

Sound Performance of Trus Joist® TJI® Joist Floor/Ceiling Assemblies

The transmission of sound from one unit to another is an important consideration in the design and construction of multi-family housing, hotels, and mixed-use occupancy applications. Floor systems must be designed to attenuate sound, reducing noise transmission through assemblies to acceptable levels. These applications may also require fire-resistance-rated floor/ceiling assemblies.

This technical resource sheet presents both airborne and impact sound ratings for Trus Joist® TJI® joist floor/ceiling assemblies with a variety of finish flooring and noise control components. In addition to tested assemblies, impact sound ratings have been developed for several assemblies based on engineering analysis of similar tested assemblies. Tests were conducted at independent accredited laboratories and sound ratings were determined in accordance with ASTM E90, E413, E492, and E989.

The floor/ceiling assembly is only one element in the sound control system for a building. Careful attention must be given to the design and detailing of the entire structure for sound performance. Consultation with a qualified acoustical design professional is recommended. It is the responsibility of the acoustical design professional to determine the appropriateness of the floor/ceiling assembly and detailing to ensure adequate performance of the sound control system. Acoustical design professionals may request copies of referenced test reports and engineering analyses from Weyerhaeuser when specifying floor/ceiling assemblies with TJI® joists.

STC and IIC

Two common measures of sound performance between compartments are Sound Transmission Class (STC) and Impact Insulation Class (IIC). Each provides a single number rating to summarize assembly performance, with higher numbers representing better sound attenuation. The STC rating represents airborne noise, such as music or voice, and the IIC rating measures impact noise such as footsteps. Both values are determined by measuring the sound transmitted through a given assembly across a range of frequencies.

Performance ratings are for the assembly as a whole. Modifications to the assembly, including the substitution of materials, may affect sound performance.

Code Requirements

The International Building Code (IBC) requires minimum STC and IIC ratings of 50 for floor/ceiling assemblies separating dwelling units.

The National Building Code of Canada (NBCC) has historically required STC values of 50 between dwelling units. Recently, rather than STC, the NBCC has begun requiring Apparent Sound Transmission Class (ASTC) ratings. ASTC considers the sound travelling through adjoining constructions and common building elements. As of 2015, NBCC requires dwelling units to be separated by a building configuration with an ASTC rating of not less than 47.

The NBCC prescriptive procedure for determining an ASTC value of 47 between units is a two-step process:

1) The separating floor assembly must have an STC rating of at least 50 (Note: STC ratings from this technical resource sheet can be used to determine this for Trus Joist® TJI® joist floor assemblies);

2) The building elements connected to the floor assembly must comply with a set of requirements, detailed in the NBCC.

The NBCC does not currently specify minimum IIC requirements. However, IIC ratings are an important consideration for many builders, and the values in this guide may be a suitable reference for Canadian specifiers.

Performance Expectations

While STC and IIC are useful tools, they do not necessarily define acceptable performance to all occupants. One shortcoming of the tests is that audible low frequency noise transmission is not measured. Consequently, a floor/ceiling assembly with a good IIC rating may still transmit the noise of heavy footsteps. Likewise, an assembly with a good STC rating may fail to adequately attenuate the bass from stereos and home theater systems. Where attenuation of low frequencies is a concern, a more detailed analysis by an acoustic specialist is recommended.

Effect of Finish Flooring

In addition to the construction of the base assembly, IIC ratings are very dependent on the combination of finish flooring and acoustic mats. Changes to flooring components can significantly alter an assembly's impact sound performance and IIC rating. Soft floor coverings, such as carpet with a pad, perform

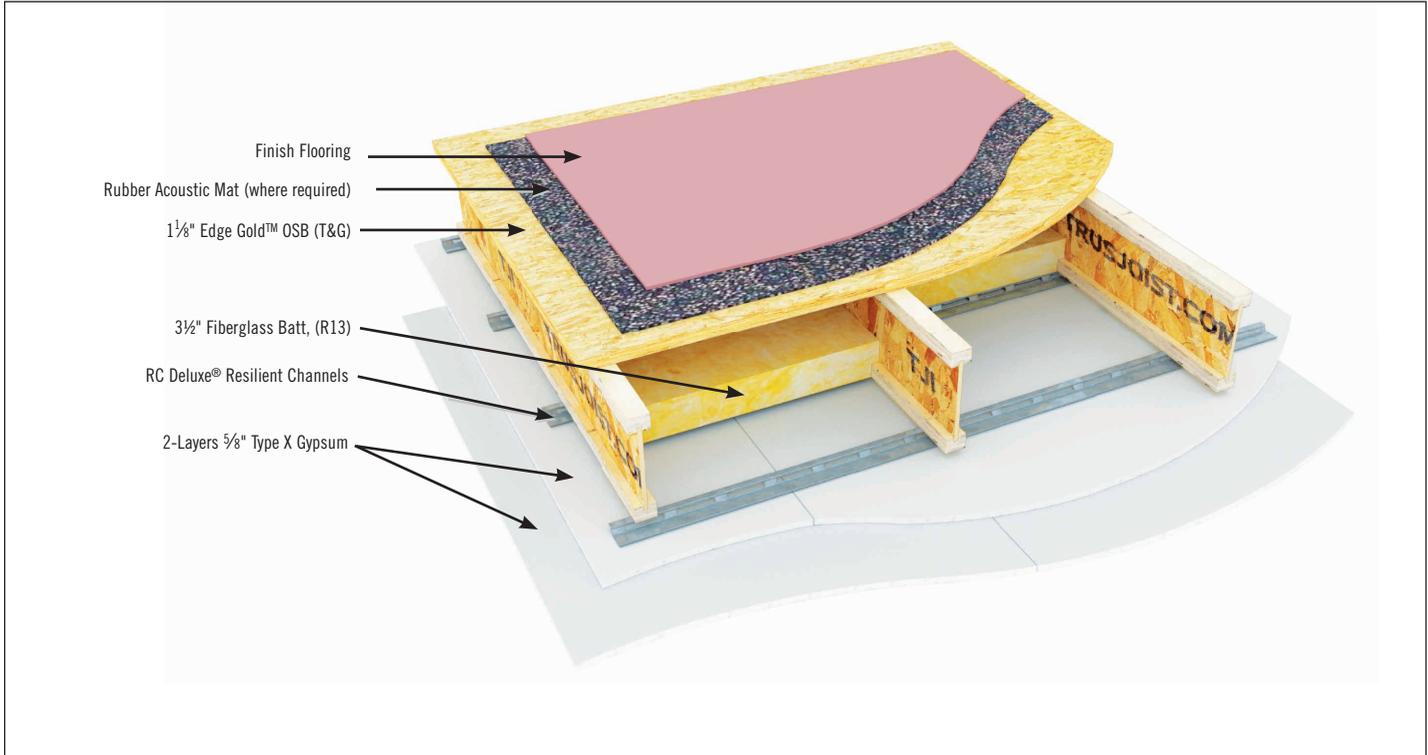
better than hard floors such as tile, hardwood, luxury vinyl tile (LVT), luxury vinyl plank (LVP), and sheet vinyl. With hard floors, special acoustic mats are commonly used to improve performance.

In contrast, the finish flooring typically has little effect on STC ratings, except when it adds significant mass. However, some combinations of flooring and acoustic mats may improve STC ratings. In general, STC ratings for assemblies with bare OSB, bare gypsum concrete, or bare concrete, or with lightweight floor finishes such as vinyl, can be conservatively used for identical assemblies with other types of finish flooring.

Fire-Resistance-Rated Assemblies

Where a fire-resistance-rated assembly is required, refer to Weyerhaeuser *Fire-Rated Assemblies and Sprinkler Systems Guide*, TJ-1500, for details. The two-layer ceiling assemblies included in this technical resource sheet will meet the requirements for a one-hour fire-resistance rating when constructed in accordance with ICC-ES ESR-1153 Assembly B; Intertek WNR/FCA 60-01, WNR/FCA 60-03, or WNR/WIJ 60-02; or PFS FA-1. Where a single-layer ceiling assembly with a one-hour fire-resistance rating is needed (see ESR-1153 Assembly F, Intertek WNR/WI 60-07, or Intertek WNR/WIJ 60-01), the single-layer ceiling assemblies in this technical resource sheet can be modified by replacing the fiberglass insulation with an equivalent thickness of mineral wool insulation without adverse effect on sound performance. Where 1½" mineral wool insulation is used in lieu of the 3½" thick fiberglass insulation, STC and IIC scores may be reduced by 2 points.

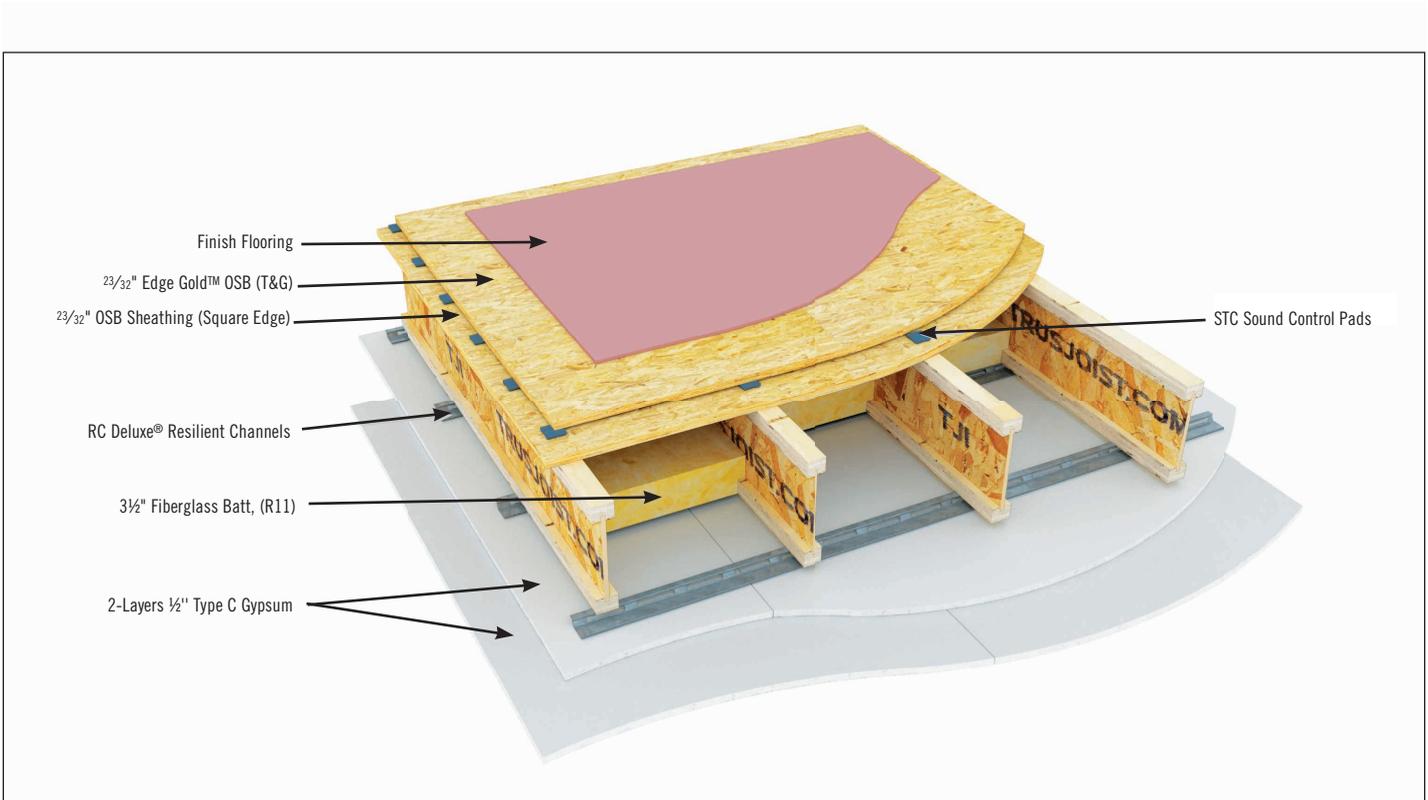
1 1/8" OSB (WITH RUBBER ACOUSTIC MAT WHERE REQUIRED)



FLOOR FINISHING	SINGLE-LAYER CEILING			TWO-LAYER CEILING		
	STC	IIC	Reports	STC	IIC	Reports
Bare OSB	--	--	--	55	44	A1-020802.2
Ceramic Tile adhered to Sonus Core 3 with Thinset Mortar	--	--	--	64	51	A1-020802.6
Quarry Tile Adhered to ECOsilence 5 with Thinset Mortar	--	--	--	--	52	NGC7015194
8.5 mm, 1.2 psf LVP with Cork Back Floating Over Sonus Core 3	--	--	--	62	53	A1-020802.4
5 mm, 2.2 psf LVT Floating Over ECOsilence 5	--	--	--	--	51	NGC7015199
3/8" Engineered Hardwood Floating Over Sonus Core 3	--	--	--	62	52	A1-020802.1
3/8" Engineered Hardwood Floating Over ECOsilence 5	--	--	--	--	53	NGC7015200
0.08", 0.56 psf Cushioned Vinyl	--	--	--	57	50	A1-020002.5
0.145", 0.53 psf Cushioned Vinyl⁽¹⁾	--	--	--	--	51	NGC7016095
Carpet and Pad	--	--	--	--	69	NGC7015197

(1) Requires minimum 3" (2.8 pcf) mineral wool batt instead of R13 fiberglass batt.

2-LAYERS 23/32" OSB WITH STC SOUND CONTROL PADS BETWEEN OSB LAYERS⁽¹⁾⁽²⁾⁽³⁾



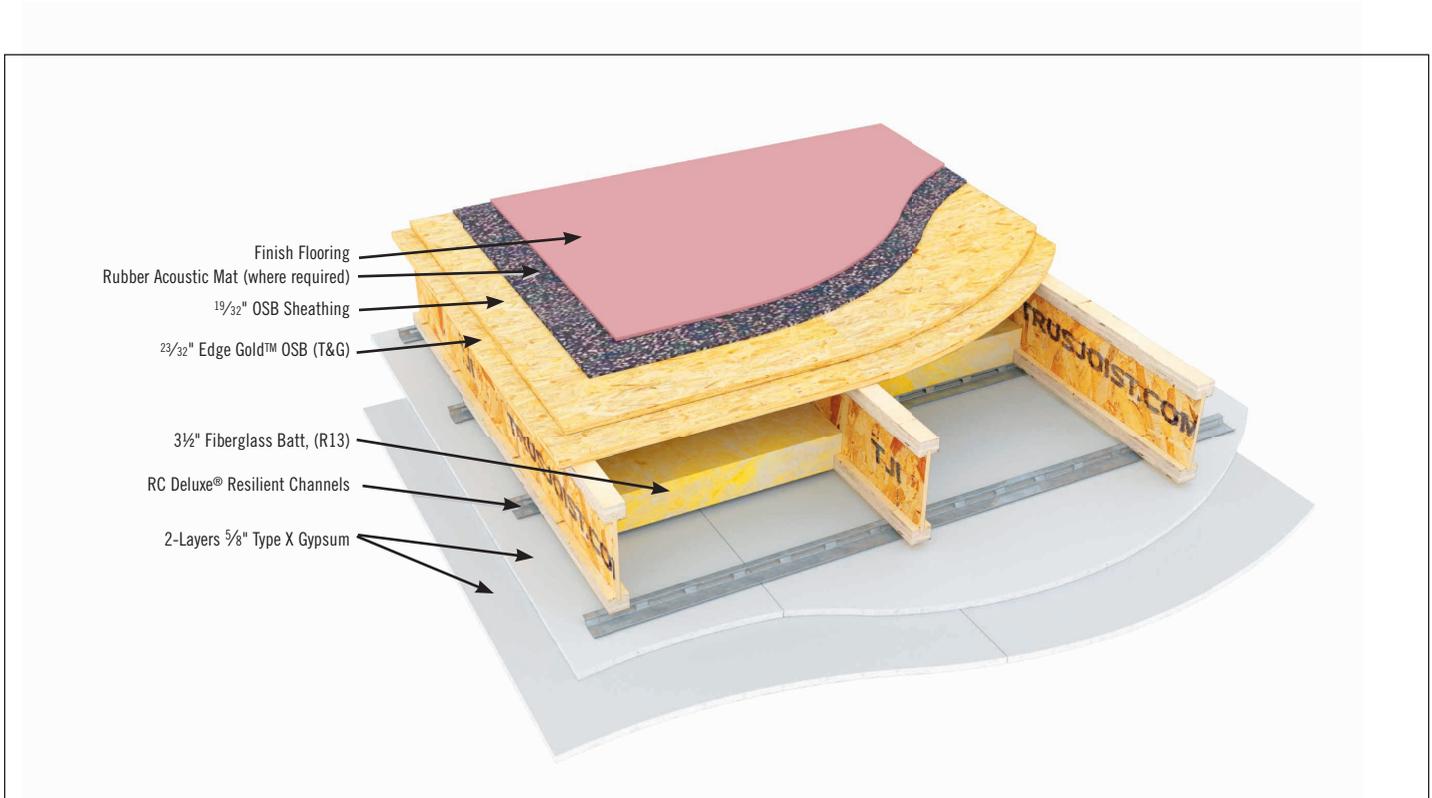
FLOOR FINISHING	SINGLE-LAYER CEILING			TWO-LAYER CEILING		
	STC	IIC	Reports	STC	IIC	Reports
Bare OSB	--	--	--	51	46	NGC5020011, NGC7020009
0.09", 1.0 psf LVT Floating Over 0.06", 0.04 psf Underlayment	--	--	--	--	53	NGC7020012
0.09", 1.0 psf LVT Adhered to OSB	--	--	--	--	51	NGC7020013
Porcelain Tile Adhered to OSB with Thinset Mortar	--	--	--	--	52	NGC7020008
3/8" Engineered Hardwood Floating over 0.05", 0.01 psf Underlayment	--	--	--	--	54	NGC7020011
Carpet and Pad	--	--	--	--	69	NGC7020010

(1) Pads installed along joists per manufacturer's recommendations; maximum 12" o.c. for Weyerhaeuser Edge® or Edge Gold™ OSB; maximum 16" o.c. for Weyerhaeuser Diamond™ OSB.

(2) Edge Gold™ may be substituted with Edge®, Diamond™, or an equivalent OSB product.

(3) The top layer of OSB must be installed after the floor system is protected from moisture exposure and the bottom layer of OSB has a moisture content of less than 16%.

1 9/32" OSB OVER 2 3/32" OSB (WITH RUBBER ACOUSTIC MAT WHERE REQUIRED)⁽¹⁾⁽²⁾



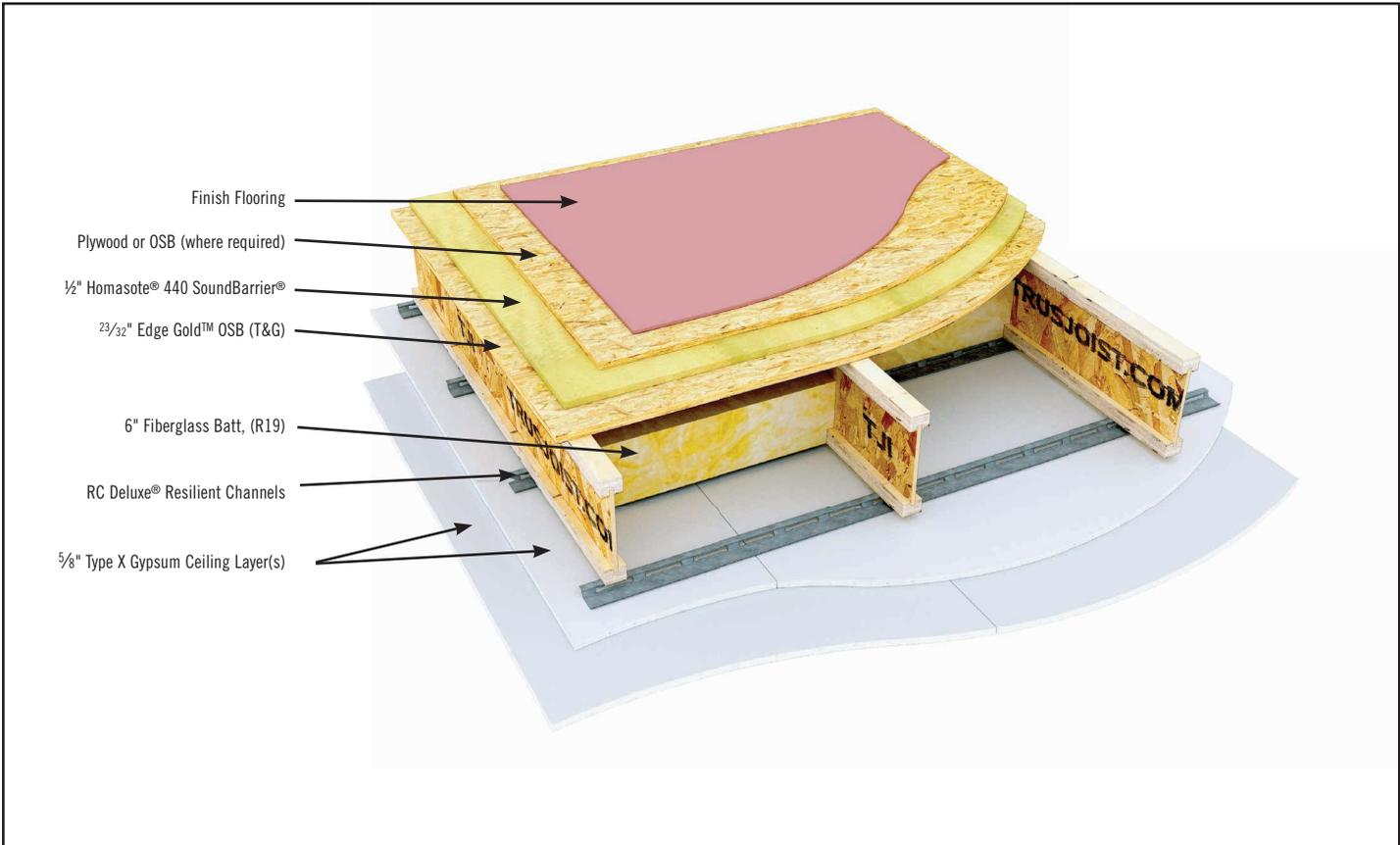
FLOOR FINISHING	SINGLE-LAYER CEILING			TWO-LAYER CEILING		
	STC	IIC	Reports	STC	IIC	Reports
Bare OSB	--	--	--	55	--	NGC5015139
Quarry Tile Adhered to ECOsilence 5 with Thinset Mortar	--	--	--	--	55	NGC7015201
5mm, 2.2 psf LVT Floating Over ECOsilence 5	--	--	--	--	50	NGC7015205
3/8" Engineered Hardwood Floating Over ECOsilence 5	--	--	--	--	50	NGC7015206
0.145", 0.53 psf Cushioned Vinyl⁽³⁾	--	--	--	--	51	NGC7016101
Carpet and Pad	--	--	--	--	67	NGC7015204

(1) Edge Gold™ may be substituted with Edge®, Diamond™, or an equivalent OSB product.

(2) The top layer of OSB must be installed after the floor system is protected from moisture exposure and the bottom layer of OSB has a moisture content of less than 16%.

(3) Assembly with cushioned vinyl flooring requires minimum 3" (2.8 pcf) mineral wool batt instead of R13 fiberglass batt.

½" HOMASOTE® 440 SOUNDBARRIER®(1)(2)

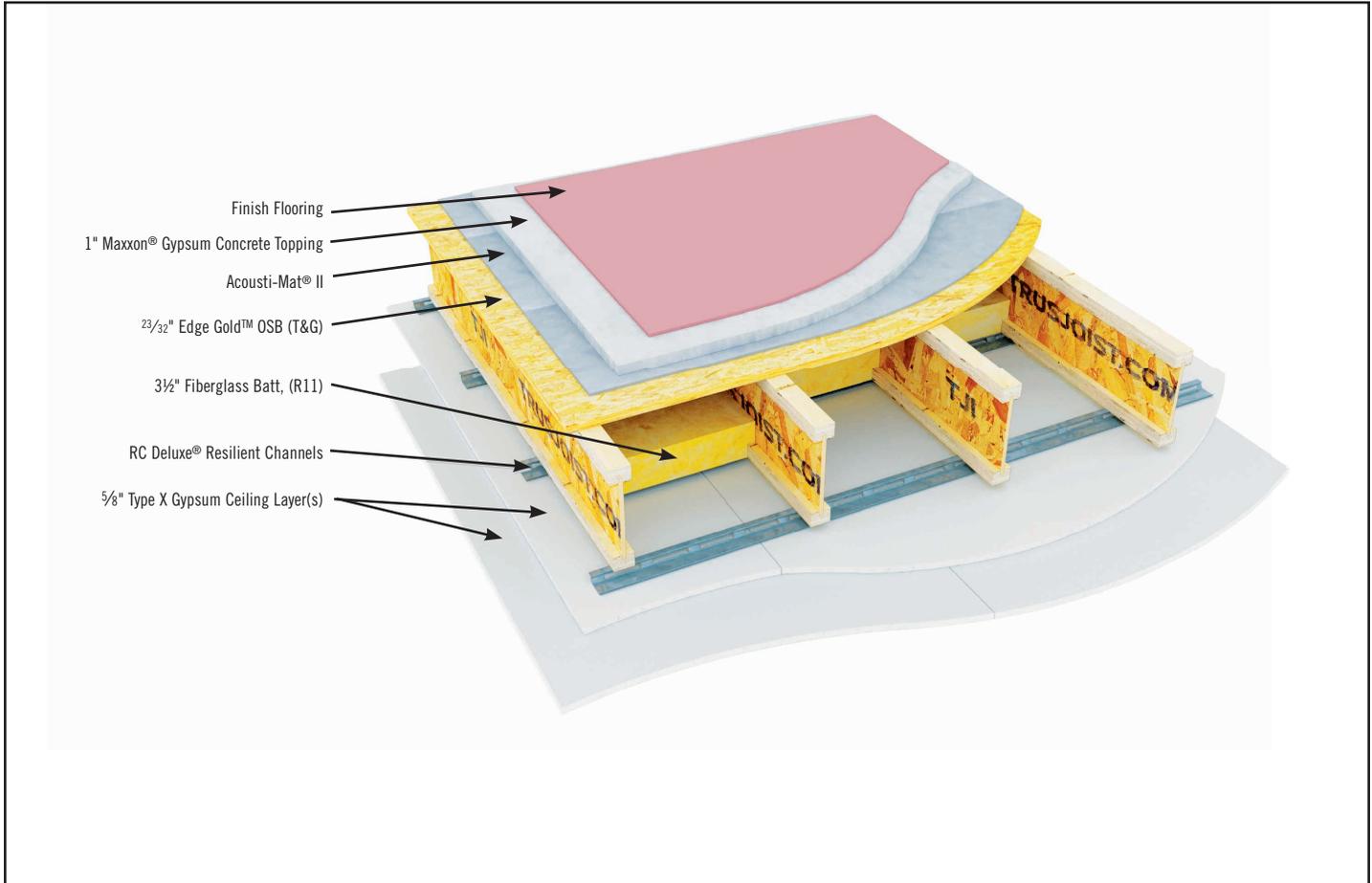


FLOOR FINISHING	SINGLE-LAYER CEILING			TWO-LAYER CEILING		
	STC	IIC	Reports	STC	IIC	Reports
8mm, 1.5 psf LVT Floating Over 23/32" T&G Edge Gold™ or Plywood	--	--	--	58	58	NGC5018056_R1, NGC7018069_R1
8mm, 1.5 psf LVT	--	--	--	55	51	NGC5018038_R1, NGC7018036_R1
0.09" Vinyl Over ¼" Plywood	52	50	MTS 258323-E, MTS 258323-F	--	--	--
Carpet and Pad	51	75	MTS 258323-A	--	--	--

(1) Edge Gold™ may be substituted with Edge®, Diamond™, or an equivalent OSB product.

(2) The Homasote® 440 SoundBarrier® must be installed after the floor system is protected from moisture exposure and the bottom layer of OSB has a moisture content of less than 16%.

1" GYPSUM CONCRETE OVER ACOUSTI-MAT® II⁽¹⁾



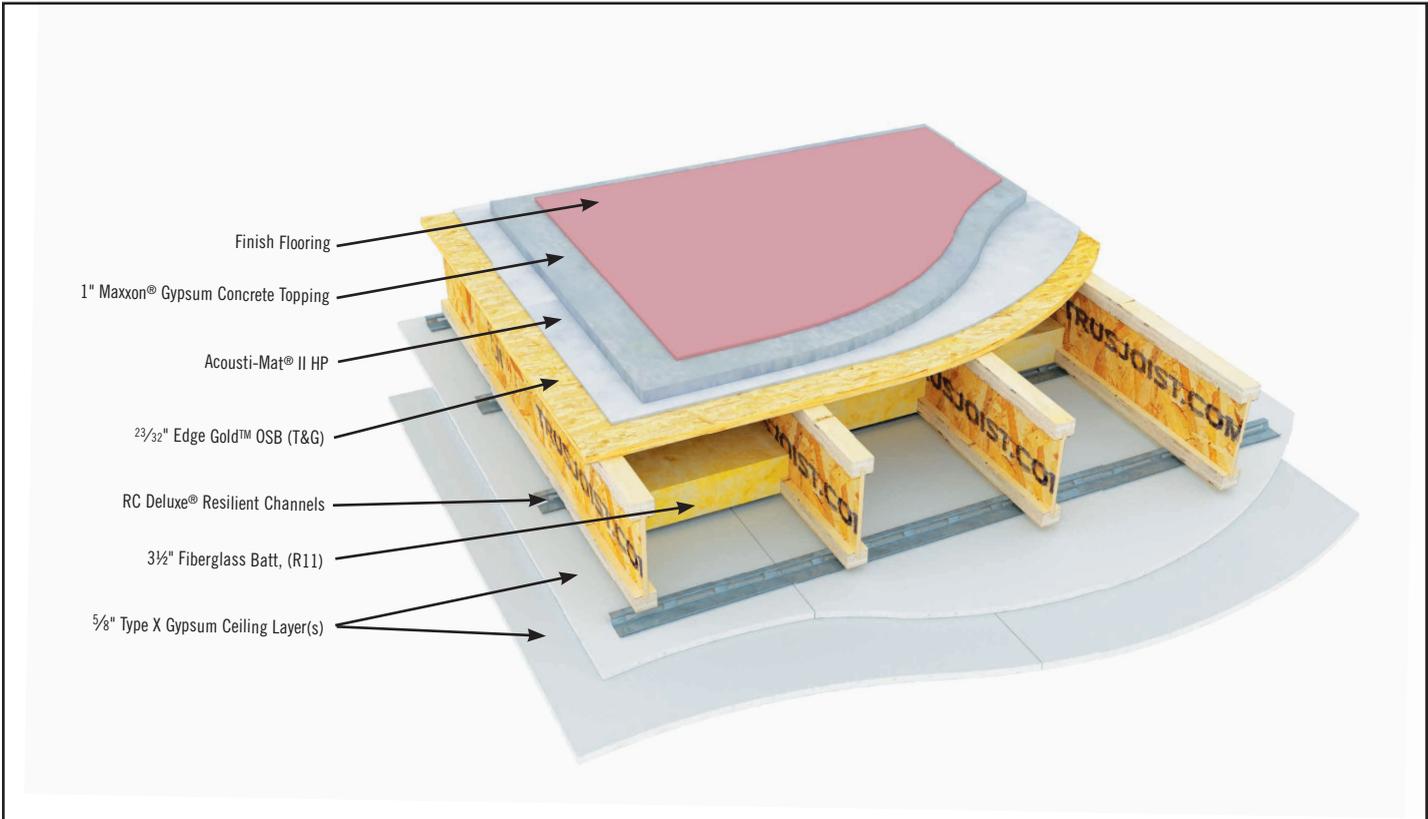
FLOOR FINISHING	SINGLE-LAYER CEILING			TWO-LAYER CEILING		
	STC	IIC	Reports	STC	IIC	Reports
Bare Gypsum Concrete	--	45	NGC7012108	--	--	--
0.145", 0.53 psf Cushioned Vinyl	58	53	NGC5012050, NGC7012109	58 ⁽²⁾	56 ^(E)	WYAnalysis6
Carpet and Pad	59	70	NGC5012051, NGC7012110	59 ⁽²⁾	69 ^(E)	WYAnalysis7

(1) Edge Gold™ may be substituted with Edge®, Diamond™, or an equivalent OSB product.

(2) Value from assembly tested with single-layer ceiling.

(E) Value determined based on engineering analysis of 3-5 similar tested assemblies.

1" GYPSUM CONCRETE OVER ACOUSTI-MAT® II HP⁽¹⁾



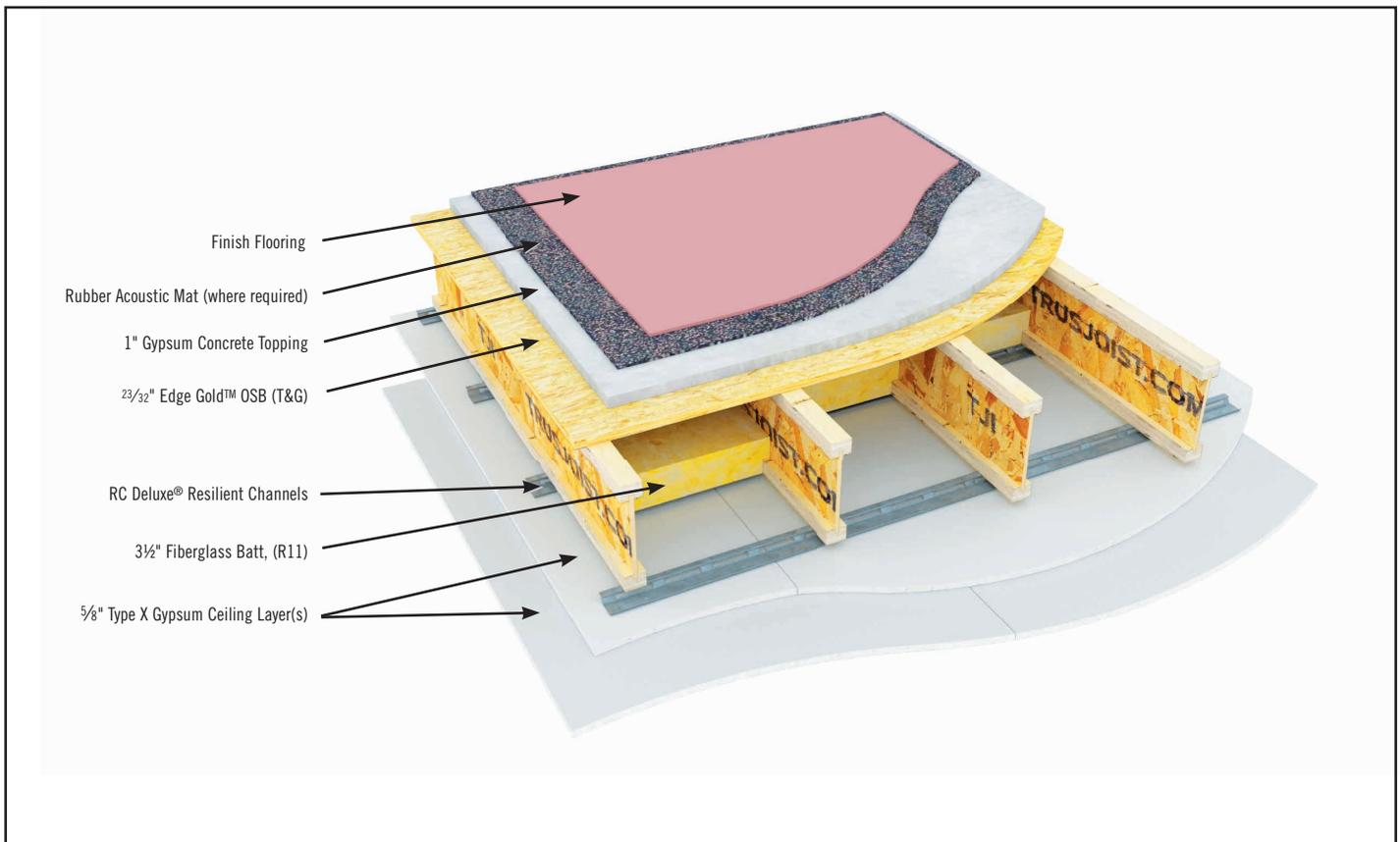
FLOOR FINISHING	SINGLE-LAYER CEILING			TWO-LAYER CEILING		
	STC	IIC	Reports	STC	IIC	Reports
Quarry Tile Bonded with Thinset Adhesive	61	53	NGC5012072, NGC7012143	61 ⁽²⁾	54 ^(E)	WYAnalysis3
1/2" Engineered Hardwood Floating Over 0.085", 0.16 psf Underlayment	--	55	NGC7012144	--	57 ^(E)	WYAnalysis4
1.75 psf LVT	--	57	NGC7012145	--	59 ^(E)	WYAnalysis5

(1) Edge Gold™ may be substituted with Edge®, Diamond™, or an equivalent OSB product.

(2) Value from assembly tested with single-layer ceiling.

(E) Value determined based on engineering analysis of 3-5 similar tested assemblies.

1" GYPSUM CONCRETE (WITH RUBBER ACOUSTIC MAT WHERE REQUIRED)⁽¹⁾



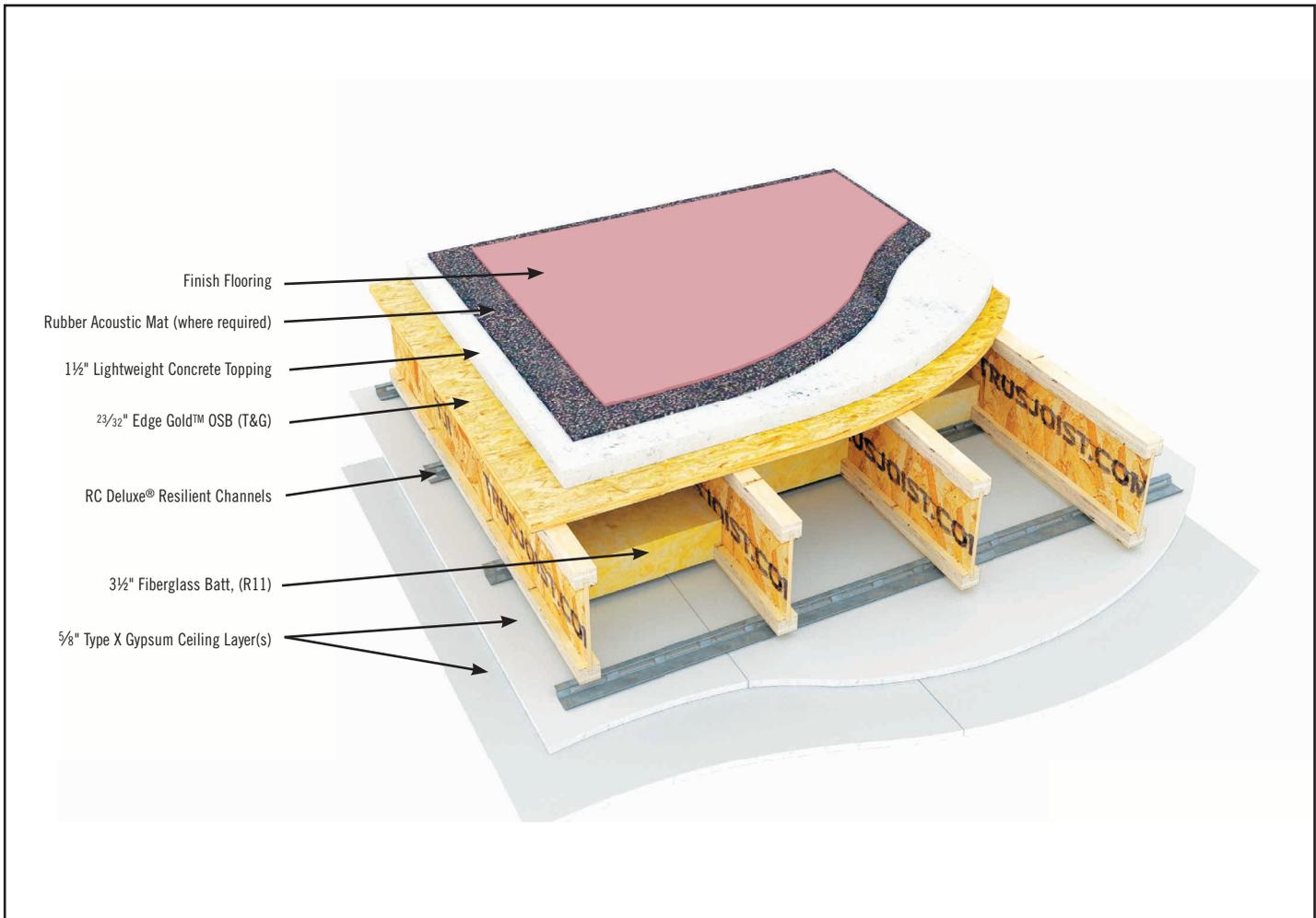
FLOOR FINISHING	SINGLE-LAYER CEILING			TWO-LAYER CEILING		
	STC	IIC	Reports	STC	IIC	Reports
Bare Gypsum Concrete	57	30	NGC5013037, NGC7013058	57	32	NGC5014163, NGC7014226
0.145", 0.53 psf Cushioned Vinyl	57	51	NGC5013036, NGC7013057	--	53	NGC7014227
Ceramic Tile Bonded with Thinset Adhesive Over ECOSilence 5, Bonded with E-Grip III Adhesive	60	50	NGC5013034, NGC7013055	60 ⁽²⁾	56 ^(E)	WYAnalysis1
3/8" Engineered Hardwood Floating Over ECOSilence 5	58	50	NGC5013035, NGC7013056	58 ⁽²⁾	55 ^(E)	WYAnalysis2
Quarry Tile Bonded with Thinset Adhesive Over Proflex® RCU 250, Bonded with Proflex® PWA-200	--	--	--	--	55 ^(E)	WYAnalysis14
3/8" Engineered Hardwood Floating Over Proflex® RCU 250	--	51 ^(E)	WYAnalysis13	--	57 ^(E)	WYAnalysis15
Carpet and Pad	57	74	NGC5013038, NGC7013059	--	73	NGC7014228

(1) Edge Gold™ may be substituted with Edge®, Diamond™, or an equivalent OSB product.

(2) Value from assembly tested with single-layer ceiling.

(E) Value determined based on engineering analysis of 3-5 similar tested assemblies.

1½" LIGHTWEIGHT CONCRETE (WITH RUBBER ACOUSTIC MAT WHERE REQUIRED)⁽¹⁾



FLOOR FINISHING	SINGLE-LAYER CEILING			TWO-LAYER CEILING		
	STC	IIC	Reports	STC	IIC	Reports
Bare Concrete	55	28	NGC5014182, NGC7014253	55	33	NGC5014183, NGC7014257
0.145", 0.53 psf Cushioned Vinyl	--	52	NGC7014255	--	53	NGC7014256
Ceramic Tile Bonded with Thinset Adhesive Over ECOSilence 5, Bonded with E-Grip III Adhesive	--	53 ^(E)	WYAnalysis8	--	54 ^(E)	WYAnalysis10
¾" Engineered Hardwood Floating Over ECOSilence 5	--	53 ^(E)	WYAnalysis9	--	54 ^(E)	WYAnalysis11
Quarry Tile Bonded with Thinset Adhesive Over Proflex® RCU 250, Bonded with Proflex® PWA-200	--	53 ^(E)	WYAnalysis16	--	54 ^(E)	WYAnalysis18
¾" Engineered Hardwood Floating Over Proflex® RCU 250	--	55 ^(E)	WYAnalysis17	--	56 ^(E)	WYAnalysis19
Carpet and Pad	--	71	NGC7014254	--	75	NGC7014258

(1) Edge Gold™ may be substituted with Edge®, Diamond™, or an equivalent OSB product.
 (E) Value determined based on engineering analysis of 3-5 similar tested assemblies.