REPORT OF THE
DEPARTMENT OF GENERAL SERVICES

Facilities Condition Assessment of the General Assembly Building

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 104

COMMONWEALTH OF VIRGINIA
RICHMOND
2005

COMMONWEALTH of VIRGINIA
Department of General Services

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December 19, 2005

Mr. William E. Wilson, Director
Division of Legislative Automated Systems
General Assembly Building
6^{th} Floor
Richmond, Virginia 23219

Re: Facilities Condition Assessment
General Assembly Building

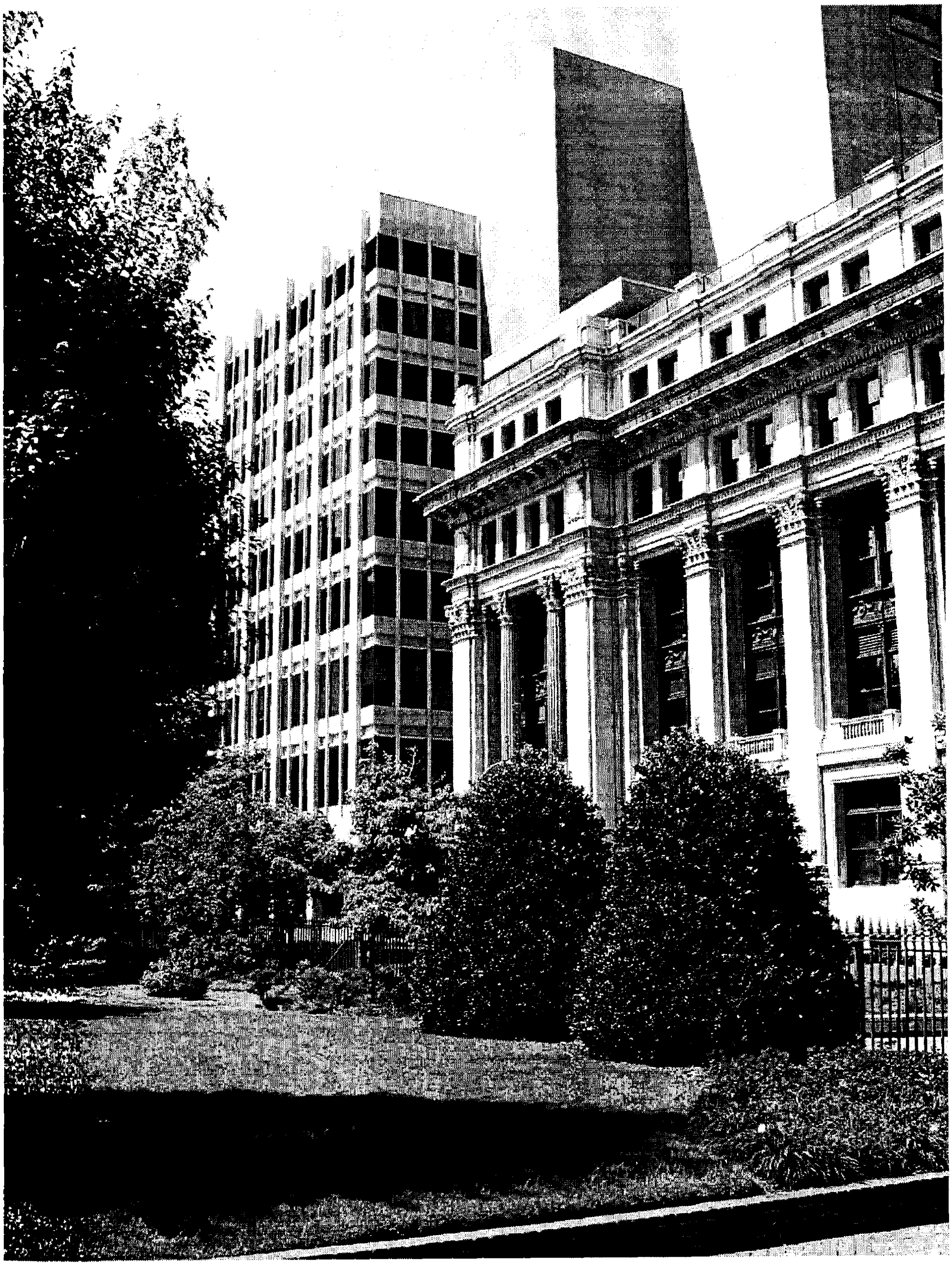
Dear Bill:

Item C-3.60 of Chapter 951 of the 2005 Acts of Assembly provides for a Facilities Condition Survey Renovation Requirements - General Assembly Building to be completed. That report has been provided to you for distribution. Please note that portions of this report have been redacted for purposes of publication, as certain of the information contained in the report is exempt under provisions of the Freedom of Information Act (§ 2.2-3705.2 subsection numbers 2, 3 and 6, Code of Virginia) regarding safety and structural security of public facilities.

Please feel free to contact me if you have any questions.

Sincerely,

James T. Roberts



FACILITIES CONDITION ASSESSMENT
OF THE
GENERAL ASSEMBLY BUILDING

EXECUTIVE SUMMARY

The General Assembly Building has had no major infrastructure improvements since 1977 with the exception of a few small interior renovation projects. A facilities condition survey conducted on the building found that most of the building infrastructure systems do not meet current Virginia Statewide Uniform Building Code requirements and that much of the equipment is at the end, or has exceeded its useful life. A significant number of system parts are no longer manufactured.

Summary of findings include the following:

1. The building is less than 55% efficient. Corridors and support spaces use up too much square footage. Mechanical spaces are not centralized.

2. Restrooms, stairs, stairwells, exterior entrances do not meet current handicapped accessibility guidelines.

3. Moisture problems are resulting in deterioration that is occurring in both the exterior and the interior of the building. Moisture damage was noted in the basement areas under the exterior sidewalks of the building and at the limestone and granite panels located on the

building exterior. Concrete balusters on the East Building are severely deteriorated. Exterior masonry work has significant amounts of cracking. Masonry shelf angles are rusting and expanding. The East Wing roof is in poor condition.

4. The existing windows are single pane windows and are not insulated. Windows in the East Building are very old with several layers of paint, in poor condition and need to be replaced.

5. Hazardous materials are present in the building in the form of asbestos, lead-based paint, mercury, and PCB's.

6. Mechanical systems including chillers, boilers, cooling towers, air-handling units and associated controls, based upon the age of the equipment, are passed their useful life and are very inefficient.

7. All plumbing fixtures need to be replaced in order to meet the current Virginia Uniform Statewide Building Code requirements.

8. [redacted]

9. Electrical service equipment including switchgear, and distribution panels are very dated and have exceeded their projected useful life. Many parts for these systems are no longer manufactured. The existing emergency generators do not meet code.

10. The exterior lighting for the building is very limited and much of the interior lighting consists of fixtures that are 30 or 40 years old and have exceeded their life expectancy.

11. The fire alarm system is obsolete and many components are no longer manufactured.

12. [redacted]

Due to the age and obsolescence of many of the building infrastructure systems and the number of deficiencies in compliance with the current Virginia Uniform Statewide Building Code, a total renovation with new infrastructure is recommended including the removal of existing hazardous materials [redacted].

The estimated construction cost for a total renovation of the General Assembly Building is $80,200,000.00.

FACILITIES CONDITION ASSESSMENT OF THE GENERAL ASSEMBLY BUILDING

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I. INTRODUCTION

A. BASIS FOR REPORT

CEGG Associates L.C. was retained by the Commonwealth of Virginia, Department of General Services to perform a Facilities Condition Survey to determine deficiencies in the existing Commonwealth of Virginia General Assembly Building and to develop future renovation requirements and associated costs to correct deficiencies and to bring the building into current code compliance.

This study was conducted in direct response to a request by the House Appropriations and Senate Finance Committees for the Department of General Services to study the structural and other building systems in the General Assembly Building and report its findings and recommendations for action.

In addition to the General Assembly the building houses work staffs and several services to the Legislature such as the Virginia State Crime Commission, House Appropriations Committee, Joint Legislative Audit and Review Commission, Legislative Automated Systems, The Division of Legislative Services, Senate Finance Committee, and there also are areas for the press, housekeeping, maintenance, and Capitol Police and Security as well as a cafeteria located on the 6th floor of the East Building.

Prior to Proceeding with this study a meeting was held which was attended by the study team, Department of General Services personnel, General Assembly representatives, work staffs, and service agencies to the Legislature to discuss the study plan and to solicit input regarding current building shortcomings.

B. FIELD INVESTIGATION EFFORTS

Facilities Condition Surveys were conducted using a team of five Professionals, including a licensed Architect, Structural Engineer, Mechanical Engineer, Electrical Engineer, and Roofing Designer. The existing conditions of the building HVAC system, plumbing system, electrical systems, fire protection systems, telecommunications systems, roofing, building exterior, asbestos abatement requirements, uniform statewide building code compliance, handicapped accessibility, interior finishes, exterior finishes and building security requirements were reviewed as part of this assessment.

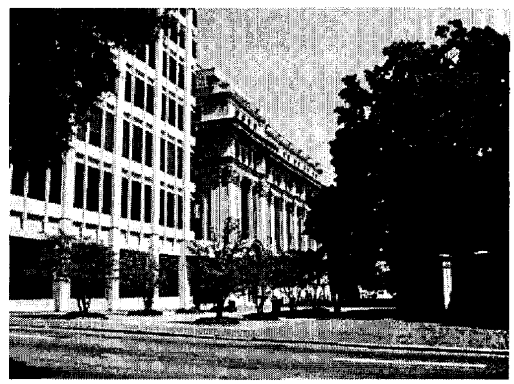
CEGG was given a temporary office location to work out of - Room 248, the Senate Redistricting office, where the team could coordinate and meet while performing field investigation efforts at the facility. Numerous meetings were held with DGS maintenance personnel to discuss operation of the building and known deficiencies as well as recurring problems. Tours of building facilities were made with DGS Maintenance Personnel.

Available As Built drawings of the existing buildings and facilities were obtained from DGS files for reference during the condition survey field investigation efforts. It should be noted that the drawings for the 1905 building are missing. The drawings for the 1965 building are very complete. The drawings for the 1955 in-fill project are fairly complete. There are Architectural and Structural drawings for the 1923 building. There are also drawings for asbestos abatement, re-roofing, and renovations and alterations for individual floors and spaces.

C. BUILDING DESCRIPTION

The 340,000 gross square foot General Assembly Building is actually a combination of four separate buildings built at different time periods 1905, 1923, 1955, and 1965. The east and west portions of the building are also designated as the West Building and the East Building. The older buildings are located in the area designated as the East Building the newer building constructed in 1965 is referred to as the West Building.

1. 1905 Building



The original building was constructed between 1905 and 1911, is L-shaped and is located on Capitol Street/Darden Gardens facing the Capitol Building and was a five story building with a basement.

2. 1923 Building

In 1923 a second L-shaped building was constructed within the area designated as the East Building and this was a eleven story structure with a two story penthouse and a basement facing Broad Street.

3. 1955 Building

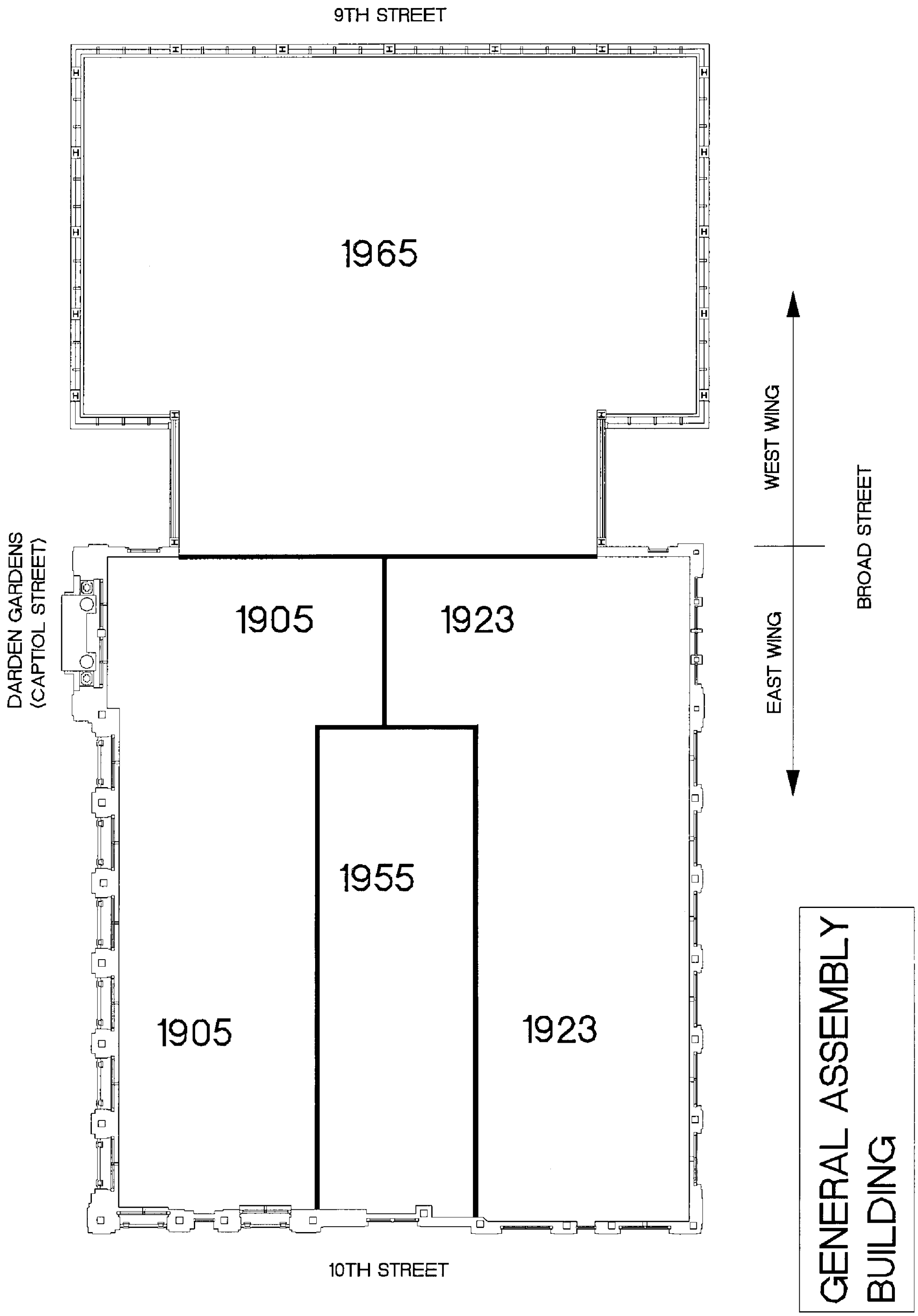
In 1955 an in-fill structure was constructed between the 1905 and 1923 buildings which was six stories tall plus a penthouse, also at that time a partial six floor story was added over half of the 1905 building.

4. 1965 Building

In 1965 the West Building was constructed which was 9 stories tall plus a two story penthouse with a sub-basement and basement. The basement served as a parking deck. All these buildings were originally constructed as private office buildings and later purchased by the Commonwealth of Virginia.

D. LOCATION AND SITE

The General Assembly Building is bounded on the North by Broad Street, a very busy major city thoroughfare, on the south by, what was formerly Capitol Street, which is now referred to as Darden Gardens which is the side of the building which faces the Capitol Building and Capitol Square. The building is bounded on the east by 10^{th} Street which is currently used primarily for a controlled access parking area and is bounded on the west by 9^{th} Street which is still an active city street.


9TH STREET
1965
WEST WING
EAST WING
BROAD STREET
DARDEN GARDENS
(CAPTIOL STREET)
1905
1923
1955
1905
1923
10TH STREET
GENERAL ASSEMBLY
BUILDING

II. ARCHITECTURAL FACILITIES CONDITION SURVEY

A. ARCHITECTURAL STYLE AND BUILDING CHARACTER

The General Assembly Building is a series of individual buildings constructed between 1905 and 1965. The original building, constructed in 1905 now forms part of the east wing and faces Capitol Street, now known as Darden Gardens. It is a Neoclassical design complete with ornate capitals, dentils, corbels and cornice work. The 1923 building, another portion of the east wing, faces Broad Street. This building is also Neoclassical. However, the elevations appear more restrained. The style of the West Wing 1965 building, appears to be a combination of 50's Modern and Post Modern. The main building is Modern while the connector appears to be Post Modern. Evidence of the Modern period is the west wing's totally functional appearance. Evidence of Post Modernism is done by the expressive or surprise use of form. In this case a rectangle in combination with the "clean" look of the elevation conveys the period. The General Assembly Building gives the appearance of a series of buildings forced together. There is no dominating character from one side of the building to the next. The General Assembly Building is symbolic of our ever changing society and the people that live in the building represents major periods in the growth of American Architecture.

B. BUILDING LAYOUT

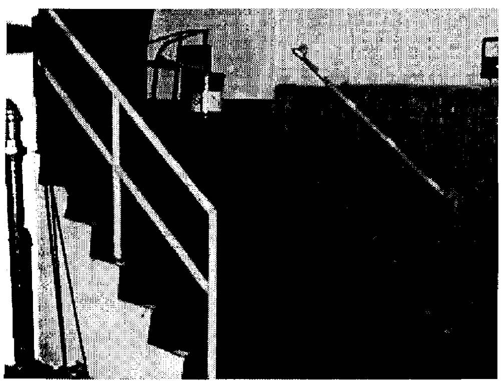
The General Assembly Building is comprised of an east and west wing that vary in height. The west wing is 9 stories tall while the east wing is a combination of 11 story- and 6 story buildings. The first floor consists of House and Senate assembly spaces that are connected by lobby and corridor spaces. The basement and sub-basement of both the east and west wing house mechanical spaces that support the building's mechanical, plumbing, and electrical systems. The upper floors provide the administrative function of the building and contain office and conference room spaces that serve House and Senate members and their staffs. Also, provided on the sixth floor is a cafeteria. The remaining upper floors contain office and conference spaces. Penthouse spaces located on the roof contain elevator and mechanical equipment that serve the building.

C. SURVEY FINDINGS

As stated previously the General Assembly Building is a series of buildings and renovations put together to form one building. The main entrance is on the first floor and off of Capitol Street/Darden Gardens. On the first floor, corridors link the support and assembly spaces with the rest of the building. Even though there are several buildings put together the General Assembly Building does have a centralized core. The core abuts the existing east wing and links the east and west wings. This core has elevators, fire stairs, and restroom spaces. It also houses electrical closets, telephone closets and storage. These spaces, although centralized, are inefficient with the exception of the first floor. There is also a secondary entrance off of 9th Street. The lobby off of 9th Street serves three different spaces. It serves Senate Room A, Senate Room B, and incoming pedestrian flow from the main lobby. This lobby is quite large, and has telephone spaces and areas where people can congregate. This space connects to the main corridor which then connects to the main lobby. A corridor also connects the lobby of House Room D and House Room C, and occupants transition in and out of this space.

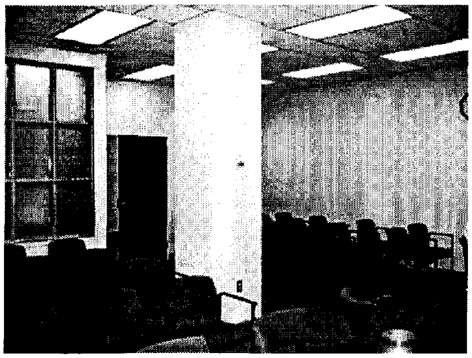
To the east of House Room C and House Room D lobby space, there is a service area which serves the rest of the building. Within this area lies a service elevator which allows shipments to be delivered to the basement floor only. After shipments reach the basement floor from there they are distributed to the rest of the building. On the south end of the building is a monumental stair installed with the original 1905 building that connects the first floor with the basement floor of the building and a small scale vending and break area. This stair is missing handrails that are required by code. Once in the basement, corridors connect the core of the building with other support and mechanical room spaces. Also located in the basement are storage spaces and small media spaces that are situated on the perimeter of the building. Natural lighting is supplied to these spaces by means of an area well.

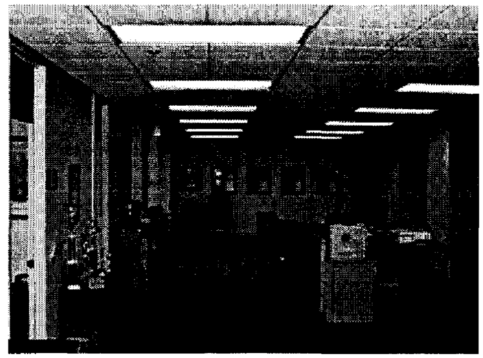
Also located in the basement are the mechanical room spaces that connect to sub-basement areas which house another mechanical space. Accessing the sub-basement is done by a set of stairs in the east and west wing. However, in both instances the stairs accessing these spaces violates code. The stairs violate code by have risers greater than 7-inches and treads that are less than 11-inches. Also, the handrails do not extend 12-inches at the top or bottom of the stair run. In the basement, the connection between the east and west is accessed by a set of stairs. Once in the west wing, a large inefficient corridor connects the pressroom spaces, storage spaces and a television studio area.



D. <u>FLOORS 2 – 5</u>

Floors two through five are a repetition of the central core, connected by a large corridor that wraps around central support spaces of the east and west wing. These support spaces include but are not limited to: secretary spaces, aide spaces, conference rooms, reception area, copy rooms, storage areas and restrooms.

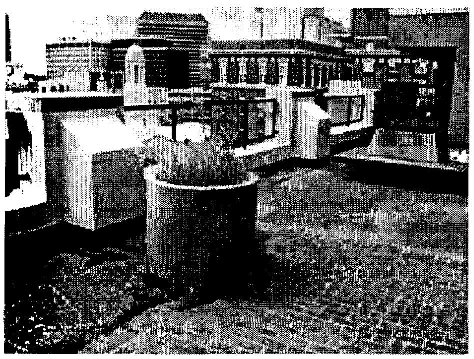


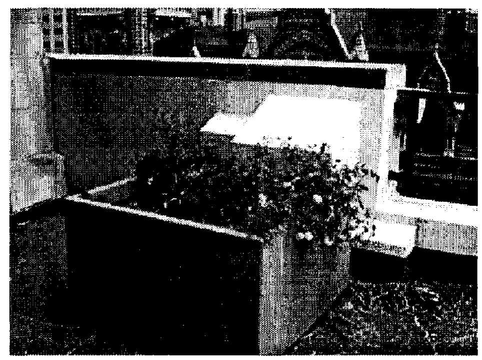


Located on the perimeter of the east and west wing are House and Senate offices. It appears that each member of the House or Senate has a window that provides natural light into their offices. Also, just outside of each members office is an aide who assists the member with their duties. Conference rooms located in each wing provide places for members to have a meeting, instead of using the main House rooms or Senate rooms located downstairs. Conceptually, this is a good layout. However, the corridor size and the location of mechanical and support spaces make the layout very inefficient. Also, storage spaces are not efficiently arranged leading to a mass of clutter behind the stairwells.

E. SIXTH FLOOR

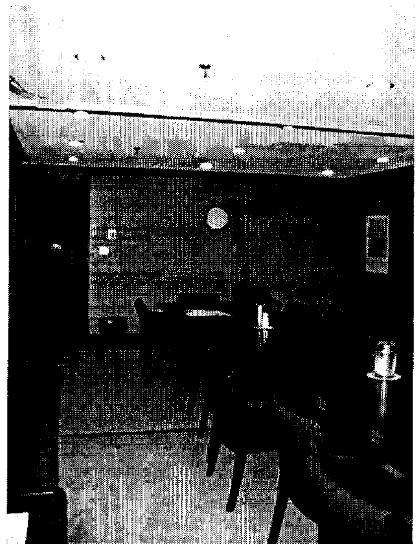
On the sixth floor, the concept stays the same with offices located on the perimeter and support and meeting spaces located towards the interior of the building. However, this floor also houses a cafeteria with a kitchen, serving, and dining area. Also, there is a patio area which allows one to eat or smoke outside. This patio area overlooks the Capitol Building. The kitchen, serving, and dining areas are undersized for the occupant load of the building. The patio is in need of repair and looks seldom used for its intended function. In fact, the planters have weeds and privately owned tomato plants growing in them.





F. UPPER FLOORS

The building layout is the same from floors seven through nine. However, on the tenth floor the west wing stops and now becomes the roof. The east wing continues to go up another two floors. The layout is the same with a corridor that travels perimeter office spaces and interior support and meeting spaces. This corridor also connects two large mechanical rooms that occupies a large amount of valuable perimeter wall space. The mechanical spaces throughout the building appear disjointed or scattered.



G. BUILDING EFFICIENCY

Building efficiency is defined as assignable square footage versus the gross square footage expressed as a percentage. Assignable space relates to usable square footage, i.e. offices, conference rooms, break rooms and secretary spaces. Unassignable square footage relates to support, wall, and circulation areas such as restrooms, mechanical rooms, electrical closets, wall thickness, and corridor spaces.

Although the core is centralized, the building is not efficient. Corridors and support spaces eat up too much useable square footage making the building less than 55% efficient. The required efficiency ratio as per the Construction and Professional Services

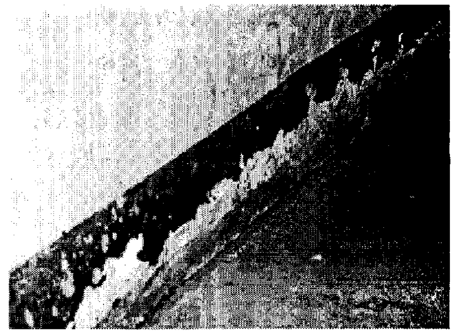
Manual is 70% for this type of building. In fact, the efficiency ratio of this building compares more to a hospital whose required efficiency ratio is 60%. Also, mechanical spaces are not centralized. Resulting in a reduction of assignable square footage.

H. FINISHES

1. General

The finishes for the General Assembly Building are in good condition. Floor finishes consist of carpet, terrazzo, vinyl composition tile, marble and painted concrete. Hard surfaces such as terrazzo, vinyl composition tile and marble were used in public spaces. However, carpet was generally used in private spaces. Wall surfaces consisted of wood, gypsum, concrete and painted masonry. Also, wood was generally used for public spaces while painted gypsum was used for private spaces. Ceilings consist of suspended acoustical tile and gypsum with a finished texture applied.

2. Findings Walls



For the most part the walls of the basement consist of painted masonry. These walls however show signs of water infiltration especially along the perimeter of the building. The rebar is beginning to rust inside of the wall which is evident through staining of the interior wall. Another indication of moisture infiltration is the massive peeling of suspected lead base paint located on the sub-basement and the basement walls. CEGG suspects that failing water proofing combined with hydrostatic pressure is forcing moisture to infiltrate the masonry. As a result this moisture is causing paint to chip and delaminate from the masonry.

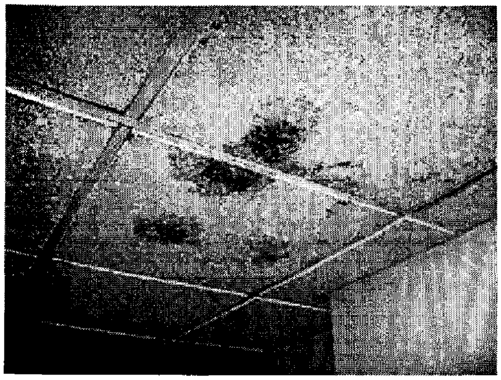
There is also evidence that steel reinforcing within the walls are in contact with moisture causing it to rust. Rusting of the steel within the wall is actually weakening the steel thus reducing the tensile strength within the wall. Although this problem appears to be correctible it should happen sometime in the near future. To hesitate with this would further cause a deterioration of the rebar which at some point may lead to a

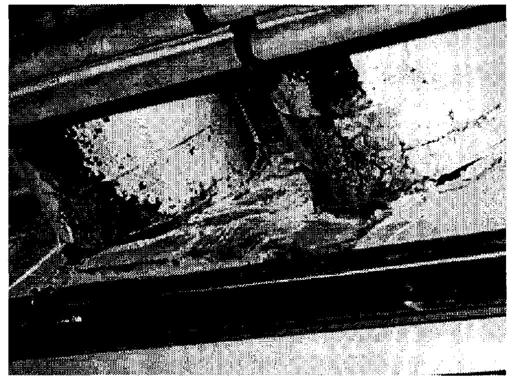
structural failure. Moisture is also infiltrating the concrete slab of the basement floor as evidenced by the rusting of file cabinets, delimitation of vinyl composition tile, and delimitation and staining of existing carpet. This moisture can be possibly caused by a failure of the waterproofing membrane under the slab or a failure at the joint between the wall and the floor slab.

Also moisture present due to moisture infiltration is causing the plaster to delaminate, peel, and fall off of the walls. Some areas of plaster are actually swollen, which is a sure indication that there is some type of moisture present. On the upper levels the walls are gypsum wall board and for the most part are in good condition. There are no signs of holes or punctures in the walls. They appear to be in sound condition. However, these walls will have to be removed because of recommended asbestos removal discussed later in this study.

3. Ceilings

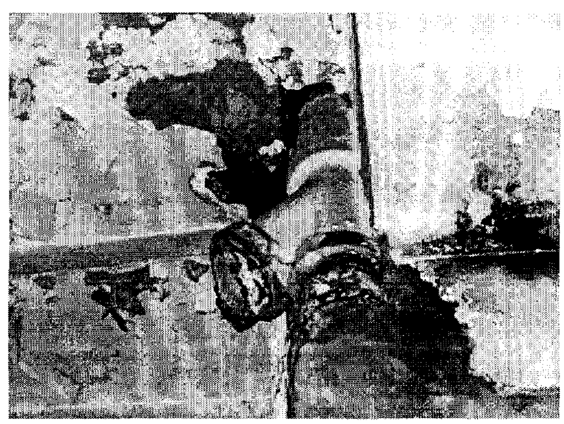
The ceilings throughout the building are either made of concrete, suspended acoustical tile, tectum, or gypsum with some type of sprayed on plaster finish. For the most part, the ceiling appear to be in good condition with the exception of areas that have been stained by water. The leaks are either caused by failed piping or by roofing failure. Because of asbestos present above the ceiling no ceiling tiles were disturbed. Located in the basement within the air intake or exhaust corridor, there are some severe problems with cracking along expansion and control joints. Moisture is penetrating the cracks





causing leaks within the ceiling. The moisture infiltration and the extreme cracking along the ceiling in this space also indicate structural problems that will be detailed later in this study. Also, moisture infiltration in this area is causing lights, fasteners, and conduit to rust to the point of failure. Ceilings of some interior spaces show signs of steel reinforcement rusting. In fact, some beams have rebar exposed due to spawling. This condition is evident along the perimeter of the building within the interior of the basement walls. Some ceiling spaces within the basement contain abandoned pipes that have been left uncapped. This uncapped piping penetrates the ceiling thus creating a fire hazard. Uncapped piping allows smoke to travel and spread throughout the building.

These are examples of deficiencies that were noticed within the basement in open areas.



It is suspected that due to the numerous renovations the building has undergone that uncapped and unsealed piping exists throughout the building. There is also a trough on the upper floors that is not fire rated or sealed. This condition also provides a vessel for smoke or fire to travel.

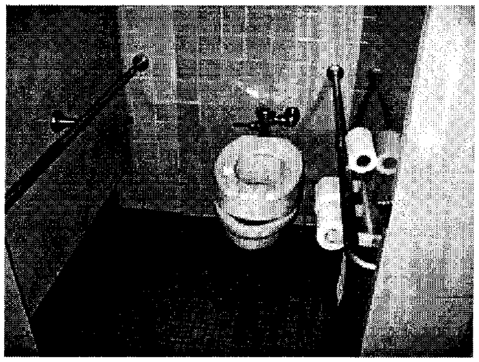
4. Floors

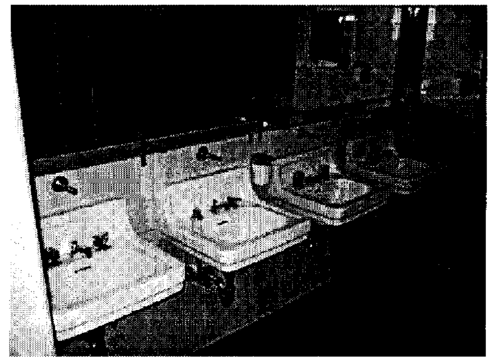
Carpet in areas of the building has been stained either through day to day coffee use or by leaks from the ceiling. As stated previously these leaks are due to failed plumbing, roof drains, or the flashing, or the roof itself. The carpet within the television studio in the basement show signs of severe moisture infiltration. Equipment has been raised up from the floor because moisture and water penetrates either the slab or the walls around it. As a result, the carpet needs to be replaced on a regular basis. Due to moisture infiltration the carpet adhesive has failed causing some areas of the carpet to bubble.

I. HANDICAPPED ACCESSIBILITY

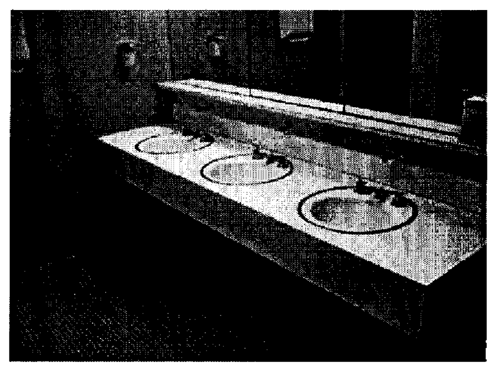
With the exception of the bathrooms on the first floor none of the bathrooms on the upper floors meet ADA and Accessibility Guidelines – 2004 (ADAAG) as required by the Virginia Uniform Statewide Building Code (VUSBC). The restrooms on the upper floors suffer from a myriad of code violations. These violations include but are not limited to:

1. The stalls do not meet the code because they are not 5' - 0"clear.
2. The makeshift handicapped accessible stall made in lieu of upgrading the toilet is not allowed.



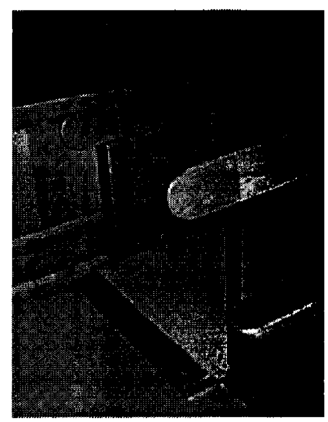


3. Handicapped accessible mirrors are missing.
4. Faucet operators are not the fan type.
5. The plumbing below the sinks is not insulated to protect someone from being scalded.
6. The soap dishes and the paper towels are too far for one in a wheelchair to reach
7. Toilets are to low.
8. Knee space under counters is to low.
9. Door entrances are too narrow.
10. 5' – 0" turn around space is missing.
11. Urinals are not the proper height.
12. 18" pull clearance not provided.
13. 12" push clearance not provided.
14. Sinks are not mounted at the proper height.



Presently, many handicapped accessibility code violations occur throughout the facility. These violations include:

1. No ramp for the disabled at the main entrance. Also there is no sign indicating where the handicapped ramp may be.
2. The ramp does not meet ADAAG requirements.
3. Throughout the facility there are level changes that are greater than ½-inch.
4. Railings do not extend 12-inches beyond landings
5. The top of handrails are not mounted between 34- to 36-inches above the ramp.
6. The approach to ramps or existing stairs do not have tactile warnings.
7. Doors lack lever type hardware.
8. Closer strength is greater than the allowed.
9. 32-inch clear opening between the face of door and edge of partition is missing.
10. The coat hooks installed are mounted higher than 48-inches.
11. Side grab bars are not 42-inches long.
12. Some handrails are greater than the 1½-inch diameter allowed.
13. The space between the wall and the grab bars is less than the minimum 1½-inches allowed.
14. The center lines of the toilets are not 18-inches from the wall.
15. Access to podium or board spaces are less than 3-foot wide.
16. The countertop height for the information desk is too high.
17. The threshold height leaving the sixth floor to the exterior balcony patio area is approximately 6- to 9-inch level change, leaving this area inaccessible by the handicapped.
18. Along accessible routes, objects protrude more than 4-inches into the means of travel.



19. Views from handicapped accessible seating spaces within the assembly areas are obstructed;

J. EGRESS/FIRE RATING

The use group for the General Assembly Building is Use group B - Business, with assembly. The overall floor area of the building is 340,000 square feet. The Virginia Uniform State Wide Building Code states that per 100 gross square feet of building allow one occupant. As a result there is potential to have approximately 3,400 people in the facility at one time. Realistically, because of the assembly areas, there could be more than 3,400 people in the building at one time. According to documents received, and through field investigation, [redacted]

[redacted].

CEGG feels the cause of this condition can be attributed to past renovations and/or poor inspections.

[redacted].

K. STAIRWELL ENCLOSURES

[redacted]. With the exception of the monumental stair, the stairs are made of concrete with metal handrails for griping on both sides. [redacted].

[redacted]. Pedestrians enter the stair enclosures off of the corridors through doors that swing in the direction of travel.

1. Deficiencies

The walls that separate the fire stair from the exiting facility need to be 2-hour rated. These walls also require a door with a minimum of 1½-hour rating. In this facility exits serving the fire stairs lack the required UL label on the door. According to the VUSBC, if an egress stair exits into a lobby or other space then the entire enclosure must be 2-hour rated. Stairwell number 5 violates this code. On the upper floors, stairwell # 5 is labeled "EXIT". This means that in an emergency situation, occupants may use this stairwell to exit the building safely. However, once on the first floor this stairwell enters into a lobby that is not 2-hour rated. Essentially, this stair misleads pedestrians by guiding them to a condition that is hazardous and threatens life safety. Also, doors located in this area are not properly labeled.

According to the VUSBC an "area of refuge" must be provided for the disabled within a stairwell or in an area adjacent to the stairwell that meets or exceeds code requirements. The area of refuge intention is to provide a relatively safe area for the disabled to remain until they can be rescued by emergency personnel. Presently none of the egress stairs in this facility provide an area of refuge.

Other notable fire stair violations include:

1. Landings that change directions are not 5' – 0" wide.
2. The handrails in the stairs are continuous. Oftentimes, they stopped at the top or bottom of the stair.
3. Handrails lack the 12-inch extension required by code.
4. Baseboard heaters, pipes, and wall structures are protruding into the required egress width thus constricting the flow of traffic.
5. Handrails are not the required 34- to 38-inches above the threads.
6. Guardrails are less than 3' – 6" (42") above finished floor. As for the egress corridors themselves, CEGG does feel that the corridors are wide enough, however, we would recommend that the wood trim and wood finish on the upper and lower floors be tested for fire rating.

L. ELEVATORS

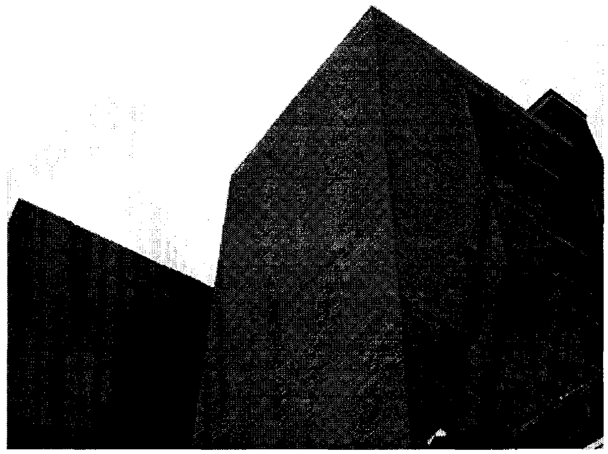
Presently, there are a total of eight elevators in the General Assembly Building. Four elevators are in the east wing; and four elevators are in the west wing. In the east wing, two elevators are intended for service use. The service elevator located on the east wall serves only the basement. The two pedestrian and remaining service elevator travel the full eleven stories. The west wing has three pedestrian elevators and one service elevator that travels the full nine stories. All the elevators are traction type with the exception of one service elevator which is a hydraulic type.

Although the elevators are relatively new in the facility not all of the elevators are capable of traveling to all of the floors. One has to get of off the elevator in the west wing if you wanted to get to the 10^{th} or 11^{th} floors of the east wing. We recommend signage be installed so that the general public is made aware of this unique situation.

M. EXTERIOR

1. Walls

[redacted]. These materials are anchored or supported by the steel structure beyond it. For the most part these materials appear to be in good condition. However, the exterior component of the east and west wing does have several deficiencies. First, caulking of limestone panels on the east wing is failing on the upper floors. Granite panels on the upper floors in the connector are bulging out. This bulging may be a result of improper anchorage, lack of expansion joints or failed anchorage due to moisture penetration. Also, the brick located on the east wing is bulging out at regular vertical intervals along the wall. This is due to a poor or failed wall flashing. Moisture is penetrating the wall, rather than being guided out of the walls. The moisture is allowed to sit on the steel shelf angles causing them to rust and weaken. Also, cornice work needs to be cleaned. Dirt and pollution has stained most of the ornamental cornice work hiding the beauty of its detail.



2. Windows

The existing windows are either fixed single pane windows or double hung operable single pane windows. None of the windows are insulated causing significant heat gain and loss in the facility. Energy efficiency is also affected by air infiltration which causes a wide range of temperature flux for common spaces in the same zone. If opened the double hung wood windows located on the upper floors creates an opportunity to lose valuable energy and offset the mechanical systems and the loads they are designed to handle. Also on the upper levels of the east wing, the copper pan that covers the Cornice work and windows sills appears to be deteriorated and need replacing. There are several areas where the caulking has failed and the seams are separating which is allowing moisture to creep within the building. Also the existing windows have several layers of paint caked on them. This excessive amount of paint can allow moisture droplets water to sit on it indefinitely. Due to freeze – thaw cycles eventfully the paint will crack or fail and allow water migrate within the wood. Later, the moisture is then soaked up by the wood causing it to rot. This is a condition that needs to be corrected to further reduce the possibility of moisture and air infiltration.

3. Miscellaneous

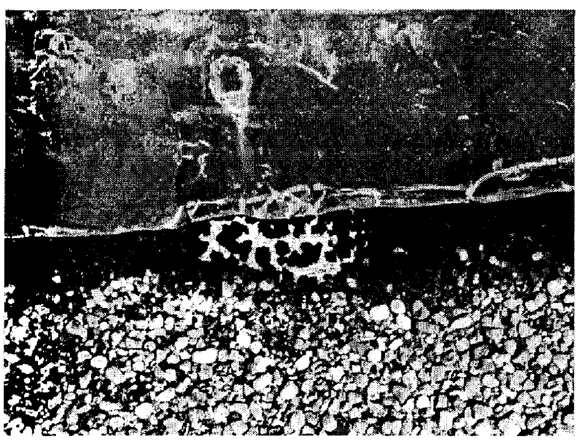
Although the exterior is in fair condition, some minor elements need to be corrected. First, the sidewalks along the 9th and Broad Street are cracked and stained. Aluminum railings along the exterior of the west wing are faded and marred. The railings are also not level. In addition, sharp edges are exposed that could cause injury. [redacted].

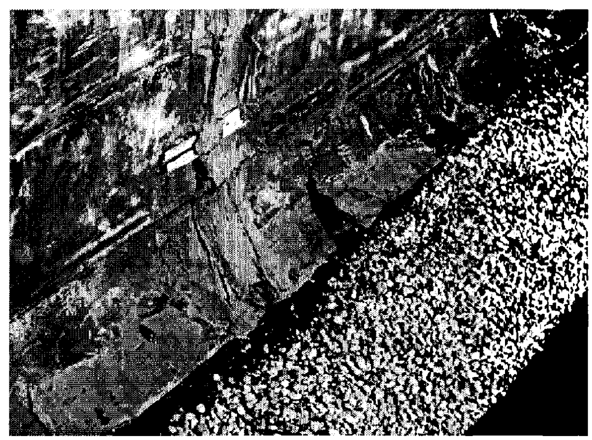
Copper flashing pans on the loading dock appear to be an after thought. In addition, slate paving is uneven leading to a possible trip hazard. As a general note the General Assembly Building looks like two buildings stuck together with a connector that does not relate or transition the architecture of the two distinct buildings. The west wing does not tie in or relate to the surrounding civic buildings such as the Capitol Building, Governors Mansion, or the Supreme Court Building. Although, the exterior of the west wing is in good condition, the architecture conveys a "contemporary" rather than "Stately" message.

N. ROOFING

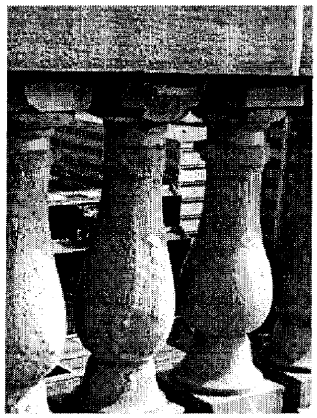
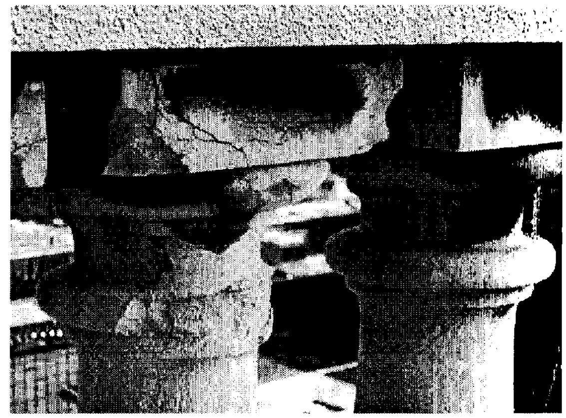
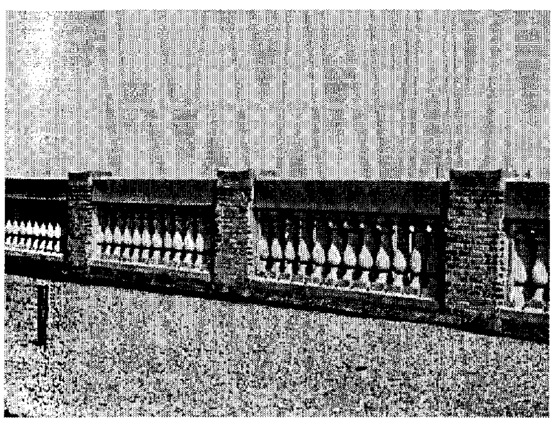
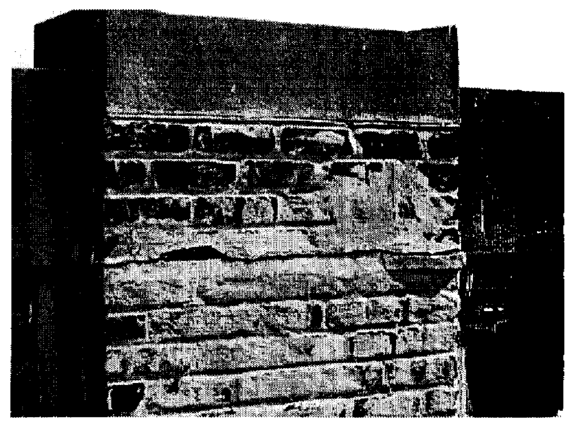
1. 1923 Building Roof

The existing roof is a multi-ply built-up roof with stone ballast. The bitumen type is unknown. The roof is in poor condition with a number of penetration and termination deficiencies. The flashing height at the perimeter is too low. The existing coping cap has numerous joints "caked" with several applications of sealant. Base flashings indicate signs of "alligatoring", this is the deterioration and subsequent cracking and splitting of felts due to a breakdown of bitumen leaving the system exposed to ultra-violet light.

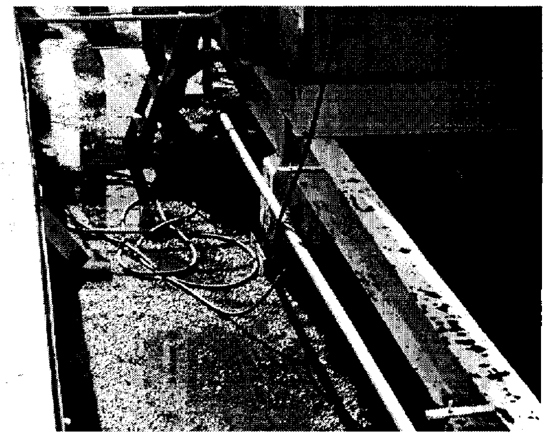




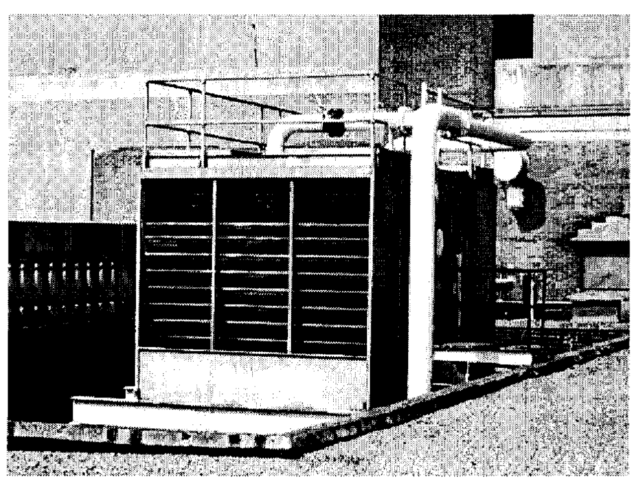
Masonry parging is cracked and shows evidence of freeze-thaw cycles and water infiltration. Pitch pocket filler is dry and exposed to ultraviolet-rays. The flashing heights at exhaust vent curbs appear to be too low. One roof drain is blocked. The concrete balusters have numerous cracks and severe deterioration. The continued neglect of the balustrade could result in shards or large debris to falling from the 12 stories and become projectiles.

The masonry shelf angles are rusting and expanding. This is evident at the large joint openings and cracking, allowing water into the joints and cavity wall. The roof drain strainers are deteriorated allowing debris to enter the drain pipe. The penthouse masonry shows evidence of shelf angle deterioration. Many bricks have been replaced especially at the door head. Cracks are "moving" vertically adjacent to the corners of the penthouse.



This roof has a large pit with a cooling tower. The pit in a constant state of ponding. The supports and frame for the condensing unit are severely rusted. Plants are growing directly out of the roof allowing moisture to penetrate into the insulation. The vent thru roofs or VTR's are not flashed properly. The skylight flashing height is too low. The roof shows no evidence of overflow, so it is not up to current code.



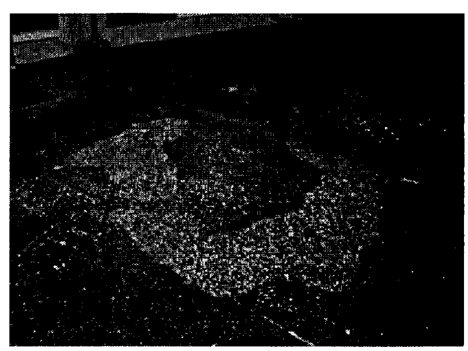
2. 7th FLOOR ROOF (Above Cafeteria)

This roof had recent work done to the base flashing for the ballasted EPDM roofs. There is a small BUR roof with ballast. The built up roof has base flashing with aluminized coating showing deterioration. The concrete copings have deteriorated sealant at joints, moisture can infiltrate the wall at this location. The masonry pilaster cap is severely deteriorated.

This roof does not show evidence of an overflow other than water falling over the gravel stop to lower roofs including the outdoor eating area adjacent to the cafeteria. There are capped pipes and openings that could be eliminated. The vent thru roofs (VTRs) are too low and not to code (12-inch minimum height above roof system).

3. 6th Floor Roof

The 6th floor cafeteria uses a roof as an outdoor patio. This roof does not appear to have adequate slope to drain. The roof configuration has a small roof (south-west corner) secured with a gate. This section "stair steps" to a level with an EPDM membrane secured with termination bars. The railing does not appear to be securely attached at this area. The flashing height appears to be at the minimum height at planters and cafeteria entry.



O. EXTERIOR DOORS

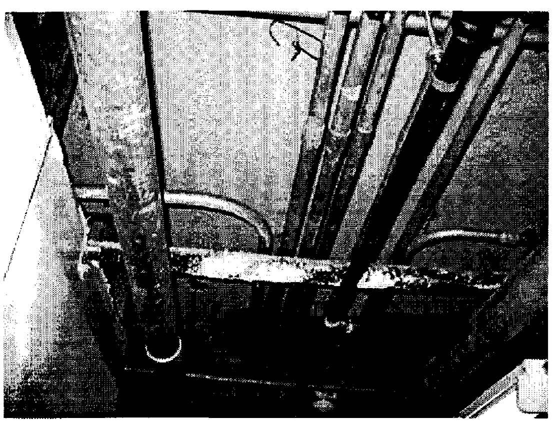
1. Doors

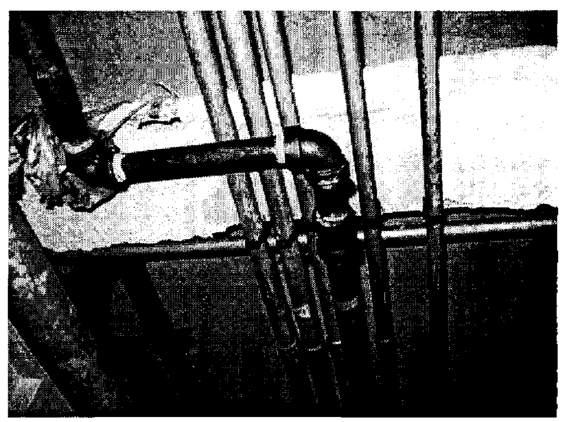
The exterior doors consist of steel hollow metal doors and aluminum glazed doors. These doors are relatively good condition, as stated previously; they do lack the required closure pull strength for the handicapped. The hardware on the interior doors appears to be in good condition, however they are not the lever type that is required for handicapped accessibility.

III. ASBESTOS FACILITIES CONDITION SURVEY

A. ASBESTOS CONTAINING MATERIAL WEST BUILDING

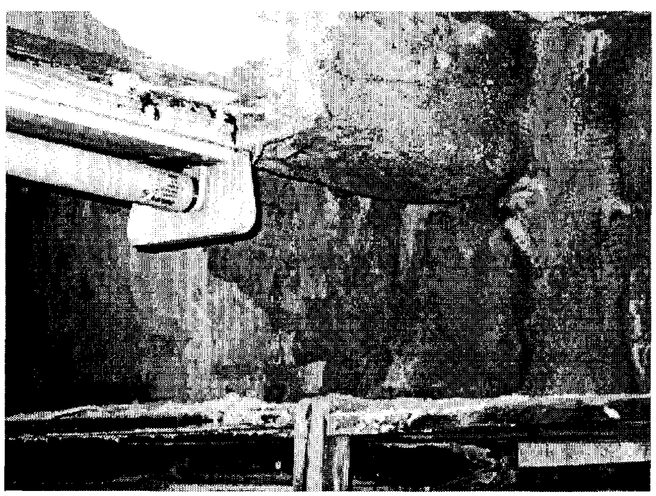
Asbestos, a known health hazard, is found throughout the West Building with the exception of the 9th floor and the roof which were abated in 1996. Asbestos in the form of sprayed on fireproofing and insulation is found on the under side of slabs and on piping and ductwork, structural steel members throughout the ceiling spaces and on columns located in floors 1 through 8. Asbestos is also present in the floor tile and mastic for the floor tile. Building components such as carpet, paint, wall coverings, suspended ceilings, system lighting fixtures, air diffusers, duct work, sprinkler heads, telephone-data cabling will be removed or damaged in the process of removing the asbestos materials.





B. ASBESTOS CONTAINING MATERIALS EAST BUILDING

Although we were told by DGS staff that the East Wing was fairly clean of asbestos, we found several significant areas where asbestos is suspected to still remain in the East Wing. These areas include build-up air handling units and duct work. In many spaces, we found what appear to be plaster lath ceilings ,which may contain asbestos, in the form of hard ceilings above the newer suspended ceiling. There also is sealant in the windows, floor tiles, and floor mastic that contain asbestos. Asbestos was also suspected to be found on steel members and the lath covering them at the basement level underneath the sidewalk area at the 10th Street side of the East Building. Asbestos is also present around all the vertical columns in the building which have been boxed in or have soffits build around them. These areas are expected to contain significant asbestos.



IV. STRUCTURAL SYSTEM FACILITIES CONDITION SURVEY

A. WEST BUILDING

1 Foundations

The West Building was constructed in 1965, it has a sub-basement, and basement which are located below grade and then there are nine floors above grade and a penthouse which is two additional floors high which covers portions of the existing building and roof. Foundations consist of individual spread footings and continuous matt foundations. Foundations have been designed for 6,000 pound per square foot soil bearing pressures with the exception of the core area between the East and West Buildings which has been designed to allow a bearing pressure of 8,000 pounds per square foot. The sub-basement floor consists of a slab on grade and the sub-basement walls are poured in place reinforced concrete.

When the West Building foundation was constructed sheet piling was installed and permanently left in place to protect the footings of the adjacent existing 1905 and 1923 buildings which comprise the East Building.

2. Steel Framing

[redacted].

3. Floor Slabs

[redacted]

[redacted]

[redacted].

4. [redacted]

[redacted]

5. [redacted]

[redacted].

[redacted]

[redacted].

B. STRUCTURAL SYSTEM EAST BUILDING

The east wing of the General Assembly Building was constructed in three separate phases; 1905, 1923 and 1955.

1. 1905 Building

There are no structural drawings available for the 1905 building.

2. 1923 Building

[redacted].

3. 1955 Building

[redacted]

[redacted].

4. [redacted]

[redacted]

[redacted].

[redacted]

[redacted].

V. MECHANICAL FACILITY CONDITIONS SURVEY

A. HVAC SYSTEMS GENERAL

Since the facility is comprised of multiple buildings which are operated independently, the mechanical systems are made-up of a collage of equipment which is primarily dedicated to their respective buildings. One exception to this is the cross-over connections associated with the steam heating system.

The east side of the facility is comprised of the original 1905 facility which had a new mechanical system installed in 1978. The eleven story structure on the east side, (referred to as Life of Virginia Building), was constructed in 1923. Although many HVAC renovation projects have been made to this mechanical system, for the most part, design changes implemented in 1975 are still maintained. The infill portion of this facility, constructed in 1955, lies between the 1905 building and the 11 story Life of Virginia Building and is 6 stories in height with a mechanical penthouse on the 7th level.

The west side structure, (referred to as the IBM Building), was constructed in 1965. It is a 9 story structure with a 2-story penthouse. With this as a back ground, the IBM facility is referred to in this report as the West Building, and the remainder of the facility as the East Building.

B. HVAC SYSTEM: WEST BUILDING

This west side structure has a sub-basement which houses central cooling and heating equipment which serve the central core of the basement through eight floor levels in addition to five major air handling systems.

As this report is being prepared, the central chiller serving the West Building is being replaced with a new 410 ton water-cooled rotary screw machine. The chilled water piping is cross-connected to the East Building via 6-inch piping. Other new equipment associated with this replacement is one new primary chilled water pump, one new condenser water pump, and two secondary chilled water pumps, all equipped with triple-duty valves. This replacement is a direct replacement with respect to capacity. The roof of the 9th floor accommodates the Marley Cooling Tower associated with the new chiller located in the sub-basement. This cooling tower has served its useful life. It is a galvanized tower which is not the material of choice by today's standards. This tower has a remote sump (receiver) tank located on the ninth floor below. This provides freeze protection.

[redacted]. (See Appendix - ASHRAE Estimates of Services Lives). The coils have deteriorated over time which degrades the performance. The condensate drain pans are rusted beyond repair. The supply and return air fans are of large size capacity and are of constant volume design. Some fans are equipped with variable inlet guide vanes which is old technology and energy wasteful. This equipment is far out-dated and does not meet the outside air requirements of the current ASHRAE 62 guidelines, nor the efficiencies required by ASHRAE 90.1. (For complete capacity information, see Appendix).

One of the major issues facing the continued use of these air handlers as currently configured is the means of how the outside air is introduced to the units. [redacted]. In addition, these air inlets are not the size necessary to achieve economizer cycles on the equipment to help reduce energy consumption levels.

Senate Room A, located on First Floor, has been recently renovated to include new digital controls on air-side equipment. Aside from this modification, the remaining systems in the West Building operate from pneumatics.

[redacted]. These are large built-up dual duct air handling systems, (AHU #3 and AHU #4), each with their respective return air fans and remote coils. Both units are of similar size and are nominal 40,000 CFM capacities. These units have been in service since 1965 and have served their useful lives. They are equipped with abandoned roll filters and humidifiers. Their 50 horsepower supply air fan motors are equipped with soft-starts. The outside air intake louvers are a problem for the maintenance of the facility as storm water leakage has created damage to the inside of the exterior walls on the floors below. [redacted].

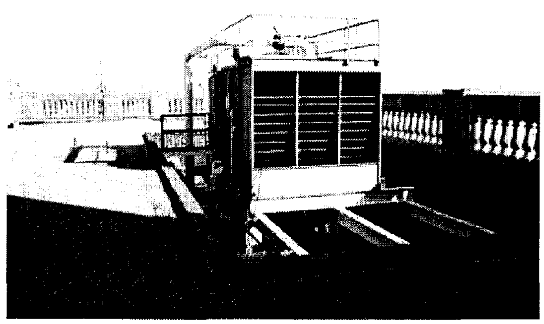
The air distribution system from all the major air handling systems deliver conditioned air to all spaces, all floors, by high pressure dual duct ductwork distribution systems. The variable temperature constant volume systems supply hot deck and cold deck ductwork to high velocity mixing boxes which deliver the required mixed air through low pressure ductwork systems to the spaces.

These dual duct, temperature systems are very energy intensive systems. They were selected based upon comfort decisions, not energy, nor first cost, especially during the period of time they were first installed.

Due to energy cost increases since this 1965 installation, and in accordance with the energy code compliance mandate, systems are not installed like this today. However, constant volume dual duct systems have been converted quite successfully to dual duct variable volume systems, when the central air handlers are replaced with variable volume air handling capability. However, due to the vintage of this system, conversion is not an option worth considering.

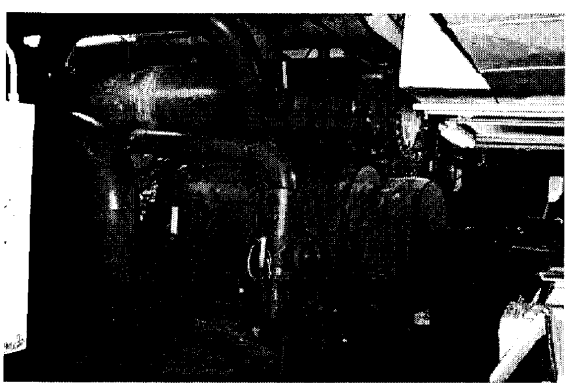
C. HVAC SYSTEM: EAST BUILDING

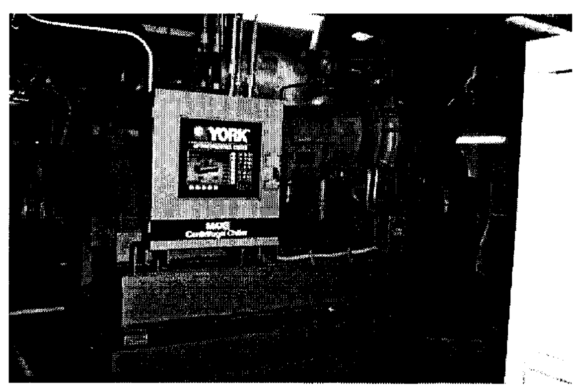
The east side has a basement, one level higher than the sub-basement, on the west side. The basement contains the central heating and cooling needs of all three structures comprising the east side, which entails the original 1905 historical structure, the 11-story Life of Virginia Building built in 1923, and the infill structure built in 1955.



The existing chiller is a 400 ton York unit which is adapted with a variable speed drive. One chilled water pump exists for chilled water distribution. One condenser water pump is available to circulate condenser water to the roof-top mounted cooling tower.

Three steam boilers serve all the heating needs of the entire facility, East and West Buildings. Four hot water pumps circulate hot water generated by these steam boilers. The steam piping is cross-connected to the West Building side to serve its heating needs also. Perimeter heating to the East Building is via perimeter radiation units on the first floor, and by perimeter induction units on all other floors. Interior spaces of the basement of the 1905 building are served by the built-up Joy air handling system (AHU #1) located on the second floor mechanical room of this building which also serves all the air conditioning needs of the entire East Building's first, second and third floors. [redacted]. The interior spaces of the fourth and fifth floors of the East Building are served by a built-up Joy air handling system (AHU #2) located in the fifth floor





mechanical room. [redacted]. Air handling system (AHU #3) is also another Joy built-up system which serves the interior of floors 7, 8, 9, 10 and 11 of the 1923 vintage Life of Virginia Building. [redacted].

[redacted].

[redacted].

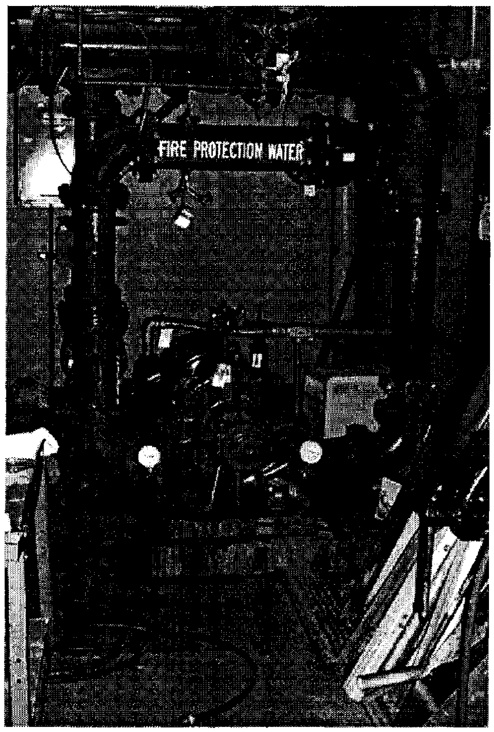
The basic system as installed in the 1978 renovation remains today, with a few exceptions of isolated areas being renovated since then, such as the modifications made to the tenth floor Senate Finance Committee area in 1987. The more recent modifications are minor changes to the overall basic system still in place today.

The air distribution system from all the major air handling systems mentioned deliver conditioned air to all spaces, all floors, by high pressure acoustically lined ductwork through-out which delivers cooled air to induction boxes (Anemostat) which are equipped with hot water reheat coils. The low pressure side of these boxes deliver the conditioned air to the spaces via air boots which straddle 2 x 4 light troffers. In addition to the perimeter induction units, this represents the highest energy consuming systems available on the market at that time. Due to energy costs over the past 28 year span, and in accordance with the energy code compliance mandate, these systems are no longer allowed. In addition, reheat systems are not allowed by today's energy code unless the reheat used is some form of heat recovery, or heat rejection.

Pneumatic controls are standard throughout the facility with both the East and West Buildings having their own dedicated control air compressors. This air must be dried by refrigerant dryers before being distributed to end controls.

D. FIRE PROTECTION

Both the east and west portions of the General Assembly Building are totally sprinkled, along with fire pump and risers. The total capacity of the sprinkler system is adequate for building and spaces as they are now.



E. MECHANICAL PLUMBING

The bathroom fixtures currently in use are germane to the building. These restroom arrangements are not ADAAG compliant. However, existing restroom arrangements for existing conditions are for the most part stack from floor to floor which helps accommodate replacement. The plumbing piping systems are also original installations and are highly suspect of their condition. In addition, pipe insulation is highly speculated to contain asbestos materials.

Hot water is provided to the entire General Assembly Building complex by hot water generator located in the sub-basement of the West Building. Domestic hot water pumps circulate through-out the facility with the use of re-circulation piping.

VI. ELECTRICAL FACILITIES CONDITION SURVEY

A. BUILDING CONSTRUCTION HISTORY

1. General

A review of the General Assembly Building's construction history provides a very helpful understanding of the electrical systems and their existing conditions. The building is currently referenced as being divided into two wings, the east wing and the west wing. Originally, the east wing was designated as the Insurance Company of Virginia (formerly addressed as 910 Capitol Street), and the west wing was designated as the IBM Building (formerly addressed as 914 Capitol Street). The adjacent roadway that used to be Capitol Street no longer exists. This former street is now a part of Darden Gardens. Capitol Street was on the south side of the building, Broad Street is on the north side of the building, 9th Street is on the west side of the building, and a small parking lot is on the east side of the building. The following discussion addresses each wing individually. The referenced dates herein used were obtain from various construction drawings, whereby the dates are subject to historical confirmation. It is unclear if the dates are design dates or construction dates or some other referenced date. Nevertheless, the dates listed provide a useful overall perspective.

B. EAST WING

The east wing is the oldest building and was built in three parts: (1) the original building, (2) the first addition, and (3) the second addition. The original building was built in 1905, was five stories tall, and was "L" shaped with the long side of the "L" running parallel along Capitol Street. The short side of the "L" was on the west end of the building and turned northward. The building's first addition was constructed in 1923, was 11 stories tall, and was a mirror image of the original building, thus being an inverted "L". The long side of the "L" ran parallel along Broad Street while the short end of the "L" butted the short end of the "L" of the original building. The composite building now formed a "U" shaped building. The building's second addition was built in 1955, is six stories tall, and is referenced as "the Infill Project" because the area located within the "U" shaped building was filled in. When the Infill Building was constructed, the original building (1905) and the first addition (1923) were renovated, including a new electrical service and interior distribution system. This 1955 service and distribution system continues to serve the General Assembly Building's east wing.

It is noted the east wing is a very inefficient structure because of its original long and narrow construction. [redacted]. (A single riser system located in the center of the building is highly preferred.) It is also difficult to install new circuits (power, lighting, controls, fire alarm, telecommunications, and so forth) because of the extensive quantity of exterior walls that are located within the interior of the composite building. [redacted].

C. WEST WING

The west wing was constructed in 1965 and is nine stories tall. The west wing abuts the east wing. The area of the west wing that directly abuts the east wing is a common area that includes the main path of building egress, the building's six principle elevators, and three major stairways. Common facilities such as toilets and lounges are also located in this abutted area. The west wing was designed and built with its own dedicated electrical infrastructure (power and telephone). This original infrastructure continues to serve the west wing today. The existing branch circuitry and branch equipment (lights and receptacles) are the building's original branch circuitry, lights and receptacles. The west wing was originally designed as a business office; and therefore, it is a large open space with an efficient distribution of structural columns. The wing's building-design-concept allows for the easy installation of new electrical circuitry (power, lighting, controls, fire alarm, telecommunications, and so forth). However, large quantities of asbestos are located above the suspended ceilings and prohibit the installation of new circuitry. [redacted]

[redacted]. Also, the telephone riser system is extremely small and falls far short of the spatial needs of today's telecommunications systems.

D. 1976 RENOVATION PROJECT

The building's last major renovation project occurred when the State converter the building into its current use as the General Assembly Building. This renovation project was designed in 1976 and the construction was completed in 1978. Under this project, both wings were selectively renovated according to their individual needs. By this time the building's electrical infrastructure was already in place. Subsequently, the existing electrical service equipment and the interior distribution systems (panelboards and panelboard feeder circuits) were retained. However, the east wing's branch circuitry and branch equipment (lights and receptacles) were replaced under this project. The west wing's branch circuitry and branch equipment (lights and receptacles) were about thirteen years old and in good condition. Therefore, the west wing experienced very little renovation work. Three important building systems were provided under the 1976 renovation project. (1) A relatively large emergency generator was added to the east wing. (2) The building's current fire alarm system was added to the entire building. (3) The building's data gathering system was provided for the entire building. Lastly, several heating, ventilation and air conditioning (HVAC) systems were provided at this time. The existing electrical systems were expanded as necessary to accommodate the new HVAC equipment.

E. LACK OF ELECTRICAL CONSTRUCTION DOCUMENTATION

The electrical survey's greatest difficulty is a lack of electrical construction documentation. This is contributed to two basic factors: (1) the building is significantly old, especially the east wing, and (2) the building was a commercial endeavor which is inclined to create minimum construction documentation. The best electrical documentation is the State's 1976 renovation project. There was only one other set of electrical drawings available in the State's drawing files, and these drawings were undated and the title block was blank. The best data available indicates these drawings were produced late 1968 or early 1969. These drawings are also of limited value because they only recorded the electrical power riser diagrams of both wings. Even then, critical information such as the ampacity rating of the electrical service equipment is not defined. In spite of efforts to obtain additional construction documentation, earlier dated electrical floor plans of either wing could not be found. Surprisingly, there is better electrical informational regarding the older east wing because it was extensively renovated under the State's 1976 renovation project. Unfortunately, there are no electrical floor plans of the west wing's original electrical systems.

F. CURRENT CODE IMPACT

The General Assembly Building's last major renovation was constructed in 1978. Even then, the west wing's renovation was very limited, whereby the wing's original 1965 construction was widely retained. Needless to say, the building codes of 1965 and 1978 are significantly different from current building codes. The following is a list of the building's current code infractions. The list does not include all code infractions, but the list does represent some of the most outstanding infractions. In addition, other code infractions will be listed in other paragraphs of this report, thereby utilizing specific paragraphs where it is more appropriate to address the associated code infraction.

1. Emergency Power System

The codes that are used to specify emergency power systems are Volume 110 of the National Fire Protection Association (NFPA 110) entitled "Standard for Emergency and Standby Power Systems," and Chapter 7 of the National Electrical Code (NEC), which is technically NFPA 70. The first publication of NFPA 110 was 1985, that is twenty years after the building's last addition was constructed. This code has some very specific requirements that the building's existing emergency power systems do not meet. This includes, but not necessarily limited to, the following: (1) a dedicated room for the generator set is now required, (2) the generator room must have two-hour fire rated construction (this is a minimum requirement of the International Building Code's high-rise building criteria versus the specific requirements defined in NFPA 110), (3) additional clearance around the generator set and around the automatic transfer switch must be provided, (4) battery operated emergency lighting units are required in the generator room, (5) high air emission restrictions are now required, (6) very significant features regarding alarm and shutdown system, annunciation system, and electrical metering system are minimum requirements, (7) remote alarm features and remote emergency shutdown features are now required, (8) the generator set must be set on a concrete pad with a minimum height of six inches, (9) a two-hour rated air transfer system is also required, and (10) emergency and standby power status indicators, plus generator supervision devices, manual start and transfer features are required to be provided at the building's fire command center as defined in Section 911 of the International Building Code.

2. Fire Pump System

The fire pump code is defined under NFPA 20 entitled "Standard for the Installation of Stationary Pumps for Fire Protection." In addition, the electrical supply must also comply with Article 695 of the NEC (NFPA 70). Current code issues regarding the existing fire pump are as follows. (1) Fire pumps must now have their own dedicated room consisting of two-hour fire rated construction. (2) The fire pump must have it own dedicated automatic transfer switch that must be FM listed and located adjacent to the fire pump controller. The fire pump controller can be specified with an integral automatic transfer pump, which is what most engineers prefer. (3) Battery operated emergency lighting units are required in the fire pump room. (4) The fire pump's electrical supply circuit must provide overcurrent protection but not overload protection. Consequently, the supply circuit's circuit breaker is very large and sized to withstand the motor's locked rotor current rating. Table 9.5.1.1 in NFPA 20 addresses this requirement. The existing fire pump motor is rated 75 HP, and the existing supply feeder circuit breaker is rated 150 amps. According to table 9.5.1.1, the lock rotor current for a 75 HP motor is 543 amps.

Therefore, the circuit breaker should be rated 600 amps. (5) When the fire pump's electrical supply circuit is run inside the building, then the supply circuit must be properly protected by either a two-inch thick concrete envelop or enclosed within one-hour fire rated construction.

3. High-Rise Building Code

The General Assembly Building is a high-rise building and is subject to the current high-rise building code. Requirements for high-rise buildings are defined in the International Building Code (IBC), Section 403. While this section of the code only uses about one page of text, the detailed requirements become quite extensive because Section 403 contains a substantial number of cross references to other sections and paragraphs of the IBC. In fact, high-rise building criteria are distributed throughout the IBC. (Examples: paragraphs 907.2.12, 907.8.2, 1003.2.13.1.1, and 2702.2.14.) The affect makes it challenging to ascertain all of the high-rise building code criteria. Finally, the IBC includes some very specific requirements that apply to specific equipment, especially to the Heating, Ventilation, and Air Conditioning (HVAC) systems. This is especially true of requirements regarding automatic fire detection and emergency power for certain HVAC equipment and the associated mechanical rooms. Subsequently, the electrical discipline must closely coordinate with other disciplines, specifically involving HVAC systems including air pressurization systems, sprinkler systems including fire alarm system zoning and annunciation, elevator systems including command and control, and egress systems including automatic door locks. All of this discussion leads to three points: (1) there are a lot of fine points to consider and resolve regarding high-rise building codes, (2) it requires detailed knowledge of specific systems and it requires multiple disciplines to finalize what code criteria are specifically applicable for a specific building, and (3) it takes a significant amount of time of multiple disciplines just to resolve points (1) and (2). As a result, this report does not address fine code points such as determining which HVAC systems require fire detectors because the General Assembly Building is a high-rise building. The following is a list of current code infractions that are probably new to the code since the General Assembly Building was last renovated. (1) Standby power must be provided for at least one elevator to serve all floors and must be transferable to any elevator. (Note: There is not one elevator in the building that currently serves all floors.) (2) Standby power must be provided for the lighting system in the fire command center and in mechanical equipment rooms. (3) A two-way communication system that is connected to an approved constantly attended station must be provided at not less than every fifth floor in each required stairway where the doors to the stairway are locked. (4) A high-rise building requires a fire command center that complies with Section 911 of the IBC. The building's existing fire command center falls far short of the current code requirements.

G. HAZARDOUS ELECTRICAL MATERIALS

The vast majority of fluorescent light fixtures installed throughout the General Assembly Building contain electromagnetic ballasts and type T12 fluorescent lamps. The east wing's light fixtures were provided around 1978 while the west wing's light fixtures were provided around 1965. Accordingly, the ballasts in these light fixtures probably contain polychlorinated biphenyls (PCBs), and the fluorescent lamps definitely contain mercury. PCBs and mercury are defined as hazardous materials and must be properly disposed.

1. PCB Materials

It is known that electromagnetic ballasts were fabricated using insulation materials that contained PCBs. As a result, current hazardous material regulations require electromagnetic ballasts be disposed as a hazardous material containing PCBs. An Owner has the right to test each ballast to prove the specific ballast is free of PCBs. However, testing for PCBs cost more than the hazardous material disposal cost. Consequently, it is usual and customary practice to have electromagnetic ballasts disposed as a hazardous PCB material.

2. Mercury Materials

When fluorescent lamps are disposed in large quantity (50 lamps or more), then the mercury contained within each lamp becomes a collective hazardous material. Current hazardous material regulations require large quantity of fluorescent lamps be disposed as a hazardous material containing mercury.

H. COST IMPACT

Disposing of hazardous materials is obviously an expensive task. However, disposing of the hazardous materials contained in fluorescent light fixtures involves a compounded cost because of the extensive labor required to remove each ballast and each fragile lamp. (A broken fluorescent lamp is potentially a hazardous spill site.) A standard four-lamp fluorescent light fixture contains two ballasts. There are two ballasts and four lamps for the vast majority of fluorescent light fixtures installed in the General Assembly Building.

I. PERTINENT REFERENCES

The following is a list of pertinent codes regarding the handling and disposal of ballasts containing PCB's and lamps containing mercury. This information was obtained from the Department of Defense's Unified Facilities Guide Specification (UFGS), specification section 13286, "Handling of Lighting Ballast and Lamps Containing PCBs and Mercury", dated August 2004. This specification is accessible from the internet at web site:

http://www.ccb.org/docs/ufgshome/UFGSToc.htm

State of Virginia Administrative Code (VAC)

9 VAC 20-60 Title 9, Agency 20, Chapter 60: Hazardous Waste Management Regulations

9 VAC 20-80 Title 9, Agency 20, Chapter 80: Solid Waste Management Regulations

U. S. National Archives and Records Administration (NARA)

40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owner and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40 CFR 265	Interim Status Standards for Owner and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 273	Standards for Universal Waste Management
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 178	Specifications for Packaging

J. ELECTRICAL SERVICES

1. General

[redacted]. The vaults are only accessible to DVP personnel. DGS maintenance personnel understand these transformers have been replaced within the last ten years. The electrical sizes of the existing transformers are not known. Electrical drawings created about 1968 indicate the building's west wing had two 2000 KVA service transformers connected in parallel. This appears to be a partially redundant system (two-thirds redundancy); however, this needs to be confirmed with DVP. In the event the building is renovated, new service schemes will have to be evaluated. Consolidation of the two existing electrical services appears to be feasible as discussed in Electrical Power Consumption.

There are no electrical documents that define the electrical service grounding system of either electrical service. The assistance of an electrical contractor is required just to uncover and examine how the electrical services are actually grounded. Based upon discussions with DGS maintenance personnel, the existing service grounds have never been tested. Furthermore, additional research is required to determine the best way to test these grounding systems, assuming it is practical and meaningful to test the systems. Testing existing electrical service grounding systems is a highly specialized service, and testing systems that are located in basements and subbasements are especially challenging. The electrical grounding system is the most overlooked component of an electrical system, thus attracting little or no interest or attention.

2. East Wing's Electrical Service Equipment

The east wing's electrical service equipment consists of draw-out style, low voltage power circuit breakers, thus being switchgear equipment (versus panelboard or switchboard equipment). This style of circuit breaker is considered to be the most reliable type of circuit breaker, but they are also the most complicated type, consisting of many operational components. The best information available indicates the switchgear was installed about 1955, making the switchgear 50 years old and well past its rated engineering life span. Most engineers and equipment manufacturers allow the rated life span of electrical equipment to be 30 years. Needless to say, replacement parts are no longer made for the circuit breakers, and the circuit breakers are in a very tenuous operational condition. Furthermore, the ampacity rating of the switchgear is not marked on the equipment or defined on the available construction drawings. It is believed the switchgear is rated 2000 amps, but even this most basic of information needs to be confirmed. From an overall perspective, this existing service equipment is in dire need of being replaced. It is reasonable to believe the equipment will have in part or in whole a significant failure in the near future. [redacted]. Replacing the switchgear will not be an easy task, thus requiring a thorough analysis to determine the best way to remove the existing equipment and to install new equipment (if elected).

3. West Wing's Electrical Service Equipment

The west wing's electrical service equipment also consists of draw-out style, low voltage power circuit breakers, thus being switchgear equipment. This switchgear is believed to be the west wing's original service equipment, which was constructed about 1965. That means this equipment is about 10 years past its rated life span. As with the east wing's service equipment, replacement parts for the circuit breakers are no longer made. The ampacity rating for this service equipment is 4000 amps. From an overall perspective, this service equipment is also believed to be in dire need of replacement, but there is no reasonable expectation that the equipment will have in part or in whole a significant failure in the near future. Lastly, this switchgear is located in a cramped utility room with only one single-leaf door. In accordance with today's code requirements, this electrical room requires two doors located on opposite sides of the room. Also, the single door restricts passing equipment into or out of the electrical room. The original design failed to allow for the future replacement of the electrical switchgear.

K. ELECTRICAL POWER CONSUMPTION

1. Consumption Data

Electrical power utilization recordings were obtained from DVP. The data provided is from July 2003 to July 2005. Peak demands occurred in the months of January, February and March, the period of time when the General Assembly is in session. The recorded KW demand values are as follows.

Year 2004	January	February	March
West Wing	729 KW	907 KW	903 KW
East Wing	676 KW	662 KW	633 KW
Total Value	1405 KW	1569 KW	1536 KW

Year 2005	January	February	March
West Wing	740 KW	720 KW	780 KW
East Wing	864 KW	864 KW	662 KW
Total Value	1604 KW	1584 KW	1442 KW

East Wing: The peak load for the east wing is 864 KW (January and February 2005), which is 1016 KVA at 0.85 power factor, and a total ampacity of 1223 amps.

West Wing: The peak load for the east wing is 907 KW (February 2004), which is 1067 KVA at 0.85 power factor, and a total ampacity of 1284 amps.

Consolidated Total: The peak load for the consolidated total is 1604 KW (January 2005), which is 1887 KVA at 0.85 power factor, and a total ampacity of 2271 amps.

L. CONCLUSION

The two electrical services could be consolidated into a single electrical service with an electrical service rated 4000 amps. A service rated 4000 amps is 1.76 times larger than the recorded maximum load consumption. If the design load is desired not to exceed 80 percent of the service's ampacity rating (4000 amps x 0.80 = 3200 amps), then 3200 amps is 1.41 times larger than the recorded maximum load consumption. It is believed these calculations represent reasonable load expectations. However, the final electrical service size would be based upon the final electrical system configuration and the final electrical load calculations.

M. EMERGENCY POWER SYSTEMS

1. General

Each building wing has a dedicated emergency power system. Both of these emergency systems fail to meet today's code requirements. It should be noted that today's code criteria (NFPA 110, "Standard for Emergency and Standby Power Systems") did not exist at the time the emergency systems were provided. Likewise, the high-rise building code has significantly expanded since the General Assembly Building was last renovated.

2. East Wing

The east wing generator set is a Caterpillar unit rated 35 KW at 277/480V, 3Ø, 4W, with the unit located in the wing's subbasement. It is speculated this emergency power system was added to the building when the Infill Project was constructed in 1955. [redacted]. Clearance around the generator unit fails to meet today's code requirements. Also in accordance with today's code criteria, generator sets are required to be located in a dedicated room, where the room has a two-hour fire rated construction. The generator's ampacity rating is 53 full load amps at a rated power factor of 0.80. The associated automatic transfer switch and associated circuitry is rated 100 amps, significantly greater than the generator's ability. Based upon usual and customary practice, the ampacity rating of an emergency power system is calculated to be 80 percent of the generator's full load rating ampacity, thus allowing 20 percent capacity to accommodate momentary peak loads, motor starting effects, and voltage dip control. Subsequently, the east wing's emergency power system is actually limited to only 40 amps, a very low value for a high-rise building. [redacted]

[redacted].

3. West Wing

The west wing generator set is also a Caterpillar unit, but is much larger, rated 210 KW at 277/480V, 3Ø, 4W. This emergency power system was added to the building in the State's 1976 renovation project. [redacted], the clearance around the unit is less than required. The generator's ampacity rating is 316 full load amps at a rated power factor of 0.80, or 253 amps at 80 percent of the generator's rated capacity. The automatic transfer switch is rated 400 amps while the associated circuitry is rated 300 amps. [redacted]

[redacted].

N. ELECTRICAL INTERIOR DISTRIBUTION SYSTEM

1. Distribution System

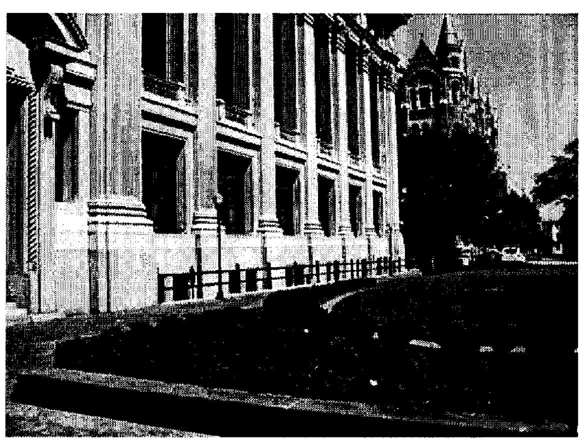
The overall design concept for the building's interior distribution system is typical of any multi-story office building. This includes the vertical stacking of the electrical rooms, thus forming a vertical riser system (or shaft). Plug-in bus ways are used extensively. Upon a first glance of the distribution system, there seems to be an unusually high number of panelboards. This may be a result of various small renovation projects that inevitably add a new panelboard for every project. However, the biggest problem expressed by DGS maintenance personnel is the lack of quality record drawings and the proper identification of circuits within each panelboard. When it comes to good maintenance, there is no substitute for quality records that properly and correctly identify each branch circuit.

[redacted].

O. OUTDOOR LIGHTING SYSTEM:

1. Exterior Lighting

The General Assembly Building has a very limited State-owned, outdoor lighting system, which consist of four cast iron lamp posts. The globes are in poor condition while the cast iron posts appear to be in acceptable condition. In the opinion of the writer, the aesthetic appearance of the lamp posts provide a positive affect to the building's adjacent site, thus making the existing lamp posts worthy of refurbishing. If this is done, then the fixtures' electrical elements (ballast, lamp socket, lamp and so forth) should be totally replaced. Lastly, it is noted that DGS maintenance personnel stated that the Guard House that serves the Capitol Building and located adjacent to Darden Gardens is also connected to the General Assembly Building's electrical system. All such outdoor circuits are probably in need of replacement. It is very unlikely the existing underground conduits will be in a condition that allows them to be reused. If excavation trenches are required, then some of the brick pavers will have to be removed and reinstalled.



P. INTERIOR LIGHTING SYSTEM

1. Interior Lighting

The vast majority of the interior lighting system consists of fluorescent light fixtures that are between 30 and 40 years old. Most of the fluorescent light fixtures are air handling style, recessed troffers with acrylic lenses, electromagnetic ballasts, and type T12 lamps. These old electromagnetic ballasts have exceeded their expected engineering life, and it should be expected the ballasts will start failing in mass. Furthermore, type T12 lamps are scheduled to cease production under Federal energy mandates. Accordingly, the existing lighting system is very energy inefficient. The existing lighting system was also designed to provide a lighting level of 100 footcandles, which was the standard practice in the 1970's. The standard today provides a lighting level of only 50 footcandles, which provides a very substantial energy savings. Further energy savings are realized by today's very efficient fluorescent light fixtures which utilize electronic ballasts and type T8 lamps. At first glance, it was actually surprising to find the old, original light fixtures in the building. It is a money-saving proposition to replace antiquated lighting systems with state-of-the-art lighting systems. Such replacement projects usually have a payback of about five years. The projects are usually a one-for-one light fixture replacement except the new light fixtures have three lamps in lieu of four lamps and have louvered lenses in lieu of acrylic lenses. The louvered light fixture is today's standard choice because it significantly reduces glare of computer monitors. It would be good engineering economics to replace the old antiquated lighting system as soon as possible.

However, a replacement project was probably never implemented because the existing lighting system is an integral part of the HVAC air distribution system. Most of existing recessed light fixtures have two duct connections to the HVAC air distribution system. This is another disadvantage of the building's existing lighting system. Lastly, these old fluorescent lighting fixtures contain hazardous materials as addressed in "G. Hazardous Electrical Materials".

Q. EMERGENCY LIGHTING SYSTEM

1. Emergency Lighting

The building's emergency lighting systems are derived from the use of the emergency power systems. Selective fluorescent light fixtures located along the paths of egress are connected to the various emergency systems' panelboards. Under current code requirements, this type of emergency lighting system requires a dedicated automatic transfer switch. By code, a total of ten seconds is allowed to sense a legitimate power outage, start the generator set, and then transfer the respective electrical systems to the emergency power systems. Ten seconds is a long time to be left in the dark. This is further compounded in buildings of assembly where there is a large quantity of people. This is why most engineers prefer to use battery operated emergency lighting units which operate almost instantaneously. Using battery operated equipment also eliminates the need to have a dedicated automatic transfer switch for the emergency egress lighting system. It is noted that multiple battery operated emergency lights have a higher maintenance cost. However, discussions with DGS maintenance personnel indicate this is an acceptable practice for DGS operations. This is because DGS has a dedicated maintenance position which is solely dedicated to the testing and maintenance of battery operated emergency lights and fire extinguishers.

R. FIRE ALARM SYSTEM

1. Fire Alarms

The current fire alarm system was provided under the State's 1976 renovation project. The existing system is a non-conventional system, and is actually a very specialized, fabricated system utilizing data gathering panels that involve multiple systems including the air conditioning systems, the heating systems, air handling systems, the domestic water system, the sprinkler system, the fire pump, the east wing emergency generator set, electrical metering parameters, and several other systems and functions. While individual components may be UL and FM approved and labeled for fire alarm service, the overall system is not. In addition, the existing system operates upon 1970's technology that is now obsolete. Maintaining the existing system has become a challenge because the various components are no longer manufactured. Maintaining the system is further compounded because the system is so massive and complicated. The system monitors and controls a total of 344 points, where 143 of these points comprise the fire alarm system. In essence, the fire alarm system is a component of a building automation system, or BAS.

The existing fire alarm system is a typical supervised system consisting of manual pull stations, smoke detectors (ionization type) located in the corridors, heat detectors located in utility spaces, various duct detectors, and a voice evacuation alarm system. There are no visual alarm devices in the building, and the system does not meet current ADA criteria. It is also noted that the voice evacuation system is very old, archaic, and extremely large in comparison to today's systems. The components in this system are no longer manufactured. Lastly, what would be defined as the fire command center is totally inadequate relative to today's high-rise building code criteria.

In addition to the fire alarm system that is a component of the BAS, there is an addressable fire alarm panel that was recently added to the building. This panel is dedicated to the elevators and was added when the elevators were renovated and upgraded. The alarm output of this panel is an input to the BAS. This panel serves the elevator lobby smoke detectors, the fire detection devices that directly serve the elevators (elevator hoistways and equipment rooms), the elevator recall system, and the fire command and control system.

[redacted]

[redacted].

S. [redacted]

I. [redacted]

[redacted]

[redacted].

T. CABLED TV SYSTEM

1. Cable TV

The General Assembly Building currently has a somewhat limited cabled TV system. The system is primarily used to monitor House and Senate Chambers in the Capitol when the Legislature is in session. As a policy, TV monitors are located at information desks, the main hearing rooms, and the main conference rooms. However, TV monitors can be found throughout the building, mostly being located where specific interests were able to obtain their installation. The TV signals are broadcast individually by the Senate and the House. The Senate utilizes the broadcasting services of Richmond's local PBS affiliate while the House provides an annual contract with a video service contractor. The associated signals are transmitted from the Capitol to the General Assembly Building via the cable TV utility company, which is Comcast. Accordingly, commercial cable TV programming can be viewed on the building's TV monitors. During this survey, some individuals expressed the perspective that the cabled TV system should be expanded. One perspective suggested that each legislative office should have a TV outlet. In the event the building is renovated, the State would need to review their desires and preferences regarding the expansion of the cabled TV system. The designing engineer will need direct and specific guidance regarding the final design of the building's new cabled TV system. As addressed in the discussion regarding the security system, it may require a committee to finalize the needs and preferences for a new cabled TV system. And once again, this endeavor may have already occurred but was not shared during this survey's interviews.

U. TELECOMMUNICATIONS SYSTEMS

1. TELECOMMUNICATIONS

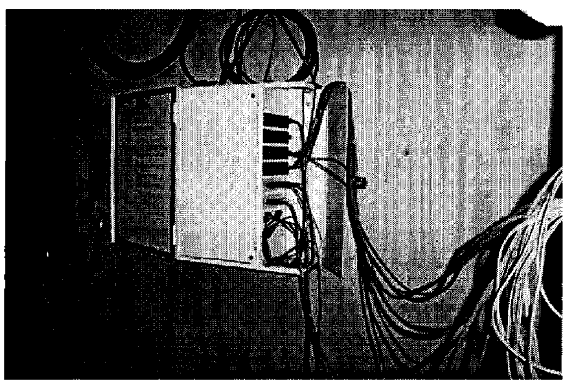
Today's telecommunication systems are comprised of two parts: (1) the voice system, which is the telephone system, and (2) the data system, which is basically a computer LAN system. In fact, today's telephone systems are actually computerized systems that only process digital voice signals. However, in the past, telephone systems were massive cabled systems that processed analog signals. Furthermore, the telephone industry experienced rapid technological changes that made prior systems obsolete. Consequently, older buildings like the General Assembly Building may have layers of obsolete systems that have been abandoned in place. It appears the existing building has at least three telephone systems, where much of the older systems' cabling has been abandoned in place. In the old keyed telephone systems, every telephone instrument had its own 25 pair cable. The building has a substantial quantity of 25 pair cable running throughout it. It is impossible to know which cables are active and which cables are inactive just by looking at the cables. Also, the building's existing telephone system is very large, thus making it difficult to grasp what the various systems actually are. Meanwhile, the building has experienced all the radical changes that have occurred in the telephone industry. Under the former Bell System, a building had a single consolidated telephone system that was basically owned and operated by the telephone company. In today's building, every tenant owns and operates his own telephone system. During the building survey, one would open a telephone closet and find no telephone cabling. You would then enter a storage room and find a major telephone backboard, patch panels installed in a floor mounted rack, and a fiber optic panel. A large backboard system was also found in one of the mechanical rooms. And finally, appreciable quantity of fiber optic cables and termination equipment were also observed throughout the building.

Needless to say, the telecommunications systems are the most difficult systems to evaluate under this engineering survey. It would take months for a team of telecommunications technicians to inventory the building's existing systems and then accurately document the telecommunication equipment, all of the backboards and racks, the cabling systems, and cable termination identification. Removing abandoned cables would be the first step to reducing the dazing effect of the existing system, or systems. In spite of the conditions encountered, the overall telephone system is reported to be in good working condition. Both the House and the Senate have fulltime staff members who operate and maintain their respective telecommunication systems. They are also knowledgeable of their respective cabling systems, including the termination identification aspects.

[redacted]. Excessive dust and humidity are always a detriment to telephone equipment. Some of the service facility components appear to be part of the west wing's original telephone installation, thus dating it about 1965. However, this needs to be confirmed with Verizon. One of the most important elements of a telephone service facility is its grounding system. In today's modern facilities, one would see a large ground bar. If this facility has a ground bar, then it is either located elsewhere or it was covered by other equipment. Also, it is doubtful if the telephone system is properly grounded with the electrical grounding system, which is a specific code requirement today. The existing telephone service facility does not comply with today's standards and practices. If the building is renovated, then it would be highly recommended to replace the existing telephone service with a new service that includes a dedicated telephone service room appropriately sized and air conditioned.

One of the tenant owned telecommunications systems is a relatively large PBX system that serves the House and Senate. [redacted] rooms are very congested and need to be substantially larger. Room [redacted] contains the PBX unit and all of its supporting equipment including the unit's batteries and battery charger. While the room was independently air conditioned, the room seemed to be warm. The air conditioning unit is a floor mounted spot cooler located in the telephone closet. This air conditioning unit is the major cause for the room's congestion. As expected, there is a significant quantity of telephone cables that interconnect the two rooms, which further adds to the congestion of both rooms. The overall perspective of the installation is an engineering example where you take the least and make the most. In spite of commendable efforts, the installation does not comply with current telecommunications standards and recommended practices.

In the event the building is renovated, the State would need to review their desires and preferences regarding the overall telecommunications system (or systems). One of the important issues to address is the resolution of tenants. In addition to the needs of the General Assembly, what other State agencies will occupy the building? And how will these other agencies obtain their telephone service? The designing engineer will need direct and specific guidance regarding the final design of the building's new telecommunications system (or systems). As addressed in the discussion regarding the security system, it may require a committee to finalize the needs and preferences for a new telephone system. And once again, this endeavor may have already occurred but was not shared during this survey's interviews.



V. MISCELLANEOUS SYSTEMS

1. General

The General Assembly Building currently contains several miscellaneous systems throughout the building. Three of the most outstanding systems are: (1) the legislature's

In-Session Annunciation System, (2) the various sound systems in the House and Senate hearing rooms and conference rooms, and (3) the computer center operated by the Division of Legislative Automated Systems (DLAS) and located on the east wing's sixth floor. The legislature's In-Session Annunciation System consists of small annunicators distributed throughout the building, while the service panel is located on the wall opposite of the telephone service facility. Sound systems are always critical systems in formal public assembly rooms. Lastly, computer rooms are always very specialized and preferential. In discussions during the survey, it was even stated that the DLAS may not remain in the General Assembly Building. All of these miscellaneous systems will require special attention and coordination with the appropriate State representatives at the time the building renovation is designed.

In addition to the three major systems addressed above, there are several roof mounted signal devices, mostly being antennas but also some devices that could not be identified. Some of this equipment could be vender owned and operated, and provided under a service contract with a building tenant or a special office of the legislature. Discussions with DGS maintenance personnel did not reveal what these systems were or who owned them. In the large scheme of the building's operations, these are small issues that should be easy to resolve when it becomes time to renovate the building. Between now and the time of renovation, some of these existing system may be removed and new systems may be added. As with all communication systems, the designing engineer will need specific guidance from the State in order to provide the proper engineering of these special signal systems.

VII [redacted]

A. [redacted]

[redacted].

B. [redacted]

[redacted].

C. [redacted]

[redacted].

D. [redacted]

[redacted]

[redacted].

[redacted].

VIII. ARCHITECTURAL RECOMMENDATIONS

A. RECOMMENDATIONS

In order to correct building deficiencies, and bring the building up to code, CEGG recommends a total renovation of all floors including the basement and sub-basement. Hazardous waste removal, in addition to structural and life safety concerns, precludes CEGG from recommending "band aid" or patchwork solutions. In fact, patchwork solutions will be more costly and troublesome.

[redacted].

All egress stairs need to be renovated to meet code. In some cases the entire stairwell will have to be demolished and floors will need to be reworked. Most of the stairs presently do not have enough room in them to make the necessary changes without tearing down the stairs completely. For example, stairs with columns minimizing egress width and stairs with landings too small or that change direction will need to be demolished. Also, all of the stairs will require railings to be upgraded. In addition, areas of refuge will have to be incorporated into the design.

Updated moisture and air infiltration measures need to be applied to this building. Slabs showing moisture penetration need to be removed, repaired, and reinstalled. Also, all windows need to be removed, properly flashed, and replaced with insulated windows. Walls in the basement need to be properly parged and waterproofed. Flashing at the cornice work should be replaced. Masonry walls at the shelf angles should be removed, properly flashed, and rebuilt to match existing.

The entire facility should be upgraded to meet the current Virginia Uniform Statewide Building Code requirements. This recommendation includes but is not limited to:

1. Handicapped Accessibility Codes
2. Construction & Professional Services Manual requirements
3. Roofing Requirements
4. Means of Egress
5. Areas of Refuge

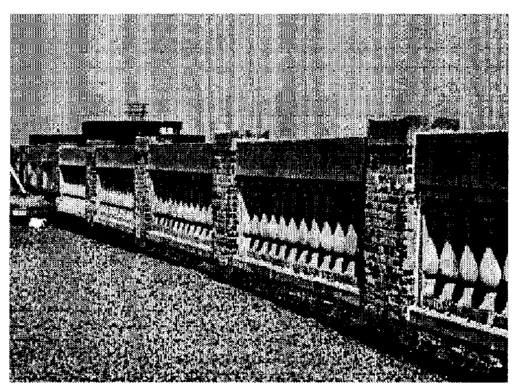
CEGG recommends that the floor plan be investigated in order to raise the building efficiency ratio. One possible solution is to centralize mechanical and support spaces in order to obtain valuable assignable square footage. We also recommend an investigation into the possibility of reducing the corridor while incorporating more waiting room space for visitors. Lastly the kitchen, cafeteria, dining areas, should be investigated for possible expansion.

B. 1923 BUILDING

1. 12th Floor Roof Recommendations

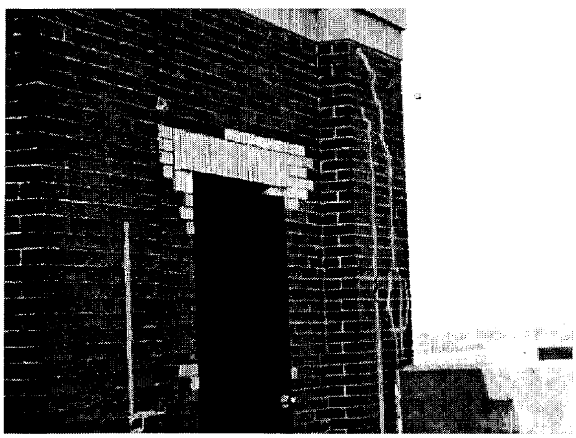
A thorough investigation is required to determine roof type and if asbestos is present in the roofing. The roof should be removed down to deck. New tapered insulation should be installed. The drainage has to be brought up to current code.

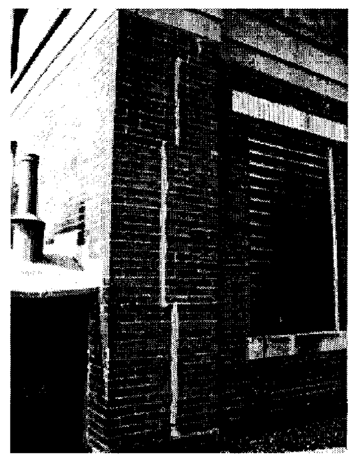
The Coping needs to be cleaned out and caulking replaced. The existing curbs have to be raised by installing additional blocking. Obsolete penetrations must be eliminated.



The balustrade is problematic. Removal and replacement has to be considered. The existing rusted and deteriorated steel must be replaced. A new synthetic balustrade should be considered. The only other solution is to replace with new concrete balustrade that has a moisture sealer.

Additional or relocated drains below the cooling tower unit can keep the cooling tower run-off from ponding. Proper tapered insulation can also assist in keeping water from collecting.





The penthouse masonry requires extensive rework. The shelf angles must be replaced. The brick must be repaired to stop the cracking which can shear the brick and subsequently damage the roof.

C. 1955 BUILDING

1. Roof Level 7

The roof drainage also needs to be brought up to code. Obsolete openings need to be eliminated.

D. 1905 BUILDING

1. Roof Level 6

This roof should be reconfigured as a patio roof with a membrane. This is more commonly known as a ISMA or inverted roof. Proper drain patterns, drains and overflows have to be incorporated. Pavers should be installed for a walking surface to protect the roof membrane. This application may result in the modification of the existing storefront to raise the sill in order to accommodate the roof system. The railings and connections should be tested and reanchored if loose.

IX. HAZARDOUS WASTE RECOMMENDATIONS

A. ASBESTOS

There is a known link between the inhalation of asbestos fibers and various diseases such as asbestosis, mesothelioma, lung and other cancers. As a result, the Asbestos Hazard Emergency Response Act (AHERA, 40 CFR Part 763) was enacted.

B. LEAD PAINT

Since 1971, the construction industry has been required to protect workers from exposure to lead through engineering and work practice controls. The current OSHA regulations 29 CFR 1956.62 set the following limits for lead exposure:

- Permissible exposure limit (PEL) to lead is 50 micrograms per cubic meter
- Action level of 30 micrograms per cubic meter, as determined using an 8-hour time weighted average.

Since lead-based paint has been determined to be a health threat, assessment of buildings for the presence of lead-based paint is required in order to:

- Prevent occupational exposure to personnel.
- Prevent exposure of the general public.
- Enact appropriate control measures for lead hazards.

C. MERCURY

In addition to asbestos and lead testing, renovation activities have the potential to disturb mercury. Fluorescent lighting fixtures contain elemental mercury in the fluorescent light bulbs. A brief narrative concerning mercury is discussed below.

Mercury is a toxic elemental metal with unique properties, including being in a liquid state at room temperatures. Human intake of mercury is primarily through oral means. Inhalation of mercury vapor is another source of human exposure. Once absorbed, mercury in all forms is distributed via the blood stream to all tissues in the body. Chronic exposure to mercury primarily affects the central nervous system and kidneys which can cause irreversible destruction of nerve cells in the cerebellar and visual cortices.

Mercury is used in a wide variety of common products including

- Fluorescent and neon lamps,
- Mercury vapor and high pressure sodium lamps,
- Switches and relays,
- Thermostats and regulators, and
- Thermometers and manometers.

Low mercury fluorescent lamps are currently in use and can be identified by looking at the metal end plates of the lamp. Low mercury lamps manufactures in the United States have "green" end caps while standard lamps have unfinished aluminum caps. Some specialty lamps may have "gold" end caps and are labeled as low mercury. Although low mercury lamps contain approximately one-tenth the amount of mercury as standard lamps, they still must be handled properly.

Broken, or crushed, fluorescent and high-intensity discharge (HID) lamps must be managed as a hazardous waste.

D. PCBs

Fluorescent lighting fixtures have potential to include ballasts containing polychlorinated biphenyls (PCBs). A brief narrative concerning the hazards of PCBs is discussed below. PCBs are synthetic organic chemicals that were produced in the United States from 1929 to 1977. A major use of PCBs was in fluorescent light fixtures ballasts (in the capacitors). Nearly all fluorescent ballasts manufactures prior to 1979 contain PCBs. All ballasts manufactured after July 1, 1978 that does not contain PCBs are required to be clearly marked "NO PCBs". Ballasts without a date of manufacture or clearly marked "NO PCBs" must be assumed to contain PCBs.

PCBs have been demonstrated to cause a variety of adverse health effects including cancer and a number of serious non-cancer health effects in animals. These effects include damage to the immune system, reproductive system, nervous system, and endocrine system. Studies in humans provide evidence for carcinogenic and non-carcinogenic effects of PCBs. Concern over PCBs in the environment led Congress in 1976 to enact §6(e) of the Toxic Substances control Act (TSCA) that included, among other things, prohibitions of the manufacture, processing, and distribution in commerce of PCBs.

The CEGG survey team identified asbestos, lead paint, mercury and PCB's as being present in the buildings that subsequently need to be tested to confirm the findings of this study. Our indication of asbestos, lead paint, mercury and PCB's being present was based upon experience and knowledge of identifying hazardous materials and was not based upon laboratory testing.

All hazardous materials should be removed from the project site during building renovation efforts and disposed of in accordance with approved methods. All work should be performed in full compliance with all applicable EPA, OSHA and NIOSH recommendations and all other applicable Federal, State and Local Government regulations.

X. STRUCTURAL RECOMMENDATIONS

A. EAST BUILDING

[redacted].

B. WEST BUILDING

[redacted].

[redacted].

[redacted].

XI. MECHANICAL RECOMMENDATIONS

A. EAST BUILDING

Mechanically, the east portion of this facility was analyzed separately from the west portion of this facility due to the distinctly different time frames from when they were constructed and since they essentially had their own dedicated equipment and systems serving them.

However, for purposes of defining renovation requirement, both portions (East and West) have similar conclusions and recommendations.

Obviously, one can look at the age on the equipment within this facility and ascertain that it has served its useful life, or is very near to the end of its design expectancy. That being said, since technology has improved through several generations of the current equipment and controls, now being used, it would be prudent as a steward of energy resources to replace this equipment on this basis alone, even if the equipment was within its design life. (See Appendix for ASHRAE Service Lives).

Direct digital control devices allow an opportunity to not only provide more instant response to change in building loads, but to improve the diversity of various loading within the facility during the same periods of time. The control within the facility today utilizes pneumatics which through the past several decades have been replaced by today's standard which is digital with computerized monitoring and control. However, it is also prudent to provide equipment that can react to this means of control.

Starting with the central equipment in the basement of the east portion, the central chiller, although still working, is working below efficiencies that we have available today, estimated at a differential of 0.20 KW/ton. Based on the current 400 ton system, this would equate to 80 KW in energy savings for every hour it works in that percent loading. In addition to providing more dependency, new chiller plants can be, and should be designed as multiple units, not only for better efficiencies at part load conditions, which is how this facility is operated, but also to provide redundancy, especially if one portion were to fail during periods of high use. At least 50 to 75 percent of required loading could be maintained until the problem was corrected. In addition, in concert with the recommended air side replacement, the pumping systems should be replaced by variable pumping systems to match building loading. This implies that when the building is not at design loading, all that pumping that the facility now has may not be required.

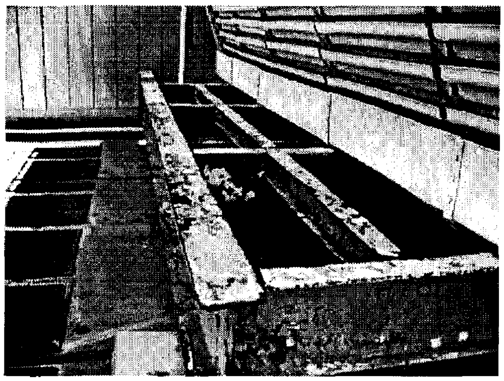
During unoccupied periods of time (low loads), energy can be saved by the use of variable flow control devices. Energy is the cube-root of flow. Therefore, if you reduce your flow by 50 percent, you reduce your energy consumption to one-eight, or approximately 12 percent. Significant savings. In addition, the facility's current system has only 1 chilled water pump and 1 condenser water pump assigned to the chiller. Since pumps run continuously, they inherently have a greater need for maintenance. Good design practice provides not only for safety in redundancy, but also in more efficient operation by operating both pumps together at their optimum efficiency operating points.

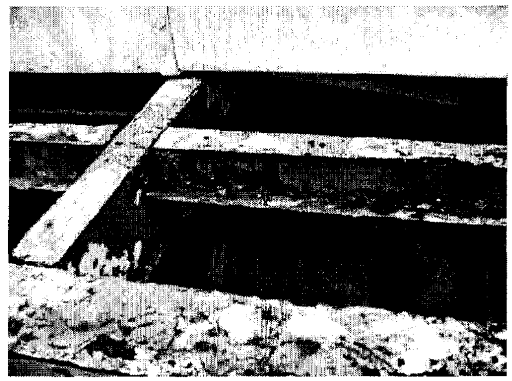
This also applies to the condenser water pumping aspects.

The current pumping operations do not have this means of control and could not be adapted to achieve variable flow. It requires total replacement.

The roof-top mounted cooling tower associated with the York chiller on the east portion is in a bad state of disrepair. The cooling tower is a high maintenance item, both during full operation, and when it sits idle during the winter-time. Cooling towers can be perceived as air cleaners since they are always drawing air, clean or dirty, across themselves to cool condenser water. Then they also have to guard against the constant flow of water with conductivity concerns and make-up water capacity and treatment. In off-season they must be protected against freezing. Scraping and constant wearing of the galvanized surfaces promotes rusting. Since the current cooling towers are galvanized, there is constant maintenance required.

The cooling towers on the GAB have served their useful lives, and should be replaced with stainless steel towers which are today's standard. Stainless steel construction meets or exceed ASHRAE'S recommended life expectancy, and remain dependable.





All central air handling equipment should be replaced. Although there are many, many reasons for this recommendation, this report will only address the critical issues. First of all, replacement of the air-side delivery systems would dictate that the existing air handling systems would be inadequate.

The major air handling systems on the East Building were installed in 1978, 28 years ago. The condensate pans are rusted, the coils are inefficient, the motors are not variable speed, nor are they the premium efficiency motors. Current ASHRAE Guidelines dictate higher filtering efficiencies that are not obtainable with existing equipment. All air handlers are high pressure, variable temperature constant flow systems which do not meet today's ASHRAE Standard 90.1 minimum energy efficiency guidelines. In addition, ASHRAE 62 ventilation air standards are not achievable with this equipment. In conversations with facility operators, equipment, such as the Joy fan built-up units serving the interior of the entire east facility, replacement parts are no longer available and units are difficult to maintain. Since they are past their useful lives, maintenance will be of primary importance in order to keep facility in operation.

The air-side delivery to the spaces is comprised of high pressure induction units with hot water reheat coils. As stated in the facilities condition survey portion of this report, these are high energy demanding systems that are not allowed in new designs by current energy standards. The entire air distribution system should be replaced and would have to be replaced anyways to facilitate removable of asbestos ceiling and sub-ceiling materials. The air-side delivery system should be a variable air volume type system that can adjust through digital computerized controls to efficiently maintain desirable space conditions. These systems automatically track the loading through the facility and provide only the energy necessary to match the load, i.e. no reheating to compensate for over-cooling. Ductwork should not be lined on a variable-volume system which also in turn reduces the propensity for mold and spore growth. As the volume of required air is reduced to match loading, new air handling systems can also be unloaded, further reducing energy and cost of operation. New air handling systems should be installed that take into consideration new ventilation standards (ASHRAE 62) that are currently being adopted into code language.

A new digital control system shall be installed to facilitate the sophistication of today's advanced technology on equipment. A building energy management and control system should be implemented to provide this standard.

All hydronic piping should be replaced in its entirety along with removal of asbestos containing insulation.

The kitchen on the sixth floor should be provided with a self-contained roof-top supply and exhaust system to capture the energy efficiency of make-up air pre-conditioning.

B. WEST BUILDING

Based upon the age, the equipment is past its useful life. Although it is still maintained and still operates, none of this equipment is operating at efficiencies found in today's equipment, or even at its original efficiency parameters. Since technology has given us the ability to control effectively and efficiently, equipment energy can be greatly reduced while giving better performance than what can be obtained from deteriorated equipment, coils, fans, valves, etc.

Pneumatic control should be replaced by computerized direct digital control.

Dual duct operations should be replaced by single duct variable air volume operation. Existing ductwork would require removal anyways due to asbestos abatement. All air handling equipment should have variable volume fans and be quipped with control and coils that have the ability to match the load in the space, and to turn down when the load is not in the space.

All flows should be controlled by variable flow to match loading, since that capability is now available. Not only does varying the water flows and air flow reduce the energy expended significantly, but it further enhances the ability to provide better humidity control. New pumps should be variable speed as well. As discussed in the East Building, for a reduction in flow to 50 percent, you only consume 12 percent of the energy.

In addition to de-rated efficiency in the coil and rusted unit casing, the motors are not variable speed, nor premium efficiency motors. The current ASHRAE Guidelines dictate higher filtering efficiencies, minimum ventilation standards (ASHRAE 62) and energy efficiencies (ASHRAE 90.1).

[redacted].

The proposed renovation for HVAC on this west portion is to locate all of the equipment on the roof. Essentially, a pre-packaged mechanical room is located on the ninth floor roof that structurally it is already design for. New efficient packaged variable volume air handlers can deliver air down to the eight floors via duct chases. All fresh air needs are inherent to the roof-mounted units. To make the system efficient, the pre-package mechanical room should be complete with either air-cooled or water-cooled chillers, along with pumps close to the coils they serve. Either steam can be piped up to mechanical room or hot water can be generated within the new roof-top system.

The newly installed chiller may be adaptable to this new roof-top mechanical room.

C. FIRE PROTECTION

It is estimated that approximately 50 percent of the existing sprinkler system will require modifications, such as removal and redistribution in order to facilitate asbestos removal and to adapt to new workable layout of spaces re-allocation.

D. BOILERS

Even though these boilers are maintained in good condition, today's technology provides the opportunity to gain up to 97 percent efficiencies through the use of fully condensing type boilers. By using hot water directly as the heating medium, maintenance associated with steam, such as pressure relief's, traps, and leaky valves is reduced, and the intermediate steps of conversion is eliminated. Hot water is easier to circulate and to control. Part load performance is easy to achieve via hot water than is steam. The additional benefit of using today's technology is the reduction in size when compared to similar steam capacity equipment. For remote equipment room areas, it may be more cost effective to install smaller boiler though-out at locations where they are needed than to pipe and pump.

E. **PLUMBING**

Generally, the facility requires all new plumbing fixtures to accommodate new ADAAG requirements specified by architectural, and to match the loading per floor requirements.

Due to the asbestos issue, and due to the reconfiguration of t bathroom layouts brought about by ADAAG, essentially all new piping should be considered.

Once again, as it was for space heating, new domestic water heaters available today can deliver hot water more efficiently than does the existing system.

XII ELECTRICAL RECOMMENDATIONS

A. INTRODUCTION

The purpose of the following discussions is to provide the basis for the strategic planning of new electrical systems for a renewed General Assembly Building. What will it cost to renew the building's electrical systems? The following discussions will provide the basis for "costing out" the new electrical systems that are herein proposed. While design concepts will be defined, it is not intended to mandate the final selection of the various electrical systems. Final system selections and final system configurations will naturally be determined when the final renovation design is performed. However, by use of this report, the electrical design engineer will be able to know if the final design selections significantly alter the cost planning that is herein performed.

B. ELECTRICAL SERVICE CHARGE

In the event the General Assembly Building is totally renovated, then a totally new electrical service should be provided. An electrical load evaluation indicates the two existing electrical services could be consolidated into a single service. If this is done, then a new centrally located electrical service room would be very highly recommended. In addition, it is believed the General Assembly Building is a highly critical facility that warrants a redundant electrical service. Consequently, two service transformers would be provided by the local electrical utility company, Dominion Virginia Power (DVP).

Incorporating these recommendations will create a significant expenditure by DVP, and thus resulting in a significant service charge for the State. Project funding needs to include DVP's service charge.

C. ELECTRICAL HAZARDOUS MATERIALS

As previously discussed, the demolition of the building's fluorescent light fixtures results in the additional burden of disposing of the fixtures associated hazardous materials, the PCB contaminated ballasts and the mercury contaminated lamps. Project funding needs to include the additional cost required for the proper disposal of these hazardous materials.

D. ELECTRICAL DEMOLITION

The conditions of the building's existing electrical systems are considered to be very poor. The primary reason for the poor condition is because the equipment is old. The vast majority of the electrical systems are between 40 and 50 years old. Much of the equipment is obsolete and replacement parts are no longer available. In addition, several elements have become code infractions because of the ever changing and more restricting code criteria. Fundamentally, the electrical systems have aged beyond proper and efficient usage, and some electrical industry representatives could reasonably argue that some electrical elements have declined below minimum safety standards. Consequently, it is past time for the building's internal infrastructures to be replaced. Other building systems are in the same poor condition as the electrical systems. This is especially true of the mechanical systems. the building is in dire need of a wholesale renovation project.

There are very few electrical components and systems that are worth salvaging. This especially applies to electrical conduits and raceway systems. The electrical conduit systems become obstructions to the demolition of larger equipment, especially the HVAC equipment and air ducts. In addition, existing conduits are seldom in locations that adequately serve the new electrical equipment. In essence, it is time to provide new electrical systems that will serve the State for the next 40 to 50 years. Meanwhile, there will be some newer and specialized components that are worth salvaging. The State will need to provide a report that defines specific electrical equipment and systems that are desired to be salvaged and reinstalled.

E. GROUNDING SYSTEMS

The existing grounding systems are unknown factors. It is recommended the State initiate an investigative project that will determine the actual parameters and configurations of the existing grounding systems. This will require the services of an electrical contractor and an electrical testing company. This investigative project should be an element of the final design contract. Information that needs to be determined, if possible, includes the following. (1) What are the existing grounding electrodes? (2) Is there a ground loop around the entire building? (3) Is the building steel connected to the grounding electrode? (4) Is it possible to measure the grounding systems' resistances?

(5) How will this information be used in the final design of the building's new grounding systems?

The ideal grounding system includes a ground loop that encircles the building and is buried 24" below grade. This loop is actually the grounding electrode, and it would be composed of a #4/0 bare copper conductor. The ground loop would be connected to ground rods (3/4" diameter by 10' long, copperclad) located 50' on centers. Building steel would be periodically connected to the ground loop. All inaccessible ground connections should be the exothermic type. All other underground utility systems' that use metallic conduits and pipes would also be connected to the ground loop. These other utility services include water, gas, telephone, cable TV, waste pipes, and so forth. Of course, this represents an ideal condition, and it remains to be seen if such a system is reasonably feasible. Nevertheless, it remains a significant and important task to determine the final type of grounding electrode to serve the new electrical service.

The electrical service room would contain a large ground bar (designated as the main service ground bar) which is directly connected to the ground loop. This ground bar should be located adjacent to the electrical service equipment. The connection from the main service ground bar to the ground loop is the grounding electrode conductor. The grounding electrode conductor continues from the main ground bar to the electrical service equipment's ground bus. This grounding electrode conductor should be located under the floor. Each electrical room would also have a dedicated ground bar (designated as a secondary ground bar) that is directly connected to the main service ground bar.

Secondary ground bars serve the needs of the electrical room. As an example, the ground lugs of dry type transformers would be connected to a secondary ground bar. All ground circuits are to be radial extensions, and there should be no ground connections that create a ground loop. Accordingly, a vertical stack of secondary ground bars can be directly interconnected in an array. It is also noted that all connections to ground bars should be the mechanical type that uses copper-based fittings.

All other grounding systems provided within the building would be derived from the main service ground bar. This especially includes the telephone system's grounding system. The telephone system should have its own main ground bar (designated as the main telephone ground bar) located at the telephone service entry facility. The telephone system's main ground bar is directly connected to the main service ground bar. Each telephone room and closet should have its own ground bar (also designated as a secondary ground bar) that is directly connected to the main telephone ground bar. Once again, all telephone system ground circuits are to be radial extensions, and there should be no ground connections that create a ground loop. As with the power system, the telephone system's secondary ground bars can be interconnected in an array.

F. <u>ELECTRICAL SERVICE EQUIPMENT</u>

It is proposed the electrical service equipment be a double, dead-ended switchboard rated 4000 amps and includes two 4000 amps main circuit breakers and one 4000 amps tie circuit breaker. This switchboard assembly is actually two separate switchboards, designated as main switchboard 'A' (MSB-A) and main switchboard 'B' (MSB-B). The two switchboards are then interconnected by the tie breaker. Each main circuit breaker is supplied from a dedicated 2500 KVA service transformer provided by DVP. Each switchboard includes ground fault protection and state-of-the-art electronic metering with communication features for remote reporting. All circuit breakers are the molded case type with state-of-the-art electronic trip units and communication elements that remotely report their operational status (opened versus closed). The main circuit breakers and the tie circuit breaker are the draw-out type, but the feeder breakers are the stationary type. (Note: Draw-out type low voltage power circuit breakers, which is switchgear configuration, could be specified in lieu of the proposed switchboard configuration. However, low voltage power circuit breakers have significant disadvantages that include much higher cost, more complex and more costly to maintain, and lower short circuit interruption ratings. Many engineers believe that today's modern molded case circuit breakers are just as reliable as low voltage power circuit breakers.)

Switchboard MSB-A serves the east wing and MSB-B serves the west wing. Each switchboard includes the following feeder breakers: (1) the wing's chiller, (2) the wing's main mechanical equipment room and other mechanical equipment centers, (3) a high voltage riser assembly (800 amps at 480 volts) that serves the wing's interior lighting system and the wing's individual mechanical equipment that is isolated and dedicated to a respective floor, and (4) the wing's dry type transformer that in turn provides a low voltage riser assembly (800 amps at 208 volts) that serves all utilization loads (120 volt circuits) on a respective floor. Switchboard MSB-A also includes a circuit breaker that serves the emergency power system, while MSB-B includes a circuit breaker that serves the building's fire pump. . Lastly, the electrical service equipment must be coordinated with all requirements regarding remote monitoring and control, which will occur at the building's fire command center and at the State's OMEGA system.

G. EMERGENCY POWER SYSTEM

[redacted]

[redacted].

H. INTERIOR DISTRIBUTION SYSTEMS

It is believed the best electrical interior distribution system is the simplest interior distribution system. The electrical service equipment should divide the building systems into its primary components, thus providing trunk lines to the building's main systems. Sub-trunk lines are then expanded from these down stream power centers, and not from the service equipment. Such a system is defined in the above paragraph that addresses the electrical service equipment. Regarding the interior distribution system for the emergency power system, it is proposed to provide a high voltage riser assembly (400 amps at 480 volts) for each wing. [redacted]. Similar provisions are provided for a low voltage riser assembly (400 amps at 208 volts) for each wing. Under this proposal, the vertical risers consist of conduit and wire versus plug-in bus way. The associated panelboards are the main lugs only style with feed-through lugs. Of course, the electrical rooms are located in the center of each wing and are stacked directly above one another. The electrical rooms should be adequately sized (usually 10' by 12' minimum) to accommodate the panelboards immediately installed and future panelboards that serve future needs. The electrical rooms should be well ventilated and well lighted, and where these systems are connected to the emergency power system.

I. DEVICES, CIRCUITRY AND CONNECTIONS

This system category includes the routine elements of the overall electrical system including receptacles, small mechanical fans and pumps, special devices that serve the owner's equipment, disconnect switches, all of the branch circuitry (conduit and wire), and all of the connections to the devices and equipment addressed herein. The State will need to provide a report that defines all State furnished equipment and their locations if specifically mandated. In most projects, the project architect will develop a master equipment floor plan, this master plan being closely coordinated with the various State representatives.

J. EXTERIOR LIGHTING AND MISCELLANEOUS OUTDOOR EQUIPMENT

This project involves very little outdoor lighting and equipment. These items are addressed under the section entitled "Facilities Condition Survey", the associated electrical section, and the paragraph entitled "Outdoor Lighting System".

K. INTERIOR LIGHTING SYSTEMS

It is proposed the building's principle lighting fixture be a standard, 2' by 4', recessed fluorescent lighting fixture with an anodized aluminum, parabolic louver that is at least 3" deep. The louver should have 24 to 27 cells and aligned into three arrays. The typical fixture would have three type T8 fluorescent lamps with two electronic ballasts. The light fixtures would be wired for three levels of light output: (1) "one lamp on" via ballast #1, (2) "two lamps on" via ballast #2, and (3) "three lamps on" via ballasts #1 and #2. Multiple lighting levels provide personal and individual control by the room's occupant. This is especially valuable in office rooms that have computer monitors, where most offices in today's modern buildings have a computer monitor. It is also proposed to use recessed parabolic fluorescent light fixtures in the corridors, except these fixtures would only be 2' by 2'. All spot type lights (down lights, wall washers, wall sconces, and so forth) would use state-of-the-art compact fluorescent lamps. The public hearing rooms and the large conference rooms would have dual lighting systems: (1) a normal fluorescent lighting system having a higher lighting level for normal occupancy, and (2) a dimmable down light system to provide low lighting levels and specifically designed to serve audio/visual presentations. In most projects, special architectural lighting systems in public common spaces are chosen by the project architect. Other lighting fixture types would be chosen to be commensurate with the type of space they serve and in conjunction with usual and customary building design practices.

L. EMERGENCY LIGHTING SYSTEM

[redacted].

M. FIRE ALARM SYSTEM

A state-of-the art, electronic, supervised, addressable fire alarm system is proposed. As with any high-rise building, the building's fire alarm system is a very complicated system and requires significant coordination with several other systems including: (1) HVAC system, (2) all elevators, their hoistways and equipment rooms, (3) sprinkler system, (4) public address system (if any), (5) door lock and release system, (6) air pressurization systems, (7) smoke control systems (if any), (8) areas of refuge, and (9) the fire command center. A critical element of the fire alarm system is the emergency voice/alarm communication system. The alarm system must also comply with the ADA, which has become more complicated because of the variable requirements concerning quantity of devices, location of devices, and the strobe intensity of the devices. The fire alarm system will include manual pull stations, smoke detectors in all paths of egress, elevator lobby smoke detectors, a smoke detector at the fire alarm control panel and in the fire command center, heat detectors in all utility spaces, duct detectors in the required air handling units, supervisory switches for the sprinkler system, and other components and features as required by all applicable codes. The high-rise building code also requires that each floor of the building be separately zoned. In response to this requirement each floor will be provided with a dedicated circuit loop. [redacted].

N. [redacted]

[redacted].

[redacted]

[redacted]

[redacted].

O. CABLED TV SYSTEM

It is proposed the cabled TV system be significantly expanded for the new General Assembly Building. TV monitors will be provided in the same basic locations where they currently exist. In addition, a TV outlet is proposed for each legislator's office. A very substantial front end system will be required to serve this quantity of TV outlets. It may also be desired to provide a signal blocking system of the commercial cabled TV signals. State representatives will also need to provide a list of specific locations where additional TV outlets and monitors are desired. It is suggested to locate the commercial cable TV service in a dedicated room. This room will also serve the cable TV system's front end equipment. In addition, the room will have a properly connected ground bar.

It is proposed to run the TV cables in wire mesh cable trays that also serve the telecommunications cables. The cable trays will be located in the corridors and above the suspended ceilings. The space above all suspended ceilings will be considered as rated air plenums. Therefore, the TV cables will also be plenum rated. Metallic conduit sleeves will be used for cable entry into a respective room where a TV outlet is located. The entry conduit and cable will be properly firestopped. The TV cable will continue to run above the suspended ceiling and on the room's perimeter walls. These TV cables will be supported by J-hooks. The associated entry conduits and J-hooks will also serve telecommunications cables. Each TV outlet will utilize a plastic outlet box and a 3/4" plastic conduit riser (schedule 40 PVC) concealed within the wall. The conduit will then turn-out of the wall 12" above the suspended ceiling and terminate 12" from the wall. The section of conduit that turns out of the wall will be electrical metallic tubing (EMT conduit). This same raceway method will be used for telecommunications outlets. Lastly, the cable TV distribution equipment will be located in the telephone rooms. Sufficient space is required for cable terminations and all associated downstream distribution equipment.

P. TELECOMMUNICATIONS SYSTEMS

A single telecommunications (telecom) distribution system will significantly help simplify, control and maintain the telephone systems provided in the renovated General Assembly Building. Consequently, it is proposed to provide a total, complete and centralized CAT 6 horizontal cabling system for the entire building. All horizontal telecom cables will be plenum rated and the associated raceway system will be as defined for the cable TV system. Both systems (cable TV and telecom) will share a common raceway system. The telecom outlets will be standardized using two jacks per outlet. Each telecom outlet will have a conduit riser as defined for cable TV outlets. In the general planning, one jack will serve a telephone instrument and one jack will serve a computer. Of course, the jacks can be used for whatever purposes the State choices. Each planned office desk will receive one work station outlet. The State will need to provide a list of all work stations that require more than two jacks. The State will also need to define locations of special telephone equipment (such as fax machines, special service telephones, pay telephones, and so forth), special computer equipment (such as printers or scanners), the telecom requirements in special rooms such as the House and Senate hearing rooms and the larger conference rooms, and all requirements regarding the fiber optic systems. It is noted that under the building's current conditions, some hearing rooms have hard wired data systems and some hearing rooms have wireless data systems. This condition is an example of a fundamental policy decisions that the State needs to resolve, and thus provide the guidance necessary to complete the final design.

Each work station outlet would be wired to a CAT 6 patch panel located in the local telephone room. Each horizontal cable will be numerically identified at each termination end (at the jack connection and at the patch panel connection). Each jack will also have a type written identification label that defines which patch panel port the jack is connected to. Each patch panel would be rack mounted in a standard 19" wide, floor mounted rack. Each patch panel will contain 24 ports. The patch panels will be combined in pairs and cable management wireways will be provided above and below the paired patch panels. Each rack will also have two vertical cable wireways, one wireway on each side of the rack. Furthermore, each rack will have a ground bus, a six outlet power module with an on/off switch, and multiple blank shelves to serve State owned equipment. The racks will also be used to mount fiber optic patch panels, where such patch panels are required by the State. Fiber optic patch panels will contain 12 ports. Each telephone room will be sized to accommodate three telephone equipment racks, all wall mounted backbone telecom cabling and terminations, and all cable TV cabling, equipment and components.

It is suggested a new telephone service entry facility be provided. The new service will have a dedicated service room that is centrally located in the building. It is proposed the room also serve all major equipment that is owned and operated by the State (such as the PBX system). The room will be properly air conditioned, ventilated and illuminated, and the main telephone ground bar will be located in this service room. Significant planning and coordination will be required to properly and fully design the telephone service room.

Two telecom risers will be provided for the building. One riser will serve the east wing, and one riser will serve the west wing. Each riser will consist of vertically stacked telephone rooms that are centrally located in each wing. All of the walls will be covered with telephone grade plywood. Each telephone room will be properly cooled, ventilated, illuminated and sized. The cable racks require front and rear access and should have four feet of clearance. A three rack telephone room needs to be 12' by 12' and built from floor to ceiling so the room is not a part of the building's rated air plenum.

The backbone cabling system will run from the telephone service room to each vertical riser system. Backbone cables will also be CAT 6 but would not be plenum rated. The largest paired CAT 6 cables need to be provided, but this may be limited to 25 pair cable. This limitation may change in the near future. The number of backbone cabling systems will match the number of telephone systems required in the building. Each backbone cabling system will be properly terminated in the associated telephone rooms. Backbone cables will be terminated on 110 punch-down blocks. Cross connects will be provided from the punch-down blocks to dedicated patch panels located on the equipment racks. The backbone cable patch panel will then be cross connected to the horizontal cable patch panel using CAT 6 jumper cables. A large inventory of jumper cables and jumper cable storage racks will also be provided.

It is noted this description is general in nature and detail design elements will be finalized as based upon the actual conditions encountered. This especially applies to the number of patch panels that will be required. Three equipment racks per telephone room may be inadequate. This cannot be finalized until the total number of telecom jacks are known and the total number of telephone systems are known.

Q. SPECIAL MISCELLANEOUS SYSTEMS

The General Assembly Building currently contains several miscellaneous systems throughout the building. Three of the most outstanding systems are: (1) the legislature's In-Session Annunciation System, (2) the various sound systems in the House and Senate hearing rooms and conference rooms, and (3) the computer center operated by the Division of Legislative Automated Systems (DLAS). In addition to these three major systems, there are several roof mounted signal devices, mostly being antennas. Some of this equipment could be vender owned and operated, and provided under a service contract with a building tenant or a special office of the legislature. As with all specialized electronic systems, the designing engineer will need specific guidance from the State in order to provide the proper engineering of these special systems. For the cost planning included in this report, a substantial allowance is provided for these specialized electronic systems.

R. FIRE COMMAND CENTER

One of the most significant elements required under the high-rise building code is the fire command center (FCC). The high-rise building code is defined in Section 403 of the International Building Code (IBC). Paragraph 403.8 mandates: (1) a high-rise building have an FCC, (2) the FCC be provided in accordance with Section 911 of the IBC, and (3) the FCC's location be approved by the fire department. Section 911 requires some very special and very specific criteria. This criteria is herein defined for the benefit and convenience of the reader. For the cost planning included in this report, a substantial allowance is provided for the associated electrical systems of the FCC. The specialized requirements for the FCC are as follows.

A. The FCC room must be a minimum of 96 SF with a minimum wall length of 8' and have a one-hour fire rated construction. Based upon the FCC's required contents, an area of 96 SF appears to be inadequate.

B. The FCC must contain the emergency voice/alarm communication system unit.

C. The FCC must contain the fire department communications unit.

D. The FCC must contain the fire detection and alarm system annunciator unit.

E. The FCC must contain an annunciator that indicates the locations of the elevators and whether they are operational.

F. The FCC must contain status indicators and controls for air handling systems.

G. The FCC must contain the fire fighter's control panel required by IBC Section 909.16 for smoke control systems installed in the building.

H. The FCC must contain the controls for unlocking stairway doors simultaneously.

I. The FCC must contain the sprinkler valve and water flow detector display panels.

J. The FCC must contain the emergency and standby power status indicators.

K. The FCC must contain a telephone for fire department use with controlled access to the public telephone system.

L. The FCC must contain fire pump status indicators.

M. The FCC must contain schematic building plans indicating the typical floor plan and detailing the building core, means of egress, fire protection systems, fire fighting equipment and fire department access.

N. The FCC must contain a work table.

O. The FCC must contain generator supervision devices, manual start and transfer features.

P. The FCC must contain the public address system.

XIII [redacted]

A. BROAD STREET

[redacted].

B. 10TH STREET

[redacted]

[redacted].

C. 9TH STREET

[redacted].

D. CAPITOL STREET / DARDEN GARDEN

[redacted].

E. [redacted]

[redacted].

F. [redacted]

[redacted].

XIV ESTIMATED RENOVATION COSTS

The estimated October 2005 costs shown are an opinion of cost based upon today's pricing structure. An inflation factor has been applied to account for recent increases in inflation of costs and contingencies have been added to allow for unforeseen conditions. Based upon a 24 month construction period with a projected startup date of October 2008, the escalated cost at the mid-point of construction in October 2009 has been shown.

This estimate reflects construction costs only. It does not include costs for loose furnishings and equipment, design fees, operations and maintenance, or other miscellaneous soft costs.

	BUILDING IMPROVEMENTS	**COST**
1.	Slab on Grade	$ 211,445.00
2.	Structural Frame	$ 2,035,206.00
3.	Roofing	$ 615,222.00
4.	Stairs	$ 1,308,206.00
5.	Exterior Walls	$ 3,002,087.00
6.	Interior Walls	$ 5,865,262.00
7.	Interior Finishes	$ 6,396,306.00
8.	Doors and Hardware	$ 2,329,147.00
9.	Windows	$ 8,106,431.00
10.	Specialties	$ 1,314,209.00
11.	HVAC	$ 9,575,089.00
12.	Fire Protection	$ 623,070.00
13.	Plumbing	$ 1,073,178.00
14.	Electrical	$10,082,625.00
15.	Hazardous Waste Removal	$ 9,632,801.00
16.	Exterior Structural Slabs	$ 362,250.00
17.	[redacted]	$ 982,905.00
	OCTOBER 2005 ESTIMATED TOTAL COST	$63,515,437.00
	MID POINT OF CONSTRUCTION OCTOBER 2009 ESTIMATED TOTAL COST	**$80,200,000.00**

APPENDIX A

Building Cost Summary : Base Bid

A & E Comm. No: 200410.10 Gross Area:

(Per BCOM Guidelines) Date Prepared: October15, 2005

Project Title: Develop Renovations Reqjirements Costs

Prepared By: **CEGG Associates, L.C.**, 381 Edwin Drive, Virginia Beach, VA 23462

Line No.	Description	System Unit	Unit of Measure	System Quantity	Material Cost	Cost/SF Gross	TOTAL COST
	BUILDING SYSTEM						
1	Slab on Grade				$ -	$ -	$175,110.00
2	Structural Frame				$ -	$ -	$1,685,471.00
3	Roofing				$ -	$ -	$509,500.00
4	Stairs				$ -	$ -	$1,083,400.00
5	Exterior Walls				$ -	$ -	$2,486,200.00
6	Interior Walls				$ -	$ -	$4,857,360.00
7	Interior Finishes				$ -	$ -	$5,297,148.00
8	Doors and Hardware				$ -	$ -	$1,928,900.00
9	Windows				$ -	$ -	$6,713,400.00
10	Specialties				$ -	$ -	$1,088,372.00
11	HVAC				$ -	$ -	$7,929,680.00
12	Fire Protection				$ -	$ -	$516,000.00
13	Plumbing				$ -	$ -	$888,760.00
14	Electrical				$ -	$ -	$8,350,000.00
15	Hazardous Waste Removal				$ -	$ -	$7,977,475.00
16	Exterior Struc tural Slabs				$ -	$ -	$300,000.00
17	[redacted]				$ -	$ -	$814,000.00
34					$ -	$ -	$0.00
35					$ -	$ -	$0.00
36					$ -	$ -	$0.00
37					$ -	$ -	$0.00
38					$ -	$ -	$0.00
39					$ -	$ -	$0.00
40					$ -	$ -	$0.00
41					$ -	$ -	$0.00
42	**SUBTOTAL (LINES 1 THRU 41)**				$ -	$ -	$52,600,776.00
43					$ -	$ -	$0.00
44					$ -	$ -	$0.00
45					$ -	$ -	$0.00
46	SUBTOTAL (LINE 42 + LINE 43)				$ -	$ -	$52,600,776.00
47					$ -	$ -	$0.00
48	SUBTOTAL (LINE 46 + LINE 47)				$ -	$ -	$52,600,776.00
54	SUBTOTAL (LINES 50 THRU 53)				$ -	$ -	$52,600,776.00
55							
56							
57							
58	SUBTOTAL SITEWORK (LINES 50 THRU 53)						$ -
59	SUBTOTAL (LINES 1 THRU 41)						$ 52,600,776.00
60	TOTAL (LINE 26 + LINE 34)						$52,600,776.00
61	TOTAL (LOCATION FACTOR OF 1.00)						$ 52,600,776.00
62	INFLATION FACTOR 5%						$ 55,230,814.80
63	TOTAL (WITH 15% CONTINGENCY) OCTOBER 2005						$63,515,437.02
64	ESCALATE TO MID-POINT CONSTRUCTION OCTOBER 2009						$80,186,775.84

CEGG ASSOCIATES LC ARCHITECTS ENGINEERS SURVEYORS

COST ESTIMATE

Project Title: Develop Renovations Requirements Costs		**Date:**	10/15/2005
Location: General Assembly Building, Richmond, VA		**Comm No.**	200410.10

DESCRIPTION	QTY	UNIT	COST PER UNIT	COST
SLAB ON GRADE				
Demolition				$ 149,500.00
New Work				$ 25,610.00
Subtotal Slab on Grade				**$ 175,110.00**
STRUCTURAL FRAME				**$ -**
Demolition				$ -
Column Enclosures Avg. 2'x2'				$ 181,555.00
Existing Fire Proofing Inc. Existing Decking				$ 367,336.00
New Fire Proofing Incl. Decking				$ 1,136,580.00
Subtotal Structural Frame				**$ 1,685,471.00**
ROOFING				**$ -**
Demolition				$ 107,000.00
New Built-up Roof East Wing				$ 402,500.00
Subtotal Roofing				**$ 509,500.00**
STAIRS				$ -
Demolition				$ -
New Work				$ 72,400.00
Subtotal Stairs				$ 1,011,000.00
				$ 1,083,400.00
EXTERIOR WALLS				
Demolition				$ 279,200.00
New work				$ 2,207,000.00
Subtotal Exterior Walls				**$ 2,486,200.00**
INTERIOR WALLS				
Demolition				$ 984,600.00
New Work Interior Walls				$ 3,872,760.00
Subtotal Interior Walls				**$ 4,857,360.00**
INTERIOR FINISHES				
Demolition Floor & Ceiling				$ 735,168.00
New Work Interior Finishes				$ 4,561,980.00
Subtotal Interior Finishes				**$ 5,297,148.00**

CEGG ASSOCIATES LC ARCHITECTS ENGINEERS SURVEYORS

COST ESTIMATE

Project Title: Develop Renovations Requirements Costs | **Date:** 10/15/2005

Location: General Assembly Building, Richmond, VA | **Comm No.** 200410.10

DESCRIPTION	QTY	UNIT	COST PER UNIT	COST
DOORS AND HARDWARE				
Demolition				$ 40,000.00
New Doors				$ 1,888,900.00
Subtotal Doors and Hardware				**$ 1,928,900.00**
WINDOWS				
Demolition				$ 150,000.00
New Work Flrs. 6-9 & 6-11				$ 1,445,000.00
Force Protected Windows Flrs. 1-5				
West Wing				$ 3,942,000.00
East Wing				$ 925,000.00
Film for East Wing				$ 67,000.00
Film for West Wing				$ 184,400.00
Subtotal Windows				**$ 6,713,400.00**
SPECIALTIES				$ -
Demolition				$ 5,312.00
Specialties				$ 1,083,060.00
Subtotal Specialties				**$ 1,088,372.00**
	TOTAL			**$ 25,824,861.00**
	Compound Factor			0.00
	TOTAL			**$ 25,824,861.00**

CEGG ASSOCIATES LC
ARCHITECTS
ENGINEERS
SURVEYORS

COST ESTIMATE

Project Title: Develop Renovations Requirements C	**Date:**	10/15/2005
Location: General Assembly Building, Richmond, V	**Comm No.**	200410.1

DESCRIPTION	QTY	UNIT	COST PER SQ FT	COST
MECHANICAL SYSTEMS				
HVAC				
Demolition				$ 1,321,680.00
Central Chillers (Two 420 Ton Centrifugals)				$ 432,000.00
Central CoolingTowers (S.S)				$ 144,000.00
Rooftop Air Handling Units (VAV)				$ 680,000.00
Distribution Systems (250 VAV Terminals)				$ 2,100,000.00
Ductwork - Systems				$ 900,000.00
Central Heating Boiler, Hot Water, Gas-Fixed (5,000 MBH)				$ 127,000.00
Pumping Systems (12 Systems)				$ 395,000.00
Piping, Insulation				$ 420,000.00
DD Controls				$ 1,080,000.00
Misc. (Exhaust fans, valving, etc)				$ 330,000.00
TOTAL COST HVAC				**$ 7,929,680.00**
	TOTAL			**$ 7,929,680.00**
	Compound Factor			0.00
	TOTAL			**$ 7,929,680.00**

CEGG ASSOCIATES LC
ARCHITECTS
ENGINEERS
SURVEYORS

COST ESTIMATE

Project Title: Develop Renovations Requirements Costs		**Date:**	10/15/2005	
Location: General Assembly Building, Richmond, VA		**Comm No.**	200410.10	

DESCRIPTION	QTY	UNIT	COST PER SQ FT	COST
MECHANICAL SYSTEMS				
FIRE PROTECTION				
Demolition				$86,000.00
SMCR existing sprinkler system exists				
but will require modifications to accommodate				
new space layouts and perhaps removal				
for asbestos abatement, 50% of NEW				
installed costs appears to be reasonable				
at this stage of planning.				
TOTAL COST FIRE PROTECTION				**$ 516,000.00**
	TOTAL			**$ 516,000.00**
	Compound Factor			0.00
	TOTAL			**$ 516,000.00**

CEGG ASSOCIATES LC ARCHITECTS ENGINEERS SURVEYORS

COST ESTIMATE

Project Title: Develop Renovations Requirements Costs | **Date:** 10/15/2005
Location: General Assembly Building, Richmond, VA | **Comm No.** 200410.10

DESCRIPTION	QTY	UNIT	COST PER SQ FT	COST
MECHANICAL SYSTEMS				
PLUMBING				
Demolition				$ 148,120.00
48 Sinks w/Rough-In				$ 76,560.00
57Toilets w/Rough-In				$ 76,080.00
19 Urinals w/Rough-In				$ 32,400.00
38 Drinking Fountains w/Rough-In				$ 51,600.00
Gas-Fired Domestic Heaters				$ 14,400.00
Piping (Waste, C.W., H.W. Venting)				$ 480,000.00
Pumping				$ 9,600.00
TOTAL COST PLUMBING				**$ 888,760.00**
				$ -
	Subtotal			**$ 888,760.00**
	Compound Factor			0.00
	TOTAL			**$ 888,760.00**

CEGG ASSOCIATES LC ARCHITECTS ENGINEERS SURVEYORS

COST ESTIMATE

Project Title: Develop Renovations Requirements Costs		**Date:**	10/15/2005	
Location: General Assembly Building		**Comm No.**	200410.10	

DESCRIPTION	QTY	UNIT	COST PER UNIT	COST
ELECTRICAL				
Electrical Service Charge by Dominion Virginia Power (Allowance)				$ 100,000.00
PCB/Mercury Disposal				$ 100,000.00
Demolition		SF	$ 3.00	$ 1,000,000.00
Grounding Systems				$ 100,000.00
Electrical Services Equipment	2	4000A		$ 300,000.00
Emergency Power System	650 KW, 1000A	KW	$ 225.00	$ 150,000.00
Interior Distribution System		SF	$ 2.00	$ 700,000.00
Devices, Circuitry and Connections		SF	$ 5.00	$ 1,700,000.00
Exterior Lighting and Outdoor Miscellaneous				$ 50,000.00
Interior Lighting System		SF	$ 5.00	$ 1,700,000.00
Emergency Lighting System (Battery Operated)		SF	$ 0.50	$ 150,000.00
Fire Alarm System for High-Rise building		SF	$ 1.25	$ 450,000.00
Secuirty Systems		SF	$ 0.50	$ 150,000.00
Cabled TV System			$ 0.75	$ 250,000.00
Telecommounications Systems		SF	$ 3.00	$ 1,000,000.00
Special Systems		SF	$ 1.00	$ 350,000.00
Fire Command Center's Electrical Components				$ 100,000.00
TOTAL COST ELECTRICAL				**$ 8,350,000.00**
	Subtotal			**$ 8,350,000.00**
	Compound Factor			$ -
	TOTAL			**$ 8,350,000.00**
Cost Comparison				

CEGG ASSOCIATES LC ARCHITECTS ENGINEERS SURVEYORS

COST ESTIMATE

Project Title: Develop Renovations Requirements Costs | **Date:** 10/15/2005
Location: General Assembly Building, Richmond, VA | **Comm No.** 200410.10

DESCRIPTION	QTY	UNIT	COST PER UNIT	COST
HAZARDOUS WASTE REMOVAL				
Asbestos Removal				$ 7,977,475.00
TOTAL HAZARDOUIS WASTE				**$ 7,977,475.00**
	Subtotal			**$ 7,977,475.00**
	Compound Factor			0.00
	TOTAL			**$ 7,977,475.00**

CEGG ASSOCIATES LC ARCHITECTS ENGINEERS SURVEYORS

COST ESTIMATE

Project Title: Develop Renovations Requirements Costs | **Date:** 10/15/2005

Location: General Assembly Building | **Comm No.** 200410.10

DESCRIPTION	QTY	UNIT	COST PER UNIT	COST
EXTERIOR STRUCTURAL SLABS				
Demolition				$ 50,000.00
New Work				$ 250,000.00
TOTAL COST STRUCTURAL				**$ 300,000.00**
	Subtotal			
				$ 300,000.00
	Compound Factor			
				0.00
	TOTAL			
				$ 300,000.00

APPENDIX B

*** ESTIMATES OF SERVICE LIVES OF VARIOUS SYSTEM COMPONENTS**

Equipment Item	Median Years	Equipment Item	Media Years
Air Conditioners		Package chillers	
Split package	15	Reciprocating	20
Boilers, hot water (steam)		Centrifugal	23
Steel water-tube	24 (30)	Absorption	23
Steel fire-tube	25 (25)	Cooling towers	
Cast iron	35 (30)	Galvanized metal	20
Burners	21	Insulation	
Radiant heaters		Molded	20
Electric	10	Blanket	24
Hot water or steam	25	Pumps	
Air terminals		Base-mounted	20
Diffusers, grilles, and registers	27	Pipe-mounted	10
Induction and fan-coil units	20	Sump and well	10
VAV and double-duct boxes	20	Condensate	15
Ductwork	30	Electric Motors	18
Dampers	20	Motor starters	17
Fans		Electric transformers	30
Centrifugal	25	Controls	
Axial	20	Pneumatic	20
Propeller	15	Electric	16
Ventilation roof-mounted	20	Electronic	15
Coils		Valve actuators	
DX, water, or steam	20	Hydraulic	15
Electric	15	Pneumatic	20
Heat exchangers		Self-contained	10
Shell-and-tube	24		
Reciprocating Compressors	20		

* Excepts from 2003 ASHRAE Handbook "HVAC Applications, Chapter 36".

GENERAL ASSEMBLY BUILDING MAJOR AIR HANDLING EQUIPMENT

West Building:

AHU#	LOCATION	AREA SERVED	EQUIPMENT	CAPACITIES	YEAR INSTALLED
5	Sub-Basement	North East Perimeter (All Floors)	Variable Temperature, Constant Volume Chilled Water Coils, Steam Heating Coil	12,550 CFM, 20 HP @ 6¼" SP Fan	1965
6	Sub-Basement	North West Perimeter (All Floors)	Variable Temperature, Constant Volume Chilled Water Coils, Steam Heating Coil	20,220 CFM, 25 HP @ 6¼" SP Fan	1965
7	Sub-Basement	South West Perimeter (All Floors)	Variable Temperature, Constant Volume Chilled Water Coils, Steam Heating Coil	11,380 CFM, 20 HP@ 6¼" SP Fan	1965
1 & 2	Sub-Basement	Interior (B, 1, 2, 3, 4th Floors)	Variable Temperature, Constant Volume Chilled Water Coils, Steam Heating Coil	Nominal 40,080 CFM, 50 HP@ 6" SP Fan	1965
3 & 4	9th Floor Mechanical Room	Interior (5, 6, 7, 8, 9th Floors)	Variable Temperature, Constant Volume Chilled Water Coils, Steam Heating Coil	40,000 CFM, 50 HP @ 6" SP Fan	1965

East Building:

AHU#	LOCATION	AREA SERVED	EQUIPMENT	CAPACITIES	YEAR INSTALLED
1 (Joy Fan)	2nd Floor	Interior (B, 1, 2, 3rd Floors)	Vaneaxial supply fan, 75 HP return air fan 25 HP Stm pre-heat coil, cooling coil, roll filters (abandoned)	44,770 CFM @ 6.5 SP	1978
2 (Joy Fan)	5th Floor	Interior (4 & 5th floors)	Vaneaxial supply fan, 40 HP return air fan 10 HP Stm pre-heat coil, cooling coil, roll filters (abandoned)	19,500 CFM @ 6.8 sp	1978
3 (Joy Fan)	12th Floor	Interior(7, 8, 9, 10, 11th Floors)	Vaneaxial supply fan, 50 HP return air fan 15 HP Stm pre-heat coil, cooling coil, roll filters (abandoned)	27,900 CFM @ 6.5 sp	1978
A	7th Floor	Perimeter (All Floors)	Supply Air Fan, 40 HP Return Air Fan, 2 HP		1955
13	7th Floor	Dining Room (6th Floor)			1955
6	7th Floor	Kitchen (6th Floor)	Supply Air Fan, 2 HP		1955
7	7th Floor	Interior (6th Floor)	Supply Air Fan, 2 HP		1955
Payne	Computer Rm.	6th Floor		4 Ton Split System	New
York Unit	Computer Rm.	6th Floor (Data Entry)			
E.F. #4	5th Floor	All	Barry Blower, 2HP		

GENERAL ASSEMBLY BUILDING
Richmond, VA
COMMONWEALTH OF VIRGINIA
JOHN SAY
ASSESSMENT CONDITIONS SURVEY

BUILDING DESCRIPTION

	Alternative 1
Alternative Description	2-Stage Centrifugal
Building Name	7+ Story Office
Floor Area	345,000 ft2
Max Building Cooling Load	839 tons
Max Building Heating Load	4,928 mbh
System Set 1	Shutoff VAV (267,247 cfm)
Cooling Plant 1 (#1)	2-Stage Centrifugal (420 tons
Cooling Plant 1 (#2)	2-Stage Centrifugal (420 tons
Heating Plant	Gas Fired (4,928 mbh)
Building Cooling Coil load	899,315 ton-hrs/year
Building Heating Coil load	2,495,185 kBtu/year
Building Energy Usage	57,626 Btu/(ft2-year)
Building Energy (Utility) Cost	1.2225 $/(ft2-year)

INPUTS TO ENERGY STAR BUILDING LABEL BENCHMARKING TOOL

Alternative	1
City	Richmond, VA
Building Area	345,000 ft2
Weekly Operating Hours	58
Number of Occupants	1,725
Number of PC's Per Occupant	User Defined
Annual Electric Consumption	4,522,675 kWh
Annual Gas Consumption	44,451 therms
Annual Oil Consumption	0 therms
Annual Steam Consumption	0 therms

Energy Star Building Label website www.epa.gov/buildinglabel

TIME PRINTED

TIME PRINTED	8:39 AM 15 Oct 05
DATASET NAME	C:\CDS\SYANALYZ\DATA\GAB.AZR

BUILDING DESCRIPTION

Description	Alt 1: 2-Stage Centrifugal
Building Name	7+ Story Office
Orientation	North
Floor Area	345,000 ft2
Wall Area	93,120 ft2
Glass Area	27,936 ft2
Roof Area	34,500 ft2
Skylight Area	0 ft2
Lighting Demand	862.50 kW
Misc Equip Demand	345.00 kW
Base Utility Demand #1	0.00 mbh
Base Utility Demand #2	331.20 mbh

ZONE PARAMETERS

	Alt 1: 2-Stage Centrifugal
Building Name	Main Building
Served by	System 1
Occup Clg Setpoint	75 deg F
Occup Htg Setpoint	72 deg F
Unoccup Htg Setpoint	60 deg F
Unoccup Clg Setpoint	90 deg F
Number of People	1725
Ventilation Rate	20 cfm/pers

AIRSIDE SYSTEM

	Alt 1: 2-Stage Centrifugal
System 1	Shutoff VAV
Served by	Equipment Plant 1
Supply Air Cooling DB	55.0 deg F
Supply Air Heating DB	125.0 deg F
Ventilation	34,500 cfm = 12.9 %
VAV Minimum Airflow	20 %
Supply Fan	FC w/ Var Speed Drive
Fan Type	Centrifugal
Design Airflow	267,247 cfm
Fan Static	6.0 in H2O
Energy Rate	750.4 kW
Exhaust Fan	FC w/ Var Speed Drive
Fan Type	Centrifugal
Design Airflow	40,324 cfm
Fan Static	3.0 in H2O
Energy Rate	56.6 kW

COOLING / HEATING EQUIP

	Alt 1. 2-Stage Centrifugal
Cooling Plant 1	2 Parallel Chillers w/ 2 Pumps
Clg Ref 1 Equip Name	2-Stage Centrifugal
Equip Type	Centrifugal
Cooling Capacity	420 tons
Full Load Rate	0.500 kW/ton
100\50% Load Points	210 kW\105 kW
Chw Pump F.L. Rate	125 ft H2O = 35.2 kW
Cond Pump F.L. Rate	75 ft H2O = 24.1 kW
Chiller-Tower Optimization	No
Cond/Twr Fan E. Rate	0.066 kW/ton = 31.7 kW
Auxiliary F.L. Rate	Not Defined
Fuel Source	Elec Utility

Chilled Water DeltaT	10.0 F
Cond Water DeltaT	10.0 F
Cond Operating Minimum	65.0 F
Condenser Entering Temp	85.0 F
Load Shedding Economizer	No
Heat Recovery Capability	No
Clg Ref 2 Equip Name	2-Stage Centrifugal
Equip Type	Centrifugal
Cooling Capacity	420 tons
Full Load Rate	0.500 kW/ton
100\50% Load Points	210 kW\105 kW
Chw Pump F.L. Rate	125 ft H2O = 35.2 kW
Cond Pump F.L. Rate	75 ft H2O = 24.1 kW
Chiller-Tower Optimization	No
Cond/Twr Fan E. Rate	0.066 kW/ton = 31.7 kW
Auxiliary F.L. Rate	Not Defined
Fuel Source	Elec Utility
Chilled Water DeltaT	10.0 F
Cond Water DeltaT	10.0 F
Cond Operating Minimum	65.0 F
Condenser Entering Temp	85.0 F
Load Shedding Economizer	No
Heat Recovery Capability	No
Other Cooling Plant Parameters	
Cooling Plant Schedule	Available all hours
Heating Plant	Gas
Heating Capacity	4,928 mbh
Full Load Rate	80.00 %
100\50% Load Points	6,160 mbh\3,457 mbh
Hotw Pump F.L. Rate	15 ft H2O = 2.1 kW
Auxiliary F.L. Rate	0.002 kW/mbh = 9.9 kW

UTILITY RATES

Alternative 1

Virginia Electric and Power Compa	Customer Charge: $ 0	Demand Ratchet: 0 %	Summer Rate Period:	Jun - Sep
Utility Type	Rate Type	Summer Charge	Rate Type	Winter Charge
Elec Consumption	On Peak	$ 0.024 /kWh	On Peak	$ 0.024 /kWh
Elec Consumption	Off Peak	$ 0.024 /kWh	Off Peak	$ 0.024 /kWh
Elec Consumption	Mid Peak	$ 0.000 /kWh	Mid Peak	$ 0.000 /kWh
Elec Consumption	Sup Peak	$ 0.000 /kWh	Sup Peak	$ 0.000 /kWh
Elec Demand	On Peak	$ 11.395 /kW	On Peak	$ 11.395 /kW
Elec Demand	Off Peak	$ 11.395 /kW	Off Peak	$ 11.395 /kW
Elec Demand	Mid Peak	$ 0.000 /kW	Mid Peak	$ 0.000 /kW
Elec Demand	Sup Peak	$ 0.000 /kW	Sup Peak	$ 0.000 /kW
	Summer Rate	Winter Rate		
Gas Consumption	$ 0.650 /therm	$ 0.650 /therm		

MAXIMUM BUILDING LOADS

Weather File Name:	Richmond, VA
Latitude:	37 deg
Longitude:	77 deg
Summer Design Dry Bulb	92.0 deg F
Summer Design Wet Bulb	78.0 deg F
Winter Design Dry Bulb:	17.0 deg F

Alt 1: 2-Stage Centrifugal

Load Component	Cooling Design (Btuh)	Percent	Heating Design (Btuh)	Percent
Roof Conduction	134,881	1.34	-132,825	2.70
Glass Solar	1,355,139	13.45	0	0
Glass Conduction	284,947	2.83	-970,303	19.69
Wall Conduction	151,160	1.50	-358,512	7.28
Infiltration	144,644	1.44	-355,130	7.21
Lights	2,943,713	29.22	0	0
People	690,000	6.85	0	0
Miscellaneous	1,177,485	11.69	0	0
Ventilation	2,109,783	20.95	-2,103,704	42.69
Fan Heat	1,140,255	11.32	0	0
Exhaust Heat	-59,039	-0.59	0	0.00
Reheat	0	0	-1,007,384	20.44
User Oversizing	0	0.00	0	0.00
Grand Totals	10,072,968	100.00	-4,927,857	100.00
Maximum Cooling Load	839 tons			
Maximum Heating Load	4,928 mbh			

MONTHLY COIL LOADS

Alt 1: 2-Stage Centrifu

Month	Cooling Coil Loads (ton-hrs)	Heating Coil Loads (kBtu)
Jan	31,841	411,829
Feb	27,785	376,308
Mar	49,541	311,494
Apr	52,445	216,974
May	103,665	71,238
Jun	134,884	54,131
Jul	128,449	42,123
Aug	137,007	60,569
Sep	102,014	62,377
Oct	50,441	273,265
Nov	47,047	278,333
Dec	34,198	336,543
Total	899,315	2,495,185

SYSTEM LOAD PROFILE

Alt 1: 2-Stage Cent

Percent Design Load	Clg Coil Capacity (tons)	Hours (%)	Hours	Htg Coil Capacity (Btuh)	Hours (%)	Hours	Clg Airflow Capacity (cfm)	Hours (%)	Hours	Htg Airflow Capacity (cfm)	Hours (%)	Hours
0	0.0	65.3	5,724	0	78.9	6,912	0	65.3	5,724	0.0	0.0	0
>0 - 5	42.0	7.6	664	246,393	1.2	107	13,362	0.0	0	0.0	0.0	0
5 - 10	83.9	2.9	253	492,786	1.8	155	26,725	0.0	0	0.0	0.0	0
10 - 15	125.9	1.4	125	739,179	6.9	603	40,087	0.0	0	0.0	0.0	0
15 - 20	167.9	1.9	169	985,571	0.0	0	53,449	11.5	1,005	0.0	0.0	0
20 - 25	209.9	1.2	108	1,231,964	5.1	447	66,812	0.0	0	0.0	0.0	0
25 - 30	251.8	0.7	63	1,478,357	1.4	119	80,174	1.4	124	0.0	0.0	0
30 - 35	293.8	2.1	181	1,724,750	0.2	21	93,537	1.9	167	0.0	0.0	0
35 - 40	335.8	1.9	168	1,971,143	0.5	44	106,899	1.0	86	0.0	0.0	0
40 - 45	377.7	1.9	170	2,217,536	0.0	0	120,261	1.0	87	0.0	0.0	0
45 - 50	419.7	1.5	131	2,463,929	0.0	0	133,624	0.0	0	0.0	0.0	0
50 - 55	461.7	3.0	259	2,710,322	0.0	0	146,986	0.2	20	0.0	0.0	0
55 - 60	503.6	0.9	80	2,956,714	0.0	0	160,348	0.2	20	0.0	0.0	0
60 - 65	545.6	0.5	45	3,203,107	0.5	40	173,711	5.7	499	0.0	0.0	0
65 - 70	587.6	1.0	86	3,449,500	0.0	0	187,073	1.0	85	0.0	0.0	0
70 - 75	629.6	1.0	85	3,695,893	0.5	42	200,435	1.0	89	0.0	0.0	0
75 - 80	671.5	3.0	259	3,942,286	1.9	170	213,798	1.7	149	0.0	0.0	0
80 - 85	713.5	2.2	190	4,188,679	0.9	79	227,160	2.2	190	0.0	0.0	0
85 - 90	755.5	0.0	0	4,435,072	0.2	21	240,522	4.6	405	0.0	0.0	0
90 - 95	797.4	0.0	0	4,681,464	0.0	0	253,885	1.3	110	0.0	0.0	0
95 - 100	839.4	0.0	0	4,927,857	0.0	0	267,247	0.0	0	0.0	0.0	0
> 0		34.7	3,036		21.1	1,848		34.7	3,036		100.0	0

EQUIPMENT ENERGY CONSUMPTION

Alt 1: 2-Stage (

Month	Main Clg (kBtu)	Clg Aux (kBtu)	Clg Twr (kBtu)	Main Htg (kBtu)	Htg Aux (kBtu)	Fan Equip (kBtu)	Lights (kBtu)	Misc Equip (kBtu)	BaseUtil & Dhw (kBtu)	Bldg Total (kBtu)
Jan	42,288	51,033	10,028	584,301	10,253	137,511	630,543	225,017	63,292	1,754,268
Feb	37,186	46,173	8,735	537,352	9,643	124,432	570,491	203,587	57,264	1,594,864
Mar	66,025	65,209	19,472	449,092	7,487	186,151	690,595	246,448	69,320	1,799,798
Apr	67,919	64,804	28,653	320,784	5,696	182,313	600,517	214,302	60,278	1,545,267
May	132,947	75,740	38,339	122,521	4,476	286,460	660,569	235,732	66,306	1,623,090
Jun	192,597	89,105	47,544	93,218	3,581	345,059	660,569	235,732	66,306	1,733,712
Jul	189,388	85,055	45,383	72,806	2,441	302,393	600,517	214,302	60,278	1,572,565
Aug	194,228	93,156	49,705	104,607	3,743	340,437	690,595	246,448	69,320	1,792,240
Sep	135,195	72,904	38,754	107,195	4,069	277,728	600,517	214,302	60,278	1,510,943
Oct	67,163	66,829	25,787	400,712	7,161	175,151	660,569	235,732	66,306	1,705,412
Nov	62,675	59,539	21,228	404,962	7,690	163,749	630,543	225,017	63,292	1,638,696
Dec	45,554	48,603	11,812	485,071	8,951	135,089	600,517	214,302	60,278	1,610,179
Total	1,233,166	818,149	345,441	3,682,622	75,192	2,656,473	7,596,544	2,710,924	762,522	19,881,033

MONTHLY ENERGY CONSUMPTION BY UTILITY

Alt 1: 2-Stage (

Month	On Peak Elec Demand (kW)	Off Peak Elec Demand (kW)	On Peak Elec Consumption (kWh)	Off Peak Elec Consumption (kWh)	Total Elec Consumption (kWh)	Gas Consumption (therms)
Jan	1,653	86	322,441	1,811	324,253	6,476
Feb	1,649	86	291,324	1,746	293,070	5,946
Mar	1,958	86	373,459	1,984	375,443	5,184
Apr	2,057	86	339,384	1,725	341,109	3,811
May	2,143	86	418,338	1,898	420,235	1,888
Jun	2,254	86	459,335	1,898	461,233	1,595
Jul	2,257	86	420,039	1,725	421,764	1,331
Aug	2,261	86	472,178	1,984	474,161	1,739
Sep	2,280	86	391,908	1,725	393,633	1,675
Oct	1,956	86	360,948	1,898	362,846	4,670
Nov	1,933	86	341,125	1,811	342,936	4,683
Dec	1,714	86	310,267	1,725	311,992	5,453
Total	2,280	86	4,500,746	21,929	4,522,675	44,451

APPENDIX C

The following code and guidelines are to provide more clarity for information and analysis provided in this study. Items "bubbled" are to provide emphasis only. This does not mean disregard other pertinent information present on the pages.

901.3.3 Calculations: The areas shall be determined from the actual floor plans for the facility. Section 701A further describes the factors and methods for calculation of floor areas.

Assignable square feet (ASF) as a percentage of gross square feet (GSF) shall be no less than the ratios listed below. Exceptions to these building efficiency factors must be approved by the Director of the Department of General Services. Requests must be supported by written justification submitted by the agency stating why these ratios cannot be obtained.

901.3.4 Building Efficiency Ratios

Building Type	Ratio: ASF to GSF	
Office Building w/partitioned offices	70%	REQUIRED
Office Building w/open office layout	90%	
Classroom Building	66%	
Classroom & Office Building	66%	
Health/Fitness Building with gymnasium & classrooms	85%	
Health/Fitness Building (gyms, classrooms, pool, handball courts)	80%	
Hospital or Infirmary	60%	
Engineering/Laboratory Building	72%	
Instructional Shop Building	90%	
Library Building	75%	
Fine Arts Building	72%	
Science Building w/Laboratories	65%	
Physical Plant Service Building	85%	
Student Union	75%	
Dormitory Housing w/ common use toilets	65%	
Apartment or Townhouse Style Housing	90%	

Suite Style Housing w/ private toilets	80%
Auditorium / Theater	70%
Dining Facility	72%
Warehouse	93%
Maintenance Garage	85%

901.4. Energy Conservation Guidelines for Design and Operation

The following guidelines shall be considered by the Agency and the A/E when developing the criteria for the design and operation of the facility.

901.4.1 Architectural

- Comply with Mechanical Design Standards for energy conservation in Section 715A
- Reduce electrical energy consumption within the building by using natural light. Locate windows high in wall to increase ceiling reflection, where practicable.
- Use light color materials for walls and ceiling.
- Use adequate insulation and light colored or reflective roof surface.

901.4.2 Heating Ventilation and Air Conditioning

- Use activated charcoal filters or other efficient systems as approved by BCOM when odor control is required.
- Evaluate heat recovery; employ when economically feasible.
- Use hot and chilled water temperature reset controls.
- Size pumps, fans, chillers etc. to design load; do not oversize.
- Use variable speed drives on VAV fans.
- Use electric ignition instead of pilots.

TABLE 503
ALLOWABLE HEIGHT AND BUILDING AREAS
Height limitations shown as stories and feet above grade plane.
Area limitations as determined by the definition of "Area, building," per floor.

		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
GROUP	HGT(feet) / Hgt(S)	UL	160	65	55	65	55	65	50	40
A-1	S	UL	5	3	2	3	2	3	2	1
	A	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	5,500
A-2	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-3	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-4	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
A-5	S	UL	UL	UL	UL	UL	UL	UL	UL	UL
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	S	UL	11	5	4	5	4	5	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
E	S	UL	5	3	2	3	2	3	1	1
	A	UL	UL	26,500	14,500	23,500	14,500	25,500	18,500	9,500
F-1	S	UL	11	4	2	3	2	4	2	1
	A	UL	UL	25,000	15,500	19,000	12,000	33,500	14,000	8,500
F-2	S	UL	11	5	3	4	3	5	3	2
	A	UL	UL	37,500	23,000	28,500	18,000	50,500	21,000	13,000
H-1	S	1	1	1	1	1	1	1	1	NP
	A	21,000	16,500	11,000	7,000	9,500	7,000	10,500	7,500	NP
H-2	S	UL	3	2	1	2	1	2	1	1
	A	21,000	16,500	11,000	7,000	9,500	7,000	10,500	7,500	3,000
H-3	S	UL	6	4	2	4	2	4	2	1
	A	UL	60,000	26,500	14,000	17,500	13,000	25,500	10,000	5,000
H-4	S	UL	7	5	3	5	3	5	3	2
	A	UL	UL	37,500	17,500	28,500	17,500	36,000	18,000	6,500
H-5	S	3	3	3	3	3	3	3	3	2
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
I-1	S	UL	9	4	3	4	3	4	3	2
	A	UL	55,000	19,000	10,000	16,500	10,000	18,000	10,500	4,500
I-2	S	UL	4	2	1	1	Np	1	1	NP
	A	UL	UL	15,000	11,000	12,000	Np	12,000	9,500	NP
I-3	S	UL	4	2	1	2	1	2	2	1
	A	UL	UL	15,000	11,000	10,500	7,500	12,000	7,500	5,000
I-4	S	UL	5	3	2	3	2	3	1	1
	A	UL	60,500	26,500	13,000	23,500	13,000	25,500	18,500	9,000
M	S	UL	11	4	4	4	4	4	3	1
	A	UL	UL	21,500	12,500	18,500	12,500	20,500	14,000	9,000
R-1	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
R-2[a]	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
R-3[a]	S	UL	11	4	4	4	4	4	3	3
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
R-4	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
S-1	S	UL	11	4	3	3	3	4	3	1
	A	UL	48,000	26,000	17,500	26,000	17,500	25,500	14,000	9,000
S-2	S	UL	11	5	4	4	4	5	4	2
	A	UL	79,000	39,000	26,000	39,000	26,000	38,500	21,000	13,500
U	S	UL	5	4	2	3	2	4	2	1
	A	UL	35,500	19,000	8,500	14,000	8,500	18,000	9,000	5,500

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2.
UL = Unlimited
a. As applicable in Section 101.2.

CHAPTER 6
TYPES OF CONSTRUCTION

SECTION 601
GENERAL

601.1 Scope. The provisions of this chapter shall control the classification of buildings as to type of construction.

SECTION 602
CONSTRUCTION CLASSIFICATION

602.1 General. Buildings and structures erected or to be erected, altered or extended in height or area shall be classified in one of the five construction types defined in Sections 602.2 through 602.5. The building elements shall have a fire resistance rating not less than that specified in Table 601 and exterior walls shall have a fire-resistance rating not less than that specified in Table 602.

602.1.1 Minimum requirements. A building or portion thereof shall not be required to conform to the details of a type of construction higher than that type, which meets the minimum requirements based on occupancy even though certain features of such a building actually conform to a higher type of construction.

602.2 Types I and II. Types I and II construction are those types of construction in which the building elements listed in Table 601 are of noncombustible materials.

602.3 Type III. Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. Fire-retardant-treated wood framing complying with Section 2303.2 shall be permitted within exterior wall assemblies of a 2-hour rating or less.

602.4 Type IV. Type IV construction (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. The details of Type IV construction shall comply with the provisions of this section. Fire-retardant-treated wood framing complying with Section 2303.2 shall be permitted within exterior wall assemblies with a 2-hour rating or less.

602.4.1 Columns. Wood columns shall be sawn or glued laminated and shall not be less than 8 inches (203 mm), nominal, in any dimension where supporting floor loads and not less than 6 inches (152 mm) nominal in width and not less than 8 inches (203 mm) nominal in depth where supporting roof and ceiling loads only. Columns shall be continuous or superimposed and connected in an approved manner.

602.4.2 Floor framing. Wood beams and girders shall be of sawn or glued laminated timber and shall be not less than 6 inches (152 mm) nominal in width and not less than 10 inches (254 mm) nominal in depth. Framed sawn or glued laminated timber arches, which spring from the floor line and support floor loads, shall be not less than 8 inches (203 mm) nominal in any dimension. Framed timber trusses supporting floor loads shall have members of not less than 8 inches (203 mm) nominal in any dimension.

602.4.3 Roof framing. Wood-framed or glued laminated-arches for roof construction, which spring from the floor line or from grade and do not support floor loads shall have members not less than 6 inches (152 mm) nominal in width and have less than 8 inches (203 mm) nominal in depth for the lower half of the height and not less than 6 inches (152 mm) nominal in depth for the upper half. Framed or glued laminated arches for roof construction that spring from the top of walls or wall abutments, framed timber trusses and other roof framing, which do not support floor loads, shall have members not less than 4 inches (102 mm) nominal in width and not less than 6 inches (152 mm) nominal in depth. Spaced members may be composed of two or more pieces not less than 3 inches (76 mm) nominal in thickness where blocked solidly throughout their intervening spaces or where spaces are tightly closed by a continuous wood cover plate of not less than 2 inches (51 mm) nominal in thickness secured to the underside of the members. Splice plates shall be not less than 3 inches (76 mm) nominal in thickness. Where protected by approved automatic sprinklers under the roof deck, framing members shall be not less than 3 inches (76 mm) nominal in width.

602.4.4 Floors. Floors shall be without concealed spaces. Wood floors shall be of sawn or glued laminated planks, splined, or tongue-and-groove, of not less than 3 inches (76 mm) nominal in thickness covered with 1-inch (25 mm) nominal dimension tongue-and-groove flooring, laid crosswise or diagonally, or 0.5-inch (12.7 mm) particle board or planks not less than 4 inches (102 mm) nominal in width set on edge close together and well spiked and covered with 1-inch (25 mm) nominal dimension flooring or $^1/_2$-inch (12.7 mm) wood structural panel or 0.5-inch (12.7 mm) particle board. The lumber shall be laid so that no continuous line of joints will occur except at points of support. Floors shall not extend closer than 0.5 inch (12.7 mm) to walls. Such 0.5-inch (12.7 mm) space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinkage movements of the floor. Corbeling of masonry walls under the floor may be used in place of molding.

602.4.5 Roofs. Roofs shall be without concealed spaces and wood roof decks shall be sawn or glued laminated, splined or tongue-and-groove plank, not less than 2 inches (51 mm) thick, $1^1/_8$ (32 mm)-inch-thick wood structural panel (exterior glue), or of planks not less than 3 inches (76 mm) nominal wide, set on edge close together and laid as required for floors. Other types of decking may be used if providing equivalent fire resistance and structural properties.

602.4.6 Partitions. Partitions shall be of solid wood construction formed by not less than two layers of 1-inch (25 mm) matched boards or laminated construction 4 inches (102 mm) thick, or of 1-hour fire-resistance-rated construction.

602.4.7 Exterior structural members. Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes may be used externally.

602.5 Type V. Type V construction is that type of construction in which the structural elements, exterior walls and interior walls are of any materials permitted by this code.

SECTION 603 COMBUSTIBLE MATERIAL IN TYPES I AND II CONSTRUCTION

603.1 Allowable uses. Combustible materials are permitted in buildings of Type I and Type II construction in the following applications:

1. Fire-retardant-treated wood shall be permitted in:
   1.1. Nonbearing partitions where the required fire-resistance rating is 2 hours or less.
   1.2. Nonbearing exterior walls where no fire rating is required.
   1.3. Roof construction as permitted in Table 601, Note c, Item 3.
2. Thermal and acoustical insulation, other than foam plastics, having a flame spread index of not more than 25.

   Exceptions:

   1. Insulation placed between two layers of noncombustible materials without an intervening airspace shall be allowed to have a flame spread index of not more than 100.
   2. Insulation installed between a finished floor and solid decking without intervening airspace shall be allowed to have a flame spread index of not more than 200.
3. Foam plastics in accordance with Chapter 26.
4. Roof coverings that have an A, B or C classification.
5. Interior floor finish and interior finish, trim and millwork such as doors, door frames, window sashes and frames.
6. Where not installed over 15 feet (4572 mm) above grade, show windows, nailing or furring strips, wooden bulkheads below show windows, their frames, aprons and show cases.
7. Finish flooring applied directly to the floor slab or to wood sleepers that are firestopped in accordance with Section 716.2.7.
8. Partitions dividing portions of stores, offices or similar places occupied by one tenant only and which do not establish a corridor serving an occupant load of 30 or more may be constructed of fire-retardant-treated wood, 1-hour fire-resistance-rated construction or of wood panels or similar light construction up to 6 feet (1829 mm) in height.
9. Platforms as permitted in Section 410.
10. Materials complying with Section 602 of the *International Mechanical Code*.
11. Combustible exterior wall coverings, balconies, bay or oriel windows, or similar appendages in accordance with Chapter 14.
12. Blocking such as for handrails, millwork, cabinets, and window and door frames.
13. Light-transmitting plastics as permitted by Chapter 26.
14. Mastics and caulking materials applied to provide flexible seals between components of exterior wall construction.
15. Exterior plastic veneer installed in accordance with Section 2605.2.
16. Nailing or furring strips as permitted by Section 803.3.
17. Heavy timber as permitted by Note c, Item 2, to Table 601 and Sections 602.4.7 and 1406.3.
18. Aggregates, component materials and admixtures as permitted by Section 703.2.2.
19. Sprayed cementitious and mineral fiber fire-resistance-rated materials installed to comply with Section 1704.11.
20. Materials used to protect penetrations in fire-resistance-rated assemblies in accordance with Section 711.
21. Materials used to protect joints in fire-resistance-rated assemblies in accordance with Section 712.
22. Materials allowed in the concealed spaces of buildings of Types I and II construction in accordance with Section 716.5.

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (hours)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A[d]	B	A	B	HT	A[d]	B
Structural frame[a] Including columns, girders, trusses	3[b]	2[b]	1	0	1	0	HT	1	0
Bearing walls Exterior[f] Interior	 3 3[b]	 2 2[b]	 1 1	 0 0	 2 1	 2 0	 2 1/HT	 1 1	 0 0
Nonbearing walls and partitions Exterior Interior[e]	 See Table 602 See Section 602								
Floor construction Including supporting beams and joists	2	2	1	0	1	0	HT	1	0
Roof construction Including supporting beams and joists	$1^1/_2$[c]	1[c]	1[c]	0	1[c]	0	HT	1[c]	0

For SI: 1 foot = 304.8 mm.

a. The structural frame shall be considered to be the columns and the girders, beams, trusses and spandrels having direct connections to the columns and bracing members designed to carry gravity loads. The members of floor or roof panels which have no connection to the columns shall be considered secondary members and not a part of the structural frame.

b. Roof supports: Fire-resistance ratings of structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

c. 1. Except in Factory-Industrial (F-1), Hazardous (H), Mercantile (M) and Moderate-Hazard Storage (S-1) occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

2. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.

3. In Type I and Type II construction, fire-retardant-treated wood shall be allowed in buildings not over two stories including girders and trusses as part of the roof construction.

d. An approved automatic sprinkler system in accordance with Section 903.3.1.1 shall be allowed to be substituted for 1-hour fire-resistance-rated construction, provided such system is not otherwise required by other provisions of the code or used for an allowable area increase in accordance with Section 506.3 or an allowable height increase in accordance with Section 504.2. The 1-hour substitution for the fire resistance of exterior walls shall not be permitted.

e. For interior nonbearing partitions in Type IV construction, also see Section 602.4.6.

f. Not less than the fire-resistance rating based on fire separation distance (see Table 602).

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a]

FIRE SEPARATION DISTANCE (feet)	TYPE OF CONSTRUCTION	GROUP H	GROUP F-1, M, S-1	GROUP A, B, E, F-2, I, R[b], S-2, U
< 5[c]	All	3	2	1
≥ 5 < 10	IA Others	3 2	2 1	1 1
≥ 10 < 30	IA, IB IIB, VB Others	2 1 1	1 0 1	1 0 1
≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.

b. Group R-3 and Group U when used as accessory to Group R-3, as applicable in Section 101.2 shall not be required to have a fire-resistance rating where fire separation distance is 3 feet or more.

c. See Section 503.2 for party walls.

and size that, for purposes of moving or storing, is capable of being reduced without being dismantled.

FOOTBOARDS. The walking surface of aisle accessways in reviewing stands, grandstands and bleachers.

GRANDSTAND. A structure providing tiered or stepped seating.

GUARD. A building component or a system of building components located at or near the open sides of elevated walking surfaces that minimizes the possibility of a fall from the walking surface to a lower level.

HANDRAIL. A horizontal or sloping rail intended for grasping by the hand for guidance or support.

MEANS OF EGRESS. A continuous and unobstructed path of vertical and horizontal egress travel from any point in a building or structure to a public way. A means of egress consists of three separate and distinct parts: the exit access, the exit and the exit discharge.

NOSING. The leading edge of treads of stairs and of landings at the top of stairway flights.

OCCUPANT LOAD. The number of persons for which the means of egress of a building or portion thereof is designed.

OPEN AIR SEATING GRANDSTANDS AND BLEACHERS. Seating facilities that are located so that the side toward which the audience faces is unroofed and without an enclosing wall.

PANIC HARDWARE. A door-latching assembly incorporating a device that releases the latch upon the application of a force in the direction of egress travel.

PUBLIC WAY. A street, alley or other parcel of land open to the outside air leading to a street, that has been deeded, dedicated or otherwise permanently appropriated to the public for public use and which has a clear width and height of not less than 10 feet (3048 mm).

RAMP. A walking surface that has a running slope steeper than one unit vertical in 20 units horizontal (5 percent slope).

REVIEWING STANDS. Elevated platforms that accommodate not more than 50 persons.

SMOKE-PROTECTED ASSEMBLY SEATING. Seating served by means of egress that is not subject to smoke accumulation within or under a structure.

STAIR. A change in elevation, consisting of one or more risers.

STAIRWAY. One or more flights of stairs, either exterior or interior, with the necessary landings and platforms connecting them, to form a continuous and uninterrupted passage from one level to another.

STAIRWAY, EXTERIOR. A stairway that is open on at least one side, except for required structural columns, beams, handrails, and guards. The adjoining open areas shall be either yards, courts or public ways. The other sides of the exterior stairway need not be open.

STAIRWAY, INTERIOR. A stairway not meeting the definition of an exterior stairway.

STAIRWAY, SPIRAL. A stairway having a closed circular form in its plan view with uniform section-shaped treads attached to and radiating about a minimum-diameter supporting column.

SECTION 1003
GENERAL MEANS OF EGRESS

1003.1 General requirements. The general requirements specified in this section shall apply to all three elements of the means of egress system, in addition to those specific requirements for the exit access, the exit and the exit discharge detailed elsewhere in this chapter.

1003.2 System design requirements. The means of egress system shall comply with the design requirements of Sections 1003.2.1 through 1003.2.13.7.1.

1003.2.1 Multiple occupancies. Where a building contains two or more occupancies, the means of egress requirements shall apply to each portion of the building based on the occupancy of that space. Where two or more occupancies utilize portions of the same means of egress system, those egress components shall meet the more stringent requirements of all occupancies that are served.

1003.2.2 Design occupant load. In determining means of egress requirements, the number of occupants for whom means of egress facilities shall be provided shall be established by the largest number computed in accordance with Sections 1003.2.2.1 through 1003.2.2.3.

1003.2.2.1 Actual number. The actual number of occupants for whom each occupied space, floor or building is designed.

1003.2.2.2 Number by Table 1003.2.2.2. The number of occupants computed at the rate of one occupant per unit of area as prescribed in Table 1003.2.2.2.

TABLE 1003.2.2.2
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

OCCUPANCY	FLOOR AREA IN SQ. FT. PER OCCUPANT
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	100 gross
Baggage handling	15 gross
Concourse	20 gross
Waiting areas	300 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Assembly with fixed seats	See Section 1003.2.2.9
Assembly without fixed seats	
Concentrated (chairs only—not fixed)	7 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	100 gross
Courtrooms—other than fixed seating areas	40 net
Dormitories	50 gross

(continued)

distinctive marking stripe shall be visible in descent of the stair and shall have a slip-resistant surface. Marking stripes shall have a width of at least 1 inch (25.4 mm) but not more than 2 inches (51 mm).

1003.3.3.3.2 Profile. The radius of curvature at the leading edge of the tread shall be not greater than 0.5 inch (12.7 mm). Beveling of nosings shall not exceed 0.5 inch (12.7 mm). Risers shall be solid and vertical or sloped from the underside of the leading edge of the tread above at an angle not more than 30 degrees (0.52 rad) from the vertical. The leading edge (nosings) of treads shall project not more than 1.25 inches (32 mm) beyond the tread below and all projections of the leading edges shall be of uniform size, including the leading edge of the floor at the top of a flight.

Exceptions:

1. Solid risers are not required for stairways that are not required to comply with Section 1003.2.13.2, provided that the opening between treads does not permit the passage of a sphere with a diameter of 4 inches (102 mm).
2. Solid risers are not required for occupancies in Group I-3.

1003.3.3.4 Stairway landings. There shall be a floor or landing at the top and bottom of each stairway. The width of landings shall not be less than the width of stairways they serve. Every landing shall have a minimum dimension measured in the direction of travel equal to the width of the stairway. Such dimension need not exceed 48 inches (1219 mm) where the stairway has a straight run.

Exceptions:

1. Aisle stairs complying with Section 1008.
2. Doors opening onto a landing shall not reduce the landing to less than one-half the required width. When fully open, the door shall not project more than 7 inches (178 mm) into a landing.

1003.3.3.5 Stairway construction. All stairways shall be built of materials consistent with the types permitted for the type of construction of the building, except that wood handrails shall be permitted for all types of construction.

1003.3.3.5.1 Stairway walking surface. The walking surface of treads and landings of a stairway shall not be sloped steeper than one unit vertical in 48 units horizontal (2-percent slope) in any direction. Stairway landings shall have a solid surface. Finish floor surfaces shall be securely attached.

Exception: In Group F, H and S occupancies, other than areas of parking structures accessible to the public, openings in treads and landing platforms shall not be prohibited provided a sphere with a diameter of 1.125 inches (29 mm) cannot pass through the opening.

1003.3.3.5.2 Outdoor conditions. Outdoor stairways and outdoor approaches to stairways shall be designed so that water will not accumulate on walking surfaces. In other than occupancies in Group R-3, and occupancies in Group U that are accessory to an occupancy in Group R-3, treads, platforms and landings that are part of exterior stairways in climates subject to snow or ice shall be protected to prevent the accumulation of same.

1003.3.3.6 Vertical rise. A flight of stairs shall not have a vertical rise greater than 12 feet (3658 mm) between floor levels or landings.

Exception: Aisle stairs complying with Section 1008.

1003.3.3.7 Circular stairways. Circular stairways shall have a minimum tread depth and a maximum riser height in accordance with Section 1003.3.3.3 and the smaller radius shall not be less than twice the width of the stairway. The minimum tread depth measured 12 inches (305 mm) from the narrower end of the tread shall not be less than 11 inches (279 mm). The minimum tread depth at the narrow end shall not be less than 10 inches (254 mm).

Exception: For occupancies in Group R-3, and within individual dwelling units in occupancies in Group R-2, both as applicable in Section 101.2, the smaller radius restriction shall not apply and the minimum tread depth at the narrow end shall not be less than 6 inches (152 mm).

1003.3.3.8 Winders. Winders are not permitted in means of egress stairways except within a dwelling unit. Winders shall have a tread depth of not less than 11 inches (279 mm) at a point not more than 12 inches (305 mm) from the narrow edge. The minimum tread depth shall not be less than 6 inches (152 mm).

1003.3.3.9 Spiral stairways. Spiral stairways are permitted to be used as a component in the means of egress only within dwelling units or from a space not more than 250 square feet (23 m^2) in area and serving not more than five occupants, or from galleries, catwalks, and gridirons in accordance with Section 1007.5.

A spiral stairway shall have a 7.5-inch (191 mm) minimum clear tread depth at a point 12 inches (305 mm) from the narrow edge. The risers shall be sufficient to provide a headroom of 78 inches (1981 mm) minimum, but riser height shall not be more than 9.5 inches (241 mm). The minimum stairway width shall be 26 inches (660 mm).

1003.3.3.10 Alternating tread devices. Alternating tread devices are limited to an element of a means of egress in buildings of Groups F, H and S from a mezzanine not more than 250 square feet (23 m^2) in area and which serves not more than five occupants; in buildings of Group I-3 from a guard tower, observation station or control room not more than 250 square feet (23 m^2) in area; and for access to unoccupied roofs.

1003.3.3.10.1 Handrails of alternating tread devices. Handrails shall be provided on both sides of al-

1003.3.2 Gates. Gates serving the means of egress system shall comply with the requirements of this section. Gates used as a component in a means of egress shall conform to the applicable requirements for doors.

Exception: Horizontal sliding or swinging gates exceeding the 4-foot maximum (1219 mm) leaf width limitation are permitted in fences and walls surrounding a stadium.

1003.3.2.1 Stadiums. Panic hardware is not required on gates surrounding stadiums where such gates are under constant immediate supervision while the public is present, and further provided that safe dispersal areas based on 3 square feet (0.28 m²) per occupant are located between the fence and enclosed space. Such required safe dispersal areas shall not be located less than 50 feet (15 240 mm) from the enclosed space. See Section 1005 for means of egress from safe dispersal areas.

1003.3.2.2 Educational uses. School grounds are permitted to be fenced and gates therein are permitted to be equipped with locks, provided that safe dispersal areas based on 3 square feet (0.28 m²) per occupant are located between the school and the fence. Such required safe dispersal areas shall not be located less than 50 feet (15 240 mm) from school buildings. See Section 1005 for means of egress from safe dispersal areas.

1003.3.3 Stairways. Stairways shall comply with Sections 1003.3.3.1 through 1003.3.3.12.1.

1003.3.3.1 Stairway width. The width of stairways shall be determined as specified in Section 1003.2.3 but such width shall not be less than 44 inches (1118 mm). See Section 1003.2.13.2 for accessible means of egress stairways.

Exceptions:

1. Stairways serving an occupant load of 50 or less shall have a width of not less than 36 inches (914 mm).
2. Spiral stairways as provided for in Section 1003.3.3.9.
3. Aisle stairs complying with Section 1008.
4. Where a stairway lift is installed on stairways serving occupancies in Group R-3, or within dwelling units in occupancies in Group R-2, both as applicable in Section 101.2, a clear passage width not less than 20 inches (508 mm) shall be provided.

1003.3.3.2 Headroom. Stairways shall have a minimum headroom clearance of 80 inches (2032 mm) measured vertically from a line connecting the edge of the nosings. Such headroom shall be continuous above the stairway to the point where the line intersects the landing below, one tread depth beyond the bottom riser. The minimum clearance shall be maintained the full width of the stairway and landing.

Exception: Spiral stairways complying with Section 1003.3.3.9 are permitted a 78-inch (1981 mm) headroom clearance.

1003.3.3.3 Stair treads and risers. Stair riser heights shall be 7 inches (178 mm) maximum and 4 inches (102 mm) minimum. Stair tread depths shall be 11 inches (279 mm) minimum. The riser height shall be measured vertically between the leading edges of adjacent treads. The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at right angle to the tread's leading edge.

Exceptions:

1. Circular stairways in accordance with Section 1003.3.3.7.
2. Winders in accordance with Section 1003.3.3.8.
3. Spiral stairways in accordance with Section 1003.3.3.9.
4. Aisle stairs in assembly seating areas where the stair pitch or slope is set, for sightline reasons, by the slope of the adjacent seating area in accordance with Section 1008.9.2.
5. In occupancies in Group R-3, as applicable in Section 101.2, within dwelling units in occupancies in Group R-2, as applicable in Section 101.2, and in occupancies in Group U, which are accessory to an occupancy in Group R-3, as applicable in Section 101.2, the maximum riser height shall be 7.75 inches (197 mm) and the minimum tread depth shall be 10 inches (254 mm). A nosing not less than 0.75 inch (19.1 mm) but not more than 1.25 inches (32 mm) shall be provided on stairways with solid risers where the tread depth is less than 11 inches (279 mm).
6. See Section 3402.4 for the replacement of existing stairways.

1003.3.3.3.1 Dimensional uniformity. Stair treads and risers shall be of uniform size and shape. The tolerance between the largest and smallest riser or between the largest and smallest tread shall not exceed 0.375 inch (9.5 mm) in any flight of stairs.

Exceptions:

1. Nonuniform riser dimensions of aisle stairs complying with Section 1008.9.2.
2. Consistently shaped winders, complying with Section 1003.3.3.8, differing from rectangular treads in the same stairway flight.

Where the bottom or top riser adjoins a sloping public way, walkway or driveway having an established grade and serving as a landing, the bottom or top riser is permitted to be reduced along the slope to less than 4 inches (102 mm) in height with the variation in height of the bottom or top riser not to exceed one unit vertical in 12 units horizontal (8-percent slope) of stairway width. The nosings or leading edges of treads at such nonuniform height risers shall have a distinctive marking stripe, different from any other nosing marking provided on the stair flight. The

1003.3.3.12.1 Roof access. Where a stairway is provided to a roof, access to the roof shall be provided through a penthouse complying with Section 1509.2.

Exception: In buildings without an occupied roof, access to the roof shall be permitted to be a roof hatch or trap door not less than 16 square feet (1.5 m²) in area and having a minimum dimension of 2 feet (610 mm).

1003.3.4 Ramps. Ramps used as a component of a means of egress shall conform to the provisions of Sections 1003.3.4.1 through 1003.3.4.9.

Exceptions:

1. Ramped aisles within assembly rooms or spaces shall conform to the provisions in Section 1008.9.
2. Curb ramps shall comply with ICC A117.1.

1003.3.4.1 Slope. Ramps used as part of a means of egress shall have a running slope not steeper than one unit vertical in 12 units horizontal (8-percent slope). The slope of other ramps shall not be steeper than one unit vertical in eight units horizontal (12.5-percent slope).

Exception: Aisle ramp slope in occupancies of Group A shall comply with Section 1008.9.

1003.3.4.2 Cross slope. The slope measured perpendicular to the direction of travel of a ramp shall not be steeper than one unit vertical in 48 units horizontal (2-percent slope).

1003.3.4.3 Rise. The rise for any ramp shall be 30 inches (762 mm) maximum.

1003.3.4.4 Minimum dimensions. The minimum dimensions of means of egress ramps shall comply with Sections 1003.3.4.4.1 through 1003.3.4.4.3.

1003.3.4.4.1 Width. The minimum width of a means of egress ramp shall not be less than that required for corridors by Section 1004.3.2.2. The clear width of a ramp and the clear width between handrails, if provided, shall be 36 inches (914 mm) minimum.

1003.3.4.4.2 Headroom. The minimum headroom in all parts of the means of egress ramp shall not be less than 80 inches (2032 mm).

1003.3.4.4.3 Restrictions. Means of egress ramps shall not reduce in width in the direction of egress travel. Projections into the required ramp and landing width are prohibited. Doors opening onto a landing shall not reduce the clear width to less than 42 inches (1067 mm).

1003.3.4.5 Landings. Ramps shall have landings at the bottom and top of each ramp, points of turning, entrance, exits and at doors. Landings shall comply with Sections 1003.3.4.5.1 through 1003.3.4.5.5.

1003.3.4.5.1 Slope. Landings shall have a slope not steeper than one unit vertical in 48 units horizontal (2-percent slope) in any direction. Changes in level are not permitted.

1003.3.4.5.2 Width. The landing shall be at least as wide as the widest ramp run adjoining the landing.

1003.3.4.5.3 Length. The landing length shall be 60 inches (1525 mm) minimum.

Exception: Landings in nonaccessible Group R-2 and R-3 individual dwelling units, as applicable in Section 101.2, are permitted to be 36 inches (914 mm) minimum.

1003.3.4.5.4 Change in direction. Where changes in direction of travel occur at landings provided between ramp runs, the landing shall be 60 inches (1524 mm) minimum by 60 inches (1524 mm) minimum.

Exception: Landings in nonaccessible Group R-2 and R-3 individual dwelling units, as applicable in Section 101.2, are permitted to be 36 inches (914 mm) by 36 inches (914 mm) minimum.

1003.3.4.5.5 Doorways. Where doorways are located adjacent to a ramp landing, maneuvering clearances required by ICC A117.1 are permitted to overlap the required landing area.

1003.3.4.6 Ramp construction. All ramps shall be built of materials consistent with the types permitted for the type of construction of the building; except that wood handrails shall be permitted for all types of construction. Ramps used as an exit shall conform to the applicable requirements of Sections 1005.3.2 and 1005.3.4 for vertical exit enclosures.

1003.3.4.6.1 Ramp surface. The surface of ramps shall be of slip-resistant materials that are securely attached.

1003.3.4.6.2 Outdoor conditions. Outdoor ramps and outdoor approaches to ramps shall be designed so that water will not accumulate on walking surfaces. In other than occupancies in Group R-3, and occupancies in Group U that are accessory to an occupancy in Group R-3, surfaces and landings which are part of exterior ramps in climates subject to snow or ice shall be designed to minimize the accumulation of same.

1003.3.4.7 Handrails. Ramps with a rise greater than 6 inches (152 mm) shall have handrails on both sides complying with Section 1003.3.3.11.

1003.3.4.8 Edge protection. Edge protection complying with Section 1003.3.4.8.1 or 1003.3.4.8.2 shall be provided on each side of ramp runs and at each side of ramp landings.

Exceptions:

1. Edge protection is not required on ramps not required to have handrails, provided they have flared sides that comply with the ICC A117.1 curb ramp provisions.
2. Edge protection is not required on the sides of ramp landings serving an adjoining ramp run or stairway.
3. Edge protection is not required on the sides of ramp landings having a vertical dropoff of not

ternating tread devices and shall conform to Section 1003.3.3.11.

1003.3.3.10.2 Treads of alternating tread devices. Alternating tread devices shall have a minimum projected tread of 5 inches (127 mm), a minimum tread depth of 8.5 inches (216 mm), a minimum tread width of 7 inches (178 mm) and a maximum riser height of 9.5 inches (241 mm). The initial tread of the device shall begin at the same elevation as the platform, landing or floor surface.

> **Exception:** Alternating tread devices used as an element of a means of egress in buildings from a mezzanine area not more than 250 square feet (23 m^2) in area which serves not more than five occupants shall have a minimum projected tread of 8.5 inches (216 mm) with a minimum tread depth of 10.5 inches (267 mm). The rise to the next alternating tread surface should not be more than 8 inches (203 mm).

1003.3.3.11 Handrails. Stairways shall have handrails on each side. Handrails shall be adequate in strength and attachment in accordance with Section 1607.7.

Exceptions:

1. Aisle stairs provided with a center handrail need not have additional handrails.
2. Stairways within dwelling units, spiral stairways and aisle stairs serving seating only on one side are permitted to have a handrail on one side only.
3. Decks, patios, and walkways that have a single change in elevation where the landing depth on each side of the change of elevation is greater than what is required for a landing do not require handrails.
4. In Group R-3 occupancies, a change in elevation consisting of a single riser at an entrance or egress door does not require handrails.
5. Changes in room elevations of only one riser within dwelling units in Group R-2 and R-3 occupancies do not require handrails.

1003.3.3.11.1 Height. Handrail height, measured above stair tread nosings, or finish surface of ramp slope, shall be uniform, not less than 34 inches (864 mm) and not more than 38 inches (965 mm).

1003.3.3.11.2 Intermediate handrails. Intermediate handrails are required so that all portions of the stairway width required for egress capacity are within 30 inches (762 mm) of a handrail. On monumental stairs, handrails shall be located along the most direct path of egress travel.

1003.3.3.11.3 Handrail graspability. Handrails with a circular cross section shall have an outside diameter of at least 1.25 inches (32 mm) and not greater than 2 inches (51 mm) or shall provide equivalent graspability. If the handrail is not circular, it shall have a perimeter dimension of at least 4 inches (102 mm) and not greater than 6.25 inches (159 mm) with a maximum cross-section dimension of 2.25 inches (57 mm). Edges shall have a minimum radius of 0.125 inch (3.2 mm).

1003.3.3.11.4 Continuity. Handrail-gripping surfaces shall be continuous, without interruption by newel posts or other obstructions.

Exceptions:

1. Handrails within dwelling units are permitted to be interrupted by a newel post at a stair landing.
2. Within a dwelling unit, the use of a volute, turnout or starting easing is allowed on the lowest tread.
3. Handrail brackets or balusters attached to the bottom surface of the handrail that do not project horizontally beyond the sides of the handrail within 1.5 inches (38 mm) of the bottom of the handrail shall not be considered to be obstructions.

1003.3.3.11.5 Handrail extensions. Handrails shall return to a wall, guard or the walking surface or shall be continuous to the handrail of an adjacent stair flight. Where handrails are not continuous between flights, the handrails shall extend horizontally at least 12 inches (305 mm) beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser.

Exceptions:

1. Handrails within a dwelling unit that is not required to be accessible need extend only from the top riser to the bottom riser.
2. Aisle handrails in Group A occupancies in accordance with Section 1008.11.

1003.3.3.11.6 Clearance. Clear space between a handrail and a wall or other surface shall be a minimum of 1.5 inches (38 mm). A handrail and a wall or other surface adjacent to the handrail shall be free of any sharp or abrasive elements.

1003.3.3.11.7 Stairway projections. Projections into the required width at each handrail shall not exceed 4.5 inches (114 mm) at or below the handrail height. Projections into the required width shall not be limited above the minimum headroom height required in Section 1003.3.3.2.

1003.3.3.12 Stairway to roof. In buildings four or more stories in height above grade, one stairway shall extend to the roof surface, unless the roof has a slope steeper than four units vertical in 12 units horizontal (33-percent slope). In buildings without an occupied roof, access to the roof from the top story shall be permitted to be by an alternating tread device.

more than 0.5 inch (12.7 mm) within 10 inches (254 mm) horizontally of the required landing area.

1003.3.4.8.1 Railings. A rail shall be mounted below the handrail 17 to 19 inches (432 to 483 mm) above the ramp or landing surface.

1003.3.4.8.2 Curb or barrier. A curb or barrier shall be provided that prevents the passage of a 4-inch-diameter (102 mm) sphere, where any portion of the sphere is within 4 inches (102 mm) of the floor or ground surface.

1003.3.4.9 Guards. Guards shall be provided where required by Section 1003.2.12 and shall be constructed in accordance with Section 1003.2.12.

1003.3.5 Turnstiles. Turnstiles or similar devices that restrict travel to one direction shall not be placed so as to obstruct any required means of egress.

Exception: Each turnstile or similar device shall be credited with no more than a 50-person capacity where all of the following provisions are met:

1. Each device shall turn free in the direction of egress travel when primary power is lost, and upon the manual release by an employee in the area.
2. Such devices are not given credit for more than 50 percent of the required egress capacity.
3. Each device is not more than 39 inches (991 mm) high.
4. Each device has at least 16.5 inches (419 mm) clear width at and below a height of 39 inches (991 mm) and at least 22 inches (559 mm) clear width at heights above 39 inches (991 mm).

Where located as part of an accessible route, turnstiles shall have at least 36 inches (914 mm) clear at and below a height of 34 inches (864 mm), at least 32 inches (813 mm) clear width between 34 inches (864 mm) and 80 inches (2032 mm) and shall consist of a mechanism other than a revolving device.

1003.3.5.1 High turnstile. Turnstiles more than 39 inches (991 mm) high shall meet the requirements for revolving doors.

1003.3.5.2 Additional door. Where serving an occupant load greater than 300, each turnstile that is not portable shall have a side-hinged swinging door which conforms to Section 1003.3.1 within 50 feet (15 240 mm).

SECTION 1004
EXIT ACCESS

1004.1 General. The exit access arrangement shall comply with Section 1004 and the applicable provisions of Section 1003.

1004.2 Exit access design requirements. The exit access portion of the means of egress system shall comply with the applicable design requirements of Sections 1004.2.1 through 1004.2.5.

1004.2.1 Exit or exit access doorways required. Two exits or exit access doorways from any space shall be provided where one of the following conditions exists:

1. The occupant load of the space exceeds the values in Table 1004.2.1.
2. The common path of egress travel exceeds the limitations of Section 1004.2.5.

Exception: Exit access doors required by Section 1004.2.3.2 for Group I-2 occupancies.

TABLE 1004.2.1
SPACES WITH ONE MEANS OF EGRESS

OCCUPANCY	MAXIMUM OCCUPANT LOAD
A, B, E, F, M, U	50
H-1, H-2, H-3	3
H-4, H-5, I-1, I-3, I-4, R	10
S	30

1004.2.1.1 Three or more exits. Access to three or more exits shall be provided from a floor area where required by Section 1005.2.1.

1004.2.2 Exit or exit access doorway arrangement. Required exits shall be located in a manner that makes their availability obvious. Exits shall be unobstructed at all times. Exit and exit access doorways shall be arranged in accordance with Sections 1004.2.2.1 and 1004.2.2.2.

1004.2.2.1 Two exit or exit access doorways. Where two exits or exit access doorways are required, from any portion of the exit access, the exit doors or exit access doorways shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building or area to be served measured in a straight line between exit doors or exit access doorways.

Exceptions:

1. Where exit enclosures are provided as a portion of the required exit and are interconnected by a 1-hour fire-resistance-rated corridor conforming to the requirements of Section 1004.3.2, the required exit separation shall be measured along a direct line of travel within the corridor. Exit enclosure walls shall not be less than 30 feet (9144 mm) apart at any point in a direct line of measurement.
2. Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2, the separation distance of the exit doors or exit access doorways shall not be less than one-third of the length of the maximum overall diagonal dimension of the area served.

1004.2.2.2 Three or more exits or exit access doorways. Where access to three or more exits is required, at least two exit doors or exit access doorways shall be placed a distance apart equal to not less than one-half of equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the maximum exit access travel distance shall be 400 feet (122 m) for occupancies in Group F-1 or S-1.

1004.2.4.2 Exterior egress balcony increase. Travel distances specified in Section 1004.2.4 shall be increased up to an additional 100 feet (30 480 mm) provided the last portion of the exit access leading to the exit occurs on an exterior egress balcony constructed in accordance with Section 1004.3.3. The length of such balcony shall not be less than the amount of the increase taken.

1004.2.5 Common path of egress travel. In occupancies other than Groups H-1, H-2 and H-3, the common path of egress travel shall not exceed 75 feet (22 860 mm). In occupancies in Groups H-1, H-2, and H-3 the common path of egress travel shall not exceed 25 feet (7620 mm).

Exceptions:

1. The length of a common path of egress travel in an occupancy in Groups B, F and S shall not be more than 100 feet (30 480 mm), provided that the building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.
2. Where a tenant space in an occupancy in Groups B, S and U has an occupant load of not more than 30, the length of a common path of egress travel shall not be more than 100 feet (30 480 mm).
3. The length of a common path of egress travel in occupancies in Group I-3 shall not be more than 100 feet (30 480 mm).

1004.3 Exit access components. Exit access components shall comply with Section 1004 and the applicable requirements of Section 1003.

1004.3.1 Aisles. Aisles serving as a portion of the exit access in the means of egress system shall comply with the requirements of this section. Aisles shall be provided from all occupied portions of the exit access which contain seats, tables, furnishings, displays, and similar fixtures or equipment. Aisles serving assembly areas, other than seating at tables, shall comply with Section 1008. Aisles serving reviewing stands, grandstands and bleachers shall also comply with Section 1008.

The required width of aisles shall be unobstructed.

Exception: Doors, when fully opened, and handrails shall not reduce the required width by more than 7 inches (178 mm). Doors in any position shall not reduce the required width by more than one-half. Other nonstructural projections such as trim and similar decorative features are permitted to project into the required width 1.5 inches (38 mm) from each side.

1004.3.1.1 Public areas Group B and M. In public areas of Group B and M occupancies, the minimum clear aisle width shall be 36 inches (914 mm) where seats, tables, furnishings, displays and similar fixtures or equipment are placed on only one side of the aisle and 44 inches (1118 mm) where such fixtures or equipment are placed on both sides of the aisle.

1004.3.1.2 Nonpublic areas. In nonpublic areas, aisle widths shall be a minimum of 36 inches (914 mm).

Exception: Nonpublic aisles serving less than 50 people, and not required to be accessible by Chapter 11 need not exceed 28 inches (711 mm) in width.

1004.3.1.3 Seating at tables. Where seating is located at a table or counter and is adjacent to an aisle or aisle accessway, the measurement of required clear width of the aisle or aisle accessway, shall be made to a line 19 inches (483 mm) away from and parallel to the edge of the table or counter. The 19-inch (483 mm) distance shall be measured perpendicular to the side of the table or counter. In the case of other side boundaries for aisle or aisle accessways, the clear width shall be measured to walls, edges of seating and tread edges, except that handrail projections are permitted.

Exception: Where tables or counters are served by fixed seats, the width of the aisle accessway shall be measured from the back of the seat.

1004.3.1.3.1 Aisle accessway for tables and seating. Aisle accessways serving arrangements of seating at tables or counters shall have sufficient clear width to conform to the capacity requirements of 1003.2.3 but shall not have less than the appropriate minimum clear width specified in Section 1004.3.1.2.

1004.3.1.3.2 Table and seating accessway width. Aisle accessways shall provide a minimum of 12 inches (305 mm) of width plus 0.5 inch (12.7 mm) of width for each additional 1 foot (305 mm), or fraction thereof, beyond 12 feet (3658 mm) of aisle accessway length measured from the center of the seat farthest from an aisle.

Exception: Portions of an aisle accessway having a length not exceeding 6 feet (1829 mm) and used by a total of not more than four persons.

1004.3.1.3.3 Table and seating aisle accessway length. The length of travel along the aisle accessway shall not exceed 30 feet (9144 mm) from any seat to the point where a person has a choice of two or more paths of egress travel to separate exits.

1004.3.2 Corridors. Corridors shall comply with Sections 1004.3.2.1 through 1004.3.2.5.

1004.3.2.1 Construction. Corridors shall be fire-resistance rated in accordance with Table 1004.3.2.1. The corridor walls required to be fire-resistance-rated shall comply with Section 708 for fire partitions.

Exceptions:

1. A fire-resistance rating is not required for corridors in an occupancy in Group E where each room that is used for instruction has at least one door directly to the exterior and rooms for assembly purposes have at least one-half of the required means of egress doors opening directly

is equipped throughout with an automatic sprinkler system.

2.5. The space between the corridor ceiling and the floor or roof structure above the corridor is used as a component of an approved engineered smoke control system.

3. Where located within a dwelling unit, the use of corridors as return air plenums shall not be prohibited.
4. Where located within tenant spaces of 1,000 square feet (93 m^2) or less in area, utilization of corridors as return air plenums is permitted.

1004.3.2.5 Corridor continuity. Fire-resistance-rated corridors shall be continuous from the point of entry to an exit. Fire-resistance-rated corridors shall not be interrupted by intervening rooms.

Exceptions:

1. Foyers, lobbies or reception rooms constructed as required for corridors shall not be construed as intervening rooms.
2. In Group B buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, corridors are permitted to lead through enclosed elevator lobbies provided all areas of the building have access to at least one required exit without passing through the elevator lobby.

1004.3.3 Egress balconies. Balconies used for egress purposes shall conform to the same requirements as corridors for width, headroom, dead ends and projections. Exterior balconies shall be designed to minimize accumulation of snow or ice that impedes the means of egress.

Exception: Exterior balconies and concourses in outdoor stadiums shall be exempt from the design requirement to protect against the accumulation of snow or ice.

1004.3.3.1 Wall separation. Exterior egress balconies shall be separated from the interior of the building by walls and opening protectives as required for corridors.

Exception: Separation is not required where the exterior egress balcony is served by at least two stairs and a dead-end travel condition does not require travel past an unprotected opening to reach a stair.

1004.3.3.2 Openness. The long side of an egress balcony shall be at least 50 percent open, and the open area above the guards shall be so distributed as to minimize the accumulation of smoke or toxic gases.

SECTION 1005
EXITS

1005.1 General. Exits shall comply with Section 1005 and the applicable requirements of Section 1003. An exit shall not be used for any purpose that interferes with its function as a means of egress. Once a given level of exit protection is achieved, such level of protection shall not be reduced until arrival at the exit discharge.

1005.2 Exit design requirements. The exit portion of the means of egress system shall comply with the design requirements of Sections 1005.2.1 through 1005.2.3.

1005.2.1 Minimum number of exits. Every floor area shall be provided with the minimum number of approved independent exits as required by Table 1005.2.1 based on the occupant load, except as modified in Section 1004.2.1 or 1005.2.2. For the purposes of this chapter, occupied roofs shall be provided with exits as required for floors. The required number of exits from any story, basement or individual space shall be maintained until arrival at grade or the public way.

TABLE 1005.2.1
MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD

OCCUPANT LOAD	MINIMUM NUMBER OF EXITS
1-500	2
501-1,000	3
More than 1,000	4

1005.2.1.1 Open parking structures. Parking structures shall not have less than two exits from each parking tier, except that only one exit is required where vehicles are mechanically parked. Unenclosed vehicle ramps shall not be considered as required exits unless pedestrian facilities are provided.

1005.2.1.2 Helistops. The means of egress from helistops shall comply with the provisions of this chapter, provided that landing areas located on buildings or structures shall have two or more exits. For landing platforms or roof areas less than 60 feet (18 288 mm) long, or less than 2,000 square feet (186 m^2) in area, the second means of egress is permitted to be a fire escape or ladder leading to the floor below.

1005.2.2 Buildings with one exit. Only one exit shall be required in buildings as described below:

1. Buildings described in Table 1005.2.2, provided that the building has not more than one level below the first story.
2. Buildings of Group R-3 occupancy.
3. Single-level buildings with the occupied space at the level of exit discharge provided that the story or space complies with Section 1004.2.1 as a space with one means of egress.

ries. The open space under exterior stairways shall not be used for any purpose.

1005.3.2.3 Discharge identification. A stairway in an exit enclosure shall not continue below the level of exit discharge unless an approved barrier is provided at the level of exit discharge to prevent persons from unintentionally continuing into levels below. Directional exit signs shall be provided as specified in Section 1003.2.10.

1005.3.2.4 Stairway floor number signs. A sign shall be provided at each floor landing in interior vertical exit enclosures connecting more than three stories designating the floor level, the terminus of the top and bottom of the stair enclosure, and the identification of the stair. The signage shall also state the story of, and the direction to the exit discharge and the availability of roof access from the stairway for the fire department. The sign shall be located 5 feet (1524 mm) above the floor landing in a position which is readily visible when the doors are in the open and closed positions.

1005.3.2.5 Smokeproof enclosures. In buildings required to comply with Section 403 or 405, each of the exits of a building that serves stories where the floor surface is located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access or more than 30 feet (9144 mm) below the level of exit discharge serving such floor levels shall be a smokeproof enclosure or pressurized stairway in accordance with Section 909.20.

1005.3.2.5.1 Enclosure exit. A smokeproof enclosure or pressurized stairway shall exit into a public way or into an exit passageway, yard, or open space having direct access to a public way. The exit passageway shall be without other openings and shall be separated from the remainder of the building by 2-hour fire-resistance-rated construction.

Exceptions:

1. Openings in the exit passageway serving a smokeproof enclosure are permitted where the exit passageway is protected and pressurized in the same manner as the smokeproof enclosure, and openings are protected as required for access from other floors.
2. Openings in the exit passageway serving a pressurized stairway are permitted where the exit passageway is protected and pressurized in the same manner as the pressurized stairway.

1005.3.2.5.2 Enclosure access. Access to the stairway within a smokeproof enclosure shall be by way of a vestibule or by way of an open exterior balcony.

Exception: Access is not required by way of a vestibule or exterior balcony for stairways using the pressurization alternative complying with Section 909.20.5.

1005.3.3 Exit passageway. Exit passageways serving as an exit component in a means of egress system shall comply with the requirements of Sections 1005.3.3.1 through 1005.3.3.2. An exit passageway shall not be used for any purpose other than as a means of egress.

1005.3.3.1 Width. The width of exit passageways shall be determined as specified in Section 1003.2.3 but such width shall not be less than 44 inches (1118 mm), except that exit passageways serving an occupant load of less than 50 shall not be less than 36 inches (914 mm) in width.

The required width of exit passageways shall be unobstructed.

Exception: Doors, when fully opened, and handrails, shall not reduce the required width by more than 7 inches (178 mm). Doors in any position shall not reduce the required width by more than one-half. Other nonstructural projections such as trim and similar decorative features may project into the required width 1.5 inches (38 mm) on each side.

1005.3.3.2 Construction. Exit passageway enclosures shall have walls, floors and ceilings of not less than 1-hour fire-resistance rating, and not less than that required for any connecting exit enclosure. Exit passageways shall be constructed as fire barriers in accordance with Section 706.

1005.3.4 Openings and penetrations. Exit passageway and vertical exit enclosure opening protectives shall be in accordance with the requirements of Section 714.

Except as permitted in Section 402.4.6, openings in exit enclosures and exit passageways other than unexposed exterior openings shall be limited to those necessary for exit access to the enclosure from normally occupied spaces and for egress from the enclosure.

Where interior exit enclosures are extended to the exterior of a building by an exit passageway, the door assembly from the exit enclosure to the exit passageway shall be protected by a fire door conforming to the requirements in Section 714.2. Fire door assemblies in exit enclosures shall comply with Section 714.2.4.

Elevators shall not open into an exit passageway.

1005.3.4.1 Penetrations. Penetrations into and openings through an exit enclosure assembly are prohibited except for required exit doors, equipment and ductwork necessary for independent pressurization, sprinkler piping, standpipes, and electrical conduit serving the exit enclosure and terminating at a steel box not exceeding 16 square inches (0.010 m^2). Such penetrations shall be protected in accordance with Section 711. There shall be no penetrations or communicating openings, whether protected or not, between adjacent exit enclosures.

1005.3.4.2 Ventilation. Equipment and ductwork for exit enclosure ventilation shall comply with one of the following items:

1. Such equipment and ductwork shall be located exterior to the building and shall be directly connected to the exit enclosure by ductwork enclosed in construction as required for shafts.

2. Where such equipment and ductwork is located within the exit enclosure, the intake air shall be taken directly from the outdoors and the exhaust air shall be discharged directly to the outdoors, or such air shall be conveyed through ducts enclosed in construction as required for shafts.

3. Where located within the building, such equipment and ductwork shall be separated from the remainder of the building, including other mechanical equipment, with construction as required for shafts.

In each case, openings into the fire-resistance-rated construction shall be limited to those needed for maintenance and operation and shall be protected by self-closing fire-resistance-rated devices in accordance with Chapter 7 for enclosure wall opening protectives.

Exit enclosure ventilation systems shall be independent of other building ventilation systems.

1005.3.5 Horizontal exits. Horizontal exits serving as an exit in a means of egress system shall comply with the requirements of Sections 1005.3.5.1 through 1005.3.5.3. A horizontal exit shall not serve as the only exit from a portion of a building, and where two or more exits are required, not more than one-half of the total number of exits or total exit width shall be horizontal exits.

Exceptions:

1. Horizontal exits are permitted to comprise two-thirds of the required exits from any building or floor area for occupancies in Group I-2.
2. Horizontal exits are permitted to comprise 100 percent of the exits required for occupancies in Group I-3. At least 6 square feet ($0.6\ m^2$) of accessible space per occupant shall be provided on each side of the horizontal exit for the total number of people in adjoining compartments.

   Every fire compartment for which credit is allowed in connection with a horizontal exit shall not be required to have a stairway or door leading directly outside, provided the adjoining fire compartments have stairways or doors leading directly outside and are so arranged that egress shall not require the occupants to return through the compartment from which egress originates.

The area into which a horizontal exit leads shall be provided with exits adequate to meet the occupant requirements of this chapter, but not including the added occupant capacity imposed by persons entering it through horizontal exits from another area. At least one of its exits shall lead directly to the exterior or to an exit enclosure.

1005.3.5.1 Separation. The separation between buildings or areas of refuge connected by a horizontal exit shall be provided by a fire wall complying with Section 705 or a fire barrier complying with Section 706 and having a fire-resistance rating of not less than 2 hours. Opening protectives in horizontal exit walls shall also comply with Section 714. The horizontal exit separation shall extend vertically through all levels of the building unless floor assemblies are of 2-hour fire resistance with no unprotected openings.

Horizontal exit walls constructed as fire barriers shall be continuous from exterior wall to exterior wall so as to divide completely the floor served by the horizontal exit.

1005.3.5.2 Opening protectives. Fire doors in horizontal exits shall be self-closing or automatic-closing when activated by a smoke detector installed in accordance with Section 907.11. Opening protectives in horizontal exits shall be consistent with the fire-resistance rating of the wall. Such doors where located in a cross-corridor condition shall be automatic-closing by activation of a smoke detector installed in accordance with Section 907.11.

1005.3.5.3 Capacity of refuge area. The refuge area of a horizontal exit shall be spaces occupied by the same tenant or public areas and each such area of refuge shall be adequate to house the original occupant load of the refuge space plus the occupant load anticipated from the adjoining compartment. The anticipated occupant load from the adjoining compartment shall be based on the capacity of the horizontal exit doors entering the area of refuge. The capacity of areas of refuge shall be computed on a net floor area allowance of 3 square feet ($0.2787\ m^2$) for each occupant to be accommodated therein, not including areas of stairways, elevators and other shafts or courts.

Exception: The net floor area allowable per occupant shall be as follows for the indicated occupancies:

1. Six square feet ($0.6\ m^2$) per occupant for occupancies in Group I-3.
2. Fifteen square feet ($1.4\ m^2$) per occupant for ambulatory occupancies in Group I-2.
3. Thirty square feet ($2.8\ m^2$) per occupant for nonambulatory occupancies in Group I-2.

1005.3.6 Exterior exit stairways. Exterior exit stairways serving as an element of a required means of egress shall comply with Sections 1005.3.6.1 through 1005.3.6.5.

Exception: Exterior exit stairways for outdoor stadiums complying with Section 1005.3.2, Exception 2.

1005.3.6.1 Use in a means of egress. Exterior exit stairways shall not be used as an element of a required means of egress for occupancies in Group I-2. For occupancies in other than Group I-2, exterior exit stairways shall be permitted as an element of a required means of egress for buildings not exceeding six stories or 75 feet (22 860 mm) in height.

1005.3.6.2 Open side. Exterior exit stairways serving as an element of a required means of egress shall be open on at least one side. An open side shall have a minimum of 35 square feet ($3.3\ m^2$) of aggregate open area adjacent to each floor level and the level of each intermediate landing. The required open area shall be located not less than 42 inches (1067 mm) above the adjacent floor or landing level.

TABLE 1004.3.2.1
CORRIDOR FIRE-RESISTANCE RATING

OCCUPANCY	OCCUPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without sprinkler system	With sprinkler system[c]
H-1, H-2, H-3	All	1	1
H-4, H-5	Greater than 30	1	1
A, B, E, F, M, S, U	Greater than 30	1	0
R	Greater than 10	1	1
I-2[a], I-4	All	Not Permitted	0
I-1, I-3	All	Not Permitted	1[b]

a. For requirements for occupancies in Group I-2, see Section 407.3.
b. For a reduction in the fire-resistance rating for occupancies in Group I-3, see Section 408.7.
c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.

to the exterior. Exterior doors specified in this exception are required to be at ground level.

2. A fire-resistance rating is not required for corridors contained within a dwelling unit or a guestroom in an occupancy in Group R.
3. A fire-resistance rating is not required for corridors in open parking garages.
4. A fire-resistance rating is not required for corridors in an occupancy in Group B which is a space requiring only a single means of egress complying with Section 1004.2.1.

1004.3.2.2 Corridor width. The minimum corridor width shall be as determined in Section 1003.2.3, but not less than 44 inches (1118 mm).

Exceptions:

1. Twenty-four inches (610 mm)—For access to and utilization of electrical, mechanical, or plumbing systems or equipment.
2. Thirty-six inches (914 mm)—With a required occupant capacity of 50 or less.
3. Thirty-six inches (914 mm)—Within a dwelling unit.
4. Seventy-two inches (1829 mm)—In Group E with a corridor having a required capacity of 100 or more.
5. Seventy-two inches (1829 mm)—In corridors serving surgical Group I, health-care centers for ambulatory patients receiving outpatient medical care, which causes the patient to be not capable of self-preservation.
6. Ninety-six inches (2438 mm)—In Group I-2 in areas where required for bed movement.

1004.3.2.3 Dead ends. Where more than one exit or exit access doorway is required, the exit access shall be arranged such that there are no dead ends in corridors more than 20 feet (6096 mm) in length.

Exceptions:

1. In occupancies in Group I-3 of Occupancy Conditions 2, 3 or 4 (See Section 308.4), the dead end in a corridor shall not exceed 50 feet (15 240 mm).
2. In occupancies in Groups B and F where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the length of dead-end corridors shall not exceed 50 feet (15 240 mm).
3. A dead-end corridor shall not be limited in length where the length of the dead-end corridor is less than 2.5 times the least width of the dead-end corridor.

1004.3.2.4 Air movement in corridors. Corridors shall not serve as supply, return, exhaust, relief or ventilation air ducts or plenums.

Exceptions:

1. Use of a corridor as a source of makeup air for exhaust systems in rooms that open directly onto such corridors, including toilet rooms, bathrooms, dressing rooms, smoking lounges and janitor closets, shall be permitted provided that each such corridor is directly supplied with outdoor air at a rate greater than the rate of makeup air taken from the corridor.
2. Use of the space between the corridor ceiling and the floor or roof structure above as a return air plenum is permitted for one or more of the following conditions:
   2.1. The corridor is not required to be of fire-resistance-rated construction.
   2.2. The corridor is separated from the plenum by fire-resistance-rated construction.
   2.3. The air-handling system serving the corridor is shut down upon activation of the air-handling unit smoke detectors required by the *International Mechanical Code*.
   2.4. The air-handling system serving the corridor is shut down upon detection of sprinkler water flow where the building

the length of the maximum overall diagonal dimension of the area served measured in a straight line between such exit doors or exit access doorways. Additional exits or exit access doorways shall be arranged a reasonable distance apart so that if one becomes blocked, the others will be available.

1004.2.3 Egress through intervening spaces. Egress from a room or space shall not pass through adjoining or intervening rooms or areas, except where such adjoining rooms or areas are accessory to the area served; are not a high-hazard occupancy; and provide a discernible path of egress travel to an exit. Egress shall not pass through kitchens, store rooms, closets or spaces used for similar purposes. An exit access shall not pass though a room that can be locked to prevent egress. Means of egress from dwelling units or sleeping areas shall not lead through other sleeping areas, toilet rooms or bathrooms.

Exceptions:

1. Means of egress are not prohibited through a kitchen area serving adjoining rooms constituting part of the same dwelling unit or guestroom.
2. Means of egress are not prohibited through rooms or spaces in a high-hazard occupancy where such rooms or spaces are the same occupancy group.

1004.2.3.1 Multiple tenants. Where more than one tenant occupies any one floor of a building or structure, each tenant space, dwelling unit, and guestroom shall be provided with access to the required exits without passing through adjacent tenant spaces, dwelling units, and guestrooms.

1004.2.3.2 Group I-2. Habitable rooms or suites in Group I-2 occupancies shall have an exit access door leading directly to an exit access corridor.

Exceptions:

1. Rooms with exit doors opening directly to the outside at ground level.
2. Patient sleeping rooms are permitted to have one intervening room if the intervening room is not used as an exit access for more than eight patient beds.
3. Special nursing suites are permitted to have one intervening room where the arrangement allows for direct and constant visual supervision by nursing personnel.
4. For rooms other than patient sleeping rooms, suites of rooms are permitted to have one intervening room if the travel distance within the suite to the exit access door is not greater than 100 feet (30 480 mm) and are permitted to have two intervening rooms where the travel distance within the suite to the exit access door is not greater than 50 feet (15 240 mm).

Suites of sleeping rooms shall not exceed 5,000 square feet (465 m^2). Suites of rooms, other than patient sleeping rooms, shall not exceed 10,000 square feet (929 m^2). Any patient sleeping room, or any suite that includes patient sleeping rooms, of more than 1,000 square feet (93 m^2) shall have at least two exit access doors remotely located from each other. Any room or suite of rooms, other than patient sleeping rooms, of more than 2,500 square feet (232 m^2) shall have at least two access doors remotely located from each other. The travel distance between any point in a Group I-2 occupancy and an exit access door in the room shall not exceed 50 feet (15 240 mm). The travel distance between any point in a suite of sleeping rooms and an exit access door of that suite shall not exceed 100 feet (30 480 mm).

1004.2.4 Exit access travel distance. Exits shall be so located that the maximum length of exit access travel, measured from the most remote point to the entrance to an exit along the natural and unobstructed path of egress travel, shall not exceed the distances given in Table 1004.2.4.

Where the path of exit access includes unenclosed stairways or ramps within the exit access, the distance of travel on such means of egress components shall also be included in the travel distance measurement. The measurement along stairways shall be made on a plane parallel and tangent to the stair tread nosings in the center of the stairway.

Exception: Travel distance in open parking garages is permitted to be measured to the closest riser of open stairs.

TABLE 1004.2.4
EXIT ACCESS TRAVEL DISTANCE[a]

OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)	WITH SPRINKLER SYSTEM (feet)
A, E, F-1, I-1, M, R, S-1	200	250[b]
B	200	300[c]
F-2, S-2, U	300	400[b]
H-1	Not Permitted	75[c]
H-2	Not Permitted	100[c]
H-3	Not Permitted	150[c]
H-4	Not Permitted	175[c]
H-5	Not Permitted	200[c]
I-2, I-3, I-4	150	200[c]

For SI: 1 foot = 304.8 mm.

a. See the following sections for modifications to exit access travel distance requirements:
Section 402: For the distance limitation in malls.
Section 404: For the distance limitation through an atrium space.
Section 1004.2.4.1: For increased limitation in Groups F-1 and S-1.
Section 1008.6: For increased limitation in assembly seating.
Section 1008.6: For increased limitation for assembly open-air seating.
Section 1005.2.2: For buildings with one exit.
Chapter 31: For the limitation in temporary structures.

b. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where sprinkler systems according to Section 903.3.1.2 are permitted.

c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

1004.2.4.1 Roof vent increase. In buildings which are one story in height, equipped with automatic heat and smoke roof vents complying with Section 910 and

CHAPTER 11
ACCESSIBILITY

SECTION 1101
GENERAL

1101.1 Scope. The provisions of this chapter shall control the design and construction of facilities for accessibility to physically disabled persons.

1101.2 Design. Buildings and facilities shall be designed and constructed to be accessible in accordance with this code and ICC A117.1.

SECTION 1102
DEFINITIONS

1102.1 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in the code, have the following meanings:

ACCESSIBLE. A site, building, facility, or portion thereof, that complies with this chapter.

ACCESSIBLE ROUTE. A continuous, unobstructed path that complies with this chapter.

CIRCULATION PATH. An exterior or interior way of passage from one place to another for pedestrians.

DETECTABLE WARNING. A standardized surface feature built in or applied to walking surfaces or other elements to warn visually impaired persons of hazards on a circulation path.

DWELLING UNIT, GROUND FLOOR. A dwelling unit with a primary entrance and habitable space at grade.

DWELLING UNIT, MULTISTORY. A dwelling unit with habitable or bathroom space located on more than one story.

DWELLING UNIT, TYPE A. A dwelling unit designed and constructed for accessibility in accordance with ICC A117.1.

DWELLING UNIT, TYPE B. A dwelling unit designed and constructed for accessibility in accordance with ICC A117.1, intended to be consistent with the technical requirements of fair housing required by federal law.

FACILITY. The entire building or any portion of a building, structure or area, including the site on which the building, structure or area is located, wherein specific services are provided or activities are performed.

PUBLIC ENTRANCE. An entrance that is not a service entrance.

PUBLIC-USE AREAS. Interior or exterior rooms or spaces that are made available to the general public.

SELF-SERVICE STORAGE FACILITY. Real property designed and used for the purpose of renting or leasing individual storage spaces to customers for the purpose of storing and removing personal property on a self-service basis.

SERVICE ENTRANCE. An entrance intended primarily for delivery of goods or services.

SITE. A parcel of land bounded by a property line or a designated portion or a public right-of-way.

SLEEPING ACCOMMODATIONS. Rooms in which people sleep, such as dormitory and hotel or motel guestrooms or suites.

TECHNICALLY INFEASIBLE. An alteration of a building or a facility that has little likelihood of being accomplished because the existing structural conditions require the removal or alteration of a load-bearing member that is an essential part of the structural frame, or because other existing physical or site constraints prohibit modification or addition of elements, spaces, or features that are in full and strict compliance with the minimum requirements for new construction and which are necessary to provide accessibility.

WHEELCHAIR SPACE. A space for a single wheelchair and its occupant.

WHEELCHAIR SPACE CLUSTER. Locations of two or more adjacent wheelchair spaces along with companion seating in assembly areas.

SECTION 1103
SCOPING REQUIREMENTS

1103.1 Where required. Buildings and structures, temporary or permanent, including their associated sites and facilities, shall be accessible to persons with physical disabilities.

1103.2 General exceptions. Sites, buildings, facilities and elements shall be exempt from this chapter to the extent specified in this section.

1103.2.1 Specific requirements. Accessibility is not required in buildings and facilities, or portions thereof, to the extent permitted by Sections 1104 through 1109.

1103.2.2 Existing buildings. Existing buildings shall comply with Section 3408.

1103.2.3 Work areas. Individual employee work stations are not required to be accessible but shall be located on an accessible route.

1103.2.4 Detached dwellings. Detached one- and two-family dwellings and accessory structures, and their associated sites and facilities as applicable in Section 101.2, are not required to be accessible.

1103.2.5 Utility buildings. Occupancies in Group U are exempt from the requirements of this chapter other than the following:

1. In agricultural buildings, access is required to paved work areas and areas open to the general public.
2. Private garages or carports that contain required accessible parking.

1103.2.6 Construction sites. Structures, sites and equipment directly associated with the actual processes of construction including, but not limited to, scaffolding, bridging, materials hoists, materials storage, or construction trailers are not required to be accessible.

1103.2.7 Raised areas. Raised areas used primarily for purposes of security, life safety, or fire safety including, but not limited to, observation galleries, prison guard towers, fire towers, or life guard stands are not required to be accessible or to be served by an accessible route.

1103.2.8 Limited access spaces. Nonoccupiable spaces accessed only by ladders, catwalks, crawl spaces, freight elevators, very narrow passageways, or tunnels are not required to be accessible.

1103.2.9 Equipment spaces. Spaces frequented only by personnel for maintenance, repair, or monitoring of equipment are not required to be accessible. Such spaces include, but are not limited to, elevator pits, elevator penthouses, mechanical, electrical, or communications equipment rooms, piping or equipment catwalks, water or sewage treatment pump rooms and stations, electric substations and transformer vaults, and highway and tunnel utility facilities.

1103.2.10 Single occupant structures. Single occupant structures accessed only by passageways below grade or elevated above grade including, but not limited to, toll booths that are accessed only by underground tunnels, are not required to be accessible.

1103.2.11 Residential Group R-1. Buildings of Group R-1 containing not more than five rooms for rent or hire that are also occupied as the residence of the proprietor.

1103.2.12 Fuel-dispensing systems. Fuel-dispensing devices are not required to be accessible.

SECTION 1104 ACCESSIBLE ROUTE

1104.1 Site arrival points. Accessible routes within the site shall be provided from public transportation stops, accessible parking and accessible passenger loading zones, and public streets or sidewalks to the accessible building entrance served.

1104.2 Within a site. At least one accessible route shall connect accessible buildings, accessible facilities, accessible elements, and accessible spaces that are on the same site.

Exception: An accessible route is not required between accessible facilities that have, as the only means of access between them a vehicular way not providing for pedestrian access.

1104.3 Connected spaces. When a building, or portion of a building, is required to be accessible, an accessible route shall be provided to each portion of the building, to accessible building entrances, connecting accessible pedestrian walkways and the public way. Where only one accessible route is provided, the accessible route shall not pass through kitchens, storage rooms, restrooms, closets or similar spaces.

Exception: A single accessible route is permitted to pass through a kitchen or storage room in an accessible dwelling unit.

1104.4 Multilevel buildings and facilities. At least one accessible route shall connect each accessible level, including mezzanines, in multistory buildings and facilities.

Exceptions:

1. An accessible route is not required to floors above and below accessible levels that have an aggregate area of not more than 3,000 square feet (278.7 m^2) unless the level contains offices of health care providers (Group B or Group I), passenger transportation facilities and airports (Group A-3 or Group B) or multiple tenant facilities of Group M.
2. In Groups A, I, R and S occupancies and care facilities in accordance with Section 1107.4, levels that do not contain accessible elements or other spaces required by Section 1107 are not required to be served by an accessible route from an accessible level.

1104.5 Location. Accessible routes shall coincide with or be located in the same area as a general circulation path. Where the circulation path is interior, the accessible route shall also be interior.

Exception: Accessible routes from parking garages contained within and serving Type B dwelling units are not required to be interior.

SECTION 1105 ACCESSIBLE ENTRANCES

1105.1 Required. At least 50 percent but not less than one entrance to each building and structure, and each separate tenant space within the building or structure, shall comply with the accessible route provisions of this chapter.

Exceptions:

1. Entrances to spaces not required to be accessible as provided for in Section 1107.
2. Loading and service entrances that are not the only entrance to a building or to a tenant space.

1105.2 Multiple accessible entrances. Where a building or facility has entrances that normally serve accessible parking facilities, transportation facilities, passenger loading zones, taxi stands, public streets and sidewalks, tunnels or elevated walkways, or accessible interior vertical access, then at least one of the entrances serving each such function shall comply with the accessible route provisions of this chapter.

SECTION 1106 PARKING AND PASSENGER LOADING FACILITIES

1106.1 Required. Where parking is provided, accessible parking spaces shall be provided in compliance with Table 1106.1 except as required by Sections 1106.2 and 1106.3.

1106.2 Groups R-2 and R-3. Two percent of parking spaces provided for occupancies in Groups R-2 and R-3, which are required to have accessible dwelling units, shall be accessible. Where parking is provided within or beneath a building, accessible parking spaces shall also be provided within or beneath the building.

TABLE 1106.1 ACCESSIBLE PARKING SPACES

TOTAL PARKING SPACES PROVIDED	REQUIRED MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2% of total
More than 1,000	20 plus one for each 100 over 1,000

1106.3 Rehabilitation facilities and outpatient physical therapy facilities. Twenty percent of patient and visitor parking spaces provided at rehabilitation facilities and outpatient physical therapy facilities shall be accessible.

1106.4 Van spaces. For every eight or fraction of eight accessible parking spaces, at least one shall be a van-accessible parking space.

1106.5 Location. Accessible parking spaces shall be located on the shortest accessible route of travel from adjacent parking to an accessible building entrance. In parking facilities that do not serve a particular building, accessible parking spaces shall be located on the shortest route to an accessible pedestrian entrance to the parking facility. Where buildings have multiple accessible entrances with adjacent parking, accessible parking spaces shall be dispersed and located near the accessible entrances.

Exception: In multilevel parking structures, van-accessible parking spaces are permitted on one level.

1106.6 Passenger loading zones. Passenger loading zones shall be designed and constructed in accordance with ICC A117.1.

1106.6.1 Medical facilities. A passenger loading zone shall be provided at an accessible entrance to licensed medical and long-term care facilities where people receive physical or medical treatment or care and where the period of stay exceeds 24 hours.

1106.6.2 Valet parking. A passenger loading zone shall be provided at valet parking services.

SECTION 1107 SPECIAL OCCUPANCIES

1107.1 General. In addition to the other requirements of this chapter, the requirements of Sections 1107.2 through 1107.6.1 shall apply to specific occupancies.

1107.2 Assembly area seating. Assembly areas with fixed seating shall comply with Sections 1107.2.1 through 1107.2.4.1. Dining areas shall comply with Sections 1107.2.5 through 1107.2.5.2.

1107.2.1 Services. Services and facilities provided in areas not required to be accessible shall be provided on an accessible level and shall be accessible.

1107.2.2 Wheelchair spaces. In theaters, bleachers, grandstands and other fixed seating assembly areas, accessible wheelchair spaces shall be provided in accordance with Table 1107.2.2. At least one seat for a companion shall be provided beside each wheelchair space.

TABLE 1107.2.2 ACCESSIBLE WHEELCHAIR SPACES

CAPACITY OF SEATING IN ASSEMBLY AREAS	MINIMUM REQUIRED NUMBER OF WHEELCHAIR SPACES
4 to 25	1
26 to 50	2
51 to 100	4
101 to 300	5
301 to 500	6
Over 500	6, plus 1 additional space for each total seating capacity increase of 200

1107.2.2.1 Wheelchair space clusters. Accessible wheelchair spaces shall be grouped in wheelchair space clusters in accordance with Table 1107.2.2.1.

Exception: In fixed seating assembly areas where sightlines require more than one step for a rise in elevation between rows, the minimum required number of wheelchair space clusters in that area shall be one-half of that required by Table 1107.2.2.1.

**TABLE 1107.2.2.1
WHEELCHAIR SPACE CLUSTERS**

CAPACITY OF SEATING IN ASSEMBLY AREAS	MINIMUM REQUIRED NUMBER OF WHEELCHAIR SPACE CLUSTERS
Up to 300	1
301 to 600	2
601 to 900	3
901 to 1,500	4
1,501 to 2,100	5
2,101 to 3,000	6
Over 3,000	6, plus 1 additional cluster for each 1,000 seats or portion thereof.

1107.2.3 Dispersion of wheelchair space clusters. Dispersion of wheelchair space clusters shall be based on the availability of accessible routes to various seating areas including seating at various levels in multilevel facilities.

1107.2.3.1 Multilevel assembly seating areas. In multilevel assembly seating areas, wheelchair space clusters shall be provided on the main floor level and on one of each two additional floor or mezzanine levels.

Exceptions:

1. In multilevel assembly spaces utilized for worship services, where the second floor or mezzanine level contains 25 percent or less of the total seating capacity, wheelchair space clusters shall be permitted to all be located on the main level.
2. In multilevel assembly seating where the second floor or mezzanine level provides 25 percent or less of the total seating capacity and 300 or fewer seats, wheelchair space clusters shall be permitted to all be located on the main level.

1107.2.3.2 Separation between clusters. Wheelchair space clusters shall be separated by a minimum of five intervening rows or by a minimum of ten intervening seats. Wheelchair spaces within any one wheelchair space cluster shall not be separated by an intervening row, nor by more than two intervening seats, nor by more than a 7-inch (178 mm) vertical level change.

Exception: A vertical level change exceeding 7 inches (178 mm) is permitted in a wheelchair space cluster where necessary to maintain sightlines.

1107.2.4 Assistive listening systems. Stadiums, theaters, auditoriums, lecture halls and similar fixed seating assembly areas where audible communications are integral to the use of the space shall have an assistive listening system if the area is equipped with an audio amplification system or the area has a capacity of 50 or more persons.

1107.2.4.1 Receivers. Receivers shall be provided for assistive listening systems in accordance with Table 1107.2.4.1. Twenty-five percent of receivers, but not less than two, shall be hearing aid compatible.

**TABLE 1107.2.4.1
RECEIVERS FOR ASSISTIVE LISTENING SYSTEMS**

CAPACITY OF SEATING IN ASSEMBLY AREAS	MINIMUM REQUIRED NUMBER OF RECEIVERS
Less than 50	2
50 to 500	2, plus 4 for each total seating capacity increase of 100 above 51
501 to 1,000	20, plus 4 for each total seating capacity increase of 100 above 501
1,001 to 2,000	35, plus 2 for each total seating capacity increase of 100 above 1,001
Over 2,000	55, plus 1 for each total seating capacity increase of 100 above 2,000

1107.2.5 Dining areas. In dining areas, the total floor area allotted for seating and tables shall be accessible.

Exception: In buildings without elevators, an accessible route to a mezzanine seating area is not required, provided that the mezzanine contains less than 25 percent of the total area and the same services are provided in the accessible area.

1107.2.5.1 Fixed or built-in seating or tables. Where fixed or built-in seating or tables are provided in dining areas, at least 5 percent, but not less than one such seat or table, shall be accessible and be distributed throughout the facility.

1107.2.5.2 Dining counters. In establishments serving food or drink for consumption where the only seating is at counters exceeding 34 inches (864 mm) in height, a 60-inch (1524 mm) minimum length portion of the counter shall be accessible.

1107.3 Group I. Occupancies in Group I shall provide for accessible features in accordance with Sections 1107.3.1 through 1107.3.3.

1107.3.1 Group I-1. In occupancies in Group I-1, at least 4 percent, but not less than one, of the residential sleeping rooms and their bathing and toilet facilities shall be accessible.

1107.3.2 Group I-2. In nursing homes of Group I-2, at least 50 percent, but not less than one, of the patient sleeping rooms and their bathing and toilet facilities shall be accessible.

In general purpose hospitals, psychiatric facilities and detoxification facilities of Group I-2, at least 10 percent, but not less than one, of the patient sleeping rooms and their bathing and toilet facilities shall be accessible.

In hospitals and rehabilitation facilities of Group I-2 that specialize in treating conditions that affect mobility, or units within either that specialize in treating conditions that affect mobility, 100 percent of the patient rooms and their bathing and toilet facilities shall be accessible.

1107.3.3 Group I-3. In occupancies in Group I-3, at least 5 percent, but not less than one, of the resident units and their bathing and toilet facilities shall be accessible.

2. Floors where the joint is protected by a shaft enclosure in accordance with Section 707.
3. Floors within atriums where the space adjacent to the atrium is included in the volume of the atrium for smoke control purposes.
4. Floors within malls.
5. Floors within open parking structures.
6. Mezzanine floors.
7. Walls that are permitted to have unprotected openings.
8. Roofs where openings are permitted.
9. Control joints not exceeding a maximum width of 0.625 inch (15.9 mm) and tested in accordance with ASTM E 119.

712.2 Installation. Fire-resistant joint systems shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and to resist the passage of fire and hot gases.

712.3 Fire test criteria. Fire-resistant joint systems shall be tested in accordance with the requirements of UL 2079. Nonsymmetrical wall joint systems shall be tested with both faces exposed to the furnace, and the assigned fire-resistance rating shall be the shortest duration obtained from the two tests. When evidence is furnished to show that the wall was tested with the least fire-resistant side exposed to the furnace, subject to acceptance of the building official, the wall need not be subjected to tests from the opposite side.

Exception: For exterior walls with a horizontal fire separation distance greater than 5 feet (1524 mm), the joint system shall be required to be tested for interior fire exposure only.

712.4 Exterior curtain wall/floor intersection. Where fire-resistance-rated floor or floor/ceiling assemblies are required, voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies shall be sealed with an approved material. Such material shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch (0.254 mm) of water column (2.5 Pa) for the time period at least equal to the fire-resistance rating of the floor assembly.

SECTION 713
FIRE-RESISTANCE RATING OF STRUCTURAL MEMBERS

713.1 Requirements. The fire-resistance rating of structural members and assemblies shall comply with the requirements for the type of construction and shall not be less than the rating required for the fire-resistance-rated assemblies supported.

Exception: Fire barriers and fire partitions as provided in Sections 706.4 and 708.4, respectively.

713.2 Protection of structural members. Protection of columns, girders, trusses, beams, lintels or other structural members that are required to have a fire-resistance rating shall comply with this section.

713.2.1 Individual protection. Columns, girders, trusses, beams, lintels or other structural members that are required to have a fire-resistance rating and that support more than two floors or one floor and roof, or support a load-bearing wall or a nonload-bearing wall more than two stories high, shall be individually protected on all sides for the full length with materials having the required fire-resistance rating. Other structural members required to have a fire-resistance rating shall be protected by individual encasement, by a membrane or ceiling protection as specified in Section 710, or by a combination of both. Columns shall also comply with Section 713.2.2.

713.2.2 Column protection above ceilings. Where columns require a fire-resistance rating, the entire column, including its connections to beams or girders, shall be protected. Where the column extends through a ceiling, fire resistance of the column shall be continuous from the top of the floor through the ceiling space to the top of the column.

713.2.3 Truss protection. The required thickness and construction of fire-resistance-rated assemblies enclosing trusses shall be based on the results of full-scale tests or combinations of tests on truss components or on approved calculations based on such tests that satisfactorily demonstrate that the assembly has the required fire resistance.

713.2.4 Attachments to structural members. The edges of lugs, brackets, rivets and bolt heads attached to structural members shall be permitted to extend to within 1 inch (25 mm) of the surface of the fire protection.

713.2.5 Reinforcing. Thickness of protection for concrete or masonry reinforcement shall be measured to the outside of the reinforcement except that stirrups and spiral reinforcement ties are permitted to project not more than 0.5-inch (12.7 mm) into the protection.

713.3 Embedments and enclosures. Pipes, wires, conduits, ducts or other service facilities shall not be embedded in the required fire protective covering of a structural member that is required to be individually encased.

713.4 Impact protection. Where the fire protective covering of a structural member is subject to impact damage from moving vehicles, the handling of merchandise or other activity, the fire protective covering shall be protected by corner guards or by a substantial jacket of metal or other noncombustible material to a height adequate to provide full protection, but not less than 5 feet (1524 mm) from the finished floor.

713.5 Exterior structural members. Structural members located in exterior walls or along the outer lines of a building or structure shall be protected as required by Table 601 for exterior load-bearing walls based on the type of construction. Structural frame elements in an exterior wall that is located where openings are not permitted or where protection of openings is required shall be protected against external fire exposure as required for exterior bearing walls or the structural frame, whichever is greater.

713.6 Bottom flange protection. Fire protection is not required at the bottom flange of lintels, shelf angles and plates, spanning not more than 6 feet (1829 mm) whether part of the structural frame or not, and from the bottom flange of lintels, shelf angles and plates not part of the structural frame, regardless of span.

SECTION 714 OPENING PROTECTIVES

714.1 General. Opening protectives required by other sections of this code shall comply with the provisions of this section.

714.2 Fire door and shutter assemblies. Approved fire door and fire shutter assemblies shall be constructed of any material or assembly of component materials that conforms to the test requirements of Section 714.2.1, 714.2.2 or 714.2.3 and the fire-protection rating indicated in Table 714.2. Fire door assemblies and shutters shall be installed in accordance with the provisions of this section and NFPA 80.

Exceptions:

1. Labeled protective assemblies that conform to the requirements of this section or UL 10A, UL 14B and UL 14C for tin-clad fire door assemblies.
2. Floor fire doors shall comply with Section 711.4.6.

TABLE 714.2
OPENING PROTECTIVE FIRE-PROTECTION RATINGS

TYPE OF ASSEMBLY	REQUIRED ASSEMBLY RATING (hours)	MINIMUM OPENING PROTECTION ASSEMBLY (hours)
Fire walls and fire barriers having a required fire-resistance rating greater than 1 hour	4	3
	3	3[b]
	2	$1^1/_2$
	$1^1/_2$	$1^1/_2$
Fire barriers of 1-hour fire-resistance-rated construction:		
Shaft and exit enclosure walls	1	1
Other fire barriers	1	$^3/_4$
Fire partitions:		
Exit access corridor enclosure wall	1	$^1/_3$[a]
Other fire partitions	1	$^3/_4$
Exterior walls	3	$1^1/_2$
	2	$1^1/_2$
	1	$^3/_4$

a. For testing requirements, see Section 714.2.3.
b. Two doors, each with a fire-protection rating of 1.5 hours, installed on opposite sides of the same opening in a fire wall, shall be deemed equivalent in fire-protection rating to one 3-hour fire door.

714.2.1 Side-hinged or pivoted swinging doors. Side-hinged and pivoted swinging doors shall be tested in accordance with NFPA 252 or UL 10C. After 5 minutes into the NFPA 252 test, the neutral pressure level in the furnace shall be established at 40 inches (1016 mm) or less above the sill.

714.2.2 Other types of doors. Other types of doors, including swinging elevator doors, shall be tested in accordance with NFPA 252 or UL 10B. The pressure in the furnace shall be maintained as nearly equal to the atmospheric pressure as possible. Once established, the pressure shall be maintained during the entire test period.

714.2.3 Doors in corridors and smoke barriers. Fire doors required to have a minimum fire-protection rating of 20 minutes where located in corridor walls or smoke barrier walls having a fire-resistance rating in accordance with Table 714.2 shall be tested in accordance with NFPA 252 or UL 10C without the hose stream test. If a 20-minute fire door or fire door assembly contains glazing material, the glazing material in the door itself shall have a minimum fire-protection rating of 20 minutes and be exempt from the hose stream test. Glazing material in any other part of the door assembly, including transom lites and sidelites, shall be tested in accordance with NFPA 257, including the hose stream test, in accordance with Section 714.3. Fire doors shall also meet the requirements for a smoke- and draft-control door assembly tested in accordance with UL 1784 with an artificial bottom seal installed across the full width of the bottom of the door assembly. The air leakage rate of the door assembly shall not exceed 3.0 cfm per square foot ($0.01524\ m^3/slm^2$) of door opening at 0.10 inch (24.9 Pa) of water for both the ambient temperature and elevated temperature tests. Louvers shall be prohibited.

Exceptions:

1. Viewports that require a hole not larger than 1 inch (25.4 mm) in diameter through the door, have at least a 0.25-inch-thick (6.4 mm) glass disc and the holder is of metal that will not melt out where subject to temperatures of 1,700°F (927°C).
2. Corridor doors in occupancies of Group I-2 shall be in accordance with Section 407.3.1.
3. Unprotected openings shall be permitted for corridors in multitheater complexes where each motion picture auditorium has at least one-half of its required exit or exit access doorways opening directly to the exterior or into an exit passageway.

714.2.4 Doors in exit enclosures. Fire door assemblies in exit enclosures shall have a maximum transmitted temperature end point of not more than 450°F (232°C) above ambient at the end of 30 minutes of standard fire test exposure.

Exception: The maximum transmitted temperature end point is not required in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.

714.2.4.1 Glazing in doors. Fire-protection-rated glazing in excess of 100 square inches ($0.065\ m^2$) shall be permitted in fire door assemblies when tested in accordance with NFPA 252 as components of the door assemblies and not as glass lights, and shall have a maximum transmitted temperature end point of 450°F (232°C) in accordance with Section 714.2.4.

Exception: The maximum transmitted temperature end point is not required in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.

714.2.5 Labeled protective assemblies. Fire door assemblies shall be labeled by an approved agency.

714.2.5.1 Labeling requirements. Fire doors shall be labeled showing the name of the manufacturer, the name of the third-party inspection agency, the fire-protection rating and, where required for fire doors in exit enclosures by Section 714.2.4, the maximum transmitted temperature end point. Smoke and draft control doors complying with UL 1784 shall be labeled as a smoke and draft control door. Labels shall be approved and permanently affixed. The label shall be applied at the factory where fabrication and assembly are performed.

714.2.5.2 Oversized doors. Oversized fire doors shall bear an oversized fire door label by an approved agency or shall be provided with a certificate of inspection furnished by an approved testing agency for such oversized doors. When a certificate of inspection is furnished by an approved testing agency, the certificate shall state that the door conforms to the requirements of design, materials and construction, but has not been subjected to the fire test.

714.2.6 Glazing material. Fire-protection-rated glazing conforming to the opening protection requirements in Section 714.2 shall be permitted in fire door assemblies.

714.2.6.1 Size limitations. Wired glass used in fire doors shall comply with Table 714.3.2. Other fire-protection-rated glazing shall comply with the size limitations of NFPA 80.

Exceptions:

1. Fire-protection-rated glazing in fire doors located in fire walls shall be prohibited except that where serving as a horizontal exit, a self-closing swinging door shall be permitted to have a vision panel of not more than 100 square inches (0.065 m^2) without a dimension exceeding 10 inches (254 mm).
2. Fire-protection-rated glazing shall not be installed in fire doors having a $1^1/_2$-hour fire protection rating intended for installation in fire barriers, unless the glazing is not more than 100 square inches (0.065 m^2) in area.

714.2.6.2 Exit and elevator protectives. Approved fire-protection-rated glazing used in fire doors in elevator and stairway shaft enclosures shall be so located as to furnish clear vision of the passageway or approach to the elevator or stairway.

714.2.6.3 Labeling. Fire-protection-rated glazing shall bear a label or other identification showing the name of the manufacturer, the test standard and the fire-protection rating. Such label or other identification shall be issued by an approved agency and shall be permanently affixed.

714.2.6.4 Safety glazing. Fire-protection-rated glazing installed in fire doors or fire window assemblies in areas subject to human impact in hazardous locations shall comply with Chapter 24.

714.2.7 Door closing. Fire doors shall be self-closing or automatic-closing in accordance with this section.

Exception: Fire doors located in common walls separating guestrooms in Group R-1 hotels and motels shall be permitted without automatic-closing or self-closing devices.

714.2.7.1 Latch required. Unless otherwise specifically permitted, single fire doors and both leaves of pairs of side-hinged swinging fire doors shall be provided with an active latch bolt that will secure the door when it is closed.

714.2.7.2 Automatic-closing fire door assemblies. Automatic-closing fire door assemblies shall be self-closing in accordance with NFPA 80.

714.2.7.3 Smoke-activated doors. Automatic-closing fire doors installed in the following locations shall be automatic-closing by the actuation of smoke detectors installed in accordance with Section 907.10 or by loss of power to the smoke detector or hold-open device. Fire doors that are automatic-closing by smoke detection shall not have more than a 10-second delay before the door starts to close after the smoke detector is actuated.

1. Doors installed across a corridor.
2. Doors that protect openings in horizontal exits, exits or exit access corridors required to be of fire-resistance-rated construction.
3. Doors that protect openings in walls required to be fire-resistance rated by Table 302.1.1.
4. Doors installed in smoke barriers in accordance with Section 709.5.
5. Doors installed in fire partitions in accordance with Section 708.6.
6. Doors installed in a fire wall in accordance with Section 705.8.

714.2.7.4 Doors in pedestrian ways. Vertical sliding or vertical rolling steel fire doors in openings through which pedestrians travel shall be heat activated or activated by smoke detectors with alarm verification.

714.2.8 Swinging fire shutters. Where fire shutters of the swinging type are installed in exterior openings, not less than one row in every three vertical rows shall be arranged to be readily opened from the outside, and shall be identified by distinguishing marks or letters not less than 6 inches (152 mm) high.

714.2.9 Rolling fire shutters. Where fire shutters of the rolling type are installed, such shutters shall include approved automatic-closing devices.

714.3 Fire-protection-rated glazing. Glazing in fire window assemblies shall be fire-protection rated in accordance with this section. Glazing in fire doors shall comply with Section 714.2.6. Fire-protection-rated glazing installed as an opening protective in fire partitions and fire barriers shall be tested in accordance with and shall meet the acceptance criteria of NFPA 257 for a fire-protection rating of 45 minutes. Fire-protection-rated glazing shall also comply with NFPA 80. Fire-protection-rated glazing required in accordance with Section 704.12 for exterior wall opening protection shall be tested in accordance with and shall meet the acceptance criteria of NFPA 257 for a fire-protection rating as required in Section 714.3.7.

Exception: Wired glass in accordance with Section 714.3.2.

714.3.1 Testing under positive pressure. NFPA 257 shall evaluate fire-protection-rated glazing under positive pressure. Within the first 10 minutes of a test, the pressure in the furnace shall be adjusted so at least two-thirds of the test specimen is above the neutral pressure plane, and the neutral pressure plane shall be maintained at that height for the balance of the test.

714.3.2 Wired glass. Steel window frame assemblies of 0.125-inch (3.2 mm) minimum solid section or of not less than nominal 0.048-inch-thick (1.2 mm) formed sheet steel members fabricated by pressing, mitering, riveting, interlocking or welding and having provision for glazing with $^1/_4$ inch (6.4 mm) wired glass where securely installed in the building construction and glazed with $^1/_4$ inch (6.4 mm) labeled wired glass shall be deemed to meet the requirements for a $^3/_4$-hour fire window assembly. Wired glass panels shall conform to the size limitations set forth in Table 714.3.2.

TABLE 714.3.2
LIMITING SIZES OF WIRED GLASS PANELS

OPENING FIRE PROTECTION RATING	MAXIMUM AREA (square inches)	MAXIMUM HEIGHT (inches)	MAXIMUM WIDTH (inches)
3 hours	0	0	0
$1^1/_2$-hour doors in exterior walls	0	0	0
1 and $1^1/_2$ hours	100	33	10
$^3/_4$ hour	1,296	54	54
20 minutes	Not Limited	Not Limited	Not Limited
Fire window assemblies	1,296	54	54

For SI: 1 inch = 25.4 mm, 1 square inch = 645.2 mm^2.

714.3.3 Nonwired glass. Glazing other than wired glass in fire window assemblies shall be fire-protection-rated glazing installed in accordance with and complying with the size limitations set forth in NFPA 80.

714.3.4 Installation. Fire-protection-rated glazing shall be in the fixed position or be automatic-closing and shall be installed in approved frames.

714.3.5 Window mullions. Metal mullions that exceed a nominal height of 12 feet (3658 mm) shall be protected with materials to afford the same fire-resistance rating as required for the wall construction in which the protective is located.

714.3.6 Interior fire window assemblies. Fire-protection-rated glazing used in fire window assemblies located in fire partitions and fire barriers shall be limited to use in assemblies with a maximum fire-resistance rating of 1 hour in accordance with this section.

714.3.6.1 Where permitted. Fire-protection-rated glazing shall be limited to fire partitions designed in accordance with Section 708 and fire barriers utilized in the applications set forth in Sections 706.3.4 and 706.3.5 where the fire-resistance rating does not exceed 1 hour.

714.3.6.2 Size limitations. The total area of windows shall not exceed 25 percent of the area of a common wall with any room.

714.3.7 Exterior fire window assemblies. Exterior openings, other than doors, required to be protected by Section 704.12, where located in a wall required by Table 602 to have a fire-resistance rating of greater than 1 hour, shall be protected with an assembly having a fire-protection rating of not less than $1^1/_2$ hours. Exterior openings required to be protected by Section 704.8, where located in a wall required by Table 602 to have a fire-resistance rating of 1 hour, shall be protected with an assembly having a fire-protection rating of not less than $^3/_4$ hour. Exterior openings required to be protected by Section 704.9 or 704.10 shall be protected with an assembly having a fire-protection rating of not less than $^3/_4$ hour. Openings in nonfire-resistance-rated exterior wall assemblies that require protection in accordance with Sections 704.8, 704.9 or 704.10 shall have a fire-protection rating of not less than $^3/_4$ hour.

714.3.8 Fire-resistance-rated glazing. Fire-resistance-rated glazing tested as part of a fire-resistance-rated wall assembly in accordance with ASTM E 119 shall be permitted where the required fire-resistance rating of the wall exceeds 1 hour in applications set forth in Sections 714.3.6 and 714.3.6.1 and shall have a fire-resistance rating equal to the fire-resistance rating required for the wall. The window area size limitations set forth in Section 714.3.6.2 shall not apply to such fire-resistance-rated assemblies tested in accordance with ASTM E 119.

714.3.9 Labeling requirements. Fire-protection-rated and fire-resistance-rated glazing shall bear a label or other identification showing the name of the manufacturer, the test standard, and the fire protection or fire-resistance rating. Such label or identification shall be issued by an approved agency and shall be permanently affixed.

SECTION 715
DUCTS AND AIR TRANSFER OPENINGS

715.1 General. The provisions of this section shall govern the protection of ducts and air transfer openings in fire-resistance-rated assemblies.

715.1.1 Ducts and air transfer openings without dampers. Ducts and air transfer openings that penetrate fire-resistance-rated assemblies and are not required by this section to have dampers shall comply with the requirements of Section 711.

715.2 Installation. Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling dampers located within air distribution and smoke-control systems shall be installed in accordance with the requirements of this section, the manufacturer's installation instructions and listing.

715.2.1 Smoke-control system. Where the installation of a fire damper will interfere with the operation of a required smoke control system in accordance with Section 909, approved alternative protection shall be utilized.

715.2.2 Hazardous exhaust ducts. Fire dampers for hazardous exhaust duct systems shall comply with the *International Mechanical Code*.

715.3 Damper testing and ratings. Dampers shall be listed and bear the label of an approved testing agency indicating compliance with the standards in this section. Fire dampers shall comply with the requirements of UL 555. Only fire dampers labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire. Smoke dampers shall comply with the requirements of UL 555S. Combination fire/smoke dampers shall comply with the requirements of both UL 555 and UL 555S. Ceiling radiation dampers shall comply with the requirements of UL 555C.

715.3.1 Fire-protection rating. Fire dampers shall have the minimum fire-protection rating specified in Table 715.3.1 for the type of penetration.

TABLE 715.3.1
FIRE DAMPER RATING

TYPE OF PENETRATION	MINIMUM DAMPER RATING (hour)
Less than 3-hour fire-resistance-rated assemblies	1.5
3-hour or greater fire-resistance-rated assemblies	3

715.3.1.1 Fire damper actuation device. The fire damper actuating device shall meet one of the following requirements:

1. The operating temperature shall be approximately 50°F (10°C) above the normal temperature within the duct system, but not less than 160°F (71°C).
2. The operating temperature shall be not more than 286°F (141°C) where located in a smoke control system complying with Section 909.
3. Where a combination fire/smoke damper is located in a smoke-control system complying with Section 909, the operating temperature rating shall be approximately 50°F (10°C) above the maximum smoke control system designed operating temperature, or a maximum temperature of 350°F (177°C). The temperature shall not exceed the UL 555S degradation test temperature rating for a combination fire/smoke damper.

715.3.2 Smoke damper ratings. Smoke damper leakage ratings shall not be less than Class II. Elevated temperature ratings shall not be less than 250°F (121°C).

715.3.2.1 Smoke damper actuation methods. The smoke damper shall close upon actuation of a listed smoke detector or detectors installed in accordance with Section 907.10 and one of the following methods, as applicable:

1. Where a damper is installed within a duct, a smoke detector shall be installed in the duct within 5 feet (1524 mm) of the damper with no air outlets or inlets between the detector and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed. Other than in mechanical smoke control systems, dampers shall be closed upon fan shutdown where local smoke detectors require a minimum velocity to operate.
2. Where a damper is installed above smoke barrier doors in a smoke barrier, a spot-type detector listed for releasing service shall be installed on either side of the smoke barrier door opening.
3. Where a damper is installed within an unducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5 feet (1524 mm) horizontally of the damper.
4. Where a damper is installed in a corridor wall, the damper shall be permitted to be controlled by a smoke detection system installed in the corridor.
5. Where a total-coverage smoke detector system is provided within areas served by an HVAC system, dampers shall be permitted to be controlled by the smoke detection system.

715.4 Access and identification. Fire and smoke dampers shall be provided with an approved means of access, large enough to permit inspection and maintenance of the damper and its operating parts. The access shall not affect the integrity of fire-resistance-rated assemblies. The access openings shall not reduce the fire-resistance rating of the assembly. Access points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch (12.7 mm) in height reading: SMOKE DAMPER or FIRE DAMPER. Access doors in ducts shall be tight fitting and suitable for the required duct construction.

715.5 Where required. Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers shall be provided at the locations prescribed in this section. Where an assembly is required to have both fire dampers and smoke dampers, combination fire/smoke dampers or a fire damper and a smoke damper shall be required.

715.5.1 Fire walls. Ducts and air transfer openings permitted in fire walls in accordance with Section 705.11 shall be protected with approved fire dampers installed in accordance with their listing.

715.5.2 Fire barriers. Duct and air transfer openings of fire barriers shall be protected with approved fire dampers installed in accordance with their listing.

Exception: Fire dampers are not required at penetrations of fire barriers where any of the following apply:

1. Penetrations are tested in accordance with ASTM E 119 as part of the fire-resistance rated assembly.
2. Ducts are used as part of an approved smoke-control system in accordance with Section 909.
3. Such walls are penetrated by ducted HVAC systems, have a required fire-resistance rating of 1 hour or less, are in areas of other than Group H and are in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.

715.5.3 Shaft enclosures. Ducts and air transfer openings shall not penetrate a shaft serving as an exit enclosure except as permitted by Section 1005.3.4.1.

715.5.3.1 Penetrations of shaft enclosures. Shaft enclosures that are permitted to be penetrated by ducts and air transfer openings shall be protected with approved fire and smoke dampers installed in accordance with their listing.

Exception: Fire dampers are not required at penetrations of shafts where:

1. Steel exhaust subducts extend at least 22 inches (559 mm) vertically in exhaust shafts provided there is a continuous airflow upward to the outside.
2. Penetrations are tested in accordance with ASTM E 119 as part of the fire-resistance rated assembly
3. Ducts are used as part of an approved smoke-control system in accordance with Section 909.
4. The penetrations are in parking garage exhaust or supply shafts that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.

715.5.4 Fire partitions. Duct penetrations in fire partitions shall be protected with approved fire dampers installed in accordance with their listing.

Exception: In occupancies other than Group H, fire dampers are not required where any of the following apply:

1. The partitions are tenant separation and corridor walls in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.
2. The duct system is constructed of approved materials in accordance with the *International Mechanical Code* and the duct penetrating the wall meets all of the following minimum requirements:
   - 2.1. The duct shall not exceed 100 square inches (0.06 m^2).
   - 2.2. The duct shall be constructed of steel a minimum of 0.0217-inch (0.55 mm) in thickness.
   - 2.3. The duct shall not have openings that communicate the corridor with adjacent spaces or rooms.
   - 2.4. The duct shall be installed above a ceiling.
   - 2.5. The duct shall not terminate at a wall register in the fire-resistance-rated wall.

715.5.4.1 Corridors. A listed smoke damper designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a corridor enclosure required to have smoke and draft control doors in accordance with Section 714.2.3.

Exceptions:

1. Smoke dampers are not required where the building is equipped throughout with an approved smoke-control system in accordance with Section 909, and smoke dampers are not necessary for the operation and control of the system.
2. Smoke dampers are not required in corridor penetrations where the duct is constructed of steel not less than 0.019-inch (0.48 mm) in thickness and there are no openings serving the corridor.

715.5.5 Smoke barriers. A listed smoke damper designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a smoke barrier.

Exception: Smoke dampers are not required where the openings in ducts are limited to a single smoke compartment and the ducts are constructed of steel.

715.6 Horizontal assemblies. Penetrations by ducts and air transfer openings of a floor, floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly shall be protected by a shaft enclosure that complies with Section 707 or shall comply with this section.

715.6.1 Through penetrations. In occupancies other than Groups I-2 and I-3, a duct and air transfer opening system constructed of approved materials in accordance with the *International Mechanical Code* that penetrates a fire-resistance-rated floor/ceiling assembly that connects not more than two stories is permitted without shaft enclosure protection provided a fire damper is installed at the floor line.

715.6.2 Membrane penetrations. Where duct systems constructed of approved materials in accordance with the *International Mechanical Code* penetrate a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly, shaft enclosure protection is not required provided an approved ceiling radiation damper is installed at the ceiling line. Where a duct is not attached to a diffuser that penetrates a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly, shaft enclosure protection is not required provided an approved ceiling radiation damper is installed at the ceiling line. Ceiling radiation dampers shall be installed in accordance with UL 555C and constructed in accordance with the details listed in a fire-resistance-rated assembly or shall be labeled to function as a heat barrier for air-handling outlet/inlet penetrations in the ceiling of a fire-resistance-rated assembly. Ceiling radiation dampers shall not be required where ASTM E 119 fire tests have shown that ceiling radiation dampers are not necessary in order to maintain the fire-resistance rating of the assembly.

715.6.3 Nonfire-resistance-rated assemblies. Duct systems constructed of approved materials in accordance with the *International Mechanical Code* that penetrate nonfire-resistance-rated floor assemblies and that connect not more than two stories are permitted without shaft enclosure protection provided that the annular space between the assembly and the penetrating duct is filled with an approved noncombustible material to resist the free passage of flame and the products of combustion. Duct systems constructed of approved materials in accordance with the *International Mechanical Code* that penetrate nonfire-resistance-rated floor assemblies and that connect not more than three stories are permitted without shaft enclosure protection provided that the annular space between the assembly and the penetrating duct is filled with an approved noncombustible material to resist the free passage of flame and the products of combustion, and a fire damper is installed at each floor line.

Exception: Fire dampers are not required in ducts within individual residential dwelling units.

715.7 Flexible ducts and air connectors. Flexible ducts and air connectors shall not pass through any fire-resistance-rated assembly. Flexible air connectors shall not pass through any wall, floor or ceiling.

SECTION 716
CONCEALED SPACES

716.1 General. Fireblocking and draftstopping shall be installed in combustible concealed locations in accordance with this section. Fireblocking shall comply with Section 716.2. Draftstopping in floor/ceiling spaces and attic spaces shall comply with Sections 716.3 and 716.4, respectively. The permitted use of combustible materials in concealed spaces of noncombustible buildings shall be limited to the applications indicated in Section 716.5.

716.2 Fireblocking. In combustible construction, fireblocking shall be installed to cut off concealed draft openings (both vertical and horizontal) and shall form an effective barrier between floors, between a top story and a roof or attic space. Fireblocking shall be installed in the locations specified in Sections 716.2.2 through 716.2.7.

716.2.1 Fireblocking materials. Fireblocking shall consist of 2-inch (51 mm) nominal lumber or two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints or one thickness of 0.719-inch (18.3 mm) wood structural panel with joints backed by 0.719-inch (18.3 mm) wood structural panel or one thickness of 0.75-inch (19 mm) particleboard with joints backed by 0.75-inch (19 mm) particleboard. Gypsum board, cement fiber board, batts or blankets of mineral wool or glass fiber or other approved materials installed in such a manner as to be securely retained in place shall be permitted as an acceptable fire block. Loose-fill insulation material shall not be used as a fire block unless specifically tested in the form and manner intended for use to demonstrate its ability to remain in place and to retard the spread of fire and hot gases. The integrity of fire blocks shall be maintained.

716.2.1.1 Double stud walls. Batts or blankets of mineral or glass fiber or other approved nonrigid materials shall be allowed as fireblocking in walls constructed using parallel rows of studs or staggered studs.

716.2.2 Concealed wall spaces. Fireblocking shall be provided in concealed spaces of stud walls and partitions, including furred spaces, at the ceiling and floor levels and at 10-foot (3048 mm) intervals both vertical and horizontal.

716.2.3 Connections between horizontal and vertical spaces. Fireblocking shall be provided at interconnections between concealed vertical stud wall or partition spaces and concealed horizontal spaces created by an assembly of floor joists or trusses, and between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings and similar locations.

716.2.4 Stairways. Fireblocking shall be provided in concealed spaces between stair stringers at the top and bottom of the run and between studs along and in line with the run of stairs if the walls under the stairs are unfinished.

716.2.5 Ceiling and floor openings. Where annular space protection is provided in accordance with Exception 6 of Section 707.2, Exception 1 of Section 711.4.2, or Section 711.4.3, fireblocking shall be installed at openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor levels, with an approved material to resist the free passage of flame and the products of combustion. Factory-built chimneys and fireplaces shall be fireblocked in accordance with UL 103 and UL 127.

716.2.6 Architectural trim. Fireblocking shall be installed within concealed spaces of exterior wall finish and other exterior architectural elements where permitted to be of combustible construction in Section 1406 or where erected with combustible frames, at maximum intervals of 20 feet (6096 mm). If noncontinuous, such elements shall have closed ends, with at least 4 inches (102 mm) of separation between sections.

Exceptions:

1. Fireblocking of cornices is not required in single-family dwellings. Fireblocking of cornices of a two-family dwelling is required only at the line of dwelling unit separation.
2. Fireblocking shall not be required where installed on noncombustible framing and the face of the exterior wall finish exposed to the concealed space is covered by one of the following materials:
   2.1. Aluminum having a minimum thickness of 0.019 inch (0.5 mm).
   2.2. Corrosion-resistant steel having a base metal thickness not less than 0.016 inch (0.4 mm) at any point.

2.3. Other approved noncombustible materials.

716.2.7 Concealed sleeper spaces. Where wood sleepers are used for laying wood flooring on masonry or concrete fire-resistance-rated floors, the space between the floor slab and the underside of the wood flooring shall be filled with an approved material to resist the free passage of flame and products of combustion or fireblocked in such a manner that there will be no open spaces under the flooring that will exceed 100 square feet (9.3 m^2) in area and such space shall be filled solidly under permanent partitions so that there is no communication under the flooring between adjoining rooms.

Exceptions:

1. Fireblocking is not required for slab-on-grade floors in gymnasiums.
2. Fireblocking is required only at the juncture of each alternate lane and at the ends of each lane in a bowling facility.

716.3 Draftstopping in floors. In combustible construction, draftstopping shall be installed to subdivide floor/ceiling assemblies in the locations prescribed in Sections 716.3.2 through 716.3.3.

716.3.1 Draftstopping materials. Draftstopping materials shall not be less than 0.5-inch (12.7 mm) gypsum board, 0.375-inch (9.5 mm) wood structural panel, 0.375-inch (9.5 mm) particleboard or other approved materials adequately supported. The integrity of draftstops shall be maintained.

716.3.2 Groups R-1, R-2, R-3 and R-4. Draftstopping shall be provided in floor/ceiling spaces in Group R-1 buildings, in Group R-2 buildings as applicable in Section 101.2 with three or more dwelling units, in Group R-3 buildings as applicable in Section 101.2 with two dwelling units and in Group R-4 buildings. Draftstopping shall be located above and in line with the dwelling unit and tenant separations.

Exceptions:

1. Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
2. Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.2, provided that automatic sprinklers are also installed in the combustible concealed spaces.

716.3.3 Other groups. In other groups, draftstopping shall be installed so that horizontal floor areas do not exceed 1,000 square feet (93 m^2).

Exception: Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

716.4 Draftstopping in attics. In combustible construction, draftstopping shall be installed to subdivide attic spaces and concealed roof spaces in the locations prescribed in Sections 716.4.2 and 716.4.3. Ventilation of concealed roof spaces shall be maintained in accordance with Section 1202.2.

716.4.1 Draftstopping materials. Materials utilized for draftstopping of attic spaces shall comply with Section 716.3.1.

716.4.1.1 Openings. Openings in the partitions shall be protected by self-closing doors with automatic latches constructed as required for the partitions.

716.4.2 Groups R-1 and R-2. Draftstopping shall be provided in attics, mansards, overhangs or other concealed roof spaces of Group R-2 buildings with three or more dwelling units and in all Group R-1 buildings. Draftstopping shall be installed above, and in line with, tenant and dwelling unit separation walls that do not extend to the underside of the roof sheathing above.

Exceptions:

1. Where corridor walls provide a tenant or dwelling unit separation, draftstopping shall only be required above one of the corridor walls.
2. Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
3. In occupancies in Group R-2 that do not exceed four stories in height, the attic space shall be subdivided by draftstops into areas not exceeding 3,000 square feet (279 m^2) or above every two dwelling units, whichever is smaller.
4. Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.2, provided that automatic sprinklers are also installed in the combustible concealed spaces.

716.4.3 Other groups. Draftstopping shall be installed in attics and concealed roof spaces, such that any horizontal area does not exceed 3,000 square feet (279 m^2).

Exception: Draftstopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

716.5 Combustibles in concealed spaces in Types I and II construction. Combustibles shall not be permitted in concealed spaces of buildings of Type I or II construction.

Exceptions:

1. Combustible materials in accordance with Section 603.
2. Combustible materials complying with Section 602 of the *International Mechanical Code*.
3. Class A interior finish materials.
4. Combustible piping within partitions or enclosed shafts installed in accordance with the provision of this code. Combustible piping shall be permitted within concealed ceiling spaces where installed in accordance with the *International Mechanical Code* and the *International Plumbing Code*.

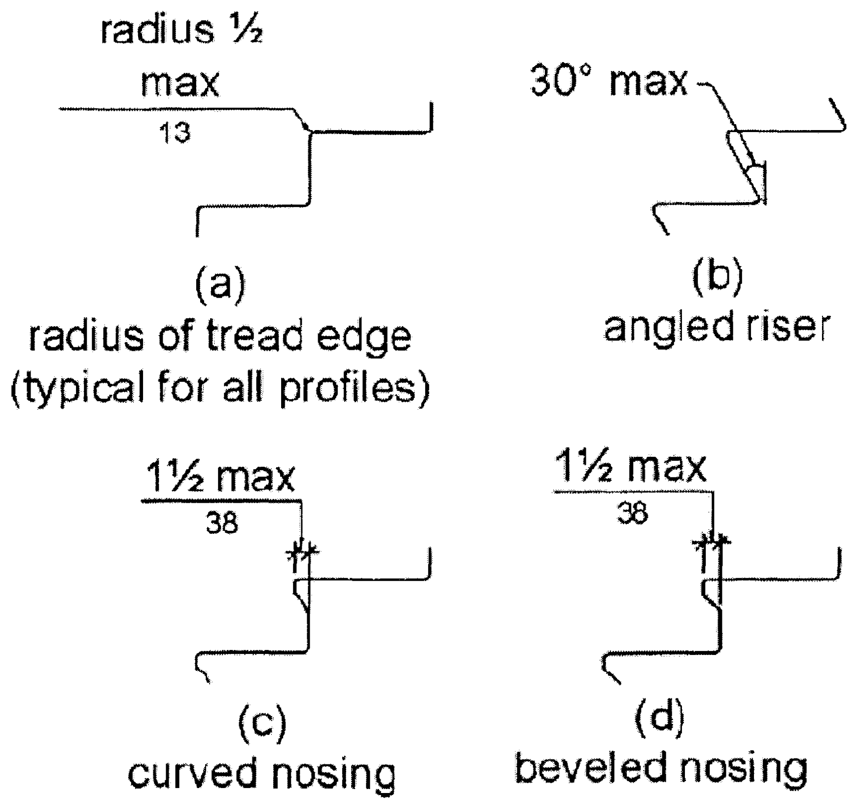


Figure 504.5
Stair Nosings

504.6 Handrails. Stairs shall have handrails complying with 505.

504.7 Wet Conditions. Stair treads and landings subject to wet conditions shall be designed to prevent the accumulation of water.

505 Handrails

505.1 General. Handrails provided along walking surfaces complying with 403, required at ramps complying with 405, and required at stairs complying with 504 shall comply with 505.

Advisory 505.1 General. Handrails are required on ramp runs with a rise greater than 6 inches (150 mm) (see 405.8) and on certain stairways (see 504). Handrails are not required on walking surfaces with running slopes less than 1:20. However, handrails are required to comply with 505 when they are provided on walking surfaces with running slopes less than 1:20 (see 403.6). Sections 505.2, 505.3, and 505.10 do not apply to handrails provided on walking surfaces with running slopes less than 1:20 as these sections only reference requirements for ramps and stairs.

505.2 Where Required. Handrails shall be provided on both sides of stairs and ramps.
EXCEPTION: In assembly areas, handrails shall not be required on both sides of aisle ramps where a handrail is provided at either side or within the aisle width.

505.3 Continuity. Handrails shall be continuous within the full length of each stair flight or ramp run. Inside handrails on switchback or dogleg stairs and ramps shall be continuous between flights or runs.
EXCEPTION: In assembly areas, handrails on ramps shall not be required to be continuous in aisles serving seating.

> Advisory 404.1 General Exception. Security personnel must have sole control of doors that are eligible for the Exception at 404.1. It would not be acceptable for security personnel to operate the doors for people with disabilities while allowing others to have independent access.

404.2 Manual Doors, Doorways, and Manual Gates. Manual doors and doorways and manual gates intended for user passage shall comply with 404.2.

404.2.1 Revolving Doors, Gates, and Turnstiles. Revolving doors, revolving gates, and turnstiles shall not be part of an accessible route.

404.2.2 Double-Leaf Doors and Gates. At least one of the active leaves of doorways with two leaves shall comply with 404.2.3 and 404.2.4.

404.2.3 Clear Width. Door openings shall provide a clear width of 32 inches (815 mm) minimum. Clear openings of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees. Openings more than 24 inches (610 mm) deep shall provide a clear opening of 36 inches (915 mm) minimum. There shall be no projections into the required clear opening width lower than 34 inches (865 mm) above the finish floor or ground. Projections into the clear opening width between 34 inches (865 mm) and 80 inches (2030 mm) above the finish floor or ground shall not exceed 4 inches (100 mm).

EXCEPTIONS: 1. In alterations, a projection of 5/8 inch (16 mm) maximum into the required clear width shall be permitted for the latch side stop.

2. Door closers and door stops shall be permitted to be 78 inches (1980 mm) minimum above the finish floor or ground.

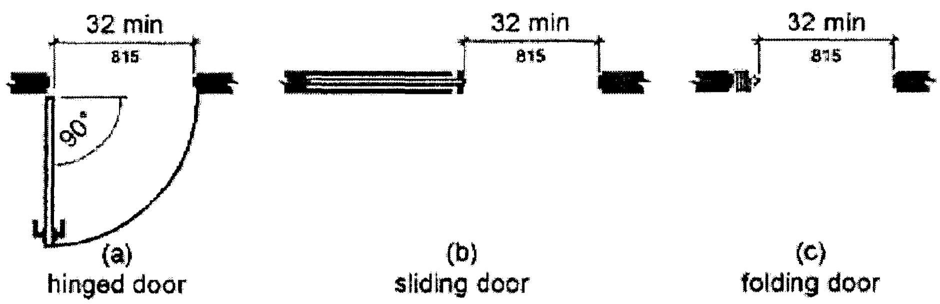


Figure 404.2.3
Clear Width of Doorways

404.2.4 Maneuvering Clearances. Minimum maneuvering clearances at doors and gates shall comply with 404.2.4. Maneuvering clearances shall extend the full width of the doorway and the required latch side or hinge side clearance.

EXCEPTION: Entry doors to hospital patient rooms shall not be required to provide the clearance beyond the latch side of the door.

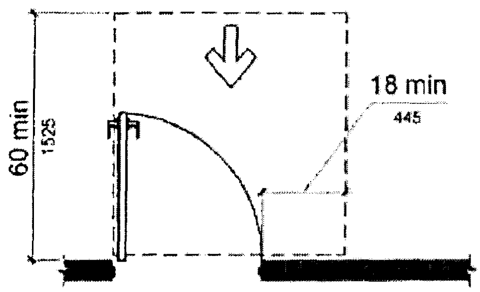
404.2.4.1 Swinging Doors and Gates. Swinging doors and gates shall have maneuvering clearances complying with Table 404.2.4.1.

404.2.4.1 Maneuvering Clearances at Manual Swinging Doors and Gates (text version)

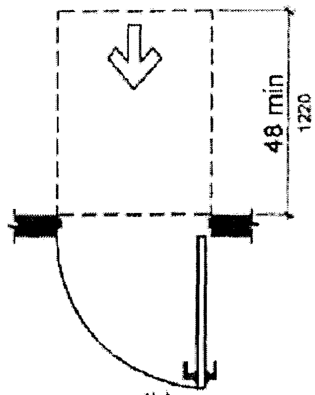
Type of Use		Minimum Maneuvering Clearance	
Approach Direction	**Door or Gate Side**	**Perpendicular to Doorway**	**Parallel to Doorway (beyond latch side unless noted)**
From front	Pull	60 inches (1525 mm)	18 inches (455 mm)
From front	Push	48 inches (1220 mm)	0 inches (0 mm)[1]
From hinge side	Pull	60 inches (1525 mm)	36 inches (915 mm)
From hinge side	Pull	54 inches (1370 mm)	42 inches (1065 mm)

From hinge side	Push	42 inches (1065 mm)2	22 inches (560 mm)3
From latch side	Pull	48 inches (1220 mm)4	24 inches (610 mm)
From latch side	Push	42 inches (1065 mm)4	24 inches (610 mm)

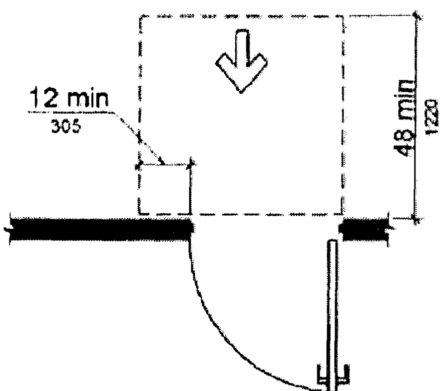
1. Add 12 inches (305 mm) if closer and latch are provided.
2. Add 6 inches (150 mm) if closer and latch are provided.
3. Beyond hinge side.
4. Add 6 inches (150 mm) if closer is provided.



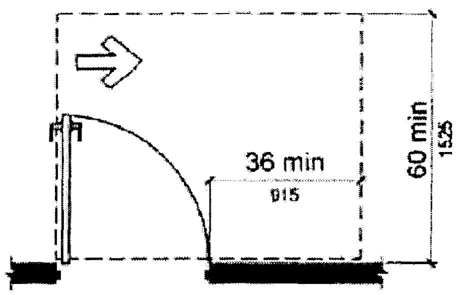
(a)
front approach, pull side



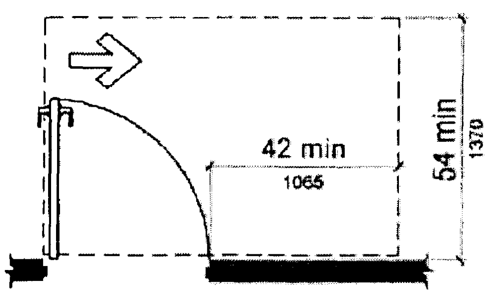
(b)
front approach, push side



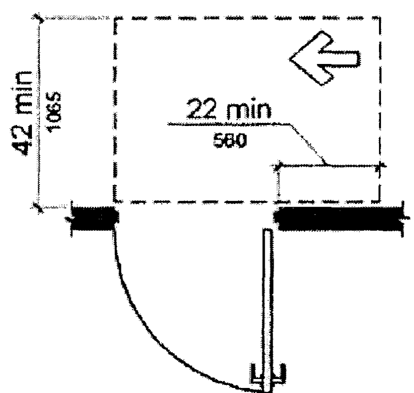
(c)
front approach, push side, door provided with both closer and latch



(d)
hinge approach, pull side



(e)
hinge approach, pull side



(f)
hinge approach, push side

compound slope that will not meet the requirements of this document. Circular or curved ramps continually change direction. Curvilinear ramps with small radii also can create compound cross slopes and cannot, by their nature, meet the requirements for accessible routes. A level landing is needed at the accessible door to permit maneuvering and simultaneously door operation.

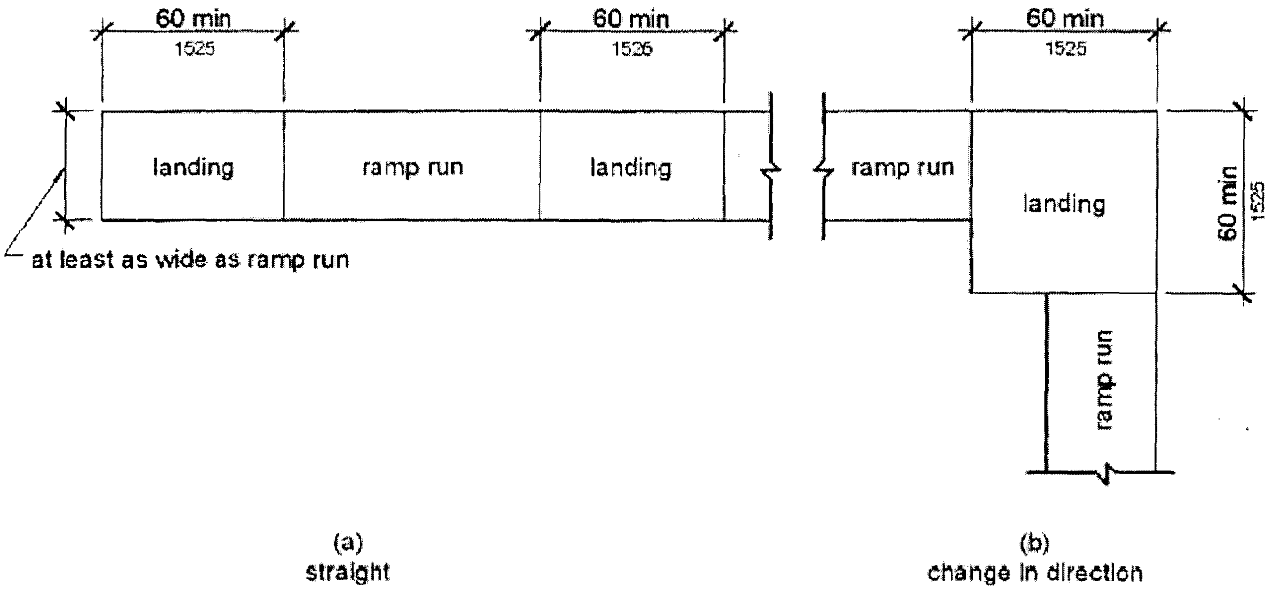


Figure 405.7
Ramp Landings

405.7.1 Slope. Landings shall comply with 302. Changes in level are not permitted.
EXCEPTION: Slopes not steeper than 1:48 shall be permitted.

405.7.2 Width. The landing clear width shall be at least as wide as the widest ramp run leading to the landing.

405.7.3 Length. The landing clear length shall be 60 inches (1525 mm) long minimum.

405.7.4 Change in Direction. Ramps that change direction between runs at landings shall have a clear landing 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum.

405.7.5 Doorways. Where doorways are located adjacent to a ramp landing, maneuvering clearances required by 404.2.4 and 404.3.2 shall be permitted to overlap the required landing area.

405.8 Handrails. Ramp runs with a rise greater than 6 inches (150 mm) shall have handrails complying with 505.
EXCEPTION: Within employee work areas, handrails shall not be required where ramps that are part of common use circulation paths are designed to permit the installation of handrails complying with 505. Ramps not subject to the exception to 405.5 shall be designed to maintain a 36 inch (915 mm) minimum clear width when handrails are installed.

405.9 Edge Protection. Edge protection complying with 405.9.1 or 405.9.2 shall be provided on each side of ramp runs and at each side of ramp landings.
EXCEPTIONS: 1. Edge protection shall not be required on ramps that are not required to have handrails and have sides complying with 406.3.
2. Edge protection shall not be required on the sides of ramp landings serving an adjoining ramp

run or stairway.
3. Edge protection shall not be required on the sides of ramp landings having a vertical drop-off of 1/2 inch (13 mm) maximum within 10 inches (255 mm) horizontally of the minimum landing area specified in 405.7.

405.9.1 Extended Floor or Ground Surface. The floor or ground surface of the ramp run or landing shall extend 12 inches (305 mm) minimum beyond the inside face of a handrail complying with 505.

Advisory 405.9.1 Extended Floor or Ground Surface. The extended surface prevents wheelchair casters and crutch tips from slipping off the ramp surface.

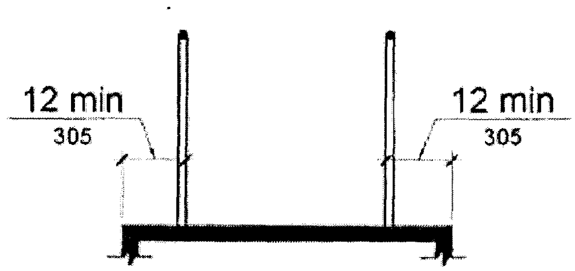


Figure 405.9.1
Extended Floor or Ground Surface Edge Protection

405.9.2 Curb or Barrier. A curb or barrier shall be provided that prevents the passage of a 4 inch (100 mm) diameter sphere, where any portion of the sphere is within 4 inches (100 mm) of the finish floor or ground surface.

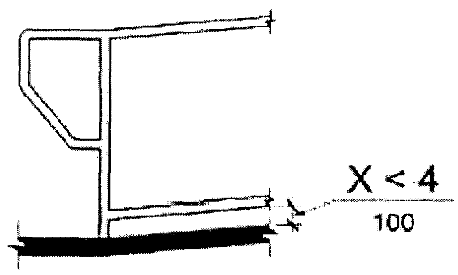


Figure 405.9.2
Curb or Barrier Edge Protection

405.10 Wet Conditions. Landings subject to wet conditions shall be designed to prevent the accumulation of water.

406 Curb Ramps

406.1 General. Curb ramps on accessible routes shall comply with 406, 405.2 through 405.5, and 405.10.

406.2 Counter Slope. Counter slopes of adjoining gutters and road surfaces immediately adjacent to the curb ramp shall not be steeper than 1:20. The adjacent surfaces at transitions at curb ramps to walks, gutters, and streets shall be at the same level.

407 Elevators

407.1 General. Elevators shall comply with 407 and with ASME A17.1 (incorporated by reference, see "Referenced Standards" in Chapter 1). They shall be passenger elevators as classified by ASME A17.1. Elevator operation shall be automatic.

> Advisory 407.1 General. The ADA and other Federal civil rights laws require that accessible features be maintained in working order so that they are accessible to and usable by those people they are intended to benefit. Building owners should note that the ASME Safety Code for Elevators and Escalators requires routine maintenance and inspections. Isolated or temporary interruptions in service due to maintenance or repairs may be unavoidable; however, failure to take prompt action to effect repairs could constitute a violation of Federal laws and these requirements.

407.2 Elevator Landing Requirements. Elevator landings shall comply with 407.2.

407.2.1 Call Controls. Where elevator call buttons or keypads are provided, they shall comply with 407.2.1 and 309.4. Call buttons shall be raised or flush.
EXCEPTION: Existing elevators shall be permitted to have recessed call buttons.

407.2.1.1 Height. Call buttons and keypads shall be located within one of the reach ranges specified in 308, measured to the centerline of the highest operable part.
EXCEPTION: Existing call buttons and existing keypads shall be permitted to be located at 54 inches (1370 mm) maximum above the finish floor, measured to the centerline of the highest operable part.

407.2.1.2 Size. Call buttons shall be 3/4 inch (19 mm) minimum in the smallest dimension.
EXCEPTION: Existing elevator call buttons shall not be required to comply with 407.2.1.2.

407.2.1.3 Clear Floor or Ground Space. A clear floor or ground space complying with 305 shall be provided at call controls.

> Advisory 407.2.1.3 Clear Floor or Ground Space. The clear floor or ground space required at elevator call buttons must remain free of obstructions including ashtrays, plants, and other decorative elements that prevent wheelchair users and others from reaching the call buttons. The height of the clear floor or ground space is considered to be a volume from the floor to 80 inches (2030 mm) above the floor. Recessed ashtrays should not be placed near elevator call buttons so that persons who are blind or visually impaired do not inadvertently contact them or their contents as they reach for the call buttons.

407.2.1.4 Location. The call button that designates the up direction shall be located above the call button that designates the down direction.
EXCEPTION: Destination-oriented elevators shall not be required to comply with 407.2.1.4.

> Advisory 407.2.1.4 Location Exception. A destination-oriented elevator system provides lobby controls enabling passengers to select floor stops, lobby indicators designating which elevator to use, and a car indicator designating the floors at which the car will stop. Responding cars are programmed for maximum efficiency by reducing the number of stops any passenger experiences.

407.2.1.5 Signals. Call buttons shall have visible signals to indicate when each call is registered and when each call is answered.
EXCEPTIONS: 1. Destination-oriented elevators shall not be required to comply with 407.2.1.5 provided that visible and audible signals complying with 407.2.2 indicating which elevator car to enter are provided.
2. Existing elevators shall not be required to comply with 407.2.1.5.

407.2.1.6 Keypads. Where keypads are provided, keypads shall be in a standard telephone keypad arrangement and shall comply with 407.4.7.2.

407.2.2 Hall Signals. Hall signals, including in-car signals, shall comply with 407.2.2.

407.2.2.1 Visible and Audible Signals. A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call and the car's direction of travel. Where in-car signals are provided, they shall be visible from the floor area adjacent to the hall call buttons.

EXCEPTIONS: 1. Visible and audible signals shall not be required at each destination-oriented elevator where a visible and audible signal complying with 407.2.2 is provided indicating the elevator car designation information.

2. In existing elevators, a signal indicating the direction of car travel shall not be required.

407.2.2.2 Visible Signals. Visible signal fixtures shall be centered at 72 inches (1830 mm) minimum above the finish floor or ground. The visible signal elements shall be 2 1/2 inches (64 mm) minimum measured along the vertical centerline of the element. Signals shall be visible from the floor area adjacent to the hall call button.

EXCEPTIONS: 1. Destination-oriented elevators shall be permitted to have signals visible from the floor area adjacent to the hoistway entrance.

2. Existing elevators shall not be required to comply with 407.2.2.2.

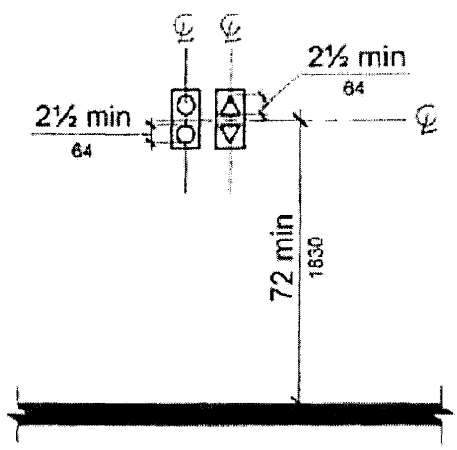


Figure 407.2.2.2
Visible Hall Signals

407.2.2.3 Audible Signals. Audible signals shall sound once for the up direction and twice for the down direction, or shall have verbal annunciators that indicate the direction of elevator car travel. Audible signals shall have a frequency of 1500 Hz maximum. Verbal annunciators shall have a frequency of 300 Hz minimum and 3000 Hz maximum. The audible signal and verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the hall call button.

EXCEPTIONS: 1. Destination-oriented elevators shall not be required to comply with 407.2.2.3 provided that the audible tone and verbal announcement is the same as those given at the call button or call button keypad.

2. Existing elevators shall not be required to comply with the requirements for frequency and dB range of audible signals.

407.2.2.4 Differentiation. Each destination-oriented elevator in a bank of elevators shall have audible and visible means for differentiation.

407.2.3 Hoistway Signs. Signs at elevator hoistways shall comply with 407.2.3.

407.2.3.1 Floor Designation. Floor designations complying with 703.2 and 703.4.1 and shall be provided on both jambs of elevator hoistway entrances. Floor designations shall be provided in both tactile characters and braille. Tactile characters shall be 2 inches (51 mm) high minimum. A tactile star shall be provided on both jambs at the main entry level.

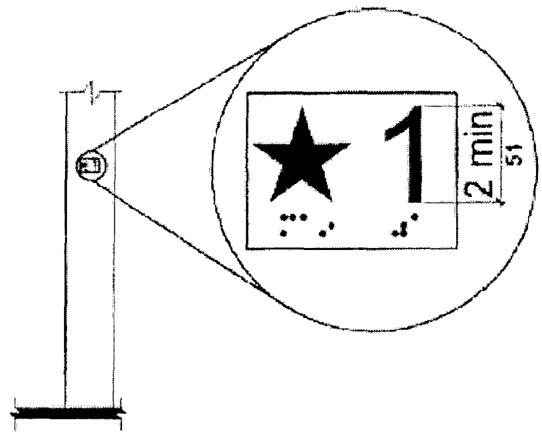


Figure 407.2.3.1
Floor Designations on Jambs of Elevator Hoistway Entrances

407.2.3.2 Car Designations. Destination-oriented elevators shall provide tactile car identification complying with 703.2 on both jambs of the hoistway immediately below the floor designation. Car designations shall be provided in both tactile characters and braille. Tactile characters shall be 2 inches (51 mm) high minimum.

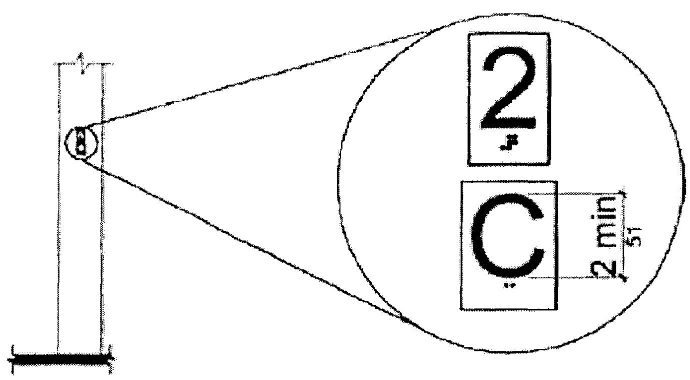


Figure 407.2.3.2
Car Designations on Jambs of Destination-Oriented Elevator Hoistway Entrances

407.3 Elevator Door Requirements. Hoistway and car doors shall comply with 407.3.

407.3.1 Type. Elevator doors shall be the horizontal sliding type. Car gates shall be prohibited.

407.3.2 Operation. Elevator hoistway and car doors shall open and close automatically. EXCEPTION: Existing manually operated hoistway swing doors shall be permitted provided that they comply with 404.2.3 and 404.2.9. Car door closing shall not be initiated until the hoistway door is closed.

407.3.3 Reopening Device. Elevator doors shall be provided with a reopening device complying

404.3.6 Break Out Opening. Where doors and gates without standby power are a part of a means of egress, the clear break out opening at swinging or sliding doors and gates shall be 32 inches (815 mm) minimum when operated in emergency mode.

EXCEPTION: Where manual swinging doors and gates comply with 404.2 and serve the same means of egress compliance with 404.3.6 shall not be required.

404.3.7 Revolving Doors, Revolving Gates, and Turnstiles. Revolving doors, revolving gates, and turnstiles shall not be part of an accessible route.

405 Ramps

405.1 General. Ramps on accessible routes shall comply with 405.

EXCEPTION: In assembly areas, aisle ramps adjacent to seating and not serving elements required to be on an accessible route shall not be required to comply with 405.

405.2 Slope. Ramp runs shall have a running slope not steeper than 1:12.

EXCEPTION: In existing sites, buildings, and facilities, ramps shall be permitted to have running slopes steeper than 1:12 complying with Table 405.2 where such slopes are necessary due to space limitations.

405.2 Maximum Ramp Slope and Rise for Existing Sites, Buildings, and Facilities

Slope[1]	Maximum Rise
Steeper than 1:10 but not steeper than 1:8	3 inches (75 mm)
Steeper than 1:12 but not steeper than 1:10	6 inches (150 mm)

1. A slope steeper than 1:8 is prohibited.

Advisory 405.2 Slope. To accommodate the widest range of users, provide ramps with the least possible running slope and, wherever possible, accompany ramps with stairs for use by those individuals for whom distance presents a greater barrier than steps, e.g., people with heart disease or limited stamina.

405.3 Cross Slope. Cross slope of ramp runs shall not be steeper than 1:48.

Advisory 405.3 Cross Slope. Cross slope is the slope of the surface perpendicular to the direction of travel. Cross slope is measured the same way as slope is measured (i.e., the rise over the run).

405.4 Floor or Ground Surfaces. Floor or ground surfaces of ramp runs shall comply with 302. Changes in level other than the running slope and cross slope are not permitted on ramp runs.

405.5 Clear Width. The clear width of a ramp run and, where handrails are provided, the clear width between handrails shall be 36 inches (915 mm) minimum.

EXCEPTION: Within employee work areas, the required clear width of ramps that are a part of common use circulation paths shall be permitted to be decreased by work area equipment provided that the decrease is essential to the function of the work being performed.

405.6 Rise. The rise for any ramp run shall be 30 inches (760 mm) maximum.

405.7 Landings. Ramps shall have landings at the top and the bottom of each ramp run. Landings shall comply with 405.7.

Advisory 405.7 Landings. Ramps that do not have level landings at changes in direction can create a

505.4 Height. Top of gripping surfaces of handrails shall be 34 inches (865 mm) minimum and 38 inches (965 mm) maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above walking surfaces, stair nosings, and ramp surfaces.

Advisory 505.4 Height. The requirements for stair and ramp handrails in this document are for adults. When children are the principle users in a building or facility (e.g., elementary schools), a second set of handrails at an appropriate height can assist them and aid in preventing accidents. A maximum height of 28 inches (710 mm) measured to the top of the gripping surface from the ramp surface or stair nosing is recommended for handrails designed for children. Sufficient vertical clearance between upper and lower handrails, 9 inches (230 mm) minimum, should be provided to help prevent entrapment.

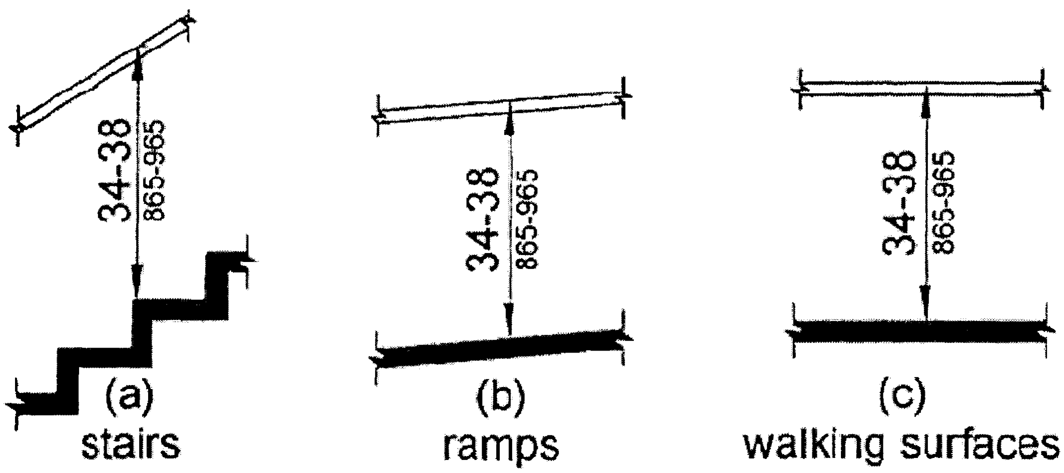


Figure 505.4
Handrail Height

505.5 Clearance. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1 1/2 inches (38 mm) minimum.

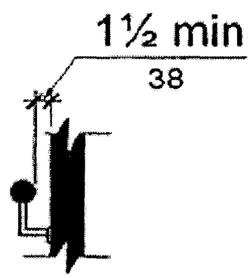


Figure 505.5
Handrail Clearance

505.6 Gripping Surface. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length. Where provided, horizontal projections shall occur 1 1/2 inches (38 mm) minimum below the bottom of the handrail gripping surface.

EXCEPTIONS: 1. Where handrails are provided along walking surfaces with slopes not steeper than 1:20, the bottoms of handrail gripping surfaces shall be permitted to be obstructed along their entire length where they are integral to crash rails or bumper guards.

2. The distance between horizontal projections and the bottom of the gripping surface shall be permitted to be reduced by 1/8 inch (3.2 mm) for each 1/2 inch (13 mm) of additional handrail perimeter dimension that exceeds 4 inches (100 mm).

Advisory 505.6 Gripping Surface. People with disabilities, older people, and others benefit from continuous gripping surfaces that permit users to reach the fingers outward or downward to grasp the handrail, particularly as the user senses a loss of equilibrium or begins to fall.

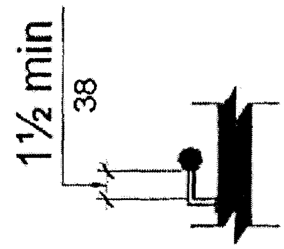


Figure 505.6
Horizontal Projections Below Gripping Surface

505.7 Cross Section. Handrail gripping surfaces shall have a cross section complying with 505.7.1 or 505.7.2.

505.7.1 Circular Cross Section. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1 1/4 inches (32 mm) minimum and 2 inches (51 mm) maximum.

505.7.2 Non-Circular Cross Sections. Handrail gripping surfaces with a non-circular cross section shall have a perimeter dimension of 4 inches (100 mm) minimum and 6 1/4 inches (160 mm) maximum, and a cross-section dimension of 2 1/4 inches (57 mm) maximum.

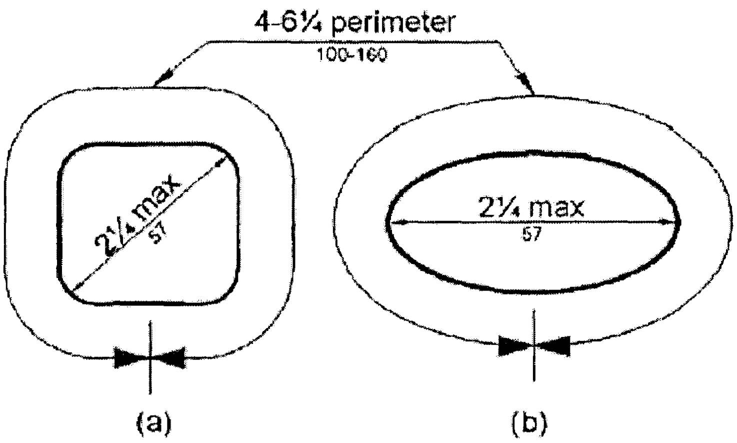


Figure 505.7.2
Handrail Non-Circular Cross Section

505.8 Surfaces. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.

505.9 Fittings. Handrails shall not rotate within their fittings.

505.10 Handrail Extensions. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with 505.10.

EXCEPTIONS: 1. Extensions shall not be required for continuous handrails at the inside turn of

switchback or dogleg stairs and ramps.
2. In assembly areas, extensions shall not be required for ramp handrails in aisles serving seating where the handrails are discontinuous to provide access to seating and to permit crossovers within aisles.
3. In alterations, full extensions of handrails shall not be required where such extensions would be hazardous due to plan configuration.

505.10.1 Top and Bottom Extension at Ramps. Ramp handrails shall extend horizontally above the landing for 12 inches (305 mm) minimum beyond the top and bottom of ramp runs. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent ramp run.

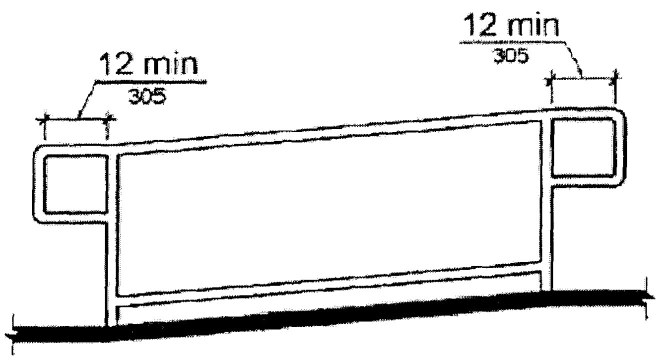


Figure 505.10.1
Top and Bottom Handrail Extension at Ramps

505.10.2 Top Extension at Stairs. At the top of a stair flight, handrails shall extend horizontally above the landing for 12 inches (305 mm) minimum beginning directly above the first riser nosing. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent stair flight.

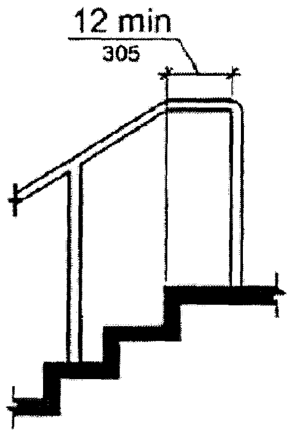
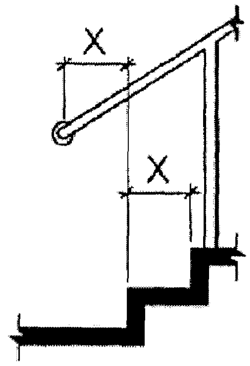


Figure 505.10.2
Top Handrail Extension at Stairs

505.10.3 Bottom Extension at Stairs. At the bottom of a stair flight, handrails shall extend at the slope of the stair flight for a horizontal distance at least equal to one tread depth beyond the last riser nosing. Extension shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent stair flight.



Note: X = tread depth

Figure 505.10.3
Bottom Handrail Extension at Stairs

CHAPTER 6: PLUMBING ELEMENTS AND FACILITIES

601 General

601.1 Scope. The provisions of Chapter 6 shall apply where required by Chapter 2 or where referenced by a requirement in this document.

602 Drinking Fountains

602.1 General. Drinking fountains shall comply with 307 and 602.

602.2 Clear Floor Space. Units shall have a clear floor or ground space complying with 305 positioned for a forward approach and centered on the unit. Knee and toe clearance complying with 306 shall be provided.

EXCEPTION: A parallel approach complying with 305 shall be permitted at units for children's use where the spout is 30 inches (760 mm) maximum above the finish floor or ground and is 3 1/2 inches (90 mm) maximum from the front edge of the unit, including bumpers.

602.3 Operable Parts. Operable parts shall comply with 309.

602.4 Spout Height. Spout outlets shall be 36 inches (915 mm) maximum above the finish floor or ground.

602.5 Spout Location. The spout shall be located 15 inches (380 mm) minimum from the vertical position that conflicts with the location of the rear grab bar, then the rear grab bar shall be permitted to be split or shifted to the open side of the toilet area.

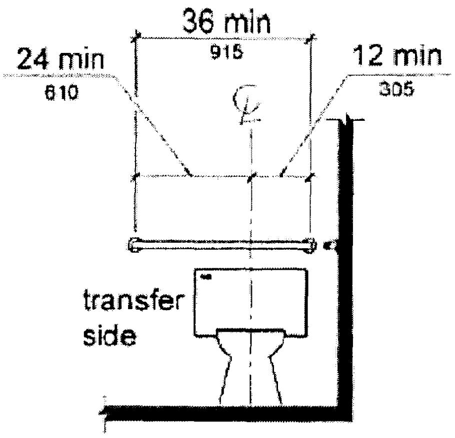


Figure 604.5.2
Rear Wall Grab Bar at Water Closets

604.6 Flush Controls. Flush controls shall be hand operated or automatic. Hand operated flush controls shall comply with 309. Flush controls shall be located on the open side of the water closet except in ambulatory accessible compartments complying with 604.8.2.

Advisory 604.6 Flush Controls. If plumbing valves are located directly behind the toilet seat, flush valves and related plumbing can cause injury or imbalance when a person leans back against them. To prevent causing injury or imbalance, the plumbing can be located behind walls or to the side of the toilet; or if approved by the local authority having jurisdiction, provide a toilet seat lid.

604.7 Dispensers. Toilet paper dispensers shall comply with 309.4 and shall be 7 inches (180 mm) minimum and 9 inches (230 mm) maximum in front of the water closet measured to the centerline of the dispenser. The outlet of the dispenser shall be 15 inches (380 mm) minimum and 48 inches (1220 mm) maximum above the finish floor and shall not be located behind grab bars. Dispensers shall not be of a type that controls delivery or that does not allow continuous paper flow.

Advisory 604.7 Dispensers. If toilet paper dispensers are installed above the side wall grab bar, the outlet of the toilet paper dispenser must be 48 inches (1220 mm) maximum above the finish floor and the top of the gripping surface of the grab bar must be 33 inches (840 mm) minimum and 36 inches (915 mm) maximum above the finish floor.

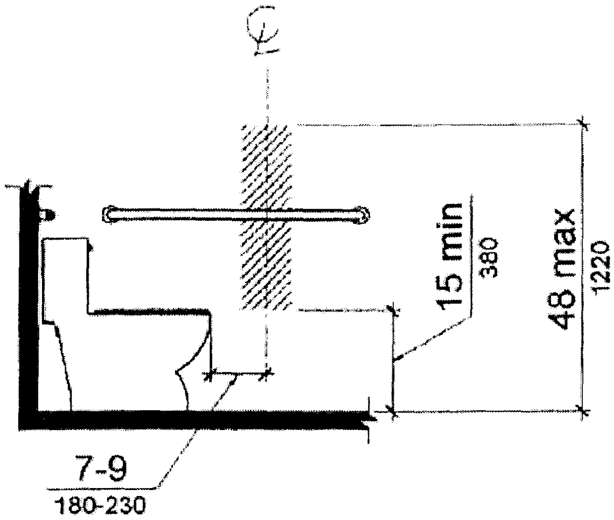


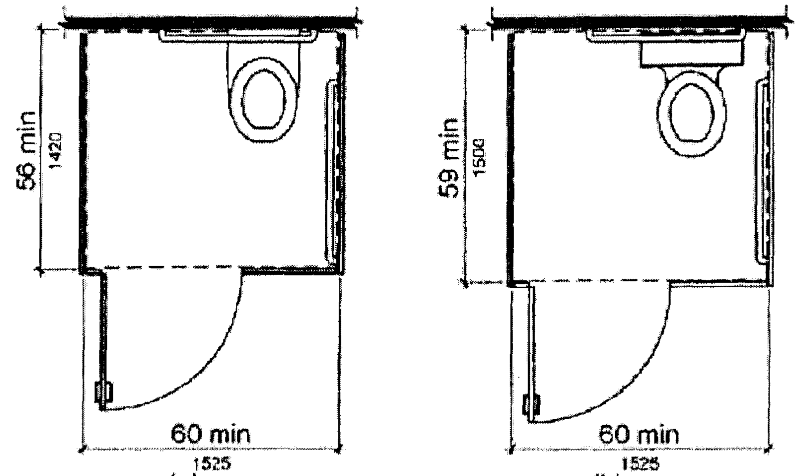
Figure 604.7
Dispenser Outlet Location

604.8 Toilet Compartments. Wheelchair accessible toilet compartments shall meet the requirements of 604.8.1 and 604.8.3. Compartments containing more than one plumbing fixture shall comply with 603. Ambulatory accessible compartments shall comply with 604.8.2 and 604.8.3.

604.8.1 Wheelchair Accessible Compartments. Wheelchair accessible compartments shall comply with 604.8.1.

604.8.1.1 Size. Wheelchair accessible compartments shall be 60 inches (1525 mm) wide minimum measured perpendicular to the side wall, and 56 inches (1420 mm) deep minimum for wall hung water closets and 59 inches (1500 mm) deep minimum for floor mounted water closets measured perpendicular to the rear wall. Wheelchair accessible compartments for children's use shall be 60 inches (1525 mm) wide minimum measured perpendicular to the side wall, and 59 inches (1500 mm) deep minimum for wall hung and floor mounted water closets measured perpendicular to the rear wall.

Advisory 604.8.1.1 Size. The minimum space required in toilet compartments is provided so that a person using a wheelchair can maneuver into position at the water closet. This space cannot be obstructed by baby changing tables or other fixtures or conveniences, except as specified at 604.3.2 (Overlap). If toilet compartments are to be used to house fixtures other than those associated with the water closet, they must be designed to exceed the minimum space requirements. Convenience fixtures such as baby changing tables must also be accessible to people with disabilities as well as to other users. Toilet compartments that are designed to meet, and not exceed, the minimum space requirements may not provide adequate space for maneuvering into position at a baby changing table.



(a)
adult wall hung
water closet

(b)
adult floor mounted water closet
and children's water closet

Figure 604.8.1.1
Size of Wheelchair Accessible Toilet Compartment

604.8.1.2 Doors. Toilet compartment doors, including door hardware, shall comply with 404 except that if the approach is to the latch side of the compartment door, clearance between the door side of the compartment and any obstruction shall be 42 inches (1065 mm) minimum. Doors shall be located in the front partition or in the side wall or partition farthest from the water closet. Where located in the front partition, the door opening shall be 4 inches (100 mm) maximum from the side wall or partition farthest from the water closet. Where located in the side wall or partition, the door opening shall be 4 inches (100 mm) maximum from the front partition. The door shall be self-closing. A door pull complying with 404.2.7 shall be placed on both sides of the door near the latch. Toilet compartment doors shall not swing into the minimum required compartment area.

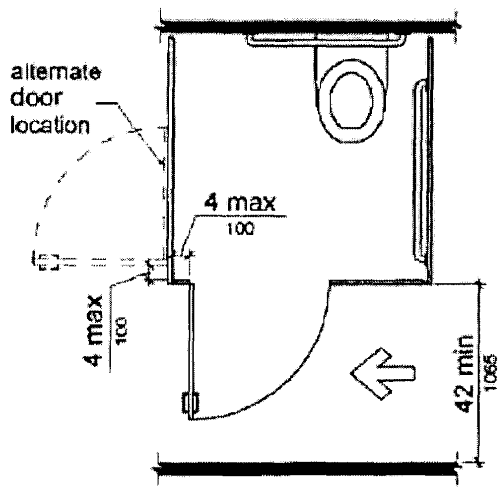


Figure 604.8.1.2
Wheelchair Accessible Toilet Compartment Doors

604.8.1.3 Approach. Compartments shall be arranged for left-hand or right-hand approach to the water closet.

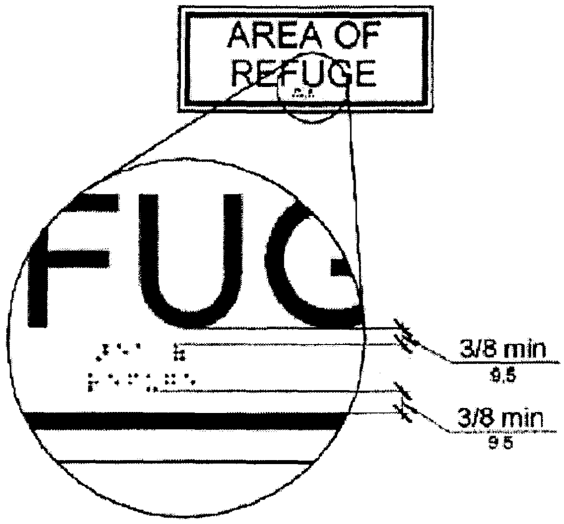


Figure 703.3.2
Position of Braille

703.4 Installation Height and Location. Signs with tactile characters shall comply with 703.4.

703.4.1 Height Above Finish Floor or Ground. Tactile characters on signs shall be located 48 inches (1220 mm) minimum above the finish floor or ground surface, measured from the baseline of the lowest tactile character and 60 inches (1525 mm) maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.

EXCEPTION: Tactile characters for elevator car controls shall not be required to comply with 703.4.1.

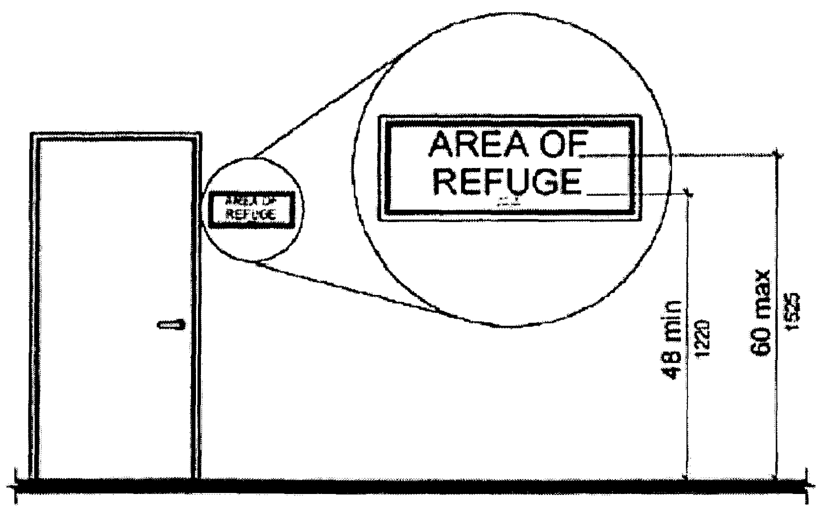


Figure 703.4.1
Height of Tactile Characters Above Finish Floor or Ground

703.4.2 Location. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leafs, the sign shall be located to the right of the right hand door. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall. Signs containing tactile characters shall be located so that a clear floor space of 18 inches (455 mm) minimum by 18 inches (455 mm) minimum, centered on the tactile