Memo

To: Mr. R. van der Klis, Reppel BV
From: prof.ir. E. Gerretsen
Cc:

Date: 2015 September 10

Project: Sound reduction Lewis Constructive Flooring systems
Reference: LA.150404.M01

Introduction

In the past TNO presented the acoustic performance, air borne and impact sound insulation, of various floor constructions applying to the LEWIS® Deck floor systems. These performances were based on laboratory measurements and calculations and expressed in the quantities used in the Netherlands at that time (I_{lu}, I_{co}; 2002).
For use in the UK these results have been transferred into quantities in use there, using a different weighting procedure and adjust to the average performance in the field ($D_{nT,w}$, $L_{nT,w}$; 2003). Later the performance for airborne sound was adjusted to the new quantity $D_{nT,w}+C_{tr}$, showing a 6 dB lower figure as the average result of various available measurement at the time.
Later the data from the original reports were reformulated in the newer European quantities ($R_w(C;C_{tr})$, $L_{nw}(C_I)$; 2005) and the average relations between these test performances (laboratory) and field results expressed in D_{nT} and L_{nT} were indicated. This overview was extended the year after, based on new laboratory results and field measurements in 2008. In the case of different results for comparable floor build-ups, the choice was made to use data consistent with the appropriate results.

Based on all this information performance data have been presented more recently for various build-ups that could be applied in the UK that have raised some questions. These questions are addressed in this memorandum and a condensed overview is presented of the performance for typical floor build-ups for the UK.

FAQ's

1. As indicated above, a fixed -6 dB rule was applied to estimate $D_{nT,w}+C_{tr}$. At a later stage the performance was reformulated in detail for the new European quantities, which also contain UK figures. This showed that there are C_{tr} deviations from the -6 dB rule and therefore these new results are applied here.

2. Since most of the results are restricted to timber joisted floors carrying the LEWIS® Deck, the question is raised as to whether the results are restricted to that type of floors. The answer is that the type and material of the beams is immaterial as long as their mechanical stiffness (EI) is comparable, likely to be already assessed for structural reasons, and also that the centres between beams is comparable.

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3. One of the floor build-ups shows very high performance results (SYLOMER resilient strips) based on measurements made in Germany with a ceiling type that is not typical in the UK, hence the construction is described with a ceiling that was thought to be equivalent. Upon further analysis of the German measurements it becomes clear that this assumption is not valid. Based on other results from measurement of this system, it can be concluded that the performance with a 2x12.5 mm plasterboard ceiling as indicated in the SYLOMER leaflet, is about 9 dB less for airborne and impact sound. This is taken into account in the renewed data presented in this memorandum.

4. Discussions are on- going regarding low-frequency sound in timber frame apartments. Indeed, over the last few years it has become clear for acousticians that, with lightweight building methods and materials, the current performance requirements are not adequately assessing comfortable conditions in real life. This has been the reason for the UK to switch to $D_{nT,w}+C_{tr}$, putting more emphasize on low frequencies at least for airborne sound without the need to actually measure these frequencies. This discussion leads to proposals to include lower frequencies (from 50 Hz upwards) in the performance data and especially for impact sound that is considered to be relevant. The report on the German measurements, mentioned before, presents the main results for the frequency range from 50 Hz upwards ($R_w(C_{50}$, C_{tr50}) and $L_{nw}(C_{I50})$. In this renewed presentation of the data it will be indicated what could be the effect of including these lower frequencies in the performance presentation. Until now only Sweden has incorporated lower frequencies in their regulations, even so, it is recommendable to take them at least somewhat into account to show how the system performs with these low frequencies.

Acoustic performance

The acoustic performance of various floor build-ups for airborne and impact sound insulation will be given as product performance (laboratory test, $R_w(C;C_{tr})$ and $L_{nw}(C_I)$) and derived from this as an indication for the field quantities as relevant for England & Wales ($D_{nT,w}+C_{tr}$, $L_{nT,w}$), Scotland ($D_{nT,w}$, $L_{nT,w}$) and Ireland ($D_{nT,w}$, $L_{nT,w}$). See table 1 on the next pages.

In table 2 (see next pages) the results of field measurements in the UK are presented, the results being expressed as relevant for the various regions of the UK and Ireland. From this there is also an estimation given for the general European way of expressing the performance.

The floor construction for the Light Gauge Steel project in London is the same as measured in the laboratory (LWS light steel frame). Taking into account the presence of floor covering the estimated field results for airborne and impact sound from the laboratory measurements compared reasonable well with the actual field measurements.

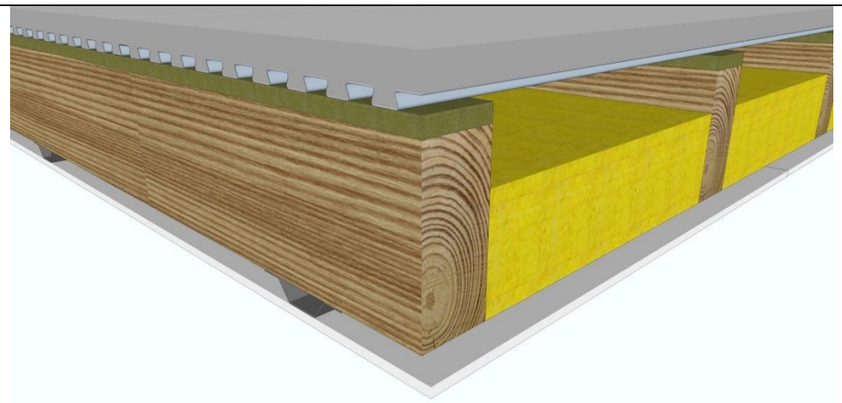
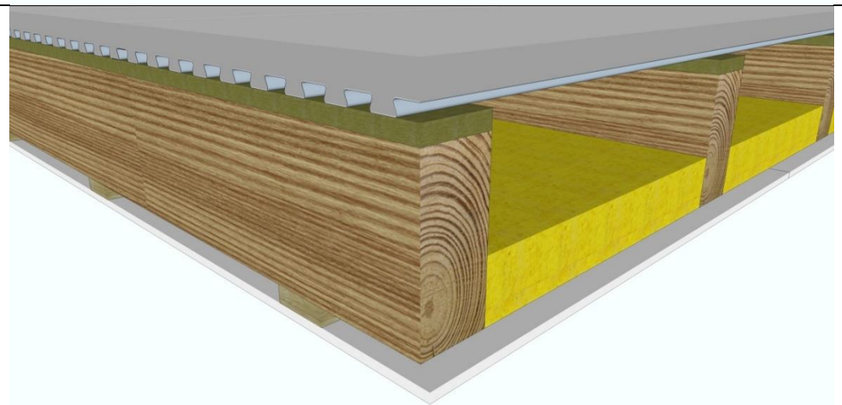
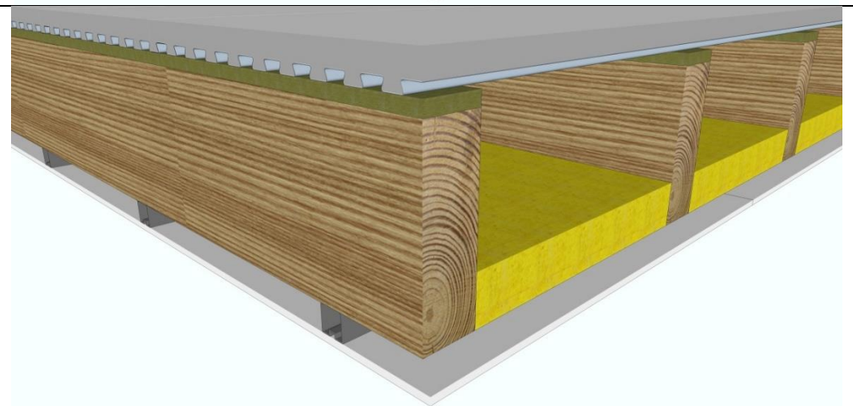
Table 1: Overview of acoustic performance for airborne and impact sound of various floor details with LEWIS® CFS; product data (laboratory) and estimated field data				**Product data, general** [1])		**Estimated field data, specific UK** [2])		
Type	Floor Construction	Components	Dimensions	Airborne sound $R_w(C;C_{tr})$[4])	Impact sound $L_{n,w}(C_I)$[4])	Airborne sound; England, Wales, Ireland $D_{nT,w}+C_{tr}$[3])	Airborne sound; Scotland $D_{nT,w}$[3])	Impact sound whole UK& Ireland $L_{nT,w}$[3])
LWS-A3		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips Timber floor Joist Isover Unipan mineral wool Knauf (or equivalent) spring stirrups Gyproc fiberglass reinforced gypsum board	34 mm 16 mm 20/25 mm 200*100 140 mm 27 mm 12,5 mm	64(-4;-10)	52(-2)	53	63	53
LWS-A5		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips Timber floor Joist Isover Unipan mineral wool Battens Gyproc fiberglass reinforced gypsum board	34 mm 16 mm 20/25 mm 200*100 80 mm 24*48 mm 12,5 mm	57(-3;-9)	62(-2)	47	56	63
LWS-A8		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips Timber floor Joist Mineral wool Metal stud profiles Gyproc fiberglass reinforced gypsum board	34 mm 16 mm 20/25 mm 75*275 80 mm 45 mm 12,5 mm	59(-3;-7)	49(-2)	51	58	50

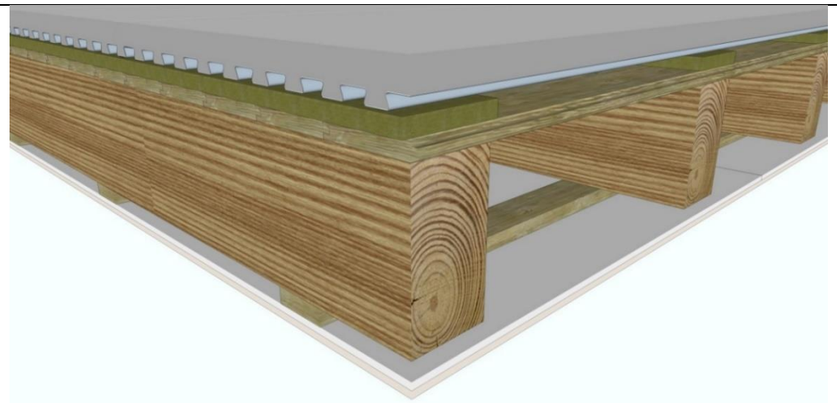
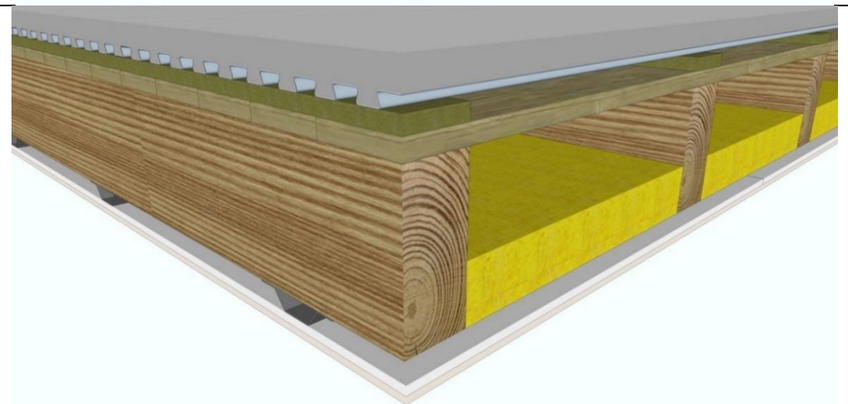
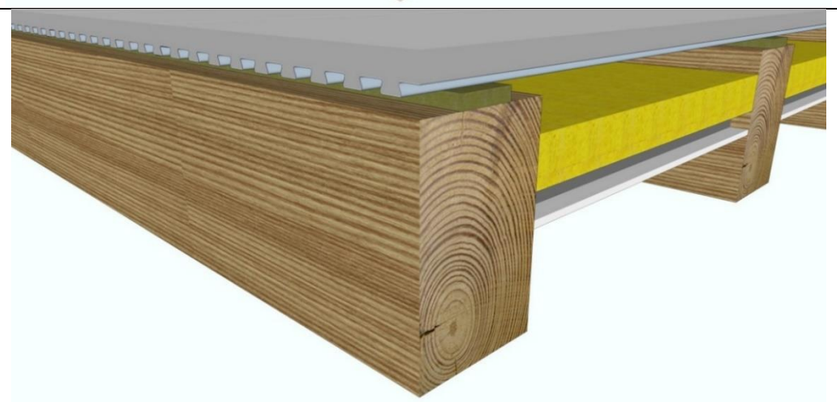
Table 1: (continue)				**Product data, general** [1])		**Estimated field data, specific UK** [2])		
Type	Floor Construction	Components	Dimensions	Airborne sound $R_w(C;C_{tr})$[4])	Impact sound $L_{n,w}(C_I)$[4])	Airborne sound; England, Wales, Ireland $D_{nT,w}+C_{tr}$[3])	Airborne sound; Scotland $D_{nT,w}$[3])	Impact sound whole UK& Ireland $L_{nT,w}$[3])
LWS-B0		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips Tongue and groove floorboards Timber floor Joist Battens Gyproc fiberglass reinforced gypsum board Gypsum plaster	34 mm 16 mm 20/25 mm 22 mm 110*200 20*50 10 mm 10 mm	55(-1;-7)	49(-1)	47	54	50
LWS-B3		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips Timber floor boards Timber floor Joist Isover Unipan mineral wool Knauf (or equivalent) spring stirrups Gyproc fiberglass reinforced gypsum board Gypsum plaster	34 mm 16 mm 20/25 mm 24 mm 200*100 80 mm 27*60 12,5 mm 10 mm	67(-5;-11)	47(-2)	55	66	48
LWS-E2		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips Timber floor Joist Rockwool 428 Metalstud profiles Gyproc fiberglass reinforced gypsum board	34 mm 16 mm 20/25 mm 220*340 80 mm 44 mm 12,5 mm	53(-2;-6)	67(-7)	46	52	68

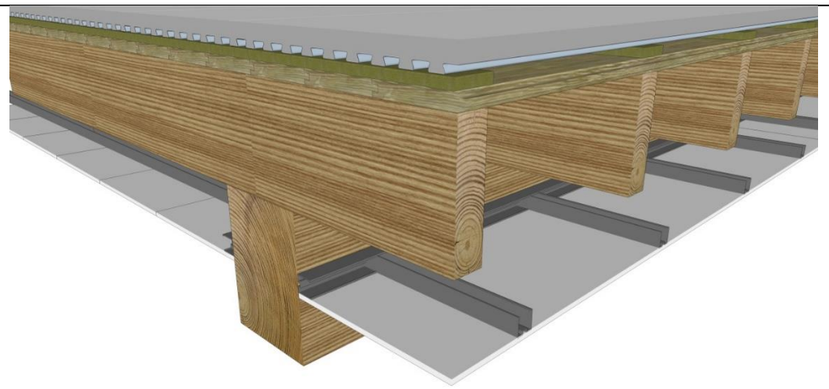
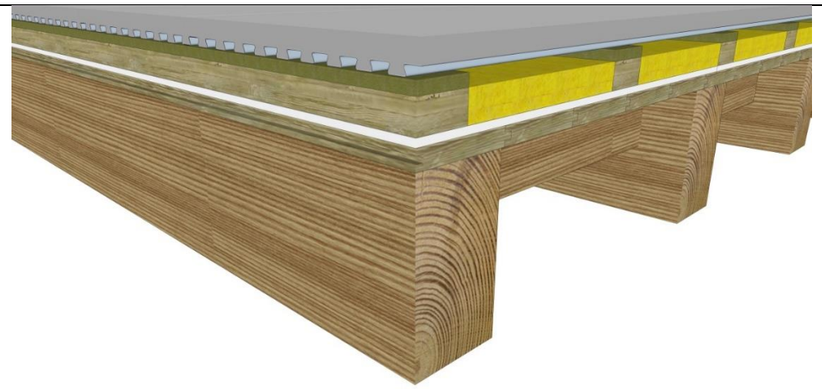
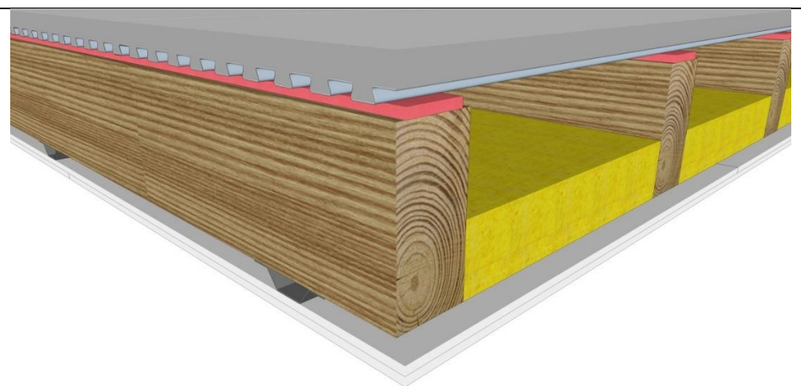
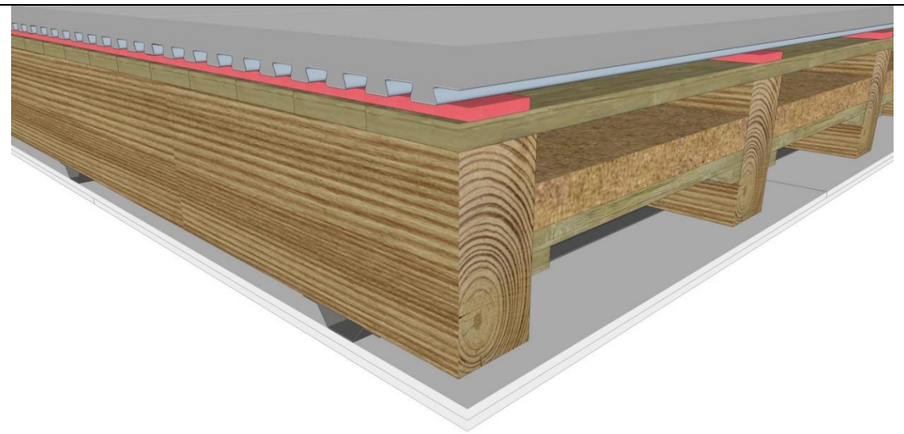
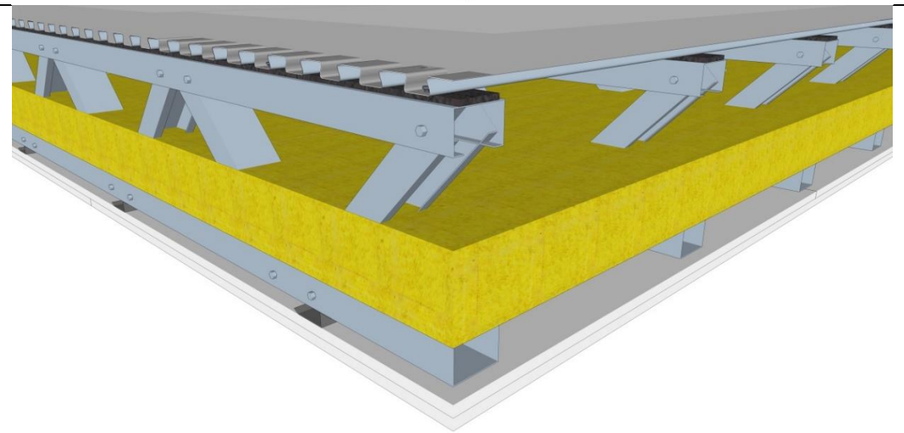
Table 1: (continue)				**Product data, general** [1])		**Estimated field data, specific UK** [2])		
Type	Floor Construction	Components	Dimensions	Airborne sound $R_w(C;C_{tr})$[4])	Impact sound $L_{n,w}(C_I)$[4])	Airborne sound; England, Wales, Ireland $D_{nT,w}+C_{tr}$[3])	Airborne sound; Scotland $D_{nT,w}$[3])	Impact sound whole UK& Ireland $L_{nT,w}$[3])
LWS-F1		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips Tongue and groove floorboards Timber bridging Joist Timber tie beams Metalstud profiles Gyproc fiberglass reinforced gypsum board	34 mm 16 mm 20/25 mm 33 mm 69*269 270*370 45 mm 12,5 mm	63(-4;-9)	54(-2)	53	62	55
LWS-MK		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips Timber beams Isover Unipan mineral wool Sheetrock Tongue and groove floorboards Timber bridging Joist Timber tie beams MK2: Concrete screed 49 mm MK3: Cavity 100-150 mm	34 mm 16 mm 20/25 mm 50*100 50 mm 12,5 mm 30 mm 150*-- 320*180 	48 (0;-3) 50(-1;-5) 52(-1;-5)	65(-2) 64(-2) 62(-2)	44 44 46	47 49 51	66 65 63
LWS-Sylomer 1		Fine grade concrete/liquid screed LEWIS® Deck SYLOMER Timber floor Joist Mineral wool Knauf (or equivalent) spring stirrups Plasterboard	37 mm 16 mm 12 mm 220*160 100 mm 27 mm 2 * 12,5 mm	74 (-5;-11)	46(0)	62	73	47

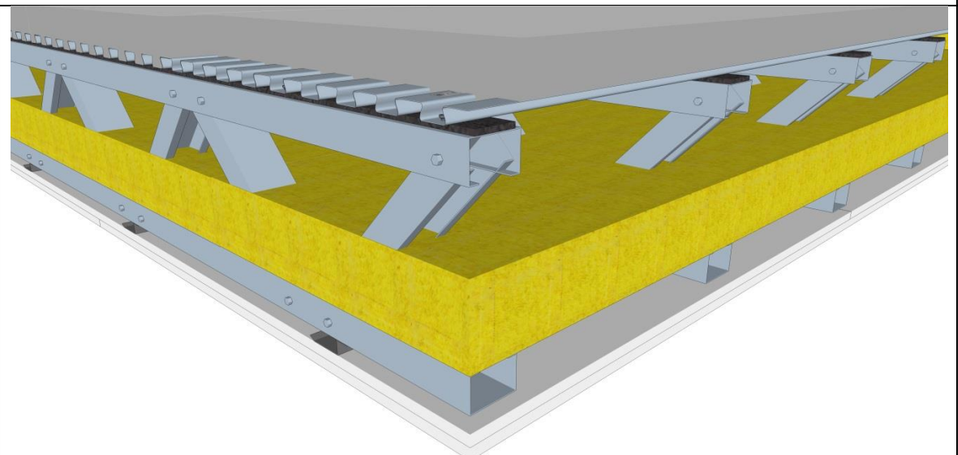
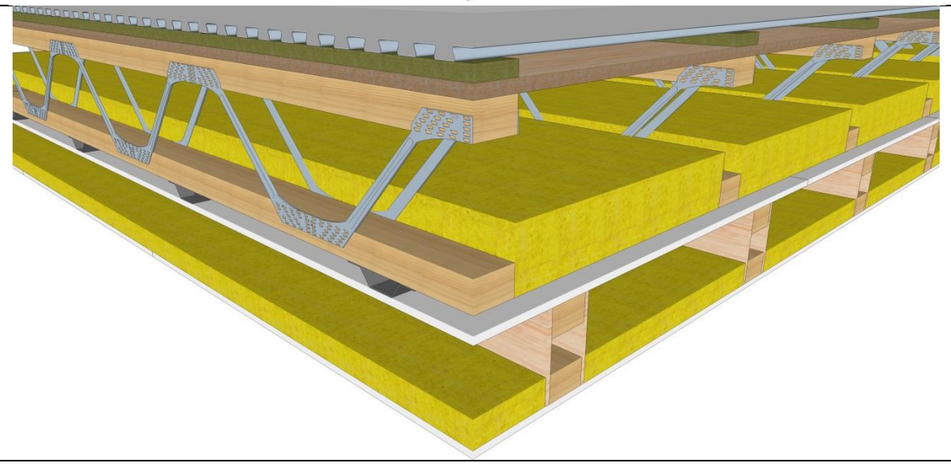
Table 1: (continue)				**Product data, general** [1)]		**Estimated field data, specific UK** [2)]		
Type	Floor Construction	Components	Dimensions	Airborne sound $R_w(C;C_{tr})$[4)]	Impact sound $L_{n,w}(C_I)$[4)]	Airborne sound; England, Wales, Ireland $D_{nT,w}+C_{tr}$[3)]	Airborne sound; Scotland $D_{nT,w}$[3)]	Impact sound whole UK& Ireland $L_{nT,w}$[3)]
LWS-Sylomer 2		Fine grade concrete/liquid screed LEWIS® Deck SYLOMER Timber floor boards Timber floor Joist Sand Timber boards Knauf (or equivalent) spring stirrups Plasterboard	37 mm 16 mm 12 mm 24 mm 220*160 50 mm 20 mm? 27 mm 2 * 12,5 mm	70(-3;-9)	44(-1)	60	69	45
LWS-Light steel frame		Fine grade concrete/liquid screed LEWIS® Deck Screwed on Lattice beams Lafarge raft 50 acoustic tape Lattice beams Isowool APR 1200 Lafarge RB3000 Resilient Bar Firecheck Wallboard	49 mm 16 mm 6 mm 225 mm 100 mm 27 mm 2 * 15 mm	61(-2;-7)	63(-4) with carpet 56(0)	53	60	64 57

1) The indicated acoustic product performance in the laboratory is based on laboratory measurements, extrapolation of these measurements to other systems and interpretation of field measurements

2) The indication of the field performance is based on the product performance and typical dimensions of field situations assuming the direct transmission through the floor system is dominant. With substantial flanking transmission the performance can be reduced, resulting in an airborne sound insulation up to 5 dB less and an impact sound pressure level up to 2 dB higher in most cases.

3) Requirements:
(new build); England & Wales: $D_{nT,w}+C_{tr} > 45$ dB, $L_{nT,w}<62$ dB; Scotland $D_{nT,w} > 56$ dB, $L_{nT,w}< 56$ dB; Ireland $D_{nT,w} > 53$ dB, $L_{nT,w} < 62$ dB
(change of use); England & Wales: $D_{nt,w}+C_{tr}> 43$ dB, $L_{nt,w} <64$ dB or (conversion) Scotland $D_{nT,w} > 53$ dB, $L_{nTw} <58$ dB

4) Taking into account lower frequencies in the assesment will effectively lead to about 1 to 5 dB higher levels for impact sound ($L_{n,w}+C_{I,50}$) and a somewhat smaller decrease for airborne sound insulation (R_w+C_{50}); for the two versions of the SYLOMER details this difference is at least twice as large.

Table 2: Overview of acoustic field performance for airborne and impact sound of various projects with LEWIS® Constructive Flooring system.				**General, Europe**		**Specific UK**		
Type	Floor Construction	Components	Dimensions	Airborne sound $D_{nT}(C;C_{tr})$ [1])	Impact sound $L_{nT,w}(C_I)$ [1])	Airborne sound; England, Wales, Ireland $D_{nT,w}+C_{tr}$	Airborne sound; Scotland $D_{nT,w}$	Impact sound whole UK& Ireland $L_{nT,w}$
Light Gauge Steel apartment building (No.1)		Floor covering Fine grade concrete/liquid screed LEWIS® Deck Screwed on Lattice beams Lafarge raft 50 acoustic tape Lattice beams Rockwool RW3 Lafarge RB3000 Resilient Bar Firecheck Wallboard	- 54 mm 16 mm 6 mm 225 mm 100 mm 27 mm 2 * 15 mm	58-64(-2;-5)	53-49(-1)	53-55	58-64	53-49
Timber Frame apartment building		Fine grade concrete/liquid screed LEWIS® Deck LEWIS® mineral wool resilient strips OSB Board AS K11/438 Eco timber frame Isolation Knauf Spring Stirrups British Gypsum soundbloc plasterboard Softwood timber framing Rockwool AS P20/192 British Gypsum soundbloc plasterboard	34 mm 16 mm 20/25 mm 18 mm 253 mm 110 mm 27 mm 12,5 mm 50*150 mm 50 mm 12,5 mm	62-66(-2;-8)	53-51(-4)	54-58	62-66	53-51

1) Taking into account lower frequencies in the assessment will effectively lead to about 3 dB higher levels for impact sound ($L_{nT,w}+C_{I,50}$) and a somewhat smaller decrease for airborne sound insulation ($D_{nT,w}+C_{50}$).

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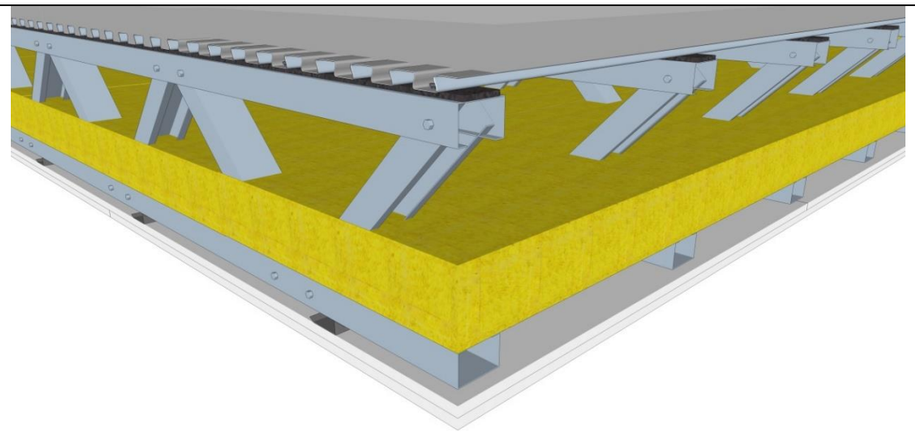
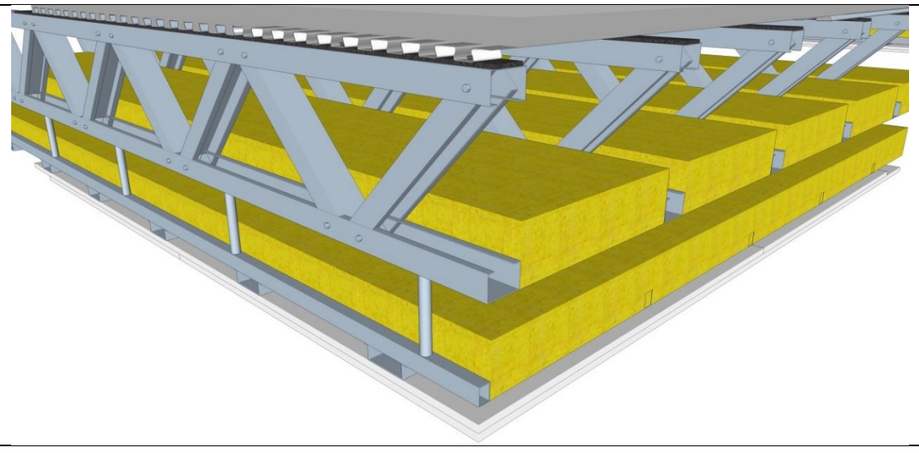
Tabel 2: (continue)				**General, Europe**		**Specific UK**		
Type	Floor Constructions	Dimensions	Measurment	Airborne sound $D_{nT}(C;C_{tr})$ [1])	Impact sound $L_{nT,w}(C_I)$ [1])	Airborne sound; England, Wales, Ireland $D_{nT,w}+C_{tr}$	Airborne sound; Scotland $D_{nT,w}$	Impact sound whole UK& Ireland $L_{nT,w}$
Light Gauge Steel apartment building (No.2)		Fine grade concrete/liquid screed LEWIS® Deck Screwed on Lattice beams Lafarge raft 50 acoustic tape Lattice beams Lattice Truss incorporating mineral fibre Resilient Bar RB1 Soundbloc	44 mm 16 mm 6 mm 300 mm 100 mm 27 mm 2 * 15 mm	53-61(-1;-5)	57-52(0)	47-57	53-61	57-52
Light Gauge Steel hotel building		Fine grade concrete/liquid screed LEWIS® Deck Screwed on Lattice beams Lafarge raft 50 acoustic tape Lattice beams Iso Wool MF suspension system Iso Wool Lafarge dBcheck wall board	24-34 mm 16 mm 6 mm 300 mm 100 mm -- mm 100 mm 2 * 15 mm	57-61(-2;-6)	57-52(-1)	51-55	57-61	57-52

1) Taking into account lower frequencies in the assessment will effectively lead to about 3 dB higher levels for impact sound ($L_{nT,w}+C_{I,50}$) and a somewhat smaller decrease for airborne sound insulation ($D_{nT,w}+C_{50}$)