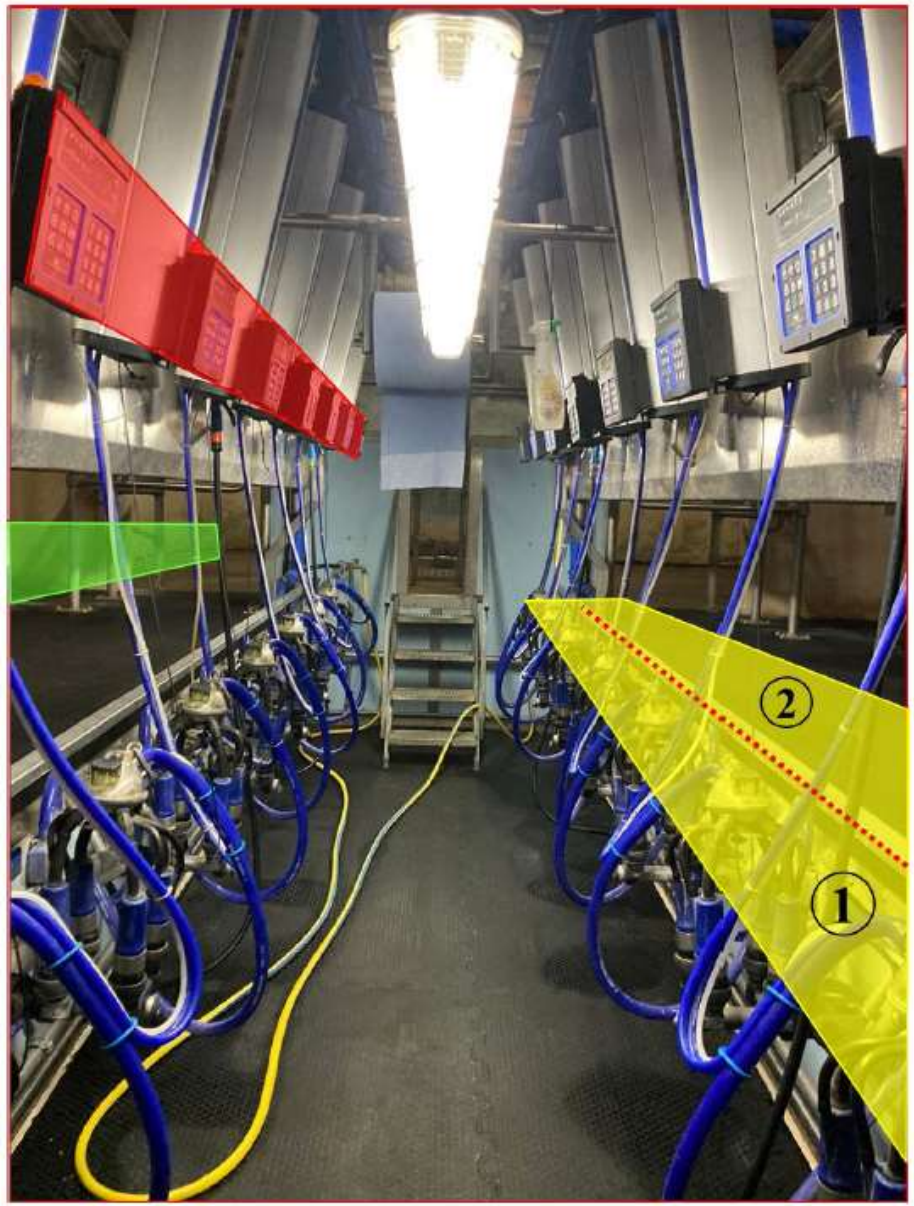

Milking parlour visual task areas illuminance: results of a field study

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ADEQUATE LIGHTING

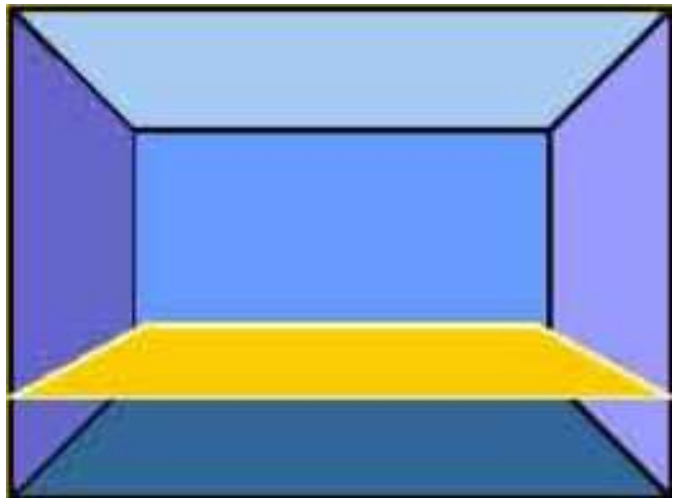
Recognising and distinguishing the elements of milking and performing the actions necessary to carry out this activity

Ensuring visual comfort for the milker by avoiding glare and shadows

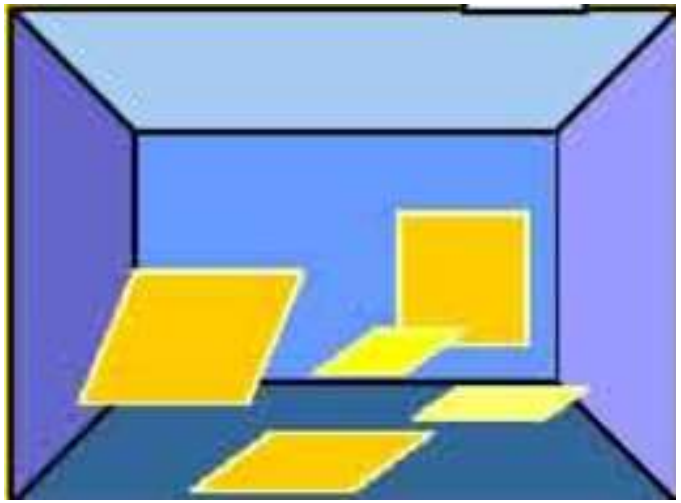
Encouraging concentration and attention at work

UNI EN 12464-1:2021

Lighting must be differentiated and concentrated where a specific visual task is required, understood as the set of elements that the observer must correctly and clearly distinguish in order to perform his tasks



Before



After

$\bar{m}$ Average maintained illuminance (lx)

U_0 Uniformity of illuminance

AIM OF THE STUDY

In order to define an objective method for assessing and improving the lighting in milking parlours, the milker's visual task areas were defined and the relative $\bar{m}$ and U_0 were calculated for the milking parlours of the two dairy farms involved in this project.

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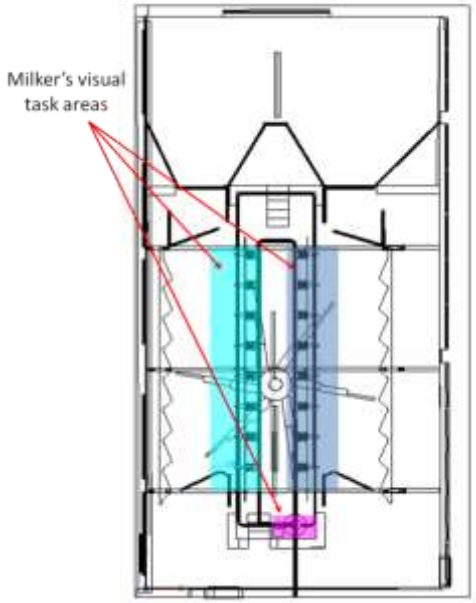
Autorità di gestione del Programma: Regione Lombardia

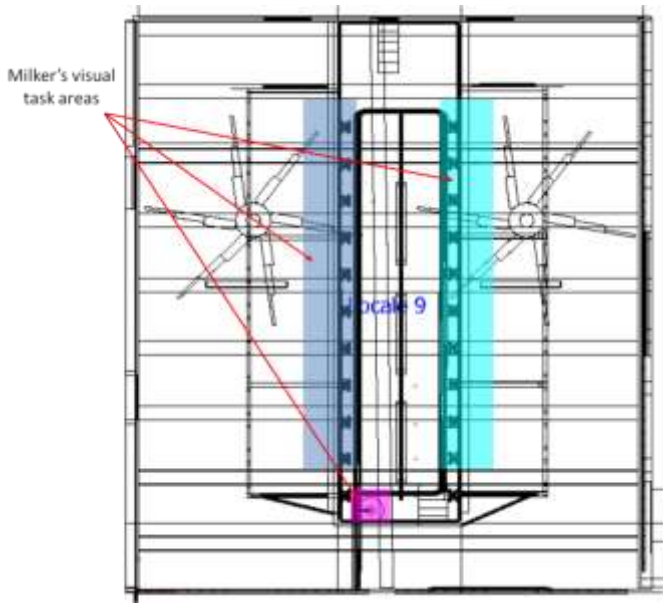
Materials and methods

MP_1



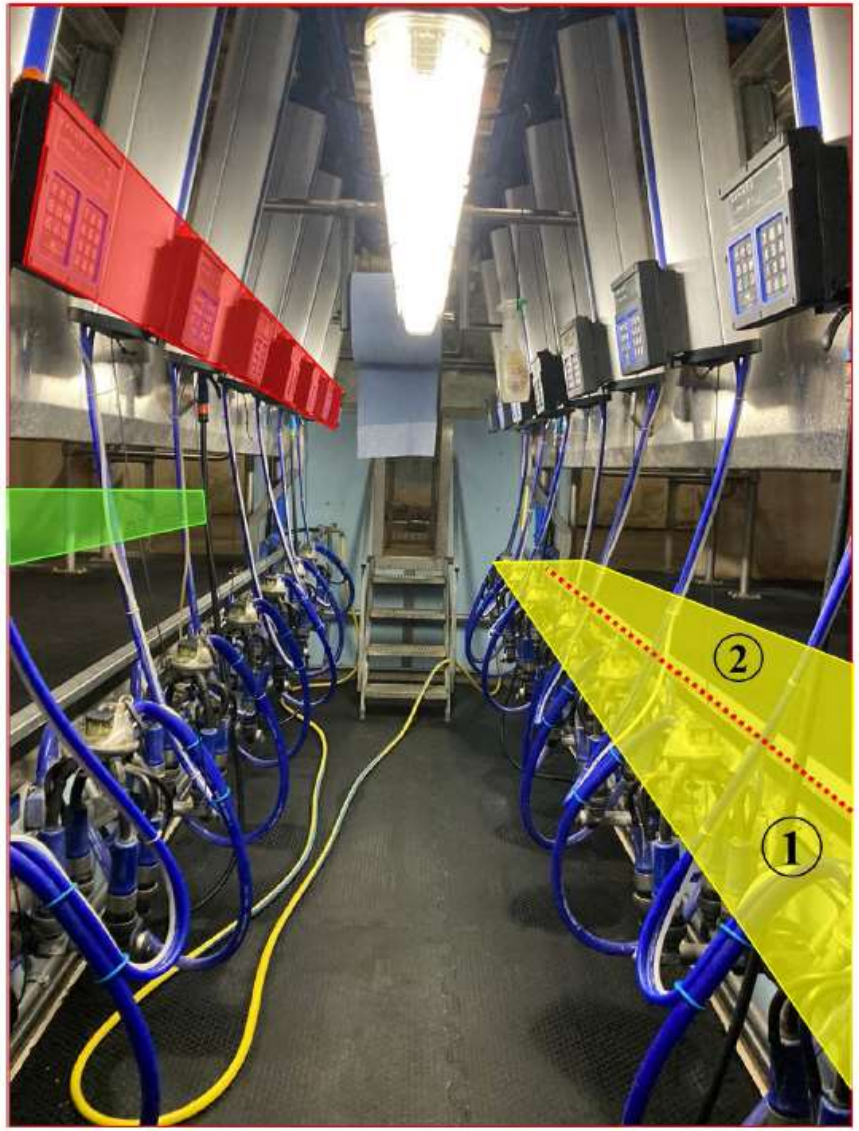
Type	Parabone 70° 8+8 milking stalls
Milking cows (n)	60 ± 2
Milkers (n)	1
Building orientation	N - S
Window to floor ratio (%)	42.2

MP_2



Type	Parallel 11+11 milking stalls
Milking cows (n)	177 ± 2
Milkers (n)	2 ± 1
Building orientation	E - W
Window to floor ratio (%)	24.7

Materials and methods

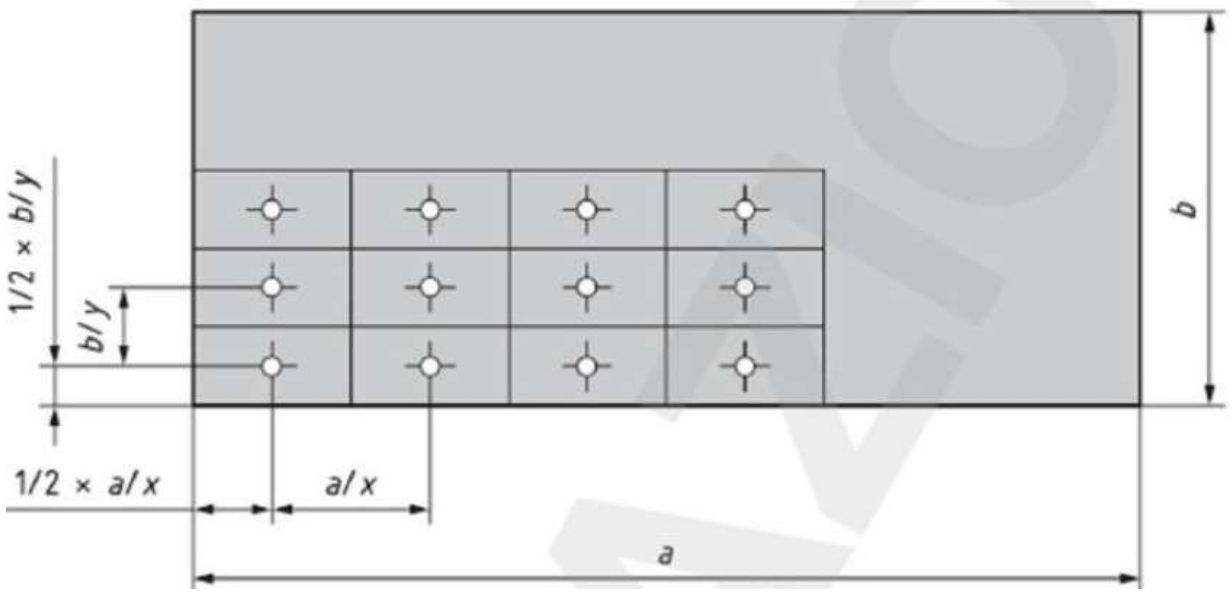


Milking stall under the udder (1) and area where milking clusters are positioned (2) — VTA 1

In front of the udder and teats — VTA 2

Milking control unit — VTA 3

Materials and methods



$$p = 0.2 \times 5^{\log 10(d)} \qquad n = d/p$$

Where:
p = maximum size of the grid cell
d = longest side of the calculation area.
If the ratio of the longest to the shortest side of the calculation area is ≥ 2, then d becomes the shortest side of the calculation area.

$$E_a = \frac{E_1 + E_2 + \ldots + E_n}{n}$$

Where:
E_a = average illuminance (lx)
$E_1 \div E_n$ = illuminance values of the measured points (lx)
n = total number of measurement points

$$U_o = \frac{E_{min}}{E_a}$$

Where:
U_o = illuminance uniformity
E_a = average illuminance (lx)
E_{min} = minimun illuminance (lx)

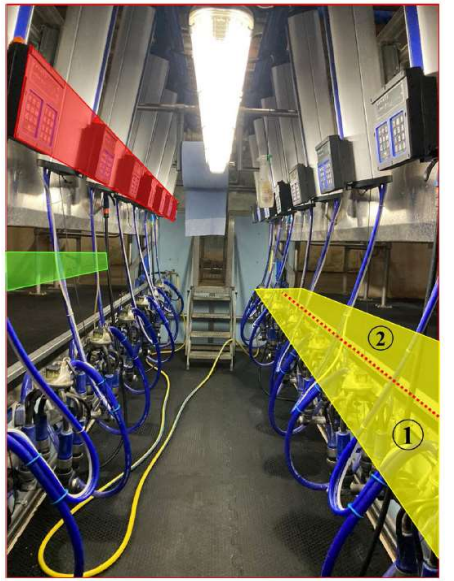
Shapiro- Wilk test
Wilcoxon test

Results and discussion

	Side	E_{a1} (lx)	E_{a2} (lx)	E_{a3} (lx)	U_{o1}	U_{o2}	U_{o3}
MP1	Left	101.5±63.7	145.0±68.6[a]	69.0±33.5[b]	0.1	0.2	0.1
	Right	107.1±67.2	153.8±68.5[a]	68.3±32.9[a]	0.1	0.2	0.1
MP2	Left	182.8±81.0	212.8±72.2[a]	162.7±80.6[b]	0.2	0.3	0.2
	Right	264.8±116.5	320.2±107.6[a]	227.9±100.7[b]	0.1	0.2	0.1

[a,b] Values with different superscript letters in a row are significantly different ($p<0.01$)

Average illuminance and illuminance uniformity of VTA1 (E_{a1}, U_{o1}), at cluster level (E_{a2}, U_{o2}) and under the udder (E_{a3}, U_{o3}) for left and right side of MP1 and MP_2



Average illuminance and illuminance uniformity of VTA_2 (E_a, U_o), for left and right side of MP_1 and MP_2.

	Left side		*Right side*	
	E_a (lx)	U_o	E_a (lx)	U_o
MP1	16.7±18.4[a]	0.0	31.9±25.5[b]	0.0
MP2	31.8±9.8	0.0	34.4±10.1	0.0

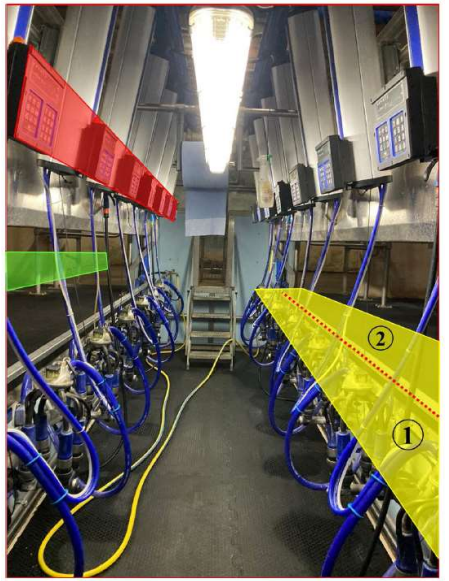
[a,b] Values with different superscript letters in a row are significantly different ($p<0.01$)

Results and discussion

Average illuminance and illuminance uniformity of VTA3 (E_a, U_o), for left and right side of MP_1 and MP_2.

	Left side		*Right side*	
	E_a (lx)	U_o	E_a (lx)	U_o
MP_1	145.6±105.5	0.1	148.2±100.2	0.1
MP_2	251.3±88.3[a]	0.3	322.1±131.6[b]	0.1

[a,b] Values with different superscript letters in a row are significantly different ($p<0.01$)



	E_a (lx)	U_o
MP_1	95.0±29.2	0.2
MP_2	170.0±45.6	0.5

Average illuminance and illuminance uniformity of VTA4 (E_a, U_o), of MP_1 and MP_2.

Conclusions

1. Four milker's visual task areas were defined

2. Parlour lighting design needs to be reconsidered in order to meet the requirements of the UNI EN 12464-1:2021 standard

3. Particular attention should be paid to improving the uniformity of lighting

Thanks for your attention

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