

One camera, one concourse. Every metre of that distance moves the same face down the ladder.

NLC ACADEMY · EPISODE 27

The old pixel-density ladder was replaced.

On 9 October 2025, IEC 62676-4:2014 was withdrawn and replaced by Edition 2.0. Its seven levels change what 250 px/m means in a new IEC-based specification.

START WITH THE DATE

The 2014 edition the industry still cites has been withdrawn

2014: Identify, 250 px/m
40 px across a 0.16 m face

2025: Characterize, 250 px/m
40 px across a 0.16 m face

2025: Scrutinize, 1500 px/m
240 px across a 0.16 m face

high-certainty identity: 6 times the pixels

IEC 62676-4:2014 was withdrawn on 9 October 2025; Edition 2.0:2025 restructured its six levels into seven: 20, 40, 80, 125, 250, 500, 1500 px/m. Saudi MOI rules and signed contracts stand as written. [1][2]

250 px/m is now **Characterize**: person type, gait, action; vehicle brand (cl. 3.1.6). **Validate** (500) confirms a known identity; **Scrutinize** (1500), high-certainty identification, is six times the old Identify figure. [2][3]

WHAT EACH LEVEL LOOKS LIKE

The same person, sampled at every level

the whole person, 1.6 m



Overview
20 px/m
32 px tall



Outline
40 px/m
64 px tall



Discern
80 px/m
128 px tall

the face, 160 mm across



Perceive
125 px/m
20 px across



Characterize
250 px/m
40 px across



Validate
500 px/m
80 px across



Scrutinize
1500 px/m
240 px across

simulated sampling of a drawn figure, not camera footage

Each tile averages a drawn figure into the pixels a level allows: the body at the low three, a 16 cm face at the top four; only the top two keep the 2.5 mm glasses rim. A real camera loses more to blur, lighting, compression, noise and focus. [3]

WHERE 250 PX/M COMES FROM

The 250 px/m rule traces back to PAL-era screen-height criteria and the Kell factor

576	× 0.7	400	÷ 1.6	250
PAL lines	Kell	usable	m body	px/m

Axis's face model agrees: 40 px on a 0.16 m face is 250 px/m

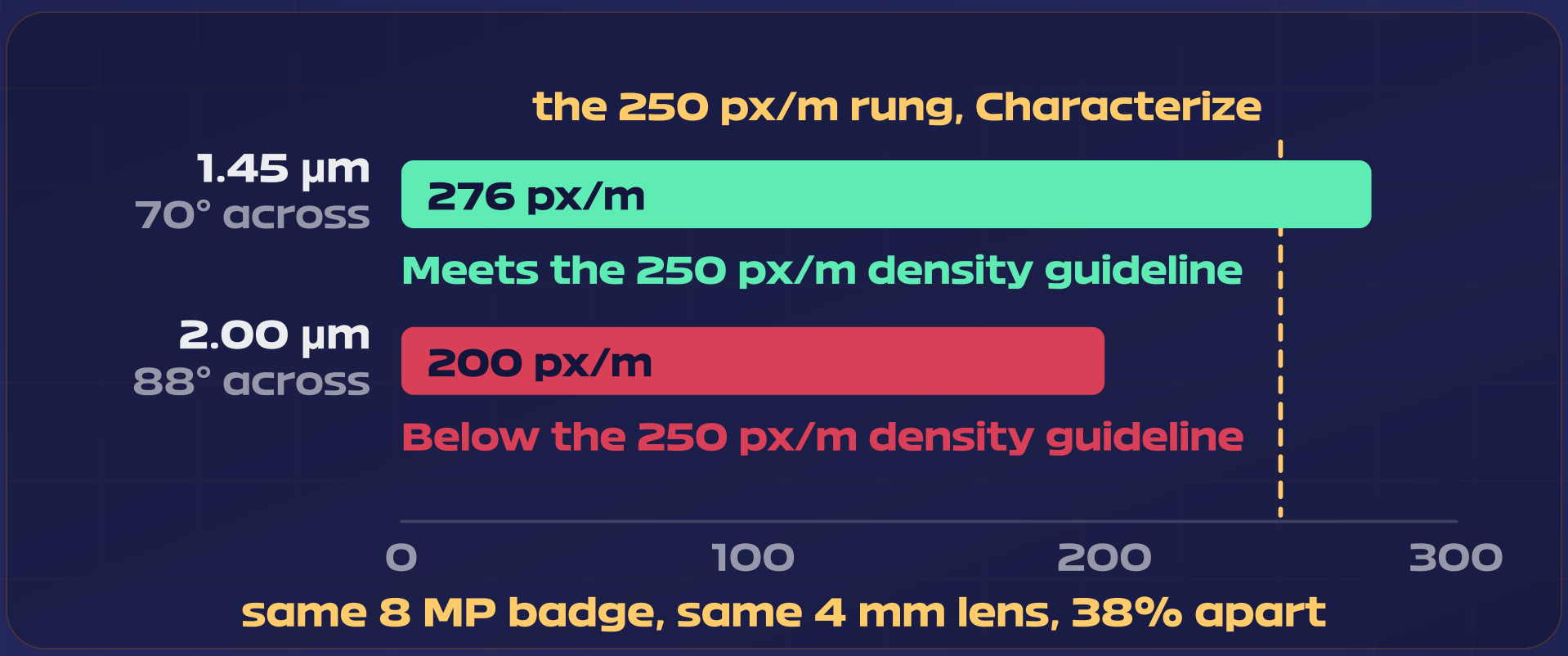
not optics: a PAL-era display assumption

PAL had 576 lines; the 2014 standard treats them as about 400 usable (the Kell factor) and sets Identify at 100% of screen height, or 4 mm per pixel:
1 m ÷ 4 mm = 250 px/m. For a 1.6 m person on 400 lines, 400 × 4 mm = 1.6 m. That reconciliation is our arithmetic, not an IEC statement. [1]

The 2014 text never uses DORI or px/m; it states levels as % of screen height or mm per pixel. Axis's route, 40 px across a 16 cm face, is Axis's model, not IEC's, and drifts low: 3, 6 and 12 px give 18.75, 37.5 and 75 px/m. [1][3]

THE EQUATION THAT ENDS THE MEGAPIXEL ARGUMENT

Megapixel count alone does not determine pixel density



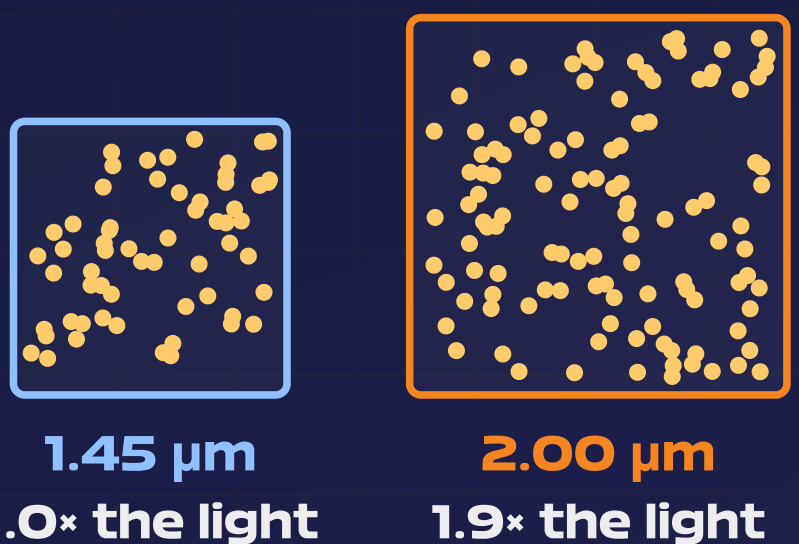
px/m = N_h / scene width = N_h / (2d · tan(HFOV/2)), and for a rectilinear lens px/m = f / (d × pitch). **Same megapixels, different density:** at a given distance, focal length and pixel pitch set px/m; the pixel count sets the field of view.

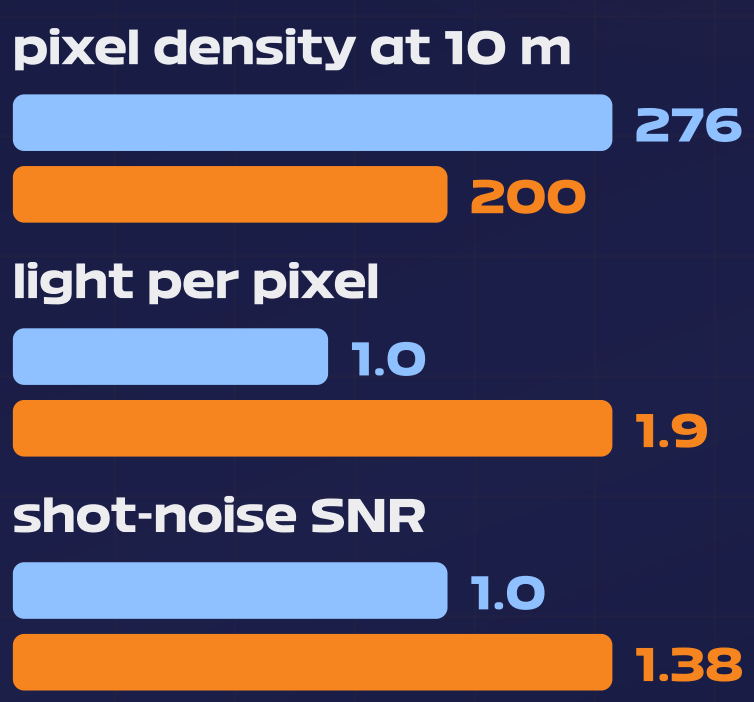
Same 4 mm lens at 10 m: IMX415 (3840 × 1.45 µm = 5.57 mm wide) gives 276 px/m over 70°; IMX678 (3840 × 2.0 µm = 7.68 mm) gives 200 px/m over 88°. Density alone does not guarantee identification or operational acceptance. [10]

THE PIXEL THAT WINS ON DENSITY LOSES ON LIGHT

Smaller pixels, less light

same lens, same f-number





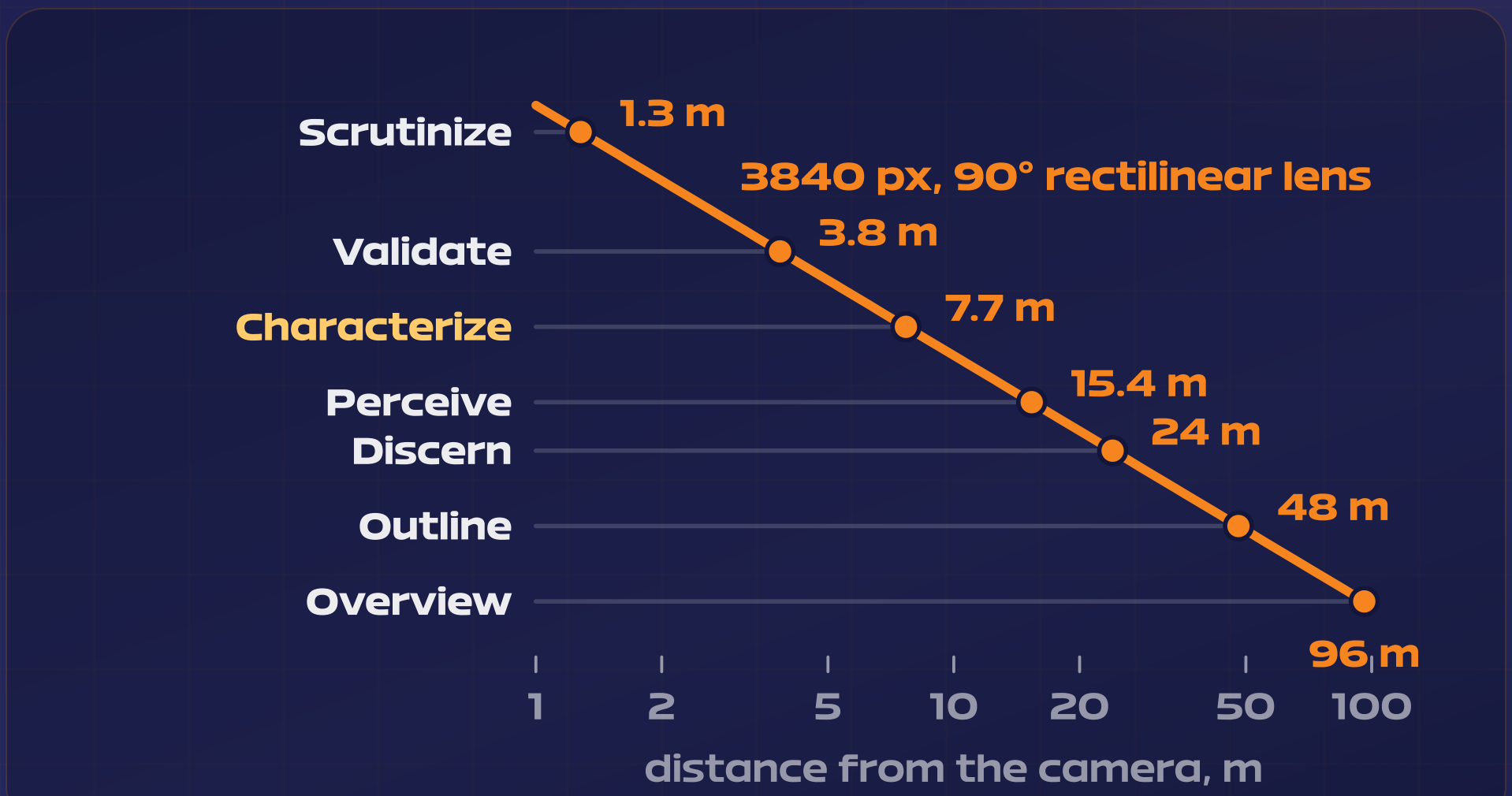
1.45 µm: 38% more density · 2.00 µm: 38% more SNR

Same lens, f-number and exposure: a 2.0 µm pixel has 1.9× the area of a 1.45 µm pixel, so 1.9× the photons. Shot-noise SNR grows with the square root, so the 2.00 µm pixel gives about **38% higher shot-noise-limited SNR**, while the 1.45 µm sensor gives **38% more density**. [10]

Idealised: equal quantum efficiency, read noise, exposure and processing. Real low-light results also depend on BSI design, conversion gain, HDR, ISP and noise reduction.

ONE CAMERA IS NEVER ONE LEVEL

Draw the bands, not a range



Density falls as 1/distance, so on log axes one camera is a straight line crossing each level at a fixed distance ratio. 3840 px, 90° rectilinear lens, centre of frame: Overview 96 m, Discern 24 m, Characterize 7.7 m, Scrutinize 1.3 m.

Pinhole geometry, not image quality. A barrel-distorted wide lens breaks the formula: tan(H/2) ÷ tan(V/2) is 1.78 on 16:9 but 2.26 for a 93°/50° dome. Use the maker's range table there.

MOTION BLUR SCALES WITH DENSITY

Higher density makes the same motion span more pixels



1/30 s	1/120 s	1/350 s	still
11.7 px of smear	2.9 px of smear	1.0 px of smear	no motion

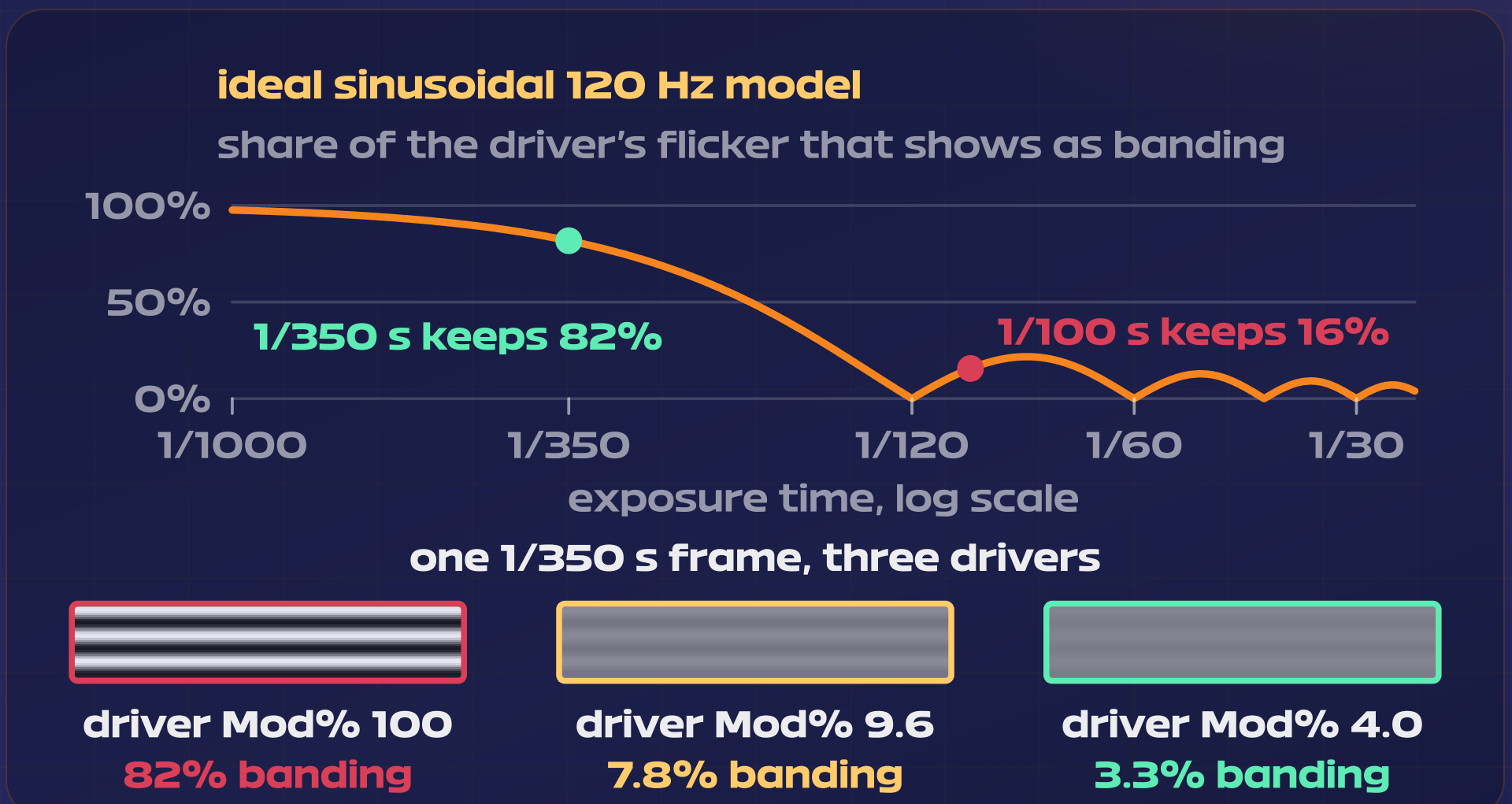
a 40 px face at 250 px/m, walking at 1.4 m/s

blur (px) = speed × exposure × density. For a subject crossing the frame at 250 px/m, a 1.4 m/s walk at 1/30 s smears **11.7 px** across a 40 px face: 29% of its width.

About 1 px of blur needs 1/350 s at 250 px/m and 1/2100 s at 1500; under 1 px needs faster still. More spatial sampling never makes up for a slow shutter; crossing motion is the worst case.

THE DRIVER DECIDES THE SHUTTER

A fast shutter needs a low-flicker driver

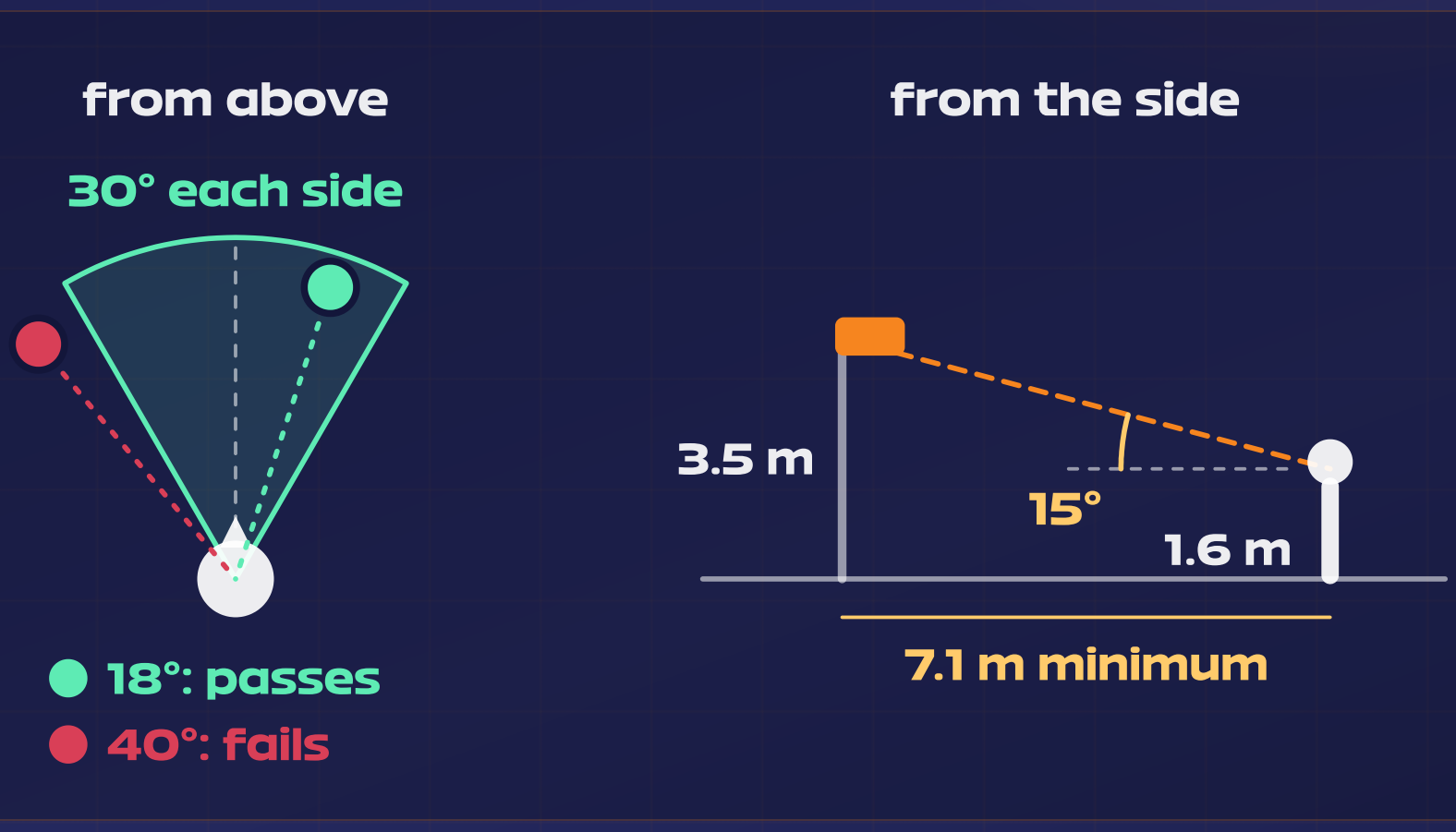


Saudi mains run at **60 Hz**. In an **ideal sinusoidal model** of lighting with mains-related 120 Hz ripple, rolling-shutter exposures of whole cycles (1/120 s, 1/60 s) cancel banding; 1/100 s keeps 16%; the 1/350 s that freezes a walk keeps **82%**. [8]

Real drivers differ: PWM, mains drift (59.9 to 60.1 Hz) and camera timing can leave banding at whole cycles. IEEE 1789 rates risk to people, not cameras; its Mod% 4.0 level gives 3.3% here, not a CCTV threshold. [8]

SAUDI ARABIA REGULATES THE GEOMETRY

An identification camera 40° off-axis fails the Saudi geometry requirement



This is aiming geometry, not resolution. MOI identification: within 30° right or left of straight-on and 15° above or below the horizon line. Strong identification: 10° both ways, image centred between the eyes. Plate reading: 30°. [4, pp. 20 to 22]

For a 1.6 m target point and a camera at 3.5 m, staying within 15° needs at least (3.5 - 1.6) ÷ tan 15° = 7.1 m on plan. Law Art. 12 fines per camera: SAR 500 for equipment off specification (a), SAR 1,000 for installation not as the document sets (b). [5]

THE CLAUSE THAT REORDERS EVERY SAUDI SPEC

Pixel density is an alternative criterion, not the primary method

the target's image size, as a share of the view



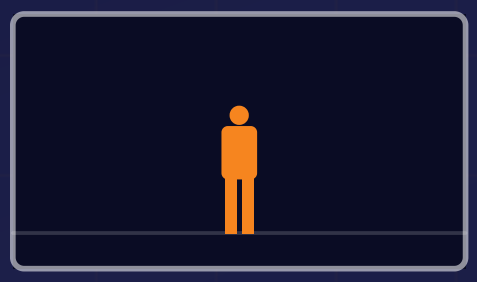
Monitoring
5%



Detection
10%



Observation
25%



Recognition
50%



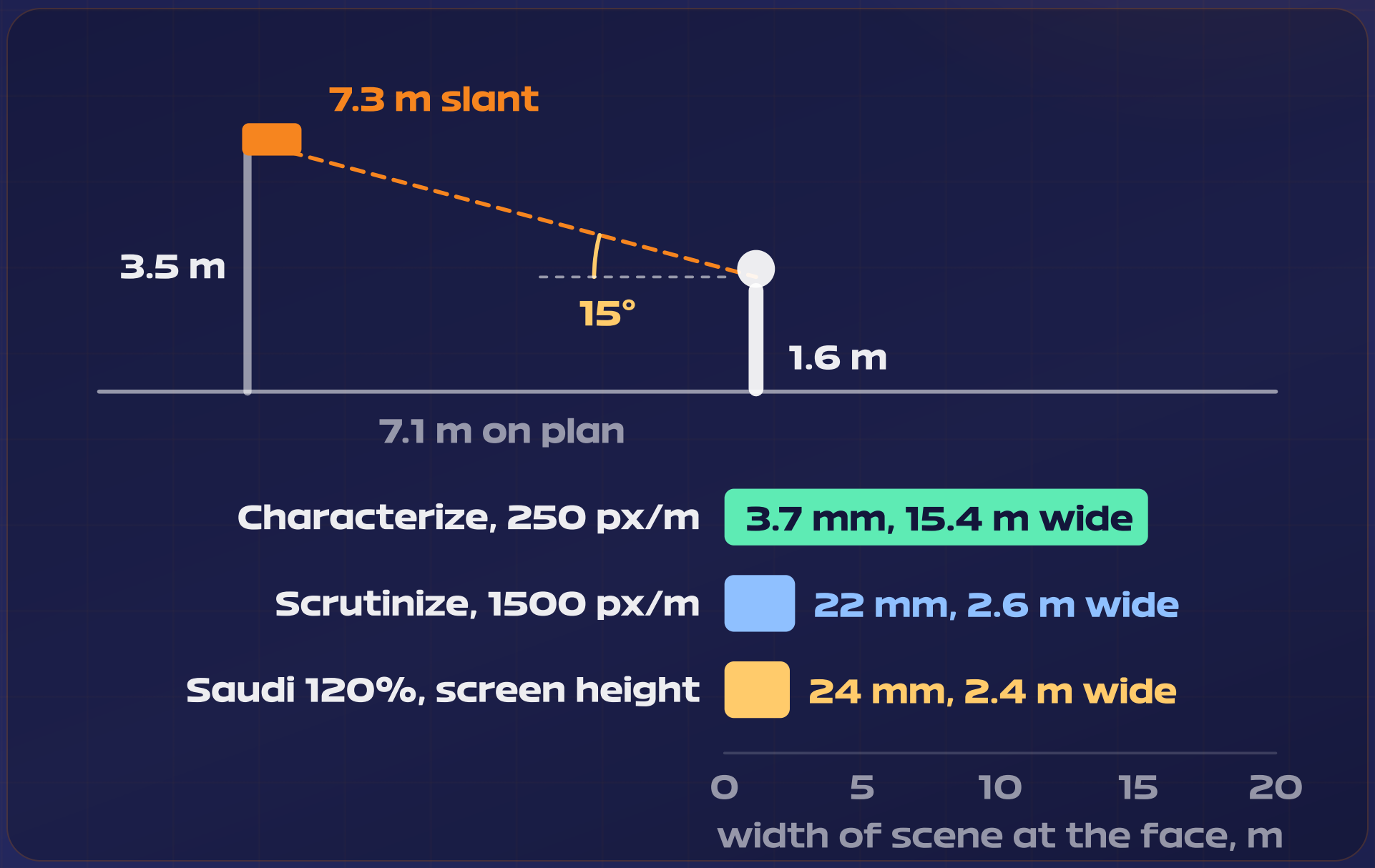
Identification
120%, 1.33 m of 1.6 m shown

Under a screen-height interpretation, a 1.6 m target at 120% corresponds to approximately 1.33 m scene height.

MOI wording: target image size not less than a share of the display view, on a **1.6 m standard target**: Identification 120%, Recognition 50%, Observation 25%, Detection 10%, Monitoring 5%. With prior Ministry approval, exceptionally, 250 px/m for Identification. [4, pp. 20 to 22]

WORK IT BACKWARDS

From mounting height to focal length



3.5 m mount, 1.6 m target point, 15° limit: 7.1 m on plan, 7.3 m slant. 8 MP, 2.0 µm pixels (7.68 × 4.32 mm active): f = px/m × d × pitch gives **≈3.7 mm** for Characterize and **≈22 mm** for Scrutinize. Under a screen-height interpretation (ours, not MOI's wording), a 1.6 m target at 120% corresponds to about 1.33 m of scene height: **≈24 mm**. [4, p. 21][10]

IDENTIFY: A DESIGN FIGURE AND A HUMAN TEST

The design figure exists. The test is a person.

	2014, cl. 6.7: design	2014, cl. 13.3.2: test
Monitor	80 mm per pixel	80 mm per pixel
Detect	40 mm per pixel	40 mm per pixel
Observe	16 mm per pixel	16 mm per pixel
Recognise	8 mm per pixel	8 mm per pixel
Identify	4 mm per pixel	face panel, 4 of 6
Inspect	1 mm per pixel	1 mm per pixel

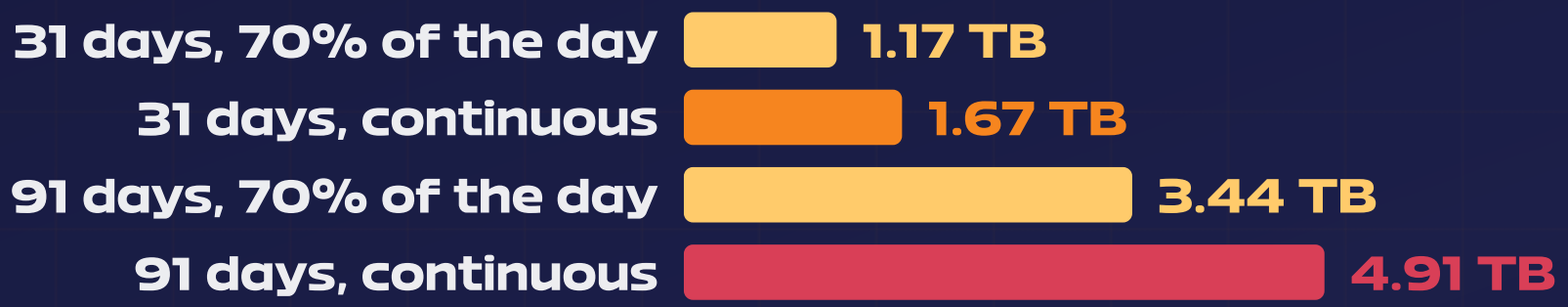
2014 Annex B: nine printed faces and an operator
identify has a number; its test is a judgement

In the withdrawn **2014 edition**, cl. 6.7 gives Identify 100% of screen height or **4 mm per pixel**; its acceptance test (cl. 13.3.2.5, Annex B) is nine printed faces, a 1.7 m height stick and an operator, passed at 4 of 6 points. [1]

The 2025 edition lists a normative Annex B test protocol, but we could not access its procedure or scoring: write the acceptance method and pass criteria into the contract. Density is a design input, not a guarantee; analytics follow the vendor's figures. [2][3]

READ THE SECTOR TABLE

31 days, 91 days, and the storage they need



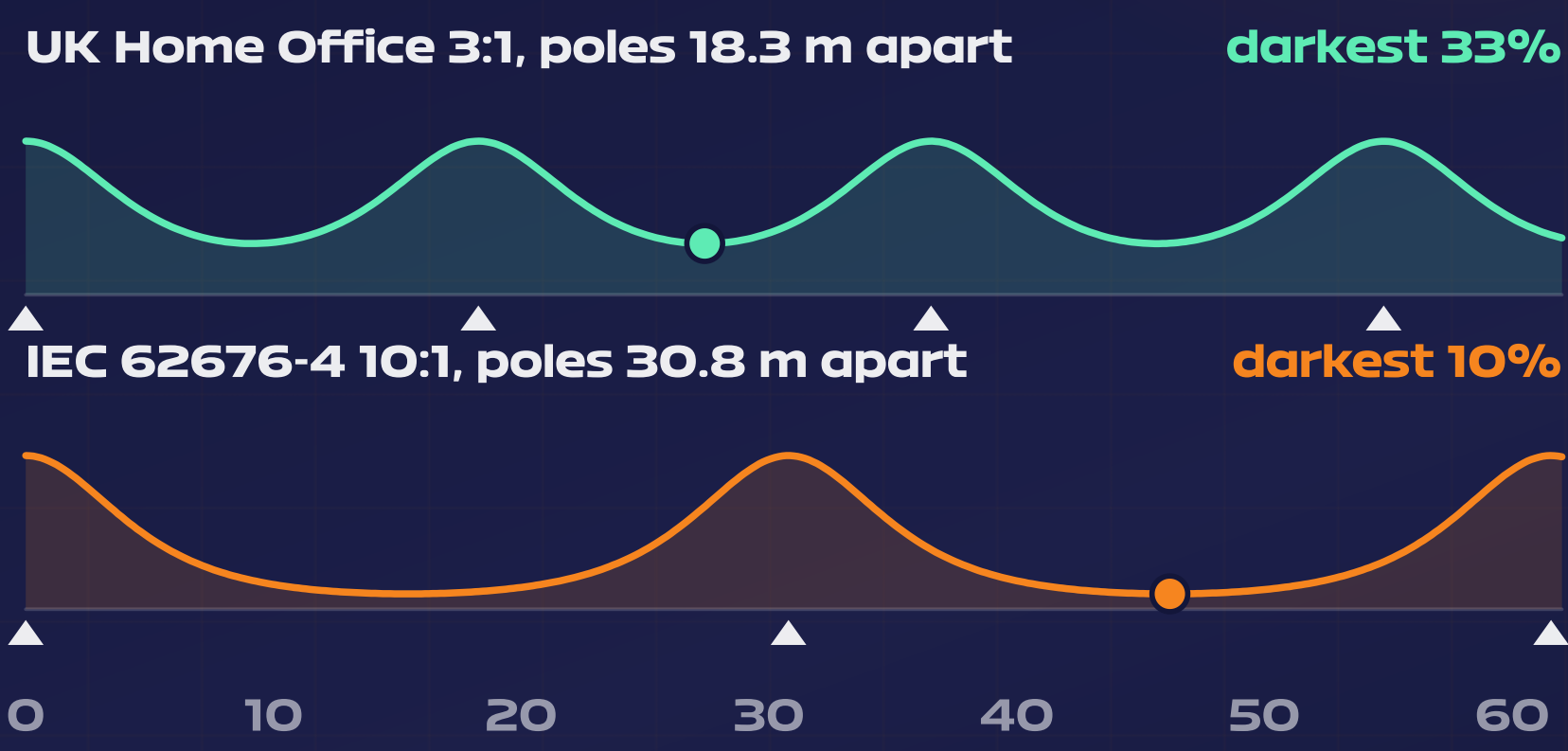
estimates: 4 Mbps, 20% of total spare, decimal TB

Baseline: **31 days**, motion-linked recording ≥70% of the day at ≥10 fps (p. 13). **91 days at 15 fps**: oil and petrochemical (p. 38), power and desalination (p. 40), category 4 and 5 hotels and conference venues (p. 45), public transport stations (p. 75). ATMs: 91 days in the malls table (p. 48); the banks table prints 19 days and 51 fps (p. 50), so confirm with MOI. [4]

Illustrative estimates per camera: 4 Mbps, exactly 70% duty, 20% of total capacity spare (item 10, p. 13: need ÷ 0.8). ≥70% is a floor, not a sizing value. Decimal TB (10^{12} bytes), before file-system, RAID and recorder overhead.

THE LIGHTING CLAUSE IN THE SAUDI DOCUMENT

A Saudi CCTV system can fail on its lighting



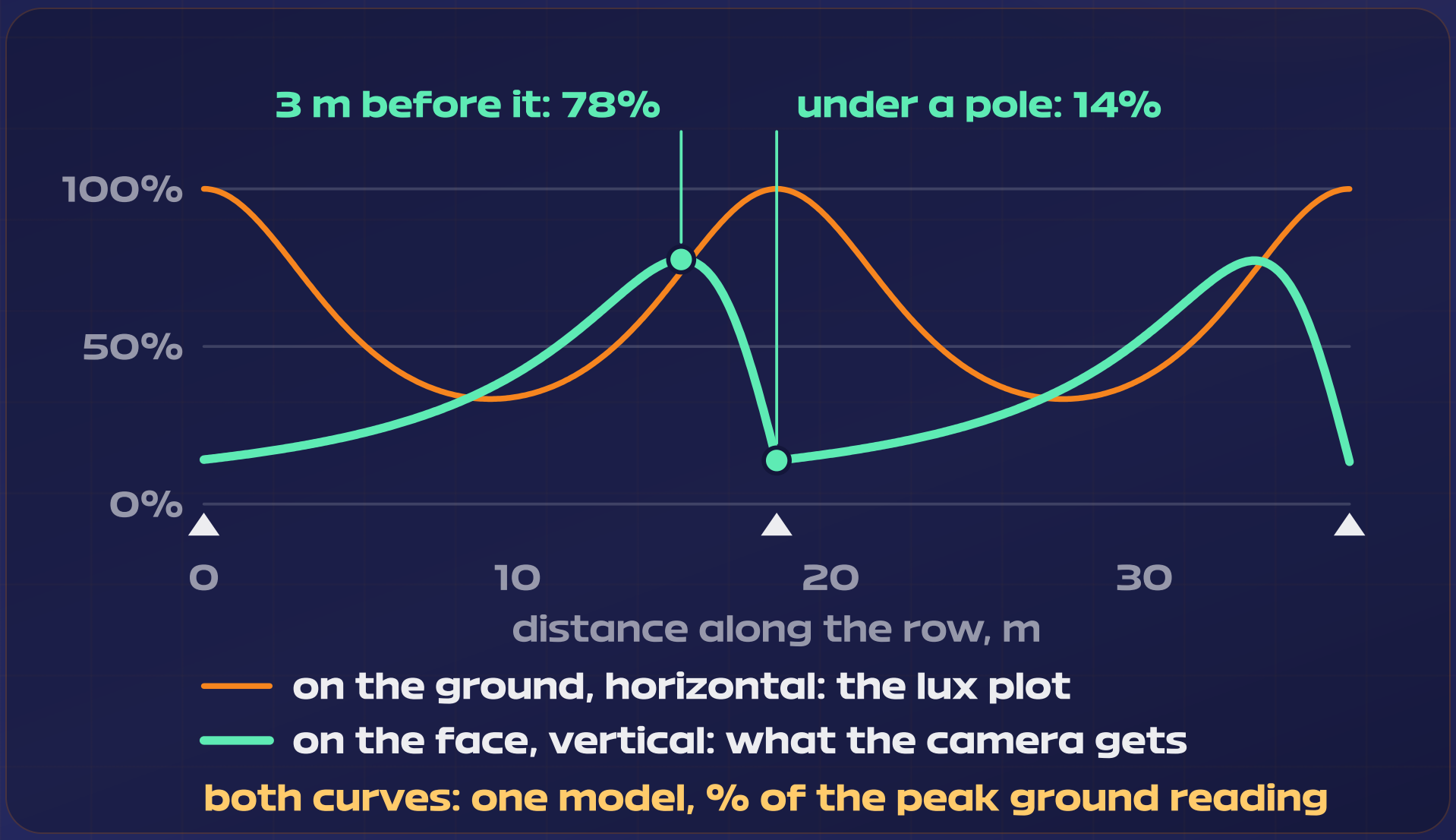
illustrative: idealised luminaires on 6 m poles

MOI's mandatory Security Lighting section: field of view fully lit, no dark areas; at external sites, infrared may be used in secondary areas or where visible light is insufficient, never reflecting into the camera; no harm to others, such as drivers' vision. **No lux, ratio or colour figure.** [4, p. 25]

So the designer brings the numbers: IEC 62676-4 recommends max-to-min ideally 10:1 or better; UK Home Office guidance, 3:1. [1][7]

CAMERAS READ THE VERTICAL PLANE

A horizontal lux plot can peak where facial vertical illuminance is low



A ground-level horizontal illuminance plot does not establish facial vertical illuminance. As shares of the **peak ground lux**, a face looking along this pole row gets **14%** under a pole and **78%** about 3 m before it.

One model: equal-intensity point sources, 6 m poles 18.3 m apart, face at 1.6 m; an example, not a rule. EN 13201-2 has semi-cylindrical classes; check values in the full text. [9]

WRITE THIS INSTEAD

The clause that survives a handover

SIX SPECIFICATION REQUIREMENTS

1. Standard: IEC 62676-4 Ed. 2.0 (2025); on Saudi projects also MOI conditions document Ed. 1 v1.1, stating which governs.

2. Per camera: operational level and target; on Saudi projects the MOI image size, px/m only with a Ministry approval reference.

3. Geometry, Saudi projects: identification ≤30° horizontal, ≤15° vertical, WDR ≥110 dB; strong identification ≤10°; focal length at the real slant distance.

4. Motion and flicker: subject speed, maximum exposure, LED driver Mod% at 120 Hz; banding checked on site.

5. Light and storage: vertical illuminance on the target, set per project; retention per MOI sector table, capacity = need ÷ 0.8.

6. Acceptance: method and pass criteria in the contract, naming the IEC edition; Saudi projects add MOI image acceptance (p. 27) and an ONVIF profile checked in ONVIF's conformant products list.

SOURCES, 1 OF 2

Where each number comes from

[1] IEC 62676-4:2014, Ed. 1.0, withdrawn 9 Oct 2025: cl. 6.7, 13.3.2, Annex B, Table 3

IEC webstore, publication 7353

[2] IEC 62676-4:2025, Ed. 2.0: foreword c), cl. 3.1.6

IEC webstore, publication 83425

Publisher's sample pages only; full text not reviewed

[3] Axis white paper, Pixel density based on IEC 62676-4:2025 (Sept 2026)

Axis white paper (PDF)

[4] MOI conditions and security requirements document, Ed. 1 v1.1: pp. 12 to 13, 20 to 22, 25, 27, 38 to 75

Archived copy, 10 Dec 2025

The moi.gov.sa link redirects to the home page

[5] Law on the Use of Security Surveillance Cameras, Royal Decree M/34: Art. 11, 12

Bureau of Experts, official text

SOURCES, 2 OF 2

Technical and manufacturer sources

[6] ONVIF Conformant Products database; Profile T
ONVIF conformant products · ONVIF Profile T

[7] UK Home Office CCTV Operational Requirements Manual 28/09 (2009, withdrawn): s. 4.2.2
No current official link; checked from an archived copy

[8] SERA, Saudi Arabian Grid Code (May 2024): cl. 2.4.2.1; IEEE 1789-2015, inactive since Mar 2026
SERA Grid Code (PDF) · IEEE SA, 1789-2015

[9] EN 13201-2:2015 Road lighting, Part 2: SC and EV classes
BSI, BS EN 13201 series
Full text not reviewed; no class values are quoted

[10] Sony IMX415-AAQR and IMX678-AAQR product flyers
IMX415 flyer (PDF) · IMX678 flyer (PDF)

All calculations are ours, not quoted from these sources.

PRACTICAL LIGHTING ENGINEERING

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