BELGIAN BUILDING RESEARCH INSTITUTE

INSTITUTION RECOGNIZED BY APPLICATION OF THE DECREE-LAW OF THE 30th OF JANUARY

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LABORATORY OF ACOUSTICS (AC)

TESTREPORT Nr. AC5472

Requested by: AGC Glass Europe
Rue J. Bordet
B- 7180 Seneffe

Contacts:	**Company:**	**BBRI - WTCB - CSTC - WTB**
	C. Matean	ir. D. Wuyts

Test carried out: Measurement of the sound reduction index R of a building element

Product tested: Pyrobelite 10

References

EN ISO 10140-2: 2010 Acoustics – Measurement of sound insulation in buildings and of building elements
– Part 2: Measurement of airborne sound insulation

EN ISO 717-1: 1996 Acoustics-Rating of sound insulation in buildings and of building elements
– Part 1: Airborne sound insulation (ISO 717-1:1996)

Date and reference of the order:	18-06-12	Nr. DE 631 x B072
Receipt of the test element:	13-06-12	Nr. Test element: 2012-24-051/2
Date of the test:	28-06-12	
Drafting date of the report:	27-07-12	

This report contains (all annexes included) 7 pages. It may only be reproduced in its entirety. Each page of the original report has been stamped (in red) by the laboratory and initialised by the head of laboratory. The results and findings are only valid for the tested samples.

☐ No sample
☐ Sample(s) submitted to a destructive test
☒ Sample(s) to be removed from our laboratories 10 calendar days after sending of the report, unless a written request is received by the demander of the test

Technical responsable,	Responsable engineer in charge of the test,	The head of the laboratory,
F. Corbugy	ir. D. Wuyts	ing. M. Van Damme

Co-operator(s) : M. Dubois

C.S.T.C. W.T.C.B.

R SOUND REDUCTION INDEX - GELUIDVERZWAKKINGSINDEX
INDICE D'AFFAIBLISSEMENT ACOUSTIQUE - SCHALLDAMMINDEX

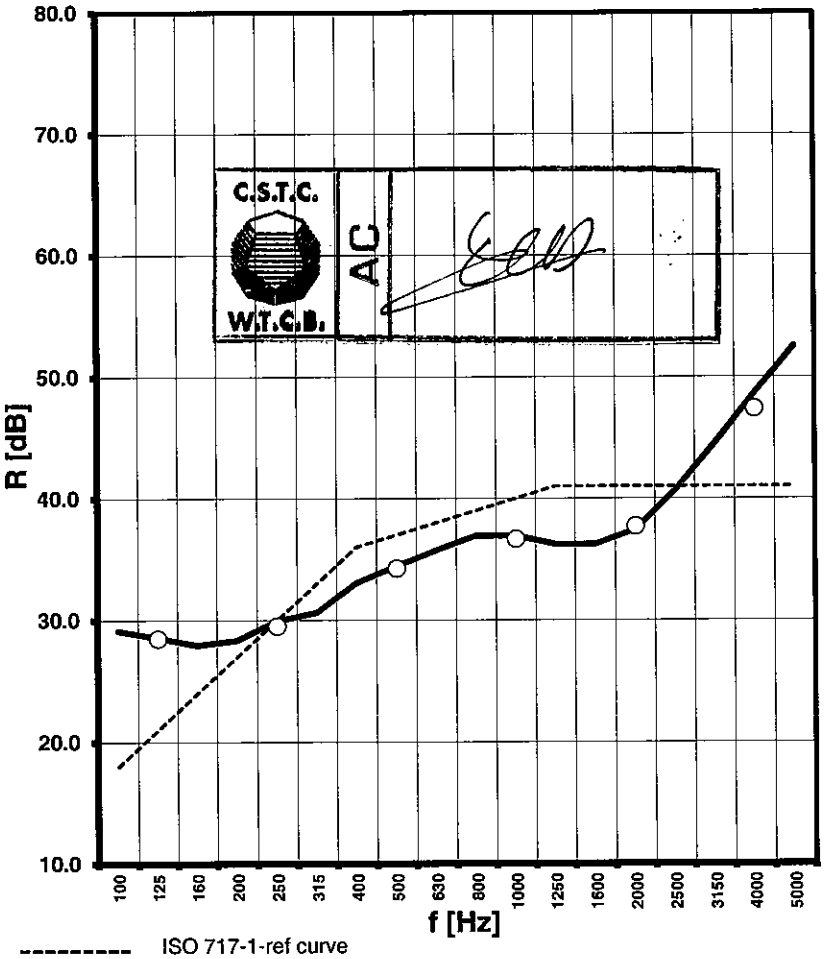
EN ISO 10140-2 : 2010 Acoustics – Measurement of sound insulation in buildings and of building elements – Part 2: Measurement of airborne sound insulation
EN ISO 717-1:1996 Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation

Date of Test / Testdatum / Date d'essais / Prüfdatum: 28/06/2012
Source room / Zendruimte / Salle d'émission / Senderaum: C (V = 75.1 m³) (% H2O = 75.1 %) (T = 22 °C)
Receiving room / Ontvangstruimte / Salle de réception / Empfangsraum: D (V = 65 m³) (% H2O = 75.2 %) (T = 21.5 °C)
Static pressure / Statische druk / Pression statique / Statischer Druck: 0.101 MPa
Test sample / Testelement / Elément de l'essai / Testelement: N°= 2012-24-051/: S= 1.88 m² <m">= 24.7 kg/m²

f (Hz)	R (dB) 1/3oct	R (dB) oct
50	28.6	
63	30.0	27.7
80	25.6	
100	29.1	
125	28.5	28.5
160	27.9	
200	28.3	
250	29.9	29.5
315	30.6	
400	33.0	
500	34.4	34.2
630	35.7	
800	36.9	
1000	36.9	36.7
1250	36.2	
1600	36.2	
2000	37.4	37.7
2500	40.6	
3150	44.5	
4000	48.6	47.4
5000	52.5	

$R_w (C;C_{tr})$ = 37 (-1;-3) dB

$C_{50-3150}$= -1 dB
$C_{tr,50-3150}$= -3 dB
$C_{50-5000}$= dB
$C_{tr,50-5000}$= -3 dB



REQUESTED BY / AANVRAGER / DEMANDEUR / ANTRAGSTELLER:

AGC Glass Europe
Rue J. Bordet - B- 7180 Seneffe

TEST ELEMENT / PROEFELEMENT / ELEMENT D'ESSAI / PRÜFMUSTER:

(Short description by the manufacturer, details: see annex(es) / Beknopte beschrijving door het bedrijf, details: zie bijlage(n) / Description sommaire par l'entreprise, détails: voir annexe(s) / Kurze Beschreibung durch den Hersteller, Details auf Anlage(n))

NL: Geen nederlandse beschrijving beschikbaar

FR: Pas de description en Français disponible

GB: Glazing Pyrobelite 10 (G3mm - IL1,9mm - G6mm)

D: Keine Deutsche Beschreibung verfügbar

MEASUREMENT PRECISION, TEST EQUIPMENT AND MEASUREMENT METHOD

1. MEASUREMENT PRECISION

Air temperature	± 0.5 °C
Relative humidity	± 5%
Atmospheric pressure	0.0005 MPa

Sound reduction index R	Is subject of study within AHWG of ISO/TC 43/SC 2/WG 18 (preparing a revised ISO/PWI 140-2)

2. TEST EQUIPMENT

- 01dB-DO12: Two fixed loudspeakers (dodecahedrons) in each room
- Bruël & Kjaer - 4190: Two microphones in each room
- Bruël & Kjaer - 2669-L: Two preamplifiers for microphones
- Bruël & Kjaer - 2829: Two current supplies for microphones
- Bruël & Kjaer - 4228: Calibration source
- Norsonic - Nor265: One rotating microphone boom in each room
- Norsonic - Nor850: A real time analyser
- Norsonic - Nor850: Building Acoustics software

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3. MEASUREMENT METHOD TO DETERMINE R

A detailed description of the measurement method to determine the spectrum of the sound reduction indices R, can be found in the EN ISO 10140-2 standard (see references on the title page). In a limited and thus incomplete way, the test method can be described as follows:

The measurements are made in a dedicated laboratory construction (see last two pages) composed of a source room and a receiving room. This construction meets the requirements of EN ISO 10140-5. In the source room a steady pink noise is emitted. It is generated by two fixed sound sources (dodecahedrons) so as to obtain an as good as possible diffuse sound field. The sound sources and their fixed positions fullfil the requirements in annex D of EN ISO 10140-5. The average sound pressure level spectrum is measured per 1/3d octave bands in the source room and receiving room by means of two microphones mounted on a continuously rotating beam. In that way, an integration of the sound pressure level in time and space is obtained, resulting in the energetically averaged sound pressure level spectrum for the source room and receiving room.

In the receiving room the reverberation time is measured as well allowing to calculate the correction term in the formula for the sound reduction index R (via the equation of Sabine: A=0.16V/T, V = volume of the receiving room). The sound reduction index R is calculated with the formula:

$$R = L_{pm1} - L_{pm2} + 10\log(S/A) \ [dB]$$

L_{pm1} = the average (space / time) sound pressure level per 1/3d octave bands in the source room [dB] (ref. 20 micro Pa)
L_{pm2} = the average (space / time) sound pressure level per 1/3d octave bands in the receiving room [dB] (ref. 20 micro Pa)
S = the surface of the test opening in which the test element is mounted [m²];
A = the equivalent absorption-surface of the receiving room [m²] (from A=0.16 V/T with V=volume of receiving room in m³).

NOTE: RATING OF THE SOUND INSULATION and SPECTRUM ADAPTATION TERMS

Calculations of the single rating and the different spectrum adaptation terms are carried out as to EN ISO 717-1:1996 (see references title page) and cannot be explained in a few lines. For your information, the old national single values (NL, B, FR) are stated as well in this report (note: D & GB = EN ISO 717-1). Calculation modules and additional information about the rating of single values for sound insulation (and about standards related to building acoustics in general) are given on the following website:

www.normes.be (Dutch) and www.normes.be (FR)

NOTE: RATINGS AS TO OLD, NATIONAL STANDARDS (B, NL, FR)

1. België - Belgique - Belgien: NBN S01-400:1977 - Criteria van de akoestische isolatie - Critères de l'isolation acoustique

categorie binnenwanden (100 - 3150 Hz):	IV a	categorie binnenwanden (100 - 5000 Hz):	IV a		
categorie gevelisolatie (100 - 3150 Hz):	V b	categorie gevelisolatie (100 - 5000 Hz):	V b		

2. Nederland: NEN 5079: mei 1989 - Geluidwering in woongebouwen. Het weergeven in één getal van de geluidisolatie van bouwelementen, gemeten in het laboratorium.

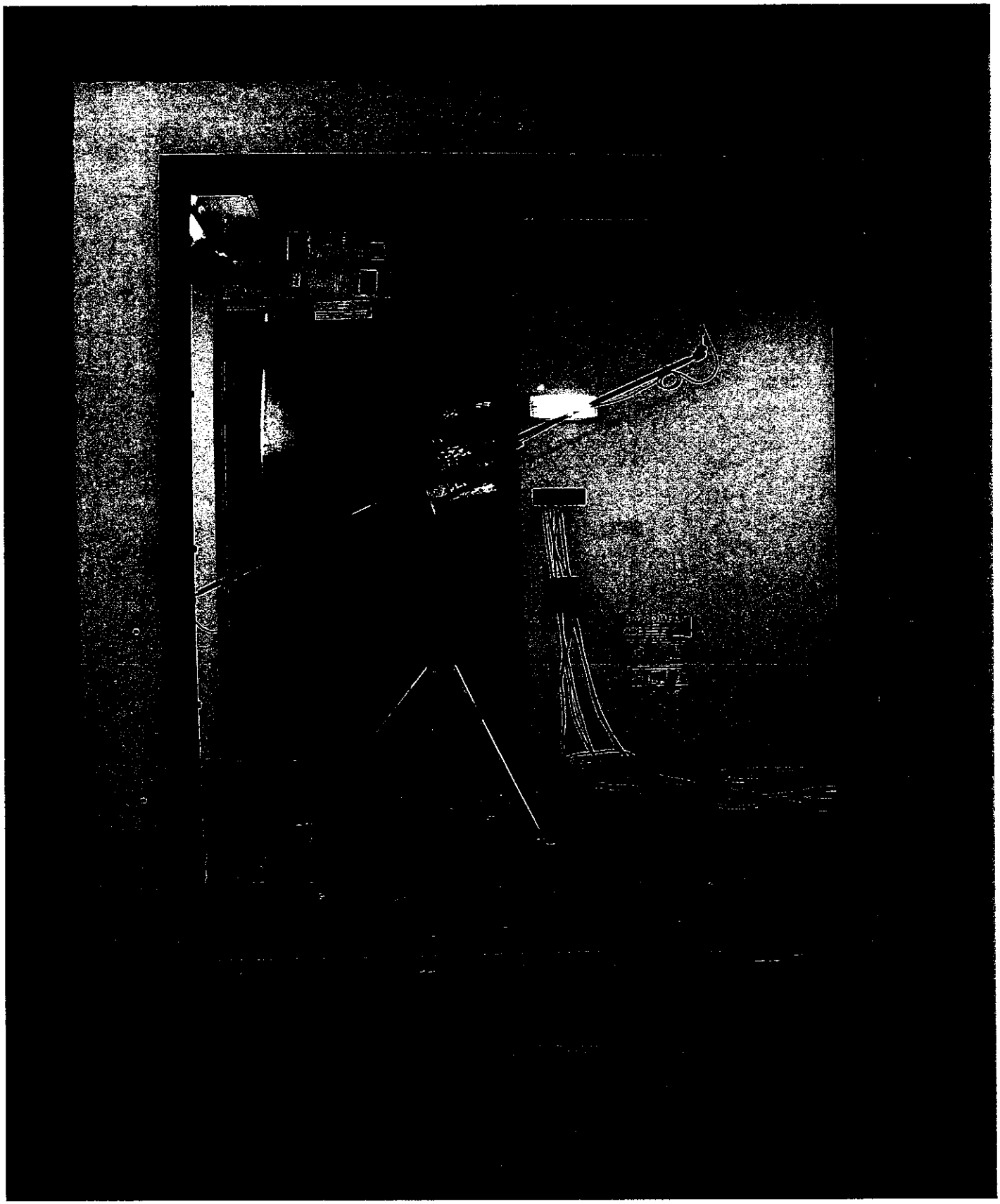
buitengeluid:	R_A = 34 dB(A)	railverkeer: $_{A,r}$ =	36.5 dB(A)	Laboratoriumisolatie-index voor luchtgeluid
wegverkeer:	$R_{A,v}$ = 34 dB(A)	luchtverkeer: $_{A,l}$ =	35.3 dB(A)	$I_{lu,\ lab}$ = -14.0 dB

3. France: NF S 31-051 (Décembre 1985) - Acoustique - Mesure du pouvoir d'isolation acoustique des éléments de construction et de l'isolement des immeubles. Mesure en laboratoire du pouvoir d'isolation acoustique au bruit aérien des éléments de construction.

Indice d'affaiblissement R exprimé en dB(A) pour un bruit rose à l'émission:	R_{rose} = 36.7 dB(A)
Indice d'affaiblissement R exprimé en dB(A) pour un bruit routier à l'émission:	R_{route} = 30.9 dB(A)

DETAILLED DESCRIPTION OF THE BUILDING ELEMENT

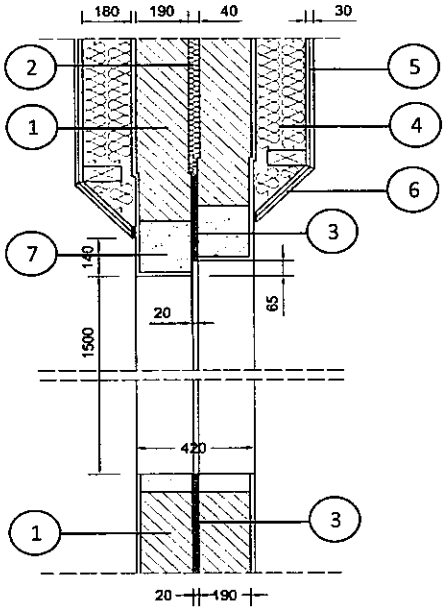
This description is given by the producer of the test element and is not guaranteed by the laboratory. The equivalence between the tested product in this report and the commercialised product is the sole responsability of the producer.

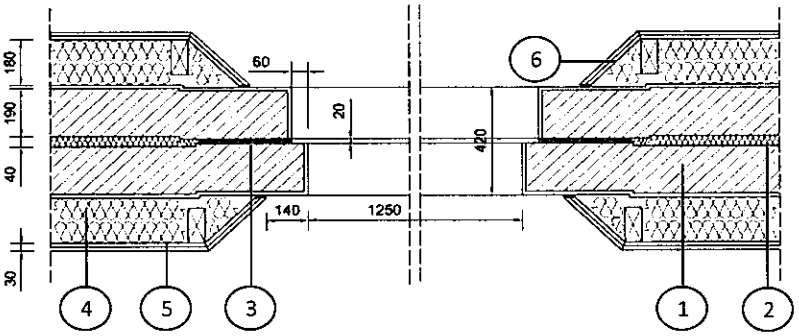


SPECIFIC PARTITION FOR REDUCED-SIZE TEST ELEMENTS

1. Partition between the source room and the emission room

The construction of the partition wall with test opening for reduced-size test elements is illustrated by the vertical and horizontal section below. The wall is symmetrically composed by different, well decoupled wall parts at both sides of the central cavity.





1 : *plastered, hollow concrete blocs filled with stabilized sand (ca. 1800 kg/m³)*
2 : *4 cm cavity filled with mineral wool*
3 : *2 cm (!) cavity filled with mineral wool*
4 : *18 cm cavity filled with mineral wool*
5 : *2 x 15 mm gypsum board*
6 : *gypsum boards chamfer of 45 %*
7 : *concrete beam (ca. 2300 kg/m³)*

2. Mounting

The total niche depth of the test opening is 42 cm. The glass pane (1.23 m x 1.48 m) is installed into the test opening so that the niches on both sides of the pane have different depths within a ratio of 2:1. To fix the test specimen a thin frame of wooden beads (25 mm x 25 mm) is used. The gap of about 10 mm between the glass pane and the reveal of the test opening is filled with putty (Perenator). The space about 5 mm between the pane and the locking edge is filled with the same putty over the full depth of 25 mm. The remaining visible glass pane after mounting measures 1.20 m x 1.45 m. Measurements are always made from the room with the smallest opening (1.25 m x 1.45 m) in which the glass pane is mounted, to the room with the largest opening. This construction meets the requirements of EN ISO 10140-1/2/4/5:2010, EN12758:2011 and EN 14351-1-2006.

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e-LAB CONSTRUCTION (1/2)

Generalities *(see next page with 3D drawings)*

The e-LAB diposes of 6 fixed transmission rooms (A, B, C, D, E, F), a mobile room M and a reverberation room (alfa). The rooms are organized in such way that airborne sound insulation measurements are possible according to following combinations (source, receiving) : (A,B), (C,B), (C,D), (E,D), (E,F), (A,F) and (E,B). Measurements are always made from the largest to the smallest room (minimum volume difference of 10 %). Finally measurements can be made from the mobile room M (movable with overhead crane) to every other ixed transmission room underneath.

Combinations of transmission rooms

(C,D) and (A,F): partition with small-sized test opening (1.25 m x 1.50 m) in accordance with "§3.3.3 Specific small-sized test opening" of the EN ISO 10140-5 to measure the sound reduction index, mainly for glazings or windows.

(E,B): partition with small-sized test opening (1 m x 2.6 m) to measure standard door constructions, board material, etc.

(E,F): special test opening on to which a mobile concrete frame can be mounted. The test element is mounted outside the room in the concrete frame and transported into this test opening with the overhead crane.

(A,B, (C,B) and (E,D) have traditional test openings in accordance with EN ISO 10140-5. The test element is mounted in rooms B or D which are completely built as a box-in-a-box by means of an additional floating floor on top of the floor slab mounted on resilient pads.

Floor slabs

Each fixed room as well as the reverberation room is built up a 30 cm thick massive concrete floor slab, resiliently mounted by CDM-pads on massive foundation beams. These slabs are isolated from the environment and the adjacent rooms by a 5 cm large cavity filled with mineral wool. The mobile room is supported on the side of the central axis (seperation rooms A,B,C from rooms F,E,D) by the adjacent rooms, and on the outside by a steel frame attached to the columns carrying the overhead crane. This way no hard contacts exist between the mobile room M and any fixed room below . To complete the box-in-box construction in rooms B en D, a 10 cm thick floating concrete slab (in blue on the figures) is placed by means of 5 cm thick CDM-pads on top of the decoupled slabs. The cavity is filled with mineral wool.

Ceiling slabs

The ceiling slab on each fixed transmission room consists of three parts, carrying from the outer walls to the central axis. The three parts are : (1) a concrete slab with 14 cm thick local savings, used for impact sound measurements according to EN ISO 140-3, and an all-around 30 cm thick and 25 cm large concrete border. (2) and (3) are 30 cm thick massive concrete elements. All ceiling slabs can be removed by the overhead crane. For each room, they are joint together and to the underlaying walls by a mortar joint. Still three exceptions remain: in rooms B en D a resilient joint is put into place between the border of the ceiling slabs and the concrete beam connected to the test element beneath, to avoid flanking transmission to the latter. The slab parts (2) and (3) as well as the thick edges of (1) are shielded by heavy (movable) suspended ceiling constructions. This in order to avoid radiated impact sound from slab parts (2) and (3), als well as to determine the vertical airborne sound insulation between the mobile room M and the fixed room below for test elements within the surface of (1) (adaptable, with or without shielded edges)

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Frame structure

The fixed rooms are built with a frame structure consisting of concrete columns supporting 60 cm high and 20 cm thick concrete beams. 30 cm thick beams are used in connection with test elements (in red on figure). The beams are fixed mechanically and can be removed easlily. The columns close to the central axis are conceived to allow for the filler walls to continue behind the columns and connect with the test element. Between the column and the filler wall, a decoupling insulation is placed. The aim of this construction is to allow for a sufficiently high, necessary coupling loss for the test element.

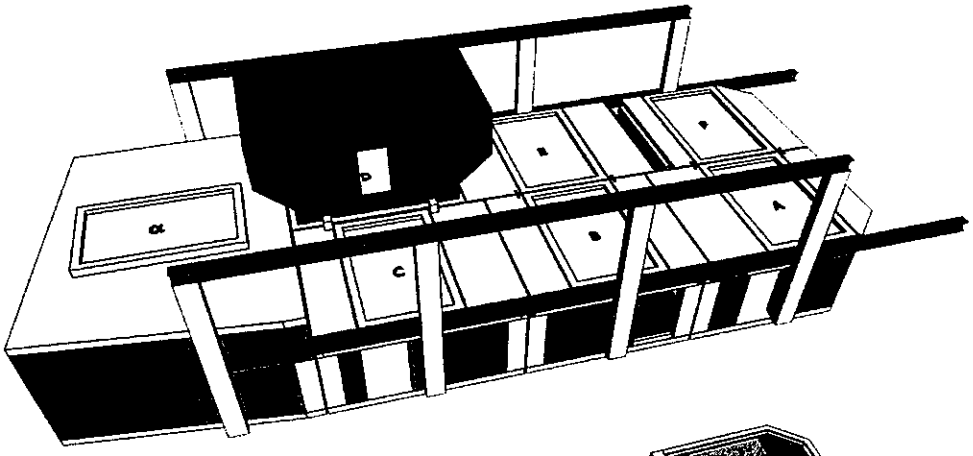
Filler walls

The non load-bearing basic filler walls are made of 19 cm thick hollow concrete blocks, mounted inversely and fully filled with stabilized sand. The surface mass of such a wall is about 380 kg/m². Only the filler walls in the central axis are plastered. All walls are shielded with linings.

Linings

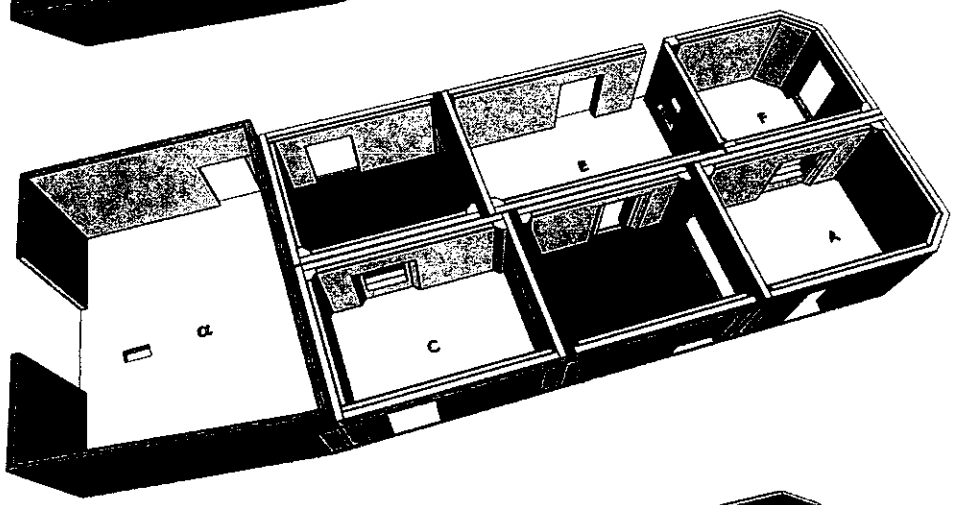
To allow for the ceiling slabs to be removed, the linings are attached to the walls. Therefore a timberframe structure (see picture) is fixed resiliently, to which a lightweight metal frame (metal studs) en gypsum boards (2 x 15 mm) are mounted. The 18 cm wide cavity is completely filled with mineral wool.

e-LAB CONSTRUCTION (2/2)

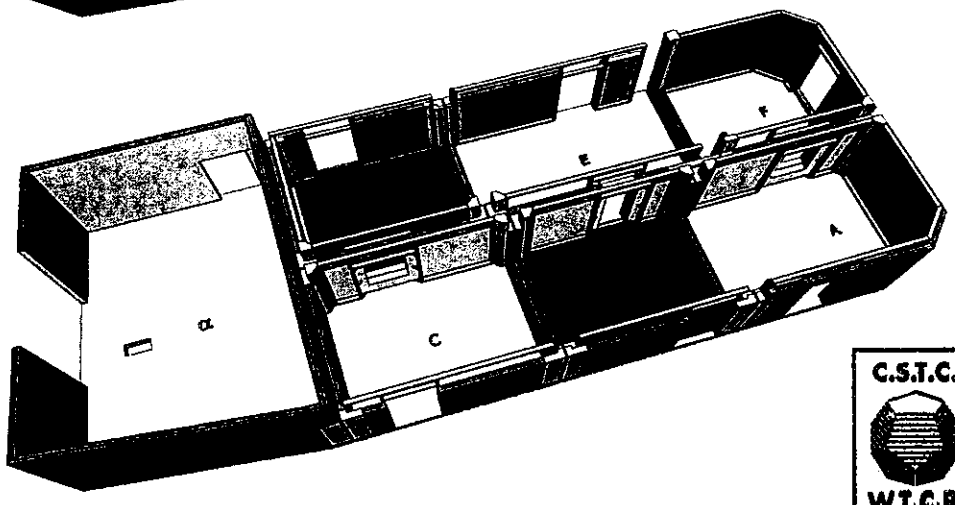


3D illustration of the acoustic laboratory, showing the overhead crane, the mobile room M and the ceiling slabs with local savings (rooms illustrated without doors).

Illustration of the laboratory without overhead crane, mobile room and ceiling slabs. View on the suspended ceilings inside the transmission rooms A to F.



View inside the transmission rooms. Blue : floating concrete slab inside rooms D and B. Red : beams and filler wall in connection with the test element (not illustrated).



View inside the transmission rooms showing the timber frame structure on which the metal framework and gypsum boards (ommitted in picture) of the linings are mounted.

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