U.S. Department of Housing and Urban Development
Office of Policy Development and Research

Residential Steel Framing

Builder's Guide to Fire and Acoustic Details

June 2004

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Residential Steel Framing

Builder's Guide to Fire and Acoustic Details

Prepared for

The U.S. Department of Housing and Urban Development
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and

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Washington, DC

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Forward

The NAHB Research Center, U.S. Department of Housing and Urban Development (HUD) and the Steel Framing Alliance have worked cooperatively to introduce cold-formed steel framing into the residential construction market and to provide objective builders and homeowners with a cost-effective alternative construction material. To accomplish this objective, many barriers have been overcome. However, one of the remaining barriers is the lack of a comprehensive set of details and guidelines for builders on fire and acoustic details.

In response, HUD and the Steel Framing Alliance commissioned the NAHB Research Center to review current knowledge and develop a comprehensive guide for builder's that include a summary of steel rated assemblies that are commonly used in the residential market. The guide also contains results of the tested steel assemblies conducted under this program.

Executive Summary

Cold-formed steel has been widely used in commercial buildings, especially in non-load bearing (partitions) and curtain wall applications. Cold-formed steel sections are increasingly being used as primary structural members, such as beams, floor joists, and load-bearing walls in commercial and residential construction.

The fire and acoustical performance of cold-formed floor and wall assemblies are important considerations when designing residential and light commercial structures. However, there is little information available on fire, sound transmission class (STC), and impact insulation class (IIC) ratings of cold-formed steel assemblies. Moreover, the available information is dispersed and not readily accessible to end users.

This guide provides a listing of fire and sound rated steel assemblies in the residential and light commercial markets. It relies on tested assemblies that were either gathered from listings in other publications or are the results of tested assemblies that were conducted as part of this program.

The intent of this guide is to provide the end users a comprehensive document that presents all available fire and sound rated cold-formed steel wall and floor assemblies.

Contents

Glossary

Acoustics. The science of sound, including its production, transmission, and effect.

Decibel. A unit adopted for convenience in representing vastly different sound pressures. It is 20 times the logarithm to the base 10 of the ratio of the sound pressure to a reference pressure of 0.0002 dyne/cm^2. This reference pressure is considered the lowest value that the ear can detect.

Draft Stop. Building materials installed in concealed passages of building components such as attics, crawl spaces, and ceiling/floor assemblies, used to restrict the movement of air, smoke, and hot gases.

Frequency. The number of times that an action occurs in a given time period. In sound, the number of complete vibration cycles per second represented by the unit hertz (Hz).

Fire Separation. A construction assembly that acts as a barrier against the spread of fire.

Fire-Resistance. The ability of an assembly to confine a fire to a given area or to continue to perform structurally when exposed to fire, or both

Fire-Resistance Rating. The time in hours or fractions thereof that a materials or assemblies will withstand fire exposure in accordance with test criteria as prescribed by the applicable code.

Firestopping (or Fireblocking). Building materials installed at penetrations to prevent or slow the movement of flames to other areas of a building.

Fire wall. A fire resistance rated wall that subdivides a building or separates adjoining buildings and which has sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall.

Hertz (Hz). The unit of measure of frequency, representing cycles per second. Named for Heinrich R. Hertz, noted German physicist.

Impact Insulation Class (IIC). A numerical evaluation of a floor-ceiling assembly's effectiveness in retarding the transmission of impact sound. The U.S. Federal Housing Administration developed this single number rating.

Occupancy. The use or intended use function of a building or part thereof for the shelter or support of persons, animals, or property.

Occupancy Classification. The level of hazard associated with identification of the occupancy of the building dictates a level of fire-resistance necessary to protect the occupants of the building.

Sound. The transfer of sound energy from one place to another, through air, structure, or other conductor.

Sound Transmission Class (STC). A rating system used to measure the insulation (or isolation) of airborne sound provided by a barrier. STC is determined from a sound-transmission-loss curve

obtained from a standardized test of a large-scale specimen. The higher the STC rating, the more soundproof the construction.

Sound Transmission Loss (STL). The difference between the sound energy (sound pressure level) in a source room and a receiving room when the two rooms are separated by the system being tested. In general, the transmission loss increases with frequency, i.e. the higher the frequency the greater the sound transmission loss.

Chapter 1: Introduction to Fire and Acoustics in Steel Framing

1 Introduction

Cold-Formed steel is a viable alternative to lumber used in conventional residential and light commercial building construction, helping to preserve natural resources. However, steel can be used much more efficiently if its market expands. Fire and acoustic performance of steel wall and floor assemblies are two important considerations that must be addressed when designing residential and light commercial steel buildings, as they are essential to the overall life, safety, and comfort level of a structure. Providing a simple and comprehensive guide to builders that lists available fire and sound rated wall and floor assemblies and providing recommended practices for improving the fire and acoustic performance of steel can expand the penetration of steel into the residential and light commercial markets.

The methods used to achieve good acoustic performance and protection from fire are often similar and have an impact on each other. Requirements for fire separation and acoustic insulation in many building codes affect the same elements of the construction. Methods for achieving fire protection and good acoustic performance of cold-formed steel framing are inevitably closely linked, and the provision of acoustic and fire separation is often achieved using the same constructions and materials.

This guide provides an overview of the current U.S. national model building code requirements related to fire and acoustic performance, and a compilation of wall and floor fire- and acoustic-rated cold-formed steel assemblies. The guide concludes by providing recommended practices for improving the fire and sound performance of cold-formed steel assemblies.

2 Fire Rating of Steel Assemblies

Building codes require assemblies to have a fire-resistance rating that is based on the construction classification, occupancy of the building, and other factors. The fire resistance ratings are determined from fire tests conducted in accordance with a recognized standard test. The most recognizable is ASTM E119 *Standard Test Methods for Fire Tests of Building Construction and Materials* [1]. Other comparable standard fire endurance tests are NFPA 251 [2], UL 263 [3] and CAN/ULC S101 (Canada) [4]. The fire resistance rating of an assembly is a measurement that indicates how long the assembly will resist the passage of flame while maintaining structural integrity. For example, a 1-hr fire resistance rated load bearing wall assembly indicates that the assembly will maintain its integrity for a minimum of one hour

If a fire does originate within a building, the goal of the assembly is to provide protection for a specified time in order to allow the occupants to exit the building or structure. Additional goals

may be to have the assembly also provide a limited amount of protection for the fire fighters and emergency responders, and if the building owner so desires to provide sufficient protection to permit the building to be re-used with little remediation (a.k.a. preparing for maximum foreseeable loss). In all of the above cases the fire resistance rated assembly represents only a part of the entire building system that addresses life safety and fire safety. Other measures include the installation of automatic fire suppression system, alarms, occupant notification system, building separation distances, etc.

Assemblies containing cold-formed steel framing generally achieve a desired fire resistance rating through the use of layers of gypsum board. When exposed to fire the free water and chemically combined water in the gypsum is gradually driven off at temperatures above approximately 100ºC (212ºF). This causes a temperature plateau on the unexposed face of the lining. This process of removal of chemically combined water is called calcination and results in a loss of strength and shrinkage of the sheet material. The resultant product is a powder, which has much less strength than the original gypsum. Further gradual product disassociation occurs at temperatures exceeding 392ºF (200ºC).

ASTM E119 Test Summary

The standard fire test was developed primarily for the purpose of establishing a method for comparing the relative performance of different construction assemblies when exposed to a controlled laboratory fire. The test standard specifies, to varying degrees, the conditions of the fire exposure, size of test assemblies, methods of recording data and acceptance of criteria. During standard fire tests, a "representative" sample of a construction assembly is exposed to a controlled laboratory fire defined by the standard time temperature curve. This curve specifies the average furnace temperature as recorded by the thermalcouples located in the immediate vicinity of the test assembly. The time temperature curve rises rapidly during the initial phases of the test, 1000 ºF at 5 minutes, 1550 ºF at 30 minutes, and then increases more gradually to 2000 ºF at 4 hours.

The fire endurance of an assembly is the time, after the beginning of the test, when any of several endpoint criteria are exceeded. In general, the endpoint criteria are defined to evaluate the assembly's ability to continue to support any superimposed loads and to resist the passage of flame or hot gases or the buildup of excessive temperatures on the unexposed surface."

3 Sound Rating of Steel Assemblies

Essential to complying with the health, safety and welfare provisions of building codes is the ability of assemblies that separate spaces or occupancies within a building to reduce or restrict the transmission of sound. This is specifically identified for residential occupancies where code provisions cite minimum values for building construction to achieve, in this case the values are specified as Sound Transmission Class (STC) for walls and floor/ceiling assemblies and Impact Insulation Class (IIC) for floor/ceiling assemblies only. Other occupancies (Such as offices, education, assembly, etc.) are not normally specifically identified in the codes, but building owners may require self mandated specifications regarding STC and IIC ratings."

In order for sound to be transmitted it requires an elastic medium where particles vibrate. The most common medium is air, but sound is also transmitted through building materials. When airborne sound is generated air particles vibrate, and when they encounter stiff building elements they induce oscillations in these materials that in turn induce oscillations in the air in neighboring rooms. Impact sound occurs when an impact to a building element induces oscillations within that element that are transferred to the neighboring air and through to other building elements.

Similar to other construction assemblies, the sound ratings of steel-framed assemblies are specified in STC rating (for walls) (see Table 1 for STC ratings for typical construction materials) or IIC rating (for floors). A wall assembly of a *Sound Transmission Class (STC)* of 45, for example, indicates the rating of the insulation (or isolation) of airborne sound provided by a barrier (such as the gypsum board). A floor assembly of an *Impact Insulation Class (IIC)* of 50 indicates the floor assembly's effectiveness in retarding the transmission of impact sound. The higher the assembly rating (STC or IIC) the more sound proof the assembly.

There are several types of sound transmission, and the two types that are related to building construction are discussed below:

Airborne Sound Transmission. Airborne sound can be measured by generating a steady sound of a particular frequency in one room (source room) and comparing it with sound pressure level in an adjacent room (receiving room). The level difference is simply the difference between the source and the receiving levels. However, the level difference is influenced by the acoustic absorption in the receiving room. This is measured by the reverberation time (the time taken for a reverberant noise to decay by 60 dB).

Impact Sound Transmission. Tends to be most relevant for floors. It arises from a variety of sources, most notably the movement of people within a building, but also from such things as the slamming of doors. A standard impact sound source (tapping machine) is used to strike the floor and the impact sound pressure level is measured in the room below. Measurements in a building can be standardized to a reverberation time of 0.5 seconds, giving the Standardized Impact Sound Pressure level.

Table 1 - STC of Various Construction Materials

Building Component	STC
¼-inch plate glass	26
¾-inch plywood	28
½-inch gypsum board, both sides of 2x4 studs	33
¼-inch steel plate	36
Concrete block: Autoclaved aerated	45
3-inch concrete wall	47
6-inch Reinforced concrete slab (4-1/8" thick)	44
6-inch concrete block wall	42
8-inch reinforced concrete wall	51
12-inch concrete block wall	53
12-inch Brick	56
2x4 wood studs (16" o.c.) with 1/2" GWB both sides	33-39
1-5/8 inch steel studs (24" o.c.) with 1/2" GWB both sides	39
3-5/8 inch steel studs (24" o.c.) with 5/8" GWB both sides	40-44
3-5/8 inch steel studs (24" o.c.) with 1/2" GWB both sides	39

Source: Australian Building Code Board [5], HUD Report [6], and LGSEA Tech Note [7].
For SI: 1 inch = 25.4 mm

For cold-formed steel framed assemblies (a.k.a. light frame construction) the key elements to increasing the STC and IIC values for that assembly are the introduction of resilient channels between the gypsum board and framing member, additional gypsum board layers, addition of insulation versus no insulation in cavity, and increase in framing member spacing.

The acoustic provisions may also dictate the fire resistance rating of an assembly, for example in order to increase the STC and/or IIC values of the assembly, by choosing to apply additional layers of gypsum board, it may increase the fire resistance rating of that assembly as a result of the additional layers of gypsum board. The acoustic properties of an assembly may also be in conflict with the fire resist rating of an assembly, in such cases as framing member spacing, resilient channel spacing, and even the selection of the type of insulation. As a result, the design assembly must be assessed for fire endurance and acoustic properties concurrently.

Chapter 2: Building Code Requirements

1 Introduction

Building construction in the United States is governed by interrelated codes and standards that regulate the construction methods and materials. While a small number of municipalities (mostly major cities) write and revise their own building code, most jurisdictions adopt one or more of the national model building codes. These codes, which are written, maintained, revised, and distributed by the model code organizations, are adopted by state or local jurisdictions either as written or more commonly with specific amendments.

Currently, there are three national model-building codes that regulate all types of construction:

- The International Building Code (IBC) published by the International Code Council (ICC) [8]
- NFPA 5000™, Building Construction & Safety Code™ published by the National Fire Protection Association (NFPA) [9].
- The International Residential Code (IRC) published by the International Code Council (ICC) [10]

2 Fire Rating Requirements

Type of Construction

The type of construction determines the level and amount of fire protection required for buildings and other structures. Building codes typically include terms such as:

- Fire-resistive
- Non-combustible
- Exterior protected combustible
- Heavy Timber
- Wood frame

Table 2.1 summarizes different construction types as illustrated in both the International Building Code and the NFPA 5000™ Building Construction and Safety Code.

Table 2.1 - Types of Construction

Building Construction Type		Description
IBC	**NFPA 5000™**	
IA	I (443)	Constructed of building elements that are of noncombustible materials (combustible materials are permitted in Type I and II buildings in certain conditions)
IB	I (332)	
IIA	II (222)	Similar to Type I Buildings
	II (111)	
IIB	II (000)	
IIIA	III (221)	Buildings with noncombustible exterior walls and any interior walls
IIIB	III (200)	
IV HT	IV (2HH)	Buildings with noncombustible exterior and interior walls. Other interior structural members are solid or laminated wood without concealed spaced
V A	V (111)	Buildings with exterior and interior of any material permitted by the code
V B	V (000)	

Use and Occupancy Classification

The fire rating of a structure or a component of a structure is also determined according to the occupancy classification of building. Building codes assigns every building or structure an occupancy group. Residential structures are typically classified as one- and two-family dwellings or other dwellings. Table 2.3 provides examples of the residential building occupancies based on the classification specified in the IBC. Table 2.4 provides examples of the residential building occupancies based on the classification specified in NFPA 5000™.

Table 2.3 – Residential Occupancy Classification (Based on 2003 IBC)

(For a complete listing and limitations, refer to Chapter 3 of the IBC)

Use	Examples
One and Two Family Dwelling	A building that contains not more than two dwellings units with independent cooking and bathroom facilities.
R-1	Residential occupancies where the occupants are primarily transient in nature, such as hotels and boarding houses.
R-2	Residential occupancies containing more than two dwelling units where the occupants are primarily permanent in nature, such as apartment houses and dormitories.
R-3	Residential occupancies where the occupants are primarily permanent in nature and not classified as R-1, R-2, or I and where buildings do not contain more than 2 dwelling units, or adult or child care facilities for less than 5 persons for less than 24 hours.
R-4	Buildings for occupancy as residential care/assisted living facilities including more than five but not more than 16 occupants (limited residential care facilities).

Source: 2003 IBC Section 310.

Table 2.4 – Residential Occupancy Classification (Based on NFPA 5000™)

(For a complete listing and limitations, refer to Chapter 6 of the NFPA 5000™)

Use	Examples
One and Two Family Dwelling	A building that contains not more than two dwellings units with independent cooking and bathroom facilities.
Lodging or Rooming House	A building that provides sleeping accommodations for up to 16 persons without personal care basis.
Hotels	A building or a group of buildings that provides sleeping accommodations for more than 16 persons and primarily used by transients for lodging.
Dormitory	A building or portion of a building that provides sleeping accommodations for up to 16 persons who are not members of the same family.
Apartment Building	A building or portion thereof containing three or more dwellings units with independent cooking and bathroom facilities.
Residential Board and Care	A building or portion thereof that is used for lodging and boarding of 4 or more residents, not related, for the purpose of providing personal care services.

Source: NFPA 5000™ Section 6.1.8.

Area and Height of Buildings

Fire protection requirements are also determined by the area and height of a building. Building codes typically limit the areas and heights of buildings to their intended use. For example, the 2003 IBC limits the area of an assisted living facility (R-4 classification) Type 5B construction to 7,000 square feet (650 m^2) and to no more than two stories high.

2.1 Fire Separation Requirements

The International Building Code (IBC) refers to the International Residential Code (IRC) for the construction of one and two family dwellings. The IRC currently does not contain requirements for the fire protection of a single-family dwelling. Tables 2.5 and 2.6 provide a summary of one0 and two-family dwelling unit separation as required by the IRC and NFPA 5000™. Tables 2.7 and 2.8 provide the minimum separation requirements for structures classified as residential buildings in accordance with the International Building Code and NFPA 5000™.

Table 2.5 – IRC Fire Separation Requirements

Framing Component or Separation	Fire Separation
Framing Elements Within Single Family Dwellings	No requirements.
Separation Between Single-Family Detached Units	No requirements.
Separation Between a Garage and a Dwelling Unit	Garage shall be separated from residence and its attic by ½" (12.6 mm) gypsum board. Garages beneath habitable rooms shall be separated by 5/8" (16 mm) gypsum board.
Exterior Walls	IRC Section R302 requires that exterior walls with a fire separation less than 3 feet (914 mm) have not less than 1-hour fire resistive rating with exposure from both sides. Projections must not extend more than 12 in. (305 mm) into areas where openings are prohibited. Projections extending into the fire separation distance must not have less than 1-hour fire resistive construction on the underside. Exceptions: Tool and storage sheds, playhouses, and similar structures are exempt.
Separation Between Two-Family Dwelling Units	Units in two-family dwellings are required to be separated by one-hour fire-resistive walls continuous to the underside of the roof sheathing (see IRC Section R317). A fire-resistance rating of ½ hour is permitted in buildings equipped with an automatic sprinkler system.
Townhouse Separation	Each townhouse is considered as a separate building that requires a one-hour separation wall (for each building), which is continuous from the foundation to the underside of the roof sheathing, deck, or slab extending the full length of the wall. A single two-hour wall is permitted if no plumbing, mechanical equipment, ducts, or vents are in the wall (electrical wiring and metallic electrical outlet boxes are permitted.)

Table 2.6 – NFPA 5000™ Fire Separation Requirements

Framing Component or Separation	Fire Separation			
Framing Elements Within Single Family Dwellings	No requirements.			
Separation Between Single-Family Detached Units	No requirements.			
Separation Between a Garage and a Dwelling Unit	Garage shall be separated from one- and two-family dwelling unit by a minimum ½" (12.6 mm) gypsum board (Section 6.2.1.5(4)).			
Exterior Walls	Horizontal Separation			
	0 to 5 feet	> 5 to ≤ 10 ft	> 10 to ≤ 30 ft	> 30 ft
	1	1	0	0
Separation Between Two-Family Dwelling Units	Units in two-family dwellings are required to be separated by one-hour fire-resistive walls continuous to the underside of the roof sheathing.			
Townhouse Separation	Townhouses are required to be separated by a single wall that provides not less than 2-hr fire resistance rating and is continuous from the foundation to the underside of the roof sheathing.			

Table 2.7 - Required Separation Between Dwelling Units (hours)[1]
2003 IBC

Use	R-1	R-2	R-3	R-4
R-1	-	2	2	2
R-2	-	-	2	2
R-3	-	-	-	-
R-4	-	-	-	-

Source: Table 302.3.2 of the 2003 IBC.
1. Private garage shall be separated from the residence and its attic area by means of minimum ½" (12.7 mm) gypsum board applied to the garage side. Openings from a private garage directly into a sleeping room are not permitted.

Table 2.8 - Required Separation Between Residential Occupancies (hours)
NFPA 5000™

Use	One & Two Family Dwelling	Lodging or Rooming House	Hotels	Dormitory	Apartment Building	Residential Board & Care
One & Two Family Dwelling	-	1	2	2	2	1
Lodging or Rooming House	-	-	2	2	2	2
Hotels	-	-	-	-	2	2
Dormitory	-	-	-	-	2	2
Apartment Building	-	-	-	-	-	2
Residential Board and Care	-	-	-	-	-	-

Source: Table 6.2.4.1 of the NFPA 5000™.

2.2 Firestopping and Draft Stopping

Firestopping – Requirements for firestoppings vary among the different codes. Places where firestopping is commonly required include: concealed spaces in stud walls and partitions, and furred spaces at the ceiling and floor levels; interconnections between concealed vertical and horizontal spaces; concealed spaces between stair stringers at the top and bottom of the run; and at openings around vents, pipes, ducts, chimneys and fireplaces at ceilings and floor levels.

Draft Stop – Requirements for draft stops also vary. A common requirement is for installation in the concealed spaces of a floor/ceiling assembly with usable space above and below it, so that the concealed space is divided into approximately equal areas not exceeding either 1000 or 500 square feet (93 m^2 or 46 m^2), depending on the code. Draft stop can also be required in attic spaces of multifamily buildings.

2.3 Automatic Sprinkler Systems

Automatic sprinkler systems are not typically required for one and two family dwellings. However, more localities and jurisdictions are requiring the installation of sprinklers in residential structures especially for two-story homes. Table 2.9 provides a summary of when automatic fire sprinkler systems are required for residential structures (IRC, IBC, and NFPA).

Table 2.9 – Required Automatic Fire Sprinkler (AFS)

Use	Requirements
2003 IRC	
One & Two Family Dwellings	Not Required
2003 IBC	
R-1	Required in all buildings. Can be substituted for a residential sprinkler system (NFPA 13R).
R-2	Required in buildings more than 2 stories high or having more than 16 dwelling units. Can be substituted for a Residential sprinkler system (NFPA 13R) for buildings up to four stories in height.
R-3	Not required. A fire-resistance rating of ½ hour is permitted for two-family dwellings equipped throughout with an automatic sprinkler system.
R-4	Required in buildings with more than 8 occupants.
NFPA 5000™	
One & Two Family Dwellings	Not Required
Lodging or Rooming House	Required in all buildings except those that have every sleeping room has direct exit to ground level.
Hotels	Required in all buildings except those where every dwelling unit has direct exit to ground level.
Dormitory	
Apartment Building	
Residential Board and Care	Required in all buildings.

3 Acoustic Insulation Requirements

Building regulations also prescribe sound insulation levels for buildings and other structures. Although these sound insulation requirements do not typically apply to individual dwellings (such as single-family homes), occupiers do expect some level of acoustic privacy between dwellings and often between rooms and floors. Acoustic insulations are normally required between units of multi-family dwellings, apartments, and other buildings.

3.1 Code Requirements

Wall and floor-ceiling assemblies separating dwelling units are typically required to provide sound insulation for walls, and both airborne and impact sound insulation for floor-ceiling assemblies. Table 2.10 summarizes the minimum STC and IIC requirements as stipulated in the US building codes.

Table 2.10 - STC and IIC Requirements From Selected Codes

Building Code [1]	Use Group [1]	Code Reference Section	STC (FSTC) Requirements (Air-Borne Sound Insulation)		IIC Requirements (Impact Sound Insulation)
			Walls	Floor/ Ceilings	Floor/Ceilings
IRC [10]	Between dwelling units or between dwelling units and public or service areas	Appendix K	45	45	45
IBC [8]	Dwelling units [2]	Section 1207	50 (45 if field tested)	50 (45 if field tested)	50 (45 if field tested)
CABO [11]	Between dwelling units	Section 320	45	45	45
BOCA [12]	R	Section 1214.0	45	45	45
UBC [13]	R	Appendix Chapter 12 Section 1208	50 (45 if field tested)	50 (45 if field tested)	50 (45 if field tested)
California Title 24 Building Code [14]	Party walls and between floors of multi-family dwellings		50 (45 if field tested)	50 (45 if field tested)	50 (45 if field tested)
NFPA 5000™ [9]	Dwelling units [2]	Section 49.4	50	50	45

[1] Use Group R includes all structures in which families or households live, or in which sleeping accommodations are provided, excluding those classified as institutional occupancies.

[2] Dwelling units are defined as dwelling units in two-family dwellings, townhouses & apartments buildings, guestrooms & guest suites in hotels and dormitories, sleeping rooms in lodging & rooming houses, and residential board and care occupancies

Chapter 3: Establishing the Fire and Sound Rating of Steel Assemblies

1 Introduction

Fire and sound ratings described in this document pertain to classifications, which are based upon the test methods and acceptance criteria such as ANSI/UL 263, ASTM E119, NFPA 251 or ASTM E90. The ratings for fire rated assemblies are expressed in hours, while the ratings for sound assemblies are expressed in STC or IIC. When a test assembly complies with the acceptance criteria, a detailed description of the assembly, its performance in the fire or sound tests and other pertinent details such as specification of materials, classification coverage and alternate assembly details are included

2 Determination of Fire-Resistance Ratings

The fire rating of cold-formed steel-framed assemblies can be established in any one of the following methods:

i. Fire Test (in accordance with industry standard tests such as ASTM E119),
ii. Fire Resistance Design Documents in Approved Sources,
iii. Engineering Analysis Based on Comparison with Tested Assemblies,
iv. Prescriptive Design,
v. Calculations (such as the Component Additive Method), or,
vi. Alternative Protection Method.

3 Determination of STC and IIC Ratings

Similar to fire rating, sound rating of cold-formed steel-framed assemblies can be established using any one of the following methods:

i. STS or IIC Test (in accordance with industry standard tests such as ASTM E90 [15]),
ii. Design Documents in Approved Sources for STC or IIC Ratings,
iii. Engineering Analysis Based on Comparison with Tested Assemblies,
iv. Prescriptive Design,
v. Alternative Protection Method.

4 Industry Sources

Table 3.1 summarizes the most common sources for obtaining fire and acoustic rated steel wall and floor assemblies. The list in Table 3.1 is not comprehensive, as there are many proprietary steel-framed assemblies that have been tested but not listed in any of the major listing directories.

Table 3.1 - Summary of Industry Sources

Source Title	Reference No.	Web Site	Contains Steel Assemblies Rated For:	
			Fire	Sound
Fire-Resistance Ratings of Load Bearing Steel Stud Walls With Gypsum Wallboard Protection With or Without Cavity Insulation.	[16]	www.steel.org	✳	—
Fire-Resistance Steel-Frame Construction	[17]	www.steel.org	✳	—
Designing Fire Protection for Steel Trusses. AISI FT 227-1281-20M-NB	[18]	www.steel.org	✳	—
Fire-Resistance Design Manual – Sound Control.	[19]	www.gypsum.org	✳	✳
Intertek Testing Services / Warnock Hersey Directory of Listed Products. Vol. I and II.	[20]	www.etlsemko.com	✳	—
Sound Rated Partitions and Floor-Ceiling Construction	[21]	www.ladbs.org	—	✳
Technical Bulletin "One-Hour Floor /Ceiling Fire-resistance Test" and "Two-Hour Floor/Ceiling Fire-Resistance Test	[22]	—	✳	—
Report BMS92: Fire-Resistance Classifications of Building Constructions	[23]	www.fire.nist.gov/	✳	—
Report TRBM44**:** Fire-Resistance and Sound Insulation Ratings for Walls, Partitions and Floors	[24]	www.fire.nist.gov/bfrlpubs/fire89/art004.html	✳	—
Fire Resistance Directory—Volumes I and II	[25]	www.ul.com	✳	—
Fire Ratings of Archaic Materials and Assemblies	[26]	www.huduser.org	✳	—
Technical Notes No. 16B, Calculated Fire-resistance	[27]	www.bia.org	✳	—
Catalog of STC and IIC Ratings for Wall and Floor/Ceiling Assemblies	[28]	—	—	✳
Sound Control for Commercial and Residential Buildings	[29]	www.naima.org	—	✳
Noise Assessment Guidelines	[30]	www.huduser.org	—	✳
The Noise Handbook	[31]	www.huduser.org	—	✳
A Guide to Airborne, Impact, and Structure Borne - Noise Control in Multifamily Dwellings	[6]	www.huduser.org	—	✳
Acoustic Insulation and Sound Transmission in Cold-Formed Steel Construction.	[7]	www.lgsea.com	✳	✳
Factory Mutual Tested Product Guide	[32]	www.fmglobal.com	✳	—
A Guide To Fire & Acoustic Data For Steel Floor & Wall Assemblies	[33]	www.steelframingalliance.com	✳	✳
SA100, Construction Selector	[34]	www.usg.com	✳	✳

Chapter 4: Fire and Sound Rated Details

1 Introduction

This chapter focuses on the most commonly used fire and sound rated steel wall and floor assemblies. The intent of this chapter is to provide builders and framers with the details that are typically used in residential and light commercial applications. For a complete list of rated details, the sources listed in Table 3.1 should be consulted.

2 Fire And Sound Rated Details

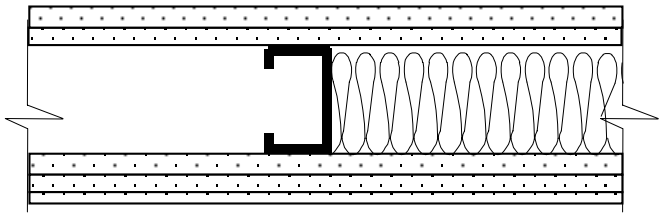
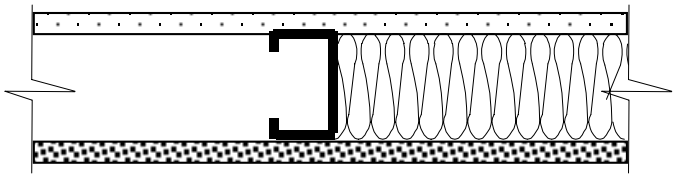
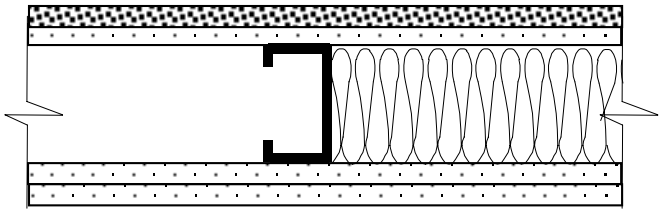
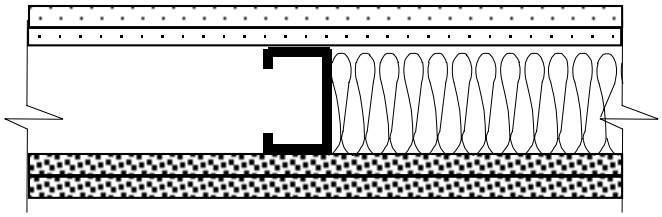
Sections 2.1 through 2.3 summarize the fire-rated assemblies that are relevant to the residential and light commercial construction markets. The contents of these tables are compiled from the main sources of information for fire and acoustic details: UL, Gypsum Association and Factory Mutual. The description for each rated assembly contained in the tables below is not complete construction details. The original source for each detail should be consulted for complete construction details, limitations and other pertinent information.

The rated details are listed as follows:

Section 2.1	Non-Load Bearing (non-structural) Walls
Section 2.2	Load Bearing (structural) Walls
Section 2.3	Floor/Ceiling Assemblies

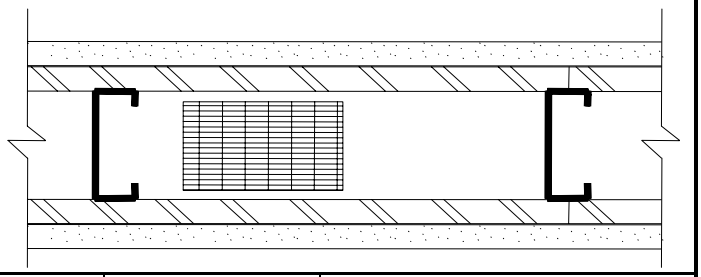
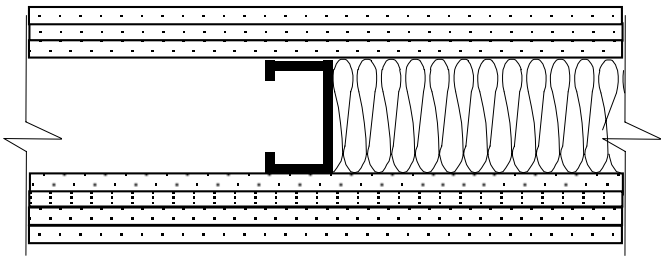
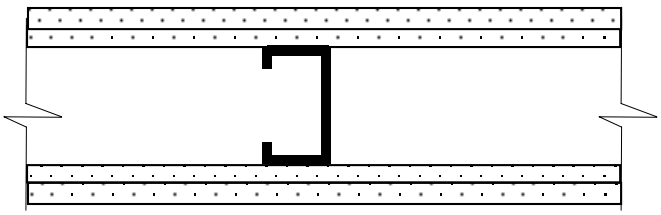
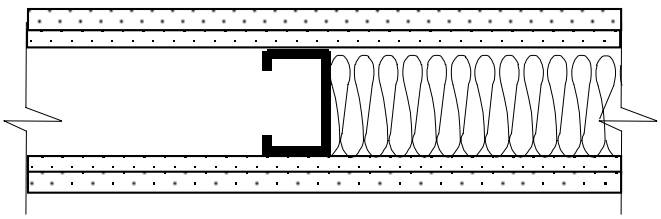
2.1 Non-Load Bearing Walls

Non-Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U403	• 3 ⅝" x 18 mil steel studs spaced at 24" o.c. • optional mineral wool or glass fiber insulation • 2 layers ⅝" thick gypsum board on one side • 1 layer ⅝", 1 layer ½" and 1 layer ¼" or ⅜" thick gypsum board on other side	 2 hr.	—
UL U404	• 3 ½" x 33 mil steel studs spaced at 16" o.c. • 3" mineral wool insulation • 1 layer ½" or ⅝" cementitous board on one side • 1 layer ⅝" thick gypsum board on other side	 1 hr.	—
UL U404	• 3 ½" x 33 mil steel studs spaced at 16" o.c. • 3" mineral wool insulation • 2 layer ⅝" gypsum board on one side • inner layer of ⅝" thick gypsum board, outer layer ½" gypsum board or ⅝" cementitous board on other side	 2 hr.	—
UL U404	• 3 ½" x 33 mil steel studs spaced at 16" o.c. • 3" mineral wool insulation • 2 layers ⅝" gypsum board on one side • 2 layers ½" or ⅝" cementitious board on other side	 2 hr.	—

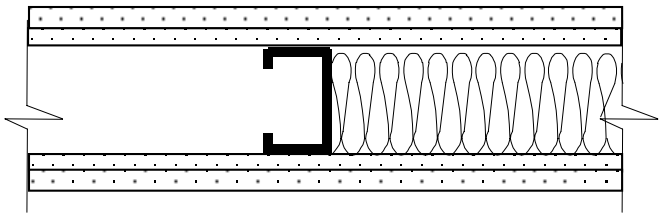
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

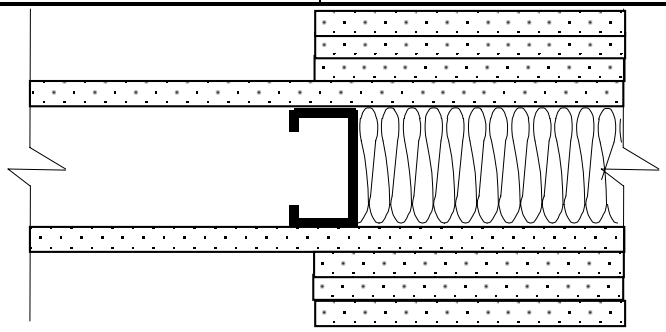
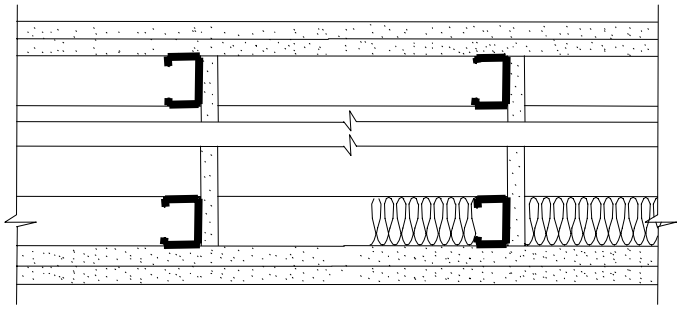
Non-Load Bearing Walls (Underwriters Laboratories)

<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td>UL
U407</td><td>• 362S125-18 mil steel studs spaced at 16” o.c.
• steel channels at mid-height for lateral support
• minimum 24 gauge fluted metal wall panels between studs
• nominal 7/8” thick concrete architectural panel on each side
• gypsum wall board on each side (as shown in the table)</td><td> 
<table><tr><th>Rating</th><th>No. of Layers & Thickness</th></tr><tr><td>1 hr.</td><td>(1) 5/8”</td></tr><tr><td>1-1/2 hr.</td><td>(1) 5/8”</td></tr><tr><td>1</td><td>(2) 5/8”</td></tr><tr><td>1-1/2 hr.</td><td>(2) 5/8”</td></tr><tr><td>2</td><td>(2) 5/8”</td></tr></table></td><td>—</td></tr>
<tr><td>UL
U408</td><td>• 350S125-18 mil steel studs spaced at 24” o.c.
• optional mineral wool or glass fiber insulation
• 18 mil furring or resilient channels spaced at 24” o.c. over first layer of gypsum board on one side of studs
• (1) layers ¼” and (1) layer ⅝” gypsum wallboard on each side</td><td> 
2 hr.</td><td>—</td></tr>
<tr><td>UL
U410</td><td>• 250S137-18 mil steel studs spaced at 24” o.c.
• (1) layer ¼” gypsum board and (1) layer ½” plain or vinyl faced gypsum board on each side of stud</td><td> 
1 hr.</td><td>—</td></tr>
<tr><td>UL
U411</td><td>• 250S125-18 mil steel studs spaced at 24” o.c.
• optional mineral wool or glass fiber insulation
• optional spray applied cellulose
• (2) layers ⅝” or ¾” paper or vinyl surfaced gypsum wallboard on each side</td><td> 
2 hr.</td><td>—</td></tr>
</table>

(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

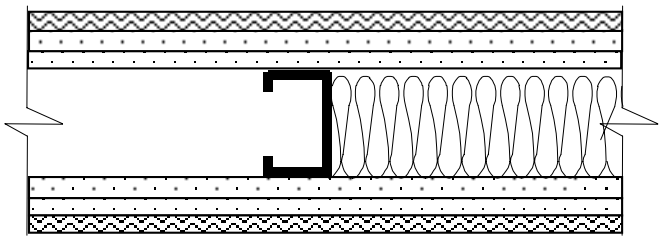
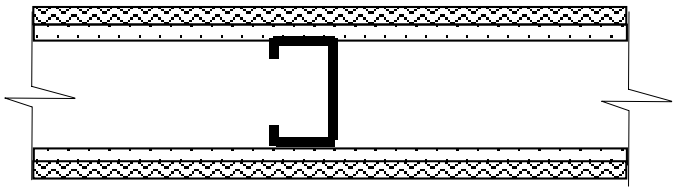
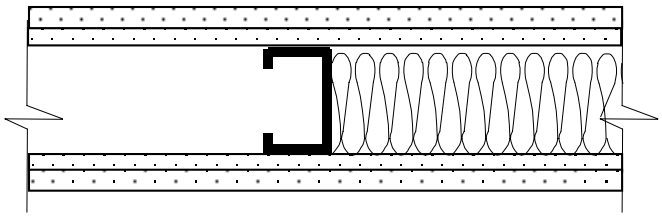
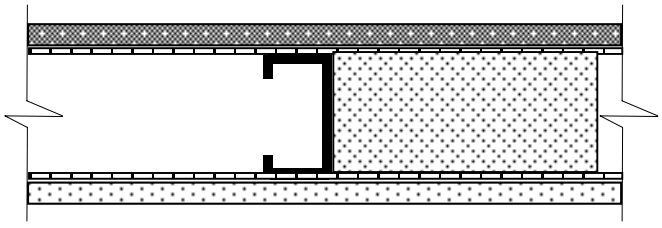
Non-Load Bearing Walls (Underwriters Laboratories)

<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="2">UL
U412</td><td rowspan="2">• 162S125-18 mil steel studs spaced at 24" o.c.
• optional mineral wool or glass fiber insulation
• optional spray applied cellulose
• (2) layers ½" thick wallboard on each side of stud</td><td>  </td><td></td></tr>
<tr><td>1 hr.</td><td>—</td></tr>
<tr><td rowspan="2">UL
U419</td><td rowspan="2">• S125 steel stud, 18 mil thick spaced at 24" o.c.
• mineral wool insulation optional except where required as noted
• stud depth, gypsum board layers and thickness and corresponding rating as shown

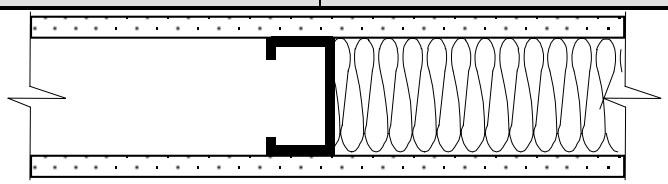
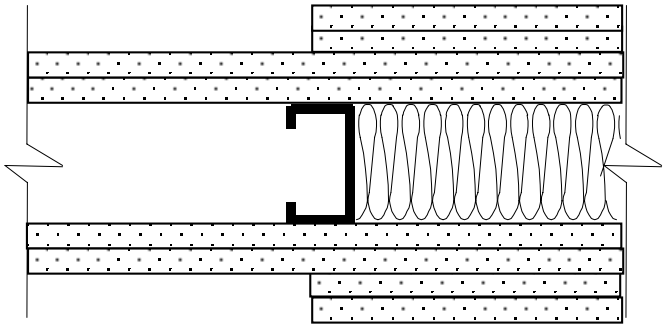
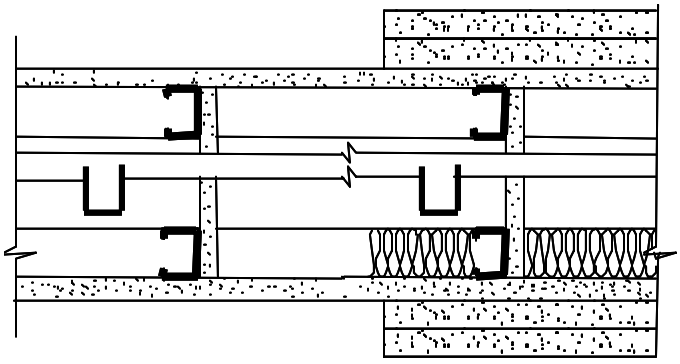
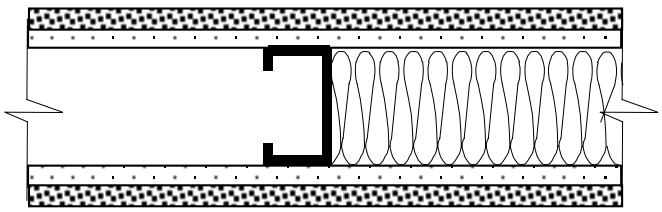
* 1 ½" mineral wool insulation</td><td>  </td><td></td></tr>
<tr><td><table><tr><th>Rating</th><th>Stud Depth</th><th>Gypsum Board</th></tr><tr><td>1 h</td><td>3-1/2"</td><td>(1) 5/8"</td></tr><tr><td>1 h</td><td>2-1/2"*</td><td>(1) 1/2"</td></tr><tr><td>2 h</td><td>1-5/8"</td><td>(2) 1/2"</td></tr><tr><td>3 h</td><td>1-5/8"</td><td>(3) 1/2"</td></tr><tr><td>3 h</td><td>1-5/8"</td><td>(3) 1/2"</td></tr><tr><td>4 h</td><td>1-5/8"</td><td>(4) 1/2"</td></tr></table></td><td>—</td></tr>
<tr><td rowspan="2">UL
U420</td><td rowspan="2">• double 162S137-18 steel studs spaced at 24" o.c.
• optional mineral wool insulation optional
• 9-1/2" long steel runners or gypsum pieces for stud bracing
• (1) layer ⅝" gypsum board on each side for 1 hr rating
• (2) layers 5/8" gypsum board on each side for 2 hr rating
• optional glass fiber or mineral wool insulation in cavity</td><td>  </td><td></td></tr>
<tr><td>1 hr. / 2 hr.</td><td>—</td></tr>
</table>

(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

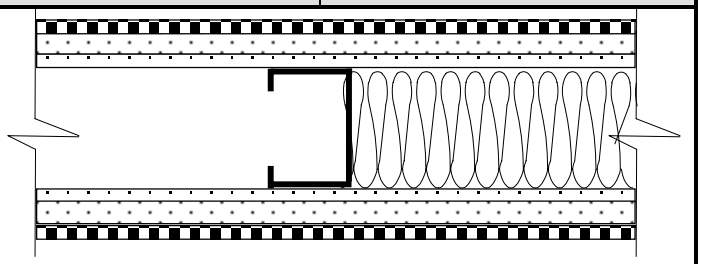
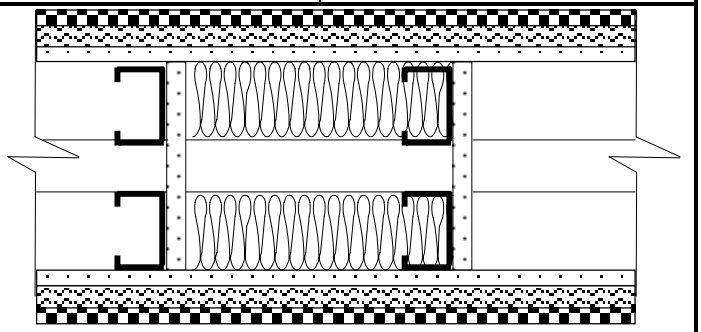
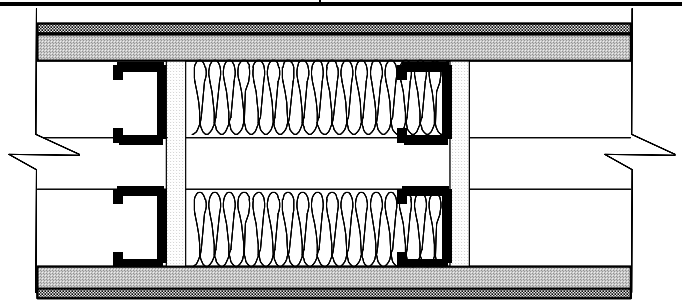
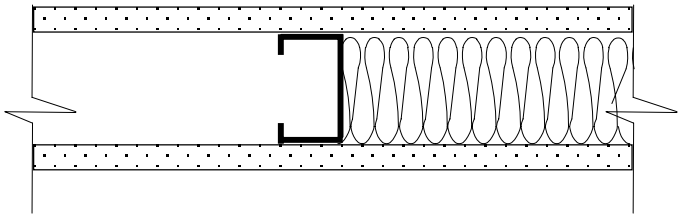
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U421	• 250S125-18 steel studs spaced at 24" o.c. • (2) layers ½" or ⅝" gypsum board on each side • ¼" mineral or fiberboard on each side (outer face)		
		2 hr.	—
UL U422	• 250S125-18 steel studs spaced at 24" o.c. • (1) layer 5/8"gypsum board on each side • ¼" mineral or fiberboard on each side (outer face)		
		1 hr.	—
UL U430	• 350S150-33 steel studs spaced at 16" o.c. • lead batten stripc attached to inside of studs • optional glass fiber or mineral wool insulation • (1) layer 5/8"gypsum board on each side for 1 hr rating • (2) layers 5/8" gypsum board for 2 hr rating		
		1 hr./2 hr.	—
UL U431	• 362S125-18 steel studs spaced at 16" o.c. • spray applied fire resistive material in cavity (minimum average density 12 pcf) • diamond mesh, expanded steel 3.4 lbs. per square yd attached with wires to studs on both sides; or metal lath • ¾" thick plaster on one side of studs • ¾" Portland cement on other side		
		4 hr.	—

Non-Load Bearing Walls (Underwriters Laboratories)

<table>
<tr><th>Source</th><th>Description</th><th colspan="2">Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="2">UL
U432</td><td rowspan="2">• 350S, 33 mil studs @ 24" o.c.
• optional glass fiber or mineral wool insulation
• (1) layer of 5/8" gypsum wallboard on each side of studs</td><td colspan="3">  </td></tr>
<tr><td colspan="2">1 hr.</td><td>—</td></tr>
<tr><td rowspan="2">UL
U435</td><td rowspan="2">• 162S, 18 mil steel studs spaced at 24" o.c.
• optional mineral wool insulation
• (3) layers ½" or (2) layers ¾" Type X gypsum wallboard on each side for 3 hr.
• (4) layers ½" Type X gypsum wallboard on each side for 4 hr.</td><td colspan="3">  </td></tr>
<tr><td colspan="2">3 hr./ 4 hr.</td><td>—</td></tr>
<tr><td rowspan="5">UL
U436</td><td rowspan="5">• 162S100-18 steel studs spaced at 24" o.c.
• optional glass fiber or mineral wool insulation
• bracing: 5 ¼" long steel track or 5 ¼"x6" long gypsum board pieces
• structural steel truss members (min. weight 3.7 plf) bolted, welded or riveted to steel studs
• gypsum board on each side (rating listed for thickness and number of layers of gypsum board applied)</td><td colspan="3">  </td></tr>
<tr><td>Rating</td><td>Layers & Thickness</td><td rowspan="4">—</td></tr>
<tr><td>1 hr</td><td>(3) ½"</td></tr>
<tr><td>2 hr</td><td>(2) ½"or 5/8"</td></tr>
<tr><td>3 hr</td><td>(1) 5/8"</td></tr>
<tr><td rowspan="2">UL
U442</td><td rowspan="2">• 250S137-33 studs at 16" o.c.
• 2½" thick batts or blanket insulation
• (1) layer 5/8" gypsum board or ½" or 5/8" cementitous backer unit and ¼" ceramic tiles on one side of studs
• ½" or 5/8" cementitous board and ¼" ceramic tiles on other side of studs</td><td colspan="3">  </td></tr>
<tr><td colspan="2">1 hr.</td><td>—</td></tr>
</table>

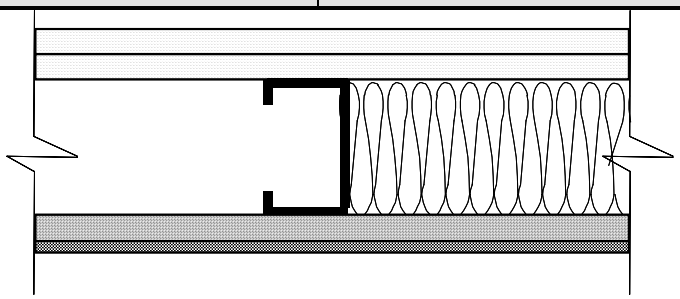
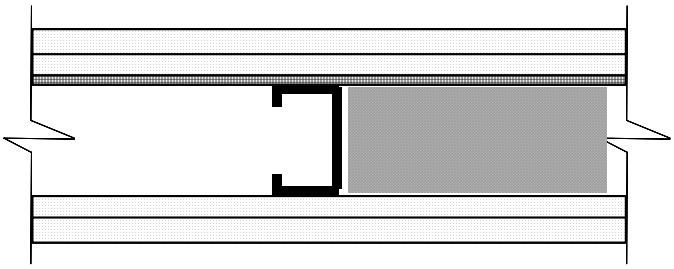
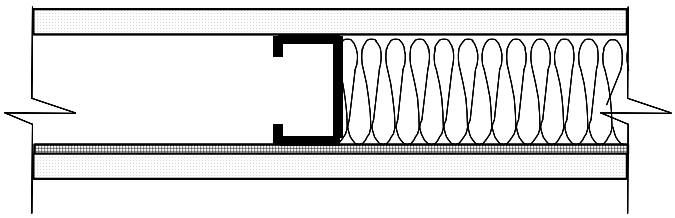
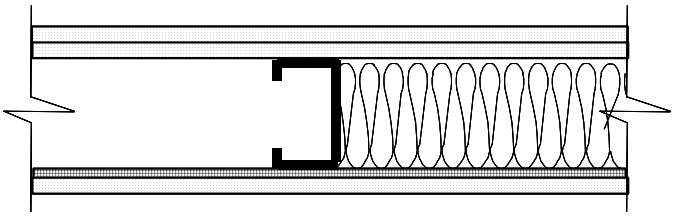
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U443	• 362S125-33 steel studs spaced at 24” o.c. • 3” Thermafiber insulation • inner layer ½” gypsum board on each side • (1) layer ½” or 5/8” cementitous board on each side • Outer layer ¼” ceramic tile on each side		
		2 hr.	—
UL U444	• double 162S125-33 steel studs spaced at 24” o.c. • 1½” thick batt or blanket insulation • bracing: cut from steel tracks or 6” wide gypsum board pieces • inner layer of ½” gypsum board on each side • ½” or 5/8” cementitous board on each side with ¼” ceramic tile		
		2 hr.	—
UL U445	• double 162S125-33 steel studs spaced at 16 .c. • 1½” thick batt or blanket insulation • bracing: cut from steel tracks or 6” wide gypsum board pieces • ½” or 5/8” cementitous board on each side with ¼” ceramic tile		
		1hr.	—
UL U448	• 250S137-18 steel studs spaced at 24” o.c. • 1 ½” thick mineral wool insulation • (1) layer ½” gypsum board on each side		
		1 hr.	—

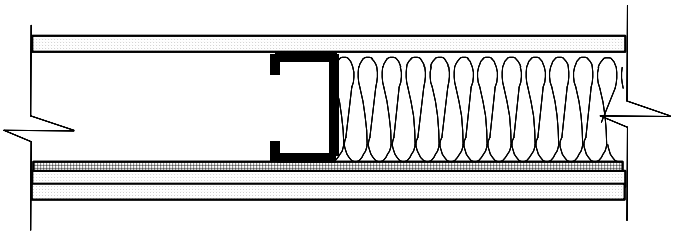
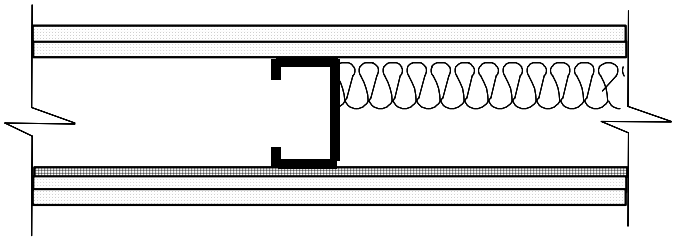
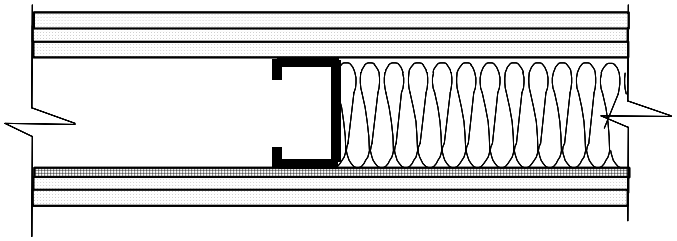
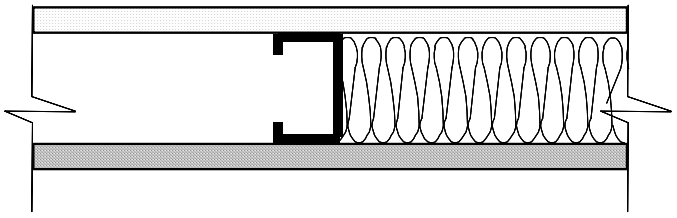
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U449	• 362S137-33 steel studs spaced at 16" o.c. • 3-5/8" cavity insulation, min. density of 3.5 pcf • (2) layers ⅝" gypsum board on one side • inner layer of 7/16" mineral and fiber board, and outer layer of ceramic tile on other side	 1-1/2 hr.	—
UL U450	• 362S125-18 steel studs spaced at 16" o.c • spray applied fire-resistive material in cavity, min. average density of 13 pcf • diamond mesh expanded steel or metal lath on one side • (2) layers ⅝" gypsum board on each side for 3-hr. rating • (3) layers ⅝" gypsum board on each side for 4-hr. rating • ¾" Portland cement plaster can be used in lieu of gypsum board layers on one side	 3 hr. / 4 hr.	—
UL U451	• 250S125-18 steel studs spaced at 24" o.c • 25 gauge resilient channels spaced at 24" o.c. on one side of studs • 1 ½" thick batt or blanket insulation • (1) layer ½", ⅝", or ¾"gypsum board on each side of studs	 1 hr.	—
UL U452	• 350S125-33 mil steel studs spaced at 24" o.c. • 3" Thermafibre cavity insulation • (2) layers ½" gypsum board on one side of stud • 25 gauge steel resilient channels spaced at 24" o.c. • (1) layer ½" gypsum board on the other side of stud	 1-1/2 hr.	—

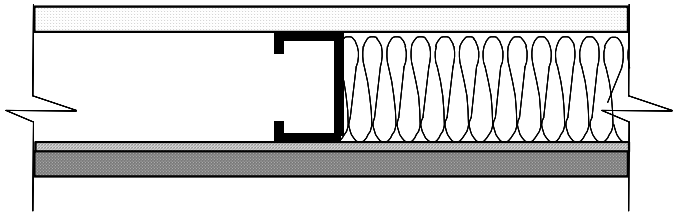
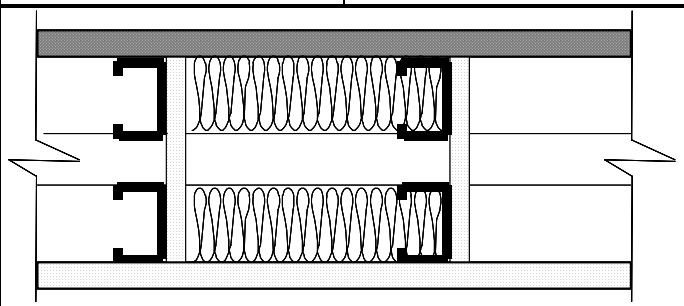
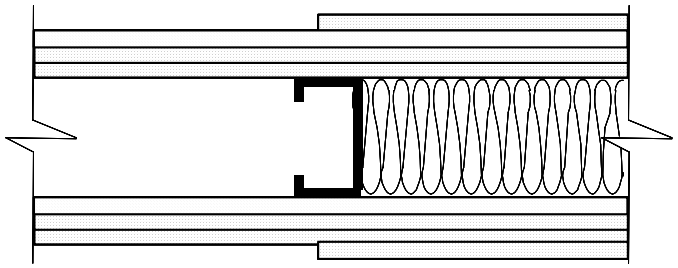
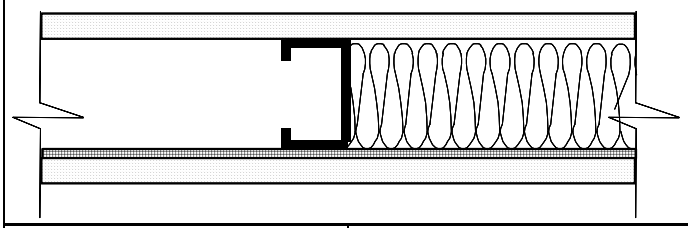
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U453	• 350S125-33 steel studs spaced at 24" o.c. • 3" Thermafiber insulation • 25 gauge steel resilient channels at 24" o.c. • (2) layers ⅝" gypsum board attached to one side of studs (at resilient channels side) • (1) layer ½" gypsum board on other side of stud	 2 hr.	—
UL U454	• 250S125-18 steel studs spaced at 24" o.c • 25 gauge resilient channels spaced at 24" o.c. on one side of studs • 1 thick mineral wool insulation • (2) layers ½", ⅝", or ¾"gypsum board on each side of studs	 2 hr.	—
UL U455	• 250S125-18 steel studs spaced at 24" o.c • 25 gauge resilient channels spaced at 24" o.c. on one side of studs • 1 thick mineral wool insulation • (2) layers ½" gypsum board on resilient channel side of studs • (3) layers ½"gypsum board on other side of studs	 3 hr.	—
UL U456	• 362S137-33 steel studs spaced at 16" o.c • mineral wool batt insulation, 3 psf density • (1) layer 5/8" gypsum board on one side of studs • 10 mm thick mineral and fiber board on other side of stud	 1 hr.	—

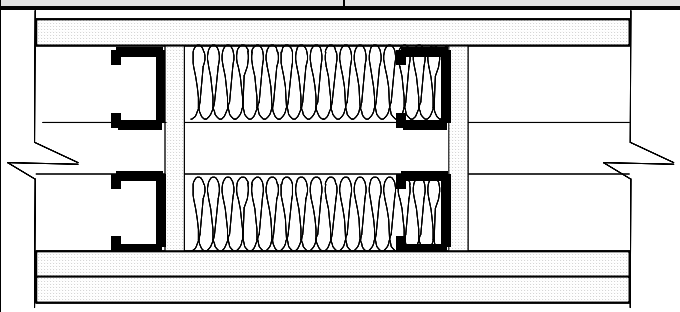
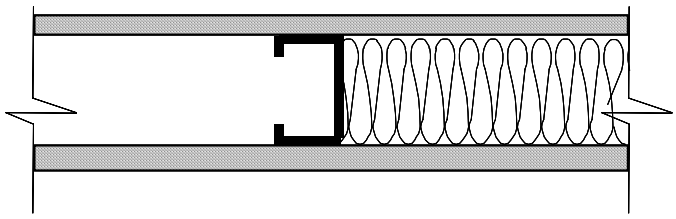
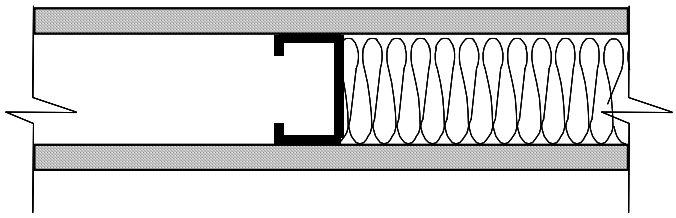
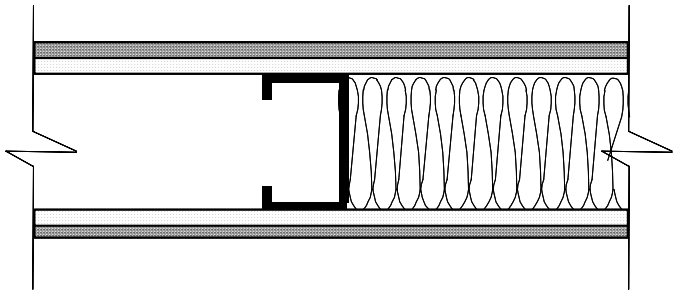
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U457	• 362S125-33 steel studs spaced at 16" o.c. • (1) layer ⅝" gypsum board on one side of studs • 3" Thermafibre insulation • optional layer of ½" rigid polystyrene insulation and outer layer of ½" or 5/8" cementitous board on other side	 1 hr.	—
UL U458	• double 162S125-33 steel studs spaced at 16 .c. • 1½" thick batt or blanket insulation in both stud cavities • bracing: cut from steel tracks or 6" wide gypsum board pieces • 5/8" gypsum board on one side of studs • ½" or 5/8" cementitous backer unit on other side of studs	 1 hr.	—
UL U463	• 162S125-33 steel studs spaced at 24 o.c. • optional 1½" thick batt or blanket insulation • (4) layers ½" gypsum board on each side of studs for 4 hr rating • (3) layers ½" gypsum board on each side of studs for 4 hr rating	 3 hr. / 4 hr.	—
UL U465	• 350S125-18 steel studs spaced at 24" o.c. • optional mineral wool or glass fiber insulation • optional 18 mil steel resilient channels at 24" o.c. • (1) layer ⅝" gypsum board on each side of studs	 1 hr.	—

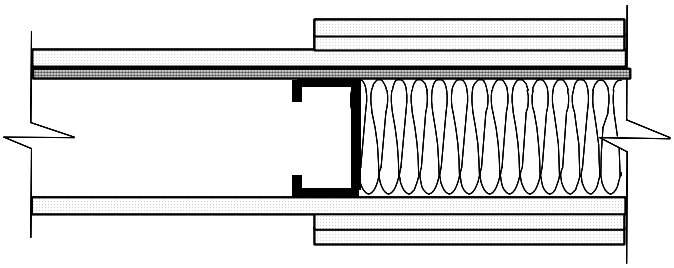
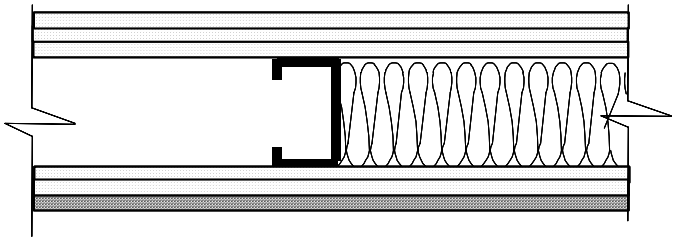
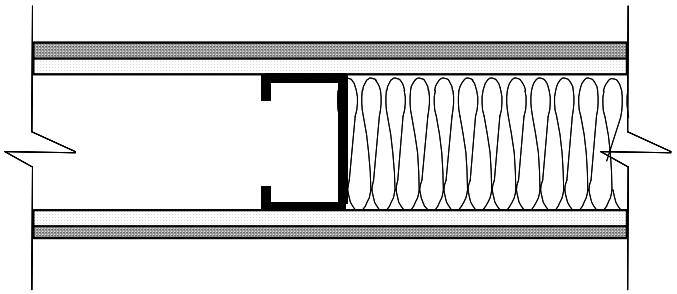
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U466	• double 162S125-18 steel studs spaced at 24 o.c. • optional mineral wool or glass fiber batts • bracing: cut from steel tracks or 6" wide gypsum board pieces • 5/8" gypsum board on one side of studs • (2) layers 5/8" gypsum board on other side of studs	 1 hr.	—
UL U470	• 275S200-18 steel studs spaced at 24 o.c. • mineral wool insulation, 4 pcf density • nominal 15 mm fiber board on the fire side • nominal 20 mm fiber board on the unexposed side	 1-1/2 hr.	—
UL U471	• 362S125-18 steel studs spaced at 24 o.c. • 3¼" thick mineral wool insulation, nominal 4 pcf density • nominal 15 mm fiber board on each side of studs	 1-1/2 hr.	—
UL U474	• 362S125-33 steel studs spaced at 16 o.c. • 3" thick mineral wool insulation • (1) base layer ½" gypsum board on each side of studs • ½" thick cementitous backer unit on each side of studs	 2 hr.	—

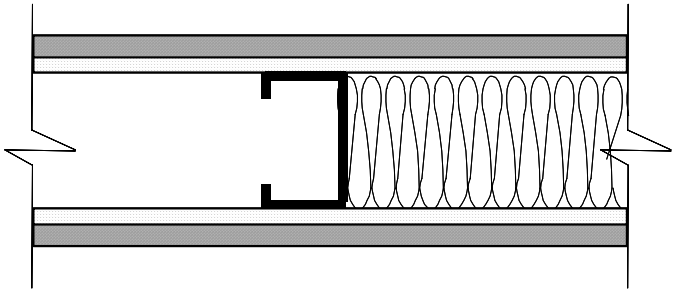
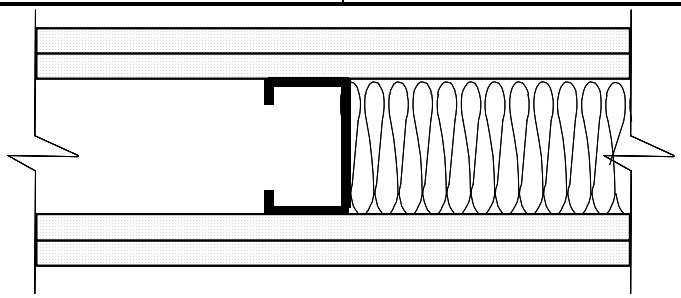
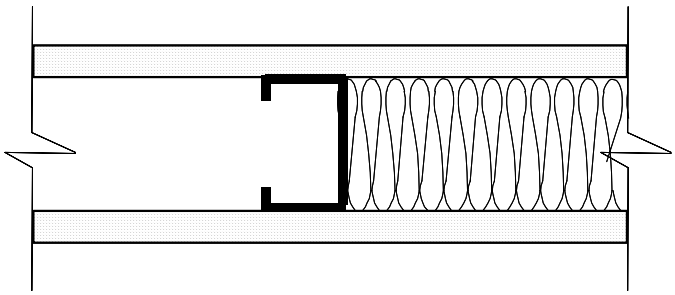
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="2">UL
U475</td><td rowspan="2">• 250S125, 325S125, 362S125, 400S125 steel studs spaced at 16 o.c. (rating listed for thickness of studs)
• cementitous mixture, min. average density 15/14 pcf in cavity
• diamond mesh, expanded steel (metal lath) on one side of studs
• gypsum board on each side (rating listed for thickness and number of layers of gypsum board applied)
• ¾" portland cement on metal lath side can be used instead of gypsum board</td><td colspan="2">  </td></tr>
<tr><td colspan="2"><table>
<tr><th>Stud Thick</th><th>Layers & Thick. of Gypsum Board</th><th>Rating</th></tr>
<tr><td>18 mil</td><td>(2) 5/8"</td><td>1 hr.</td></tr>
<tr><td>18 mil</td><td>(2) 5/8"</td><td>2 hr.</td></tr>
<tr><td>18 mil</td><td>(2) 5/8"</td><td>3 hr.</td></tr>
<tr><td>43 mil</td><td>(3) 5/8"</td><td>4 hr.</td></tr>
</table></td><td>—</td></tr>
<tr><td>UL
U478</td><td>• 162S125-18 steel studs spaced at 24 o.c.
• optional mineral wool insulation
• (3) layers ½" gypsum board on one side of studs
• (2) layers of ½" gypsum board and (1) layer of ½" or 5/8" thick cementitous backer unit on the other side of studs</td><td colspan="2">  </td></tr>
<tr><td></td><td></td><td>3 hr.</td><td>—</td></tr>
<tr><td>UL
U484</td><td>• 250S100-18 steel studs spaced at 24" o.c.
• optional mineral wool insulation
• (1) layer 3/8" gypsum board on each side
• metal lath self furring diamond mesh and ¾" plaster on each side</td><td colspan="2">  </td></tr>
<tr><td></td><td></td><td>2 hr.</td><td>—</td></tr>
</table>

(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U488	• 250S125-33 steel studs spaced at 16” o.c. • 1” min. Thermafibre insulation • (1) layer 3/8” gypsum board on each side • 7/16” plaster on each side of studs		
		1 hr.	—
UL U490	• 250S125-18 steel studs spaced at 24” o.c. • 2” nominal mineral wool (Thermafiber) insulation • (2) layers ¾” gypsum board on each side of studs		
		4 hr.	—
UL U491	• 350S125-18 steel studs spaced at 24” o.c. • 3” nominal Thermafiber insulation • (1) layer ¾” gypsum board on each side of studs		
		2 hr.	—

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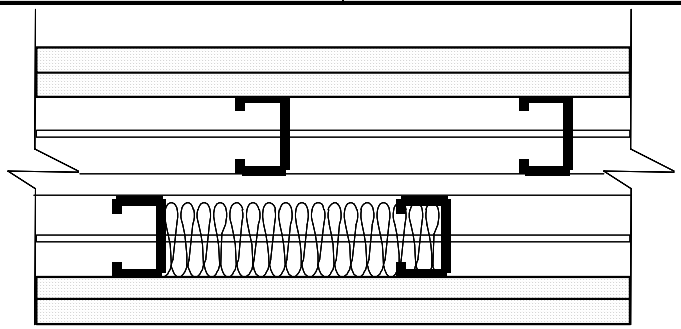
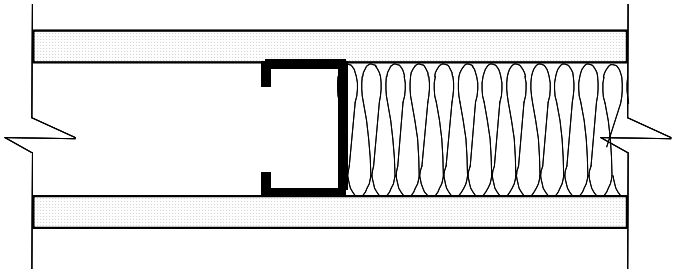
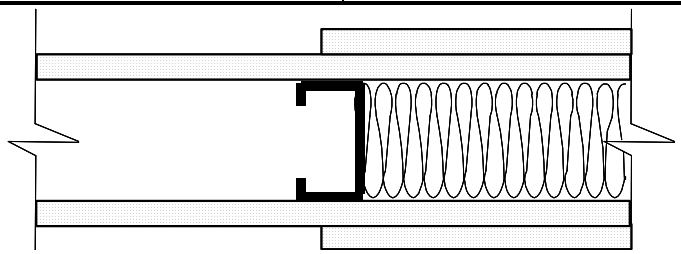
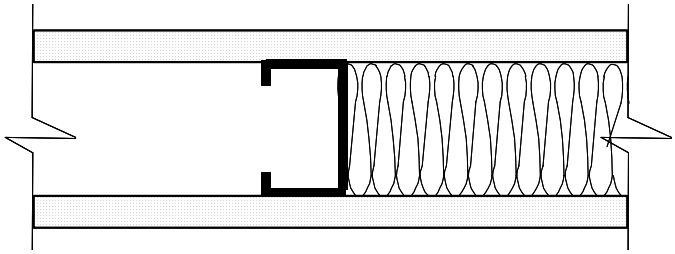
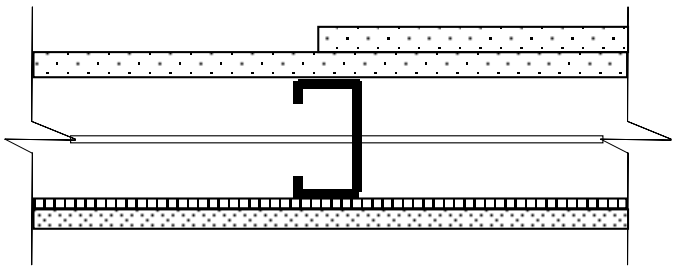
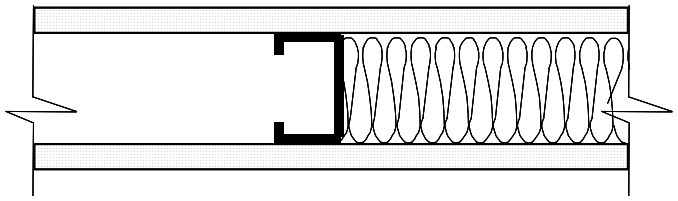
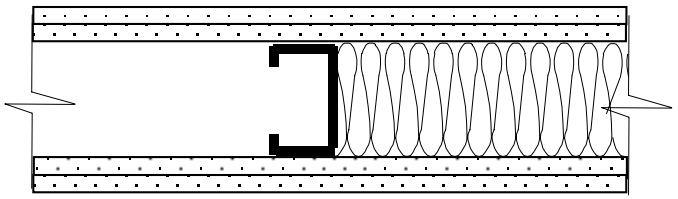
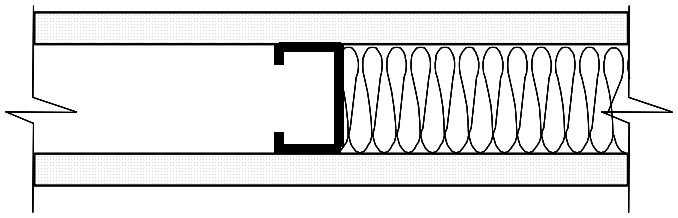
Non-Load Bearing Walls (Underwriters Laboratories)

<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="2">UL
U493</td><td rowspan="2">• staggered double steel studs spaced at 16” o.c. (rating listed for size and thickness of studs)
• lateral bracing by 075U50-43 welded to studs at cutouts at horizontal third points
• glass fiber 3½” nominal thickness, 0.5 pcf density
• (2) layers 5/8” gypsum board on each side of studs</td><td colspan="2">  </td></tr>
<tr><td><table><tr><th>Stud Size</th><th>Rating</th></tr><tr><td>250S162-33</td><td>1 hr.</td></tr><tr><td>362S162-43</td><td>2 hr.</td></tr></table></td><td>—</td></tr>
<tr><td rowspan="2">UL
U494</td><td rowspan="2">• 250S125-18 steel studs spaced at 16” or 24” o.c.
• 2½” nominal fiber glass batts
• (1) layer 5/8”gypsum board on each side of studs</td><td colspan="2">  </td></tr>
<tr><td>1 hr.</td><td>—</td></tr>
<tr><td rowspan="2">UL
U495</td><td rowspan="2">• 362S125-18 steel studs spaced at 24” o.c.
• optional mineral wool or glass fiber insulation
• gypsum board on each side (rating listed for thickness and number of layers of gypsum board applied)</td><td colspan="2">  </td></tr>
<tr><td><table><tr><th>Layers & Thick. of Gypsum Board</th><th>Rating</th></tr><tr><td>(1) 5/8” or ¾”</td><td>1 hr.</td></tr><tr><td>(2) 5/8” or ¾”</td><td>2 hr.</td></tr></table></td><td>—</td></tr>
<tr><td rowspan="2">UL
U496</td><td rowspan="2">• 162S125-18 steel studs spaced at 24” o.c.
• optional mineral wool
• (1) layer ¾” gypsum board on each side of studs</td><td colspan="2">  </td></tr>
<tr><td>1 hr.</td><td>—</td></tr>
</table>

(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls (Underwriters Laboratories)

<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="2">UL
A100</td><td rowspan="2">• 362S125-18 steel studs spaced at 16” o.c.
• bracing: min. 17 gauge steel channels at mid-height, welded at each stud
• 24 gauge fluted metal panel and 7/8” partitiona panel unit on one side of studs
• gypsum board on other side of studs (rating listed for thickness and number of layers of gypsum board applied)</td><td>  </td><td></td></tr>
<tr><td><table><tr><th>Fire Side</th><th>Gyp. Board</th><th>Rating</th></tr><tr><td>Exterior</td><td>(1) 5/8”</td><td>1 hr.</td></tr><tr><td>Exterior</td><td>(1) 5/8”</td><td>1 ½ hr.</td></tr><tr><td>Interior</td><td>(2) 5/8”</td><td>1 hr.</td></tr><tr><td>Interior</td><td>(2) 5/8”</td><td>1 ½ hr.</td></tr><tr><td>Exterior</td><td>(2) 5/8”</td><td>2 hr.</td></tr></table></td><td>—</td></tr>
<tr><td rowspan="2">UL
V401</td><td rowspan="2">• 250S137-18 mil steel studs spaced at 24” o.c.
• 2” mineral wool insulation with UL Classification Marking
• (1) layer ½” paper or vinyl surfaced gypsum board on each side of studs</td><td>  </td><td></td></tr>
<tr><td>1 hr.</td><td>—</td></tr>
<tr><td rowspan="2">UL
V410</td><td rowspan="2">• 162S125-18 mil steel studs spaced at 24” o.c.
• optional mineral wool or glass fiber batts
• (2) layers ½” gypsum board on each side of studs</td><td>  </td><td></td></tr>
<tr><td>2 hr.</td><td>—</td></tr>
<tr><td rowspan="2">UL
V412</td><td rowspan="2">• 350S125-18 mil steel studs spaced at 24” o.c.
• nominal 3” thick mineral wool insulation
• (1) layer ¾” faced gypsum wallboard panels on each side of studs</td><td>  </td><td></td></tr>
<tr><td>2 hr.</td><td>—</td></tr>
</table>

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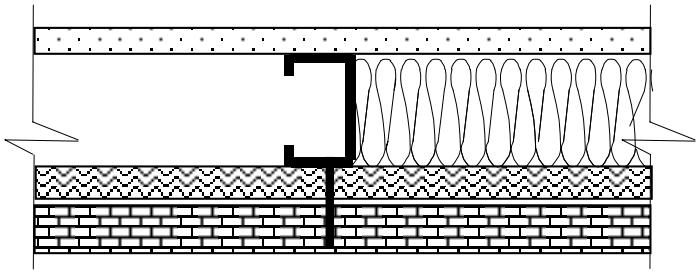
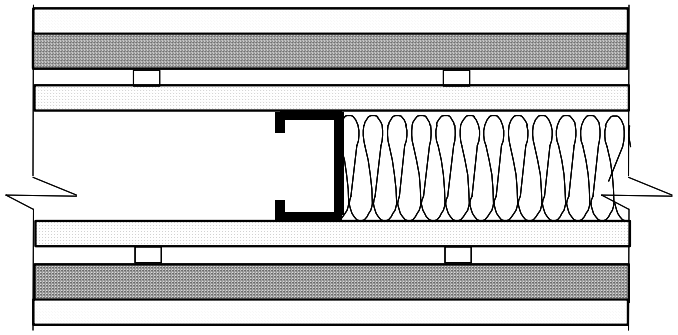
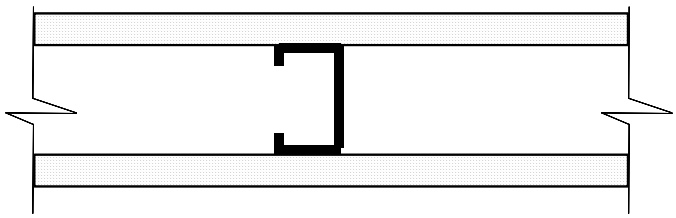
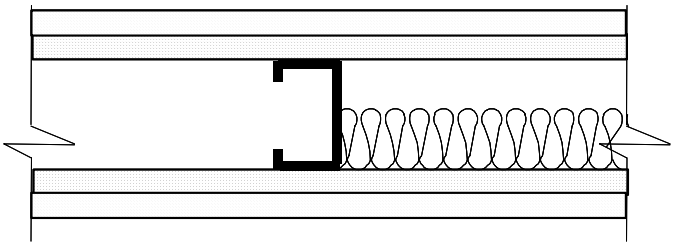
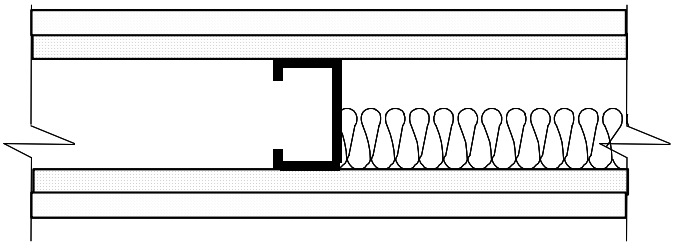
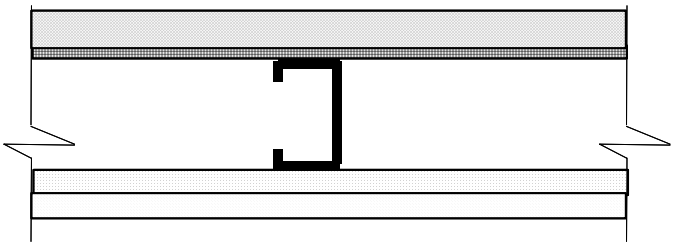
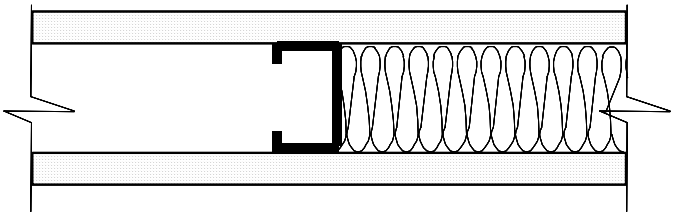
Non-Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL V414	• 362S162-33 mil steel studs spaced at 16" o.c. • studs braced by 150U50-54 cold rolled channels • 3-1/2" Kraft paper, foil or unfaced fiber glass cavity insulation, min. density 0.8 pcf or unfaced 3 ½" thick mineral wool insulation • (1) layer ⅝" gypsum board on one side • (1) layer 2" (max. thickness) foam plastic board on other side and 4" brick veneer, min. 2" gap between brick and foam board		
		1 hr. Interior 3 hr. Exterior	—
UL V415	• 562S162-33 mil steel studs spaced at 16" o.c. • 3-1/2" mineral wool insulation • inner layer ⅝" Type X gypsum board on each side of studs • 1½" x 33 mil furring channels spaced at 24" o.c. • 2" thick structural cement fiber board attached to furring channels, on each side of studs • outer layer 5/8" thick Type X gypsum wallboard attached to cement board, on each side of studs		
		2 hr.	—
UL V416	• 362S125-18 steel studs spaced at 24" o.c. • optional mineral wool or fiber glass cavity insulation • (1) layer ⅝" or ¾" faced gypsum wall board panel on each side • optional 25 gauge thick furring channels at 24" o.c.		
		1 hr.	—

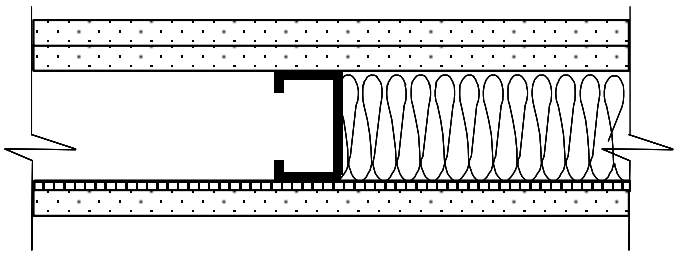
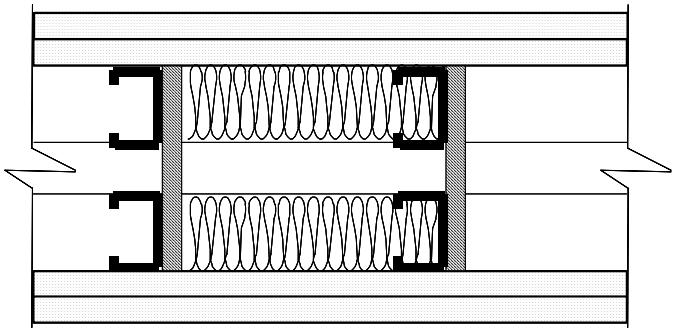
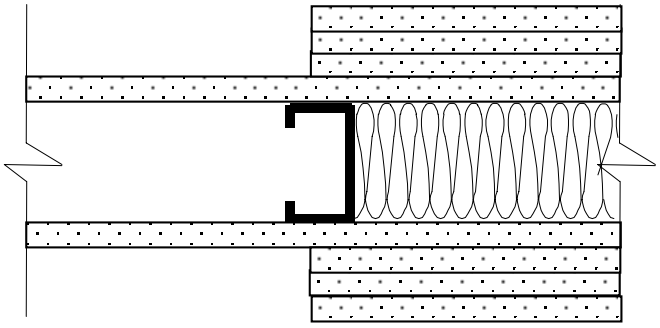
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL V418	• 162S125-18 steel studs spaced at 24" o.c. • mineral wool batts, partially or completely filling cavity • (2) layers ½" gypsum wallboard panel on each side of stud		
		2 hr.	—
UL V419	• 250S125-18 steel studs spaced at 24" o.c. • mineral wool batts, partially or completely filling cavity • (2) layers 5/8" gypsum wallboard panel on each side of stud, outer layer paper or vinyl faced, inner layer laminated system		
		2 hr.	—
UL V420	• 350S, 33 mil steel studs spaced at 24" o.c. • (2) layers 5/8" gypsum wallboard on one side of the studs • min. 3" thick precast autoclaved aerated concrete attached to 7/8" deep, 25 gauge furring channels spaced at 24" o.c. on the other side of the studs		
		2 hr.	—
UL V425	• 250S125-18 steel studs spaced at 16" o.c. • min. untamped thickness of 1½" sprayed fiber insulation, min. average density 6 pcf • (1) layer 5/8" gypsum wallboard on each side of the studs		
		2 hr.	—

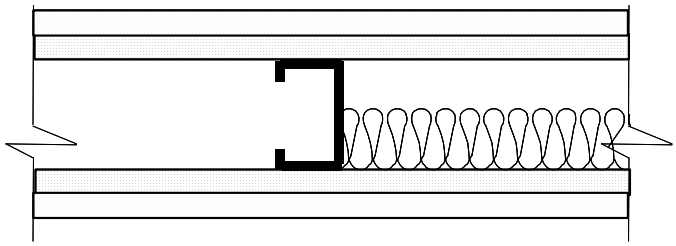
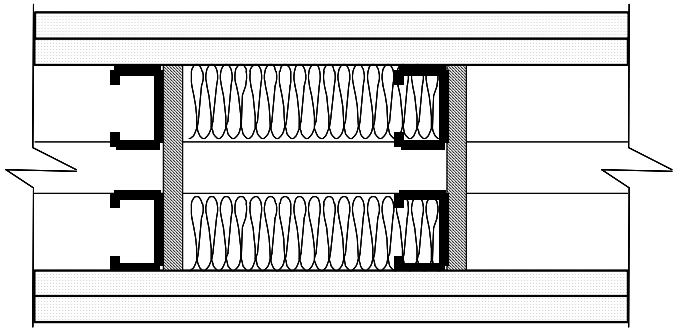
(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls

<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td>UL
V435</td><td>• 362S125-18 steel studs spaced at 24” o.c.
• 25 gauge resilient furring channels spaced at 24” o.c. on one side of wall
• min. 2.5 pcf density unfaced mineral wool batts, full width
• (1) layer 5/8” gypsum wallboard on furring channels side
• (2) layers 5/8” gypsum wallboard on other side</td><td colspan="2"> 
1 hr. | 52</td></tr>
<tr><td>UL
U437</td><td>• double 162S125-18 steel studs spaced at 24 o.c.
• bracing: cut from steel tracks or studs, space braces at 48” max
• optional mineral wool or glass fiber batts completely filling stud cavity
• (2) layers 5/8” gypsum board on each side of studs</td><td colspan="2"> 
1 hr. | —</td></tr>
<tr><td>UL
V438</td><td>• xxxS125-18 steel studs spaced at 24” o.c., for web size (xxx) size refer to table
• mineral wool batts as indicated in table
• thickness and number of gypsum board layers as shown in table
• optional 18 mil furring or resilient channels spaced at 24” o.c.
• optional aluminum, steel, or vinyl siding, brick veneer or stucco over gypsum board</td><td colspan="2"> 
<table>
<tr><th>Rating (hr)</th><th>Min. Stud Size</th><th>No. of Layers</th><th>Layer Thick.</th><th>Insulation</th></tr>
<tr><td>1</td><td>362S</td><td>1</td><td>5/8”</td><td>optional</td></tr>
<tr><td>1</td><td>250S</td><td>1</td><td>½”</td><td>2” thick</td></tr>
<tr><td>2</td><td>162S</td><td>2</td><td>½”</td><td rowspan="6">optional</td></tr>
<tr><td>2</td><td>250S</td><td>2</td><td>5/8”</td></tr>
<tr><td>3</td><td>162S</td><td>3</td><td>½”</td></tr>
<tr><td>3</td><td>162S</td><td>3</td><td>5/8”</td></tr>
<tr><td>4</td><td>162S</td><td>4</td><td>½”</td></tr>
<tr><td>4</td><td>162S</td><td>4</td><td>5/8”</td></tr>
</table>
—</td></tr>
</table>

(Not complete construction details; consult original source for detailed information. UL- Underwriters Laboratories, Inc.)

Non-Load Bearing Walls

<table>
<tr><th>Source</th><th>Description</th><th colspan="2">Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="4">UL
V440</td><td rowspan="4">• 250S137-27 steel studs spaced at 24” o.c.
• 25 gauge resilient furring channels spaced at 24” o.c. on one side of wall
• min. 2” glass fiber batts, 0.7 pcf density
• optional gypsum board shims on one or both sides of the studs
• 5/8” gypsum wallboard on each side of wall (rating listed for number of layers of gypsum board applied)</td><td colspan="2">  </td><td rowspan="4">—</td></tr>
<tr><td>No. of Layers</td><td>Rating</td></tr>
<tr><td>1</td><td>1 hr.</td></tr>
<tr><td>2</td><td>2 hr.</td></tr>
<tr><td rowspan="4">UL
U442</td><td rowspan="4">• double 250S137-27 steel studs spaced at 24 o.c.
• bracing: cut from steel tracks or studs or 6” piece of gypsum board, space braces at 48” max
• min. 2” glass fiber batts, 0.7 pcf density
• optional mineral wool or glass fiber batts completely filling stud cavity
• 5/8” gypsum wallboard on each side of wall (rating listed for number of layers of gypsum board applied)</td><td colspan="2">  </td><td rowspan="4">—</td></tr>
<tr><td>No. of Layers</td><td>Rating</td></tr>
<tr><td>1</td><td>1 hr.</td></tr>
<tr><td>2</td><td>2 hr.</td></tr>
</table>

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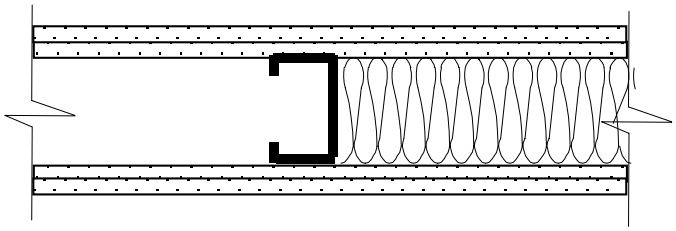
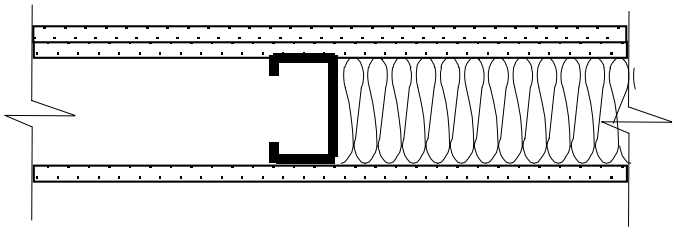
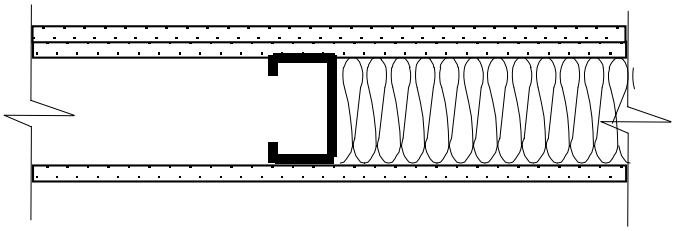
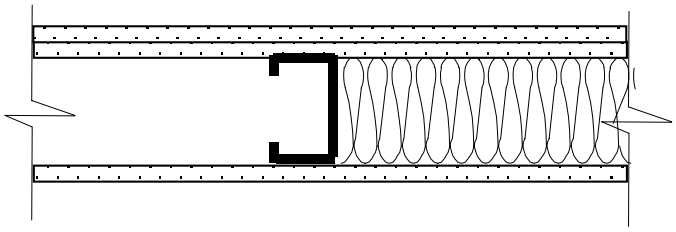
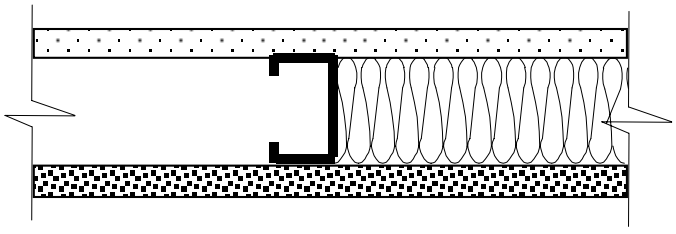
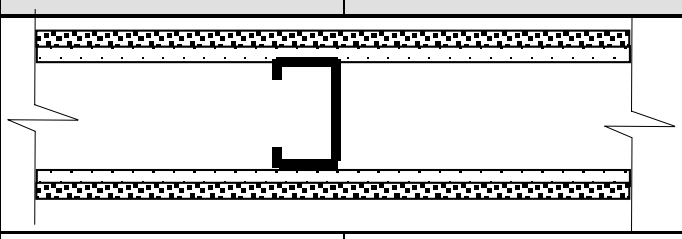
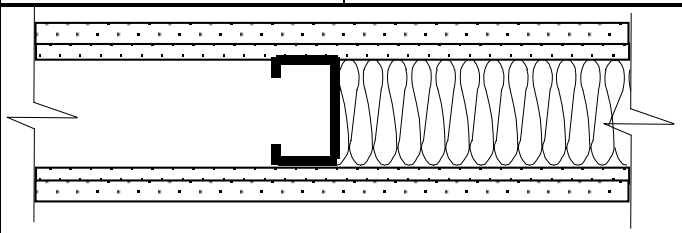
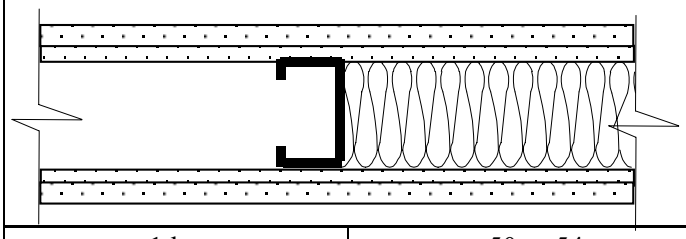
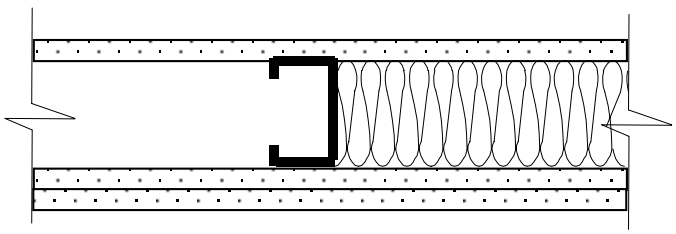
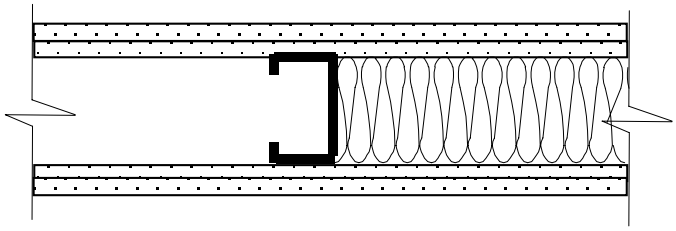
Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1015	• 250S studs @ 24" o.c. • 1-1/2" mineral fiber insulation in cavity (3.0 pcf) • Base layer ¼" gypsum wallboard on each side • Face layer 5/8" Type X gypsum wallboard on each side		
		1 hr	55 to 59
GA WP1021	• 250S studs @ 24" o.c. • 3-1/2" glass fiber insulation • (1) layer ½" Type X gypsum board on one side • Other side: base layer of ½" Type X gypsum board, face layer ½" plain or predecorated gypsum wallboard		
		1 hr	50 to 54
GA WP1022	• 250S studs @ 24" o.c. • 3" glass fiber insulation • ½" Type X gypsum board on one side of wall • Other side: base layer of ½" Type X gypsum board, face layer Type X gypsum wallboard or gypsum veneer		
		1 hr	50 to 54
GA WP1023	• 362S steel studs spaced at 24" o.c. • 2-3/4" glass fiber insulation (0.30 pcf) • ½" Type X gypsum board on one side of wall • Other side: base layer of ½" Type X gypsum board, face layer of ½" Type X gypsum wallboard		
		1 hr	50 to 54
GA WP1035	• 362S162-33 studs @ 24" o.c. • 3" mineral fiber insulation in cavity • 5/8" Type X gypsum board on one side of wall • ½" cementitious board on other side		
		1 hr.	—

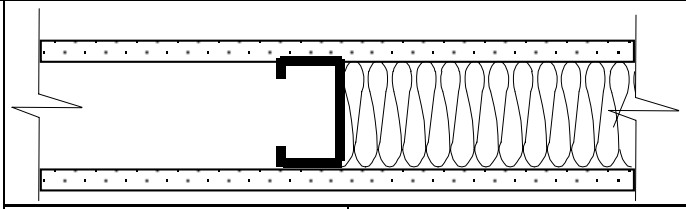
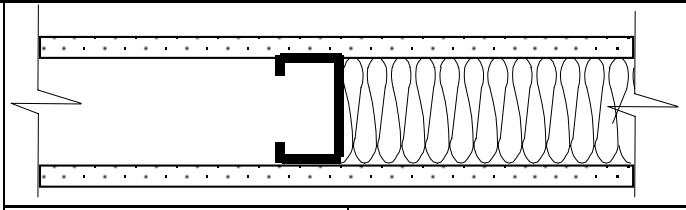
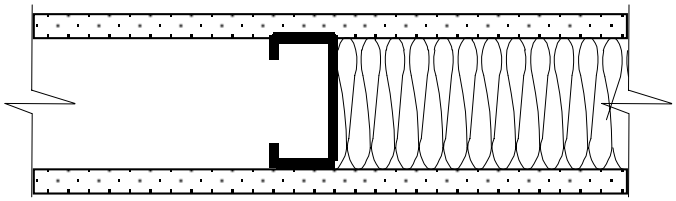
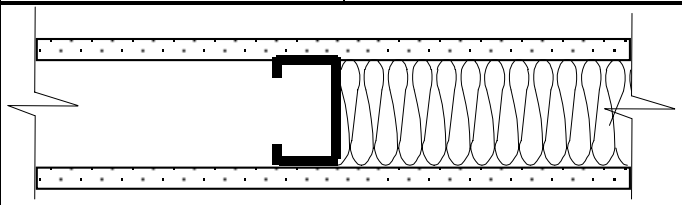
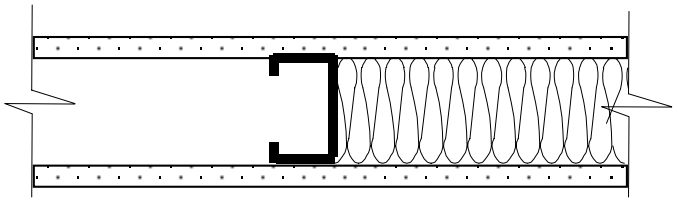
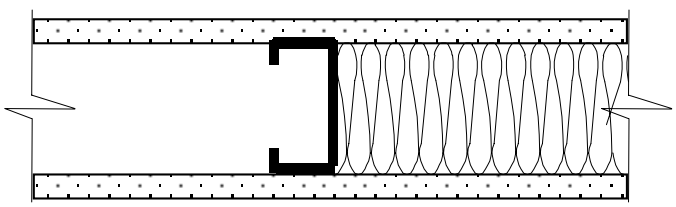
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1041	• 362S, 33 mil steel studs spaced at 24" o.c. • inner layer ½" Type X gypsum board, on each side • outer layer ¼" fiber cement board, on each side		
		1 hr.	50 to 54
GA WP1050	• 250S studs spaced @ 24" o.c. • 2" glass fiber insulation in cavity • Base layer ¼" gypsum wallboard on each side • Face layer ½" Type X gypsum wallboard on each side		
		1 hr	50 to 54
GA WP1051	• 250S studs spaced @ 24" o.c. • 2" glass fiber insulation in cavity • Base layer ¼" gypsum wallboard on each side • Face layer ½" Type X gypsum wallboard on each side		
		1 hr.	50 to 54
GA WP1052	• 362S studs spaced @ 24" o.c. • 3-1/2" glass fiber insulation in cavity • 5/8" Type X gypsum wallboard or gypsum veneer on one side of wall • Other side: base layer of 5/8" Type X gypsum wallboard, face layer of 5/8" Type X gypsum wallboard		
		1 hr.	50 to 54
GA WP1053	• 250S studs spaced @ 24" o.c. • 3-1/2" glass fiber insulation in cavity • Base layer 3/8" square edge gypsum wallboard on each side • Face layer ½" Type X gypsum wallboard on each side		
		1 hr.	50 to 54

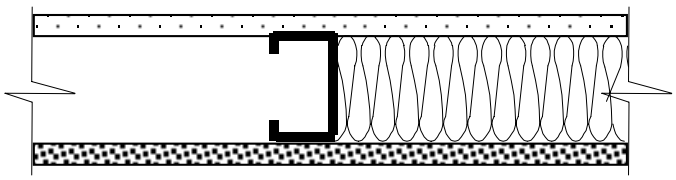
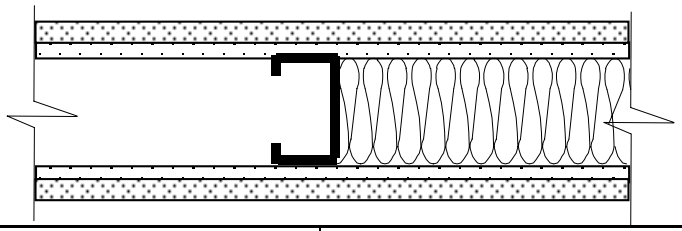
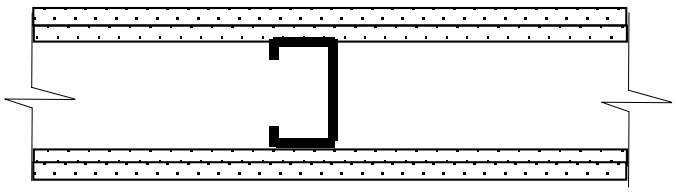
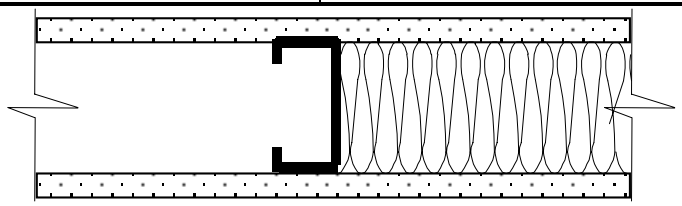
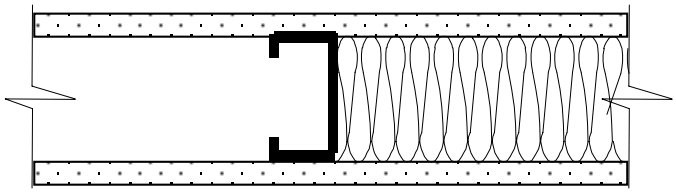
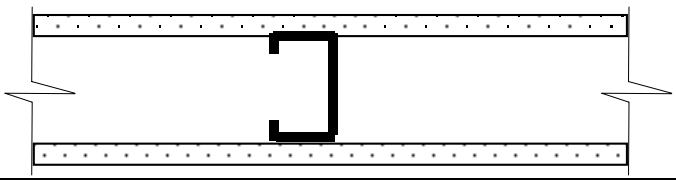
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1070	• 250S studs spaced @ 24" o.c. • 1½" glass fiber insulation (3.0 pcf) • ½" Type X gypsum board on each side of studs	 1 hr.	45 to 49
GA WP1071	• 250S studs spaced @ 24" o.c. • 2" glass fiber insulation (3.0 pcf) • ½" Type X gypsum board on each side of studs	 1 hr.	45 to 49
GA WP1072	• 362S studs spaced @ 24" o.c. • 3 ½" glass fiber insulation (3.0 pcf) • 5/8" Type X gypsum board on each side of studs	 1 hr.	45 to 49
GA WP1073	• 250S studs spaced @ 16" o.c. • 3 ½" glass fiber insulation (3.0 pcf) • ½" Type X glass mat water resistant gypsum backing board on each side of studs	 1 hr.	45 to 49
GA WP1076	• 250S studs spaced @ 24" o.c. • 2 ¾" glass fiber insulation (0.65 pcf) • 5/8" Type X gypsum wallboard or gypsum veneer on each side of studs	 1 hr.	45 to 49
GA WP1081	• 362S studs spaced @ 24" o.c. • 3" mineral fiber insulation (2.5 pcf) • 5/8" Type X gypsum wallboard or gypsum veneer on each side of studs	 1 hr.	45 to 49

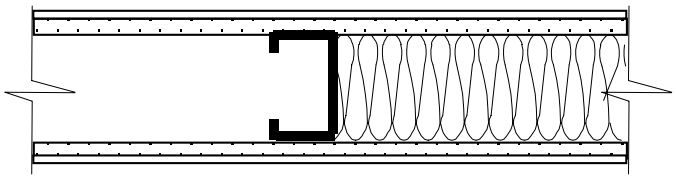
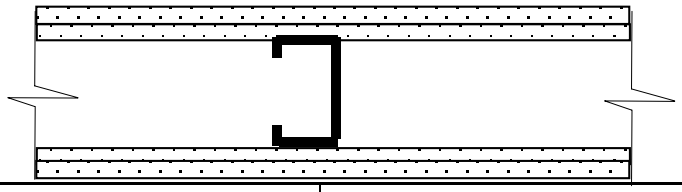
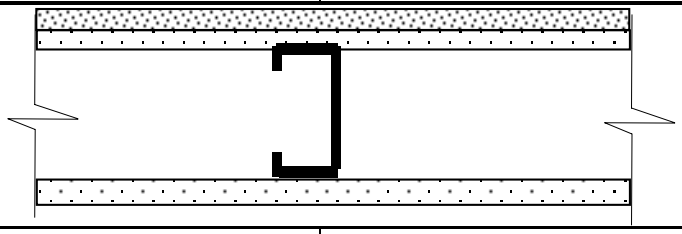
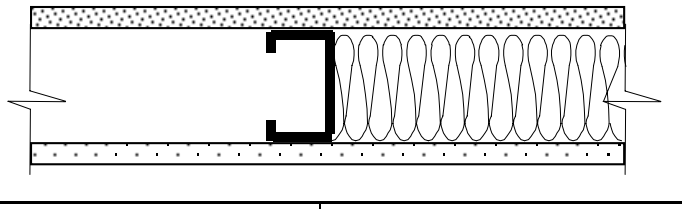
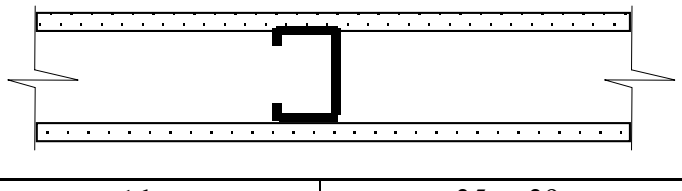
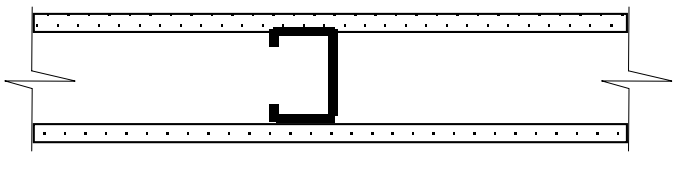
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1082	• 362S, 33 steel studs spaced at 16" o.c. • 3" mineral fiber insulation • ½" Type X gypsum board on one side of wall • ½" cementitous board on other side	 1 hr.	—
GA WP1085	• 250S steel studs spaced at 16" o.c. • 1" mineral fiber insulation • 7/16", 1:2 gypsum-sand basecoat plaster and 1/16" lime gauging plaster finish over one layer of 3/8" Type X gypsum lath	 1 hr.	45 to 49
GA WP1090	• 162S steel studs spaced at 24" o.c. • Base layer ¼" gypsum wallboard on each side of studs • Face layer ½" Type X gypsum wallboard on each side of studs	 1 hr.	45 to 49
GA WP1121	• 362S, 33 mil steel studs spaced at 24" o.c. • 3 ½" glass fiber insulation • ½" layer Type X gypsum wallboard on each side of studs	 1 hr.	45 to 49
GA WP1200	• 362S steel studs spaced at 24" o.c. • 5/8" layer Type X gypsum wallboard or gypsum veneer on each side of studs	 1 hr.	40 to 44
GA WP1201	• 250S, 33 mil steel studs spaced at 16" o.c. • 5/8" layer Type X gypsum wallboard or gypsum veneer on each side of studs	 1 hr.	40 to 44

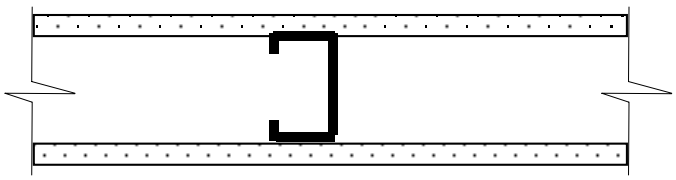
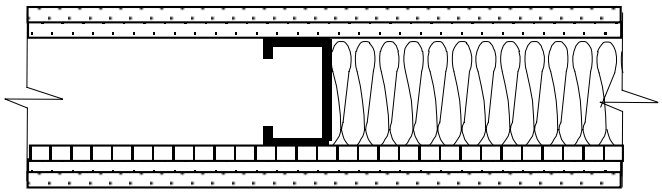
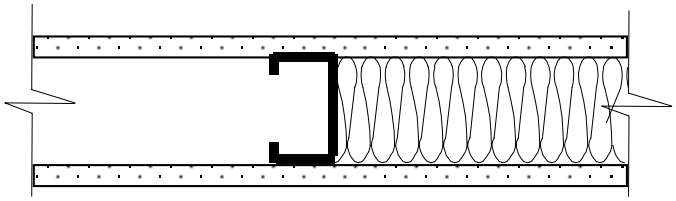
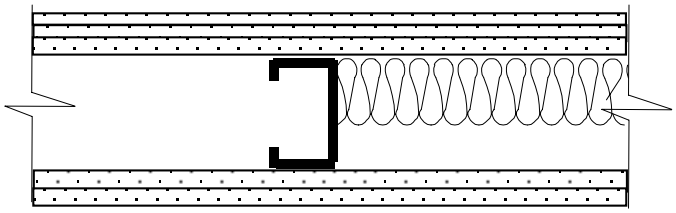
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1240	• 250S steel studs spaced at 24" o.c. • 3" glass fiber insulation • ½" Type X gypsum veneer base applied to each side of stud • 1/16" gypsum veneer plaster applied over each side	 1 hr.	40 to 44
GA WP1290	• 250S steel studs spaced at 24" o.c. • ½" 1:2 gypsum sand plaster applied over ½" plain gypsum lath	 1 hr.	40 to 44
GA WP1295	• 362S, 33 mil steel studs spaced at 24" o.c. • 5/8" Type X gypsum wallboard on one side of studs • base layer of ½" Type X gypsum wallboard, face layer ¼" fiber cement board on other side	 1 hr.	40 to 44
GA WP1296	• 362S steel studs spaced at 16" o.c. • 3" mineral fiber insulation (3.0 pcf) • 5/8" Type X gypsum wallboard on one side of studs • 7/16" fiber cement board on other side	 1 hr.	40 to 44
GA WP1340	• 162S steel studs spaced at 24" o.c. • 5/8" Type X gypsum wallboard on each side of studs	 1 hr.	35 to 39
GA WP1370	• 250S steel studs spaced at 24" o.c. • ½" 1:2 gypsum sand plaster applied over 3/8" Type X gypsum lath	 1 hr.	35 to 39

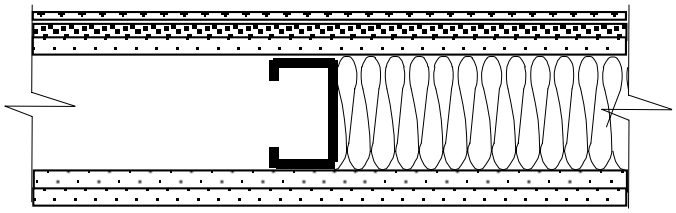
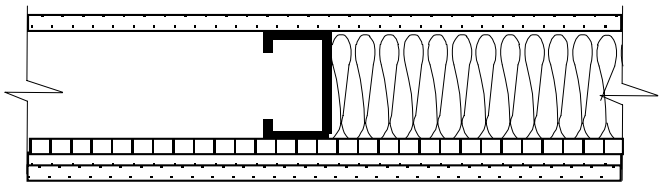
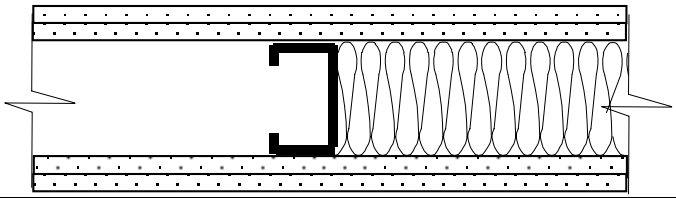
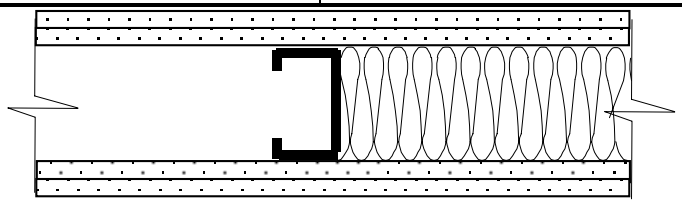
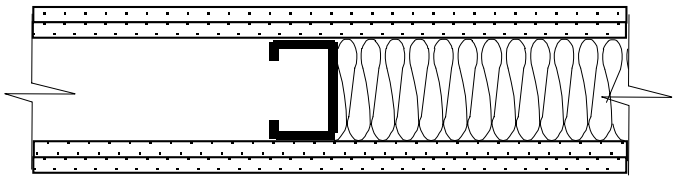
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1400	• 162S steel studs spaced at 16" o.c. • 5/8" 1:2-1:3 gypsum-sand plaster applied over 3.4 lb. Metal lath wire tied 6" o.c. to each side of stud		
		1 hr.	35 to 39
GA WP1470	• 350S, 33 steel studs spaced at 24" o.c. • 3" mineral fiber insulation • (2) layers ½" Type X gypsum board on one side • resilient channels spaced at 24" o.c. and (2) layers ½" Type X gypsum board on other side		
		2 hr.	55 to 59
GA WP1505	• 250S steel studs spaced at 24" o.c. • 2 ½" glass fiber insulation • ½" Type X gypsum board layer on one side of stud • 5/8" Type X gypsum board layer on other side of stud		
		2 hr.	55 to 59
GA WP1510	• 362S steel studs spaced at 24" o.c. • 2" glass fiber insulation (0.9 pcf) staples to one side of studs • (2) layers of 5/8" Type X gypsum board on one side of studs • base layer of 5/8" Type X gypsum board. Second layer of ½" Type X gypsum wall board and face layer of ¼" or 3/8" regular gypsum wallboard on other side of studs		
		2 hr.	55 to 59

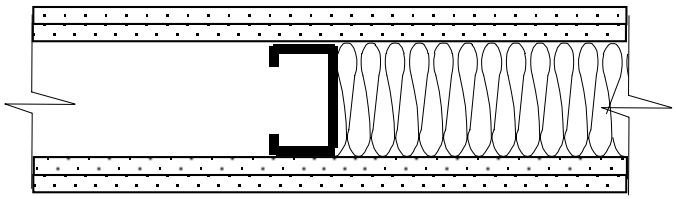
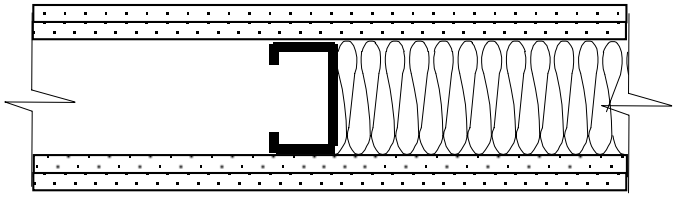
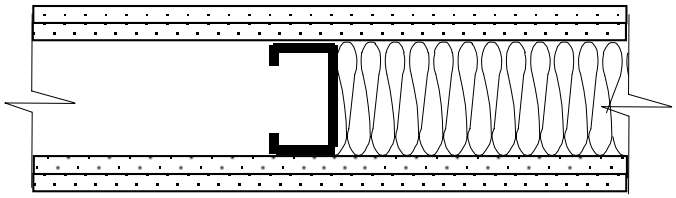
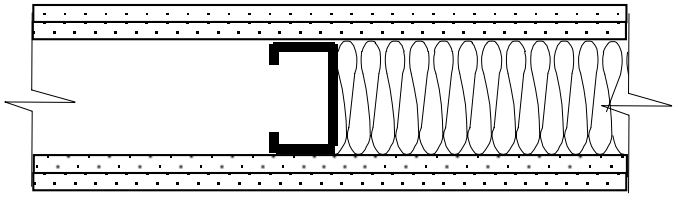
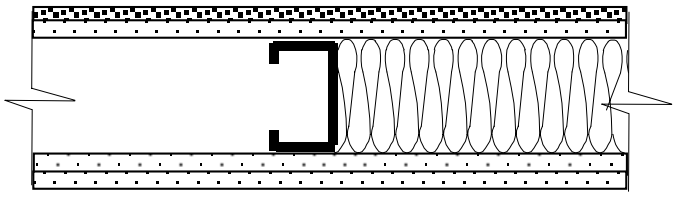
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1515	• 362S, 33 mil steel studs spaced at 24" o.c. • 3" glass fiber insulation (2.0 pcf) • (2) layers of ½" Type X gypsum wallboard on one side of studs • ½" Type X gypsum wallboard base layer, ½" cementitous backer board with joints covered with glass fiber mesh tape and ¼" ceramic tiles on other side of studs		
		2 hr.	55 to 59
GA WP1520	• 350S, 33 mil steel studs spaced at 24" o.c. • 3" mineral fiber insulation (2.0 pcf) • (1) layer ½" Type X gypsum wallboard on one side of studs • resilient channels at 24"o.c. and (2) layers of ½" Type X gypsum wallboard on other side of studs		
		2 hr.	55 to 59
GA WP1521	• 362S, 33 steel studs spaced at 24" o.c. • 3 ½" fiber glass insulation • base layer ½" Type X gypsum board on each side • face layer ½" Type X gypsum board on each side		
		2 hr.	55 to 59
GA WP1522	• 362S steel studs spaced at 24" o.c. • 3-½" glass fiber insulation • (2) layers 5/8" Type X gypsum wallboard on each side of studs		
		2 hr.	55 to 59
GA WP1530	• 162S steel studs spaced at 24" o.c. • 1-½" mineral fiber insulation • (2) layers ½" Type X gypsum wallboard on each side of studs		
		2 hr.	50 to 54

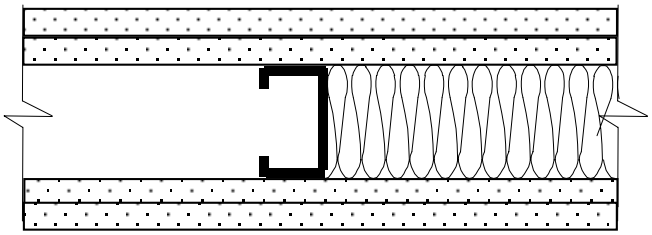
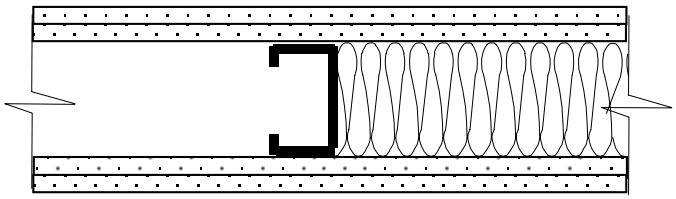
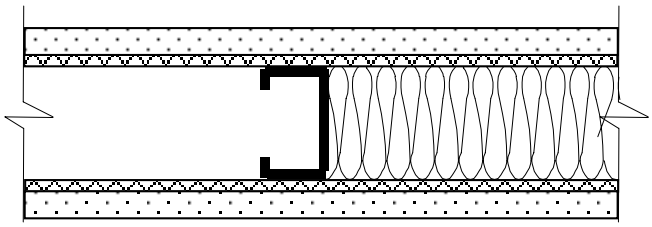
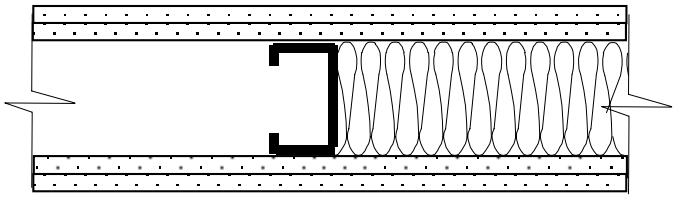
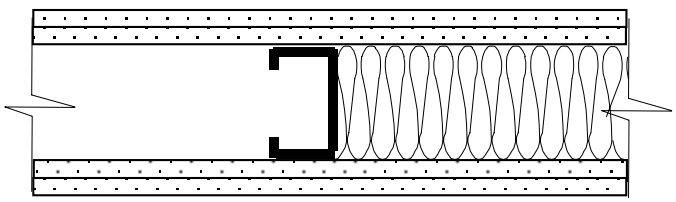
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1545	• 250S steel studs spaced at 24" o.c. • 1-½" mineral fiber insulation • (2) layers ½" Type X gypsum wallboard on each side of studs	 2 hr.	50 to 54
GA WP1546	• 250S steel studs spaced at 24" o.c. • 2-½" glass fiber insulation • (2) layers ½" Type X gypsum wallboard on each side of studs	 2 hr.	50 to 54
GA WP1548	• 250S steel studs spaced at 24" o.c. • 2-½" glass fiber insulation • (2) layers 5/8" Type X gypsum wallboard on each side of studs	 2 hr.	50 to 54
GA WP1560	• 250S steel studs spaced at 24" o.c. • 1" mineral fiber insulation stapled in stud space • (2) layers ½" Type X gypsum wallboard on each side of studs	 2 hr.	50 to 54
GA WP1565	• 250S steel studs spaced at 24" o.c. • 3" mineral fiber insulation batts (2.5 pcf) • (2) layers ½" Type X gypsum wallboard on one side of studs • ½" Type C gypsum wallboard base layer, ½" cementitous backer board face layer on other side of studs	 2 hr.	50 to 54

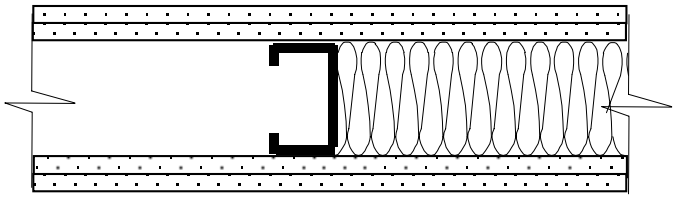
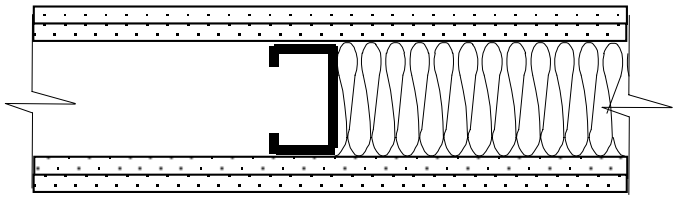
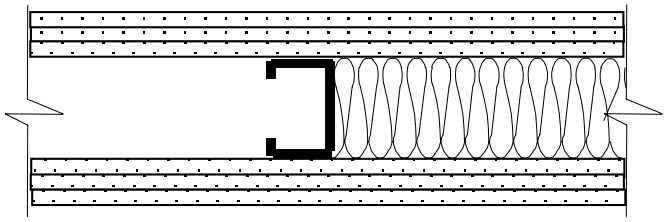
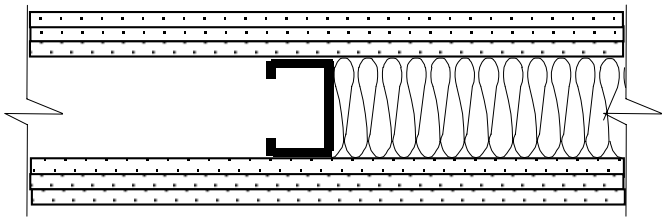
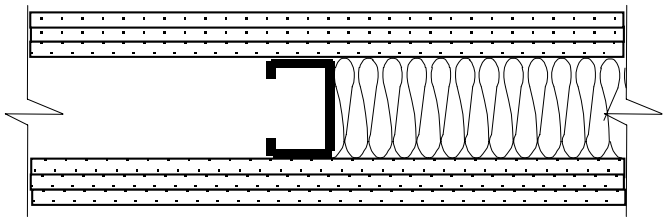
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1570	• 350S steel studs spaced at 24" o.c. • 3"mineral fiber insulation (2.0 pcf) • (2) layers ¾" Type X gypsum wallboard on each side of studs		
		2 hr.	50 to 54
GA WP1615	• 250S steel studs spaced at 24" o.c. • 3"mineral fiber insulation (2.0 pcf) • (2) layers ½" Type X gypsum wallboard on each side of studs		
		2 hr.	45 to 49
GA WP1625	• 250S, 33 mil steel studs spaced at 16" o.c. • 2"mineral fiber batts • ¾" 1:2 gypsum-sand plaster with lime gauging plaster finish applied over 3.4 lb self furring diamond mesh metal lath applied over 3/8" thick gypsum lath on each side of studs		
		2 hr.	45 to 49
GA WP1630	• 250S steel studs spaced at 24" o.c. • base layer of ½" Type X gypsum wallboard on each side of studs • face layer of ½" Type X gypsum wallboard with 4" wide strips of drywall laminating adhesive on each side of studs		
		2 hr.	45 to 49
GA WP1632	• 250S steel studs spaced at 24" o.c. • base layer of ½" Type X gypsum wallboard on each side of studs • face layer of ½" glass mat water-resistant gypsum backing board		
		2 hr.	45 to 49

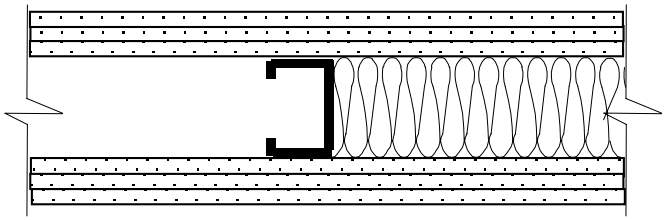
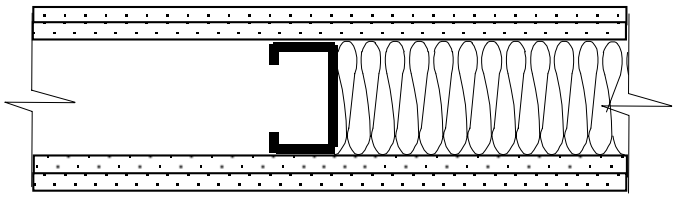
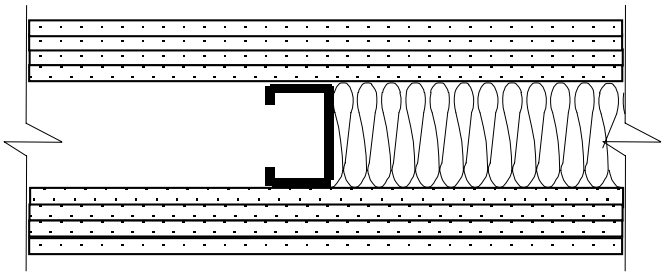
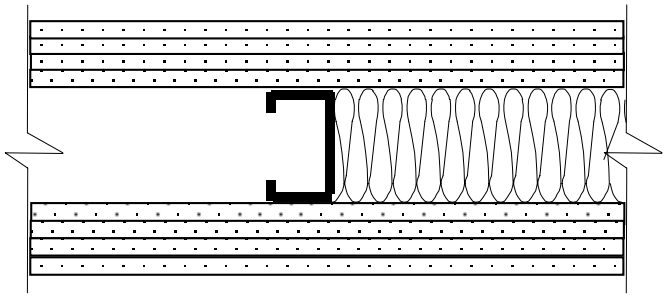
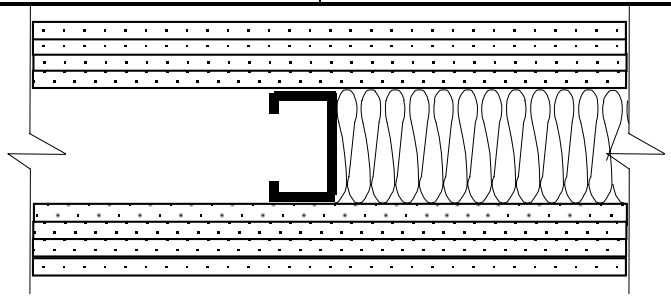
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1711	• 250S steel studs spaced at 24" o.c. • base layer of ½" Type X gypsum wallboard on each side of studs • face layer of ½" plain or predecorated Type X gypsum wallboard on each side of studs	 2 hr.	40 to 44
GA WP1940	• 250S, 33 mil steel studs spaced at 16" o.c. • (2) layers 5/8" Type X gypsum wallboard on each side of studs	 2 hr.	—
GA WP2800	• 162S steel studs spaced at 24" o.c. • 1 ½" mineral fiber insulation • (3) layers ½" Type X gypsum wallboard on each side of studs	 3 hr.	55 to 59
GA WP2921	• 162S steel studs spaced at 24" o.c. • 1 ½" mineral fiber insulation • (3) layers ½" Type X gypsum wallboard on each side of studs	 3 hr.	50 to 54
GA WP2922	• 162S steel studs spaced at 24" o.c. • 1 ½" mineral fiber insulation • (3) layers ½" Type X gypsum wallboard on each side of studs	 3 hr.	50 to 54

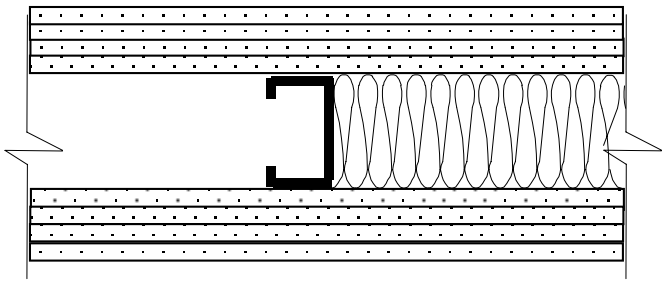
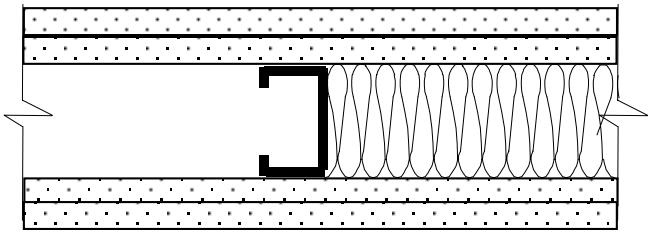
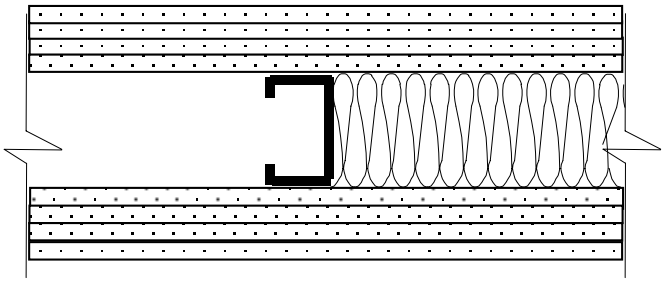
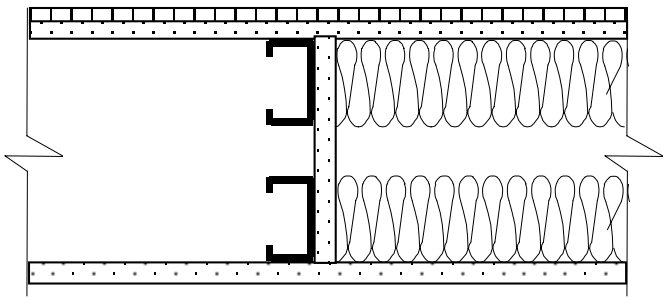
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP2924	• 162S steel studs spaced at 24" o.c. • 1 ½" mineral fiber insulation • (3) layers ½" Type X gypsum wallboard on each side of studs		
		3 hr.	50 to 54
GA WP2930	• 162S steel studs spaced at 24" o.c. • (2) layers ¾" Type X gypsum wallboard on each side of studs		
		3 hr.	—
GA WP2945	• 162S steel studs spaced at 24" o.c. • (4) layers ½" Type X gypsum wallboard on each side of studs		
		4 hr.	60 to 64 FSTC
GA WP2960	• 162S steel studs spaced at 24" o.c. • 1-½"glass fiber insulation • (4) layers ½" Type X gypsum wallboard on each side of studs		
		4 hr.	50 to 59
GA WP2961	• 162S steel studs spaced at 24" o.c. • 1-½"glass fiber insulation • (4) layers ½" Type X gypsum wallboard on each side of studs		
		4 hr.	50 to 59

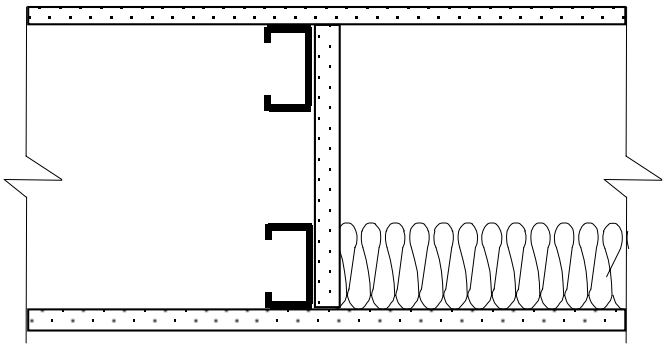
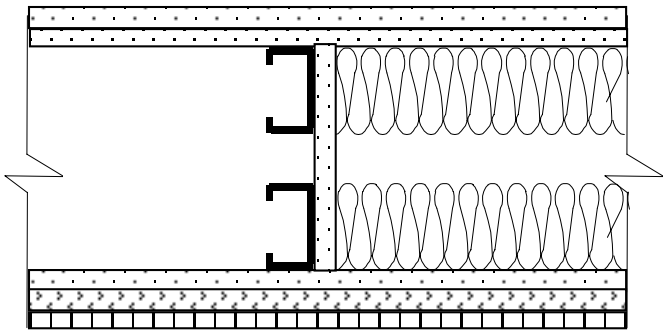
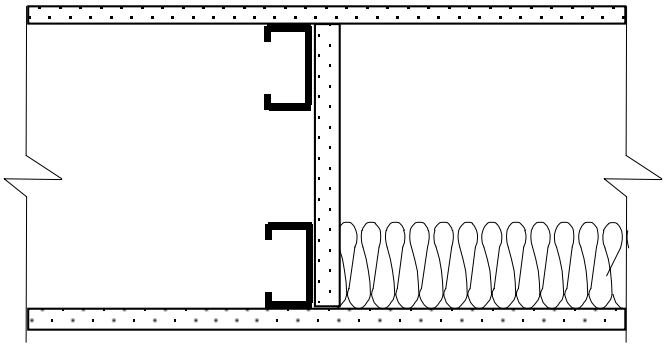
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP2963	• 162S steel studs spaced at 24" o.c. • 1-½"mineral fiber insulation • (4) layers ½" Type X gypsum wallboard on each side of studs		
		4 hr.	50 to 59
GA WP2964	• 162S steel studs spaced at 24" o.c. • 2" mineral fiber insulation batts (2.0 pcf) • (2) layers ¾" Type X gypsum wallboard on each side of studs		
		4 hr.	50 to 59
GA WP2970	• 162S steel studs spaced at 24" o.c. • 2" mineral fiber insulation batts (2.0 pcf) • (4) layers ½" Type X gypsum wallboard on each side of studs		
		4 hr.	50 to 59
GA WP5005	• double row of 162S, 33 mil steel studs spaced at 16" o.c. • 1-½" mineral fiber insulation on each side (2.0 pcf) • 5/8" Type X gypsum wallboard on one side of studs • ½" cementitous backer unit and ¼" ceramic tiles on other side of studs • cross brace 5/8"gypsum pieces, 6" wide spaced at 48" o.c. to webs of both studs		
		1 hr.	60 to 64 FSTC

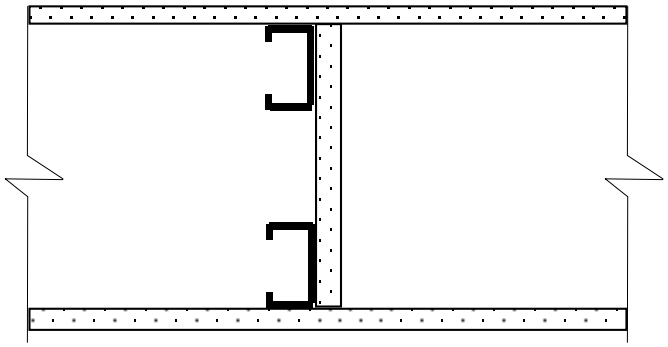
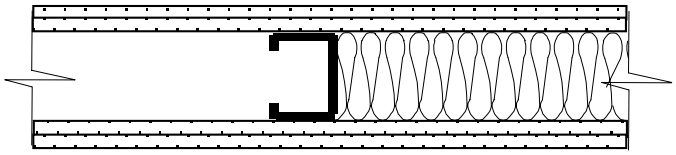
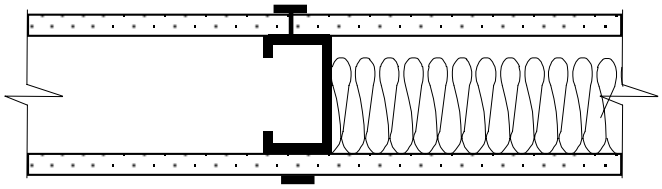
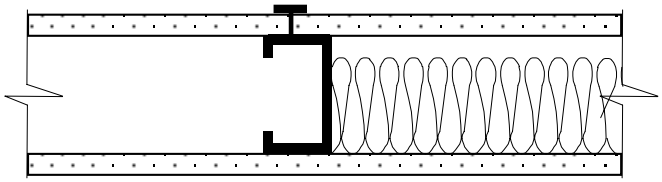
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP5015	• double row of 162S, 33 mil steel studs spaced at 16" o.c., 6¼" apart • 3½" glass fiber insulation stapled to one side cavity • 5/8" Type X gypsum wallboard on each side of wall • cross brace 5/8" gypsum pieces, 12" wide x 9½" long located at 1/3 points attached to webs of both studs	 1 hr.	50 to 54
GA WP5070	• double row of 162S, 33 mil steel studs spaced at 16" o.c., 6¼" apart • 1-½" mineral fiber insulation on each side (2.0 pcf) • (2) layers ½" Type X gypsum wallboard on one side of wall • ½" Type X gypsum wallboard base layer, ½" cementitous backer unit w/ glass fiber mesh tape, and ¼" ceramic tiles face layer on other side of wall • cross brace ½" gypsum pieces, 6" wide spaced at 48" o.c. attached to webs of both studs	 2 hr.	60 to 64
GA WP5105	• double row of 162S, 33 mil steel studs spaced at 24" o.c., 6¼" apart • 3½" glass fiber insulation stapled to one side cavity • (2) layers of 5/8" Type X gypsum wallboard on each side of wall • cross brace 5/8" gypsum pieces, 12" wide x 9½" long located at 1/3 points attached to webs of both studs	 2 hr.	55 to 59

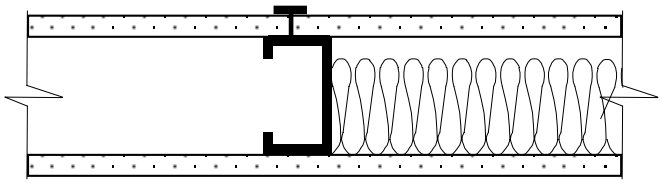
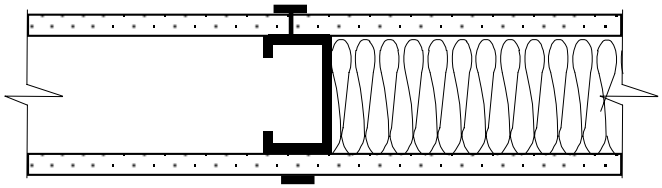
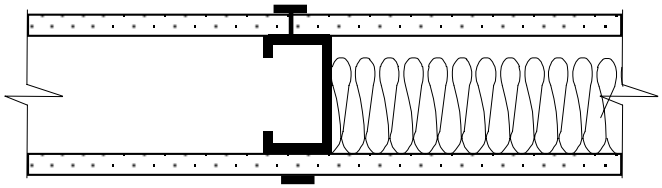
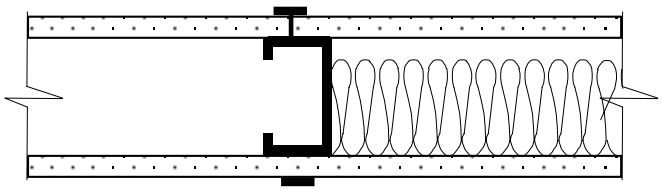
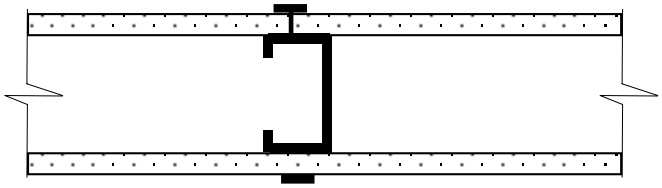
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP5130	• double row of 162S, 33 mil steel studs spaced at 24" o.c., 6¼" apart • (2) layers of 5/8" Type X gypsum wallboard on each side of wall • cross brace 5/8" gypsum pieces, 12" wide x 9½" long located at 1/3 points attached to webs of both studs		
		2 hr.	50 to 54
GA WP5910	• 162S steel studs spaced at 24" o.c. • 2¾" glass fiber insulation • base layer 3/8" gypsum wallboard on each side of studs • face layer ½" gypsum wallboard on each side of studs		
		1 hr.	50 to 54
GA WP6010	• 250S steel studs spaced at 24" o.c. • 2" mineral fiber insulation (3.0 pcf) • ½" Type X gypsum wallboard on each side of studs • Aluminum battens snapped over 7/8" wide, 25 gauge galvanized steel track at vertical joints		
		1 hr.	45 to 49
GA WP6020	• 250S steel studs spaced at 24" o.c. • 2" mineral fiber insulation (3.7 pcf) • ½" Type X gypsum wallboard on each side of studs • Aluminum battens snapped over 7/8" wide, 25 gauge galvanized steel track at vertical joints		
		1 hr.	45 to 49

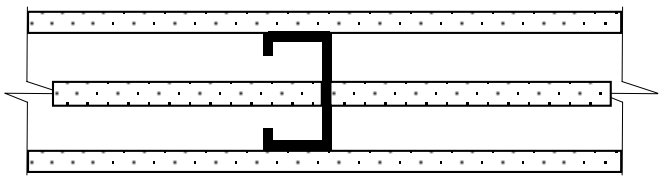
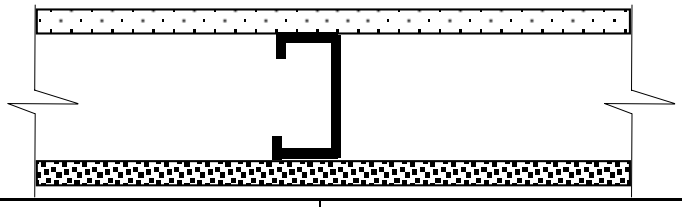
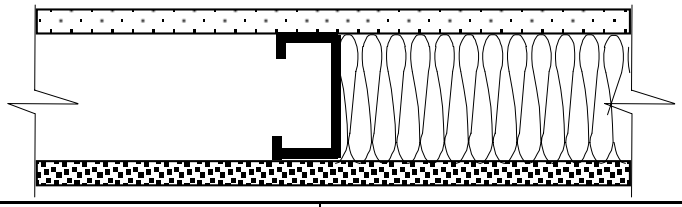
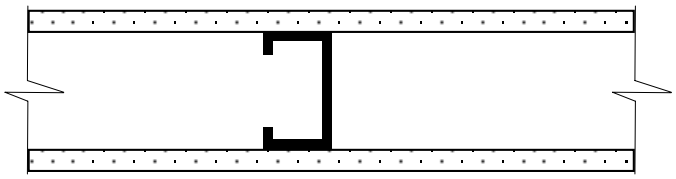
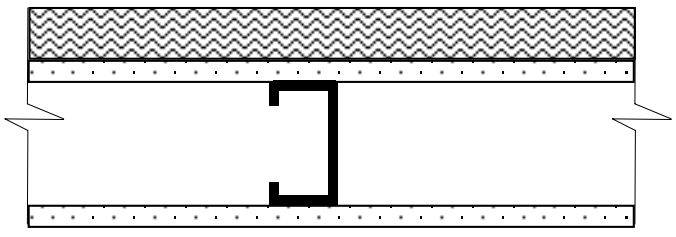
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP6025	• 250S steel studs spaced at 24" o.c. • 2" mineral fiber insulation (3.8 pcf) • ½" Type X gypsum wallboard on each side of studs • 3½" Aluminum base along bottom edge		
		1 hr.	45 to 49
GA WP6040	• 250S steel studs spaced at 24" o.c. • 3" glass fiber insulation • ½" Type X gypsum wallboard on each side of studs • 3½" Aluminum base along bottom edge		
		1 hr.	45 to 49
GA WP6130	• 250S steel studs spaced at 30" o.c. • 2" glass fiber insulation • (1) layer 30", 5/8" Type X gypsum wallboard on each side of studs • Aluminum battens snapped over steel batten retainer strips at each stud and ceiling runner		
		1 hr.	40 to 44
GA WP6135	• 250S steel studs spaced at 24" o.c. • 2" mineral fiber insulation (2.63 pcf) • (1) layer ½" Type X gypsum wallboard on each side of studs • Aluminum battens attached over each stud		
		1 hr.	40 to 44
GA WP6250	• 250S steel studs spaced at 24" o.c. • (1) layer 5/8" Type X gypsum wallboard on each side of studs • Aluminum battens attached over each stud		
		1 hr.	35 to 39

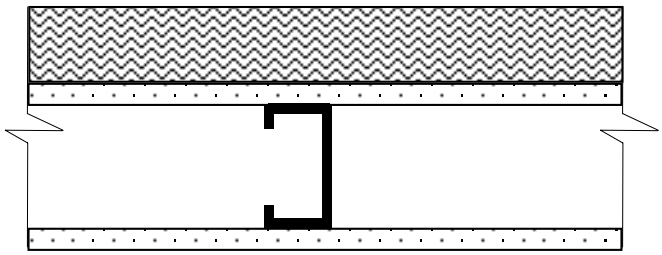
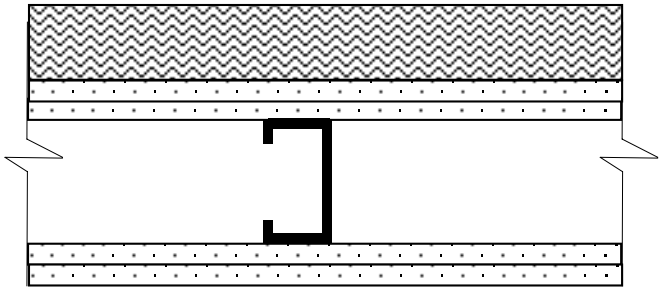
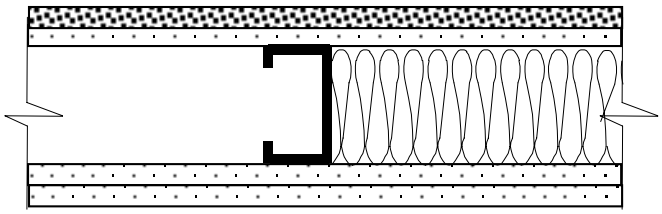
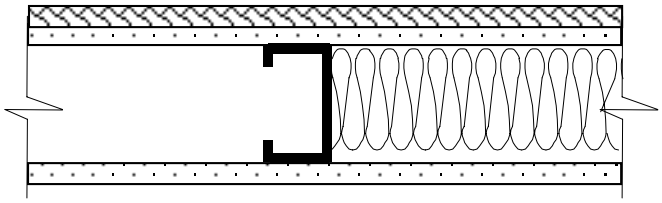
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP6254	• 250S steel studs spaced at 24" o.c. • (1) layer ½" Type X gypsum wallboard on each side of studs • ½" Type X gypsum piece placed between studs in cavity		
		1 hr.	35 to 39
GA WP8003	• 362S, 33 studs @ 24" o.c • exterior side: (1) layer ½" Type X gypsum board and (1) face layer of ¼" fiber cement board • interior side: (1) ½" Type X gypsum board		
		1 hr.	—
GA WP8004	• 362S, 33 studs @ 16" o.c • (1) layer of 7/16" fiber cement board on exterior side • 3 ½" mineral fiber insulation (3.0 pcf) • (1) 5/8" Type X gypsum board on interior side		
		1 hr.	—
GA WP8005	• 362S, 33 studs @ 24" o.c • (1) layer of 5/8" Type X glass mat gypsum substrate • (1) 5/8" Type X glass mat gypsum substrate, glass-mat water resistant gypsum backing board, gypsum wallboard, water resistant gypsum backing board, or gypsum veneer base on interior side		
		1 hr.	—
GA WP8122	• 362S, 43 studs @ 16" o.c • interior side: (1) layer ⅝" Type X gypsum board • exterior side: base layer of ⅝" Type X gypsum board and face layer of 2" expanded polystyrene		
		1 hr.	—

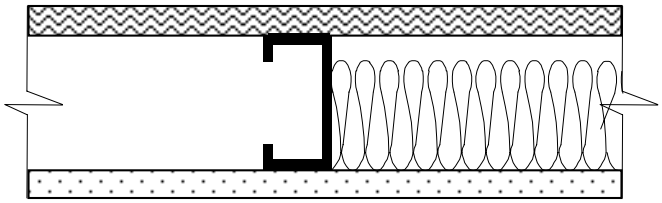
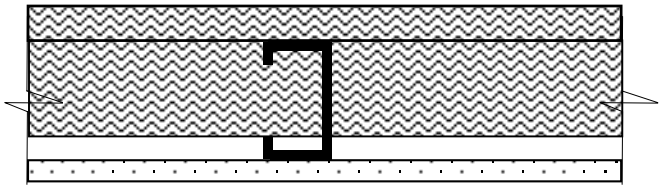
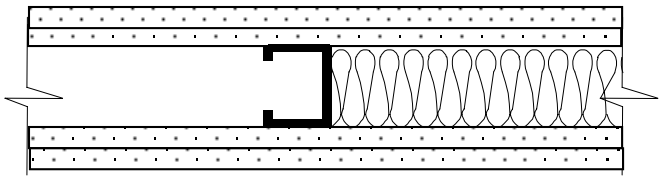
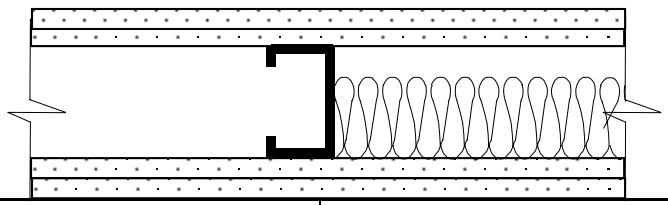
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP8123	• 362S, 43 studs @ 16" o.c • interior side: (1) layer ⅝" Type X gypsum board • exterior side: base layer of ⅝" Type X gypsum board and face layer of 4" expanded polystyrene	 2 hr.	—
GA WP8202	• 350S, 43 steel studs spaced at 24" o.c • interior side: (2) layers ⅝" Type X gypsum board • exterior side: (2) layers ⅝" Type X gypsum board and 4" expanded polystyrene	 2 hr.	—
GA WP8205	• 362S, 33 steel studs spaced at 24" o.c • 3" mineral fiber insulation • base layer of ½" Type X gypsum board on each side • face layer of ½" cementitous board on one side • face layer of ½" cementitous board or ½" Type X gypsum board on other side	 2 hr.	—
GA WP8250	• 362S, 33 studs @ 16" o.c • 3" mineral fiber insulation (2.0 pcf) • ½" gypsum sheathing, 3.4 lb. self-furring metal lath and 1" Portland cement-lime stucco over lath on exterior side • 5/8" foil backed Type X gypsum wallboard or gypsum veneer on interior side	 2 hr.	—

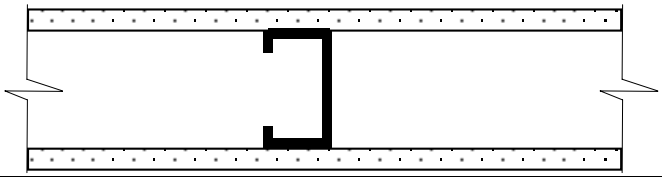
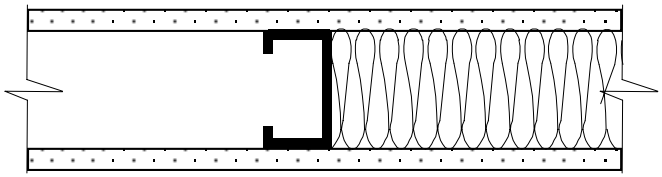
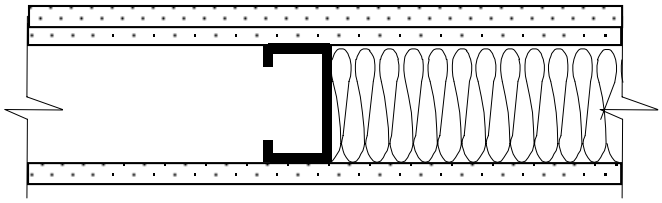
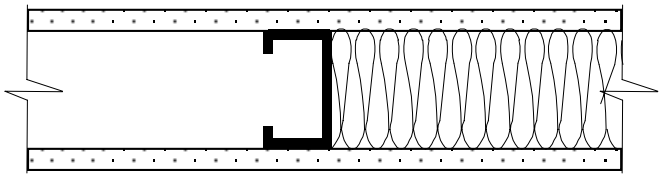
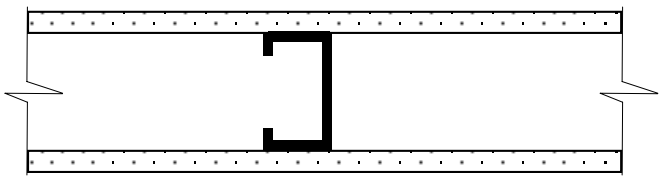
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP8310	• 400S studs @ 16" o.c. • ¾" channel bridging at third points • 2 mil polyethylene vapor retarder on interior side • 3" mineral fiber insulation (3.86 pcf) • 1" 1:2 gypsum-sand plaster over 3.4 lb. metal; lath wire attached to studs with resilient clips on interior side • 1" portland cement-lime plaster over 3.4 lb. galvanized metal lath wire tied with 43 mil steel wire		
		2 hr.	—
GA WP8325	• 362S-33 mil steel studs spaced at 16" o.c. • exterior side: 1½" x 17 gage galvanized woven wire self-furring paper back lath and 1" 6:1:1 perlite portland cement-lime plaster over lath • interior side: 5/8" Type X gypsum wallboard veneer, 3¼" 6:1:1 perlite-portland cement-lime back plaster spray applied in stud cavity		
		2hr.	—
GA ASW 1100	• 162S steel studs spaced at 24" o.c. • (2) layers ½" Type X gypsum wallboard or gypsum veneer on each side of stud • 1½" mineral fiber insulation in cavity		
		2 hr.	50 to 54
GA ASW 1105	• 250S steel studs spaced at 24" o.c. • (2) layers ½" Type X gypsum wallboard or gypsum veneer on each side of stud • 1½" mineral fiber insulation in cavity		
		2 hr.	50 to 54

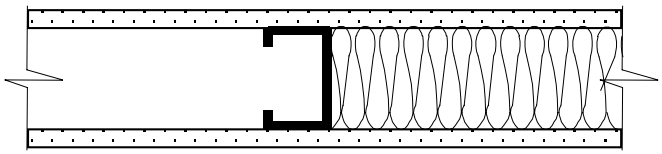
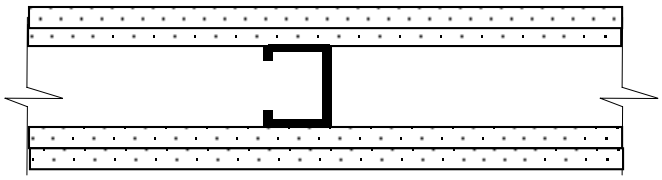
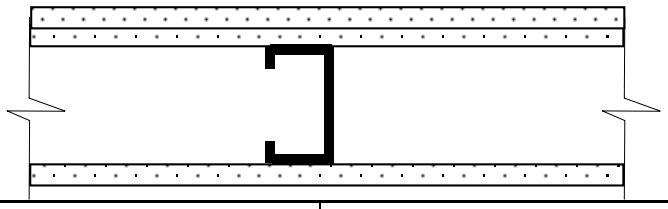
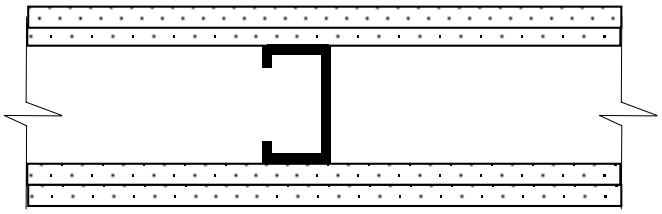
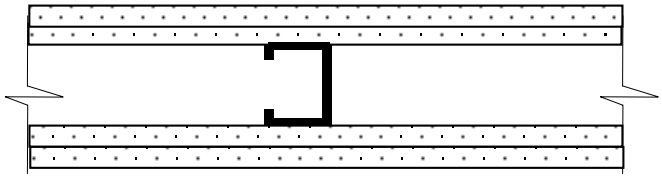
(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Non-Load Bearing Walls (Factory Mutual)

Source	Description	Fire Resistance Rating	Sound Transmission Class
FM Wall 1 1 HR	• 362S137-27 steel studs spaced at 24" o.c. • (1) layer 5/8"gypsum wallboard on each side of stud	 1 hr.	—
FM Wall 2 1 HR	• 250S137-27 steel studs spaced at 24" o.c. • 2" thick, 24" wide batts, 2½ lb/ft density mineral wool insulation • (1) layer ½" wallboard on each side of stud	 1 hr.	—
FM Wall 3 1 HR	• 250S137-22 steel studs spaced at 24" o.c. • 2" thick, 24" wide batts, 2½ lb/ft density mineral wool insulation • (1) layer ½" paper or vinyl-faced wallboard on one side of studs • (2) layers ½" paper or vinyl-faced wallboard on the other side	 1 hr.	—
FM Wall 6 1 HR	• 250S137-22 steel studs spaced at 24" o.c. • 2" thick, 24" wide batts, 3 lb/ft density mineral wool insulation • (1) layer ½" wallboard on each side of stud	 1 hr.	—
FM Wall 7 1 HR	• 250S137-22 steel studs spaced at 24" or 30" o.c. • (1) layer 5/8" paper or vinyl-faced wallboard on each side of stud • 2½" extruded aluminum snap-on base trim	 1 hr.	—

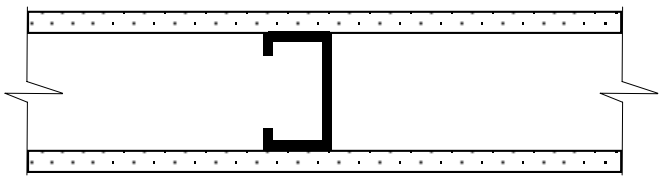
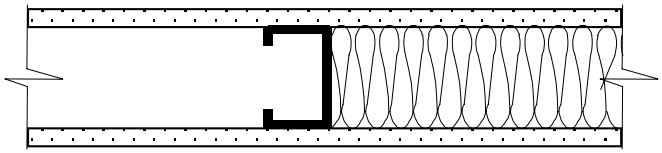
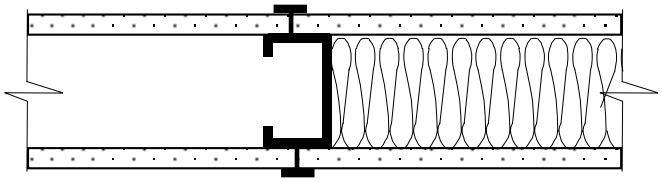
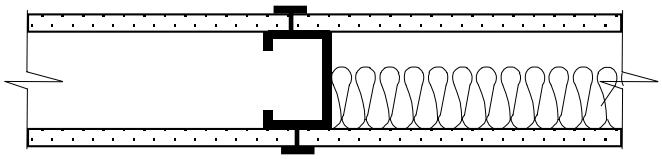
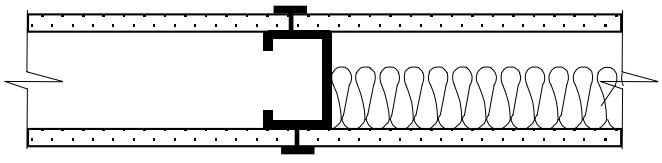
(Not complete construction details; consult original source for detailed information. FM – Factory Mutual)

Non-Load Bearing Walls (Factory Mutual)

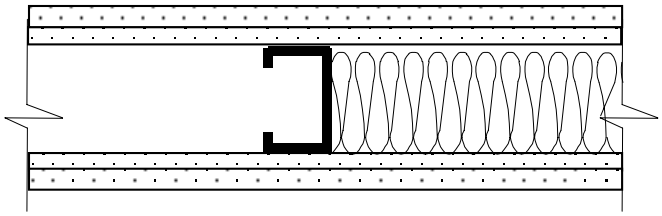
Source	Description	Fire Resistance Rating	Sound Transmission Class
FM Wall 8 1 HR	• 250S137-22 steel studs spaced at 24" o.c. • 2" thick, 24" wide batts, 3.7 lb/ft density mineral wool insulation • (1) layer ½" paper or vinyl-faced wallboard on each side of stud • 2½" extruded aluminum snap-on base trim	 1 hr.	—
FM Wall 11 1 HR	• 250S137-22 steel studs spaced at 24" o.c. • (1) base layer ¼" regular gypsum wallboard on each side of stud • (1) face layer of ½" paper or vinyl-faced wallboard on each side of stud	 1 hr.	—
FM Wall 1 1 ½ HR	• 362S137-22 steel studs spaced at 24" o.c. • (1) layer 5/8" wallboard on one side of studs • (2) layers 5/8" wallboard on the other side	 1 hr.	—
FM Wall 7 2 HR	• 362S137-22 steel studs spaced at 24" o.c. • (2) layers 5/8" wallboard on each side of stud	 2 hr.	—
FM Wall 14 2 HR	• 250S137-22 steel studs spaced at 24" o.c. • (2) layers ½" wallboard on each side of stud	 1 hr.	—

(Not complete construction details; consult original source for detailed information. FM – Factory Mutual)

Non-Load Bearing Walls (Factory Mutual)

Source	Description	Fire Resistance Rating	Sound Transmission Class
FM WP 45	• 362S steel studs spaced at 24" o.c. • 5/8" layer Type X gypsum wallboard or gypsum veneer on each side of studs	 1 hr.	42
FM WP 51	• 250S steel studs spaced at 24" o.c. • 2" glass fiber insulation (2.5 pcf) • (1) layer ½" gypsum wallboard on each side of studs	 1 hr.	45
FM WP 96	• 250S steel studs spaced at 24" o.c. • 2" mineral wool insulation in cavity (3 pcf) • (1) layer ½" gypsum wallboard on each side of studs • Aluminum battens snapped over steel batten retainer strips at each stud and ceiling runner • ½" vinyl inserts in batten	 1 hr.	47
FM WP 109	• 250S steel studs spaced at 30" o.c. • 2" glass fiber insulation • (1) layer 5/8" gypsum wallboard on each side of studs • aluminum battens snapped over steel batten retainer strips at each stud and ceiling runner	 1 hr.	44
FM WP 110	• 250S steel studs spaced at 24" o.c. • 2" mineral fiber insulation (3.7 pcf) • ½" Type gypsum wallboard on each side of studs • Aluminum battens snapped over 7/8" wide, 25 gauge galvanized steel track at vertical joints	 1 hr.	41

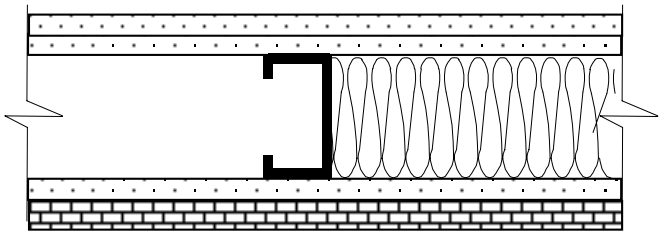
Non-Load Bearing Walls (Factory Mutual)

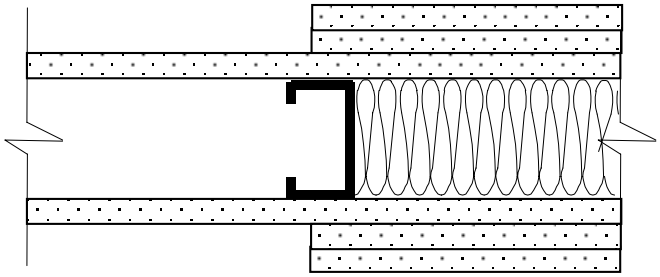
Source	Description	Fire Resistance Rating	Sound Transmission Class
FM WP 152	• 250S steel studs spaced at 24" o.c. • 2" glass fiber insulation in cavity • Face layer ½" gypsum wallboard on each side • Base layer ¼" gypsum wallboard on each side		
		1 hr.	53

(Not complete construction details; consult original source for detailed information. FM – Factory Mutual)

2.2 Load Bearing Walls

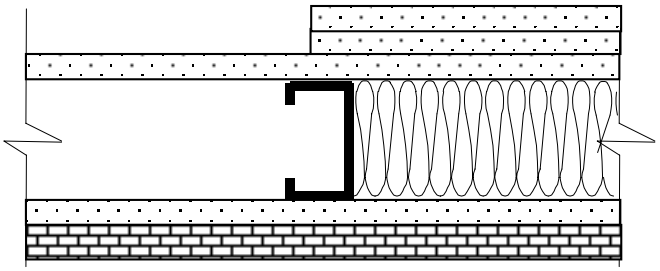
Load Bearing Walls (Underwriters Laboratories)

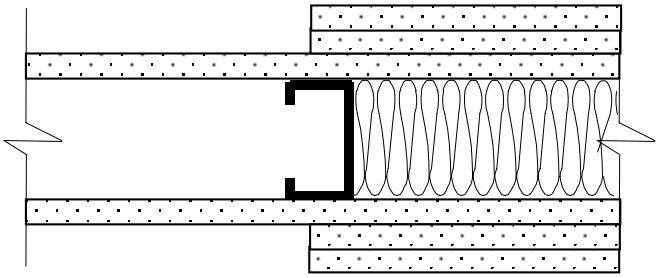
<table>
<tr><th>Source</th><th>Description</th><th colspan="3">Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="2">UL
U418</td><td rowspan="2">• 350S150-43 or 550S150-43 mil steel studs @ 24" o.c.
• 2"x43 mil flat strap attached to both sides of stud at one third point
• 3 ½" glass fiber batts, 2' wide between studs
• gypsum board on fire (interior) side (rating listed for thickness and number of layers of gypsum board applied)
• (1) layer of ½" gypsum on exterior side
• exterior facing: aluminum siding, steel siding, brick veneer, or stucco</td><td colspan="3">  </td><td rowspan="2"></td></tr>
<tr><td colspan="3"><table><tr><th>Rating</th><th>No. & Thickness of Layers</th></tr><tr><td>45 min.</td><td>(1) 5/8"</td></tr><tr><td>1 hr.</td><td>(2) 1/2"</td></tr><tr><td>2 hr.</td><td>(3) ½"</td></tr></table></td></tr>
<tr><td rowspan="2">UL
U423</td><td rowspan="2">• 350S162-33 steel studs spaced at 24" o.c.
• optional glass fiber or mineral wool insulation
• gypsum board on each side (rating listed for thickness and number of layers of gypsum board applied)
• exterior facing: aluminum siding, steel siding, brick veneer, stucco, or mineral and fiberboard

* 80% of design load
** 2" mineral wool batts insulation required</td><td colspan="3">  </td><td rowspan="2">—</td></tr>
<tr><td colspan="3"><table><tr><th>No. of Layers</th><th>Thick. of Layers</th><th>Rating</th></tr><tr><td>1</td><td>½"</td><td>45 min</td></tr><tr><td>1</td><td>5/8"</td><td>1 hr.</td></tr><tr><td>2</td><td>½"</td><td>1½ hr.</td></tr><tr><td>2</td><td>5/8"</td><td>2 hr. *</td></tr><tr><td>2</td><td>5/8"</td><td>2 hr. **</td></tr><tr><td>3</td><td>½"</td><td>2 hr.</td></tr><tr><td>2</td><td>¾"</td><td>2 hr.</td></tr></table></td></tr>
</table>

(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)

Load Bearing Walls (Underwriters Laboratories)

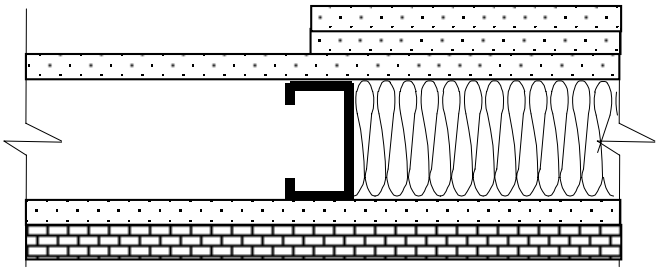
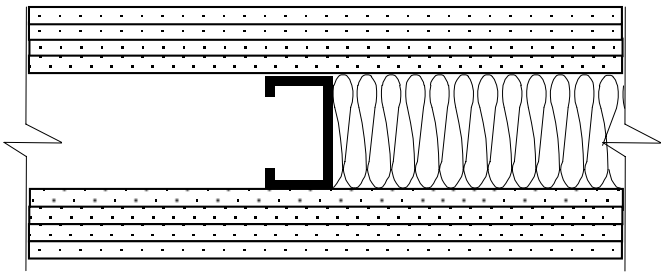
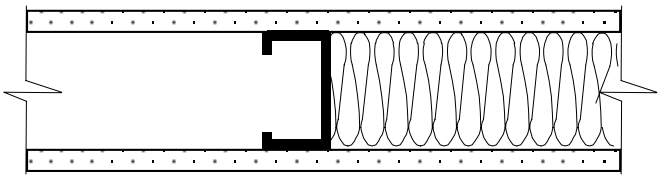
<table>
<tr><th>Source</th><th>Description</th><th colspan="3">Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="2">UL
U424</td><td rowspan="2">• 350S, 33 mil steel studs spaced at 24” o.c. (16” o.c. when cementitous backer unit is used
• optional glass fiber or mineral wool insulation
• optional steel resilient channels spaced at 24” o.c.
• (1) layer of ½” or 5/8” gypsum board on exterior side
• gypsum board on interior (fire side) side (rating listed for thickness and number of layers of gypsum board applied)
• exterior facing: aluminum siding, steel siding, brick veneer, or stucco; ½” or 5/8” cementitous backer unit; EPS foamed plastic board; NOTE: Exposed to fire on interior side only</td><td colspan="3">  </td><td></td></tr>
<tr><td><table><tr><th>No. of Layers</th><th>Thick. of Layers</th><th>Rating</th></tr><tr><td>1</td><td>5/8”</td><td>45 min</td></tr><tr><td>2</td><td>½”</td><td>1 hr.</td></tr><tr><td>2</td><td>5/8”</td><td>1½ hr.</td></tr><tr><td>3</td><td>½”</td><td>2 hr.</td></tr><tr><td>2</td><td>¾”</td><td>2 hr.</td></tr></table></td><td>—</td></tr>
<tr><td rowspan="2">UL
U425
(Interior Walls)</td><td rowspan="2">• 350S, 33 mil steel studs spaced at 24” o.c. (16” o.c. when cementitous backer unit is used
• optional glass fiber or mineral wool insulation
• gypsum board on each side (rating listed for thickness and number of layers of gypsum board applied)

* 80% of design load</td><td colspan="3">  </td><td></td></tr>
<tr><td><table><tr><th>No. of Layers</th><th>Thick. of Layers</th><th>Rating</th></tr><tr><td>1</td><td>½”</td><td>45 min</td></tr><tr><td>1</td><td>5/8”</td><td>1 hr.</td></tr><tr><td>2</td><td>½”</td><td>1½ hr.</td></tr><tr><td>2</td><td>5/8”</td><td>2 hr. *</td></tr><tr><td>3</td><td>½”</td><td>2 hr.</td></tr><tr><td>2</td><td>¾”</td><td>2 hr.</td></tr></table></td><td>—</td></tr>
</table>

(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)

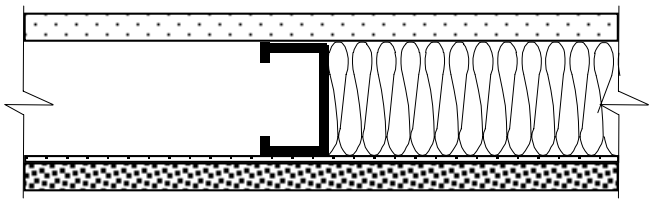
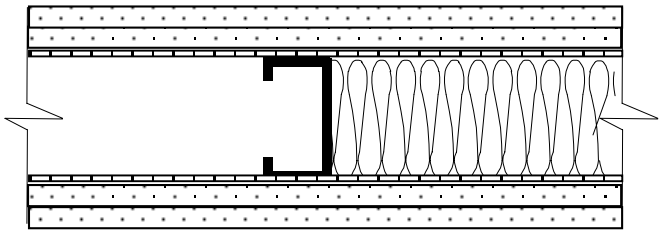
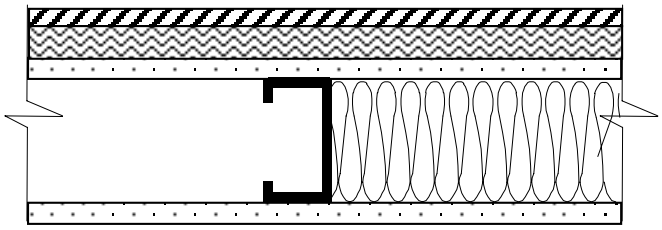
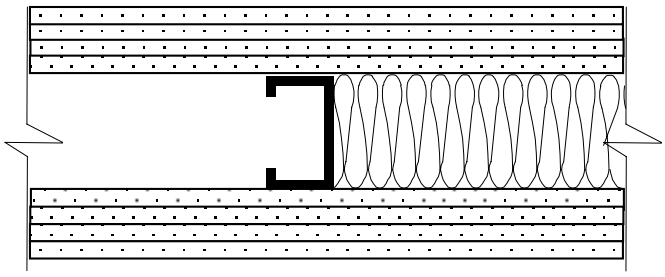
Load Bearing Walls (Underwriters Laboratories)

<table>
<tr><th>Source</th><th>Description</th><th colspan="3">Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="3">UL
425
(Exterior Walls)</td><td rowspan="3">• 350S, 33 mil steel studs spaced at 24" o.c. (16" o.c. when cementitous backer unit is used
• glass fiber or mineral wool batt insulation
• optional steel resilient channels spaced at 24" o.c.
• (1) layer of ½" or 5/8" gypsum board on exterior side with Brick/Stucco, ½" or 5/8" cementitious backer unit, or mineral fiber board
• gypsum board on interior side (rating listed for thickness and number of layers of gypsum board applied)

NOTE: Exposed to fire on interior side only</td><td colspan="3">  </td><td></td></tr>
<tr><td>No. of Layers</td><td>Thick. of Layers</td><td>Rating</td><td rowspan="2">—</td></tr>
<tr><td>1
2
2
3
2</td><td>5/8"
½"
5/8"
½"
¾"</td><td>45 min
1 hr.
1½ hr.
2 hr.
2 hr.</td></tr>
<tr><td>UL
U426</td><td>• 350S, 33 mil steel studs @ 24" o.c.
• optional mineral wool or spray applied cellulose insulation
• (4) layers of ½" gypsum wallboard on each side of studs</td><td colspan="3">  </td><td></td></tr>
<tr><td></td><td colspan="3">3 hr.</td><td>—</td></tr>
<tr><td>UL
U432</td><td>• 350S, 33 mil steel studs @ 24" o.c.
• optional glass fiber or mineral wool insulation
• (1) layer of 5/8" gypsum wallboard on each side of studs</td><td colspan="3">  </td><td></td></tr>
<tr><td></td><td colspan="3">1 hr.</td><td>—</td></tr>
</table>

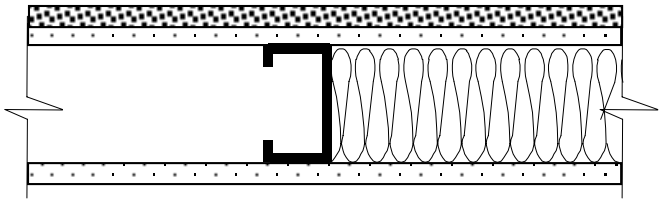
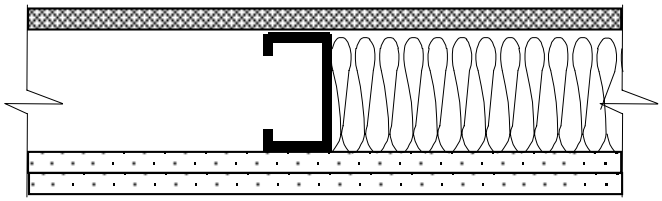
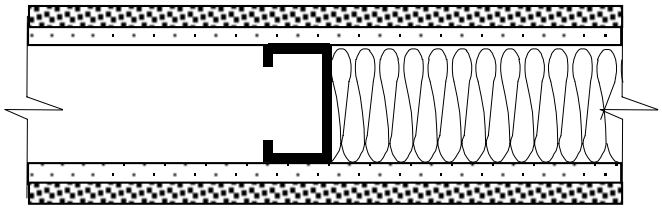
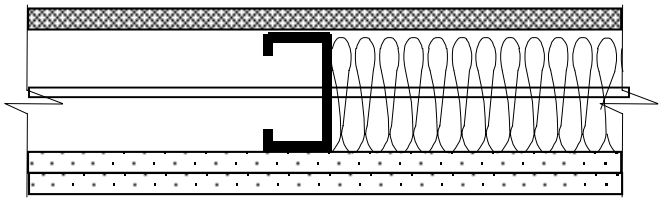
(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)

Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U434	• 350S, 33 mil steel studs spaced @ 24" o.c. • optional glass fiber or mineral wool insulation • (1) layer of 5/8" gypsum wallboard on one side • 7/8" portland cement plaster over diamond mesh metal lath on other side	 1 hr.	—
UL U440	• 350S, 33 mil steel studs spaced @ 24" o.c. • optional steel resilient channels spaced at 24" o.c. • optional mineral wool insulation • (2) layers of ½" gypsum wallboard on each side of studs	 1 hr.	—
UL U460	• 350S, 33 mil steel studs spaced @ 24" o.c. • 3½" mineral wool insulation • (1) layer of 5/8" gypsum wallboard on interior isde • 5/8" gypsum sheathing, 1" rigid polystyrene or polyisocyanurate insulation, and ½"plywood sheathing on exterior side	 1 hr.	—
UL U462	• 350S, 33 milsteel studs spaced @ 24" o.c. • optional mineral wool insulation • (4) layer of ½" gypsum wallboard on each side of studs	 3 hr.	—

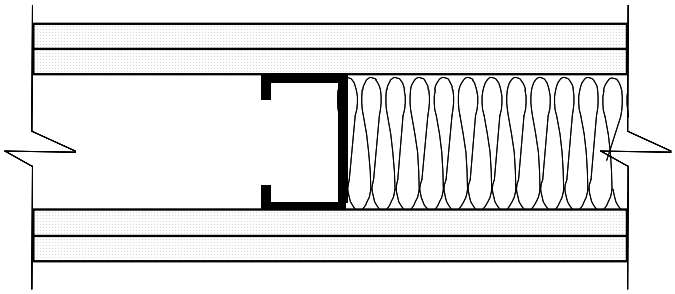
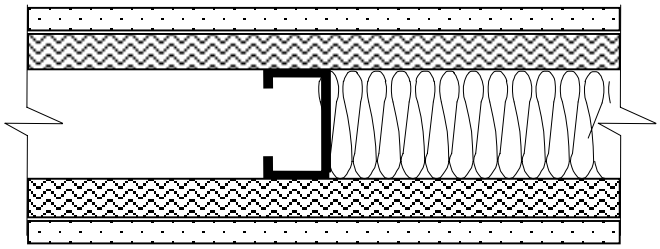
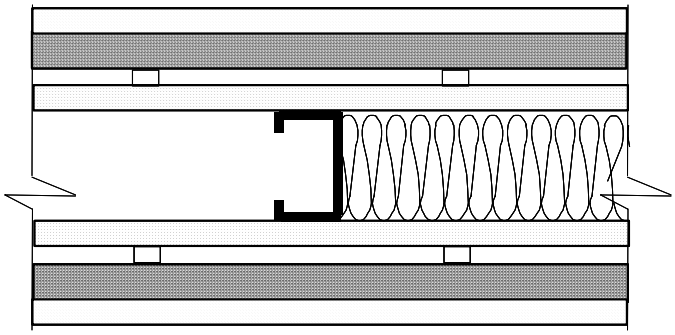
(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)

Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U473	• 350S, 33 mil steel studs spaced @ 16" o.c. • 3" thick cavity insulation • (1) layer of 5/8" gypsum wallboard on one side • (1) layer of 5/8" gypsum wallboard and (1) layer of ½" or 5/8" cementitous board on other side	 1 hr.	—
UL U477	• 362S162-33 steel studs spaced @ 24" o.c. • top & bottom tracks 362T162-33 • nominal 2"x 43 mil diagonal strap bracing, welded to each stud • nominal 3½" mineral wool insulation, min density 6 pcf • (2) layers of 5/8" gypsum wallboard on one side • min. 15 mm mineral and fiber board on other side	 2 hr.	—
UL U485	• 350S, 33 mil steel studs spaced @ 16" o.c., top and bottom tracks 33 mil min. thickness • 3" min. cavity insulation • nominal ½" or 5/8" cementitous backer unit on each side of stud • (1) layer of 5/8" gypsum wallboard (outer layer) on each side of studs	 2 hr.	—
UL U487	• 362S162-33 steel studs spaced @ 24" o.c. • top & bottom tracks 362T162-33, max. stud height is 10' • 150U056-54 bracing through cutout with clip angles • 3" mineral wool insulation, 6 pcf density • (2) layers of 5/8" gypsum wallboard on one side of studs • 17 mm thick mineral and fiber board on other side	 1 hr.	—

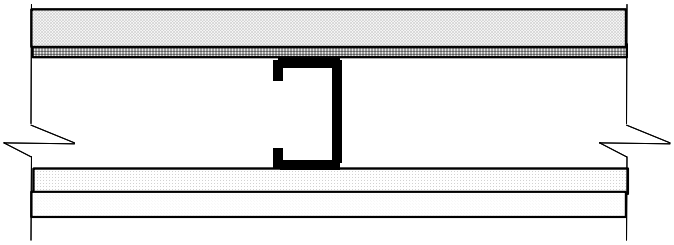
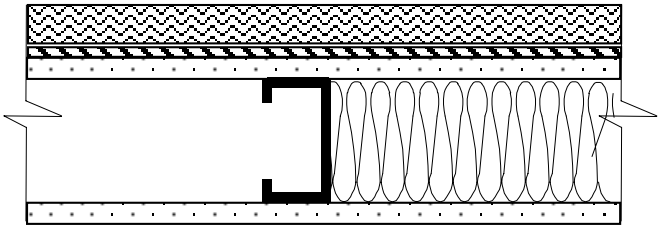
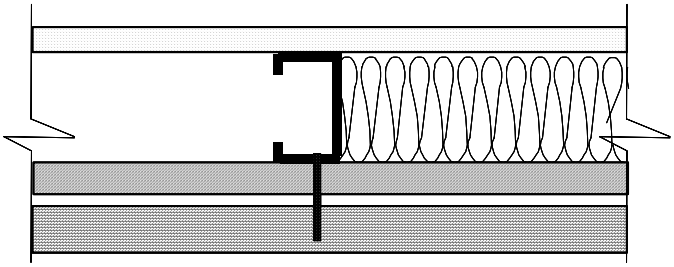
(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)

Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U490	• 350S162-33 steel studs spaced at 24" o.c. • 3" mineral wool insulation for 3 hr. rating • 3" mineral wool insulation for 4 hr. rating (min. 4.0 pcf) • (2) layers ¾" gypsum board on each side of stud		
		3 hr. / 4 hr.	—
UL U530	• 362S175-33 steel studs spaced @ 24" o.c., top and bottom tracks 362T175-33 • nominal 2"x 54 mil diagonal strap bracing, welded to each stud • min. 1-7/32" thick mineral and fiber board on each side of stud • diamond mesh metal lath on each side • spray applied fire resistive materials, base coat min. thickness ½", finish coat 1/8" min. on each side		
		4 hr.	—
UL V415	• 562S162-33 mil steel studs spaced at 16" o.c. • 3-1/2" mineral wool insulation • inner layer ⅝" Type X gypsum board on each side of studs • 1½" x 33 mil furring channels spaced at 24" o.c. • 2" thick structural cement fiber board attached to furring channels, on each side of studs • outer layer 5/8" thick Type X gypsum wallboard attached to cement board, on each side of studs		
		2 hr.	—

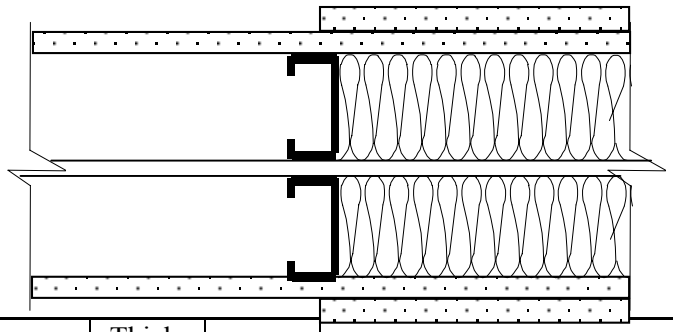
(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)

Load Bearing Walls (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL V420	• 350S, 33 mil steel studs spaced at 24" o.c. • (2) layers 5/8" gypsum wallboard on one side of the studs • min. 3" thick precast autoclaved aerated concrete attached to 7/8" deep, 25 gauge furring channels spaced at 24" o.c. on the other side of the studs	 2 hr.	—
UL V432	• 350S, 33 mil steel studs spaced at 24" o.c. • glass fiber or mineral wool insulation • (1) layers 5/8" gypsum wallboard on each side of the studs • optional 7/16" wood structural panel sheathing on one side • exterior facings: aluminum, steel or vinyl siding attached over wood sheathing; brick veneer, particleboard siding; wood structural panel or lap siding; exterior insulation and finish system (nominal 1" foam plastics insulation)	 1 hr.	—
UL V434	• 33 mil steel studs spaced at 24" o.c. • 3-1/2" Kraft paper, foil or unfaced fiber glass cavity insulation, min. density 0.5 pcf or faced or unfaced 3 ½" thick mineral wool batts • (1) layer ⅝" gypsum board on one side • (1) layer 2" (max. thickness) foam plastic board and 4" brick veneer, min. 2" gap between brick and foam board on other side of studs	 1 hr.	—

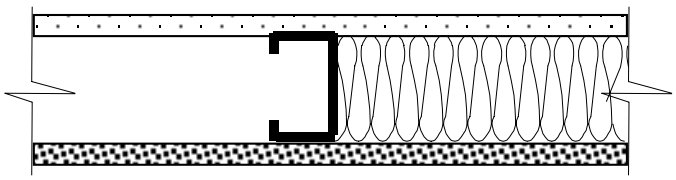
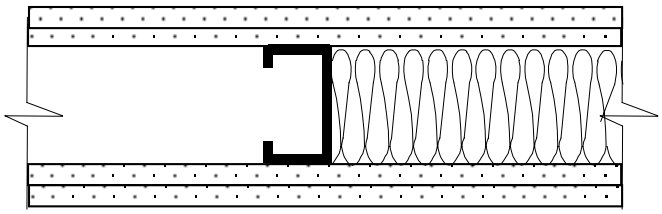
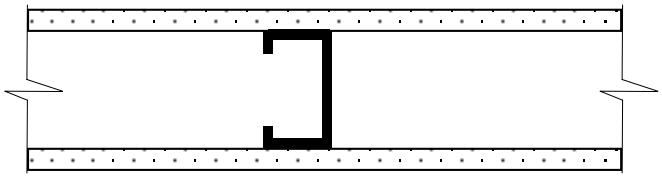
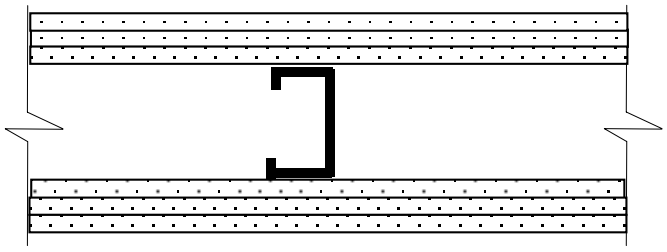
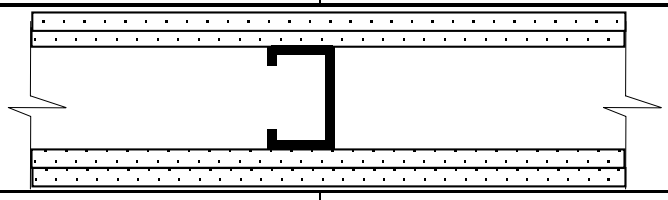
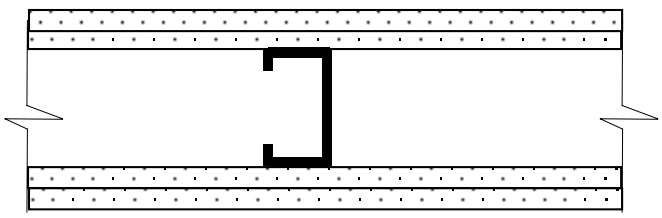
(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)

Load Bearing Walls (Underwriters Laboratories)

<table>
<tr><th>Source</th><th>Description</th><th colspan="3">Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td rowspan="4">UL
V446</td><td rowspan="4">• double 350S162-33 steel studs spaced @ 24” o.c., 2” apart
• glass fiber insulation with UL Classification Marking (min. o.5 pcf)
• (1) layer of 5/8” Type X gypsum wall board for 1 hr rating (80% design load)
• (2) layers of 5/8” Type X gypsum wall board for 2 hr rating (100% design load)
• 1½”x 33 mil steel strap bracing at mid-height of studs, on interior flanges
* 80% design load</td><td colspan="3">  </td><td></td></tr>
<tr><td>No. of Layers</td><td>Thick. of Layers</td><td>Rating</td><td>STC [1]</td></tr>
<tr><td>1</td><td>5/8”</td><td>1 hr. *</td><td>51</td></tr>
<tr><td>2</td><td>5/8”</td><td>2 hr.</td><td>59</td></tr>
</table>

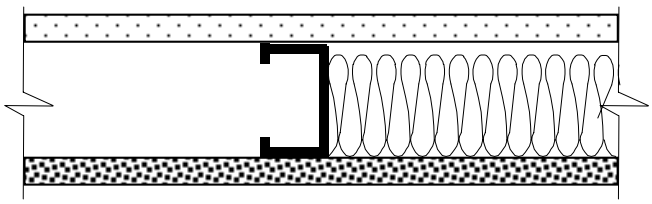
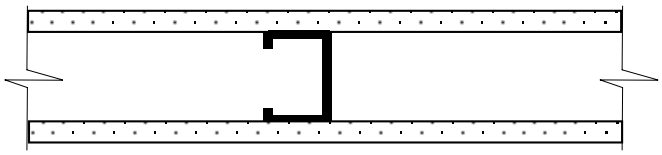
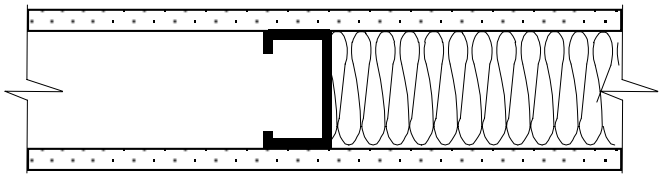
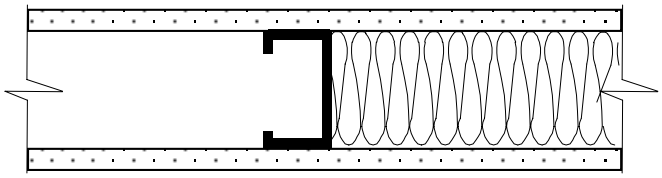
(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)
[1] Reference NGC Report No. 2003006

Load Bearing Walls (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1035	• 350S, 33 mil studs @ 16" o.c. • 3" mineral fiber insulation • (1) layer of 5/8" Type X gypsum wallboard on one side • (1) layer ½" cementitous board on other side	 1 hr.	—
GA WP1204	• 350S, 33 mil studs @ 16" o.c. • Base layer ½" Type X gypsum wallboard on each side of studs • Face layer ½" Type X gypsum wallboard on each side of studs • 1"x 43 mil strap bracing or channel bracing at 40" o.c. to each side of stud	 1 hr.	40 to 44
GA WP1206	• 350S, 33 mil studs @ 16" o.c. • (1) layer of 5/8" Type X gypsum wallboard on each side of studs • 1"x 43 mil strap bracing at 40" o.c. to each side of stud	 1 hr.	40 to 44
GA WP1635	• 350S, 33 mil steel studs spaced at 16" o.c. • (3) layers of ½" Type X gypsum wallboard on each side of studs • 1"x 43 mil strap bracing at 40" o.c. to each side of stud	 2 hr.	45 to 49
GA WP1714	• 250S, 43 mil steel studs spaced at 16" o.c • (2) layers 5/8" Type X gypsum wallboard on each side of studs • ¾" cold rolled channel @ 1/3 points	 2 hr.	40 to 44
GA WP1716	• 350S, 33 mil steel studs spaced at 16" o.c • (2) layers 5/8" Type X gypsum wallboard on each side of studs • 1"x 43 mil strap bracing at 40" o.c. to each side of stud • rated at 80 percent of design load	 2 hr.	40 to 44

(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

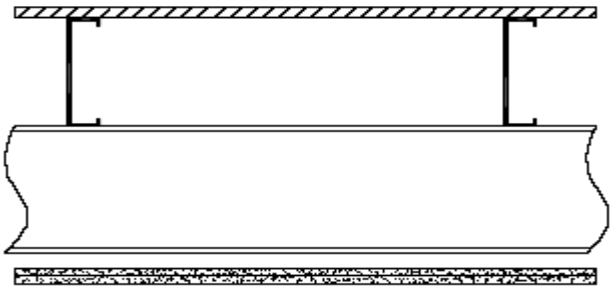
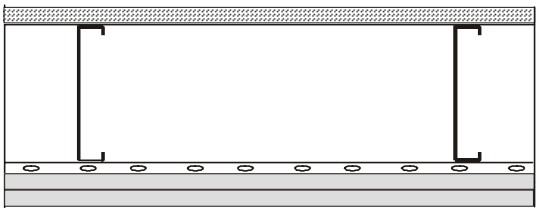
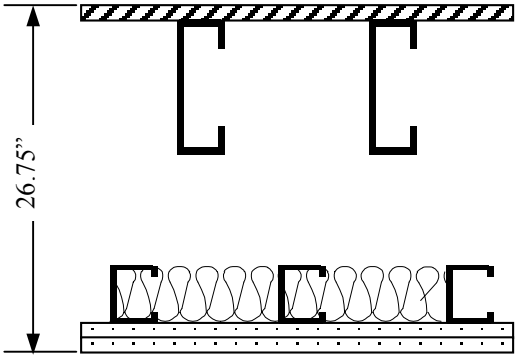
Load Bearing Walls

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP8002	• 362S, 33 studs @ 24” o.c. • exterior side: ½” cementitous backer unit • 3” mineral fiber insulation • interior side: (1) layer 5/8” Type X gypsum board • lateral support for studs	 1 hr.	—
FM Wall 1 2 HR	• 250S137-43 studs @ 16” o.c. • studs welded to tracks • ¾”x1/2” leg, 54 mil bridging channels fastened to studs at 1/3 point on each side of wall • (2) layers 5/8” gypsum board on each side of studs	 2 hr.	—
Johns Manville	• 362S steel studs @ 16” o.c. • 2” fiber glass insulation (0.75 pcf) • (1) layer ½” gypsum board on each side of studs	 —	46
Johns Manville	• 362S steel studs @ 16” o.c. • 2” rock wool insulation (2.0 pcf) • (1) layer ½” gypsum board on each side of studs	 —	45

(Not complete construction details; consult original source for detailed information. GA – Gypsum Association; FM – Factory Mutual)

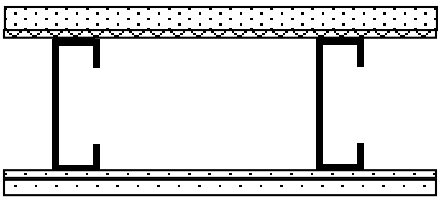
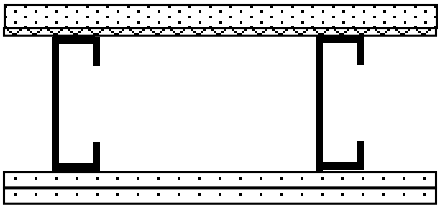
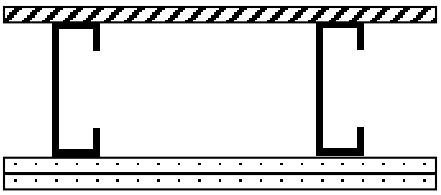
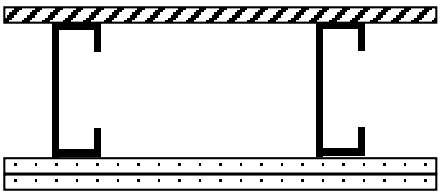
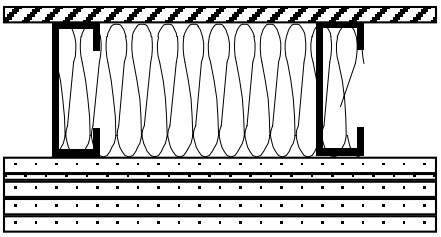
2.3 Floor Assemblies

Floor Assemblies (Underwriters Laboratories)

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL L524	• W8x15 (min.) steel beam • 19/32" T&G plywood floor • 700S162-43 joists @ 24" o.c. with stiffeners at all bearing locations • (2) layers of ½" Type X gypsum wallboard on bottom (ceiling level)			
		1 hr.	—	—
UL L527	• 9385S, 54 mil joists @ 24" o.c. • 24 gauge resilient channel spaced at 16" o.c. and (2) layers of 5/8" Type X gypsum wallboard on bottom • ¾" thick plywood on top • optional floor topping concrete mixture			
		1-1/2 hr.	—	—
UL L543	• 800S156-43 floor joists @ 19" o.c. with joist bridging • 350S156-43 ceiling joists @ 16" o.c. with joist bridging • 3 ½" mineral wool insulation at ceiling level • 23/32" wood structural panel on top • (2) layers of ½" Type X gypsum wallboard on bottom • rating is for restrained and non-restrained assembly			
		1 hr.	—	—

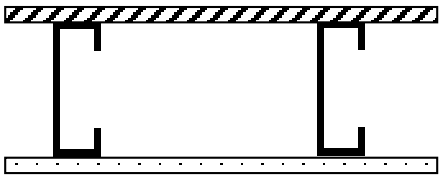
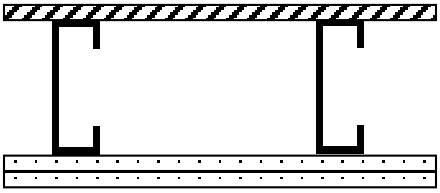
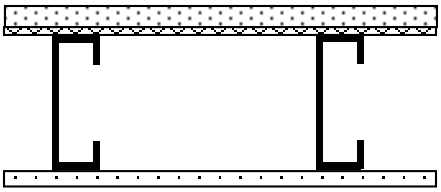
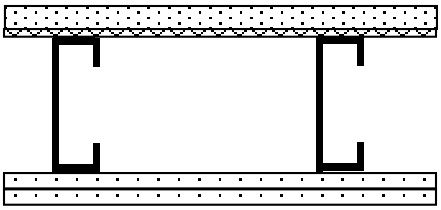
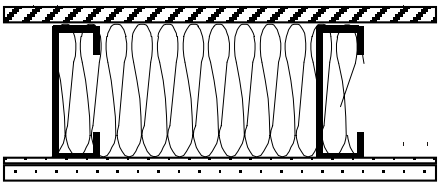
(Not complete construction details; consult original source for detailed information. UL – Underwriters Laboratories, Inc.)

Floor Assemblies (Gypsum Association)

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
GA FC 1145	• 600S162-43 joists @ 24" o.c. • (1) layer of ½" Type X gypsum wallboard or gypsum veneer to resilient furring channels spaced @ 24" o.c. on bottom • 25 gauge corrugated metal deck and 2" light weight, 105 pcf, concrete slab on top • Unrestrained assembly			
		1 hr.	—	—
GA FC 2116	• 725S, 43 mil joists @ 24" o.c. • (2) layers of 5/8" Type X gypsum wallboard or gypsum veneer on bottom • 28 gauge corrugated metal deck and 2½" concrete slab on top • bottom of joists braced at midspan with 2" x 43 mil steel straps			
		2 hr.	—	—
GA FC 4502	• 700S, 43 mil joists @ 24" o.c. • (2) layers of ½" Type X gypsum wallboard on bottom • 5/8" T&G plywood floor on top			
		1 hr.	—	—
GA FC 4503	• 600S, 43 mil joists @ 24" o.c. • (2) layers of ½" Type X gypsum wallboard on bottom • ¾" T&G plywood floor on top			
		1 hr.	—	—
GA FC 4750	• 800S, 43 mil joists @ 24" o.c. • (4) layers of 5/8" Type X gypsum wallboard on bottom • ¾" T&G plywood sheathing on top • resilient steel channels spaced at 24" o.c. and applied perpendicular to joists over third layer of gypsum board			
		2 hr.	—	—

(Not complete construction details; consult original source for detailed information. GA – Gypsum Association)

Floor Assemblies (Factory Mutual)

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
FM FC 184	• 725S, 43 mil joists @ 24" o.c. • (1) layer of 5/8" Type X gypsum wallboard on bottom • ¾" T&G plywood sheathing on top			
		45 min.	—	—
FM FC 196	• 725S, 43 mil joists @ 24" o.c. • (2) layers of ½" Type X gypsum wallboard on bottom • ¾" T&G plywood sheathing on top			
		1 hr.	—	—
FM FC 218	• 725S, 43 mil joists @ 24" o.c. • 1½" lite-crete foam concrete on top • 28 gauge corrugated metal deck with 9/16" deep corrugations • (1) layer of 5/8" Type X gypsum wallboard on bottom			
		1 hr.	—	—
FM FC 224	• 725S, 43 mil joists @ 24" o.c. • 2½" concrete slab on top • 28 gauge corrugated metal deck with 9/16" deep corrugations • (2) layers of 5/8" Type X gypsum wallboard on bottom			
		2 hr.	—	—
NAIMA Figure 27	• 725S162-43 joists @ 24" o.c. • T&G plywood subfloor on top • Carpet and pad on top of subfloor • 3½" fiber glass insulation • 5/8" gypsum board attached to resilient channels spaced at 24" o.c. on bottom of joists • steel strap bridging at bottom flanges of joists			
		—	56	71

(Not complete construction details; consult original source for detailed information. FM – Factory Mutual; NAIMA - North American Insulation Manufacturers Association [30])

Chapter 4: Recommended Construction Practice to Improve Fire and Sound Rating

1 Introduction

This chapter will provide the reader with points of interest that are good practice in the design and construction fields. These points of interests go beyond the regulatory requirements and tested designs as discussed in previous chapters. Typically fire and sound ratings are initially established by laboratory tests under controlled environment. What can be done in the field, however, is ensuring that the parameters that affect the rating of an assembly are not compromised. Many times, paying attention to small details can make a big difference for an assembly. The following are practical construction practices that can lead to improved fire and sound performance of steel-framed assemblies.

2 Fire Rating of Framing Elements

2.1 Walls

- Stud Size, Thickness and Spacing
    - Larger and/or thicker studs than those described in a fire endurance tested design can be substituted in a fire rated assembly.
    - The stud spacing provided in a rated assembly is the maximum spacing. Studs are permitted to be installed closer than the maximum spacing specified in the fire endurance tested design.

- Service Installation
    - Service installation on exterior walls should be avoided since they reduce the impermeability and thereby increase the risk of fire spread.

- Insulation
    - Mineral wool should have a surplus measurement of 3/16” to 3/8” (5 to 10 mm) in width in order to ensure a tight fit so that they remain in place should the board covering burn away.

- When not specified as a component of a fire endurance test design, mineral fiber, glass fiber, or cellulose fiber insulation of a thickness not exceeding that of the stud depth is permitted to be added within the stud cavity.

- Gypsum Board

  - Additional layers of gypsum board increase the fire resistance.
  - The gypsum board cited in the fire endurance test design is to be used in the field installation. Substitutions may only be permitted when approved by the local official.
  - Fire rated assemblies that specify a proprietary system provides the fire resistance with that system only.
  - The face layers of an assembly that contain multiple layers of gypsum board shall have the joints finished with compound and tape. Base layers for multi-layer systems are not required to have the joints finished with compound and tape, unless specifically cited in the tested design.

- Load Bearing and Non-Load Bearing Studs

  - Partitions or interior walls required to have a fire-resistance rating must be rated equally from each side since a fire could develop on either side of the fire separation. They are normally designed symmetrically. If they are not symmetrical, the fire-resistance rating of the assembly is normally determined based on testing from the weakest side.
  - Load bearing and non-load bearing steel stud wall listings are not interchangeable because the properties of the studs in these assemblies are not the same.
  - National model codes generally stipulate that exterior walls require rating for fire exposure from within (interior side) a building. This is because fire exposure is assumed to be generated from the interior of the building. As a result, exterior wall assemblies are not symmetrical (exception: Walls that are close to lot line as described in Table 2.7).

- Double Wall Assembly

  - Within design limitations, the distance between parallel rows of studs, such as in a double stud party wall, is permitted to be increased beyond that of the fire endurance tested design.

2.2 Floors/Ceilings

- Location of Screws

  The location of screws used to fasten gypsum board edges to resilient channels may have an influence on the fire-resistance rating of floor assemblies. A resilient channel is a long strip of thin steel, or flexible furring, placed between the joist and the gypsum board and attached to both.

- Joist Spacing

  Unlike wood I-joist assemblies, the steel joist spacing does not significantly affect the fire-resistance of steel floors.

- Cavity Insulation

  - The installation of glass fibre insulation in the floor cavity may reduce the fire-resistance rating of the assembly. The cavity insulation causes the temperature of the gypsum board to increase and leads to premature failure. The location of glass fiber insulation within the joist cavity, however, does not impact the fire-resistance of the floor assembly.
  - The installation of mineral fiber insulation will have an impact on fire endurance, generally providing an increase in fire resistance over assemblies that either do not contain insulation or cavities that contain glass fiber insulation. Mineral fiber insulation is most effective when installed at the bottom of the cavity.
  - The installation of cellulose insulation will also have an impact on fire endurance, generally providing an increase in fire resistance over assemblies that either do not contain insulation or do contain glass fiber insulation. Cellulose insulation is most effective when wet sprayed onto the underside of the deck and onto the exposed portions of the framing members.

- Additional Layers of Gypsum Board

  An additional layer of gypsum board increases the fire resistance.

- Floor Finish

  Floor assemblies with OSB or plywood subfloors provide similar fire resistance. Concrete topping reduces the fire resistance of a lightweight floor assembly.

- Tested Assemblies

  - It is important to ensure that the restraint conditions of the test are the same as the construction in the field.
  - Floors, ceilings and roofs are tested for fire exposure from the underside only. This is because a fire in the compartment below presents the most severe threat. For this reason, the fire-resistance rating is required from the underside of the assembly only.

3 Sound Rating of Framing Elements

Aside from economic factors, the choice of suitable wall or floor assemblies, that will achieve the desired sound insulation and privacy between rooms and structures, will depend on the type of building structure (i.e., wood, steel, concrete or masonry). The following are practical construction practices that can lead to an improved acoustical performance of steel houses and other structures:

3.1 Walls

- Insulation

  - The greater the fraction of the cavity filled with absorptive material, the higher the sound transmission loss wall provides the same separating function between apartments as the walls or floors separating one apartment from another.
  - Use of heavier board sheathings (such as glass fiber reinforced or cellulose-fixed cement boards) can improve the sound insulation of walls between apartments.
  - Where batt insulation is used, ensure that sagging or gaps do not occur between batts and framing. Where blanket insulation is used, take care to avoid sagging of the blanket and no gaps are left unfilled.

- Gypsum Board

  - Sound rating can be increased by increasing the mass which is accomplished by increasing the number of layers of gypsum board on each side from one to two.
  - All gypsum board (or plasterboard) joints must be staggered a minimum of 12" (300 mm) from each other (horizontal or vertical, where multiple sheets are required).
  - Gypsum board orientation has an insignificant impact on the STC rating of steel walls.
  - Taped joints of gypsum board walls only give an STC rating of 1 dB lower than normal construction practice.
  - Avoid installing internal layers of gypsum board in the wall cavity. The sound insulation decreases because of the internal layers.

- Resilient Channels and Sound Absorbers

  - The orientation (horizontal or vertical, installed facing up or down), the side of the partition on which they are installed, and the manufacturer of resilient channels do not have a significant effect on its sound isolating performance expressed in terms of STC.
  - Resilient metal channels should never be used between two layers of gypsum board in a wall, because small cavities in walls usually lead to low STC ratings.
  - Use sound absorbent material in the cavities or voids in structures of discontinuous or double-shell construction.
  - The spacing of the resilient channels has little or no effect on the performance of a partition when the studs are spaced at 24 in. (610 mm) on center. When the studs are spaced at 16 in. (406 mm) on center, installing resilient channels at 24 in. (610 mm) rather than at 16 in. (406 mm) on center provides a 2 to 4 point increase in STC rating of the partition. The most effective arrangement for the studs and resilient channels of a partition is to have them both spaced at 24 in. (610 mm) on center.

- Stud Size and Thickness

  - Increasing the depth of the cavity, to allow thicker insulation to be installed increases the sound rating of the assembly.

- When resilient furring channels are used in single steel stud partitions, the stud thickness has little influence on the STC rating obtained. There is however, a slight increase in transmission loss as the thickness is decreased (lighter stud).

- Stud Spacing and Framing

  - Flanking transmission can decrease the effectiveness of a wall's STC value through flanking paths through joints between walls and floors, between walls and ceilings, cabinets mounted back to back, penetrations such as electrical, piping, telecommunication, and poor or non-existent seals at joints.
  - To increase the sound rating of a wall, use double studs, staggered studs (with or without resilient channels), or load-bearing steel studs with resilient channels.
  - The greater the spacing of the framing members, the greater the sound reduction (Within limitations). Usually the STC increases by one or two points when going from 16 in. (400-mm) to 24 in. (600-mm) spacing.

- Fasteners

  - Fasteners spacing has a small effect on the sound transmission for light gauge steel framing.
  - STC ratings are not affected by increasing the number or tightness of screws or nails, or by the use of adhesives

- Sealants

  - All connections between partitions should be completely sealed. A gap of 1/32" (1 mm) can diminish the other benefits of the partition's STC rating. .
  - Secure the wall studs in junctions with the exterior wall to the exterior wall itself and apply sealant to the gypsum board of the exterior wall.

- Party Wall

  - Refrain from mounting noisy appliances or devices on or against party walls connections, or adjacent to habitable spaces. Consideration should also be made for isolating equipment from the structure through the use of isolators
  - Continuous curtain walls may be carriers of flanking sound. The airborne sound enters the curtain wall and may transmit a clear signal into each room along the path of the curtain wall. For correction, the curtain wall should be interrupted or made discontinuous at each party wall intersection.

3.2 Floors/Ceiling Construction

- Resilient Channels

- Joist floors require resilient metal channels to achieve high sound rating (STC of 50 or more), with or without insulation.
- Acoustic performance of floors and ceilings can be improved by increasing the spacing of the resilient channels.
- Adding resilient channels to floor assemblies that contain concrete subflooring significantly improves IIC ratings.
- Adding a resilient layer under a hard floor surface improves the sound rating.
- (Already say this a zillion times)
- Subfloors and floors that contain hard floor surfaces, and without resilient channels, have poor IIC (Impact Insulation Class) ratings.
- Placing resilient channels between two layers of drywall (attached to ceilings) is not effective in reducing sound transmission.
- Using resilient channel to support butt ends of single layer gypsum boards reduces acoustic performance.

- Joist Size and Thickness

  - Acoustic performance of floors and ceilings can be improved by increasing the depth of the joists to accommodate thicker insulation [35].
  - The thickness of the steel framing has an insignificant effect on the sound insulation of steel floor and ceiling assemblies.

- Insulation

  - Acoustic performance can be improved by increasing the thickness and density of the insulation, however it is not significant without resilient channels.

- Fasteners

  - Screws used to suspend the gypsum board ceilings to the secondary profiles, if too long, can create a sound transfer bridge and thus reduce the sound performance of the assembly.
  - Tightening or increasing the number of screws or adding adhesives does not affect the sound rating of a steel floor assembly.
  - It is important that the fasteners employed connect directly with the intended framing or resilient channel in order to prevent the unwanted squeak, which may occur as a result of the fastener rubbing or vibrating against the framing or resilient channels.

- Bracing

  - Cross bracing or strapping of steel floor or ceiling joists result in similar acoustic performance.

- Sealants

  - Cracks in flooring often leak sound through an otherwise high-performance system assembly. Tongue-and-groove subflooring or subflooring with joints are a remedy. In

either case, the perimeters and all penetrations should be sealed to protect the performance. Subflooring should be adhesively applied, in addition to being fastened to the framing, for two reasons: pins transmit sound through the floor to the structure, and with use, pins tend to loosen breaking through the floor covering. The resulting loose flooring could creak and thump when walked on.

- Connections between partitions should be completely sealed.
- For continuous joists over a partition, double blocking above the partition to close off the plenum is recommended. The blocking should be caulked on three sides to form an airtight seal, and the ceiling interrupted at the partition if possible.
- Regardless of the ceiling construction, it is necessary to caulk the perimeter of the partition to prevent flanking sound transmission. This is best done with a continuous bead of acoustical sealant under the edge of each base layer of gypsum panel or lath. Caulking under the runner or plate is not as effective since the sound travels under the panel, up over the runner, and out the other side.

3.3 Service Penetrations

Since air paths between spaces can particularly affect sound attenuation, special care should be taken around penetrations. It is important to provide an adequate sealing around any joints including where walls meet other walls and floors, as even a small gap can lead to a marked deterioration in performance. Service penetrations through the lining can cause air paths through the wall and should be avoided in separating walls wherever possible. Flush mounted power points and light switches, where necessary, should have a backing of the wall lining material.

3.3.1 Electrical Penetrations

Guidance about the impact of service penetrations generally focuses on appropriate location of electrical sockets and switches, preferably not on a separating wall, but on internal partitions or external walls. If electrical boxes have to go on separating walls they should not be placed back-to-back, but separated by at least 24 inches (600 mm).

Penetrations in walls and ceilings for electrical switches and light fittings can be a substantial source of sound transmission. The following are a few recommendations to reduce sound leakage through service penetrations:

- Preferably, electrical boxes, phone jacks, light switches and power outlets should not be located in walls between apartments. These outlets should be located in partition walls within an apartment or a house or through the use of external baseboard boxes. If electrical outlets are placed in acoustically insulated walls, they should not be placed back-to-back, but staggered separated by at least 24 in. (600 mm) horizontally with a double stud frame and limited to one per stud opening.
- Electrical boxes should be sealed with a special acoustic sealing compound or mineral wool, covering at least 4 in. (100 mm) all around the opening.

- Recessed down lights should not be used in ceiling systems requiring acoustic integrity. Surface mounted lights should be considered in these applications.
- Fire rated switch boxes should be considered to assist in maintaining the acoustic integrity of wall systems.
- Wherever electrical switch penetrations are made, it is recommended that glass wool batts be incorporated in the wall cavity to assist acoustic integrity.
- All cable penetrations should be sealed as per switch box manufacturer's requirements.
- Seal around cutouts in gypsum board with fire mastic.
- Install all electrical vibrating equipment (such as exhaust fans, electric motors, washers, dryers, dishwashers) in resilient mounts, connected with flexible conduit.

3.3.2 Plumbing Penetrations

Where pipes and plumbing systems are to be installed in acoustic sensitive situations, care must be exercised that acoustic ratings can be achieved.

- All gaps must be fully sealed to reduce the possibility of sound flanking transmission paths affecting the acoustic integrity of the wall or ceiling system.
- Pipes can be wrapped tightly with vinyl or other acoustical insulation material.
- All pipes should be kept clear of gypsum board or plasterboard lining and baffles.
- There should not be more than one pipe penetration through the wall between any two studs.
- Seal around penetration for sprinkler pipes.
- Some severe penetrations of the sound wall are concealed and often go undetected. An example is back-to-back bathtubs or other plumbing fixtures in adjoining apartments. Placed this way for economy of plumbing, they create a first-class communication system between the bathrooms. Often the tubs are installed immediately after the framing, with the gypsum panels coming later. The panels are then applied only down to the tubs, leaving an open space from tub to tub. The solution is simple: complete the entire sound wall, including caulking, down to the floor before the tubs are installed

3.3.3 HVAC Penetrations

- Whenever possible, it is good practice to route air conditioning supply lines in interior partitions runs than in party walls. This should include separate runs to each unit (or apartment) and minimum penetration of sound control assemblies. Penetrations should be as small as possible and must be caulked airtight. Runs to adjacent unit or apartments should be at least one stud space apart, preferably two
- Ventilation ducts should be insulated with mineral wool and not touch the structure or gypsum boards in a separating wall, and ventilation ducts for adjacent apartments should be kept well away from each other and filled with mineral wool.

Chapter 5: References

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