Noise Barriers for Motorways & Railways in the European Union – European Regulations & Construction Tec
Thessaloniki Greece 20

A cost-benefit evaluation of Noise Barriers shows positive outcomes when the products meet the criteria of durability & sustainability

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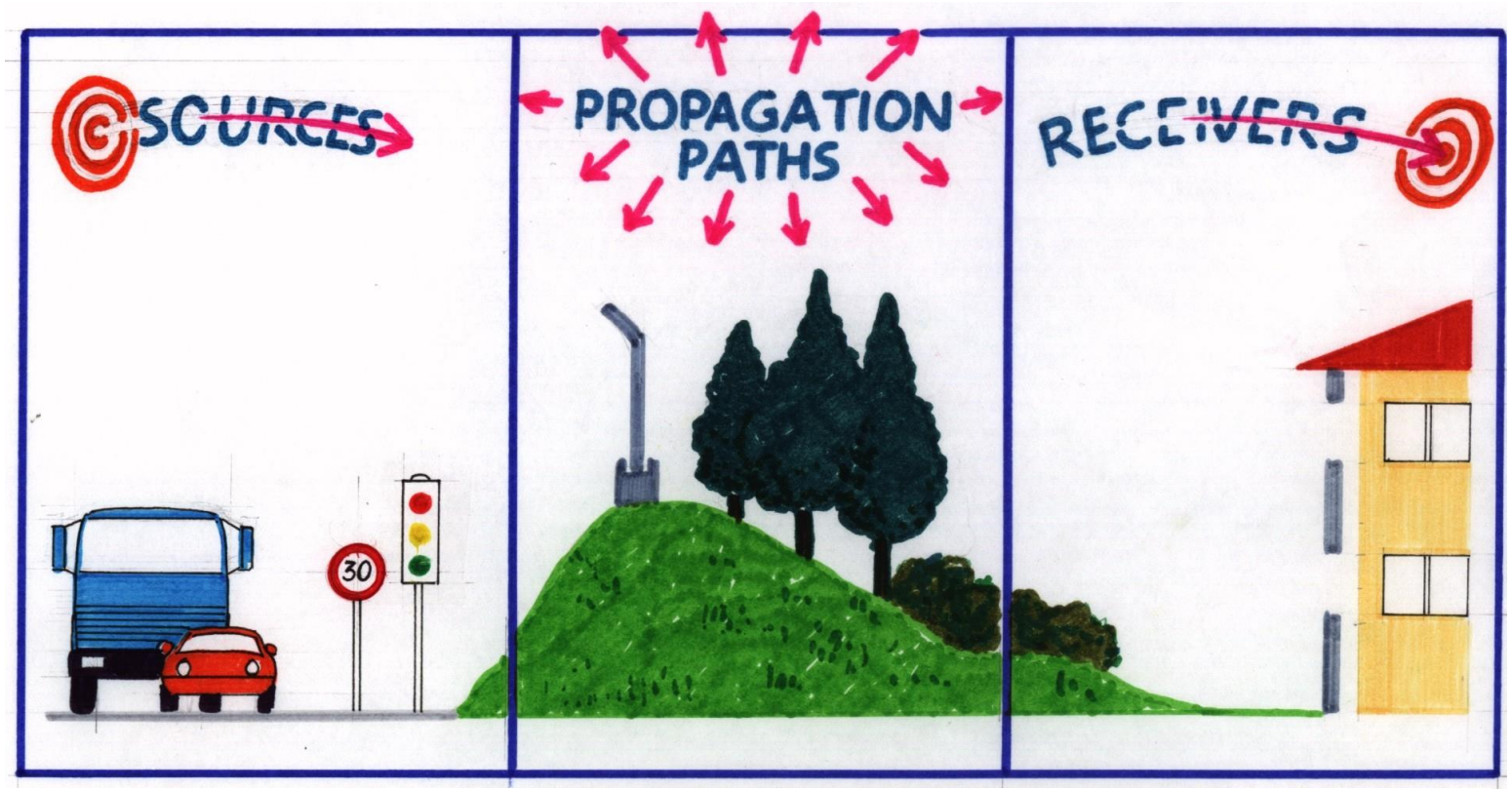
Member of CEN standardization technical committees
Noise Expert in DGENV EU Commission

Summary:

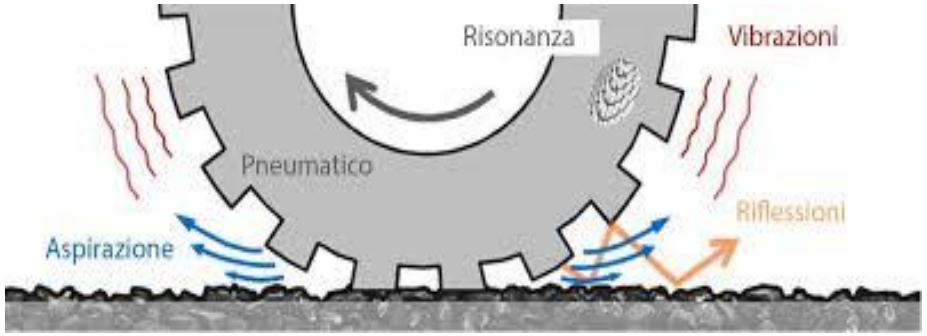
- Noise barriers as a tool for noise reduction strategy
- Design activities
- Product/system performance
- Focus on durability & sustainability



EXPECTED INSERTION LOSS VS POPULATION INVOLVED

- 4 dB(A)	-10 up to -20 dB(A)	> 20 dB(A)
FOR ALL RECEVERS	FOR MANY REVEICERS	FOR A FEW RECEIVERS

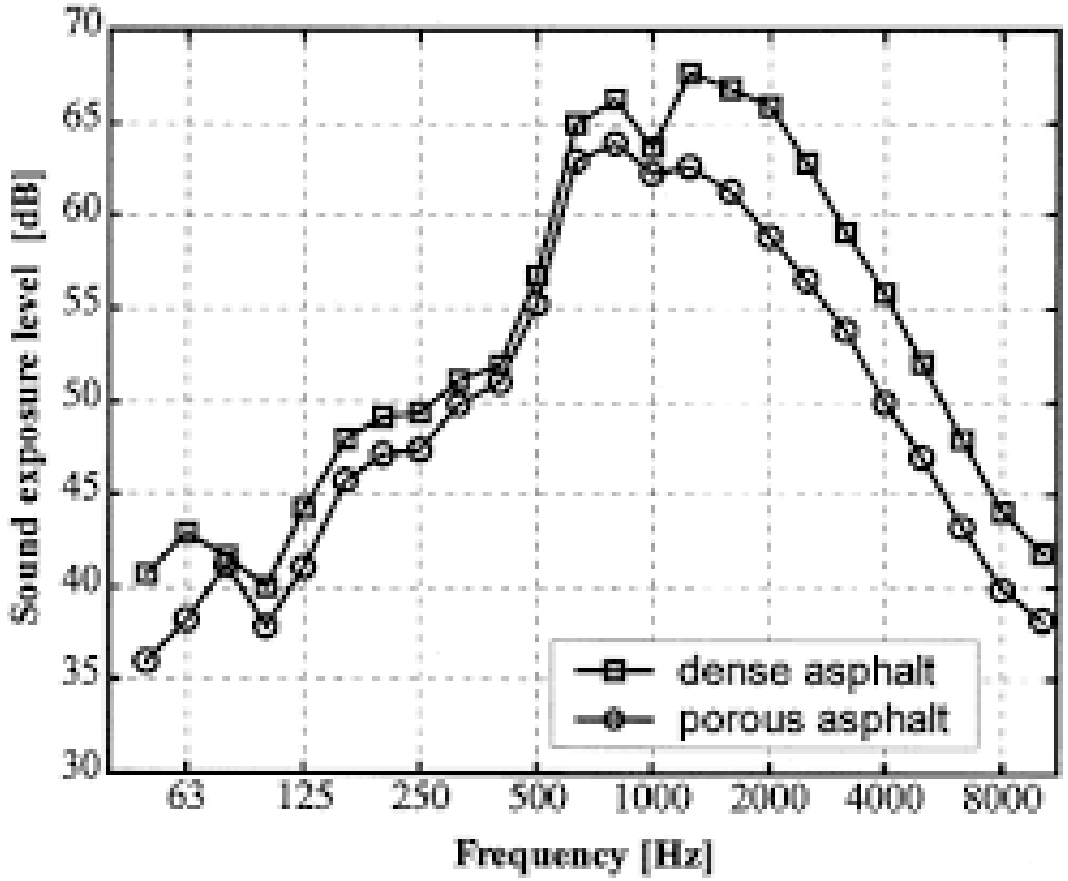
Interventions at the source: expected outcomes in terms of noise reduction



Porous asphalt case

Tyre Noise label

Combination of porous asphalt and noise barrier: any chance?

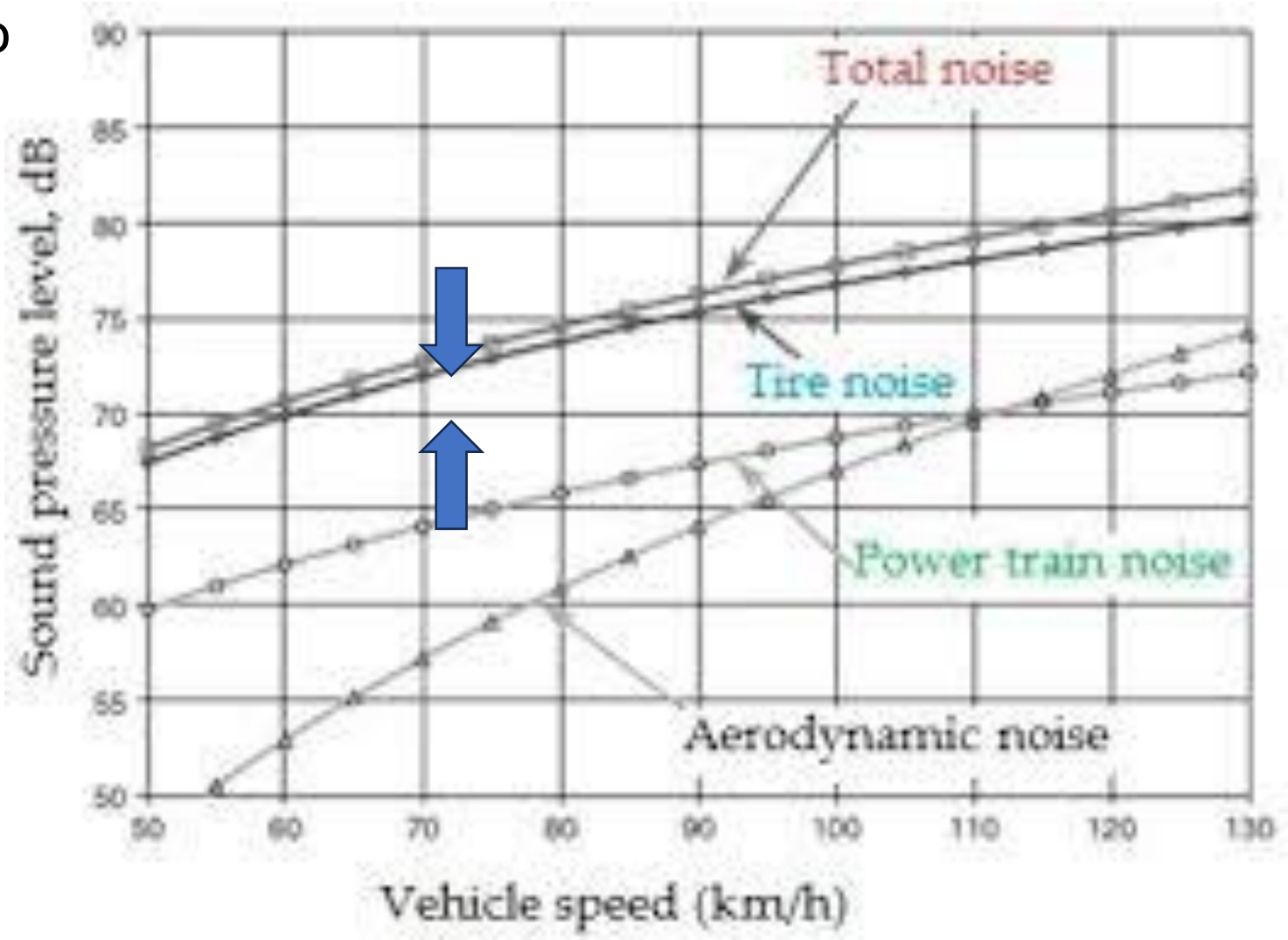


- Conventional porous asphalt effect is evident over 500 Hz third octave band
- Effect of noise barrier due to diffraction is expected in the same frequency range
- This is not a favourable condition as total results is not the mere summation of the effects; i.e.

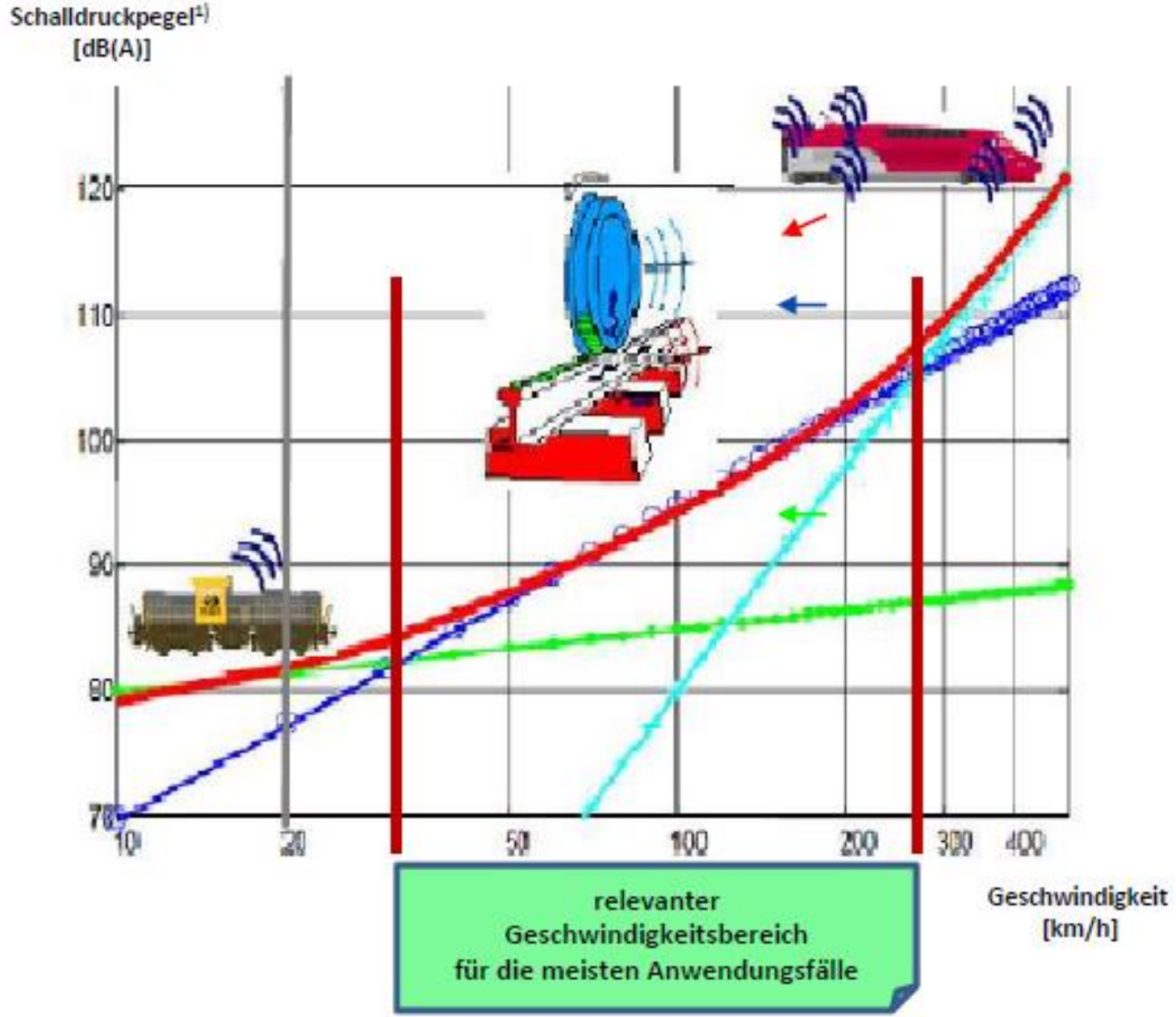
- IL (measured behind a noise barrier) = 15 dB
- IL (measured with a porous asphalt) = 4 dB
- IL (measured with their combination) = 16 dB

Electric mobility: possible scenario

Road traffic noise sources
Expressway motorway
Light vehicle case



rail sector case





In the rail sector

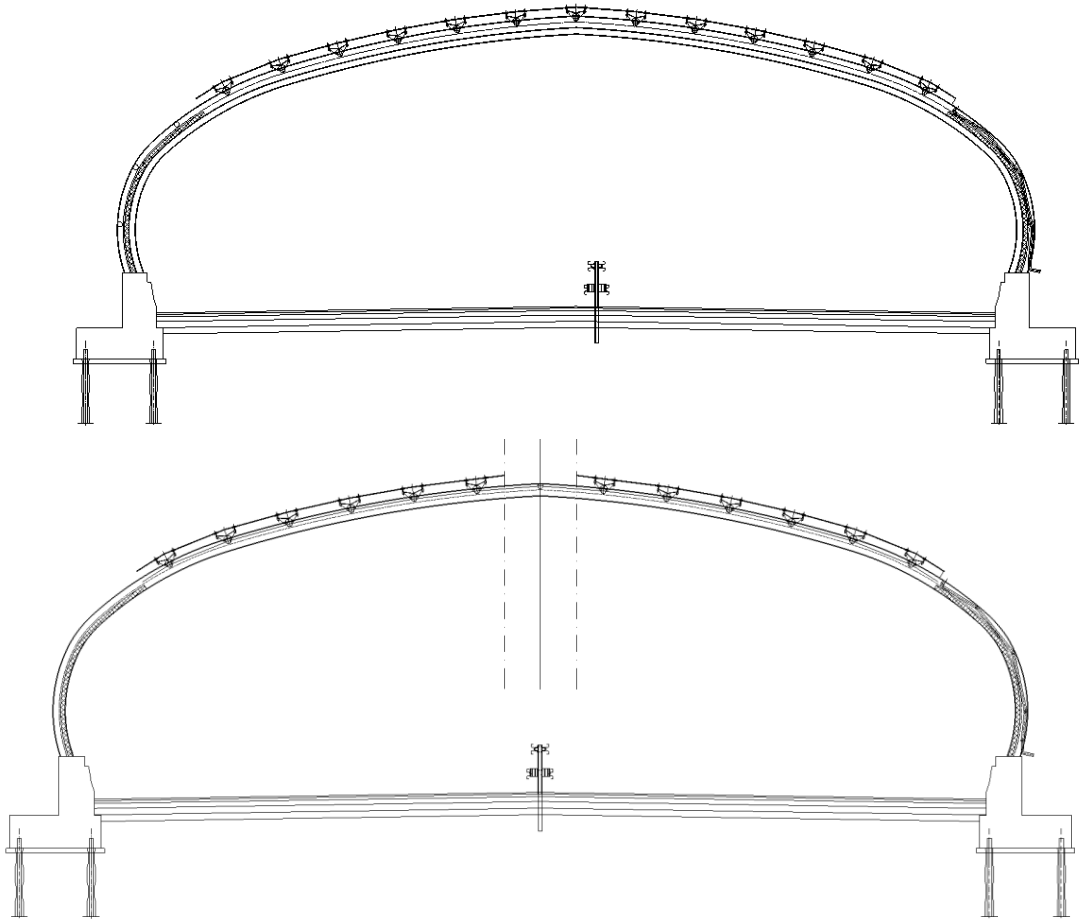
Absorbing track surface - Close proximity barrier - Rail dumper - Low height noise barrier

Electric mobility will not provide a solution in extra urban areas

Action on road surface can ensure a moderate noise reduction for many receivers

Action on the building can ensure an high noise reduction for a few receivers

Noise barriers (or covering) remains the unique approach in case a significative noise reduction is required for many receivers

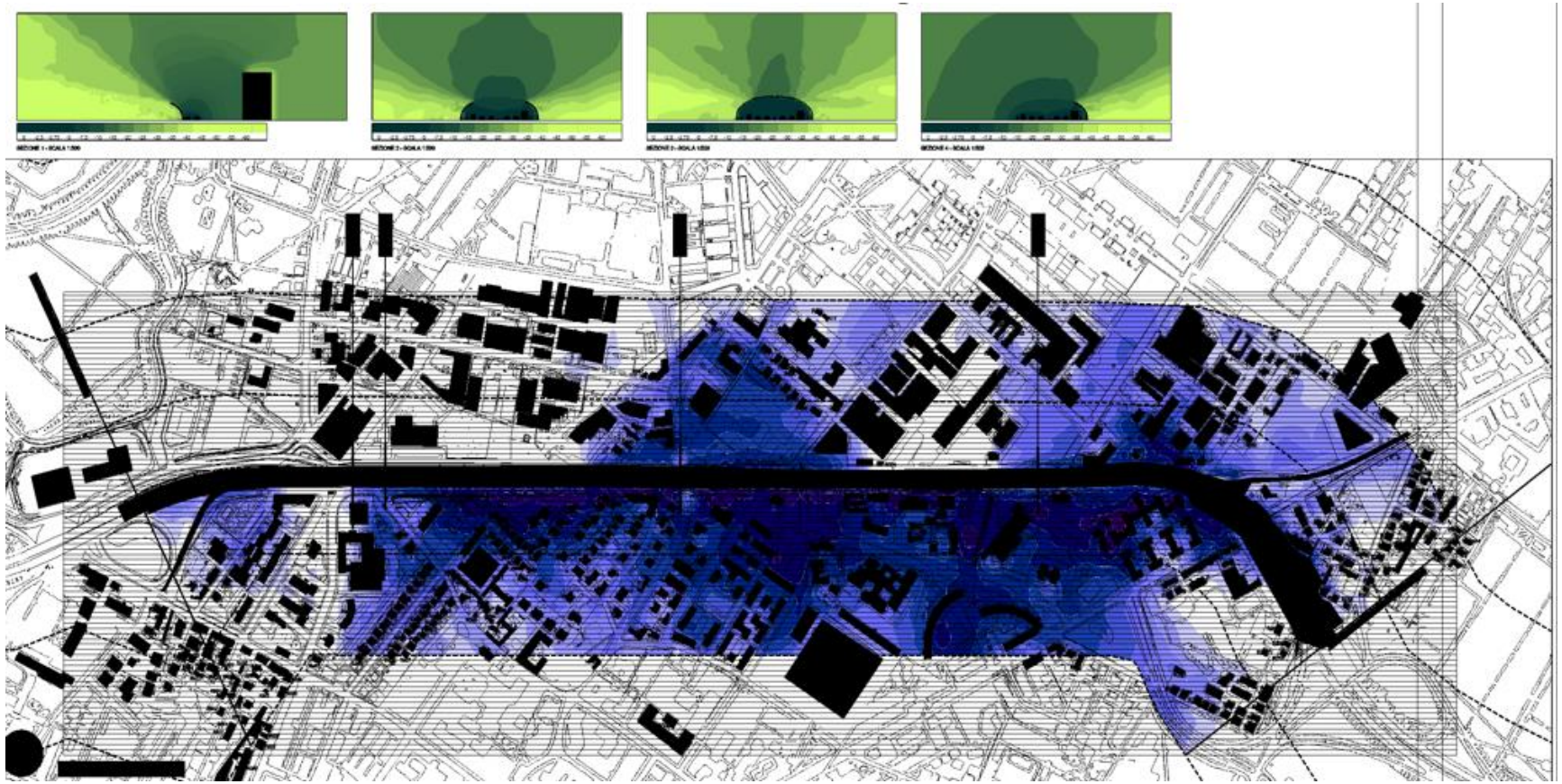


How to address public resources for traffic noise reduction ?

Option a)

Use available fundings for a few decibel reduction on the whole network ?

Option b)



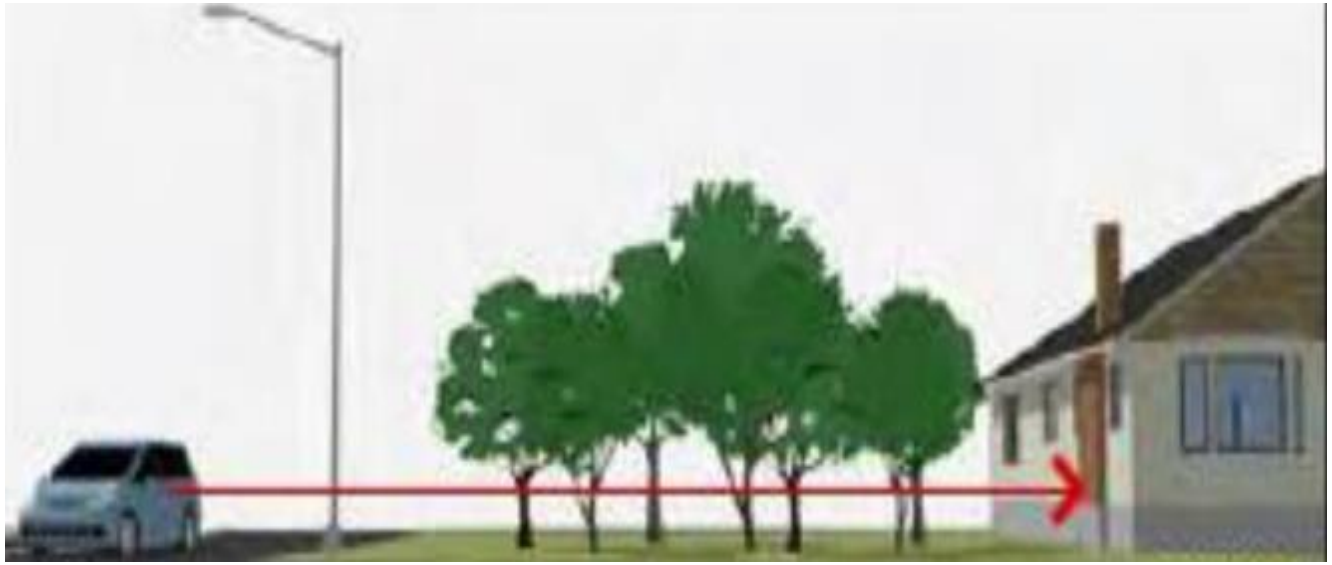
Start focusing on the black spots to achieve a significative noise reduction for more exposed receivers ?

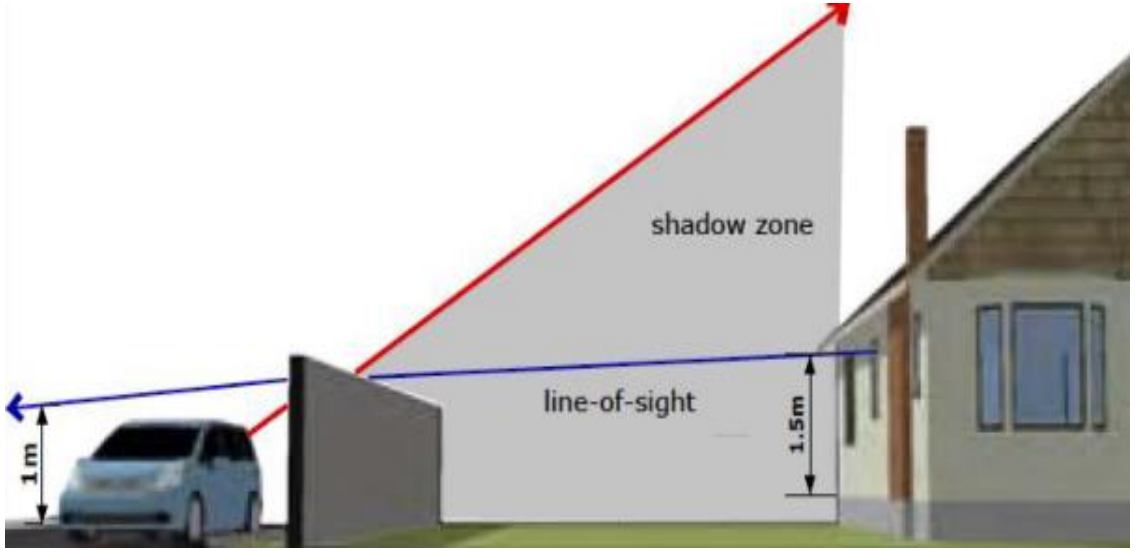
Let's start with the word we use:

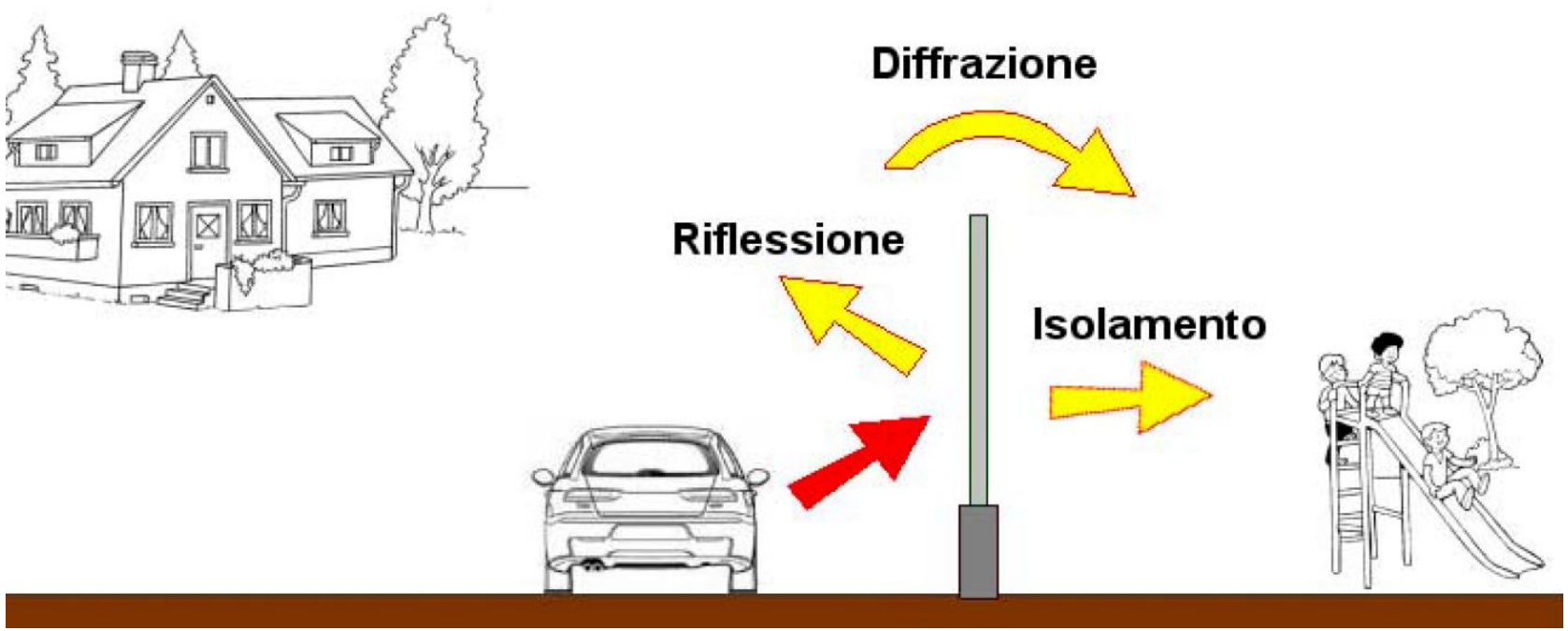
Target of the acoustic design of the noise barrier:

To improve its extrinsic performance

Characterized by the Insertion Loss IL: difference of noise levels without and with the noise barrier







Acoustic design steps:

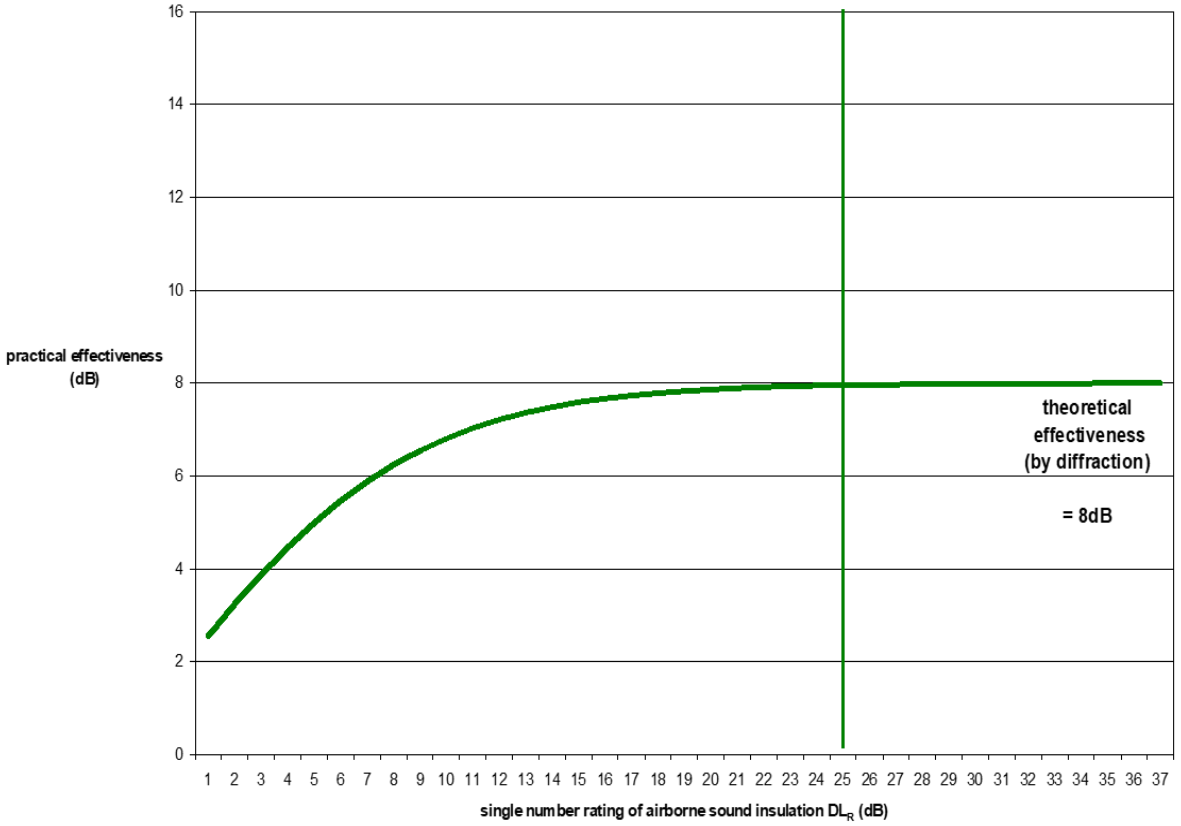
1 - calculation based on **diffraction**: the height and the length of the noise barrier is defined to achieve ti noise reduction required at receiver point

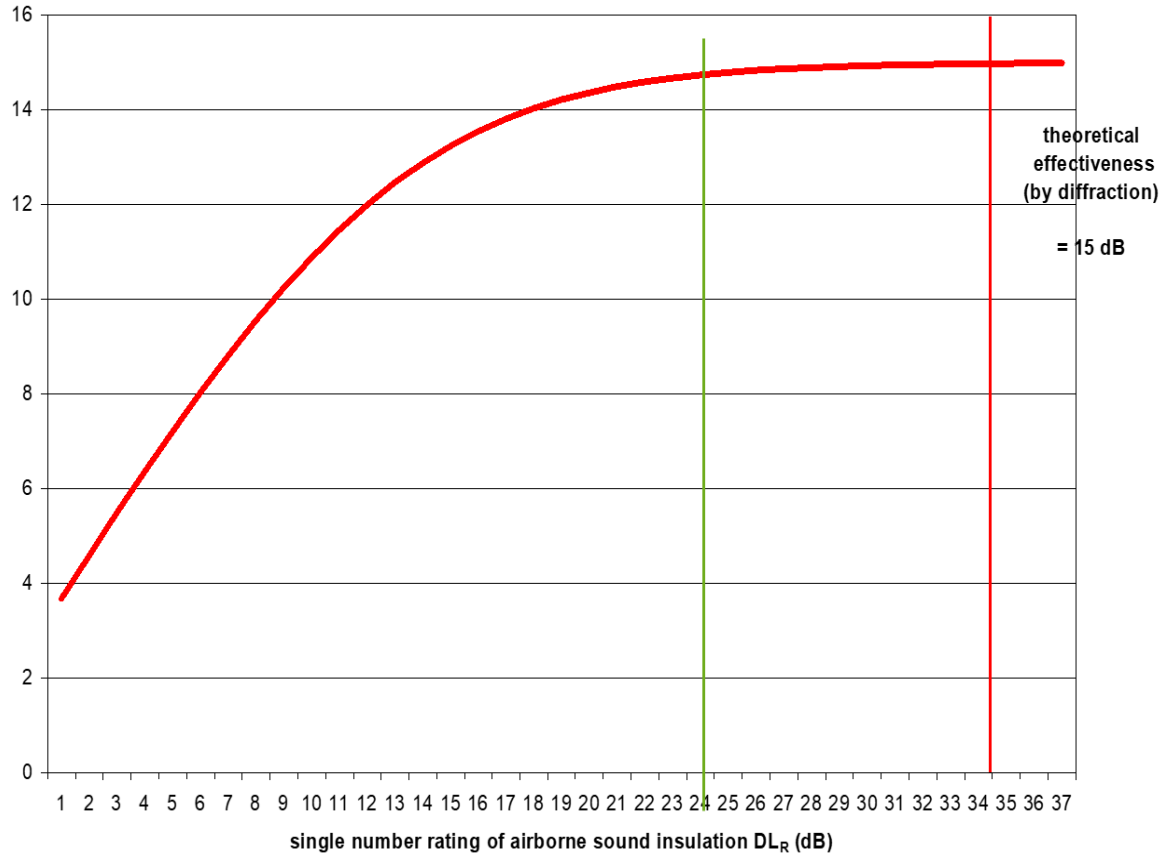
2 - choice of the noise barrier type to achieve maximum **acoustic insulation** requested

3 - choice of the noise barrier type to achieve maximum **acoustic absorption (minimum reflection)** requested

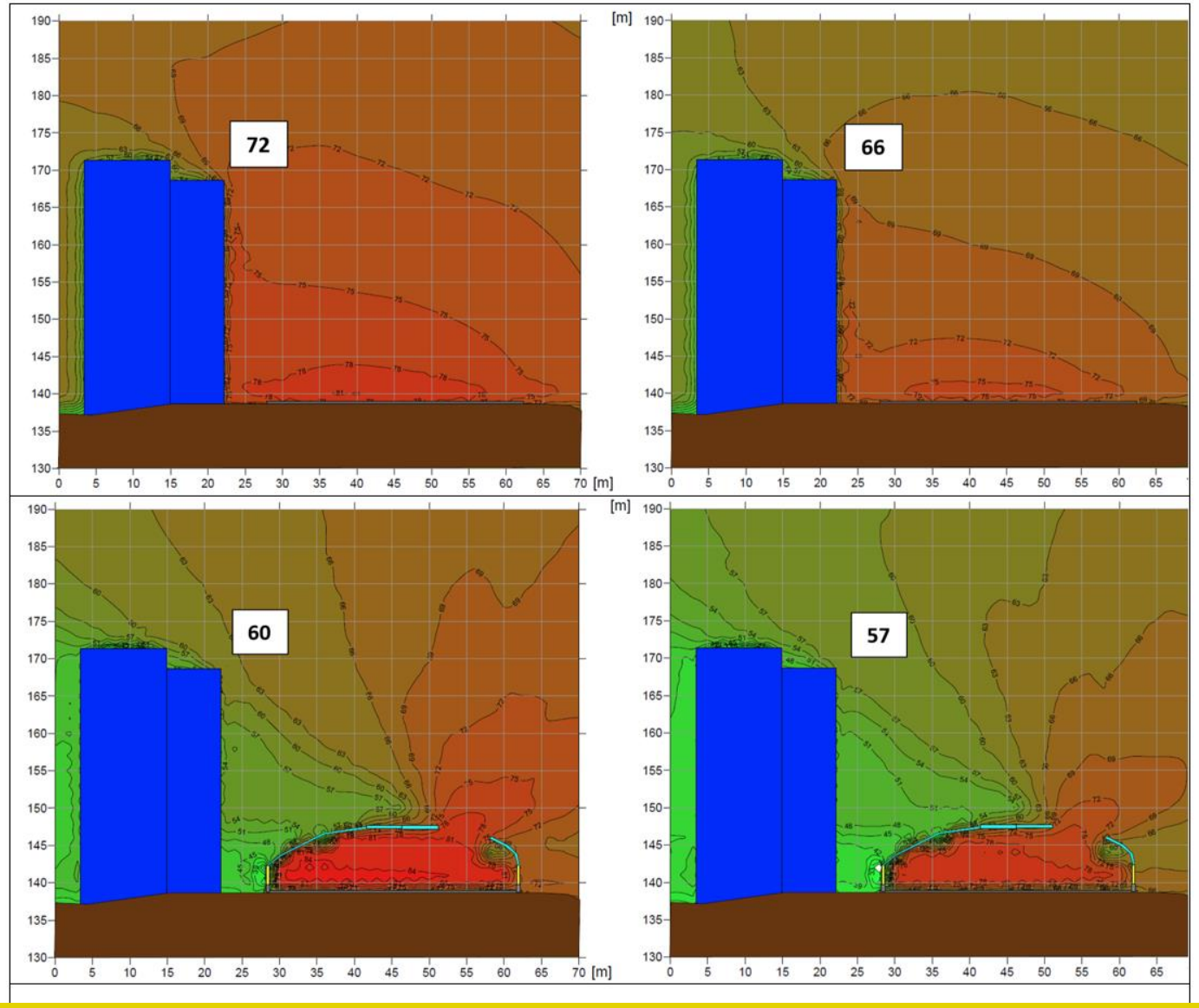
Once the expected effectiveness by diffraction is defined,

- the optimal acoustic insulation is calculated
- choice of the materials (depending on the surface mass)



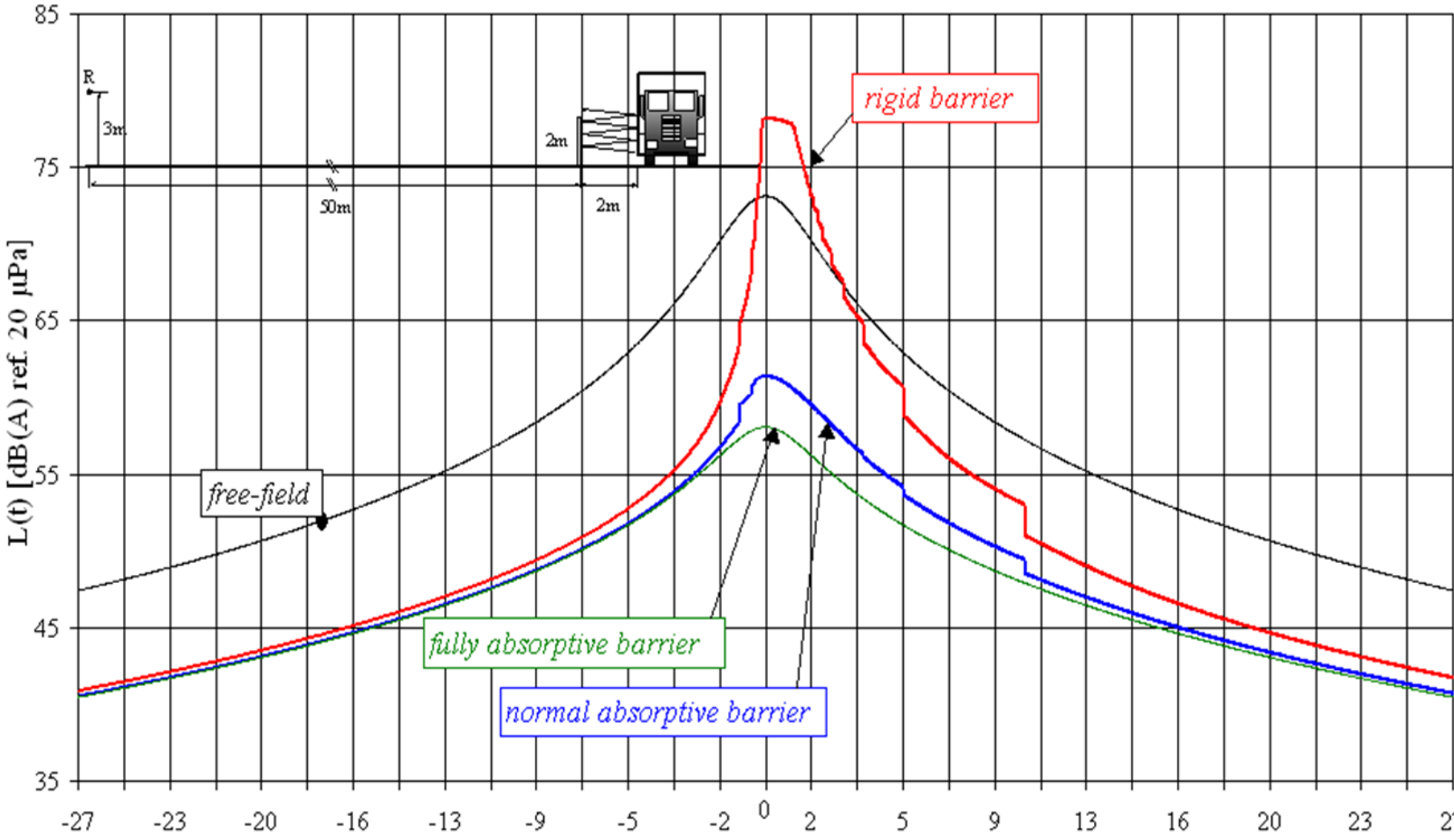


Acoustic modeling tools
Insertion loss achieved with a noise barrier partially spanning over the road



Minimizing the noise reflected by the barrier to:

- avoid any increase of noise levels in the screened area behind the barrier.
- Minimise the multiple reflection effect between the vehicles and the barriers (the figure aside show the potential consequences at the receiver point for a truck pass-by measurement)



Material > Construction

Products > Construction

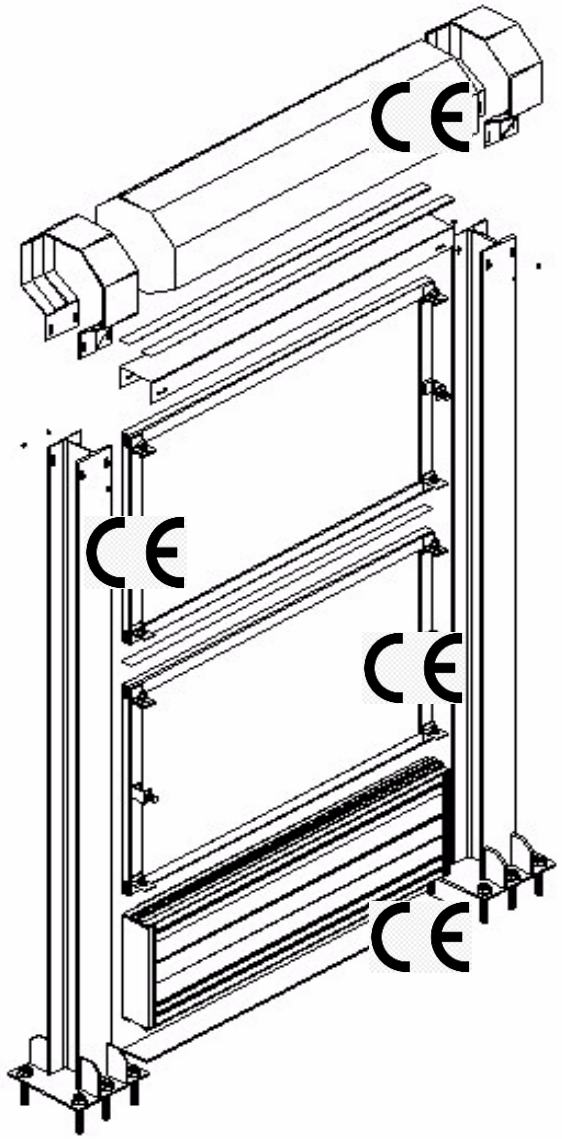
Performace declared for essential characteristics, i.e.:

Basic work requirements :

Sound insulation
Sound absorption
Mechanical perfomance
Safety perfomance
Durability
Sustainability

1 - Structural integrity of costruction works
2 - Fire safety of c.v.
3 - Protection against adverse hygiene and health impacts related to c.w.
4 - Safety and accessibility of c.w.
5 - Resistance to the passage of sound and acoustic properties of c.w.
6 - Energy efficiency and thermal performance of c.w.
7 - Emissions into the outdoor environment of c.w.
8 - Sustainable use of natural resources of c.w.

Images by LEGO



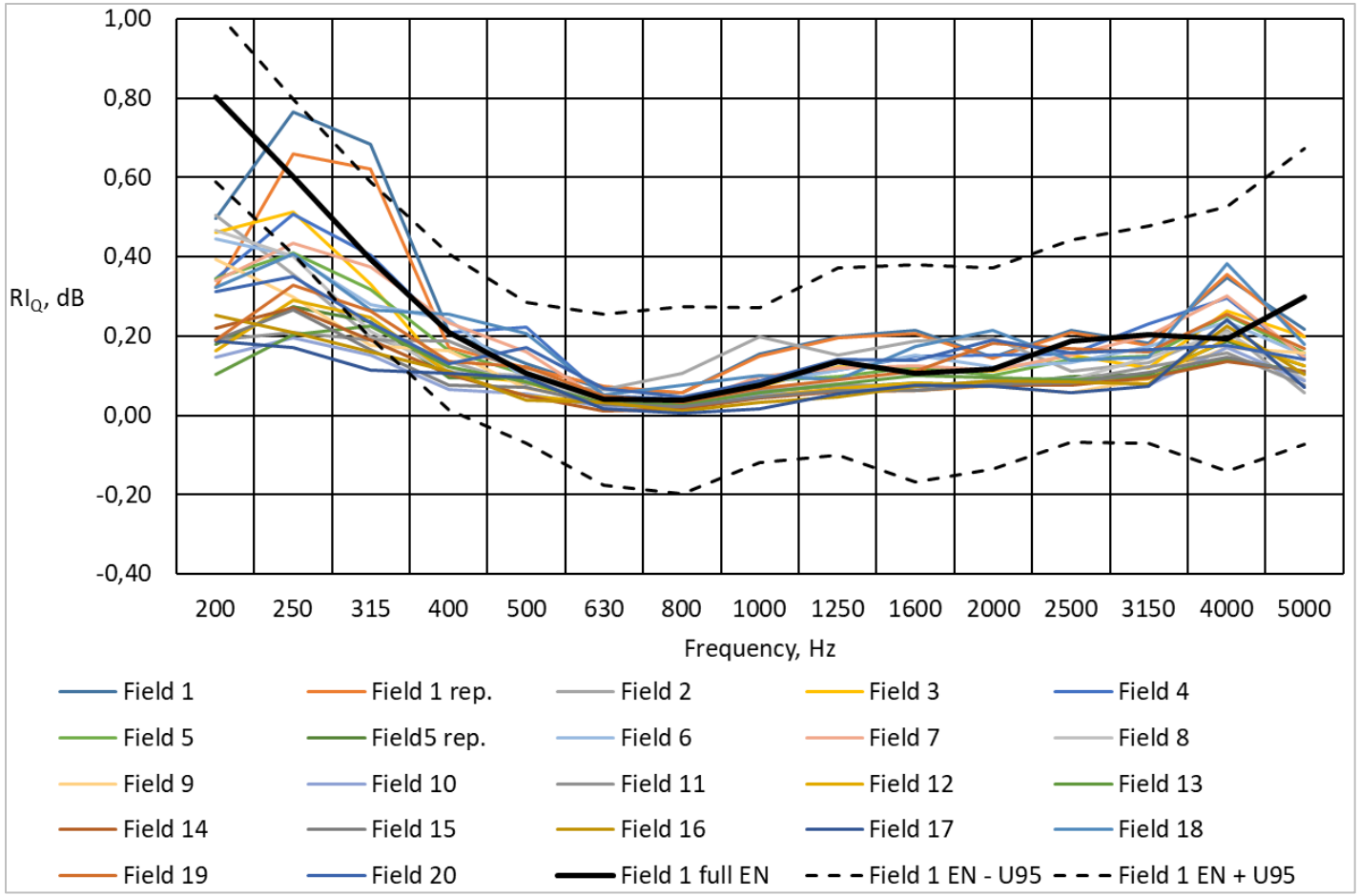
Example of noise barrier components:

- Structural post, i.e. HE steel profiles + base plate + anchor bolts
- Cassette metallic panels with inner absorbing material
- Trasparent modules, i.e. PMMA solid sheet + EPDM gasket and metallic frame
- Added device + clamping system

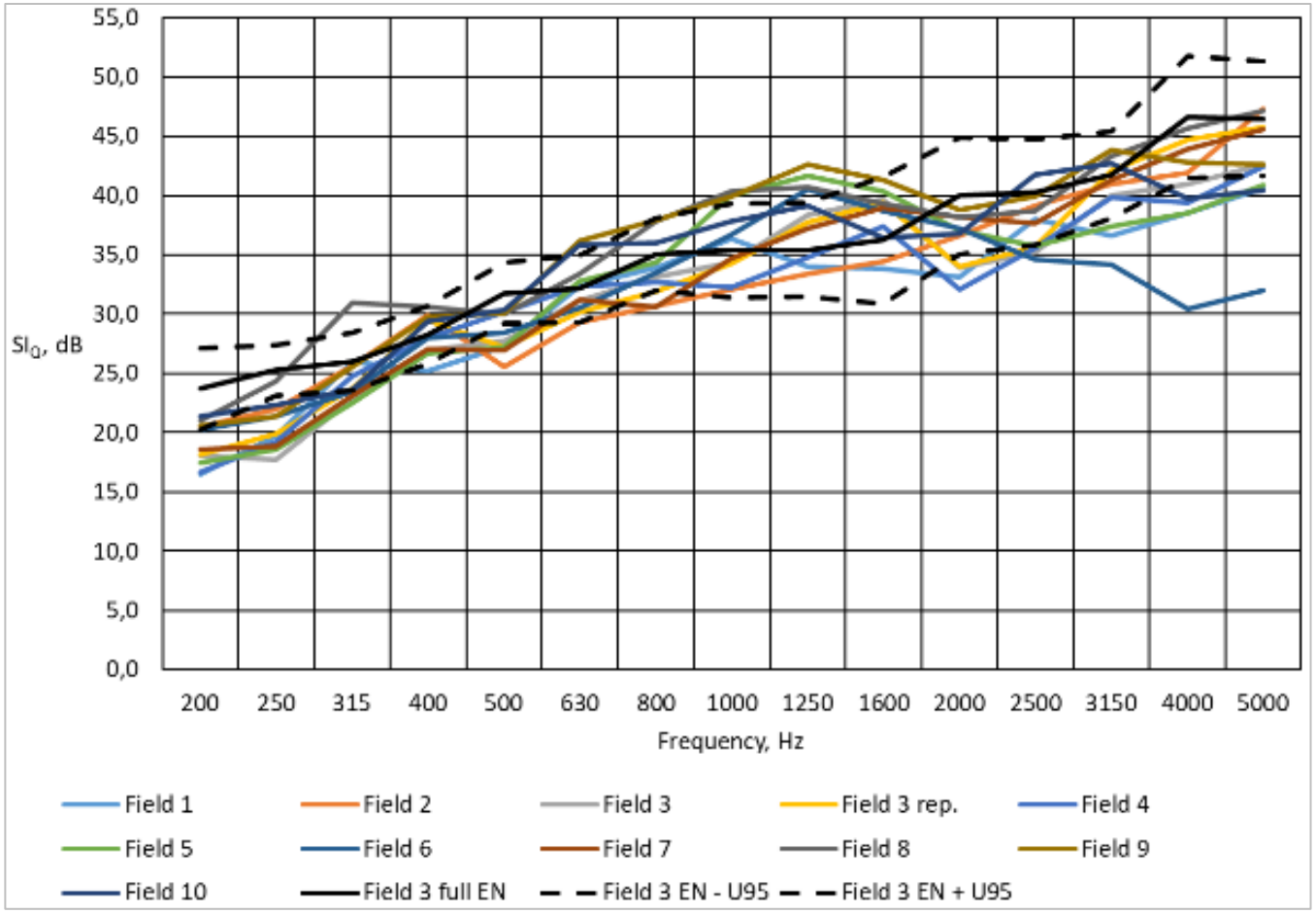
CE marking in NOT an OPTION for ROAD pplications
Homologation is requested for RAIL applications

For both a common set of techncial standards is developed by:
CEN TC 226 Road Equipment WG 6 Anti noise devices
CEN TC 256 SC1 WG 40 Noise barriers

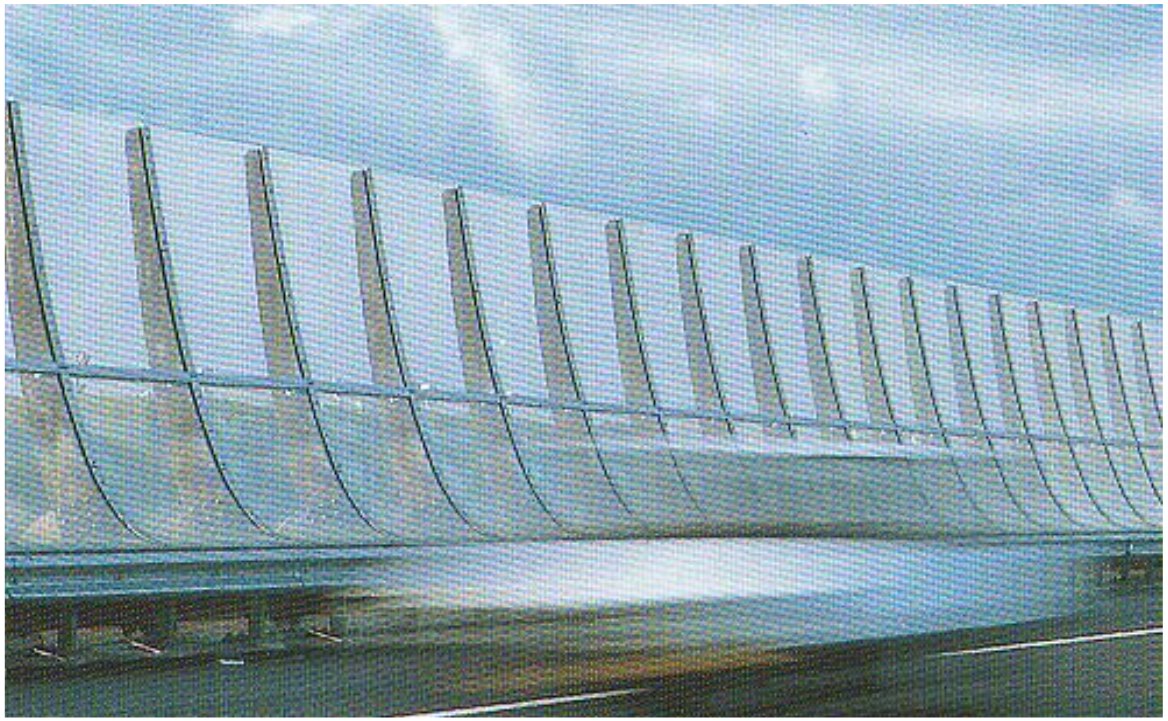
Noise barrier system perfomance tested in situ: sound reflection



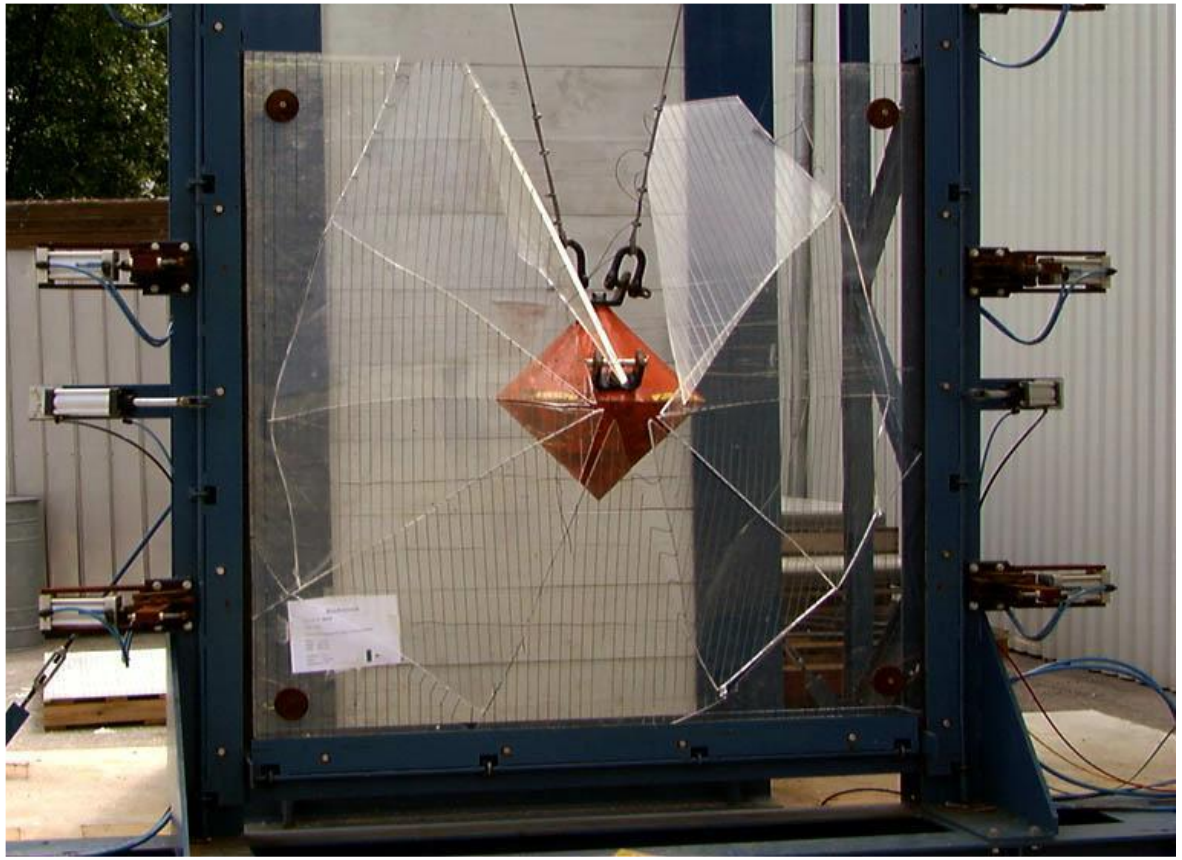
Noise barrier system perfomance tested in situ: sound insulation



Resistance to load of acoustic panels measured in laboratory

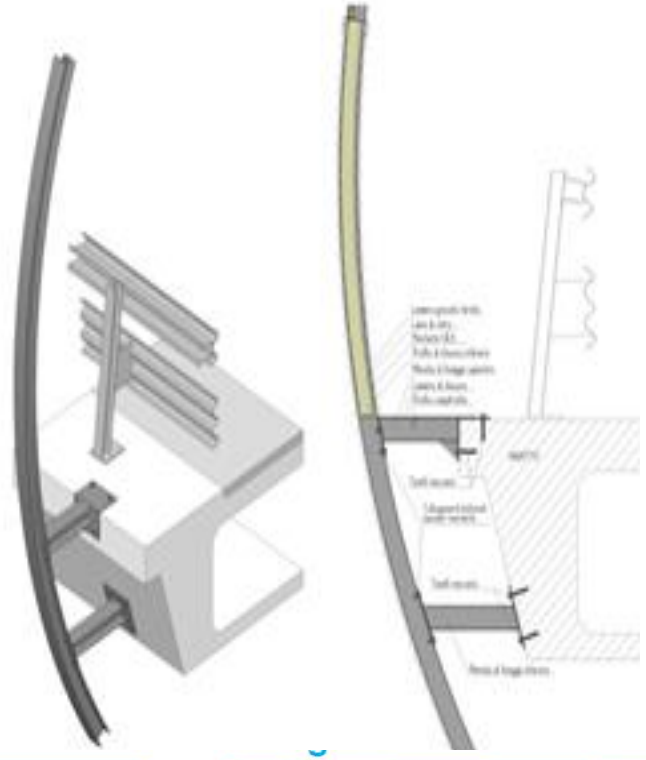


Resistance to load of the whole noise barrier calculated in situ



Resistance to impact loads of the acoustic element measured in laboratory

Safety of the nois barrier ensured in situ by a correct design

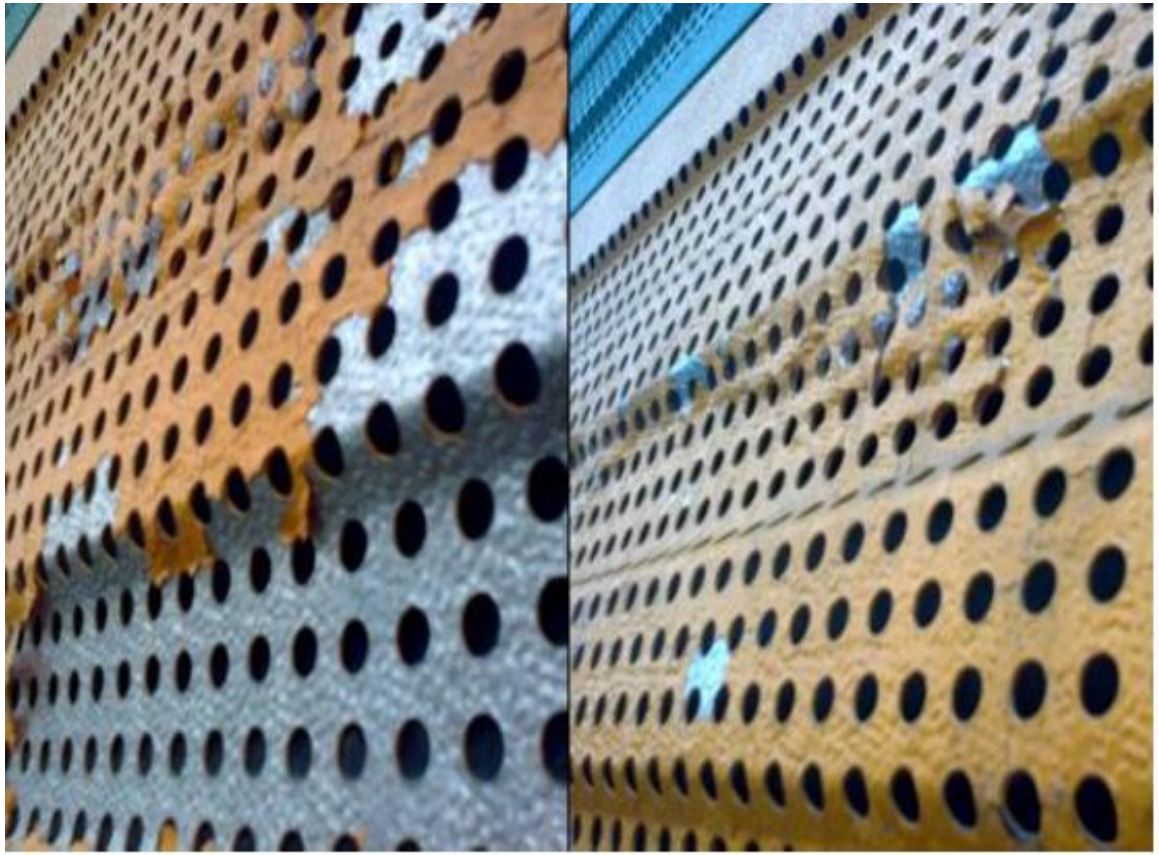


Resistance to impact of errant vehicles measured in laboratory on integrated noise-safety barrier

The installation manual is prepared by the noise barrier manufacturer

Specialized contractors (especially in the rail sector) need to be involved for the installation

Once installed Noise barriers require inspections and maintenance by road managers or contractors



Durability is declared by the manufacturer according to EN 14389 together with the maintenance manual
Inspection and maintenance activities are part of the design process
Examplesa are given for metal or timber surface protection

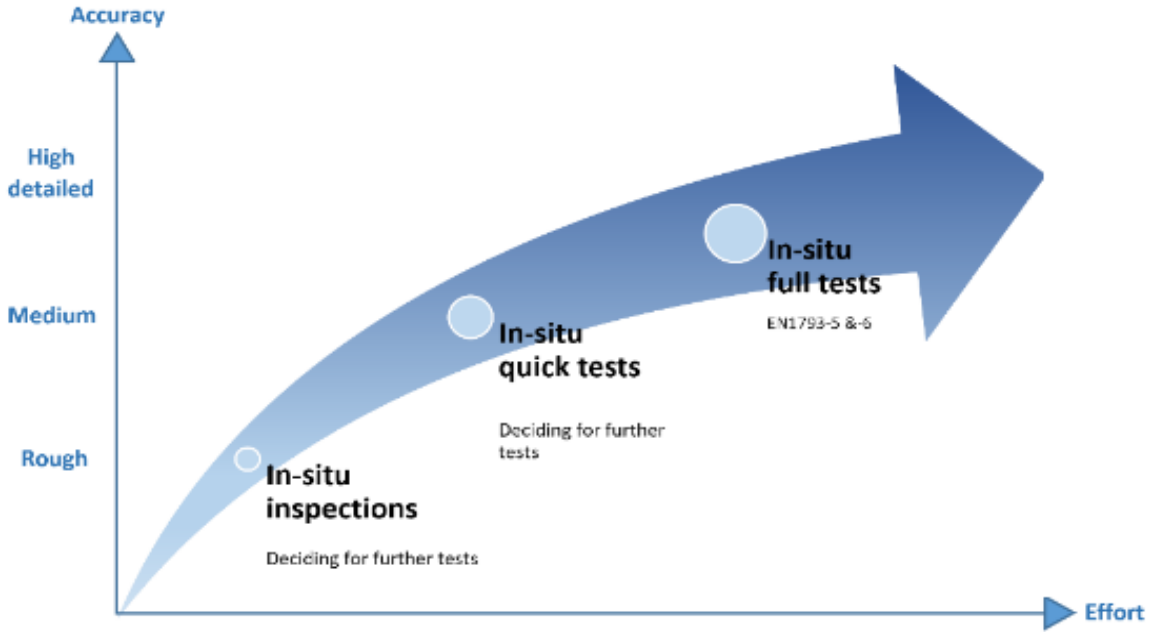
Once installed Noise barriers require inspections and maintenance by road managers or contractors

Examples are given for rockwool layer defects

Once installed Noise barriers require inspections and maintenance by road managers or contractors

Examples are given for damages occurred to the road that are detrimental for the noise barrier performance

Durability affected by vandalism or accident combined with lack of maintenace



NB inspection protocol
Sheet 1: Location

road name	B42	
near	Oberwalluf	
emergency lane	yes	
from/to km	45.7	46.5
direction	Frankfurt	
from/to coordinates	50.044433	8.137693
	50.044482	8.137751

NB inspection protocol
Sheet 2: Construction

main construction material	absorbing front?	absorbing back?	material of posts
acrylic glass	no	no	steel
combined with			
combined with			

NB inspection protocol
Sheet 4: Acoustic assessment

Assessment for each NB field individually

field no.	acoustic condition	critical radius /m
35	G	5
57	G	9
83	Q	17
84	G	8
86	G	5
87	G	9
89	Q	17

Estimated overall assessment (superposition)

field no.	acoustic condition	critical radius /m
35	G	5
57	G	9
83	Q	39
84	Q	44
86	Q	48
87	Q	46
89	Q	38

Research project : SOPRANOISE

- **S**ecuring and **O**ptimizing the **P**erformance of **R**oad tr**A**ffic noise barriers with **N**ew meth**O**ds and **I**n- **S**itu **E**valuation

- European research
  funded by **CEDR** (Conference of European Directors of Roads)

- Simplified methods to characterize the in-situ intrinsic acoustic performances of noise barriers

How Sustainability can be defined ?

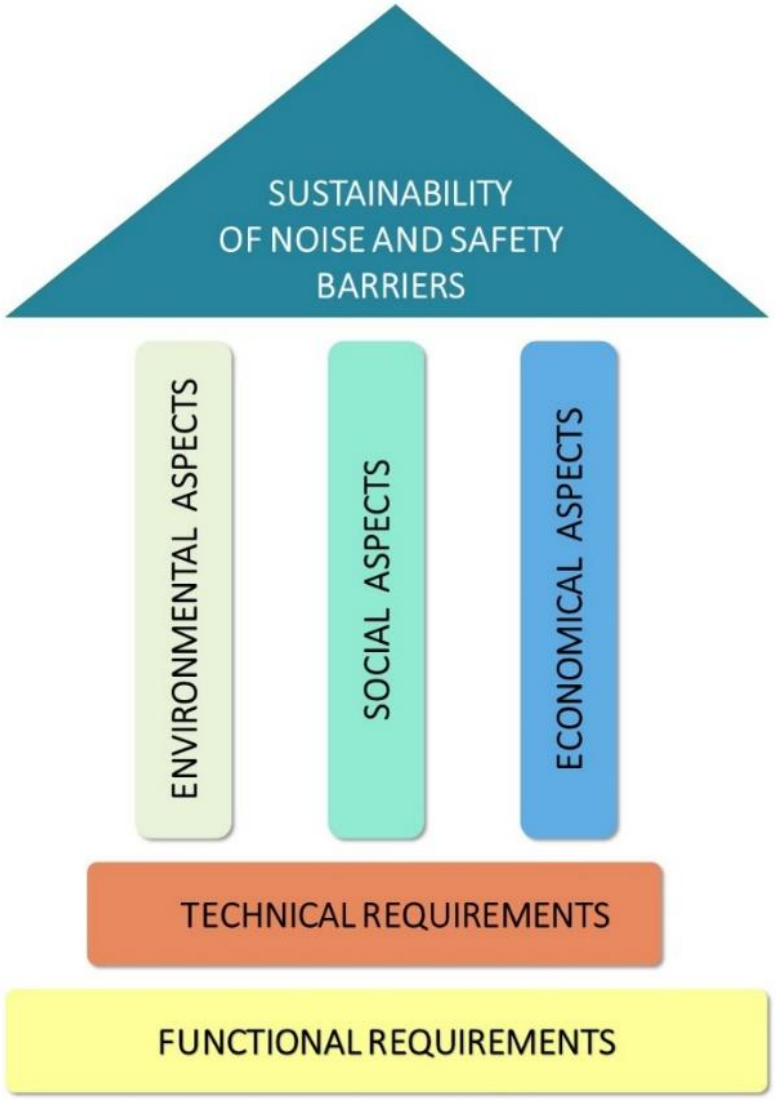
for a noise barrier project:

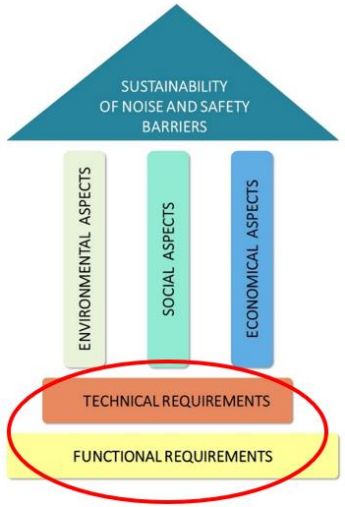
technical (and functional) requirements represents the basement design technical specification to be fulfilled, on the top of that for each project:

economic,

social,

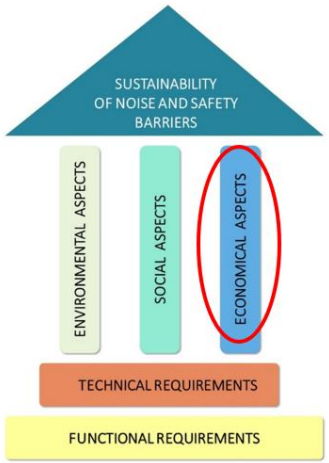
and environmental requirements need then to be considered.





ESSENTIAL REQUIREMENTS FOR NOISE BARRIERS ACCORDING TO CPR 305/2011 (today under revision)

1. Mechanical resistance and stability
2. Safety in case of fire
3. Hygiene, health and the environment
4. Safety and accessibility in use
5. Protection against noise
6. Energy economy and heat retention
7. Sustainable use of natural resources



Economic sustainability

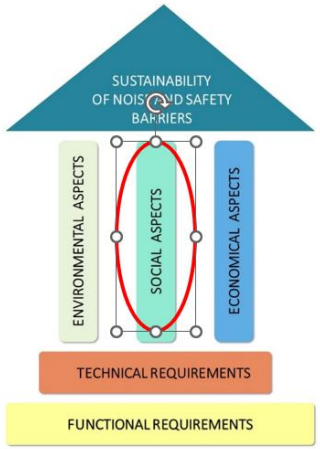
different approaches for Noise barriers:

- Cost / Benefit evaluation

(take into account new functionalities of Noise barriers (energy production, use of the surface…)

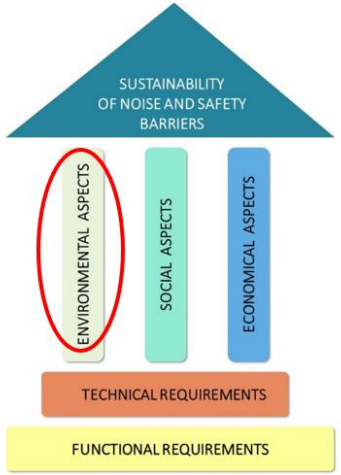
- Willingness to pay for noise reduction

Noise barrier sustainability



Social sustainability:

- Impact on landscape
- Obstruction of the view
- Shadowing
- Security

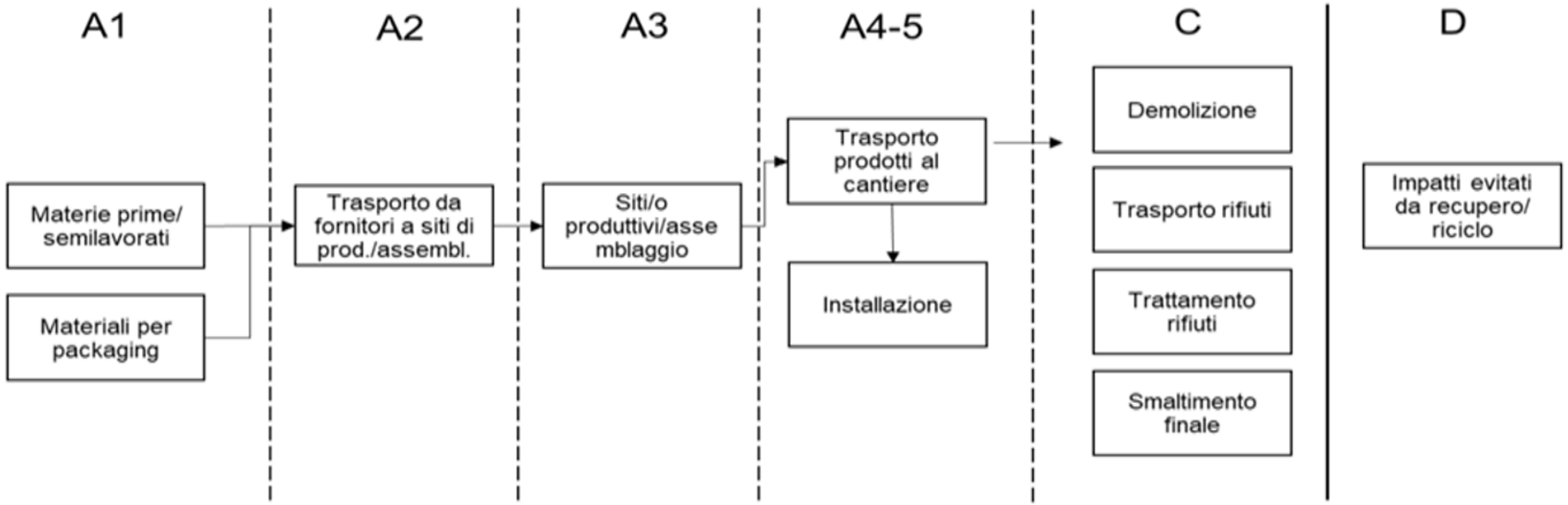


Environmental sustainability:

EN 17383

http://www.environdec.com/

LCA based on the set of indicators over the whole life cycle defined in EN15804:2019.



PROCEEDR
OPTIMISING RESOURCE USE
FOR ROADSIDE INFRASTRUCTURES

PROCEEDR - OPtimising Resource Use for Roadside Infrastructures

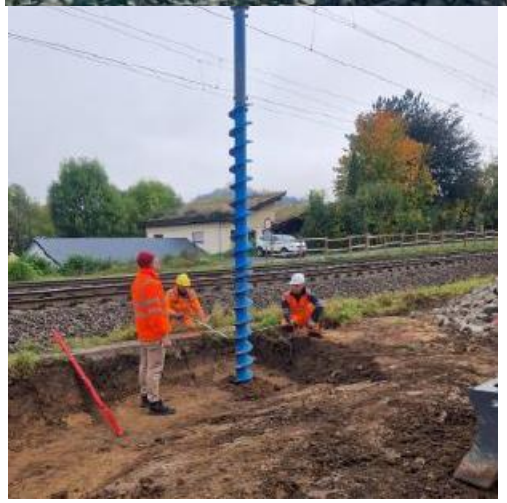
PROCEEDR
OPTIMISING RESOURCE USE FOR ROADSIDE INFRASTRUCTURES

Material	Details
Aluminium	Rock wool or polyester filling
Steel	Rock wool or polyester filling
Recycled PVC	polyester filling
Glass	+ steel frame + EPDM gaskets
PMMA	+ steel frame + EPDM gaskets
Wood	Timber frame + HDPE sheet

Life cycle stages to be considered

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	x	x	x	x	x	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	IT	IT	IT	RER									RER				-
Specific data used	X			X	-	-	-	-	-	-	-	-	-	-	-	-	x


AXOR



Noise barrier sustainability

Mandatory impact category indicators according to EN 15804

Results per declared unit									
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-fossil	kg CO_2 eq.	1,6E+01	1,6E+00	2,31E-02	5,12E-04	1,62E-01	2,5E+00	1,0E+00	-4,28E+00
GWP-biogenic	kg CO_2 eq.	6,18E-02	1,60E-03	-9,9E-01	3,13E-07	1,10E-05	1,10E-03	4,66E-05	-1,18E-02
GWP-luluc	kg CO_2 eq.	2,41E-03	5,65E-04	6,84E-06	2,82E-08	1,30E-06	1,09E-04	1,32E-05	-7,64E-03
GWP-total	kg CO_2 eq.	1,6E+01	1,6E+00	-9,7E-01	5,13E-04	1,62E-01	2,5E+00	1,0E+00	-4,30E+00
ODP	kg CFC 11 eq.	3,15E-06	3,25E-07	2,48E-09	4,32E-11	3,82E-08	1,59E-07	7,04E-09	-1,83E-05
AP	mol H^+ eq.	3,79E-02	1,03E-02	1,52E-04	1,07E-06	7,30E-04	4,72E-03	2,92E-04	-2,38E-02
EP-freshwater	kg P eq.	2,32E-04	2,62E-05	3,44E-07	1,62E-08	8,23E-08	4,78E-05	3,92E-07	-2,49E-04
EP-marine	kg N eq.	8,62E-03	3,98E-03	6,47E-05	2,64E-07	2,68E-04	1,46E-03	4,09E-04	-4,93E-03
EP-terrestrial	mol N eq.	9,33E-02	4,38E-02	7,17E-04	2,99E-06	2,95E-03	1,61E-02	1,37E-03	-4,70E-02
POCP	kg NMVOC eq.	2,38E-02	1,06E-02	1,63E-04	7,93E-07	7,15E-04	4,08E-03	3,75E-04	-1,25E-02
ADP-minerals&metals*	kg Sb eq.	9,07E-06	7,00E-08	9,85E-10	1,60E-11	6,99E-09	6,68E-08	5,55E-09	-5,27E-06
ADP-fossil*	MJ	2,7E+02	2,4E+01	2,24E-01	1,22E-02	2,3E+00	3,8E+01	2,74E-01	-1,14E+02
WDP*	m^3	7,5E+00	5,12E-02	6,02E-04	2,43E-05	-3,9E-04	8,63E-02	8,11E-03	-4,15E+00
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption								

GWP-GHG[1]	kg CO_2 eq.	1,64E+01	1,57E+00	2,35E-02	5,13E-04	1,62E-01	2,49E+00	1,01E+00	-4,3E+00
Particulate matter emissions	Disease incidence	1,96E-07	1,32E-07	1,58E-09	8,04E-12	1,45E-08	5,54E-08	3,96E-09	-2,52E-07
Ionizing radiation, human health	kBq U235 eq.	2,42E-01	1,27E-01	1,41E-03	1,70E-04	9,91E-03	4,92E-01	1,49E-03	-1,77E-01
Eco-toxicity (freshwater)	CTUe	7,97E+01	9,57E+00	1,52E-01	3,91E-03	1,00E+00	1,60E+01	2,81E+00	-8,6E+01
Human toxicity, cancer effects	CTUh	9,76E-09	1,34E-10	9,07E-11	1,20E-12	1,40E-11	3,66E-09	1,44E-10	-9,43E-10
Human toxicity, non-cancer effects	CTUh	5,36E-08	1,58E-08	4,10E-10	1,69E-12	1,96E-09	1,38E-08	1,61E-09	-5,59E-08
Land use related impacts/Soil quality	dimensionles	1,23E+02	6,73E-01	1,44E-02	1,49E-03	6,72E-03	4,40E+00	4,32E-01	-4,6E+00

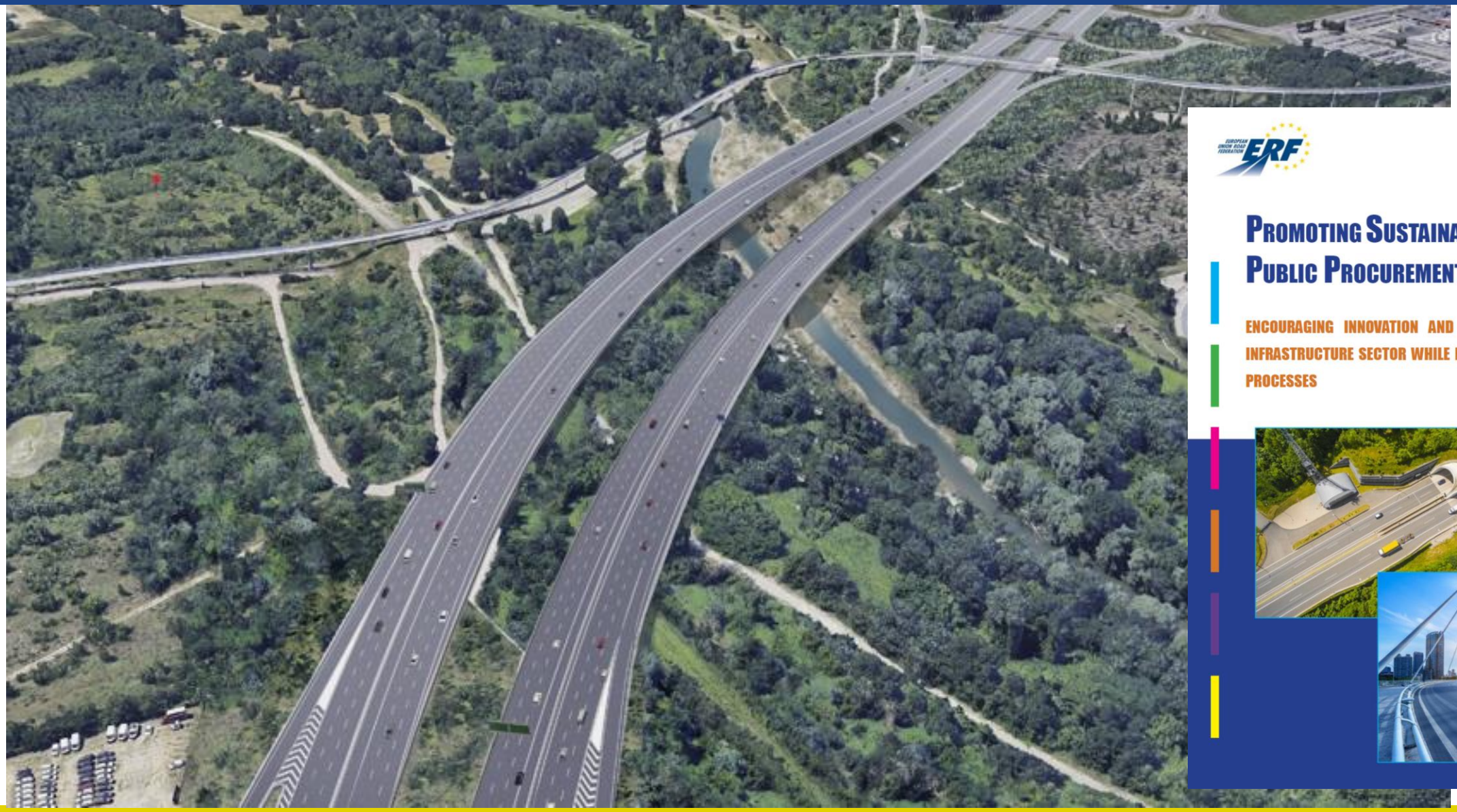
Additional voluntary indicators e.g. the voluntary indicators from EN 15804 or the global indicators according to ISO 21930:2017

How to implement environmental sustainability in GPP ?

- Confine declarations to modules A
- Eventually extended to modules C
- Clarify the use of module D
- Defined appropriate scenario for modules B

- Identify a global indicator i.e.:

The Environmental Cost Indicator (ECI) is a single-score indicator expressed in Euro.



Promoting Sustainable Roads Through Public Procurement

ENCOURAGING INNOVATION AND SUSTAINABILITY IN THE ROAD INFRASTRUCTURE SECTOR WHILE MODERNISING PUBLIC TENDERING PROCESSES

Thanks for your attention

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