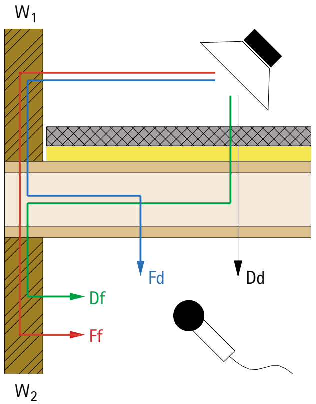
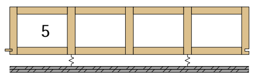
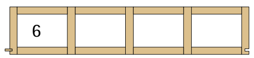
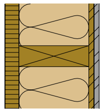
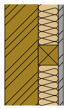
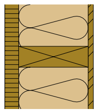
Prognosis of airborne sound transmission in separating floors



$W_1 + W_2$	 5	 6
1  2 	$R_{Ff,w,R}$ = 72dB $R_{Fd,w,R}$ = 82dB $R_{Df,w,R}$ ~85dB	$R_{Ff,w,R}$ = 72dB $R_{Fd,w,R}$ = 70dB $R_{Df,w,R}$ ~85dB
3 	$R_{Ff,w,R}$ = 70dB $R_{Fd,w,R}$ = 80dB $R_{Df,w,R}$ ~85dB	$R_{Ff,w,R}$ = 70dB $R_{Fd,w,R}$ = 67dB $R_{Df,w,R}$ ~85dB
4 	$R_{Ff,w,R}$ = 64dB $R_{Fd,w,R}$ = 80dB $R_{Df,w,R}$ ~85dB	$R_{Ff,w,R}$ = 64dB $R_{Fd,w,R}$ = 63dB $R_{Df,w,R}$ ~85dB

The forecast model for airborne noise insulation in buildings essentially corresponds to DIN EN 12354-1. Calculating the noise insulation R` including all flanking transmissions is done based on the following equation.

$$R'_w = -10\log\left(10^{\frac{-R_w}{10}} + \sum_{ij=1}^{n} 10^{\frac{-R_{ij,w}}{10}}\right) dB$$

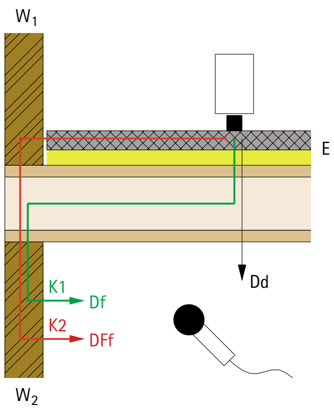
$$R_{ij,w} = R_{ij,w,R} + 10\log\frac{l_{lab}}{l_{Bau}} + 10\log\frac{S_S}{A_0}\ dB$$

R_w	evaluated noise reduction index of the separating floor without flanking transmission
$R_{ij,w}$	evaluated flanking reduction index for flanking transmission paths ij in the building
$R_{ij,w,R}$	calculated value of the evaluated flanking reduction index for flanking transmission paths ij with edge lengths of l_{lab}
n	number of walls
l_{lab}	edge length between the separating component and the flanking component in the laboratory
l_{Bau}	edge length between the separating component and the flanking component in the building
S_S	separating surface in the building
A_0	reference absorption surface, A_0 = 10m²
W_1	wall structure of transmitting room
W_2	wall structure of receiving room

E screed
1 gypsum fibreboard (GF) or plasterboard (GKB)
2 cross laminated timber (CLT) and GF or GKB (level of installation d ≥ 60mm)
3 composite board
4 cross laminated timber (CLT)
5 LIGNATUR with suspended ceiling
6 LIGNATUR

Part of the basic data for the forecast has been taken from the new component catalogue of DIN 4109. We have performed a large number of measurements with respect to this method for LIGNATUR silence12.

Prognosis of impact sound transmission in separating floors



K_1 (dB) / W_2		5	6
1	2	7	1
3	4	9	4

K_2 (dB)		$L_{n,w} + K_1$ (dB)															
$W_1 + W_2$	E	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
1	7	4	4	3	3	2	2	1	1	1	1	1	1	0	0	0	0
2	8	3	3	2	2	1	1	1	1	1	1	0	0	0	0	0	0
3	7	8	7	6	5	5	4	4	3	3	2	2	1	1	1	1	1
4	8	5	5	4	4	3	3	2	2	1	1	1	1	1	1	0	0

We developed the forecast model for impact sound transmission in cooperation with the ift Rosenheim following DIN EN 12354-2.

The standard impact sound level in buildings is composed of the direct impact sound transmission L_n of the floor and the flanking walls. The transmission values relevant in timber constructions are shown in the diagram on the left.

The shares of flanking transmissions $L_{n,Df}$ and $L_{n,DFf}$ correspond to the sum of the sound transmissions via all four flanking walls.

For impact sound calculation the shares of the transmission paths from the above equation were converted into correction summands.

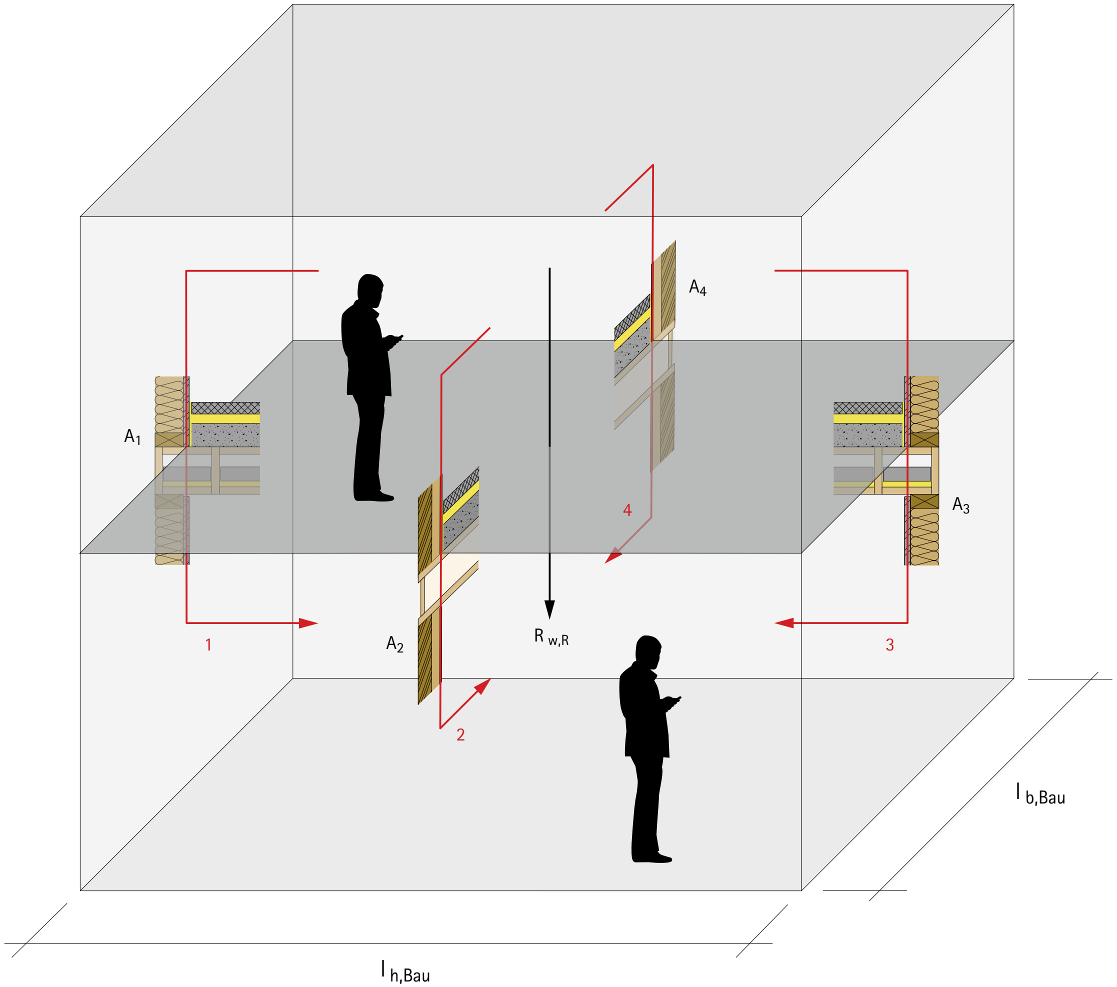
$$L'_{n,w} = L_{n,w} + K_1 + K_2$$

$L_{n,w}$ evaluated standard impact sound level of the separating floor without flanking transmission
K_1 correction summand for transmission via path Df
K_2 correction summand for transmission via path DFf

K_1 and K_2 depend on the slab, the screed applied and the flanking walls. The values are given in the adjacent table. K_2 is given as function of impact sound $L_{n,w} + K_1$.

1 gypsum fibreboard (GF) or plasterboard (GKB)
2 cross laminated timber (CLT) and GF or GKB (level of installation d ≥ 60mm)
3 composite board
4 cross laminated timber (CLT)
5 LIGNATUR with suspended ceiling
6 LIGNATUR
7 wet screed on mineral fibre
8 dry screed on wood fibre

Example prognosis of vertical airborne and impact sound transmission



See the following demonstration for predicted values for your project in terms of airborne and impact sound transmission.

Basic conditions

$l_{l,lab}$ = 4.5m, $l_{b,lab}$ = 4.5m
$l_{l,Bau}$ = 6.0m, $l_{b,Bau}$ = 5.0m
A_0 = 10.0m², S_S = 30.0m²

Floor system chosen

cement screed, mineral fibre insulation, bonded chippings, LIGNATUR silence12
R_w = 72dB
$L_{n,w}$ = 44dB

Flanking elements example A

A_1, A_3 gypsum fibreboard (GF)
A_2, A_4 cross laminated timber and GF

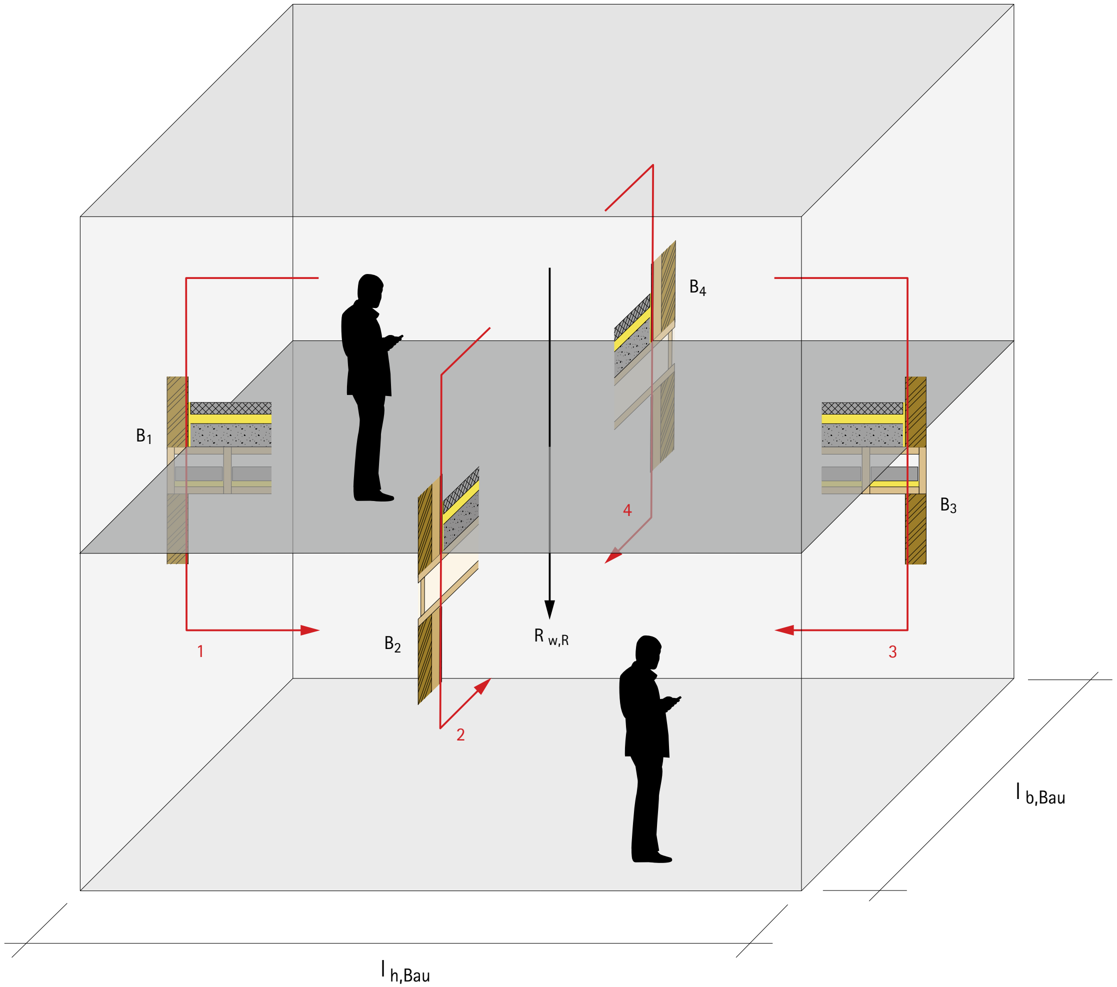
- $R_{Ff,w,R,1-4}$ = 72dB
- $R_{Fd,w,R,1-4}$ = 70dB
- $R_{Dd,w,R,1-4}$ ~ 85dB

Prognosis example A

R'_w = 65dB
$L'_{n,w}$ = 44dB + 1dB + 1 = 46dB

We are happy to predict the airborne and impact sound transmission for your project.

Example prognosis of vertical airborne and impact sound transmission



Basic conditions

$l_{l,lab}$ = 4.5m, $l_{b,lab}$ = 4.5m
$l_{l,Bau}$ = 6.0m, $l_{b,Bau}$ = 5.0m
A_0 = 10.0m², S_S = 30.0m²

Floor system chosen

cement screed, mineral fibre insulation, bonded chippings, LIGNATUR silence12
R_w = 72dB
$L_{n,w}$ = 44dB

Flanking elements example B

B_1, B_3 cross laminated timber

- $R_{Ff,w,R,1+3}$ = 64dB
- $R_{Fd,w,R,1+3}$ = 63dB
- $R_{Dd,w,R,1+3}$ ~ 85dB

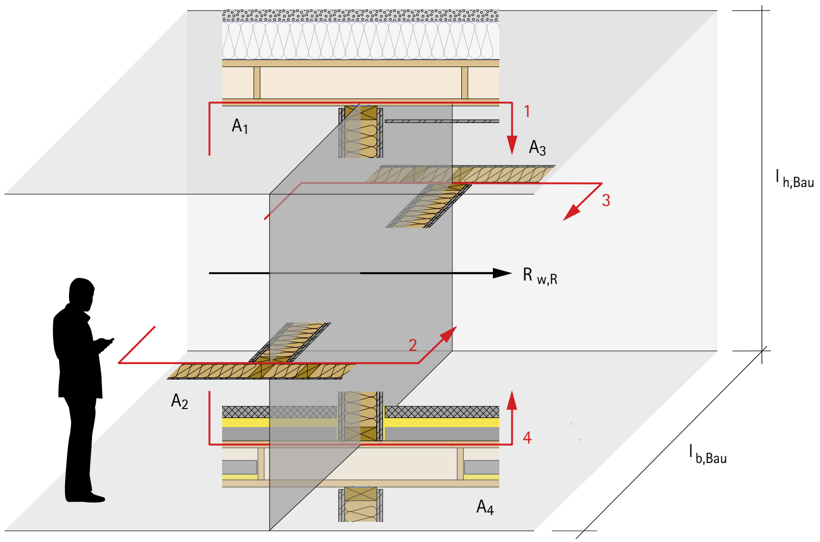
B_2, B_4 cross laminated timber and GF

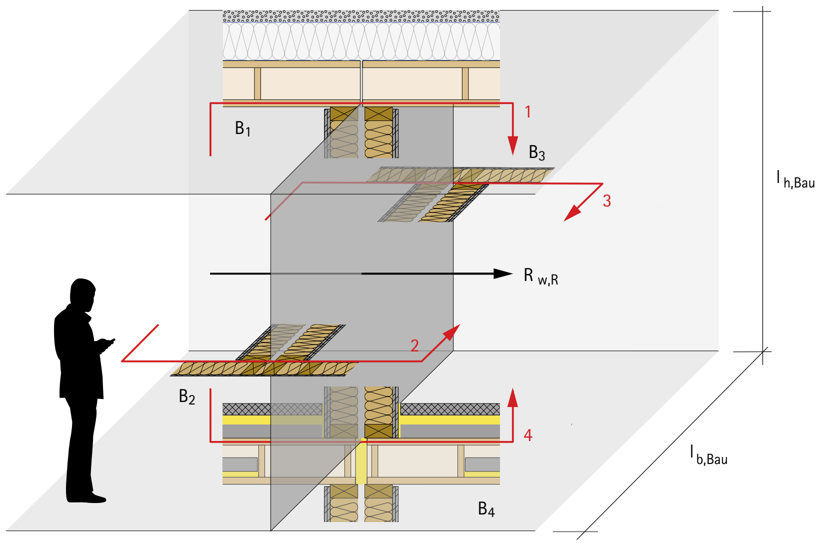
- $R_{Ff,w,R,2+4}$ = 72dB
- $R_{Fd,w,R,2+4}$ = 70dB
- $R_{Dd,w,R,2+4}$ ~ 85dB

Prognosis example B

R'_w = 61dB
$L'_{n,w}$ = 44dB + 4dB + 2 = 50dB

Example prognosis of horizontal airborne sound transmission





For support of this prognosis model for airborne sound insulation on horizontal levels on site, we have done various tests with the laboratory for building acoustics ift in Rosenheim.
Two examples of prognoses from the research project are shown here.

Basic conditions

$l_{b,lab}$ = 4.5m, $l_{h,lab}$ = 2.8m
$l_{b,Bau}$ = 6.0m, $l_{h,Bau}$ = 2.8m
A_0 = 10.0m², S_S = 16.8m²

Wall system chosen example A

2 · gypsum fibreboard (GF), timber frame (TF) construction insulated, 2 · GF
R_w = 46dB

Side elements example A

A_1 LIGNATUR, one-sided suspended ceiling, gravel roof
- $R_{Ff,w,R,1}$ = 53dB, $R_{Fd,w,R,1}$ = 47dB, $R_{Df,w,R,1}$ = 57dB

A_2, A_3 timber wall, panelling separated
- $R_{Ff,w,R,2-3}$ = 54dB, $R_{Fd,w,R,2-3}$ = $R_{Df,w,R,2-3}$ ≈ 57dB

A_4 LIGNATUR silence12, screed
- $R_{Ff,w,R,4}$ = 70dB, $R_{Fd,w,R,4}$ = $R_{Df,w,R,4}$ = 80dB

Prognosis example A

R'_w = 43dB

Wall system chosen example B

2 · gypsum fibreboard (GF), TF insulated, construction joint, TF insulated, 2 · GF
R_w = 65dB

Side elements example B

B_1 LIGNATUR separated, gravel roof
- $R_{Ff,w,R,1}$ = 62dB, $R_{Fd,w,R,1}$ = $R_{Df,w,R,1}$ > 70dB

B_2, B_3 timber wall, panelling separated
- $R_{Ff,w,R,2-3}$ = 68dB, $R_{Fd,w,R,2-3}$ = $R_{Dd,w,R,2-3}$ ≈ 70dB

B_4 LIGNATUR silence12 separated, screed
- $R_{Ff,w,R,4}$ = 80dB, $R_{Fd,w,R,4}$ = $R_{Df,w,R,4}$ = 80dB

Prognosis example B

R'_w = 59dB

We are happy to predict the airborne sound transmission for your project.