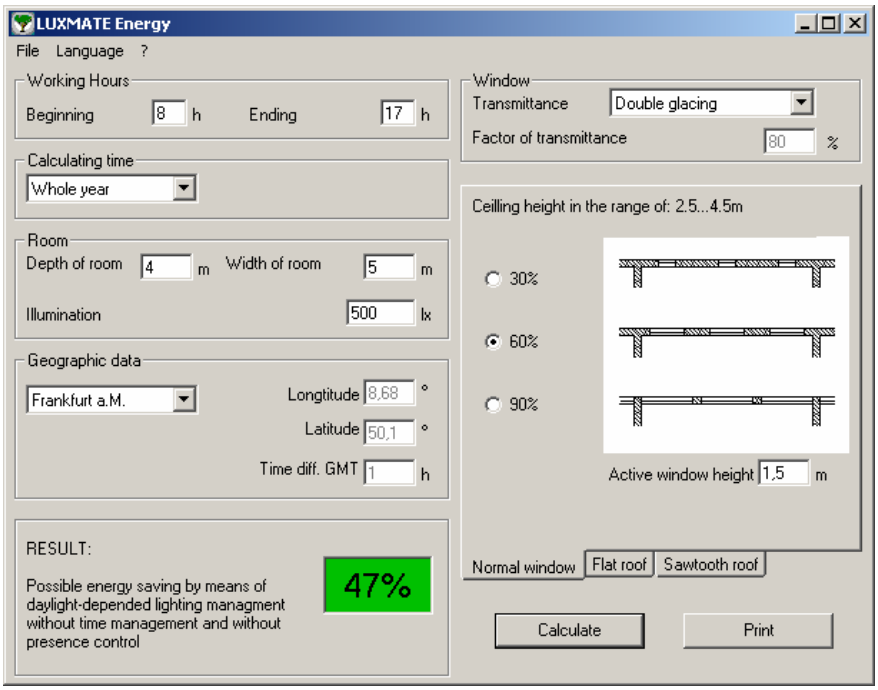
LUXMATE Energy



Content

General – Potential energy savings in rooms with incident daylight

Energy optimisation in a building is usually equated with optimising the heating and cooling systems. Nevertheless, even today, up to 30% of the total power consumption of an office building continues to be invested in the lighting, despite the fact that in our part of the world there is usually sufficient daylight available.

During the course of the year, maximum levels of over 20,000 lx are recorded on an overcast day and over 100,000 lx on a clear day. Utilising the available daylight not only reduces power consumption but also increases productivity and the users' sense of well-being.

As the day and the year progress, the path of the sun as well as the location of the windows and outside obstructions will have a considerable influence on the extent to which daylight can be utilised in the interior. Too much daylight may cause annoying glare and overheating, thus resulting in a negative effect on the space and the people who occupy it.

An intelligent daylight management system ensures that the level of daylighting is just sufficient to prevent any discomfort to the person in the workplace, and dims the artificial lighting down to minimum lighting and energy levels. People are then able to enjoy the optimum combination of daylight and artificial light.

Daylight is becoming an indispensable part of modern lighting. The artificial lighting system prevents a drop in the level of illumination and compensates for any major differences in the level of lighting that may be apparent at times within the space.

Only an appropriately dimensioned lighting system is up to the task. Every operational scenario for a building must be taken into account (winter, summer, working hours, nights, weekends) as well as exceptional situations such as occasional night work, etc.

The enclosed program calculates the anticipated energy saving potential of an intelligent artificial lighting and blinds management system for an interior exposed to natural daylight.

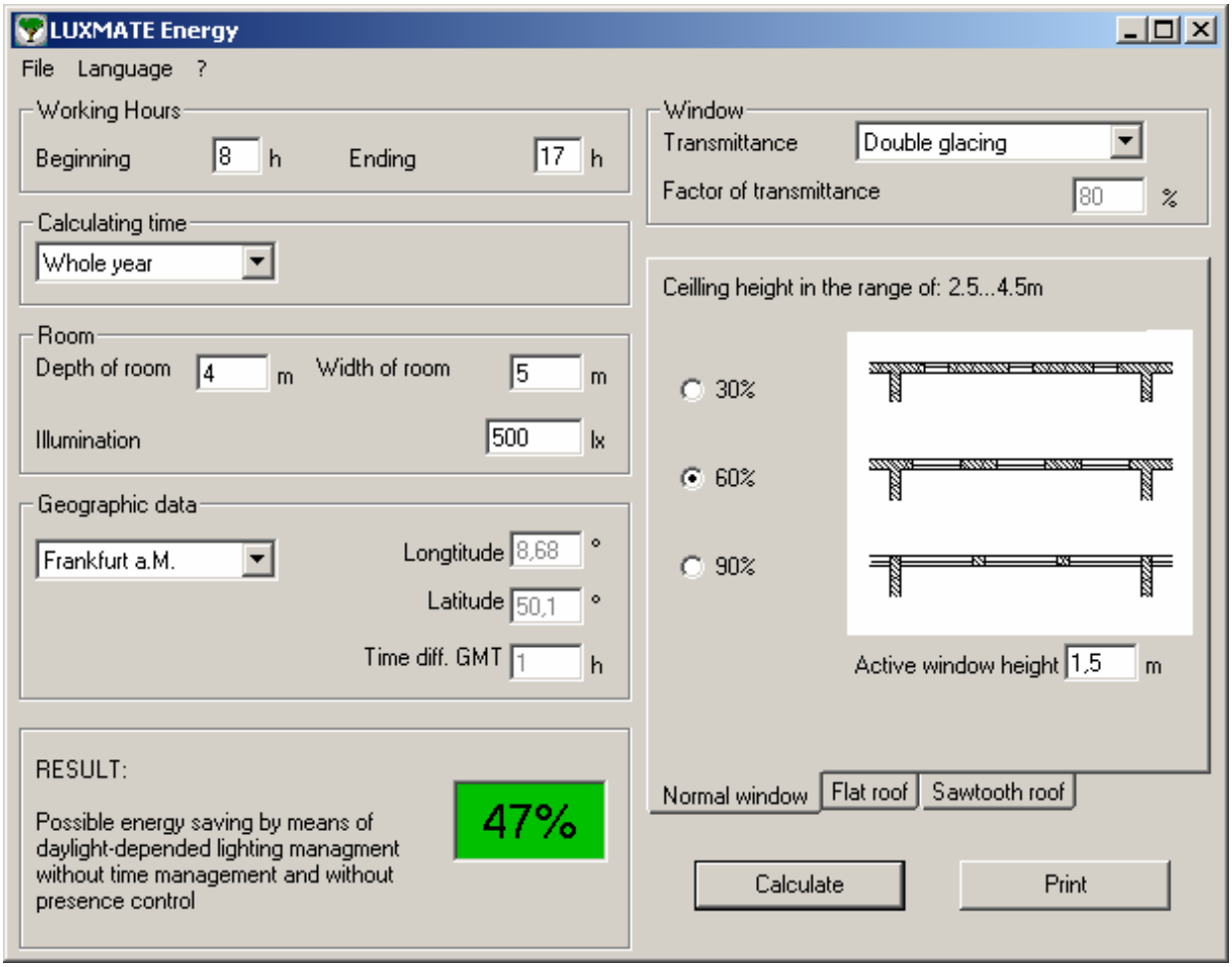
The energy saving potential is the possible annual saving in electricity. The basis for comparison is a lighting installation which is in constant operation during working hours.

The program does not take any outside obstructions into consideration.

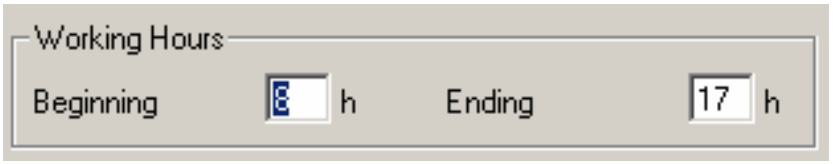
Providing optimum protection against sunlight and glare by architectural means or by using daylighting systems increases the energy saving potential still further.

The only way to be sure that this potential will be fully exploited is to design the lighting system on the basis of daylight utilisation.

Program description



Working hours



The working hours must be within one calendar day.

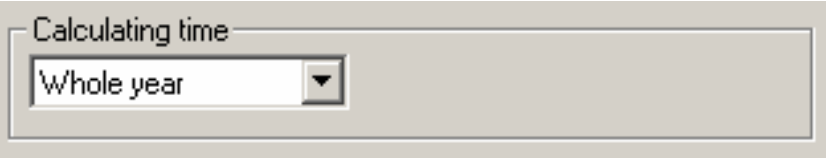
Beginning

The time at which work commences.
Only complete hours are entered and taken into account.

Ending

The time at which work finishes.
Only complete hours are entered and taken into account.

Calculating time

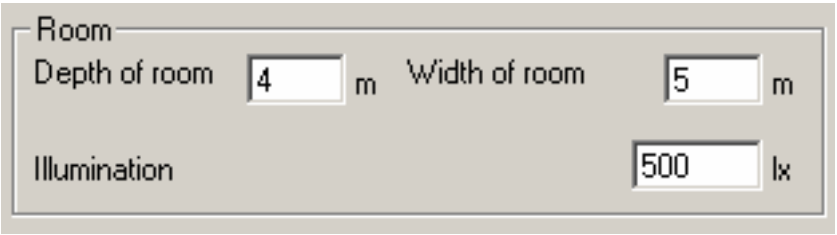


Use this field to select a whole year or an individual month as the time period for calculating the energy saving potential.

The default for the calculating time is one whole year.

By selecting a set month, the calculating time is restricted to this individual month.

Room



Depth of room

The depth of the room is considered for this calculation.

For rooms with windows at the side, this is the distance from the wall with the windows to the wall opposite.

For simple skylights, this is the length of the room.

For sawtooth roofs, this is the length of the room that has skylights. The depth of room (the length of the room) is always measured vertically to the sawtooth windows.

Width of room

The width of the room is always measured along the window frontage.

For rooms with windows on one side only, this is the total length of the wall with the side windows.

For simple skylights, this is the width of the room.

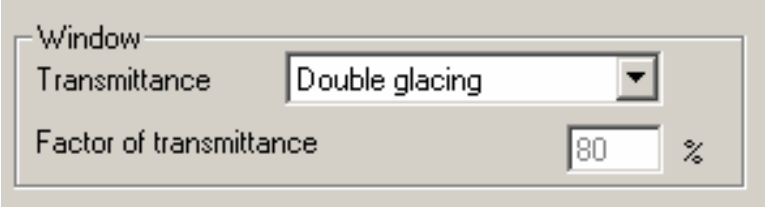
For sawtooth roofs, this is the length of the room.
The width of the room is always measured parallel to the sawtooth windows.

Nominal illuminance

This is the average illuminance required at the task level for the area of interest at a room height of 0.85 m.

This illuminance level can be achieved by utilising natural daylight or artificial light.

Window



Transmittance

User-defined
Allows the window transmittance factor to be entered individually as a percentage. 100% is full, uninterrupted transmittance of daylight into the interior.

Double-glazing (transparent)
A preset transmittance factor of 80% is assumed for calculation purposes.

Tinted glass (light)

A preset transmittance factor of 50% is assumed for calculation purposes.

Tinted glass (dark)

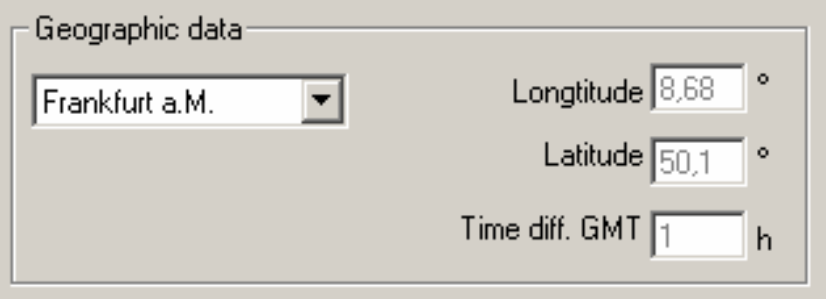
A preset transmittance factor of 30% is assumed for calculation purposes.

Factor of transmittance

Represents the transmittance factor for window transmittance as a percentage.

With user-defined input, the user can enter an individual transmittance factor here.

Geographic data



The geographic data required for the calculation is selected by choosing a location.

The longitude and latitude of the location are needed for the calculation.
The time difference to Greenwich Mean Time (GMT) is also used (for example, Vienna: +1).

The daylight calculations and the resultant illuminance level provided by daylight are based on the geographic location and the time difference to GMT.

It is possible to personalise the geographic location and time difference entries with the "user-defined" option.

The relevant values can then be entered in the "Latitude“, "Longitude“ and "Time diff. GMT“ fields.

North and east geographic position values are entered as positive values, south and west values as negative values.

Only values in degrees can be entered – geographic positions in degrees and minutes have to be converted to degrees (for example, Vienna: N 48° 15' and E 16° 22' become +16.37° and +48.25°).

There is no logical testing.

Note:

When the program is launched, the geographic data from the "default.geo" file is loaded (see also the GEO file description section).

If the "default.geo" file is not available, "user-defined" is the only possible option.

Individual GEO files containing your own geographic data are quick to create and can also be read in using the menu item "File > Read geogr. data... “ (see the Menu item: File section).

Longitude

The longitude of the location in degrees for calculation purposes (east positions = positive values).

Latitude

The latitude of the location in degrees for calculation purposes (north positions = positive values).

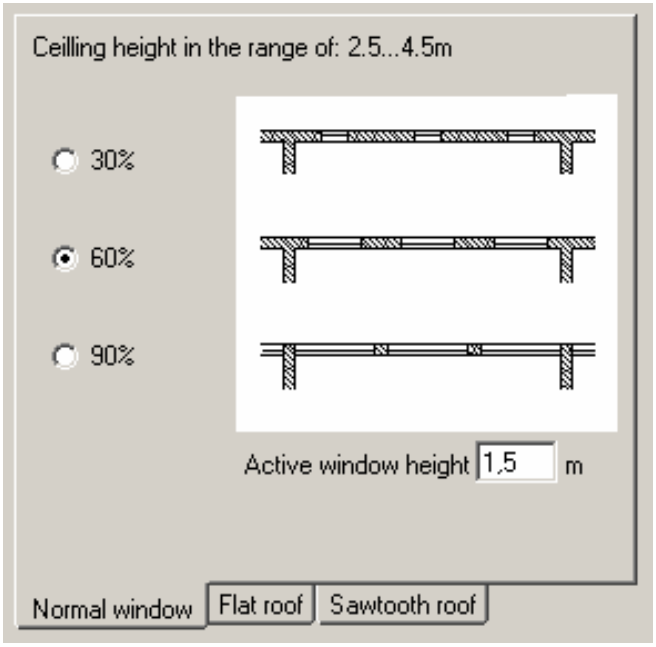
Time diff. GMT

The time difference of the default time zone of the location to be considered to Greenwich Mean Time.

Window type

The program supports three different types of window:

normal window (side window frontage)



With side window frontages, the program is designed for ceiling heights of between 2.50 m and 4.50 m. Lower or higher ceiling heights will cause systematic errors in the calculation.

window percentage

The total width of the window surface expressed as a percentage of the width of the entire wall of window frontage.

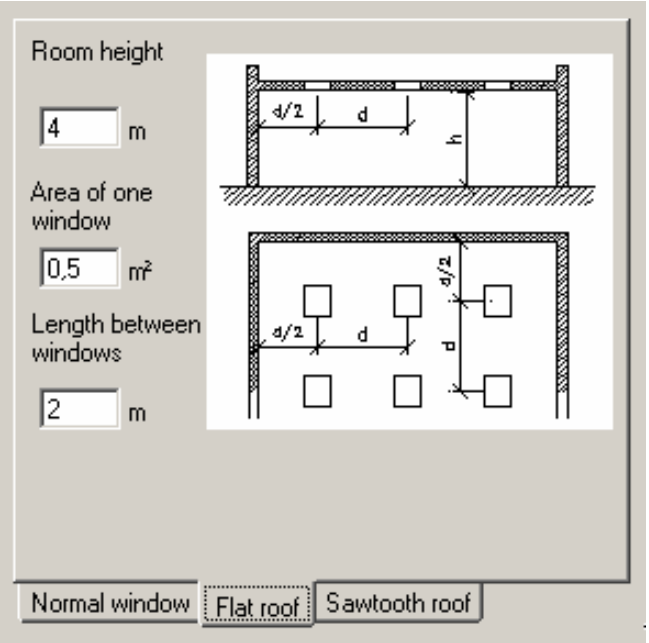
The choice for the window percentage is 30%, 60% or 90%.

Active window height

This is the window height above the task level (0.85 m).

The daylight from the window percentages below the task level can only effect the latter by being reflected several times, and is therefore less significant.

Flat roof (skylights)



The skylights are evenly distributed along the roof.

Room height

The height of the room

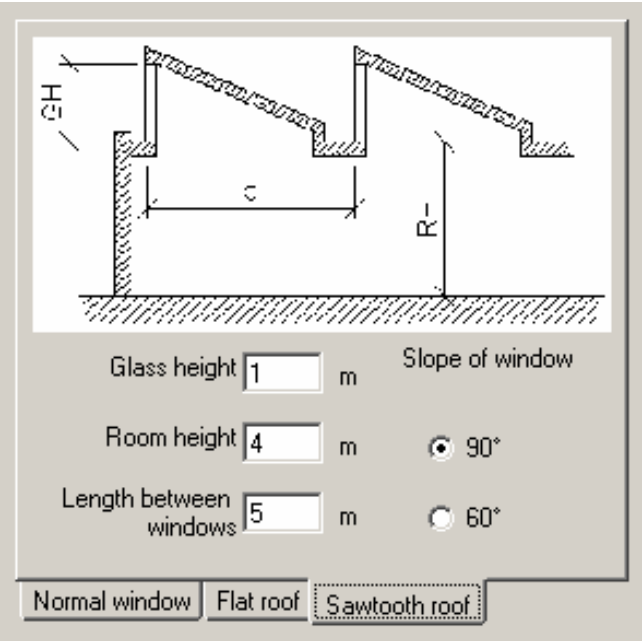
Area of one window

Area of a single window

Length between windows

The distance from window to window

Sawtooth roof



Glass height

Height of the window pane in the sawtooth roof

Room height

The height of the room

Length between windows

The distance from one window to the next

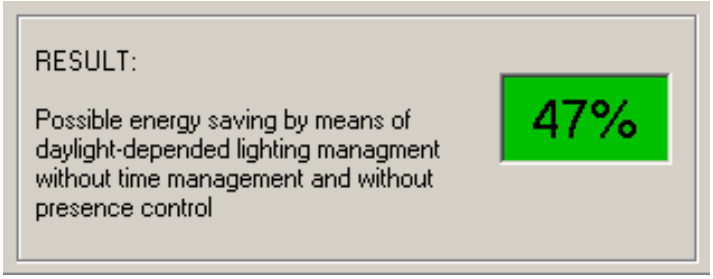
Slope of window / inclination of window

Inclination of the window frontage to the horizontal:

90° : vertical window frontage

60° : inclined window frontage

Result



The program calculates the energy saving potential of a lighting installation with daylight-based control as a percentage, in comparison with a lighting installation without control system, during the entered working hours.

Calculate

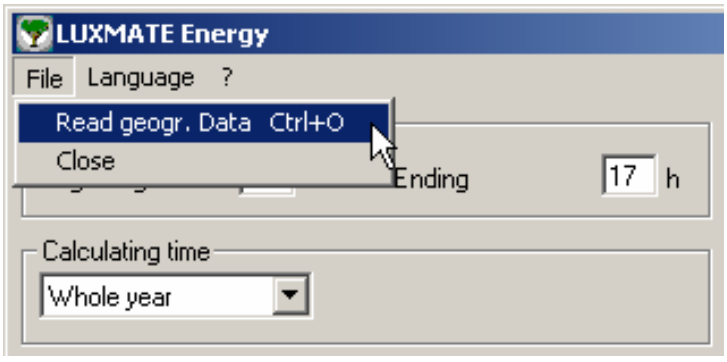
Starts the calculation

The input is not checked to see if it is logically correct.

Print

Opens the Print dialogue box and prints the calculation

File



Read geogr. data ...

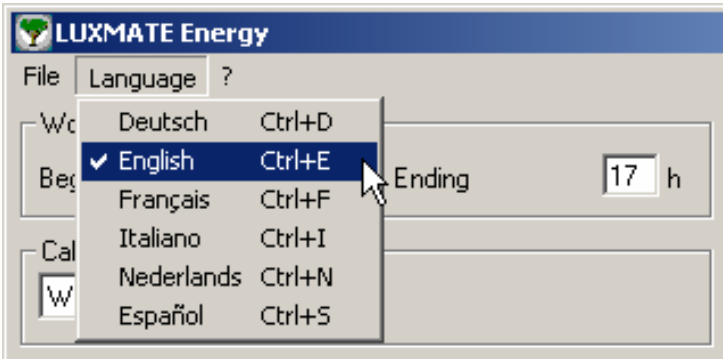
An individual GEO file can also be read in using the "File –> Read geogr. data“ menu item. GEO files for various countries are included with the program.

The files are also easy to create with an Editor.

Exit

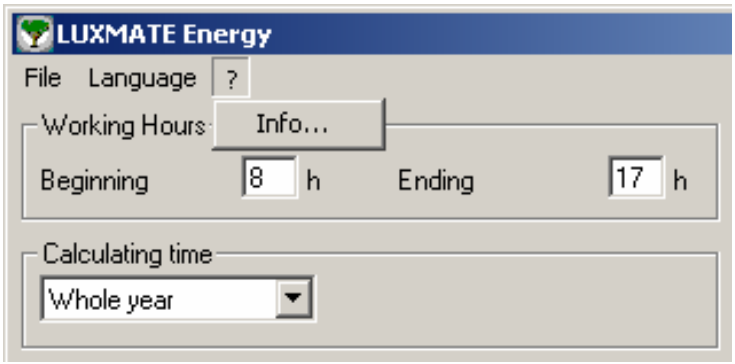
Exits the program

Language



Language option

Info ?



Program info option

GEO file description

The first 7 lines are a description of the GEO file format.

50 is the maximum number of possible entries.

The data separator is „;“.

The data syntax is a line with:
placename;longitude;latitude;time difference to GMT
placename;xx,xx;xx,xx;GMTDiff

The longitudes and latitudes are entered in degrees.

The time difference to Greenwich Mean Time (GMT) is given in complete hours.

An example from "default.geo"

```
**********************************************************
**     This file can be extended or edited.             **
**     The syntax must be followed absolutely.          **
** Placename;longitude[xx,xx];latitude[xx,xx];GMTDiff[xx]  **
**             maximum of 50 entries per file           **
**        This text must not be deleted                 **
**********************************************************
Amsterdam;4,9;52,35;1
Athens;23,73;38;2
Barcelona;2,17;41,42;1
Belfast;-5,83;54,67;0
Berlin;13,42;52,53;1
Bern;7,43;46,95;1
Bilbao;-2,93;43,25;1
Birmingham;-1,83;52,5;0
....
```

References

Thomas Roth, Energieeinsparungspotential durch Tageslichtnutzung in Innenräumen, FH München, 1996

CIE Technical Report Daylight, Pub N° CIE 16

Andras Majoros, Daylighting, PLEA 1998, ISBN 086499021X

DGR Hunt, MA; Availability of daylight, BRE Building Research Station 1979