Uniformity — Emin / Eavg

Spatial consistency, comfort, and load on visual system

Definition

Ratio of minimum to average illuminance. Higher uniformity means fewer dark corners and less adaptation stress.

Recommended Ranges

|  |  |
| --- | --- |
| Optimal | ≥0.6 in classrooms (≥0.7 desirable in exam halls if practicable). |
| Caution | 0.4–0.59 (caution); <0.4 (avoid). |

Biological Effects

Hormones (Endocrine)

Uneven fields raise adaptation stress → sympathetic/HPA activation → cortisol↑ in susceptible students.

Skin (Photobiology & Peripheral Clocks)

Neutral at indoor levels.

Nervous System (ipRGC → SCN → CNS)

Frequent retinal adaptation (bleach/recover) increases metabolic load and visual cortex effort; attention stamina declines.

Biochemical Pathways (Mechanistic Detail)

Photoreceptor mitochondrial load↑ → ROS generation; antioxidant defenses (SOD, catalase) taxed.

Chronic visual stress may upregulate inflammatory mediators (e.g., IL-6, TNF-α) in susceptible individuals.

Classroom Recommendations

Lay out luminaires to minimize contrast; consider indirect components.

Verify uniformity at desks and whiteboards with measurements.

Quick Checklist

Uniformity ratio from lighting calc documented.

Spot measurements confirm design values.

References

EN 12464-1 — Uniformity requirements for classrooms.

Human factors studies on uneven lighting and visual stress.