DIMENSION IV
Madison Design Group
architecture · interior design · planning

December 27, 2023

City of Madison
Building Code Variance Committee
215 Martin Luther King, Jr. Blvd. Suite 017
Madison, WI 53703

Project Address: 2206 University Avenue
Variance Petition for: 1208.2

1. The rule being petitioned reads as follows: (Cite the specific rule number and language. Also, indicate the nonconforming conditions for your project.)

This building is designed to have a playroom of 338 sq. ft. The playroom will be divided into an upper and lower floor level. The lower floor level will be 201 sq. ft. with an average ceiling height of 9'-10". The upper floor level will be 137 sq. ft. with an average ceiling height of 6'-8". The average ceiling height for the playroom will be 8'-8". The playroom is classified as an "habitable" space rather than a "means of egress". The IBC has requirements for Interior Space Dimensions in code section IBC 1208. (Playroom: floor plans, sections, and elevations related to Playroom can be found in Exhibits EX-1 and EX-2.)

BACKGROUND INFORMATION ON THE INTENT OF IBC Chapter 12 Interior Environment (All background information can be found in the IBC Code Commentary Exhibit *)

> The environmental and physiological justification for the code requirements relevant to light and ventilation of occupiable spaces is based on our knowledge, technology and practices developed over centuries of building structures in which humans live and work. These design practices have been further validated by studies during the 19th and 20th centuries.
>
> Even though it was not completely understood, the need for "fresh air" had been recognized for centuries. Designers of centuries-old adobe buildings in the southwestern United States, hide covered Native American teepees of the plains and frame houses of early settlers in the eastern United States all relied on the buoyancy of warm air, enabling it to rise and cooler air to flow in to replace it. Whether the design relied on solar energy, thermal mass, or even wind velocity to cause the movement, it reflected a natural movement and, as a result, as been termed "natural ventilation." Only recently have we begun to recognize the reasons for ventilation and the implications of failing to provide an adequate quantity and acceptable quality of air for all occupants. The expression "sick building syndrome" has crept into our vocabulary and reflects the increased understanding of the relationship between interior environment requirements and the physiological well-being of the occupants.
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> The other purpose of regulating the interior environment is psychological. Merely providing adequate conditions is not sufficient if the occupant does not perceive them as adequate. Minimum space requirements (floor area, yard dimensions or ceiling height) address the need to perceive adequate light, ventilation, and space to promote psychological well-being. Regulation of sound transmission also bears directly on the psychological and long-term physical well-being of the occupant.
>
> Finally, adequate lighting from natural sources also meets the physical and psychological needs of the occupants and contributes directly to their overall safety. Safe use of any building under ordinary and emergency conditions depends greatly on proper illumination of the space.

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This chapter references the *International Mechanical Code (IMC)* as the performance standard to which ventilation must be compared and the installation standard for mechanical systems used in buildings regulated by the code.

Section 1205 requires light for every room or space intended for human occupancy. The method of compliance is the choice of the designer, who may elect to provide artificial instead of natural light. Prescriptive requirements for stairway lighting in dwelling units are also included.

Section 1206 specifies the minimum requirements for courts and yards, including area width, accessibility for cleaning, and the location of air intakes when natural light or natural ventilation is the chosen design option.

Section 1207 establishes the sound transmission control requirements for air-borne and structure-borne sound in residential buildings.

Section 1208 addresses the minimum ceiling height for all habitable and occupiable spaces along with the other spaces as specified (i.e., toilet rooms and bathrooms.) The minimum area for rooms in dwelling units is also specified.

CODE REQUIREMENT FOR MINIMUM CEILING HEIGHT IBC Section 1208.2 Minimum ceiling heights:

1208.2 Minimum ceiling heights. Occupiable spaces, *habitable spaces* and *corridors* shall have a ceiling height of not less than 7 feet 6 inches (2286 mm). Bathrooms, toilet rooms, kitchens, storage rooms and laundry rooms shall have a ceiling height of not less than 7 feet (2134 mm).

Exceptions:

1. In one- and two-family *dwellings*, beams or girders spaced not less than 4 feet (1219 mm) on center shall be permitted to project not more than 6 inches (152 mm) below the required ceiling height.
2. If any room in a building has a sloped ceiling, the prescribed ceiling height for the room is required in one-half the area thereof. Any portion of the room measuring less than 5 feet (1524 mm) from the finished floor to the ceiling shall not be included in any computation of the minimum area thereof.
3. The height of *mezzanines* and spaces below *mezzanines* shall be in accordance with Section 505.1.
4. Corridors contained within a *dwelling unit* or *sleeping unit* in a Group R occupancy shall have a ceiling height of not less than 7 feet (2134 mm).

1208.2.1 Furred ceiling. Any room with a furred ceiling shall be required to have the minimum ceiling height in two thirds of the area thereof, but in no case shall the height of the furred ceiling be less than 7 feet (2134 mm).

BACKGROUND INFORMATION ON THE INTENT OF IBC Section 1208.2 Minimum ceiling heights:

Occupiable spaces or rooms (including habitable spaces) are required to have a specific minimum ceiling height. Bathrooms, toilet rooms, kitchens, storage rooms and laundry rooms are permitted to have a lower minimum ceiling height in accordance with this section. Ceiling height is one of the variables that affects the circulation of air space. Additionally, there is a psychological need for spaciousness in a living space or in one of the accessory spaces.

VARIANCE REQURESTED: This document requests a variance to IBC 1208.2 to allow the upper floor level of the playroom space to have a minimum ceiling height of 6'-8".

2. The rule being petitioned cannot be entirely satisfied because:

The upper playroom floor is required to be raised above the lower floor level due to the area underneath the upper floor being used to provide vehicular access to the lower parking level (Exhibit EX-2).

There is a structural "BEAM" that protrudes below the ceiling that is located above the point of the playroom area where the floor elevation changes (Exhibit EX-2).

The minimum headroom height required in a means of egress area, per IBC 1003.3, is 6'-8". It is desirable to have the entire playroom have the minimum means of egress headroom height. A sloped ceiling will require that a portion of the upper floor level have a ceiling height of less than 6'-8" and would reduce the height of the room's exterior wall (Exhibit EX-2).

> **1003.3 Protruding objects.** Protruding objects on *circulation paths* shall comply with the requirements of Sections 1003.3.1 through 1003.3.4.
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> **1003.3.1 Headroom.** Protruding objects are permitted to extend below the minimum ceiling height required by Section 1003.2 where a minimum headroom of 80 inches (2032 mm) is provided over any walking surface, including walks, *corridors, aisles* and passageways. Not more than 50% of the ceiling area of a *means of egress* shall be reduced in height by protruding objects.
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> > **Exception:** Door closers and stops shall not reduce headroom to less than 78 inches (1981 mm).
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> A barrier shall be provided where the vertical clearance is less than 80 inches (2032 mm) high. The leading edge of such a barrier shall be located 27 inches (686 mm) maximum above the floor.

BACKGROUND INFORMATION ON INTENT OF IBC Section 1003.3.1 Headroom:

> This provision is applicable to all routes that make up components of the means of egress. Specifically, the limitations in this section and those in Sections 1003.3.2 and 1003.3.3 provide a reasonable level of safety for people with vision impairments as well as during emergency events when vision may be obscured by smoke or low lighting.
>
> Minimum dimensions for headroom clearance are specified in this section. The minimum headroom clearance over all walking surfaces or circulation paths is required to be maintained at 80 inches (2032 mm). This minimum headroom clearance is consistent with the requirements in Section 1011.3 for stairs and Section 1012.5.2 for ramps.

A conversation with the City of Madison indicated that a variance would be required to be filed and approved in order for the upper floor level to be approved for a 6'-8" ceiling height (Exhibits EX-1 and EX-2).

3. The following alternatives and supporting information are proposed as a means of providing an equivalent degree of health, safety, and welfare as addressed by the rule:

The playroom will be provided with a mechanical ventilation system to maintain appropriate circulation throughout the floor area per the International Mechanical Code. The installed system can be tested to assure the system works as designed. (Ducts are shown in plan on EX-1 and in section on EX-2).

In addition to the mechanical ventilation, the opening area below the "BEAM" is sized to meet the requirement for adjoining spaces for natural ventilation per the International Mechanical Code 402.3 (See Exhibit EX-1 showing railing between upper and lower floors, and EX-2 showing sections of this area).

> **IMC 402.3 Adjoining spaces.** Where rooms and spaces without openings to the outdoors are ventilated through an adjoining room, the opening to the adjoining rooms shall be unobstructed and shall have an area not less than 8 percent of the floor area of the interior room or space, but not less than 25 square feet (2.3 m^2). The minimum openable area to the outdoors shall be based on total floor area being ventilated.

In order to address the psychological concerns for a low ceiling space, the exterior wall of the upper floor space is designed with windows to the exterior. (See Exhibits EX-1 and EX-2).

In addition to the exterior windows, the opening area below the "BEAM" is sized to meet the requirements for Natural Lighting per IBC 1205.2.1. This opening will also provide a visual connection between the upper and lower floor level.

> 1205.2.1 Adjoining spaces. For the purpose of natural lighting, any room is permitted to be considered as a portion of an adjoining room where one-half of the area of the common wall is open and unobstructed and provides an opening of not less than one-tenth of the floor area of the interior room or 25 square feet (2.32 m^2), whichever is greater.

The "BEAM" will have an open guardrail underneath to protect the low headroom area from occupants having access to the floor area under the "BEAM." The guardrail is required per IBC 1003.3.1. This will reduce the occupiable space floor area of the upper floor to 107 sq. ft. The occupiable upper floor will be less than 1/3 the playroom floor area (107/338 = 31.7%).

IBC 1208.2.8 allows furred ceilings to have a ceiling height of 7'-0" if less than 1/3 the total room area.

> **1208.2.1. Furred ceiling.** Any room with a furred ceiling shall be required to have the minimum ceiling height in two thirds of the area thereof, but in no case shall the height of the furred ceiling be less than 7 feet (2134 mm).

IBC 1208.2 exception 3 allows a mezzanine to have a 7'-0" ceiling height under IBC 505.2

> **505.1 General.** *Mezzanines* shall comply with Section 505.2. *Equipment platforms* shall comply with Section 505.3.
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> **505.2 Mezzanines.** A *mezzanine* or *mezzanines* in compliance with Section 505.2 shall be considered a portion of the *story* below. Such *mezzanines* shall not contribute to either the *building area* or number of *stories* as regulated by Section 503.1. The area of the *mezzanine* shall be included in determining the *fire area*. ***The clear height above and below the mezzanine floor construction shall be not less than 7 feet.***

This petition requests that an allowable ceiling height of 7'-0" be allowed to be reduced to 6'-8" or 95% of the allowable height of a furred or mezzanine required ceiling height (80/84 = .952)

The required ceiling height per 1003.2, in a means of egress is required to be 7'-6" but is allowed to be reduced to 6'-8" for protruding objects for 50% of the circulation path or per other areas in the IBC. The higher ceiling height requirement in means of egress provides an area above the 6'-8" headroom space which may provide a space for smoke to accumulate. The exceptions reflect lower ceiling heights allowed in IBC 1208.2 and for areas above mezzanines.

1003.2 Ceiling height. The *means of egress* shall have a ceiling height of not less than 7 feet 6 inches (2286 mm).

Exceptions:

1. Sloped ceilings in accordance with Section 1208.2.
2. Ceilings of *dwelling units* and *sleeping units* within residential occupancies in accordance with Section 1208.2.
3. Allowable projections in accordance with Section 1003.3.
4. *Stair* headroom in accordance with Section 1011.3.
5. Door height in accordance with Section 1010.1.1.
6. *Ramp* headroom in accordance with Section 1012.5.2.
7. The clear height of floor levels in vehicular and pedestrian traffic areas of public and private parking garages in accordance with Section 406.4.1.
8. Areas above and below *mezzanine* floors in accordance with Section 505.2.

BACKGROUND INFORMATION ON INTENT OF IBC Section 1003.2 Ceiling height:

Generally, the specified ceiling height is the minimum allowed in any part of the egress path. The exceptions are intended to address conditions where the code allows the ceiling height to be lower than specified in this section.

This section is consistent with the minimum ceiling height for other areas as specified in Section 1208. The exceptions are pointers to the lower headroom areas permitted in the code. For example, the headroom above and below a mezzanine is 7 feet (2134 mm) minimum.

The requested lower ceiling height may decrease the level of safety for people with vision impairments as well as during emergency events when vision may be obscured by "smoke or low lighting" similar to the commentary for headroom height. Time for an occupant to exit in an emergency will depend on the emergency to be detected, the time for the occupant to decide to exit the area and the time of travel to an exit. The SFPE Handbook of Fire Protection Engineering in Occupants speed of travel once they start to move toward an exit for an occupant is typically between 120 and 200 feet per minute, the maximum time to travel from the furthest point on the upper level to the stairs is 58 seconds. Early warning will allow occupants to determine if emergency exiting is required which will increase the level of safety for all occupants more than the reduction of ceiling height.

In order to decrease the time of an occupant to exit a smoke detection system will be installed in the playroom to provide early warning to the occupants in the event smoke is developed in playroom (Exhibit EX-1).

In order to assist in the evacuation of the upper level, a wall sign will be provided at the floor level to aid in location of the exit if smoke migrates to the upper level from the floor level (Exhibit EX-1).

In addition, we will also provide a wall sign at the stair to upper level that states "6'-8" MAX. HEADROOM" (Exhibit EX-1).