

**Research  
Project F 1641**

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**Avoiding accidents caused by  
stumbling, twisting and misstepping**

**Geometrical limits for preventing  
tripping accidents**

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This publication is an extract from the final report of a project "Investigation of influencing factors on stumbling and twisting" – Project F 1641 – of the Federal Institute for Occupational Safety and Health.

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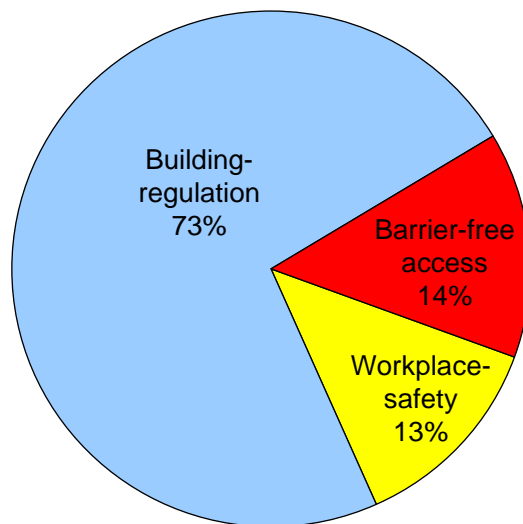
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## Geometrical limits for preventing tripping accidents

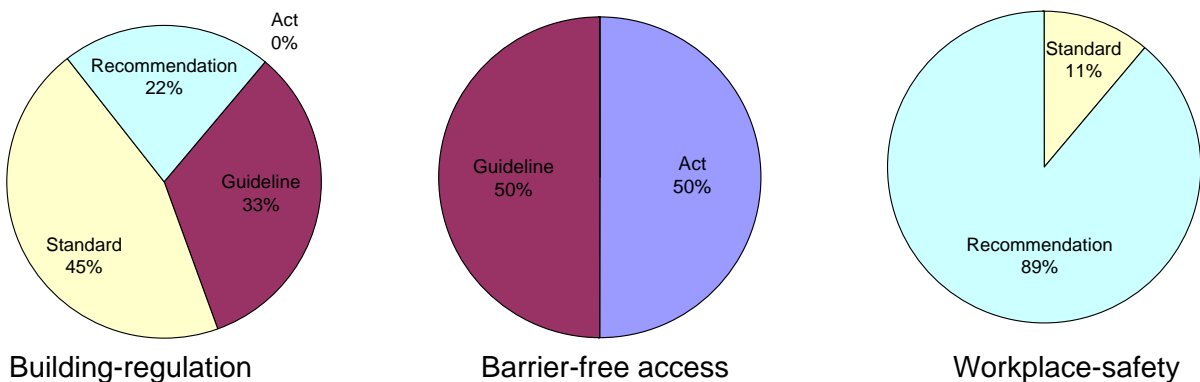
This paper is a summary of chapter 4 on the report of project 1641 “Avoiding accidents caused by stumbling, twisting and misstepping”.

The investigation of the international limits for the design of floors and stairs was done with the aim to collect data for the prevention of tripping accidents. Sources for the data were the Internet and personal contact to experts in foreign institutes. Regulations in the field of workplace-safety, building regulation and barrier-free access were studied.

As shown in figure 1, most of the values found belong to the building regulations. Most of the limits in that field of regulation are to be found in standards (45 %, figure 2), followed by guidelines (33 %) to fulfil the building law and in recommendations (22 %). In the field of barrier-free access the limits to be found are either in the act or in guidelines. In the field of workplace-safety the situation is completely different. The limits are mostly in recommendations (89 %) (for example, in recommendations of the statutory accident insurance) or in standards (11 %).



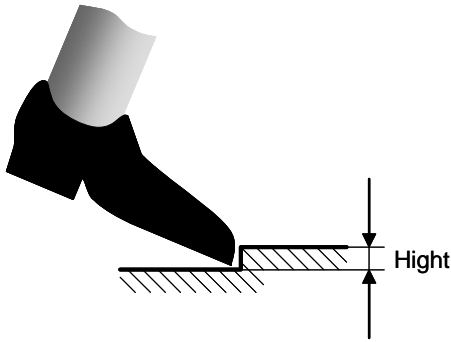
**Figure 1: Distribution of limits over fields of regulation**



**Figure 2: Distribution of limits over levels of regulation**

Abbreviation of countries in the tables according to ISO 3166-1. Listing is in alphabetical order.

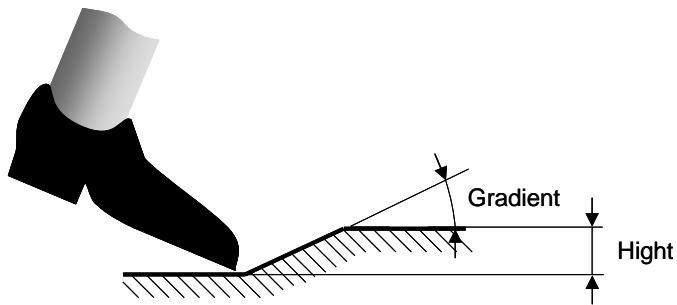
Table 1: Differences in level



Country	Hight [mm]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
	4			x		x				ISO 14122-2:2001 Safety of machinery - Permanent means of access to machinery – Part 2: Working platforms and walkways
DE	4				x	x				BGR 110, BGR 111, BGR 112, BGR 181, BGR 202, BGI 588, BGI 650, BGI 717, BGI 742, BGI 860-1, BGI 869, BGI 889, BGI 5001, BGI 5016
	3				x	x			On gratings	BGI 717
	4			x			x		On gratings, joints between paving units	DIN 24537-1:2006 Gratings used as floor coverings – Part 1: Metal gratings, DIN 24537-3:2007 Gratings used as floor coverings – Part 3: Plastic gratings
	2			x			x		On gratings, profil-hight	DIN 24531-1:2006 Gratings used as stairtreads – Part 1: Metal gratings
ES	6		x				x			Documento Básico SU, Seguridad de utilización
GB	5		x				x		Joints between paving units	Building Regulation 2000, Guide M, Access to and Use of Buildings
IT	2	x						x		decreto ministeriale 14 giugno 1989, n. 236
JP	5		x					x		Consideration for the Aged and others' of the Evaluation Method Standards under the Housing Quality Assurance Act (Ministry of Land, Infrastructure and Transport Notification No. 1347 of 2001)

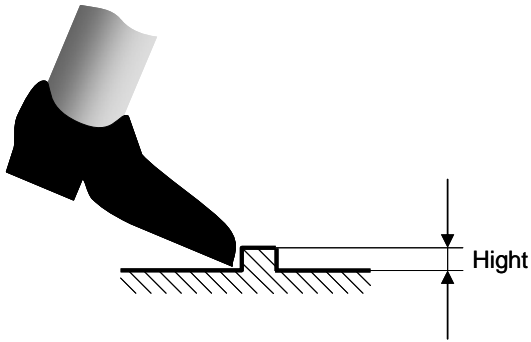
Country	Hight [mm]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
NO	0,8 1,2 2			x	x		x		tiles tolerance-class 1 tolerance-class 2 (preferred) tolerance-class 3 (max. value)	520.008 Toleranser. Anbefalte toleransekrav til ferdig overflate,  NS 3420 Beskrivelsestekster for bygg, anlegg, installasjoner. 3. utg., 1999
	1			x	x		x		Cast-concrete, tolerance-class 3	
	7 9 11			x	x		x		Road blocks tolerance-class 3 4 5	
	4 6 8			x	x		x		Natural stones tolerance-class 3 4 5	
	2			x	x		x		Concrete paving slabs, Werkstein, brick, tolerance- class 2	
US	6			x			x		ICC/ANSI A 117.1-1998 Accessible and usable buildings and facilities	

Table 2: Gradients



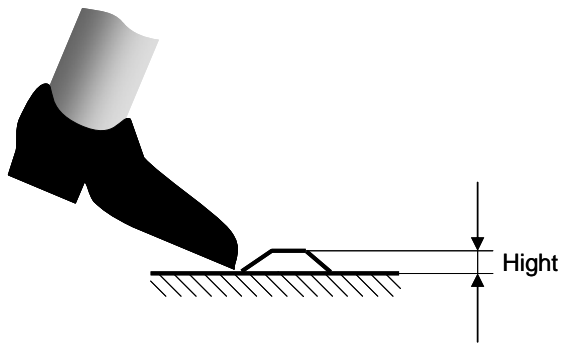
Country	Gradient Hight [mm]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
US	1:2 6-13 mm			x			x			ICC/ANSI A 117.1-1998 Accessible and usable buildings and facilities
ES	25 % 50 mm		x				x			Documento Básico SU, Seguridad de utilización

Table 3: Thresholds



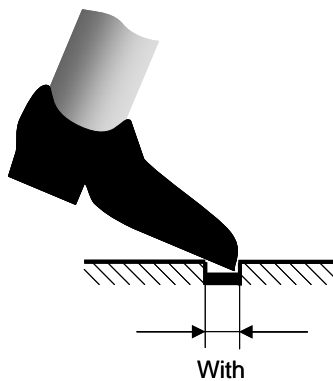
Country	Hight [mm]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
DE	30				x	x			Entrances of cash-boxes	BGI 532
GB	15		x				x		entrances	Building Regulation 2000, Guide M, Access to and Use of Buildings
IE	15		x					x	entrances	Building Regulations 2000, Technical Guidance Document M, Access for People with Disabilities
IE	10		x					x	Internal doors	Building Regulations 2000, Technical Guidance Document M, Access for People with Disabilities
JP	20		x					x	entrances	Consideration for the Aged and others' of the Evaluation Method Standards under the Housing Quality Assurance Act (Ministry of Land, Infrastructure and Transport Notification No. 1347 of 2001)
NZ	20		x				x		entrances	Approved Document for New Zealand Building Code, Clause D1 Access Routes
US	13			x			x		entrances	ICC/ANSI A 117.1-1998 Accessible and usable buildings and facilities

Table 4: Tactile elements



Country	Hight [mm]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
GB	5		x				x		External areas	Building Regulation 2000, Guide M, Access to and Use of Buildings
	6		x				x		400 to 1200 mm in front of stairs	
US	5			x			x		In front of platform edges	ICC/ANSI A 117.1-1998 Accessible and usable buildings and facilities

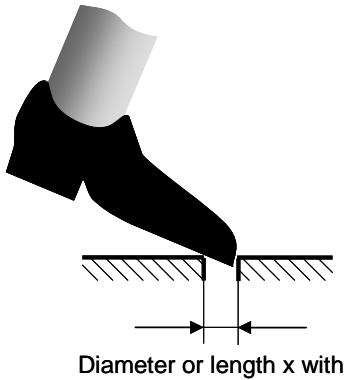
Table 5: Joints between paving units



Country	with [mm]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
GB	10		x				x		max. dept von 5 mm, external areas	Building Regulation 2000, Guide M, Access to and Use of Buildings
	5		x				x		Without limit in dept, external areas	
IT	5	x						x		decreto ministeriale 14 giugno 1989, n. 236

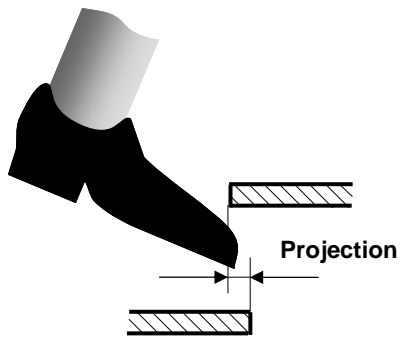


Table 6: Openings in floorings



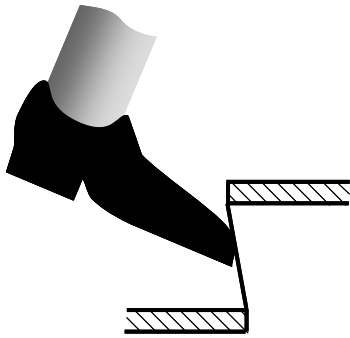
Country	Diameter or length x with [mm]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
DE	50,8 x 34,3			x			x		Gratings on platforms	DIN 24537-1:2006 Gratings used as floor coverings – Part 1: Metal gratings
	50 x 38			x			x		Gratings on platforms	DIN 24537-3:2007 Gratings used as floor coverings – Part 3: Plastic gratings
	20				x	x			With	BGI 810-1
	50,8 x 34,3				x	x			Gratings on platforms	BGI 588
	60 x 60 or 120 x 40				x	x			Gratings on platforms penetrable for bulk material	BGI 588
	10				x	x			With of gratings in public areas	BGI 588
ES	15		x				x			Documento Básico SU, Seguridad de utilización
IT	20	x						x		decreto ministeriale 14 giugno 1989, n. 236
US	13			x			x			ICC/ANSI A 117.1-1998 Accessible and usable buildings and facilities

Table 7: Projection of step nosings



Country	Value [mm]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
DE	30			x			x			DIN 18065:2000 Stairs in buildings - Terminology, measuring rules, main dimensions
GB	≤25		x				x			Building Regulation 2000, Guide M, Access to and Use of Buildings
IE	15-25		x					x		Building Regulations 2000, Technical Guidance Document M, Access for People with Disabilities
IE	≥16		x				x		Open raisers	Building Regulations 1997 Technical Guidance Document K, Stairways, Ladders, Ramps and Guards
IT	20-25	x						x	Open raisers	decreto ministeriale 14 giugno 1989, n. 236
NZ	15-25		x				x		Open raisers	Approved Document for New Zealand Building Code, Clause D1 Access Routes
	0-25		x				x		Closed raisers	
US	≤38			x			x			ICC/ANSI A 117.1-1998 Accessible and usable buildings and facilities

Table 8: Projection-angle of step nosings



Country	Value [°]	Act	Guideline	Standard	Recommendation	Workplace-safety	Building-reg.	Barrier-free acc.	Remark	Source
ES	≤15		x				x		To vertical	Documento Básico SU, Seguridad de utilización
GB	≥60		x				x		To horizontal	Building Regulation 2000, Guide M, Access to and Use of Buildings
IT	75-80	x						x	To horizontal	decreto ministeriale 14 giugno 1989, n. 236
NZ	≥60		x				x		To horizontal	Approved Document for New Zealand Building Code, Clause D1 Access Routes
US	≤30			x			x		To vertical	ICC/ANSI A 117.1-1998 Accessible and usable buildings and facilities