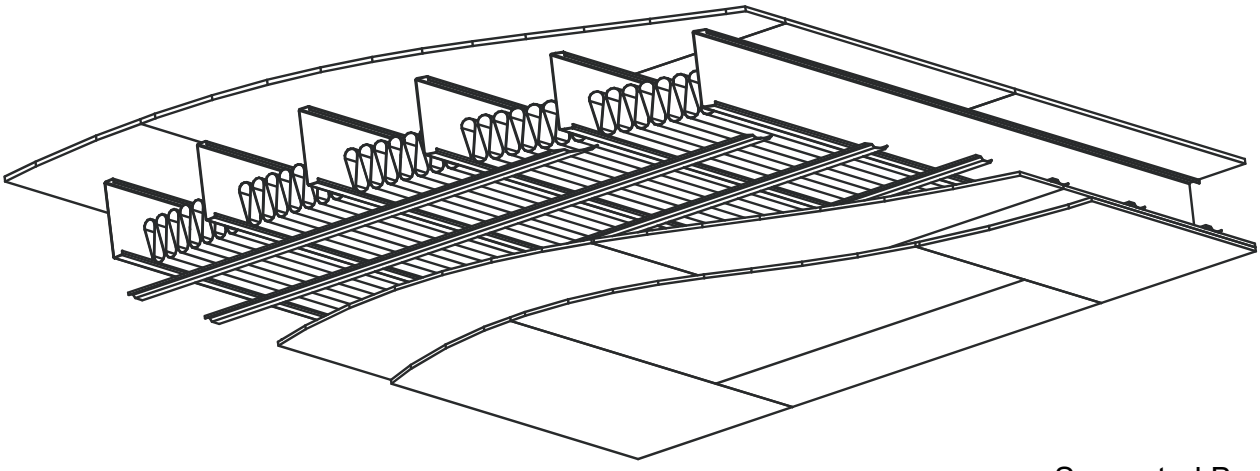
Steel Framing Alliance™

Steel. The Better Builder.

A GUIDE TO FIRE & ACOUSTIC DATA FOR STEEL FLOOR, WALL & ROOF ASSEMBLIES

(September 2006)



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SSMA

DISCLAIMER

The material in this guide has been prepared as a reference of fire and sound rated lightweight steel framed assemblies. While every effort has been taken to ensure that the material is technically correct, it only offers a brief description of the tested assemblies. It must not be used without first reviewing the source documents of the testing agencies for a full description of the assembly. The Steel Framing Alliance, nor their organization's members, warrant or assume liability for the suitability of the material for any general or particular use.

Please note that some assemblies are constructed with proprietary products that may not be available in all geographical areas. Please consult the source documents of the testing agencies for these details.

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PREFACE

The purpose of this guide is to amalgamate fire and sound data for steel floor and wall assemblies that are relevant to residential and light commercial construction. Fire data has been compiled from the following five sources:

Underwriters' Laboratories of Canada ULC
7 Underwriters Road
Toronto, Ontario, Canada M1R 3B4
www.ulc.ca

National Research Council of Canada NRCC
Institute for Research in Construction
1200 Montreal Road
Ottawa, Ontario, Canada K1A OR6
www.NRCC.ca/irc

Underwriters Laboratories Inc. UL
333 Pfingsten Road
Northbrook, Illinois, U.S.A. 600062-2096
www.ul.com

Gypsum Association GA
810 First Street NE, #510
Washington, D.C., U.S.A. 20002
www.gypsum.org

Factory Mutual Research FM
FM Global Corporate Offices
1301 Atwood Ave.
PO Box 7500
Johnston, Rhode Island, U.S.A. 02919
www.fmglobal.com

NOTES

1. ULC Design Numbers (published in the Fire Resistance Directory of Underwriters' Laboratories of Canada) and NRCC Report/Assembly Numbers (research publications of the Institute for Research in Construction, National Research Council of Canada) should be referenced when considering steel floor and wall assembly designs in Canadian Building Code jurisdictions.

2. For non-load bearing wall assemblies, steel stud thickness as per ASTM C 645, Standard Specification for Nonstructural Steel Framing Members, where minimum thickness is specified as 0.0179 in. (0.455 mm) before application of protective coating.

3. The majority of sound data that has been incorporated into this guide were based on the following report:

   Warnock, A.C.C., *Estimation of Sound Transmission Class and Impact Insulation Class Rating for Steel Framed Assemblies*, Report No. B3436.1, Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, December 2005.

   The above report has surveyed existing published sound test reports denoted in the source column by an alphanumeric acoustic test identifier. Letter prefixes in the identifier denote various acoustic testing laboratories. The report also provides numerous acoustic "estimates" and these have been noted with an asterisk that refers to the above report, i.e., Warnock (2005). Further information on the acoustic "SOund Classification RATing EStimator" called "Socrates" is available via the following website:

   http://www.alfwarnock.info/sound/socindex.html

   Acoustic data in some cases appears with the following codes to denote a material:

   AIR – a gap in the construction (a layer of air with thickness)
   CAR-UND – carpet and underpad
   CEMBRD – cement board (with thickness)
   G – gypsum board (with thickness)
   GFB – glass fiber batts (with thickness)
   NI – no insulation
   NRC – no resilient metal channels
   RC - resilient metal channels
   RFB – rock fiber (mineral wool) matts (with thickness)

NOTES (continued)

4. Information on UL fire rated cold-formed steel truss assemblies is available from the Steel Truss and Component Association via the following website:

   www.steeltruss.org

5. Details of UL and ULC listings for fire rated floor, wall and truss assemblies can be downloaded from the website of UL and ULC by using the alphanumeric fire identifier within a keyword search. For example, on the UL website enter the following information:

   - go to UL website at: http://www.ul.com
   - click on “Certifications” located along left side of webpage
   - type in alphanumeric fire identifier, for example “L568” in keyword box and click on “Search”
   - go to row with “Design No. L568” and click on “*BXUV.L568”*

   Similarly for the ULC website enter the following information:

   - go to ULC website at: http://www.ulc.ca
   - click on “Online Directories” located along top of webpage
   - on the “Online Directories” webpage, click on “ULC Online Directories”
   - in “Keyword” type in alphanumeric fire identifier, for example “M511” in keyword box and click on “Search”
   - go to row with “Design No. M511” and click on “*BXUVC.M511”*

ACKNOWLEDGEMENTS

This guide has been prepared by Bill Kraft of the Steel Framing Alliance and George Frater of the Canadian Steel Construction Council.

Acknowledgement is also made for the financial support provided by the Steel Stud Manufacturers Association for NRCC's Phase II joint research project on the Fire and Acoustical Performance of Floor Assemblies.

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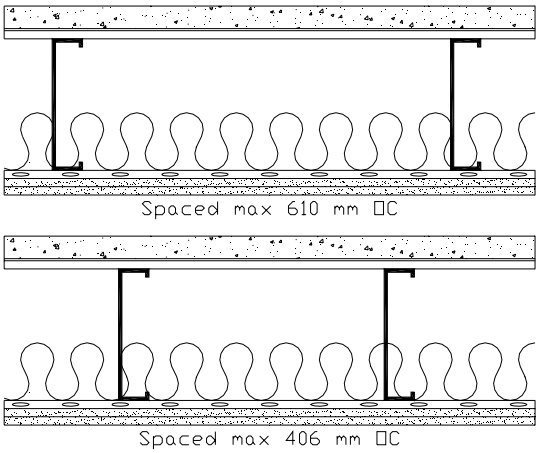
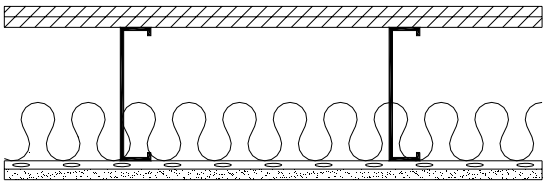
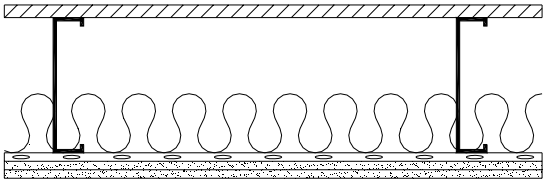
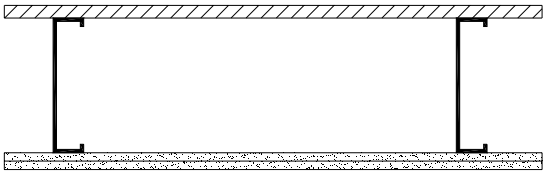
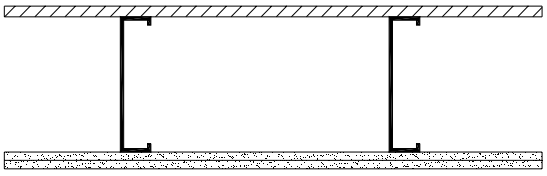
FLOOR/CEILING ASSEMBLIES

<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th><th>Impact Insulation Class</th></tr>
<tr><td rowspan="5">ULC
I523

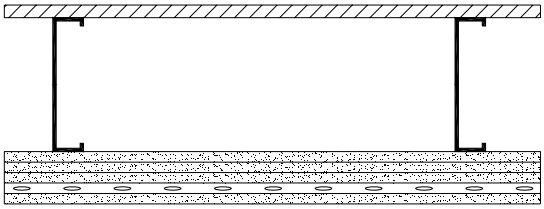
a) TLF-02-051a
b) IIF-02-032</td><td rowspan="5">35 mm concrete
0.38 mm thick steel deck with 15.9 mm deep corrugations
203 mm deep steel joist with 1.15 mm material thickness and spaced at 406 mm o.c. or 610 mm o.c.
optional resilient metal channels spaced 610 mm o.c.
optional 90 mm mineral wool or glass fibre batt insulation
2 layers of 12.7 mm gypsum board on ceiling side</td><td colspan="3"> 
</td></tr>
<tr><td rowspan="4">1 h</td><td colspan="2">610 mm joist spacing</td></tr>
<tr><td>65* (GFB RC)
60* (NI RC)</td><td>29* (GFB RC)
30* (NI RC)</td></tr>
<tr><td colspan="2">406 mm joist spacing</td></tr>
<tr><td>66[a] (GFB RC)
60* (NI RC)</td><td>34[b] (GFB RC)
<30* (NI RC)</td></tr>
</table>

* Estimated value as per Warnock (2005)

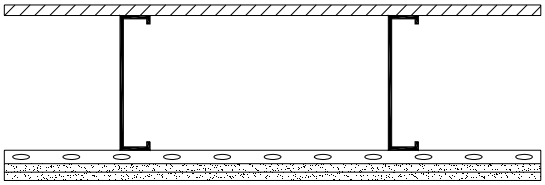
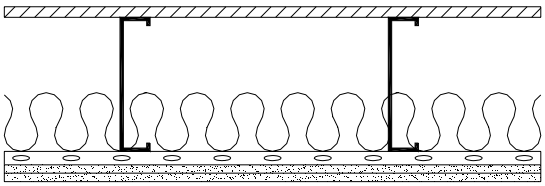
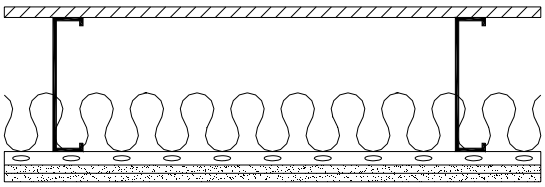
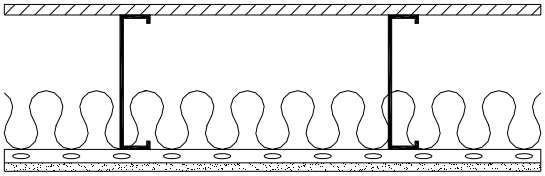
Floor/Ceiling - Underwriters' Laboratories of Canada

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
ULC M511	• subfloor of 15.9 mm plywood and finish floor of 15.9 mm wood structural panels • 203 mm deep steel joist with 1.15 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 90 mm thick mineral wool batt insulation • 1 layer of 15.9 mm gypsum board on ceiling side			
		45 min	53*	46*
	• subfloor of 19 mm plywood • 203 mm deep steel joist with 1.15 mm material thickness and spaced at 610 mm o.c. • resilient metal channels spaced 406 mm o.c. • 90 mm thick glass fibre batt insulation • 2 layers of 12.7 mm gypsum board on ceiling side			
		45 min	52*	45*
	• subfloor of 19 mm plywood • 203 mm deep steel joist with 1.15 mm material thickness and spaced at 610 mm o.c. • 2 layers of 12.7 mm gypsum board on ceiling side			
		45 min	<40*	<40*
	• subfloor of 15.9 mm plywood • 203 mm deep steel joist with 1.15 mm material thickness and spaced at 406 mm o.c. • 2 layers of 12.7 mm gypsum board on ceiling side			
		1 h	<40*	<40*

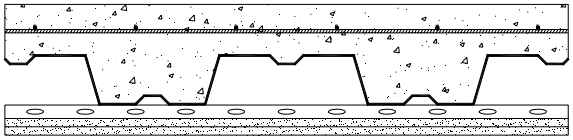
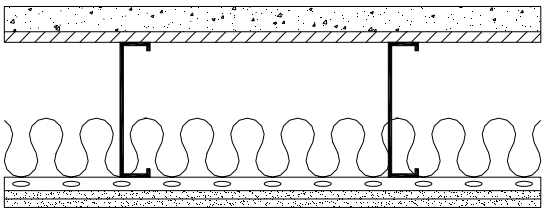
* Estimated value as per Warnock (2005)

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
ULC M514 a) NGC5004021 b) NGC7004068 c) NGC7004069	• subfloor of 19 mm plywood • 203 mm deep steel joist with 1.07 mm material thickness and spaced at 610 mm o.c. • 4 layers of 15.9 mm Type X gypsum board on ceiling side • resilient metal channels spaced 610 mm o.c. and applied perpendicular to joists over third layer of gypsum board			
		2 h	48[a]	37[b] 60[c] (CAR-UND)

Floor/Ceiling – National Research Council of Canada

Source	Description	Fire Endurance	Sound Transmission Class	Impact Insulation Class
NRCC IR-764 FF22	• subfloor of 15.9 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		74 min	<50*	<40* 60**
NRCC IR-764 FF23 a) TLF-01-003a b) TLF-01-005a c) IIF-00-036 d) IIF-01-001	• subfloor of 15.9 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 90 mm thick glass fibre insulation • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		68 min	49[a] 52[b] (CAR-UND)	39[c] 70[d] (CAR-UND)
NRCC IR-764 FF24	• subfloor of 15.9 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 610 mm o.c. • resilient metal channels spaced 406 mm o.c. • 90 mm thick glass fibre insulation • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		69 min	49*	42* 62**
NRCC IR-764 FF25	• subfloor of 15.9 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 90 mm thick mineral fibre insulation • 1 layer of 12.7 mm Type X gypsum board on ceiling side			
		46 min	45*	39* 64**
* Estimated value as per Warnock (2005)		** With carpet and pad (Warnock, 2000)		

Floor/Ceiling – National Research Council of Canada

Source	Description	Fire Endurance	Sound Transmission Class	Impact Insulation Class
NRCC IR-764 FF26 a) TLF-97-109a b) IIF-97-049	• 76 mm composite concrete slab with 152 x 152 x MW3.8 x MW3.8 welded steel wire mesh on 0.91 mm thick steel deck with 76 mm deep corrugations • resilient metal channels spaced 406 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		105 min	57[a]	36[b] 70**
NRCC IR-764 FF27	• 38 mm concrete topping • subfloor of 15.9 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 90 mm thick glass fibre insulation • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		60 min	66*	36* 70**
* Estimated value as per Warnock (2005)		** With carpet and pad (Warnock, 2000)		

References:

Sultan, M.A., Séguin, Y.P. and Leroux, P., *Results of Fire Resistance Tests on Full-Scale Floor Assemblies, IRC Internal Report No. 764*, National Research Council of Canada, Ottawa, Ontario, Canada, May 1998.

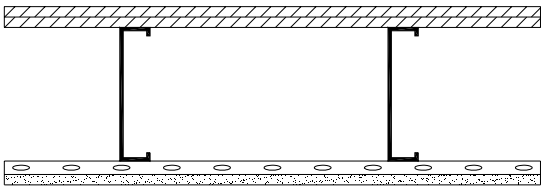
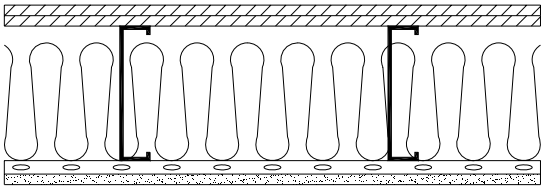
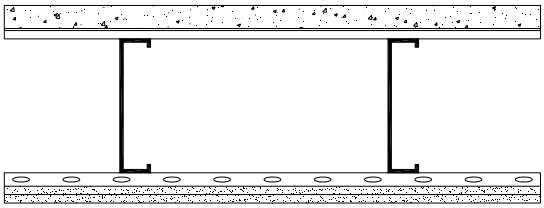
Warnock, A.C.C. and Birta, J.A., *Summary Report for Consortium on Fire Resistance and Sound Insulation of Floors: Sound Transmission Class and Impact Insulation Class Results, IRC Internal Report No. 766,* National Research Council of Canada, Ottawa, Ontario, Canada, April 1998.

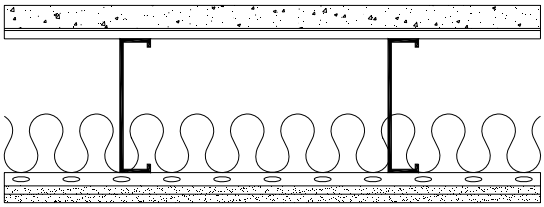
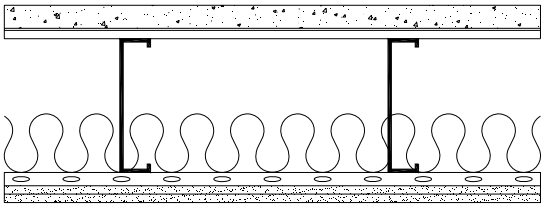
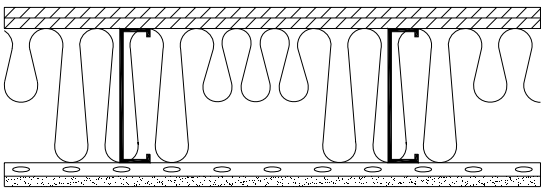
** Warnock, A.C.C., *Sound Transmission Estimates for Steel-Framed Floor Assemblies,* Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, January 12, 2000.

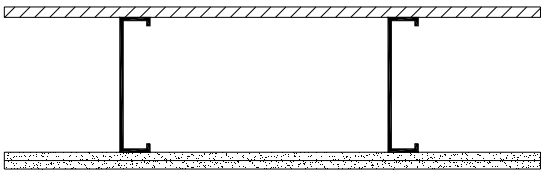
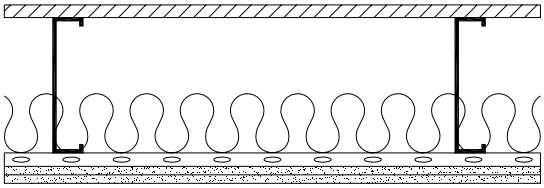
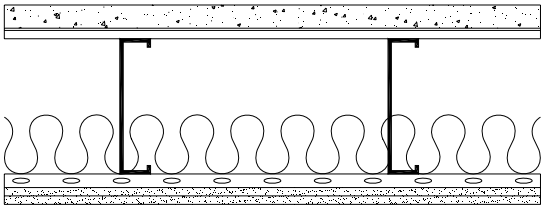
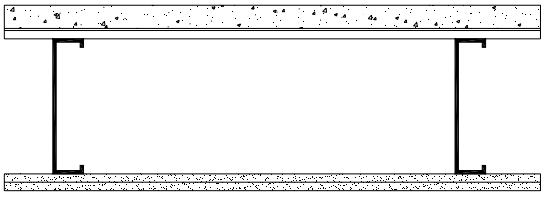
* Warnock, A.C.C., *Estimation of Sound Transmission Class and Impact Insulation Class Rating for Steel Framed Assemblies*, Report No. B3436.1, Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, December 2005.

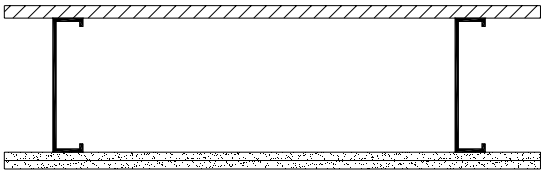
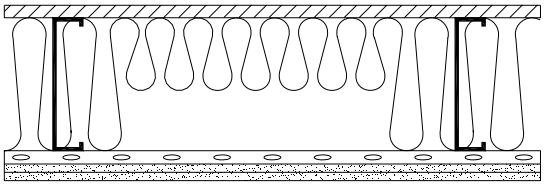
Birta, J.A. and Warnock, A.C.C., *Airborne and Impact Sound Transmission Measurements Performed on Specimen B1363-1,* National Research Council of Canada, Ottawa, Ontario, Canada, 2001.

Birta, J.A. and Warnock, A.C.C., *Airborne and Impact Sound Transmission Measurements Performed on Specimen B1363-2,* National Research Council of Canada, Ottawa, Ontario, Canada, 2001.

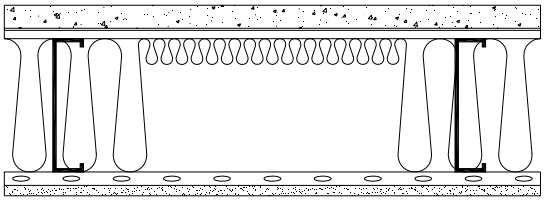
Source	Description	Fire Endurance	Sound Transmission Class	Impact Insulation Class
NRCC RR-184 FF37	• 2 layers of 15.9 mm plywood subfloor • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 1 layer of 15.9 mm Type X gypsum board on ceiling side			
		39 min	-	-
NRCC RR-184 FF38	• 2 layers of 15.9 mm plywood subfloor • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 178 mm thick rock fibre insulation • 1 layer of 15.9 mm Type X gypsum board on ceiling side			
		54 min	-	-
NRCC RR-184 FF40 a) TLF-03-011a b) IIF-03-005	• 35 mm concrete • 0.38 mm thick steel deck with 15.9 mm deep corrugations • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		75 min	62[a]	32[b]

Source	Description	Fire Endurance	Sound Transmission Class	Impact Insulation Class
NRCC RR-184 FF43 a) TLF-03-005a b) IIF-03-003	• 35 mm concrete • 0.38 mm thick steel deck with 15.9 mm deep corrugations • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 90 mm thick glass fibre insulation • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		68 min	68[a]	36[b]
NRCC RR-184 FF44 a) TLF-02-051a b) IIF-02-032	• 35 mm concrete • 0.38 mm thick steel deck with 15.9 mm deep corrugations • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 610 mm o.c. • 89 mm thick glass fibre insulation • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		61 min	66[a]	34[b]
NRCC RR-184 FF50 a) TLF-04-029a b) IIF-04-016	• 2 layers of 15.5 mm plywood subfloor • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • 91 mm thick cellulose fibre insulation on joist sides and 112 mm on underside of subfloor • resilient metal channels spaced 406 mm o.c. • 1 layer of 12.7 mm Type X gypsum board on ceiling side			
		64 min	51[a]	45[b]

Source	Description	Fire Endurance	Sound Transmission Class	Impact Insulation Class
NRCC RR-184 FF51	• subfloor of 15.5 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		67 min	-	-
NRCC RR-184 FF52	• subfloor of 19 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 610 mm o.c. • 89 mm thick glass fibre insulation • resilient metal channels spaced 610 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		53 min	-	-
NRCC RR-184 FF53 a) TLF-03-007a b) IIF-03-004	• 35 mm concrete • 0.38 mm thick steel deck with 15.9 mm deep corrugations • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 406 mm o.c. • resilient metal channels spaced 406 mm o.c. • 89 mm thick rock fibre insulation • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		70 min	68[a]	37[b]
NRCC RR-184 FF54	• 35 mm concrete • 0.38 mm thick steel deck with 15.9 mm deep corrugations • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 610 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		66 min	-	-

Source	Description	Fire Endurance	Sound Transmission Class	Impact Insulation Class
NRCC RR-184 FF62	• subfloor of 19 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 610 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		55 min	-	-
NRCC RR-184 FF65 a) TLF-04-011a b) IIF-04-007	• subfloor of 19 mm plywood • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 610 mm o.c. • 100 mm thick cellulose fibre insulation on joist sides and 94 mm on underside of subfloor • resilient metal channels spaced 610 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on ceiling side			
		69 min	57[a]	51[b]

Floor/Ceiling – National Research Council of Canada

Source	Description	Fire Endurance	Sound Transmission Class	Impact Insulation Class
NRCC RR-184 FF74	• 35 mm concrete • 0.38 mm thick steel deck with 15.9 mm deep corrugations • 203 mm deep steel joist with 1.22 mm material thickness and spaced at 610 mm o.c. • resilient metal channels spaced 406 mm o.c. • 89 mm thick cellulose fibre insulation on joist sides and 38 mm on underside of subfloor • 1 layer of 15.9 mm Type X gypsum board on ceiling side			
		56 min	63*	29*

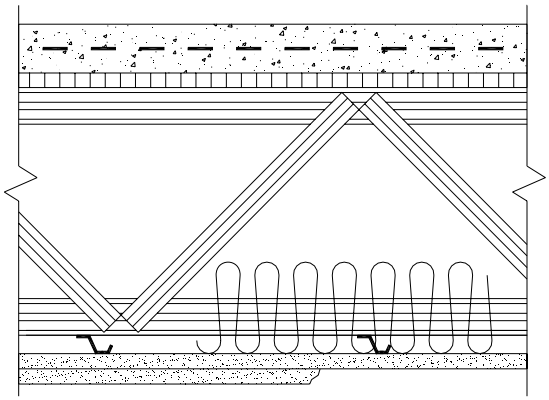
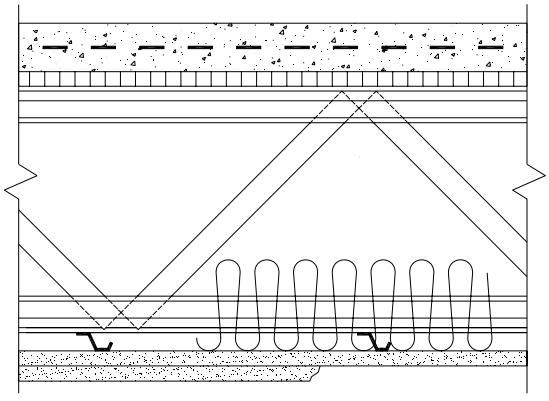
* Estimated value as per Warnock (2005)

References:
Sultan, M.A., Latour, J.C., Leroux, P., Monette, R.C., Séguin, Y.P. and Henrie, J.P., *Results of Fire Resistance Tests on Full-Scale Floor Assemblies – Phase II, Research Report No. 184 (RR-184)*, Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, March 2005.

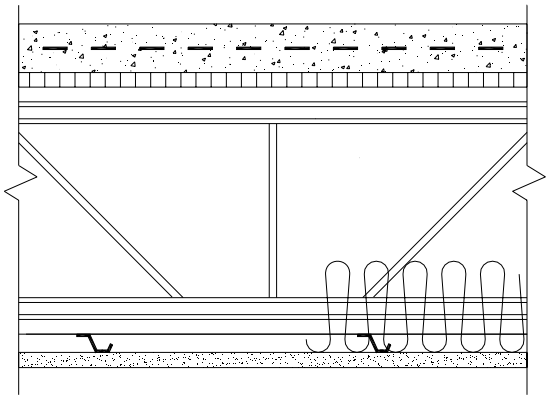
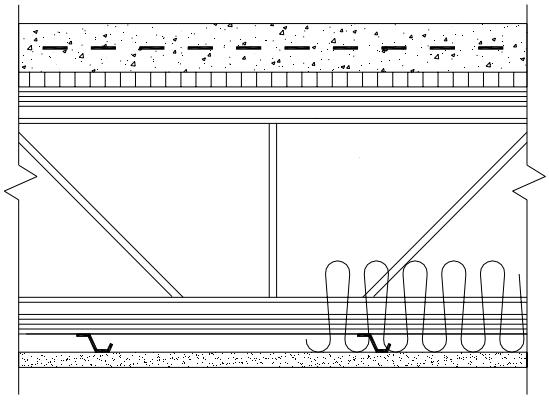
Warnock, A.C.C., *Summary Report for Consortium on Fire Resistance and Sound Insulation of Floors: Sound Transmission and Impact Insulation Data, Research Report No. 169 (RR-169)*, Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, January 2005.

* Warnock, A.C.C., *Estimation of Sound Transmission Class and Impact Insulation Class Rating for Steel Framed Assemblies*, Report No. B3436.1, Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, December 2005.

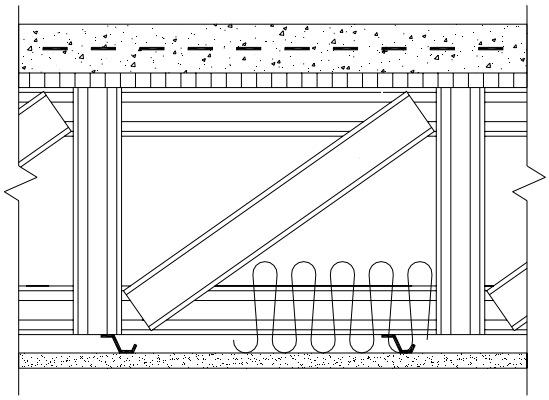
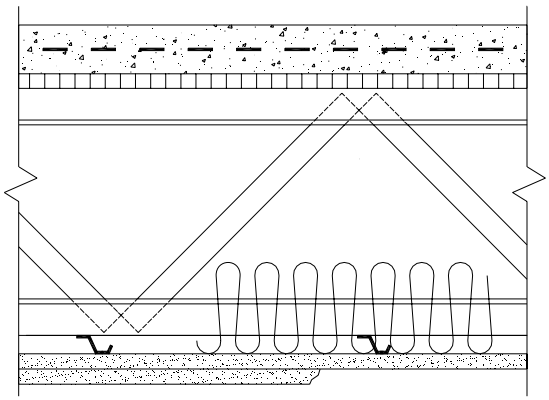
Floor/Ceiling – Underwriters Laboratories Inc.

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL G540	• 2” min. normal or lightweight concrete with 3000 psi comp. strength • welded wire fabric, 6” by 6”, 10/10 SWG • expanded steel lath with ⅜” rib • **proprietary** pre-fabricated light gauge steel truss system, Ultra-Span by Aegis Metal Framing, spaced at 48” o.c. • resilient or furring channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional for 1 h and omitted for 2 h • 1 hour - 1 layer of ⅝” gypsum board on ceiling side • 2 hour – 2 layers of ⅝” gypsum board on ceiling side			
		1 h 2 h	-	-
UL G542	• 2” min. normal or lightweight concrete with 3000 psi comp. strength • welded wire fabric, 6” by 6”, 10/10 SWG • expanded steel lath with ⅜” rib • **proprietary** pre-fabricated light gauge steel truss system, TrusSteel by Alpine Engineered Products, Inc., spaced at 48” o.c. • resilient or furring channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional for 1 h and omitted for 2 h • 1 hour - 1 layer of ⅝” gypsum board on ceiling side • 2 hour – 2 layers of ⅝” gypsum board on ceiling side			
		1 h 2 h	-	-

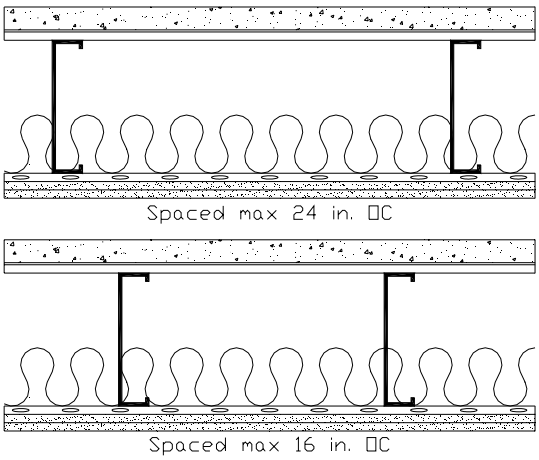
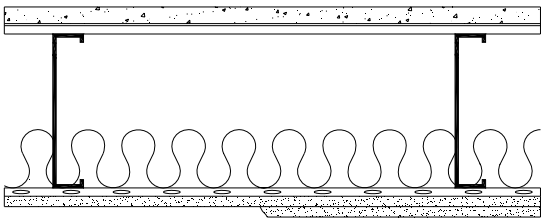
Floor/Ceiling – Underwriters Laboratories Inc.

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL G543	• 2” min. normal or lightweight concrete with 3000 psi comp. strength • welded wire fabric, 6” by 6”, 10/10 SWG • expanded steel lath with ⅜” rib • **proprietary** pre-fabricated light gauge steel truss system, Amkey System by Allied Studco, spaced at 48” o.c. • resilient channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝” gypsum board on ceiling side			
		1 h	-	-
UL G544	• 2” min. normal or lightweight concrete with 3000 psi comp. strength • welded wire fabric, 6” by 6”, 10/10 SWG • expanded steel lath with ⅜” rib • **proprietary** pre-fabricated light gauge steel truss system, Versa-Truss by Dale/Incor, spaced at 48” o.c. • resilient channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝” gypsum board on ceiling side			
		1 h	-	-

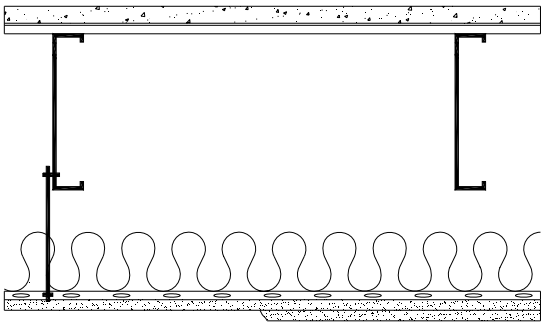
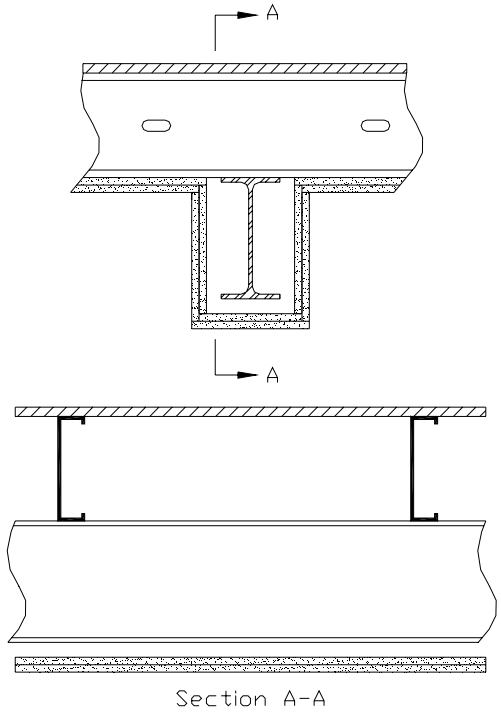
Floor/Ceiling – Underwriters Laboratories Inc.

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL G545	• 2” min. normal or lightweight concrete with 3000 psi comp. strength • welded wire fabric, 6” by 6”, 10/10 SWG • expanded steel lath with ⅜” rib • **proprietary** pre-fabricated light gauge steel truss system, Strong-Span by Hexaport International Ltd., spaced at 48” o.c. • resilient or furring channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional for 1 h only • 1 layer of ⅝” gypsum board on ceiling side			
		2 h	-	-
UL G546	• 2” min. normal or lightweight concrete with 3000 psi comp. strength • welded wire fabric, 6” by 6”, 10/10 SWG • expanded steel lath with ⅜” rib • **proprietary** pre-fabricated light gauge steel truss system, Gus Truss by Nucon Steel Corporation, spaced at 48” o.c. • resilient or furring channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional for 1 h and omitted for 2 h • 1 hour - 1 layer of ⅝” gypsum board on ceiling side • 2 hour – 2 layers of ⅝” gypsum board on ceiling side			
		1 h 2 h	-	-

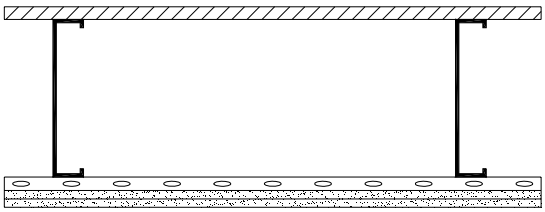
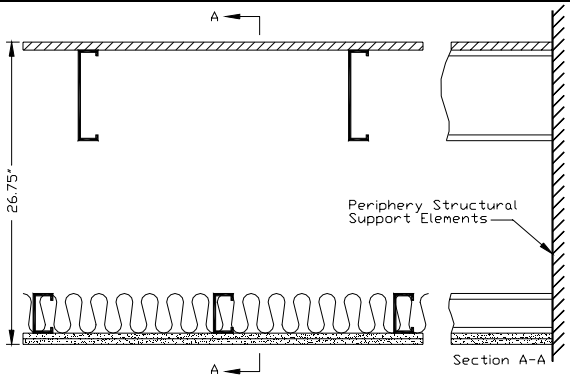
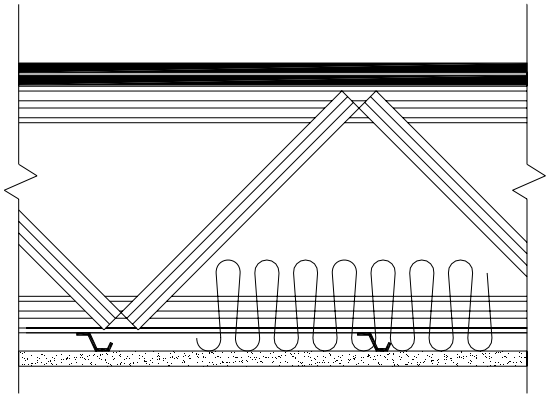
<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th><th>Impact Insulation Class</th></tr>
<tr><td rowspan="4">UL
G549

a) TLF-02-051a
b) IIF-02-032</td><td rowspan="4">• 1 ⅜” concrete
• 28 ga (0.015” thick) steel deck with ⅝” deep corrugations
• 8” x 18 ga steel joist spaced at 16” o.c. or 24” o.c.
• optional resilient metal channels spaced 24” o.c.
• optional 3 ½” mineral wool or glass fiber batt insulation
• 2 layers of ½” gypsum board on ceiling side</td><td colspan="3">  </td></tr>
<tr><td rowspan="3">1 h</td><td colspan="2">24” joist spacing</td></tr>
<tr><td>65* (GFB RC)
60* (NI RC)</td><td>29* (GFB RC)
30* (NI RC)</td></tr>
<tr><td colspan="2">16” joist spacing</td></tr>
<tr><td rowspan="2">UL
G551</td><td rowspan="2">• 1” min. floor topping mixture with 3500 psi comp. strength
• $^{9}/_{16}$” min. deep, 22 MSG corrugated fluted steel deck
• 9¼” x 16 MSG proprietary steel joist (Dietrich Industries Inc.) spaced at 24” o.c.
• resilient metal channels spaced 12” o.c.
• 3 ½” mineral wool or glass fiber batt insulation
• 1 hour - 1 layer of ⅝” gypsum board on ceiling side
• 2 hour – 2 layers of ⅝” gypsum board on ceiling side</td><td colspan="3">  </td></tr>
<tr><td>1 h
2 h</td><td>-</td><td>-</td></tr>
</table>

* Estimated value as per Warnock (2005)

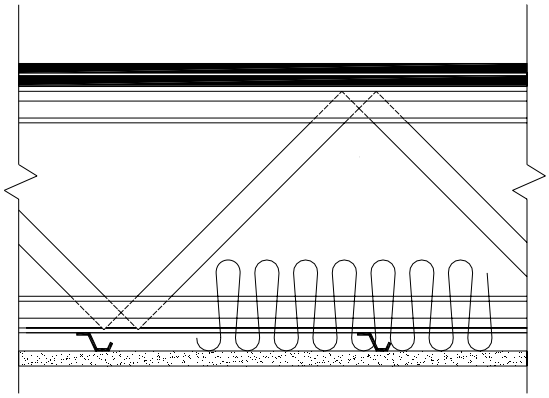
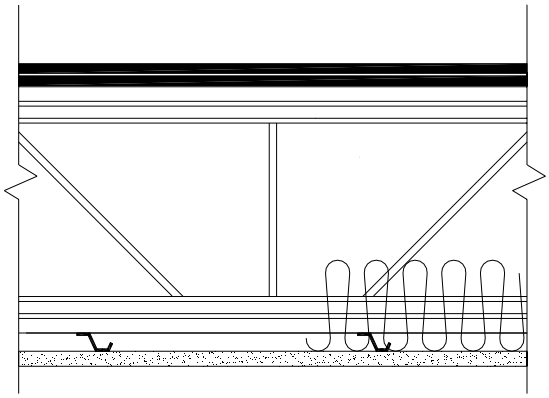
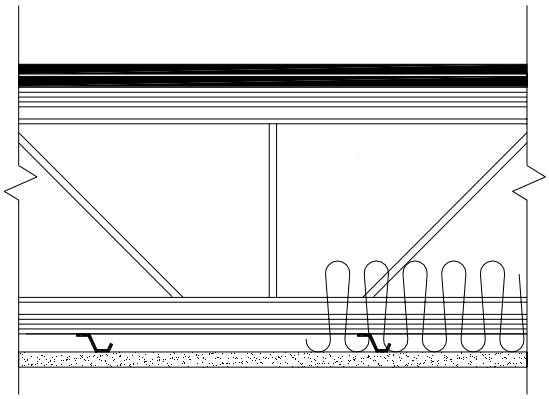
Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL G553	• 1" min. floor topping mixture with 3500 psi comp. strength • $^{9}/_{16}$" min. deep, 22 MSG corrugated fluted steel deck • 9¼" x 16 MSG **proprietary** steel joist (Dietrich Industries Inc.) spaced at 24" o.c. • hanger wire 12 SWG at 48" o.c. • resilient metal channels spaced 12" o.c. • 3 ½" mineral wool or glass fiber batt insulation • 1 hour - 1 layer of ⅝" gypsum board on ceiling side • 2 hour – 2 layers of ⅝" gypsum board on ceiling side			
		1 h 2 h	-	-
UL L524 a) USG760105 b) USG760310 c) USG760106 d) USG760405	Steel Beam – W8x15 min. size • subfloor of $^{19}/_{32}$" plywood • 7" x 18 ga steel joist spaced at 24" o.c. • 2 layers of ½" gypsum board on ceiling side a) Based on 9½" 16 gauge steel joists b) Based on 9½" 16 gauge steel joists and 3" mineral wool batt c) Based on 9½" 16 gauge steel joists and carpet pad d) Based on 9½" 16 gauge steel joists and carpet pad with 3" mineral wool batt			
		1 h	39[a] 43[b] 56[c] 60[d]	-

Floor/Ceiling – Underwriters Laboratories Inc.

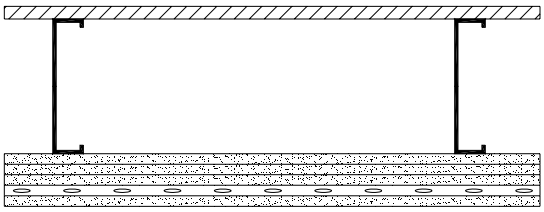
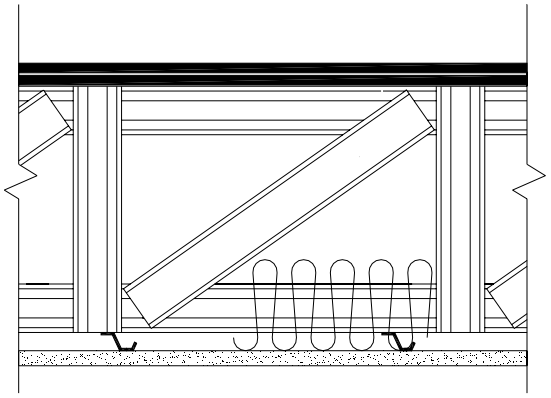
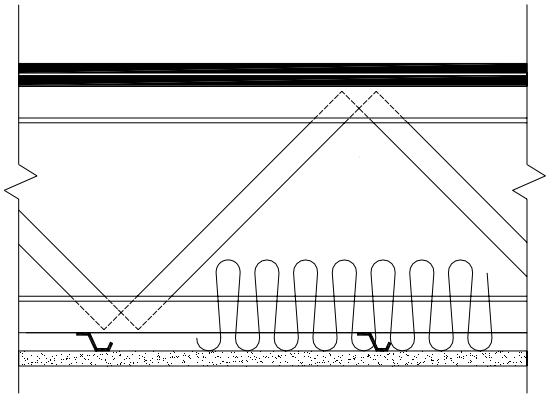
Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL L527 a) USG771101 b) SA781110	• subfloor of ¾” plywood • 9 ⅜” x 16 ga steel joist spaced at 24” o.c. • 24 ga metal resilient channels spaced 16” o.c. • 2 layers of ⅝” gypsum board on ceiling side			
		1–½ h	48[a] 51[b] (CAR-UND)	<40* 70* (CAR-UND)
UL L543	• subfloor of $^{23}/_{32}$” plywood • 8” x 18 ga steel joist spaced at 19” o.c. • 3 ½” x 18 ga steel joists spaced at 16” o.c. • 3 ½” mineral wool insulation • 2 layers of ½” gypsum board on ceiling side			
		1 h	> 60*	> 50*
UL L549	• 2 layer flooring system (9 types) • **proprietary** pre-fabricated light gauge steel truss system, Ultra-Span by Aegis Metal Framing, spaced at 48” o.c. • resilient or furring channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝” gypsum board on ceiling side			
		1 h	-	-

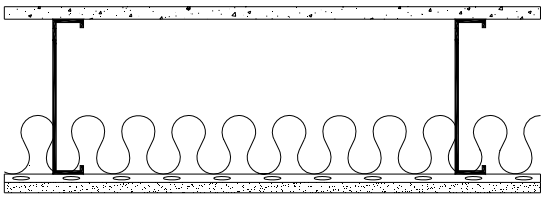
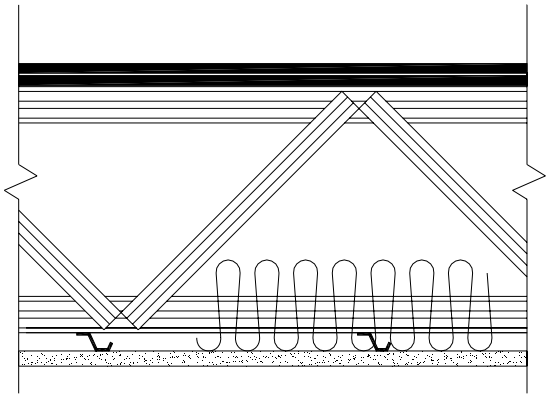
* Estimated value as per Warnock (2005)

Floor/Ceiling – Underwriters Laboratories Inc.

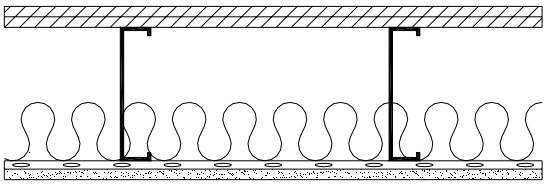
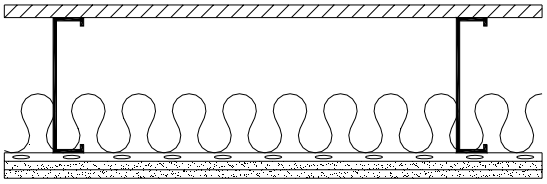
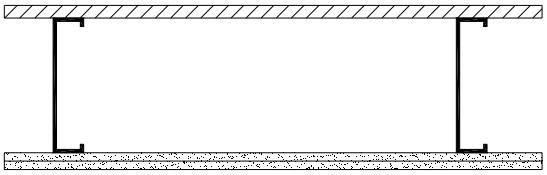
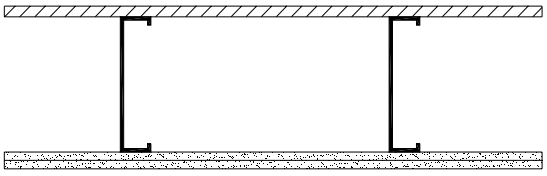
Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL L551	• 2 layer flooring system (9 types) • **proprietary** pre-fabricated light gauge steel truss system, TrusSteel by Alpine Engineered Products, Inc., spaced at 48” o.c. • resilient or furring channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝” gypsum board on ceiling side			
		1 h	-	-
UL L552	• 2 layer flooring system (9 types) • **proprietary** pre-fabricated light gauge steel truss system, Amkey System by Allied Studco, spaced at 48” o.c. • resilient channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝” gypsum board on ceiling side			
		1 h	-	-
UL L553	• 2 layer flooring system (9 types) • **proprietary** pre-fabricated light gauge steel truss system, Versa-Truss by Dale/Incor, spaced at 48” o.c. • resilient channels spaced 16” o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝” gypsum board on ceiling side			
		1 h	-	-

Floor/Ceiling – Underwriters Laboratories Inc.

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL L556 a) NGC5004021 b) NGC7004068 c) NGC7004069	• subfloor of ¾" plywood • 8" x 16 ga steel joist spaced at 24" o.c. • 4 layers of ⅝" Type X gypsum board on ceiling side • resilient metal channels spaced 24" o.c. and applied perpendicular to joists over third layer of gypsum board			
		2 h	48[a]	37[b] 60[c] (CAR-UND)
UL L559	• 2 layer flooring system (9 types) • **proprietary** pre-fabricated light gauge steel truss system, Strong-Span by Hexaport International Ltd., spaced at 48" o.c. • resilient or furring channels spaced 16" o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝" gypsum board on ceiling side			
		1 h	-	-
UL L560	• 2 layer flooring system (9 types) • **proprietary** pre-fabricated light gauge steel truss system, Gus Truss by Nucon Steel Corporation, spaced at 48" o.c. • resilient or furring channels spaced 16" o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝" gypsum board on ceiling side			
		1 h	-	-

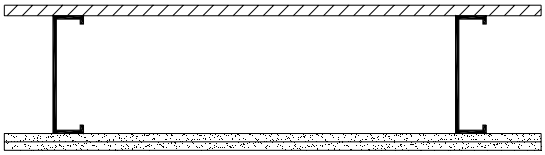
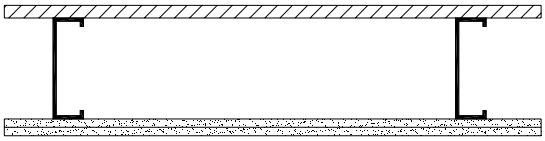
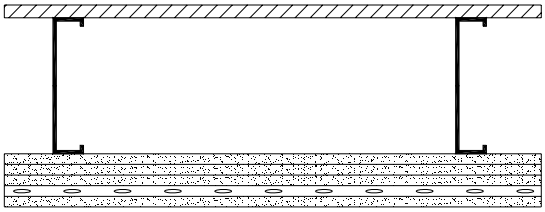
Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL L564	• subfloor of ¾" cement-fiber unit • 9¼" x 16 MSG **proprietary** steel joist (Dietrich Industries Inc.) spaced at 24" o.c. • resilient metal channels spaced 12" o.c. • 3⅝" mineral wool or glass fiber batt insulation • 1 layer of ⅝" gypsum board on ceiling side			
		1 h	-	-
UL L565	• 2 layer flooring system (6 types) • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss systems, 1. Ultra-Span by Aegis Metal Framing 2. Amkey System by Allied Studco 3. Versa-Truss by Dale/Incor 4. Strong-Span by Hexaport International Ltd. 5. Gus Truss by Nucon Steel Corporation 6. TrusSteel by Alpine Engineered Products • resilient or furring channels spaced 16" o.c. • any thickness mineral wool or glass fiber insulation, optional • 1 layer of ⅝" gypsum board on ceiling side			
		1 h	-	-

Floor/Ceiling – Underwriters Laboratories Inc.

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
UL L568	• subfloor of ⅝" plywood and finish floor of ⅝" wood structural panels • 8" x 18 ga steel joist spaced at 16" o.c. • resilient metal channels spaced 16" o.c. • 3 ½" mineral wool batt insulation • 1 layer of ⅝" gypsum board on ceiling side			
		45 min	53*	46*
	• subfloor of ¾" plywood • 8" x 18 ga steel joist spaced at 24" o.c. • resilient metal channels spaced 24" o.c. • 3 ½" glass fiber batt insulation • 2 layers of ½" gypsum board on ceiling side			
		45 min	52*	45*
	• subfloor of ¾" plywood • 8" x 18 ga steel joist spaced at 24" o.c. • 2 layers of ½" gypsum board on ceiling side			
		45 min	<40*	<40*
	• subfloor of ⅝" plywood • 8" x 18 ga steel joist spaced at 16" o.c. • 2 layers of ½" gypsum board on ceiling side			
		1 h	<40*	<40*

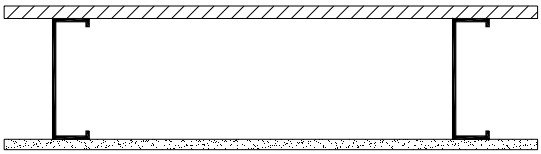
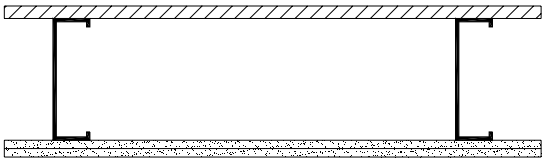
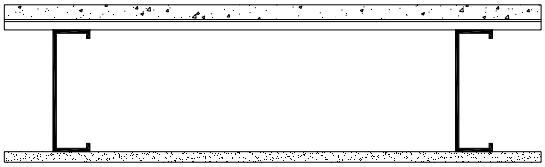
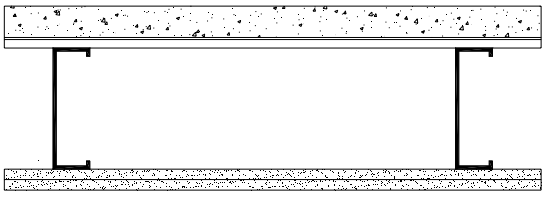
* Estimated value as per Warnock (2005)

Floor/Ceiling – Gypsum Association

Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
GA FC 4502	• subfloor of ⅝" plywood • 7" x 18 ga steel joist spaced at 24" o.c. • 2 layers of ½" Type X gypsum board on ceiling side			
		1 h	<50*	<40*
GA FC 4503	• subfloor of ¾" plywood • 6" x 16 ga steel joist spaced at 24" o.c. • 2 layers of ½" Type X gypsum board on ceiling side			
		1 h	<50*	<40*
GA FC 4750 a) NGC5004021 b) NGC7004068 c) NGC7004069	• subfloor of ¾" plywood • 8" x 16 ga steel joist spaced at 24" o.c. • 4 layers of ⅝" Type X gypsum board on ceiling side • resilient metal channels spaced 24" o.c. and applied perpendicular to joists over third layer of gypsum board			
		2 h	48[a]	37[b] 60[c] (CAR-UND)

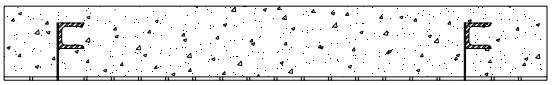
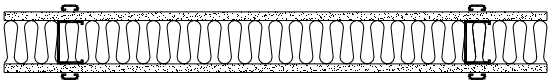
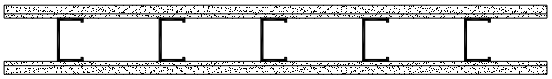
* Estimated value as per Warnock (2005)

Floor/Ceiling – Factory Mutual Research

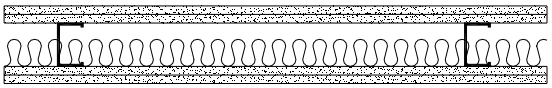
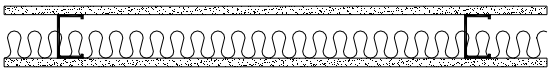
Source	Description	Fire Resistance Rating	Sound Transmission Class	Impact Insulation Class
FM FC 184	• subfloor of ¾" plywood • 7 ¼" x 18 ga steel joist spaced at 24" o.c. • 1 layer of ⅝" Type X gypsum board on ceiling side			
		45 min	<50*	<40*
FM FC 196	• subfloor of ¾" plywood • 7 ¼" x 18 ga steel joist spaced at 24" o.c. • 2 layers of ½" Type X gypsum board on ceiling side			
		1 h	<50*	<40*
FM FC 218	• 1 ½" Lite-Crete foam concrete • 28 ga (0.016" thick) steel deck with $^{9}/_{16}$" deep corrugations • 7 ¼" x 18 ga steel joist spaced at 24" o.c. • 1 layer of ⅝" Type X gypsum board on ceiling side			
		1 h	<50*	<40*
FM FC 224	• 2 ½" concrete • 28 ga (0.016" thick) steel deck with $^{9}/_{16}$" deep corrugations • 7 ¼" x 18 ga steel joist spaced at 24" o.c. • 2 layers of ⅝" Type X gypsum board on ceiling side			
		2 h	50*	<40*

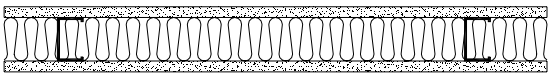
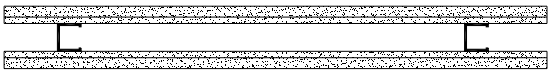
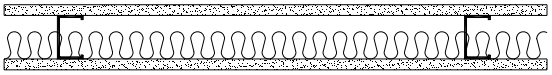
* Estimated value as per Warnock (2005)

NON-LOAD BEARING WALL ASSEMBLIES

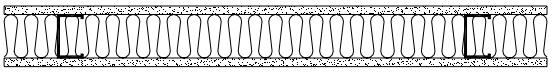
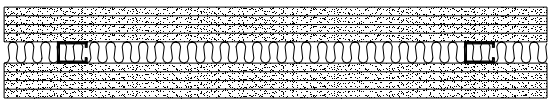
Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC U202	• paper backed wire fabric • 38 mm x 38 mm x 5 mm thick steel channel spaced at 600 mm o.c. • clips • vermiculite concrete		
		4 h	-
ULC U406 RAL-TL69-42	• 64 mm x 33 mm x 0.5 mm thick steel studs spaced at 600 mm o.c. • 38 mm mineral wool insulation • 1 layer 12.7 mm gypsum board each side		
		1 h	45
ULC W400	• 64 mm x 35 mm x 0.5 mm thick steel studs spaced not less than 150 mm o.c. • inner layer 6.4 mm gypsum board each side • laminating compound • outer layer 12.7 mm gypsum board on each side		
		1 h	-
ULC W402	• 64 mm x 35 mm x 0.5 mm thick steel studs spaced not less than 150 mm o.c. • inner layer 9.5 mm gypsum board each side • laminating compound • outer layer 12.7 mm or 15.9 mm gypsum board on each side		
		1 h	<45* (G 12.7mm)

* Estimated value as per Warnock (2005)

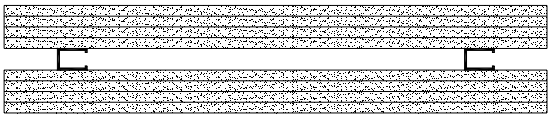
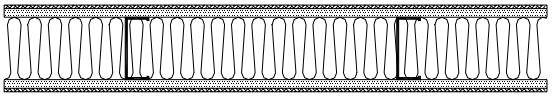
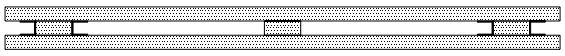
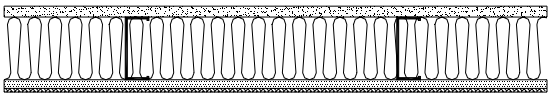
Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W404 RAL-TL75-73	• 64 mm x 35 mm x 0.5 mm thick steel studs spaced not less than 150 mm o.c. • inner layer 12.7 mm or 15.9 mm gypsum board each side • optional adhesive • outer layer 15.9 mm gypsum board on each side		
		2 h	47 (G 15.9mm)
ULC W406 a) CK654-40 b) USG800502 c) SA860932	• 64 mm x 32 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • optional 38 mm mineral wool insulation • 2 layers 12.7 mm gypsum board each side • laminating adhesive between inner and outer layer		
		2 h	54[a] (RFB 40mm) 53[b] (RFB 40mm) 52[c] (RFB 40mm)
ULC W407 RAL-TL92-239	• 92 mm x 35 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • 1 layer of 15.9 mm gypsum board on each side		
		1 h	39
ULC W408 RAL-TL69-42	• 64 mm x 35 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • 38 mm mineral wool insulation • 1 layer of 12.7 mm gypsum board on each side		
		1 h	45

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W409	• 63 mm x 31 mm x 0.6 mm thick steel studs spaced 600 mm o.c. • 70 mm glass fibre insulation • 1 layer of 15.9 mm gypsum board on each side * 45 min rating without insulation		
		1 h 45 min *	49*
ULC W410	• 41 mm x 32 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • inner layer of 9.5 mm gypsum board on each side • outer layer of 12.7mm or 15.9 mm gypsum board on each side		
		1 h	27* (G 12.7mm) 29* (G 15.9mm)
ULC W411	• 67 mm x 17 mm x 0.6 mm thick H section vented studs spaced at 600 mm o.c. • 19 mm "ultrawall" panels each side		
		1 h	39*
ULC W412 a) RAL-TL69-42 b) USG 800506	• 64 mm x 35 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • 38 mm mineral wool insulation • 1 layer of 12.7 mm or 15.9 mm gypsum board on each side		
		1 h	45[a] (G 12.7mm) 46[b] (G 15.9mm)

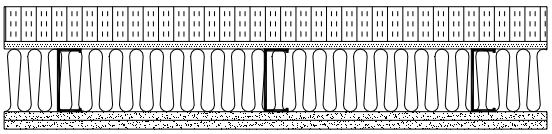
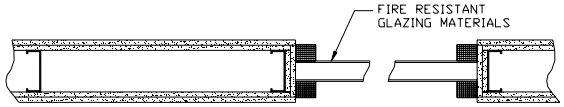
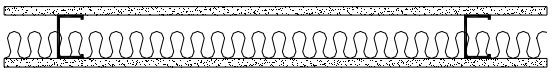
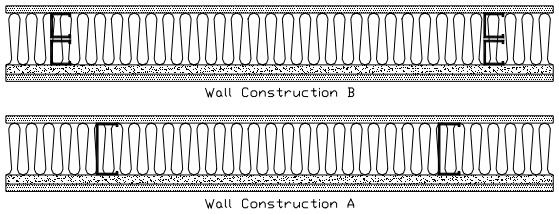
* Estimated value as per Warnock (2005)

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W413	• 64 mm x 35 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • 70 mm glass fibre insulation • 1 layer of 12.7 mm gypsum board on each side		
		45 min	47*
ULC W414	• 63 mm x 31 mm x 0.6 mm thick steel channel spaced 600 mm o.c. • 2 layers 12.7 mm or 15.9 mm gypsum board each side • outer layer laminated to inner layer with laminating compound		
		2 h	44* (G 12.7mm) 47* (G 15.9mm)
ULC W415 NRC TL-92-376	• 92 mm x 35 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • 1 layer of 15.9 mm gypsum board on each side		
		1 h	38
ULC W417 a) SA 830113 b) SA 830112	• 41 mm x 31 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • optional 38 mm mineral wool insulation • 4 hours - 4 layers of 12.7 mm gypsum board on each side • 3 hours – 3 layers of 12.7 mm gypsum board on each side		
		4 h 3 h	62[a] (RFB 40mm) 59[b] (RFB 40mm)

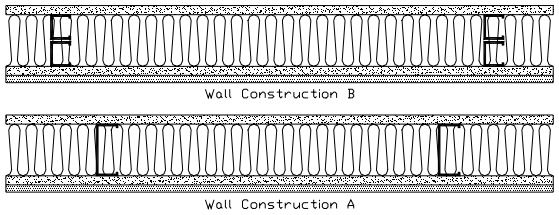
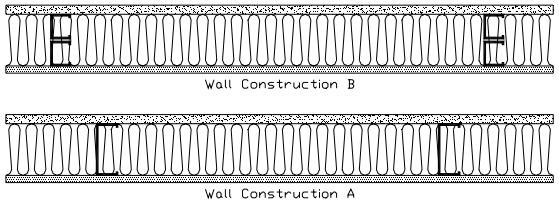
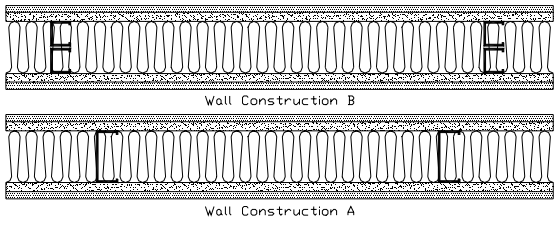
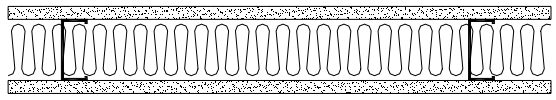
* Estimated value as per Warnock (2005)

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W418	• 41 mm x 32 mm x 0.53 mm thick steel studs spaced 600 mm o.c. • 4 hours - 4 layers of 12.7 mm or 15.9 mm gypsum board on each side • 3 hours – 3 layers of 12.7 mm or 15.9 mm gypsum board on each side		
		4 h 3 h	50* (G 12.7mm) 46* (G 12.7mm)
ULC W419	• 92 mm x 32 mm x 0.5 mm thick steel studs spaced 400 mm o.c. • 90 mm mineral wool insulation • inner layer of 12.7 mm tile backer board each side • outer layer of 5.2 mm ceramic tile each side, joints filled with wall grout		
		1 h	54*
ULC W421	• 38 mm x 40 mm x 0.6 mm channel studs spaced 1220 mm o.c. • 1 layer 38 mm thick x 1.22 m wide mineral and fibre board each side • 38 mm thick x 101.6 mm wide mineral and fibre board backing strips		
		2 h	-
ULC W423	• 92 mm x 32 mm x 0.5 mm thick steel studs spaced 400 mm o.c. • 90 mm mineral wool insulation • inner layer of 12.7 mm tile backer board on one side, designated "Durock" • outer layer of 5.2 mm ceramic tile, joints filled with wall grout • 1 layer of 12.7 mm or 15.9 mm gypsum board on one side.		
		1 h	51* (G 12.7mm) 52* (G 15.9mm)

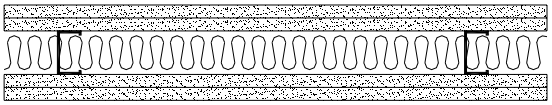
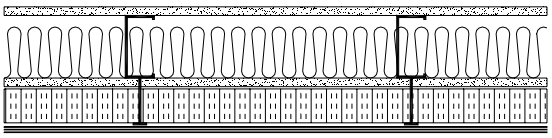
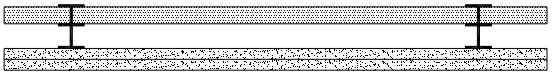
* Estimated value as per Warnock (2005)

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W425	• 92 mm x 35 mm x 0.9 mm thick steel studs spaced 305 mm o.c. • 90 mm glass fibre insulation • 38 mm x 12.7 mm x 1.2 mm thick channel bracing inserted in the knockouts and supported by angles • 0.05 mm clear polyethylene • 2 layers of 12.7 mm gypsum board on one side • see ULC description for exterior insulation and stucco finish details		
		2 h	-
ULC W426	• 102 mm x 32 mm x 1.0 mm thick steel studs spaced 600 mm o.c. • 2 layers of 12.7 mm gypsum board on each side • fire resistant glazing materials		
		1 h	-
ULC W433 RAL-TL69-42	• 64 mm x 35 mm x 0.5 mm thick steel studs spaced 600 mm o.c. • 38 mm mineral wool insulation designated "Acoustical Fire Batts" • 1 layer of 12.7 mm gypsum board on each side		
		1 h	45
ULC W436	• Wall A – 90 mm x 35 mm x 0.62 mm thick steel studs spaced at 600 mm o.c. • 89 mm mineral wool insulation • 1 layer of 12.7 mm or 15.9 mm gypsum board on one side • 1 layer of 12.7 mm reinforced cement board, designated "PanaRoc" on each side		
		1 h *see ULC listing for Wall B design	51* (Wall A, G 12.7mm) 54* (Wall B, G 15.9mm)

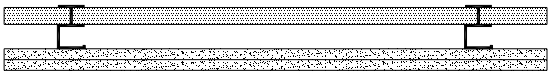
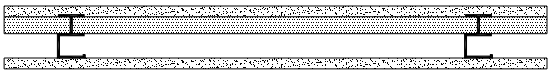
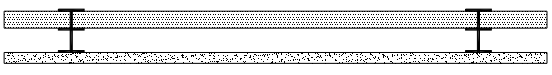
* Estimated value as per Warnock (2005)

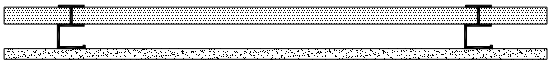
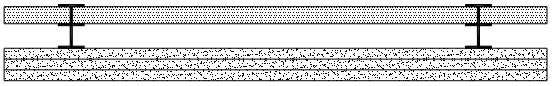
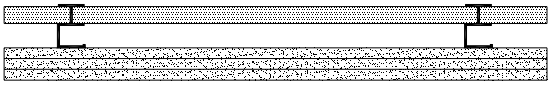
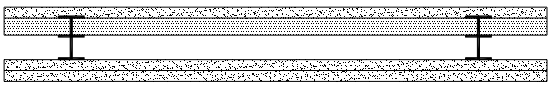
Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W437	• Wall A – 90 mm x 35 mm x 0.62 mm thick steel studs spaced at 600 mm o.c. • 89 mm mineral wool insulation • 1 layer of 12.7 mm or 15.9 mm gypsum board on each side • 1 layer of 12.7 mm reinforced cement board, designated "PanaRoc" on one side		
		1 h *see ULC listing for Wall B design	52* (Wall A, G 12.7mm) 54* (Wall A, G 15.9mm) 55* (Wall B, G 12.7mm) 57* (Wall B, G 15.9mm)
ULC W438	• Wall A – 90 mm x 32 mm x 0.62 mm thick steel studs spaced at 600 mm o.c. • 89 mm mineral wool insulation • 1 layer of 15.9 mm gypsum board on one side • 1 layer of 12.7 mm reinforced cement board, designated "PanaRoc" on other side		
		1 h *see ULC listing for Wall B design	49* (Wall A) 55* (Wall B)
ULC W439	• Wall A – 90 mm x 32 mm x 0.62 mm thick steel studs spaced at 600 mm o.c. • 89 mm mineral wool insulation • 1 layer of 12.7 mm or 15.9 mm gypsum board on each side • 1 layer of 12.7 mm reinforced cement board, designated "PanaRoc" on each side		
		2 h *see ULC listing for Wall B design	55* (Wall A, G 12.7mm) 56* (Wall A, G 15.9mm) 55* (Wall B, G 12.7mm) 57* (Wall B, G 15.9mm)
ULC W440 USG910617	• 89 mm x 32 mm x 0.5 mm thick steel studs spaced at 610 mm o.c. • 76 mm mineral wool insulation • 1 layer of 19.1 mm gypsum board on each side		
		2 h	50

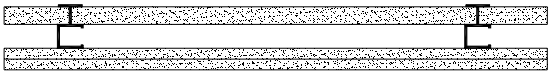
* Estimated value as per Warnock (2005)

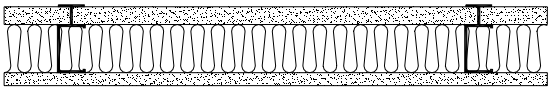
Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W441 a) SA910507 b) USG910907	• 64 mm x 32 mm x 0.5 mm thick steel studs spaced at 610 mm o.c. • 50 mm mineral wool insulation • 2 layers of 19.1 mm gypsum board on each side		
		4 h	56[a & b]
ULC W442	See ULC listing for full description * Fire exposure from exterior side ** Fire exposure from interior side		
		1 h * 1 ½ h **	-
ULC W446	System A • 64 mm x 38 mm x 0.53 mm thick steel "I" studs with 19 mm x 57 mm high holding tabs spaced at 610 mm o.c. • 25.4 mm gypsum board on one side • 2 layers of 12.7 mm or 15.9 mm gypsum board on other side		
		2 h	39* (G 12.7mm) 41* (G 15.9mm)

* Estimated value as per Warnock (2005)

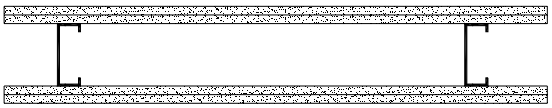
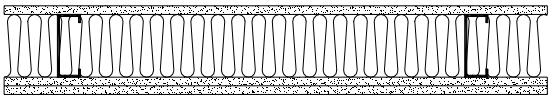
Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W446 (cont.)	System B • 64 mm x 38 mm x 0.53 mm thick steel "I" studs with 19 mm x 57 mm high holding tabs spaced at 610 mm o.c. • inner layer of 25.4 mm gypsum board on one side • 1 layer of 12.7 mm or 15.9 mm gypsum board on each side		
		2 h	-
	System C • 64 mm x 38 mm x 0.53 mm thick steel "C-T" shaped studs spaced at 610 mm o.c. • 1 layer 25.4 mm gypsum board on one side • 2 layers of 12.7 mm or 15.9 mm gypsum board on other side		
		2 h	-
	System D • 64 mm x 38 mm x 0.53 mm thick steel "C-T" shaped studs spaced at 610 mm o.c. • inner layer of 25.4 mm gypsum board on one side, with 12.7 mm or 15.9 mm gypsum board outer layer • 1 layer of 12.7 mm or 15.9 mm gypsum board on other side		
		2 h	-
	System E • 64 mm x 38 mm x 0.53 mm thick steel "I" studs with 19 mm x 57 mm high holding tabs spaced at 610 mm o.c. • 1 layer 25.4 mm gypsum board on one side • 1 layer of 15.9 mm gypsum board on other side		
		1 h	-

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W446 (cont.)	System F • 64 mm x 38 mm x 0.53 mm thick steel "C-T" shaped studs spaced at 610 mm o.c. • 1 layer 25.4 mm gypsum board on one side • 1 layer of 15.9 mm gypsum board on other side		
		1 h	-
	System G • 64 mm x 38 mm x 0.53 mm thick steel "I" studs with 19 mm x 57 mm high holding tabs spaced at 610 mm o.c. • 1 layer 25.4 mm gypsum board on one side • 3 layers of 15.9 mm gypsum board on other side		
		3 h	-
	System H • 64 mm x 38 mm x 0.53 mm thick steel "C-T" shaped studs spaced at 610 mm o.c. • 1 layer 25.4 mm gypsum board on one side • 3 layers of 15.9 mm gypsum board on other side		
		3 h	-
	System I • 64 mm x 38 mm x 0.53 mm thick steel "I" studs with 19 mm x 57 mm high holding tabs spaced at 610 mm o.c. • inner layer of 25.4 mm gypsum board on one side, with 15.9 mm gypsum board outer layer • 2 layers of 15.9 mm gypsum board on other side		
		3 h	-

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W446 (cont.)	System J • 64 mm x 38 mm x 0.53 mm thick steel "C-T" shaped studs spaced at 610 mm o.c. • inner layer of 25.4 mm gypsum board on one side, with 15.9 mm gypsum board outer layer • 2 layers of 15.9 mm gypsum board on other side		
		3 h	-
ULC W502	• two or three layers of 12.7 mm or 15.9 mm thick, 150 mm wide wallboard ribs spaced at 600 mm o.c. • 1 layer 15.9 mm gypsum board on each side		
		1 h	-
ULC W506	• 64 mm x 35 mm x 0.5 mm thick steel "C-H" shaped studs spaced at 600 mm o.c. • 1 layer 25 mm gypsum board on one side • 2 layers 12.7 mm gypsum board on other side		
		2 h	-
ULC W507	• 64 mm x 35 mm x 0.5 mm thick steel "C-H" shaped studs spaced at 600 mm o.c. • 1 layer 25 mm gypsum board on one side • 2 layers 15.9 mm gypsum board on other side		
		2 h	-

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W508 USG910913	• 100 mm x 38 mm x 0.5 mm thick steel "C-H" shaped studs spaced at 610 mm o.c. • 76 mm mineral wool insulation • 1 layer 25.4 mm gypsum board on one side • 1 layer 19.1 mm gypsum board on other side		
		2 h	52

NOTE: ULC Certification Bulletin No. 2003-08 (dated August 21, 2003) provides an official ULC permission for ULC listed and package labelled mineral fibre building insulation (processed from rock, slag and glass only) to be used in ULC non-load bearing wall assembly designs consisting of gypsum wallboard and steel or wood studs with a fire resistance rating not exceeding 2 hours when illustrated without insulation, without detracting from the rating assigned to the assembly.

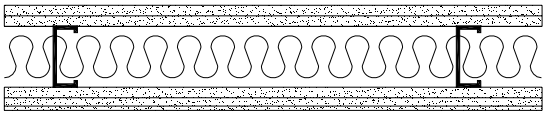
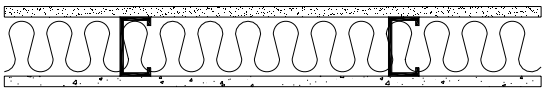
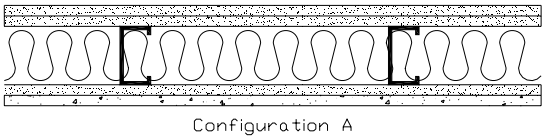
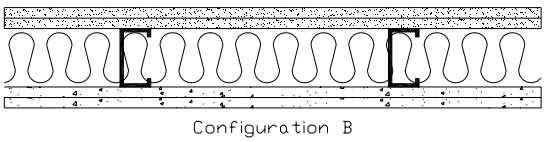
Source	Description	Fire Endurance	Sound Transmission Class
NRCC IR-674 F03 F05 USG840817	• 90 mm x 30 mm x 0.46 mm thick steel studs spaced at 600 mm o.c. • 2 layers 12.7 mm gypsum board on each side NOTE: Density of gypsum board varies between two tests; F03=7.35kg/m^2 F05=7.80 kg/m^2	 F03 = 63 min F05 = 69 min	50
NRCC IR-675 F07 TLA-02-013a	• 90 mm x 30 mm x 0.46 mm thick steel studs spaced at 600 mm o.c. • 1 layer 12.7 mm gypsum board on one side • 2 layers 12.7 mm gypsum board on other side	 65 min	41
NRCC IR-675 F09 F10 F10B F11 a) NRC TL-92-411 b) TL-93-027	• 90 mm x 30 mm x 0.46 mm thick steel studs spaced at 600 mm o.c. • 1 layer 12.7 mm gypsum board on one side • 2 layers 12.7 mm gypsum board on other side • 90 mm thick insulation as follows: F09 - glass fibre F10 - 584 mm wide mineral fibre F10B - 615 mm wide mineral fibre F11 - cellulose	 F09 = 65 min F10 = 60 min F10B = 100 min F11 = 62 min	52[a] 52* 52* 53[b]

* Estimated value as per Warnock (2005)

References:
Sultan, M.A., Lougheed, G.D., Denham, E.M.A., Monette, R.C. and MacLaurin, J.W., *Temperature Measurements in Full-Scale Fire Resistance Tests on Non-Insulated Regular Gypsum Board Wall Assemblies, IRC Internal Report No. 674*, National Research Council of Canada, Ottawa, Ontario, Canada, December 1994.

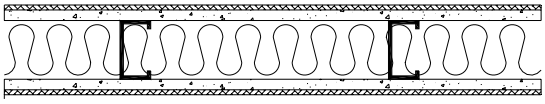
Sultan, M.A., MacLaurin, J.W., Denham, E.M.A. and Monette, R.C., *Temperature Measurements in Full-Scale Insulated and Non-Insulated (1x2) Gypsum Board Protected Wall Assemblies with Steel Studs, IRC Internal Report No. 675*, National Research Council of Canada, Ottawa, Ontario, Canada, December 1994.

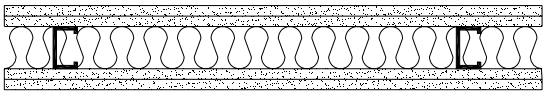
* Warnock, A.C.C., *Estimation of Sound Transmission Class and Impact Insulation Class Rating for Steel Framed Assemblies*, Report No. B3436.1, Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, December 2005.

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U403	• 3 ⅝” x 25 ga 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 h	58*
UL U404	• 3 ½” x 20 ga steel studs spaced at 16” o.c. • 3” mineral wool insulation • 1 layer ½” or ⅝” cementitious board on one side • 1 layer ⅝” thick gypsum board on other side		
		1 h	-
	• 3 ½” x 20 ga steel studs spaced at 16” o.c. • 3” mineral wool insulation • 2 layers ⅝” gypsum board on one side • inner layer of ⅝” thick gypsum, outer layer of ½” or ⅝” cementitious board on other side	 Configuration A	
		2 h	-
	• 3 ½” x 20 ga steel studs spaced at 16” o.c. • 3” mineral wool insulation • 2 layers ½” or ⅝” cementitious board on one side • 2 layers ⅝” thick gypsum board on other side	 Configuration B	
		2 h	-

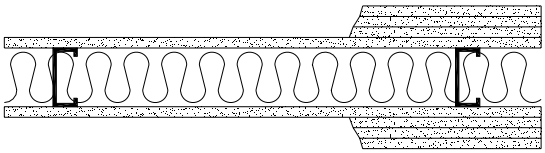
* Estimated value as per Warnock (2005)

<table>
<tr><th>Source</th><th>Description</th><th>Fire Resistance Rating</th><th>Sound Transmission Class</th></tr>
<tr><td>UL
U407

USG 840321</td><td>• 3 ½” x 20 ga steel studs spaced at 16” o.c.
• 3” mineral wool insulation
• ⅝” cementitious board, ceramic tiles and exterior finish on either side</td><td colspan="2">  </td></tr>
<tr><td></td><td></td><td>1 h</td><td>48</td></tr>
<tr><td>UL
U411

NRC TL-93-037</td><td>• 2 ½” x 25 ga steel studs spaced at 24” o.c.
• optional mineral wool or glass fiber insulation
• 2 layers ⅝” gypsum board on each side</td><td colspan="2">  </td></tr>
<tr><td></td><td></td><td>2 h</td><td>55 (GFB 2½”)</td></tr>
<tr><td>UL
U419

a) SA870717
b) SA860620
c) RAL-TL90-166
d) USG860808
e) USG910617
f) SA830112
g) SA830113
h) USG910907</td><td>• min 25 ga steel studs spaced at 24” o.c.
• mineral wool insulation optional except where required as noted by asterisk and described below
• stud depth, drywall layers, drywall thickness, and corresponding rating as shown

* 1½” mineral wool insulation
** 3” mineral wool insulation
*** 2” mineral wool insulation</td><td colspan="2">  </td></tr>
<tr><td></td><td></td><td colspan="2">
<table>
<tr><th></th><th>#Layer & Size</th><th>Stud Depth</th><th></th></tr>
<tr><td>1 h</td><td>1-⅝</td><td>3-½</td><td>49[a] (RFB 3”)
51[b&c] (RFB 3½”)
40[d] (NI)</td></tr>
<tr><td>1 h</td><td>1-½</td><td>2-½*</td><td></td></tr>
<tr><td>1 h</td><td>1-¾</td><td>1-⅝</td><td></td></tr>
<tr><td>2 h</td><td>2-½</td><td>1-⅝</td><td></td></tr>
<tr><td>2 h</td><td>2-⅝</td><td>1-⅝</td><td></td></tr>
<tr><td>2 h</td><td>1-¾</td><td>3-½**</td><td>50[e]</td></tr>
<tr><td>3 h</td><td>3-½</td><td>1-⅝</td><td>59[f] (RFB 1½”)</td></tr>
<tr><td>3 h</td><td>2-¾</td><td>1-⅝</td><td></td></tr>
<tr><td>3 h</td><td>3-⅝</td><td>1-⅝</td><td></td></tr>
<tr><td>4 h</td><td>4-⅝</td><td>1-⅝</td><td></td></tr>
<tr><td>4 h</td><td>4-½</td><td>1-⅝</td><td>62[g] (RFB 1½”)</td></tr>
<tr><td>4 h</td><td>2-¾</td><td>2-½***</td><td>56[h]</td></tr>
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</td></tr>
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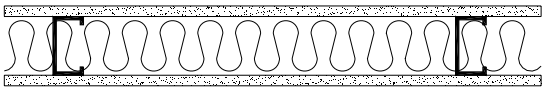
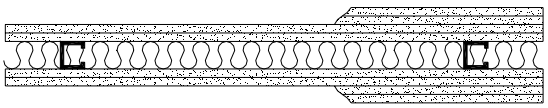
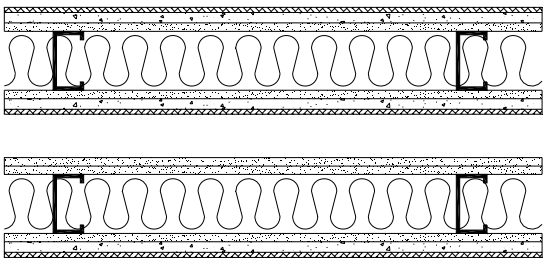
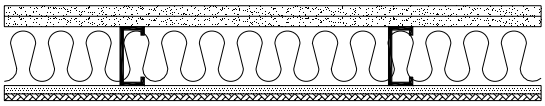
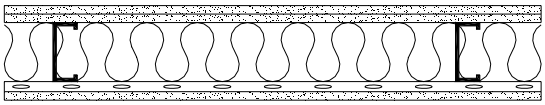
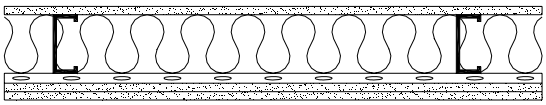
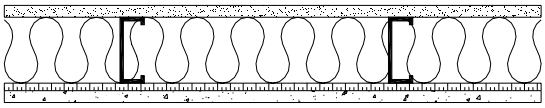
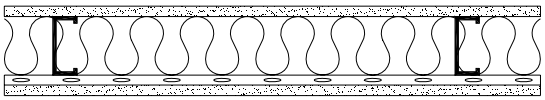
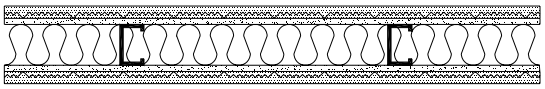
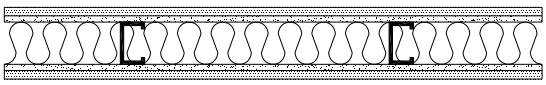
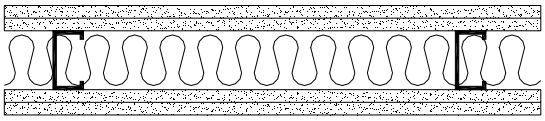
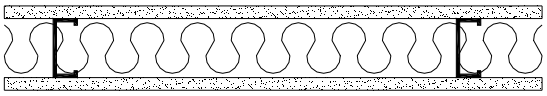
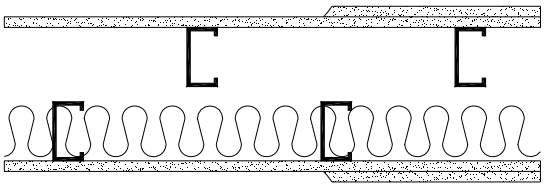
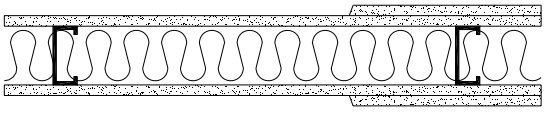
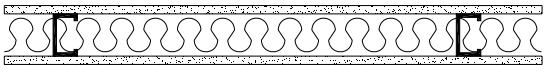
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U432	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • optional glass fiber or mineral wool insulation • ⅝" gypsum board on each side		
		1 h	-
UL U435 a) SA830112 b) SA830113	• 1 ⅝" x 25 ga steel stud spaced at 16" or 24" o.c. • optional mineral wool insulation • 4 layers ½" gypsum board on each side for 4 h • 3 layers ½" or 2 layers ¾"gypsum board on each side for 3 h		
		3 h 4 h	59[a] (RFB 1½") 62[b] (RFB 1½")
UL U443 SA851028	• 3 ⅝" x 20 ga steel studs spaced at 24" o.c. • 3" min "Thermafiber" insulation • inner layer ½" gypsum board on each side • 1 layer ½" or ⅝" cementitious board on each side • outer layer ¼" ceramic tile on each side	 Alternate Construction	
		2 h *see UL listing for Alternate design	58 (CEMBRD ½")
UL U449	• 3 ⅝" x 1 ⅜" x 20 ga steel studs spaced at 16" o.c. • 3 ⅝" insulation having min 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 - ½ h	<50*

* Estimated value as per Warnock (2005)

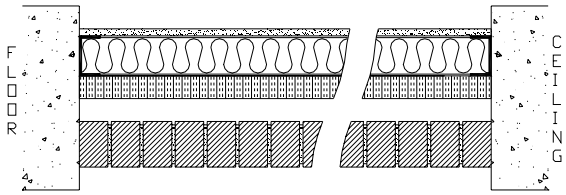
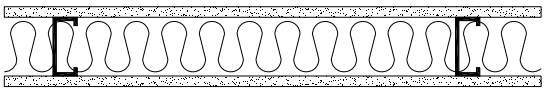
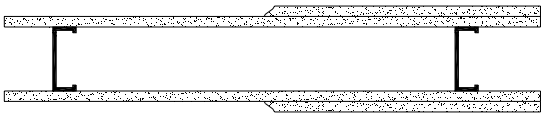
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U452 RAL-TL83-215	• 3 ½" x 1 ¼" x 20 ga steel studs spaced at 24" o.c. • 3" min "Thermafiber" insulation • 2 layers ½" gypsum board on one side • steel resilient channels, 25 ga, spaced at 24" o.c. • 1 layer of ½" gypsum board on other side		
		1 - ½ h	58
UL U453	• 3 ½" x 1 ¼" x 20 ga steel studs spaced at 24" o.c. • 3" min "Thermafiber" insulation • 1 layer ½" gypsum board on one side • steel resilient channels, 25 ga, spaced at 24" o.c. • 2 layers of ½" gypsum board on other side		
		2 h	-
UL U457 USG840222	• 3 ⅝" x 1 ¼" x 20 ga steel studs spaced at 16" o.c. • 1 layer ⅝" gypsum board on one side • 3" min "Thermafiber" insulation • inner layer of ½" rigid polystyrene insulation (optional), and outer layer of ½" or ⅝" cementitious board on other side		
		1 h	50 (CEMBRD ½")

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U465 a) SA870717 b) SA860620 c) RAL-TL90-166	• 3 ⅝" x 1 ¼" x 25 ga steel studs spaced at 24" o.c. • optional mineral wool or glass fiber insulation • optional steel resilient channels, 25ga, spaced at 24" 0.c. • 1 layer ⅝" gypsum board on each side		
		1 h	49[a] (RFB 3") 51[b & c] (RFB 3½") 51*(RFB 3½" RC)
UL U484	• 2 ½" x 1¼" x 20 ga steel stud spaced at 16" o.c. • optional "Thermafiber" insulation • 1 layer ⅜" gypsum board on each side • metal lath and ¾" plaster on each side		
		2 h	<50*
UL U488	• 2 ½" x 1¼" x 20 ga steel stud spaced at 16" o.c. • 1" min "Thermafiber" insulation • 1 layer ⅜" gypsum board on each side • $^{7}/_{16}$" plaster on each side		
		1 h	<50*
UL U490 USG910907	• 2 ½" x 1¼" x 25 ga steel stud spaced at 24" o.c. • 2" nominal "Thermafiber" insulation • 2 layers ¾" gypsum board on each side		
		4 h	56

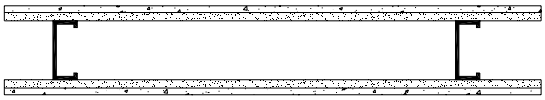
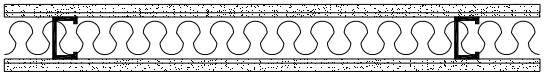
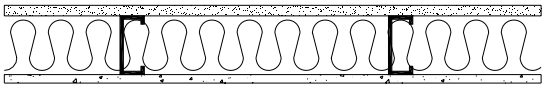
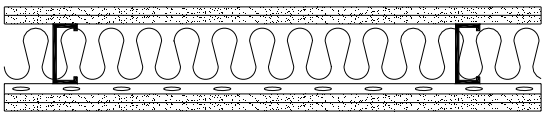
* Estimated value as per Warnock (2005)

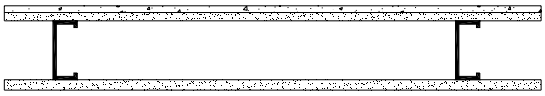
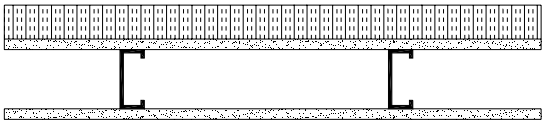
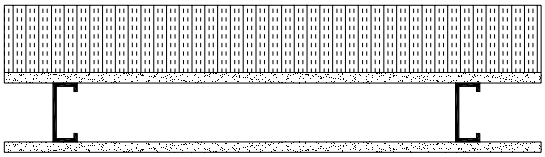
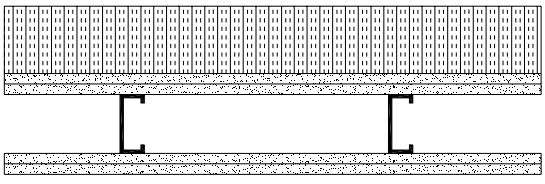
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U491 USG910617	• 3 ½" x 1¼" x 25 ga steel stud spaced at 24" o.c. • 3" nominal "Thermafiber" insulation • 1 layer ¾" gypsum board on each side		
		2 h	50
UL U493	• 1 hour - 2 ½" x 1 ⅝" x 20 MSG steel studs spaced at 16" o.c. • 2 hour - 3 ⅝" x 1 ⅝" x 18 MSG steel studs spaced at 16" o.c. • 3 ½" glass fiber insulation on one side of wall assembly with nom. density of 0.5 pcf • 1 hour - 1 layer ⅝" or ¾" gypsum board on each side • 2 hour – 2 layers ⅝" gypsum board on each side		
		1 h for 1 - ⅝ in. 2 h for 2 - ⅝ in.	-
UL U495 a) SA860620 b) RAL-TL90-166	• 3 ⅝" x 1 ¼" x 25 ga steel studs spaced at 24" o.c. • optional mineral wool or glass fiber insulation • 1 hour - 1 layer ⅝" or ¾" gypsum board on each side • 2 hour – 2 layers ⅝" gypsum board on each side		
		1 h 2 h	51[a&b] (G ⅝"RFB 3½") 53* (G ¾" RFB 3½") 58* (RFB 3½")
UL V401	• 2 ½" x 1⅜" x 25 ga steel stud spaced at 24" o.c. • 2" mineral wool insulation with UL Classification Marking • 1 layer ½" gypsum board on each side		
		1 h	47*

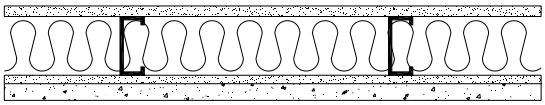
* Estimated value as per Warnock (2005)

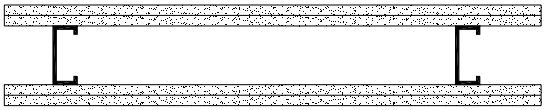
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL V414	• 3 ⅝" x 1 ⅝" x 20 ga steel studs spaced at 16" o.c. • 3 ½" glass fiber insulation • 1 layer ⅝" gypsum board on one side • 1 layer 2" foamed plastic board on other side • 4" brick veneer		
		3 h Interior 1 h Exterior	-
UL V416 USG860808	• 3 ⅝" x 1 ¼" x 25 ga steel studs spaced at 24" o.c. • optional mineral wool or glass fiber insulation • 1 layer ⅝" or ¾" gypsum board on each side		
		1 h	40 (G ⅝" NI) 43* (G ¾" NI) 53* (G ¾" RFB 3½")
UL V450	• 3 ⅝" x 1 $^{3}/_{16}$" **proprietary** steel stud (Dietrich Industries Inc.) with 0.0155" thickness spaced at 24" o.c. • 1 hour - 1 layer of ⅝" gypsum board on each side • 2 hour – 2 layers of ⅝" gypsum board on each side		
		1 h 2 h	-

* Estimated value as per Warnock (2005)

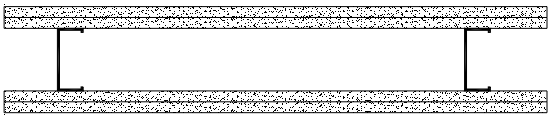
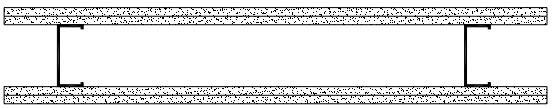
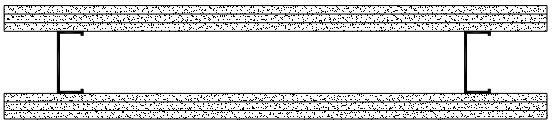
Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1041 ASL AS-TL1510	• 3 ⅝" x 20 ga steel studs spaced at 24" o.c. • inner layer ½" Type X gypsum board and outer layer ¼" fiber-cement board on each side		
		1 h	50 to 54
GA WP1051 NGC 2318	• 2 ½" steel studs spaced at 24" o.c. • 2" glass fiber insulation • inner layer ¼" gypsum board and outer layer ½" Type X gypsum board on each side		
		1 h	53
GA WP1082 NGC 2099015	• 3 ⅝" x 25 ga steel studs spaced at 16" o.c. • 3" mineral fiber insulation • 1 layer ⅝" Type X gypsum board on one side • 1 layer ½" cementitous board on other side		
		1 h	45 to 49
GA WP1470 RAL TL83-214	• 3 ½" x 20 ga steel studs spaced at 24" o.c. • 3" mineral fiber insulation • 2 layers ½" Type X gypsum board on one side • resilient channels spaced 24" o.c. and 2 layers ½" Type X gypsum board on other side		
		2 h	55 to 59

Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP8003	• 3 ⅝" x 20 ga steel studs spaced at 24" o.c. • 1 layer ⅝" Type X gypsum board on one side • inner layer of ½" Type X gypsum board and outer layer of ¼" fiber-cement board on other side		
		1 h	-
GA WP8122	• 3 ⅝" x 18 ga steel studs spaced at 16" o.c. • 1 layer ⅝" Type X gypsum board on one side • inner layer of ⅝" Type X gypsum board and outer layer of 2" expanded polystyrene on other side		
		1 h	-
GA WP8123	• 3 ⅝" x 18 ga steel studs spaced at 24" o.c. • 1 layer ⅝" Type X gypsum board on one side • inner layer of ⅝" Type X gypsum board and outer layer of 4" expanded polystyrene on other side		
		2 h	-
GA WP8202	• 3 ⅝" x 18 ga steel studs spaced at 16" o.c. • 2 layers ⅝" Type X gypsum board on one side • 2 layers of ⅝" Type X gypsum board and 4" expanded polystyrene on other side		
		2 h	-

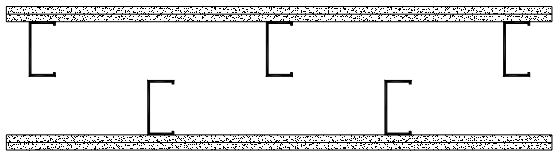
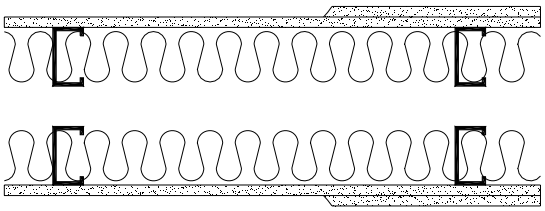
Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP8250	• 3 ⅝" x 20 ga steel studs spaced at 16" o.c. • 3" mineral fiber insulation • 1 layer ⅝" foil backed Type X gypsum board on one side • ½" gypsum board with stucco finish on other side		
		2 h	-

Source	Description	Fire Resistance Rating	Sound Transmission Class
FM Wall 1 USG810519	• 3 ⅝" x 22 ga steel studs spaced at 24" o.c. • 1 layer ⅝" gypsum board on each side		
		1 h	40
FM Wall 7 BBN760808	• 3 ⅝" x 22 ga steel studs spaced at 24" o.c. • 2 layers ⅝" gypsum board on each side		
		2 h	48

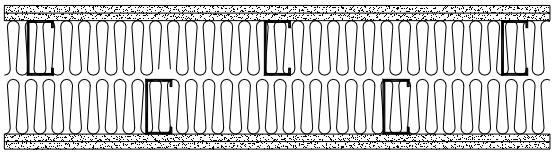
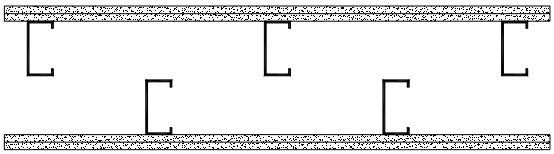
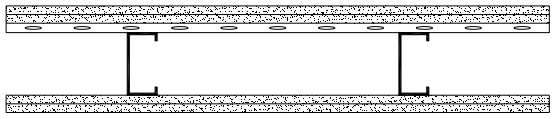
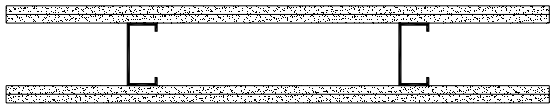
LOAD BEARING
WALL ASSEMBLIES

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W424 a) USG810519 b) BBN760808	• 92 mm x 35 mm **proprietary** steel stud (Bailey Metal Products), 0.9 mm thickness spaced at 600 mm o.c. • 1 layer of 15.9 mm Type X gypsum board (Canadian Gypsum Company, Sheetrock Firecode C) on each side		
		1 h	40[a]
	• 92 mm x 35 mm **proprietary** steel stud (Bailey Metal Products), 0.9 mm thickness spaced at 600 mm o.c. • 2 layers of 15.9 mm Type X gypsum board (Canadian Gypsum Company, Sheetrock Firecode C) on each side ** 60% of Design Load		
		** 2 h	48[b]
	• 92 mm x 35 mm **proprietary** steel stud (Bailey Metal Products), 0.9 mm thickness spaced at 600 mm o.c. • 2 layers of 12.7 mm Type X gypsum board (Canadian Gypsum Company, Sheetrock Firecode C) on each side ** 85% of Design Load		
		** 1 – ½ h	<50*
	• 92 mm x 35 mm **proprietary** steel stud (Bailey Metal Products), 0.9 mm thickness spaced at 600 mm o.c. • 3 layers of 12.7 mm Type X gypsum board (Canadian Gypsum Company, Sheetrock Firecode C) on each side ** 60% of Design Load		
		** 2 h	50*

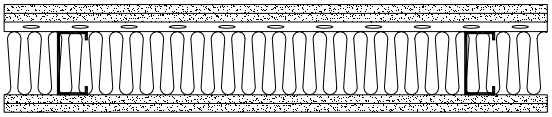
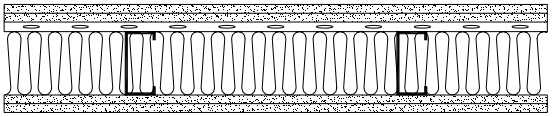
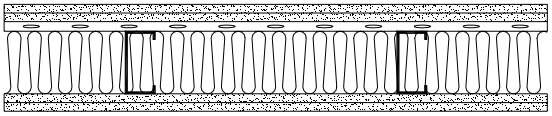
* Estimated value as per Warnock (2005)

Source	Description	Fire Resistance Rating	Sound Transmission Class
ULC W445	• double wall system with min 7 mm space between each 92 mm x 41 mm x 0.80 mm thick steel stud spaced at 400 mm o.c. • 2 layers of 12.7 mm gypsum board on each side		
		1 – ½ h	54*
ULC W449	• double wall system with 89 mm x 41 mm x 0.86 mm thick steel stud spaced at 610 mm o.c. • any glass fibre insulation with ULC Listing Mark with min. density of 8.0 kg/m^3 • 1 or 2 layers of 15.9 mm gypsum board on each side		
	** 80% of Design Load	**1 h for 1–15.9mm 2 h for 2-15.9mm	58* (AIR 25mm) 59* (AIR 50mm) 68* (AIR 25mm) 69* (AIR 50mm)

* Estimated value as per Warnock (2005)

Source	Description	Fire Endurance	Sound Transmission Class
NRCC A4222.2 F26	• double wall system with 92 mm deep x 0.91 mm thick steel stud spaced at 406 mm o.c. • 90 mm mineral fibre insulation • 2 layers of 12.7 mm Type X gypsum board on each side		
		84 min	64*
NRCC A4222.2 F30 F30R TLA-01-019a	• double wall system with 92 mm deep x 0.91 mm thick steel stud spaced at 406 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on each side NOTE: F30R used to measure the repeatability of the results.		
		F30 -100 min F30R -102 min	55
NRCC A4222.2 F37	• 92 mm deep steel stud with 0.91 mm thickness spaced at 406 mm o.c. • steel resilient channels spaced 406 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on each side		
		77 min	46*
NRCC A4222.2 F39	• 92 mm deep steel stud with 0.91 mm thickness spaced at 406 mm o.c. • 2 layers of 12.7 mm Type X gypsum board on each side		
		83 min	<50*

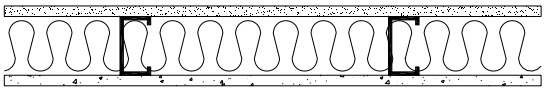
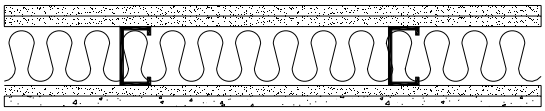
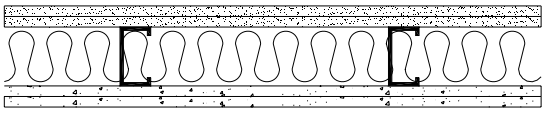
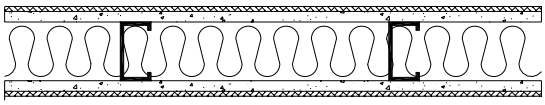
* Estimated value as per Warnock (2005)

Source	Description	Fire Endurance	Sound Transmission Class
NRCC A4222.2 F28	• 92 mm deep steel stud with 0.91 mm thickness spaced at 610 mm o.c. • steel resilient channels spaced 406 mm o.c. • 90 mm mineral fibre insulation • 2 layers of 12.7 mm Type X gypsum board on each side		
		74 min	56*
NRCC A4222.2 F35 F36	• 92 mm deep steel stud with 0.84 mm thickness spaced at 406 mm o.c. • steel resilient channels spaced 406 mm o.c. • 90 mm glass fibre insulation • 2 layers of 12.7 mm Type X gypsum board on each side NOTE: Applied load varies between two tests; F35=78.4kN, F36=70.9kN		
		F35 = 68 min F36 = 63 min	55*
NRCC A4222.2 F27 F31 F38	• 92 mm deep steel stud with 0.91 mm thickness spaced at 406 mm o.c. • steel resilient channels spaced 406 mm o.c. • insulation (see below) • 2 layers of 12.7 mm Type X gypsum board on each side F27 - 90 mm glass fibre insulation F31 - 90 mm cellulose insulation F38 – 90 mm mineral fibre insulation		
		F27 = 56 min F31 = 71 min F38 = 59 min	55* 54* 54*

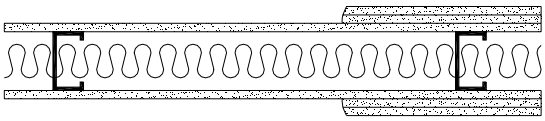
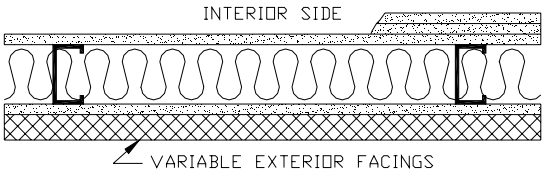
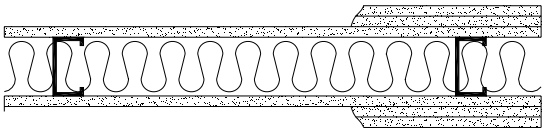
* Estimated value as per Warnock (2005)

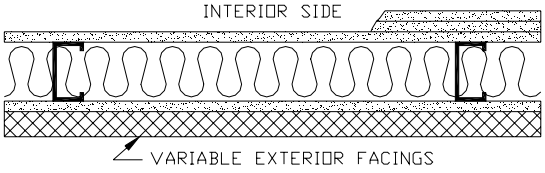
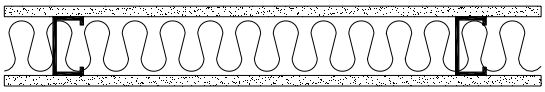
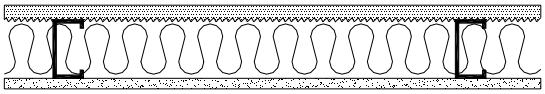
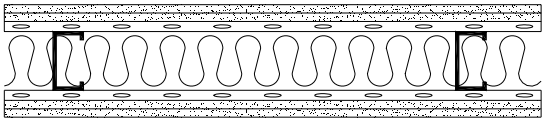
References:
Kodur, V.K.R., Sultan, M.A., Latour, J.C., Leroux, P. and Monette, R.C., *Fire Resistance Tests on Gypsum Board-Protected Loadbearing Steel Stud Walls, IRC Client Report No. A-4222.2*, National Research Council of Canada, Ottawa, Ontario, Canada, February 2002.

* Warnock, A.C.C., *Estimation of Sound Transmission Class and Impact Insulation Class Rating for Steel Framed Assemblies*, Report No. B3436.1, Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada, December 2005.

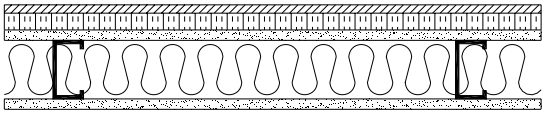
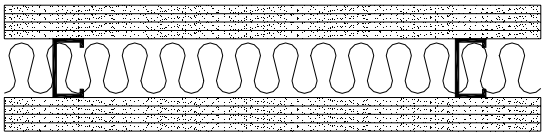
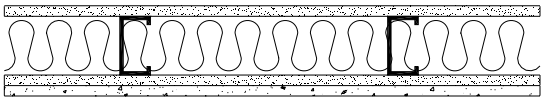
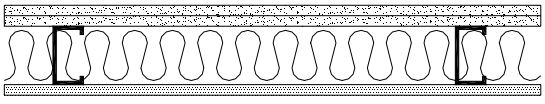
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U404	• 3 ½" x 20 ga steel studs spaced at 16" o.c. • 3" mineral wool insulation • 1 layer ½" or ⅝" cementitious board on one side • 1 layer ⅝" thick gypsum board on other side		
		1 h	<50*
	• 3 ½" x 20 ga steel studs spaced at 16" o.c. • 3" mineral wool insulation • 2 layers ⅝" gypsum board on one side • inner layer of ⅝" thick gypsum, outer layer of ½" or ⅝" cementitious board on other side	 Configuration A	
		2 h	<50*
	• 3 ½" x 20 ga steel studs spaced at 16" o.c. • 3" mineral wool insulation • 2 layers ½" or ⅝" cementitious board on one side • 2 layers ⅝" thick gypsum board on other side	 Configuration B	
		2 h	<50*
UL U407 USG840321	• 3 ½" x 20 ga steel studs spaced at 16" o.c. • 3" mineral wool insulation • ⅝" cementitious board, ceramic tiles and exterior finish on either side		
		1 h	48

* Estimated value as per Warnock (2005)

Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U423 a) USG810518 b) USG810519 c) USG811006	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • optional glass fiber or mineral wool insulation • gypsum board on each side (rating listed for thickness of gypsum and number of layers applied) * 80% of Design Load. ** Insulation required.		
		45 min for 1 layer ½ in. 1 h for 1 layer ⅝ in. 1-½ h for 2 layers ½ in. * 2 h for 2 layers ⅝ in. ** 2 h for 2 layers ⅝ in. 2 h for 3 layers ½ in. 2 h for 2 layers ¾ in.	- 41[a] (RFB 2") 40[b] (NI) - - 48[c] (RFB 2") - -
UL U424	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • optional glass fiber or mineral wool insulation • optional steel resilient channels spaced 24" o.c. • gypsum board on interior side (rating listed for thickness of gypsum and number of layers applied) • 1 layer of ½" or ⅝" gypsum board on exterior side NOTE: Exposed to fire on interior face only.		
		45 min for 1 layer ⅝ in. 1 h for 2 layers ½ in. 1-½ h for 2 layers ⅝ in. 2 h for 3 layers ½ in. 2 h for 2 layers ¾ in.	- - - - -
UL U425 Interior Walls a) USG811009 b) USG811006	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • optional glass fiber or mineral wool insulation • gypsum board on each side (rating listed for thickness of gypsum and number of layers applied) * 80% of Design Load		
		45 min for 1 layer ½ in. 1 h for 1 layer ⅝ in. 1-½ h for 2 layers ½ in. * 2 h for 2 layers ⅝ in. 2 h for 3 layers ½ in. 2 h for 2 layers ¾ in.	- - 49[a] (RFB 2") 48[b] (RFB 2") - -

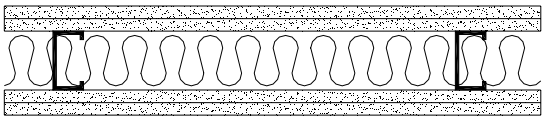
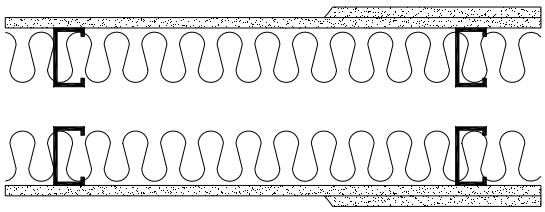
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U425 Exterior Walls a) USG811009 b) USG811006	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • glass fiber or mineral wool insulation • gypsum board on interior side (rating listed for thickness of gypsum and number of layers applied) • 1 layer of ½" or ⅝" gypsum board on exterior side NOTE: Exposed to fire on interior face only.		
		45 min for 1 layer ⅝ in. 1 h for 2 layers ½ in. 1-½ h for 2 layers ⅝ in. 2 h for 3 layers ½ in. 2 h for 2 layers ¾ in.	- 49[a] (RFB 2") 48[b] (RFB 2") - -
UL U432	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • optional glass fiber or mineral wool insulation • ⅝" gypsum board on each side		
		1 h	-
UL U434	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • optional glass fiber or mineral wool insulation • ⅝" gypsum board on one side • metal lath and 2 coat ⅞" portland cement plaster		
		1 h	<50* (RFB 3½")
UL U440 a) USG811009 b) SA840715	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • optional steel resilient channels spaced 24" o.c. • optional mineral wool insulation • 2 layers of ½" gypsum board on each side		
		1 h	49[a] (NRC RFB 2") 51[b] (one RC NI)

* Estimated value as per Warnock (2005)

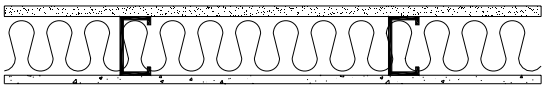
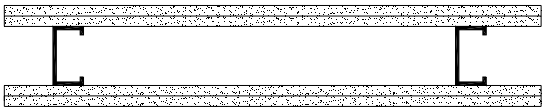
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U460	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • 3 ½" mineral wool insulation • ⅝" gypsum board on interior side • ⅝" gypsum sheathing on exterior side • 1" rigid polystyrene or polyisocyanurate insulation on exterior side • ½" plywood sheathing on exterior side		
		1 h	-
UL U462	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • optional mineral wool insulation • 4 layers of ½" gypsum board on each side		
		3 h	-
UL U473	• 3 ½" x 20 ga steel stud spaced at 16" o.c. • min 3" insulation • 1 layer ⅝" gypsum board on one side • 1 layer ⅝" gypsum board and 1 layer ½" or ⅝" cementitious board on other side		
		1 h	<50* (CEMBRD ½" RFB 3")
UL U487	• 3 ⅝" x 20 ga steel stud spaced at 24" o.c. • 3" mineral wool insulation • 2 layers ⅝" gypsum board on one side • 1 layer 17 mm thick mineral and fiber board on other side		
		1 h	<50*

* Estimated value as per Warnock (2005)

Load Bearing Walls – Underwriters Laboratories Inc.

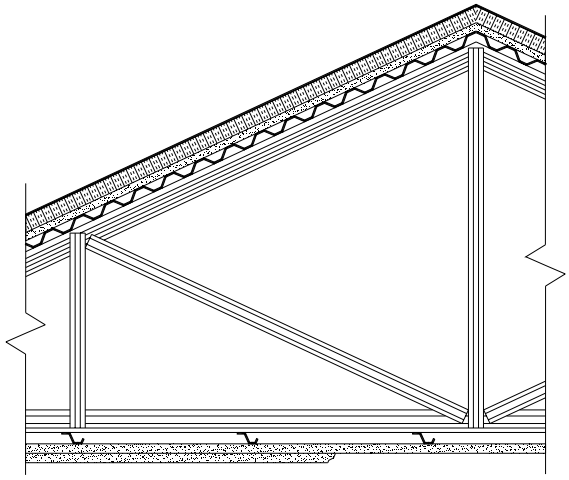
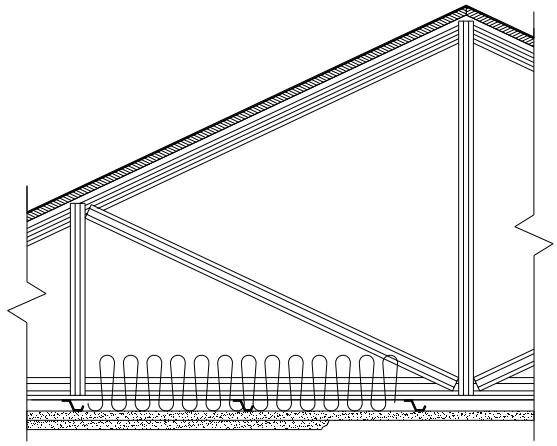
Source	Description	Fire Resistance Rating	Sound Transmission Class
UL U490	• 3 ½" x 1⅝" x 20 ga steel stud spaced at 24" o.c. • 3" mineral wool insulation for 3h • 3" mineral wool insulation with minimum 4 pcf for 4h • 2 layers ¾" gypsum board on each side		
		3 h 4 h	<50* <50*
UL V446	• double wall system with 3 ½" x 20 ga steel stud spaced at 24" o.c. • any glass fiber insulation with UL Classification Marking with min. density of 0.5 pcf • 1 or 2 layers of ⅝" gypsum board on each side ** 80% of Design Load		
		**1 h for 1 - ⅝" 2 h for 2 - ⅝"	58* (AIR 1") 59* (AIR 2") 68* (AIR 1") 69* (AIR 2")

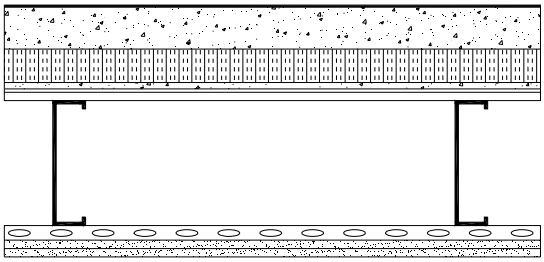
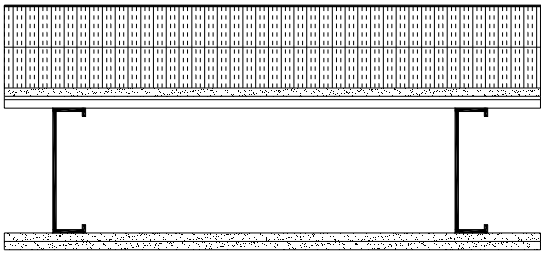
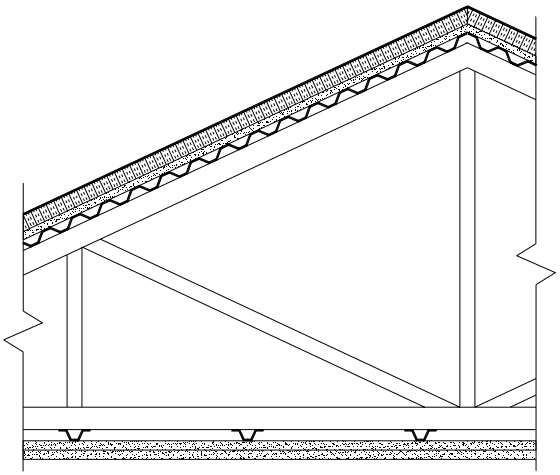
* Estimated value as per Warnock (2005)

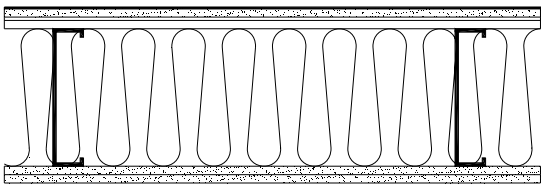
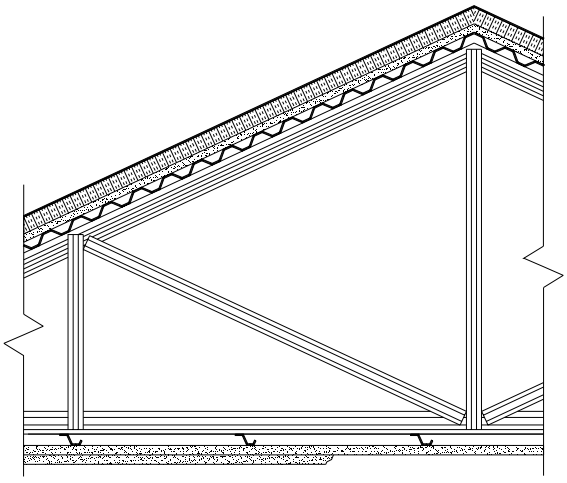
Source	Description	Fire Resistance Rating	Sound Transmission Class
GA WP1035	• 3 ½" x 20 ga steel stud spaced at 16" o.c. • 3" mineral fiber insulation • 1 layer ⅝" Type X gypsum board on one side • 1 layer ½" cementitious board on other side		
		1 h	<50*
GA WP1716 NGC 2250	• 3 ½" x 20 ga steel stud spaced at 24" o.c. • 2 layers ⅝" Type X gypsum board on each side		
		2 h	40 to 44

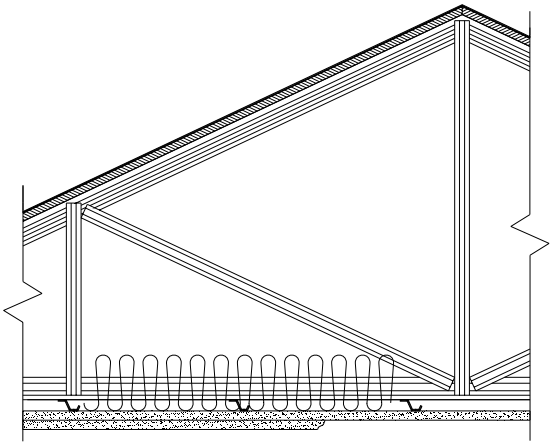
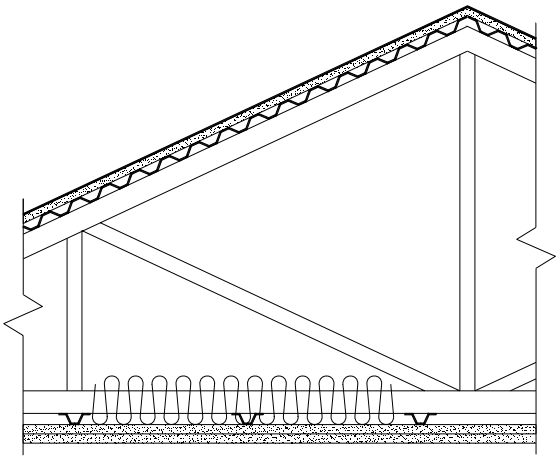
* Estimated value as per Warnock (2005)

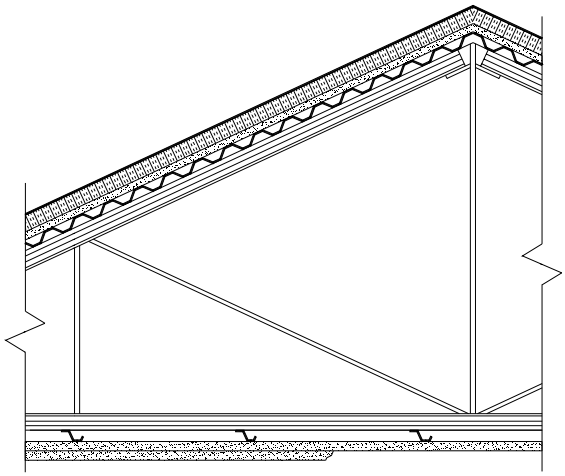
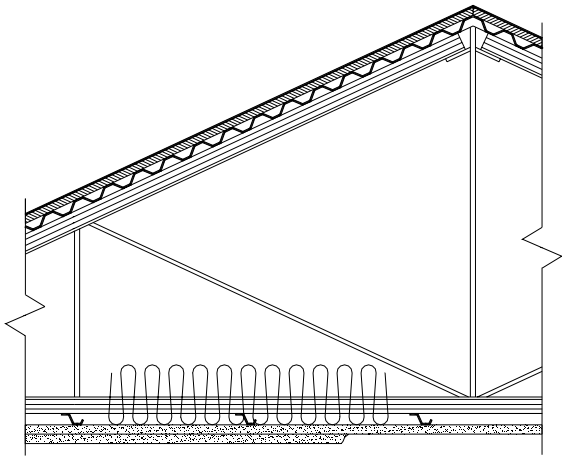
ROOF/CEILING ASSEMBLIES

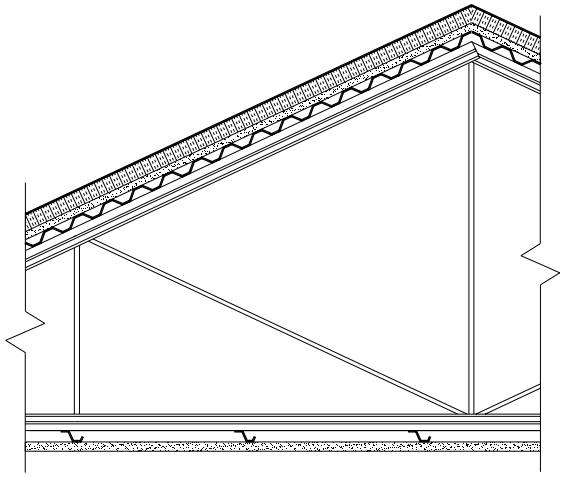
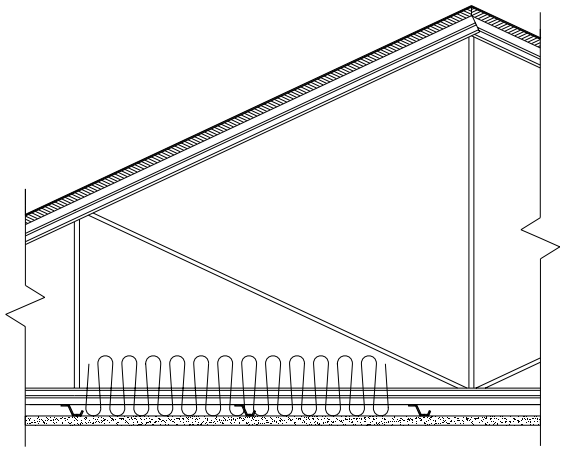
Source	Description	Fire Resistance Rating
ULC R500	• roof covering • foamed plastic insulation boards, 1" for 1h, 2" for 1½ h & 4" for 2h • gypsum sheathing min. 12.7 mm thick • steel roof deck corrugated or fluted, min. 0.76 mm thick • trusses spaced a max. 1220 mm o.c. • **proprietary** pre-fabricated light gauge steel truss system, Ultra-Span by Aegis Metal Framing • resilient or furring channels spaced 406 mm o.c. • 1 & 1½ hour - 1 layer of 15.9 mm gypsum board on ceiling side • 2 hour - 2 layers of 15.9 mm gypsum board on ceiling side	 1 h 1½ h 2 h
ULC R501	• roof covering • nom. 18 mm thick wood structural panels • trusses spaced a max. of 1220 mm o.c. • **proprietary** pre-fabricated light gauge steel truss system, Ultra-Span by Aegis Metal Framing • min. 241 mm thick glass fibre insulation for 1½h, any thickness mineral wool or glass fibre insulation for 1 h, optional • resilient or furring channels spaced 406 mm o.c. • 1 hour - 1 layer of 15.9 mm gypsum board on ceiling side • 1½ hours - 2 layers of 15.9 mm gypsum board on ceiling side	 1 h 1½ h

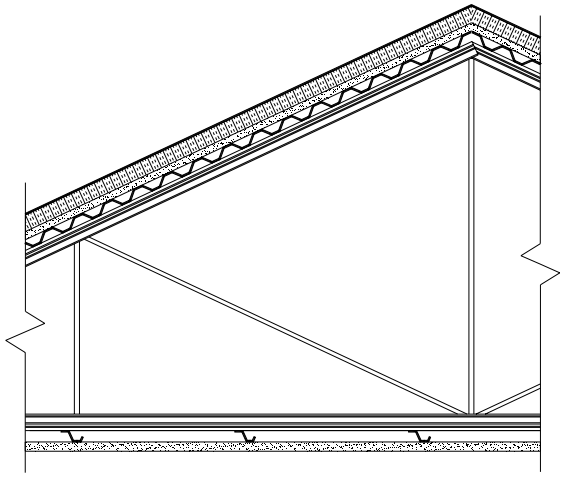
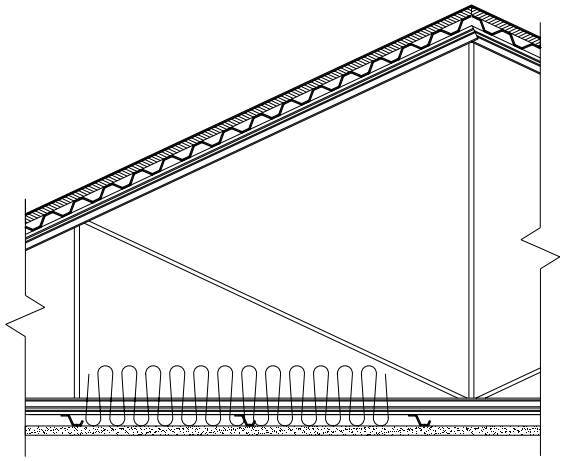
Source	Description	Fire Resistance Rating
UL P511	• crushed stone & roof covering • insulating concrete, min. 2” • foamed plastic insulation boards, thickness 1” to 8” • 28 MSG roof deck, $^{9}/_{16}$” deep • 7¼” x 18 MSG steel roof joist spaced 24” o.c. • furring channels spaced 24” o.c. • 2 layers of ½” gypsum board	 1 h
UL P512	• roof covering • 2 layers of 2 $^{7}/_{16}$” mineral & fiber boards • gypsum sheathing ½” thick • 28 MSG roof deck, $^{9}/_{16}$” deep • 7¼” x 18 MSG steel roof joist spaced 24” o.c. • 2 layers of ½” gypsum board	 1 h
UL P515	• roof covering • foamed plastic, mineral wool, glass fiber or perlite insulation boards, 1” min. thickness and no limit on max. overall thickness • gypsum sheathing ½” thick • steel roof deck corrugated or fluted, min. 28 MSG • trusses spaced a max. 24” or 48” o.c. • truss chord & web sections designed to AISI Specifications • resilient or furring channels spaced 24”o.c. • 2 layers of ⅝” gypsum board on ceiling side	 1 h

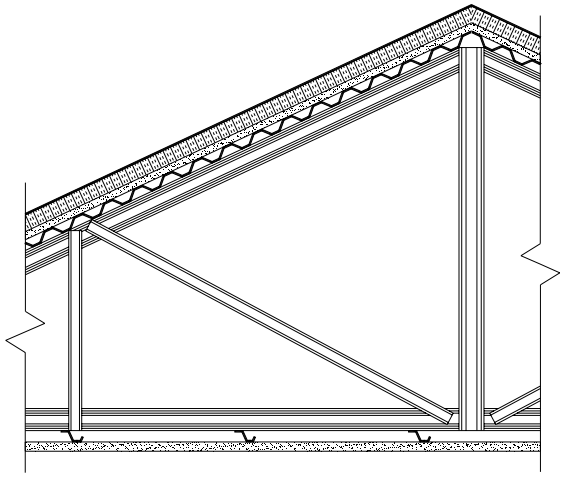
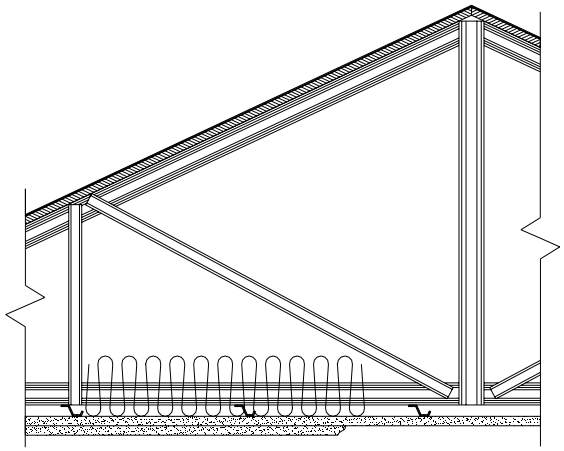
Source	Description	Fire Resistance Rating
UL P518	• roof covering • gypsum sheathing ½" thick • 28 MSG roof deck, $^{9}/_{16}$" deep • 8" x 18 MSG steel roof joist spaced at 24" o.c. • 8" thick glass fiber insulation • 2 layers of ½" gypsum board	 1 h
UL P521	• roof covering • foamed plastic insulation boards, 1" for 1h, 2" for 1½ h & 4" for 2h • gypsum sheathing min. ½" thick • steel roof deck corrugated or fluted, min. 22 MSG • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Ultra-Span by Aegis Metal Framing • resilient or furring channels spaced 16"o.c. • 1 & 1½ hour - 1 layer of ⅝" gypsum board on ceiling side • 2 hour - 2 layers of ⅝" gypsum board on ceiling side	 1 h 1½ h 2 h

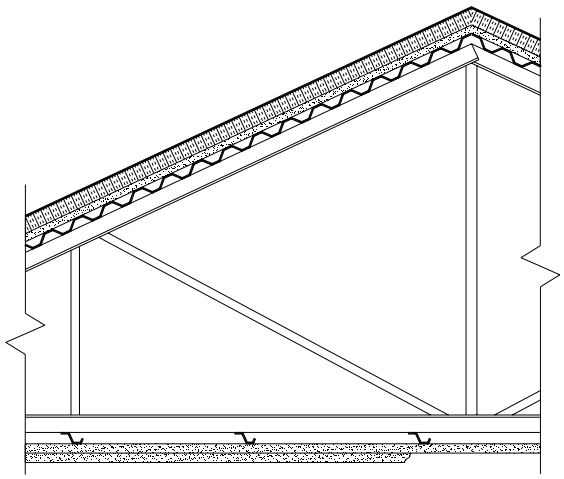
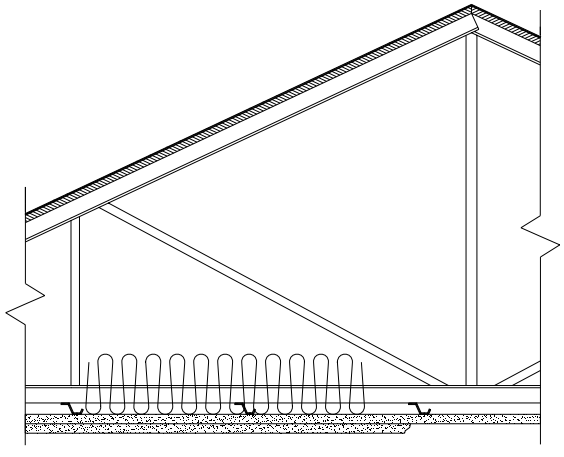
Source	Description	Fire Resistance Rating
UL P523	• roof covering • nom. $^{23}/_{32}$" thick wood structural panels • trusses spaced a max. of 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Ultra-Span by Aegis Metal Framing • min. 9½" thick glass fiber insulation for 1½h, any thickness mineral wool or glass fiber insulation for 1 h, optional • resilient or furring channels spaced 16"o.c. • 1 hour - 1 layer of ⅝" gypsum board on ceiling side • 1½ hours - 2 layers of ⅝" gypsum board on ceiling side	 1 h 1½ h
UL P524	• roof covering • gypsum sheathing ½" thick • steel roof deck corrugated or fluted, min. 28 MSG • trusses spaced a max. 24" or 48" o.c. • truss chord & web sections designed to AISI Specifications • resilient or furring channels spaced 24"o.c. • 8" thick glass fiber insulation • 2 layers of ⅝" gypsum board on ceiling side	 1 h

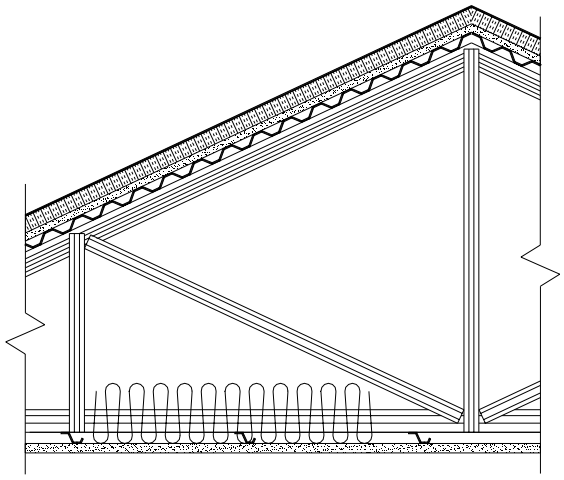
Source	Description	Fire Resistance Rating
UL P525	• roof covering • foamed plastic insulation boards, no minimum for 1h, 2" for 1½ h & 4" for 2h • gypsum sheathing min. ½" thick • steel roof deck corrugated or fluted, min. 22 MSG • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, TrusSteel by Alpine Engineered Products, Inc. • resilient or furring channels spaced 16"o.c. • 1 & 1½ hours - 1 layer of ⅝" gypsum board on ceiling side • 2 hours - 2 layers of ⅝" gypsum board on ceiling side	 1 h 1½ h 2 h
UL P526	• roof covering • nom. $^{23}/_{32}$" thick plywood sheathing • trusses spaced a max. 24" or 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, TrusSteel by Alpine Engineered Products, Inc. • resilient or furring channels spaced 16"o.c. • min. 9½" thick mineral wool or glass fiber insulation for 1½h, any thickness mineral wool or glass fiber insulation for 1 h, optional • 1 hour – 1 layer of ⅝" gypsum board on ceiling side • 1½ hours - 2 layers of ⅝" gypsum board on ceiling side	 1 h 1½ h

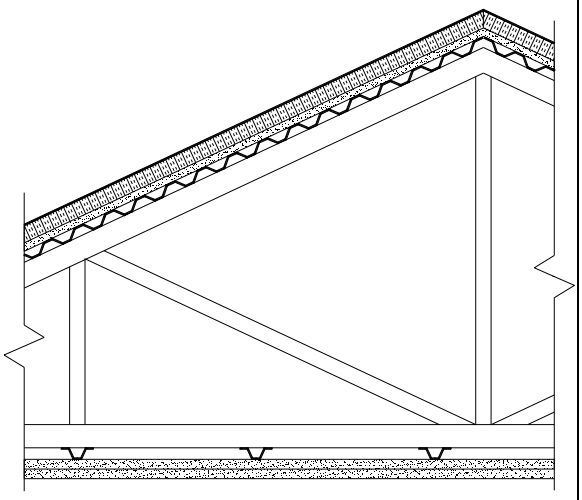
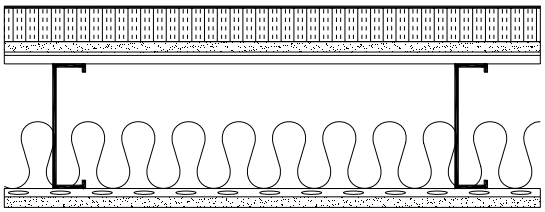
Source	Description	Fire Resistance Rating
UL P527	• roof covering • foamed plastic insulation boards, no minimum for 1h & 2" for 1½ h • gypsum sheathing min. ½" thick • steel roof deck corrugated or fluted, min. 22 MSG • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Amkey System by Allied Studco • resilient channels spaced 16"o.c. • 1 layer of ⅝" gypsum board on ceiling side	 1 h 1½ h
UL P528	• roof covering • nom. $^{23}/_{32}$" thick plywood sheathing • trusses spaced a max. 24" or 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Amkey System by Allied Studco • resilient channels spaced 16"o.c. • mineral wool or glass fiber insulation • 1 layer of ⅝" gypsum board on ceiling side	 1 h

Source	Description	Fire Resistance Rating
UL P529	• roof covering • foamed plastic insulation boards, no minimum for 1h & 2" for 1½ h • gypsum sheathing min. ½" thick • steel roof deck corrugated or fluted, min. 22 MSG • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Versa-Truss by Dale/Incor • resilient channels spaced 16"o.c. • 1 layer of ⅝" gypsum board on ceiling side	 1 h 1½ h
UL P530	• roof covering • nom. $^{23}/_{32}$" thick plywood sheathing • trusses spaced a max. 24" or 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Versa-Truss by Dale/Incor • resilient channels spaced 16"o.c. • mineral wool or glass fiber insulation • 1 layer of ⅝" gypsum board on ceiling side	 1 h

Source	Description	Fire Resistance Rating
UL P532	• roof covering • foamed plastic insulation boards, no minimum for 1 h, 2" for 1½ h & 3" for 2 h • gypsum sheathing min. ½" thick • steel roof deck corrugated or fluted, min. 22 MSG • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Strong-Span by Hexaport International Ltd. • resilient channels spaced 16"o.c. • 1 layer of ⅝" gypsum board on ceiling side	 1 h 1½ h 2 h
UL P534	• roof covering • nom. $^{23}/_{32}$" thick wood structural panels • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Strong-Span by Hexaport International Ltd. • resilient or furring channels spaced 16"o.c. • min. 9½" thick glass fiber insulation for 1½ h, any thickness mineral wool or glass fiber insulation for 1 h, optional • 1 hour - 1 layer of ⅝" gypsum board on ceiling side • 1½ hours - 2 layers of ⅝" gypsum board on ceiling side	 1 h 1½ h

Source	Description	Fire Resistance Rating
UL P536	• roof covering • foamed plastic insulation boards, no minimum for 1 h, 1" for 1½ h & 2.6" for 2 h • gypsum sheathing min. ½" thick • steel roof deck corrugated or fluted, min. 22 MSG • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Gus Truss by Nucon Steel Corporation • resilient channels spaced 16"o.c. • 1 & 1½ hours - 1 layer of ⅝" gypsum board on ceiling side • 2 hours - 2 layers of ⅝" gypsum board on ceiling side	 1 h 1½ h 2 h
UL P537	• roof covering • nom. $^{23}/_{32}$" thick wood structural panels • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss system, Gus Truss by Nucon Steel Corporation • resilient or furring channels spaced 16"o.c. • min. 9½" thick glass fiber insulation for 1½ h, any thickness mineral wool or glass fiber insulation for 1 h, optional • 1 hour - 1 layer of ⅝" gypsum board on ceiling side • 1½ hours - 2 layers of ⅝" gypsum board on ceiling side	 1 h 1½ h

Source	Description	Fire Resistance Rating
UL P540	• roof covering • foamed plastic, mineral wool, glass fiber or perlite insulation boards, no min. thickness and no limit on max. overall thickness • gypsum sheathing min. ½" thick • steel roof deck corrugated or fluted, min. 22 MSG • trusses spaced a max. 48" o.c. • **proprietary** pre-fabricated light gauge steel truss systems, 1. Ultra-span by Aegis Metal Framing 2. Amkey System by Allied Studco 3. Versa-Truss by Dale/Incor 4. Strong-Span by Hexaport International Ltd. 5. Gus Truss by Nucon Steel Corporation 6. TrusSteel by Alpine Engineered Products • resilient or furring channels spaced 16"o.c. • any thickness mineral wool or glass fiber insulation • 1 layer of ⅝" gypsum board on ceiling side	 1 h

Source	Description	Fire Resistance Rating
UL P541	• roof covering • foamed plastic, mineral wool, glass fiber or perlite insulation boards, 1” min. thickness and no limit on max. overall thickness • gypsum sheathing ½” thick • steel roof deck corrugated or fluted, min. 28 MSG • trusses spaced a max. 24” or 48” o.c. • truss chord & web sections designed to AISI Specifications • resilient channels spaced 24”o.c. • 2 layers of ⅝” gypsum board on ceiling side	 1 h
UL P546	• roof covering • foamed plastic insulation boards, 1” min. thickness and no limit on max. overall thickness • gypsum board ½” or ⅝” thick • 22 MSG roof deck, $^{9}/_{16}$” deep • 9¼” x 16 MSG **proprietary** steel joist (Dietrich Industries Inc.) spaced at 24” o.c. • resilient channels spaced 12” o.c. • any glass fiber insulation, min. 3½” and max. 6¼” thick • 1 layer of ⅝” gypsum board on ceiling side	 1 h