ALBUM OF TYPICAL TECHNICAL SOLUTIONS

OF THIN SOUND INSULATING ENCLOSING STRUCTURES
(version TC/01.2020/RD/C/RU)
Moscow 2020

TECHNO
SONUS
architectural and construction acoustics

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General information

The album “Typical technical solutions of thin sound insulating enclosing structures” (version TS/00.2020/RDS/C/RU) was developed on the basis of NIISF RAASN materials with participation of TechnoSonus experts. The album contains working drawings of main components for solving noise protection problems by sound insulation methods which can be used in design work.

The use of traditional and special sound insulating materials sold by TechnoSonus in frame-lining and frameless structures provides compliance with both normative and increased requirements to sound insulating of enclosing structures that is confirmed by the results of tests and technical expertise performed at NIISF RAASN and practical experience of their regular use on construction sites.

The purpose of this Album is to create a typical design base for introduction of sound insulating systems in domestic construction practice combining effective noise reduction solutions with high quality final finishing of premises on the base of modern materials widely used in domestic and foreign construction practice.

Sound insulating systems described in this album are recommended by NIISF RAASN for use in design, construction, reconstruction and restoration of residential, public and industrial buildings of any purpose in order to improve sound insulation of enclosing structures as well as for protection of premises from all types of noise and vibration.

Appendix A provides recommendations on vibration insulation of utility equipment.

Appendix B provides a brief description and conventional symbols for acoustic materials and structures used in sound insulating systems.

Appendix C provides specification of fasteners and metal products.

Appendix D contains normative requirements stipulated by SP 51.13330.2011 Noise protection. Updated version of SNiP 23-03-2003 (with Amendment No. 1) as well as basic terms and definitions.

Appendix E provides methods of calculation of sound insulation of internal enclosing structures of residential and public buildings (extract from SP 23-103-2003 Design of sound insulation of enclosing structures of residential and public buildings).

Normatives and methods

When compiling this Album, the following standards, normative and legal acts of the Russian Federation were used and/or taken into account:

- SP 51.13330.2011 Noise protection. Updated version of SNiP 23-03-2003 (with Amendment No. 1).
- SP 23-103-2003 Design of sound insulation of enclosing structures of residential and public buildings.
– SP 20.13330.2011 Loads and impacts. Updated version of SNiP 2.01.07-85.
- SP 55-101-2000 Enclosing structures using plasterboard sheets.
- SP 29.13330.2011 Floors. Updated version of SNiP 2.03.13-88 (with Amendment No. 1).

- SP 44.13330.2011 Administrative and domestic buildings. Updated version of SNiP 2.09.04-87 (with Amendment No. 1, 2).

- SP 54.13330.2016 Residential multi-family buildings. Updated edition of SNiP 31-01-2003.

- SP 55.13330.2016 Residential single-family houses. Updated version of SNiP 31-02-2001 (with Amendment No. 1).

- SP 56.13330.2011 Industrial buildings. Updated version of SNiP 31-03-2001 (with Amendments N 1, 2).

- GOST 31706-2011. Acoustic materials used in floating floors of residential buildings. Method for determining dynamic stiffness.

- GOST 23499-2009 Sound insulating and sound-absorbing building materials and products. General specifications.

- Federal Law No. 123-FZ of July 22, 2008 “Technical regulations on fire safety requirements”.

- SanPiN 2.1.2.2645-10 “Sanitary and epidemiological requirements to living conditions in residential buildings and premises” (with amendments on December 27, 2010).

- GOST R 56769-2015 (ISO 717-1:2013) Buildings and structures. Assessment of airborne noise insulation.

- SP 254.1325800.2016 Buildings and territories. Rules for designing protection against industrial noise.

- SP 275.1325800.2016 Enclosing structures of residential and public buildings. Sound insulation design rules.

When selecting a specific TechnoSonus sound insulating solution, its functional purpose, required normative indices of airborne sound insulation of enclosing structures and reduced levels of impact noise of floor structures under transmission of sound from top to bottom and from bottom to top should be taken into account (Appendix D, Tables 2 and 3).

Note that in natural conditions, frame-lining partitions and interapartment walls have lower sound insulation than determined by calculation and/or measured in laboratory conditions, due to indirect noise transmission and as a rule better mounting in laboratory conditions. Sound insulation reduction values should be taken according to Table 5 (Appendix D).

Then brief description of the TechnoSonus sound insulating systems, their application areas, installation requirements and some recommendations related to their installation are given.

Note. Single-digit insulation indices of structures are given without regard to spectral adaptation members.

Section I

Sound insulating framed partitions

1. Description, application and properties

Sound insulating framed partitions of TechnoSonus systems presented in this album (hereinafter, the partitions) may be used in construction and reconstruction of buildings of any type and purpose. Under correct installation with the use of cushioning materials (StopZvuk DB and StopZvuk V100 tapes) and vibroacoustic sealant (Sonetik), transmission of structural noise to adjacent enclosing structures will be significantly reduced.

The partitions shown in this album are designed for up to 3.5 m height. If partitions of a greater height are required, appropriate design calculations for strength and stability should be performed.

Table 1 provides brief descriptions of the partitions' design, their thickness, airborne noise insulation indices (Rw, dB) and Numbers of sheets in the graphic part of the album where their frequency characteristics, schematic diagrams and main drawings of their connection to each other and to other enclosing structures are given.

Most of the partitions may be used for partitioning rooms being subject to increased noise protection requirements (hotel rooms, meeting rooms, music rooms, etc.).

TS-1.6 and TS-1.7 partitions may be used for partitioning premises of movie theaters.

Table 1

Type	Brief description of design of sound insulating framed partitions			Thickness, mm	Rw, dB	Numbers of sheets in the graphic part
	Description of sound insulating part					
	Frame	Filling	Lining			
1	2	3	4	5	6	7
TS-1.1	A single metal frame made of reinforced stud (PS 50/50) and channel (PN 50/40) AcousticGyps profiles with 600 mm stud step. Channel profiles around the entire perimeter of the partition are isolated from floor slabs and building load-bearing elements (external walls, load-bearing columns and internal walls) using StopZvuk V100 vibrodamping tape 4 mm thick and Sonetik vibroacoustic sealant. Stud profiles are isolated from inner lining layers using StopZvuk DB sealing tape 2.5 mm thick.	StopZvuk BP Premium, mineral board 50 mm thick	AcousticGyps GKLZ sheets 12.5 mm thick are mounted on the both sides of the frame in two layers.	104.0	52	
TS-1.2			SonoPlat panels 12 mm thick are mounted in one layer, then AcousticGyps GKLZ sheets 12.5 mm thick are mounted in one layer.	103.0	56	

1	2	3	4	5	6	7
TS-1.3			AcousticGyps GKLZ sheets 12.5 mm thick are mounted on the both sides of the frame. Then a heavy viscoelastic membrane ZvukoIzol VEM 4 (SMK)/ Tecsound 70 (SY) 4 mm/3.7 mm thick is glued to the external surface of the mounted AcousticGyps GKLZ sheets. Then a next layer of AcousticGyps GKLZ sheets 12.5 mm thick is mounted on the both sides.	113	58	
TS-1.4			AcousticGyps M1 panels 17 mm thick are mounted on the both sides of the frame in one layer, so that viscoelastic layer of the panel is outside. Then AcousticGyps GKLZ sheets 12.5 mm thick are mounted in one layer.	114.0	60	
TS-1.5	Two independent single metal frames spaced 15 mm apart, made of reinforced stud (PS 50/50) and channel (PN 50/40) AcousticGyps profiles with 600 mm stud step. Channel profiles around the entire perimeter of the partition are isolated from floor slabs and building load-bearing elements (external walls, load-bearing columns and internal walls) using StopZvuk V100 vibrodamping tape 4 mm thick and Sonetik vibroacoustic sealant. Stud profiles are isolated from inner lining layers using StopZvuk DB sealing tape 2.5 mm thick.		AcousticGyps M1 panels 17 mm thick are mounted on the both sides of the frame in one layer, so that viscoelastic layer of the panel is outside. Then AcousticGyps GKLZ sheets 12.5 mm thick are mounted in one layer.	179.0	66	

1	2	3	4	5	6	7
TS-1.6	Two independent single metal frames spaced 140 mm apart, made of standard stud (PS 100/50) and channel (PN 100/40) profiles with 600 mm stud step where AcousticGyps GKLZ sheet 12.5 mm thick is fixed between each corresponding pair of the studs providing structural rigidity. Channel profiles around the entire perimeter of the partition are isolated from floor slabs and building load-bearing elements (external walls, load-bearing columns and internal walls) using StopZvuk V100 vibrodamping tape 4 mm thick and Sonetik vibroacoustic sealant. Stud profiles are isolated from inner lining layers using StopZvuk DB sealing tape 2.5 mm thick.		AcousticGyps GKLZ sheets 12.5 mm thick are mounted on the both sides of the frame in two layers.	395.0	66	
TS-1.7	Two independent single metal frames spaced 200 mm apart, made of standard stud (PS 100/50) and channel (PN 100/40) profiles with 600 mm stud step where AcousticGyps GKLZ sheet 12.5 mm thick is fixed between each corresponding pair of the studs providing structural rigidity. Channel profiles around the entire perimeter of the partition are isolated from floor slabs and building load-bearing elements (external walls, load-bearing columns and internal walls) using StopZvuk V100 vibrodamping tape 4 mm thick and Sonetik vibroacoustic sealant. Stud profiles are isolated from inner lining layers using StopZvuk DB sealing tape 2.5 mm thick.		AcousticGyps M1 panels 17 mm thick are mounted on face sides of the frame in one layer, so that viscoelastic layer of the panel is outside. Then AcousticGyps GKLZ sheets 12.5 mm thick are mounted in two layers.	489.0	74	

2. Basic requirements to construction technology

Sound insulating framed partitions of TechnoSonus systems should be mounted taking into account the following basic requirements:

- the frame and partition linings should be abut on the walls and floor slabs (at the bottom and at the top) through vibrodamping pads from StopZvuk V100 tape;

- double frames should not be connected each to other (except for TS-1.6 and TS-1.7 partitions);

- external joints of the lining with the walls and floor slabs as well as gaps between the lining sheets should be filled with Sonetik vibroacoustic sealant.

Section II

Sound insulating wall lining

1. Description, application and properties

This album presents additional sound insulation of wall enclosing structures most commonly used in the modern construction practice:

- from D500 foam concrete blocks, 200 mm thick, with own airborne noise insulation index Rwbase = 45 dB;

- from monolithic reinforced concrete, 140 mm thick, with own airborne noise insulation index Rwbase = 50 dB.

Table 2 presents brief descriptions of additional sound insulating wall lining structures, their thickness and improvement indicators (after applying sound insulating lining) of airborne noise insulation index ΔRw, dB.

Table 2

Type	Base	Brief description of sound insulating wall lining Description of sound insulating structure Frame	Filling	Lining	Lining thickness, mm	ΔRw, dB	Numbers of sheets in the graphic part
1	2	3	4	5	6	7	8
TS-2.1	Option 1: Wall made of foam concrete blocks 200 mm thick. Option 2: Reinforced concrete wall 140 mm thick.	Metal frame made of reinforced ceiling (PP 60/27) and channel (PN 27/28) AcousticGyps profiles on SonoKrep Protector/Protector Pro vibrofasteners. Channel profiles around the entire perimeter of the partition are isolated from floor slabs and building load-bearing elements (external walls, load-bearing columns and internal walls) using StopZvuk V100 vibrodamping tape 4 mm thick and Sonetik vibroacoustic sealant. Stud profiles are isolated from inner lining layers using StopZvuk DB sealing tape 2.5 mm thick.	StopZvuk BP Premium, mineral board, 27 mm thick.	Before assembling the frame, ThermoZvukoIzol Standard sound-absorbing mats 14 mm thick (7 mm thick under compression) are fixed on the entire surface of the wall using Bautger glue with at least 100 mm overlapping. After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then two layers of AcousticGyps GKLZ sheets 12.5 mm thick are sequentially mounted on the frame.	69.0	13 12	
TS-2.2				Before assembling the frame, ThermoZvukoIzol Standard sound-absorbing mats 14 mm thick (7 mm thick under compression) are fixed on the entire surface of the wall using Bautger glue with at least 100 mm overlapping. After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then a layer of	68.5	17 15	

1	2	3	4	5	6	7	8
				SonoPlat panels 12 mm thick is mounted on the frame followed by a next layer of AcousticGypsum GKLZ sheets 12.5 mm thick.			
TS-2.3				Before assembling the frame, ThermoZvukoIzol Standard sound-absorbing mats 14 mm thick (7 mm thick under compression) are fixed on the entire surface of the wall using Bautger glue with at least 100 mm overlapping. After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then a layer of AcousticGyps GKLZ sheets 12.5 mm thick is mounted on the frame. Then heavy ZvukoIzol VEM 4 (SMK)/Tecsound 70 (SY) 4 mm/3.7 mm thick viscoelastic membrane is glued. Then a next layer of AcousticGyps GKLZ sheets 12.5 mm thick is mounted.	72.7	19 17	
TS-2.4				Before assembling the frame, ThermoZvukoIzol Standard sound-absorbing mats 14 mm thick (7 mm thick under compression) are fixed on the entire surface of the wall using Bautger glue with at least 100 mm overlapping. After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then a layer of AcousticGyps M1 panels 17 mm thick is mounted, so that viscoelastic layer of the panel is outside. Then a next layer of AcousticGyps GKLZ sheets 12.5 mm thick is mounted.	73.5	20 18	

1	2	3	4	5	6	7	8
TS-2.5		Metal frame made of reinforced ceiling (PP 60/27) and channel (PN 27/28) AcousticGyps profiles on SonoKrep EP20 vibrofasteners. Channel profiles around the entire perimeter of the partition are isolated from floor slabs and building load-bearing elements (external walls, load-bearing columns and internal walls) using StopZvuk V100 vibrodamping tape 4 mm thick and Sonetik vibroacoustic sealant. Stud profiles are isolated from inner lining layers using StopZvuk DB sealing tape 2.5 mm thick.		Before assembling the frame, Tecsound FT55 felt-based viscoelastic membrane is mounted on the entire surface of the wall using Bautger glue and plate-shaped dowel pins with at least 50 mm overlapping (for this, felt layer of the appropriate width is cut from one edge of the memrane sheet). After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then a layer of AcousticGyps M1 panels 17 mm thick is mounted, so that viscoelastic layer of the panel is outside. Then a next layer of AcousticGyps GKLZ sheets 15 mm thick is mounted.	83.5	24 23	
TS-2.6	<u>Option 1:</u> Wall made of foam concrete blocks 200 mm thick. <u>Option 2:</u> Reinforced concrete wall 140 mm thick.	Without frame	Without filling	The surface of the wall is pre-leveled (plastered by screeds). The surface should be dry (21 day ageing after wet work is recommended). StopZvuk V100 vibrodamping tape is glued around the perimeter of the insulated wall. Then SonoPlat Combi panels 22 mm thick are mounted starting from the lower left corner. The panels are placed vertically with a horizontal shift of the joint. Cutted ends of the panels are glued with Sonoplat tape designed for this. The panels are fixed on the base using 6×70 mm polymer dowels without iron core. One panel requires 11-12 fasteners arranged as follows: 4 pieces in the corners, 2 pieces on the long sides (visually making three squares on the panel), one dowel is added to the	34.5	9 8	

1	2	3	4	5	6	7	8
				center of the squares. Each next row of the panels is mounted after completion of the previous one. Upon completing the mounting, joints and abutments are sealed with Sonetic vibroacoustic sealant. Then a next layer of AcousticGyps GKLZ sheets 12.5 mm thick is mounted.			
TS-2.7				The wall surface is preleveled (up to 10 mm irregularities per meter of surface are allowed). StopZvuk V100 vibrodamping tape is glued around the perimeter of the insulated wall. Then AcousticGyps Basic panels 40 mm thick are mounted. The panels are mounted from left to right and from bottom to top. For the first panel, the rabbets are cut on the long and short sides, and only on the long side for the next panels of the first row. The panels are mounted exclusively through vibrodamping units. When mounting the whole panel on the wall, six holes on the edges are enough. When cutting the panel, all available holes should be used. Unused mounting holes are filled with Sonetik vibroacoustic sealant. Then AcousticGyps GKLZ sheets 12.5 mm thick are mounted over the panels.	52.5	11 10	
TS-2.8				All the operations listed in description of TS-2.7 sound insulating structure lining are repeated with replacement of AcousticGyps Basic 40 panels 40 mm thick to AcousticGyps Basic 70 panels 70 mm thick.	82.5	14 13	

2. Basic requirements to construction technology

TechnoSonus sound insulating wall lining should be mounted taking into account the following recommendations:

- the frame around the entire perimeter of sound insulating lining should be isolated from load-bearing elements (external walls, load-bearing columns and internal walls) using StopZvuk V100 vibrodamping tape 4 mm thick;
- external joints of the lining with walls and floor slabs, gaps between the sheets and mounting holes of communication lead-ins should be filled with Sonetik vibroacoustic sealant (mounting foam is not suitable for this purpose);
- number of Sonokrep vibrofasteners should calculated as follows: one fastener per 1 running meter of stud profile but no less than 4 pieces for profile length up to 3.0 m.

Section III

Sound insulating ceilings

1. Description, application and properties

TechnoSonus sound insulating suspended ceilings (hereinafter referred to as “sound insulating ceilings”) are designed for construction and reconstruction of buildings of any type and purpose.

All sound insulating ceilings presented in this album have high values of airborne noise insulation, and to some extent protect premises from impact noise.

Subject to mounting recommendations, sound insulating ceilings have a low level of radiated structural noise.

As a base for determining acoustic properties of sound insulating ceilings, a monolithic reinforced concrete slab 140 mm thick with own airborne noise insulation index Rw base = 51 dB and reduced level of impact noise 81 dB was chosen.

Table 3 presents a brief description of sound insulating ceilings, their thickness and airborne noise insulation improvement index (ΔRw, dB) as well as impact noise insulation index (ΔLnw, dB).

Table 3

Type	Base	Brief description of sound insulating ceilings Description of sound insulating structure Frame	Filling	Lining	Thickness, mm	ΔRw, dB	ΔLnw, dB	Numbers of sheets in the graphic part
1	2	3	4	5	6	7	8	9
TS-3.1	Void-free reinforced concrete floor slab 140 mm thick.	Metal frame made of reinforced ceiling (PP 60/27) and channel (PN 27/28) AcousticGyps profiles on SonoKrep Protector/Protector Pro vibrofasteners. Channel profiles around the entire perimeter of the partition are isolated from floor slabs and building load-bearing elements (external walls, load-bearing columns and interior walls) using StopZvuk V100 vibration damping tape 4 mm thick and Sonetik vibroacoustic sealant. Stud profiles are isolated from inner lining layers using StopZvuk DB sealing tape 2.5 mm thick.	StopZvuk BP Premium, mineral board, 50 mm thick.	Before assembling the frame, ThermoZvukoIzol Standard sound-absorbing mat 14 mm thick (7 mm thick under compression) is fixed on the entire surface of the wall with at least 100 mm overlapping using Bautger glue. After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then two layers of AcousticGyps GKLZ sheets 12.5 mm thick are sequentially mounted on the frame.	90.0	15	13	
TS-3.2				Before assembling the frame, ThermoZvukoIzol Standard sound-absorbing mat 14 mm thick (7 mm thick under compression) is fixed on the entire surface of the wall with at least 100 mm overlapping using Bautger glue. After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then a layer of SonoPlat panels 12 mm thick is mounted on the frame followed by a next layer of AcousticGypsum GKLZ sheets 12.5 mm thick.	90.0	18	15	
TS-3.3				Before assembling the frame, ThermoZvukoIzol Standard sound-absorbing mats 14 mm thick (7 mm thick under compression) are fixed on the entire surface of the wall using Bautger glue with at least 100 mm overlapping. After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then a layer of AcousticGyps GKLZ sheets 12.5 mm thick is mounted on the frame. Then	90.9	20	16	

1	2	3	4	5	6	7	8	9
				heavy ZvukoIzol VEM 4 (SMK)/Tecsound 70 (SY) 4 mm/3.7 mm thick viscoelastic membrane is glued. Then a next layer of AcousticGyps GKLZ sheets 12.5 mm thick is mounted.				
TS-3.4				Before assembling the frame, ThermoZvukoIzol Standard sound-absorbing mats 14 mm thick (7 mm thick under compression) are fixed on the entire surface of the wall using Bautger glue with at least 100 mm overlapping. After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then a layer of AcousticGyps M1 panels 17 mm thick is mounted, so that viscoelastic layer of the panel is outside. Then a next layer of AcousticGyps GKLZ sheets 12.5 mm thick is mounted.	90.5	22	16	
TS-3.5		Metal frame made of reinforced ceiling (PP 60/27) and channel (PN 27/28) AcousticGyps profiles on SonoKrep EP20 vibrofasteners. Channel profiles around the entire perimeter of the partition are isolated from floor slabs and building load-bearing elements (external walls, load-bearing columns and interior		Before assembling the frame, Tecsound FT55 felt-based viscoelastic membrane is mounted on the entire surface of the wall using Bautger glue and plate-shaped dowel pins with at least 50 mm overlapping (for this, felt layer of the appropriate width is cut from one edge of the memrane sheet). After assembling the frame, gaps between its elements are filled with sound-absorbing filler. Then a layer of AcousticGyps M1 panels 17 mm thick is mounted, so that viscoelastic layer of the panel is outside. Then a next layer of AcousticGyps GKLZ sheets 15 mm thick is mounted.	98.5	24	21	

1	2	3	4	5	6	7	8	9
		walls) using StopZvuk V100 vibration damping tape 4 mm thick and Sonetik vibroacoustic sealant. Stud profiles are isolated from inner lining layers using StopZvuk DB sealing tape 2.5 mm thick.						
TS-3.6		Without frame	Without filling	The ceiling surface is preleveled (up to 10 mm irregularities per meter of surface are allowed). StopZvuk V100 vibrodamping tape is glued around the perimeter of the insulated surface. Then AcousticGyps Basic panels 40 mm thick are mounted. The panels are mounted from left to right and from bottom to top. For the first panel, the rabbets are cut on the long and short sides, and only on the long side for the next panels of the first row. The panels are mounted exclusively through vibrodamping units. When mounting the whole panel on the ceiling, six holes on the edges are enough. When cutting the panel, all available holes should be used. Unused mounting holes are filled with Sonetik vibroacoustic sealant. Then AcousticGyps GKLZ sheets 12.5 mm thick are mounted over the panels.	52.5	10		
TS-3.7				All the operations listed in description of TS-3.6 sound insulating structure lining are repeated with replacement of AcousticGyps Basic 40 panels 40 mm thick to AcousticGyps Basic 70 panels 70 mm thick.	82.5	14		

2. Basic requirements to construction technology

Sound insulating suspended ceilings should be mounted taking into account the following recommendations:

- the frame around the entire perimeter of sound insulating ceiling should be isolated from load-bearing elements (external walls, load-bearing columns and internal walls) using StopZvuk V100 vibrodamping tape 4 mm thick;

- number of fasteners per unit area of the ceiling should be minimized;

- distance between the fasteners should be at least 600 mm;

- to fix StopZvuk BP Premium sound-absorbing plates, free ends of suspension nibs should be bent to the surface of the mounted plates between elements of the frame;

- external joints of the lining with walls and floor slabs, gaps between the sheets and mounting holes of communication lead-ins should be filled with Sonetik vibroacoustic sealant (mounting foam is not suitable for this purpose).

Section IV

Sound insulating floors

1. Description, application and properties

TechnoSonus sound insulating ceilings (hereinafter referred to as "sound insulating ceilings") are designed for construction and reconstruction of buildings of any type and purpose.

Their design is based on the concept of "floating floor" with "floating" cement-sand screed.

As a base for determining acoustic properties of sound insulating floors, a monolithic reinforced concrete slab 140 mm thick with own airborne noise insulation index Rw base = 51 dB and reduced level of impact noise Lnw base = 81 dB was chosen. Table 4 presents a brief description of sound insulating floors, their thickness and airborne noise insulation improvement index (ΔRw, dB) as well as impact noise insulation index (ΔLnw, dB).

Table 4

Type	Base	Brief description of sound insulating ceilings		Thickness, mm	ΔRw, dB	ΔLnw, dB	Numbers of sheets in the graphic part
		Description of sound insulating structure					
		Elastic liner for screed	Screed and base layer for finish floor				
1	2	3	4	5	6	7	8

1	2	3	4	5	6	7	8
TS-4.1	Void-free floor slab 140 mm thick	The surface of the base is cleaned of debris. Then ThermoZvukoizol Standard material 14 mm thick (7 mm thick under load) is laid. For this purpose, the material is cut into strips with allowance for adjacent wall overlapping. The height of the overlapping equals to design thickness of the screed plus 20-30 mm margin. The cutted end of the material is glued with reinforced tape. Each next strip of the material should be laid parallel to the previous one with 100 mm overlapping.	A "wet" or "semi-dry" cement-sand "floating" screed is made at least 50 mm thick that approximately corresponds to 100 kg/m2 optimum surface density. Upon gaining “step load” strength by the screed, edges of the elastic liner protruding above the screed surface around its perimeter are cut, and the resulting seam is filled with Sonetik vibroacoustic sealant. Then, as a base for the finish floating floor, Vibrofloor sheet 4 mm thick is laid butt-to-butt with overlapping the wall to the height of the finish floor height.	63.0	10	31	
TS-4.2		The surface of the base is cleaned of debris. Then StopZvuk-M material 4 mm thick is laid with felt down. For this purpose, the material is cut into strips with allowance for adjacent wall overlapping. The height of the overlapping equals to design thickness of the screed plus 20-30 mm margin. Each next strip of the material should be laid parallel to the previous one with 50 mm overlapping (for this purpose, felt layer of the appropriate width is cut from one of the edges of the material). To form a waterproofing layer, joints of the material are thermally welded (using hot air gun) or coated with bituminous primer.		59.0	8	27	
TS-4.3		The surface of the base is cleaned of debris. Then StopZvuk BP Floor plates 20 mm thick (18 mm thick under load) are laid with a shift relative to each other and without gaps over the entire surface of the base. In base/wall junction places, a collar made of StopZvuk BP Floor plates is laid directly on the base and pressed by the plates laid on their surface. The height of the collar equals to design thickness of the screed plus 20-30 mm margin. Before making the screed, the laid StopSound BP Floor plates (together with the collar) are covered with PET film at least 100 microns thick with 100-150 mm overlapping. The joints of the film are glued with adhesive tape.		78.0	17	35	

1	2	3	4	5	6	7	8
TS-4.4		The surface of the base is cleaned of debris. Then ThermoZvukoizol Standard material 14 mm thick (6 mm thick under load) is laid. For this purpose, the material is cut into strips. The cutted end of the material is glued with reinforced tape. Each next strip of the material should be laid parallel to the previous one with 100 mm overlapping. Upon laying the first layer of ThermoZvukoIzol Standard material, a viscoelastic membrane Tecsound 70 3.7 mm thick is laid in the same way with 50 mm overlapping of the sheets. Then the second layer of ThermoZvukoIzol Standard is laid with repeating all the operations listed in the description of elastic liner for TS-4.1 structure screed.		96.0	18	40	

2. Basic requirements to construction technology

TechnoSonus sound insulating floor construction technology is described in Table 4.

In addition to this description, requirements to "floating" cement-sand screeds are briefly given. Usually the screeds are made in two ways:

- by traditional "wet" method with mandatory reinforcement by metal mesh placed inside the screed, approximately in the middle of its thickness;

- by "semi-dry" method with reinforcement by polypropylene fiber placed evenly over the entire thickness of the screed.

"Floating" cement-sand screeds made by any technology should have at least 80 kg/m2 surface density. Lightweight "floating" screeds and, all the more, finish "floating" floors do not provide sufficient protection against impact noise. The optimum is "floating" cement-sand screed with 100 kg/m2 surface density.

In addition, "floating" screeds should have sufficient strength. Mixtures with strength grade below M-150 are not recommended. Optimum strength grade of the screed mixture is M-300.

Installation of room partitions on a "floating" screed is recommended.

Section V

Solutions for wooden housing

Widespread use of timber-frame structures in residential construction is due both to Russian housing construction traditions and new materials and technologies applied for creating a comfortable living environment.

Until recently, however, acoustic comfort was not a priority of timber-frame house design due to requirements ensuring effective noise insulation which are poorly compatible with such advantages of wood-based materials as relatively low elasticity and low specific density. The development of new materials such as mineral wool, gypsum-containing panels and heavy membranes allowed to develop new compositions and structural solutions for new sound insulating technologies used in timber-frame construction.

This section presents some typical high performance designs taking into account features of wood as a material and compliance with governmental sound insulating requirements SP51.13330-2011/2017.

Special attention in construction solutions is paid to wooden structures. The structures are listed in the order of increase of acoustic comfort and proportional budgetary costs.

Addition of heavy innovative Tecsound/VEM membranes, combined elastic TZI and Vibrofloor elastic liners significantly increases acoustic comfort in premises by insulation of airborne noise and impact noise.

It is still traditional to use plywood sheets instead of new gypsum-containing panels in some tasks, for example, studio construction. For this purpose, wall partition structures containing Tecsound/VEM heavy membranes are provided.

Section VI

Acoustic solutions for utilities

Acoustic protection of utilities in this album is presented by Tecsound SY and FT heavy viscoelastic membranes which proved their effectiveness as a tape winding of pipelines of various configurations.

For example, combined extract-and-input system based on rigid metal ducts of rectangular and circular cross-section has a number of operational advantages against soft systems that is the reason of their popularity under designing. Thus, the use of heavy strip materials based on Tecsound 35 and 70 combined with a felt layer and foil coating becomes an increasingly popular solution due to high reliability, ergonomics and high sound insulating properties together with fireproof and environmental features.

The album presents the most common examples of sound insulating ventilation system. Nodes and joints of air ducts for Tecsound material of various modifications providing compliance with normative indicators are shown on sheets 6.1–6.7.

Design of Tecsound-based AcousticGyps Box sound insulating socket box is worth of special attention (sheet 6.8). Its use prevents undesirable sound leaks through socket box loosely mounted in the wall which can nullify all noise insulation efforts.

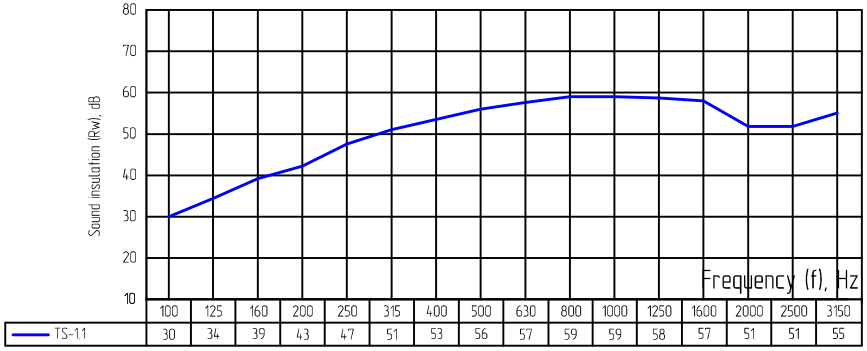
SECTION 1

Sound insulating framed partitions

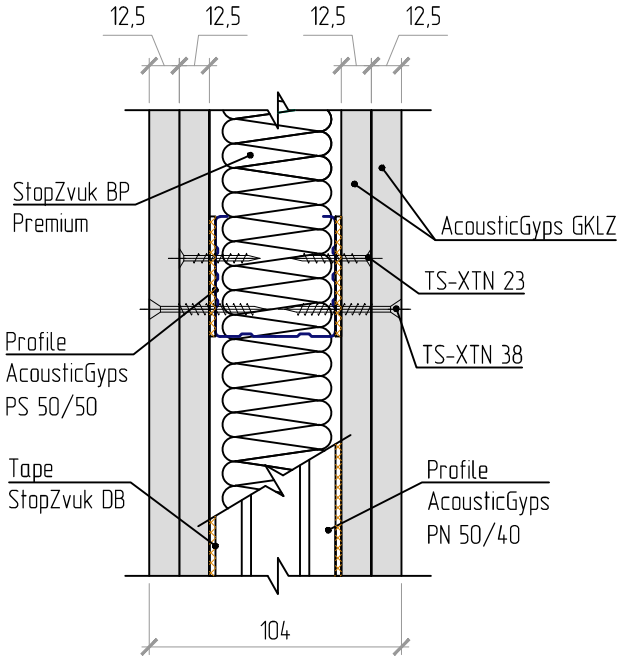
TS-1.1 sound insulating framed partition 104 mm thick (basic)

Rw= 52 dB

Airborne noise insulation frequency response, Rw (f)



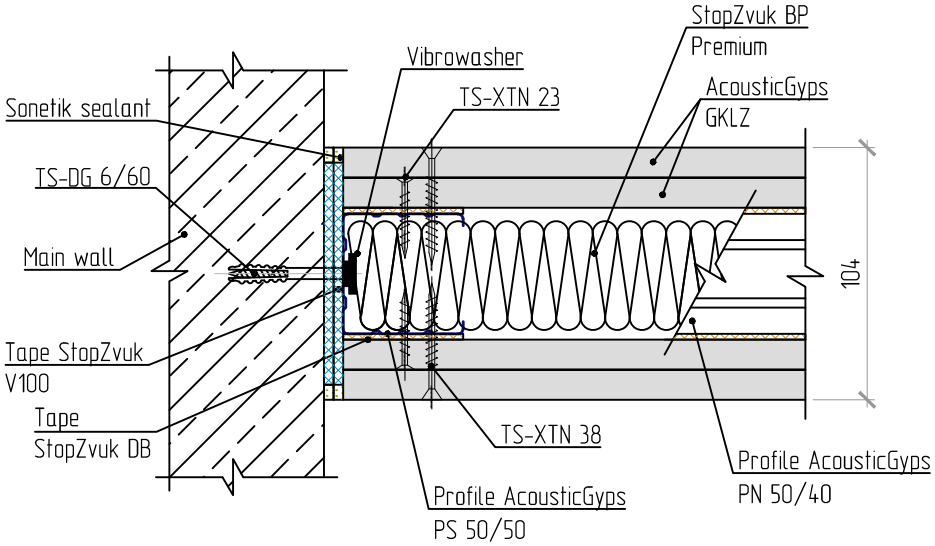
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-1.1	30	34	39	43	47	51	53	56	57	59	59	58	57	51	51	55



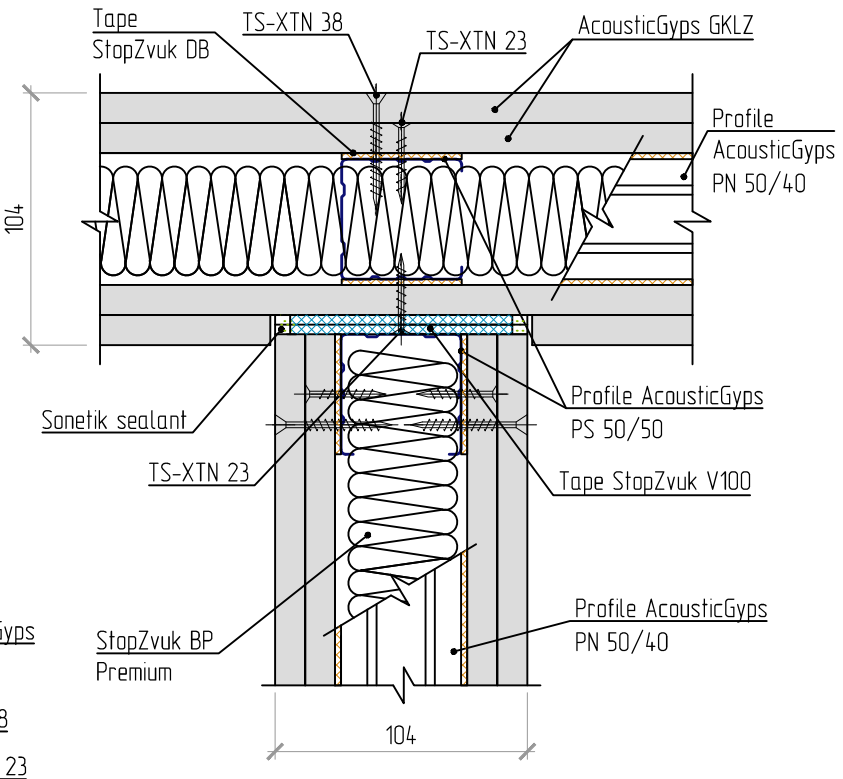
Design type	Section formula[1]	Partition thickness (mm)	Rw, (dB)
TS-1.1	2GKLZ-(M50-SZBPPremium)-2GKLZ	104	52

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the partition (see Appendix B).

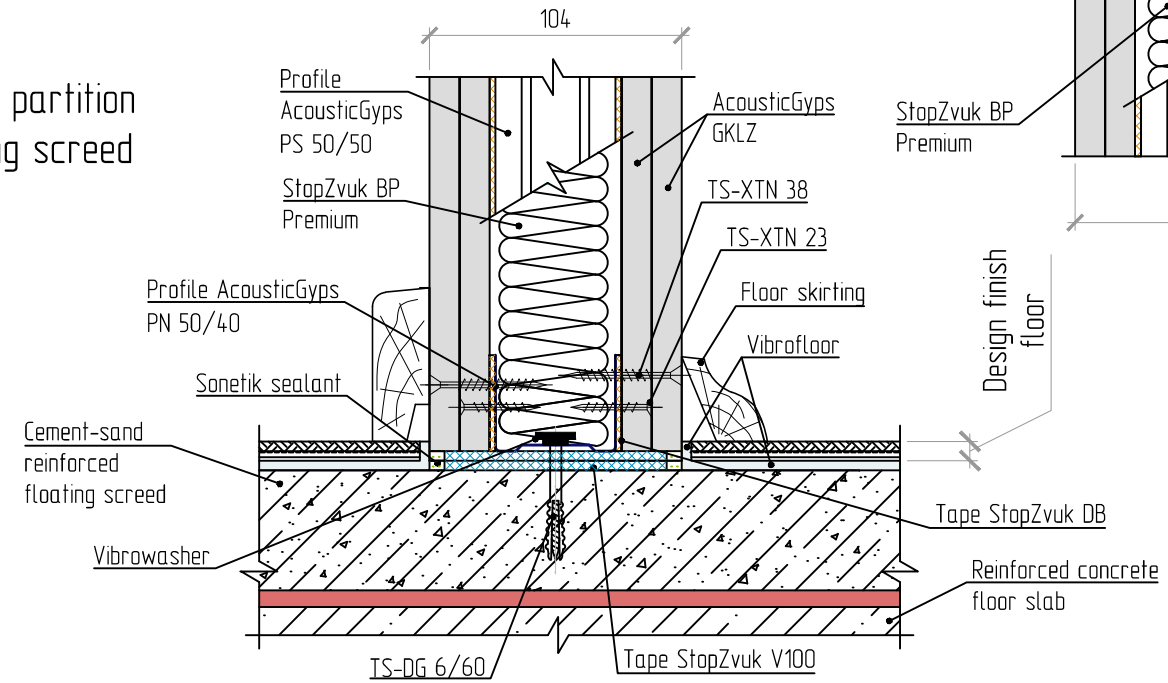
Junction of partition and main wall



Junction of partition and partition at 90° angle



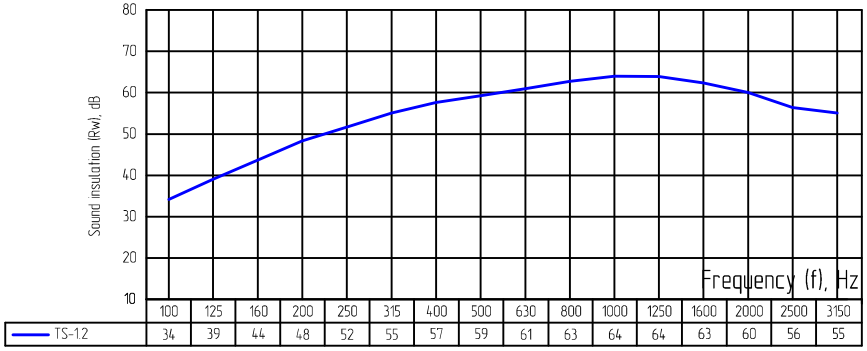
Junction of partition and floating screed



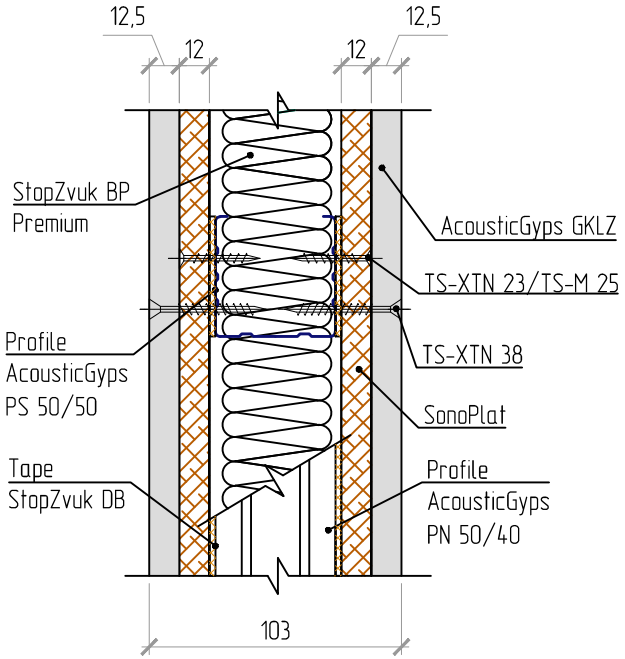
TS-1.2 sound insulating framed partition 103 mm thick (Standard P)

Rw= 56 dB

Airborne noise insulation frequency response, Rw (f)



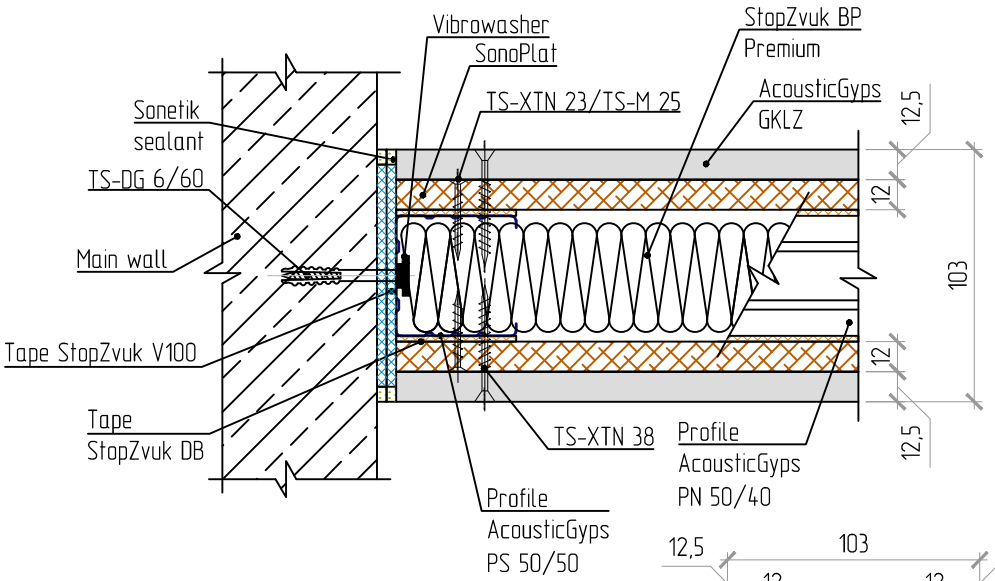
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-1.2	34	39	44	48	52	55	57	59	61	63	64	64	63	60	56	55



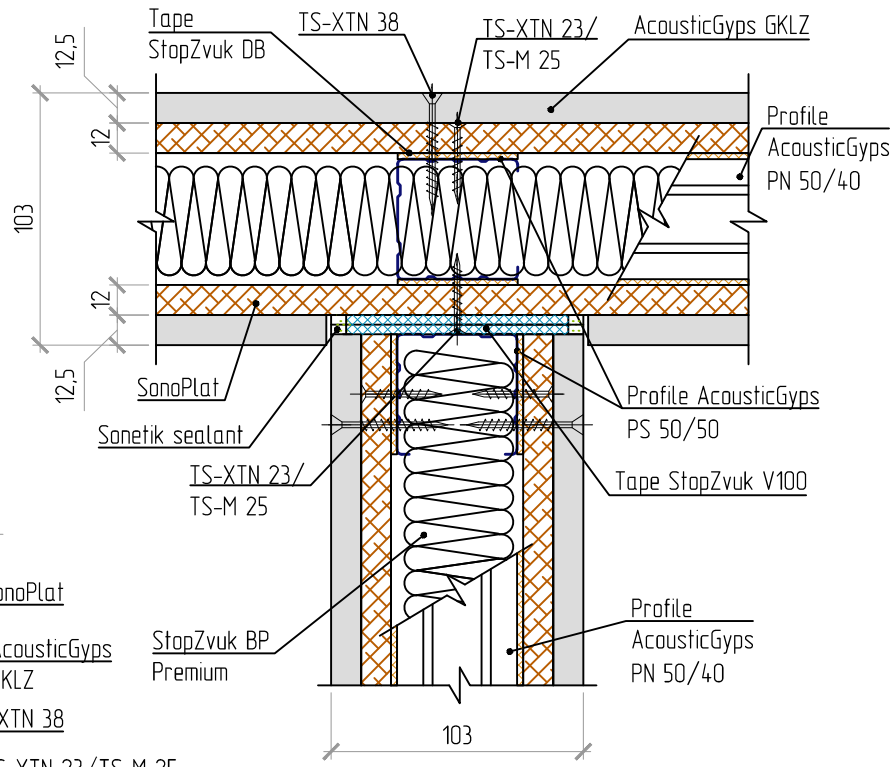
Design type	Section formula[1]	Partition thickness (mm)	Rw, (dB)
TS-1.2	2GKLZ-(M50-SZBPPremium)-SP-GKLZ	103	56

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the partition (see Appendix B).

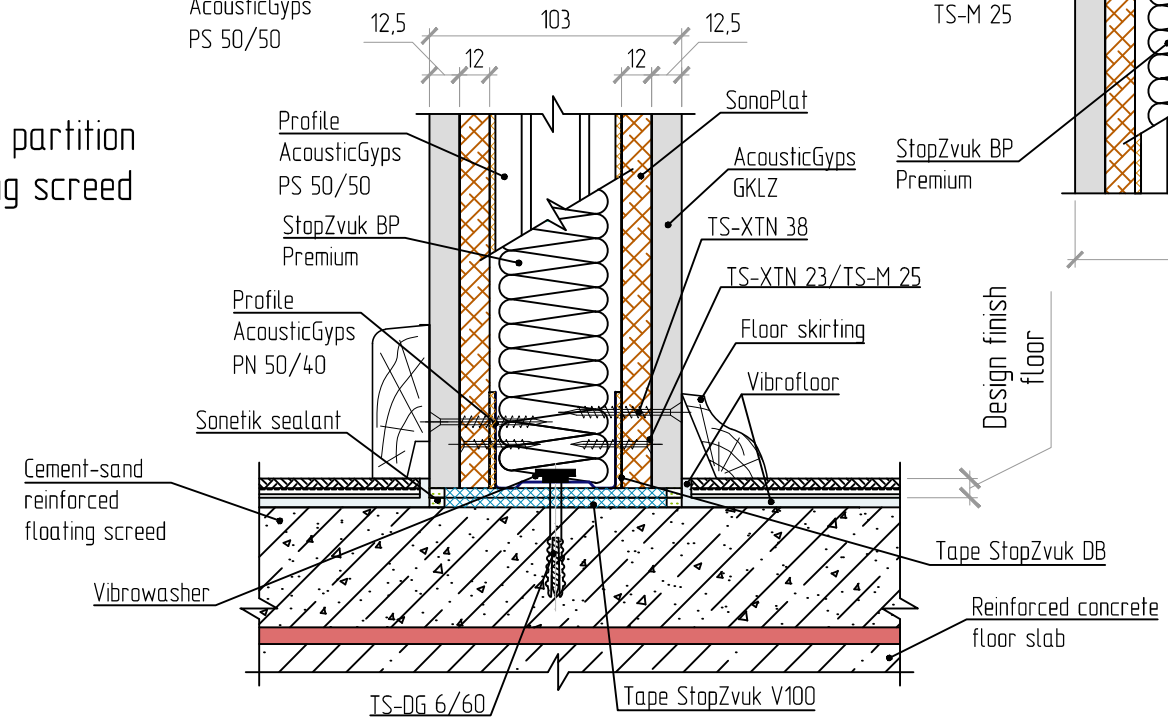
Junction of partition and main wall



Junction of partition and partition at 90° angle



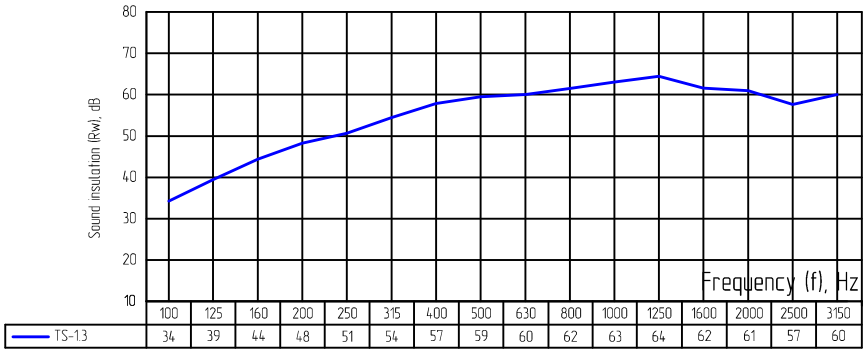
Junction of partition and floating screed

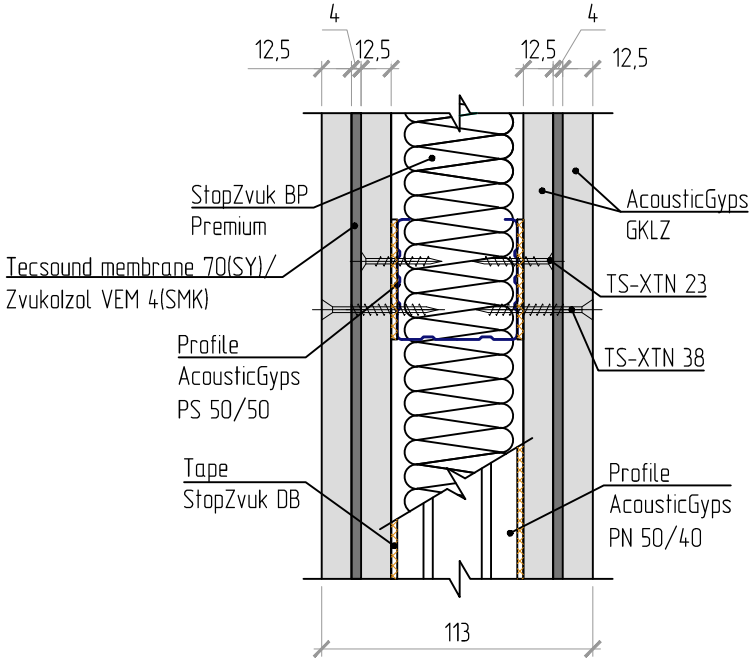


TS-1.3 sound insulating framed partition 113 mm thick (Standard M)

Rw= 58 dB

Airborne noise insulation frequency response, Rw (f)

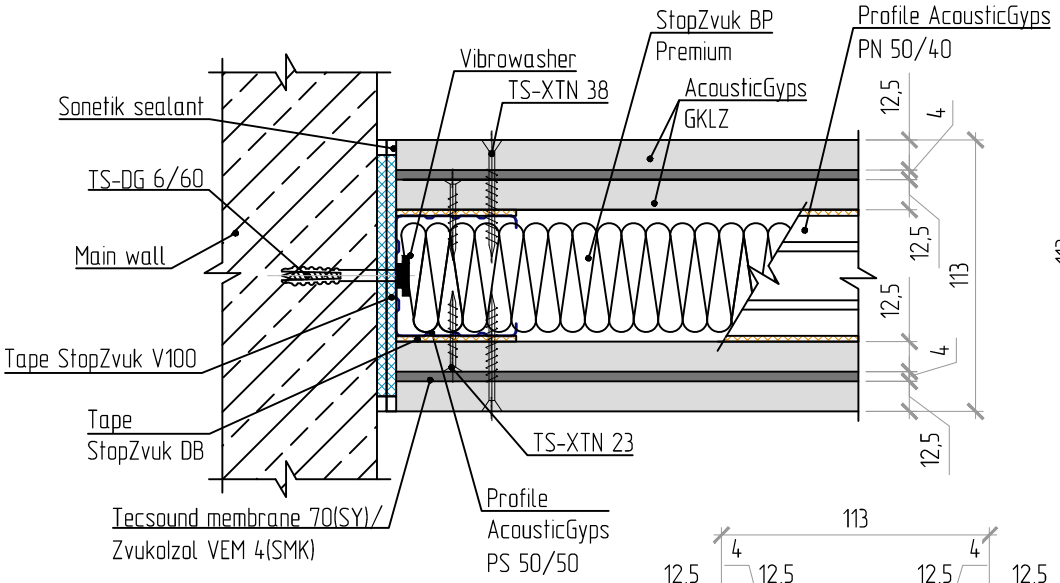




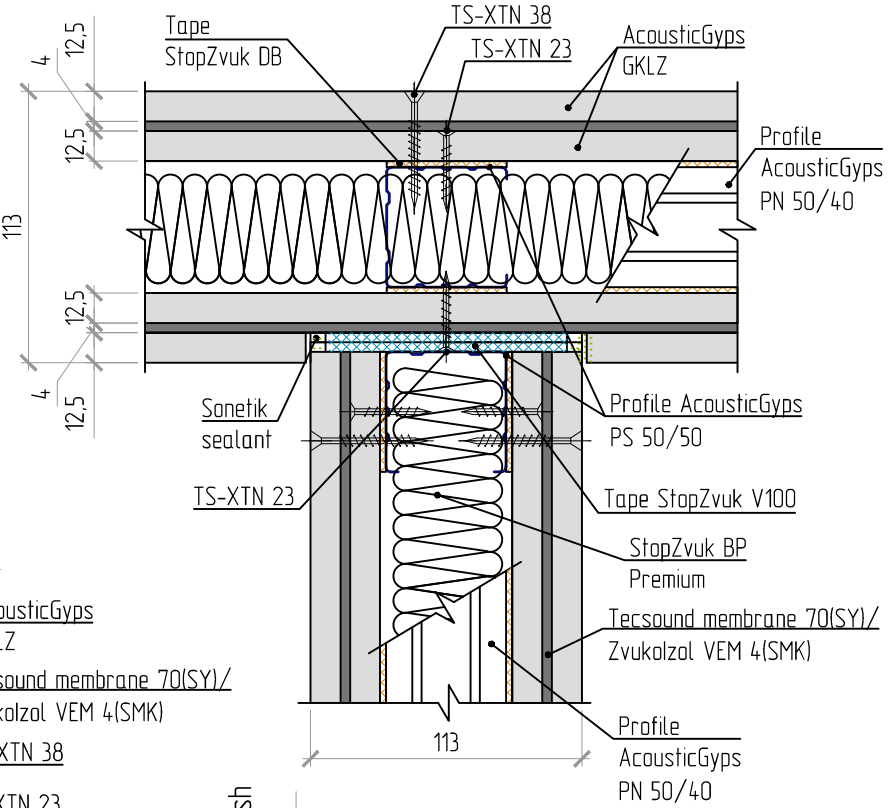
Design type	Section formula[1]	Partition thickness (mm)	Rw, (dB)
TS-1.3	GKLZ-(TS70/VEM4)-GKLZ-(M50-SZBPPremium)-GKLZ-(TS70/VEM4)-GKLZ	113	58

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the partition (see Appendix B).

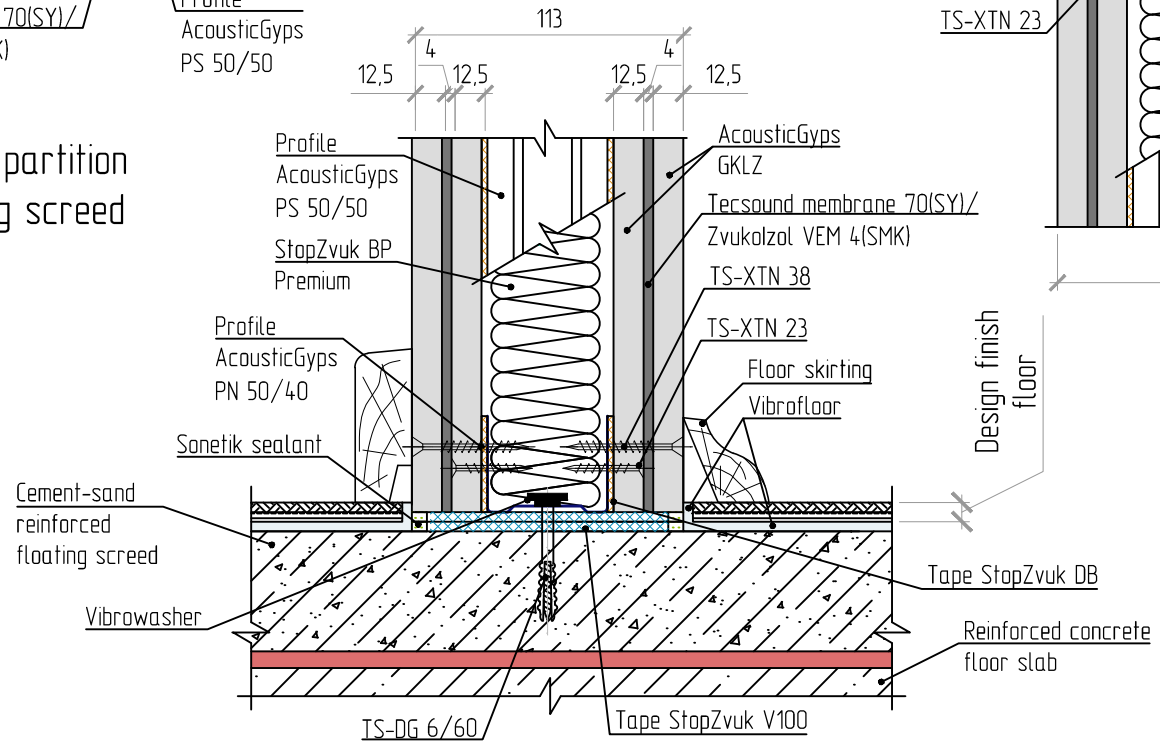
Junction of partition and main wall



Junction of partition and partition at 90° angle



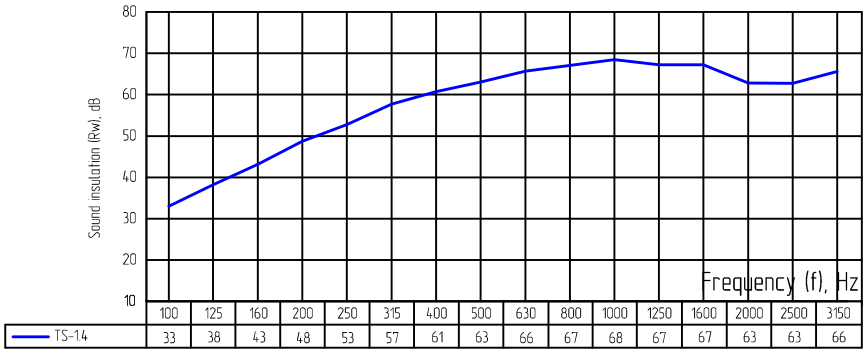
Junction of partition and floating screed

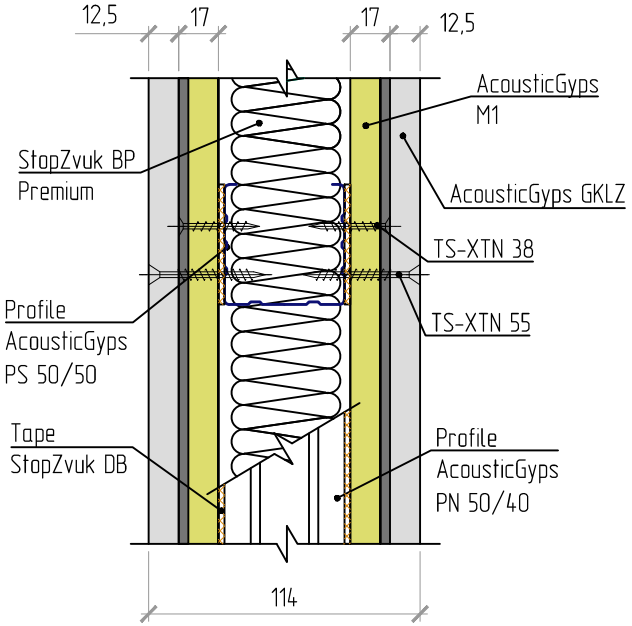


TS-1.4 sound insulating framed partition 114 mm thick (Standard M1)

Rw= 60 dB

Airborne noise insulation frequency response, Rw (f)

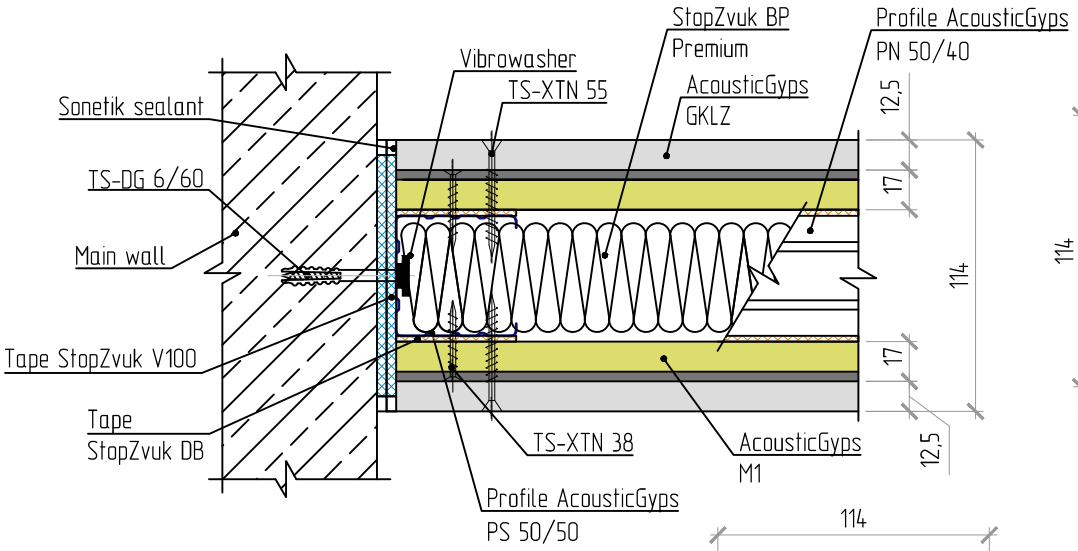




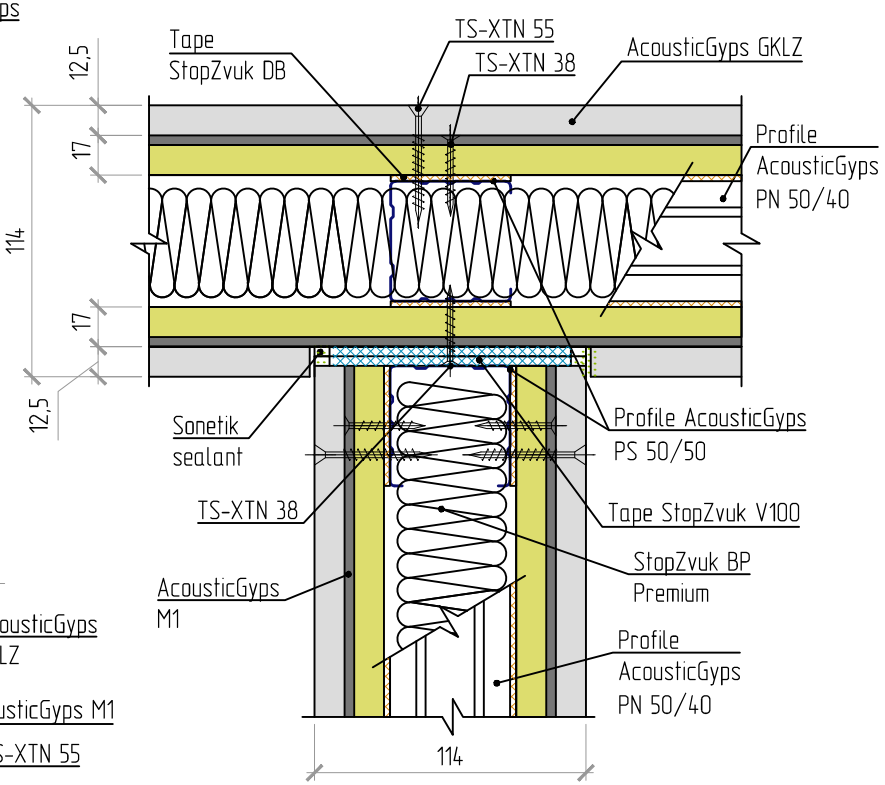
Design type	Section formula[1]	Partition thickness (mm)	Rw, (dB)
TS-1.4	GKLZ-AGM1-(M50-SZBPPremium)-AGM1-GKLZ	114	60

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the partition (see Appendix B).

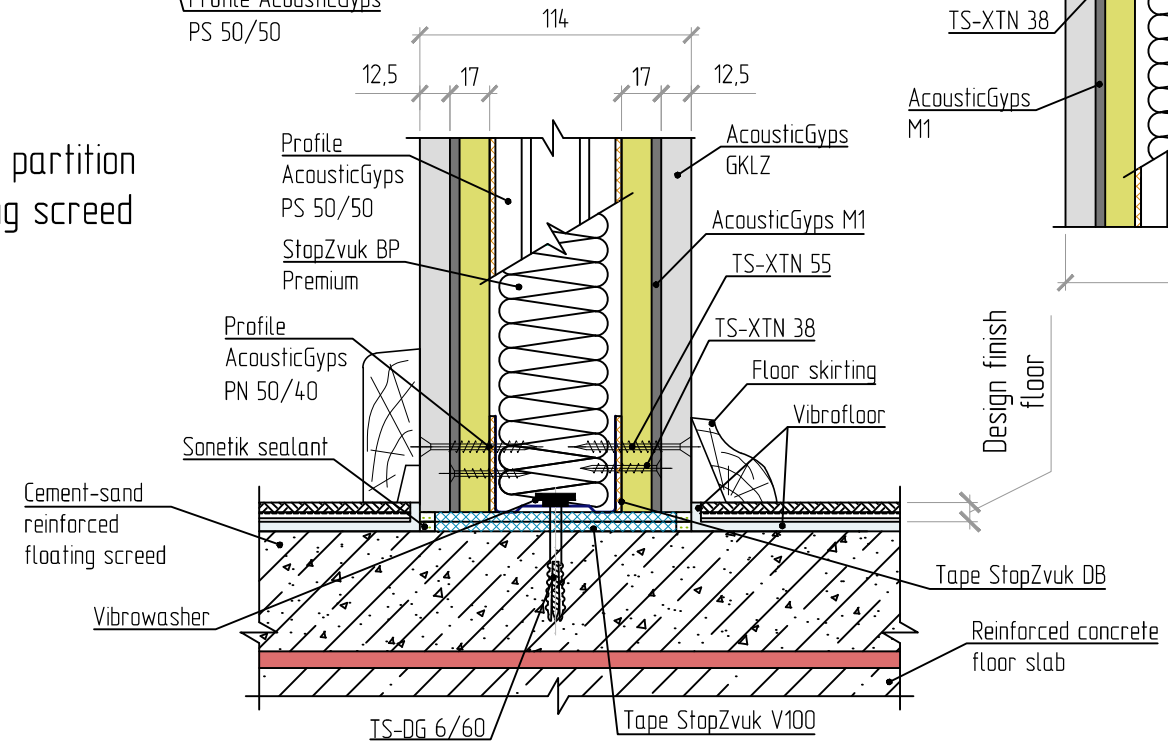
Junction of partition and main wall



Junction of partition and partition at 90° angle



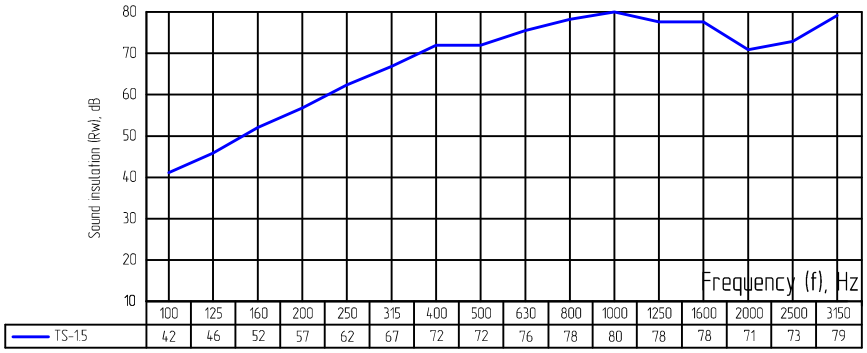
Junction of partition and floating screed

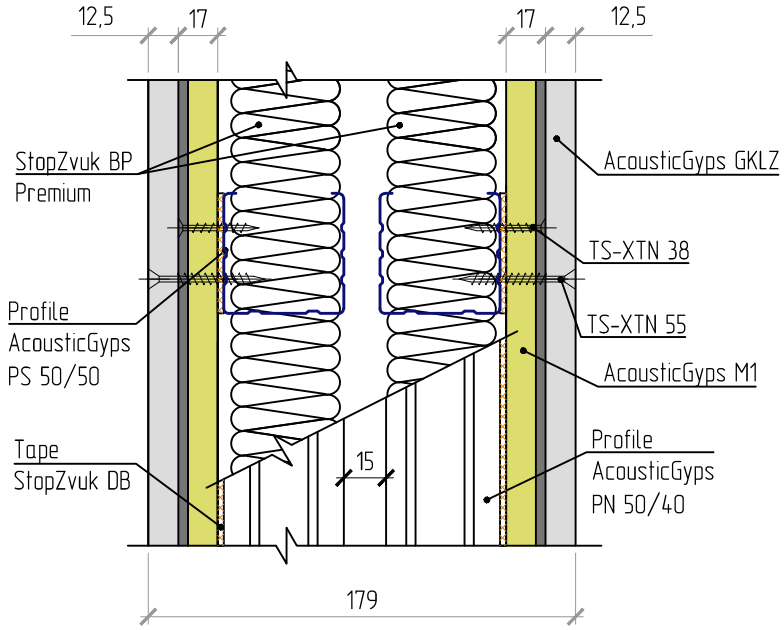


TS-1.5 sound insulating framed partition 179 mm thick (Standard M1)

Rw= 66 dB

Airborne noise insulation frequency response, Rw (f)

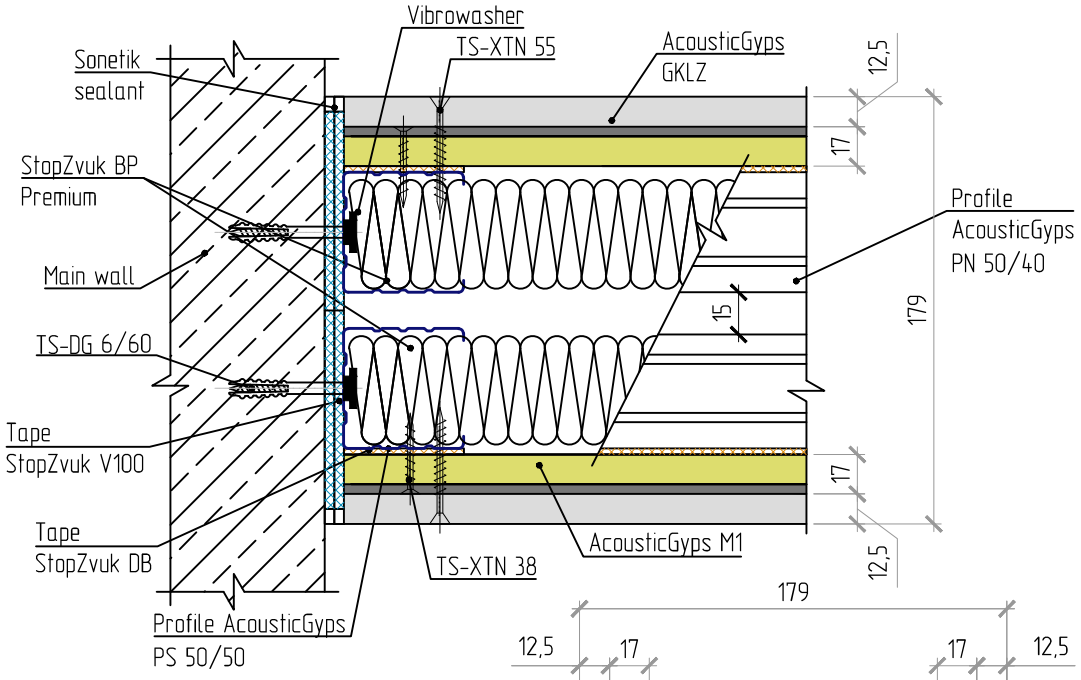




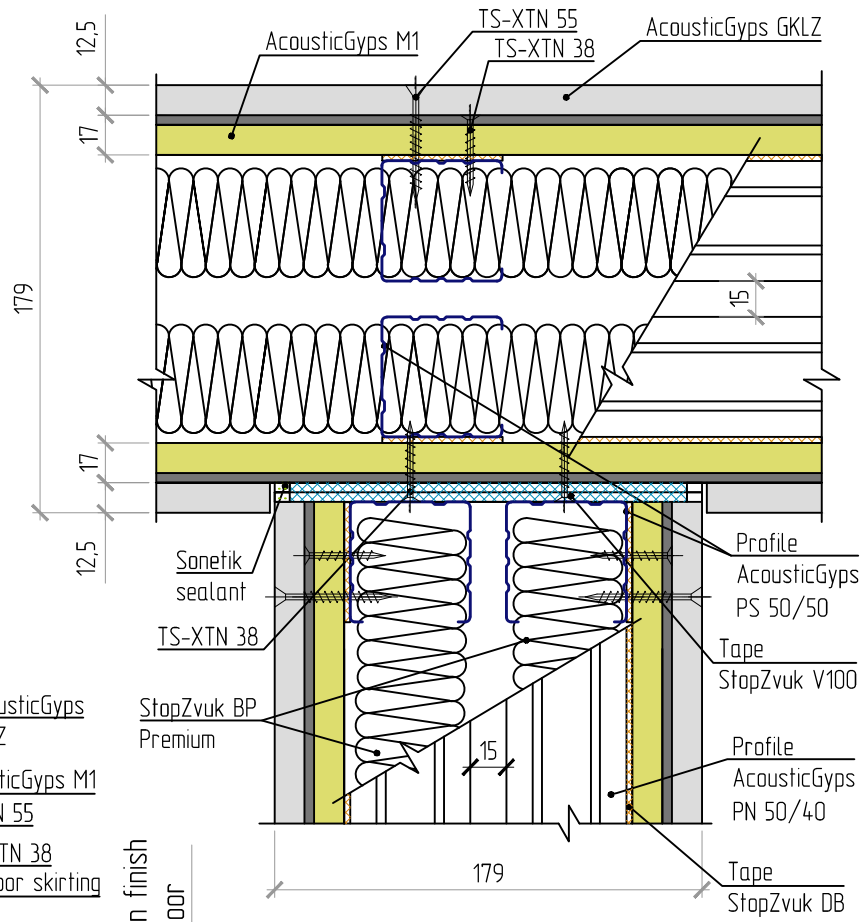
Design type	Section formula[1]	Partition thickness (mm)	Rw, (dB)
TS-1.5	GKLZ-AGM1-(2M50-2SZBPPremium)-AGM1-GKLZ	179	66

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the partition (see Appendix B).

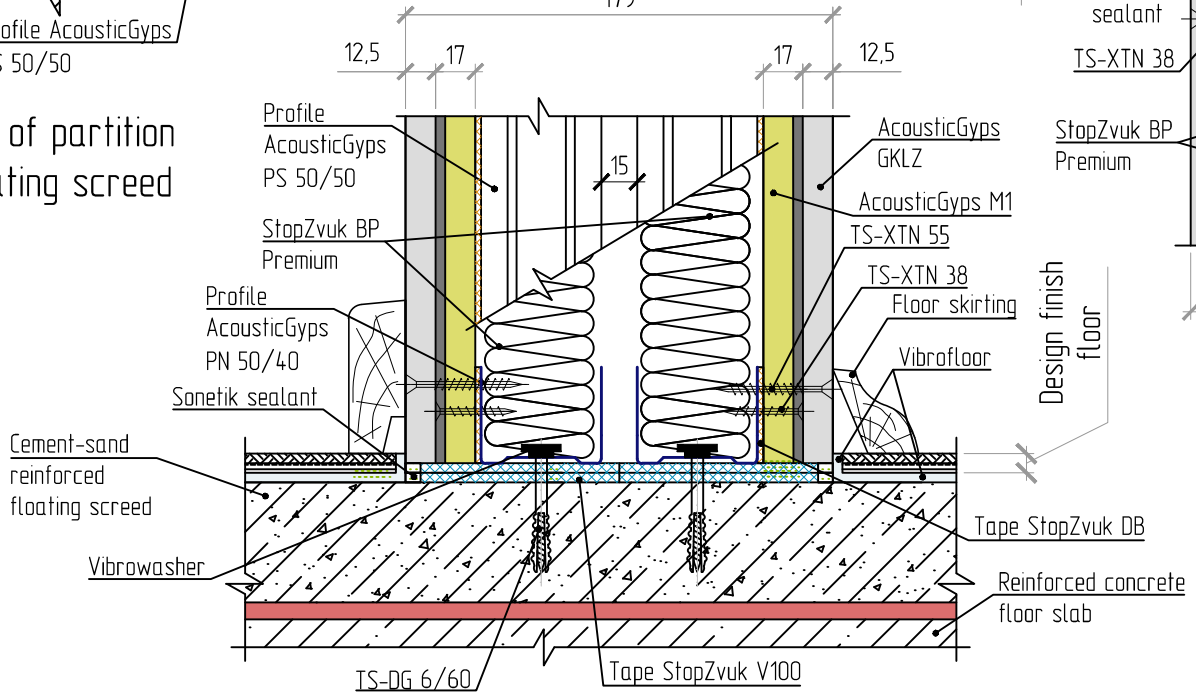
Junction of partition and main wall



Junction of partition and partition at 90° angle



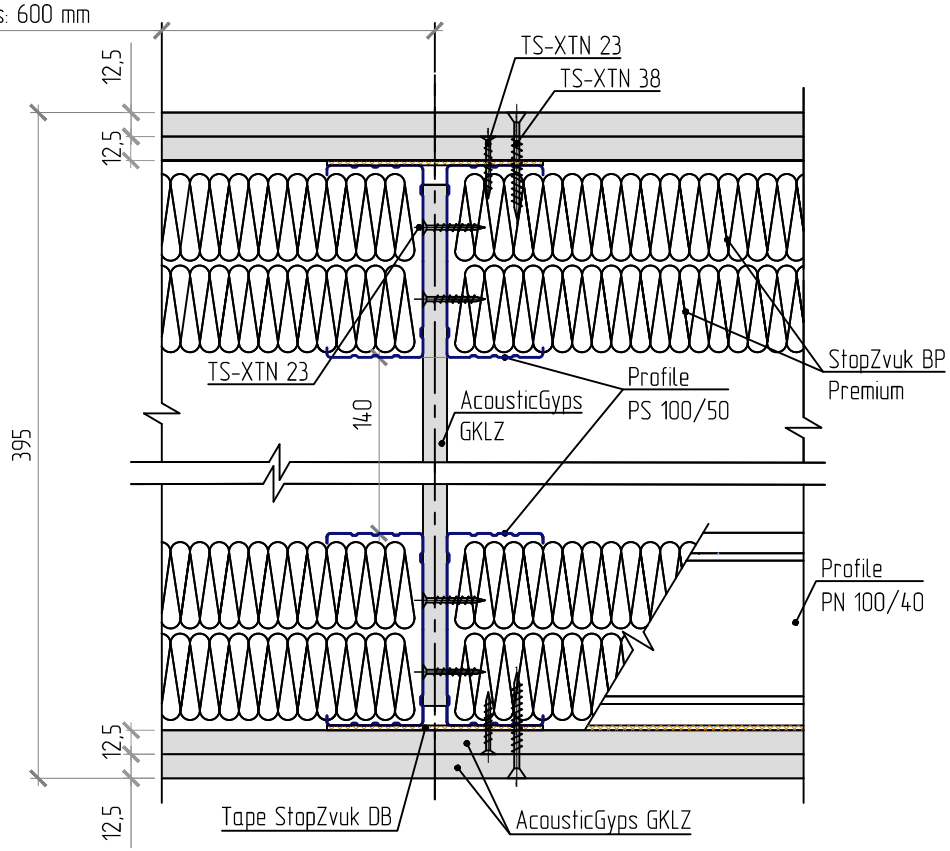
Junction of partition and floating screed



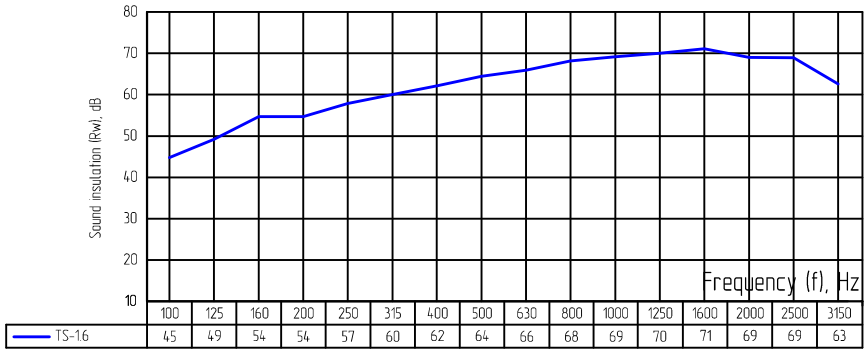
TS-1.6 sound insulating framed partition 395 mm thick (Profi)

Rw= 66 dB

Axial distance between studs: 600 mm



Airborne noise insulation frequency response, Rw (f)

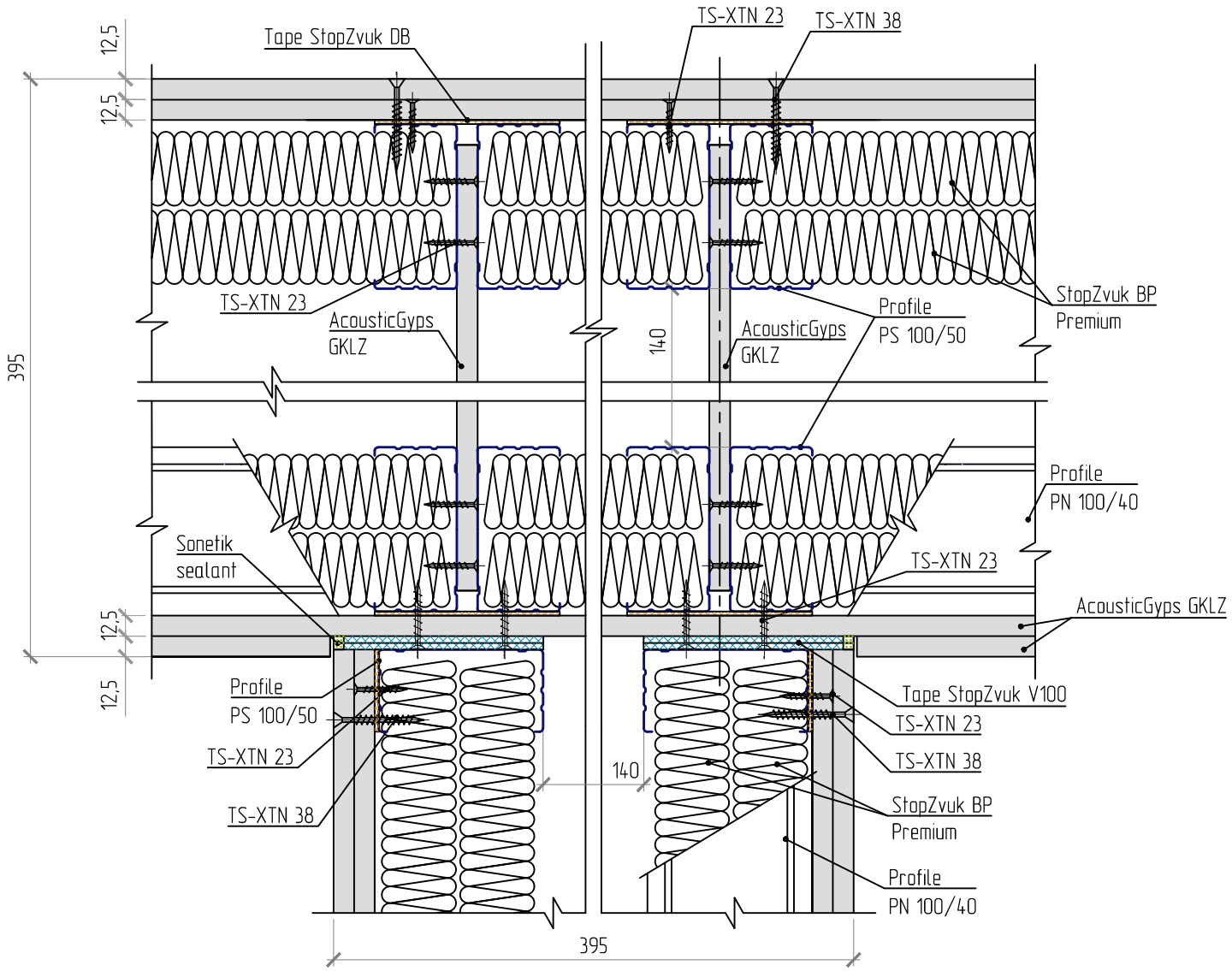


	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-1.6	45	49	54	54	57	60	62	64	66	68	69	70	71	69	69	63

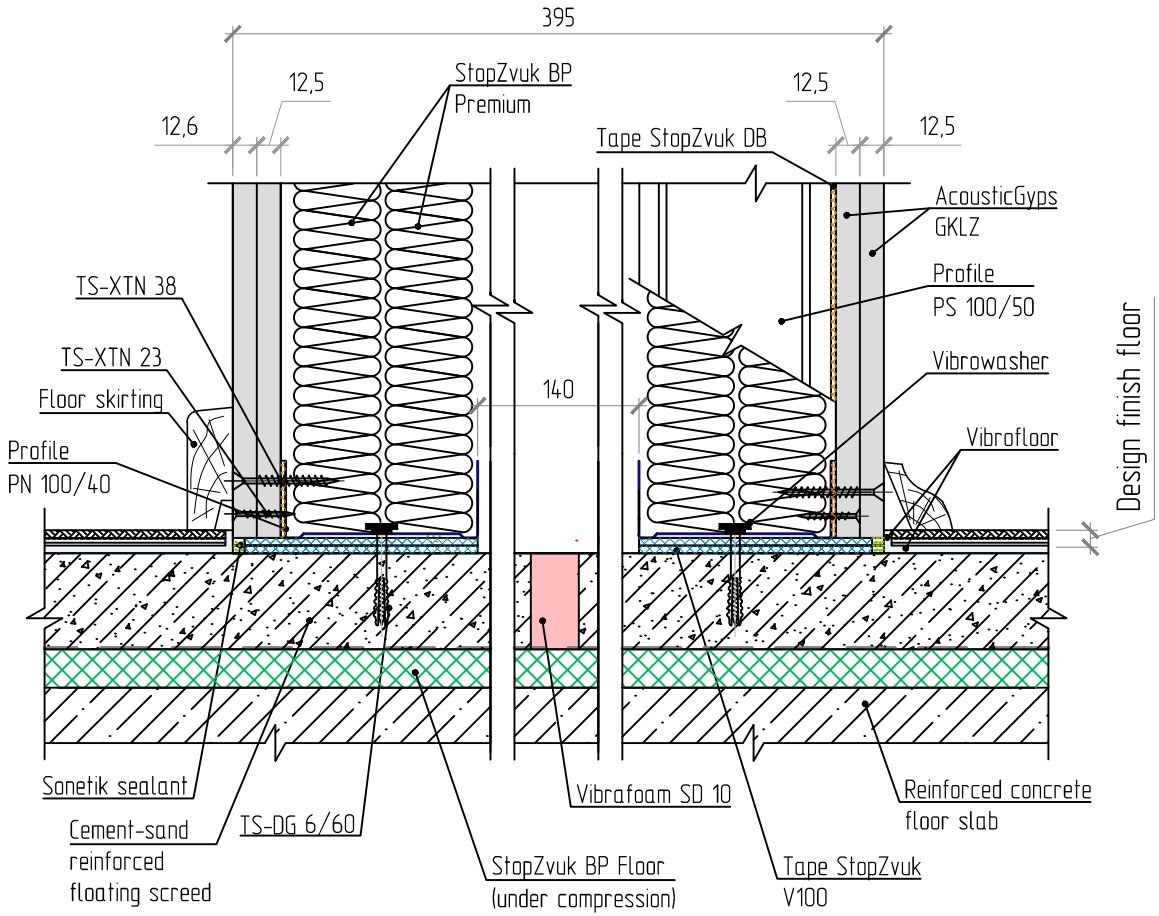
Design type	Section formula[1]	Partition thickness (mm)	Rw, (dB)
TS-1.6	2GKLZ-(M100-2SZBPPremium-140-SZBPPremium-M100)-2GKLZ	395	66

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the partition (see Appendix B).

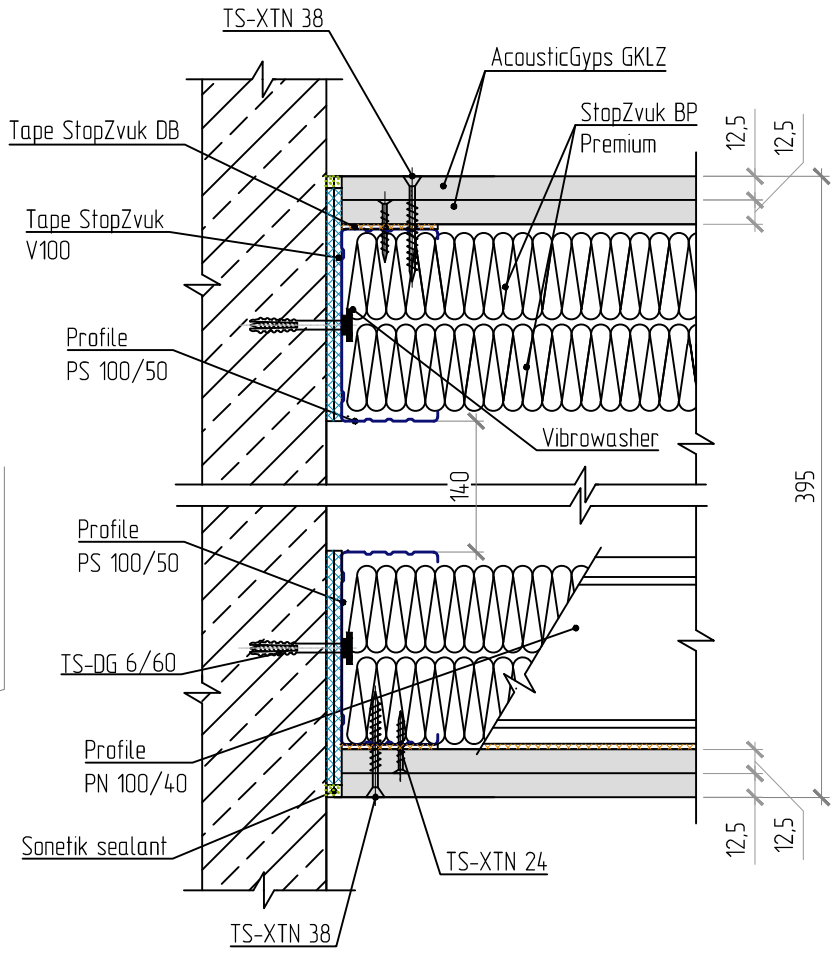
Junction of partition and partition at 90° angle



Junction of partition and floating screed



Junction of partition and main wall

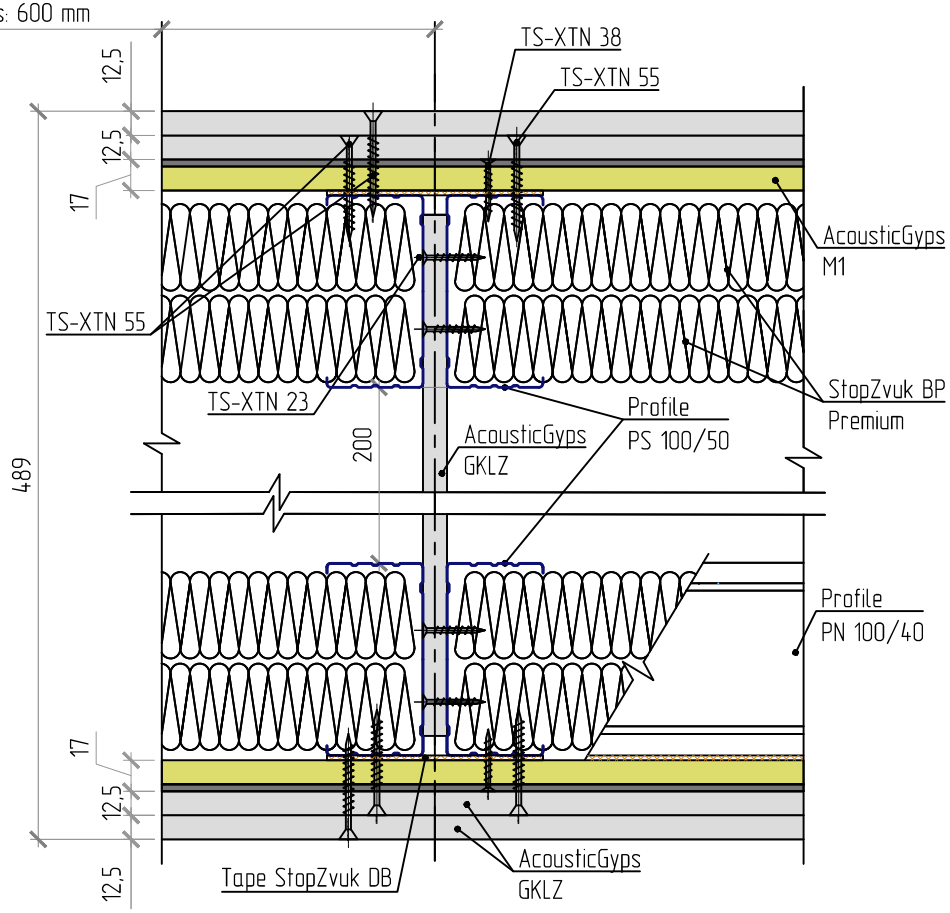


Sheet 1.6 (3)

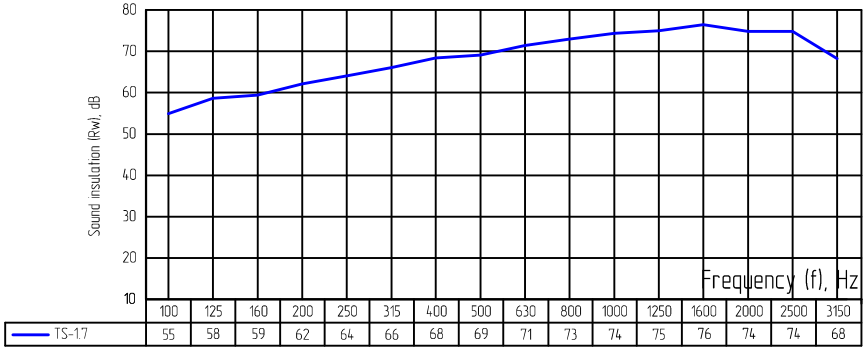
TS-1.7 sound insulating framed partition 489 mm thick (Profi M1)

Rw= 74 dB

Axial distance between studs: 600 mm



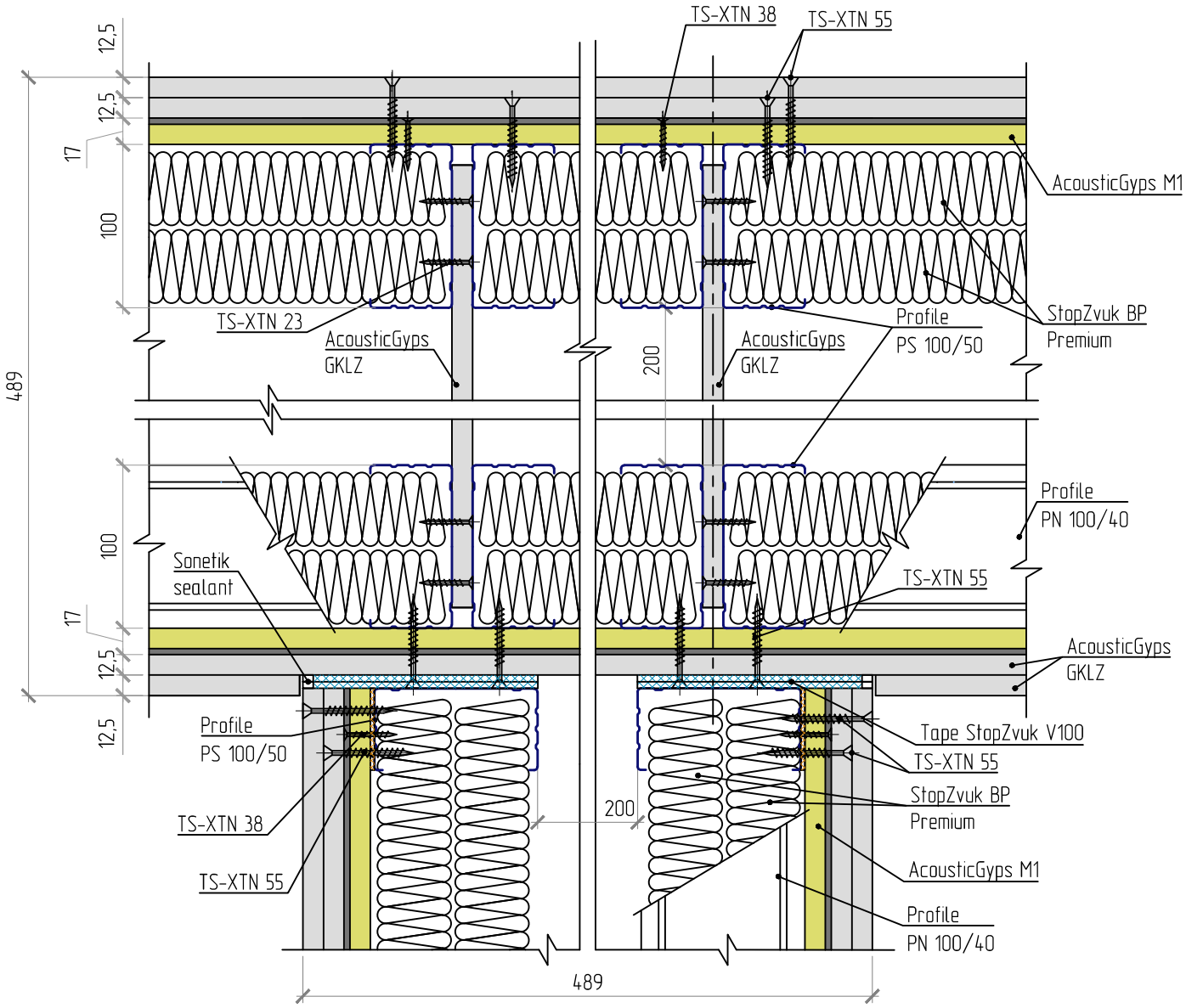
Airborne noise insulation frequency response, Rw (f)



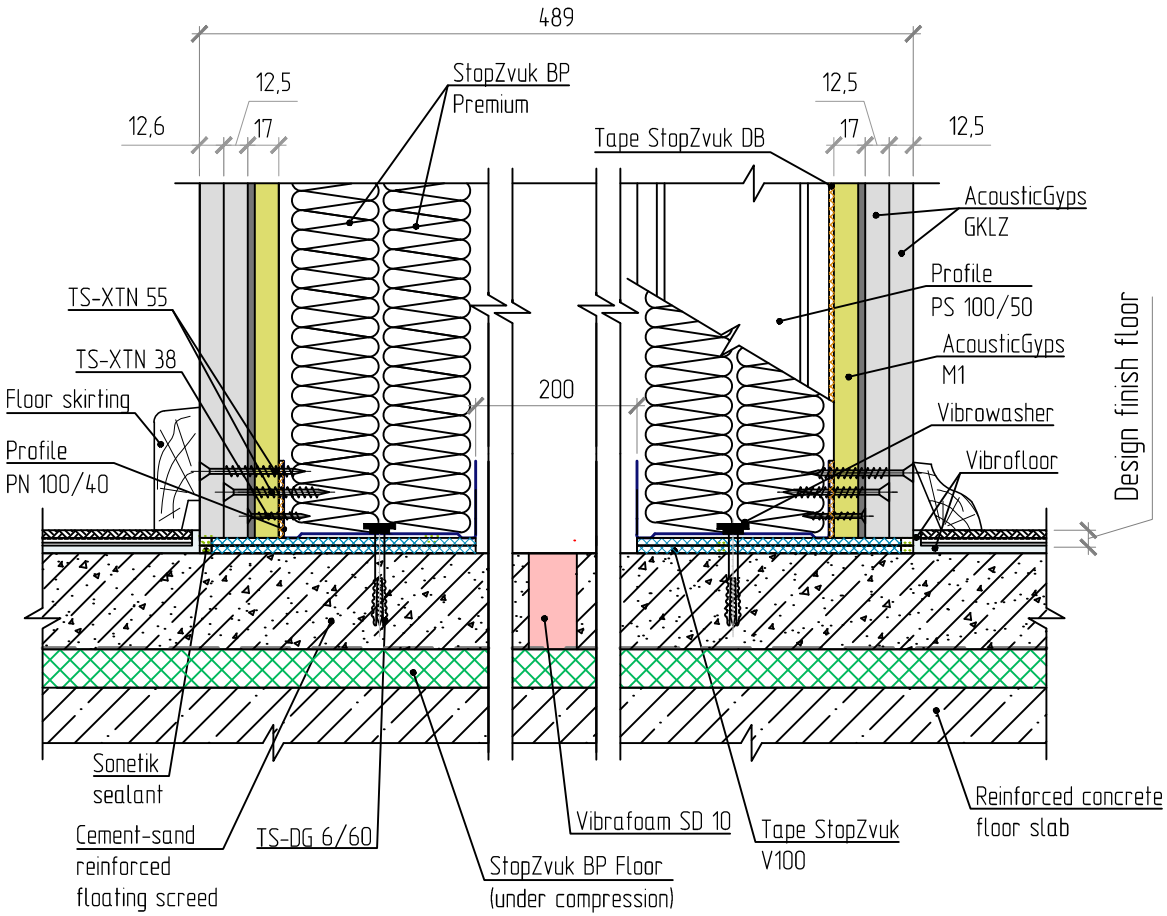
Design type	Section formula[1]	Partition thickness (mm)	Rw, (dB)
TS-1.7	2GKLZ-AGM1-(M100-2SZBPPremium-200-SZBPPremium-M100)-AGM1-2GKLZ	489	74

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the partition (see Appendix B).

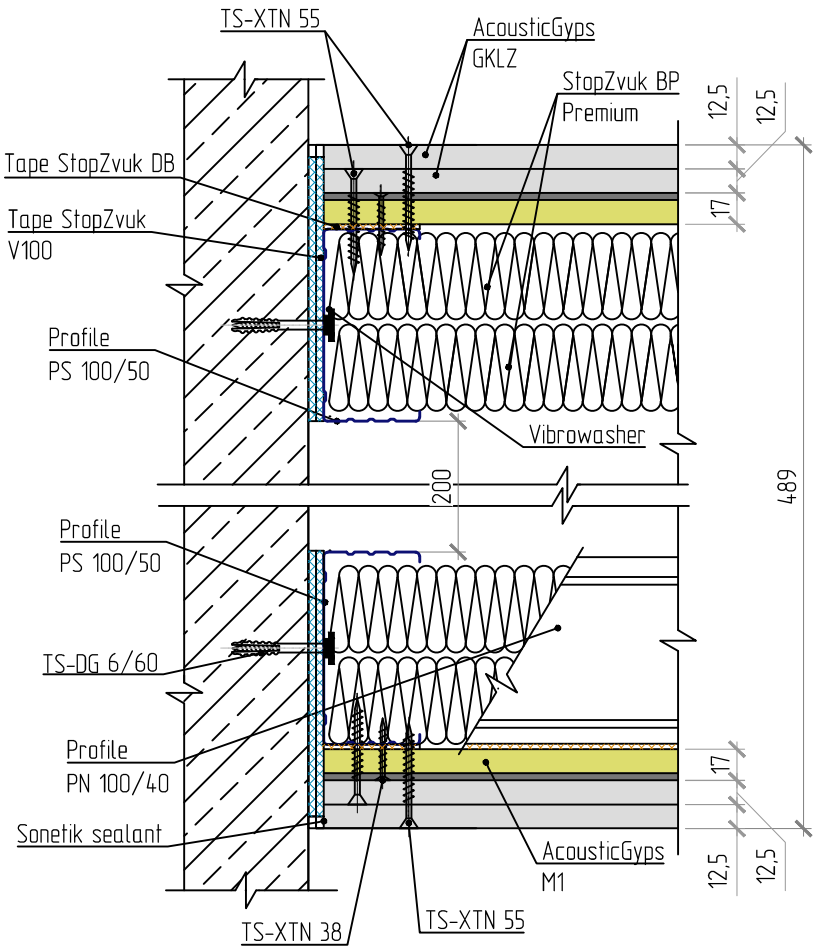
Junction of partition and partition at 90° angle



Junction of partition and floating screed



Junction of partition and main wall



SECTION 2

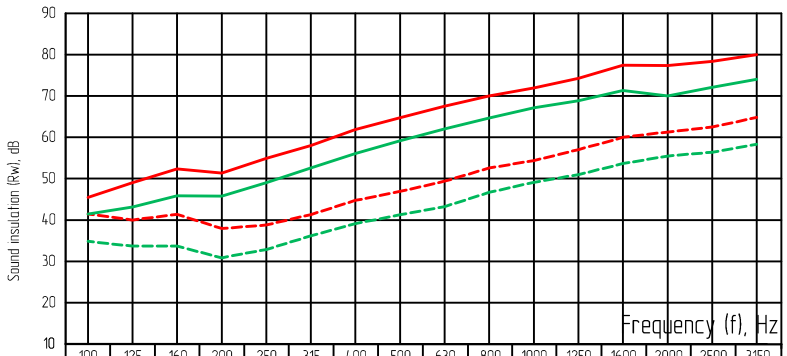
Sound insulating wall lining

TS-2.1 sound insulating lining 69 mm thick (on SonoKrep Protector/Protector Pro vibrofasteners) (basic)

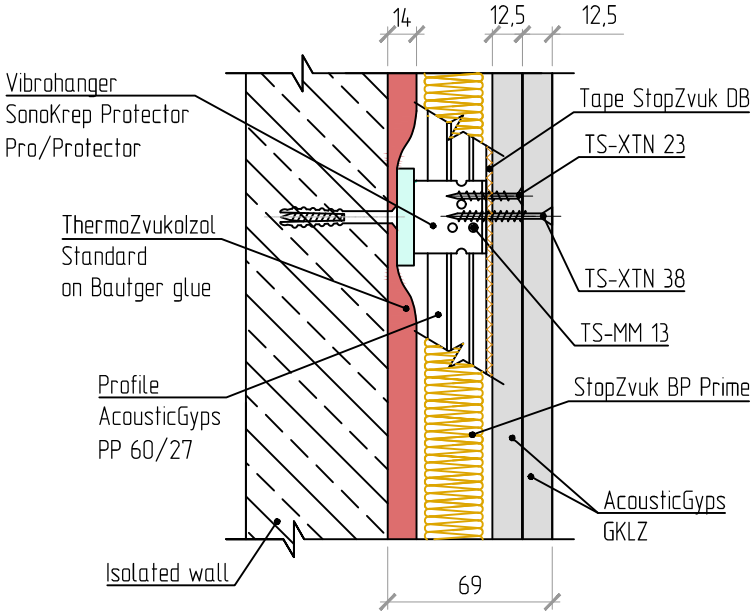
ΔRw_1= 13 dB

ΔRw_2= 12 dB

Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-2.1 (base 1)	41	43	46	46	49	53	56	59	62	65	67	69	71	70	72	74
Base 1	35	34	34	31	33	36	39	41	44	47	49	51	53	55	56	58
TS-2.1 (base 2)	46	49	53	52	55	58	62	64	67	70	72	74	77	77	78	80
Base 2	41	40	41	38	39	41	44	46	49	52	54	57	60	61	63	65

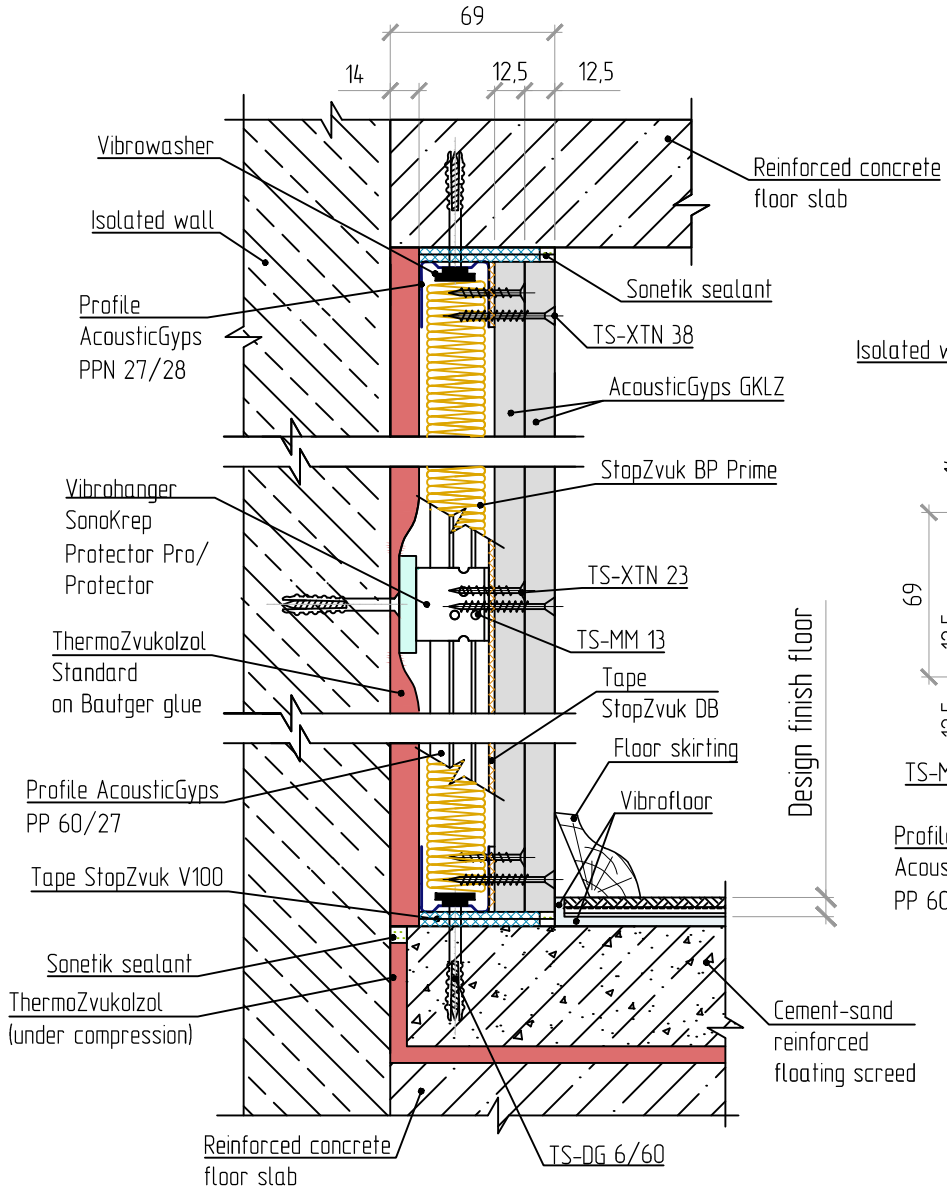


Design type	Section formula [1]	Lining thickness (mm)	Rw_{base} (dB)	Rw (dB)
TS-2.1 [2]	PBS200-TZIST-SZBPPrime-2GKLZ	69	45	58
	ZhBS140-TZIST-SZBPPrime-2GKLZ		50	62

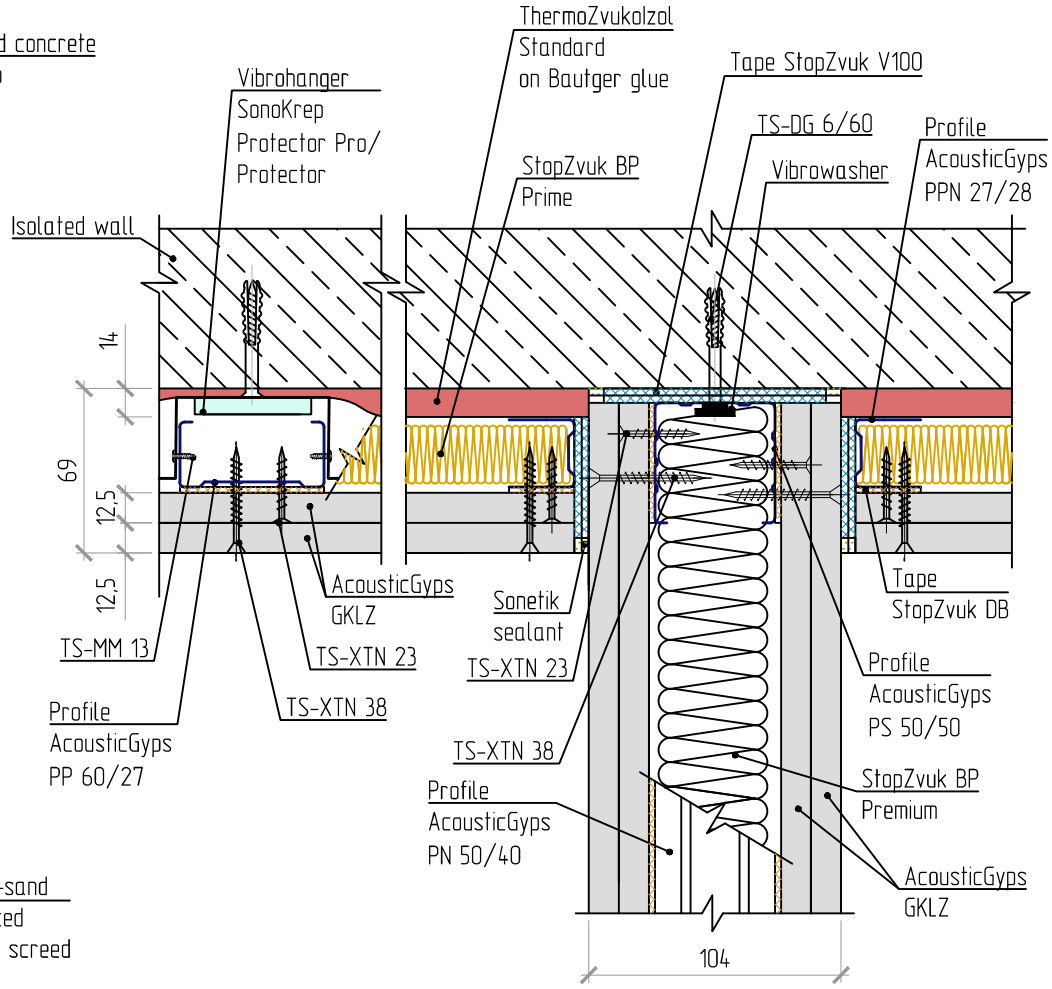
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the structure (see Appendix B).

[2] This sound insulating lining scheme has been tested for two wall types:
- foam concrete blocks 200 mm thick (PBS200);
- reinforced concrete 140 mm thick (ZhBS140).

Junction of wall lining, floating floor screed and floor slab at ceiling level



Junction of wall lining and TS-1.1 partition



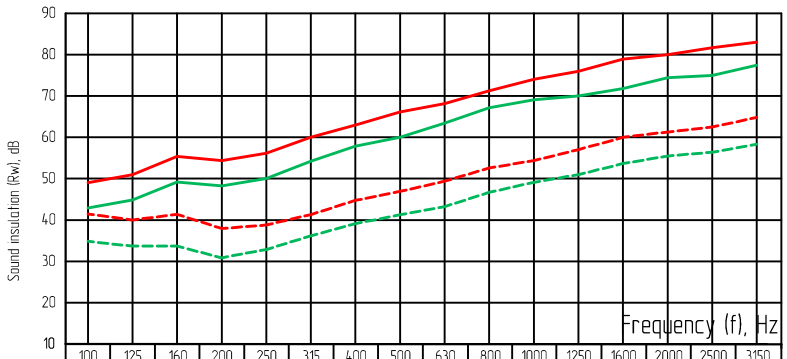
Sheet 2.1 (2)

TS-2.2 sound insulating lining 68.5 mm thick (on SonoKrep Protector/Protector Pro vibrofasteners) (Standard P)

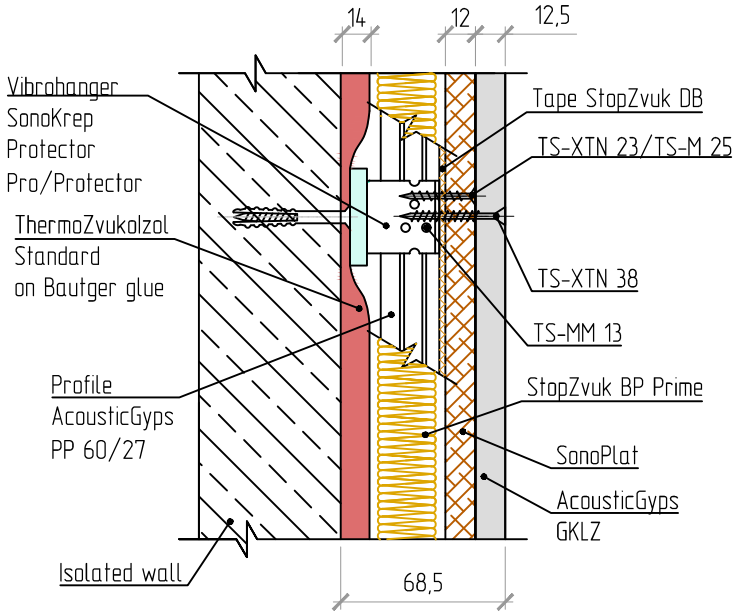
ΔRw_1= 17 dB

ΔRw_2= 15 dB

Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-2.2 (base 1)	43	45	49	48	50	54	57	60	63	67	69	70	72	74	75	77
Base 1	35	34	34	31	33	36	39	41	44	47	49	51	53	55	56	58
TS-2.2 (base 2)	49	51	55	54	56	60	63	66	68	71	74	76	79	80	82	83
Base 2	41	40	41	38	39	41	44	46	49	52	54	57	60	61	63	65

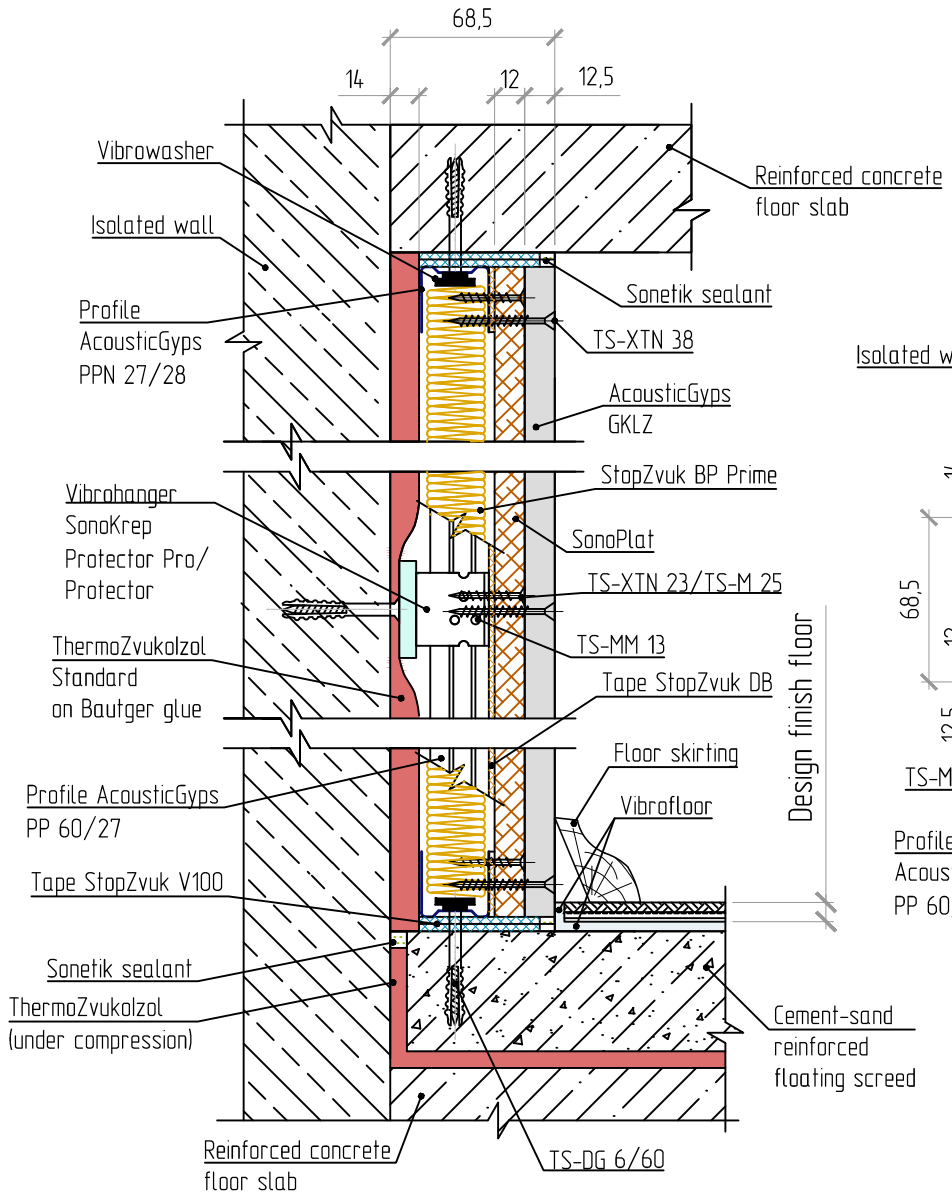


Design type	Section formula [1]	Lining thickness (mm)	Rw_{base} (dB)	Rw (dB)
TS-2.2 [2]	PBS200-TZIST-SZBPPrime-SP-GKLZ	68,5	45	62
	ZhBS140-TZIST-SZBPPrime-SP-GKLZ		50	65

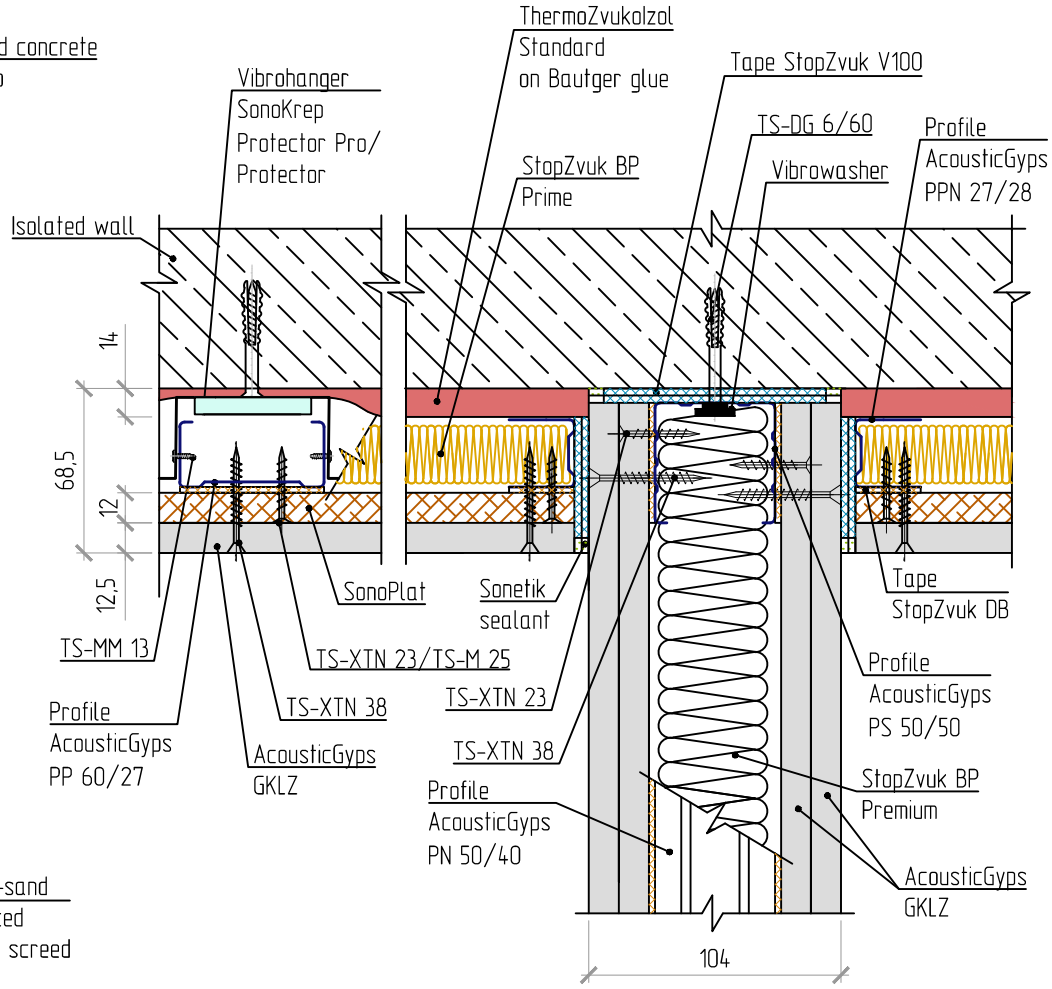
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the structure (see Appendix B).

[2] This sound insulating lining scheme has been tested for two wall types:
- foam concrete blocks 200 mm thick (PBS200);
- reinforced concrete 140 mm thick (ZhBS140).

Junction of wall lining, floating floor screed and floor slab at ceiling level



Junction of wall lining and TS-1.1 partition



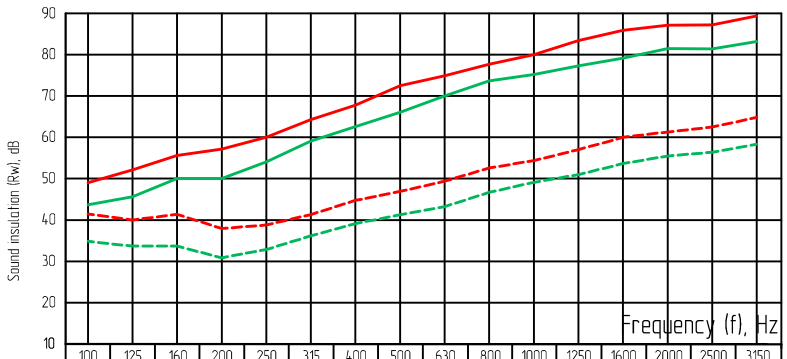
Sheet 2.2 (2)

TS-2.3 sound insulating lining 72.7 mm thick (on SonoKrep Protector/Protector Pro vibrofasteners) (Standard M)

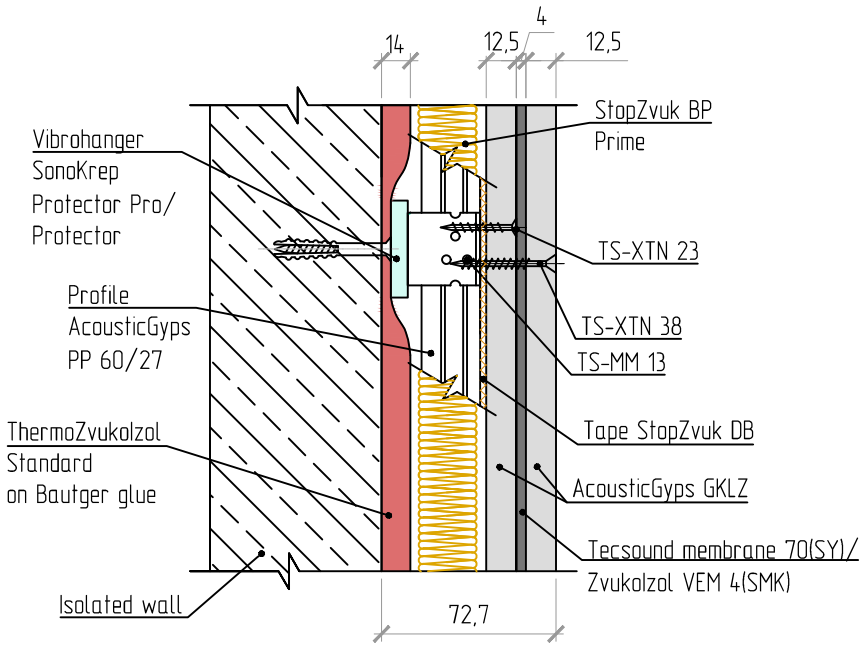
ΔRw_1= 19 dB

ΔRw_2= 17 dB

Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-2.3 (base 1)	44	46	50	50	54	59	63	66	70	73	75	77	79	81	81	83
Base 1	35	34	34	31	33	36	39	41	44	47	49	51	53	55	56	58
TS-2.3 (base 2)	49	52	56	57	60	64	68	72	75	78	80	83	86	87	87	89
Base 2	41	40	41	38	39	41	44	46	49	52	54	57	60	61	63	65

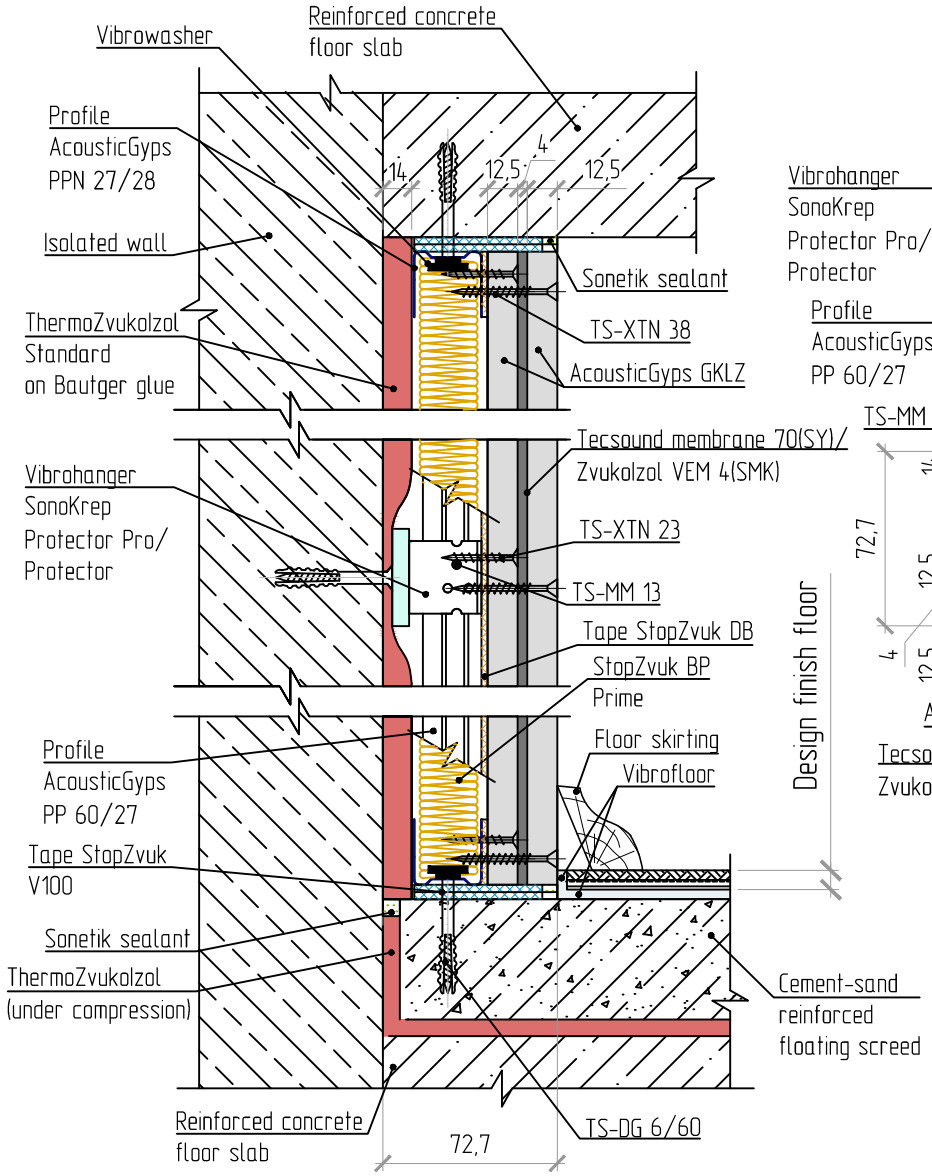


Design type	Section formula [1]	Lining thickness (mm)	Rw_{base} (dB)	Rw (dB)
TS-2.3 [2]	PBS200-TZIST-SZBPPrime-GKLZ-(TS70/VEM4)-GKLZ	72,7	45	64
	ZhBS140-TZIST-SZBPPrime-GKLZ-(TS70/VEM4)-GKLZ		50	67

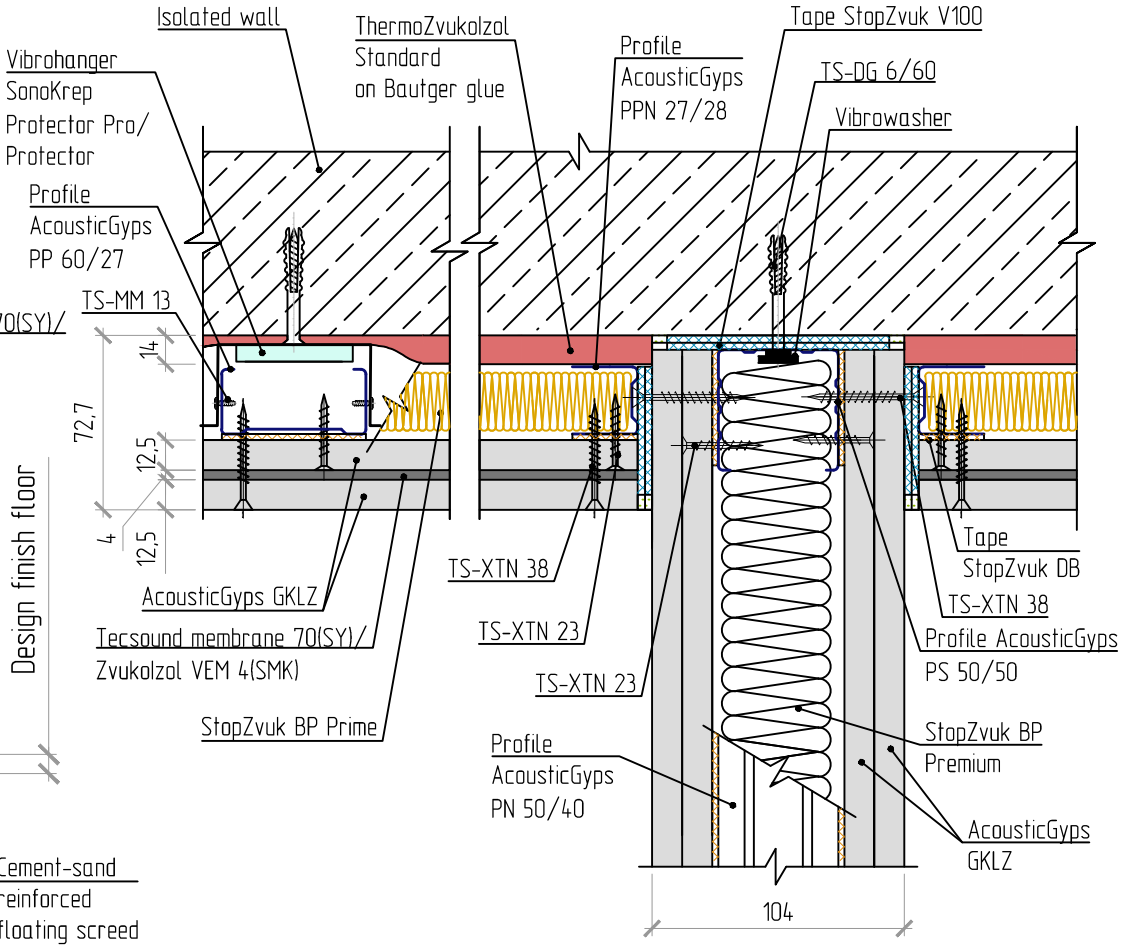
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the structure (see Appendix B).

[2] This sound insulating lining scheme has been tested for two wall types:
- foam concrete blocks 200 mm thick (PBS200);
- reinforced concrete 140 mm thick (ZhBS140).

Junction of wall lining, floating floor screed and floor slab at ceiling level



Junction of wall lining and TS-1.1 partition

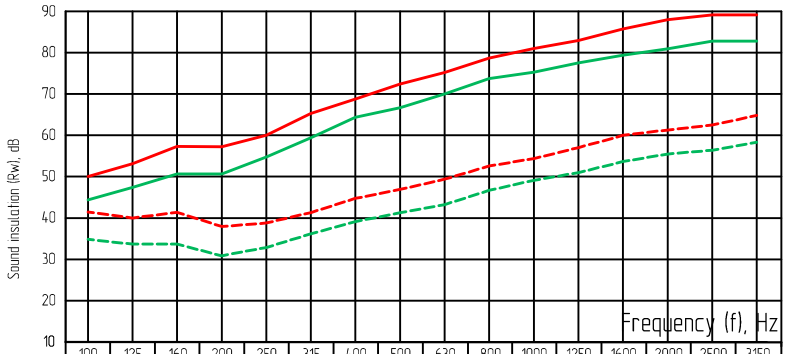


TS-2.4 sound insulating lining 73.5 mm thick (on SonoKrep Protector/Protector Pro vibrofasteners) (Standard M1)

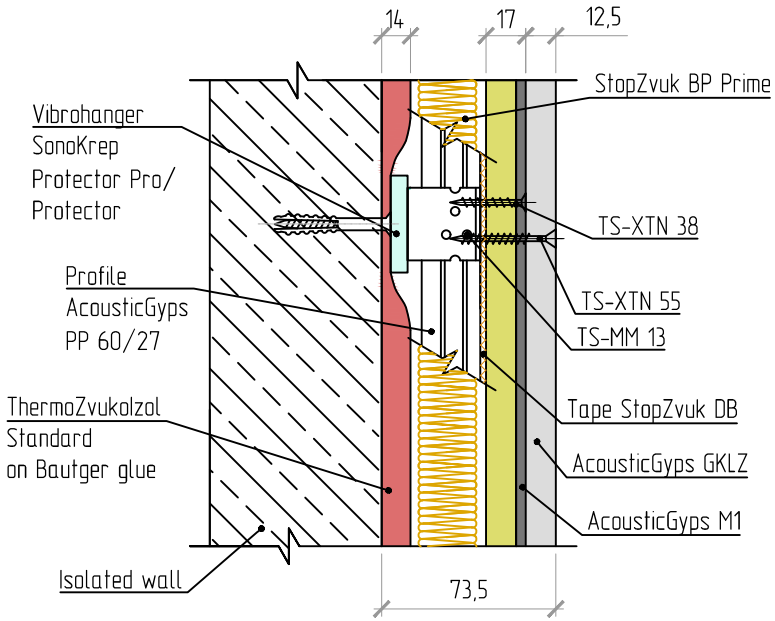
ΔRw_1= 20 dB

ΔRw_2= 18 dB

Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-2.4 (base 1)	44	47	51	51	55	59	64	67	70	74	75	77	79	81	83	83
Base 1	35	34	34	31	33	36	39	41	44	47	49	51	53	55	56	58
TS-2.4 (base 2)	50	53	57	57	60	65	69	72	75	78	81	83	86	88	89	89
Base 2	41	40	41	38	39	41	44	46	49	52	54	57	60	61	63	65

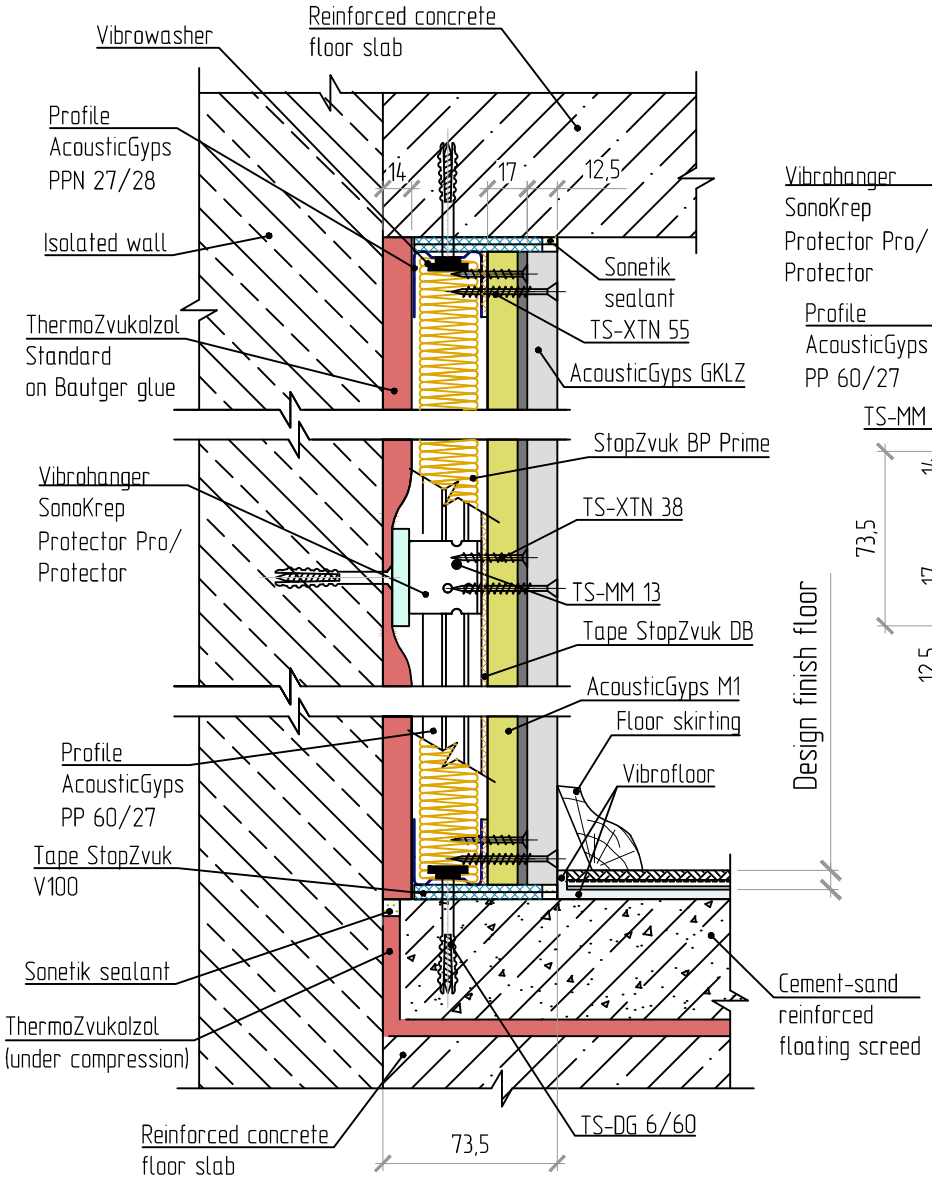


Design type	Section formula [1]	Lining thickness (mm)	Rw_{base} (dB)	Rw (dB)
TS-2.4 [2]	PBS200-TZIST-SZBPPrime-AGM1-GKLZ	73,5	45	65
	ZhBS140-TZIST-SZBPPrime-AGM1-GKLZ		50	68

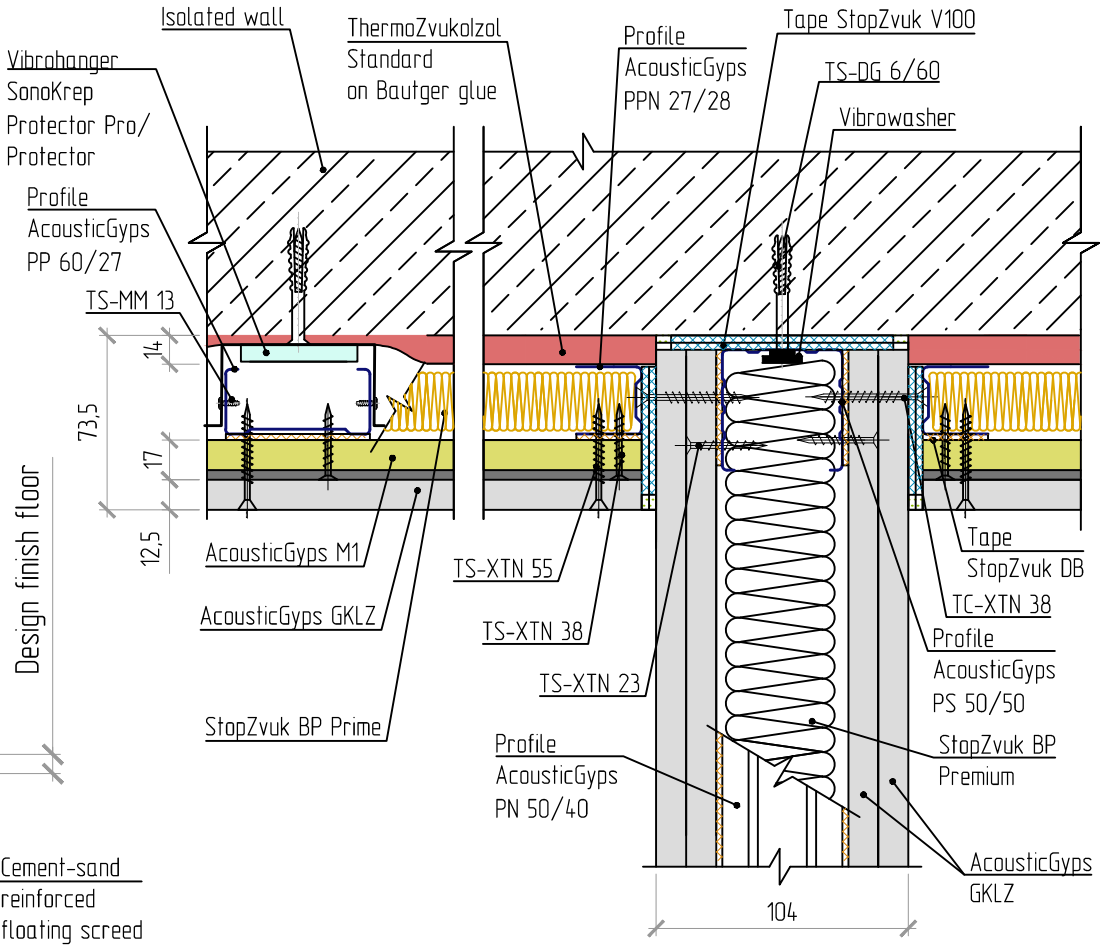
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the structure (see Appendix B).

[2] This sound insulating lining scheme has been tested for two wall types:
- foam concrete blocks 200 mm thick (PBS200);
- reinforced concrete 140 mm thick (ZhBS140).

Junction of wall lining, floating floor screed and floor slab at ceiling level



Junction of wall lining and TS-1.1 partition

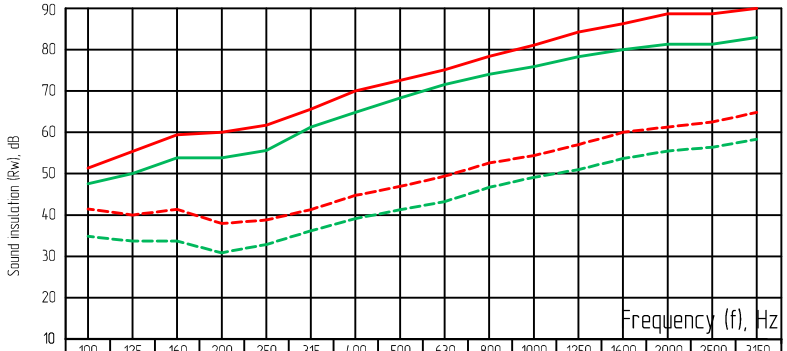


TS-2.5 sound insulating lining 83.5 mm thick (on SonoKrep EP20 vibrofasteners) (Premium M1)

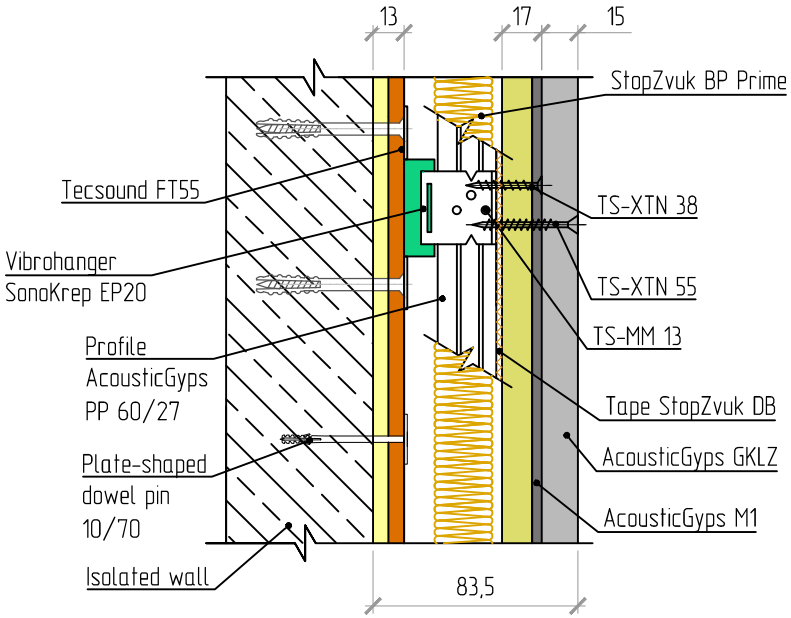
ΔRw_1= 24 dB

ΔRw_2= 23 dB

Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-2.5 (base 1)	47	50	54	54	56	61	65	68	71	74	76	78	80	81	81	83
Base 1	35	34	34	31	33	36	39	41	44	47	49	51	53	55	56	58
TS-2.5 (base 2)	52	55	59	60	62	66	70	73	75	78	81	84	86	88	88	90
Base 2	41	40	41	38	39	41	44	46	49	52	54	57	60	61	63	65

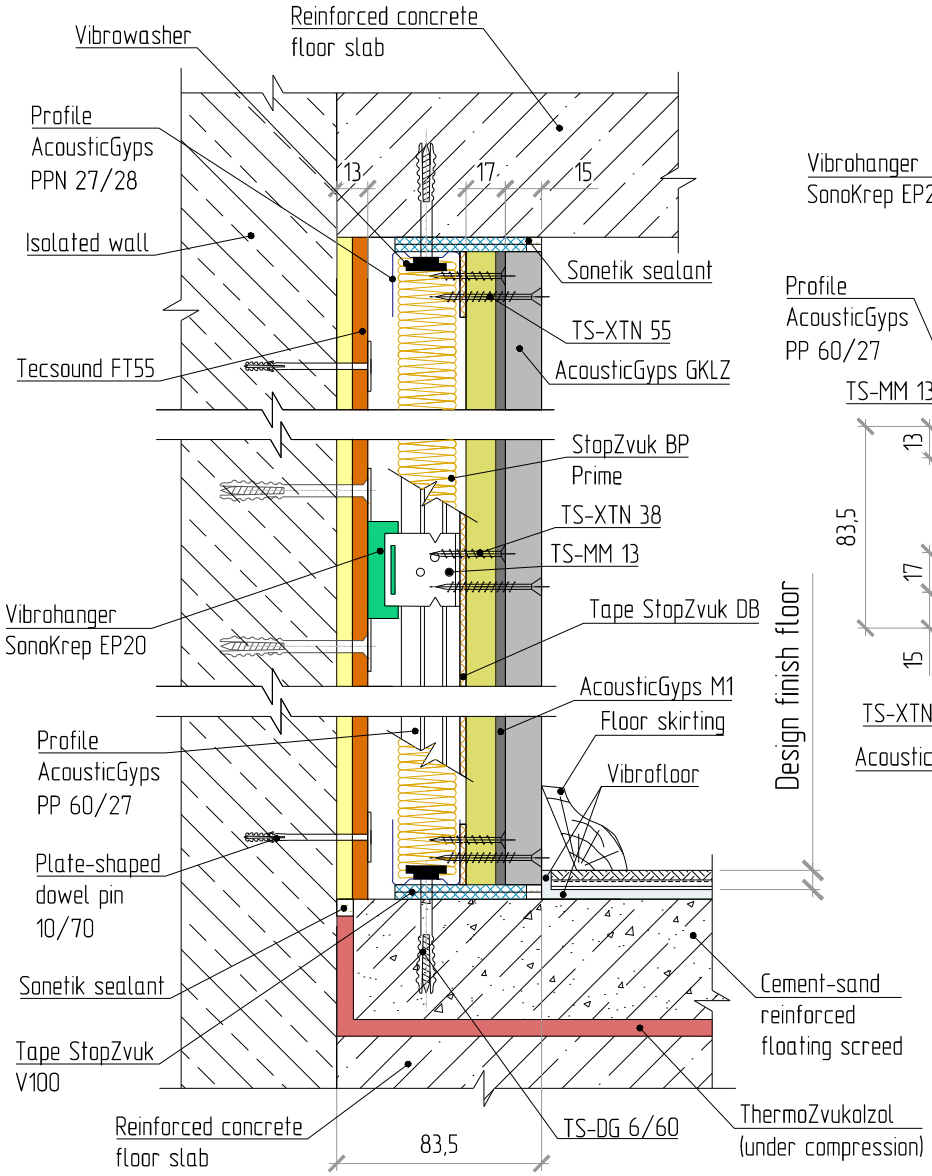


Design type	Section formula [1]	Lining thickness (mm)	Rw_{base} (dB)	Rw (dB)
TS-2.5 [2]	PBS200-TS55-SZBPPrime-AGM1-GKLZ15	83,5	45	69
	ZhBS140-TS55-SZBPPrime-AGM1-GKLZ15		50	73

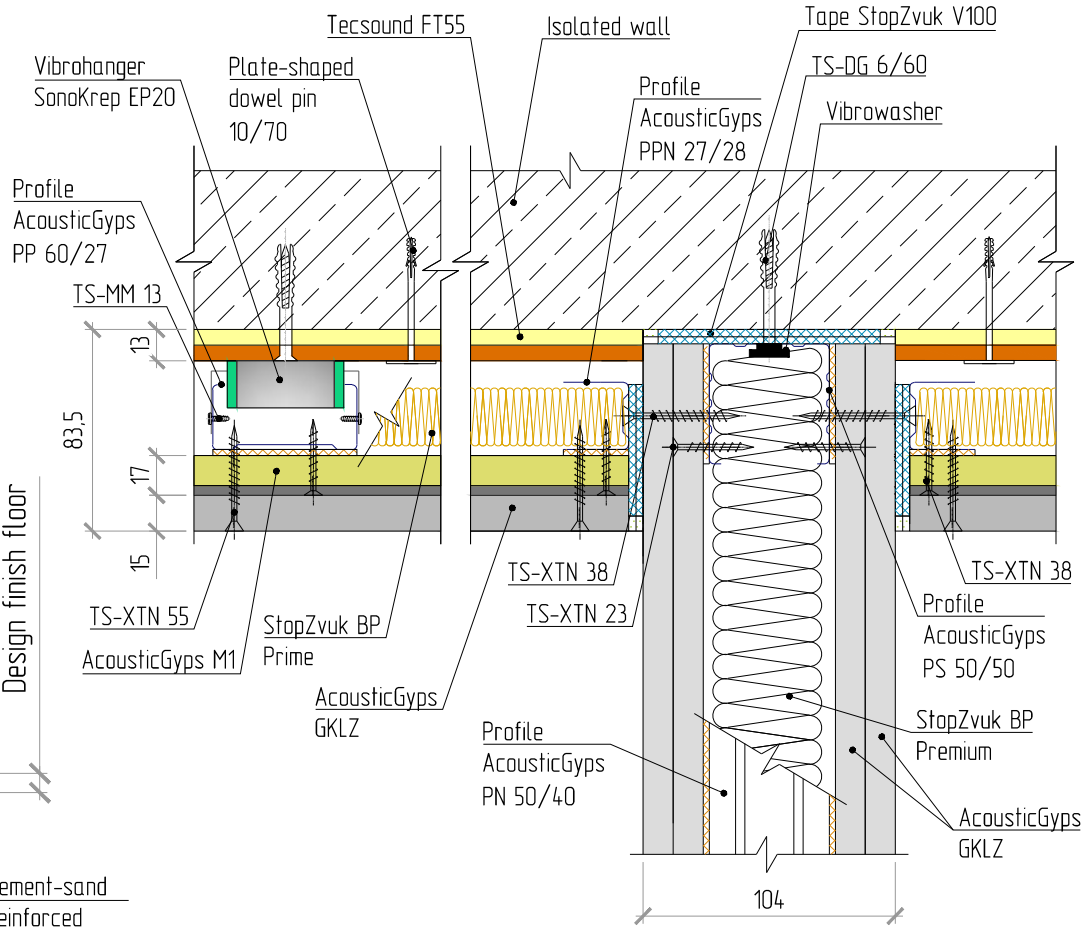
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the structure (see Appendix B).

[2] This sound insulating lining scheme has been tested for two wall types:
- foam concrete blocks 200 mm thick (PBS200);
- reinforced concrete 140 mm thick (ZhBS140).

Junction of wall lining, floating floor screed and floor slab at ceiling level



Junction of wall lining and TS-1.1 partition

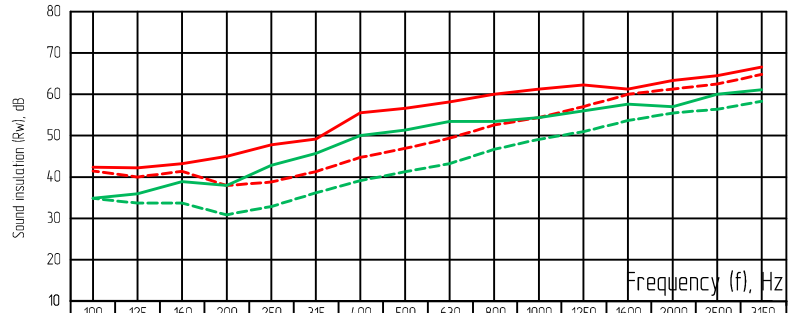


TS-2.6 "Slim P" frameless wall sound insulating system 34.5 mm thick

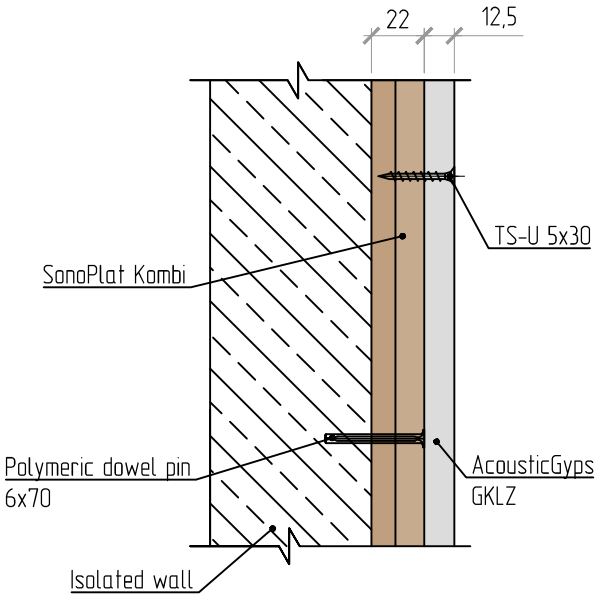
ΔRw_1= 9 dB

ΔRw_2= 8 dB

Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-2.6 (base 1)	35	36	39	38	43	46	50	51	53	53	54	56	58	57	60	61
Base 1	35	34	34	31	33	36	39	41	44	47	49	51	53	55	56	58
TS-2.6 (base 2)	42	42	43	45	48	49	55	56	58	60	61	62	61	63	64	66
Base 2	41	40	41	38	39	41	44	46	49	52	54	57	60	61	63	65

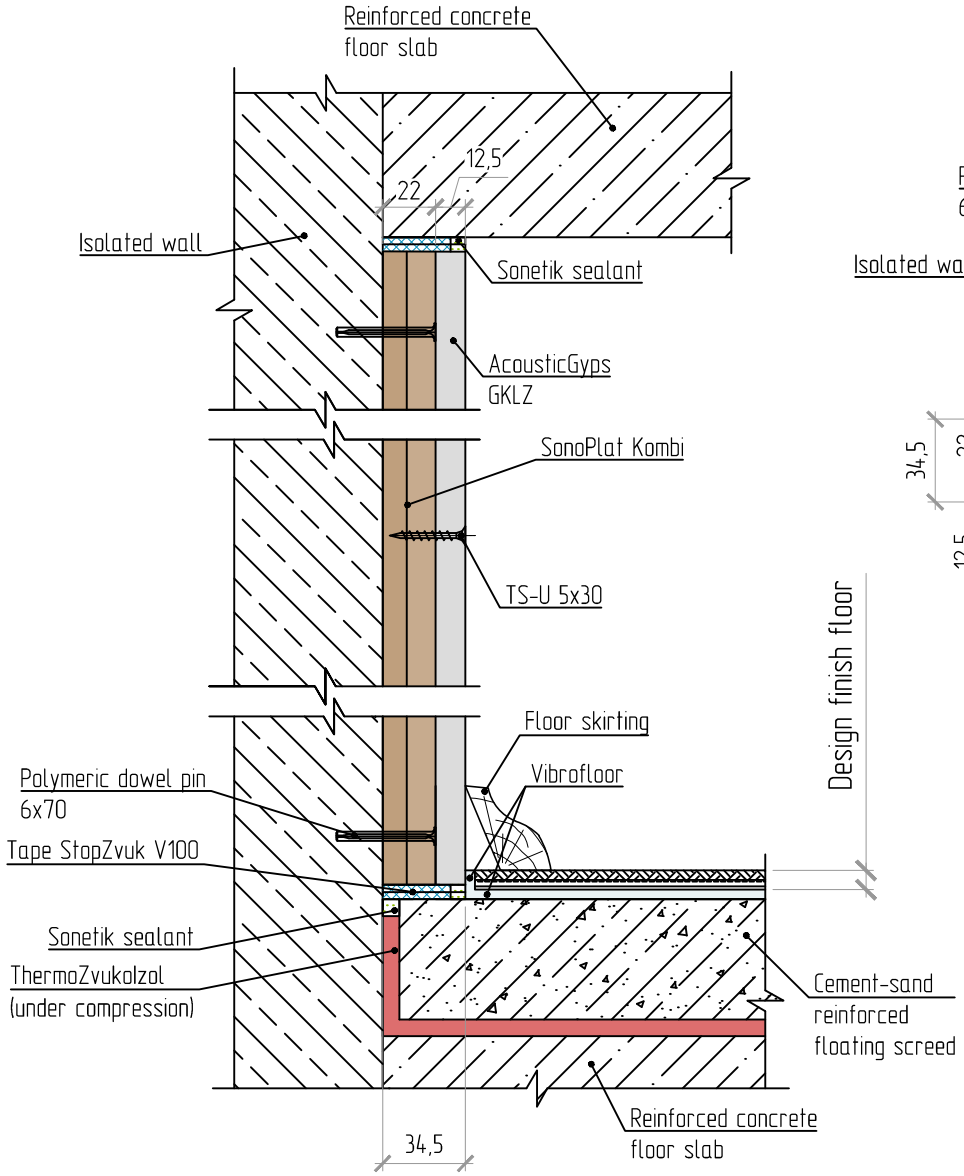


Design type	Section formula [1]	Lining thickness (mm)	Rw_{base} (dB)	Rw (dB)
TS-2.6 [2]	PBS200-SPKombi-GKLZ	34,5	45	54
	ZhBS140-SPKombi-GKLZ		50	58

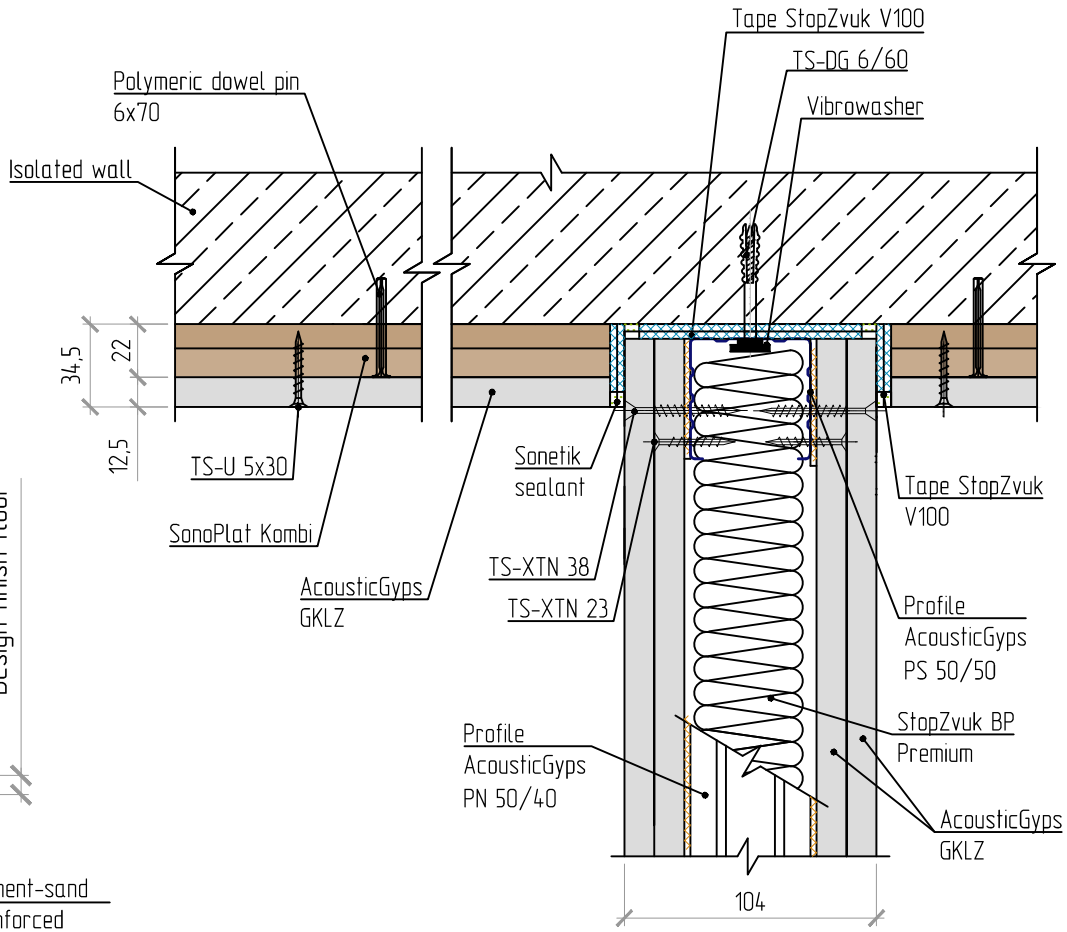
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the structure (see Appendix B).

[2] This sound insulating lining scheme has been tested for two wall types:
- foam concrete blocks 200 mm thick (PBS200);
- reinforced concrete 140 mm thick (ZhBS140).

Junction of wall lining, floating floor screed and floor slab at ceiling level



Junction of wall lining and TS-1.1 partition

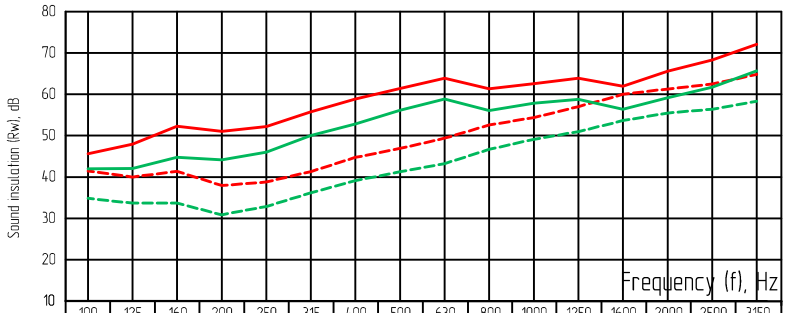


TS-2.7 "Slim A1" frameless wall sound insulating system 52.5 mm thick

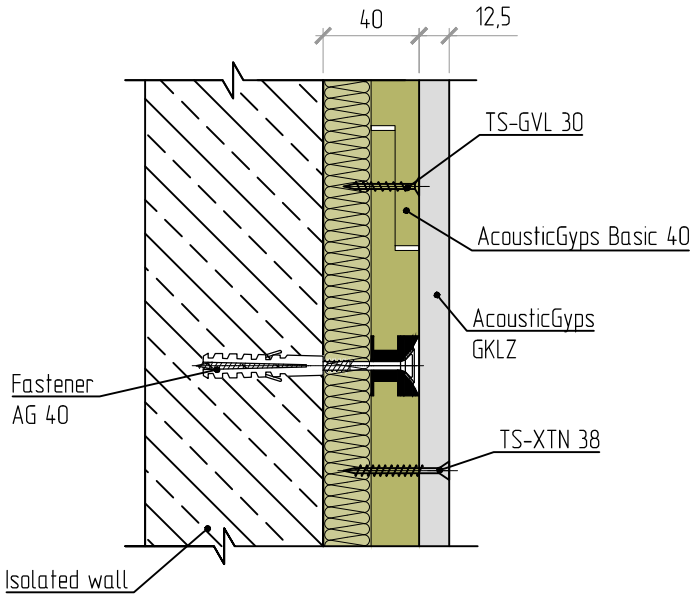
ΔRw_1= 11 dB

ΔRw_2= 10 dB

Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-2.7 (base 1)	42	42	45	44	46	50	53	56	59	56	58	59	56	59	62	66
Base 1	35	34	34	31	33	36	39	41	44	47	49	51	53	55	56	58
TS-2.7 (base 2)	46	48	52	51	52	56	59	61	64	61	63	64	63	66	68	72
Base 2	41	40	41	38	39	41	44	46	49	52	54	57	60	61	63	65

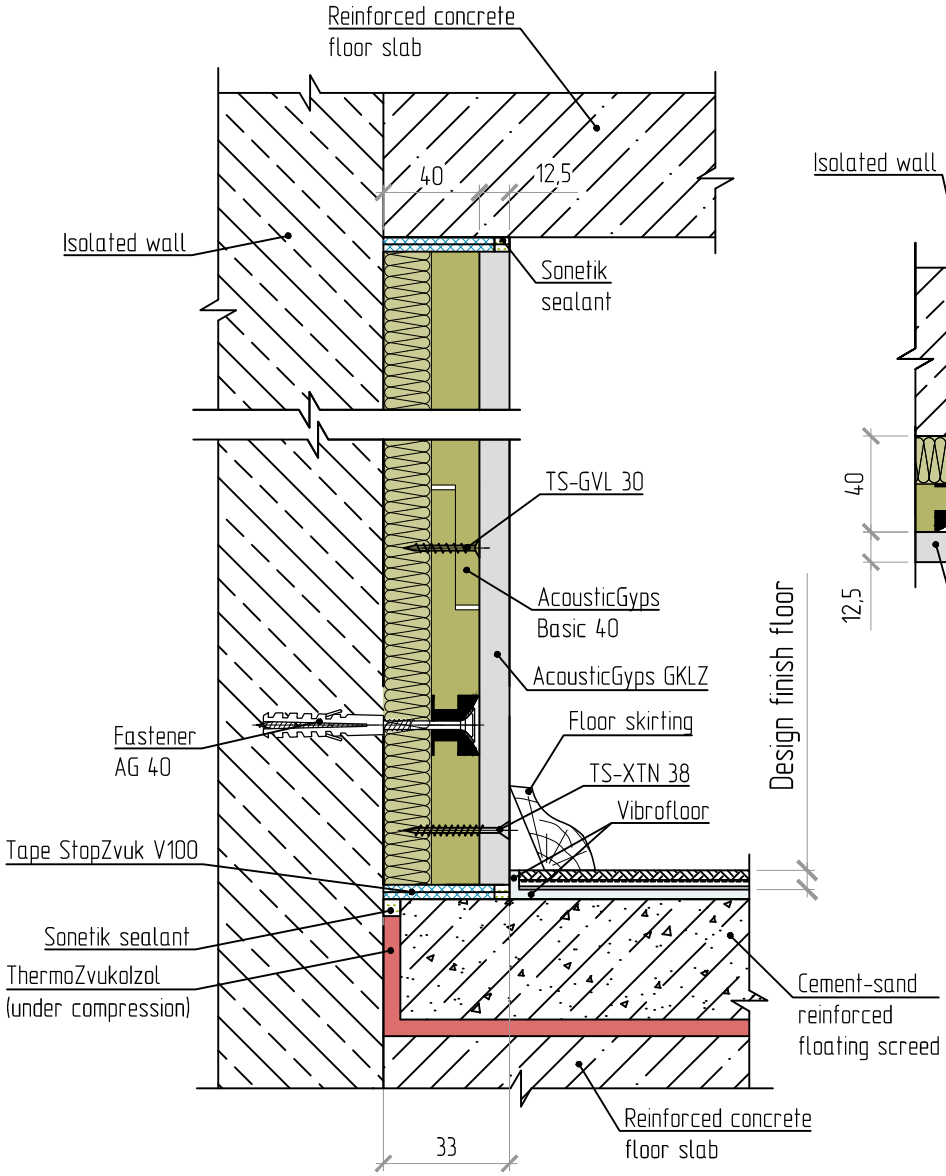


Design type	Section formula [1]	Lining thickness (mm)	Rw_{base} (dB)	Rw (dB)
TS-2.7 [2]	PBS200-AG40-GKLZ	52,5	45	56
	ZhBS140-AG40-GKLZ		50	60

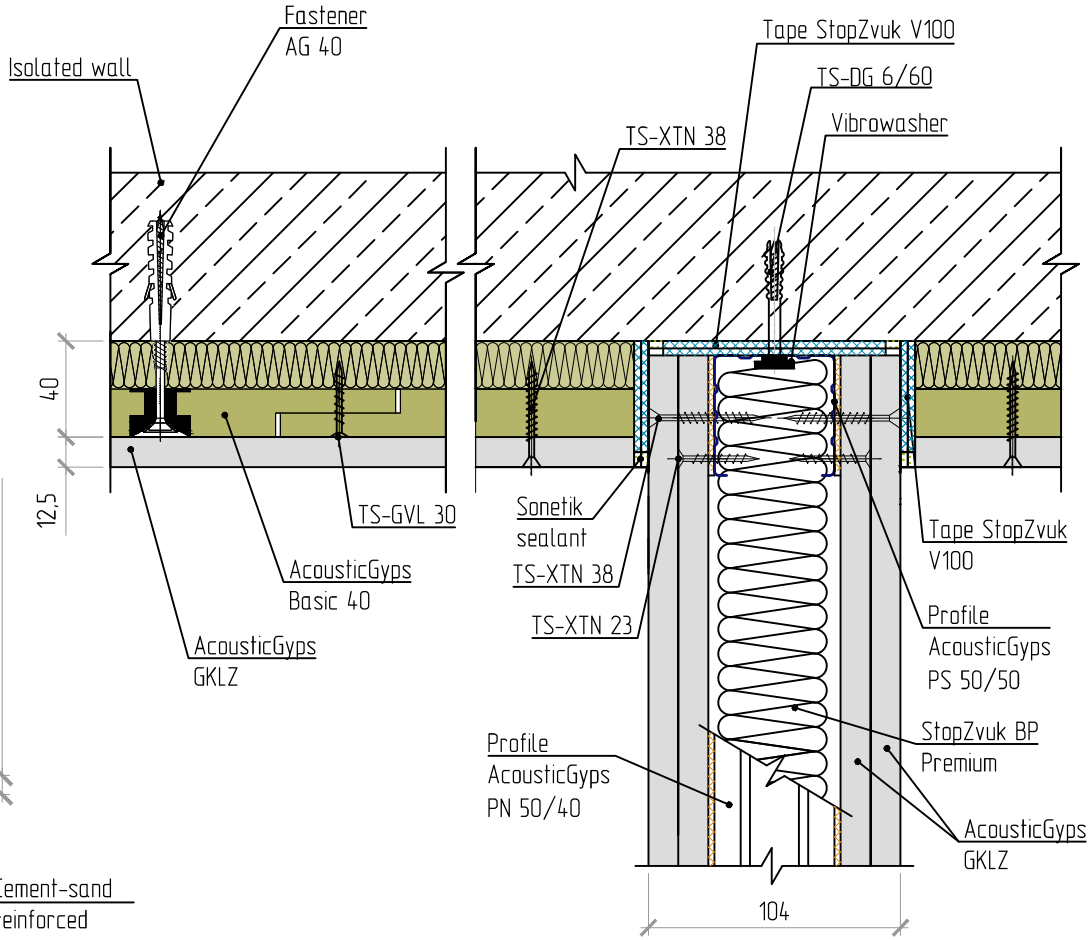
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the structure (see Appendix B).

[2] This sound insulating lining scheme has been tested for two wall types:
- foam concrete blocks 200 mm thick (PBS200);
- reinforced concrete 140 mm thick (ZhBS140).

Junction of wall lining, floating floor screed and floor slab at ceiling level



Junction of wall lining and TS-1.1 partition

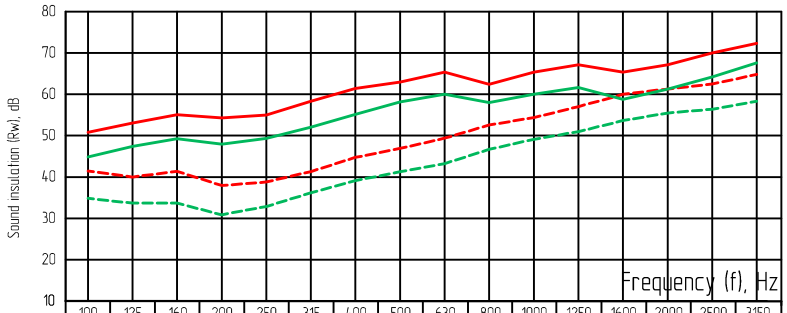


TS-2.8 "Slim A2" frameless wall sound insulating system 82.5 mm thick

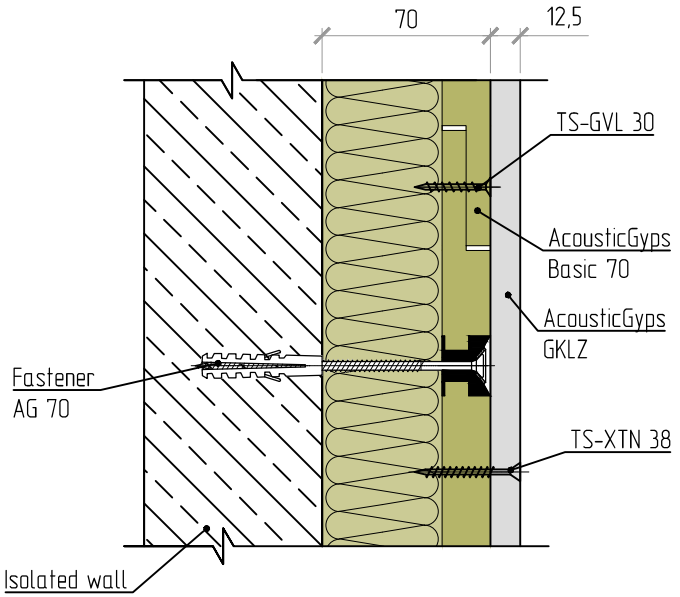
ΔRw_1= 14 dB

ΔRw_2= 13 dB

Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-2.8 (base 1)	45	47	49	48	49	52	55	58	60	58	60	61	58	61	64	67
Base 1	35	34	34	31	33	36	39	41	44	47	49	51	53	55	56	58
TS-2.8 (base 2)	51	53	55	54	55	58	61	63	66	63	65	66	65	67	70	73
Base 2	41	40	41	38	39	41	44	46	49	52	54	57	60	61	63	65

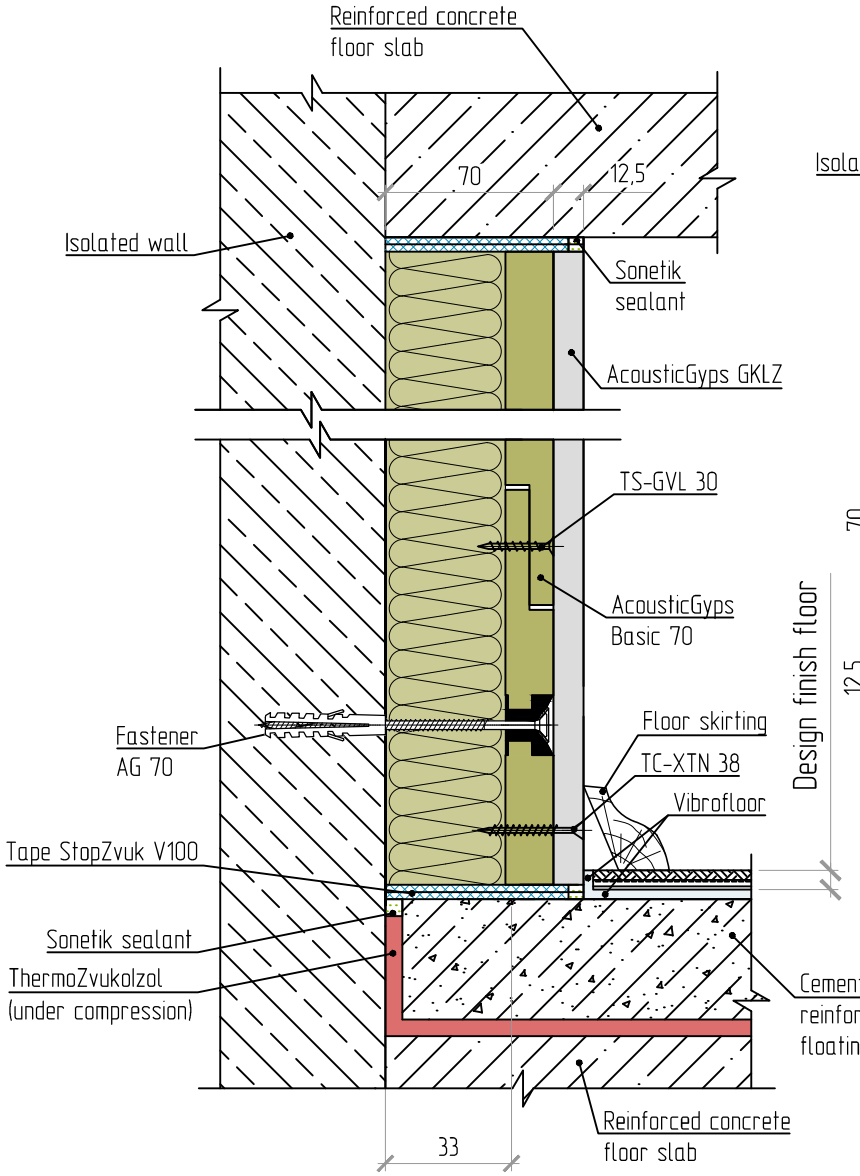


Design type	Section formula [1]	Lining thickness (mm)	Rw_{base} (dB)	Rw (dB)
TS-2.8 [2]	PBS200-AG70-GKLZ	82,5	45	59
	ZhBS140-AG70-GKLZ		50	63

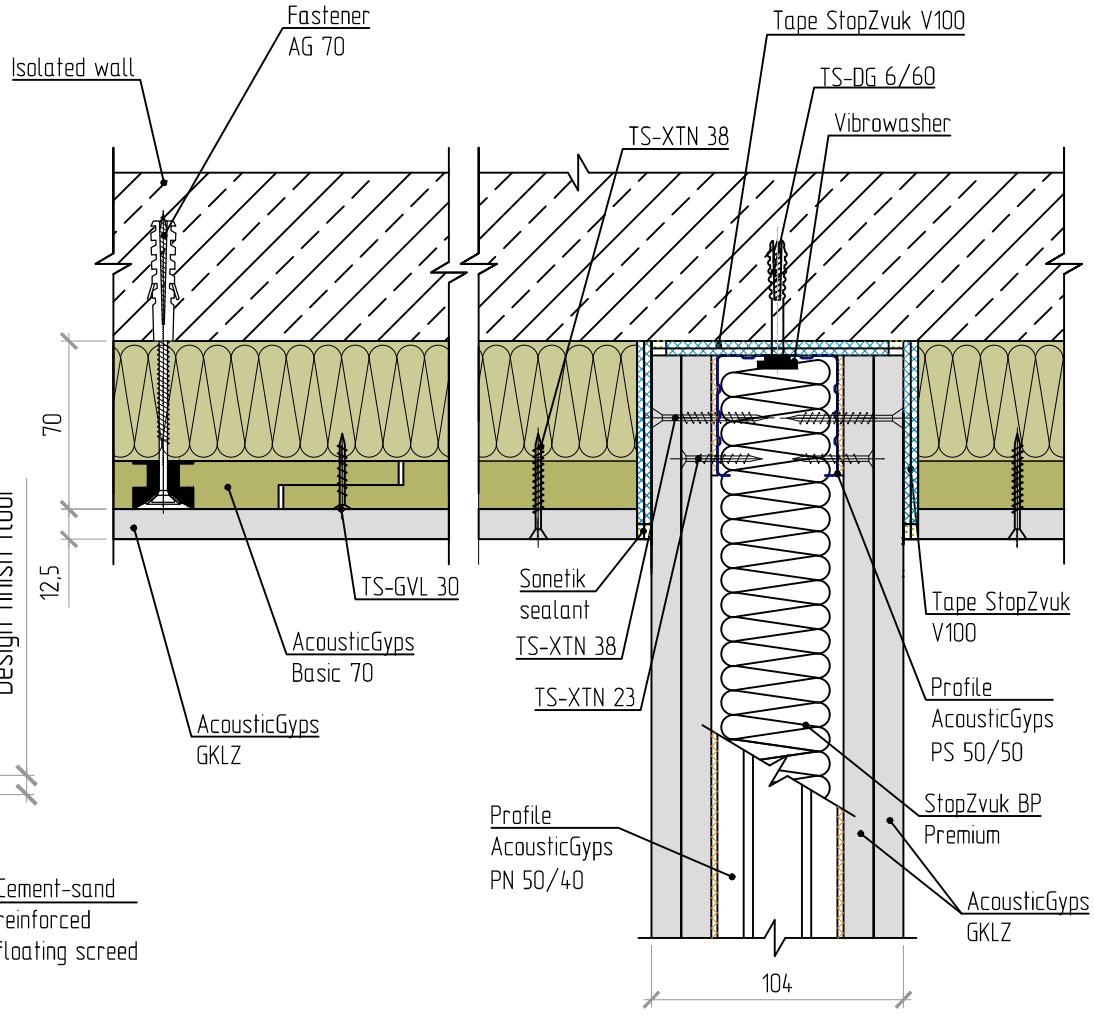
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the structure (see Appendix B).

[2] This sound insulating lining scheme has been tested for two wall types:
- foam concrete blocks 200 mm thick (PBS200);
- reinforced concrete 140 mm thick (ZhBS140).

Junction of wall lining, floating floor screed and floor slab at ceiling level



Junction of wall lining and TS-1.1 partition



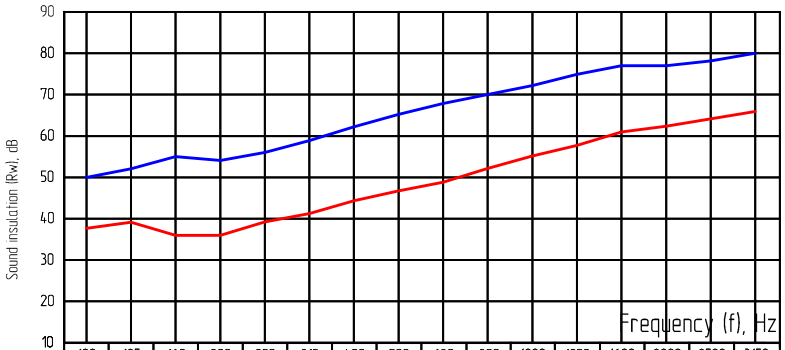
SECTION 3
Sound insulating ceilings

TS-3.1 sound insulating ceiling lining 90 mm thick (on SonoKrep Protector/Protector Pro vibrofasteners) (basic)

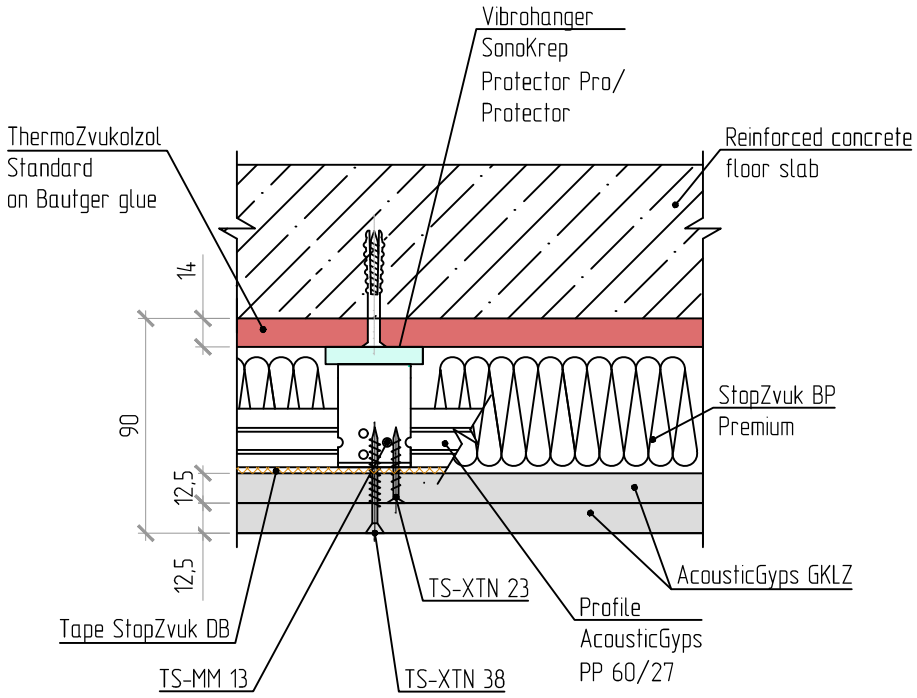
ΔRw= 15 dB

ΔLw= 13 dB

Airborne noise insulation frequency response, Rw (f)



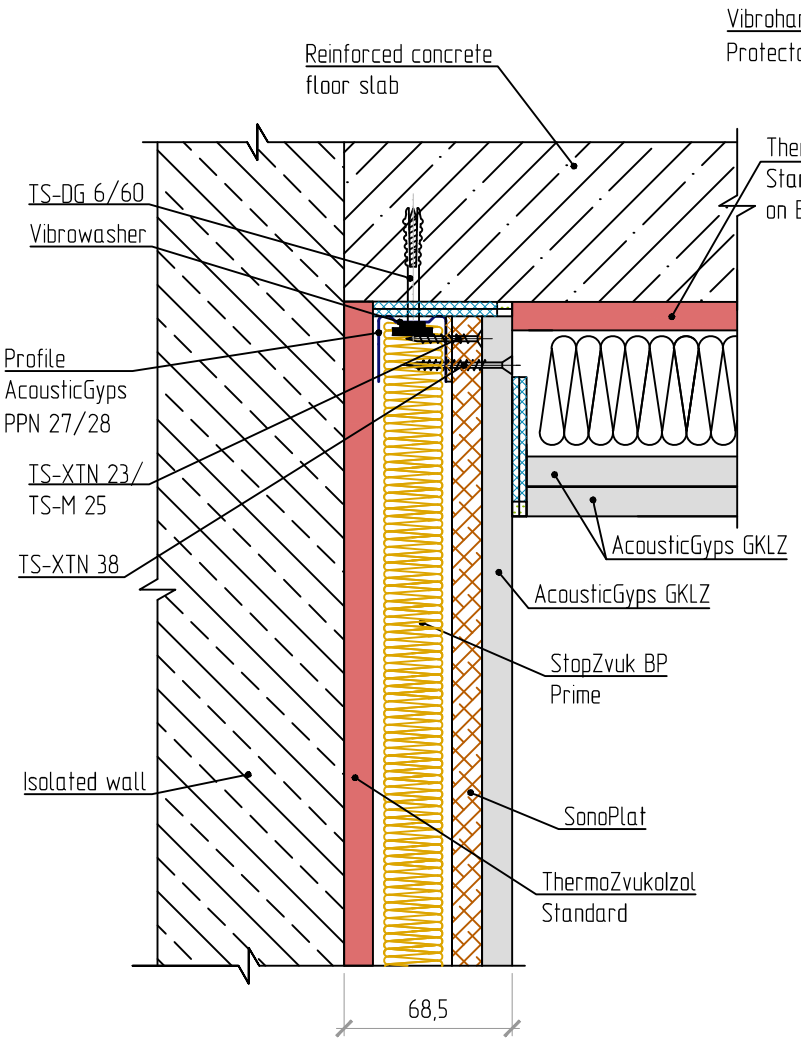
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-3.1	50	52	55	54	56	59	62	65	67	70	72	74	77	77	78	80
Base	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66



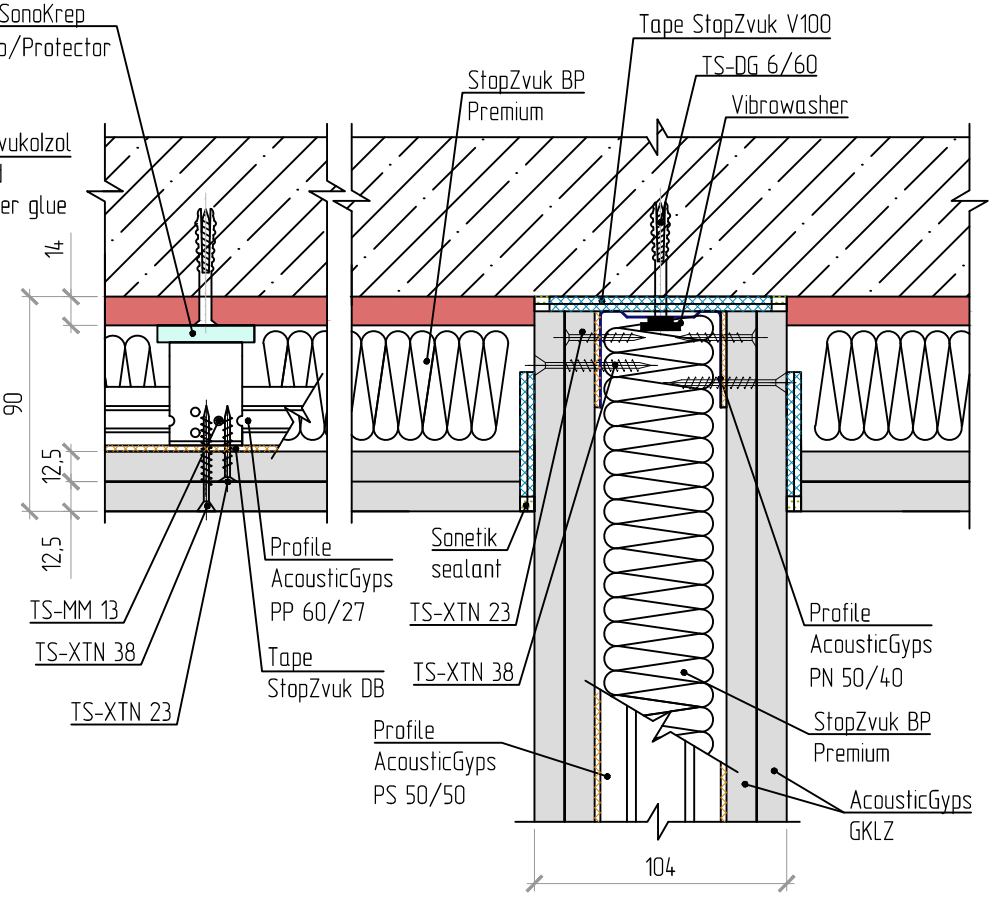
Design type	Section formula [1]	Suspended ceiling thickness (mm)	Rw_{base} (dB)	Rw (dB)	ΔLw (dB)
TS-3.1	ZhBP140-TZIST-SZBPPremium-2GKLZ	90	51	66	13

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the suspended ceiling (see Appendix B).

Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining



Junction of ceiling and TS-1.1 partition



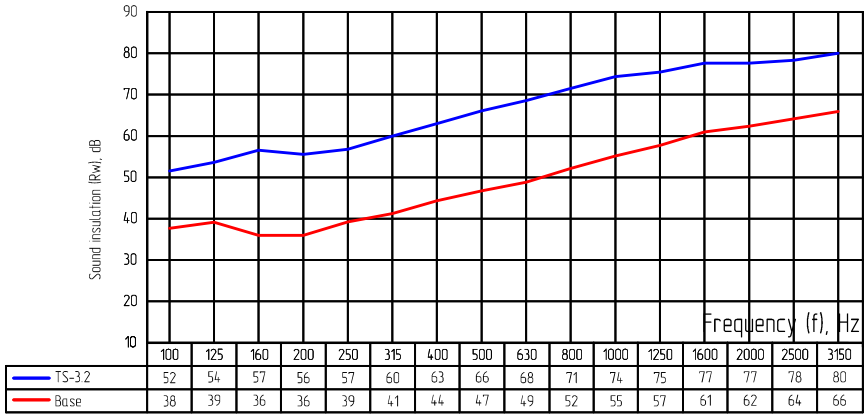
Sheet 3.1 (2)

TS-3.2 sound insulating ceiling lining 90 mm thick (on SonoKrep Protector/Protector Pro vibrofasteners) (Standard P)

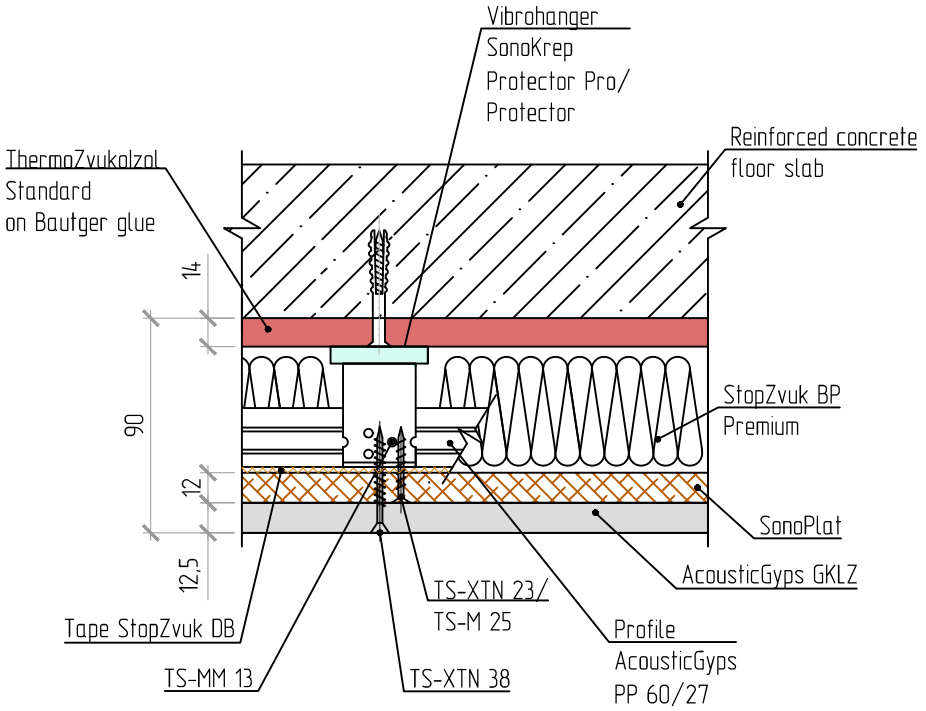
ΔRw= 18 dB

ΔLw= 15 dB

Airborne noise insulation frequency response, Rw (f)



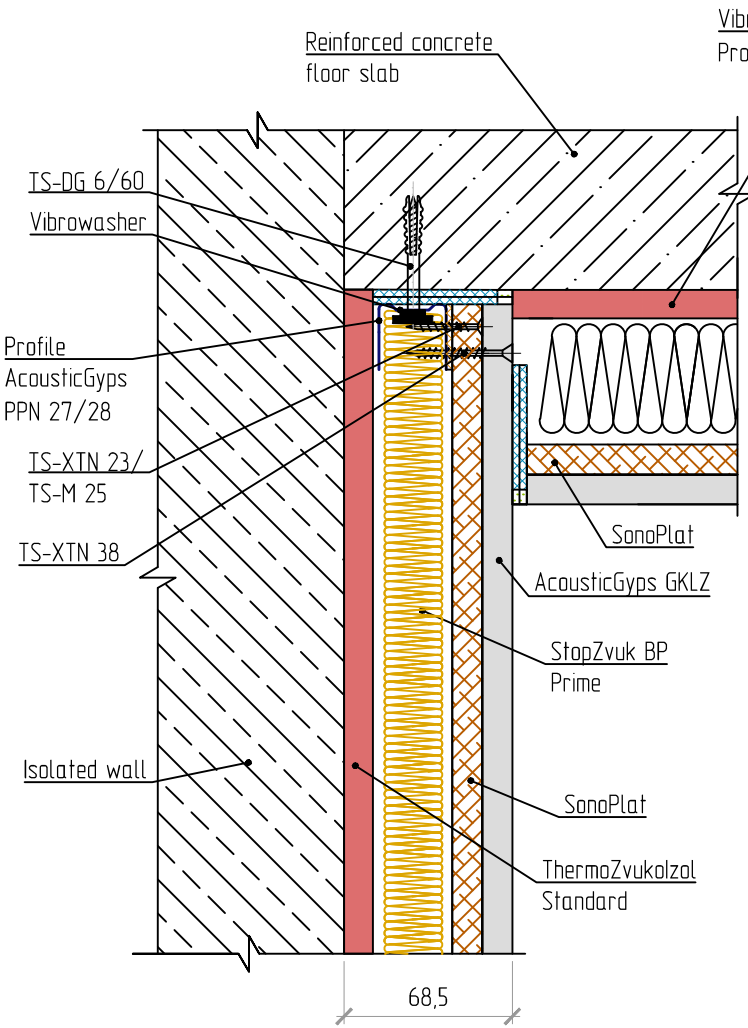
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-3.2	52	54	57	56	57	60	63	66	68	71	74	75	77	77	78	80
Base	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66



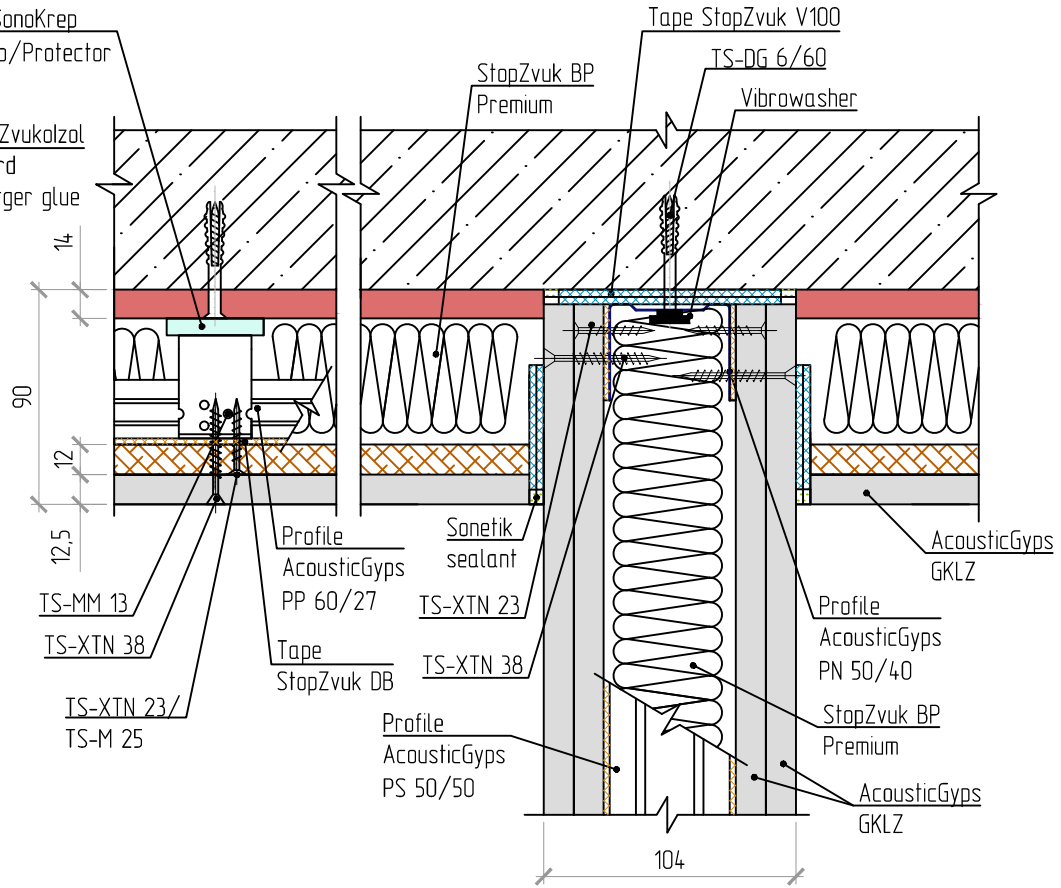
Design type	Section formula [1]	Suspended ceiling thickness (mm)	Rw_{base} (dB)	Rw (dB)	ΔLw (dB)
TS-3.2	ZhBP140-TZIST-SZBPPremium-SP-GKLZ	90	51	69	15

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the suspended ceiling (see Appendix B).

Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining



Junction of ceiling and TS-1.1 partition

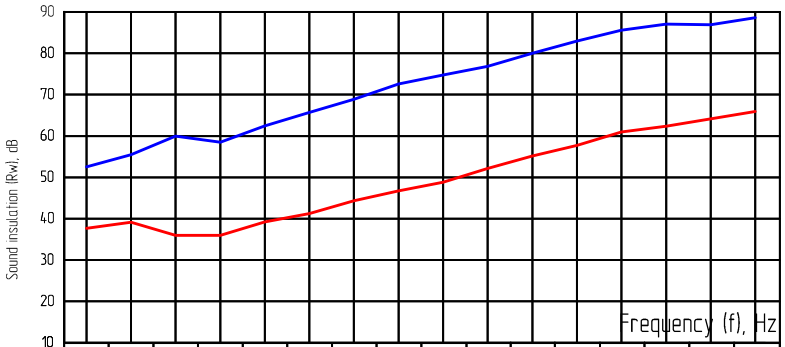


TS-3.3 sound insulating ceiling lining 90.9 mm thick (on SonoKrep Protector/Protector Pro vibrofasteners) (Standard M)

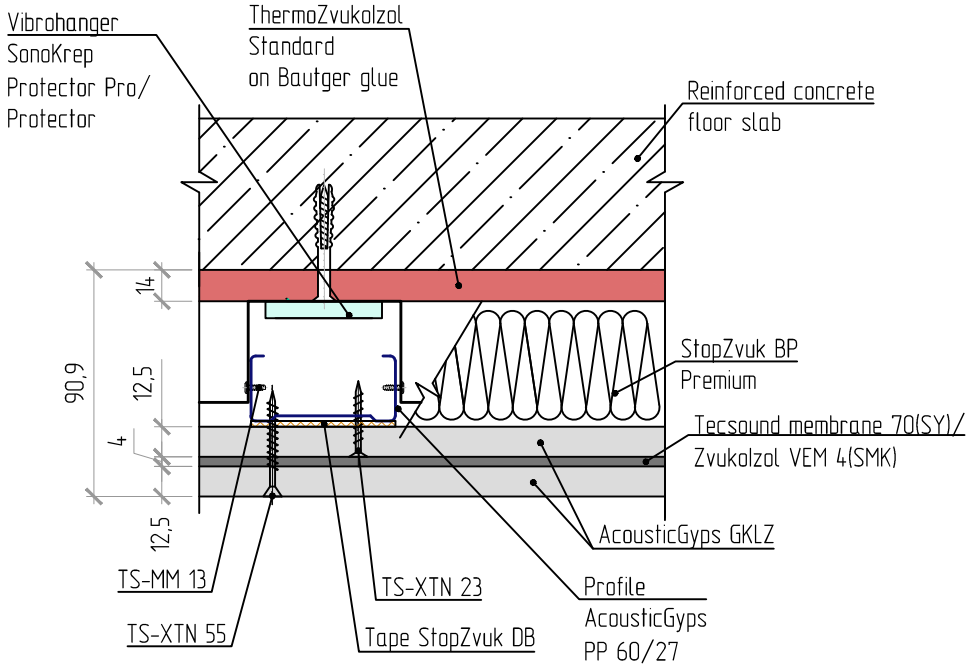
ΔRw= 20 dB

ΔLw= 16 dB

Airborne noise insulation frequency response, Rw (f)



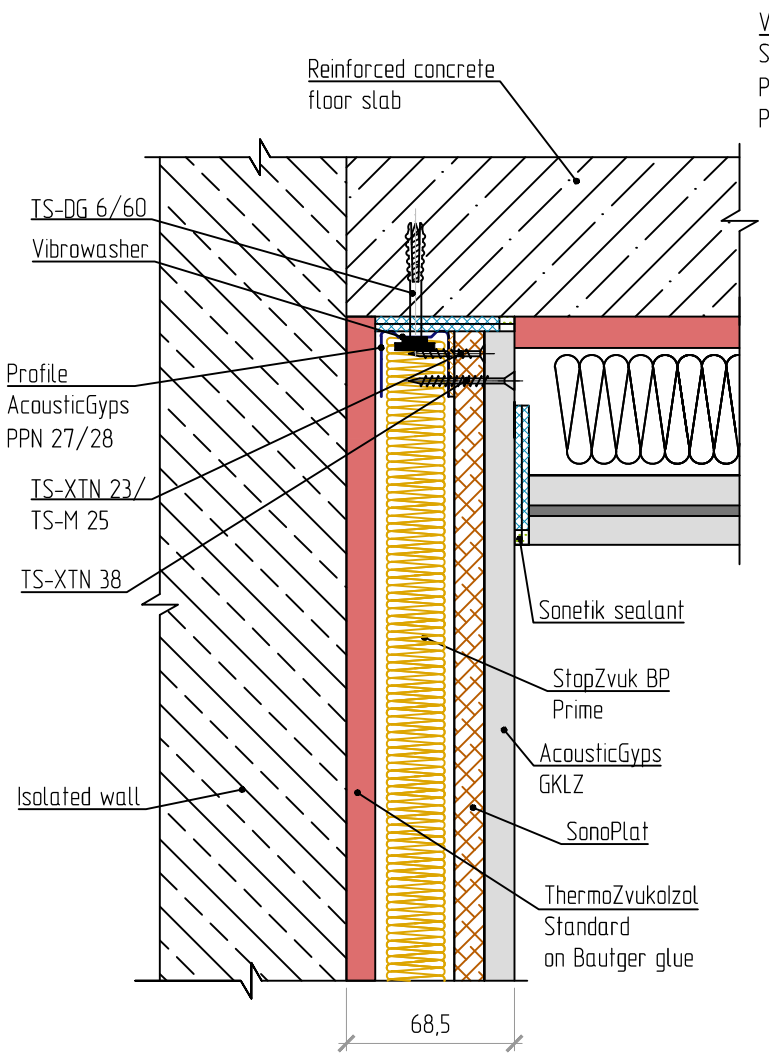
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-3.3	53	56	60	59	62	66	69	72	75	77	80	83	86	87	87	89
Base	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66



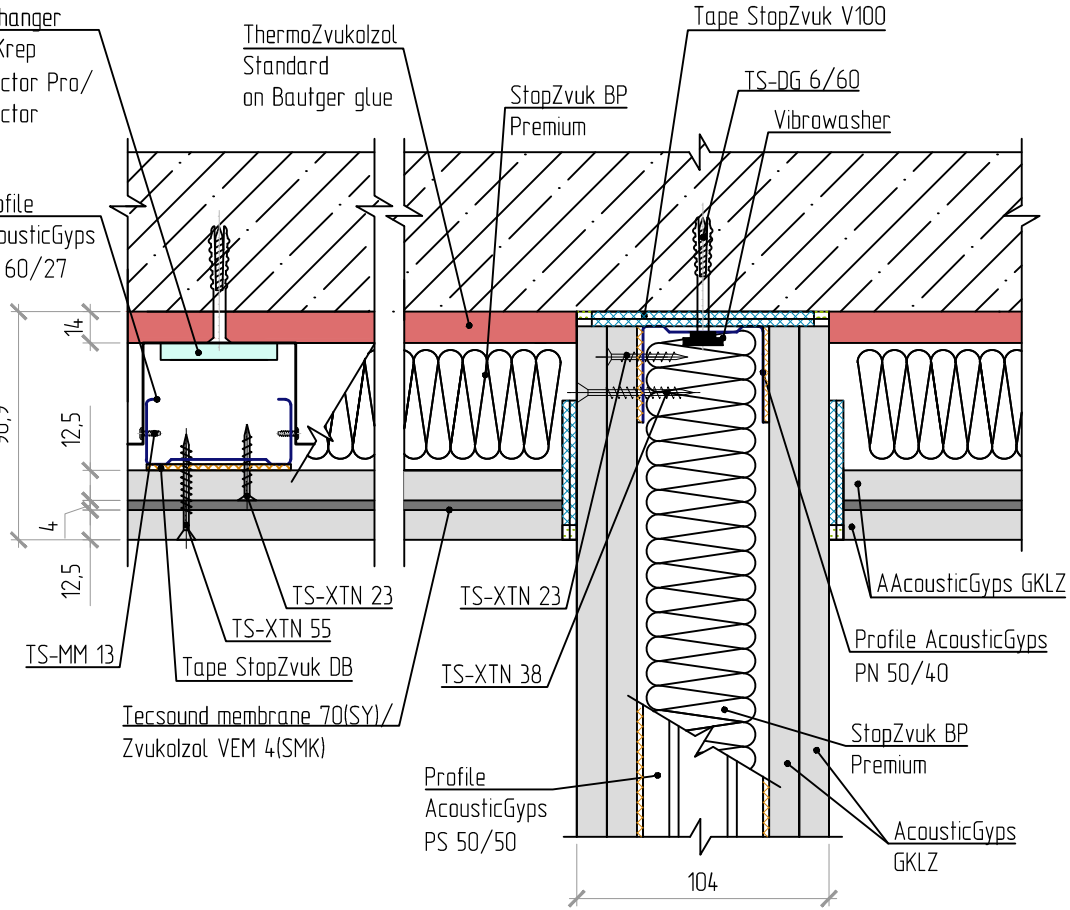
Design type	Section formula [1]	Suspended ceiling thickness (mm)	Rw_{base} (dB)	Rw (dB)	ΔLw (dB)
TS-3.3	ZhBP140-TZIST-SZBPPremium-GKLZ-(TS70/VEM4)-GKLZ	90,9	51	71	16

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the suspended ceiling (see Appendix B).

Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining



Junction of ceiling and TS-1.1 partition

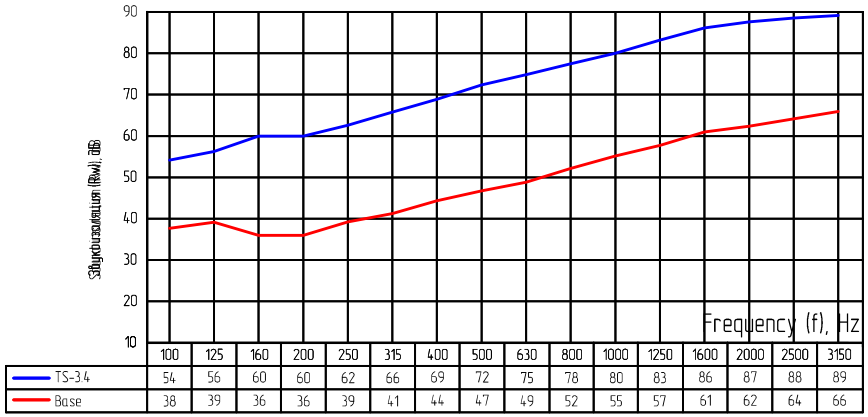


TS-3.4 sound insulating ceiling lining 90.5 mm thick (on SonoKrep Protector/Protector Pro vibrofasteners) (Standard M1)

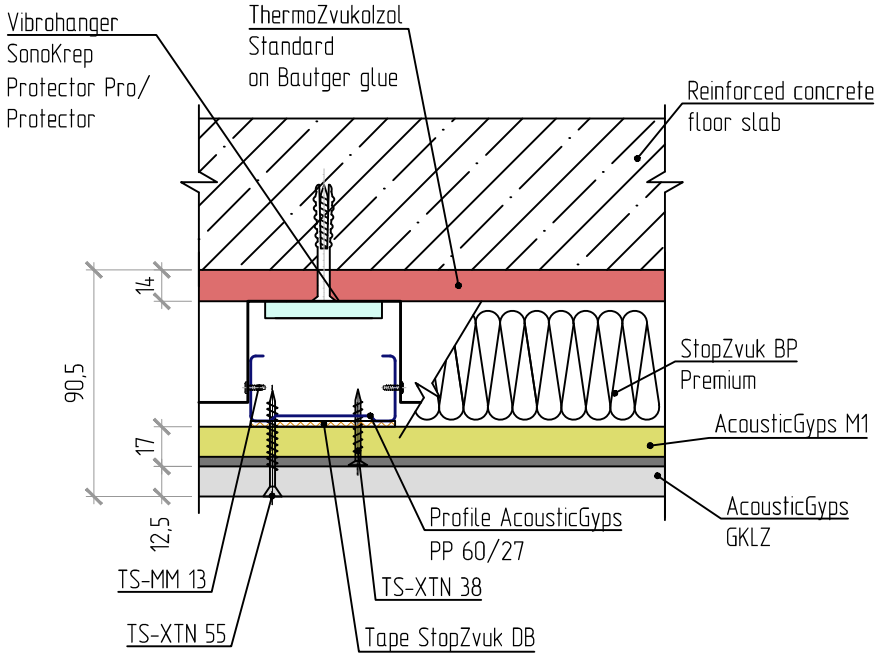
ΔRw= 22 dB

ΔLw= 16 dB

Airborne noise insulation frequency response, Rw (f)



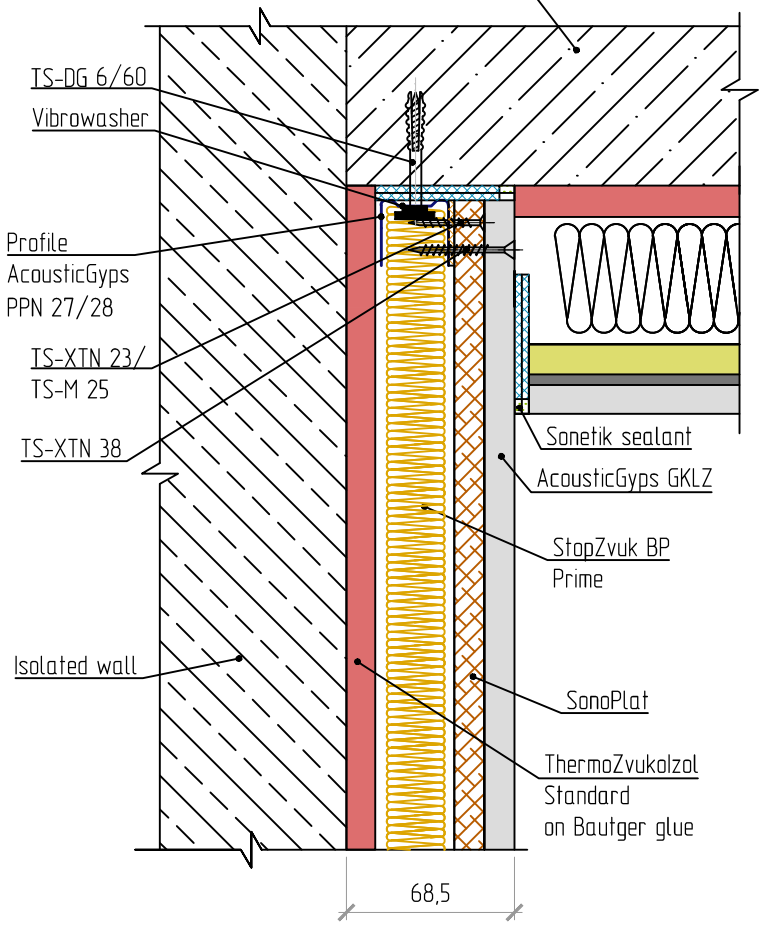
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-3.4	54	56	60	60	62	66	69	72	75	78	80	83	86	87	88	89
Base	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66



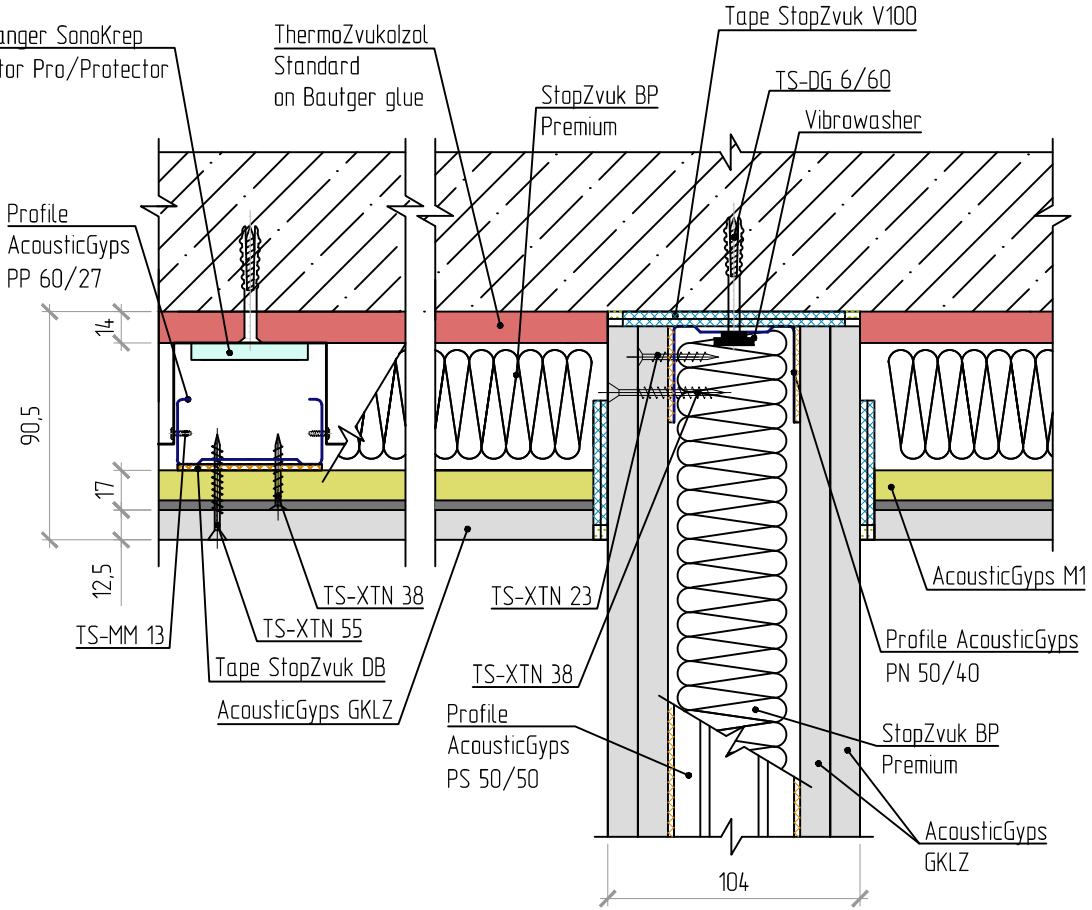
Design type	Section formula [1]	Suspended ceiling thickness (mm)	Rw_{base} (dB)	Rw (dB)	ΔLw (dB)
TS-3.4	ZhBP140-TZIST-SZBPPremium-AGM1-GKLZ	90,5	51	73	16

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the suspended ceiling (see Appendix B).

Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining



Junction of ceiling and TS-1.1 partition



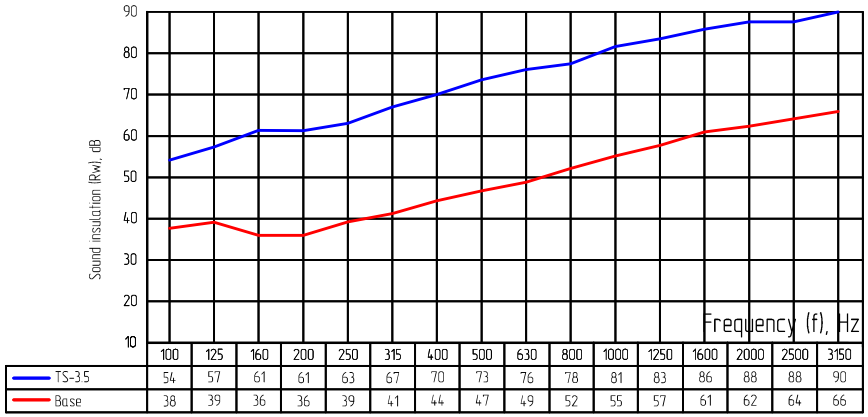
Sheet 3.4 (2)

TS-3.5 sound insulating ceiling lining 98.5 mm thick (on SonoKrep EP20) (Premium M1)

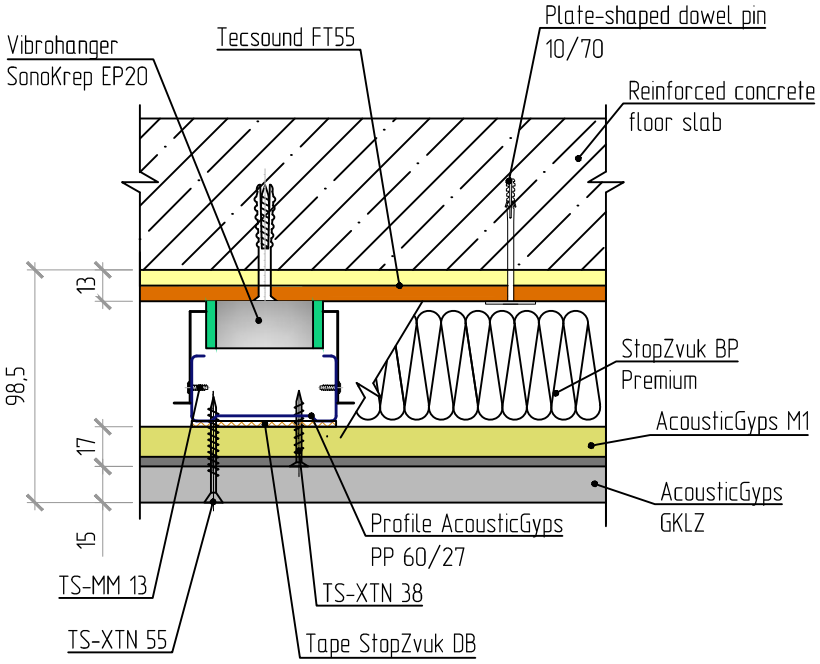
ΔRw= 24 dB

ΔLw= 21 dB

Airborne noise insulation frequency response, Rw (f)



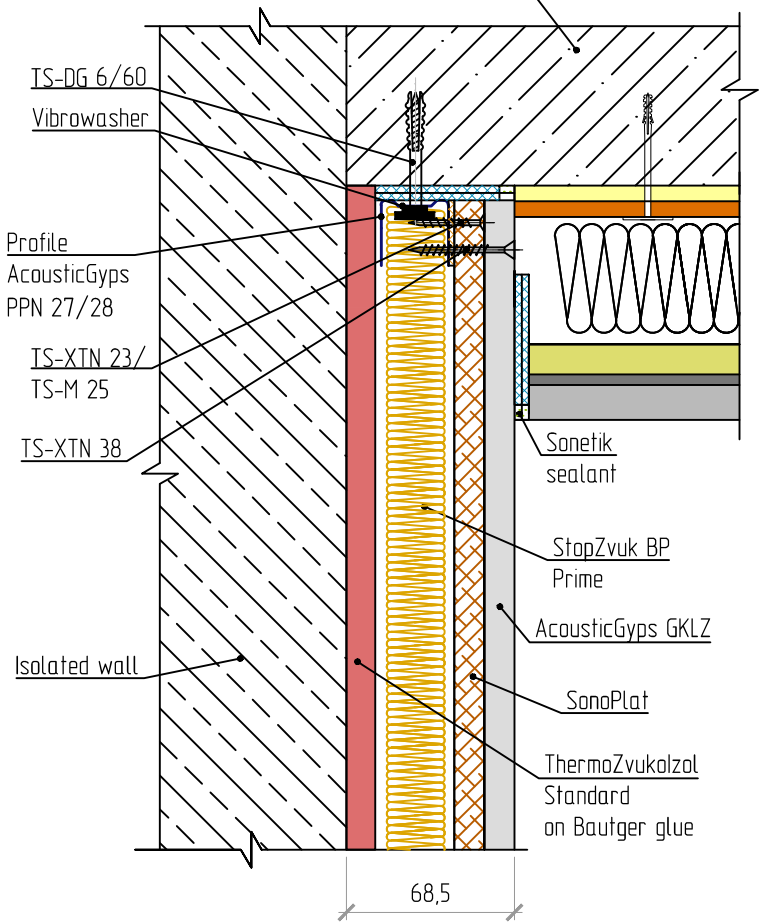
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-3.5	54	57	61	61	63	67	70	73	76	78	81	83	86	88	88	90
Base	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66



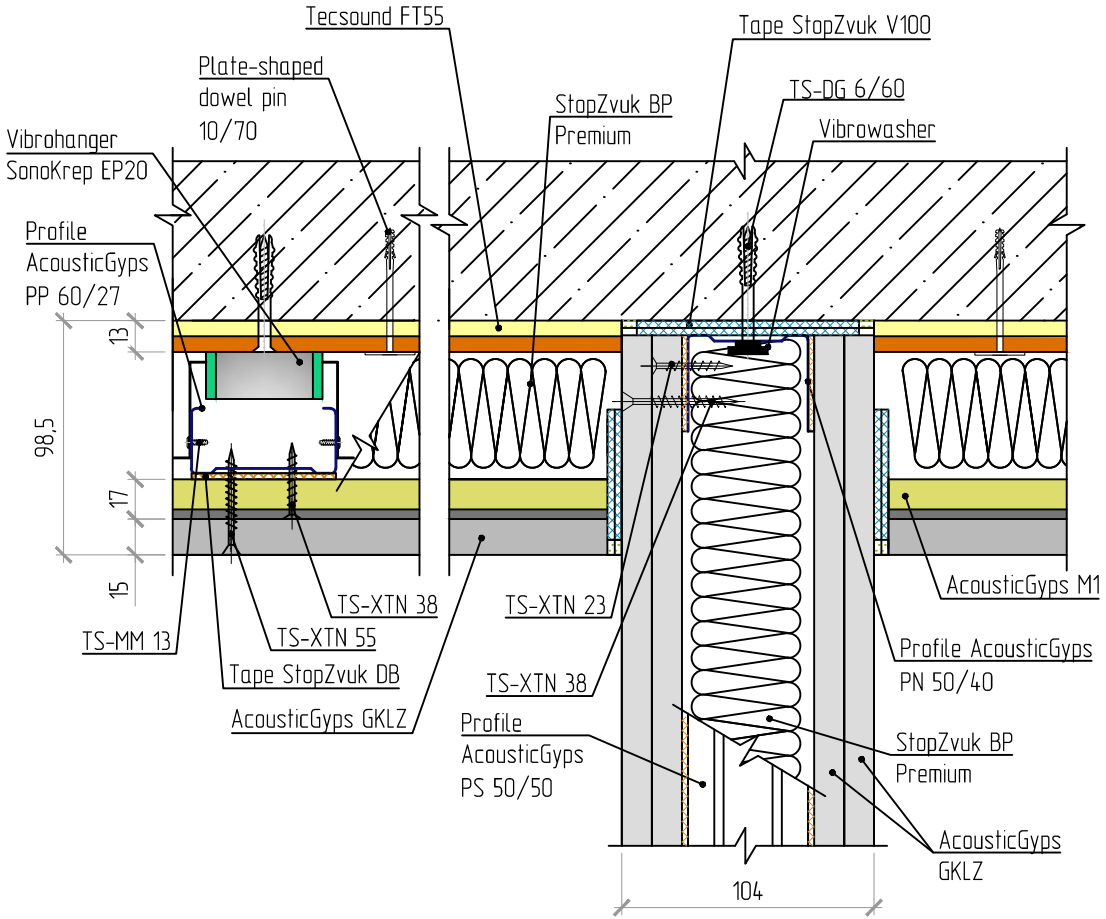
Design type	Section formula [1]	Suspended ceiling thickness (mm)	Rw_{base} (dB)	Rw (dB)	ΔLw (dB)
TS-3.5	ZhBP140-TS55-SZBPPremium-AGM1-GKLZ15	98,5	51	75	21

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the suspended ceiling (see Appendix B).

Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining



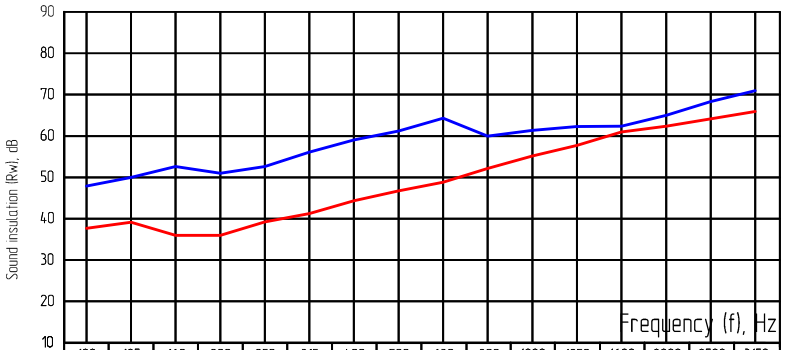
Junction of ceiling and TS-1.1 partition



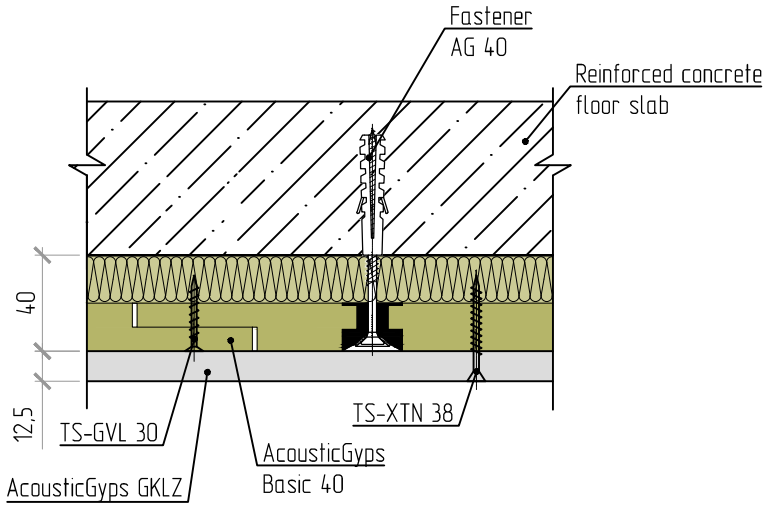
TS-3.6 sound insulating ceiling lining 52.5 mm thick (Slim A1)

ΔRw= 10 dB

Airborne noise insulation frequency response, Rw (f)



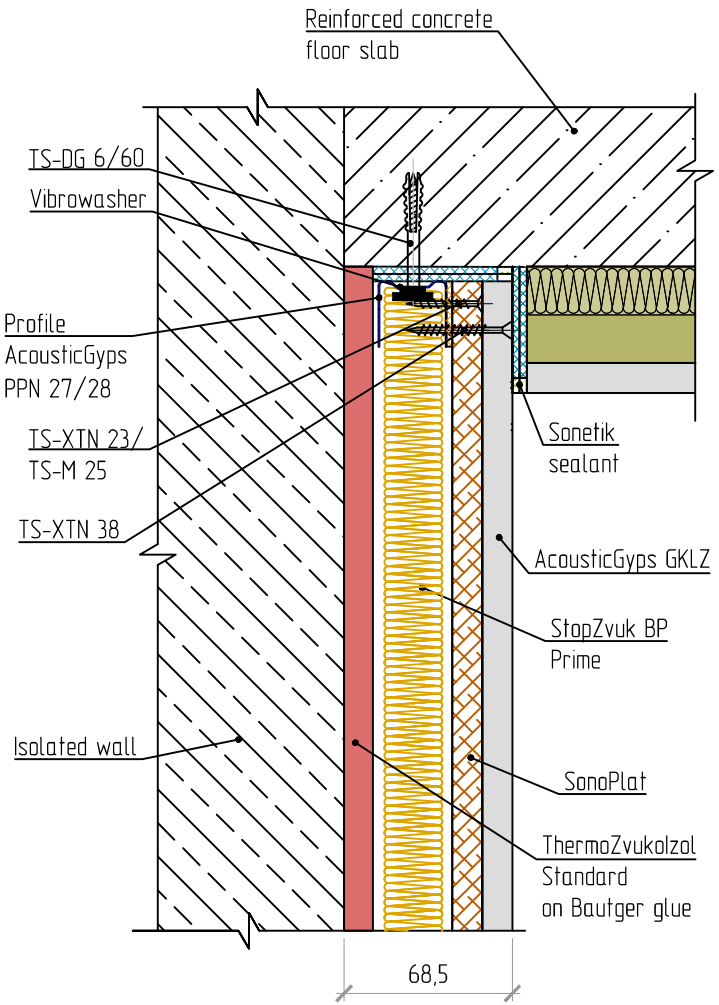
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-3.6	48	50	53	51	53	56	59	61	64	60	62	63	63	65	68	71
Base	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66



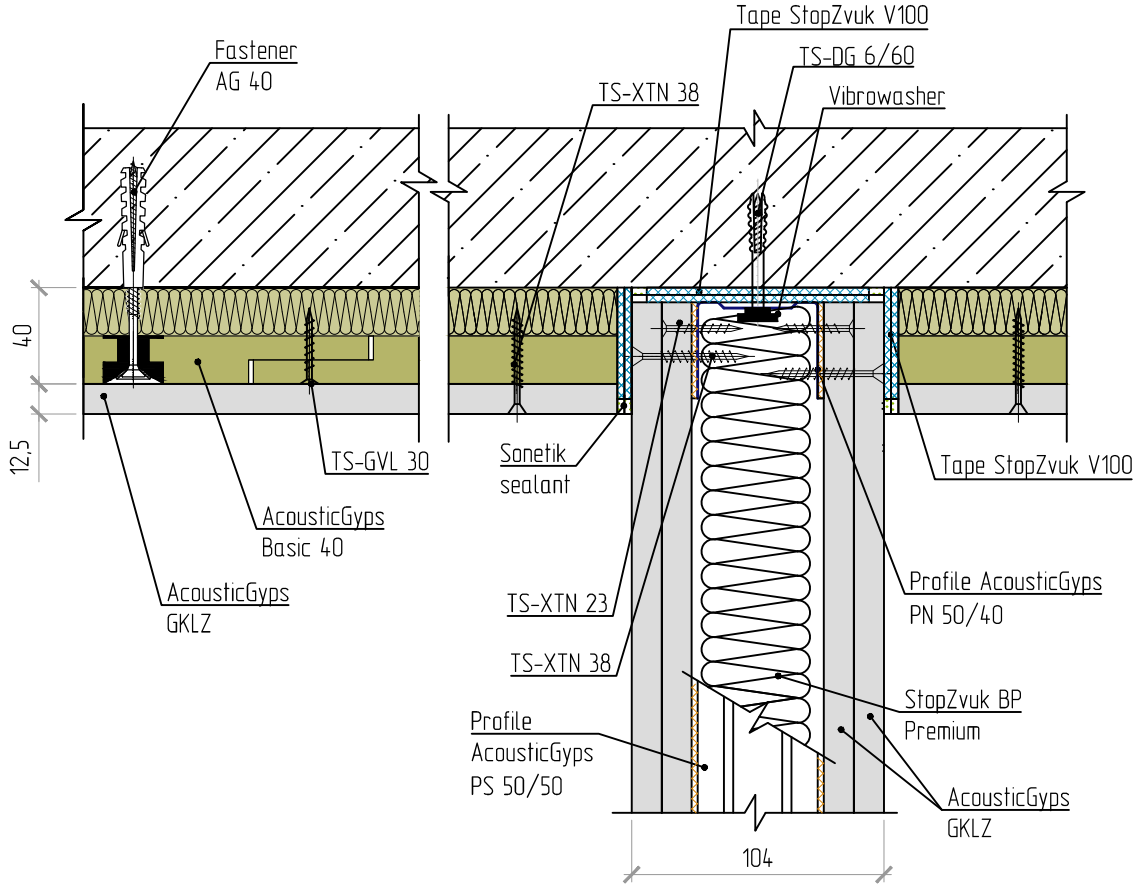
Design type	Section formula [1]	Suspended ceiling thickness (mm)	Rw_{base} (dB)	Rw (dB)	ΔLw (dB)
TS-3.6	ZhBP140-AG40-GKLZ	52,5	51	61	

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the suspended ceiling (see Appendix B).

Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining



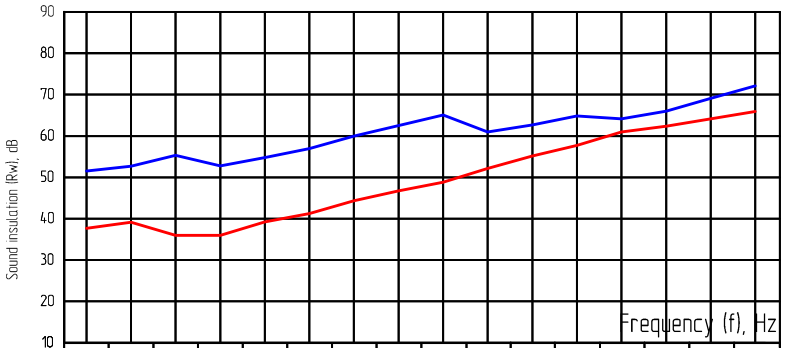
Junction of ceiling and TS-1.1 partition



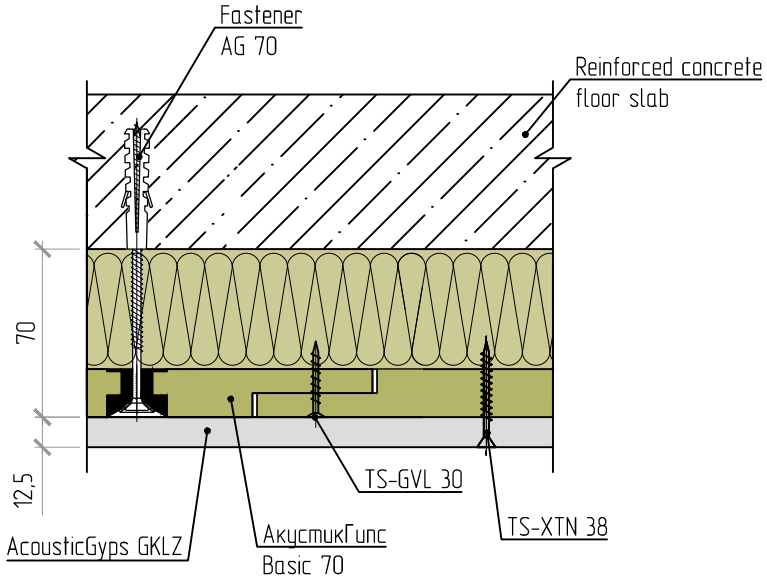
TS-3.7 sound insulating ceiling lining 82.5 mm thick (Slim A2)

ΔRw= 14 dB

Airborne noise insulation frequency response, Rw (f)



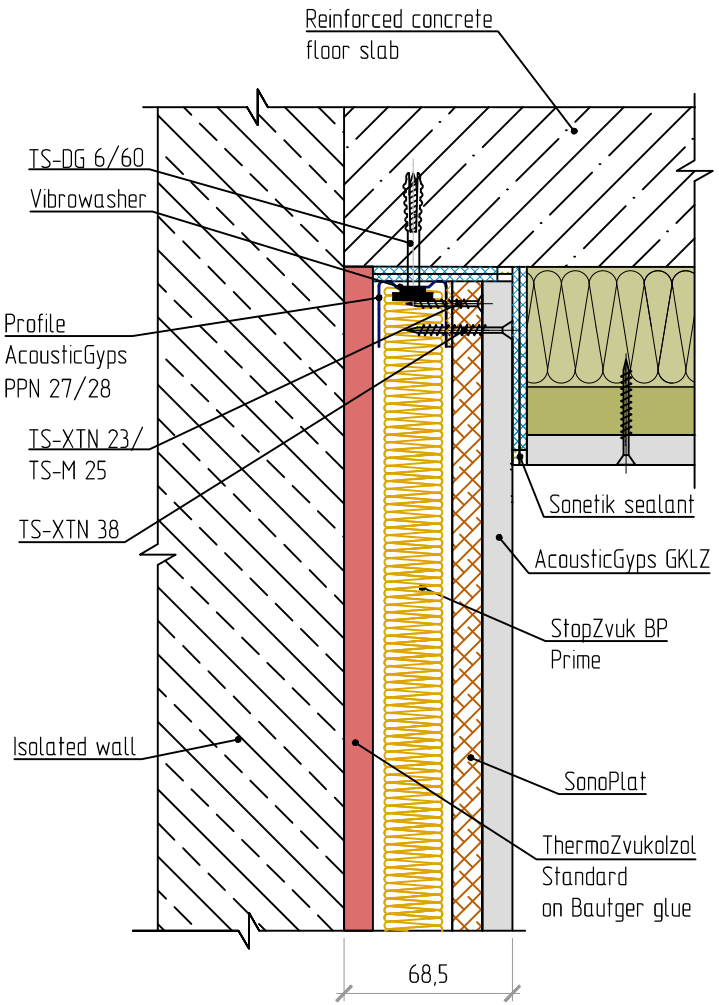
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-3.7	52	53	55	53	55	57	60	62	65	61	63	65	64	66	69	72
Base	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66



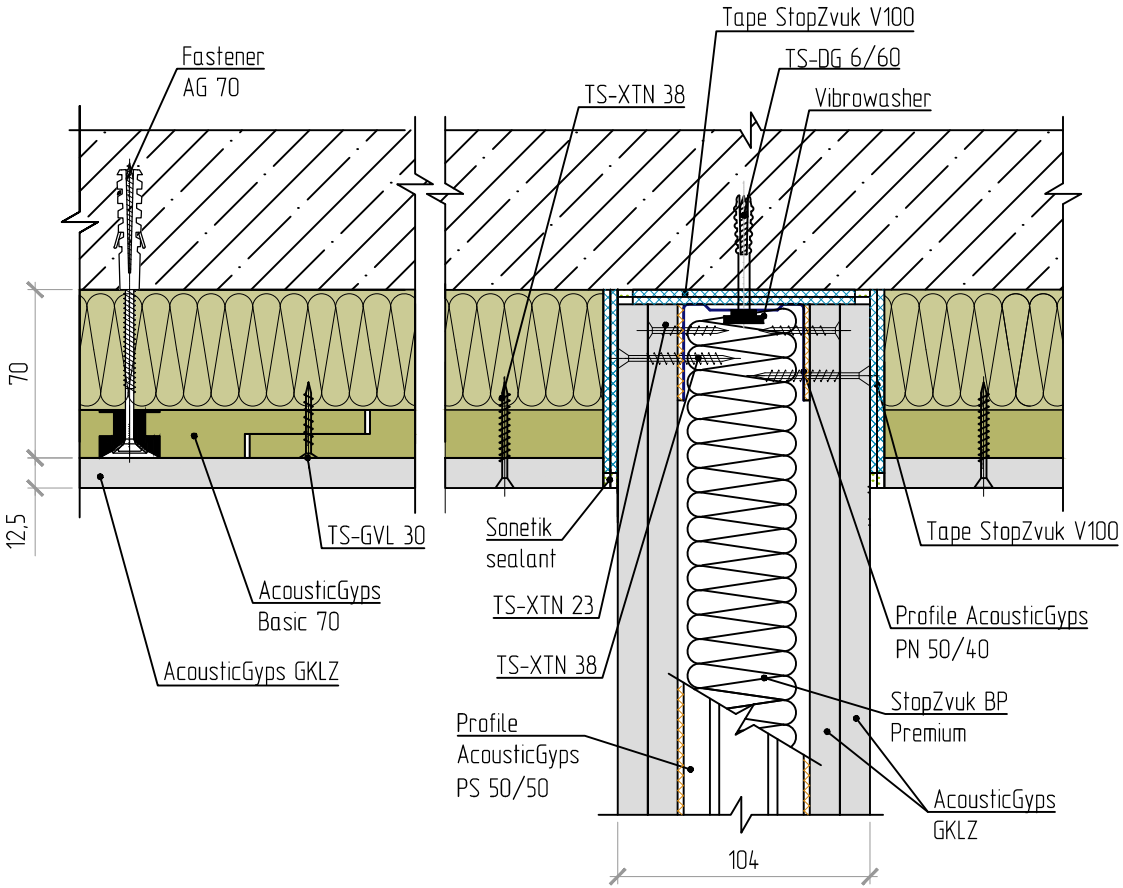
Design type	Section formula [1]	Suspended ceiling thickness (mm)	Rw_{base} (dB)	Rw (dB)	ΔLw (dB)
TS-3.7	ZhBP140-AG70-GKLZ	82,5	51	65	

[1] Section formula is a symbolic combination of abbreviated words denoting layers of the suspended ceiling (see Appendix B).

Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining



Junction of ceiling and TS-1.1 partition



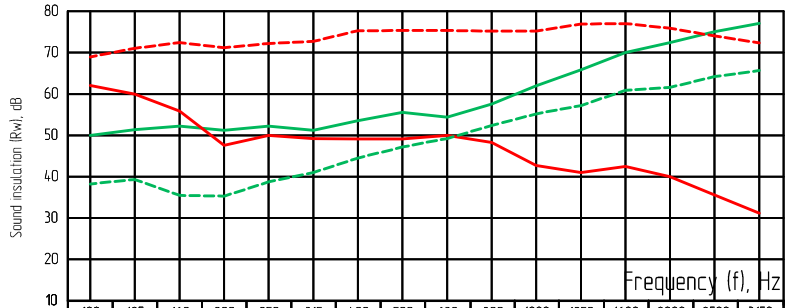
SECTION 4
Sound insulating floors

TS-4.1 sound insulating floor 63 mm thick (Standard 1)

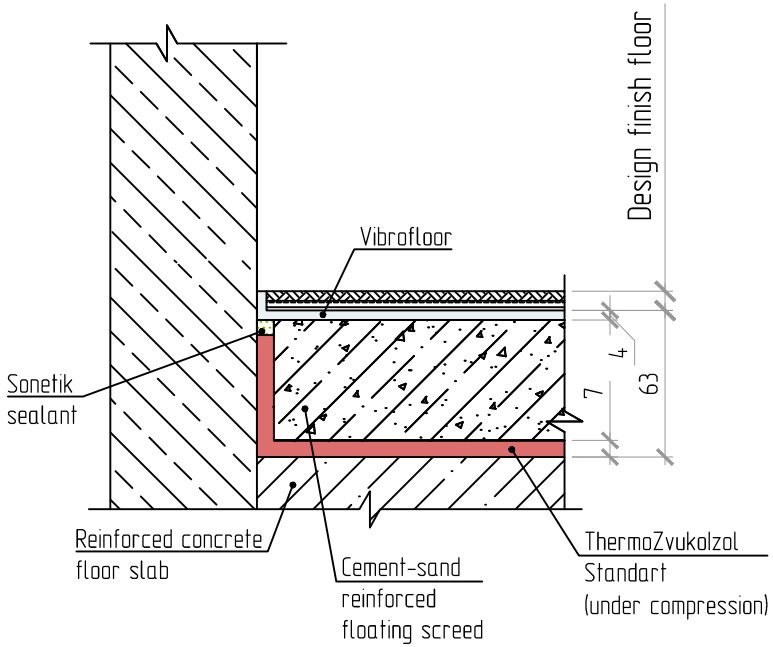
ΔRw= 10 dB

ΔLnw= 31 dB

Frequency response of airborne Rw(f) and impact Lnw(f) noise insulation, dB



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-4.1 (airborne noise)	50	51	52	51	52	51	53	55	54	58	62	66	70	72	75	77
Base (airborne noise)	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66
TS-4.1 (impact noise)	63	60	56	48	50	49	49	49	50	48	43	41	42	40	36	31
Base (impact noise)	69	71	72	71	72	73	76	76	76	76	76	77	77	76	74	73

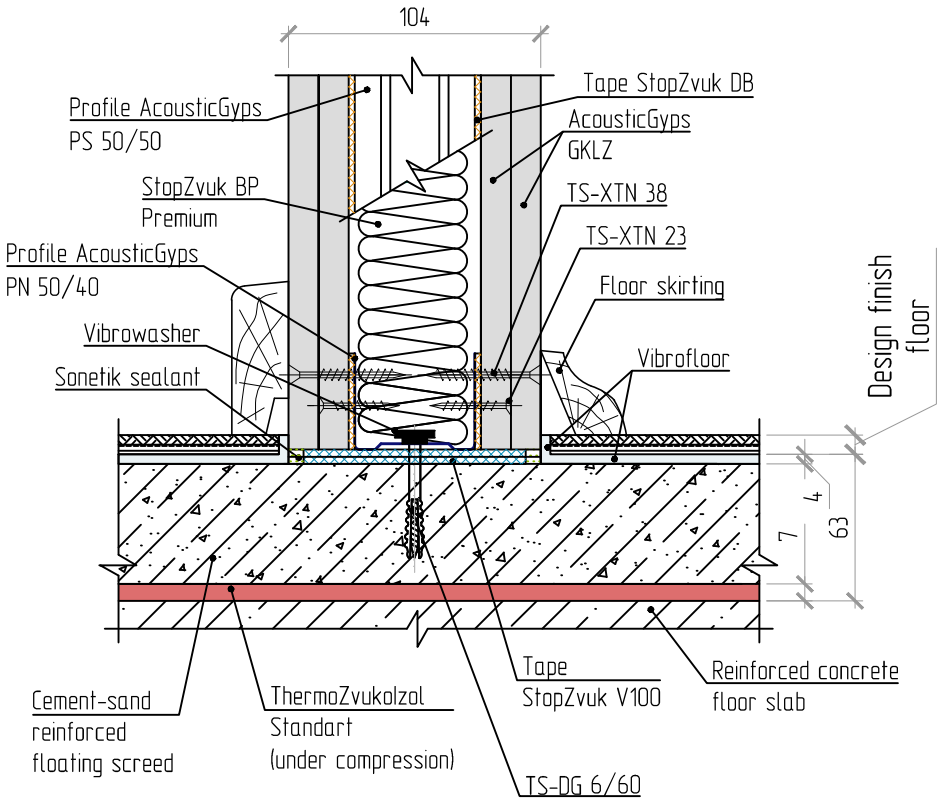


Design type	Section formula [1]	Suspended ceiling thickness (mm)	ΔRw (dB)	ΔLnw (dB)
TS-4.1	ZhBP140-TZIST-CPS50-VF-Dff	63	10	31

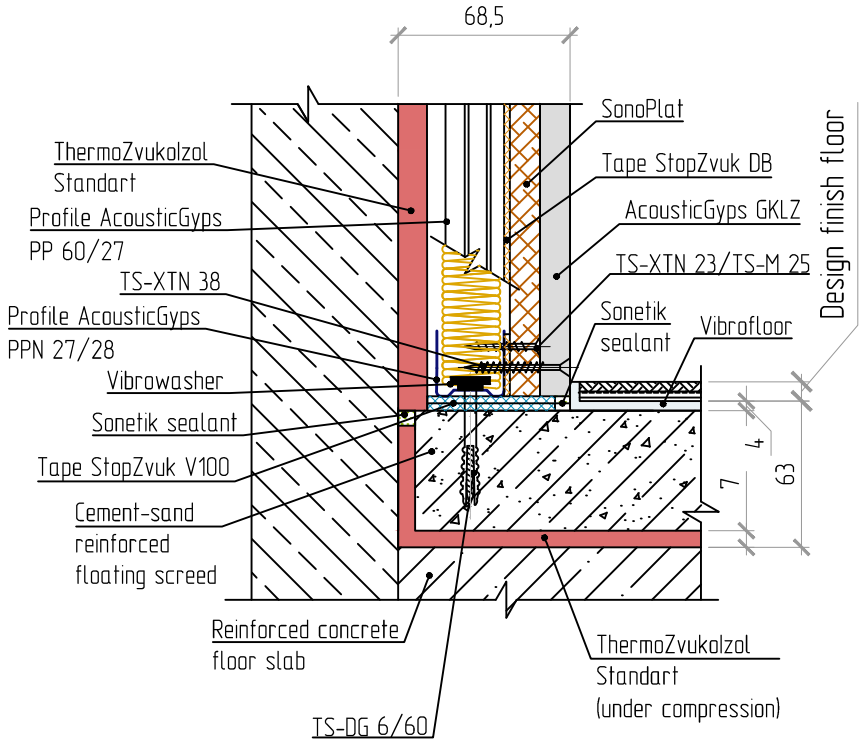
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the sound insulating floor (see Appendix B).

[2] Sound insulating floor thickness is given without finish floor thickness.

Junction of sound insulating floor and TS-1.1 sound insulating partition



Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining

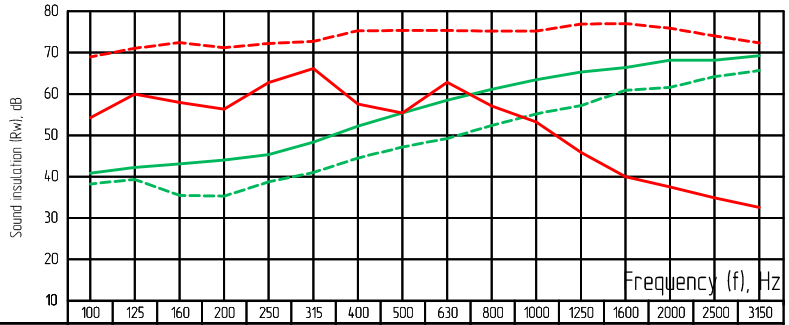


TS-4.2 sound insulating floor 59 mm thick (Standard 2)

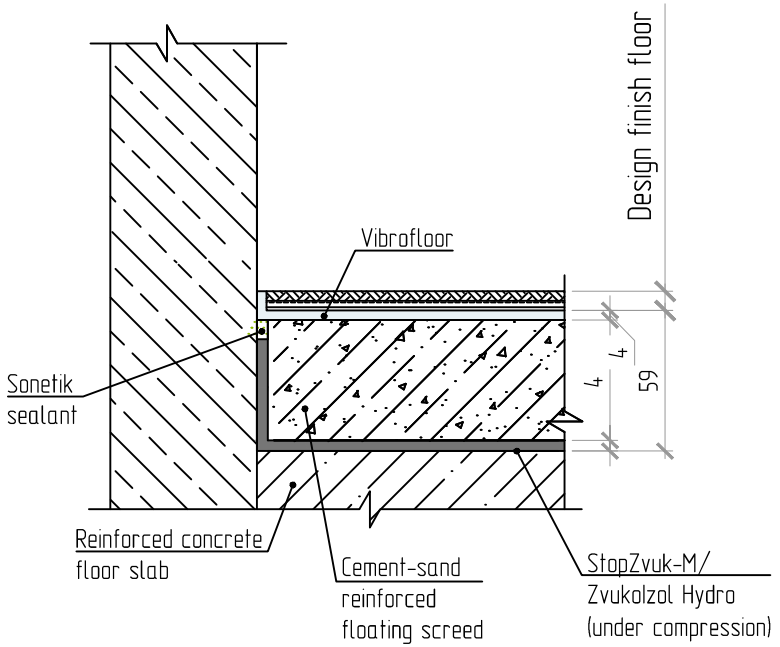
ΔRw= 8 dB

ΔLnw= 27 dB

Frequency response of airborne Rw(f) and impact Lnw(f) noise insulation, dB



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-4.2 (airborne noise)	41	42	43	44	45	48	52	55	58	61	63	65	65	66	68	69
Base (airborne noise)	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66
TS-4.2 (impact noise)	54	60	58	57	62	66	58	55	62	57	53	46	40	38	35	33
Base (impact noise)	69	71	72	71	72	73	76	76	76	76	76	77	77	76	74	73

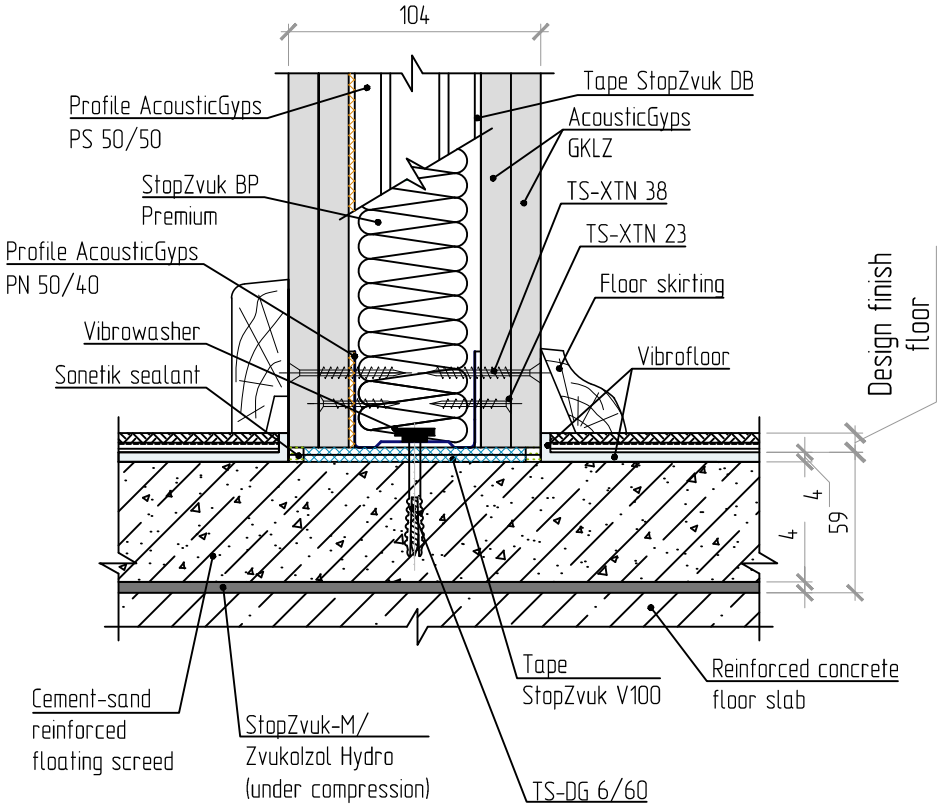


Design type	Section formula [1]	Suspended ceiling thickness (mm)	ΔRw (dB)	ΔLnw (dB)
TS-4.2	ZhBP140-(SZM/ZIG)-CPS50-Dff	59	8	27

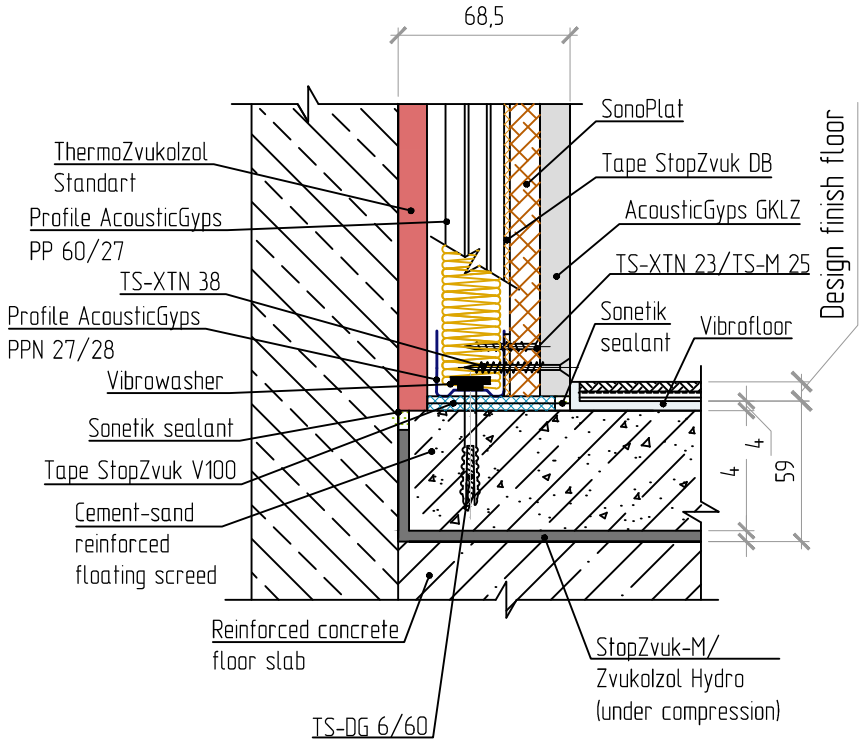
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the sound insulating floor (see Appendix B).

[2] Sound insulating floor thickness is given without finish floor thickness.

Junction of sound insulating floor and TS-1.1 sound insulating partition



Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining

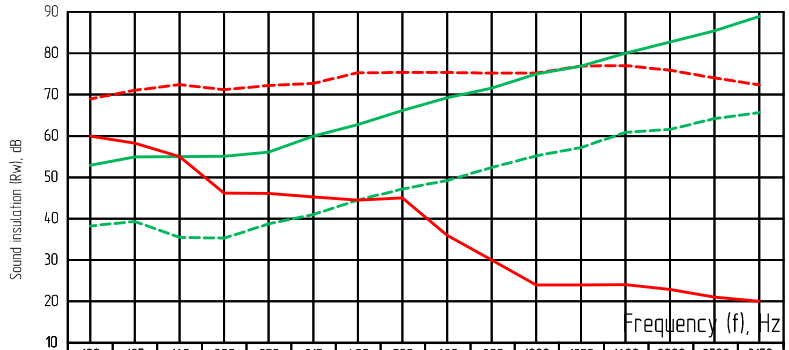


TS-4.3 sound insulating floor 78 mm thick (Profi)

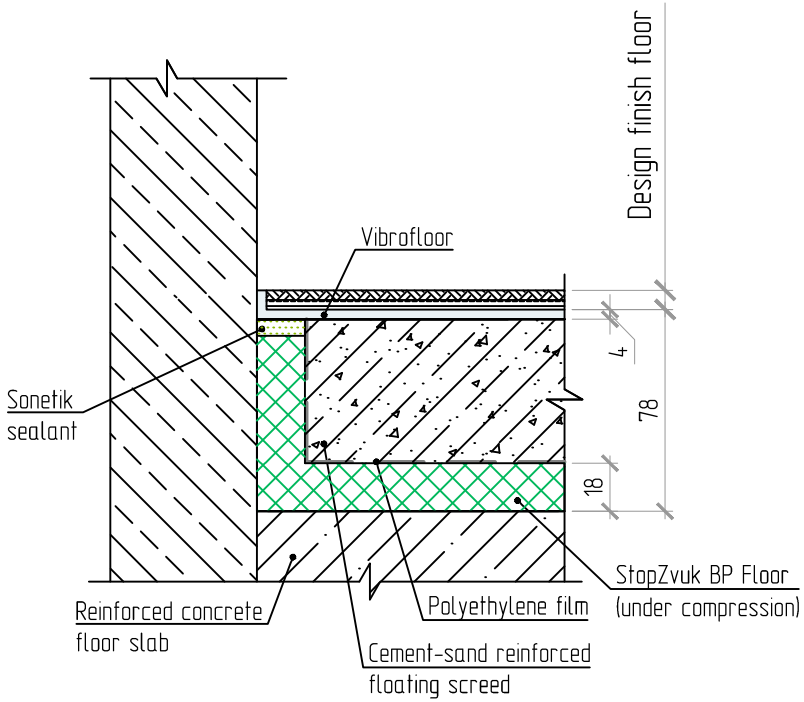
ΔRw= 17 dB

ΔLnw= 35 dB

Frequency response of airborne Rw(f) and impact Lnw(f) noise insulation, dB



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-4.3 (airborne noise)	53	55	55	55	56	60	63	66	69	72	75	77	80	83	86	89
Base (airborne noise)	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66
TS-4.3 (impact noise)	60	58	55	46	46	45	44	45	36	30	24	24	24	23	21	20
Base (impact noise)	69	71	72	71	72	73	76	76	76	76	76	77	77	76	74	73

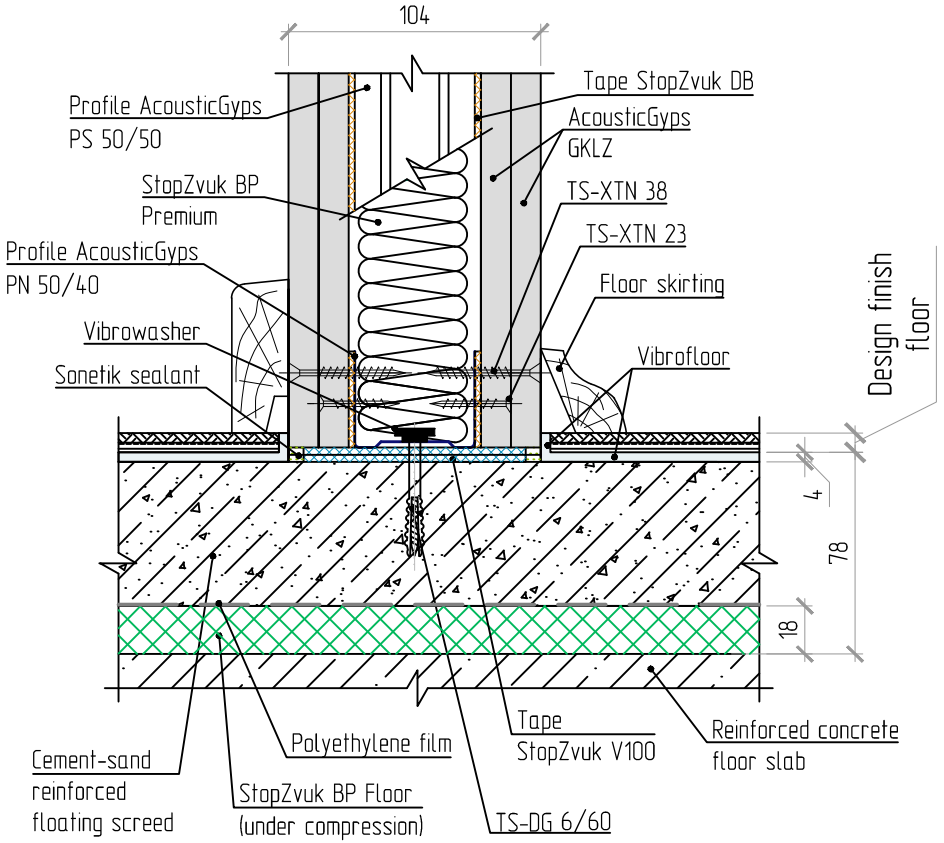


Design type	Section formula [1]	Suspended ceiling thickness (mm)	ΔRw (dB)	ΔLnw (dB)
TS-4.3	ZhBP140-SZBPF-PE-CPS60-Dff	78	17	35

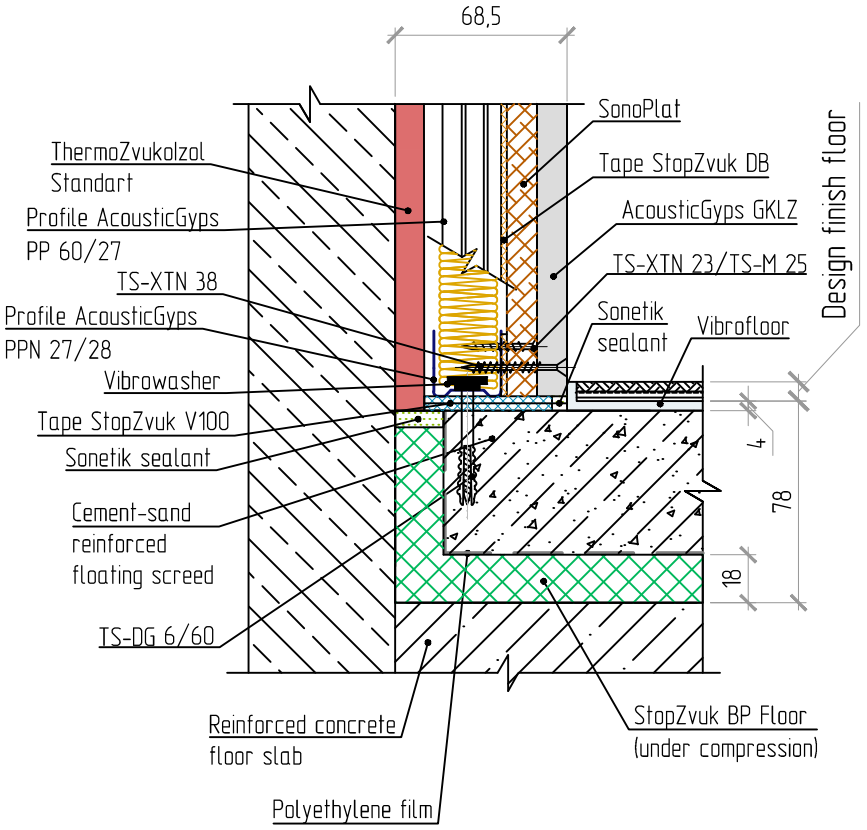
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the sound insulating floor (see Appendix B).

[2] Sound insulating floor thickness is given without finish floor thickness.

Junction of sound insulating floor and TS-1.1 sound insulating partition



Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining

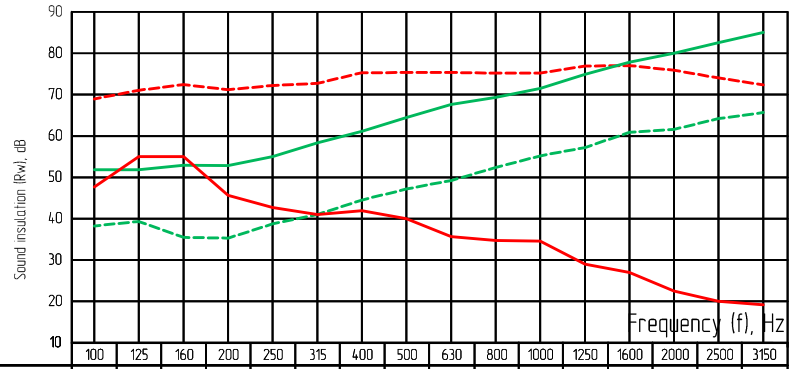


TS-4.4 sound insulating floor 96 mm thick (Premium)

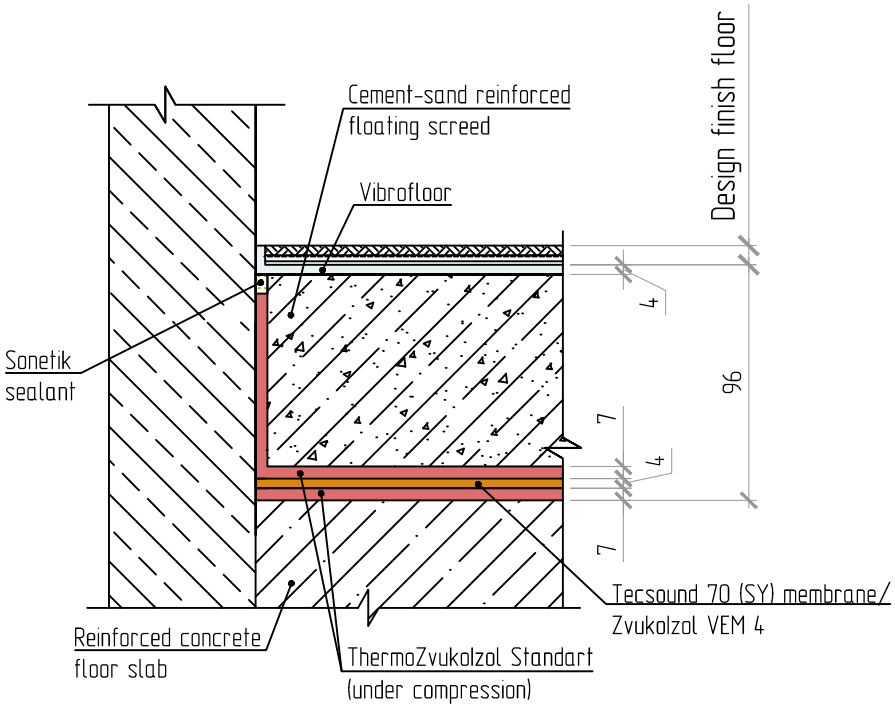
ΔRw= 18 dB

ΔLnw= 40 dB

Frequency response of airborne Rw(f) and impact Lnw(f) noise insulation, dB



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
TS-4.4 (airborne noise)	52	52	53	53	55	58	61	64	67	69	72	75	78	80	83	85
Base (airborne noise)	38	39	36	36	39	41	44	47	49	52	55	57	61	62	64	66
TS-4.4 (impact noise)	48	55	55	46	43	41	42	40	36	35	35	29	27	23	20	19
Base (impact noise)	69	71	72	71	72	73	76	76	76	76	76	77	77	76	74	73

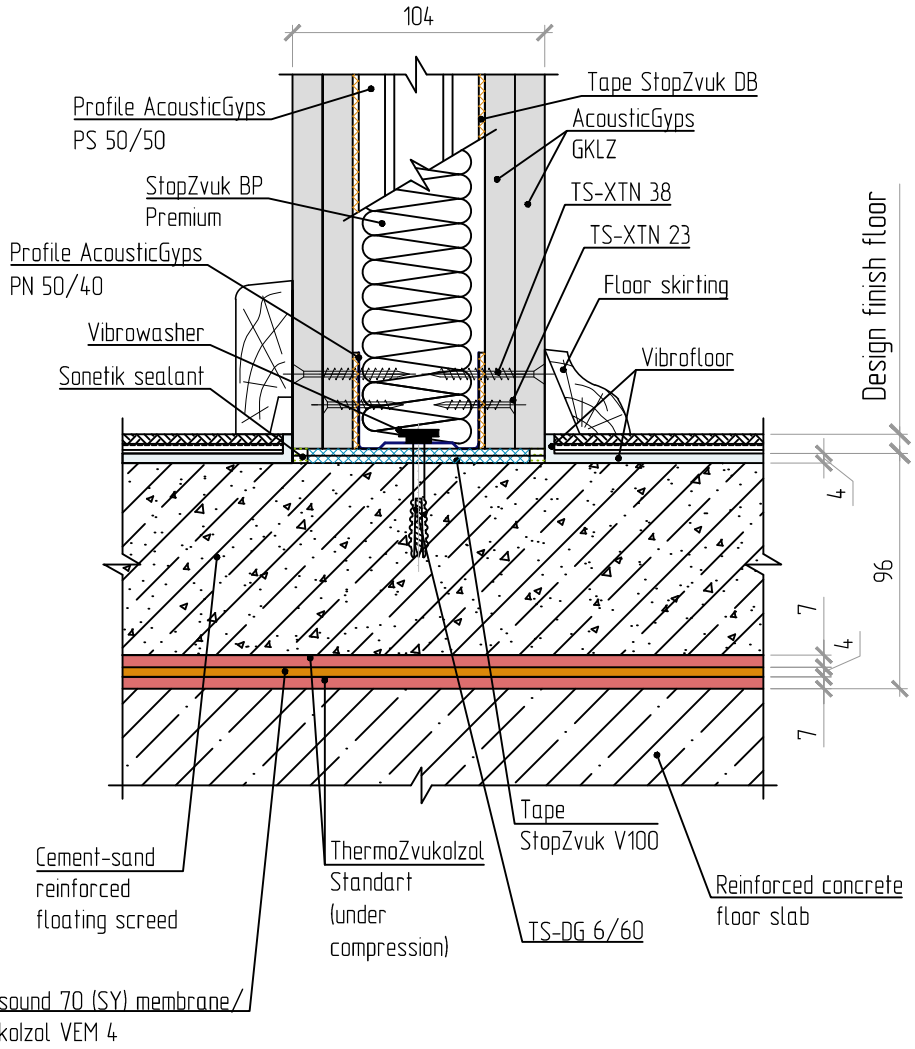


Design type	Section formula [1]	Suspended ceiling thickness (mm)	ΔRw (dB)	ΔLnw (dB)
TS-4.4	ZhBP140-TZIST-T70-TZIST-CPS80-Dff	96	18	40

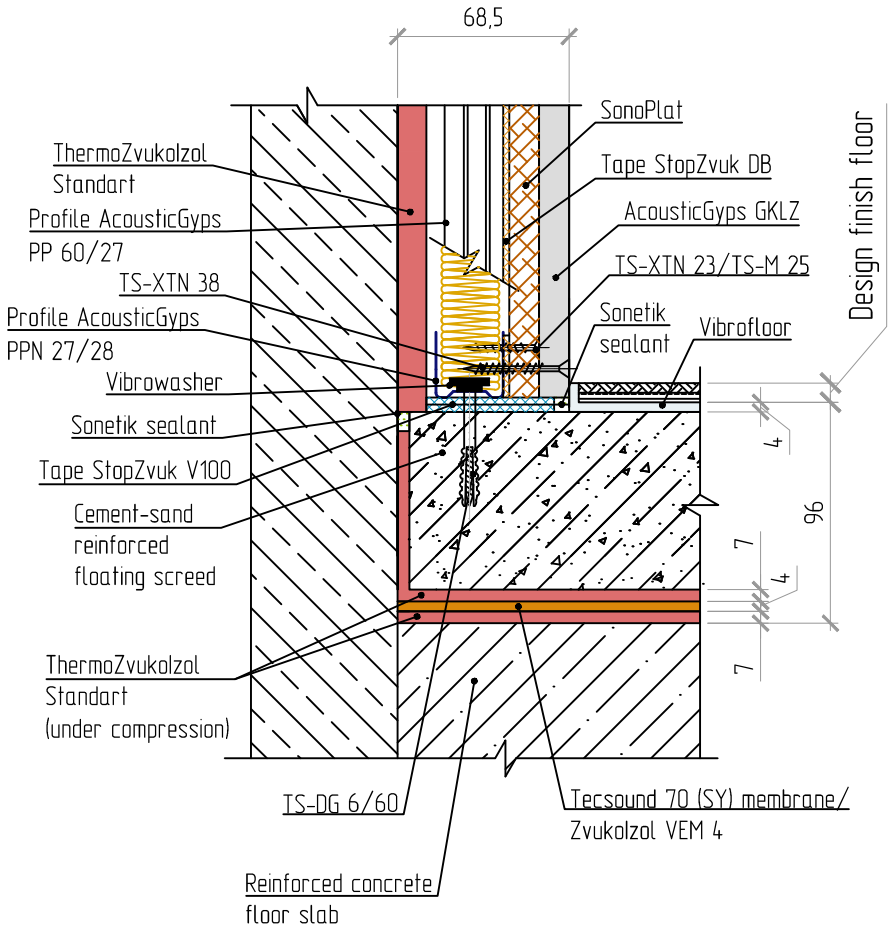
[1] Section formula is a symbolic combination of abbreviated words denoting layers of the sound insulating floor (see Appendix B).

[2] Sound insulating floor thickness is given without finish floor thickness.

Junction of sound insulating floor and TS-1.1 sound insulating partition



Junction of sound insulating ceiling and TS-2.2 sound insulating wall lining



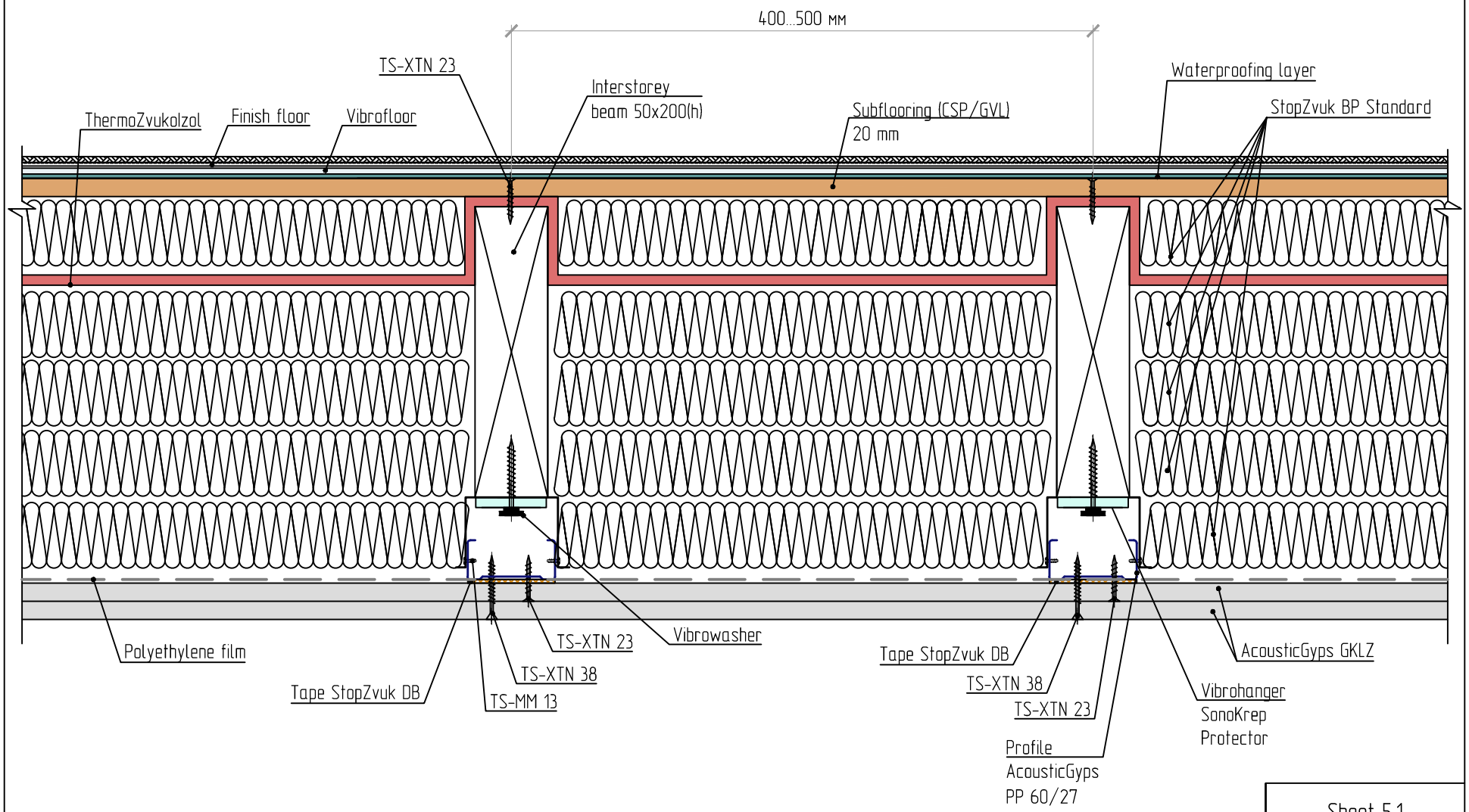
SECTION 5

Wooden housing solutions

Sound insulating interstorey wooden floor structure (Basic 1)

Rw= 61 dB

Lnw= 60 dB

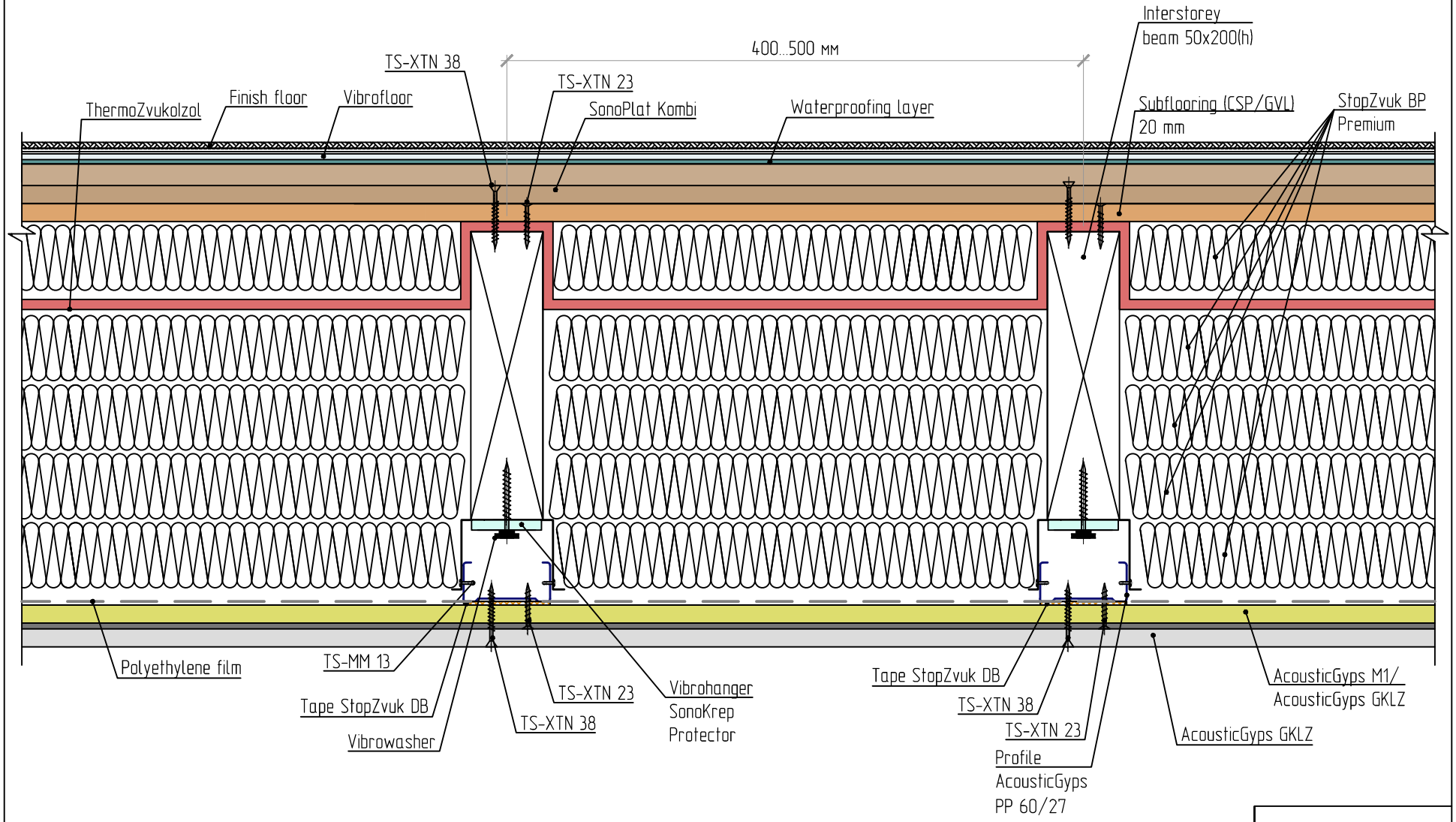


Sheet 5.1

Sound insulating interstorey wooden floor structure (Premium 1)

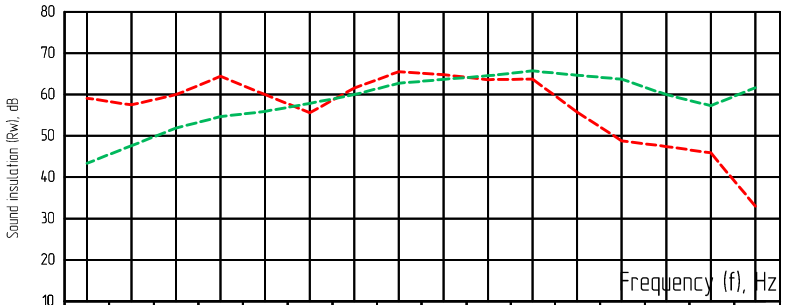
Rw= 67 dB

Lnw= 52 dB



Sheet 5.2

Frequency response of airborne Rw(f) and impact Lnw(f) noise insulation, dB (Basic 1)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Base (airborne noise)	44	48	52	55	56	58	60	62	63	65	66	65	64	60	58	61
Base (impact noise)	59	57	60	65	60	56	61	66	65	63	63	56	49	48	46	33

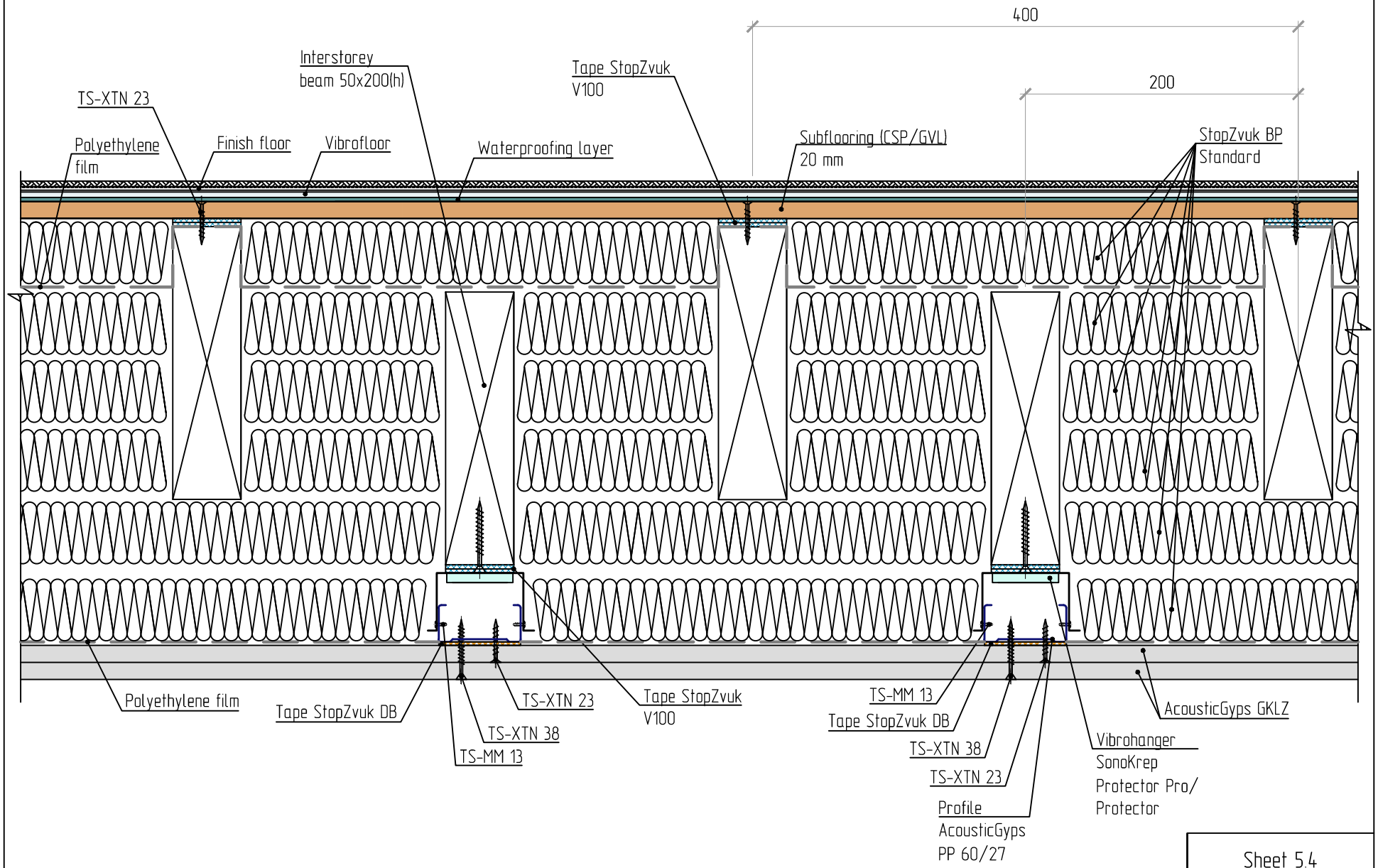
Frequency response of airborne Rw(f) and impact Lnw(f) noise insulation, dB (Premium 1)

	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Base (airborne noise)	49	53	56	59	60	62	64	66	67	69	70	70	69	65	63	66
Base (impact noise)	52	51	54	59	54	52	56	61	57	57	56	53	44	45	46	39

Sound insulating interstorey wooden floor structure (Basic 2)

Rw= 68 dB

Lnw= 50 dB

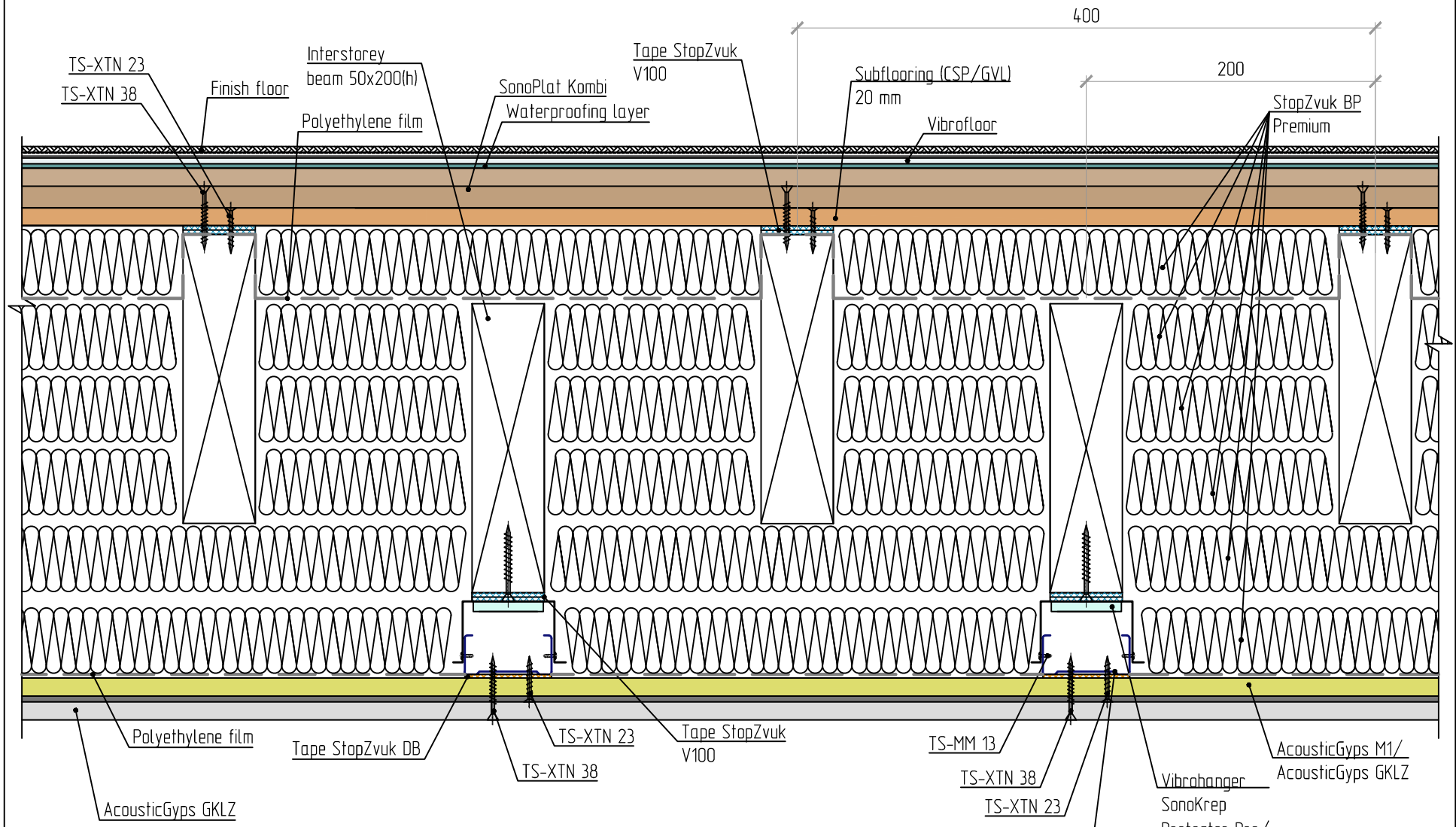


Sheet 5.4

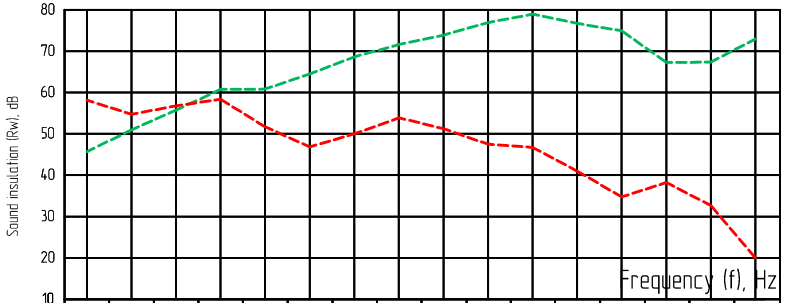
Sound insulating interstorey wooden floor structure (Premium 2)

Rw= 75 dB

Lnw= 43 dB

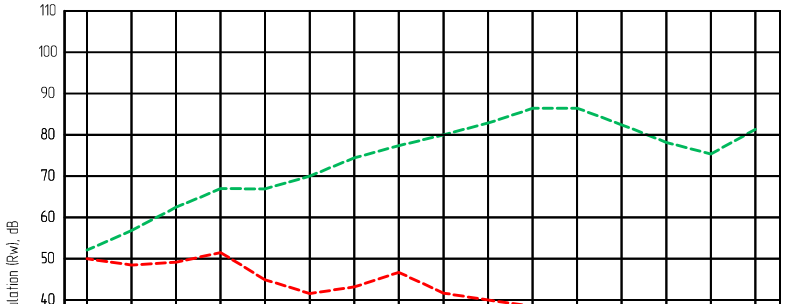


Frequency response of airborne Rw(f) and impact Lnw(f) noise insulation, dB (Basic 2)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Base (airborne noise)	46	51	56	61	61	64	68	71	74	77	79	77	75	67	67	73
Base (impact noise)	58	55	57	59	52	47	50	54	51	48	47	41	35	38	33	20

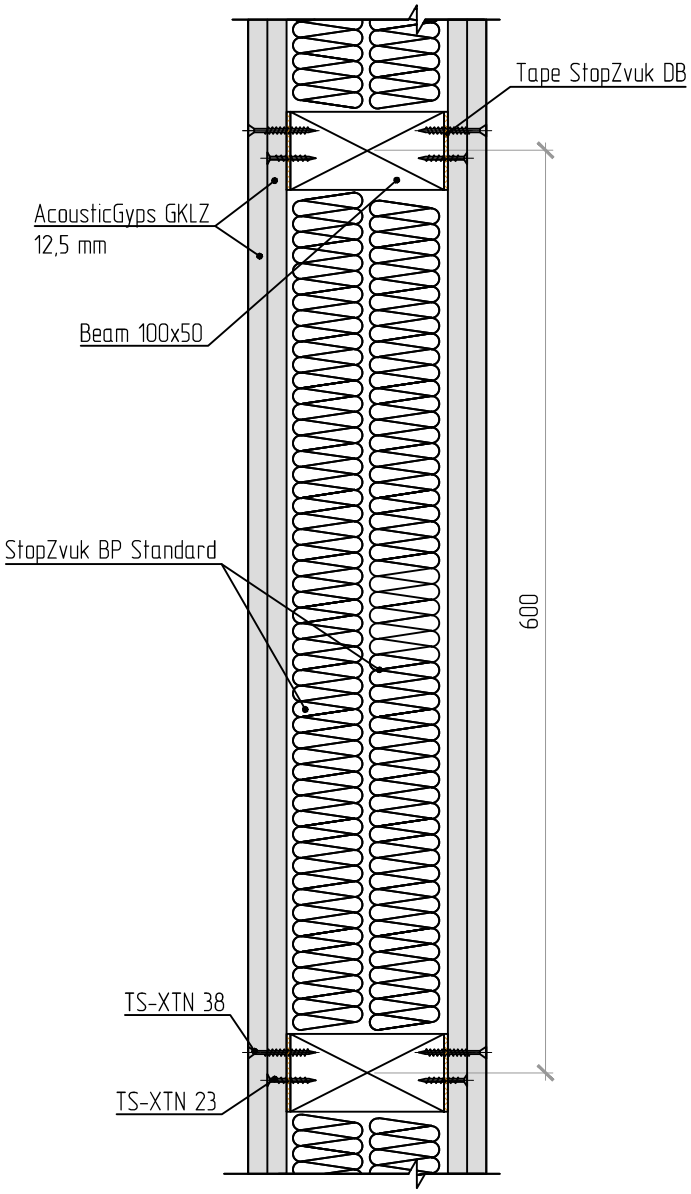
Frequency response of airborne Rw(f) and impact Lnw(f) noise insulation, dB (Premium 2)



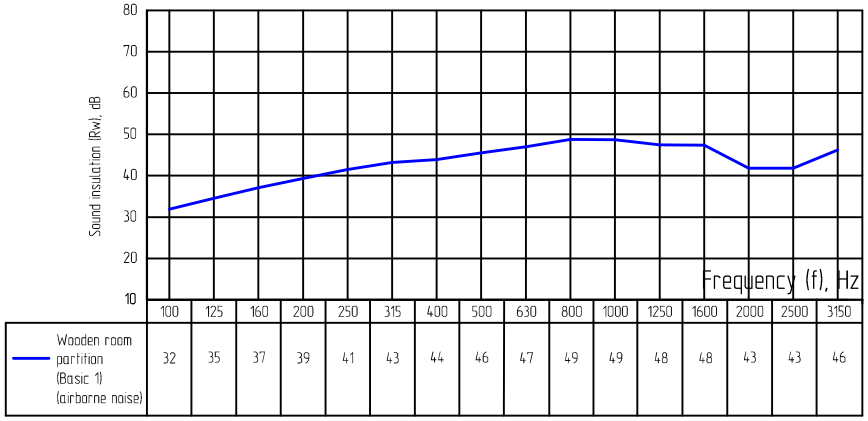
	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Base (airborne noise)	52	57	62	67	67	70	74	77	80	83	86	86	83	79	76	81
Base (impact noise)	50	48	49	51	45	41	43	47	41	40	39	37	28	30	32	23

Sound insulating wooden room partition (Basic 1)

Rw= 47 dB



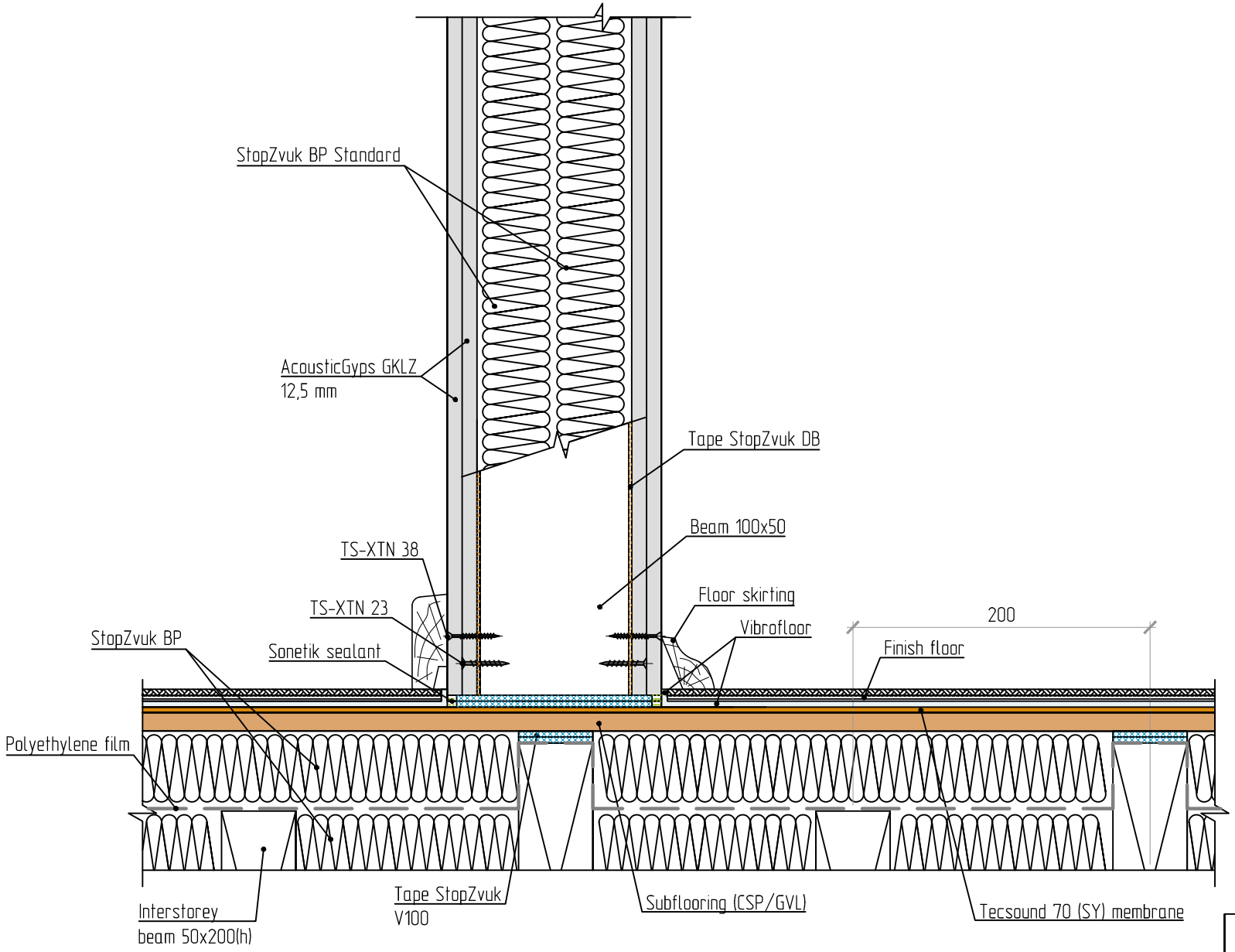
Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Wooden room partition (Basic 1) (airborne noise)	32	35	37	39	41	43	44	46	47	49	49	48	48	43	43	46

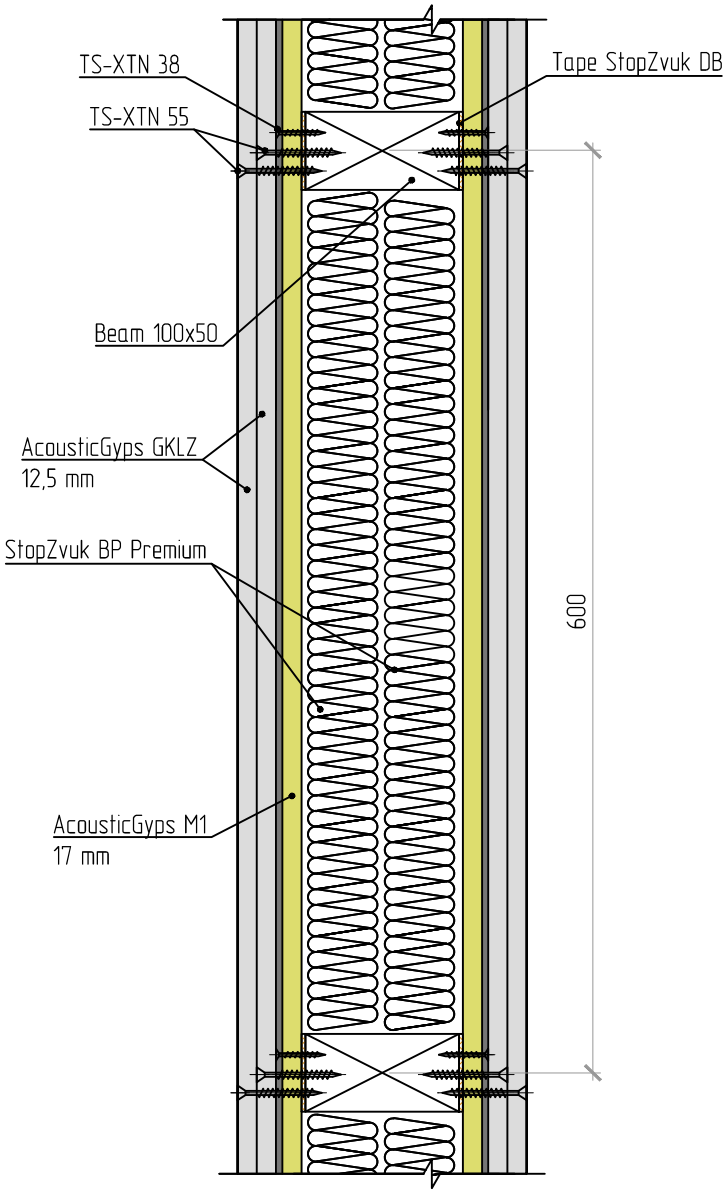
Sound insulating wooden room partition (Basic 1)

Junction of sound insulating wooden partition and floor structure

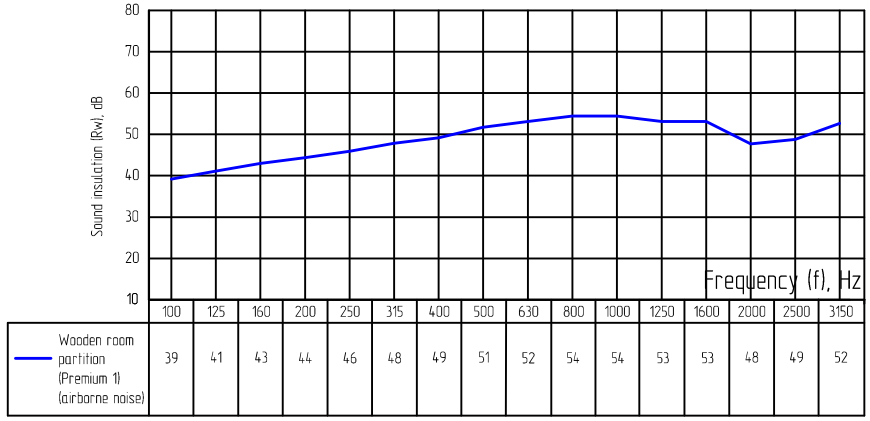


Sound insulating wooden room partition (Premium 1)

Rw= 52 dB



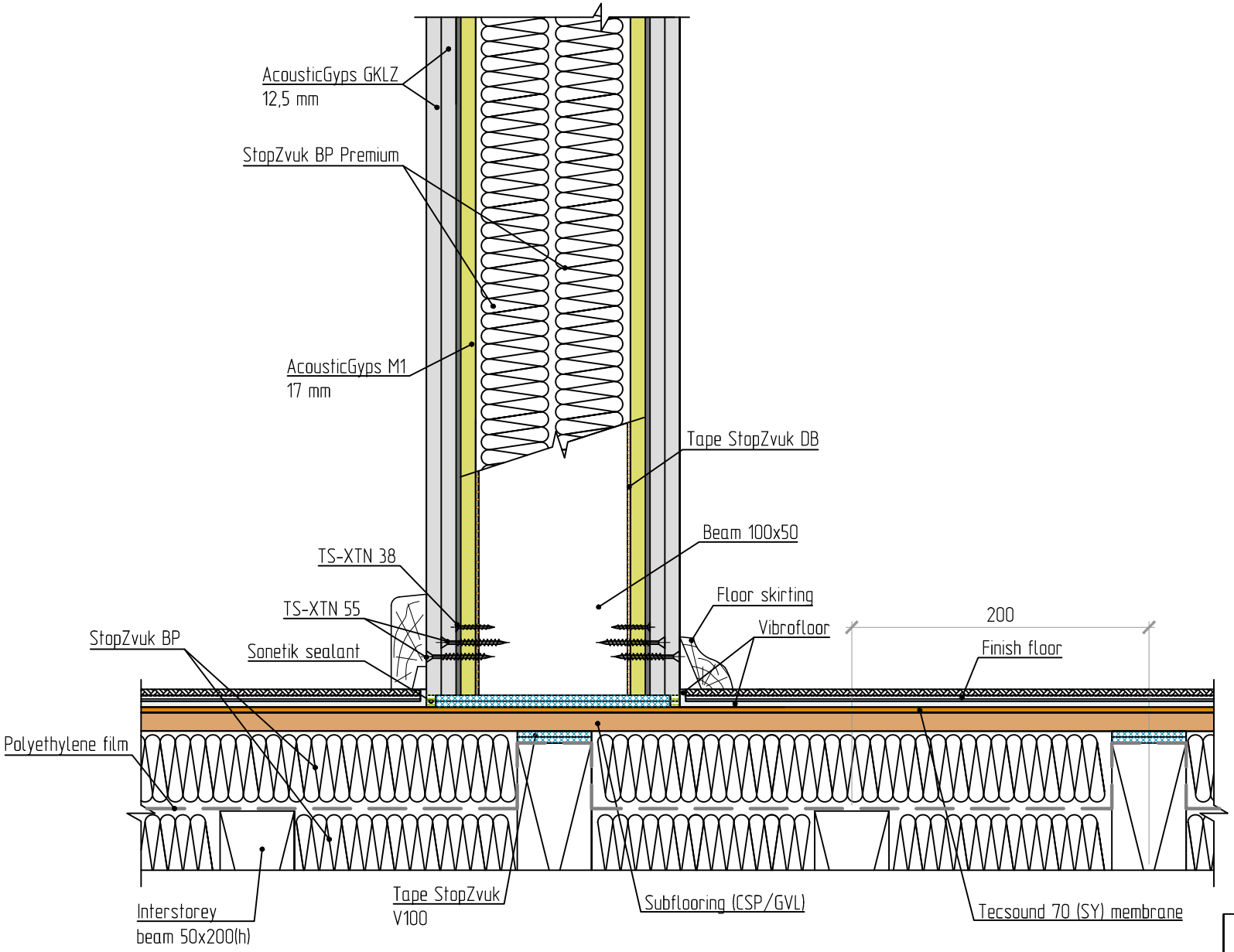
Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Wooden room partition (Premium 1) (airborne noise)	39	41	43	44	46	48	49	51	52	54	54	53	53	48	49	52

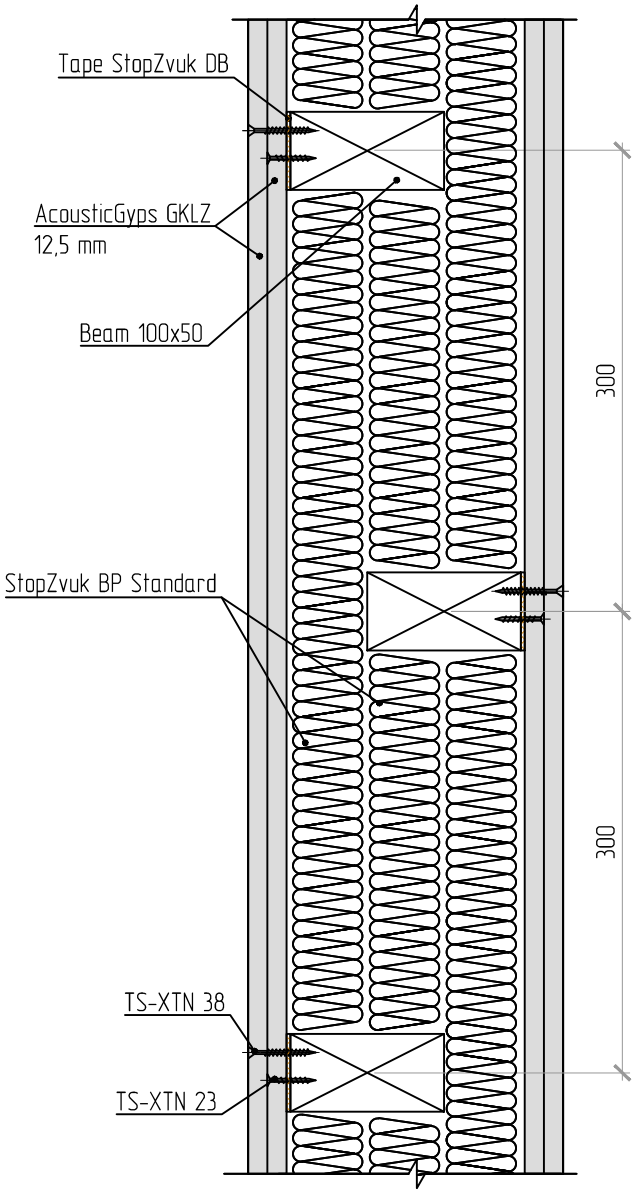
Sound insulating wooden room partition (Premium 1)

Junction of sound insulating wooden partition and floor structure

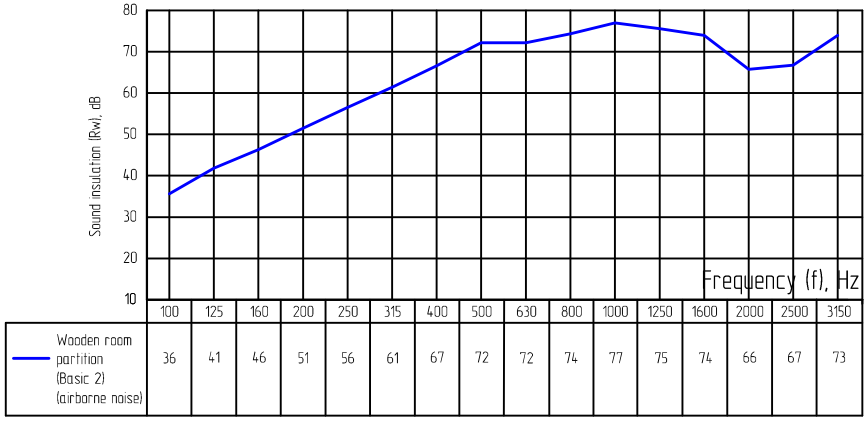


Sound insulating wooden room partition (Basic 2)

Rw= 64 dB



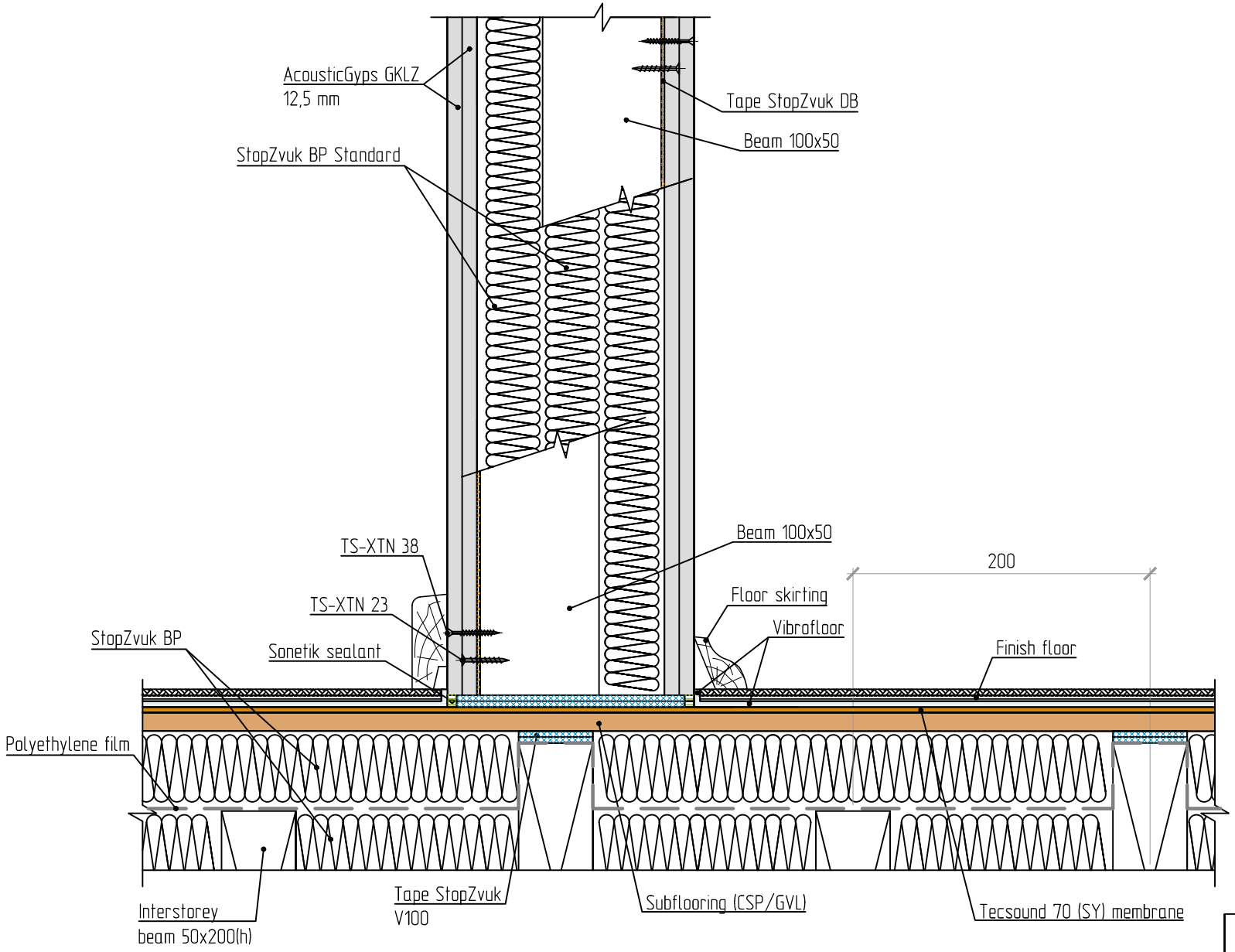
Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Wooden room partition (Basic 2) (airborne noise)	36	41	46	51	56	61	67	72	72	74	77	75	74	66	67	73

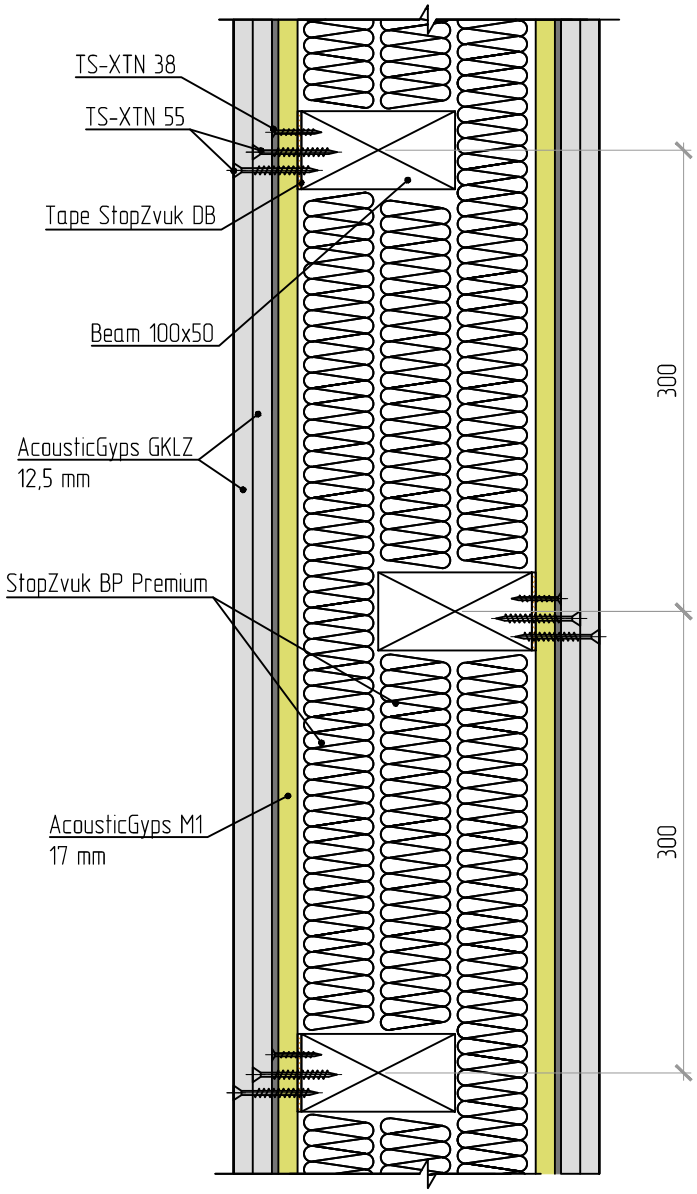
Sound insulating wooden room partition (Basic 2)

Junction of sound insulating wooden partition and floor structure

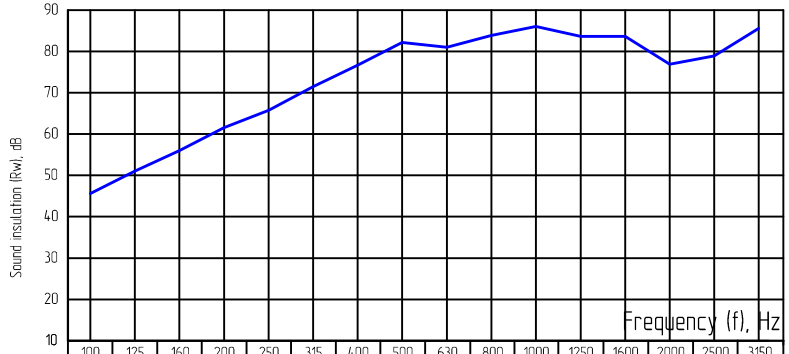


Sound insulating wooden room partition (Premium 2)

Rw= 74 dB



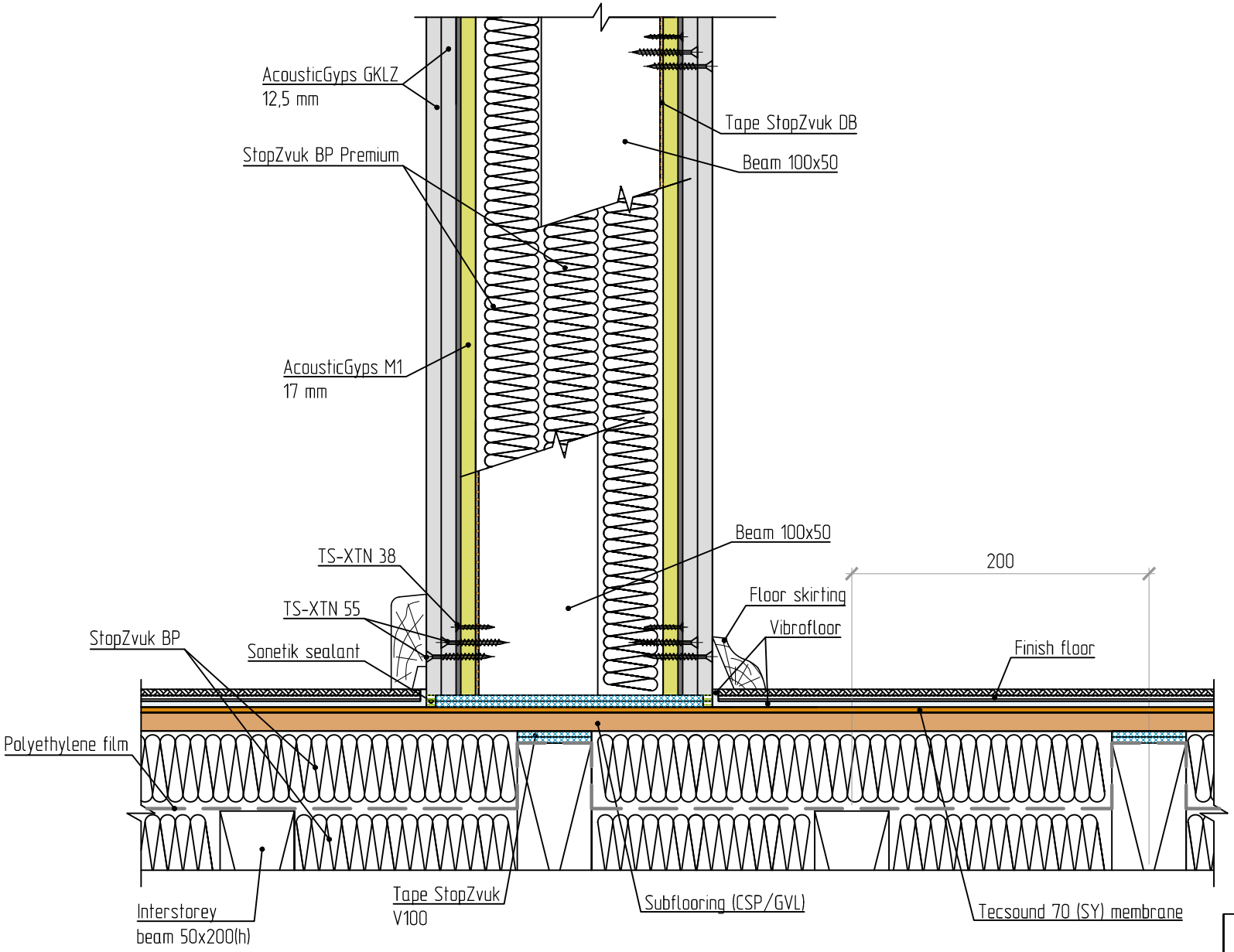
Airborne noise insulation frequency response, Rw (f)



	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Wooden room partition (Premium 2) (airborne noise)	46	51	56	61	66	71	77	82	81	84	86	84	84	77	79	85

Sound insulating wooden room partition (Premium 2)

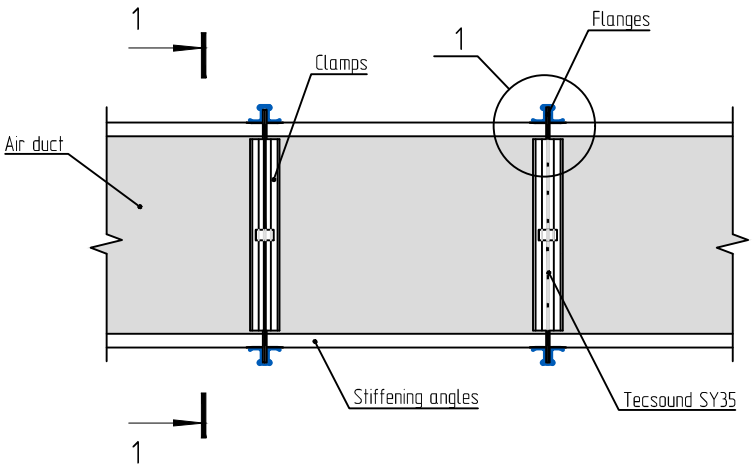
Junction of sound insulating wooden partition and floor structure



SECTION 6

Acoustic solutions for utilities

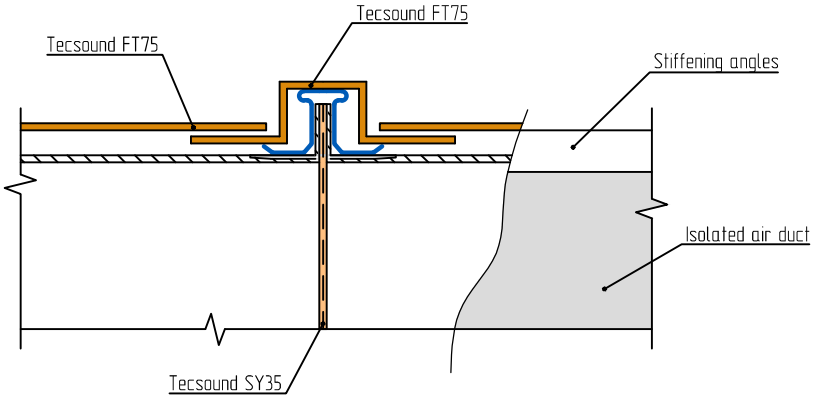
Sound insulating ventilation systems

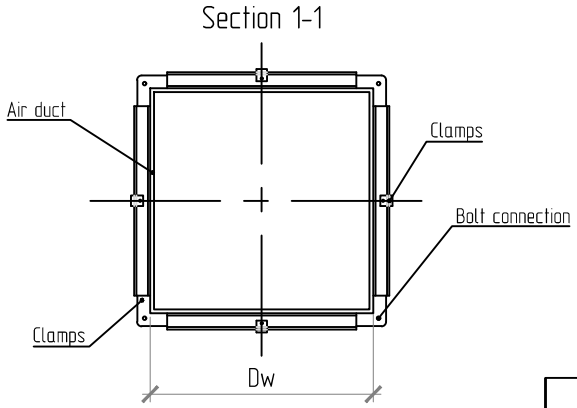


Unit 1. Protected duct surface gluing scheme

Note.

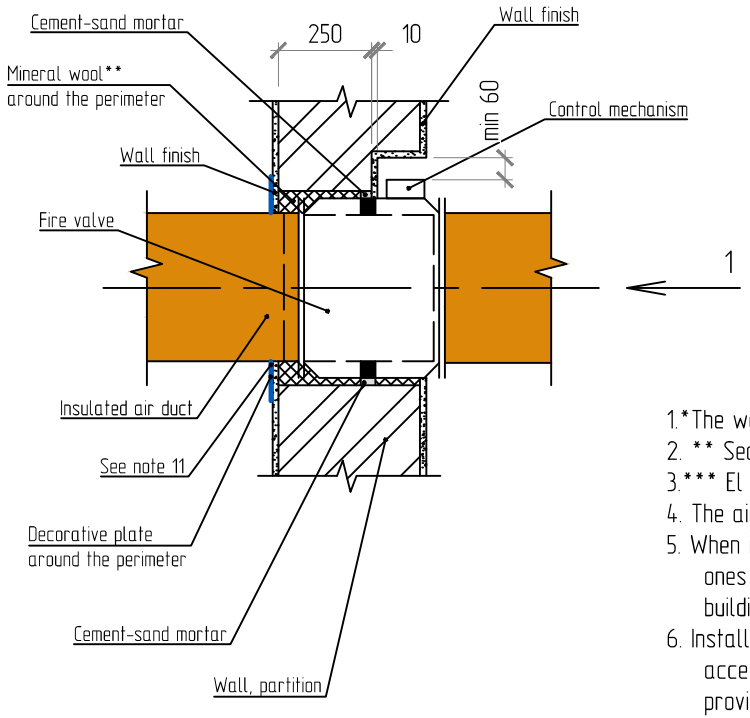
1. Rectangular duct sections are mounted using flanges.
2. The flanges are made of rail bar 20 and 30 mm wide. A stiffening angle is inserted into each corner of the flange.
3. Individual sections of the ducts including shaped elements are mounted by tightening bolt connection through stiffening angles.
4. Before coupling the sections, the connection is sealed. The sealing is made by gluing Tecsound SY35.
5. Protected surfaces of the air duct are glued by Tecsound FT55 A1 or Tecsound FT75 (as intended).
6. For more tight connection, an additional stapled clamp is used.
7. In pipeline bendings, sound insulating material is cut by a template.



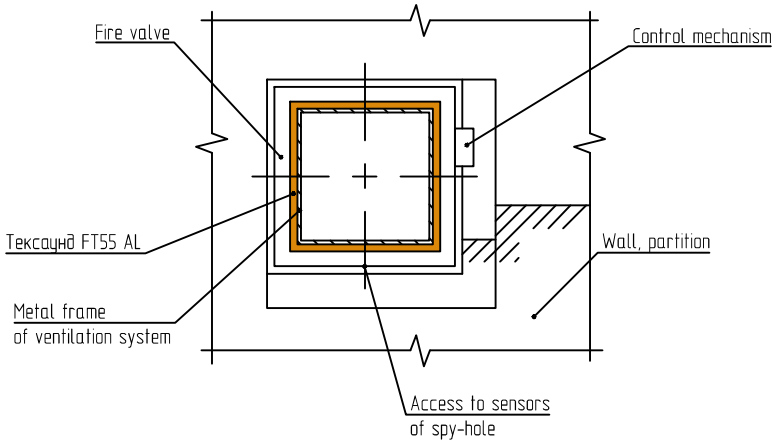


Sound insulating ventilation systems

Unit of air duct passage through firewall, partition (Option 1)



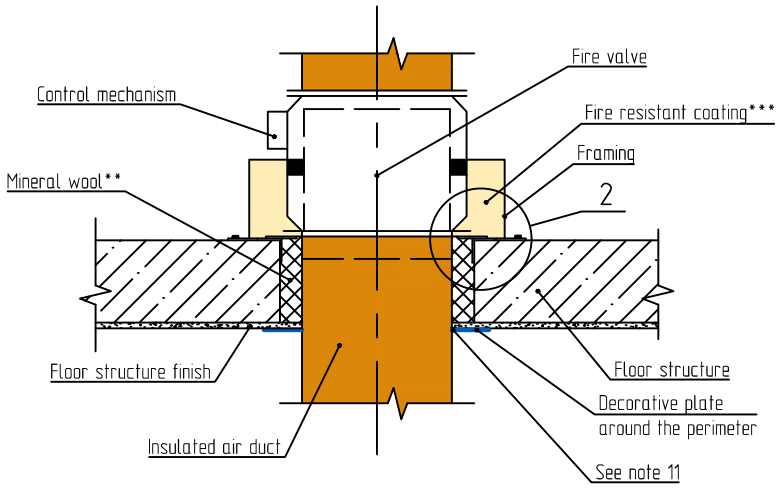
View 1



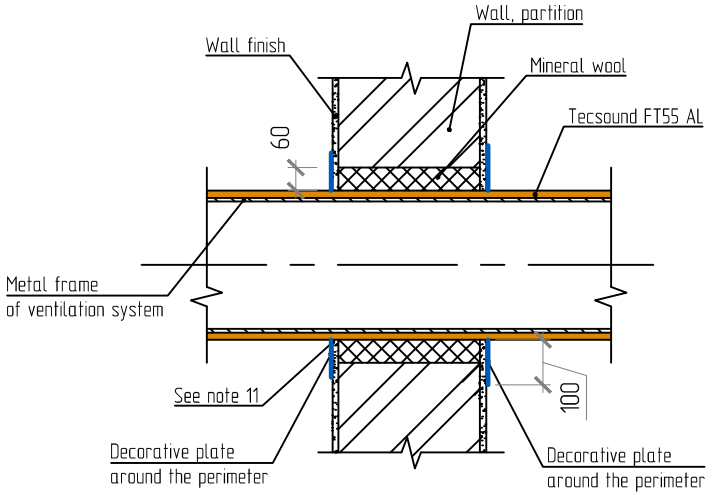
1.*The wall thickness must be less than the width of the valve.
2. ** Seal the mineral wool.
3.*** El is not less than El of the fire-fighting crane.
4. The air duct cover is provided, but is not shown conditionally.
5. When installing the valve, ensure a minimum distance of 60 mm along the perimeter from the adjacent ones
building construction.
6. Install the valve and apply a fire-resistant coating in such a way as to ensure access for inspection and inspection of the valve through the inspection hole, provided in its design.
7. If there is no opening in the valve structure, arrange a viewing hatch in the air duct.
8. Install the valve according to the recommendations specified in the technical documentation for it, if they are different from these solutions.
9. The metal parts of the valve mounts should be primed with an anti-corrosion coating before laying.
10. The seal between the flanges is not shown conditionally.
11. When passing the air duct through building structures, leave a gap of 5 mm (for further hermitization) along the perimeter between the air duct and the finish of the structure.
12. Building structures are shown conditionally.

Sound insulating ventilation systems

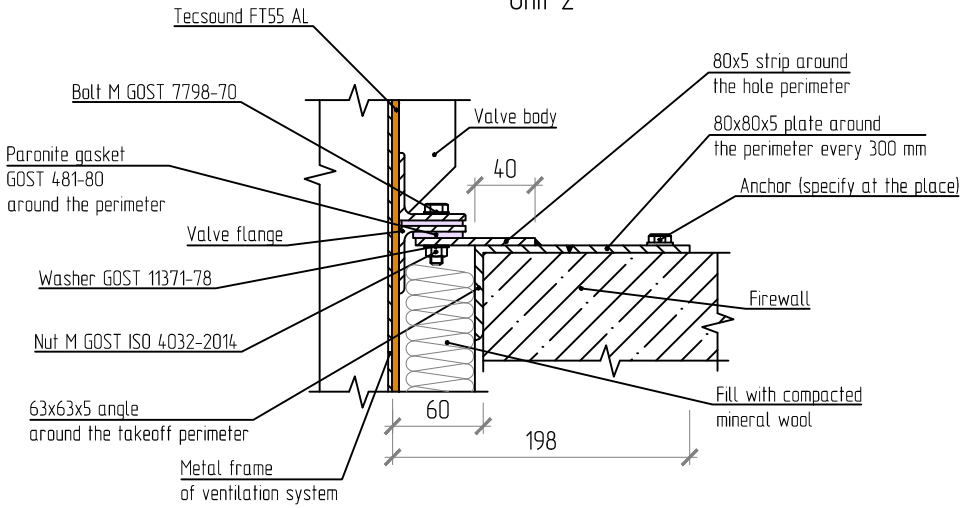
Unit of air duct passage through fire barrier slab



Unit of air duct passage through wall, partition

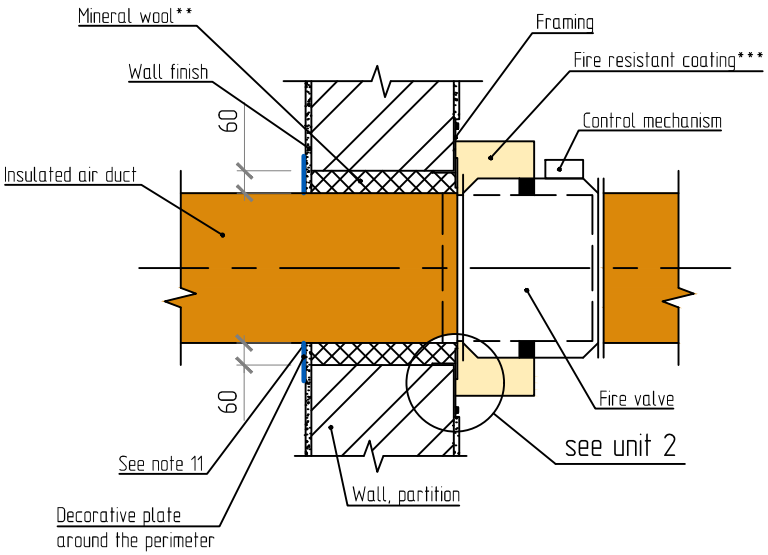


Unit 2

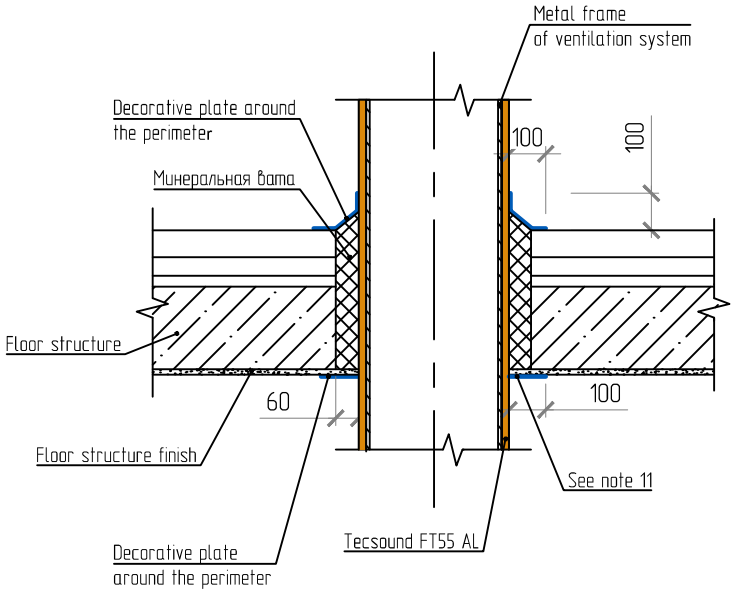


Sound insulating ventilation systems

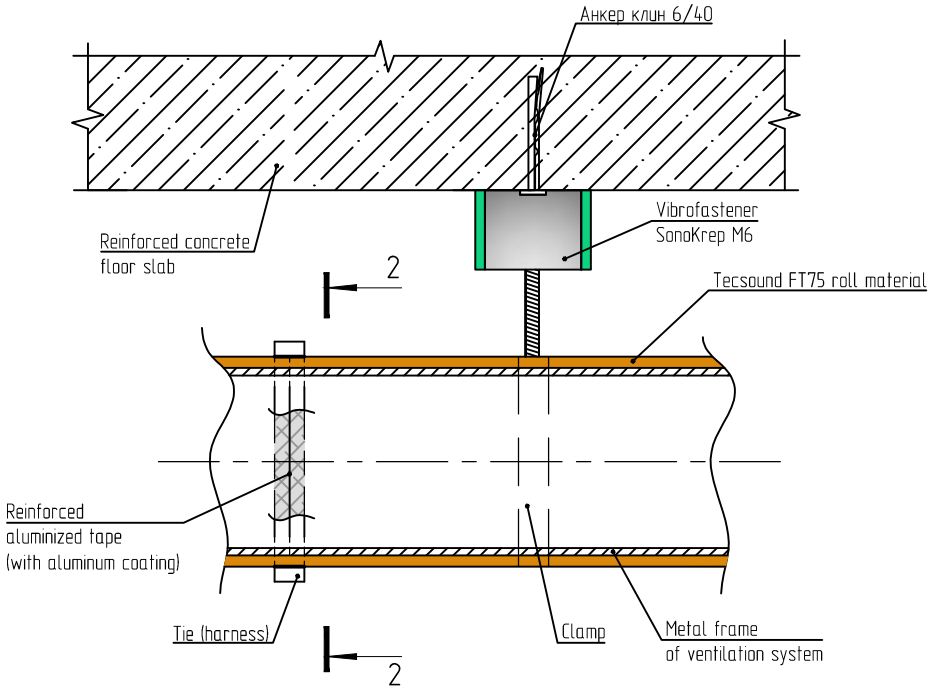
Unit of air duct passage through firewall, partition (Option 2)

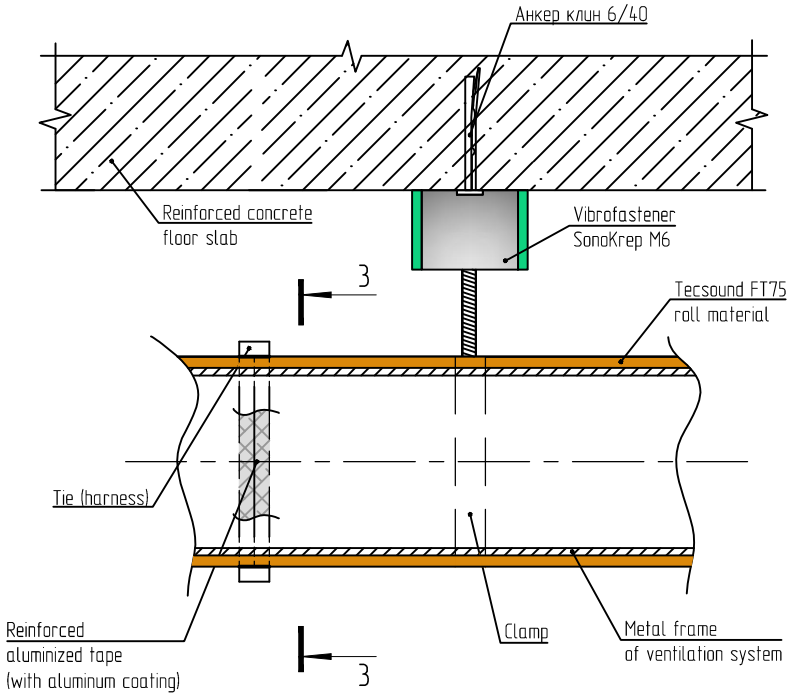


Unit of air duct passage through floor structure

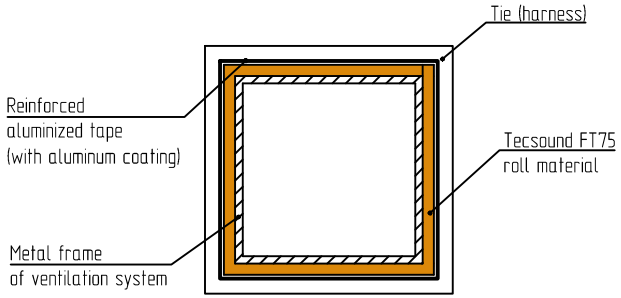


Insulation of ventilation and air conditioning ducts with Tecsound FT75 roll material

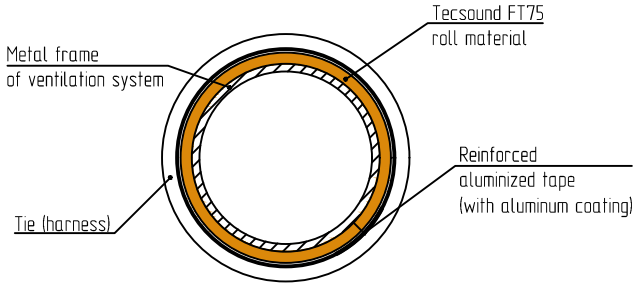




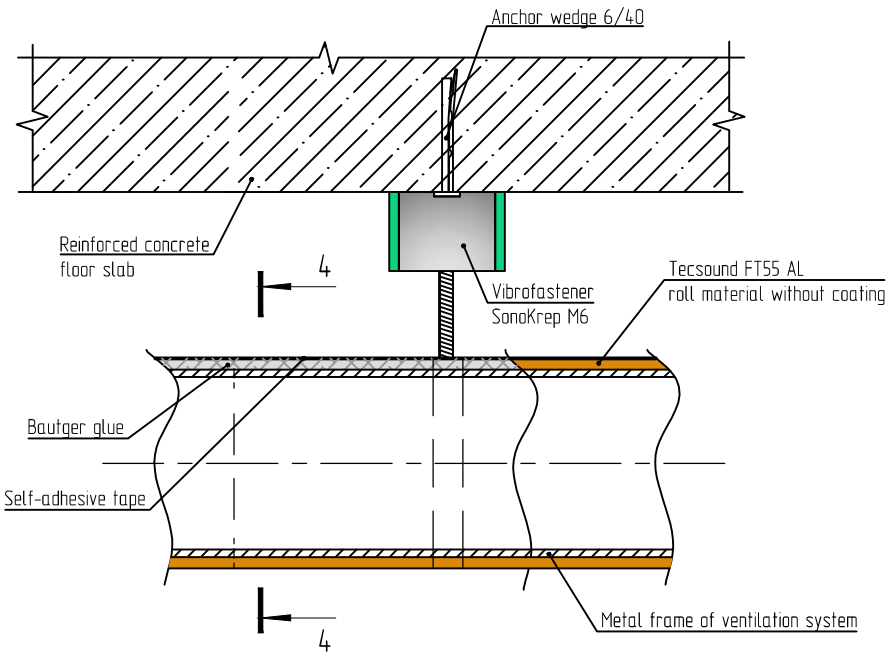
Section 2 - 2



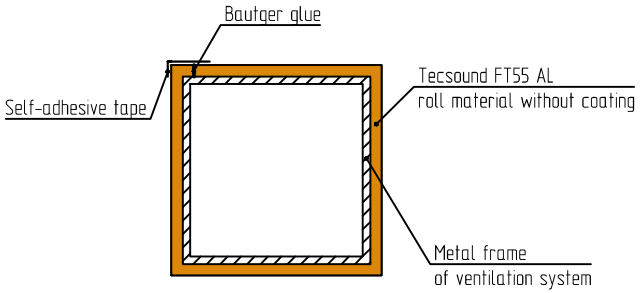
Section 3 - 3

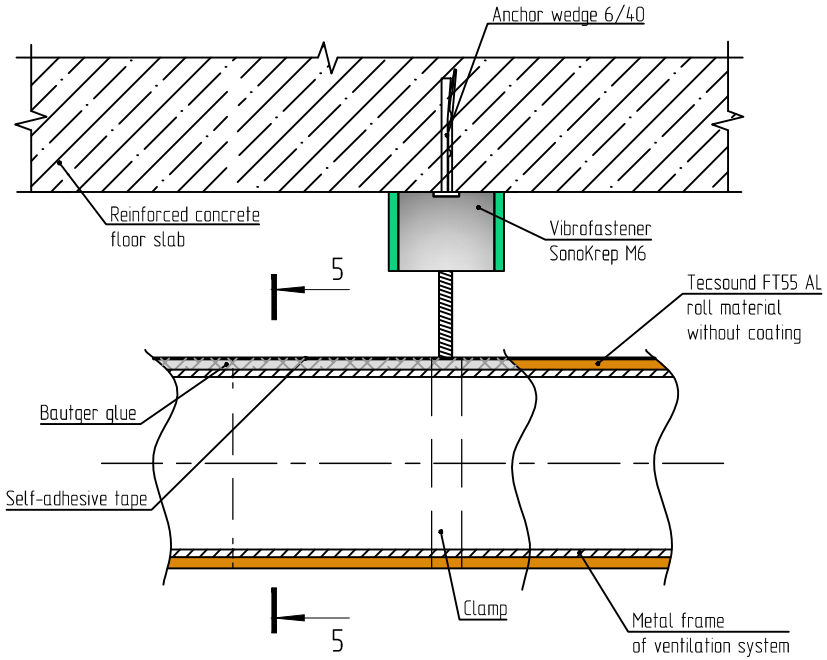


Insulation of ventilation and air conditioning ducts with Tecsound FT 55AL roll material

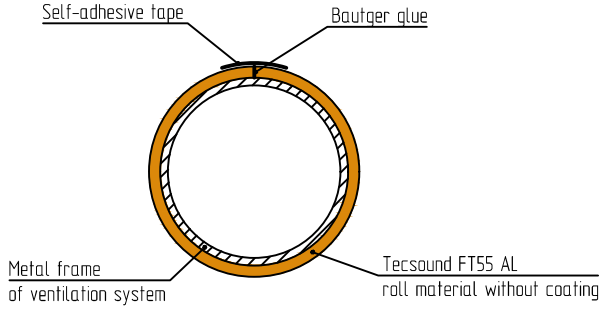


Section 4 - 4

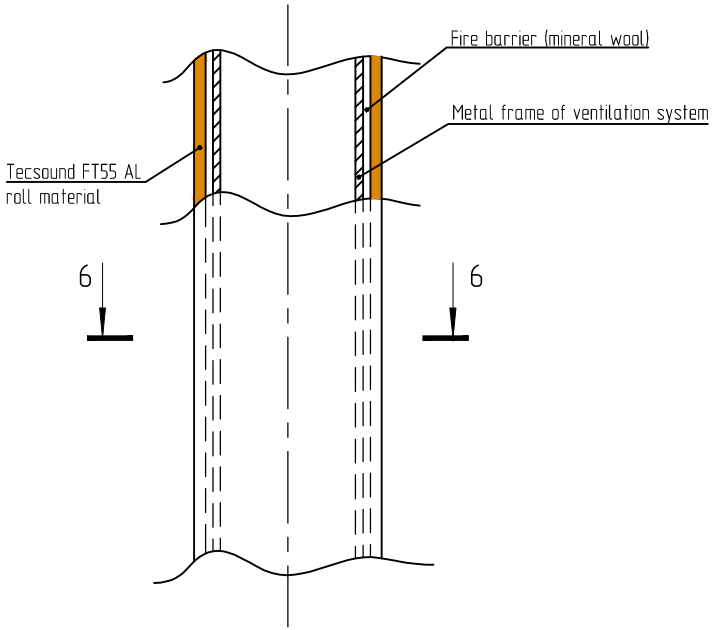




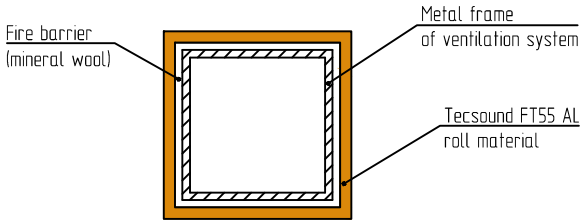
Section 5 - 5



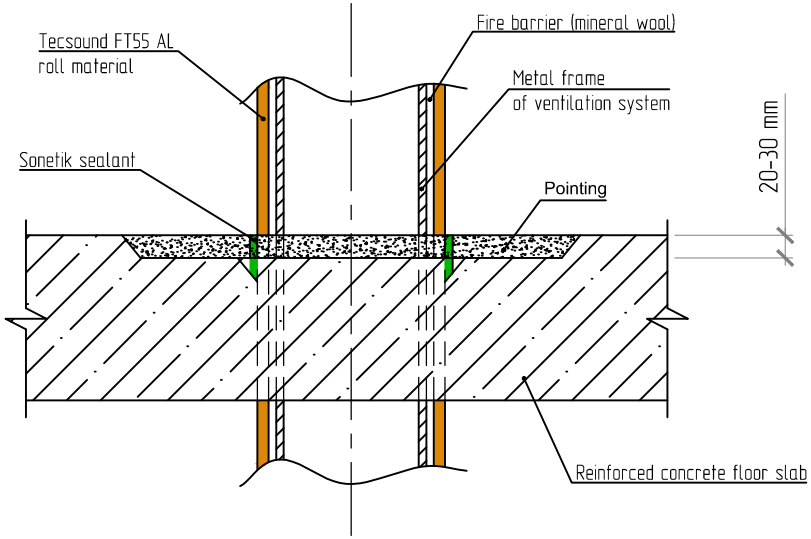
Insulation of ventilation and air conditioning ducts with Tecsound FT 55AL roll material



Section 6 - 6

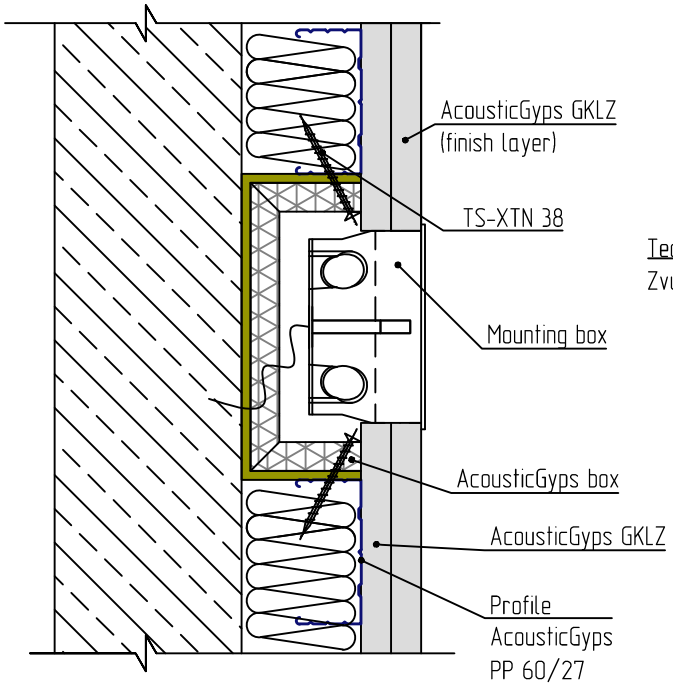


Junction of ventilation air ducts and floor slab

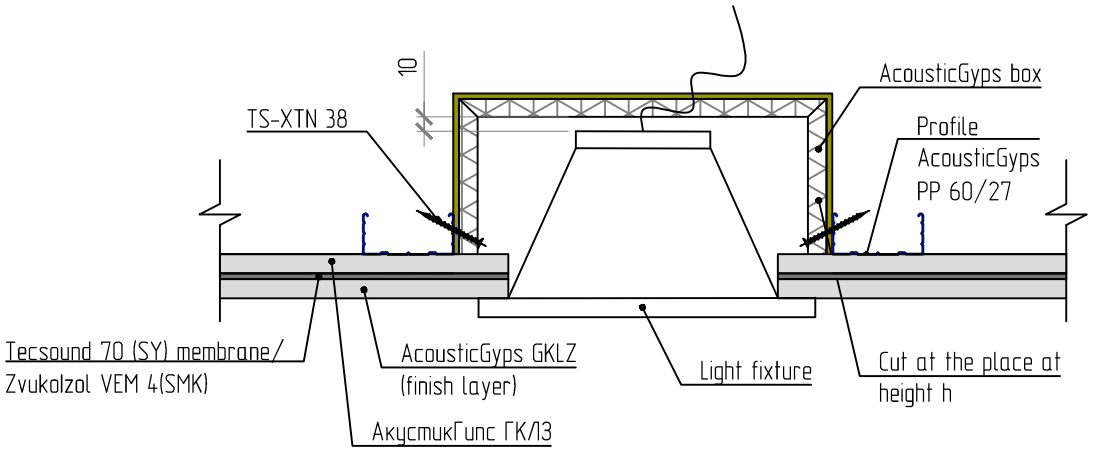


Sound insulation of receptacles in framing system. Ceiling light fixture installation

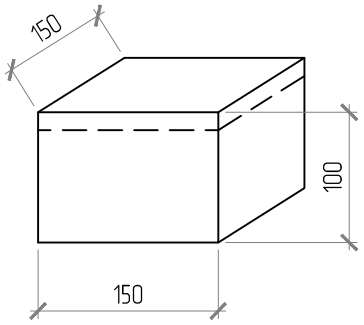
Mounting box installation scheme



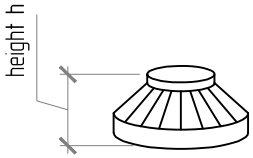
Ceiling light fixture installation scheme



AcousticGyps box



Light fixture



Vibration insulation of utility equipment

Utilities of industrial and residential buildings include vibro-hazardous equipment. Such working utility equipment (pumps, compressors, generators, refrigerators, etc.) generates vibration transmitted to enclosing structures of premises in a great measure. Its magnitude may be so that it is essential not only in close vicinity of the source but at a great distance from it. Its transfer to adjacent premises (residential or public) is especially adverse.

There are regulatory values of permissible vibrations in residential and public buildings at different times of the day (SN 2.2.4/2.1.8.566. Sanitary standards. Industrial vibration, vibration in premises of residential and public buildings). So, when designing a building or utility premise, use of elastic supports should be taken into account as soon as a source of vibration and noise is often impossible or difficult to isolate afterwards.

To exclude transmission of vibrations, installation of aggregates on a concrete foundation with sufficient bearing capacity is recommended. Under the entire foundation area (and around its perimeter) a polyurethane elastomer (vibration insulation mat) should be inserted which effectively absorbs vibrations and impacts in a certain frequency band. As a vibration-proofing mat, TechnoSonus successfully uses the Vibrafoam material manufactured by KRAIBURG PuraSys GmbH & Co. KG (Germany). These mats vary in thickness and elasticity (grade).

Vibration insulation efficiency is determined by the load and natural frequency of the system:

1) Load of at least 70-90% of the material's static load is recommended. Under insufficient or excessive (more than 105%) load, efficiency and stability of the material is drastically reduced.

2) Natural (resonant) frequency of the system and therefore frequency band of effective vibration damping are determined by thickness of the material. In general, with increase of elastomer thickness natural frequency of the system decreases and, as a consequence, effective frequency range expands.

In addition to "floating floor on elastomer" (the most efficient solution of vibration insulation, see Sheet A.3), point and continuous damping may be used through laying the material directly under the support (see Sheet A.3). Size of the vibration mount at least 350x350 mm is important.

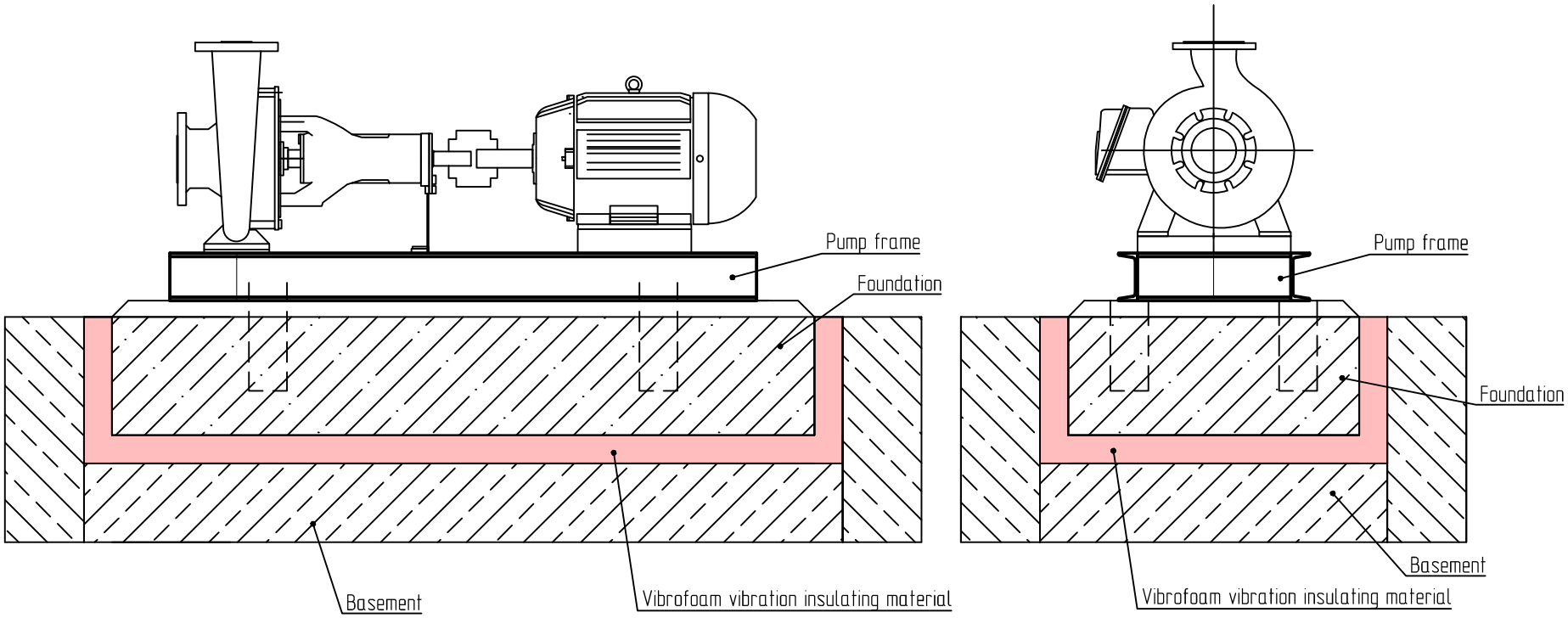
Each specific vibration protection problem is subject to engineering design. TechnoSonus made appropriate calculations for the most popular specific case: vibration insulation of pumping equipment (for various capacities, weights and dimensions):

Recommended grades of Vibrafoam SD vibration insulation for foundations of pumps, 2900 rpm

Power, kW	Power, kW	Power, kW	Power, kW	Power, kW	Power, kW	Power, kW	Power, kW	Power, kW		Power, kW	
0.75	750	500	300	35-41	35	41	0.1125	281	316	SD10 80%	322	SD10 80%
1.1	800	600	300	37-43	37	43	0.144	360	397	SD10 80%	403	SD10 80%
1.5	850	600	300	39-53	39	53	0.153	383	422	SD10 80%	436	SD10 80%
2.2												
3	950	600	300	53-63	53	63	0.171	428	481	SD10 80%	491	SD10 80%
4	950	600	300	61-75	61	75	0.171	428	489	SD10 80%	503	SD10 90%
5.5	1000	650	300	72-110	72	110	0.195	488	560	SD10 80%	598	SD10 90%
7.5												
11	1250	750	300	123-190	123	190	0.28125	703	826	SD10 88%	893	SD10 88%
15												
18.5	1300	800	300	152-262	152	262	0.312	780	932	SD10 88%	1 042	SD10 98%
22												
30	1400	900	450	265-400	265	400	0.567	1 418	1 683	SD16 78%	1 818	SD16 85%
37												
45	1500	950	450	377-499	377	499	0.64125	1 603	1 980	SD16 85%	2 102	SD16 85%
55	1600	1000	500	467-612	467	612	0.8	2 000	2 467	SD16 91%	2 612	SD16 97%
75	1700	1100	500	586-742	586	742	0.935	2 338	2 924	SD16 90%	3 080	SD16 96%

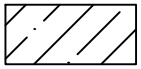
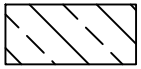
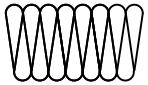
Vibration insulation of pumping equipment

Single-stage pumps with horizontal shaft (such as NK cantilever, NB monoblock cantilever and LS double inlet types) generate more vibration than vertical pumps (CR, TP, etc.). Therefore, careful calculation of the foundation and vibration insulation is required.



Appendix B

List of acoustic materials and structural elements

Name	Abbreviated name	Conventional symbol	Brief description
Void-free reinforced concrete floor slab	ZhBP140		Thickness: 140 mm
Cement-sand screed	CPS50/ CPS60		Thickness: 50 mm/60 mm
Reinforced concrete interapartment walls	ZhBS140		Thickness: 140 mm
Interapartment walls from foam concrete blocks	PBS200		Thickness: 200 mm
ThermoZvukoIzol Standard	TZIST		Fiberglass fabric 14 mm thick with needle-punching (mechanical) compaction, sealed in protective spunbond envelope
StopZvuk BP Premium	SZBPPremium		Sound-absorbing board of 60 kg/m^3 bulk density, 50 mm thick from basalt fiber with fiberglass backing
StopZvuk BP Prime	SZBPPrime		Sound-absorbing board of 65 kg/m^3 bulk density, 27 mm thick from basalt fiber
StopZvuk BP Floor	SZBPF		Sound-absorbing board of 110 kg/m^3 bulk density, 20 mm thick from basalt fiber
StopZvuk-M	SZM		Bituminous-polymeric roll material 4 mm thick with polyester fiber substrate
ZvukoIzolHydro	ZIG		Bituminous-polymeric roll material 4 mm thick with gas foamed polyethylene substrate
SonoPlat Kombi	SPKombi		Composite panel 22 mm thick from pressed fiberboard filled with fine quartz sand and soft fiberboard substrate

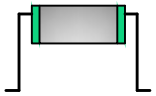
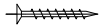
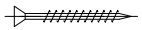
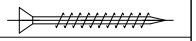
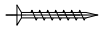
Name	Abbreviated name	Conventional symbol	Brief description
Vibrofloor	VF		Elastic non-woven fabric-liner 4 mm thick from primary processed polyester fiber, without binders
Tecsound 70 (SY) membrane	TS70		Thin heavy aragonite-based viscoelastic membrane 3.7 mm thick. SY is a modification with self-adhesive layer
Tecsound 35 (SY) membrane	TS35		Thin heavy aragonite-based viscoelastic membrane 1.8 mm thick. SY is a modification with self-adhesive layer
ZvukoIzol VEM 4(SMK) membrane	VEM4		Thin heavy viscoelastic membrane 4 mm thick based on a complex polymer composition. SMK is a modification with self-adhesive layer
Tecsound FT55 (AL)	TS55		Heavy viscoelastic aragonite-based membrane 13 mm thick with felt coating on one side. AL is a modification with metallized coating
Tecsound FT55	TS75		Heavy viscoelastic aragonite-based membrane 14 mm thick with felt coating on one side
AcousticGyps GKLZ	GKLZ		Fiberglass-reinforced gypsum plasterboard (GKL) of increased density 12.5/15 mm thick
	GKLZ15		
AcousticGyps M1	AGM1		Composite panel 17 mm thick consisting of reinforced gypsum plasterboard (GKL) of increased density and heavy viscoelastic membrane
SonoPlat	SP		Panel 12 mm thick from pressed corrugated fiberboard filled with fine quartz sand
AcousticGypsBasic 40	AG40		Sandwich panel 40 mm thick consisting of gypsum fiber board (GVL) 20 mm thick with fold offset for joining and staple fiberglass plate 20 mm thick. There are eight factory holes for mounting
AcousticGypsBasic 70	AG70		Sandwich panel 70 mm thick consisting of gypsum fiber board (GVL) 20 mm thick with fold offset for joining and basalt plate of 45 kg/m^3 density 50 mm thick.
AcousticGyps Box	-		Box for mounting at points of installation of receptacles, switches, light fixturres based on reinforced gypsum plasterboard (GKL) of increased density and Tecsound heavy viscoelastic membrane
StopZvuk DB tape	-		Fine porous polyethylene foam tape 2.5 mm thick, 50 mm wide
StopZvuk V100 tape	-		Fiberglass based tape 4 mm thick, 100 mm wide (lay in two layers)
Sonetik sealant	-		Non-combustible one-component silicone sealant with silicon-containing additives

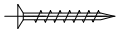
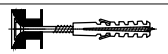
Appendix C

Specification of fasteners and metal products

Product name and grade		Product Sketch	1 run. m mass, kg	Thickness, mm	Standard length, mm
AcousticGyps stud profile	PS 50/50		0,73	0,6	3000
Stud profile	PS 100/50		0,97	0,55	3000, 4000
Channel profile	PN 100/40		0,85	0,5	3000

Product name and grade		Product Sketch	1 run. m mass, kg	Thickness, mm	Standard length, mm
AcousticGyps channel profile	PN 50/40		0,61	0,6	3000
AcousticGyps ceiling channel profile	PPN 27/28		0,4		
AcousticGyps ceiling profile	PP 60/27		0,6		

Product name and grade	Product Sketch	Purpose
SonoKrep Protector Pro vibrohanger		For fastening AcousticGyps profiles to floor slabs at ceiling level and walls
SonoKrep Protector vibrohanger		
Sonokrep EP20 vibrohanger TS-XTN 23		
TS-XTN 23		For fastening AcousticGyps GKLZ, SonoPlat, AcousticGyps M1 to AcousticGyps
TS-XTN 38		
TS-XTN 55		
TS-M 25		
TS-U 5x30		For fastening AcousticGyps GKLZ to SonoPlat Combi panels

Product name and grade	Product Sketch	Purpose
TS-MM 13		For fastening AcousticGyps profiles and SonoKrep vibrohanger
TS-GVL 30		For fastening gypsum fiber boards (GVL)
AG 40 fastener		Fasteners for AcousticGyps sandwich panels
AG 70 fastener		
Plate-shaped dowel pin 10/70		For fastening soft acoustic materials and fiberboards to walls and interstorey floor structures
Polymeric dowel pin 6x70		For fastening SonoPlat Combi
TS-DG 6/60		For fastening AcousticGyps profiles and vibrohangers to walls and floor slabs

Appendix D

THE MINISTRY OF REGIONAL DEVELOPMENT
OF THE RUSSIAN FEDERATION
REGULATIONS SP 51.13330.2011

NOISE PROTECTION
Updated edition
SNiP 23-03-2003

Moscow 2011

Table 1 – Maximum permissible and permissible sound pressure levels, sound levels, equivalent and maximum levels of sound, penetrating noise in premises of residential and public buildings and noise on residential area territory

Destination of premises or territories	Time of day	Sound pressure levels (equivalent sound pressure levels), dB, in octave frequency bands with geometric mean frequencies, Hz									Sound level (equivalent sound level L_{Aequ}), dBA	Maximum sound level L_{Amax}, dBA
		31,5	63	125	250	500	1000	2000	4000	8000		
1	2	3	4	5	6	7	8	9	10	11	12	13
1 Work premises for administrative and managerial personnel of manufacturing enterprises, laboratories, premises for measuring and analytical work	-	93	79	70	63	58	55	52	50	49	60	75
2 Work premises for dispatching services, cabins of surveillance and remote control with voice telephone communication, precision assembly sections, telephone and telegraph stations	-	96	83	74	68	63	60	57	55	54	65	80
3 Premises of laboratories for experimental work, cabins of surveillance and remote control without voice telephone communication	-	103	91	83	77	73	70	68	66	64	75	90
4 Premises with permanent workplaces of manufacturing enterprises, territories of enterprises with permanent workplaces (except works listed in pos. 1-3)	-	102	90	82	77	73	70	68	66	64	75	90
5 Hospital and sanatorium wards, operating rooms	7.00-23.00	76	59	48	40	34	30	27	25	23	35	50
	23.00-7.00	69	51	39	31	24	20	17	14	13	25	40
6 Doctor's offices in hospitals, polyclinics, outpatient clinics,	-	76	59	48	40	34	30	27	25	23	35	50

sanatoriums, dispensaries												
7 Classrooms, training rooms, lecture rooms of educational organizations, conference halls, library reading rooms, club audience halls, judgment halls, religious buildings, club audience halls with conventional equipment	-	79	63	52	45	39	35	32	30	28	40	55
8 Music classes	-	76	59	48	40	34	30	27	25	23	35	50
9 Living rooms of apartments	7.00-23.00	79	63	52	45	39	35	32	30	28	40	55
	23.00-7.00	72	55	44	35	29	25	22	20	18	30	45
10 Living rooms of dormitories	7.00-23.00	83	67	57	49	44	40	37	35	33	45	60
	23.00-7.00	76	59	48	40	34	30	27	25	23	35	50
11 Hotel rooms:												
four star and five star hotels	7.00-23.00	76	59	48	40	34	30	27	25	23	35	50
	23.00-7.00	69	51	39	31	24	20	17	14	13	25	40
three star hotels	7.00-23.00	79	63	52	45	39	35	32	30	28	40	55
	23.00-7.00	72	55	44	35	29	25	22	20	18	30	45
below three star hotels	7.00-23.00	83	67	57	49	44	40	37	35	33	45	60
	23.00-7.00	76	59	48	40	34	30	27	25	23	35	50
12 Living premises of rest houses, holiday hotels, boarding houses for elderly and disabled, sleeping rooms of kindergartens and boarding schools	7.00-23.00	79	63	52	45	39	35	32	30	28	40	55
	23.00-7.00	72	55	44	35	29	25	22	20	18	30	45
13 Office premises, workrooms and cabinets of administrative buildings, designing, engineering and research organizations	-	86	71	61	54	49	45	42	40	38	50	65
14 Halls of cafes, restaurants, canteens	-	89	75	66	59	54	50	47	45	43	55	70
15 Foyer of theaters and concert halls	-	83	67	57	49	44	40	37	35	33	45	60
16 Auditoriums of theaters and concert halls	-	72	55	44	35	29	25	22	20	18	30	45
17 Multipurpose halls	-	76	59	48	40	34	30	27	25	23	35	50
18 Cinemas with Dolby equipment	-	72	55	44	35	29	25	22	20	18	30	45
19 Sports halls	-	83	67	57	49	44	40	37	35	33	45	60
20 Trade halls of shops, passenger halls of railway stations and airports, reception centers of consumer service enterprises	-	93	79	70	63	58	55	52	50	49	60	75
21 Territories directly adjacent to buildings of hospitals and sanatoriums	7.00-23.00	83	67	57	49	44	40	37	35	33	45	60
	23.00-7.00	76	59	48	40	34	30	27	25	23	35	50

22 Territories directly adjacent to residential buildings, rest houses, boarding houses for elderly and disabled, holiday hotels	7.00-23.00	90	75	66	59	54	50	47	45	44	55	70
	23.00-7.00	83	67	57	49	44	40	37	35	33	45	60
23 Rest areas on territory of communities and residential building groups, rest houses, holiday hotels, boarding houses for elderly and disabled, playgrounds of preschool educational organizations and other educational organizations		90	75	66	59	54	50	47	45	44	55	70

Notes:

1. Permissible noise levels in rooms specified in it. 1, 5-13 refer only to noise penetrating from other rooms and from the outside.
2. Permissible noise levels from external sources in premises specified in it. 5-12 determined for normative air exchange (under absence of forced ventilation or air conditioning system) should be provided under open ventilating windows or other devices providing air inflow.
3. Permissible noise levels from ventilation, air conditioning and air heating systems as well as from pumps of heating and water supply systems and refrigeration units of built-in (attached) trade and public catering facilities should be taken 5 dB (dBA) below the values specified in table 1 except items 9-12 (for night time). In this case, correction for noise tonality is not taken into account.

Table 2 - Required normative indices of airborne noise insulation of enclosing structures and reduced levels of impact noise of floor structures when transmitting sound from top to bottom

Name and location of enclosing structure	Rw_{req}, dB	Lnw_{req}, dB
1	2	3
Residential buildings		
1 Floor structures between apartment rooms and floor structures separating apartment rooms from halls, staircases and attics in use	52	60
2 Floor structures between apartments and shops below them	57	60
3 Floor structures between apartments on two levels	45	63
4 Floor structures between residential premises of dormitories	50	60
5 Floor structures between apartments and restaurants, cafes, sports halls under them	57	63**
6 Floor structures between apartments and administrative premises, offices under them	52	63
7 Walls and partitions between apartments, between apartment premises and offices; between apartment premises and staircases, halls, corridors, lobbies	52	-

8 Walls between apartment premises and shops	57	-
9 Walls and partitions separating apartment premises from restaurants, cafes, gyms	60	-
10 Partitions without doors between rooms, between kitchen and room in apartment	43	
11 Partitions between toilet and room in the same apartment	47	***
12 Walls and partitions between dormitory rooms	50	-
13 Entrance apartment doors to staircases, lobbies and corridors	32	-
Hotels		
14 Floor structures between rooms:		
four star and five star hotels	53	55
three star hotels	51	58
below three star hotels	50	60
15 Floor structures separating rooms from common premises (lobbies, halls, bar-rooms):		
four star and five star hotels	53	55
below three star hotels	51	58
16 Floor structures separating rooms from premises of restaurants, cafes:		
four star and five star hotels	60	58
below three star hotels	57	60
17 Walls and partitions between rooms:		
four star and five star hotels	53	-
three star hotels	51	-
below three star hotels	50	-
18 Walls and partitions separating rooms from common premises (staircases, lobbies, halls, bar-rooms):		
four star and five star hotels	53	-
below three star hotels	51	-
19 Walls and partitions separating rooms from restaurants, cafes:		
four star and five star hotels	60	-
below three star hotels	57	-
Administrative buildings, offices		

20 Floor structures between workrooms, cabinets, secretariats and separating these rooms from common premises (lobbies, halls)	45	63
21 Walls and partitions between cabinets and separating cabinets from workrooms	45	-
22 Walls and partitions between offices of various firms, between cabinets of various firms	48	-
Hospitals and sanatoriums		
23 Floor structures between wards, doctors' offices	48	60
24 Floor structures between operating rooms and separating operating rooms from wards and cabinets	54	60
25 Floor structures separating wards, doctors' offices from common premises (lobbies, halls)	50	63
26 Floor structures separating wards, doctors' offices from dining rooms, kitchens	54	63
27 Walls and partitions between wards, doctors' offices	48	-
28 Walls and partitions between operating rooms and separating operating rooms from other premises	54	-
Educational organizations		
29 Floor structures between workrooms, cabinets, secretariats separating these rooms from common premises (corridors, lobbies, halls)	47	63
30 Floor structures between music classrooms of general secondary schools	55	58
31 Floor structures between music classrooms of higher schools	57	55
32 Walls and partitions between classrooms, cabinets and lecture rooms and separating these premises from common premises	48	-
33 Walls and partitions between music classrooms of general secondary schools and separating these premises from common areas	55	-
34 Floor structures between music classrooms of higher schools	57	
Preschool educational organizations		
35 Floor structures between group rooms, bedrooms	47	63
36 Floor structures separating group rooms, bedrooms from kitchens	51	63
37 Walls and partitions between group rooms, bedrooms and other children's rooms	47	-
38 Walls and partitions separating group rooms, bedrooms from kitchens	52	-
* The requirements are also applied to transmission of impact noise to a premise when impacting staircase landing and flight (including that on the same floor).		

** When playing loud music in these rooms, calculation of sound insulation is required.

*** The requirements are applied under guaranteed absence of plumbing equipment near adjacent wall, taps and (or) pipelines mounted on it.

Table 3 - Normative indices of reduced impact noise level (for floor structure of lower premise) when transmitting sound from bottom to top

Name and location of enclosing structure	Lnw, dB
1 Floor structures between shops and apartments above them	43
2 Floor structures between food stores, convenience stores and apartments above them	38
3 Floor structures between shops and dormitory premises above them	45
4 Floor structures between food stores, convenience stores and residential dormitory premises above them	41
5 Floor structures between restaurants, cafes, sports halls and apartment premises above them	38
6 Floor structures between administrative premises, offices and apartment premises above them	45
7 Floor structures separating common areas (lobbies, halls, bar-rooms) from hotel rooms:	
- four-star and five-star hotels	43
- below three star hotels	45
8 Floor structures separating premises of restaurants, cafes from hotel rooms:	
- four-star and five-star hotels	38
- below three star hotels	41
9 Floor structures separating common areas (lobbies, halls, bar-rooms) from wards, doctors' offices:	43
10 Floor structures separating canteens, kitchens from doctors' offices	43
11 Floor structures separating kitchens from group rooms, bedrooms	43

Table 4 - Estimation spectra of airborne noise insulation, reduced level of impact noise and reference spectrum of traffic noise

	Spectrum	Geometric mean frequencies of one-third octave bands, Hz															
		100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
1	Estimated spectrum of airborne noise insulation R, dB	33	36	39	42	45	48	51	52	53	54	55	56	56	56	56	56

2	Estimated spectrum of reduced impact noise level L_n, dB	62	62	62	62	62	62	61	60	59	58	57	54	51	48	45	42
3	Adjusted sound pressure level of reference spectrum L_n, dB	55	55	56	59	60	61	62	63	64	66	67	66	65	64	62	60

Table 5 – Values of decrease of insulation indices of structures when applying them in natural conditions

R_w, dB	ΔR_w, dB
≤ 45	0
≤ 46-50	1
≤ 51-55	2
≤ 56-61	3
≤ 62-65	4

Basic terms and definitions

Penetrating noise – noise arising outside the space with design points and penetrating into it through enclosing structures of building, ventilation, air conditioning, water supply and heating systems.

Permanent noise – noise with no more than 5 dBA change measured by “slow” time characteristic of noise meter according to GOST 17187.

Non-permanent noise – noise with more than 5 dBA change measured by “slow” time characteristic of noise meter according to GOST 17187.

Octave sound pressure level, dB is sound pressure level in the octave frequency band.

Sound level, dBA – energy sum of octave sound pressure levels in normalized frequency range corrected for A frequency response of noise meter according to GOST 17187.

Equivalent (in energy) sound level, dBA – permanent noise level with the same root mean square sound pressure as the measured non-permanent noise within a certain time interval.

Maximum sound level, dBA – non-permanent noise level corresponding to maximum reading of a measuring, direct-reading instrument (noise meter) under visual readout, or sound level exceeded within 1% of measuring interval when recording noise by an automatic estimation instrument (statistical analyzer).

Insulation of air noise (sound insulation) *R*, dB – ability of an enclosing structure to reduce the sound passing through it. In general, it is tenfold decimal logarithm of the ratio of the sound energy impinging the enclosing structure to the energy passing through the structure.

Insulation of impact noise by floor structure – value characterizing reduction of impact noise by floor structure.

Reduced level of impact noise under floor structure *Ln*, dB – characterizes impact noise insulation by a floor structure that is sound pressure level in a premise under the floor structure when operating a standard impact machine on the structure and conditionally reduced to equivalent sound absorption area of the premise A_0 = 10 m^2.

Frequency response of airborne noise insulation – value of airborne noise insulation R, dB, in one-third octave frequency bands in the range 100–3150 Hz (in graphical or tabular form).

Frequency response of airborne noise insulation under floor structure – value of impact noise reduced level *Ln*, dB, in one-third octave frequency bands in the range 100–3150 Hz (in graphical or tabular form).

Airborne sound insulation index *Rw*, dB – one number value for evaluating airborne noise insulation by an enclosing structure. Determined by comparing frequency response of airborne noise insulation with a special reference spectrum.

Index of impact noise reduced level *Lnw*, dB – one number value for evaluating impact noise insulation by a floor structure. Determined by comparing frequency response of impact noise reduced level under floor structure with a special reference normative spectrum.

Window sound insulation RA_{tran}, dBA – one number value for evaluating external noise generated by public transport when transmitting it inside a room through a window.

Sound power, W – amount of energy generated by noise source per unit time.

Sound power level, dB: tenfold decimal logarithm of the ratio of sound power to reference sound power (W_0 = 10–12 W).

Sound absorption coefficient – ratio of sound energy not reflected from surface to incident energy.

Equivalent sound absorption area (of a surface or object), m^2 – area of a surface completely absorbing sound (with sound absorption coefficient = 1) which absorbs the same sound energy as the given surface or object.

Average sound absorption coefficient cp – ratio of total equivalent sound absorption area in a premise *Asum* (including absorption of all surfaces, equipment and people) to the entire area of all surfaces of the premise (buildings with noise insulating windows equipped by special ventilation devices with noise suppressors on the facade facing external noise source; buildings of a combined type with simultaneous use of the above noise insulating techniques).

Noise insulating windows – windows with special ventilation devices providing increased sound insulation while ensuring normative air exchange in the premise.

Noise insulating screens – various structures in the form of vertical or inclined walls, earth banks, excavations, galleries, etc. installed along motor and rail roads for reduction of noise.

Reverberation – gradual decline of sound energy in a premise after termination of sound source activity.

Reverberation time *T*, s – time when sound pressure level in a premise after termination of sound source activity declines by 60 dB.

STATE COMMITTEE OF THE RUSSIAN FEDERATION
ON CONSTRUCTION AND HOUSING AND COMMUNAL COMPLEX
(GOSSTROY OF RUSSIA)
REGULATIONS SP 23-103-2003
DESIGNING SOUND INSULATION OF ENCLOSING STRUCTURES
OF RESIDENTIAL AND PUBLIC BUILDINGS
Moscow
2004

Method of calculation of sound insulation of internal enclosing structures of residential and public buildings

Airborne sound insulation index for single-layer enclosing structures and two-layer blind glazings and partitions in the form of two frame linings with air gap is determined on the base of calculated frequency response of airborne noise insulation. Airborne noise insulation index for floor structures on elastic base and impact noise reduced level index under floor structures are determined directly (without building a design frequency response). Under tentative calculations, airborne noise insulation index for massive enclosing structures (with 100 to 800 kg/m^3 surface density) may be determined directly, without building a design frequency response of noise insulation.

Frequency response of airborne noise insulation of single-layer flat solid-section enclosing structure of 100 to 800 kg/m^3 surface density from concrete, reinforced concrete, brick and similar materials is determined by plotting it as a broken line like ABCD line in Figure 1.

The abscissa is determined using Table 1 depending on material's thickness and density. f_B value is rounded to geometric mean frequency. Boundaries of one-third octave bands are given in Table 2.

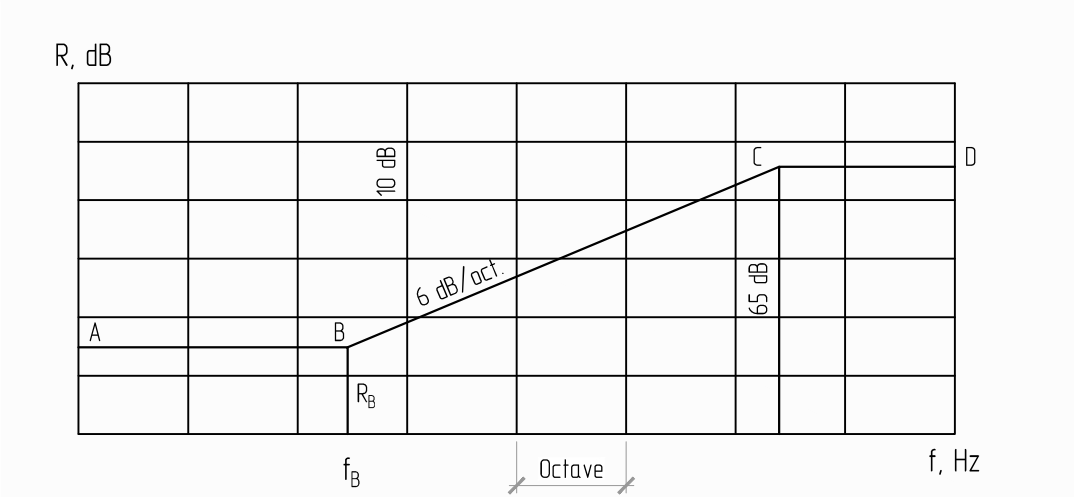


Figure 1 - Frequency response of airborne noise insulation of single-layer flat enclosing structure

Table 1

Concrete density (γ), kg/m^3	f_B, Hz
≥1800	29000/*h*
1600	31000/*h*
1400	33000/*h*
1200	35000/*h*
1000	37000/*h*
800	39000/*h*
600	40000/*h*

Notes.

1. h is enclosing structure thickness, mm.
2. For intermediate γ values, f_B frequency is determined by interpolation.

Table 2

Geometric mean frequency of one-third octave band	One-third octave band limits
50	45-56
63	57-70
80	71-88
100	89-111
125	112-140
160	141-176
200	177-222
250	223-280
315	281-353
400	354-445
500	446-561
630	562-707
800	708-890
1000	891-1122
1250	1123-1414
1600	1415-1782
2000	1783-2244
2500	2245-2828
3150	2829-3563
4000	3564-4489
5000	4490-5657

R_B ordinate of point B is determined depending on equivalent surface density using the formula:

$$R_B = 20lg \cdot m_e - 12, \text{ dB}, \quad (1)$$

Equivalent surface density m_e is determined using the formula:

$$m_e = K \cdot m, \text{ kg/m}, \quad (2)$$

where m is surface density, kg/m^2 (taken without ribs for ribbed structures);

K is coefficient taking into account relative increase of bending stiffness of enclosing structure from lightweight aggregate concrete, porous concrete, etc. relating to heavy concrete structures with the same surface density.

For continuous enclosing structures with density γ = 1800 kg/m and more, K = 1.

For continuous enclosing structures from lightweight aggregate concrete, porous concrete, brick masonry and hollow ceramic blocks, K coefficient is determined using table 3.

Table 3

Material	Class	Density, kg/m^3	K
1	2	3	4
Expanded-clay concrete	B 7,5	1500-1550	1,1
		1300-1450	1,2
		1200	1,3
		1100	1,4
	B 12,5 - B 15	1700-1750	1,1
		1500-1650	1,2
		1350-1450	1,3
		1250	1,4
Perlite concrete	B 7,5	1400-1450	1,2
		1300-1350	1,3
		1100-1200	1,4
		950-1000	1,5
Fly ash concrete	B 7,5	1300	1,1
		1100-1200	1,2

1	2	3	4
		950-1000	1,3
	B 12,5	1500-1800	1,2
Slag pum concrete	B 7,5	1600-1700	1,2
	B 12,5	1700-1800	1,2
Aerated concrete, foam concrete, gas silicate	B 5,0	1000	1,5
		800	1,6
		600	1,7
Brick masonry, hollow ceramic blocks		1500-1600	1,1
		1200-1400	1,2
Gypsum concrete, gypsum (including porous one or with lightweight aggregates)	B 7,5	1300	1,3
		1200	1,4
		1000	1,5
		800	1,6

For enclosing structures from concrete with 1800 kg/m^3 density with round voids, *K* coefficient is determined using the formula:

$$K = 1{,}5\sqrt[4]{\frac{j}{bh_{red}^3}}, \tag{7}$$

where *j* is section inertia moment, m^4;
b is section width, m;
h_{red} is reduced section thickness, m.

For enclosing structures made of lightweight concrete with round voids, *K* coefficient is product of coefficients defined separately for solid structures made of lightweight concrete and structures with round voids.

R_B value should be rounded to 0.5 dB.

The frequency response is plotted as follows: BA horizontal segment is drawn from point B to the left, BC segment is drawn from point B to the right with 6 dB slope per octave to point C with ordinate $R_c = 65\ dB$, CD horizontal segment is drawn from point C to the right. If point C is outside the normalized frequency range ($f_c > 3150$ Hz), CD segment is absent.