Specifying Colors that Support Safe Built Environment

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Abstract. Safety is one of vital aspects of liveable built environment. Designing a safe built environment requires comprehension regarding people’s activities in that environment as well as their characteristics and abilities linked to those activities. People with various characteristics and abilities might use different methods and/or need different facilitations for performing activities, even when performed activities are similar. This paper presents how important comprehending characteristics and abilities of people in terms of visual sense is to color applications expected to support safe mobility in built environments. Colors in built environment have various functions. One of these functions is to provide visual information for identifying and navigating the environment. Color combinations enabling identification of built environment for fully-sighted people might be different from those of individuals with visual impairment. Conspicuous color combinations for fully-sighted people are not necessarily distinguishable for individuals with visual impairment having reduced functional vision. Building codes in Indonesia have included colour contrast as a requirement supporting safe mobility of people with visual impairment. Some public facilities in Indonesia have applied color combinations based on this requirement. However, this requirement is normative and vague; its applications are open to broad interpretation, which could lead to the occurrence of hazardous settings for mobility of people with visual impairment. The requirement needs more detailed descriptions established by utilising reliable measurement methods entailing comprehension of characteristics and abilities of people with visual impairment. Detailed descriptions will enable appropriate applications of colors supporting safe built environment for people with and without visual impairment.

Keywords: colors, navigation, safe built environment, visual impairment, visual information, visual sense

1 Introduction

Safety is a significant aspect of liveability. Safety, together with these aspects: accessibility, usability, affordability, sustainability and aesthetics; are expected to be possessed by a liveable or well-designed built environment. Well-designed built environment can enable people to live and conduct activities within it, which include finding the way when traveling in space or between spaces. Spatial layouts, architectural elements and information facilities that are appropriately designed, composed and/or assembled could allow safe and independent movement and wayfinding. Unsafe spaces, buildings or facilities generated by inappropriate process of design and/or construction, could cause accidents such as falls, trips or bumps and increase dependency on other persons, for individuals (whether they have impairment or not) when traveling.

This study focuses on safety of people with visual impairment when moving in or between spaces. Falls, trips or slips caused by building elements or spatial features that were not be detected in time or
undetectable at all were common origins of injuries for adults or aging people with vision deficits \(^5, 6, 7\). A few elements in the built environment, such as tactile ground surface indicators (TGSIs) and step nosings, are specifically designed and installed to support safe navigation of people with visual impairment by informing about direction, transitional spaces and changes in level. As well as these specific elements, there are common elements shared by people with vision impairment and normally-sighted individuals, such as door handles, electronic switches or buttons and handrails. People without visual impairment normally identify built environment and its elements through visual perception of attributes of those elements, which include form, colour, texture or size. Approximately 75\% of acquired information concerning built environment is collected through visual sense \(^8\). How an individual situates him/herself in an environment is commonly based on visual reference and/or visual interface between the individual and the environment \(^9\).

This might influence the way built environment is designed. Designing built environment has been performed mostly by people without vision impairment and commonly conducted by prioritising visual sense over the other senses. Privileged position of visual sense might lead to unintentional exclusion of people with visual impairment in using or navigating built environment. The process of identifying built environment is different between people with and without visual impairment; vision might have less significant roles in the process of identifying built environment for the former than that of the latter, due to decreasing ability to visually recognise the attributes or details of the elements. Ability to distinguish details is vital for people with visual impairment for detecting hazardous elements or obstacles and for identifying the specific features of an environment. Hazard detection is beneficial for preventing falls or injuries, whereas identification of specific features is useful for determining point of reference when traveling. Some people with visual impairment can still use their remaining vision combined with their other senses such as haptic or auditory to detect elements of buildings or spaces, while others with more severe visual impairment may completely depend on non-visual senses. Those who still have residual vision to visually detect the elements, would commonly rely on color contrast or differences between the element and its background. Appropriate application of color contrast can enable people with visual impairment who still have residual vision to detect or identify the element in front of them before stepping on or bumping into it.

2 Methods

2.1 Color and Its Characteristics

Color perception or color vision is discussed by usually involving one or both of these theories: trichromacy theory and colour opponency theory. The first theory, trichromacy theory, positions color vision as materialisation of three kinds of wavelength light that hit the eye: long (L), middle (M) and short (S) wavelength \(^10\). These types of wavelength correspond to photoreceptors called cones, which are contained in the retina. System that regulates the process of human visual information commonly includes the retina and these elements: the cornea, the iris and the lens \(^11\). The cornea, which is located on the front of the eye, serves as refracting surface and is linked to a transparent liquid. \(^11, 12\). This transparent liquid has the iris, which controls the pupil diameter to manage the amount of light falling on the retina situated on the back of the eye \(^11, 12\). Space between the retina and the lens located behind the iris is filled with transparent liquid enabling light to cross from the lens to the retina \(^11\). The lens can adjust its shape to direct the light to reach the retina and change the focal distance \(^11\). Object being viewed will be projected onto the retina to form an optical image \(^11\). The retina contains photoreceptors comprising rods and cones. Rods regulate scotopic vision involving low level of light and cones control photopic vision entailing high level of light \(^11\). The numbers and conditions of these photoreceptors, which vary accross different persons, determine the way humans perceive and identify colors \(^11\). Three types of wavelength captured by the cones as mentioned above are signified by these three different colors \(^11\): red (R) for long (L) wavelength, green (G) for medium (M) wavelength and blue (B) for short (S) wavelength.

Trichromatic theory emphasising on the connections of Red (R) light/ long (L) wavelength, green
(G) medium (M) wavelength and blue (B)/ short (S) wavelength have been complemented by the second theory, color opponency theory proposed by Ewald Hering. Based on this theory, signals derived from the cones are altered into one lightness signal and two opposing color signals and subsequently conducted to the brain across the optic nerve and the lateral geniculate nucleus. These signals can be described by an arrangement consisting of three axes. One axis contains one pair of achromatics (black – white) signifying lightness and the other two axes encompass two pairs of opposing basic colors (red-green and blue-yellow). Color opponency theory does not acknowledge mixing of two basic colors located in the same axis such as red and green or blue and yellow. Therefore, according to this theory, combinations such as reddish green, greenish red, bluish yellow or yellowish blue do not exist or could not be perceived by normal human visual system.

The system entailing opponent colors such as red-green or yellow-blue is evolved from trichromatic system involving cones that capture long (L), medium (M) and short (S) wavelength represented by red, green and blue color, as a part of survival mechanism, such as finding food or a mate. The evolved system contain three types of signal: 1) a luminance signal derived from combined signals of red and green cones 2) a red-green color signal constituted by output ratio of red and green cones 3) a blue-yellow color signal formed by output ratio of luminance signal and blue cones. Combination of these signals can be described as perceptual color opponency by subtracting data (that are originated from three cones capturing long (L), medium (M) and short (S) wavelength) from each other. Luminance signal containing black-white opponency is represented by L+M data, red-green signal is signified by L-M data and blue-yellow signal is defined by (L+M)-S data. Both trichromacy and color opponency theories have been used as reference for ordering and specifying colors in different fields.

There are three attributes of color related to color specification: brightness or lightness, hue and intensity (which is commonly termed as saturation or chroma). Brightness or lightness signifies the quantity of light that is reflected from a surface. Hue encompasses label of color according to language that indicates the separation, differentiation or transition of a basic color from other basic colors. Examples of basic colors, which are generally also termed as unique hues, are: red, green, blue and yellow. Saturation or chroma is the attribute that defines the intensity of a color depending on brightness or lightness of achromatics such as black or white serving as reference. Figure 1a presents hue differences of dark red, yellow and dark blue. Figure 1b displays intensity differences of dark red and lighter reds. Figure 1c expresses the difference of lightness between dark red and lighter reds when the intensity or saturation is detached, showing similarity with difference between dark and lighter greys.

![Figure 1.](image)

One of references involving these attributes of colors described above that can be used to define colors is three-dimensional diagram developed by Commission Internationale de l’Éclairage, (CIE) or International Commission on Illumination, that is called CIELAB 1976 (L*a*b*) color space as displayed in Figure 4. L*, which indicates the degree of lightness of a surface, from 0 (black) to 100 (white), is represented by vertical lines in Figure 2 presenting transition from pure black to pure white. Horizontal axes and circumferences contains hues and intensity/ saturation/ chroma. Horizontal axes represent color opponency between red and green and between yellow and blue, which is in accordance with Hering’s theory. Circumferences and surrounding areas of vertical axes display saturation or chroma. a* located on one horizontal axis, signifies the redness and/or greenness of a surface, with positive values indicating a reddish characteristic and negative values denoting a greenish characteristic. b* positioned on another horizontal axis, specifies the yellowness and/or blueness of a surface, with positive values indicating a yellowish characteristic and negative values...
denoting a bluish characteristic.

![Diagram of CIELAB Color Space](https://commons.wikimedia.org/wiki/File:Coloroid.png)

**Figure 2. CIELAB Color Space**

Source: https://commons.wikimedia.org/wiki/File:Coloroid.png

2.2 *Colors and Accessibility For People With Visual Impairment*

Well-designed environment that can allow people with and without impairment to travel and deal with any barriers in it independently should consider these aspects of wayfinding that involve perceptual system:

1. Active sensory perception linked to reactions to objects in spaces
2. The formation of cognitive maps, which encompasses order, distance, proximity, sequence and connectivity
3. The making of sequence through the superimposition of identity, structure and meaning
4. Motivation regarding the utilization of spatial information.

The impairment(s) or deficit(s) in either one or a few parts of perceptual system would compel the person to adapt and the environment to provide enablers or supports. Spaces, architectural elements and graphical features that are appropriately designed, composed and positioned are expected to provide adequate information for wayfinding. The spaces, elements and features should be able to be accessed by not only fully-sighted people but also individuals with visual impairment, considering that the scarcity or absence of visual perception does not necessarily avert the formation of mental images concerning the environment. Nevertheless, the wayfinding of groups of fully-sighted people and individuals with visual impairment would still require different facilitations, due to different visual functionality between these groups.

Wayfinding of people with visual impairment in built environments embraces these two aspects commonly serve as basis for training of daily activities: orientation that deals with establishing of one’ position relative to others and mobility that entails moving from one position to another. Perceived or experienced environment according to people with visual impairment can be distinguished into ‘near’ space encompassing small-scale space that can be explored by involving movement of body parts without changing position of the body and ‘far’ space covering exploration of large-scale space that demands moving the whole body from one position to another.

Orientation and mobility skills are useful for people with visual impairment to collect spatial
information when navigating or exploring spaces. Collecting spatial information engages ‘spatial updating and frames of reference’ \(^{21}\). Spatial updating can be described as maintaining the trails of distances and directions to objects that are originated from self-movement \(^{21}\). Frames of reference utilised to define one’s position can be differentiated into egocentric involving recent position or internal aspects and allocentric referring to other position or external aspects \(^{21}\). Visual perception is commonly applied by fully-sighted people to develop frames of reference. People with visual impairment may need different strategies which have less reliance on visual perception to develop frames of reference. For people with or without visual impairment, comprehending the environment can be achieved through two strategies: mapping and routing \(^{22, 23, 24}\). The former commences from identification of the whole and then the details, whereas the latter starts with details for identifying the whole \(^{22, 23, 24}\). Most of people with visual impairment might utilise the routing strategy \(^{23}\) in a less familiar environment and for those still have residual vision, their visual perception might still be important to collect spatial information through the routing strategy. There are three theories commonly serve as bases of discussing the ability of people with visual impairment to collect spatial information: deficiency theory, inefficiency theory and difference theory \(^{19}\). The first, deficiency theory positions people with visual impairment as having poor spatial information due to the lack or absence of visual perception \(^{19}\). The second, the inefficiency theory situates people with visual impairment as having similar but less efficient ability than that of fully-sighted individuals to collect spatial information \(^{19}\). The third and more inclusive than the previous two, the difference theory, places people with visual impairment as having different but equally efficient ability from that of fully-sighted individuals to collect spatial information \(^{19}\).

People with vision impairment who still have residual vision could use limited visual cues, which might need to be supplemented by cues from the use of other senses, for wayfinding in an environment. Color contrast or difference is one of the object properties that can be used by people with visual impairment to identify object as part of acquiring visual cues for their wayfinding. In terms of color attributes described above, color contrast or difference can be distinguished into: contrast containing difference of all attributes (hue, lightness/ brightness and intensity), contrast covering difference of hue and intensity and contrast encompassing merely difference of lightness/ brightness. People with visual impairment commonly have reduced or damaged color vision. However, they might still be able to recognise particular color contrast, such as yellow or white situated against red or a darker background \(^{25, 26, 27, 28}\). Sufficient color contrast can enable people to identify objects or elements in the built environment to ensure their safe navigation. However, determining sufficient color contrast is not like walking in the park. Nature, origins and appearances of colors diverge, which depend on the perceivers and the contexts. Color that is considered as a form of perception rather than a physical property, makes its quantification in physical terms is difficult. There is no system that can measure and define the whole aspects of human color perception yet, because of the wide varieties of human vision, the material properties, light sources and illumination angles.

The function of colors is not limited to merely utilitarian, such as identifying or defining spaces and their elements, but also include aesthetics preference, symbolic meanings or cultural associations and feelings. Colors can deliver symbolic and/or associative information and be used to instigate certain feelings or affect moods \(^{29, 30, 31}\). Color can also be applied to motivate its perceivers to react in a particular way such as buying or using products \(^{31}\). Color together with position, orientation and size are properties can be used to define the aesthetics aspects of a composition such as harmony or balance \(^{32}\). The function of color might start from other-than-utilitarian aspect and then proceed to utilitarian aspect such as influencing mood to improve work productivity \(^{33}\).

One significant issue regarding color and contrast in the built environment is how to ensure that combinations of colors and/or materials are not only considered attractive by fully-sighted people but also suitable for supporting the provision of visual cues for people with visual impairment. Color combinations were normally applied by architects and designers in their designs based on aesthetics as well as functional consideration. There are three conditions that should be considered by architects and designers if they want their design to provide accessible visual cues for people with varying levels of
vision, including visual impairment. First, the colors preferred by architects and designers are not necessarily visible for people with visual impairment to identify spatial elements. Second, colour preferences may present high variations due to dependence on contextual and dynamic factors such as personal beliefs, trends and cultural values. Third, the conspicuity provided by color contrast for people with visual impairment may be different from that of fully-sighted individual. Certain color contrasts may be less useful for some people with visual impairment who may have abnormal or reduced color vision in identifying spatial elements than for fully sighted individuals who have healthy color vision.

2.3 Colors and Accessibility in Indonesia In Terms of Vision Impairment

Color contrast is important for supporting accessibility of people with visual impairment when navigating the built environment or using public facilities. People with disabilities or impairment encompass at least 5% of the population in Indonesia according to Census 2010 and individuals with visual impairment cover about 30% of population with disability or impairment or about 2% of the population in Indonesia. This number is predicted to raise in accordance with the increase of life expectancy. The increase of life expectancy leads to growing number of aging population. The prediction described above refers to the argument stating that aging people are more likely to have or experience disability than younger individuals.

Regulations related to buildings and facilities in Indonesia such as Ministerial Regulation No 30/PRT/M/2006 (which addresses technical guidance for facilities and accessibility in buildings and environments) and Law No 8/2016 (which recognises the rights of people with disabilities), have stated about the provision of accessible facilities for people with visual impairment. These regulations also have contained recommended application supporting safe mobility of people with visual impairment. However, the portions linked to people with visual impairment in these regulations are extremely small. The words linked to visual impairment such as only occur three times and the term ‘kontras’ (which means ‘contrast’ in English) in relation to color only appears twice in Ministerial Regulation No 30/PRT/M/2006. The words connected to visual impairment only occur in two clauses of total 153 clauses in Law No 8/2018. The word ‘kontras’ presented in Ministerial Regulation No 30/PRT/M/2006 is mentioned in terms of signage and traffic markers; there is no direct connection with building elements yet. There is no detailed description in Ministerial Regulation No 30/PRT/M/2006 that at least explain how much color contrast should be provided to enable identification of building elements related to safe mobility of people with visual impairment. The lack or absence of sufficient description regarding color contrast in these regulations might affect the applications of inaccessible color combinations in some public buildings or facilities for people with visual impairment in Indonesia.

The applications of inaccessible color combinations might be influenced not only by the lack or absence of definitive description that can be used as clear guidance but also the lack of comprehension about the ability of people with visual impairment to identify color contrast. Limited information and/or comprehension regarding color contrast and the characteristics and ability of people with visual impairment compel architects or designers to depend on their own references when designing spaces, facilities or products expected to be accessible for people with visual impairment. These references could differ according to their own experience and knowledge. Relying solely on standards or regulations that do not provide sufficient description or on architects’ own experiences and knowledge, may lead to inappropriate facilitation, which eventually may unintentionally exclude people with impairment, including those with vision deficits.

The examples presented in the next sections show applications of color combinations in public facilities. Some of them might have provided sufficient color contrast for supporting safe navigation of people with visual impairment, whereas the others have not. Each example consist of three images: the first image is the original photograph, the second image is the grayscale version of the original and the third image is the blurred version of the second image. The purpose of presenting this set of images is to provide simple illustration regarding how people with visual impairment might see or perceive the
elements appeared in the picture. Grayscale image represents damaged color vision, which lead to
difficulties of distinguishing hue, intensity or purity of colors, that is commonly experienced by people
with vision impairment. Blurred image is chosen by considering that it can represent reduced vision or
visual scene that could be experienced by individuals having cataract as part of population with visual
impairment. There are other kinds of vision impairment having different impacts on vision, such as
age-related macular degeneration causing damaged central vision and glaucoma leading to impaired
peripheral vision \(40\). Cataract is selected as representation of visual impairment based on the fact that
cataract is one of the main causes of visual impairment in Indonesia \(41\). All blurred images was
modified by using Adobe Photoshop and applied similar settings. It is important to note that grayscale
and blurred images only serve as pure illustrations to assist the readers for comprehending visual
perception of people with visual impairment; it does not completely represent actual visual scenes
experienced by individuals having cataract or other forms of visual impairment. The actual visual
scenes in the real world may highly vary depending the cause and severity of visual impairment and
physical characteristics of visual sense possessed by individuals with visual impairment. The images
displayed in Figures 3 to 6 present the example of good color combinations with appropriate color
contrast, which are applied on public facilities, that provides sufficient visual cues for people with
visual impairment. The images shown in Figures 7 and 8 express the example of poor color
combinations with inappropriate color contrast, which are applied on public facilities, that provides
insufficient visual cues for people with visual impairment.

2.4 Application of Colors In Public Facilities

Figure 3a present safety element in Gambir train station, Jakarta, Indonesia, in a form of a yellow line
on dark grey floor, which marks the safe distance between the train and the passengers standing on the
platform. When the image was altered into grayscale version (see Figure 3b), contrast between the line
and the platform formed by their lightness difference is still distinctive. When the grayscale image was
blurred (see Figure 3c), contrast between the line and the platform could still appear although its
conspicuity was reduced.

Figure 3. (a) Safety line with good color contrast in Gambir train station; (b) Grayscale version; (c)
Blurred grayscale version

Figure 4a present another spot on the platform of Gambir train station. Original image shows
yellow tactile indicators on dark grey floor signifying the safe distance between the train and the
passengers standing on the platform. When the image was altered into grayscale version (see Figure
4b), contrast between the tactile indicators and the platform formed by their lightness difference is still
distinctive. When the grayscale image was blurred (see Figure 4c), contrast between the tactile
indicators and the platform could still appear although its conspicuity was reduced.
Figure 4. (a) Tactile indicators with good color contrast in Gambir train station; (b) Grayscale version; (c) Blurred grayscale version

Figure 5a presents another application of safety elements in Gambir train station. Original image shows black step nosings on white background indicating the steps of the stairs. When the image was altered into grayscale version (see Figure 5b), contrast between the step nosings and their background formed by their lightness difference is still distinctive. When the grayscale image was blurred (see Figure 5c), contrast between the step nosings and their background could still appear although its conspicuity was reduced.

Figure 5. (a) Step nosings with good color contrast in Gambir train station; (b) Grayscale version; (c) Blurred grayscale version

Figure 6a presents a pedestrian facility in the area of “Gelora Bung Karno” (GBK) stadium, Jakarta, Indonesia that was viewed at night. Original image shows yellow tactile indicators on brown floor signifying direction toward the stadium. The actual color of the floor when viewed under the sun is grey; the use of yellow colored lamp has changed the appearance of the floor at night. When the image was altered into grayscale version (see Figure 6b), contrast between the tactile indicators and the floor formed by their lightness difference is still distinctive. When the grayscale image was blurred (see Figure 6c), contrast between the tactile indicators and the floor could still appear although its conspicuity was reduced.
Figure 6. (a) Tactile indicators with good color contrast in the area of GBK stadium; (b) Grayscale version; (c) Blurred grayscale version

Figure 7a present poor application of safety elements in Gambir train station. Original image shows beige step nosings on light green background indicating the steps of the stairs. When the image was altered into grayscale version (see Figure 7b), contrast between the step nosings and their background formed by their lightness difference is reduced. When the grayscale image was blurred (see Figure 7c), contrast between the step nosings and their background disappeared, which eliminates boundaries between steps.

Figure 7. (a) Step nosings with poor color contrast in Gambir train station; (b) Grayscale version; (c) Blurred grayscale version

Figure 8a present another poor application of safety elements, which is located in Bandung train station, West Java, Indonesia. Original image shows a yellow line on dark grey floor, which marks the safe distance between the train and the passengers standing on the platform. When the image was altered into grayscale version (see Figure 8b), contrast between the line and the platform formed by their lightness difference is highly reduced. When the grayscale image was blurred (see Figure 8c), contrast between the line and the platform disappeared, which eliminates previously defined safe distance.
Figure 8. (a) Safety line with poor color contrast in Bandung train station; (b) Grayscale version; (c) Blurred grayscale version

Figure 9a present both good and poor application of safety element. Original image shows a white emergency door panel with white door frames and red grab bar, which is surrounded by white wall. When the image was altered into grayscale version (see Figure 9b), contrast between the door and its surroundings formed by their lightness difference is highly reduced, whereas lightness contrast between the door panel and the grab bar is still maintained. When the grayscale image was blurred (see Figure 9c), contrast between the door and its surroundings disappeared, whereas contrast between the door panel and the grab bar could still appear although its conspicuity was reduced. In the case of this emergency door, good application of color contrast is displayed by color combinations used in door panel and grab bar, whereas poor application is shown by difference of door panel, door frames and the wall.

Figure 9. (a) Emergency door; (b) Grayscale version; (c) Blurred grayscale version

3 Discussion
The examples presented above have shown how important color selection and application for safe mobility for people with visual impairment in public spaces or facilities. The line or indicators displayed in Figures 3 and 4 are beneficial to prevent individual with visual impairment from bumping
into the train or falling into railway below. The step nosings shown in Figure 5 might assist people with visual impairment coming down the stairs to carefully take the step, especially if they are in a hurry or in an emergency situation. The indicators presented in Figure 6 could inform about the direction to the stadium. If all the elements of the emergency door in Figure 9 applied appropriate contrast, it might support effective, efficient and independent process of evacuation for people with vision impairment during an emergency situation.

The examples of contrast and color combination displayed above imply that specifying and/or selecting color combination to be applied in elements of spaces, buildings or facilities that are intended to provide detectable or identifiable visual cues which support safe mobility of people with vision impairment, might still be able to be managed by architects and designers who mostly are categorised as fully-sighted individuals. Color combinations selected by fully-sighted architects or designers, which possess high contrast in terms of all color attributes consisting of hue, lightness/ brightness and intensity, would still have capability to provide visual cues for people with vision impairment, although these people with vision loss were not involved in the process of design and/or construction. Referring to examples presented above, it can be stated that difference of lightness has to come first prior to other color attributes (hue and intensity) in considering color options. Architects and/or designers may use simple description above as guidance for designing built environment or facilities that support safe navigation of people with vision impairment. However, it is important to emphasise that aspects of built environment and psychophysical conditions of human visual system are complex. Therefore, what have been described above may need to be complemented by calculation based on measurement in the field and involvement of people with visual impairment as actual users. Calculation based on measurement in the field is intended to provide quantifiable or tangible references concerning the recommended level of contrast in a dynamic environment with varying lighting (natural and/or artificial), considering that perception of color is also influenced by lighting. The process of measurement and calculation can adopt materials, equipments, applications and methods commonly utilised in several developed countries who already have relatively definitive standards and building codes related to accessibility, such as United States of America (USA), United Kingdom (UK) and Australia. Involving people with visual impairment is expected to supply information regarding suitable facilitation related to different impacts of impairment on capability of visually identifying the elements. Different impacts may require different facilitations. Difference of impacts, ability and required facilitations in this case are not only situated between people with visual impairment and fully-sighted people but also among people with visual impairment themselves, who have various causes and conditions of impairment.

4 Conclusion
This study proposes that the process of design and construction of elements related to safe mobility in built environments and public spaces or facilities needs more than assumptions from experts such as architects, designers or engineers. The process should include the utilization of appropriate measurement methods and the involvement of individuals with impairment, including those with vision deficit. The utilization of appropriate measurement methods and the involvement of individuals with impairment are expected to produce more definitive and comprehensive references concerning the types of suitable facilitations that should be provided in environment and facilities that are intended to be accessible and inclusive. The definitive and comprehensive references should be incorporated in all design standards, building codes and regulations that are used in Indonesia, in order to create more livable and sustainable Indonesian cities and/or environments. Sustainable in this sense is not only ecologically, but also socially.

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