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LIGHTING SCIENCE:
VISION – PERCEPTIONS AND PERFORMANCE

AN AMERICAN NATIONAL STANDARD

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1.0 Introduction and Scope

1.1 Introduction

Lighting is one of the components of the built environment that enables our visual perceptions and provides for human visual performance. Acting in concert with the geometry of architecture, light allows people to perceive, assess, and react to an environment. Lighting also renders text and objects visible, and thus determines, in part, how well visual work can be performed, whether that means reading a book, operating a lathe, or driving a car. What humans perceive and how well they perform is often in the hands of the lighting specifier.

Perceptions are, in some sense, part of people's self-awareness. Though a person may not know precisely why a space appears small, dim, and restful, they recognize it for being so and can describe it as such. Yet for all their nearness to the surface, perceptions are difficult to quantify and the search for precise, analytic ways to predict them is ongoing. Nevertheless, lighting design is informed by knowledge of the factors that affect perceptions and the general principles that govern them.

Though humans constantly do visual work, they usually have a very imperfect idea of how well or how they do. In that sense, visual performance is below the surface. Nevertheless, performance, if defined with sufficient care and detail, can be measured. Combined with assessments of experience, such measurements can produce recommendations that guide the analytic aspects of lighting.

1.2 Scope

This document provides an overview of visual perception and performance, covering topics such as brightness, glare, flicker, visibility, and illuminance criteria. It introduces scientific literature and past research results but does not serve as a complete literature review on any specific topic. The document provides basic descriptions and background of visual phenomena in order to guide lighting practitioners. For some topics, established formulas and processes are reviewed, but specific criteria or other recommendations are not provided. This document begins with a review of psychophysics, which is the primary method of study for perception and performance, in order to help readers understand the strength and limitations of the provided material.

2.0 Psychophysics: Studying Perceptions and Performance

Psychophysics is a sub-discipline of psychology that analyzes perceptual processes by studying the relationships between physical stimuli and human response.[1,2] The response can be the observer's report of a perception or performance of a task, or it can be another measurable physiological outcome (e.g., heart rate, pupil size) or behavior change. That is, the response may be captured by either subjective or objective means. In psychophysical experiments, the properties of stimuli are varied along one or more physical dimensions (e.g., changes in light level or light spectrum), and the resulting change in an observer's experience or behavior is noted. Subsequent analysis of the data is used to test hypotheses about relationships between stimuli and perceptions, and to evaluate the reliability and limits of models of vision or perception built from these hypotheses. Modern lighting design and illuminating engineering are guided by these models.

The reliability and utility of relationships between physical stimuli and visual outcomes can vary considerably, from weak and unreliable to robust and of great generality. This variability arises because human perceptual mechanisms are complex; therefore, it is quite difficult to establish an unbroken link between cause and effect based on a full understanding of the precise mechanisms involved. That is, usually only the input (the stimuli) and the output (the perceptual response) are known. Careful inference and repeated testing and analysis are required to develop reliable and robust relationships. Boyce gives a useful, practical overview of these issues, from which the information in **Section 2.1** is derived.[3]