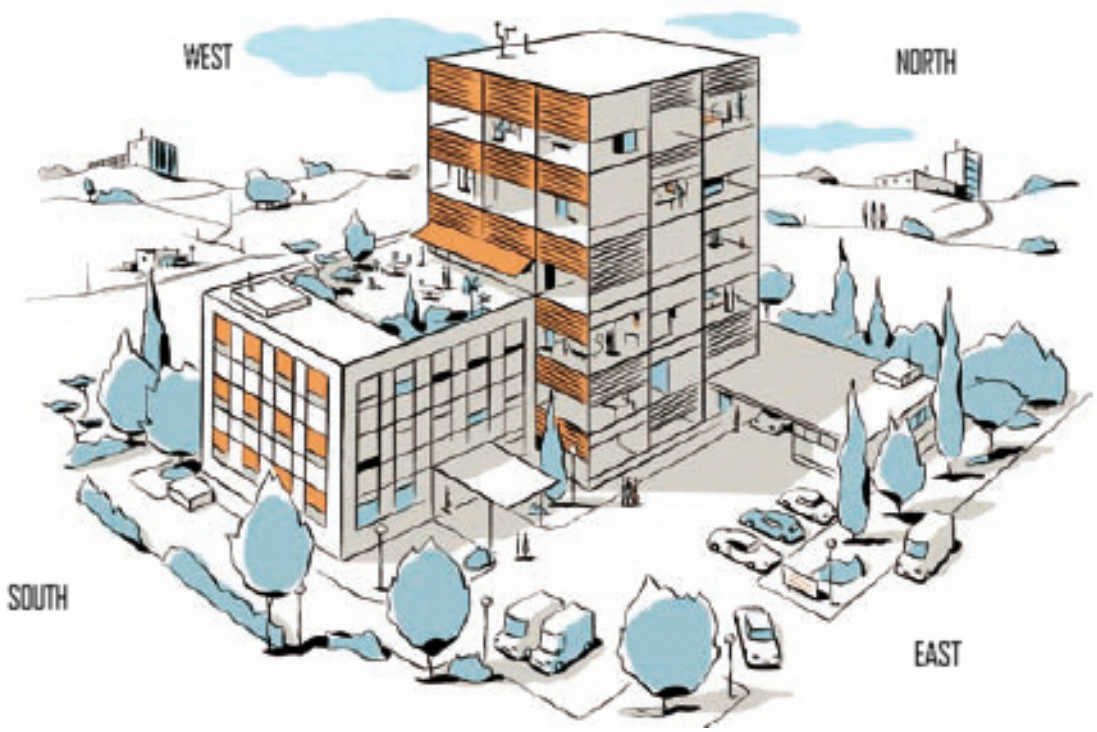
Planning, purchasing and installing Solar Shading in public buildings

As a follow-up on the BELOK project in Sweden 2006-2007

by Anders Hall, 2008



Introduction

This document, or manual, came about as a follow-up to an exciting and interesting demonstration and research project I was involved with in 2006 and 2007. The project was initiated by the BELOK group and STEM, the Swedish Energy Agency. It was run by Helena Bülow Hübe at the Faculty of Engineering, LTH, in Lund, and clearly demonstrated how energy efficient a correctly planned and installed solar shading system can be. For example, in certain situations the electricity consumption for artificial cooling can be reduced by up to 80%. (You can download the full report on the project from www.belok.se or www.solskyddsforbundet.se).
The project also tested the combination between energy-intelligent solar shading and dimmer-controlled roof lighting, aiming at maintaining 500 lux on work surfaces next to the window. Measurements were taken to see how electricity consumption was affected – and here, too, the results were very positive. One of interesting conclusions we were able to demonstrate was that two completely different, autonomous systems can cooperate and generate significant savings without requiring complex links between the logical systems.

In my opinion, however, if the entire project concludes with nothing but a scientific report, there is a risk that the new knowledge will not be used in reality. I have therefore set myself the task of providing guidelines, tips and advice to you – property owners, operators, tenants or consultants – as you plan and install solar shading in commercial premises. I will be concentrating on the solar shading and its functions. I will leave it to others, with more specialist knowledge, to describe solutions relating to lighting or any other functions or activities, but would welcome future cooperation, possibly including updates and additions in later editions. I have also not attempted to cover all possible circumstances and alternative solutions. Instead, I aim to draw attention to important factors, give good advice, etc that may help to produce an effective system of sufficient quality that delivers the required energy efficiency and indoor comfort.

I also hope that the content will hasten the more widespread use of LCC, life cycle cost, in the process, instead of short-term calculations based on payoff time.

I would like to thank Dick Dolmans and Heiner Praun at ES-SO for checking the factual content.

Also note that this text was originally written for Sweden, relating to local rules and market conventions. This might differ from other countries.

The manual was approved by the board of BELOK group and by the Swedish Solar Shading Association at its meeting in April 2008.

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Background

These days it is virtually impossible to avoid all the reports and political discussions about global climate change and its causes. Wherever the truth lies, it is certain that our runaway consumption of energy cannot carry on. We will need to take a new approach in future. We need to think seriously about the contribution we can make, and a good place to start is in all the offices, schools and hospitals in your own country. Small, reasonable steps can generate significant savings in energy - as well as profit.

People say that modern humans in developed countries spend more than 90% of their waking hours indoors – either at home or at work. This is a shocking statistic, demonstrating how important a good indoor climate is to us when it comes to feeling good and acting as individuals in society and at our place of work. Within the EU, people are increasingly starting to talk about the importance of **“sustainable summer comfort”**. This shows that a clear link is being made between environmental sustainability in energy issues and the indoor environment for human beings. In future, people will probably be able to prove the link between indoor climate, in the form of lighting, temperature and air quality, and how we feel subjectively, with why we tend to fall ill in terms of headaches, migraine etc. Work is already underway to document and find measurable, relevant methods for this connection.

The traditional view of Awnings, Venetian blinds, Roller blinds is that they are a sun shading, purely and simply. The name sun shading or solar protection suggests something we need to guard against, and it is certainly true that the sun can be harmful to us humans sometimes. Yet the sun also has many positive effects, some of them essential to life itself. For example, recent research has found a third receptor in the eye, which controls the hormones involved in wakefulness and sleep. The style of architecture that is popular at the moment – with large glass surfaces – is not just about appearance and aesthetics. The trend also shows that people are starting to realise that we feel and work better with plenty of daylight and eye contact with the outside world. However, this also means that well executed solar shading becomes more important if health is not to be bought at the expense of higher temperatures and higher energy consumption.

That is why I would like to introduce a new way of looking at solar shading by calling it the “FACADE ENERGY FILTER” instead, the energy in question coming in the form of heat and light. If we control solar shading intelligently over the year, we can generate significant energy savings for the property, while providing the people in the building with a comfortable and healthier working environment.

Existing or new building

According to forecasts, 90% of the buildings that will be standing in 50 years are already standing today. The conclusion from this is that the greatest need for solar shading exists in today's current stock of buildings. However, much of the good advice and checklists can equally be applied to a new building.

A very common mistake with new buildings is the failure to plan certain details early enough in the process. Too often, the problems are not noticed until the

tenants move in and start complaining. In these situations, solar shading becomes an “add on” solution that is rushed into with a minimal budget, a lack of planning and then fails to deliver many of the benefits that would otherwise have been possible. In the worst case, the whole project can fail completely and simply turn into an expense. Whatever the result, no-one is really satisfied with it. To prevent this happening, the various specialists need to work together at an early stage, and the preliminary work can be synchronised by the architect in consultation with the client.

- The solar protection specialist can detail the requirements that need to be met for installation, for example whether reinforced fixing points are necessary, where motors will be placed so they have an electricity supply, which sensors should be used and where they need to be positioned in order to work correctly.
- The glazing and facade specialist can plan for fixings and space for cabling.
- The electrical consultant can optimise all the cabling.
- The HVAC consultant can take account of the solar shading in his climate calculations, minimising the use of comfort cooling.

In an existing building, all the circumstances are fixed, so it is a matter of forming a clear picture of them before starting work. Many of the questions you should be asking can be discussed with a skilled installer.

Such questions include:

- Which facades are affected?
- Surroundings of the property. Do neighbouring houses or trees provide shade during the day?
- Is there a prevailing wind direction?
- What are the various functions on different floors and behind different windows? Cell office, group room, canteen, open-plan office, etc.?

The facade material and structure may also determine which solutions you can choose from. Certain types of solar protection require a secure fixing point above the window, and others need each side of the window to be load bearing.

Define the objectives

A good way to start is to write down your requirements and desired objectives. Clearly formulating all requirements will make things easier for suppliers and for your own quality control when installation is complete. Your list can be updated as the planning process progresses, but it is important to include certain details right from the start. Examples:

- The solar shading must help minimise the used of comfort cooling
- -”- must provide good daylight comfort and remove any glare problems
- -”- must be motorised and controlled in an energy-intelligent way, and must include the safety functions to prevent damage to the system and secure a long lifetime, like e.g. wind alarm.

Always try to describe your requirements in short, clear points. Do not over elaborate. This will prevent misunderstandings.

At this stage it may be a good idea to contact the city planning administration to check if a formal building permit is necessary. They can often give you a quick yes or no, and will probably be most interested in outdoor installations. As far as I know, between-panes and internal solutions have never required a building permit unless the property is listed in some way.

Detail the circumstances

Now that you have defined your objectives, it is time to create a detailed list of the relevant circumstances. It is useful to start by gathering all the necessary documents, for example

- Facade and plan drawings
- Plot drawing showing the surroundings of the property and its geographical location
- Electrical diagrams
- Description of any existing control system
- Documentation for any cooling and ventilation system

If an HVAC consultant will perform energy calculations, you should check with him/her which input data is needed. It is a good idea to detail the energy costs of the property, so you can compare them with the data after the work has been done.

If you want to perform additional detailed calculations of the solar shading in PARASOL, there is a checklist of the main details in appendix 5 – Input data for PARASOL.

You will need to work through the following points:

Building

- Orientation of the facades
- Number of floors per facade
- Number of windows per room
- Size of windows, W x H
- For external solar shading
    - Position of drainpipes on the facade
    - Possible fixing points, either above windows or on the sides
- Surrounding properties, nature or vegetation. Height and distance. (To determine any shading on the facades)

Rooms

- Office modules
- Open plan
- Are partitions used that can be moved around, requiring the relocation of indoor switches and the regrouping of solar protection
- Need for black-out during the day in a canteen or conference room
- Any problems with privacy during the day/night

Other areas

- Is there an existing control system, of type EIB/KNX or LON, in the building (and a wish to connect to it), or will a free-standing system be used

Designing and planning

The project planning phase is the time to specify everything governing the actual execution in practice.

- Start by deciding who will have responsibility for the project
- Define a timetable
- Define precisely what the project will consist of. Which parts of the property are affected
- Which requirements will be placed on the execution? This includes how the project will be carried out and the products and materials used, but also the quality that is expected

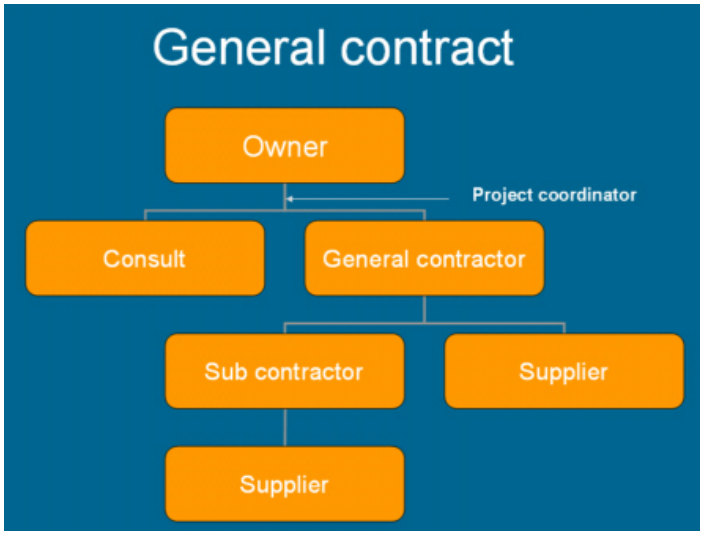
This is also the time to decide on the type of contract to be used for the project. This decision contains several important points, so we will look at them in more detail.

For small projects, it is often enough simply to get in touch with solar shading and electrical contractors and arrange a joint meeting to review the project and create a project plan.

In larger projects, the choice of the contract type determines the client's role and may also affect the quality control that can be applied to execution. We usually talk of three types of contract.

- General contract
- Split contract
- Turnkey contract

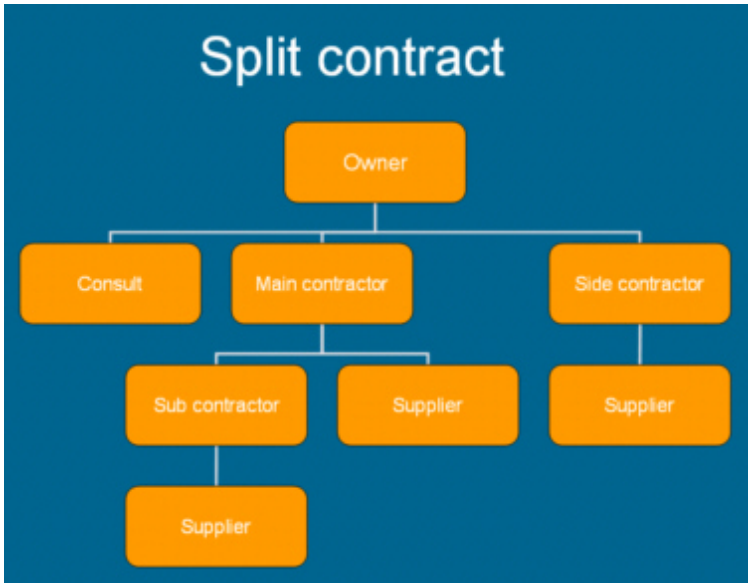
Let's look more closely at the main differences.

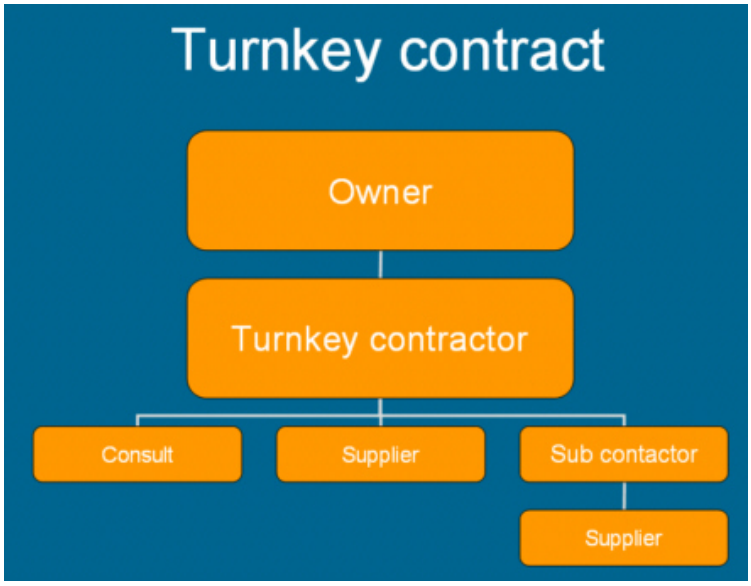


In this case, the client is in touch with the consultants who define the project, perform calculations, etc.

The client is involved in all decisions throughout, and stays informed about the choice of material and any design changes.

Here, too, the client stays in close contact with consultants, etc. The main contractor could be in charge of erecting the actual building, with the subsidiary contractor installing the solar shading along with the electrical contractor.





In this type of contract, the client leaves everything to the turnkey contractor in return for a budget or a total price.

This is less demanding on the client, but the contact with the consultants is severely restricted, reducing the ability to monitor materials and quality in detail.

Having worked with contracts since 1995 and having come across all sorts of arrangements, I feel that I am in a position to give my personal opinion – which could be interpreted either as good advice or as somewhat provocative by some readers. However, now is not the time to mince our words.

In Sweden it has long been standard practice when specifying the choice of material, etc. to allow for”equivalent solutions”. This means that the architect only gives examples of the make to be used, followed by the words”or equivalent”. It is then up to one of the building contractor's buyers to decide whether to use an equivalent alternative. Because the budget is usually under pressure, what this means in practice is a cheaper alternative. The usual criteria is that the choice must last longer than the building guarantee period (the standard period is still

two years but five years is starting to become more widespread). What happens after the guarantee inspection then becomes the client's responsibility.

So who exactly decides what is equivalent? In my opinion, the client frequently does not stand a chance in these contracts, or simply lacks the knowledge or interest to decide what is equivalent. After all, that's why the experts were called in.

The consequence of this approach is that a large proportion of the country's office buildings are fitted with substandard solar shading. The problem could be with the design and construction quality, the choice of motor types or the strategy employed by the control system. Many of these installations do not really belong on public buildings – they were designed for private houses, etc.

So my advice to you as client is to find out about the products and follow up the quality that is delivered. Make comparisons and ask questions, and request documentation if any changes are made to the material or supplier. This will make a successful outcome much more likely. In the appendix 1.2 Specification example you can also read a few lines that will make a world of difference for you and clearly state where the responsibility lies.

The consultants below should be involved in project planning together with the project manager:

Architect
HVAC consultant
Electrical consultant
Solar Shading provider

In the case of large glass constructions, the facade manufacturer should also be involved.

Contract boundaries

This section is intended to help everyone involved avoid expensive problems and tedious construction meetings. All too often, the responsibilities within the project are not adequately defined, and someone eventually will have to pay for this. The best way to tackle the problem is to use a list specifically designed for projects involving solar shading. This has a direct effect on whether a good result is achieved within the specified timetable and budget.

The full list appears in appendix 2 - Responsibilities but some of the concepts are explained in more detail here.

CL	Client/representative
TEN	Tennant
BC	Building contractor
EC	Electrical contractor
SSC	Solar shading contractor
CM	Control and monitoring contractor

These contractors can perform different functions in the project, which can be specified as follows:

Delivery	Supplying the products used in the project
	Supplying documentation for the products
Installation	Physically installing the products as instructed

Connection	Connecting the products to the electricity system for example
Operation	Taking responsibility for putting the products into operation
	Carrying out initial adjustment and testing of operation
	Correcting any operating faults

The following questions tend to keep cropping up without getting a clear answer:

- Who specifies the type of sensors that should/will be used?
- Who specifies the location of all sensors?
- Who is responsible for cable installation and penetration through the facade?
- Who is responsible for specifying facade penetration points and for ensuring that drilling can really take place there?
- Who guarantees that these penetrations are correctly sealed?
- Where exactly is the contract boundary between EC and SSC with regard to connecting motors to the property's electricity system?

A well-designed matrix of contract responsibilities can answer these questions and many more, much to the relief of everyone involved! Take my word for it. Arrange an introductory meeting before the start of the project and work through the list with the affected parties. Add or remove items if necessary.

Choice of control system

The next step is to choose the right type of control system for the system. Because there is such a wide range available on the market, I have decided to create a list of questions for you to think about before starting the project planning process. Many of the questions are themselves indications of the options available to you. See the list of questions in appendix 4 – List of functions.

Over the years, I have met many customers and even consultants who are not aware of the possibilities, believing that all they can choose from is ”Sun, Wind and Up or Down”. But these are by no means the only parameters. There are other important factors, including all the energy savings the installation will be able to deliver in the future, while creating a pleasant indoor environment for people inside the building and guaranteeing reliability and a long service life.

Appointing a contractor

General description

Before you can start inviting tenders, you will need to create an enquiry document. You can do this in the form of a specification, and a suggested layout appears in appendix 1.1 – Specification. Appendix 1.2 – Specification, example, contains concrete examples of the kind of texts you could use.

Call for tender

Now you are ready to go to the market and invite quotations for the project. So who do you approach? If you have opted for a general contract or split contract, I suggest asking the main contractor for some local companies that they can recommend. The main contractor may have past experience that could be useful

to you. Even in turnkey projects, I think you should still keep yourself informed of the companies that are being contacted.

Be aware that certain rules for purchase apply in EU countries above a certain amount.

If the project is small enough to be handled directly by an SSC, I would recommend obtaining references and I would also insist on an LCC calculation presenting the contractors' proposals, as well as a quality plan and a self-inspection report.

LCC calculation

LCC is short for Life Cycle Cost, a calculation designed to provide a clearer picture of the total cost of the system throughout its estimated service life. It happens again and again – the cheap option turns out to be the most expensive in the end. A”budget solution” probably needs more maintenance and has a shorter service life compared with a higher-quality product. The LCC calculation takes account of all operating and maintenance costs, providing a more realistic picture of the investment. It is also much easier to make comparisons with other possible solutions in the property and decide which is the most beneficial in your particular case.

The LCC calculation – in appendix 6 – gives you an idea of the layout and content, but you will not be able to use the form manually because the underlying formulas are not active. Visit **www.es-so.com** to download a working Excel file. It is free to download and all the formulas are open for editing. This means you can see what the underlying calculations look like and make any necessary changes. Note that some details must be entered by you, as the purchaser or client. Such details include the cost per kWh, the cost of the electrical contract and the interest rate to be used. The other details are entered by the SSC.

Quality control

How do you guarantee quality throughout the project? Here are a few tips to remember while working on the project:

- The project coordinator and the SSC must create a quality plan for self-inspection according to ISO 9001 or equivalent, which must be accepted by you as purchaser.
- During project planning, the architect and the SSC must be able to detail the technical solutions that motivate the choice of product, and they must ensure that everything is properly documented.
- If the project is large or complicated, a test installation may be necessary. This will only be possible if there is sufficient time.
- During installation, random checks can be carried out in the presence of the supplier's quality representative.
- In larger projects, installation is often phased. In this case, partial inspections and testing can be carried out when each phase is completed.

- When installation is finished, a coordinated test is carried out involving all the various contractors linked to the system. For example, SSC, EC, CM.
- Take care – the solar shading must not be operated by the EC for testing without the approval of the SSC!
- So-called self-inspection must be carried out by each contractor in accordance with the agreed quality plan.
- All subcontractors are normally governed by local guidelines. Check what is applicable for your country and specify it in the Specification. See also appendix 1.1 Specification.

Technical documentation

In the project planning stage, it is also important to describe marking, labelling and testing requirements. Check what is applicable for your country and specify it in the Specification. See also appendix 1.1 Specification.

Here follows a list of suggested headlines:

- Marking of installations
- Marking of electricity and telephone installations
- Marking of control and monitoring installations
- Labelling of control and monitoring installations
- Testing of control and monitoring systems
- Initial adjustment of control and monitoring systems
- TECHNICAL DOCUMENTATION FOR BUILDINGS
- CONSTRUCTION DOCUMENTS FOR INSTALLATIONS
- Construction documents for control and monitoring installations
- Production of as-built documents for buildings
- As-built documents for control and monitoring installations
- Operating instructions for buildings
- Operating instructions for control and monitoring installations
- Self-inspection
- Coordinated function test
- Maintenance instructions for control and monitoring installations
- ENVIRONMENTAL DOCUMENTATION
- INFORMATION for operating and maintenance personnel

Commissioning and training/information

Commissioning

Commissioning is usually carried out by the SSC or the supplier of the control system if the system was built for solar shading only. However, if it is a BUS system of the type EIB/KNX, LONWorks or similar, the commissioning work is done by a system integrator. In this case, you must ensure that the system integrator is in contact with the SSC and the supplier of motors for the solar shading. Without the necessary expertise, the motors may be damaged and need to be replaced. Such damage is usually not covered by warranty, so it can become very costly.

Training/information

If operating personnel are employed in the building, the commissioning period is the time to give them basic training on the day-to-day handling of the system.

The training is normally provided on site.

You should also plan the information to be provided to the staff/tenants who will be working in the building. If this is not done, experience shows that there is a real risk of complaints. People do not always understand why the system behaves in a particular way, and this can cause irritation. But if people know why the system does certain things and that the reason is to save energy and improve the indoor climate, their criticisms can usually be overcome. You can inform people in a meeting or by putting the information on an intranet, or simply by e-mailing everyone affected.

Both these items should be included in the original call for tender.

As-built documentation/final documentation

You should always insist that the contractors involved leave comprehensive documentation for the components and functions installed in the property. Such documentation includes CE marking, manuals, operating instructions, drawings.

Service agreement and guarantees

When the system is in operation, it will hopefully deliver energy savings and a pleasant indoor climate for many years to come. As the purchaser, you receive usually a two-year warranty period although five-year period is becoming more widespread. But however the guarantees you have – everything needs maintenance. That is why, at this early stage when all contacts and information are fresh, you should already be talking about setting up a service agreement. The service agreement could provide an annual inspection with a list of work that needs doing.

Conclusion

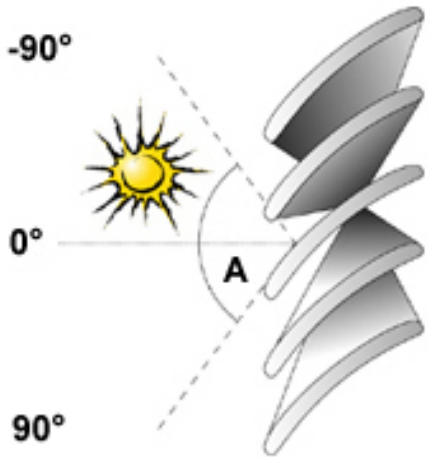
New EU rules are currently being implemented, requiring all commercial properties to produce an energy certificate and to develop and carry out improvement work. I am convinced that an investment in solar shading compares well to the many other possible interventions. Especially when it comes to existing buildings.

I hope that this simplified manual will help you plan and execute a solar shading project and ensure that the results are to expectation. It is the combination of quality and functionality that will keep your premises energy efficient, and filled with satisfied tenants or employees, for years to come.

Good luck!

Useful web sites:

www.belok.se
www.es-so.com
www.rehva.eu
www.ebd.lth.se
www.parasol.se
www.ceeeta.pt/keepcool (www.keep-cool.eu from April 2009)



Appendix 1.1 - Specification

Background

Briefly describe the project and the final objective.

Introduction

Give specific facts about the building and its surroundings.

Scope

Which parts of the property are affected? What work will be carried out?

Documents/descriptions

Which documents are relevant to this project?

Execution

Specify timetables and the different phases/stages.
Specify quotation period, etc.

Facade

Describe the facade and concepts for function and orientation

Solar shading in general

Has the function or type of solar shading been suggested in the program or the planning documents? For example an external, between-panes or internal solution?

Type of solar shading

Specific description of the actual solar shading. Type, model names, colour of profiles, colour of fabric or slats, etc. These details are drawn up by the architect during the introductory planning meeting, when the solar shading contractor is invited to participate.

Quality requirements of the design in terms of strength of pipes, profiles and motors. Always specify that that all components should be documented to have the strength and durability required for the actual installation.

Automation

Describe functions, for example wind, sun, rain, frost, log, energy saving, that must be provided or specify a product name of a control system that you know meets your needs and wishes.

Also specify whether local switches will be used in the premises, by group or by room, etc. Specify whether they must be connected by cable or via wireless remote control.

Installation of components in the control system

Describe where they will be placed in general terms. For example ”close to windows in room” or ”on cable ladders in corridors”. Where will the actual

automation system be located? In its own room, in the equipment room, with the caretaker? If the system requires a computer, where will it be located?

Motors

Specify quality requirements such as ”silent”, ”documented suitable motor strength with extra capacity where relevant”. Motors should have a documented overcapacity of +10 to 15% to secure long term function.

Types? 230V AC or 24V DC?

Matrix of Responsibilities, see appendix

See the separate appendix on responsibilities. The content to be altered according to which different contractors are involved, and should be discussed at an early stage by the parties so everyone agrees.

Electricity

Are there any specific issues that need to be mentioned relating to the power supply to the solar shading and cabling?

Other

Other.

Inspection and quality

Specify that the contractor must provide a quality plan for the company.
Each installation must be inspected in a so-called ”self-inspection” and a copy submitted to the client's representative.

Documentation

Refer to the required documentations.

Complete documentation on the solar shading must be submitted to the client's representative in the form of a technical declaration of the products, their place of origin/manufacture, manuals and CE documents. This is important for future traceability.

Rules governing the contract

Specify which rules will be applied.

List of documents

Specify the other documents that are relevant to the enquiry. Usually drawings and other appendixes, for example the list of responsibilities.

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Appendix 1.2 – Specification, example

Background

The project concerns Sunlight Ltd., 52 Energy St., Brighton. The property already has window awnings in places, and additional shading is needed now.

Introduction

The property is situated in the town centre next to a park to the west. The surrounding buildings are the same height and there are trees in the park which partly shade the facade to the west.

Scope

The project concerns the installation of window awnings on the west facade as indicated on drawing X.

Documents/descriptions

Tender and Execution

The quotation period will end at 12.00 on Friday X June. Quotations submitted after this deadline will not be considered.
The decision as to which contractor is selected will be communicated in writing by Thursday X June at the latest.
The contract can start immediately afterwards, and the work must be completed by X August.

Facade

The facade is made of bricks and allows the Installation of window awnings with associated arms. The solar shading must be motorised and be connected to an automated control system.

Solar shading

The window awnings are described in detail in appendix AA:1 from Great Design architects. Before production all measures must be checked on site by the SSC.

Type of solar shading

Window awning of type SunShade in cassette without front cover. All profiles in RAL colour ”ABCD”. Awning fabric of type SunBlock, colour ”123”.

Each window has its own awning. All awnings must be motorised but may be linked with a shaft if the distance between outside frames is less than 50 cm and if the windows are for the same room.

The awning arms must be must made of at least XY mm profiles and the built-in springs must have a documented adjusted strength consistent with the size of the awning.

Automation

The motorised awnings must be connected to a central automation system of type SunSmart and must have integrated sensors allowing adjustments to be made for the following functions:

Sun, wind, rain, fire alarm and 24-hour clock for locking in the up position on Level 1 to prevent damage outside office hours.

Location of sensors on the roof or facades will be advised by the SSC to the EC to secure optimised functionality of the system.

The facade must be divided into five groups or zones. It must be possible to operate each group from the automation system. Each room must be equipped with a local control switch for all awnings in that room.

The system must be fitted with the number of relays necessary in order to connect the motors to the automation system correctly.

Necessary information must be given to the electrical consultant or the installer to enable a proper installation of all cables according to requirements.

Installation of components in the control system

The automation system must be installed in an equipment cabinet in the equipment room on Level 1.

Motors

The motors must be silent motors of type SunMove 230V AC and must have documented spare capacity of 15% for maximum reliability.

Matrix of Responsibilities, see appendix

Electricity

Other

The client will erect scaffolding for use during the period of the contract. The scaffolding will be erected away from the facade or in a position that allows testing of the solar protection during installation.

Inspection and quality

At the kick-off meeting, the contractors submitting a quotation must be able to provide a quality plan for their company and a proposal for self-inspection for approval by the client's representative.

Documentation

Complete documentation on the solar shading must be submitted to the client's representative in the form of a technical declaration of the products, their place of origin/manufacture, manuals and CE documents for future traceability.

Rules governing the contract

Solar shading contractors are governed by xxxxxx.

List of documents

Drawings X and Y

Appendix: List of responsibilities

APPENDIX 2 – Matrix of responsibilities

This appendix should be carefully studied before the project, and adapted depending on which contractors are involved etc. This proposal involves CL = client, TE = tenant, BC = building contractor, EC = electrical contractor, SSC = solar shading contractor, CM = control and monitoring contractor.

Item	Delivery	Installation	Connection	Operation	Comments
Control boxes	SSC or EC	EC	EC	SSC	
Power supply to control boxes	EC	EC	EC	EC	
Outdoor sensors	SSC or EC	EC	EC	SSC	SSC should advise on locations for sensors.
Holes through external walls	EC	EC	EC	EC	
Relay boxes for solar protection	SSC or EC	EC	EC	SSC	SSC should advise on grouping
Power supply to relay boxes	EC	EC	EC	EC	
Ducting	EC	EC	EC	EC	
Indoor control units for solar protection	SSC or EC	EC	EC	SSC	SSC should advise on grouping
Solar protection	SSC	SSC	EC	SSC	Hirschmann contacts usually. Boundary between SSC or EC in the relevant half of the contact.
Motors for solar protection	SSC	SSC	EC	SSC	Sufficient motor type to be documented.
Central equipment, software	SSC or EC	SSC or EC	SSC or EC	SSC or EC	
Isolating switches next to solar protection outside	SSC	EC	EC	EC	
Control lines	EC	EC	EC	EC	
Error signal, sum alarm	CM	CM	EC	SSC	
Connection of GSM modem	SSC or EC	EC	EC	SSC	Applies for remote access.
Connection to phone network	EC	EC	EC	EC	Applies for remote access.
Connection to fire alarm	CM	CM	CM	CM	
Information to TE	SSC	-	-	SSC	IMPORTANT
Information to CL	SSC	-	-	SSC	Operating personnel

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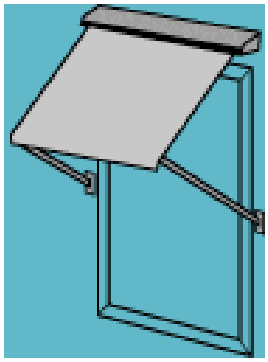
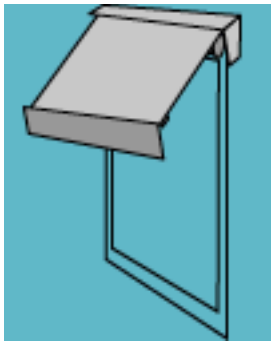
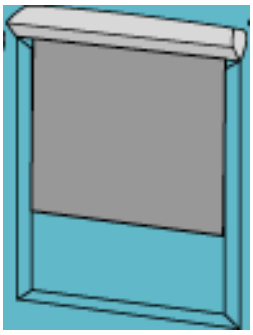
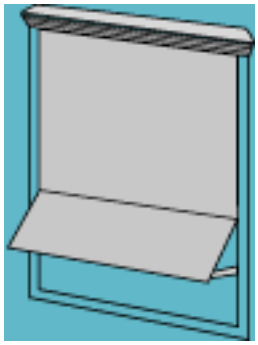
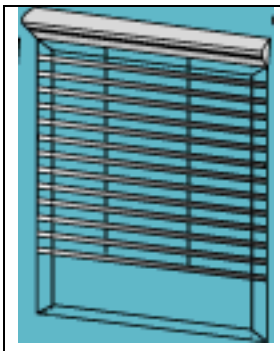
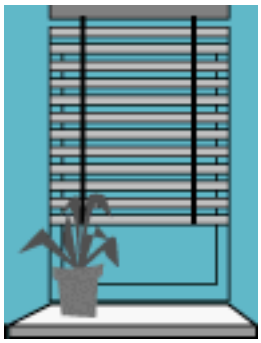
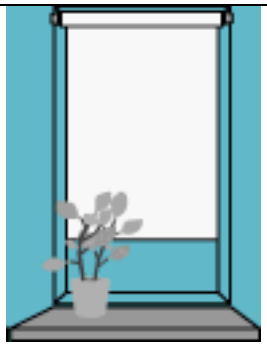
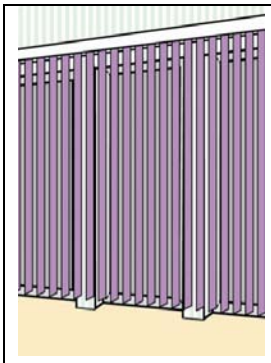
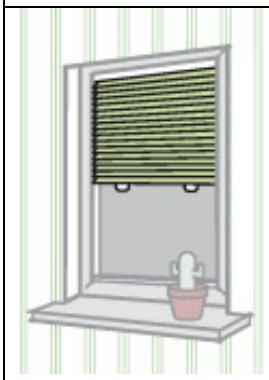
APPENDIX 3 – Description of solar shading systems

The following is a brief description of the most widespread types of solar shading, with comments on their use and function.

	**Window or drop-arm awning.** Frequently used for smaller windows where access is not needed along the building. The supports can get in the way. Available in many different designs as a half-open cassette with a cover along the front or as a fully enclosed cassette without a cover. It is easy to connect a number of awnings to the same motor, usually up to a maximum of three and only if the facade allows it in terms of the distance between windows, the window height, drainpipes, etc. It is important for the arms and springs to be of high quality as these components determine the service life and wind resistance of the awning. Awnings should not be used on the ground floor to avoid the risk of damage. In certain orientations and a certain times of day, awnings may allow light to enter from the sides unless they are covered.
	**Terrace or folding arm awning.** For larger shop windows, open-air restaurants, etc. These awnings are also available in a range of designs as half-open and fully enclosed cassettes. These days they are available in designs with a span from the wall of > 4 metres. Not usually connected in series – mostly controlled individually. They are wind sensitive so they should always be used min in combination with wind sensors. It is important for the arms and springs to be of high quality as these components determine the service life. The fixing to the facade must be strong. It is also important to use the correct type of motor in terms of strength and patterns of movement.

	**Screen.** Screens use fabric that is perforated so it filters the incident light and reflects unwanted light or radiated heat while still providing views to the outside. These days fabrics are available in a large range of technical types, colours and perforation densities. During the day, it is possible to get a good view of the outside through the fabric, reducing the feeling of being shut in. Remember, however, that this works the other way round at night. With the lights switched on, people can see inside just as well. Screens are available in various designs for installation outside, between the panes in double skin facades, or inside. Be careful using white shades for larger windows and fabrics. If the fabric is too light, the problem of incident direct sunlight may be exacerbated. Also available with windproof locking of the lower strip of the fabric. Side steering with cables or profiles called guides. Usually available with profiles of the same RAL colour as the facade.
	**Markisolette.** A combination of the functions of a window awning and a screens. It drops vertically to the required height, then it is angled out from the facade. The advantage is that the upper part screens the disturbing light and heat, while the lower part allows open views to the outside. Can be used with high windows, extends a short distance from the wall (usually about 60 cm) and is relatively wind resistant. Other features – see screens.

	**Facade or external Venetian blind.** Made of aluminium with slats of various widths. The most widespread are 80 mm curved slats, but there are many variations with different profiles for greater rigidity or light exclusion. For side steering of the slats, steering cables or profiles, called guides, can be used. Usually installed outside on the facade or within a double skin facade. According to LTH in Lund, this type of solar protection provides the best shading but with the disadvantage that the view to the outside is correspondingly limited, mainly in the winter when the sun is low because the Venetian blind has to be fully closed. Multiple units can easily be connected to the same motor if the facade allows it.
	**Internal or between-panes Venetian blind.** Available for installation either between panes of glass or free hanging indoors. Always aluminium for installation between panes, but free hanging Venetian blinds can be made of either aluminium or wood. In both cases, slats are available in a vast range of colours, structures and widths. Normally 16, 25, 35 or 50 mm´s.
	**Roller blind or blackout roller blind.** Available in a number of alternative designs with different rollers depending on size, fabric type and function. They differ from screens in that they are never installed outdoors and have no side steering, except for blackout roller blinds and roller blinds installed on hinged doors. There is an infinite range of colours, patterns and transparencies.

	**Vertical blind.** In vertical blinds, the slats run from top to bottom and can be angled. The slats can be pulled to the right, left or both directions. There is an infinite range of colours, patterns and transparencies. One of the main advantages of these blinds is that they can be used in difficult situations, for example if the top of the window is slanting.
	**Pleated or Duette blind.** Made of pleated fabric and available in a number of different designs. Apart from standard window shapes, they can be used for roof windows or windows with a slanting top. They can even be cut into triangular shapes, etc. Pleated blinds are single pleated, taking up very little space when they are raised. They are available in transparent fabrics. Duette blinds are double pleated. Motorisation is only possible if the fabric is rectangular. Otherwise, the blinds are operated manually.

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Appendix 4 - List of functions

The following list is an example of the functions that may be considered before selecting a control system for solar shading. Use it in consultation with the SSC to work out the best solution for your particular property.
The questions will help the SSC quote for the right solution first time, and they will also let you know the various functions you can choose from.

Buildings level – entire building	**YES**	**NO**	**Comment**
Is energy efficiency a priority?			
Do you want to be able to reset the solar protection for a "neat facade"?			
Do you want to connect a fire alarm for UP blocking?			
Do you want to be able to block each zone for window cleaning etc?			
Do you want an error alarm to be passed to another higher-level system?			
Do you want all events in the system to be logged?			
Remote service and monitoring of the system?			
Controlled by the sun?	x		Always YES
Control based on sun height over the seasons, known as sun tracking?			Mostly used for Venetian blinds
Controlled by the wind?			always for external blinds
Frost protection?			only for external blinds
Rain protection?			only for external blinds
Icing protection?			only for external blinds
Room level			
Do you want allow tenants to control blinds at certain times during the day?			
Do you want local control switches in each room or by group/zone?			
Do you want to allow a "favourite position" to be set for the room?			
Do you want this switch to be wired?			
Do you want this switch to be connected via wireless remote control?			
Do you want local settings to apply only during working hours?			
Service and support			
Do you want user training?			
Do you want training of operating personnel?			
Do you want a service agreement?			

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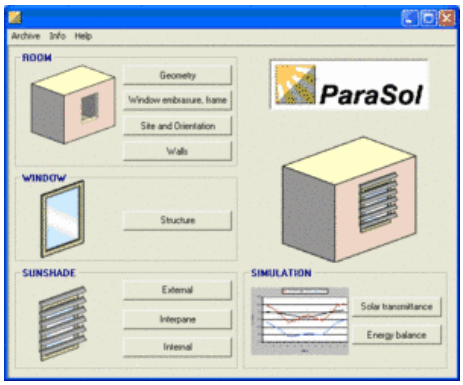
Appendix 5 – Input data for PARASOL

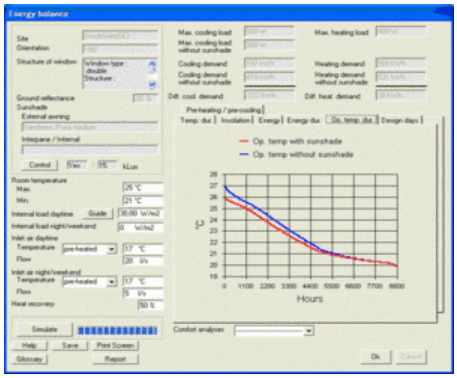
ParaSol is a user-friendly calculation tool that compares energy consumption, power requirements and indoor temperatures for different glazing and solar protection solutions.

The program is targeted mainly at architects, HVAC consultants, designers, purchasers and building proprietors to help them decide from the range of glazing and solar protection alternatives, glass sizes, etc.

ParaSol is designed to run on the operating system Microsoft Windows 95/98/2000/XP. You can choose between Swedish and English with a setting in the application. The program is free and you can download it from www.parasol.se. To download, you will be asked you to complete a simple registration. The ONLY purpose in doing this is to gather information about the number of downloads, by whom, from where, etc. and the details you enter will NOT be used to contact you.

You can use the program for the planning and conversion of premises including offices, schools, hospitals and residential buildings.





www.ebd.lth.se

Certain input data is required before the program can perform a calculation. The list below contains most of the necessary data.

Type:	Data
Room - size WxDxH	
Window - size	
No. of sq. m / window	
Orientation of room	
Facade type	
Glass type	
Location	
Type of solar protection	
Function of solar protection	
Internal load DAY	
Internal load NIGHT	
Max. permitted temp.	
Min. permitted temp.	
Air flow DAY	
Air flow NIGHT	
Temp. of delivered air	
Heat recovery	
Number of persons and computers in the room	