

# Index

---

Note: Page numbers followed by *b* indicate boxes, *f* indicate figures, *t* indicate tables and *np* indicate footnotes.

## A

- Action planning
  - 'acoustical planning', 105
  - competent authority, 104–105
  - effective and sustainable noise reduction, 104
  - noise mitigation measures, 105–106, 105<sup>t</sup>
  - policymakers, 106
  - public consultation, 106
- AEDT. *See* Aviation environmental design tool (AEDT)
- Aerodynamic noise, 127
- Aircraft noise
  - ANP database, 155
  - 'blade-slap', 155
  - CNOSSOS-EU, 160–161
  - complaints, 153<sup>b</sup>
  - description, 153
  - ECAC-CEAC Doc 29 Version 3, 155–158
  - engine thrust, 154–155
  - FAA-INM, 158–160
  - flight profiles, 167
  - ground operations at airports, 155<sup>b</sup>
  - jet engines, 154
  - $L_{eq}$ -based indicators, 166–167
  - noise emission, 154
  - noise modelling and mapping, 153
  - propeller driven/driven, 154
- Aircraft noise and performance (ANP)
  - database, 155, 156, 157, 159–160, 161
- Airports
  - CNOSSOS-EU model, 189
  - END legislation, 188–189
  - noise mapping assessment, 188
- Atmospheric absorption
  - attenuation, 42
  - sound level, 42
  - temperature, 42, 42<sup>t</sup>
- Aviation environmental design tool (AEDT), 160<sup>b</sup>
- A-weighting
  - and C-weighting curves, 26, 26<sup>f</sup>
  - human ear, 24–25
  - loudness, 25<sup>b</sup>
  - and octave bands, 26, 26<sup>t</sup>

- 40 phon curve, 26–27, 27<sup>b</sup>
- sound levels, 26

## B

- Broadband *vs.* tonal noise sources
  - adjacent bands, 16–18
  - frequency, 16–18
  - level difference, 16–18
  - tone, 18, 18<sup>f</sup>
- Building/façade insulation, 231–233

## C

- Calculation methods, noise mapping
  - assessment and management, 89, 94<sup>b</sup>
  - CNOSSOS-EU, 94–95
  - Dutch prediction, 93
  - equivalence, 92–93
  - French national computation method, 92
  - interim methods, 92
  - software packages, 95–96, 96<sup>b</sup>
  - types, 93–94, 95<sup>t</sup>
- Calculation of railway noise (CRN)
  - CNOSSOS-EU, 150–153
  - and DEFRA, 148
  - description, 145, 148
  - limitations, 150<sup>b</sup>
  - quantities, 149
  - RMR, 145–148
  - rolling noise, track support structure, 148, 149<sup>t</sup>
  - SEL, 148, 149<sup>t</sup>
  - United Kingdom, 148
- Calculation of road traffic noise (CRTN)
  - method
    - calculation details, 133–134
    - converting  $L_{A10,18h}$  to  $L_{den}$  and  $L_{night}$ , 134–135
    - description, 132–133
    - dual source lines, 133
    - emission and propagation models, 132–133
    - $L_{10}$  index, 133
    - noise mapping, 133
    - origin, 132<sup>b</sup>
    - vs.* XPS31-33, 134<sup>b</sup>

- Cardiovascular disease and noise  
  hypertension, 66–68  
  IHD, 68–69
- CNOSSOS-EU, railway noise  
  aerodynamic noise, 153  
  calculation details, 151  
  classification, 150–151  
  definition, 150  
  impact noise, 152  
  rolling noise, 151–152  
  source heights and mechanisms, 151, 151f  
  squeal, 152, 152f  
  traction noise, 152  
  Working Group 3, 150
- CNOSSOS-EU, road traffic noise  
  acceleration and deceleration of  
  vehicles, 140  
  advantages, 140  
  categories of vehicle, 138  
  description, 138  
  propulsion noise, 138, 139, 139f  
  rolling noise, 138, 139, 139f  
  sound powers, 140
- Cognitive impairment and environmental  
  noise, children  
  aircraft noise, 70, 72b  
  cardiovascular issues, 70  
  description, 69–70  
  mental health, 70–71  
  noisy communities, 71
- Construction noise  
  ABC method, 197  
  factors, 195  
  hours of activity, 195–197  
  sensitive, 194–195  
  sources, 195
- Continuously welded rail (CWR), 217
- CRN. *See* Calculation of railway noise (CRN)
- CRTN. *See* Calculation of road traffic noise (CRTN)
- CWR. *See* Continuously welded rail (CWR)
- D**
- DALYs. *See* Disability-adjusted life years (DALYs)
- Data collection, END, 88–89, 90f
- DCTA. *See* Denton County Transportation Authority (DCTA)
- Decibel (dB) scale  
  acoustic tests, 22–23, 23f  
  changing noise levels, 22, 23f  
  environmental noise, 18  
  human ear, 18, 19b  
  logarithmic addition, 24, 25t  
  logarithmic scale, 19b  
  noise emission and immission, 21b  
  noise sources, 22, 22f  
  reference values, 21  
  sound intensity, 20  
  sound power, 20  
  sound pressure level, 20  
  sound source, 24, 24b  
  source of noise, 20
- DEFRA. *See* Department for Environment, Food and Rural Affairs (DEFRA)
- Dense-graded asphaltic concrete (DGAC), 137
- Denton County Transportation Authority (DCTA), 237
- Department for Environment, Food and Rural Affairs (DEFRA), 148
- DGAC. *See* Dense-graded asphaltic concrete (DGAC)
- Diffraction  
  barrier, 43  
  calculating attenuation coefficients, 44  
  foliage, 46–47, 47t  
  noise barriers, 45  
  path length difference, 43, 44f  
  temperature inversion, 45, 45f  
  wind effects, 45, 46f
- Disability-adjusted life years (DALYs), 53–54, 54f
- E**
- ECAC-CEAC Doc 29 Version 3  
  ANP database, 156  
  applications guide, 156  
  the Commission Recommendation of 2003, 156  
  description, 155–156  
  flight path, 157  
  and ICAO, 158b  
  noise contour generation process, 156, 157f  
  noise contours, 158  
  noise level, 157  
  noise mapping, 157  
  and NPd, 156  
  pre process airport data, 156  
  technical guide, 156
- Effective perceived noise level (EPNL), 32
- Electric vehicles  
  acoustic tests, 128, 128f  
  description, 128

- END. *See* Environmental Noise Directive (END)
- Environmental noise
- acoustics, 10*b*
  - adverse effects, 9
  - assessment, 9
  - A-weighting, 24–27
  - noise metrics, 27–32
  - sound, 10–18
- Environmental Noise Directive (END)
- action planning, 104–106
  - calculation methods, 89–96
  - and CRTN, 134–135
  - data collection, 88–89, 90*t*
  - definition, 85–87
  - dissemination, information, 106–110
  - and ECAC-CEAC Doc 29, 155–156
  - EU, 253
  - industrial areas, 86
  - legislation, 255–256
  - Member States, 253–254
  - night-time noise exposure, 84–85
  - noise–health problem, 53–54
  - noise level reduction, 85
  - noise maps, 131–132
  - population exposure, 99–104, 251–252
  - production, noise map, 96–99
  - requirements, 87
  - and RMR, 145
  - roads, railways, airports and agglomerations, 88
  - road traffic noise, 129
  - standardise approach, 88, 89*f*
  - strategic approach, 251–252
  - weighting factors, 87–88
- Environmental noise health
- burden of disease, 52–53, 53*t*
  - cognitive impairment, children, 69–71
  - DALYs, 53–54, 54*f*
  - END, 52–53
  - EU attitudes, 51, 52*f*
  - noise and cardiovascular disease, 66–69
  - noise pollution, 51
  - noise–stress relationship, 55–57
  - non-auditory effects, 54–55
  - sleep disturbance, 61–65
  - sound environment, 51–52
  - ‘soundscape’, 51–52
  - and tinnitus, 72
  - WHO methodology, 53–54
- EPNL. *See* Effective perceived noise level (EPNL)
- EU Environmental Noise Directive (END), 203
- EU noise policy and legislation
- complementarities and disparities, 85
  - END, 84–85
  - environmental impacts, 82
  - health relationships, 84
  - road traffic vehicles, 85
  - sources, 82, 83*t*
  - WHO estimation, 82–84
- ## F
- The US Federal Aviation Authority–integrated noise model (FAA-INM)
- advantages, 159–160
  - and AEDT, 160*b*
  - and ANP database, 159–160
  - average input data, 159
  - DBF structure, 158
  - DNL/ $L_{dn}$ , 159
  - and FAR, 158–159
  - line source model, 159
  - and NASA, 158–159
  - and NPD, 159–160
  - take-off and landing, 159
  - version (7.0c), 158–159
- Federal Aviation Regulation (FAR), 158–159
- The Federal Highway Administration (FHWA), 135, 138
- Forum of European National Highway Research Laboratories (FEHRL), 239
- ## G
- Geographic Information System (GIS), 97, 101–102
- Geometric divergence
- description, 40, 41*b*
  - thumb rule, 41–42
- GIS. *See* Geographic Information System (GIS)
- ## H
- Hypertension
- aircraft noise, 67–68
  - evidence base, 68
  - road traffic noise, 67
  - sympathetic and endocrine system, 66
- ## I
- IHD. *See* Ischaemic heart disease (IHD)
- Industrial noise
- annoyance, 177–178
  - description, 175–176

Industrial noise (*Continued*)  
 dose–response curves, 176  
 emission, 180–181  
 and impulsive noises, 176–177  
 impulsive sound sources, 176–177, 177t  
 noise maps, 178–186  
 penalties, 176, 177t  
 subjective listening tests, 176, 176f  
 The International Convention on  
 International Civil Aviation (ICAO),  
 158

Ischaemic heart disease (IHD)  
 caveats, 69  
 occupational noise, 69  
 physiological responses, 68  
 road traffic noise, 68–69

## L

Land use planning  
 buildings, noise barrier, 224–225  
 description, 224  
 development control process, 225  
 levels of exposure, 224  
 noise abatement effect, demolition,  
 224–225  
 noise-abating effect, 224–225  
 noise-compatible terraced housing, 225  
 LFN. *See* Low frequency noise (LFN)  
 Low frequency noise (LFN)  
 A-weighted noise level, 74  
 components, 73  
 control of annoyance, 73–74, 74t  
 description, 73  
 and health, 73–74

Low-noise road/rail surfaces  
 abatement measures, 215  
 absorptive surfaces, 215  
 acoustical properties, 213–214  
 asphalt rubber concrete, 215  
 civil engineering properties, 213–214,  
 214f  
 composite brake block technology, 217  
 CWR, 217  
 engine and rolling noise, 213–214  
 lawned light rail track, 217, 218f  
 noise emissions, 217–218  
 noise reduction effect, 215  
 non-electrified trains, 215–216  
 open surface structure, 214  
 optimal road surface, 216b  
 porous asphalt, 214  
 roughness-based noise reduction, 217–218

surface defects, 216–217  
 track and wheel irregularities, 216–217

## M

Microphone position, 36  
 Mining mineral/extraction sites  
 coal mining, 198  
 community consultation, 197  
 mobile equipment, 197

## N

The National Aeronautics and Space  
 Administration (NASA), 158–159  
 NMPB 96 method  
 description, 129  
 disadvantages, 129  
 European Commission recommended  
 corrections for road surface,  
 131–132, 131t  
 ‘Guide du Bruit’, 129  
 light vehicles travelling in fluid  
 continuous flow, 130–131, 131t  
 and NMPB 2008, 129b  
 noise emission, 130  
 noise mapping, 129  
 nomograms, 130–131  
 segmentation techniques, 130, 130f  
 sound emission levels, 130  
 sound power, 130  
 values for spectral correction ( $R_f$ ),  
 131, 131t  
 Noise action planning  
 action plans, 205–206, 208  
 exposure levels, 204  
 ‘hot spots’, 207  
 implementation timeline, 207–208  
 leadership role, 206–207  
 mapping, 208  
 nine-step process, 206–207, 206f  
 noise abatement measures, 208–210  
 noise reduction and management, 204  
 plan implementation, 208  
 public health policy, 204  
 residential and business community,  
 208–210  
 responsible authority, 207  
 stakeholder consultation, 208  
 stakeholders and role, 208, 209t  
 strategic mapping, 205  
 structured and coherent process, 205  
 urban development, 204–205  
 validation mechanism, 208–210

- Noise and annoyance
- answer cards, verbal and numeric scale, 61, 60f
  - health effects, 59–60, 57f
  - human organism, 59
  - noise reaction surveys, 61
  - prevalence, 61
  - road traffic noise, 59–60
  - sensitivity, 57–59
  - surveys, research, 60–61, 59
  - transportation noise, 57
- Noise assessments, 173–174
- Noise barriers
- absorption, 228
  - angled and dispersive, 229
  - capped, 228
  - design considerations, 230–231
  - earth berms, 227
  - embankments and earth berms, 229
  - ISO 9613, 227–228
  - random edge profile, 229
  - range, 228–230, 228f
  - sonic crystals, 231b
  - sound transmission, 227
  - square-lattice structure of sonic crystal, 231, 232f
  - transmission loss, 231
  - tunnel/sound tube, 229, 230f
  - vegetation, 229–230
- Noise criteria
- community noise annoyance assessments, 174
  - “creep”, 175
  - dose–response relationships, 174
  - “pivot threshold”, 175
  - sources, 174–175, 175t
- Noise maps
- area sources, 180
  - determination, sound power, 181–182
  - emission, source, 178
  - END, 178
  - industrial activity, 178
  - industrial noise emission, 180–181
  - Member States, 179
  - modelling industrial noise emission, 185–186
  - operating conditions effect, 183–184
  - parameters, 182–183
  - sound power, 179
  - WG-AEN Good Practice Guide, 179
- Noise metrics
- competent person, 33–34
  - continuous equivalent noise level, 28–29, 29f
  - continuous noise, 28
  - CRTN method, 38b
  - day/night average sound level, 32
  - description, 27
  - EPNL, 32
  - extraneous and residual, 36
  - impulsive noise, 28
  - intermittent noise, 28
  - $L_{\text{peak}}$ , 32
  - maximum and minimum levels, 31
  - measurement, 33–39
  - microphone position, 36
  - period measurement, 34–36
  - road traffic noise, 38–39
  - SEL, 32
  - sound level metres and calibration, 34
  - sound metres, 28
  - statistical indicators, 29–30
  - strategic noise maps, 37, 37b
  - universal EU noise indicators, 30–31
- Noise mitigation
- action planning process, 204–210
  - detrimental health effects, 210–212
  - driver behaviour, 220
  - END, 203
  - environmental noise pollution, 210
  - legislation (regulation), 212–213
  - low-noise road/rail surfaces and maintenance, 213–218
  - low-noise tyres, 218–219
  - noise abatement, 210–212
  - propagation measures, 224–233
  - roads, 233–234
  - source and propagation measures, 203
  - source-based abatement, 212–224
  - traffic engineering and modal shift, 223–224
  - traffic management, 220–222
- Noise pollution
- annoyance and sleep disturbance indicators, 253, 256–257
  - assessment and reduction programme, 255–256
  - A-weighting system, 253
  - debates and challenges, 1–3
  - decibel and A-weighted system, 248
  - definitions, 3–4
  - description, 247

Noise pollution (*Continued*)

- END, 251–252
- EU legislative and policy, 251
- EU populations, 257
- health effects, 5
- human health, 250
- legislation, 253–254
- low-cost noise measurement devices, 259–260
- mitigation, 254
- night-time activity, 248–249
- noise and human health, 5–6
- noise characteristics, 2–3
- noise exposure, 250
- noise maps, 253
- noise prediction capabilities, 252–253
- noise sources, 249
- outdoor sound, 4
- pollutant, 247
- population exposure, 257–258
- sensitivity, 247–248
- software, 254–255
- ‘sound out of place’, 4
- technology, 259–260
- Noise-power-distance (NPD), 156, 157, 159–160
- Noise–stress relationship
  - ‘direct’ and ‘indirect’ arousal, 55
  - environmental noise exposure, 56–57, 58*t*
  - hormones, 55
  - noise effects reaction scheme, 56–57, 56*f*
  - relaxation and sleep, 56
- NoMEPorts project, 187
- NPD. *See* Noise-power-distance (NPD)

## O

- OGAC. *See* Open-graded asphaltic concrete (OGAC)
- Open-graded asphaltic concrete (OGAC), 137

## P

- PCC. *See* Portland cement concrete (PCC)
- Population exposure
  - dwellings, 99–100, 103
  - establishment, dose–effect relations, 103–104
  - estimation, 103, 110–111, 111*t*
  - façade calculations, 100, 101*f*
  - German method, 100–101, 102–103
  - GIS, 101–102
  - individuals living, 102
- Portland cement concrete (PCC), 137

## Port noise

- description, 186–187
- NoMEPorts project, 187
- operational data, 187–188
- practice procedures, 188
- sources, 187, 187*t*
- Propagation measures, noise
  - building design, 225–227
  - building/façade insulation, 231–233
  - land use planning, 224–225
  - noise barriers, 227–231

## R

## Railway noise

- aerodynamic noise, 144
- calculation methods, 145–153
- CNOSSOS-EU, 165–166
- curve and brake squeals, 144
- 50 dB(A), 140–141
- engine noise, 144
- in Germany, 141
- ground vibrations, bridge noise and impact noise, 144
- line operation, 141
- mechanism, 141, 141*f*
- noise emission, 142
- passenger and freight trains, 141
- rolling noise, 142–143, 143*f*
- roughness, 142*b*
- TWh, 140–141

## Railways

- Federal Act on Railways Noise Abatement (2000), 235–236
- noise abatement measures, 236
- noise limit values, Switzerland, 234–235, 235*t*
- noise mapping, 234–235
- political and public support, 236
- public transport programme, 235–236
- Swiss railway infrastructure, 236
- wayside horns utilised for rail-noise abatement, 237, 237*f*
- Reference energy mean emission level (REMEL), 136
- RMR standard for railway noise
  - concrete and steel structures, 147
  - different train categories, 145–146, 145*t*
  - emission values, 146–147, 146*t*
  - measurement method, 147–148
  - SRM-I, 146–147
  - SRM-II, 147
  - track types, 146–147, 147*t*
  - Wolfel translated version, 145

- Roads
- aircraft noise, 240–241
  - cost-efficiency issues, 239–241
  - END legislation, 233
  - noise action plan, 234
  - noise control and abatement measures, 234
  - progressive noise management, 233
  - railways, 234–236
  - rolling and squealing noise, 240*np*
  - STAIRRS study, 240
  - traffic management strategies, 234
  - traffic noise management and control, 233
  - tyre labelling, 239–240
  - urban soundscapes, 236–238
- Road traffic noise
- CNOSSOS-EU, 138–140, 162–165, 164*f*
  - CRTN method, 132–135
  - description, 126
  - engine noise, 127–128
  - NMPB 96 method, 129–132
  - rolling noise, 126–127
  - TNM Version 2.5, 135–138
  - vehicle design, 125
- Rolling noise, road traffic
- ‘horn effect’, 127
  - level of noise emission, 126–127
  - low-noise surfaces, 127
  - porous surface, 127
  - type of road surface, 127
- S**
- SBB. *See* Swiss national railway wagons (SBB)
- SEL. *See* Sound exposure level (SEL)
- Sleep disturbance
- cardiovascular function, 63
  - description, 61–62
  - electroencephalography, 62–63
  - environmental noise, 63–64
  - night-time, 64–65
  - performance tasks, 65
  - road traffic noise, 64
  - SWS, 62–63
  - tiredness, 65
- Slow wave sleep (SWS), 62–63
- SMILE. *See* Sustainable Mobility Initiatives for Local Environment (SMILE)
- Sound
- ageing, 13*b*
  - amplitude, 11
  - broadband *vs.* tonal noise sources, 16–18
  - characteristics, 11
  - frequency, 12–15
  - low-frequency noise, 12–13
  - natural frequencies and resonance, 13–14, 14*b*
  - octave bands, 15, 16*f*
  - period, 11
  - range of frequencies, 15, 15*t*
  - SONAR, 10
  - speed, wavelength and frequency, 11–12, 12*b*
  - wavelength, 11
  - wave motion, 10–11, 10*f*
- Sound exposure level (SEL), 32, 148–149, 149*t*
- Sound power determination
- END, 181
  - engineering method, 181
  - EN ISO 3746, 182
  - measurement, 181
- Sound propagation
- atmospheric absorption, 42
  - attenuation mechanisms, 39
  - calculation methodology, 39
  - diffraction, 43–45
  - geometric divergence, 40–42
  - ground effect, 42–43
  - industrial source, 39
  - point and line sources, 40*b*
- ‘Stick-slip’ type vibrations, 127
- Strategic noise mapping
- Brazil, Chile and Argentina, 116
  - data submission, 110
  - description, 81
  - END. (see Environmental Noise Directive (END))
  - EU noise policy and legislation, 82–85
  - Eurostat data, 111–112
  - Hong Kong, 115, 117*b*, 117*f*
  - Middle East, 116
  - non-enforcement, 114
  - Pakistan, 115–116
  - proportion of inhabitants,
    - agglomerations, 112–114, 112*f*, 113*f*
  - South Korea, 115
  - United States (US), 114–115
- Sustainable Mobility Initiatives for Local Environment (SMILE), 233
- Swiss national railway wagons (SBB), 235*np*
- SWS. *See* Slow wave sleep (SWS)

**T**

Texture depth (TD), 134

Traffic management

calming measures, 222

effect, speed reduction, 221–222, 221*t*

engineering and modal shift, 223–224

night-time restrictions, 222

noise reduction, 222*b*

propulsion noise, 221–222

sensitive receivers, 220–221

Traffic Noise Model (TNM) Version 2.5

European software developers, 135

and FHWA, 135, 138

full-throttle noise emission levels, 136

reference vehicle noise emission level,  
137–138

and REMEL, 136

single lane of single traffic type, 136

user-defined vehicle types, 136–137

vehicle types, 136, 137*f*

Version 1, 135

Version 3.0, 135

Transportation noise

aircraft, 153–161

calculation methods, 124

CNOSSOS-EU model, 167

description, 123

emission of source, 125

END, 123–124

in Europe, 123

French and Dutch methods, 125

measurements/predictions, 124

noise mapping, 167

railway, 140–153

road traffic, 125–140

sound pressure level, 125

Transport Research Laboratory (TRL),  
134–135

**U**

Uniform and irregular receiver grids, 96–97,  
98*f*

Urban soundscapes, 236–238

**W**

Wind farm noise

amplitude modulation, 189–190

description, 189

emission, 191

night-time noise limit, 193–194

noise limits, 193–194

noise monitoring periods, 193

permissible noise limits, 192

shear, 191

sound power levels, 191, 192*t*

speed and sound power, 190–191, 194

turbines, 190

windshields, 193