

Session III-13: Certification of services and of the WT facility

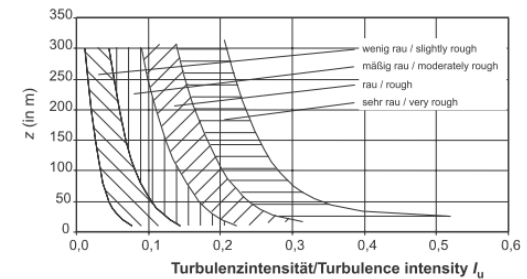
Best Practice Guidelines for simulating atmospheric boundary layer (ABL)

- VDI (Verein Deutscher Ingenieure) guideline No. 3783-12 on Environmental Meteorology:

Physical modelling of flow and dispersion processes in the atmospheric boundary layer

- Application of wind tunnels

- vertical profiles of mean and turbulence approach flow
- roughness parameter accord. to terrain type
- gust spectra
- similarity laws
- further requirements:
 - max. blockage, min. roughness Reynolds number, ...



$$\frac{f \cdot S_{uu}(f, z)}{\sigma_u^2(z)} = \frac{A \cdot f_{red}}{(E + B \cdot f_{red}^C)^D}$$

Approximation constant	A	b	c	d	e	f_{red}
Kaimal et al. (1972)	16.8	33.0	1	5/3	1	$\frac{f \cdot z}{U(z)}$
Simiu, Scanlan (1986)	32.0	50.0	1	5/3	1	$\frac{f \cdot z}{U(z)}$
von Kármán (1948)	4.0	70.78	2	5/6	1	$\frac{f \cdot L_{0.10}(z)}{U(z)}$
Harris (1971)	0.64	1.0	2	5/6	2	$\frac{1800 \cdot f}{U_{10}}$
Oleson et al. (1984)	40.42	60.62	1	5/3	1	$\frac{f \cdot z}{U(z)}$

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- WTG (Windtechnologische Gesellschaft - Association of Wind Engineers in Austria, Germany, Switzerland)
memorandum from 1994: *Wind tunnel experiments in Building Aerodynamics*
 - provides similar information / data as VDI 3783-12 guideline
 - specifies / suggests measurement instrumentation
 - in German
 - WTG committee is currently working on new / revised memorandum, goes beyond the scope of the existing memorandum from 1994
 - publication in 2023?, 2024?, ...? (to my knowledge almost completed)
 - in German or bilingual?

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- ESDU (Engineering Science Data Base)
 - very detailed information on atmospheric mean and turbulent flow characteristics, also in terms of spectral characteristics
 - relevant documents for atmospheric boundary layer wind tunnels:
 - ESDU 74030 Part I: Characteristics of atmospheric turbulence near the ground – Definitions and general information
 - ESDU 85020 Part II: Characteristics of atmospheric turbulence near the ground – Single point data for strong winds
 - ESDU 86010 Part III Characteristics of atmospheric turbulence near the ground – variations in space and time for strong winds

Best Practice Guidelines for simulating atmospheric boundary layer (ABL)

- Eurocode 1 (EC 1) part 1-4: *General actions - Wind actions*

is the European standard for wind loading of buildings and structures

- reference for wind conditions at site of investigation
- specification of parameters for flow and turbulence modelling in ABL WT

terrain category	I	II	III	IV
minimum height z_{min}	2,00 m	4,00 m	8,00 m	16,00 m
mean wind velocity (10-min mean) v_m für $z > z_{min}$	$1,18 \times v_b (z/10)^{0,12}$	$1,00 \times v_b (z/10)^{0,16}$	$0,77 \times v_b (z/10)^{0,22}$	$0,56 \times v_b (z/10)^{0,30}$
v_m / v_b für $z < z_{min}$	0,97	0,86	0,73	0,64
turbulence intensity I_v für $z > z_{min}$	$0,14 \times (z/10)^{-0,12}$	$0,19 \times (z/10)^{-0,16}$	$0,28 \times (z/10)^{-0,22}$	$0,43 \times (z/10)^{-0,30}$
I_v für $z < z_{min}$	0,17	0,22	0,29	0,37
peak velocity pressure (gust dynamic pressure) q_p für $z > z_{min}$	$2,6 \times q_b (z/10)^{0,19}$	$2,1 \times q_b (z/10)^{0,24}$	$1,6 \times q_b (z/10)^{0,31}$	$1,1 \times q_b (z/10)^{0,40}$
q_p / q_b für $z < z_{min}$	1,9	1,7	1,5	1,3
peak velocity (2-4 sec) (gust velocity) v_p für $z > z_{min}$	$1,61 \times v_b (z/10)^{0,095}$	$1,45 \times v_b (z/10)^{0,120}$	$1,27 \times v_b (z/10)^{0,155}$	$1,05 \times v_b (z/10)^{0,200}$
v_p / v_b für $z < z_{min}$	1,38	1,30	1,23	1,15

- further means of quality assurance for (atmospheric boundary layer) wind tunnels

- participation in round robin test (part of TWEET-IE)
- replication of benchmark tests