DIN 4150-1:2022-12 (E)

Vibrations in buildings - Part 1: Predictions of vibration parameters

Contents

Page

Foreword ... 5

1 Scope ... 6

2 Normative references ... 6

3 Terms and definitions ... 6

4 Prediction principles ... 7
4.1 Method ... 7
4.2 Propagation of vibration ... 7
4.3 Transmission to structures ... 11
4.3.1 General ... 11
4.3.2 Transmission of vertical vibration from the subsoil to the foundation ... 11
4.3.3 Transmission of vertical vibration from the foundation to floors ... 12
4.3.4 Transmission of horizontal vibration ... 13

5 Vibration sources ... 13
5.1 Excitation due to single events ... 13
5.1.1 General ... 13
5.1.2 Blasting ... 13
5.1.3 Falling masses ... 15
5.1.4 Induced seismic events ... 16
5.2 Excitation due to construction work ... 16
5.2.1 General ... 16
5.2.2 Impulsive vibration sources ... 16
5.2.3 Stationary vibration sources ... 16
5.2.4 Vibration induced during general construction work ... 17
5.3 Excitation due to traffic ... 18
5.3.1 General ... 18
5.3.2 Rail traffic ... 18
5.3.3 Road traffic ... 19
5.3.4 Shipping (inland waterway transport) ... 20
5.4 Excitation due to machinery ... 20
5.4.1 General ... 20
5.4.2 Machines with periodic excitation characteristics ... 20
5.4.3 Machines with transient excitation characteristics ... 21
5.4.4 Machines with periodic shock excitation ... 21
5.4.5 Machine groups ... 21

Annex A (informative) Source types with characteristic examples ... 22
A.1 General ... 22
A.2 Blasts (see 5.1.2) ... 22
A.2.1 General ... 22
A.2.2 Propagation in the free field ... 22
A.2.3 Transmission to building ... 24
A.3 Falling masses (see 5.1.3) ... 26
A.3.1 General ... 26
A.3.2 Chimney blasting ... 26
A.3.3 Blasting — Three chimneys ... 28
A.4 Impulsive vibration sources (see 5.2.2) ... 29

A.4.1 General ... 29
A.4.2 Pile driving of precast piles — Single drive and drive sequence ... 29
A.5 Stationary vibration sources (see 5.2.3) ... 31
A.5.1 General ... 31
A.5.2 Vibratory compaction ... 32
A.5.3 Resonance caused by vibratory pile driving (see 5.2.3) ... 34
A.5.4 Vibro-compaction ... 35
A.6 Rail traffic (see 5.3.2) ... 36
A.6.1 General ... 36
A.6.2 Passing of a freight train ... 36
A.6.3 Passing of a regional train ... 38
A.6.4 Passing of subway train ... 39
A.7 Road traffic (see 5.3.3) ... 40
A.7.1 General ... 40
A.7.2 Passing of an articulated bus ... 40
A.7.3 Passing of a lorry on a highway ... 42
A.8 Vibration induced by machinery ... 43
A.8.1 General ... 43
A.8.2 Screening trough with mono-frequency excitation on a building floor (see 5.4.2) ... 43
A.8.3 Vibration induced by CHP drive on a ground level foundation (see 5.4.2) ... 44
A.8.4 Vibration-isolated hammer system (see 5.4.3) ... 45
A.8.5 Metal forming machinery (see 5.4.3) ... 46
A.8.6 Punching machine for cardboard boxes on floor slab (see 5.4.4) ... 48
A.8.7 Saw frame in operation (see 5.4.4) ... 49
A.8.8 Saw frame idle (see 5.4.4) ... 51

Bibliography ... 52

Figures

Figure 1 — Vibration amplitude attenuation over distance due to spatial propagation ... 10

Figure 2 — Effect of vibration energy absorption by the soil on vibration amplitude attenuation with increasing distance, as a factor of frequency acc. to Equation (2); as an example for: D_B = 0,01 and c_s = 200 m/s ... 11

Figure A.1 — Blasts — Propagation of vibration: Variation over time and spectra ... 23

Figure A.2 — Blasts — Propagation of vibration: Amplitudes and best-fit lines for single components ... 24

Figure A.3 — Blasts — Vibration in a building: Variation over time and spectra ... 26

Figure A.4 — Falling masses — Chimney blasting in a port area: Variation over time and spectra ... 28

Figure A.5 — Influence of distance on the maximum vibration velocities in the mass impact of three similar chimneys made of reinforced concrete — Vibration velocity v_{max} acc. to individual components ... 29

Figure A.6 — Pile driving (single drive) — Vibration propagation: Variation over time and spectra ... 30

Figure A.7 — Pile driving (drive sequence) — Vibration propagation: Variation over time and spectra ... 31

Figure A.8 — Vibratory compaction — Propagation of vibration: Variation over time and spectra.... 33

Figure A.9 — Vibratory compaction — Propagation of vibration: Amplitudes and best-fit line..... 33

Figure A.10 — Vibratory pile driving — Resonance in buildings: Variation over time and frequency spectra..... 34

Figure A.11 — Vibro-compaction — Resonance in buildings: Variation over time and frequency spectra..... 36

Figure A.12 — Variation over time and frequency spectra for a passing freight train 37

Figure A.13 — Regional train, above-ground..... 38

Figure A.14 — Regional train, underground..... 39

Figure A.15 — Passing of an articulated bus — Variation over time and spectra..... 41

Figure A.16 — Passing of a lorry on a highway — Variation over time and spectra..... 43

Figure A.17 — Screening trough with mono-frequency excitation on a floor slab — Variation over time and spectrum 44

Figure A.18 — CHP drive on ground level foundation — Variation over time and spectrum..... 45

Figure A.19 — Forging hammer — Variation over time and spectrum..... 46

Figure A.20 — Operation of several forging aggregates — Variation over time and spectrum 48

Figure A.21 — Punching machine for cardboard boxes on floor slab..... 49

Figure A.22 — Saw frame in operation — Variation over time and spectra..... 50

Figure A.23 — Idling saw frame — Variation over time and spectra..... 51