

A nighttime photograph of an airport apron. In the background, a large airport terminal is illuminated with many lights. Two tall, bright floodlights are positioned on the apron, casting a strong light. Two Airberlin aircraft are visible on the left and right sides of the apron. The foreground shows the textured surface of the apron with some drainage channels.

IES-ALC Fall CONFERENCE St. Pete, FLA Oct-2012

LED as light source for Apron Floodlighting

by Alfred Seiterle
AEROPLAN Ltd. Zurich, Switzerland

1. Basics of apron floodlighting
2. Light sources
3. Environmental impact analysis
4. LED Floodlight
5. Lighting control and monitoring
6. Maintenance
7. Cost analysis

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1. ICAO recommendations for Apron Floodlighting

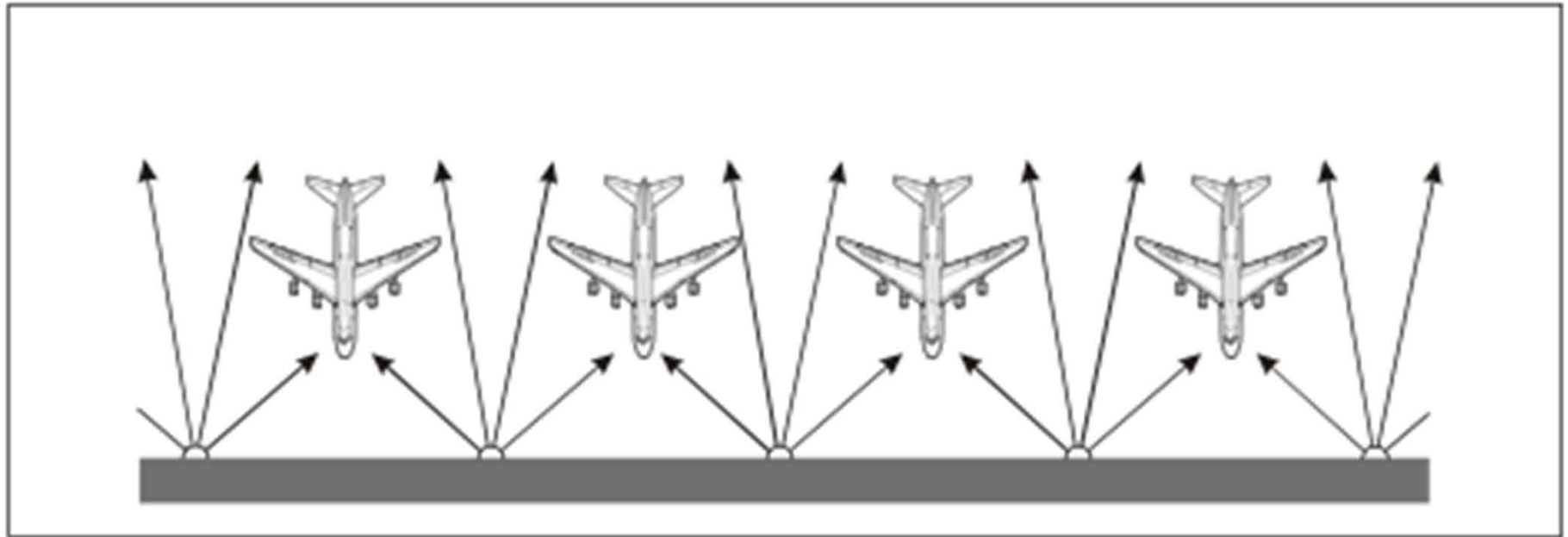
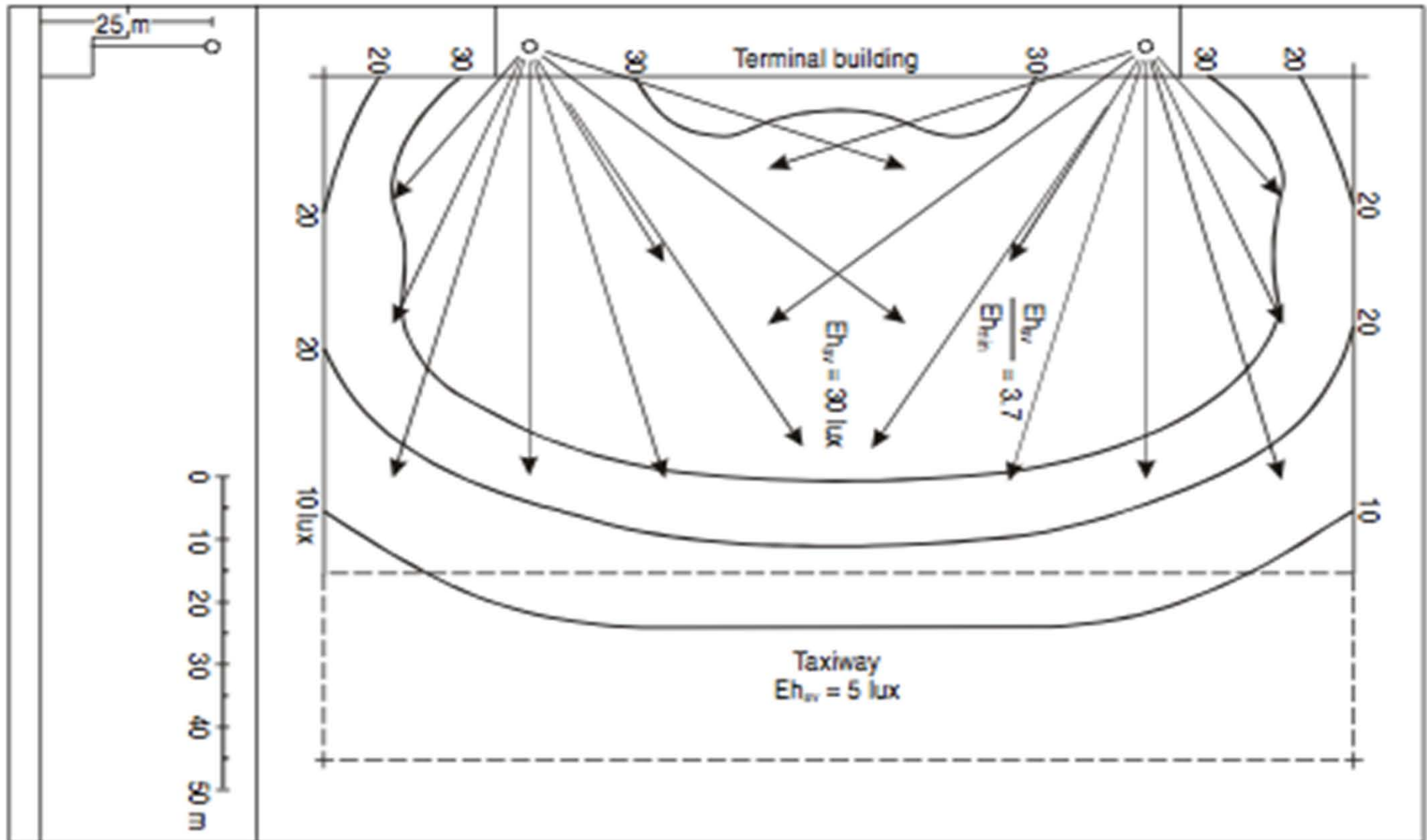


Figure 13-8. Typical floodlight arrangement and aiming for nose-in parking

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1. ICAO recommendations for Apron Floodlighting



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1. ICAO recommendations for Apron Floodlighting

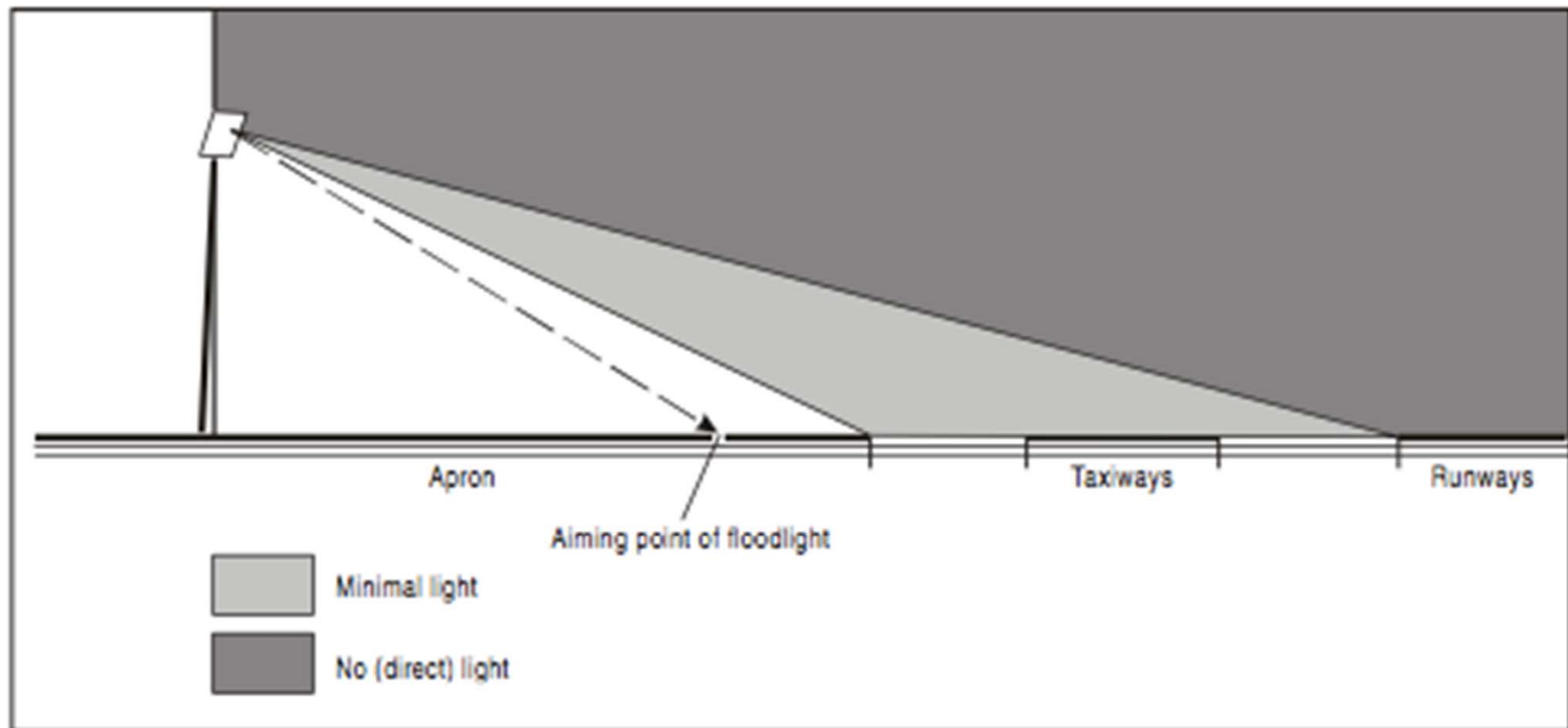


Figure 13-5. Aiming to avoid glare

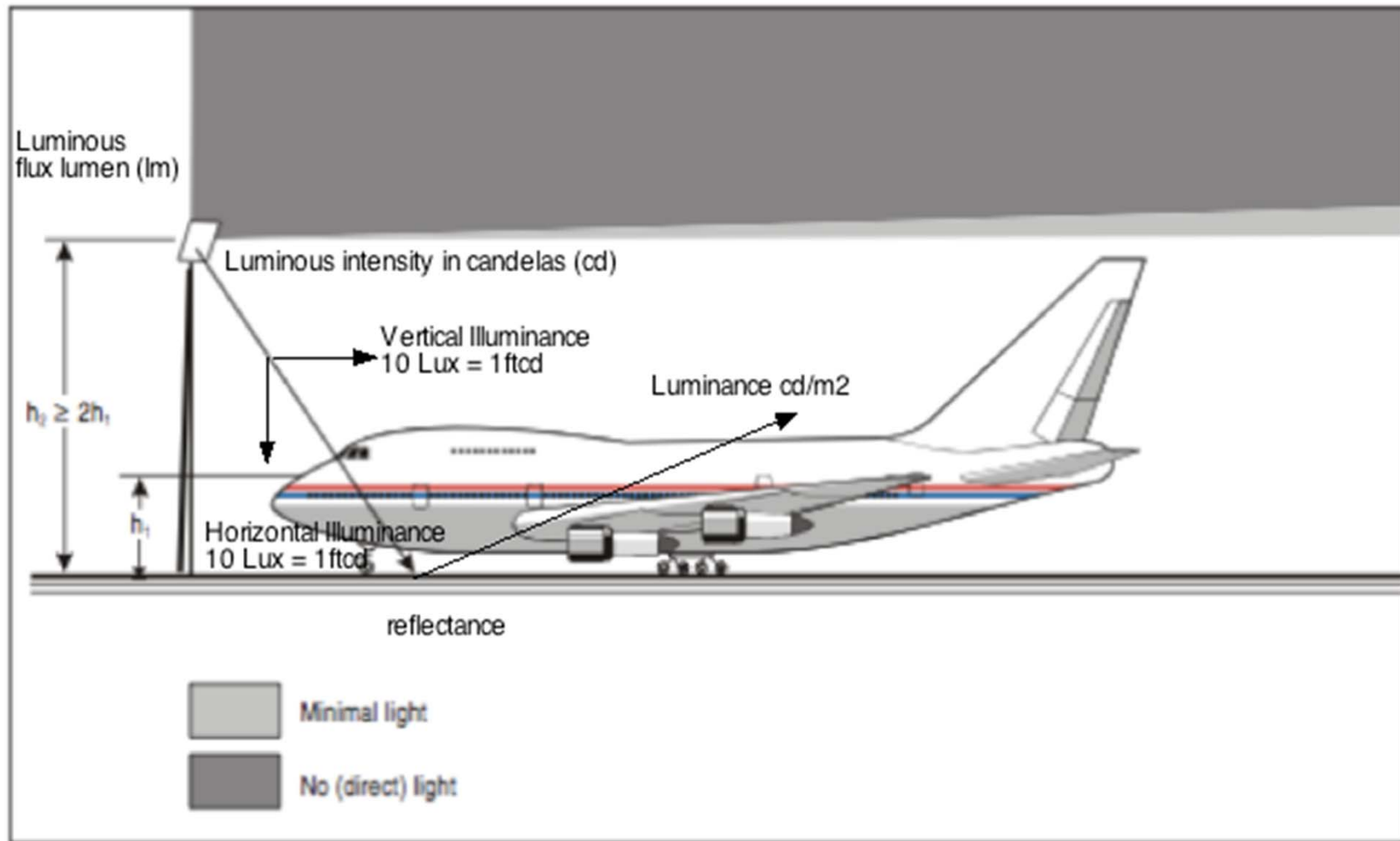


Figure 13-6. Mounting height to avoid glare

AFL 1. ICAO requirements for Apron Floodlighting

Appropriate design of the AFL minimizes glare:

- Appropriate positioning of the luminaries
- Careful selection of the luminaries
- Precise vertical and horizontal alignment of the luminaries

1. LED Apron Floodlighting at Innsbruck Airport (Austria)

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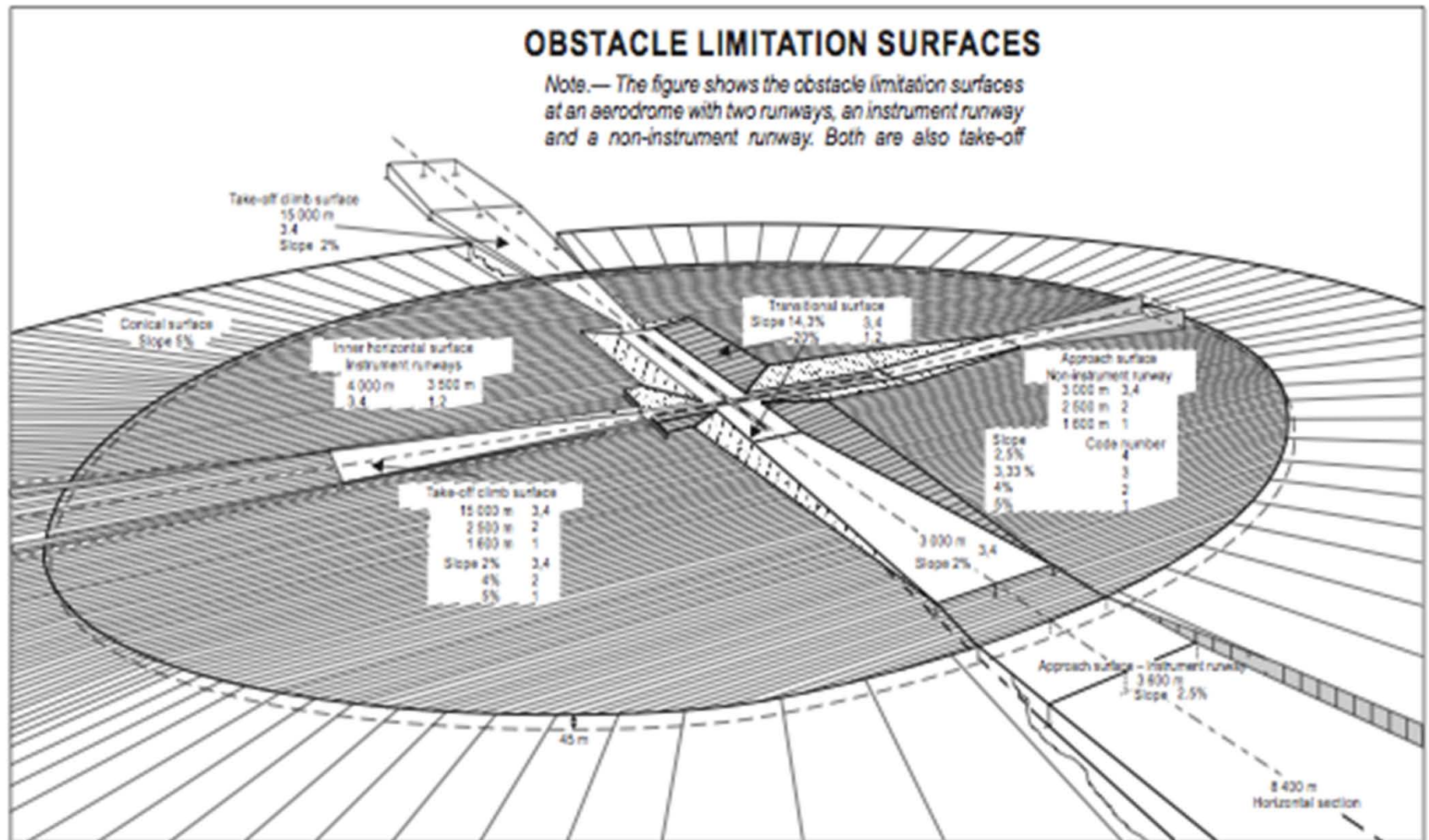


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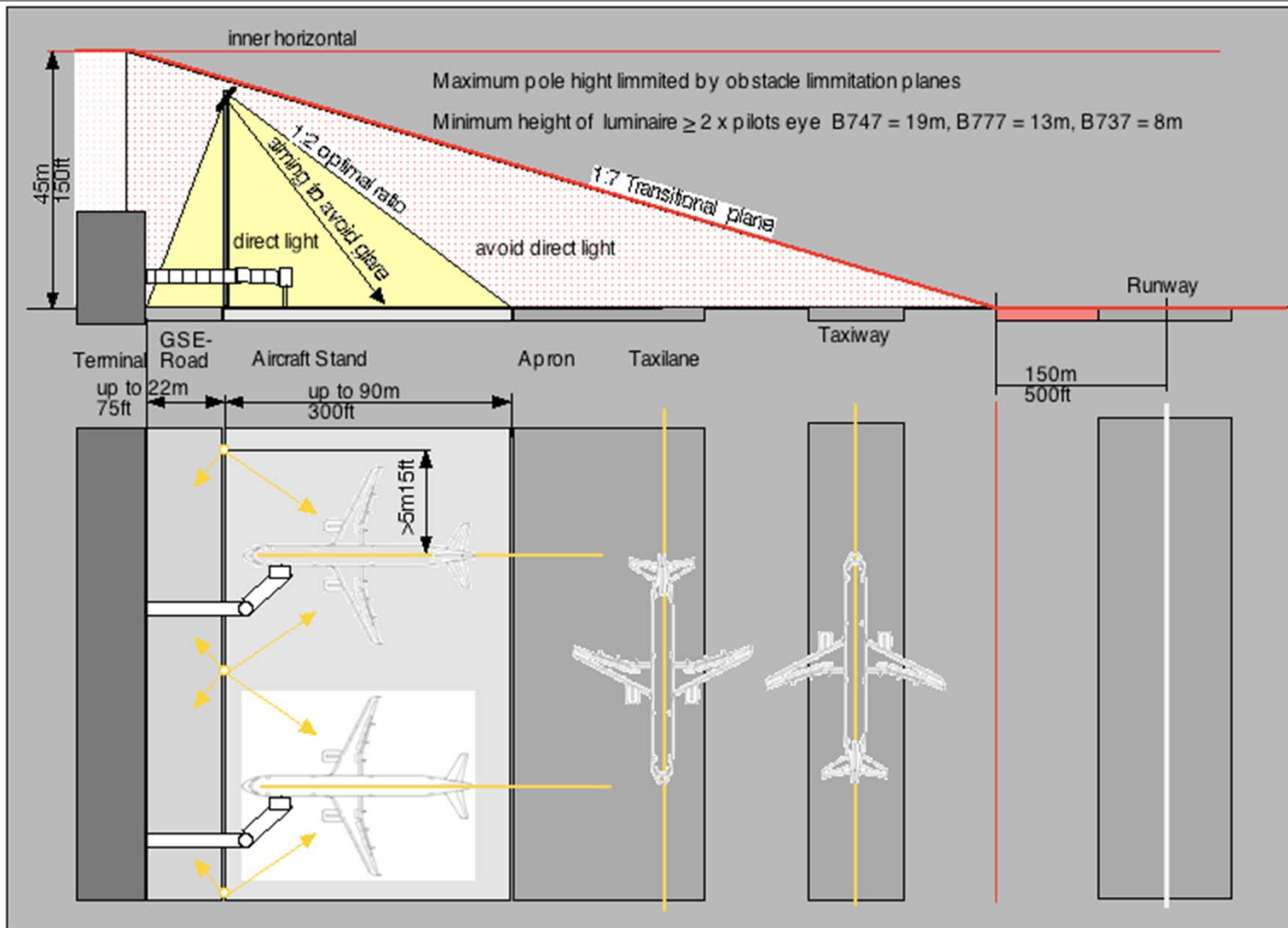
1. ICAO Obstacle limitation surfaces

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1. ICAO Aerodrome design Apron Floodlighting

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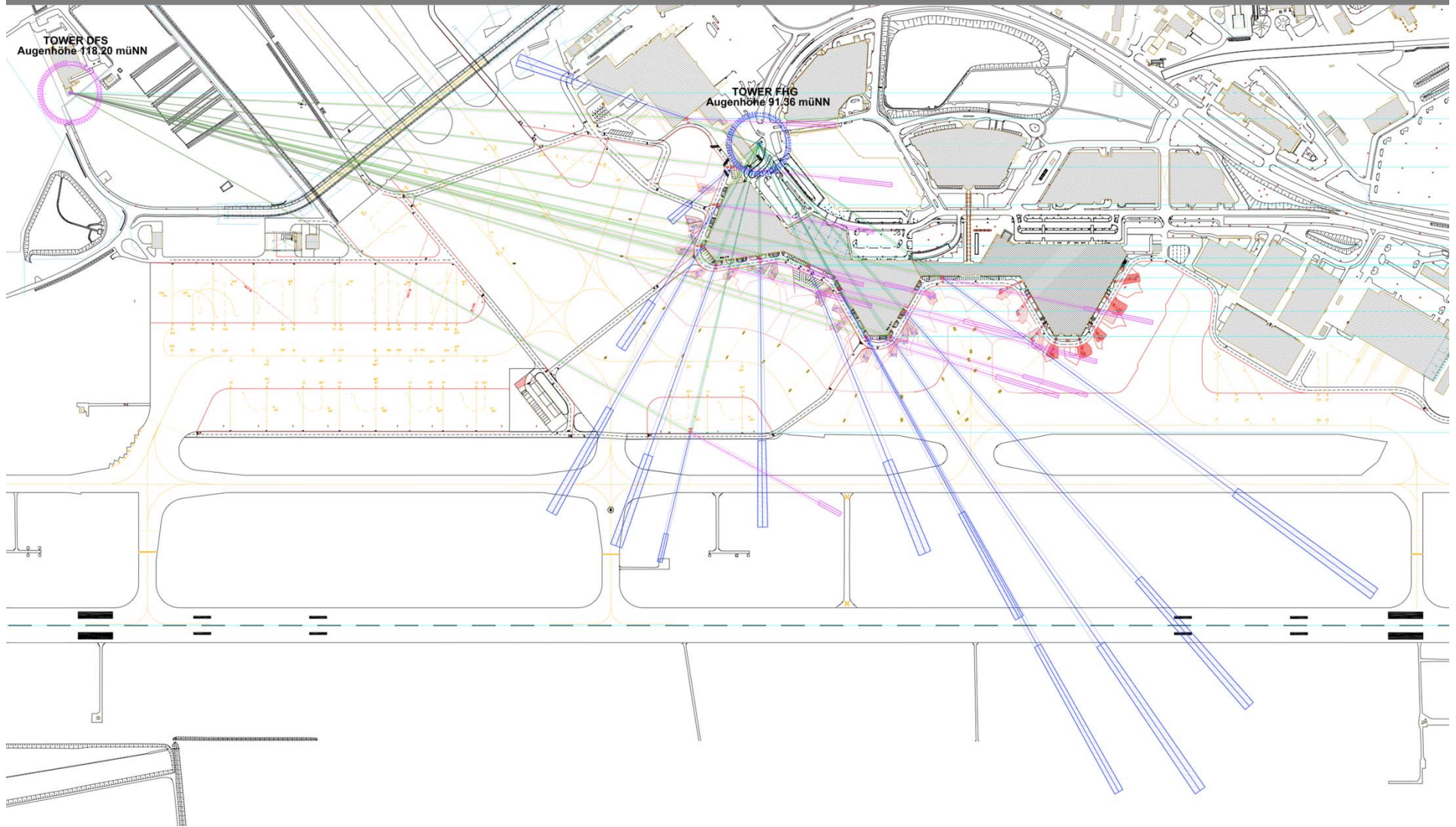
1. ICAO requirements for Apron Floodlighting

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- Light poles must be located outside of the taxiway
- The wingtip clearance has to be provided for the most demanding design Acft.
- The masts must not disturb TWR and Apron controllers
- must not disturb ground radar wave propagation

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1. Shadow study (Hannover Airport)



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1. View from Hannover TWR



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2. Light sources

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Most of Apron flood lighting are based on energy efficient High pressure gas discharge lamps such as:

Metal-halide

or

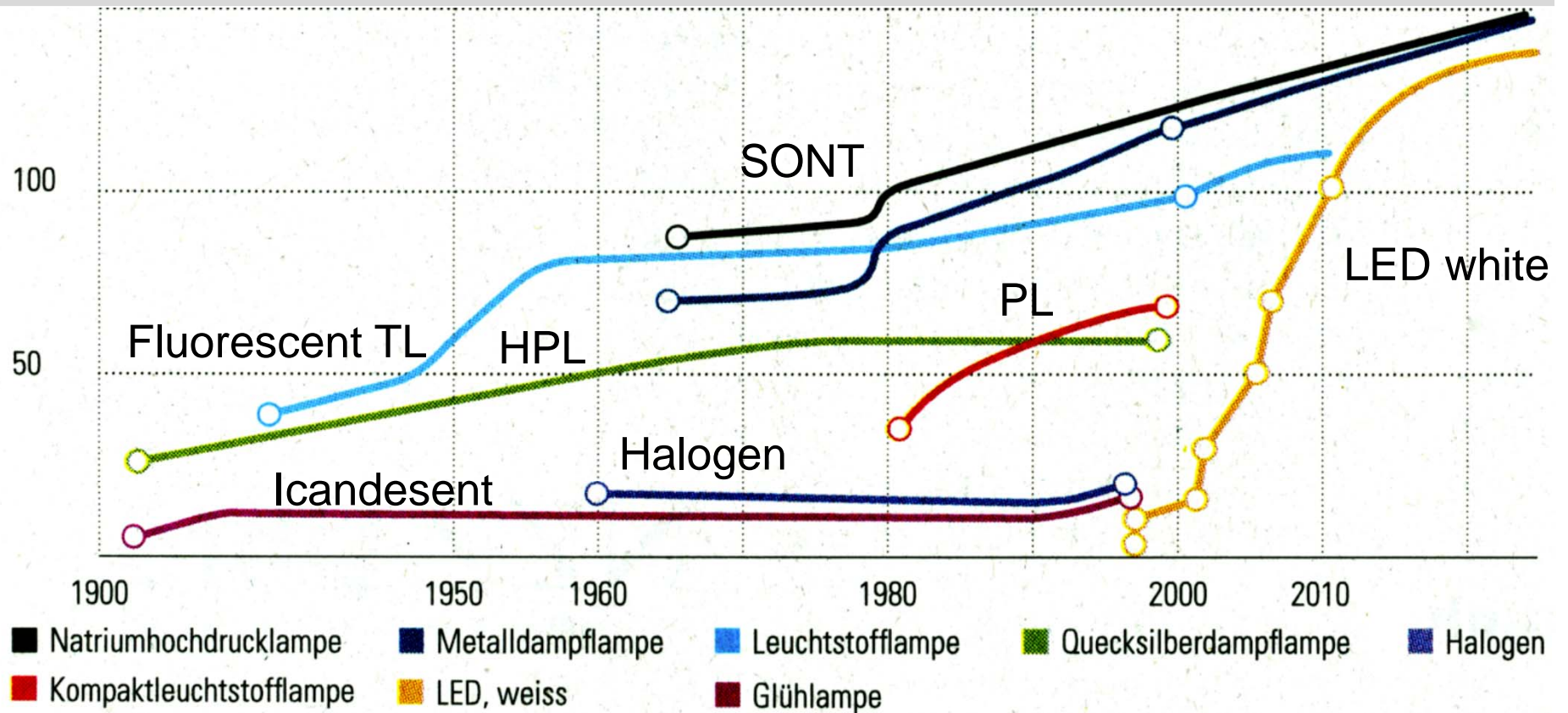
Sodium high pressure

In 2011 LED made a break through in energy efficacy. Today apron floodlights on the base of LED light sources are fit for use

2. Development of Lamp efficiency

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Standard light source in lm/W



QUELLE: ASETRONICS

NZZ-INFOGRAFIK/saf.

2. Lamp comparison

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Light source	Efficiency	Lamp life Average	Colour Temperature ° K	Rendering 1 Excellent 2 good 3 adequate 4 marginal 5 poor	Equipment		Startup Time		Costs	
					Ballast	Starter	cold min	Restrike after blackout min	Lamp (1000W) \$	per hour of lamp life (1000W) cts/h
Sodium low pressure SOX	180	6000	1500	5	Hybrid	in Ballast	10	2	250	4.17
Sodium high pressure SONT	130	13000	2000	4	Ballast	Starter	5	<1	88	0.68
Mercury high pressure HpL	70	9000	3000	3	Ballast	-	3	5	80	0.89
Metal Halide HPI	110	9000	3500	1,2	Ballast	Starter	3	10	115	1.28
HPI Hot restrike		1000	3500	1,2	Ballast	Hot restrike	5	<1	200	20
LED	90	50000	4200	1	Regulator	-	0	0	3000	6
LED	108	50000	6000	1	Regulator	-	0	0	3000	6

2. Comparison 400W SON-T and 500W LED flood light AFL



Environmental sustainability became key factor not only for the aviation industry:

- Low energy consumption
- Low CO2 immission
- Sustainable concepts and equipment
- Minimize Sky glow
- Impact on wildlife (insects, birds)

3. Energy Demand and CO2 Emission

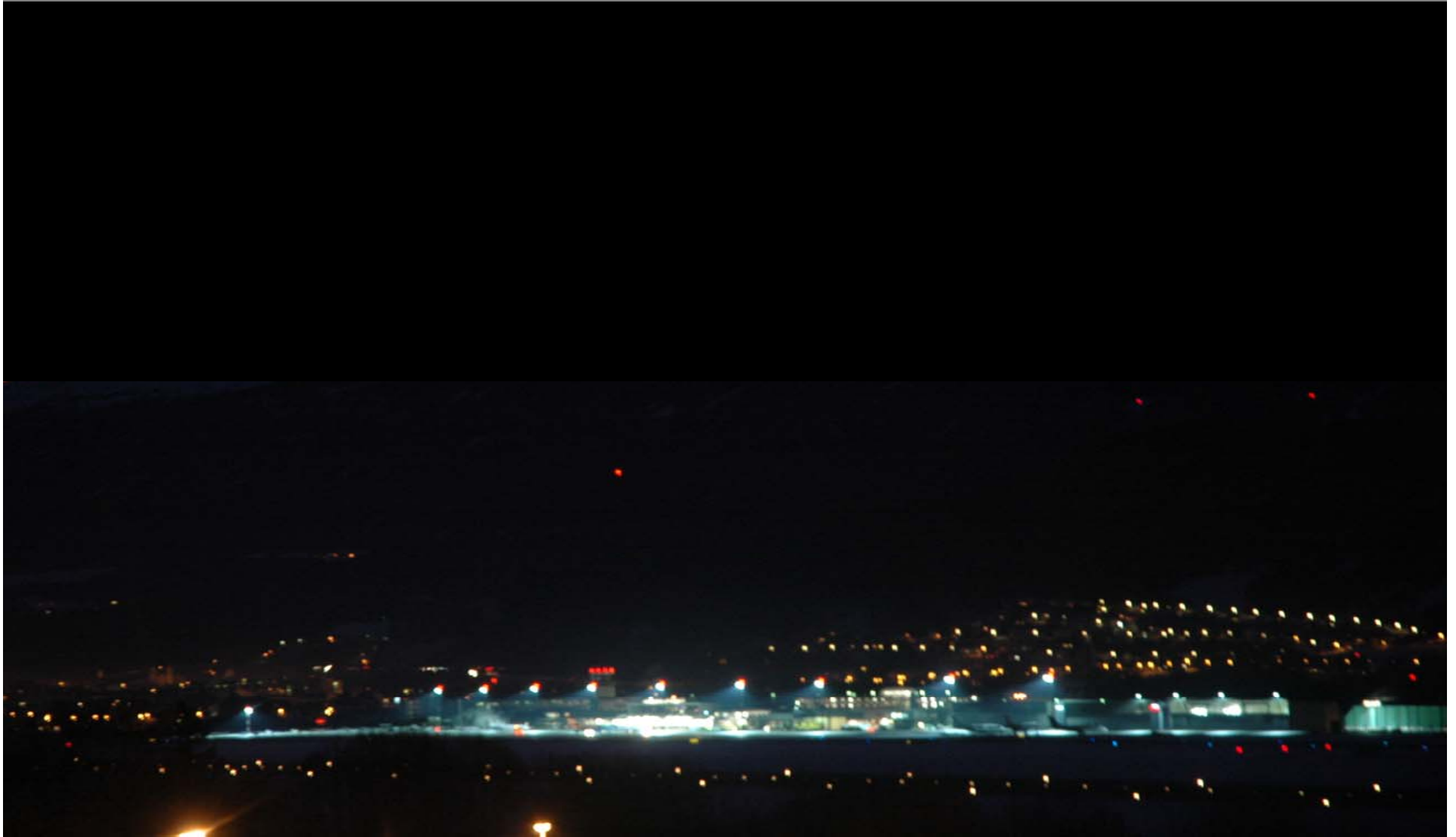
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Variante:			Installed lamp load	Annual Operation hours	Annual power demand	CO2 emmission	
Pos	Lamp	Mast position	kVA	hrs/A	kWh/A	563 gr/kWh Metric t/A	Comparison in %
A5	NAV	Fassade	65	4'000	260'000	146	67
A6	HPI	Fassade	97	4'000	388'000	218	100
A7	LED	Fassade	61	4'000	244'000	137	63

Part of a case study for Hannover Airport/Germany 2012

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3. Avoidance of sky glow by LED luminaries with low spill LED Floodlights at Innsbruck Airport (Austria)

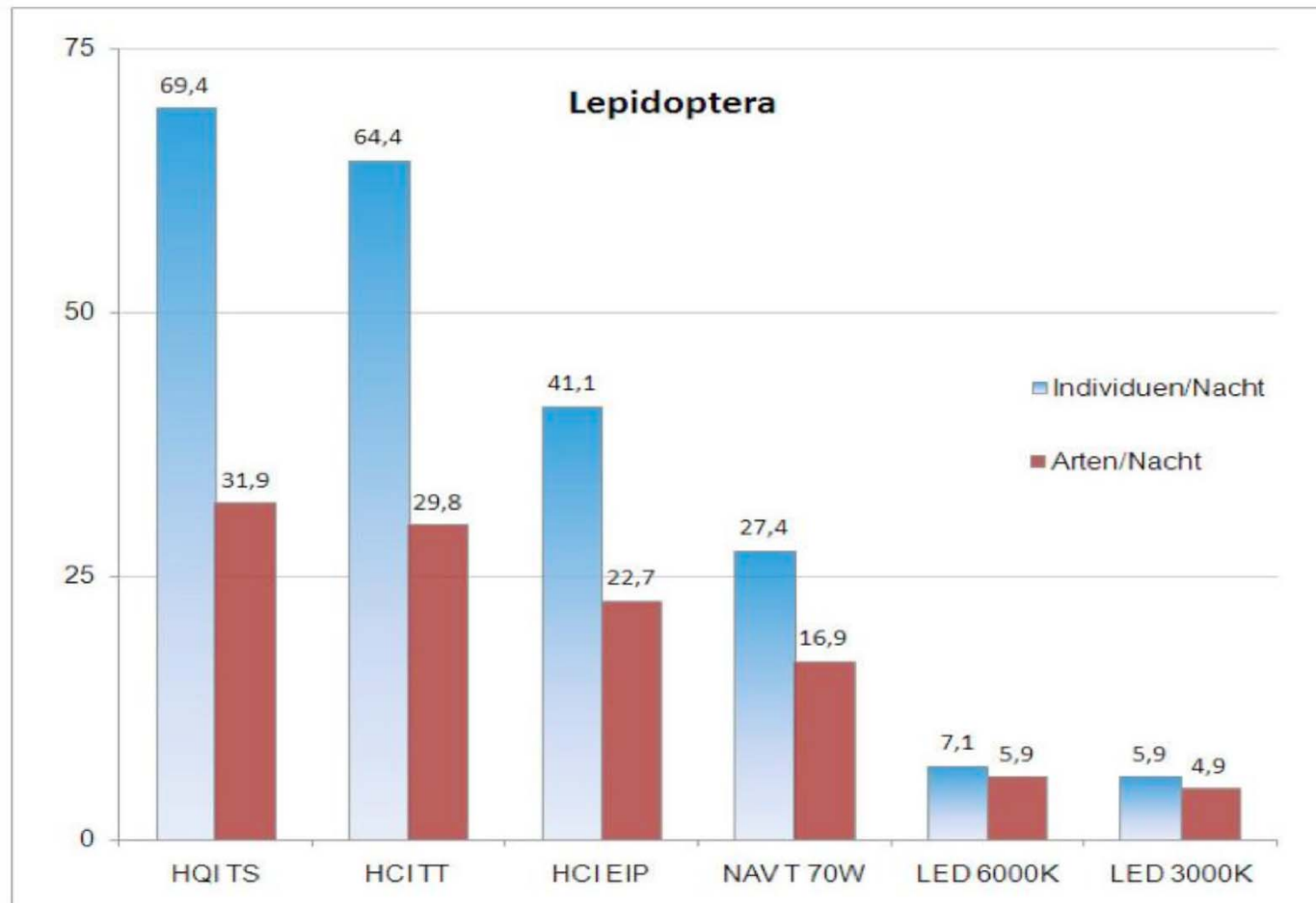


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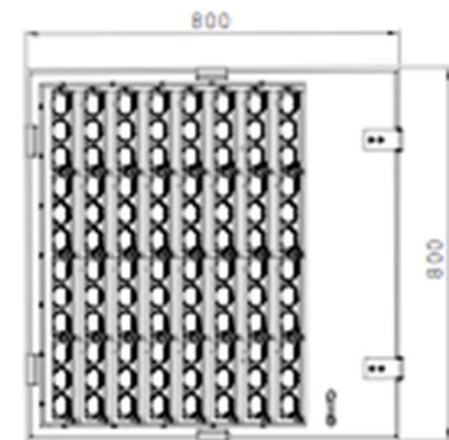
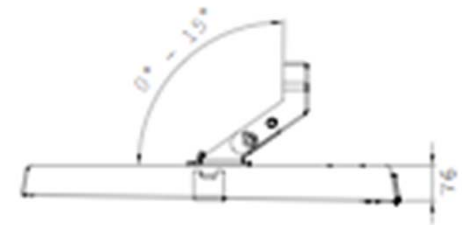
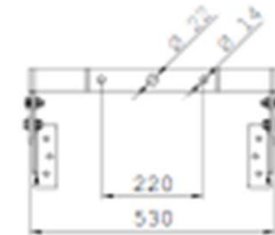
3. Attracting insects at night by artificial light source

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Fieldstudy in Tyrol (A), Huemer/Kühtreiber/Tarmann, Innsbruck, Dezember 2010)

4. Asymmetric 500W LED Floodlighting (EWO-Italy)



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4. Asymmetric 500W LED Floodlighting AFL



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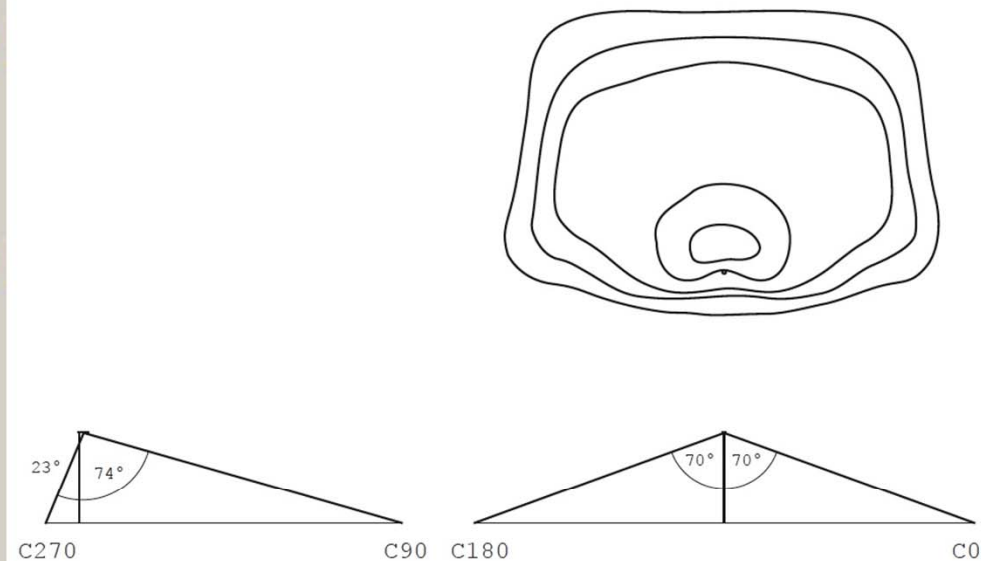
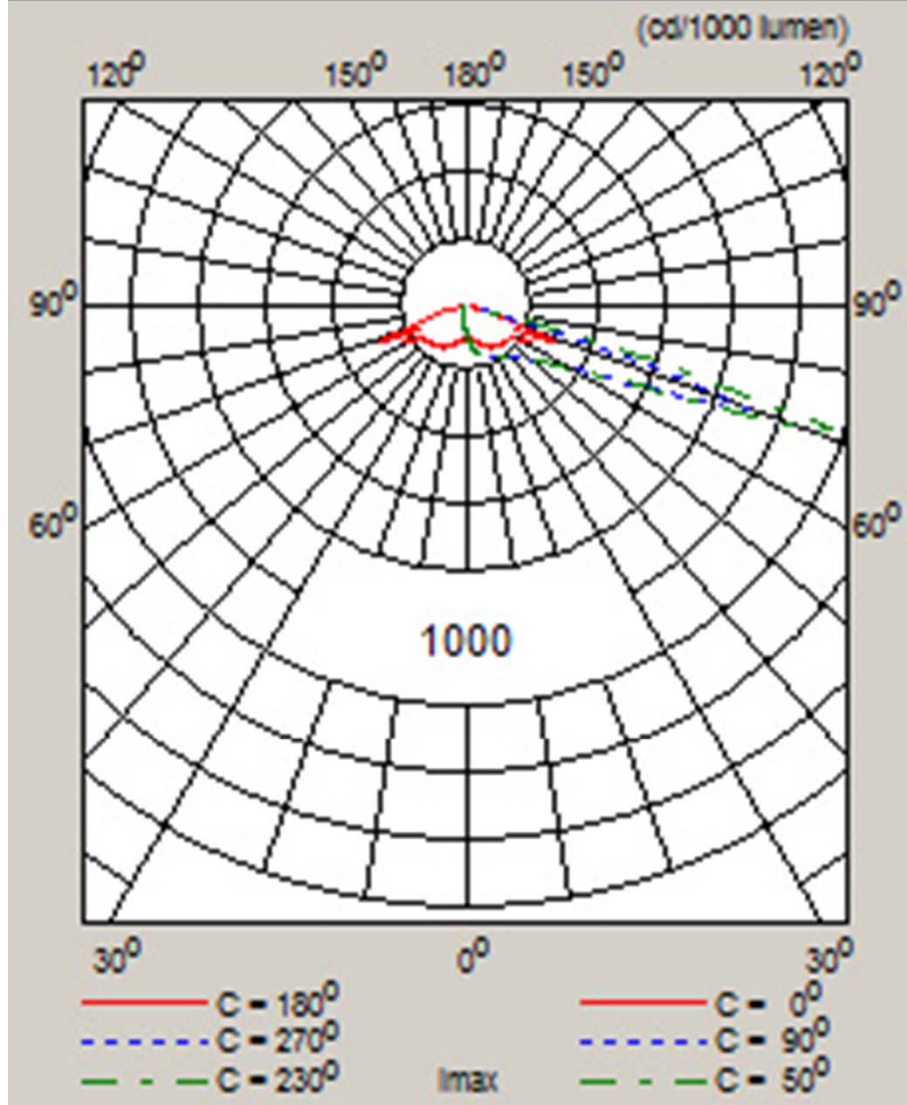
4. Asymmetric 500W LED Floodlighting AFL



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4. Asymmetric 500W LED Floodlighting (Photometrics)

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1. Avoiding sky glow LED Floodlights at Innsbruck Airport (Austria)



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4. Asymmetric 500W LED Floodlighting (Technical Data)

Feeder Current	Colour 4500° K		Colour temperature 6000° K		
	lumen		lumen		Power
	output	efficacy	output	efficacy	consumption
mA	lm	lm/W	lm	lm/W	W
350	25	75	31	91	345
400	28	75	35	31	307
450	32	72	38	87	438
500	34	70	39	88	438
550	37	68	44	82	540
600	40	67	48	80	595

6. LED Floodlight 500W (low glare and overspill)

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6. Calculation for Terminal A and B at Hannover Airport



4. Installationsdaten

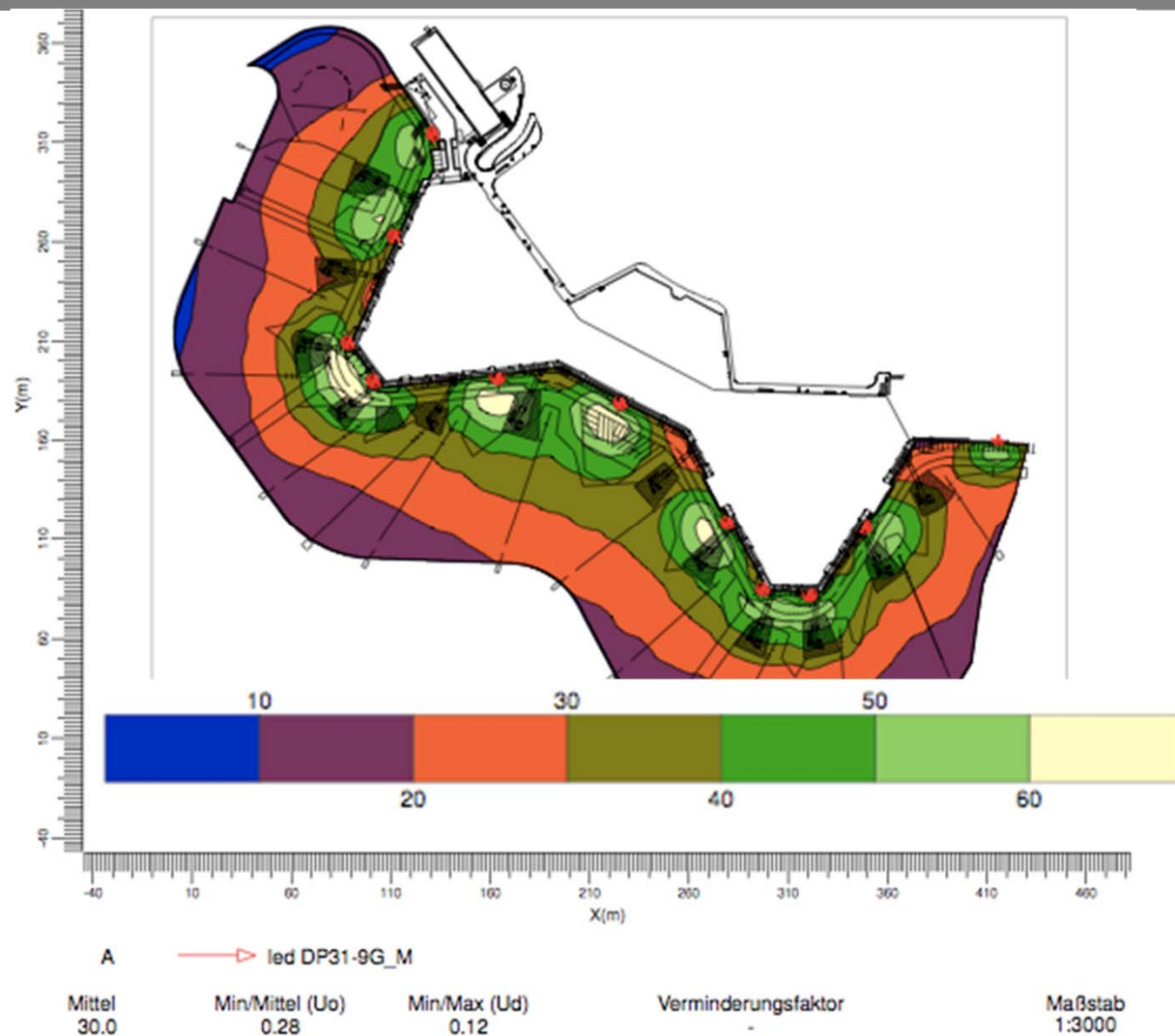
4.1 Legende

Projektleuchten:		Lampentyp	Lichtstrom (lm)
Code	Anzahl Leuchtentyp		
A	100 led DP31-9G_M	32 * 3x3 XP-G 500mA coolwhite	32 * 1521

4.2 Leuchtenanordnung und Ausrichtung

Anz. * Code	Position			Ausrichtwinkel		
	X (m)	Y (m)	Z (m)	Dreh.C	Neig.A	Neig.B
1 * A	89.02	209.45	28.00	-89.4	8.0	0.0
1 * A	89.02	209.45	28.00	-153.2	8.0	0.0
2 * A	89.02	209.45	28.00	145.6	8.0	0.0
2 * A	89.02	209.45	28.00	-123.5	8.0	0.0
2 * A	89.02	209.45	28.00	175.4	8.0	0.0
1 * A	101.74	190.08	28.00	145.6	8.0	0.0
1 * A	101.74	190.08	28.00	-154.4	8.0	0.0
1 * A	101.74	190.08	28.00	175.4	8.0	0.0
3 * A	101.74	190.08	28.00	-123.5	8.0	0.0
3 * A	101.74	190.08	28.00	-77.5	8.0	0.0
3 * A	112.08	262.38	28.00	111.2	8.0	0.0
2 * A	112.08	262.38	28.00	-163.2	8.0	0.0
1 * A	112.08	262.38	28.00	174.0	8.0	0.0
2 * A	112.08	262.38	28.00	139.9	8.0	0.0
2 * A	112.08	262.38	28.00	84.2	8.0	0.0
1 * A	131.93	314.53	28.00	-127.3	8.0	0.0
1 * A	131.93	314.53	28.00	-154.0	8.0	0.0
2 * A	131.93	314.53	28.00	-102.9	8.0	0.0
2 * A	131.93	314.53	28.00	-175.1	8.0	0.0
2 * A	131.93	314.53	28.00	164.5	8.0	0.0
2 * A	131.93	314.53	28.00	139.9	8.0	0.0
2 * A	163.92	191.88	28.00	-39.5	8.0	0.0
2 * A	163.92	191.88	28.00	-154.2	8.0	0.0
1 * A	163.92	191.88	28.00	-56.5	8.0	0.0
2 * A	163.92	191.88	28.00	-108.6	8.0	0.0
2 * A	163.92	191.88	28.00	-128.8	8.0	0.0
2 * A	163.92	191.88	28.00	-81.1	8.0	0.0
3 * A	225.98	179.22	28.00	-79.1	8.0	0.0
2 * A	225.98	179.22	28.00	-176.7	8.0	0.0
1 * A	225.98	179.22	28.00	-94.0	8.0	0.0
2 * A	225.98	179.22	28.00	-141.3	8.0	0.0
2 * A	225.98	179.22	28.00	-158.5	8.0	0.0
2 * A	225.98	179.22	28.00	-121.0	8.0	0.0
3 * A	280.09	118.80	28.00	166.6	8.0	0.0
1 * A	280.09	118.80	28.00	-98.9	8.0	0.0
2 * A	280.09	118.80	28.00	-172.6	8.0	0.0
3 * A	280.09	118.80	28.00	-143.6	8.0	0.0
2 * A	280.09	118.80	28.00	-118.1	8.0	0.0
1 * A	297.63	85.43	28.00	-145.7	8.0	0.0
1 * A	297.63	85.43	28.00	-120.0	8.0	0.0
1 * A	297.63	85.43	28.00	-171.6	8.0	0.0
1 * A	297.63	85.43	28.00	-58.4	8.0	0.0
2 * A	297.63	85.43	28.00	-85.1	8.0	0.0





5. Control and Monitoring

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Energy saving by maintaining light control became a key factor:

Switching the lights on operational request

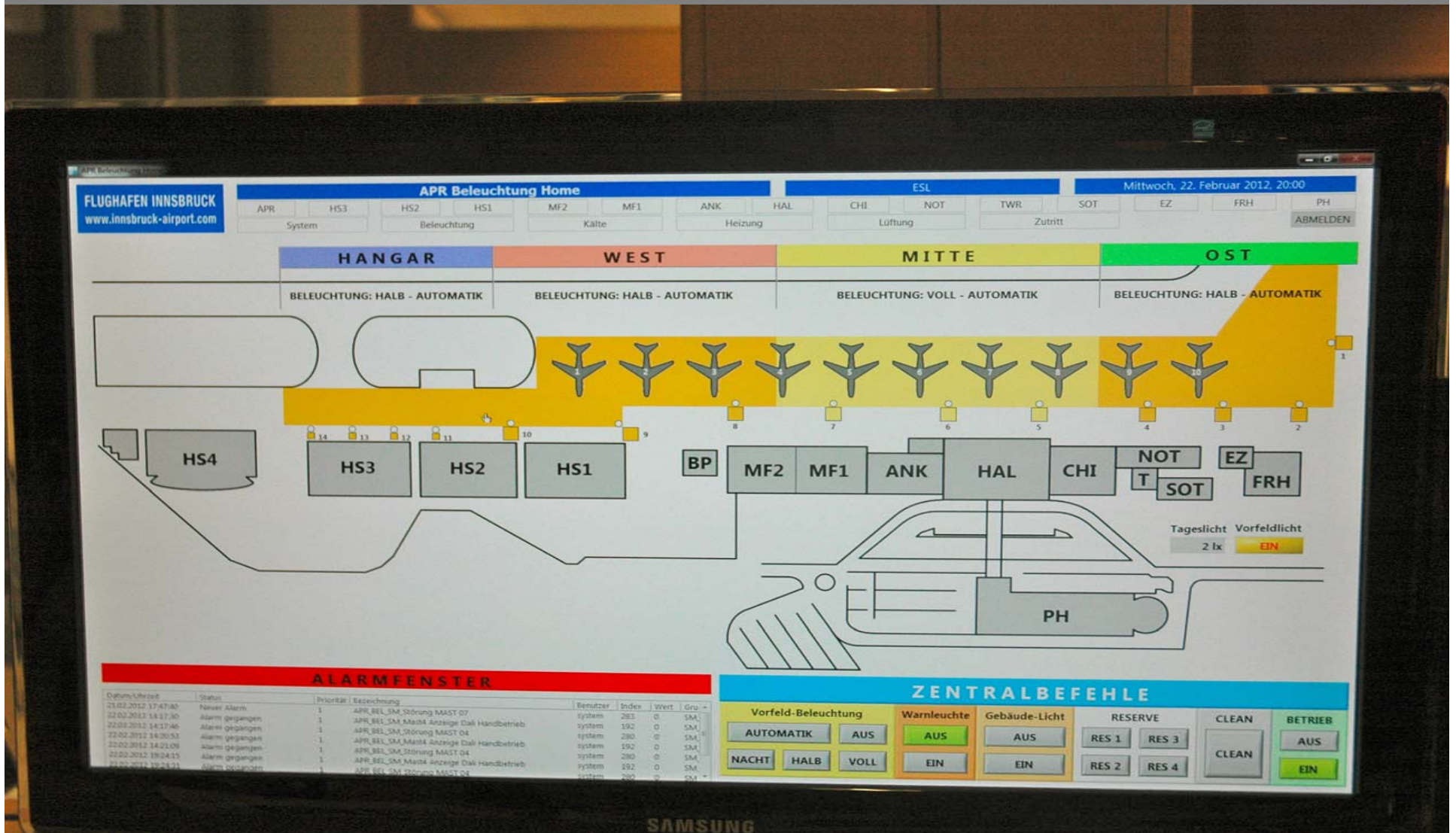
Interfacing flood light control system with automatic Illuminance setting on the individual acft stands

Switching Groups (eg. 1/3, 2/3, 3/3)

Digital Control via KNX or DALI for dimming LED's

5. Control and Monitoring

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- Lamp replacement (Intervention periods, preventive, reactive)
- Cleaning
- Accessibility to luminaries
- Number of lights (Impact of an outage on the illumination level)
- Monitoring
- Statistics

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6. Maintenance periodically measuring of the illumination level (Hannover Airport)



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6. Maintenance up to 20m (60ft) by cherry picker
(LED Driver in pillar box on apron)



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6. Piller Box for LED-luminaries

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6. Accessibility by floodlight lowering device

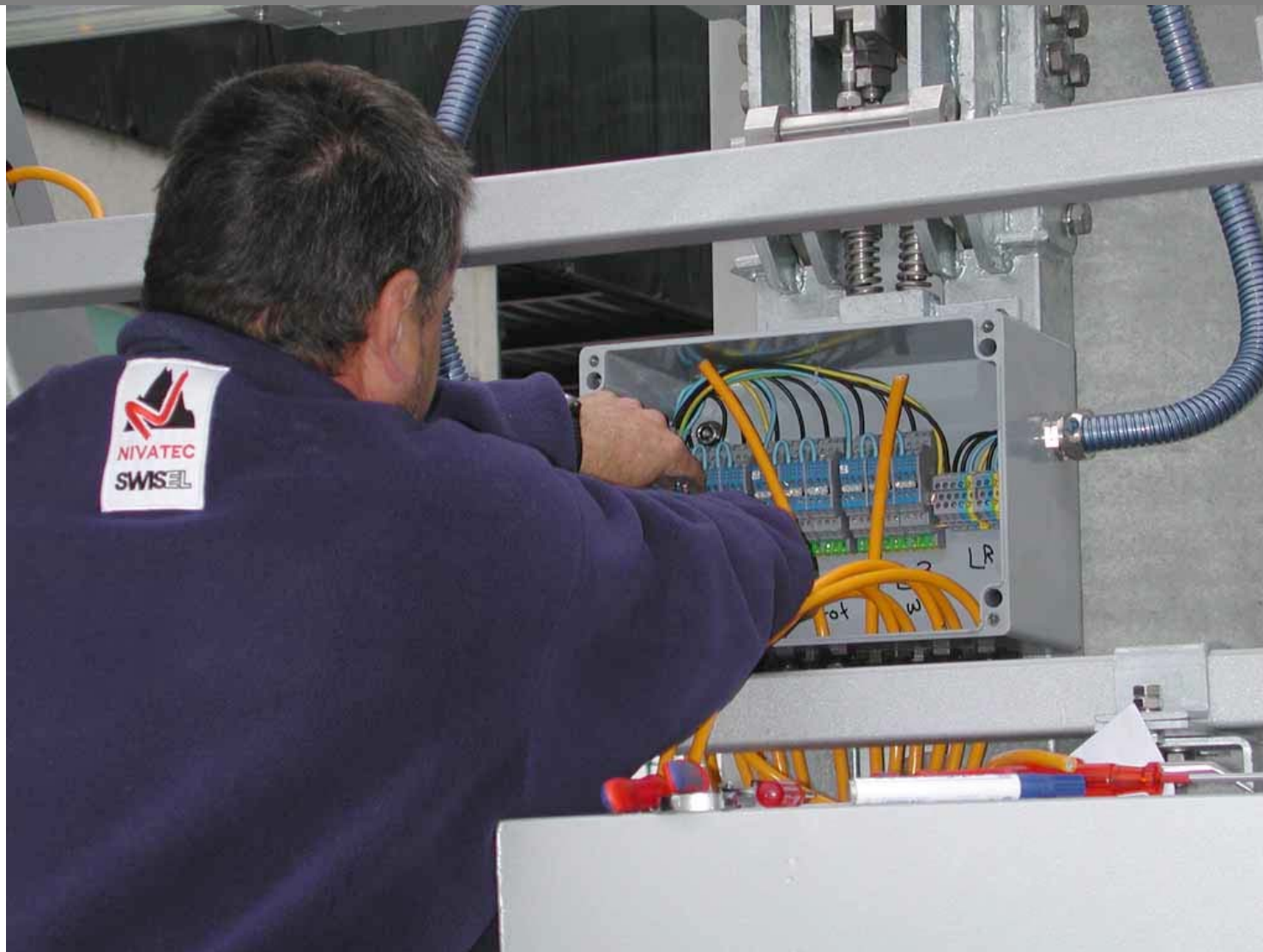


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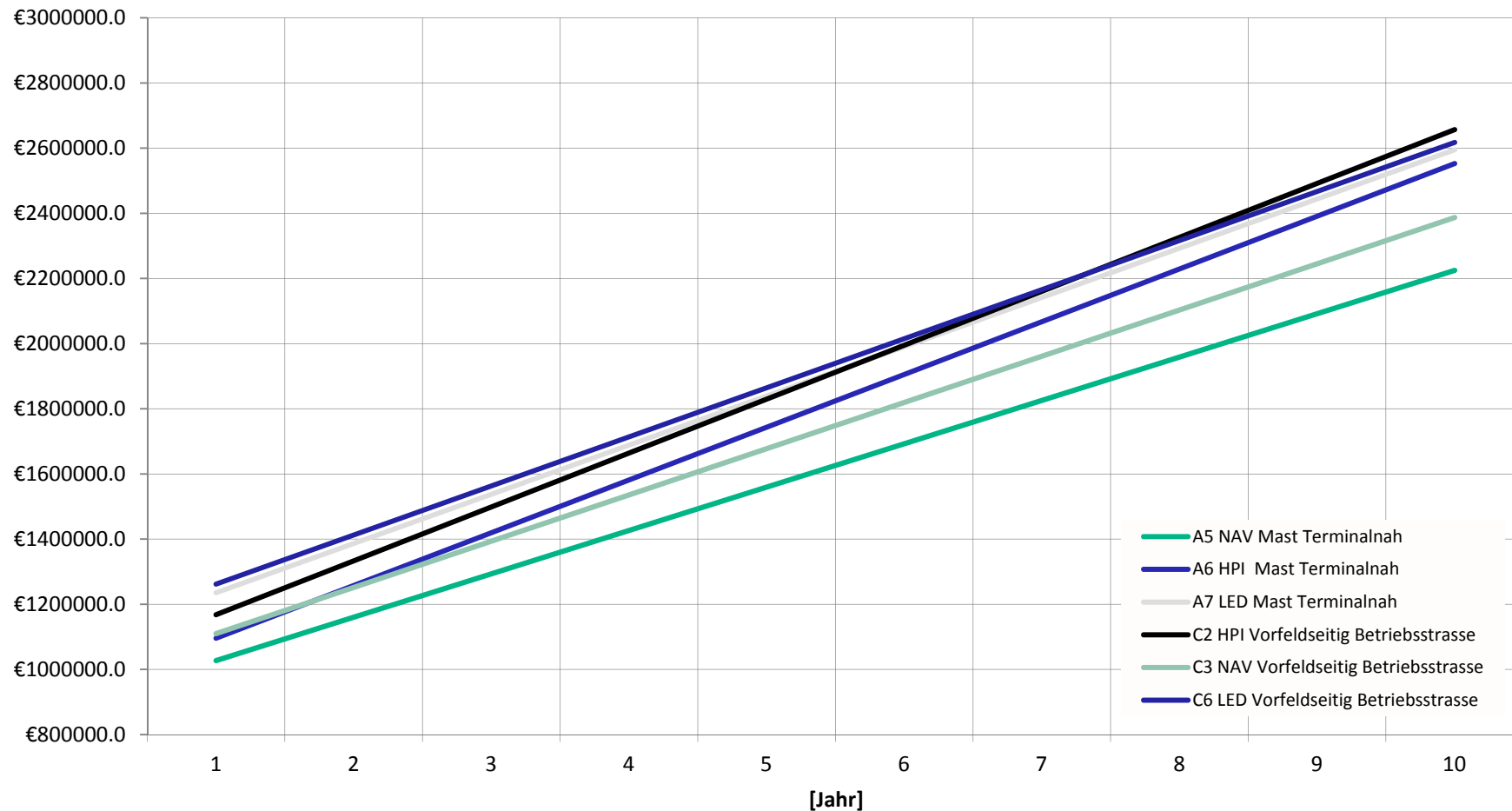
6. Maintenance Connector and lighting arrestor box



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**Overall Costs, Co2 duty €19/t, Schadstoff Abgabe 2cts/kWh,
Electricity =cts 17/kWh, LED replacement 50% of todays price**



Questions?

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9. References

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References:

ICAO	Annex 14, Vol 1
ICAO	ADM Part 4, Visual Aids
IESNA	RP-37 Draft
Philips	Lighting Handbook
Philips	Calculux light design program
E.A.Reeves	Electrical Pocket Book 1996
SLG/LiTG	Beleuchtungshandbuch
EWO	LED-Flood Light F32
Nivatec	Lamp lowering device
Wikipedia	http://en.wikipedia.org/wiki/Lux
AEROPLAN	Apron flood light calculations for LED floodlights