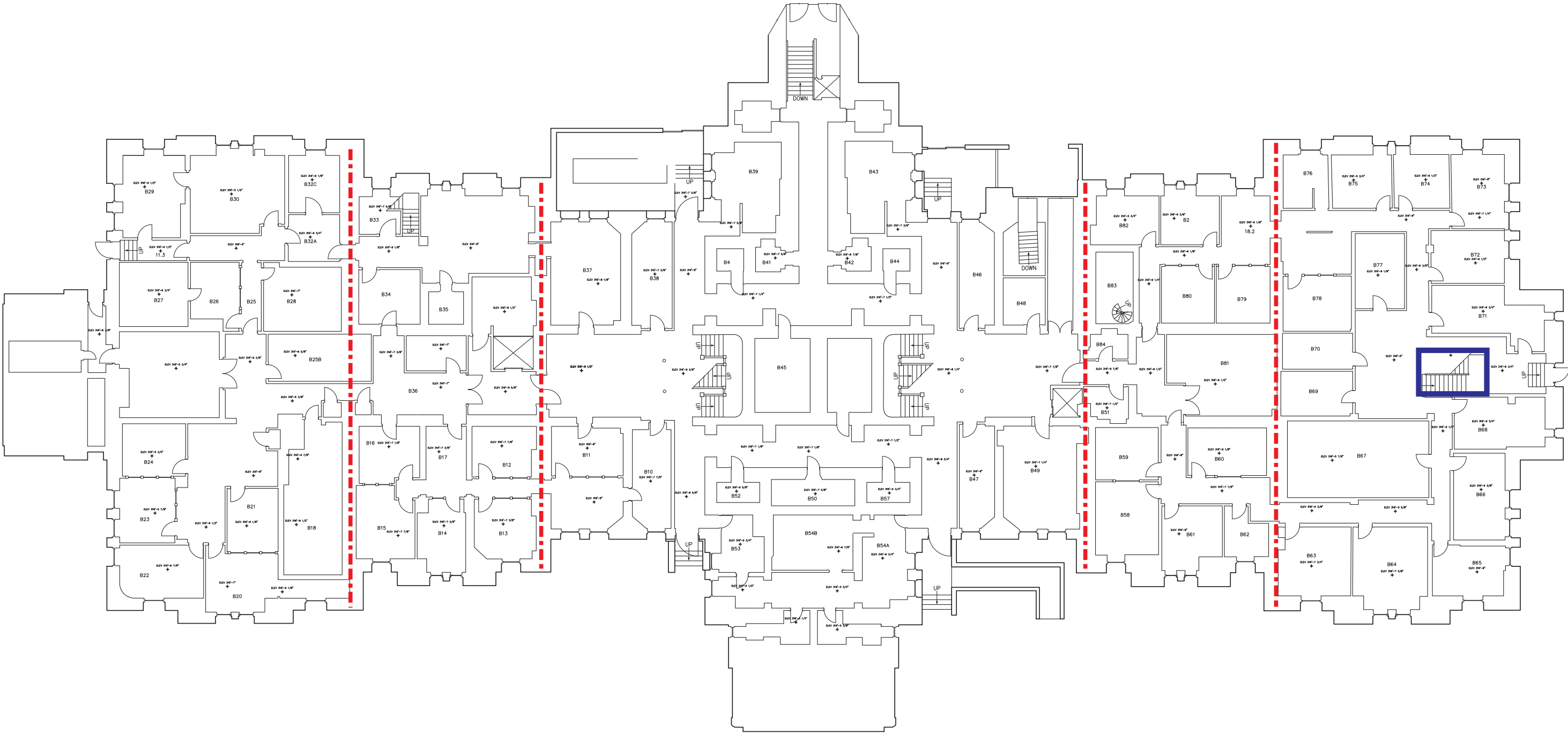
I

II

III

IV

V



- MINIMUM 1-HOUR FIRE RESISTANCE RATED ASSEMBLY
- UNMARKED DOOR
- UNPROTECTED VERTICAL OPENING

Figure 2-3. Basement Level Existing Horizontal Fire Barriers and Vertical Openings.



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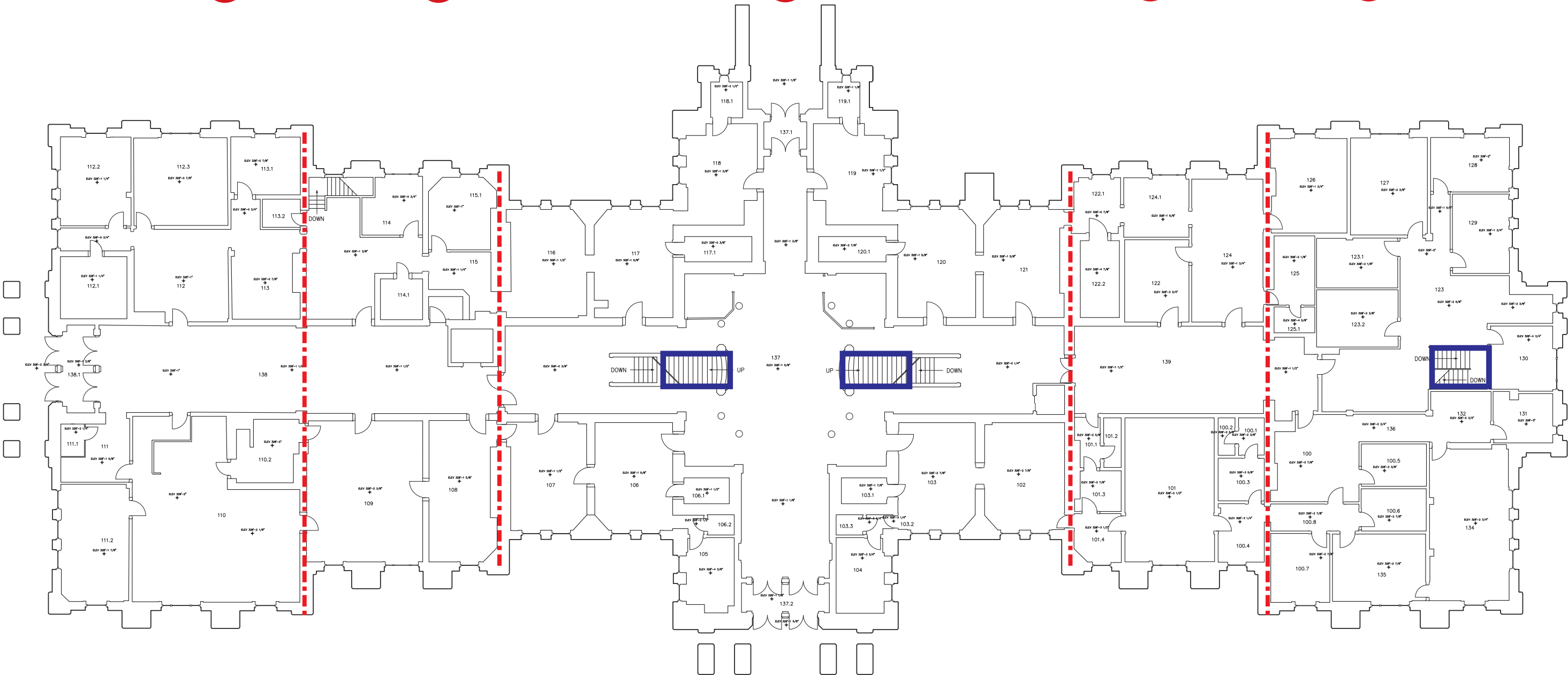
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- MINIMUM 1-HOUR FIRE RESISTANCE RATED ASSEMBLY
- UNMARKED DOOR
- UNPROTECTED VERTICAL OPENING

Figure 2-4. First Floor Level Existing Horizontal Fire Barriers and Vertical Openings.



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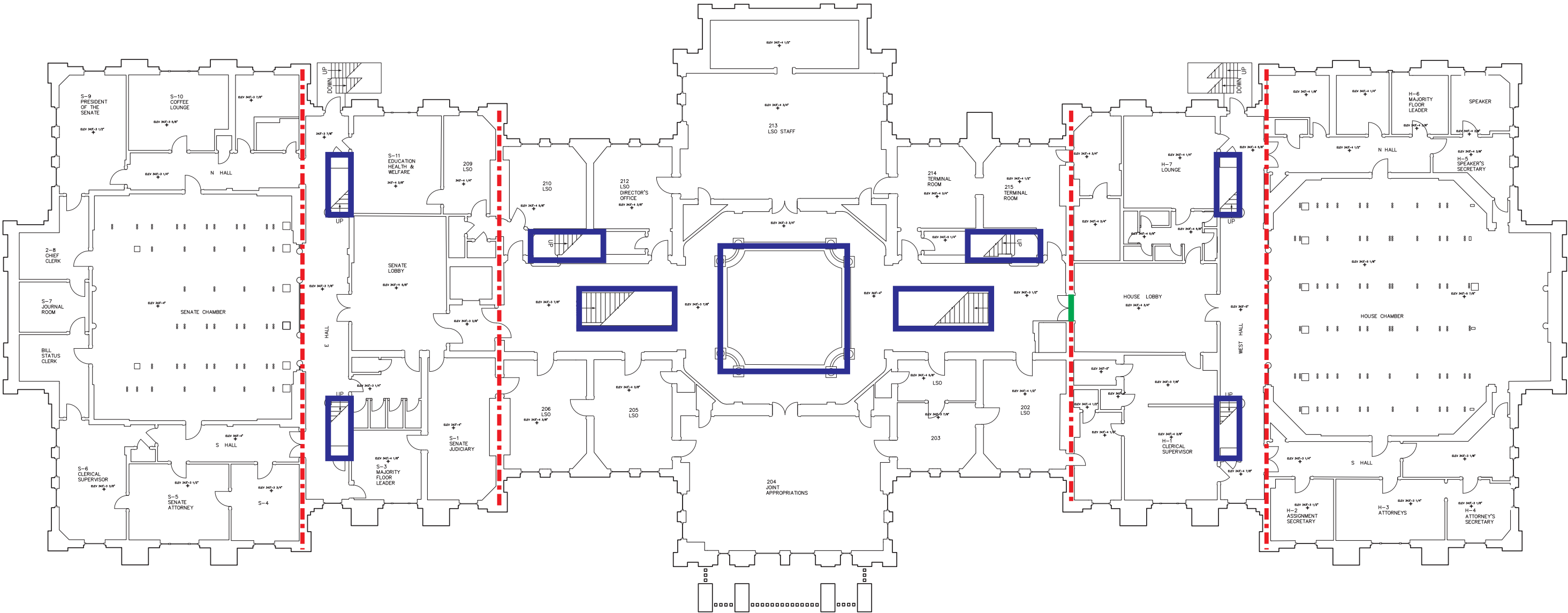
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- MINIMUM 1-HOUR FIRE RESISTANCE RATED ASSEMBLY
- UNMARKED DOOR
- UNPROTECTED VERTICAL OPENING

Figure 2-5. Second Floor Level Existing Horizontal Fire Barriers and Vertical Openings.



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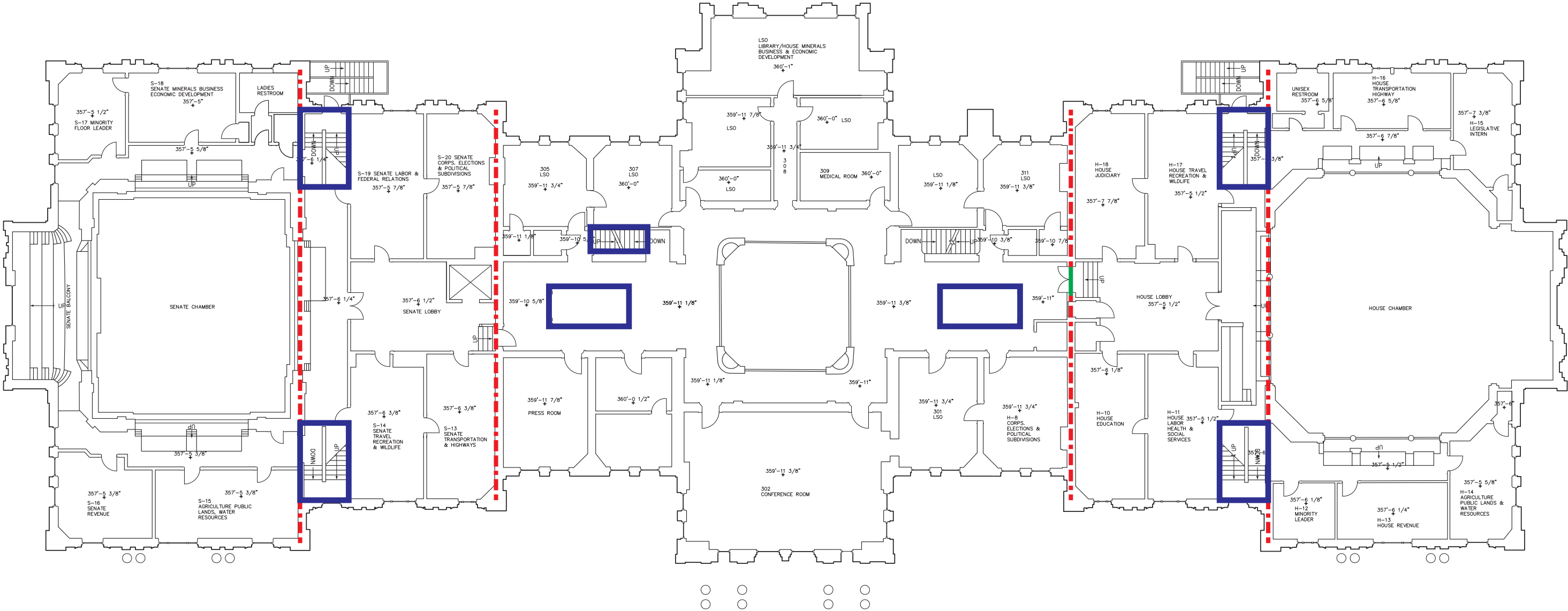
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- MINIMUM 1-HOUR FIRE RESISTANCE RATED ASSEMBLY
- UNMARKED DOOR
- UNPROTECTED VERTICAL OPENING

Figure 2-6. Third Floor Level Existing Horizontal Fire Barriers and Vertical Openings.



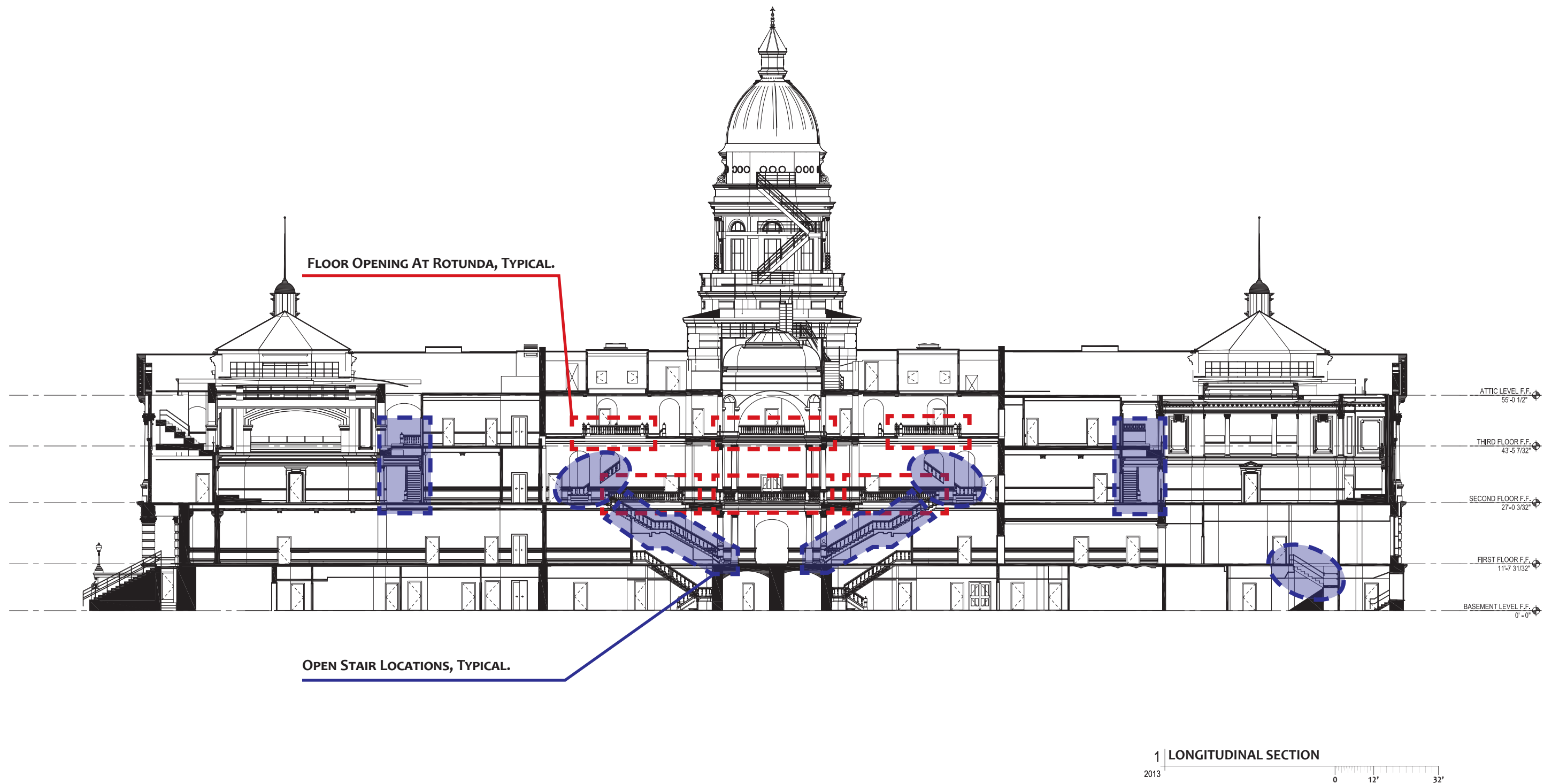


Figure 2-7. Longitudinal Building Section Indicating the Existing Floor/Ceiling Assembly Openings and Fire Barrier Continuity.





Figure 2-8. Third Floor House Lobby, Looking West.



Figure 2-9. Third Floor Main Corridor, Looking East.



Figure 2-10. Second Floor Main Corridor, Looking West.

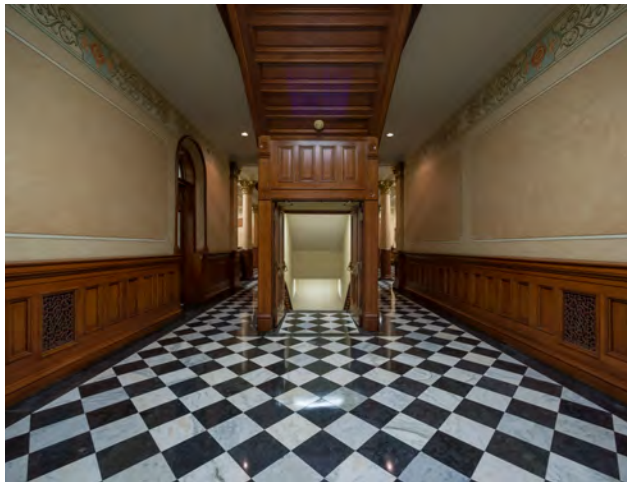


Figure 2-11. First Floor Main Corridor, Looking West.

A preliminary review of the floor/ceiling assemblies separating the Basement, First Floor, Second Floor, and Third Floors indicates the assemblies provide a minimum 1-hour fire-resistance rating/separation. Vertical openings [stairs] between the Basement and First Floor are protected with 1-hour fire-resistance-rated door assemblies, thus creating two separate vertical fire compartments as shown in [Figure 2-3](#).

The First through Third Floors are open to each other via the Rotunda and two stairs, thus creating a single fire area. The floor/ceiling assembly separating the Third Floor from Attic appears to be of steel and wood frame construction that, thus, does not provide a fire-rated separation. Therefore, the building center extending from the First Floor to Third Floor and the entire Third Floor and Attic are considered to be a single fire area.

Because of the lack of separation - vertically and horizontally - on all floors and attic, the Capitol Building is considered to be a single space and single fire area.

2.4.5 Interior Finishes

The interior walls, ceilings, and floors are of various materials and finishes. The wall finishes are primarily plaster or gypsum. A significant portion of the building's core corridor walls on the First Floor and Second Floors are decorative wood wainscot and trim. At the Third Floor, the main corridor walls have wood base and chair rail and plaster walls. Ceilings are a combination of painted plaster, applied noncombustible acoustic tiles, and suspended noncombustible acoustic ceiling tiles. Based on preliminary investigations by the Design Team, it appears that the applied and suspended noncombustible acoustic ceiling tiles conceal historically significant plaster ceilings and decorative beam enclosures. As part of the Design Team's proposed restoration of the Capitol interior, all acoustic tile will be removed and presently concealed and/or enveloped historic fabric will be restored. These materials appear to be Class C interior finish classification or better, as defined by the building code.

Flooring varies from marble over either concrete slab or wood joists in the public areas and carpeting over concrete slab in the offices and House and Senate Chambers.

2.4.6 Fire Detection and Alarm Systems

A manual fire alarm system is provided throughout the building. The system consists of manual pull stations generally installed at the exit/exit access doors in the common corridor areas.

The automatic fire detection system appears to be limited to the local area smoke detection installed at the elevators and cross corridor fire-resistance-rated doors for the purpose of elevator recall and door closure, respectively. General building area smoke detection is not provided.

Alarm indicating appliances consist of bells and horns and generally appear to be installed in the public/common spaces.

2.4.7 Fire Suppression Systems

The building is not provided with an automatic fire suppression [automatic sprinkler] system.

A Class I fire standpipe system complete with 2½-inch diameter fire hose valve outlets is provided in the building. The fire hose valve outlets are located in cabinets installed in locations within the building.

As part of the scope of renovations, the existing standpipe system will be removed and a new standpipe system will be provided. Two [2] standpipe risers consisting of one [1] riser each located in the east and west "service cores" will provide coverage for the entire building at all occupied floors.

Portable fire extinguishers are provided throughout the building. The extinguishers are multi-purpose type units, 2A10BC rating, and are typically installed in visible cabinets.

2.4.8 Means of Egress

Occupant Load and Egress Capacity

The building is a supervised facility with ingress and egress controlled by a uniformed police officer during business hours and access control locks after hours. The building population fluctuates daily and is dependent upon the legislative and gubernatorial schedule and related functions.

An occupant load analysis conducted in accordance with the building code-based on the number of occupants per square foot - indicates the theoretical building population is **1,459 persons total**. The occupant loads in all spaces, except the assembly spaces, were determined by gross floor area in accordance with the building code; the occupant loads in assembly spaces were determined by net floor area.

The Capitol population during normal business hours is less than 200 persons when the legislature is not in session. **During legislative sessions, the building population is approximately 750 persons.** Access to the non-public spaces, including the House and Senate Chambers, is restricted.

The building code occupant load calculation yields an occupant load twice that of the maximum expected number of occupants. Therefore, the maximum expected occupant load of 758 persons, as indicated in [Table 2-1](#) [[Page M.2.11](#)], is used to calculate evacuation times.

Maximum legislative session occupant loads were determined based upon attendance calculations provided by the State of Wyoming Legislative Services Office. This occupant load is considered the maximum expected occupant load within the building. The occupant loads per floor are indicated in Table 2-1.

The building's means of egress on Floors 2 and 3 consist of interior open stairs connecting Floors 2 and 3 to Floor 1. Floor 1 and the Basement's means of egress consist of exits discharging directly outdoors. It is noted that the existing building has two fire escape stairs, accessed from both Floors 2 and 3. The fire escape stairs are open to the elements and are subject to snow and ice accumulation. However, as part of the modernization effort, these stairs will be removed and thus will not be considered for egress.

Interior stairs on the Second and Third Floors provide an egress capacity of 720 and 1,420 persons, respectively. The exits at the Basement and First Floor provide an egress capacity of 2,440 and 1,134 persons, respectively.

The available egress capacity on each floor is indicated in [Table 2-1](#).

A detailed egress analysis is provided in [Appendix M1](#) of this report.



Figure 2-12. Second Floor Rotunda.