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Accessible
– And everyone can find their way!

The use of contrast for protection against hazards, navigation and greater convenience

Brochure for active members of the self-help movement

Published by PRO RETINA Deutschland e.V.

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Foreword

This final report on a study by PRO RETINA Deutschland e.V. addresses a state of affairs of increasing importance in the self-help movement. The issue at hand: Does a disability or chronic illness enable a person to evaluate the objectively necessary conditions required for accessibility? One of the findings is that, without the proper instruments and recommendations, people can only evaluate their own situation and its associated limitations subjectively, making an objective conclusion on the status of accessibility impossible. All the more important is this brochure, because it provides facts and arguments for objectively giving information in consulting situations, in this case information on the needs of people with visual impairments. As explained in the brochure, this helps to ensure that statements such as, "We had this tested by a person with a disability," no longer come up in future. Testing by people with disabilities is inadequate if the basis on which they perform a given test is unknown. These criteria are explained in detail in the text below in relation to contrasts, for other people in the field of self-help, and are intended to provide practice-oriented support.

Further important statements in the brochure address common defence strategies used to get around justified requirements for accessibility. Arguments are offered that help to successfully conduct what is in itself an objectionable discussion.

We hope this brochure is widely distributed in the self-help sector and used as an effective tool.

Wolfgang Tigges
BAG SELBSTHILFE e. V.
Deputy National Chairman

Welcome

Members of the self-help movement frequently encounter resistance from municipalities, developers, planners and architects when calling for stronger contrasts in the design of signs, stairways, steps, etc. that serve to facilitate navigation.

This brochure explains the necessity of taking such features into account when designing public spaces. In keeping with the UN Convention on the Rights of Persons with Disabilities, the brochure is intended to ensure that not only people with visual impairments, but also the elderly can navigate through their environment more easily and conveniently thanks to higher contrasts, which reduce the risk of falling or injury.

This brochure on contrast, sponsored by the German Federal Ministry of Health, delivers objective arguments to support discussions with decision-makers on the design of public spaces.

Ute Palm
PRO RETINA Deutschland e.V.
Deputy Chairwoman

Elke Lehning-Fricke
PRO RETINA Deutschland e. V.
Head of the Mobility Working Group

1. Reasons behind the creation of this brochure

Are you an active member of a self-help group? Are you asked for advice on designing public spaces in line with the needs of people with visual impairments? Then you probably are familiar with several problems.

For instance, perhaps you frequently hear the following statements from people with visual disabilities:

“I couldn’t operate the public transportation ticket machine! Grey buttons on a grey background!”

“In the toilets, I had to feel my way along the entire wall before I found the towel dispenser!”

“The barrier chain was practically invisible!”

“I didn’t discover the step until I fell!”

On the other hand, maybe you often hear the following from decision-makers:

“We can’t spoil everything with red-and-white stripes!”

“Designing for the visually impaired is not subject to any valid standards.”

“The contrasts requested cannot be achieved in reality.”

“Designing for the visually impaired unfortunately is too expensive.”

In addition to excessively small print and a lack of markings, unclear perception in public spaces is most often caused by inadequate contrast levels. Although colour contrast can promote better perception, it is the luminance contrast that is more relevant. However, developers, architects and decision-makers often are unaware of this

fact. Self-help groups are key partners for improving safety, navigation and convenience in public places, but in most cases they cannot obtain technical training in the subject. For this reason, the German Federal Ministry of Health promoted the development of this brochure, to provide support in these situations.

“Accessible – And everyone can find their way!” addresses self-help associations in general. The specific need for information in the self-help sector was determined in late 2011 by a survey, the results of which are discussed in Section 2. Nearly half of those surveyed said their current knowledge of contrasts is poor or non-existent. The brochure therefore provides basic knowledge in the most urgent fields of application, including for instance contrast optimization for signs, barriers, operating controls, stairs, handrails and ground surface indicators. This basic knowledge is paired with supportive arguments that help to counter typical objections encountered in consulting situations, such as legal concerns, user groups, aesthetic aspects, the subsequent integration of contrasts and cost issues.

It is a handbook on visual contrasts, condensed to the most urgent needs in self-help and intended to provide simple technical support in first-time meetings with decision-makers on questions of designing public spaces.

2. Needs in self-help in terms of contrasts

The characteristics of this brochure's target group and their specific needs were determined in a written survey of the national associations and state working groups of BAG Selbsthilfe e. V. (Federal Self-Help Association for People with Disabilities, the Chronically Ill and their Families), and of various forums and contact lists of PRO RETINA Deutschland e. V. (Self-Help Association for People with Retinal Degeneration).

2.1 Target group of the brochure

Section A of the survey asked about the degree to which self-help groups already provide advice on the subject of contrasts, who the contacts are, how great the demand is, what kind of resistance is encountered and how respondents rate their own level of knowledge. At present, 64% of those surveyed already work in an advisory capacity, 20% would like to do so in future. In providing consulting services, self-help groups are in contact with: Municipalities / counties / boroughs (58%), developers (29%), architects (41%), town planners (51%) and construction material manufacturers (19%). Further contacts named in this category include housing associations, public utility companies, universities, transport authorities, political groups, state and municipal counsellors for the disabled, political parties, parliaments and senates. The majority of consultations (61%) take place on the initiative of the self-help groups themselves, which primarily target offices with decision-making authority. When asked about the types of resistance encountered in consultations, respondents agreed with various given statements.

36%: **"But we can't design everything in exaggerated colours!"** 36%: **"The building project has already been completed, we can't go back and change anything!"** 14%: **"We build public spaces for the general public. We cannot take minorities into**

account!" and 42%: **"Designing for accessibility would break our budget!"**. Another counterargument mentioned frequently was the preservation of historic buildings and monuments, followed directly by aesthetic concerns: **"Contrasts ruin the overall appearance!", "Do not go with the style of the building!", "Compromise the artistic design and freedom of the architects!"**. Additional arguments mentioned were that contrasts cannot be manufactured from materials that are inexpensive and easy to clean, and any future improvement is not technically feasible. Some lines of argumentation are based on statements such as: **"Standards for accessible design are non-binding, and therefore must not be taken into account!", "Construction projects by a private investor are not a public matter!", "This is not a new building, only a renovation, and renovations need not give consideration to accessibility!", The renovation concept simply does not include any accessible design!",** etc. It repeatedly was clear that decision-makers rely on supposed experts: **"Our architects themselves know what accessibility is!", "We already took accessibility into account; we asked a wheelchair users association!"** or **"We did use contrasts!"**

In summary, self-help groups encounter very diverse types of resistance. One participant said that it is more an issue of ignorance than resistance, because people without impairments often cannot imagine how important something like contrasts can be. Bringing along simulation goggles would eliminate a lot of debates. In simplified terms, the problem can be reduced to a lack of knowledge among several decision-making authorities who believe that designing public spaces to meet the needs of people with visual disabilities is too expensive, too complex and ultimately infeasible. Mentioning the preservation of historic buildings and

monuments, or referring to the fact that standards are not mandatory, is an indication that the potential of designing for people with visual impairments to protect against hazards and enhance navigation and convenience for all, is considered secondary or not recognized at all. In response to the question, **"How frequently are you asked about information on contrasts for designing for people with visual impairments?"**, 15% said **"Very frequently"**, 42% **"Sometimes"**, and 22% **"Never"**. These results reflect the lack of knowledge among decision-making authorities. In terms of the self-help sector's own level of knowledge on luminance contrasts, 5% rated it as **"Extensive"**, 29% as **"Adequate"**, 37% as **"Poor"** and 10% as **"Non-existent"**. Nineteen percent of those surveyed did not respond to this question. Consequently, only one-third of respondents can use their own knowledge in consultations to positively influence pending decisions and defuse any resistance using well-founded arguments. The fact that two-thirds of respondents already work in an advisory capacity, and another 20% plan to do so in the future, underlines the necessity of this brochure. Forty-nine percent of respondents said they refer to the importance of contrasts frequently, 19% sometimes and only 7% never. Forty-one percent do so when asked, 61% also when not asked. This means that the usefulness of contrasts basically is known. Taking these results together with those on the level of knowledge clearly indicates the potential of self-help groups to improve public spaces through persuasive argumentation.

2.2 Information needs of the target group

Section B of the survey asked about areas in which the self-help sector has a need for information. Each category included a space under "Other" for a written answer. Some responses could later be matched to

the given survey questions. Others are listed separately.

Results on information needs in the category "Print, symbols and pictograms":

- Correspondence (54%),
- Posters (27%),
- Placards (25%),
- Room signs (68%),
- Direction signs (73%),
- Building designations (69%),
- Roadway information (71%),
- Self-luminous display boards and signs (53%),
- Other frequent responses: Passenger information in the local public transportation system.

Results in the category "Markings":

- Danger zones such as construction sites,
- Areas with a risk of tripping, etc. (68%),
- Automated self-service machines and operating controls, e.g. on elevators, money machines, emergency telephones, etc. (71%),
- Stairways and handrails, escalators and ramps (73%),
- Bollards, flag poles, traffic lights, sign and lamp posts (64%),
- Columns and pillars (53%),
- Walls, doors and revolving doors made of glass (68%).
- Other: Toilet facilities, barrier chains and furniture in public spaces (such as bike stands, garbage cans, advertising objects).

Results in the category "Ground surface indicators":

- Walkway edge indicators (51%),
- Directional indicators (69%),
- Tactile or visual contrast enhancement indicators (47%),
- Warning indicators (surfaces that alert users to special areas/functions) (63%).

Space was provided at the end to name additional categories relating to contrast that could facilitate work in self-help based on information in the

brochure. Some of the extensive remarks made here went far beyond the general topic of contrast in public spaces: Typefaces, font sizes, illuminance, information flood in display cases, explanations on various aids, examples for private residences. A desire for in-depth legal information also was expressed: Legal possibilities and obligations of municipalities under state building regulations, free publication of DIN specifications, decisions affecting the preservation of historic buildings and monuments, Model Building Regulations, uniform designations in the EU. Another frequent request was for information on website design and computer settings in various operating systems and with various special programs. Suggestions on the argumentation concept of the brochure and localities also were received: Reconciling aesthetics and contrasts, different types of visual impairment, promoting independence, perception and navigation using contrasts, problems of lighting, weathering and soiling, contrasts in museums, churches and public toilets, etc.

2.3 Resulting topics for the brochure

This brochure makes no claim to replacing the scientific literature on various application possibilities. The scope of the brochure was limited from the outset. It therefore addresses only those topics that appeared to be urgent based on the survey and gives examples of critical points. Possibilities for application with computers, or topics that go beyond the general subject of contrasts, as well as legal issues cannot be given consideration here. Every single one of these topics not addressed here justifies its own, extensive brochure and must be viewed as an urgent appeal for future projects. Remarks on argumentation and locations requiring contrast optimization were given consideration to the greatest possible extent.

3. Which contrasts?

3.1 Contrasts to DIN 32975

Navigating through public areas using contrasts helps to avoid hazards by promoting easy perception. Therefore, adequate contrasts benefit not only people with visual impairments, but everyone. The DIN 32975 standard on Designing Visual Information in Public Areas for Accessible Use (2010) specifies on Page 3:

"Because we primarily register information in our environment with our eyes, the majority of relevant information is offered visually. The sense of sight or visual perception is a complex process comprising colour perception, spatial vision, twilight vision, adaptation to changing brightness levels, perception of moving visual objects, etc. Perceiving an item of information is particularly dependent on its luminance contrast, illumination, location and the size of the information elements."

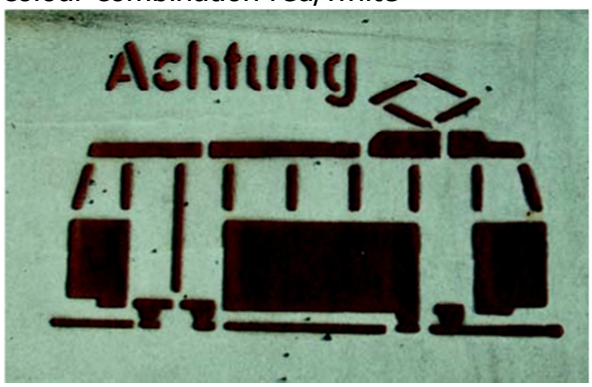
Contrasts can be perceived visually, tactilely and acoustically. Tactile and acoustic contrasts are not the object of this brochure and information on them must therefore be sought elsewhere. The sections below exclusively address visual contrasts based on differences in brightness, which are referred to as luminance contrasts.

3.1.1 Brightness differences versus colour differences

Contrasts basically are generated by differences in brightness. Objects can only be perceived if they contrast with their surroundings. Visual functions, such as visual acuity, shape recognition and reading, are only possible in the next step. Whether the colour of an object is seen as different from another is not decisive for contrast perception, rather can only promote it. What is much more relevant is if the brightness of a surface differs from that of another. This can only be determined by the luminance contrast, which is explained in Section 3.1.3.

On the subject of colours, it must only be emphasized that red tones frequently and unexpectedly can cause confusion. Because red generally is very distinctive as a signal colour, it often is used to emphasize specific lettering or markings. When lighter red tones are used for lettering or symbols to contrast with a white background, planners often forget that despite the colour's signal effect, the luminance contrast may be very low under certain circumstances and therefore not easily perceivable. For example, the ground surface indicator for streetcar crossings, shown in Figure 1, does not display adequate contrast and therefore is poorly visible - and not despite the use of the signal colour combination red/white, but because of the indiscriminate use of this colour combination for marking hazard areas.

Figure 1: Negative example of the colour combination red/white

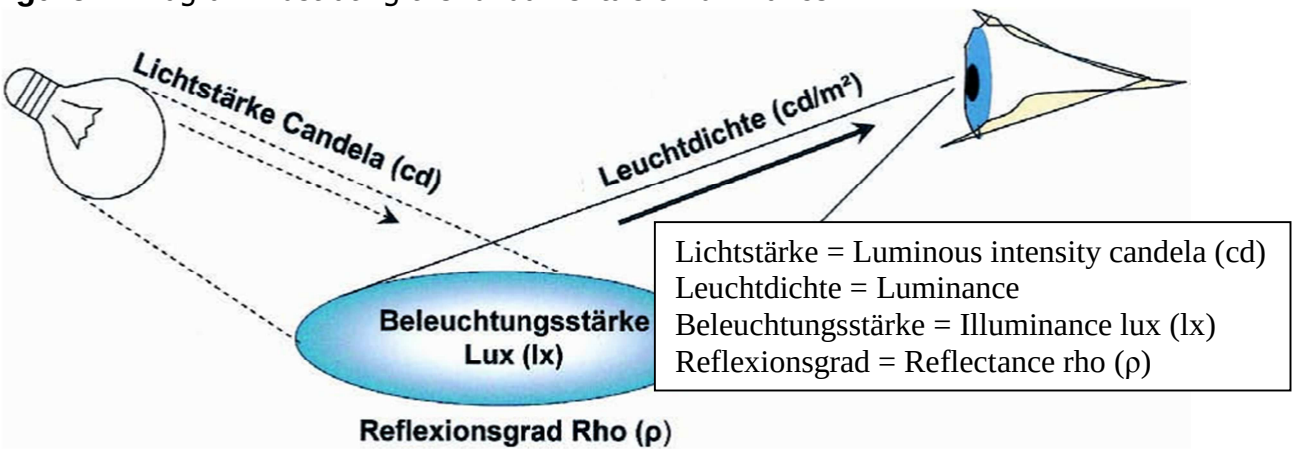


The same problem exists with the use of dark red tones in combination with dark surfaces. For instance, cycling paths frequently are marked in red to contrast with walkways, so that the two separate areas are distinguishable. However, this does not help enough to visually mark out these traffic areas. If both colours are perceived at a similarly dark level, the red colour, claimed to have such a strong signal effect, is useless for distinguishing between the two traffic zones. As a result, collisions between cyclists and visually impaired pedestrians continue to be a frequent occurrence. A signal colour only enhances contrast for people who can distinguish between colours, who are familiar with specific colours and colour combinations as signal colours, and only when lighting conditions make it possible to perceive colour.

3.1.2 Luminance and other light parameters

The physical parameter that describes the brightness of an object as people perceive it is known as luminance (unit of measurement: cd/m^2 or candela per square metre). The level of luminance depends not only on a light source's luminous intensity, the illuminance on a given object and the angle of incidence of the light in relation to the observer, but also on the reflectance of the illuminated surface. Figure 2 illustrates the relationships between these technical terms: Light falls on an object with a specific luminous intensity (unit of measurement: candela, cd). As a result, a certain level of illuminance (unit of measurement: lux, lx) is achieved on its surface. The surface of the object displays a degree of reflectance (unit of measurement: Greek rho, ρ) depending on whether it is more rough or smooth, or on its material composition. Resulting from all these factors, the luminance of the object perceived by an observer is what provides information on how bright or dark the object appears. Fortunately, visual perception of luminance in technical lighting terms is non-linear: The eyes and the information processing centres in humans attempt to balance extremes in luminance by using colours as a reference, and by filling in gaps in information from a sense of what people expect to perceive at such an instant.

Figure 2: Diagram illustrating the fundamentals of luminance



3.1.3 Luminance contrast

Luminance contrast k defines the difference between the brightness of two surfaces. To determine the luminance contrast of two adjacent

surfaces, or between an object and its background, the luminance values of the individual materials are measured. The results are then used to calculate the luminance contrast in accordance with DIN 32975 based on the following formula (Michelson contrast):

$$k = (L1 - L2) / (L1 + L2)$$

L1 stands for the luminance of the first surface, L2 for that of the second. The values for luminance contrast k obtained with this formula are between 0 and 1. For the purpose of better reading, the term "luminance contrast k" is referred to simply as "contrast" in the sections below.

3.1.4 Effects of unfavourable lighting conditions

Luminance contrast has even greater significance in unfavourable overall lighting conditions, due for example to fog, twilight or dim lighting, because such conditions impair the performance capabilities of the human eye. The macula at the centre of the retina, which is responsible for high acuity vision, can fail under these conditions. What remains for vision is the periphery of the retina. However, colour perception and visual function decrease towards the peripheral retina. The colour signal fails entirely at the outer margins of the retina and is replaced solely by the brightness signal. In other words, particularly under unfavourable lighting conditions, high luminance contrast is critical to being able to see important objects.

3.1.5 Effects of illuminance

Planners and practitioners often ask about the illuminances at which sufficient luminance contrast levels can be reached. "How many lux?" is a common question. However, it is not about the lux generated by lamps, but rather about the luminance generated by an object. As illuminance changes (assuming the surface properties of the material and the angle of incidence of the light remain the same), the luminances of two surfaces change proportionally, meaning that luminance contrast remains constant across all illuminance levels. Basically therefore, the question as to suitable illuminances for achieving adequate luminance

contrast cannot possibly be answered. Although measuring the luminance of an individual surface under changing illuminances yields different results, the difference in brightness between two adjacent surfaces (at constant illuminance) must always be considered in order to calculate the contrast. Therefore, the question planners and practitioners ask about illuminances suitable for the visually impaired is not expedient if luminance contrast is critical, because the luminance contrast of a specific material combination cannot be changed by different illuminances. However, a comfortable range for luminance in an environment does exist, and it is between 100 and 500 cd/m^2 depending on the intended purpose.

A special case in reference to the relevance of illuminance is self-luminous or backlit displays. For more information on this topic, go to Section 4.6.

3.2 Principles of the use of contrasts

3.2.1 The continuous chain of information

A continuous chain of information is the prerequisite for safe mobility and accurate navigation in public places. The continuity of an information chain on the way from point A to point B includes a uniform design, designations and mounting locations, as well as analogous marking of the return route using elements that provide information. Contrast planners must also take this into consideration in designing markings, signs, ground surface indicators, etc. The system must be tolerant to mistakes made by users. A wrong turn, or preferences for specific routes must not lead users in individual cases to suddenly become disoriented and thus helpless. Ensuring the continuity of contrasts is therefore urgently recommended.

3.2.2 Focus on transitional areas

The quality of the information provided by contrasts becomes most evident in transitional areas. These are defined as locations where

depth differences must be overcome, such as ramps, stairs or elevators, or where one space leads into another, such as building entrances and exits, the area between large rooms and hallways, or between different rooms, etc., because the structure and rules of a user's current mode of progress change at all of these locations. Transitional areas therefore pose a potential risk to people with visual impairments if they are not marked by adequate contrasts.

However, "too much" information resulting from too many different contrasts can lead to confusion and overload. To fulfil both requirements, contrast planning should above all focus on the continuity of contrasts, particularly in transitional areas.

3.2.3 Comfortable contrasts and DIN standards

A contrast ranging from 0.4 to 0.6 generally is rated as "comfortable". Contrasts less than k = 0.28 and greater than k = 0.83 can impair the ability of the partially sighted to reliably perceive objects: Low contrasts can appear blurry, very high contrasts can be blinding.

The DIN 32975 standard defines the different luminance contrasts that must be observed for different fields of application. The contrasts it calls for are described in Sections 4 and 5, which cover various fields of application.

3.3 Testing contrasts

Contrast solutions for large building complexes, outdoor areas or traffic routes ideally are the result of targeted assessments based on perception psychology, which help to test and plan the use of contrasts for navigation, avoiding dangers and enhancing convenience. Surveys of, and observations by, the largest possible user population are helpful in this connection, as is the experimental testing of typical information elements on these target groups. Surveys of individuals with visual impairments are not recommended, because the types of visual disabilities and their respective effects vary greatly. Scientific studies on the subject should be incorporated instead. Individual contrasts can be

measured objectively using luminance cameras. The sections below describe a testing method that also integrates the use of DIN standards for assessing luminance contrasts. Other methods are evaluated on a comparative basis.

3.3.1 Contrast testing to DIN

Contrasts between material combinations must be measured to DIN 32975 or confirmed in accordance with correspondingly prescribed specifications. To determine contrast, luminance factors are measured to DIN 5036-3, which defines specific test geometries.

3.3.2 Standardized laboratory luminance tests

Luminance is measured in diffused light, using the type of lighting intended for the application, at a measurement angle of 0° (vertical to the surface) as a minimum, and if necessary at other angles of observation relevant in practice. The angle of observation has a particular influence on the luminance of materials that have a textured surface or incorporate different degrees of glossiness. As the angle of observation changes, so does the reflectance. To determine the luminance contrast of ground surface indicators, DIN 32984 requires that a surface area of at least 4 cm x 4 cm be measured in order to adequately capture such profiled surfaces. This ensures that a sufficiently large area is tested if the material composition displays uneven brightness, such as light and dark areas on granite stones or in material mixes. Speckled surfaces with glossy elements, or fluorescent and pearlescent colours with glossy inclusions, likewise can be measured in this way. For the measurements to be reproducible, and to take into account the intended use outdoors or indoors, the measurements must be conducted under standard light types A or D65. Standard light type A corresponds roughly to incandescent lamp lighting, while standard light type D65 is equivalent to daylight conditions. It is not permissible to determine the contrast between two surfaces measured under different types of lighting. Under DIN, luminance contrast can be determined by directly measuring the luminances, or alternatively by calculating the

reflectance. This concludes the description of how luminance is measured under standardized conditions in a light laboratory. But what if the material combination in question has already been installed and material samples cannot be taken from it, for example in the case of protected historic buildings and facilities? Section 3.3.3 provides information on this situation.

3.3.3 Luminance testing in existing buildings under typical conditions

The lighting conditions required for testing under DIN 5036-3 cannot be recreated indoors or outdoors in existing public buildings or facilities. The lighting usually is not diffused, but rather contains portions of directed light from lighting systems or reflections from the surroundings. Previously installed materials are not, however, excluded from contrast testing for this reason. The test geometry must be adapted to the typical conditions of use such that the data still achieve a high degree of reliability and reproducibility. Because lighting situations involving daylight are subject to fluctuations, measurements inside buildings should be conducted after sundown if possible under typical lighting conditions. If measurements must be taken outdoors, and if the area normally is frequented in daylight, the measurements may be performed only in good weather. An acceptable level of steady daylight is available on sunny days with clear skies.

3.3.4 Methods for estimating luminance

In practice, a method occasionally is used that yields vague estimates of luminance contrast based on black-and-white images of material combinations. Photos of material samples are printed in grayscale by switching colour images on a computer to grayscale or by setting a digital camera to black-and-white mode. However, images of this kind depend greatly on the characteristics of the devices and only depict surfaces in the different intensity of their grey tones. Contrasts that were clearly visible before can disappear. According to proponents of this method, if the two surfaces are distinguishable from one another on these visualizations on screen or paper, it can be assumed that the

luminance contrast is adequate.

From a professional standpoint, this method can at best be viewed as a makeshift solution for obtaining an initial, general impression of luminance contrasts. Actual contrast values cannot be calculated in this way or tested to determine if they meet specific requirements of accessible design. Because it is not a measurement method, it does not provide any numerical values. Furthermore, computer monitors and paper copies usually render the original brightness of actual surfaces incorrectly and are easily manipulated. However, in on-site meetings with planners and practitioners, this method can be an illustrative way of demonstrating that differences in the brightness of objects are much more critical in designing facilities for the visually impaired than colour contrasts. Another method for testing contrasts is based on the use of colour charts, colour fan decks or digital colour systems. This can be explained using the example of RAL colour charts. RAL colours are standardized colours sold by the RAL GmbH company. Each colour has a numerical designation. The contrast values of two materials are derived from lightness values and conversion tables. The greatest potential error of this method lies in the correct matching of material surfaces to corresponding colour samples. Wall and floor coverings in particular frequently cannot be matched definitively, because their surfaces contain components that mix light and dark elements, such as granite, sandstone, roughcast, patterned surfaces, etc. The advantage of standardizing the chart numbers is that customers and suppliers exchange only RAL numbers and not material samples. However, the sections above clearly show that measuring the specific material is unavoidable, because its surface makeup has considerable influence on the contrast, i.e. both the surface structure and the material composition visible on the surface. The colour chart method attempts to solve this problem by assuming that a margin of error of 0.1 to 0.15 contrast levels generally should be allowed, and that glossy colours should not be considered for use in accessible design due to the potential reflection. With regard to the recommended margin of error, it must be mentioned

here that because materials are subject to wear, new materials should significantly exceed the required contrast levels (see Section 6.4 for more information on this topic). Therefore, additional increases in calculated values that result from using a test method that requires additional margins of error, is likely to be problematic. What is more, it further restricts the range of useable materials unnecessarily. DIN 32975 also recommends avoiding the use of glossy materials in new buildings due to glare effects and reflections. However, this

also unnecessarily excludes from contrast testing other materials that are only partly glossy or contain various inclusions (see Section 3.3.2).

3.3.5 Conclusion on contrast testing by self-help groups

Generally speaking, contrast testing based on colour systems or black-and-white images must be considered useful only to a limited extent because it is too inaccurate, especially since the two methods are not reliably reproducible measurements, but rather will always remain estimates based on visual inspection. The most reliable alternative appears to be the direct and objective measurement of luminance for contrasting surfaces using predefined measurement geometries and plausible methods. A comparative study of measurement methods by Joos et al. on behalf of the Swiss Federal Ministry of Transportation (2012) also advocates the necessity of thoroughly evaluating luminance contrasts through measurements made under typical conditions of use: "The contrast of objects in public areas can only be determined with special luminance cameras having sufficient accuracy, and with the necessary manpower and time."

This brochure endeavours to enable active members of the self-help movement to successfully argue in favour of the testing and observance of contrasts. The required luminance measurements themselves should continue to be conducted by experienced company or institutional inspectors who are competent in carrying out such tests and do so on a daily basis on behalf of material manufacturers, planners, associations, municipalities, federal and state authorities. See Section 6.3 for

information on evaluating the costs associated with such testing.

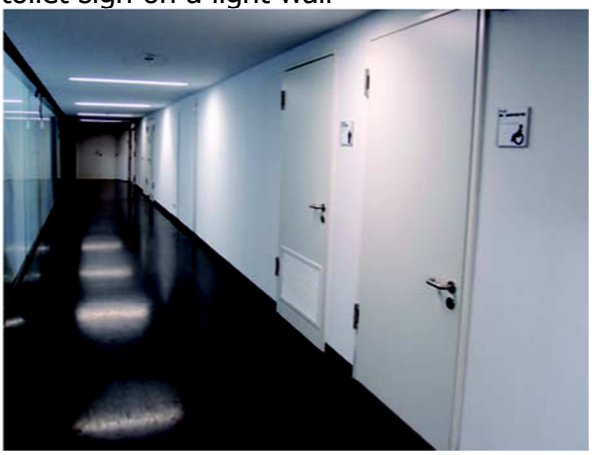
4. Optimising the contrast of signs, texts and pictograms

Much of the information provided in public spaces, either for navigation or for protection against hazards, is communicated through signs, texts and pictograms. Contrast values serving to make this information easier to locate and read, should be higher than others. DIN 32975 requires compliance with a luminance contrast of at least 0.7, and at least 0.8 for black-and-white depictions.

4.1 Basics of locatability and legibility

The locatability of information through contrasts refers to the ratio of the luminance of an overall information carrier to that of its background. For instance, if the basic colour of a toilet sign and that of the surrounding wall are of similar brightness, the luminance differs only minimally as a result of the different reflective properties of the material surfaces. This is illustrated in Figure 3. Insufficient contrast is generated, making it more difficult to locate the information carrier. The situation can be remedied by a high-contrast border around the sign or a high-contrast design of the sign's background in relation to the wall.

Figure 3: Negative example – Light toilet sign on a light wall



The legibility of information through contrasts refers to the ratio of the luminance of the signs, texts and pictograms to that of directly adjacent surfaces. Examples of such surfaces include sign backgrounds, as in Figure 4, which shows a pictogram indicating a men's toilet. The relevant luminance contrast is created between the black figure and the surface of the base material, a stainless-steel plate.

Figure 4: Positive example – Dark pictogram on a light background

If signs are used directly, i.e. without a base material, the adjacent surfaces are formed by surrounding walls, adjacent objects and other surroundings as seen in perspective. Surfaces of this kind, directly surrounding signs, are illustrated in Figure 5, showing a floor number on a wall, and Figure 6, showing pictograms as markings on a glass surface.

Figure 5: Number with a wall as the surrounding surface

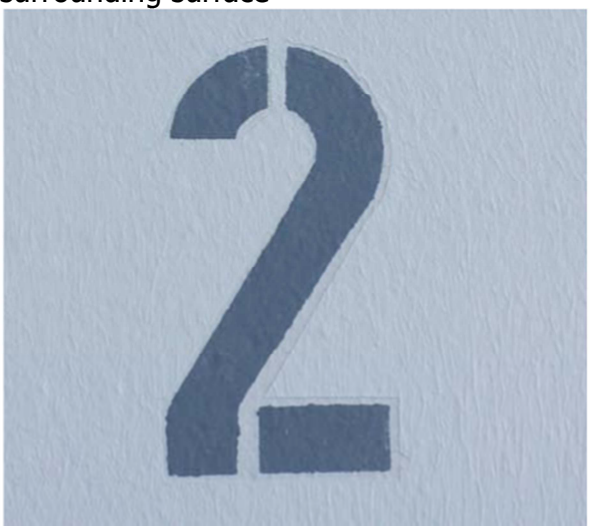
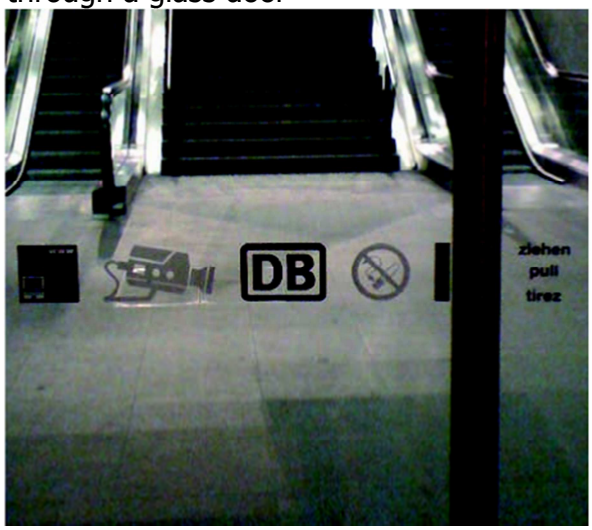


Figure 6: Pictograms with the ground as the surrounding surface when looking through a glass door



In the case of the floor number, the surrounding surface is a roughcast wall, painted in a light colour. In the case of the markings on glass, the background – a floor covering in this perspective – forms the surrounding surface for determining the contrast.

4.2 Transparent information carriers

The combination of light texts on glass with an equally light background proves to be particularly unfavourable. Figure 7 shows the name of an Inland Revenue Office building in the form of silvery-white adhesive letters applied to the safety glass of a transom window above an entrance door. As a result of the adjacent surface, consisting of a white ceiling when viewed from the typical perspective, the letters in the top row are almost impossible to see, those in the lower rows only being legible with difficulty, since there is too little contrast between letters and ceiling.

Figure 7: Negative example – Light text on glass with a light background

This situation could be remedied by a far darker ceiling design or darker lettering, or by backing the light text with a dark film. Figure 8 shows a display case at an exhibition. Figure 9 shows what is revealed to the observer upon coming closer. Each of the four sides is made of glass and covered in light-coloured text providing information about the exhibit. The floor, being the surface adjacent to the text from the observer's perspective, has a marbled appearance due to the medium-light granite tiles used and does not contrast sufficiently with the text, meaning that the latter can hardly be distinguished from the floor. In addition to which, all the outer glass surfaces of the exhibit bear text. As a result, the texts overlap in the perspective view, making it definitively impossible to read the information.

Figure 8: Example – Exhibit in a glass display case with stainless-steel frame

Figure 9: Negative example – Overlapping texts on glass with a light background

Backing the texts with dark films would ruin the look of the exhibit, since the interior would no longer be visible. Dark lettering would also not be the answer, because the problem of overlapping texts would remain. One remedy would be to transfer the information to an additional sign with sufficient background contrast.

4.3 Ill-considered decorations and colours

Images or colour gradients should generally be avoided as backgrounds, since they at least locally reduce the luminance contrast of lettering. Figure 10 shows a building nameplate that is in itself of high-contrast design. The partial backing of the text with a decorative seal interrupts and greatly reduces the contrast of individual words in relation to the sign's background. One remedy would be to reduce the size of the seal, such that the text is no longer backed by it. The size of the sign offers enough space to position the seal separately.

Figure 10: Negative example – Text on a background with backing

Information brochures and posters are usually of elaborate design. Many different colours are used to draw attention to different items of content. Differentiation through luminance contrasts often takes a back seat in this context. As a result, it may be that information that is of no great relevance is visually emphasised by strong brightness contrasts in relation to the background, while important items are ignored because of their insufficient luminance contrasts, even though the colour scheme was chosen to be striking.

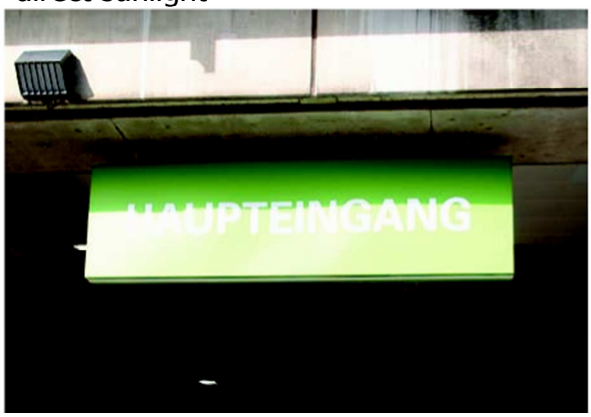
4.4 Glare and shadows – Evil spirits

Section 3.1.5 explains that it is impossible to formulate global standards for illuminances to arrive at designs suitable for the visually impaired. What is instead needed is lighting that is appropriate for the prevailing local situation. Even if contrasts can be confirmed by measurement, it may be that they are imperceptible to the human eye because the lighting is too dim or too bright. The lighting is insufficient if objects throw shadows, for example, while excessive lighting can lead to glare caused by reflection of the light. The latter can also be brought about by direct sunlight. Figures 11 and 12 show a sign that hangs from the ceiling on the shady side of a building and draws attention to a main entrance. The contrast between the lettering and the sign's background is sufficient, meaning that the individual letters can easily be made out. An identical sign is installed on the sunny side of the building. The direct

sunlight causes partial glare on the letters, making them no longer legible.

Figure 11: Example – Sign in the shade

Figure 12: Negative example – Sign in direct sunlight



Moving the sign towards the back could remedy this situation. The ceiling would then uniformly shade the entire sign, and the contrasts would remain perceptible. Alternatively, if the surface of the information carrier were less smooth, the glare would be reduced because the light would be reflected less on the surface of the material. Fitted directly on the top edge of the sign, shading elements made of opaque material could likewise make for uniform lighting conditions on the sign.

Undesirable reflections similarly can occur on information carriers equipped with covers or windows, such as notice boards with glass or Perspex panes. They can be avoided by anti-reflection materials. The contrast of the displays on automated self-service machines should be adjustable.

Figure 13 shows a partial map of a bus and railway station. As the cover over the map is not made of anti-reflection material, its surface is highly reflective in normal daylight, meaning that the numbers of the railway platforms are illegible. The same problem is illustrated in Figure 14, which shows information on the opening times of a library. Although the information text is in itself of high-contrast design, positioning it on the inside of a glass wall means that passers-by and the surroundings behind the observer's back are reflected. The texts look washed-out, since the contrasts are sometimes weaker and sometimes stronger as a result of

the changing surroundings.

Figure 13: Negative example – Glare on a glass cover, caused by sunlight

Figure 14: Negative example – Surroundings reflected on information behind glass

Figures 15 and 16 show sections of a map that is installed outside a primary school and needs no covers. Although it catches the sun, the contrasts are not impaired because the surface is matt. Unfortunately, the background of the text in the key does not always display sufficient contrast. The individual areas of the building are easily distinguishable on the map as a result of high-contrast colours and borders, but the associated building designations are only legible for some of the buildings, owing to poor contrast.

Generally speaking, notice-board information with a navigational or decision-making function should itself be sufficiently illuminated to permit the perception of contrasts and to avoid shadows being cast when approaching the information. According to DIN 32975, directional illumination should be provided either from below, above or behind.

Figure 15: Positive example – Map without cover

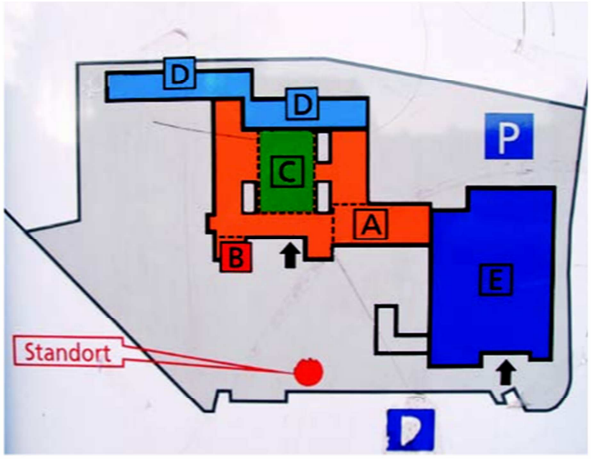


Figure 16: Negative example – Key to the map with inadequate contrast

Even objects deliberately designed for people with visual impairments can be problematic. Figure 17 shows a toilet sign including not only letters, but also Braille characters. The raised letters are on a colourless Perspex panel with a gap between it and the wall. The letters therefore cast a shadow on the wall and unnecessarily impair the otherwise perfect contrast of the dark letters against the light wall.

Figure 17: Negative example – Shadows cast by relief letters on Perspex

4.5 Different kinds of paper for information carriers

If paper is used as the carrier material for information, e.g. for folding maps, the thickness of the paper is additionally important for preserving contrasts. If paper is printed on both sides, information on the back must

not show through the front. As the surface adjacent to the printing, it unnecessarily reduces the luminance contrast. A minimum paper weight of 100 g/m² must therefore be ensured.

Since notice-board information in particular is subject to frequent alterations, it likewise is usually printed on paper as a low-cost option. Glossy surfaces on paper result in undesirable glare effects, especially in daylight, this greatly reducing the contrast between the print and its background.

For reasons of cost or environmental protection, bulk mail and circulars are often printed on paper that is very grey and has a very rough surface. Compared to pure white paper, i.e. very bright paper, this has a contrast-reducing effect on the legibility of texts and should be avoided. In terms of the printing, the effect of the paper on the contrast is the same as the negative effect of texts on a coloured background.

4.6 Illuminated lettering – Beware!

Information provided by backlit or luminous displays is a special case in terms of luminance contrasts. Contrary to the situation with opaque signs, the contrast can be reduced in practical application. For displays of this kind, the contrast must achieve the customary specification of 0.7, or 0.8 in the case of black-and-white, but under less favourable conditions.

For example, a bright light box with an opaque pictogram affixed to it yields different luminances, depending on whether it is switched on or off. This does not alter the luminance of the opaque pictogram. The contrast is calculated from the adjacent surfaces of the pictogram and the background. In other words, switching the light on and off results in different contrasts. The situation is similar in the case of transparent signs on light boxes. It then depends on the transparency of the signs and the background, whether the illuminance from the inside has a uniform effect (which in turns directly influences the luminances of the individual surfaces). Therefore, in the case of internally-lit displays, the lower contrast must always be sufficiently high.

Section 3.1.5 explains that ambient illuminances have no impact on existing contrasts. Luminous or backlit displays constitute a special case in this respect, too. Daylight or artificial light is superimposed on the luminances and can have a contrast-reducing effect. According to DIN 32975, the lighting situation must be taken into account when assessing luminous or backlit displays. Without the influence of daylight indoors, the minimum contrast must be present at an external-light illuminance of at least 200 lux. With the influence of daylight and outdoors, the minimum contrast must be present at an external-light illuminance of at least 2,000 lux. This incidentally also applies if the displays are fitted with protective covers that can cause additional reflections.

Electronic displays are increasingly being used for dynamic information, such as passenger information boards. A study comparing the readability of dynamic information displays (Lang et al., 2004) showed that, among other things, LCD displays are generally perceived as having higher contrast than LED displays, particularly when viewed from the side, this probably being the most frequent case in practice. This result proved to be independent of the age and visual performance of the test persons. LED displays should therefore not be used. In addition, a high numbers of pixels is beneficial to contrast.

Moving messages in electronic displays should generally be avoided, even if the contrast is sufficient. The eye usually has too little time to adjust to the rapid changes in contrast at individual points to be able to perceive first individual letters, then entire words, and subsequently to read and understand them.

5. Optimising the contrast of markings

5.1 General notes on high-contrast markings

The aim of optimising the contrast of markings is to increase safety when a risk exists of running into obstacles or falling, and to ensure accessibility for using service facilities and individual operating controls.

DIN 18024-1, DIN 18024-2 and DIN 18040-1 define minimum movement areas, movement spaces and traffic areas in public. Unfortunately, restrictions of these minimum specifications are commonplace, depending on the prevailing local conditions or as a result of the ignorance of the responsible persons. Furnishings, such as waste bins, bicycle stands, benches, post boxes, advertising media or automated self-service machines, unfortunately are often installed in movement areas, or project into them, thus giving rise to the danger of running into them or tripping over them. Both events can cause serious injury, especially if the collision is accompanied by a fall. Obstacles that protrude into pavements, including those that are parts of buildings or installations, such as entrances or steps, therefore need to be provided with high-contrast markings to DIN 32975, just like doors or walls made of glass, in order to prevent collisions and falls.

Service facilities that are only made readily identifiable and usable by a high-contrast design – such as automated machines, post boxes, telephones and emergency call devices, and also their individual operating controls, as well as the operating controls on traffic lights, toilets and lifts, for example – need to be provided with high-contrast markings. The choice of marking material is governed by the respective conditions of use and the base material of the object. Well-established colour schemes for service facilities and operating controls have the advantage of high recognition and this should not be compromised without good reason.

Adhesive films or paints are often used for markings on metal objects. This option also applies to objects made of plastic, which can additionally be pigmented themselves during production. Material combinations in the objects themselves also prove to be favourable. For example, if wood, metal and hard rubber are combined in service facilities, this offers both visual and tactile contrasts. There are no bounds to the imagination as regards the marking material, provided that the contrasts are sufficiently great.

5.2 Dangerous furniture and other obstacles

DIN 32975 calls for compliance with a minimum contrast of 0.7 when marking obstacles and barriers. Glossy surfaces must be avoided, since their directional illumination can lead to reduced contrasts or glare. Even if diffused light is present, reflection effects can lead to a situation where physically existing contrasts between an object and its surroundings are imperceptible, because the surroundings are reflected in the object, as illustrated in Figure 18. A waste bin made of polished aluminium reflects both the floor and the wall, thus becoming invisible for people with visual impairments. What would be needed is an all-round marking that at least contrasts strongly with the floor covering, so that the bin can be perceived as an obstacle standing on the floor.

Figure 18: Negative example – Surroundings reflected in a metal waste bin

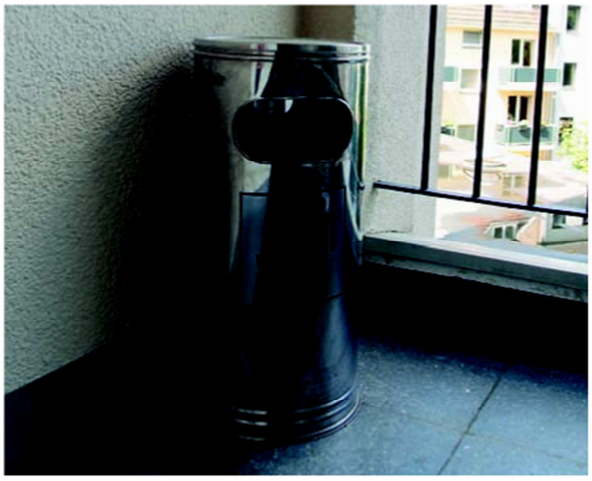


Figure 19 shows a typical combination of waste bin, power distribution box and power mast on the pavement

The luminances of the individual elements differ only insufficiently from the luminance of the paving and pose collision risks. An optical safeguard in the form of high-contrast markings could be implemented for all the objects, using adhesive films, paints or ground indicators.

Figure 20 shows a pedestrian crossing on a six-lane road, divided in the middle by two tram tracks. It leads from the three-lane carriageway of the one direction to the centre island, proceeding to the tramline crossing and, from there, the crossing of the three-lane carriageway in the other direction. To prevent pedestrians from thoughtlessly stepping onto the road or the tracks, the centre island is fitted with a labyrinth of countless metal barriers. The contrast of the individual barriers in relation to the ground, and to the dynamic background created by passing vehicles, is insufficient. Markings in alternating contrasts should be provided, so as to afford protection against collisions and improve short-range orientation.

Figure 20: Negative example – Lack of contrast between metal barriers, paving and dynamic background

Figure 21 shows a positive example of similar metal barriers with alternating contrast. This is a high-contrast way of preventing cyclists from crossing a road without thinking. The colour used for the alternating contrast is irrelevant and could be varied, provided the difference in brightness between the two colours is sufficient.

Figure 21: Positive example – Metal barrier with alternating contrast on a footpath

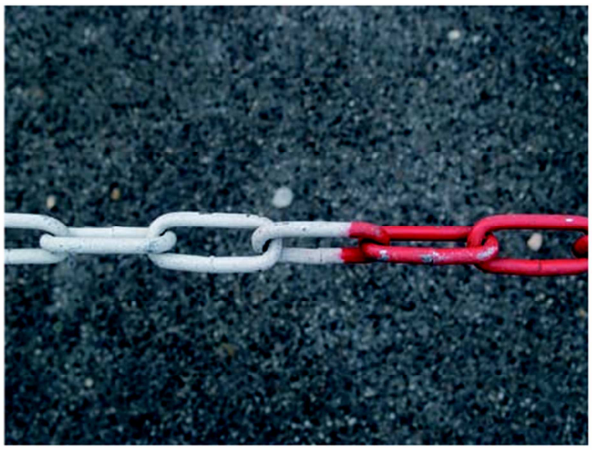
Figure 22: Positive example – Protection by vegetation

The problem with low-contrast combinations of untreated metal and medium-light materials on pavements is also frequently encountered on traffic light posts, lampposts, signposts and flag poles. Figure 22 shows an example of how high-contrast protection can be provided around flagpoles by planting low hedges at the base of the pole.

Figure 23 illustrates the same problem caused by a lack of contrast between paving and steel barrier chains. The risk of tripping over them is enormous. Figure 24 shows the difference when using a chain with alternating contrast. However, since the chains usually have a very small cross-section, making them generally hard to perceive, it would be better to avoid the use of chains entirely.

Figure 23: Negative example – Medium-light barrier chain against medium-light paving

Figure 24: Positive example – Barrier chain with alternating contrast



5.3 Automated self-service machines and operating controls

According to DIN 32975, operating controls on emergency call and alarm devices are to be provided with high-contrast markings with a minimum value of 0.7. Figure 25 shows the alarm device of a building alarm. The contrast value between housing and wall is sufficient.

Figure 25: Positive example – Alarm device

The operating control, a button in the middle to be pressed in an emergency, displays sufficient contrast with its surroundings. As both the button on the background and the associated instructions for use are in black on white, a minimum contrast of 0.8 applies to both according to DIN 32975.

DIN 32975 states that operating controls not forming part of an

emergency call or alarm device must have a minimum contrast of 0.4. In addition, the lighter surface of the contrast must have a reflectance of at least 0.5. Key pads on which numbers are selected, such as on door bells, in lifts, on ATMs, automated self-service machines or public telephones, are often made of stainless steel. Both the keys and the surrounding backing plate are frequently made of the same material. As a result, there is no contrast and the operating controls can hardly be distinguished from the backing plate.

Figure 26 shows a customary ATM. The brightness of all the operating controls is similar, meaning that there is no sufficient contrast. All the keys and their backing plates are made of stainless steel. The same applies to the card slit, which is surrounded by an equally light plastic housing.

Figure 26: Negative example – ATM

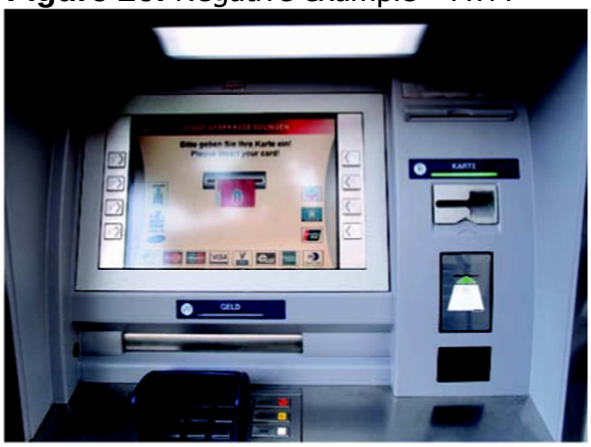


Figure 27: Negative example – Key pad in a lift

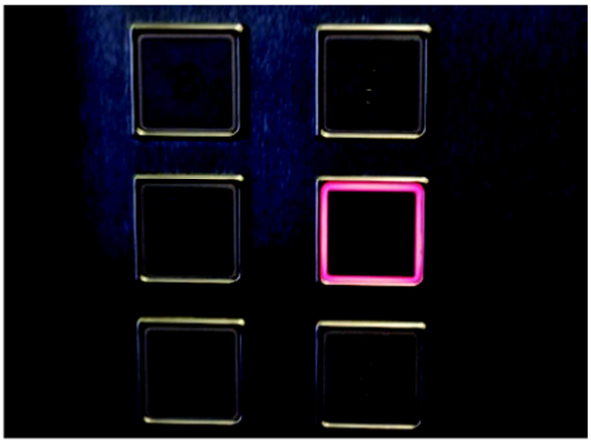


Figure 27 shows the key pad of a lift. Absurdly, a contrast is only produced when a key is pressed, the floor already selected then being indicated by a ring of red light. The operating panel of the call button outside the lift (not shown here) is again made entirely of stainless steel and can hardly be distinguished from the light wall owing to its daylight-reflecting surface. Provision of a backing frame contrasting with the wall, as provided for by DIN 32975 in such cases, would be more convenient and cause less groping around on the wall.

The influence of high contrasts on good personal hygiene becomes clear in connection with sanitary facilities, as shown in Figures 28 to 30.

Figure 28: Negative example – Light sanitary fittings on light walls

Figure 29: Negative example – Invisible towel dispensers

Figure 30: Negative example – Toilet cubicle in a cultural centre

Objects such as toilets, towel dispensers, soap dispensers and their operating controls, which all have equally light colours, as shown here, result in the unpleasant necessity of feeling along walls and objects to find them. Use of the toilet paper dispenser and toilet brush likewise would benefit from contrasts. Figure 30 shows a standard toilet cubicle in a cultural centre. The walls, toilet, cistern, paper dispenser, waste bin and toilet brush are in uniformly light colours. The lack of a difference in brightness between the objects and the walls means that the objects cannot be perceived individually. However, the darker floor does make it possible to recognise the toilet, the brush and the bin, at least upon coming closer. On the other hand, people with visual impairments can

only find the button for flushing the toilet and the toilet paper by feel.

5.4 Invisible glass walls and doors

Doors consisting largely or entirely of glass, and also glass walls, give a normally-sighted observer the illusion of expansive spaces, creating transparency in an environment that is in fact divided. This illusion is more pronounced for people with visual impairments, leading to a situation where paths are perceived as being obstacle-free and uninterrupted. Walls and doors thus become invisible and there is a risk of collisions. Glass parapets pose a similar risk, particularly if the lighting is such that it produces reflections on the surfaces that suggest the floor surface is completely accessible.

DIN 32975 prescribes strip-like markings on glass surfaces. If the markings make up at least 50% of the surface, they may also take the form of individual elements. Figure 31 shows safety markings of this kind, with alternating contrasts generated by light and dark elements. The contrast effect is preserved against varying backgrounds and when lighting conditions change. The light lettering above the alternating contrast illustrates clearly how the white elements are hardly legible due to the likewise very light wall in the background, whereas the black elements have a striking effect. The opposite effect would occur if people in dark clothing were to walk past on the other side of the glass.

Figure 31: Alternating contrast on glass doors

According to DIN 32975, the high-contrast markings must extend over the entire glass surface, have a width of at least 8 cm and be provided at a height of both 40 to 70 cm and 120 to 160 cm, measured from the floor up in each case.

This also applies to revolving glass doors, so as to provide visible high-contrast markings on the individual door elements, thus making them distinguishable from one another to ensure collision-free passage.

Another positive example is illustrated in Figure 32, which shows two automatic sliding doors, located one behind the other, at the main entrance to a university canteen. Instead of the usual safety markings, adhesive films are used. They show life-sized representations of human silhouettes with different degrees of lightness that visually "populate" the doors over their entire width when closed.

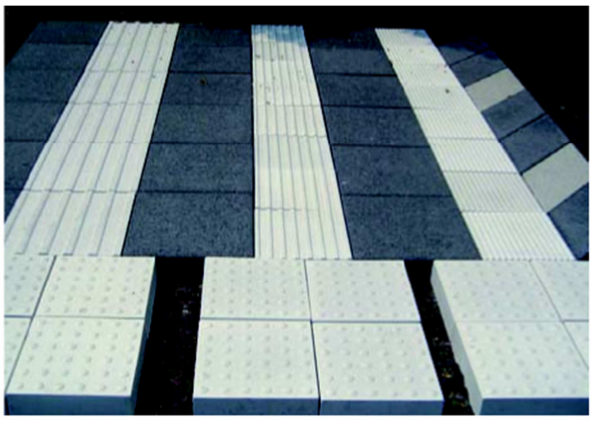
Figure 32: Positive example – Use of adhesive film for alternating contrast on glass doors

5.5 High-contrast marking and identification of floor areas

5.5.1 Warning and directional indicators

According to DIN 32975, navigation and guidance systems that work without text or pictograms must have a luminance contrast of at least 0.4. A minimum reflectance of 0.5 must be observed for the lighter surface. Figure 33 shows a current selection of different high-contrast materials for outdoor warning and directional indicators.

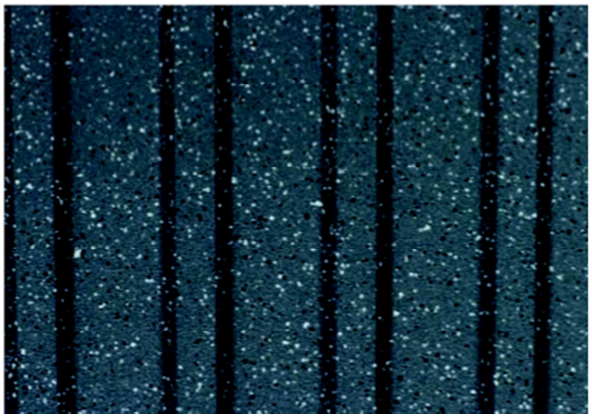
Figure 33: Positive example – Currently available directional indicators, warning indicators and contrast enhancement indicators

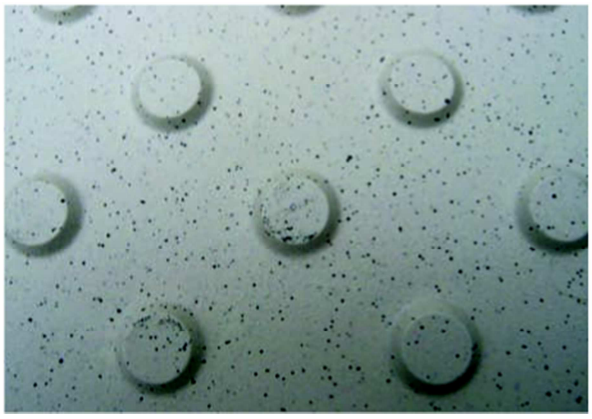


The luminance contrast in the example shown is well above the minimum value of 0.4. The colour scheme of the individual paving stones would, however, be variable. Regarding the different colours of available materials, it should generally be noted that supply is always governed by demand. The accessibility of guidance systems is, however, decided solely by compliance with minimum luminance contrasts. With a required minimum value of 0.4, these contrasts are within a perfectly feasible range and can be achieved with numerous different colours and materials. They do not always have to be realised in black-and-white or black-and-yellow. Attractive designs with sufficiently high contrast for use inside buildings can also be achieved, as illustrated by the ceramic materials in Figures 34 and 35.

Figure 34: Positive example – Dark directional indicators indoors

Figure 35: Positive example – Light warning indicator indoors





The individual luminances of these examples are high or low enough to permit their combination with a wide range of luminances of other materials, so as to create sufficient contrast. Figure 36 shows an equally adequate alternative for navigating with the help of floor markings. An arrow-shaped floor marking steers visitors at a university from the lift at the building entrance to a tactile building map.

Figure 36: Positive example – Indoor directional indicator, applied to the finished floor

5.5.2 Transitional areas

Particular attention must be paid to the marking of transitional areas, as they often must afford protection when movement needs to change

abruptly. In particular, areas involving a change in level – such as single steps, staircases, ramps, escalators and travolators – need to be provided with sufficiently high-contrast markings, since they pose a greater risk of falling. Figure 37 illustrates the problem of poor recognisability at the top of a flight of three steps directly inside a building entrance. In this case, the situation is slightly improved by the high-contrast marking of the stringers, as shown in Figure 38.

Figure 37: Negative example – No step markings in the stairwell

Figure 38: Negative example – No step markings and low-contrast handrail

Safety markings on individual steps are nonetheless necessary. DIN 32975 requires both the treads and the risers of stairs and escalators to be marked over the full width. A 4 to 5 cm deep strip, measured from the front edge of the step, must be applied to the treads. The riser must have a 1 to 2 cm deep strip, measured from the edge of the step. In addition, the handrail of the staircase does not contrast enough with the wall.

Figure 39 shows another critical staircase design with railings. Depending on the perspective, the railings are perceived in contrast with the dark stairs or the light wall. The contrast with the stairs is insufficient, while the contrast with the wall is adequate. This could be remedied by railings with alternating contrasts, which would work successfully from different

angles. Moreover, a handrail on the wall side would be recommendable, since no difficulties caused by different perspectives can arise there. The steps should be individually marked with a much lighter strip.

Figure 39: Negative example – No step markings, low-contrast handrail

Figure 40: Positive example – Step markings on linoleum

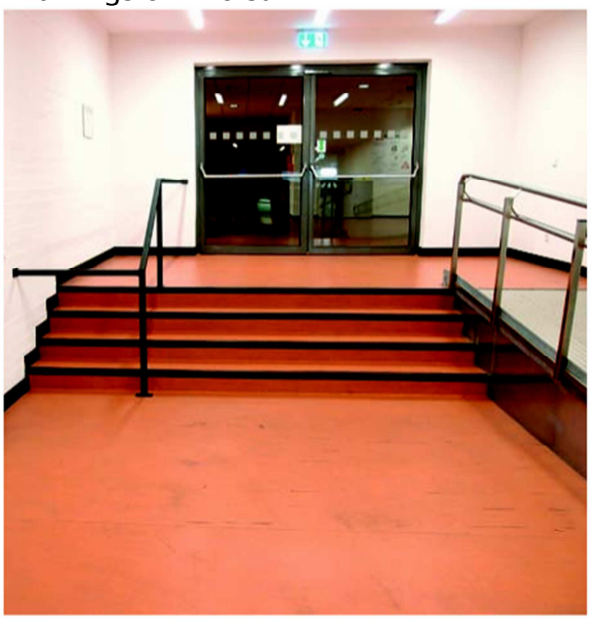


Figure 40 shows a positive example of indoor stairs with high-contrast step markings made of hard rubber on a linoleum floor.

The newly built flight of outdoor concrete steps shown in Figure 41 is a negative example, since step markings were dispensed with. Neither the treads nor the risers have any contrast, meaning that the transitions between individual steps are invisible for people with visual impairments when going either up or down them.

Figure 41: Negative example – No step markings, outdoor concrete steps

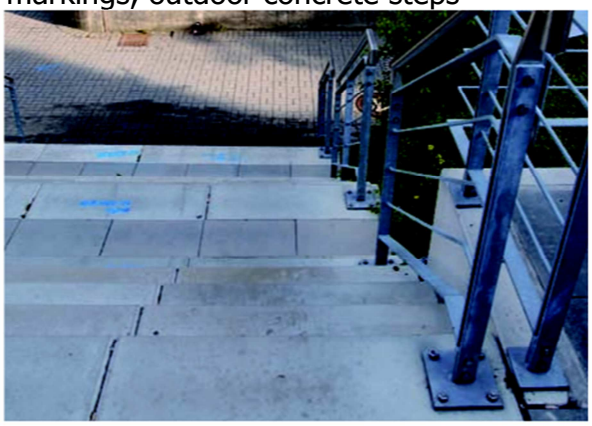


Figure 42: Positive example – Step markings, outdoor concrete steps

Positive examples in highly frequented outdoor areas are provided by, for instance, solid rectangular steps that have contrasting brightnesses in a single block, as shown in Figure 42. Alternatively, rails made of hard rubber, metal, wood or plastic can be used on steps. Films, cold plastics and paint-like materials are also used, sometimes in reflective, retroreflective or luminescent form.

Steps with metal grid treads should generally be avoided, since the separation of the individual steps disappears when looking down. Figures 43 and 44 illustrate the problem.

Figure 43: Negative example – Metal grid steps

Figure 44: Negative example – Perspective through metal grid steps

6. Arguments to counter common objections

6.1 Legal background

It would exceed the limits of this brochure to list and explain all legislation that ultimately leads to the consideration of minimum contrasts in public places.

DIN 32975, to which this brochure on contrasts frequently refers, is one of various standards defining accessibility. In specific terms, it is always applicable when public spaces are to be considered accessible. However, high-contrast design alone is just as incapable of creating accessibility as is exclusively wheelchair-oriented design, for example. All standards on accessible design must be considered equally relevant. Statutory obligations regarding accessibility often exist in the case of new buildings, renovation and re-design. In Germany, the Building Codes of the Federal States additionally stipulate which public spaces must be designed accessibly.

However, since compliance with certain minimum contrasts not only protects people with visual impairments against dangers, but also improves navigation and convenience in public spaces, legal arguments are not absolutely necessary. Rather, the aim should be to promote the acknowledgement of high-contrast design as a systematic service for everyone, not just a special solution for people with visual impairments.

6.2 The user group for contrasts – Too small?

People with visual impairments are not counted in Germany. The following is an approximately realistic assessment of the available figures on people with visual impairments in Germany. It is based on the 2009 statistics of the Federal Statistical Office on people with severe disabilities, published in June 2012, WHO figures for Europe from 2002 and plausible considerations for estimating the actual size of the user population for sufficient contrasts in public spaces.

6.2.1 Statistics on people with severe disabilities in Germany

The statistics of the Federal Statistical Office on people with severe disabilities indicate that only 352,943 people in Germany were acknowledged as being blind or visually impaired as of 31 December 2009. This corresponds to 5% of the total number of people with severe disabilities, who in turn account for roughly 8.7% of the population. People are considered to be visually impaired if, despite correction, their distance or near vision is reduced to between 1/3 (30%) and 1/20 (5%) of the norm (100%).

The number of people in Germany who see poorly, and thus benefit from contrasts, multiplies inestimably if a closer look is taken at those not included in the statistics. A few notes on this subject:

- People whose visual acuity is greater than 30%, but less than 100%, are not taken into account. Their number is generally growing as a result of increased life expectancy, and it rises still further with the increasing age of the affected persons.
- Only people with a disabled persons pass were included. Those who meet the criteria for a visual impairment, but have not applied for a pass, are not considered.
- Women apply less often than men, since they are less often gainfully employed, meaning that they see no advantage in applying in terms of the labour market or pensions.
- In the case of people with several disabilities, only the most severe disability is considered in each case. The visual impairment is not always a person's most severe disability.
- People are only classified as disabled if their impairments exist for more than six months and impair participation in social life. The extent of the impairment must deviate from the typical condition for the person's age. In other words, temporary visual impairments do not count. Since visual performance declines with increasing age, older people are also not included, since the impairment is typical for their age.

6.2.2 WHO figures for Europe on people with visual impairments

A total of roughly 1,066,000 people with visual impairments in Germany can be derived from the WHO figures for Europe for 2002. An 80% increase in the number of visually impaired persons was recorded between 1990 and 2002 (owing to the rise in life expectancy). Consequently, there were probably already as many as 1.7 million people with visual impairments in 2011. According to the WHO, the over-65s in particular are affected by a dramatic deterioration in their visual performance. So, as demographic change progresses, planners and practitioners will in future be confronted with more and more people whose visual performance is far worse than that of others.

6.2.3 Actual user groups for contrasts

Information in public spaces that promotes navigation and protection against hazards must serve the public in general. As explained above, this public is changing and in no way defined as a homogeneous majority of people with good eyesight. High-contrast design in public spaces always benefits everyone, which is why there is really no need to speak of a specific user group. For people with visual impairments, however, sufficient contrast is often the only way for them to navigate and move safely through public spaces without assistance.

Even people classified as blind can have some visual perception and navigate better with the help of good contrast.

Not least, it should be pointed out that everyone suffers from "temporary visual impairment" from time to time. The main reason in this case is distraction, e.g. owing to haste, fatigue, telephone calls, emotions, carrying heavy baggage, pushchairs, children or pets. Sufficient contrast is also required for perception when visibility is restricted, such as in twilight, poor lighting, power failures, snow, rain, fog or smoke or when wearing fogged up glasses. Tourists and business travellers likewise benefit from good contrast since, being on unfamiliar territory, they are reliant on good navigation aids. Children and people with learning and reading problems, or with poor language skills, similarly benefit from

high-contrast aids for navigation and protection against hazards.

6.3 Accessible design – Exploding costs?

When using high-contrast materials in new buildings, design suitable for people with visual impairments need not generate additional material costs. On the other hand, a lack of expert knowledge and training on the part of the planners and practitioners responsible for public spaces quite often leads to unsuitable designs that subsequently require improvement. Compared to the increase in safety, however, these costs are often within reasonable limits. Only rarely do building materials have to be completely replaced, since the existing structures can often be upgraded to higher contrast.

Testing costs for determining the luminance contrasts of individual material combinations in new condition can usually be borne by the manufacturers. They can distribute these costs over many customers, and additionally benefit from the tests if they effectively market the accessible design of their products. This has long been standard practice for achieving other standardised safety goals, such as the non-slip ratings on floor coverings.

In designing public spaces, the general aim must be to give well-founded consideration to accessible design early in the planning phase. Should expensive measures for the subsequent creation of contrasts be necessary, the objective of these measures must be examined. If the aim is to use contrast to provide protection against falls or the risk of collision with obstacles, the costs should be examined on a long-term and sustainable basis, because no cost-neutral solutions exist. This is where the argumentation skills of the self-help associations come into play. This brochure is intended to help illustrate existing hazards and solutions, and convincingly present both. Rather than – for lack of arguments – listing potential consequential costs in the event of accidents, i.e. generated by court cases, extended hospitalisation, loss of earnings, etc., it often makes a far greater impression to inspect a site together with the responsible decision-makers and provide goggles for simulating various

visual impairments. The importance of contrast then is usually self-explanatory.

6.4 Durability of contrasts

Luminance contrasts between materials are frequently determined in new condition. Typical phenomena in outdoor applications are weathering, wear and soiling, which can lead to a decline in luminance contrast. It is therefore advisable to use material combinations that substantially exceed the required contrast values, so as to comply with the specifications in the long term, even in the event of the contrast being reduced by impairments typical for the application. Colourfast surface protection and invisible material impregnation can help, but are also stretched to their limits over the course of time. The authors of this brochure therefore recommend that specified contrast values be exceeded by at least 0.1 as a tolerance for impairments. Short cleaning intervals are likewise recommended. Values for resistances to frost and road salt, as well as abrasion classes, can be found elsewhere and should likewise be clearly exceeded. Regular inspections at realistic intervals are urgently advised, in order to check for, and remedy, reductions in contrast caused by wear, weathering and vandalism. Figures 45 to 47 show the consequences of neglect on a barrier, a call button on a set of traffic lights, and on a ticket machine monitor, each with a different cause for the reduction in contrast.

Figure 45: Negative example – Flaking paint and rust on a metal barrier

Figure 46: Negative example – Dirty call button on a traffic light

Figure 47: Negative example – Dirty monitor of a ticket machine

6.5 Contrasts – An insult to aesthetics?

High-contrast design is sometimes rejected for aesthetic reasons. There is no need here to discuss or compare the relevance of aesthetics with the relevance of using contrasts to provide protection against hazards. The situation is often misunderstood, since the difference between colour contrast and luminance contrast is not sufficiently familiar. People who express concerns often assume that everything is to be designed in black-and-white, red-and-white or yellow-and-black. However, since compliance with required contrasts is not a matter of determining colours, but of differences in brightness, even combinations of similar colours with different degrees of saturation can have high contrast in terms of colour design.

Moreover, the imaginative use of material combinations still plays far too small a role. Where materials are concerned, demand is frequently still governed by supply. In this context, customers are first and foremost called upon to demand high-contrast materials in aesthetic designs from material manufacturers and to take new approaches. Also, the influence of different material surfaces for achieving a high-contrast design has yet to be fully exploited.

Cultural heritage management and accessibility are often said to be incompatible. Here, too, ignorance of colour and luminance contrasts is

often encountered. In addition, the aim of accessible design is not to senselessly destroy existing buildings, but to make them safely accessible to a wider public. The brightness of defined areas can sometimes be successfully increased by incorporating daylight or spotlights in such a way that useful contrasts with adjacent areas result.

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In connection with optimising the contrast of signs, lettering, markings and ground surface indicators for accessible design in public spaces, this brochure, funded by the Federal Government, serves as a practical guide, presenting the content of current DIN standards in practice-oriented form and giving many examples.

Typical mistakes and solutions are outlined concisely and comprehensibly. Basic knowledge is combined with examples of materials, assessments of luminance contrasts and design proposals. The purpose is to enable self-help associations to competently advocate the accessible design of public spaces through visual contrasts, both in consultations and when replying to questions from practitioners.

The content of the brochure is rounded off by specific arguments for use when dealing with persons responsible for deciding on implementation measures.