

פורום אנרגיה: חיסכון באנרגיה במערכות תאורה

6.12.2010

התקינה הבינלאומית בנושא החיסכון באנרגיה בתאורה בהשוואה לזו בישראל - מה ניתן לאמץ ממנה בישראל ?

ד"ר גדי קפלזון, הטכניון, הפקולטה לארכיטקטורה ובינוי ערים



מוסד שמואל נאמן
למחקר מתקדם במדע וטכנולוגיה



Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

arguedi@technion.ac.il



Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

arguedi@technion.ac.il



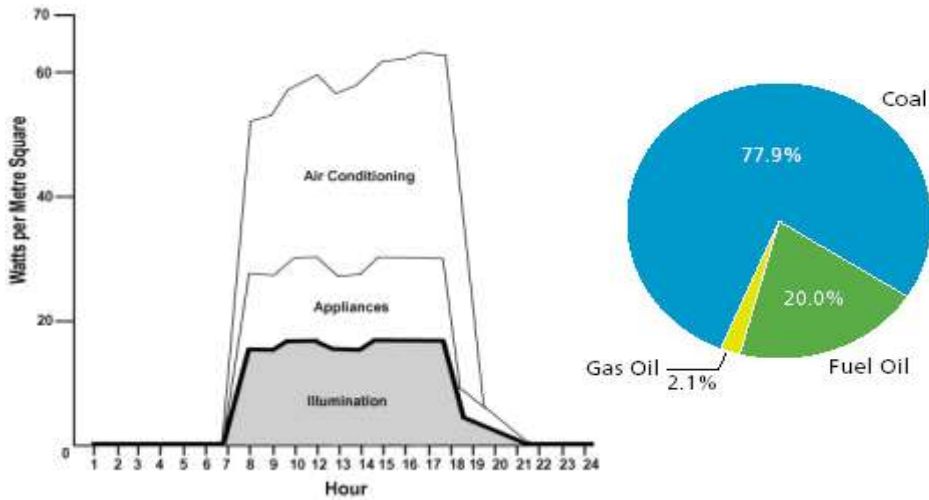
תאורה טבעית

איך תקן יכול לעודד תכנון נכון (בניין ומערכת תאורה)?



arguedi@technion.ac.il

Climate and Energy Lab, Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology



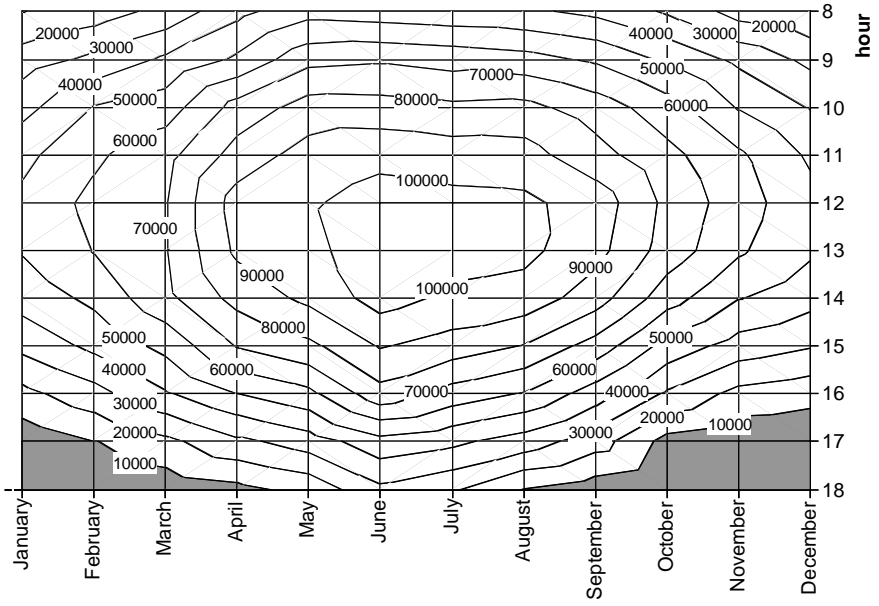
Electricity demands per hour in an office building by end-uses on a summer day (left) and annual electricity production in Israel by type of fuel (right).
Source: Israel Electric Company, 1994 and 2001



arguedi@technion.ac.il

Climate and Energy Lab, Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology





Global horizontal solar illuminance - lux

Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

arguedi@technion.ac.il



Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

arguedi@technion.ac.il

לעודד שימוש בתאורה טבעית

היבטים איכותיים

- ✓ נוחות ראייתית
- ✓ צבע אור
- ✓ היבטים פסיכולוגיים

היבטים כמותיים

האם יותר אור = יותר טוב ??

DF או מדדים אחרים



arguedi@technion.ac.il

Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology



בשימוש בתאורה טבעית יש להתייחס ולתת פתרון לבעיות של:

• סנוור

• רוחחי או הפסדי חום דרך פתחים



arguedi@technion.ac.il

Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology



5281

| | |
|---|--|
| 3 | 1.3 תאורה טבעית (עבור בניינים שאינם בנייני מגורים) שטח החלונות גדול מהנדרש בחוק התכנון וחבנייה: |
| 2 | - ב-20% מהנדרש, לכל הפחות |
| 3 | - ב-10% מהנדרש לכל הפחות |
| 3 | 1.4 אמצעים לשיפור התאורה המלאכותית (עבור בניינים שאינם בנייני מגורים), כמפורט בת"י 8995, סעיף 4.9 |

הצעה לרויזיה

סעיף 1.3 תאורה טבעית

(עבור בניינים שאינם בנייני מגורים)

אין צורך בניקוד נפרד בסעיף זה. הפתרונות המבוססים על ת"י 5282 חלק 2, בפרק אנרגיה מתייחסים בצורה כוללת (קירור, חימום ותאורה) לנושא זה.

View /1/ - מבט

DAYLIGHT AND VIEWS—DAYLIGHT

| | HC | SCHOOLS | CS |
|--------|----------------|----------------|----------------|
| Credit | IEQ Credit 8.1 | IEQ Credit 8.1 | IEQ Credit 8.1 |
| Points | 1 point | 1-3 points | 1 point |

Intent
To provide for the building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

IEQ CREDIT 8.1



Figure 1. Horizontal View at Eye Height

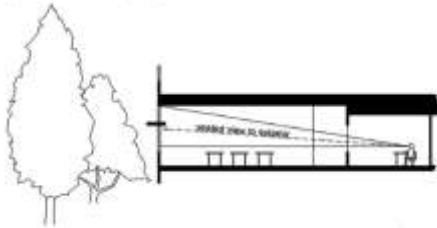
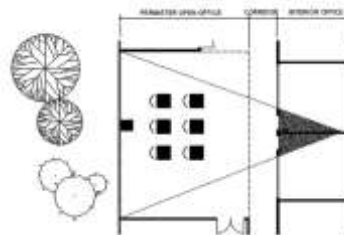


Figure 2. Down Line of Sight to Perimeter Glazing



| BREEAM - Offices - 2008 |
|-------------------------|
| Health & Wellbeing |
| Hea 2 – View out |

| Minimum BREEAM Standards | | | | | |
|--------------------------------|---|---|----|---|---|
| Rating Level | P | G | VG | E | O |
| Min. credits to achieve rating | - | - | - | - | - |

Credit aim

To allow occupants to refocus their eyes from close work and enjoy an external view, thus reducing the risk of eyestrain and breaking the monotony of the indoor environment.

Credit criteria

| Credits | |
|---------|---|
| 1 | Where evidence provided demonstrates that all <i>relevant building areas</i> have an <i>adequate view out</i> . |

breeam, BRE Environmental & Sustainability Standard, 2008



arguedi@technion.ac.il

Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology



צורה - Form /2/

עומק החלל קובע את פוטנציאל השימוש בתאורה טבעית



San Francisco Federal Building, Thom Mayne -- Morphosis Architecture



arguedi@technion.ac.il

Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology



בגרמניה תקנות תאורה טבעית מגבילות ל-7 מ' את המרחק המקסימלי של משתמשי הבניין מחלון

| | |
|-------------------------|--|
| BREEAM : Offices : 2008 | |
| Health & Wellbeing | |
| Hes 2 - View out | |

| | | | | | |
|--------------------------------|---|---|----|---|---|
| Minimum BREEAM Standards | | | | | |
| Rating Level | P | G | VG | E | O |
| Min. credits to achieve rating | - | - | - | - | - |

באנגליה - breem

Credit aim

To allow occupants to refocus their eyes from close work and enjoy an external view, thus reducing the risk of eyestrain and breaking the monotony of the indoor environment.

Credit criteria

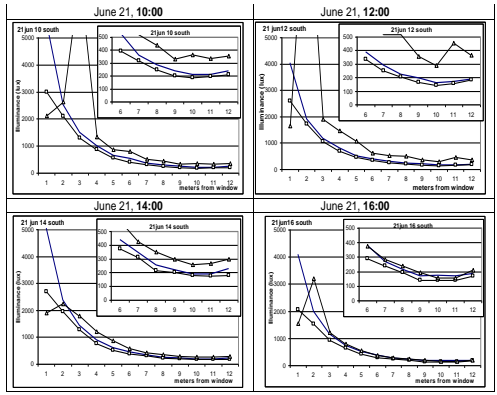
| Credits |
|--|
| † Where evidence provided demonstrates that all relevant building areas have an adequate view out. |

Compliance requirements

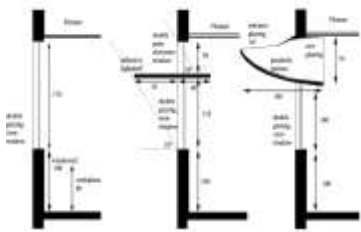
The following demonstrates compliance:

- The relevant building areas are within 7m distance of a wall with a window or permanent opening providing an adequate view out, where the window/opening is 20% of the total inside wall area (refer to compliance notes for a definition of relevant building areas and adequate view out).

בארץ:



(From Ochoa and Capeluto 2005)



עומק המשרד : עד 7 מ' מהחלון - לשימוש אפקטיבי של תאורת יום

Envelope - מעטפת /3/

- ✓ הצללה / חשיפה של החלון בהתאם לצורך
- ✓ שיפור פיזור האור הטבעי בחלל
- ✓ הפחתת קונטרסט וסנוור
- ✓ מבט

Daylight redirection elements. Lightshelves in SOKA-BAU Bldg. Source: Herzog, T. "SOKA-BAU", 2009



arguedi@technion.ac.il



Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

| | IEQ |
|---------|------------|
| AC | Credit 8.1 |
| SCHOOLS | Credit 9.1 |
| CS | Credit 6.1 |

Photo-responsive controls for electric lighting can be incorporated into daylighting strategies to maintain consistent light levels and to minimize occupant perception of the transition from natural light to artificial light. These controls help save energy by reducing electric lighting in high-daylight conditions while preserving foot-candle levels on the task surface. These types of automatic controls require commissioning, as well as measurement and verification attention.

Despite the known benefits of views in buildings, a clear downside is the increased likelihood that birds may fly into the windows. Perhaps as many as 1 billion birds die in this way each year. Larger areas of unfragmented or untreated glazing increase the risk. To reduce these collisions, consider treating the window glazing. Use exterior shading devices, introduce etched or frit patterns, and/or create appropriate visual markers, such as differentiated planes, materials, textures, colors, opacity, or other devices that help fragment glass reflections and reduce apparent overall transparency and reflectivity.

To control glare, use any of the following common strategies:

- Fixed exterior shading devices
- Exterior light shelves
- Interior light shelves
- Interior blinds and louvers
- Operable draperies and blinds
- Fritted glazing
- Electronic blackout glazing

כאמצעי להפחתת סנוור



arguedi@technion.ac.il



Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

| IEE | |
|---------|------------|
| NC | Credit 5.1 |
| SCHOOLS | Credit 5.1 |
| CS | Credit 5.1 |

1. Benefits and Issues to Consider

This credit addresses the availability of daylight to a building's occupants. When designing for maximum daylight, designers must evaluate and balance a number of environmental factors, such as heat gain and loss, glare control, visual quality, and variations in daylight availability.

Environmental Issues

Buildings emphasizing daylighting may need larger daylighting apertures. Daylighting reduces the need for electric lighting of building interiors, which, if integrated into the overall approach to lighting, can result in decreased energy use. A well-designed daylight building is estimated to reduce lighting energy use by 50% to 80%.¹⁷ This conserves natural resources and reduces air pollution impacts due to energy production and consumption.

Daylighting design involves a careful balance of heat gain and loss, glare control, visual quality, and variations in daylight availability. Shading devices, light shelves, courtyards, atriums, and window glazing are all strategies employed in daylighting design. Important considerations include the selected building's orientation, window size and spacing, glass selection, reflectance of interior finishes, and locations of interior walls.

Large expanses of unfragmented or untreated glazing can give the illusion of transparency or reflect sky and habitat, causing birds in flight to collide into the windows. See the Implementation sections for measures to reduce bird collisions.

Economic Issues

Specialized glazing can increase initial costs for a project and can lead to excessive heat gain if not designed properly. Glazing provides less insulating effects compared to standard walls, resulting in higher energy use and requiring additional maintenance. However, offices with sufficient natural daylight and a visual connection to outdoor environments have been proven to increase occupant productivity and comfort, leading to better employee retention. In most cases, employee compensation significantly outweighs the initial costs of incorporating daylighting measures into a building design.

כאמצעי הצללה



Climate and Energy Lab, Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

arguedi@technion.ac.il



4/ שילוב תאורה טבעית וחשמלית

- ✓ תכנון הבניין (מעטפת וצורה)
- ✓ בקרת תאורה



Climate and Energy Lab, Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

arguedi@technion.ac.il



סיכום

- ✓ לעודד תכנון אדריכלי נכון:
- ✓ לעודד פתרונות המתייחסים להשפעה הכוללת של מעטפת הבניין על תפקודו התרמי
- ✓ לעודד פתרונות שילוב תאורה טבעית וחשמלית
- ✓ לעודד פתרונות המתייחסים גם להיבטים איכותיים של תאורה – קשר עם החוץ, מניעת סנוור, צבע אור...



arrguedi@technion.ac.il

Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology



תודה - Thanks!

arrguedi@technion.ac.il

tx.technion.ac.il/~arrguedi/



arrguedi@technion.ac.il

Climate and Energy Lab. Faculty of Architecture and Town Planning - Technion - Israel Institute of Technology

