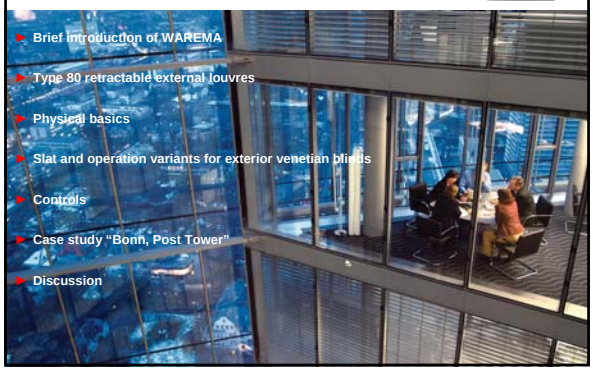
# Shading systems and sustainable design

Randall Kohn
Shade Factor Pty Ltd
*Australian agents for Warema*

Sun. Light. WAREMA.



## Content



- Brief introduction of WAREMA
- Type 80 retractable external louvres
- Physical basics
- Slat and operation variants for exterior venetian blinds
- Controls
- Case study "Bonn, Post Tower"
- Discussion



## From family business to European market leader

- Established in 1955 (by Karl-Friedrich Wagner and Hans-Wilhelm Renkhoff)
- Three names **WA**gner **RE**nkhoff **MA**rktheidenfeld
  – gave rise to a new word which was to become a hallmark for both a region and an entire industry: **WAREMA.**



- Angelique Renkhoff-Mücke entered her father's company in 1998
- CEO and President of WAREMA Renkhoff Holding AG (Corp.) since 2001





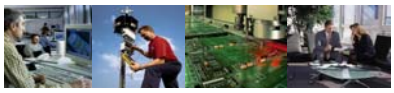


## Company profile

- Headquarters Marktheidenfeld
- Sales revenue 2004 240 Mio Euro (app. 300Mio USD)
- Staff 2200
- 18 branches in Germany


## Service

- Tailor-made products (interior and exterior window shades, electronic controls)








## Product range





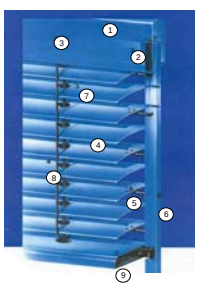
WAREMA EXTERNAL VENETIAN BLINDS

The Technical Catalogue.




## Type 80 Construction

- 1= cover panel
- 2= headrail
- 3= motor or crank-drive
- 4= slats
- 5= guiding-nipples
- 6= guide-rails
- 7= lifting-tape
- 8= tilting-tape
- 9= bottom-rail



## Minimum / maximum Dimensions

| type | maximum/minimum dimensions | | | | | | | | average weight [kg/m²] |
|---|---|---|---|---|---|---|---|---|---|
| | single unit | | | | coupled units | | | | |
| | width [mm] | | height [mm] | surface [m²] | width [mm] | | surface [1] [m²] | number of curtains | |
| | min. [2] | max. | | | lateral drive | central drive | | | |
| C 80/60 A2<br>C 80/60 A6 | 450 | 6000<br>5000 | 5000 | 12.0 | 7000 | 12000 | 12.0 | 5 | 2.8/2.7 |
| E 80/60 A2<br>E 80/60 A6 | 600 | 6000<br>5000 | 5000 | 18.0<br>up to 21.0 | 7000 | 12000 | 18.0<br>up to 21.0 | 5 | 3.1/3.0 |
| E 80/60 A2 AS<br>E 80/60 A6 AS | 600 | 6000<br>5000 | 5000 | 18.0<br>up to 21.0 | 6000 | 10000 | 18.0<br>up to 21.0 | 3 | 3.1/3.0 |

Tab. 1: Maximum/minimum dimensions types C/E 80/60 A

1) *The maximum surfaces depend on the individual height. Deviating dimensions are subject to individual clarification!*
2) *With smaller widths, an asymmetrical running of the slats cannot be avoided.*





## Stack heights

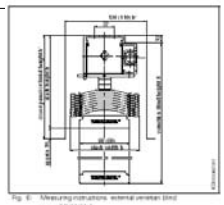


Fig. 6: Measuring instructions, external venetian blind types C/E 80/60 A

**Stack heights [mm]**

H = venetian blind height
h = stack height (from the bit)
h' = recess height or cover panel height
(h' = h+15mm)
b = stack width — 80mm slats = 110mm; 60mm slats = 90mm
b' = recess width — 80mm slats minim. 130mm; 60mm slats minim. 110mm

Note:
+10mm for work setting
(installation with higher bracket)

**Stack heights [mm]**

| type | venetian blind height [mm] | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1400 | 1600 | 1800 | 2000 | 2200 | 2400 | 2600 | 2800 | 3000 | 3200 | 3400 | 3600 | 3800 | 4000 | 5000 |
| C 80 A2/A6 | 175 | 185 | 200 | 215 | 225 | 235 | 245 | 255 | 270 | 285 | 295 | 310 | 320 | 335 | 395 |
| C 60 A2/A6 | 195 | 210 | 225 | 240 | 255 | 270 | 285 | 300 | 315 | 330 | 350 | 365 | 380 | 395 | 470 |
| E 80 A2/A6 | 195 | 205 | 225 | 250 | 245 | 255 | 270 | 280 | 295 | 305 | 320 | 330 | 345 | 355 | 415 |
| E 60 A2/A6 | 215 | 230 | 245 | 265 | 275 | 290 | 305 | 325 | 340 | 355 | 370 | 385 | 400 | 415 | 490 |

*Stack heights are approximate values. For technical reasons, they might deviate to the minus or plus area.*
***Extend venetian blind with work setting:*** *Slat stack + 7mm higher if bracket article no 66 1012 for installation to the ceiling or the lintel is required*





## Solar Parameters

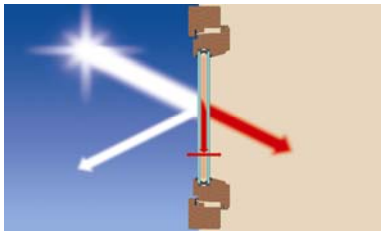



## General demands of shading systems

- Improve SHGC.(solar heat gain coefficient) or ‘g’ factor in Europe.
- Energy saving (heating, cooling and artificial lighting)
- Increase of productivity and performance (High value building )
  - Daylight using, visual comfort
  - Glare protection
  - Thermal comfort
- Adjustable to own needs
- Motorised and automated systems

## Interaction of sun light

- Transmission $\tau$
- Reflection $\rho$
- Absorption $\alpha$

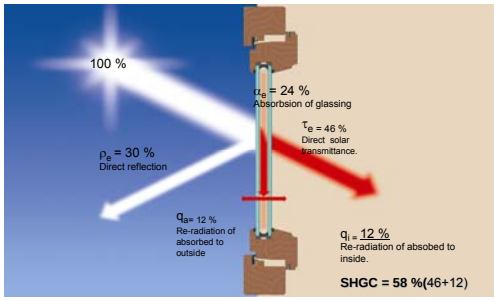






## Total energy conduction coefficient
glazing

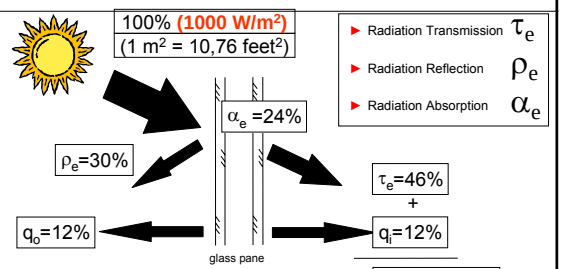
- Simplified display








## Total energy conduction coefficient
glazing



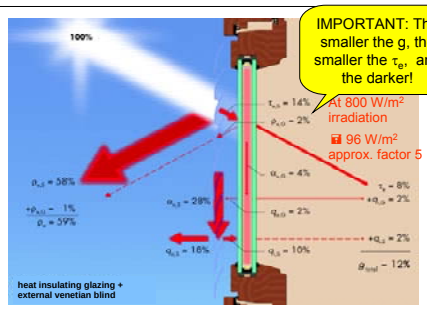

- Radiation Transmission $\tau_e$
- Radiation Reflection $\rho_e$
- Radiation Absorption $\alpha_e$

- $q_o$ secondary energy emission to "outside"
- $q_i$ secondary energy emission to "inside"





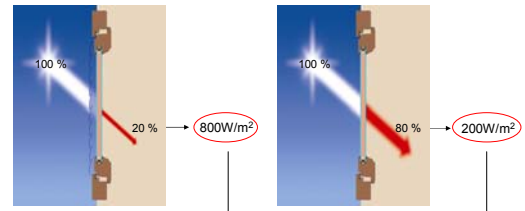
## g Value Glazing + Solar Protection



Shading systems and sustainable design

## General demands of shading systems

- Improve SHGC
- Energy saving (heating and cooling)



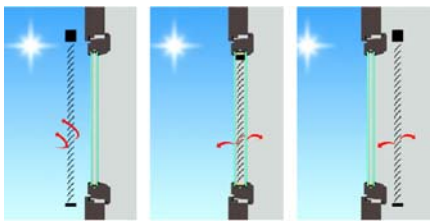

**Adjustable SHGC-value !**

reduction of 600W/m²
reduction of 75%



Physical Principles of Solar Protection

## Installation Type



$F_c$ = 0.09 g = 0.53 | $F_c$ = 0.21 g = 0.53 | $F_c$ = 0.60 g = 0.53

? outside is 7 to 10 x more effective than inside
? between the panes is 3 to 4 x better than inside

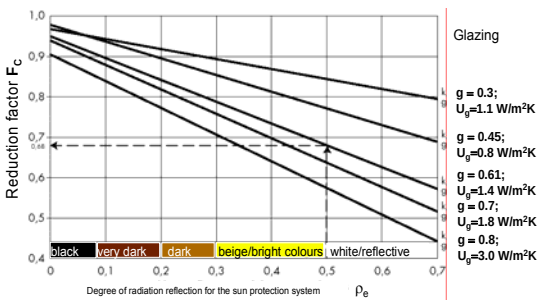
Compiled: Sep 2005



Physical Principles of Solar Protection

## Inside Sun Protection Systems

**How can an $F_c$ value be estimated easily?**




Compiled: Sep 2005

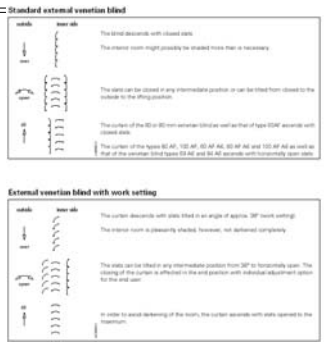


Shading systems and sustainable design

## CONTROLLING DAYLIGHT.

Work setting and daylight guidance.

Work setting. For external blinds.

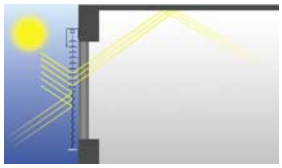


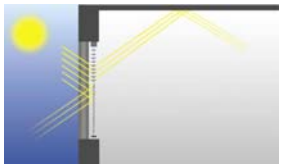





## Venetian blinds with light guidance
internal and external

► Reduce solar radiation, using daylight and provide glare protection.





with external venetian blind

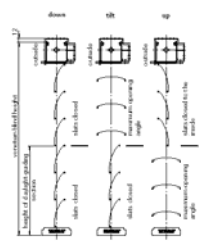
with internal venetian blind

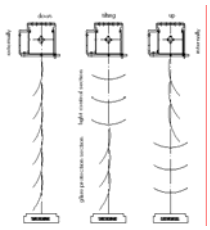




## Venetian blinds with light guidance
internal and external

| external<br>double curtain wall | internal | internal |
|---|---|---|



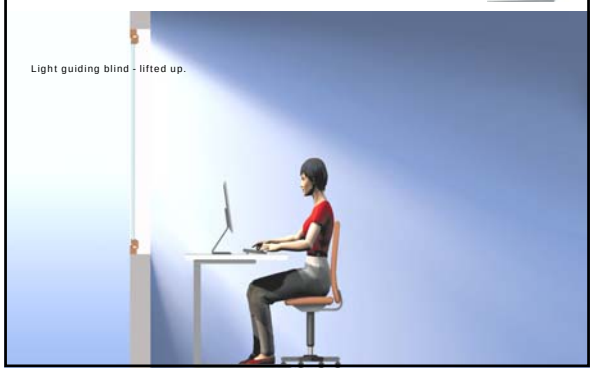





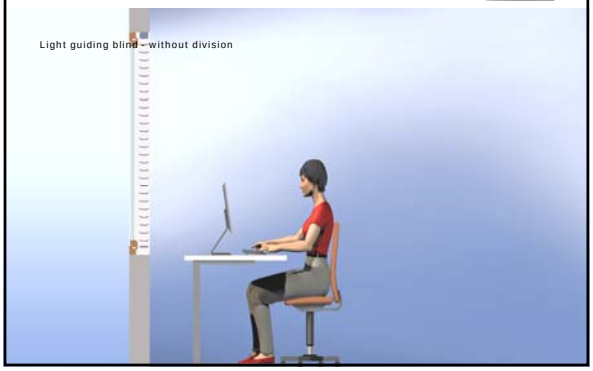



## DAYLIGHT GUIDANCE.

Light guiding blind - lifted up.

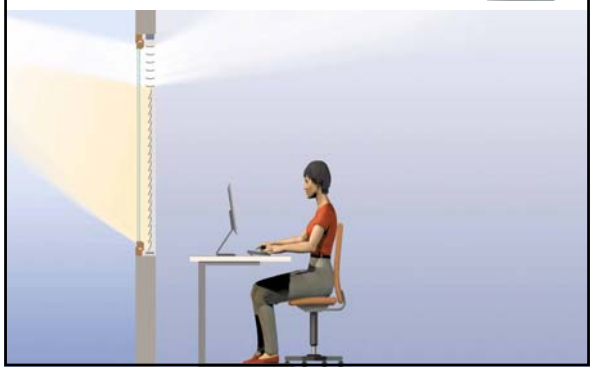


## DAYLIGHT GUIDANCE



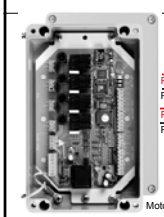



## Light guiding blind - work station optimised



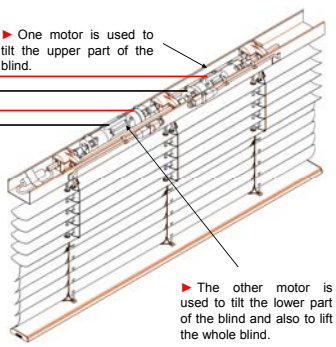


## Venetian blind with light guidance
internal




► One motor is used to tilt the upper part of the blind.

► A pulse generator is providing a feedback signal in order to adjust the angle of the slats very exactly.

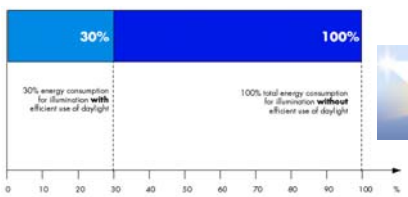


► The other motor is used to tilt the lower part of the blind and also to lift the whole blind.



## Cost reduction - illumination costs

► Cost reduction (illumination costs). Through efficient and intelligent use of daylight, illumination costs of buildings can be reduced. By combining light-control systems with measurement and control technology,energy savings of up to 70% are possible.



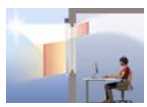
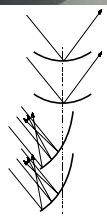



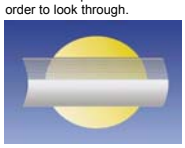
Figure: Energy consumption

## Slats and perforation

► The slats of the upper part are not perforated.



► The slats of the lower part are half-side perforated in order to look through.

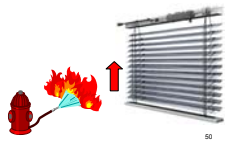






## Controls - Why do we need them ?

- Permanent increasing demands of comfort functions
- Safety (fire alarm) / protection against rain, ice, wind
- Energy consumption / reducing costs by using daylight
- Flexibility demands / changing of room division
- Complexity of building / conventional control systems are not suitable for large buildings (e.g. low efficiency, fire protection, installation costs)
- Save installation and maintenance costs

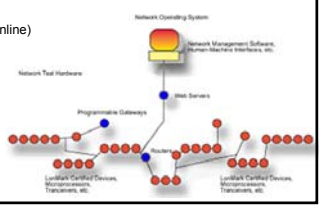






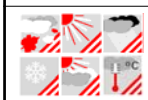
## Controls - Why do we need a network ?

- Information flow between all devices (e.g. weather data's)
- All information is available for the whole building
- Synergy of services / support of heating and cooling
- Visualisation of different values and information
- Enables diagnosis from a distance (online)






## Protection and comfort



Standard functions
(photo automatic,
wind-, rain-, ice monitoring)

→ Conventional control systems
no communication

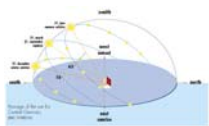
Calculation of azimuth and elevation

Slat tracking as a function
of azimuth and elevation

Calculation /Evaluation
the shadow and light-
zones of a building in conside-
ration of the buildings around

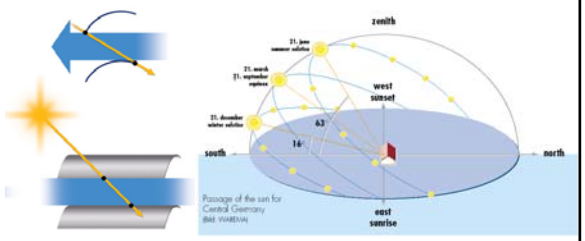
Visualisation and remote control
for maintenance

→ Network systems
communication between all
network members
(LONWorks =
local operating network)



## Slat tracking / slat guidance

► Slat tracking as a function of azimuth and elevation












## Annual shading program

► This additional module for optimising deflection of light uses the contours of the building, the position relative to neighbouring buildings as well as its own geographical orientation to calculate the development of shadows which are typical for the day and the time of year.

► Like all other previous functions, these are stored as a data bank in the LON actuator and provide additional support for the daylight system technology.





## Annual shading program