

IPHA Tech Seminar Gothenburg 7 Nov 2007



Sound insulation with hollow core elements

Christian Simmons

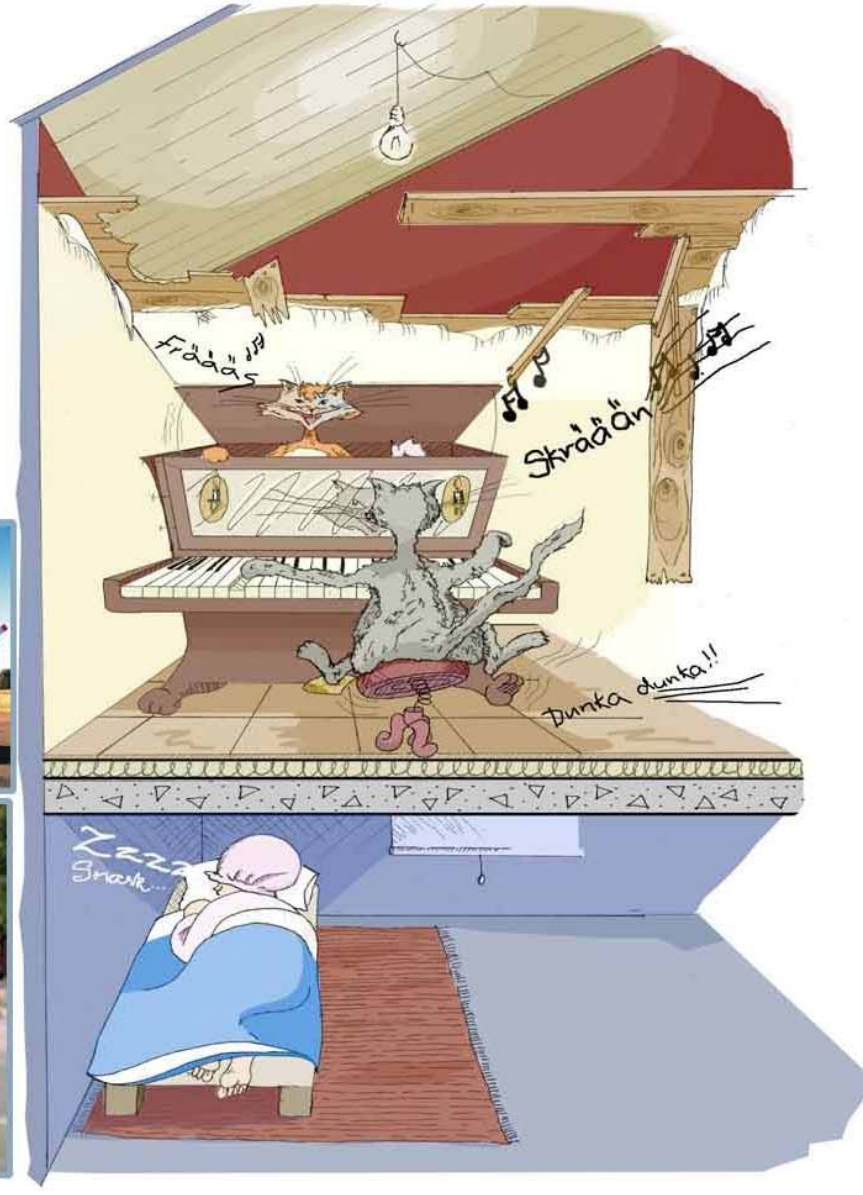
Simmons akustik & utveckling ab, Krokslätts Fabriker 1, SE-431 37 Mölndal

Telefon/Mobil: +46 (0) 31 27 66 00 info@simmons.se www.simmons.se

Simmons akustik & utveckling

Outline

- Needs for sound insulation – advent of "*values, customers & "markets"*" in 1990
- Codes and standards of Sweden, the Nordic countries and CEN
- New EN-standard proposed by St Gobain (et al), possibilities & difficulties
- Swedish BBR: responsibility and product documentation
- Use of the Common Rules "acoustic properties"
- Using EN 12354 and BASTIAN – sound insulation in the building > lab measurement
- Uncertainty, Nordtest studies, safety margins for construction
- HC concrete slabs: Perform well, with the right flooring and 1-2 heavy walls
- Questions ?

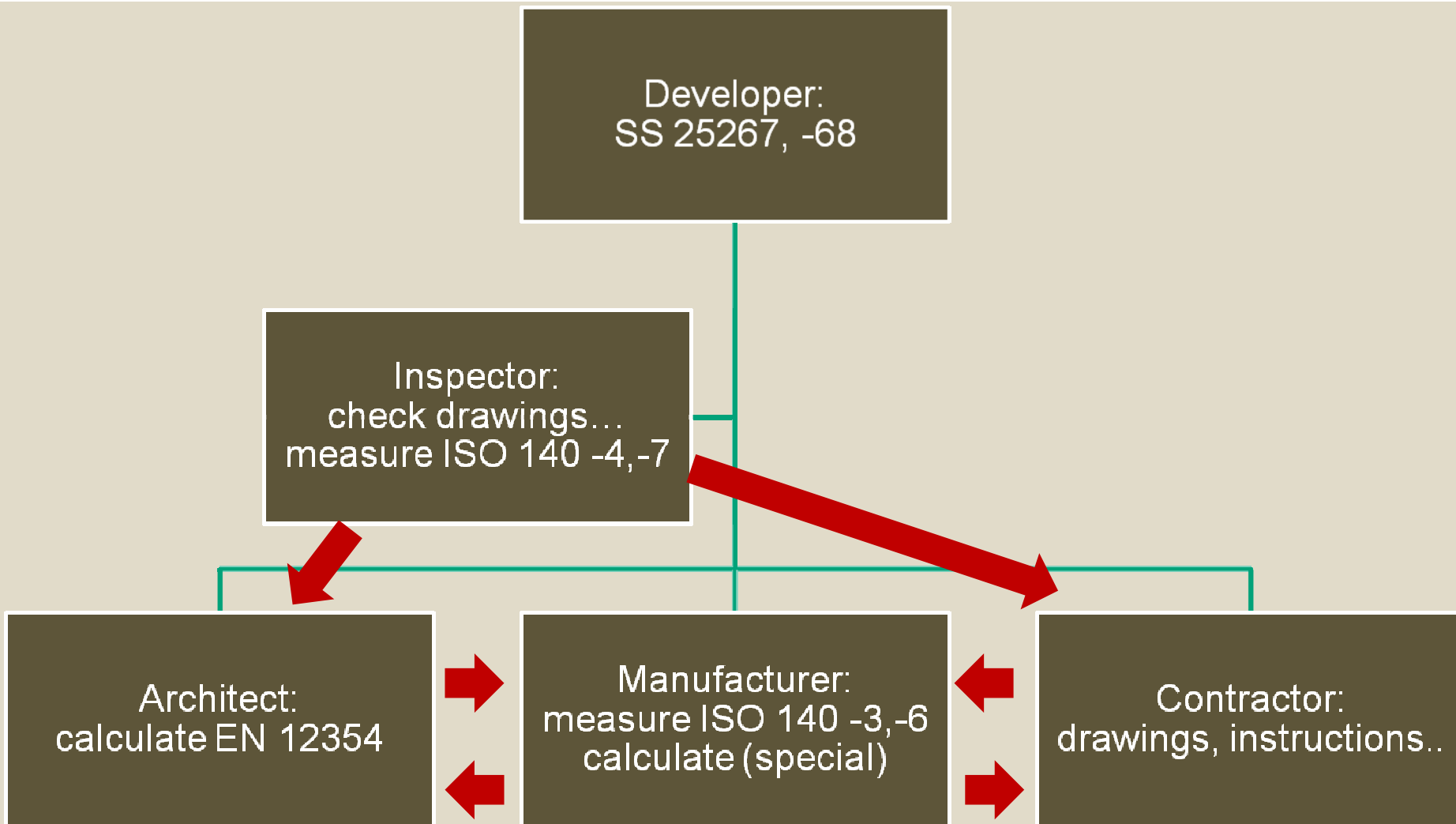


Codes and standards

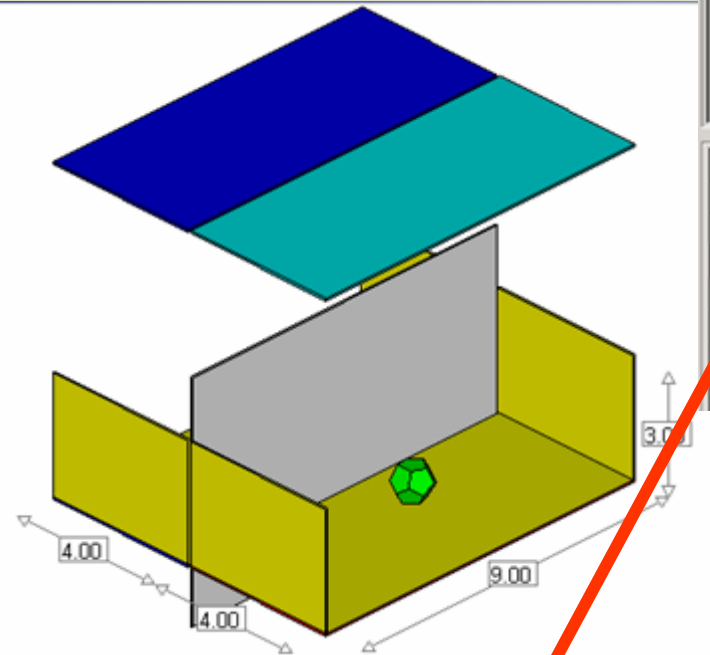
- Sweden: Codes BVF and BBR put general **demands** on the sound insulation of a building, → "habitants and users not being disturbed by intrusive sounds"
- The authority **recommends** class C of SS 25267 (exceptions may be accepted by local authority for good reasons), *use class B or A if higher quality is expected*
- Airborne sound insulation $R'_w + C_{50-3150} \geq 53$ dB (0-2 dB accepted if average OK)
- Impact sound insulation $L'_{n,w} + C_{I,50-2500} \leq 56$ dB (0-2 dB accepted if average OK)
- Sweden the first country to apply the 50-3150 frequency range, "no problems..."
- NO, FI, DK, IS, EE implemented the INSTA-122 draft standard, using $R'_w \geq 55$ dB and $L'_{n,w} \leq 53$ dB (strictly, each room and measurement direction).
- Considering effects of C-terms and safety margins, → 1 dB differences to class B
- No CEN-standard for the classification of sound insulation yet, variety of req's...
- Proposal by St Gobain close to the INSTA-122 would fit us, but...
- Surprisingly wide variety of building traditions among the member states
- → Hard work to convince all member states to harmonize the requirements

BBR ↔ Standards:

responsibilities made clear, cooperation facilitated
 (→ efficient solutions competitive !)



Demo:BASTIAN



Country: (all) | Sort: abc | Sketch | Diagram | Adopt SR-Element | Auto-Scale

Elements

monolithic wall

Construction	Rw + C50-3150
200 mm concrete (2300 kg/m3). www.betongbanken.com	57
220 mm concrete (2300 kg/m3). www.betongbanken.com	59
240 mm concrete (2300 kg/m3). www.betongbanken.com	60
300 mm concrete (2300 kg/m3). www.betongbanken.com	64
aerated concrete 0.5 115 mm	35
aerated concrete 0.5 115 mm, re	37
aerated concrete 0.5 115 mm, re	40

Junction Type

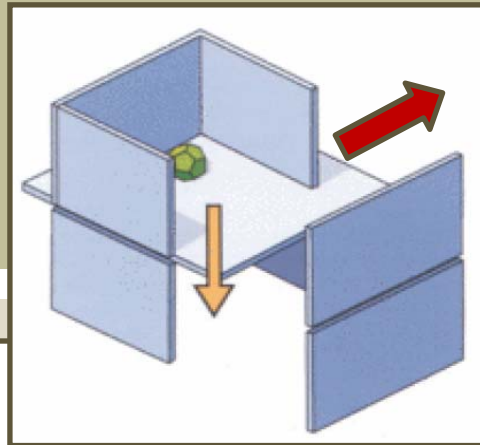
OK Cancel Help

Klicka och välj i listor!

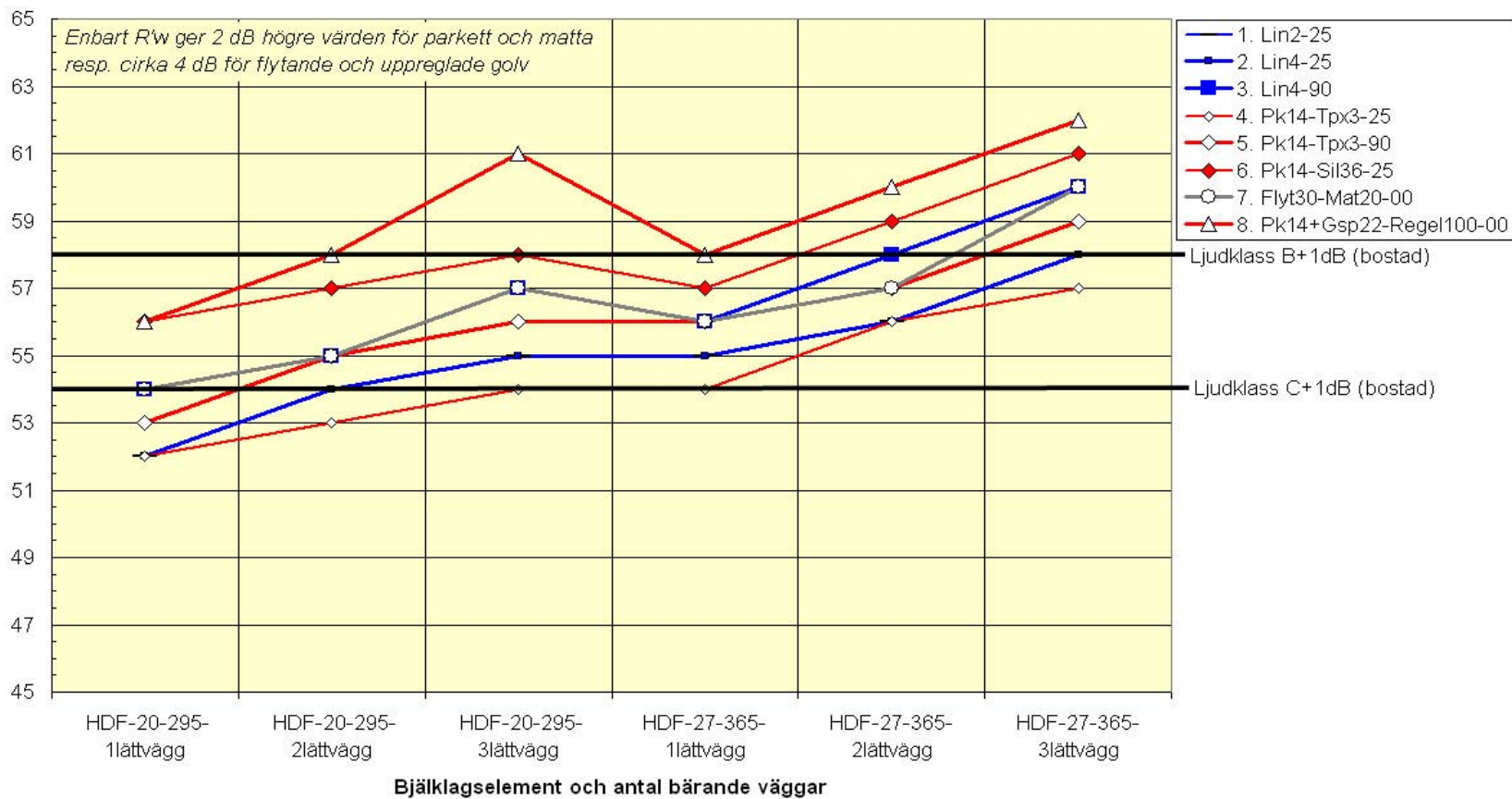
M	t	Basic Element	Additional Layer	Junction Type-No.
X	d	240 mm concrete (2300 kg/m3). www.betongbanken.com		
X	f1	Gyproc E 95/95 202 (600) M30. (SP96F32673A).		14
X	f2	Gyproc E 95/95 202 (600) M30. (SP96F32673A).		14
X	f3	HD/F120/185 concr. el. + 0 concr. 300 kg/m2 wv	Granab S100-150 (22 parquet or part	1
X	f4	HD/F120/185 concr. el. + 0 concr. 300 kg/m2 wv		1

L'n,w + Ci,50-2500	dB	%
	37.5	59
	36.0	41
	39.5	100

Sound insulation **higher** *in situ* than in the laboratory...



Vägt reduktionstal i byggnad $R'_w + C_{50-3150}$ (dB)



QuickGuide:

Sound insulation ~

- Element type
- Screed min weight
- Flooring
- Boundary cond's

Sound insulation per element profile acc. to EN 13369 (C rules) is *conservative* vs. *in situ*

Element data at

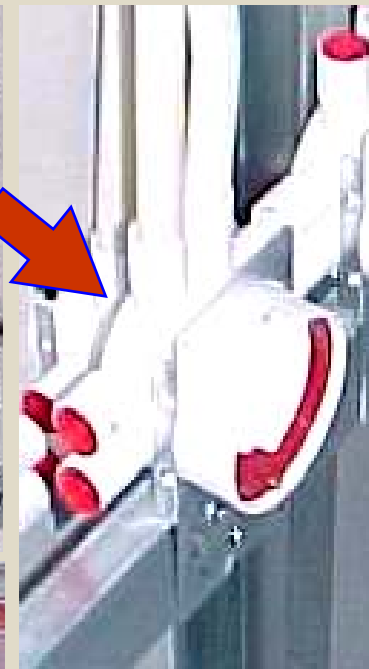
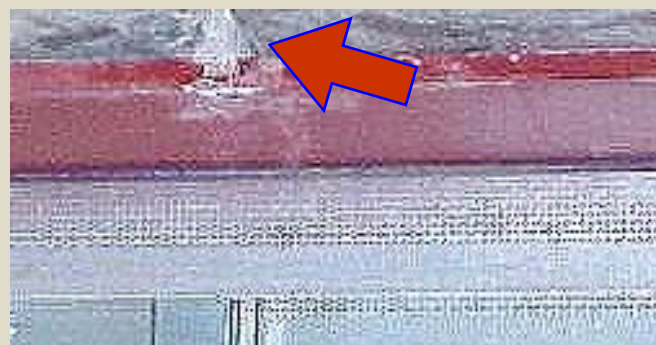
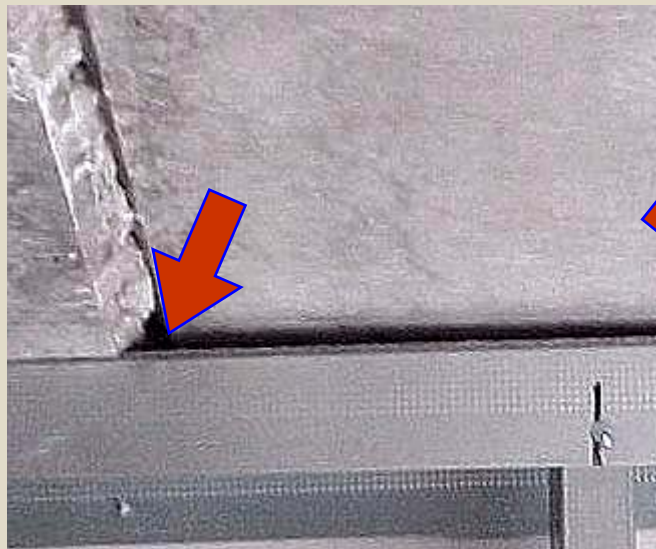
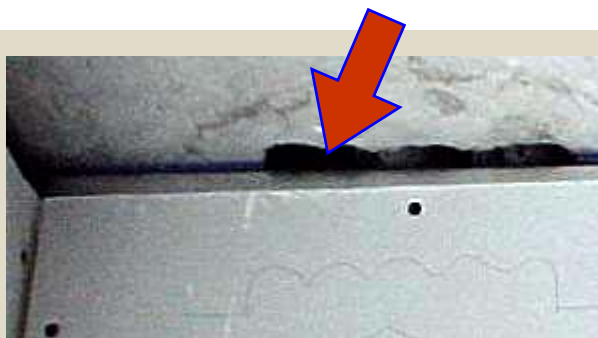
www.byggamedprefab.se

Estimates *in situ* in

Table 3:

		Golveläggning, stegljudsklass					
Beräkningsfall (stomtyp)	Bjälklag HD/F 120/ : tjocklek (cm) ytvikt element (kg/m ²), ytvikt pågjutning (kg/m ²)	5	6	7m	7p	8B	8A
		(Ex. klinker på hårdmatta)	(Ex. klinker på stegljudsmatta)	(Ex. linoleum med akustiskum)	(Ex. parkett på tunn stegljudsmatta)	(Ex. parkett och golvgips på stegljudsskiva)	(Ex. parkett på avvirrade golvreglar)
		Värdena anger vägd luftljudsisolering $R_w + C_{50-3150}$ / stegljudsnivå $L_{nw} + C_{i,50-2500}$ Färgerna anger ljudklass (A grön, B gul, C orange, D/Oklassat röd).					
1 Vertikalt	HD/F 120/20 255, <10	54 / 65	54 / 61	53 / 60	51 / 60	55 / 56	57 / 53
	HD/F 120/20 295, <10	54 / 64	55 / 59	54 / 58	52 / 59	56 / 55	57 / 52
	HD/F 120/19 290, 25	55 / 63	55 / 59	54 / 58	52 / 58	56 / 54	57 / 52
	HD/F 120/19 290, 90	56 / 61	57 / 56	56 / 56	54 / 56	57 / 52	59 / 49
	HD/F 120/27 365, <10	57 / 61	57 / 57	56 / 55	55 / 56	58 / 52	59 / 49
	HD/F 120/27 365, 90	59 / 58	60 / 54	59 / 53	57 / 53	60 / 49	61 / 47
2 Horisont.	HD/F 120/20 255, <10 2a	56 / 55	56 / 48	56 / 48	55 / 51	56 / 45	56 / 43
	HD/F 120/20 255, <10 2b	60 / 55	60 / 48	60 / 48	59 / 51	60 / 45	61 / 43
	HD/F 120/20 255, <10 2c	60 / 52	60 / 45	60 / 46	59 / 49	60 / 42	60 / 41
	HD/F 120/19 290, 25 2a	56 / 53	56 / 48	56 / 47	55 / 49	56 / 43	56 / 42
	HD/F 120/19 290, 25 2b	60 / 53	60 / 48	60 / 47	59 / 49	60 / 43	61 / 42
	HD/F 120/19 290, 25 2c	60 / 51	60 / 45	60 / 44	59 / 48	60 / 41	60 / 39
	HD/F 120/27 365, <10 2a	56 / 52	56 / 46	56 / 46	55 / 48	56 / 42	56 / 40
	HD/F 120/27 365, <10 2b	61 / 52	61 / 46	61 / 46	60 / 48	61 / 42	61 / 40
HD/F 120/27 365, <10 2c	60 / 49	60 / 43	60 / 43	59 / 45	60 / 39	60 / 38	
3 Vertikalt	HD/F 120/20 255, <10	55 / 64	55 / 60	54 / 59	52 / 59	56 / 55	57 / 52
	HD/F 120/20 295, <10	56 / 62	57 / 58	55 / 57	54 / 57	57 / 53	58 / 51
	HD/F 120/19 290, 25	56 / 62	57 / 57	56 / 56	54 / 56	57 / 52	59 / 50
	HD/F 120/19 290, 90	57 / 59	59 / 54	57 / 54	56 / 54	58 / 50	60 / 47
	HD/F 120/27 365, <10	58 / 60	59 / 55	58 / 54	57 / 54	59 / 50	60 / 47
	HD/F 120/27 365, 90	60 / 57	60 / 52	60 / 51	58 / 53	61 / 47	62 / 44
4 Horisont.	HD/F 120/20 295, <10	53 / 66	53 / 60	52 / 60	50 / 64	54 / 56	53 / 55
	HD/F 120/19 290, 90	53 / 62	55 / 56	54 / 56	52 / 60	55 / 52	54 / 52
	HD/F 120/27 365, <10	54 / 62	56 / 56	55 / 56	53 / 60	55 / 52	56 / 51

Calculated values may be realistic...





Calculations vs. Measurements *in situ*

Delta Akustik&Vibr. Nordtest study 1998: Calc's vs. 200 field measurements

*Design margins:
10% risk non-conf*

- Approx 4 dB scatter calculation – measurement.
- Small systematic difference
 - *Poor documentation of constructions and measurements*
 - *Uncertain calc model*
 - *Uncertain meas methods*

Läs mera:
Bygg & Teknik 03/02:
Kan lätta bjälklag ersätta
tungta ? www.simmons.se

	Direction of transm.	Average	St. dev.	90% conf. limits
Monolithic basic constructions	Horizontally (walls)	0.2 dB	1.9 dB	2,7 dB
	Vertically (floors)	0.4 dB	2.6 dB	3,6 dB
Lightweight double constructions	Horizontally (walls)	0.1 dB	3.1 dB	4,2 dB
	Vertically (floors)	0.4 dB	3.2 dB	4,4 dB

Table 4.1. Average, standard deviation, and 90% confidence limits for the difference between calculated and measured R'_w -values.

	Average	St. dev.	90% conf. limits
Monolithic basic constructions	-0.5 dB	3.1 dB	4,2 dB
Lightweight double constructions	0.0 dB	5.4 dB	7,3 dB

Table 4.2. Average, standard deviation, and 90% confidence limits for the difference between calculated and measured $L'_{n,w}$ -values vertically.

Our Nordtest project 04030: design margins

Tabell 2. Standardavvikelse vid jämförelse beräkning-mätning av 40 byggnadsfall i Nordtestprojekt 04030

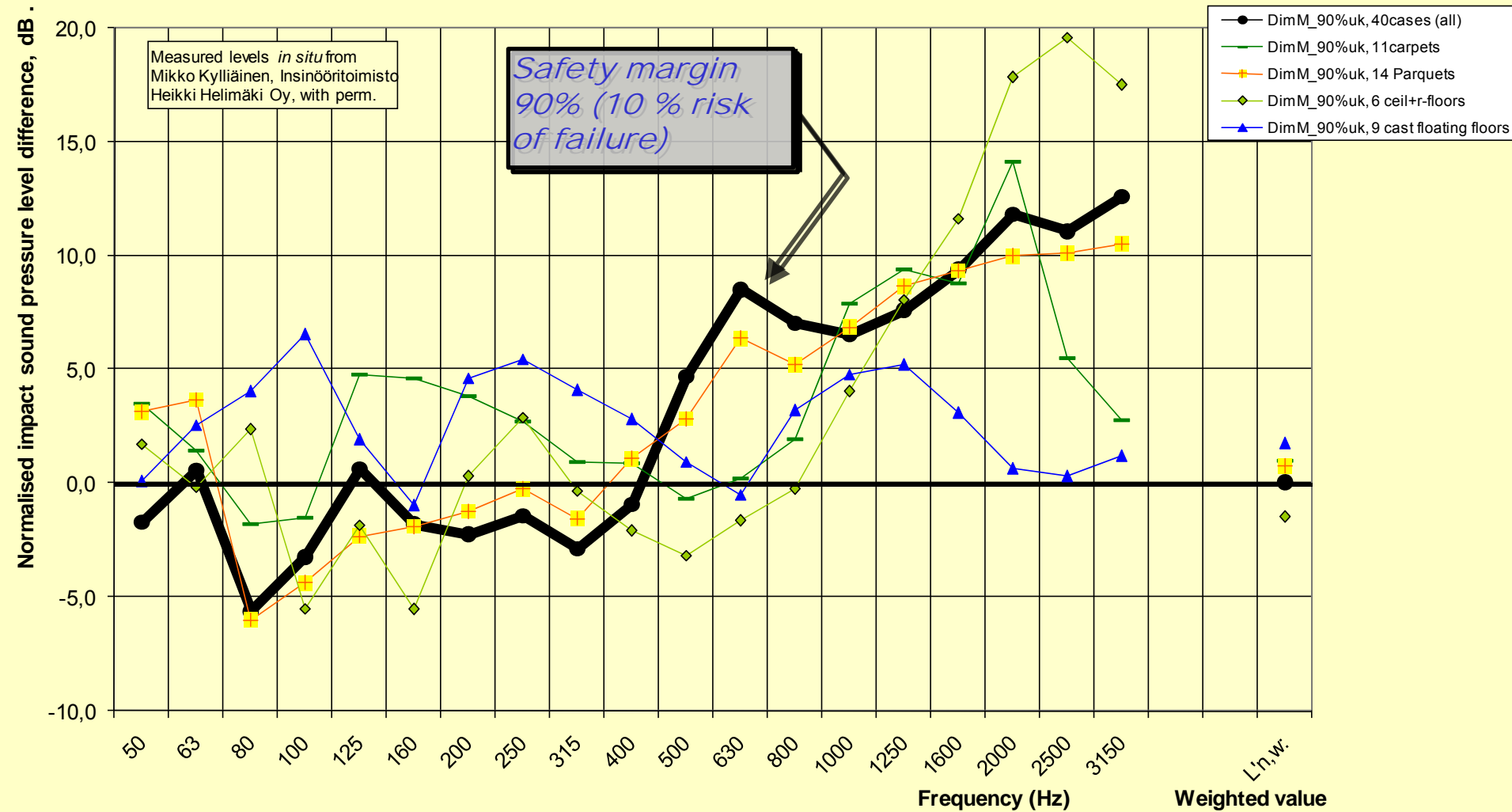
Differens beräknad-mätt ljudisolering:	R'_w	$R'_w + C_{50-3150}$	$L'_{n,w}$	$L'_{n,w} + C_{1,50-2500}$
...systematiskt, mellan medelvärdena	-0,17	0,42	1,87	1,91
...slumpmässigt, standardavvikelse	2,3	1,6	4,4	2,9
...90%-konfidens (5% marginal)	3,5	3,0	5,1	2,7

Tabell 3. Rekommenderade säkerhetsmarginaler vid dimensionering av ljudisolerande tunga konstruktioner med väl kända konstruktioner (Nordtestprojekt 04030)

Praktiska säkerhetsmarginaler vid dimensionering av tunga konstr. med BASTIAN (mot kontrollmätning enligt standard):	R'_w	$R'_w + C_{50-3150}$	$L'_{n,w}$	$L'_{n,w} + C_{1,50-2500}$
Mot krav i ett utrymme	2	3	2	3
Mot medelvärde av utrymmen, 0-2 dB avvikelse godtas i en enskild mätning	0	1	0	1

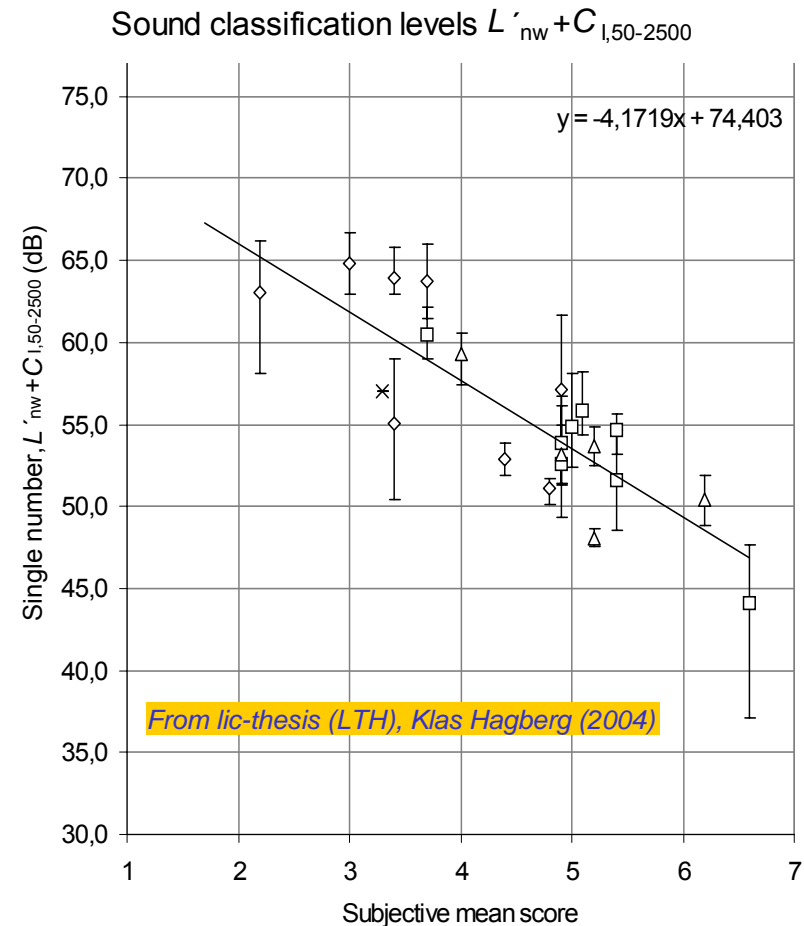
Finnish study (Mikko Kylliäinen) of 40 H C slabs with floorings

Calculated - Measured L'n, L'nw



Sound classes in SS 25267 – relevance, dose/response

- Surveys among habitants
- Regression analysis, $r > 0,8$
- "Boverket" accept approx. 20% may be disturbed by sound insulation, occasionally,
 - ➔ cost efficiency vs public requirements
- "Socialstyrelsen" requires sufficient protection from intrusive sounds also for sensitive habitants ➔ 45 dB maximum SPL from traffic during nights



Questions & Answers...?

- The learned know
- The wise ask

