DESIGNING GLASS FACADES FOR NEAR ZERO ENERGY BUILDINGS

2ND BIG REVISED EDITION

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BUILDING GLASS POLAND

SAINT-GOBAIN

We live in times when the sense of the company's existence and its social usefulness become an important factor not only in the motivation and commitment of our employees, but also in distinguishing ourselves from the competition.

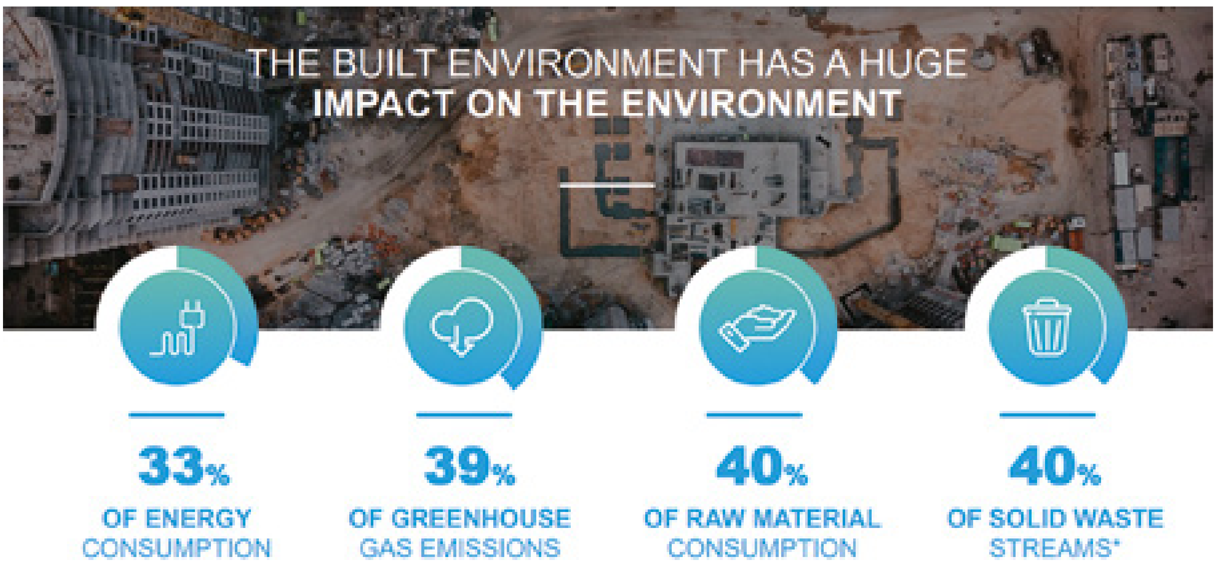
MAKING THE WORLD A BETTER HOME THAT'S SAINT-GOBAIN'S PURPOSE

Our partners, customers and users no longer need only products, they are looking for the value that products and companies bring with them. On the other hand, investors definitely prefer the portfolios of companies focused on sustainable development and involved in climate protection.

The Saint-Gobain Group's purpose specifies and underlines the direction in which Saint-Gobain has been following for several years. So it is not a revolution, but an evolution. We pursue our goal both in terms of optimization of production processes and the benefits of using our solutions. The planet has been facing climate change, decline in biodiversity and social unrest for years. Our purpose is a clear azimuth that will set the framework for our activities in the coming decades. We want our common HOME - the Earth - to be a better place to live for us and the future generations. We can do it by protecting the environment, reducing greenhouse gas emissions, energy consumption, caring for limited resources and, finally, for the safety and comfort of buildings.

We want to act every day to make the world a more beautiful and sustainable place to live.

BUILDINGS ARE AT THE HEART OF THE SUSTAINABILITY CHALLENGE



Building and construction accounts for nearly 40% of the energy related greenhouse gas emissions. 70% of those emissions are related to the energy consumed for heating, cooling, sanitary water, etc., 30% of those emissions are related to the "embodied carbon" within the materials used for construction, transportation, etc. The solid waste streams have also a big impact on environment.

Saint-Gobain Building Glass offers a complete range of energy efficient coated glass and insulated glazing. With solar control, low emissivity, low maintenance and transparency, our glass meets the requirements of low energy consumption buildings.

GLASS FOREVER

Saint-Gobain Building Glass conducts **GLASS FOREVER** program in which we engage employees, customers and partners, uniting our activities with a common idea and vision of sustainable development. From small seeds to big rivers, our vision is to grow our business and to differentiate, while improving our environment footprint and increasing our contribution to people's wellbeing.
This program is strongly in line with Saint-Gobain purpose: **MAKING THE WORLD A BETTER HOME.**

"We have made the commitment to reach zero net carbon emissions by 2050. This long-term goal must guide all our strategic decisions, and must be a factor in ensuring our teams' cohesiveness and their additional commitment" says Pierre Andre de Chalendar, CEO of Saint-Gobain Group.

NET ZERO CARBON BY 2050

In September 2019, during the Climate Action Summit, Saint-Gobain has signed the pledge of the Global Compact "Business ambition for 1.5°C", committing itself to reach net-zero emissions by no later than 2050 in line with 1.5°C scenarios. Already Saint-Gobain is committed to reducing its CO_2 emissions by 20% until 2025.

THREE MAJOR MEGATRENDS ON THE CONSTRUCTION MARKET

TOWARDS ZERO CARBON	CIRCULAR ECONOMY		HEALTH & WELLBEING
Low operational carbon Energy efficiency in buildings, high quality building envelop	**Recyclable** or **reusable** Construction products	Products & systems **easy to repair** & **to dismantle**	Push for **healthy** & **comfortable** buildings
Low embodied carbon Recycled content, eco innovation, alternative raw materials, more energy efficient processes, switch renewable or low carbon energies	Products with a **high(er) recycled** or **renewable content**	Products containing no **hazardous substances**	Need for **comfort solutions** Increasing focus on **hazardous substances** in construction Growing demand for **emissions** and **ingredients disclosure**

Saint-Gobain is committed to offer sustainable products and solutions for its customers. Saint-Gobain continuously strengthens health and environmental performance of its products and deliver transparency documentation to prove the actual sustainability level of each product.

SPECIFICATION FOR BUILDING SIMULATION

In 2019 the Energy Performance of Buildings Directive (EPBD) of the EU enters a new face – all new constructions should be "near zero energy" from then on. In the Nordic countries the main driver behind energy use in buildings is the energy loss through the façade, and particularly through doors and windows. Hence it is natural that we have focused on low U-value in facades. The latest BR 29 building norm in Sweden sets U-value demand 0,5 for the entire building skin with roof and floor and façade. For taller buildings this means a U-value for the façade (Ucw) under 0,6.

DESIGNING GLASS FACADES

INTRODUCTION

It is impossible to reach a U-value of 0,5 for a fully glazed façade, at least using standard windows on the market. This has caused a trend towards smaller windows, curtain wall facades with 30-50% glass share is what is generally designed for future buildings in Sweden. There is a great risk of less daylight for people in their work place.

THE NORM

To counter the threat of darkness in places where people are permanently placed, such as schools and offices, the new norm EN 17037 for daylight in buildings was officially introduced at the end of 2018. It forms a counterweight to the EPBD in that it speaks of the necessity of bigger windows to bring in daylight. The norm is split in four parts:

1. Daylight provision
2. Exposure to sunlight for hygienic purposes
3. View out
4. Protection from glare

The norm is only seen as a recommendation in Sweden, but the provision of daylight is a part of building legislation in many countries. With smaller windows the light transmission of those windows is becoming more and more important. If you for instance want to make an office building with open office landscapes the daylight factor will decide the possible depth of the landscape. If the desire is to have the landscape three desks deep counted from the window then you need the correct daylight factor on the third desk. If not the daylight study might conclude that only 2 desks are possible. The building will either be narrow or potentially lossmaking.

And even though the main energy cost driver in the Nordics is the loss of energy, there is also a substantial amount of heat coming in through the windows causing overheating risks during a large part of the year. The lower sun angle in the north makes the sun hit the windows at an perpendicular angle, especially during spring and fall. A Swedish school or office could easily be overheated between 4 am and 7 am in the morning in May if the façade is facing east or northeast.

The different demands from new legislation and certification schemes makes façade design much more complicated than in the past. It can be seen as a reaction to the fact that many double glazed fully glazed facades from the 1990's and forward create comfort problems for the inhabitants. The HVAC systems are not able to balance the problems of cold draught and overheating in the buildings.

The answer to the contradictory demands of insulation, daylight and solar control is the dynamic façade. Glass and shading system must be optimized together to create a comfortable and light working space that prevent problems of cold draught and overheating. But there is not one simple answer, and the discussion of different options is the main purpose of this booklet.

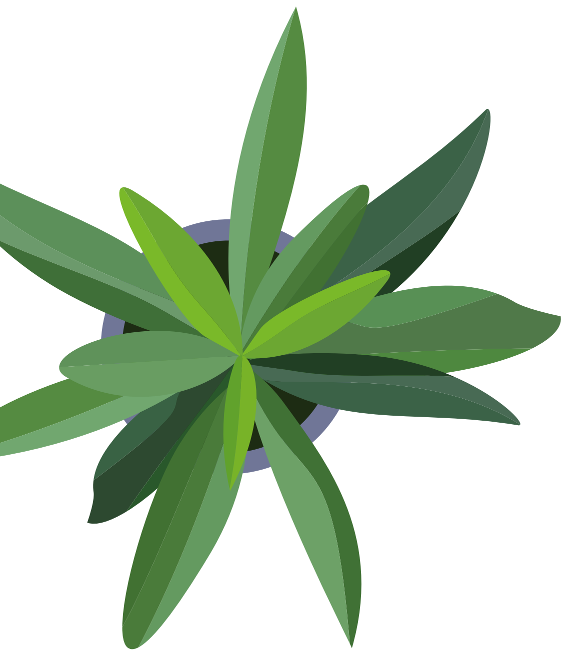
To illustrate that there is not one given answer we can compare the open office landscape with the cell office: In an open landscape the daylight is the main problem – how to get light transmission as far into the office as possible. Overheating needs prevention, but by blocking 80-85% of the solar energy this can be fixed. For the cell office on the other hand daylight is not a problem. But overheating quickly becomes an issue. Air conditioning is expensive and not comfortable, so at least 90% of the solar heat must be blocked out. If it is not decided for a building at an early stage what the interior will look like, you have to provide a solution with very high light transmission and very low solar transmission, or g-value.

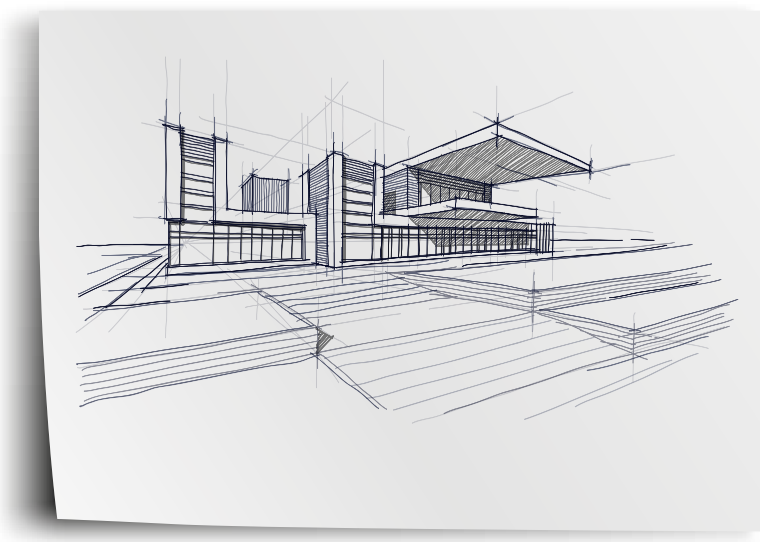
To get an idea of what way the market will move it is a good idea to look at Sweden. Because according to Swedish legislation, investors need to prove the climate comfort and energy performance of buildings before even receiving a building permit. This has strengthened the tradition of building simulation in Sweden. The first computer program to simulate ventilation and façade performance in a building was written before there were even computers in Sweden to perform the calculations. Today nearly 2000 consultants work full time in the dominating software IDA ICE. In Sweden we hence have a pretty good grip on what is needed to achieve "nearly zero energy" buildings.

And with recent development in the program we now have tools for very precise calculations and easy methods for communicating these methods. In this revised booklet we will go into detail on some products. For marketing purpose of course, but also to show the benefits of a complete and detailed specification.

In Sweden the dominating certification system Miljöbyggnad gives an indication on the direction of the market in many countries. It has a daylight requirement for a table surface one meter from the wall in the center of the room and a limit for solar gain set as W/m2 floor surface. During large parts of the building process it can often not be said with certainty how big the rooms will be, so there is a need for flexible solutions, we call them dynamic facades.

But first it is necessary to take a look at the effect of increased U-value demands down to and sometimes under 0,5 for the whole façade. These demands put some strains on the design of the entire façade.





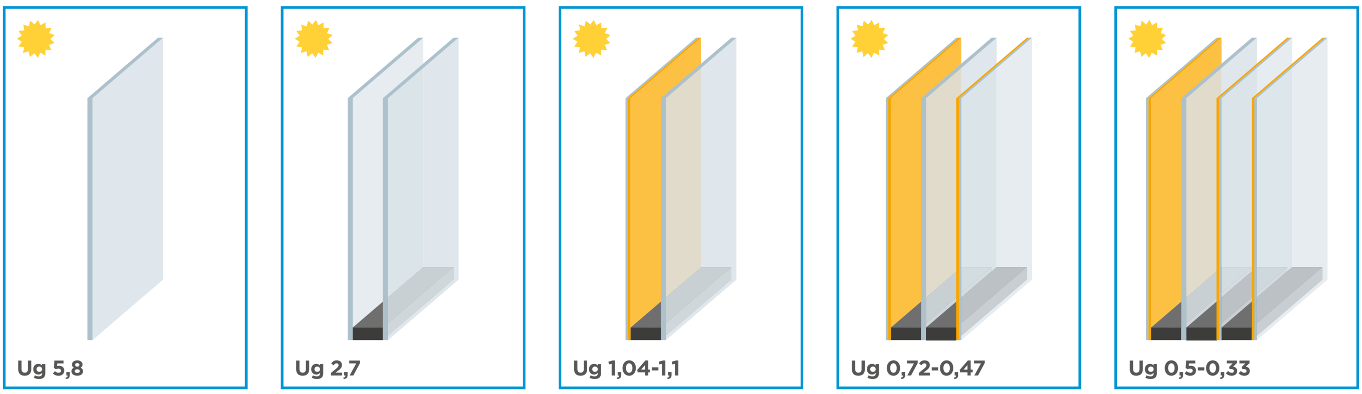
DESIGNING GLASS FACADES

U-VALUE IN FAÇADE

It is common to supply U-values for different materials. Those materials are combined into the façade that has been designed. If the total façade U-value required is not met, often we try to improve the U-value for different materials. This has lead to the re-introduction of quadruple glass, for instance.

WINDOW DESIGN

The U-value for a single glass is 5,6. Some 40% of buildings in Europe are still equipped with single glass, and the replacement with double glass and triple glass solutions is the most important factor in reducing the energy consumption of buildings. Between 2000 and 2014 the energy consumption in Swedish buildings was lowered by 14%. The main reasons (the only mentioned) were replacement of poor windows and doors by better ones. The standard of IGU stated double and triple non-coated units with U-value 2,7-1,8 before 2000, was improved by double glass units (DGU) with one coated glass (1,1) 2000-2010 and after 2010 the trend is towards present standard of triple glass units (TGU) with 2 coated glasses (0,7-0,5).



U-value evolution, spacers for DGU 16 mm, for TGU and quadruple 12-18 mm

For very low U-values, it is necessary to focus on the design of the entire façade. The shape of the glass will influence the amount of running meters of spacer and frame, and the percentage of edge zone. There is a clear disadvantage for tall and narrow windows compared to windows with a low width to height ration.

Decreasing the U-value of glass is not sufficient, especially since we create bigger climate loads inside the units with every increase in spacer width. Especially on narrow windows these stresses create problems of poor aesthetics (bulging glass) and doubtful technical lifespan (stress on sealants). The shape of the window and the frame, and if it is openable or non-openable, will have a bigger influence.

In the table below U-value for the whole window is analyzed in a program called Caluwin, to focus on the effects of different window widths, assuming windows from floor to ceiling 2,4 meters high. The is a difference of almost 0,4 W/m2K in U-value depending on window width. It is not advisable to use glass more narrow than 1 meter. This fact is further underlined by increased thickness of insulation material. A narrow window in a thick wall brings little daylight and even less views to outside.

DIMENSION GLASS	Ug	Uf	SPACER	Uw
300 mm x 2400 mm	0,6	1,0	Swisspacer Advance	1,16
500 mm x 2400 mm	0,6	1,0	Swisspacer Advance	0,97
700 mm x 2400 mm	0,6	1,0	Swisspacer Advance	0,88
900 mm x 2400 mm	0,6	1,0	Swisspacer Advance	0,84
1100 mm x 2400 mm	0,6	1.0	Swisspacer Advance	0,81
1300 mm x 2400 mm	0,6	1.0	Swisspacer Advance	0,79

Ug=U-value glass center point, Uf= U-value frame, Uw= U-value window

Regionens Hus in Gothenburg and Axis head office in Lund are both based on TGU U-value glass Ug <0,6. Regionens Hus windows are 1250x2400, the U-value for window Uw can be calculated to 0,84 assuming warm edge spacer and frame U-value 1,0. The same assumptions for an example widow at Axis at 400x2700 mm gives Uw 1,20.

Project:
Regionens Hus, Gothenburg

Architect:
White Arkitekter

COLD BRIDGES

In addition to window design comes the problems caused by cold bridges. These come in many different shapes, and need to be dealt with individually. In Norway, the Glass- & Fasadeforening has made a booklet called "Koldebruer" that deals with the subject in great depth. An attempt at translating the table of contects give a clue to what it is all about:

3.1 Facade U-value calculation
3.2 Internal cold bridges into U-value calculation
3.3 Spandrels
3.4 Tall and narrow windows
3.5 Glazed corners
3.6 Seal between facade unit and wall
3.7 Inside floor meets outside facade
3.8 Components mounted on facade after unit mounting
3.8.1 Locks on doors and windows
3.8.2 Fixing of solar shading and decorative items on facade
The points 3.3-3.7 are based on geometry, edge zone problems; between window and spandrel, in corners, in joints between units of a unitized facade and in joining the curtain wall to the heavy structure of the building.

The point 3.8 is material based divided into 2 where the façade focus is point 3.8.2: To hold decorative items and/or solar shadings correctly fixed to the façade, steel structures sometimes need to go straight through all insulation, causing heat exchange between inside and outside.

Potential cold bridges caused by fixing of solar shadings and decorative items on facade.

To reach very low U-values we risk limiting the creativity of architects in the façade expression. The Regionens Hus Building features TGU top to bottom, horizontal window bands, inside shadings and quite big and homogenous spandrels. The façade U-value could be 0,3 W/m2K lower than Axis head office or even more. We can argue about if these buildings are beauties or beasts, but for better or for worse, future buildings will definitely look more like Regionens Hus than Axis head office.

RISKS CONCERNING TRIPLE GLASS UNITS

On many markets not used to the notion of triple glass units there is a debate on the risks of 2 cavities. There are risks that need to be handled. Here below I list the main issues with TGU and how to handle them:

CLIMATE LOADS

IGUs are hermetically sealed meaning they are produced and carry a footprint of the temperature and air pressure on the date of production as well as the altitude of the place of production. Warmer production site and lower air pressure means a tendency for the glass to bend inwards. If you look carefully at a façade you can always spot replacement glasses because they bend differently than the main delivery.

When temperature of a gas changes by 27 degrees it changes volume by ten percent. If a glass is produced at 27 degrees in a factory and it is 0 degrees at the building site where glasses are mounted the glass the gas will shrink and the glasses will bulge inwards in the middle and stay fixed at the sides by the spacer. The stress on the glass and glue is substantial, but if it is critical depends on the shape and size of the glass:

Narrow glasses have higher loads than wider glasses. Between 300 and 600 mm wide you find the most critical loads, 300x900 mm is the most critical measurement, the pressure releases as the glass grows taller. The solution is to not design glass more narrow than 800 mm, for Uw-values and climate loads both. If it must be a narrow glass then 2x12 mm argon should not cause problems. Today 2x16 mm is more or less standard and 2x18 mm argon is on the rise.

Triangular glasses have at least twice the climate load of rectangular glass. Triangular triplets look ugly due to the bending and run the risk of breakage. Assume all panes tempered until a calculation can prove otherwise. Or use 2x12 mm argon as a standard.

When blinds are integrated into triple glass units the described effect of glass bulging inwards becomes even more important. If this effect is not managed well the glass may obstruct the movement of the blind. It is important that glass supplier works closely with blind suppliers to evaluate for each project the risk of glass bending and finding the right glass composition that meets all demands and to allow the blind to move freely.

THERMAL BREAKAGE

The middle pane is not ventilated and so it runs a higher risk of thermal breakage than outer pane. Thermal breakage occurs when one part of the glass has a very different temperature than another part of the glass and can start at a delta of 25 degrees if glass edges are damaged. There are a lot of factors that affect the risk of thermal breakage and individual calculation of the risk is advisable. But some assumptions can be made for budget purposes:

If outer pane is a solar control glass it absorbs a lot of the energy and generally the risk of breakage is very low in middle and inner pane. The exception to that rule is if the inside ceiling of the room goes lower than the top of the glass creating a heat pocket at the top of the glass.

If the outer pane is uncoated float and middle and inner panes are low-e coated glass, then middle pane should be tempered and inner pane calculated, assuming the façade is exposed to sunlight.

WINDOW DESIGN AND CARBON FOOTPRINT

It is a common misconception that glass producers want to sell as many kilos of glass as possible. We strive to sell the most advanced coatings and generally see the weight as a logistic problem. Triple glass units are sometimes criticized because the extra glass increases the carbon footprint in production. That might be the case but the energy saved during the life span of the glass will give a payback many times. Other factors have a higher impact on carbon footprint:

Cutting waste: Glass is generally produced to a raw material size of 321x600 cm. The 321 cm is decided by the width of the float glass production line, the 600 cm can be altered for bigger projects if the problem is known in time. The optimization of uncommon glass types can differ widely. A glass that is 1700x3300 mm can have a cutting waste of over 70% whereas 1450x3100 mm can have a cutting waste below 10%

Sound reduction demands: As we build closer and closer to big roads and railways and comfort demands increase, glass constructions tend to get thicker and thicker. The weight of the glass and the use of special silence PVBs and the width of the cavities are used to prevent noise penetration. Quite often the sound reduction glass weighs twice as much as the standard glass. Sound reduction requirements need to be revised carefully with this in mind. Also the use of bigger cavities and thinner glass can be an option. There are potential savings up to 20 kilos per square meter depending on how the build-up is tailored.

Safety glass: Glass that break in facades get a lot of attention from the general public and have led to an increase in laminated and laminated heat treated glass in facades. These initiatives have saved very few lives, if any, but will on average increase the weight of the glass. One should also bear in mind that a laminated glass is more difficult to recycle than a tempered or annealed glass, especially a heat treated laminated glass since it requires thicker PVB. This leads us over to recycling:

Circular use of flat glass is a big potential saver when it comes to carbon footprint and raw material consumption. 1200 kilos of raw material are saved with every ton of glass cullet recycled, and the energy consumption in the melting process drops by 30%. Cullet is normal to use in all glass production (only flat glass cullet can be used) but the use of end of life cullet makes up less than 1% of the raw material used. Taking care of the glass from the building potentially torn down to make room for the new building and/or requesting glass that can be branded as "recycled" are good steps towards a more circular use of flat glass and in turn a lower carbon footprint.

OVERSIZE

Now that I am talking about glass build-up I would like to say a few words about oversize glass, measures exceeding six meters high. Saint-Gobain in Torgau and Thiele Glas in Wermsdorf, both close to Leipzig in Germany, took it to the next level with an offering of glass up to 18 meters, with solar control coatings, printing possibilities and everything. There are some futuristic examples of large panes where the IGU step becomes a balustrade at the next floor or stair cases made from 2 glass fins and one fiber cement stair. Some things to consider.

Tempered or laminated?

Oversize glass is mainly produced as to be tempered coatings. One reason is that the pressure on the glazing at the setting block, no matter how heavy a flat IGU gets it is still set on only 2 positions an annealed glass gets into difficulty. For big panes tempered or heat strengthened laminates are preferred since a granulation can come falling with great force from the heights indicated. Some basic rules to stick to:

- Annealed glass is OK up to IGU weight of 350 kg. With higher weights Thiele recommends grinding any laminated glass, before or after lamination. This is a conservative measure from a company that ships across the world.

- Tempered glass is OK for panes up to 3x6 meters if the glass is lying down. If standing up it is wise to go to tempered laminate. Tempered glass in constructions of this size should always be heat soak tested.

For heavy units it also necessary to consider the material of the setting blocks. Stadard setting blocks from PP or PVC become insufficient, block from POM C are recommended by an investigation made by the university of Dresden.

Tolerances:

Thiele works with different sets of tolerances at different price levels. For really big units the tolerance of size can exceed +/-4 mm, careful estimation of the needs should be made. Some systems for slim profiles or invisible sliding doors have started adopting better tolerances than industry standard, this also goes for many structural glazing systems. The best example of what can be done with small tolerances is the Thiele patented glass staircase:

Triple laminated tempered glass fins for this Thiele Glas / ABT self carrying staircase in Holland is for me the ultimate masterpiece in tolerances.


Which glass and why?
Unique support on
NEW website!
https://pl.saint-gobain-building-glass.com/pl/Oskar-Storm

DESIGNING GLASS FACADES

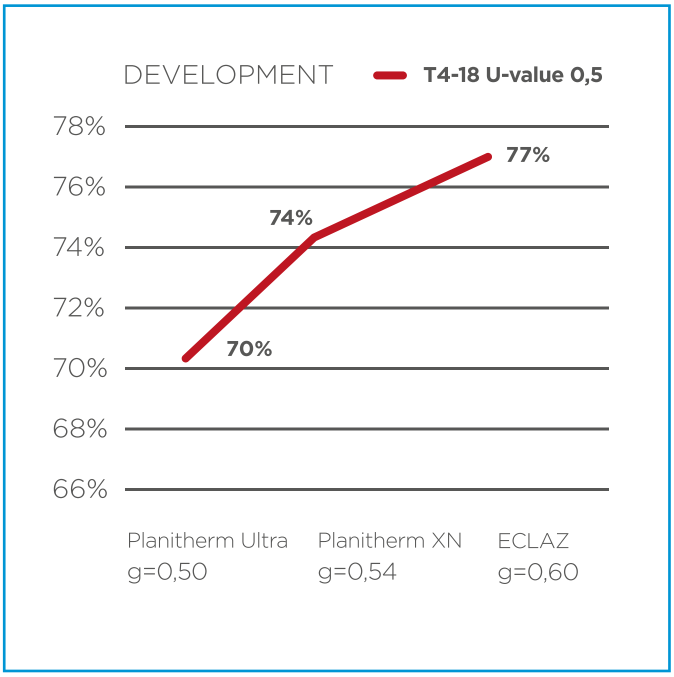
GLASS TYPES IN SSF ESBO

Before drilling deeper into the dynamic facades it is good to stop and make an overview of the different glass types easily at hand in SSF ESBO tool and what they are there for. This presentation takes a strict triple glass (TGU) perspective:

LOW-E GLASS

Planitherm XN: this is the standard low e glass from Saint-Gobain since 2014, light transmission in TGU is max 74%. It is coated on the lighter float glass Planiclear, also introduced in 2014 to replace Planilux. Before 2014 there was a different low-e glass called Planitherm Ultra. Ultra had lower light transmission of 70% and also lower g-value. Many consultants are not updated, they use too low g-value when they specify low-e glass, making it tricky to maximize light transmission.

ECLAZ: the premium low-e glass is the first low e coating to be light enough and low reflective enough to actually increase the light transmission in the glass it is coated on. Shifting from Planitherm XN on Planiclear to ECLAZ on Planiclear is more efficient from light transmission point of view than shifting from Planitherm XN on Planiclear to Planitherm XN on low iron substrate Diamant. ECLAZ on Planiclear as inner pane also shifts the color of a white curtain less than Planitherm XN on Diamant. Planitherm XN and Planiclear has replaced Planitherm Ultra and Planilux. ECLAZ exist parallel to Planitherm XN. Their relation is described in the diagram below.



Development of light transmission and g-value for TGU with two pieces low glass low e glass 2013-2018. When adding 1 mm of glass or 0,38 mm of PVB light transmission decreases by 0,23 and 0,22 percentage points respectively.

Solar control glass Xtreme 70/33 with inner glass Planitherm XN left and ECLAZ right.

The reflection of low-e glass is held as low as possible and is actually very close to zero. This causes a TGU with 2 low-e coatings to have more or less the same reflection as a DGU with 2 uncoated glasses. Both build-ups have four standard float glass surfaces each reflecting 4%, ending up with about 15% reflection. This reflection can be called "natural reflection". Since daylight factor in a room is generally only one percent of daylight on the outside a window will look very dark. The lower the reflection and the smaller the window, the darker the glass looks.

COOL-LITE SKN 183

All solar control glass from Saint-Gobain start the name with "COOL-LITE". In the text of booklet that prefix is avoided. The increased use of triple glass units has decreased the maximum amount of daylight possible from a solar control glass.

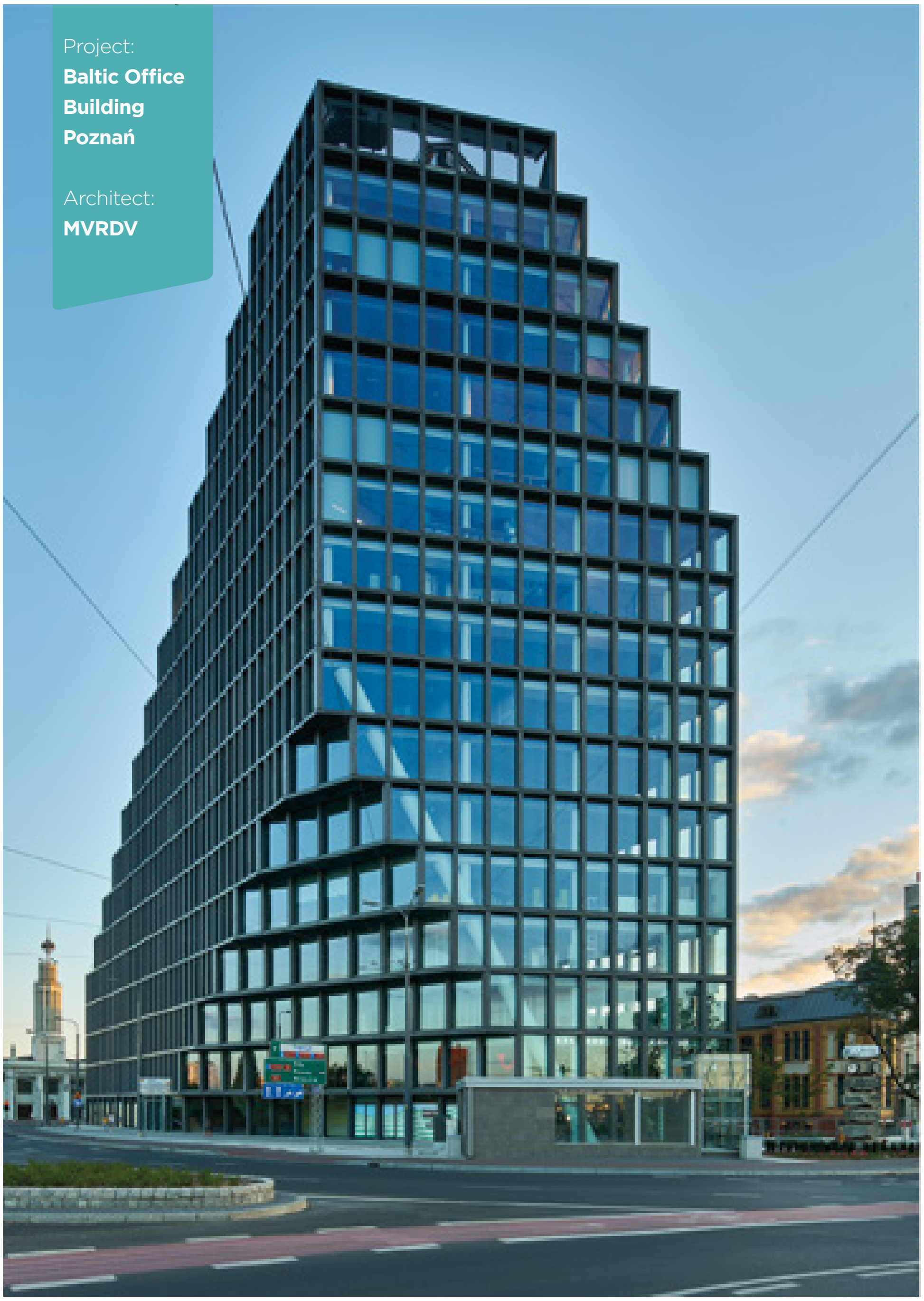
For double glass units, a light transmission of 70% has been the highest standard for a long time, but such a glass barely reaches over 60% in a triple glass unit. The SKN 183 has been developed to restore daylight up towards 70% for a triple glass solar control unit. Triple glass values for SKN 183 are very similar to double glass values for SKN 176.

Project:
Public Service Center

Architect:
Heinle, Wischer und Partner Architects

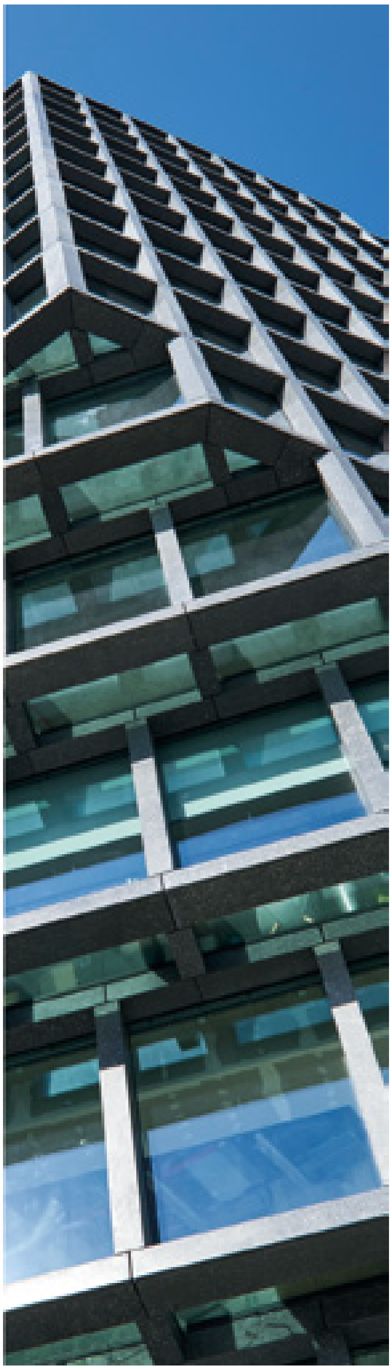
SKN 176

SKN 176 is the standard step if the g-value of the low-e glass is insufficient to provide a good indoor climate. There are many suppliers for this glass type. The group of glass is known as “70/37” glass types. The name comes from light transmission and g-value properties in double glass units DGU. In TGU the values are 65/35. A TGU with g-value 0,35 is a standard to reach demands of the Polish building legislation, that is why 70/37 glass types are so readily available if you team up with a Polish glass processor. The reflection of the SKN 176 is nearly as low as for standard low-e glass. They look equally dark in perpendicular view to a window. In some angles and lights a blueish note can be found in the reflection.



Project:
Baltic Office Building Poznań

Architect:
MVRDV



Project:
Varso I
& Varso II

Architect:
HRA
Architects

XTREME 70/33

If the SKN 176 is not sufficient to meet g-value demands, the Xtreme 70/33 gives a lower g-value without affecting the light transmission. Xtreme 70/33 has the values 65/31 in TGU.

The reflection of the Xtreme 70/33 is the lowest among solar control glasses. From the outside it will look darker than the SKN 176. The low reflection makes the glass suitable in shop fronts, that subject is treated later.

Project:
Foajen, Malmö

Architect:
Fojab

@felixgerlach_fotograf

Project:
Mennica Residence

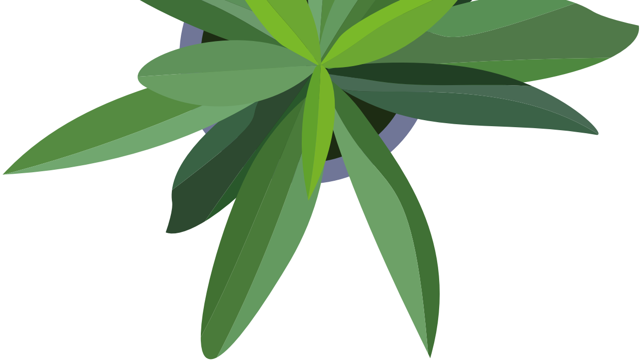
Architect:
BBGK Architects

XTREME 60/28

The g-value drops further, in TGU the value pair is 55/26. The transmission is still very neutral.
The reflection increases a little and becomes a bit greenish. Now it starts looking like a solar control glass.

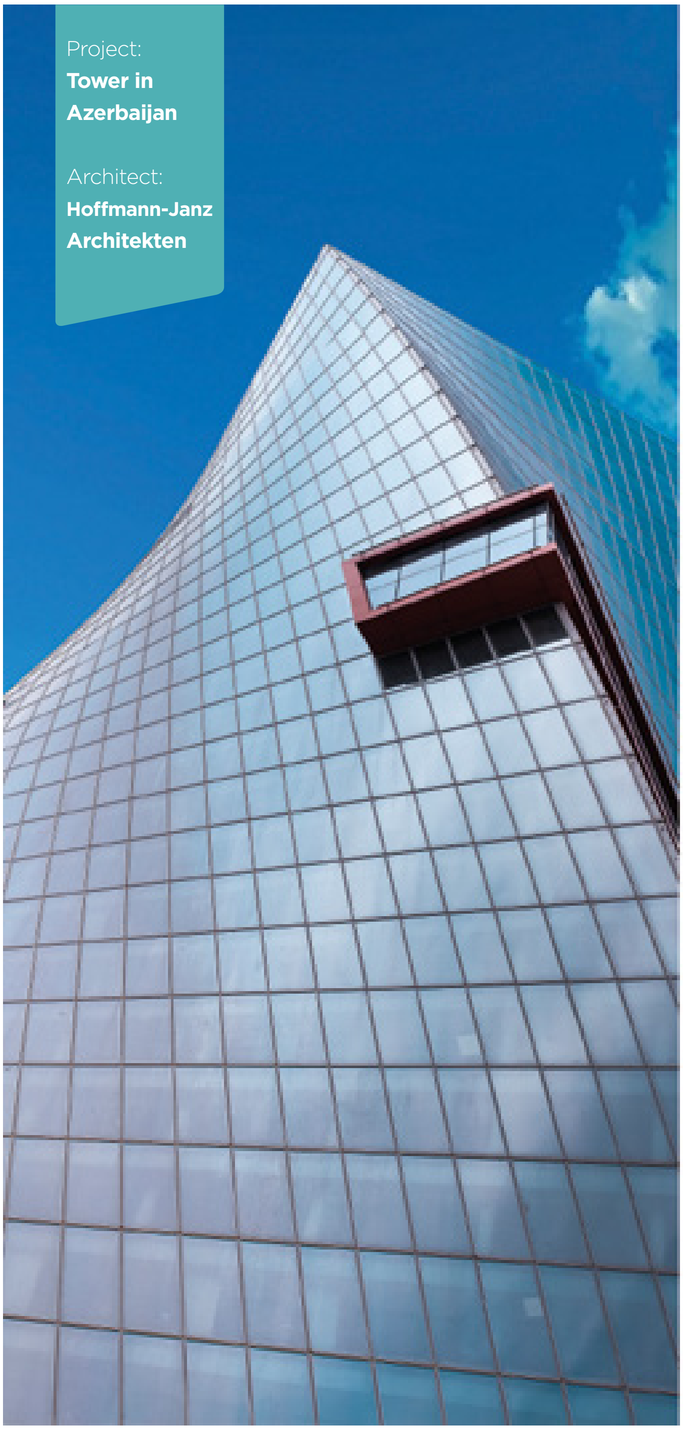
Project:
Forum Gdańsk

Architect:
SUD Architects



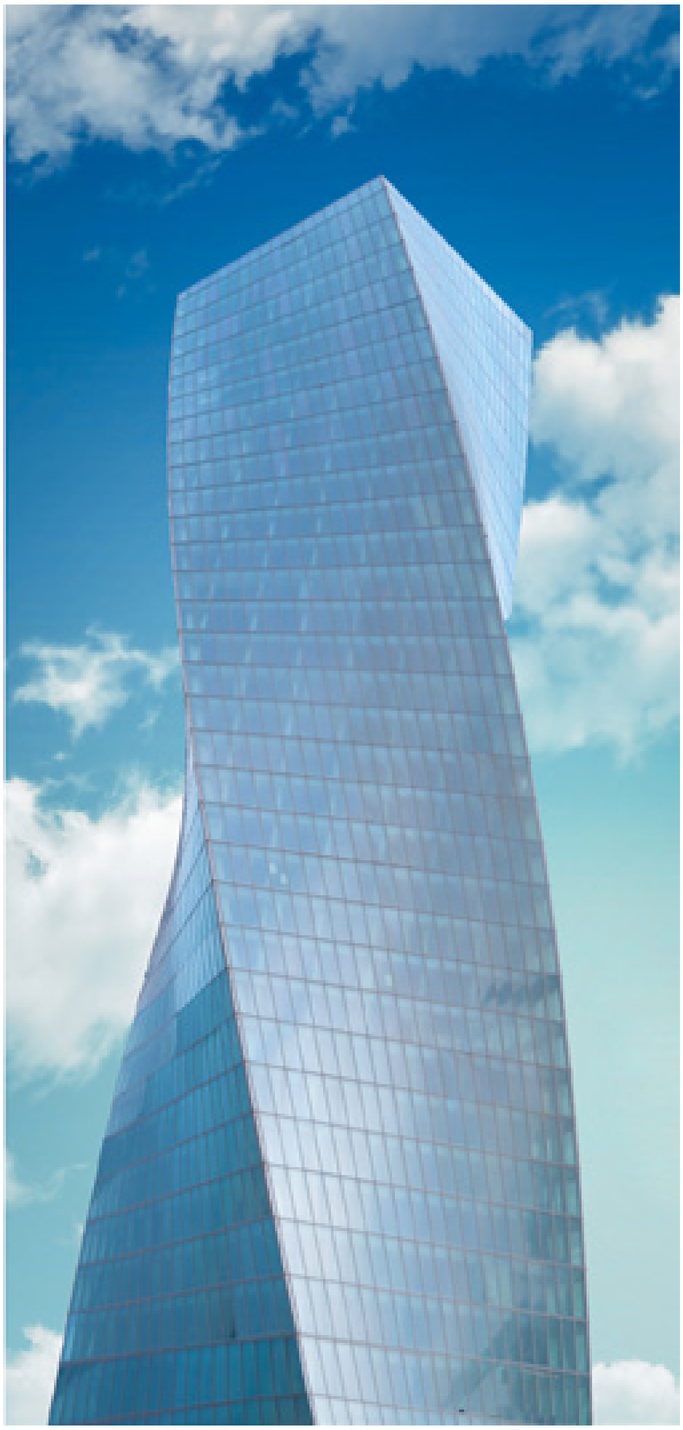
XTREME SILVER

This newcomer has the highest selectivity ever seen in high reflective glass. With acceptable light transmission and good g-value, the 31% crisp silver reflection gives a truly different appearance, much lighter from the outside. Please note that the climate loads will ruin the appearance of the reflection unless the outer pane is at least 8 mm or thicker and/or the outer cavity is relieved of pressure by special valve called Swisspacer Air.



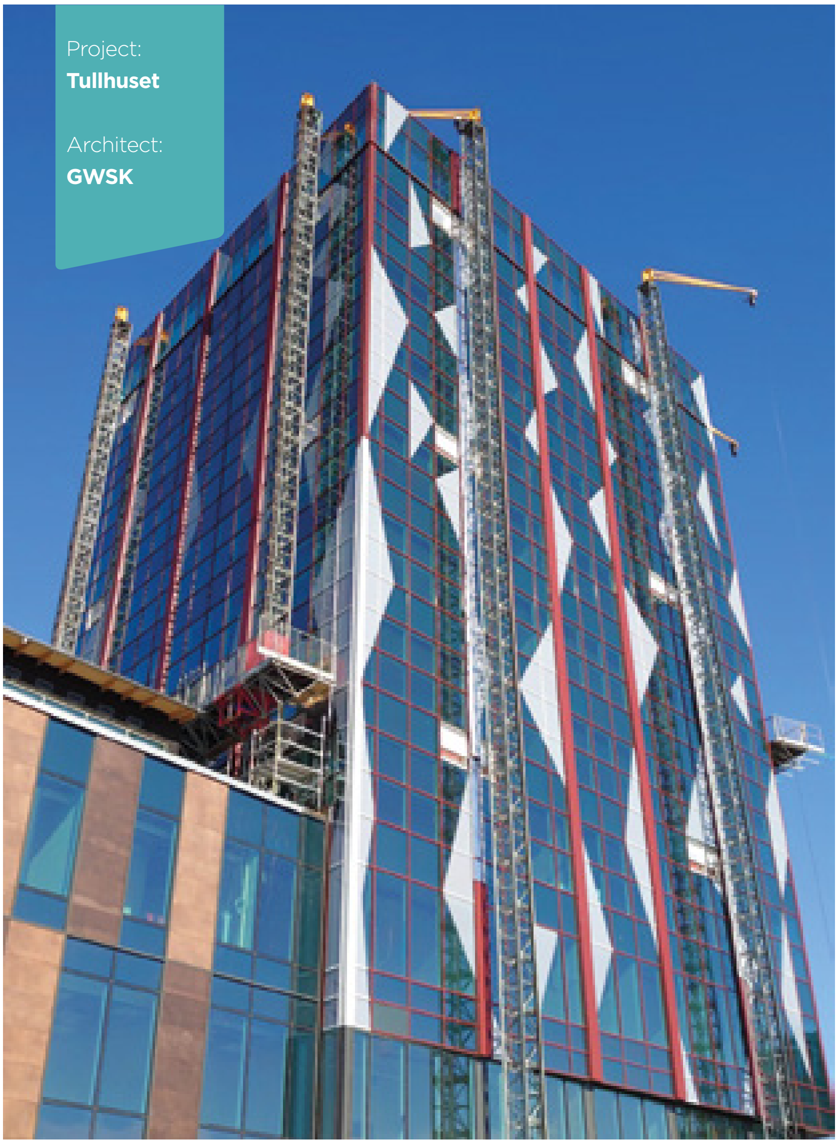
Project:
Tower in Azerbaijan

Architect:
Hoffmann-Janz Architekten



XTREME 50/22

The lowest g-value we actively market. It is for lobbys and other places where shading devices are easily damaged. 50/22 is not high in reflection, but the light in transmission becomes a bit sterile. Below a summarizing table.



Tullhuset, Gävle. Outer pane 6 mm XTreme 50/22, spandrels DGU 50/22 inner pane Emalit RAL 7026 #4

PRODUCT	LT%	g-value	Selectivity	Outside reflection	Ra transm.	Color reflection
TGU ECLAZ	77%	0,60	1,28	14%	98%	neutral
TGU PLANITHERM XN	74%	0,55	1,35	14%	97%	neutral
TGU SKN 183	69%	0,55	1,86	15%	98%	neutral
TGU SKN 176	64%	0,35	1,83	15%	95%	neutral blue
TGU Xtreme 70/33	64%	0,31	2,06	13%	93%	neutral
TGU Xtreme 60/28	55%	0,26	2,11	16%	92%	neutral green
TGU Xtreme Silver	45%	0,23	1,95	31%	88%	silver
TGU Xtreme 50/22	43%	0,19	2,26	17%	83%	neutral blue

Summary of glass types, extended version

DESIGNING GLASS FACADES

DYNAMIC FACADES

The cheapest way to reach a certain level of solar control is the solar control glass. These have as we know developed into more and more neutral products. If I enter the bank at Carlsgatan in Malmö the glasses have high reflection, a light transmission of 30% and a sterile light on the inside. When entering the café on the ground floor of Foajen across the street the glazing looks like single glass with very little color. Yet both facades block out the sun with the same efficieny and provide good proof of glass development over the last 25 years.

SOLAR CONTROL GLASS

It is very important to point out that a solar control glass should be part of any solar exposed façade. The reason for this is that solar control glass is the only ingredient in the façade soup that has selectivity over 1. And with the triple silver coatings like the Xtreme family we have brought the selectivity above 2 even. This makes solar control glass the most effective tool in the façade tool-box.

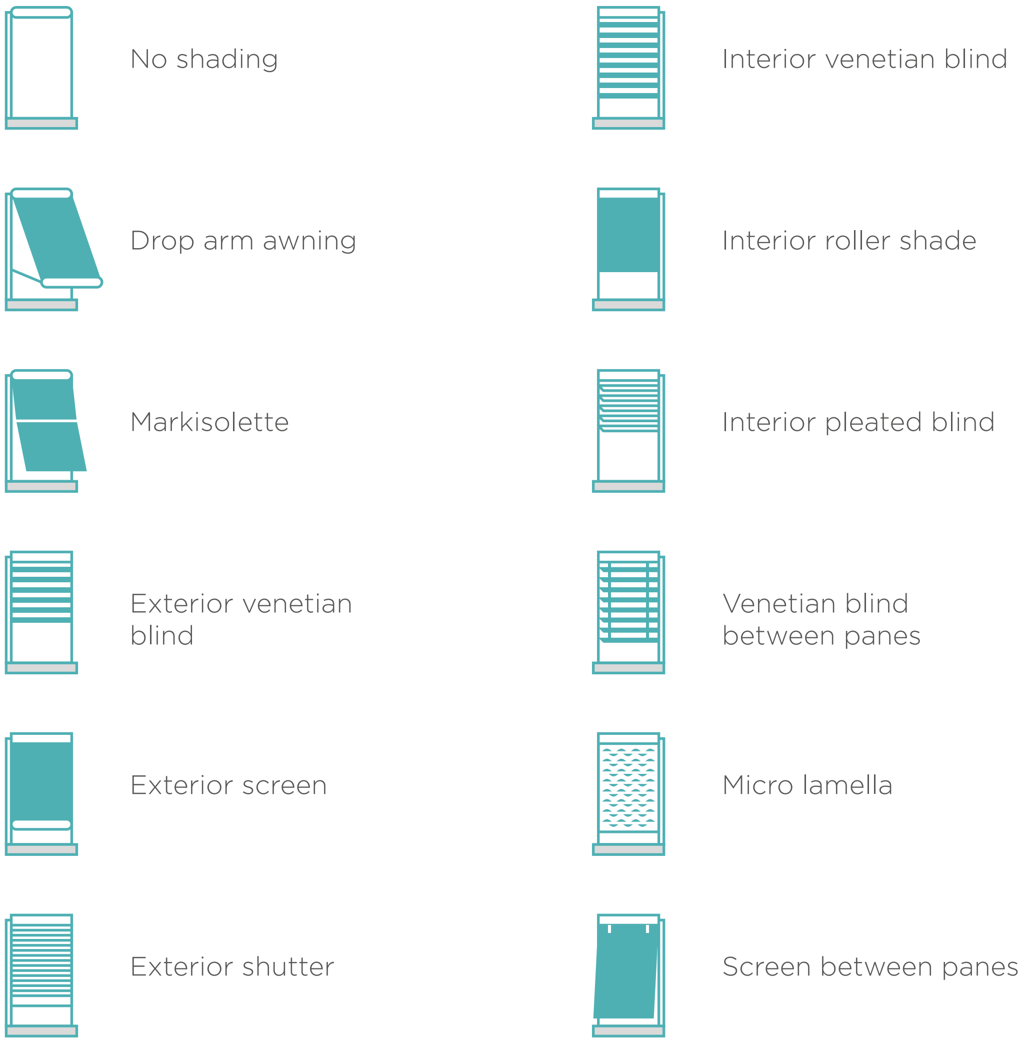
My wife Åsa and daughter Ida at Café Le Croissant, Foajen, Malmö

With a solar control glass we bring down the light transmission some, but we also drastically bring down the amount of time that other shading devices need be active, and so get more hours of good daylight. For instance; with outside shading like zip screen the screens must be down also on cloudy summer days because of the background radiation, if combined with low e glass only. But if combined with a solar control glass the screens only need to be down during times with direct sunlight on the glass, and then some sort of glare control is needed anyway.

The lightest solar control glass, SKN 183, can reach up towards 70% light transmission. And traditionally daylight analysis of building (case 1 in 17037, neutal grey sky) are done assuming 70% light transmission for low-e glass. This means that in many cases the comfort of the solar control glass can be reached without changing the assumptions of the daylight study.

But the g-value demands we meet in Sweden today down to 0,08 or lower cannot be met with really neutral solar control glass, we need to combine the glass with dynamic shading systems to achieve the desired building comfort. There are a lot of different methods to achieve a dynamic façade with the possibility to adjust the inflow of light and heat.

If we look at the Swedish freeware SSF ESBO (or the European ESSO ESBO) we find a palate of solutions to choose from:



In this booklet I take the IGU supplier perspective and focus on the use of solar control glass with inside or outside shader, venetian blind between panes and of course SageGlass. Adding cost to the IGU is in my opinion always a shortcut to cost effective improvement of a facade. In a facade combining glass and shader the g-value is called g-tot and calculated with the ISO 52022 norm instead of the EN 410 used for glass alone. The g-value and TL-value for the glass will differ slightly in the two calculation modes, and the difference appears because of differences in calculation assumptions. It is as simple as that.

Dynamic facades come with a cost. And here it is important to point out that building comfort is essential for the profitability of the office workers. In an office building normally 80% of the total cost to a company consists of salaries and employee related costs, 10% are building costs and as a part of building cost only around 0,5% is energy cost. Research has established a link between office temperature and number of dissatisfied users (too hot or too cold). It is called PPD (Perdicted Percentage of Dissatisfied) Even a one percent increase in worker efficiency can offset the whole energy cost for a building.

2000 €/m²a staff

200 €/m²a building

20 €/m²a energy

€

Scheme of cost distribution in normal office building

EXTERIOR SCREEN

So now we have established a need for dynamic facades and have also made the extra cost seem more feasible. The first conclusion of the building business in Sweden became a threat to solar control glasses: The heat from the sun must be stopped as early as possible. Let us use outside shaders (blinds or zip screens) and glass with the highest possible light transmission. When I started in specification 6 years ago a lot of buildings were fitted with outside shadings and low-e glass.

The REHVA guidebook no 12 called "Solar Shading – How to integrate solar shading in sustainable buildings" appeared in 2010, there are a lot of interesting discussions in it, reading is recommended, but the case studies are all on outside shading.

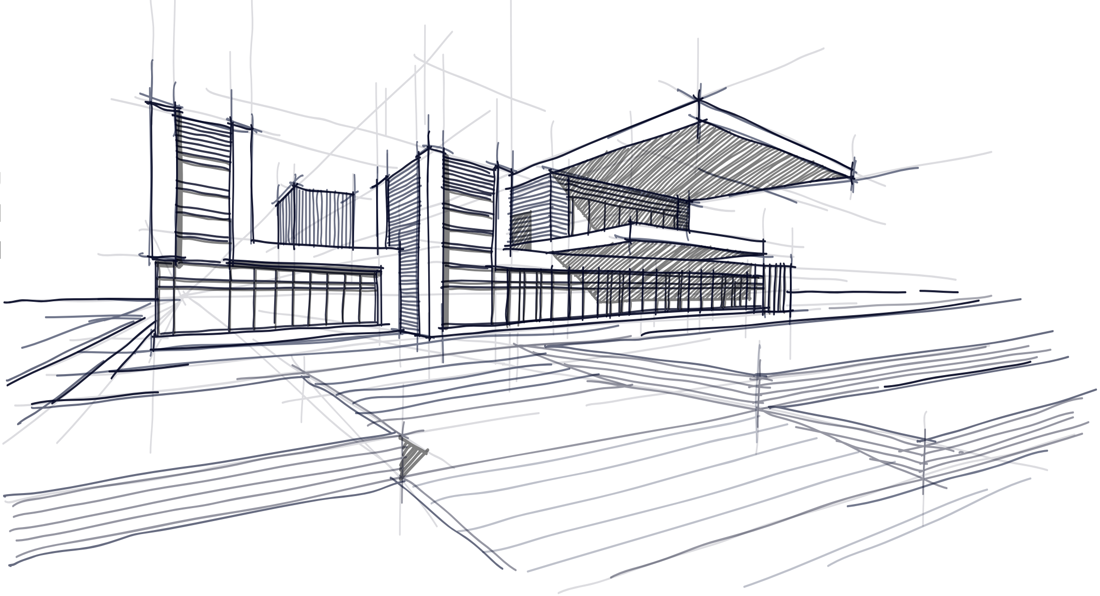
I see this trend in Norway now, buildings are moving from the 30/17 glass to the outside shading, mainly with zip screen. This is a way to swing the pendulum all the way from solving the façade with glass only to maximizing daylight with low-e glass and solving the solar shading with outside shaders only. The solar shaders in Norway are normally specified as very dark, black in color to make a "look-alike" to the glass and with 3% openness factor to provide glare control. Helioscreen 118118 is designed like this and is a true market leader. This brings very dark offices in the warmer half of the year. Shaders this dark should be combined with solar control glass, I will get back to that later.

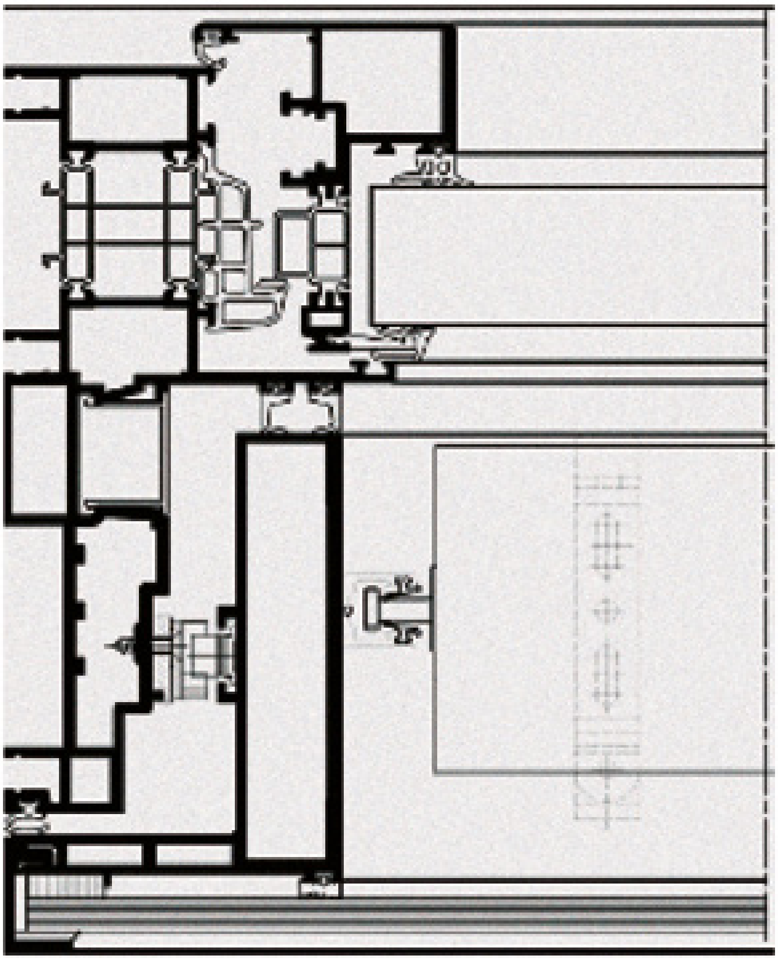
In Sweden we have used outside shadings over a number of years and drawbacks are starting to appear. The REHVA guidebook has a full chapter on maintenance of solar shading systems. They recite the EPBD recast 2008/0223: *„Regular maintenance and inspection of heating and air conditioning systems by qualified personnel contributes to maintaining their correct adjustment in accordance with the product specification and in that way ensures optimal performance from an environmental, safety and energy point of view"*. This applies equally well to solar shading systems but that is not written out.

In fact the maintenance is the main drawback for the outside shaders. They become dirty, are not cleaned and maintained. In many cases experiences show serious malfunction even in high quality equipment after 10 years. On top of this the patent for the zip screen has expired, and now cheap suppliers are flooding the market with solutions of very doubtful quality.

Another drawback of external zip screen is noise, here is an example of the Quadrum Building in Vilnius. Lithuania: There are reports that on windy days, the zip screens create a lot of noise when closed shaders whip the glass.

The Swedish market is starting to look for new solutions, and the solution given was a hybrid window or box window.





From the top you see an IGU, then space for the screen and lowest the single glass protecting the screen.

Now we have a solution protecting the screen, but also adding reflection, lowering light transmission and increasing cost. The main drawback is that in the hybrid solution either the single glass or (more often) the inner IGU must be made openable for maintenance. A main cost driver and also a clumsier look from the inside.

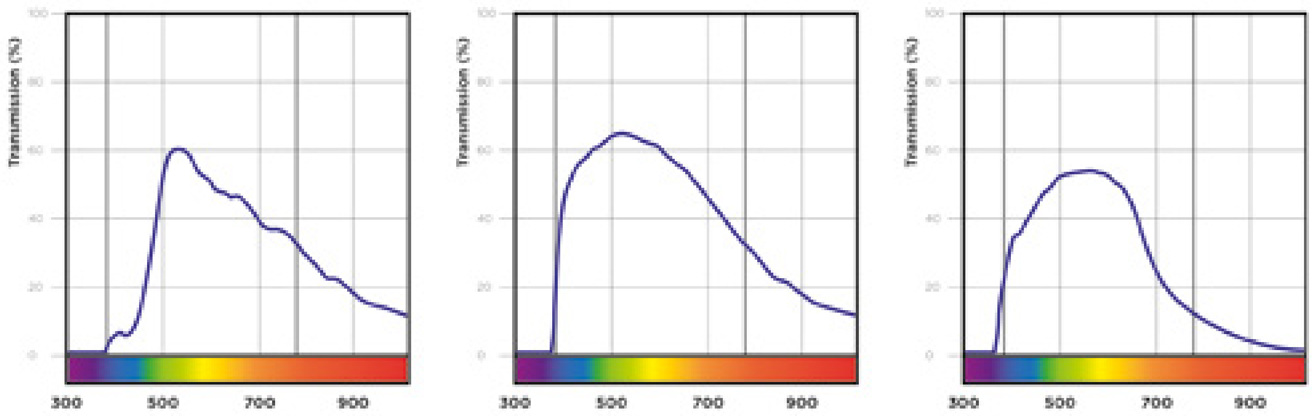
A fixed IGU has a frame percentage of 5-10%, an openable window often has a frame percentage of up to 30%. The decrease in glass to frame ratio also decreases light transmission, further reducing the light transmission advantage of low e glass.

The most used outside zip screen in Sweden is the Soltis 86. The 86 comes from the amount of material, 86% of the surface is fabric, 14% openness factor (OF). The decrease in daylight is of course great, and one must also point out that 86% coverage is not enough to prevent glare. Inside glare control is needed even when screens are down. The color must be dark.

An interesting case of box windows is the ÅF-Huset in Gothenburg. This is a positive case study, they work really well and bring the g-tot value down to approximately 0,10 when screens are down.

Two costly mistakes were made in the design, due to the architects wish for a white building with blue stripes, like the local football team IFK Göteborg.

THE FIRST was to use Vanceva Aquamarine in the outer skin. It does give a blueish impression, at least against a white background, but it really warps the daylight quality. Colored PVB should never be used for all see-through glasses in a room.



Spectral analysis of the 1+3 build up at ÅF-Huset with Vanceva Aquamarine (left LT 50%) and had it been standard clear PVB (centre LT 63%) And how it looks for the Arlanda Forest Hotel (right LT 50%). The SKN option shows superior selectivity with neutral transmission, only the visible red light is cut off a bit.

THE SECOND was to choose a very light color on the Soltis 86 fabric. When the screens came down the blue of the glass was emphasized to the outside, yes. But at the same time enormous glare was created on the inside, you could not look at the windows. Within 9 months of opening the building all screens had been switched to dark grey.

ÅF-huset Gothenburg

The conclusion of this is that it is better to work with the reflection colors than the transmission colors when creating the look of a building. I will get back to this in the late chapter on how to look at glass.

CLOSED CAVITY FAÇADE – CCF

The closed cavity façade is a version of the hybrid window. But instead of ventilating the cavity between one and three it is completely sealed and a pneumatic system is installed to keep an overpressure between the IGU and the outer single pane.

One advantage is an improved U-value, you get a quadruple glass unit, although with an uncoated outer pane. And you do not have to maintain the space between the single pane and the IGU, so there is no need for openable units. And the cavity is completely clean. The La Roche offices in Switzerland are white buildings, and thanks to the CCF technology, the shaders can also be bright white. When shaders are activated the whole building becomes one white block.

The drawback is that the façade unit becomes a sealed unit like an IGU, there is no possibility to maintain it, repairing errors in construction and mounting potentially means changing the whole façade unit. And the environment is not really kind to the mechanics. It is dust free but with big shifts in temperatures, you easily get 80+ degrees in the big cavity. If you by mistake have any volatile organic compounds (VOC) in the strings or shaders or mechanics, they will turn into a gas that condenses like mist on the outer single pane.

Closed Cavity facades is something that divides experts: Either you are a strong believer, or you are not at all. I have seen all the pitfalls of production units in my years as production manager at a glass processor. So I am not a believer, the cost of error is too high for me.

EXTERNAL SHADING COMBINED WITH SOLAR CONTROL GLASS

As mentioned before there are arguments for using solar control glass in combination with outside shadings as well. The first argument is valid for the Swedish tradition of Soltis 86: Here you normally get a g-tot value of 0,12 and if needed this can be vastly improved with the combination of outside shading and solar control glass, down towards 0,05.

The second advantage applies more to the Norwegian tradition of Helioscreen 118118; that outside screens need not be down so much. Users complain that a building with outside zip screens and low-e glass will not give you any real contact with the outside during the summer. When you come to work in the morning the screens will go down to greet you and as you leave in the evening the screens will wave goodbye by going up again. The addition of solar control glass as stated before gives a soft advantage that is often difficult to sell to the project.

Lund + Slaatto Architect office in Oslo. The outside screen has OF only 2% and so gives glare control. The combination with SKN 174 means it is only down when glare control is needed, and then only 2/3 of the way, letting in natural light at the bottom of the glass surface.

DOUBLE SKIN FAÇADE

Architects and other stakeholders think we should love double skin facades in the glass industry, since there are so many tons of glass involved. But it is a common misunderstanding that the glass industry wants to sell as many tons of glass as possible. That we love double skin facades because of the many tons of glass in all those layers of glass. But in fact raw glass producers prefer to sell the know-how bottled up in the coatings. Double skin facades are often expensive facades with very little value added for the raw glass supplier.

We do find some ways to try and squeeze in some fancy coatings:

1. The architect wants a light and shiny building from the outside – ST Bright Silver outer skin.
2. The temperature in the cavity between the 2 skins gets too high – SKN laminated to PVB in outer skin.

But anything added will decrease the light transmission of the total 1+3 construction. And the extra glass means we are already close to 60% light transmission. Adding a solar control glass will put us close to 50% light transmission.

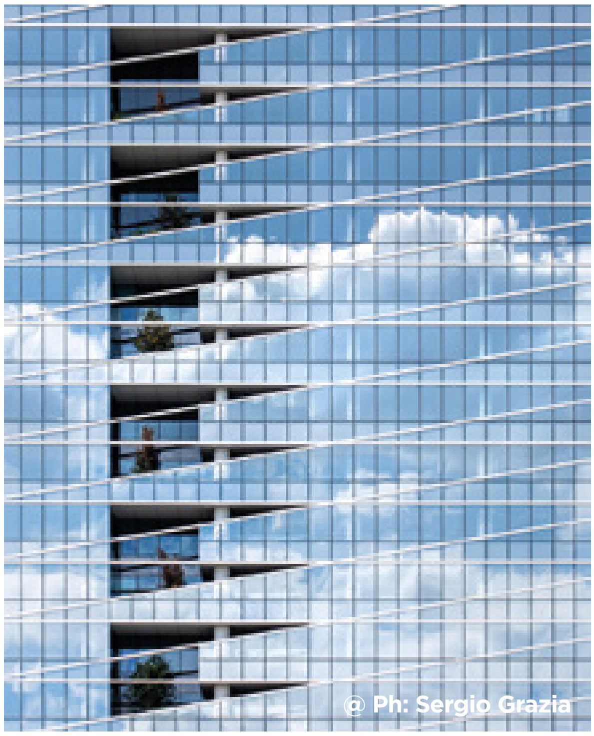
- And double skin facades are tricky creatures to calculate in building simulation programs: Adding a solar control glass in the outer pane as at Arlanda Forest Hotel should be an improvement over adding it to the inner skin by gut feeling. But the calculations does not agree, values are more or less the same. The temperature between the outer and inner skin is affected, but how much?

- How much do we count on the natural ventilation between the skins to keep temperatures down? Can it be blocked by obstacles that lower air speeds? Can air speeds get too high?

- Can we stop the ventilation enough in the winter time to turn it into a quadruple IGU calculation and gain a u-value advantage in the winter or is that exclusive to closed cavity facades?

A glass specifier should try to see if double skin can be switched to single: There is enough money in the budget to afford even SageGlass, a shift to Screenline also solves any g-tot problems in a single skin.

The conclusion to draw is that the single skin is always the most affordable and can replace double skin by adding functions to the TGU. The only case where the box window or double skin façade cannot be avoided is when the sound reduction demand is too high. If the demand ***for the whole façade*** *is above 49 dB (43 dB CTR) we can be fairly sure that it is not feasible to solve it with a single skin façade.*



Project: Saint-Gobain Headquater Paris / Architect: Valode & Pistre

Project:
Saint-Gobain Headquater Paris

Architect:
Valode & Pistre

@ Ph: Laurent Kronental

Project:
Paris Courthouse

Architect:
Renzo Piano Building Workshop

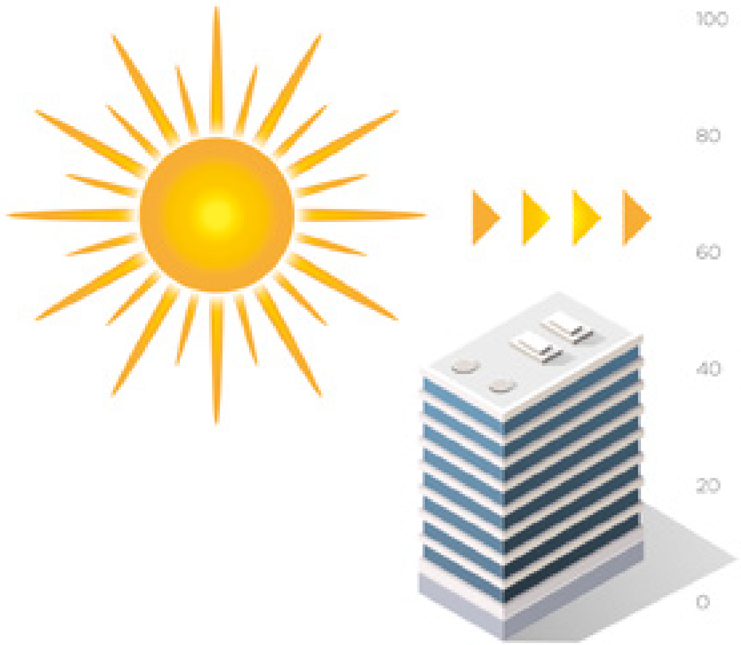
INTERIOR ROLLER SHADE

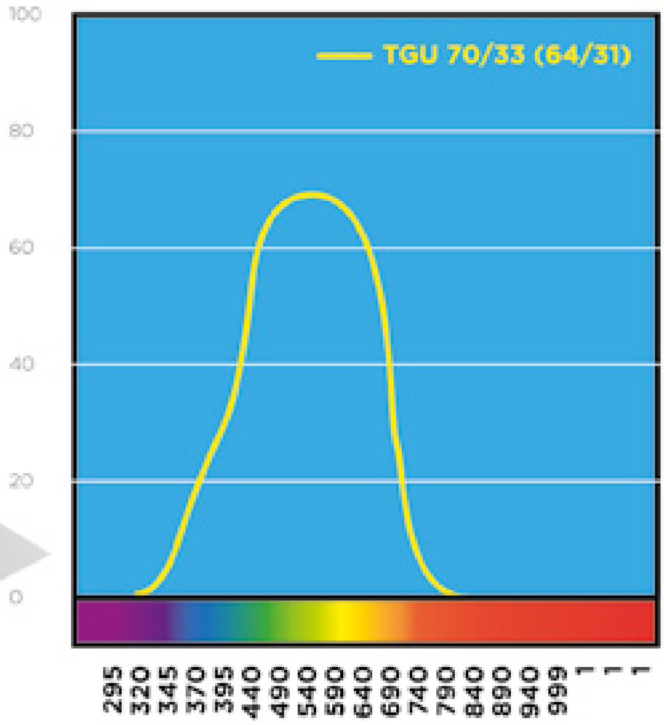
The big driver of success for Xtreme 70/33 on the Swedish market is the strong increase in facades with interior roller shades.

There is a definite cost advantage compared to external shading. TGU Xtreme 70/33 plus inside shader is about 30% cheaper than a box window construction for the whole façade. With a very small difference in light transmission, because the fourth pane of the box window eats away more than 8 percentage points of light. 1+3 or TGU with Xtreme 70/33 glass both struggle to stay above 63% light transmission

And there is a big advantage in accessibility for maintenance and replacement. There are three main reasons why the solution is growing right now:

Glass development: The Xtreme 70/33 has very high selectivity and low reflection. It is an effective solar control glass without the appearance of solar control glass. High selectivity here means that energy penetrates the glass directly only in the form of visible light.





Visible light runs from 380-780 nm and contains 43% of the energy from the sun. Rays longer than 780 mm is called infrared light and contains 55% of the energy from the sun. The spectra of direct transmission through a TGU with Xtreme 70/33 shows a near perfect adaption to the human eye.

Development interior roller shade: The inside shaders look better than they used to, the reflectance is higher (close to 80% for the one I acquired for my home) and the price of motors for inside shaders is dropping. And according to Anders Berkander of Shader contractor Thorens of Gothenburg there is higher end-user satisfaction with inside shaders over outside shaders. This remains to be proven statistically.

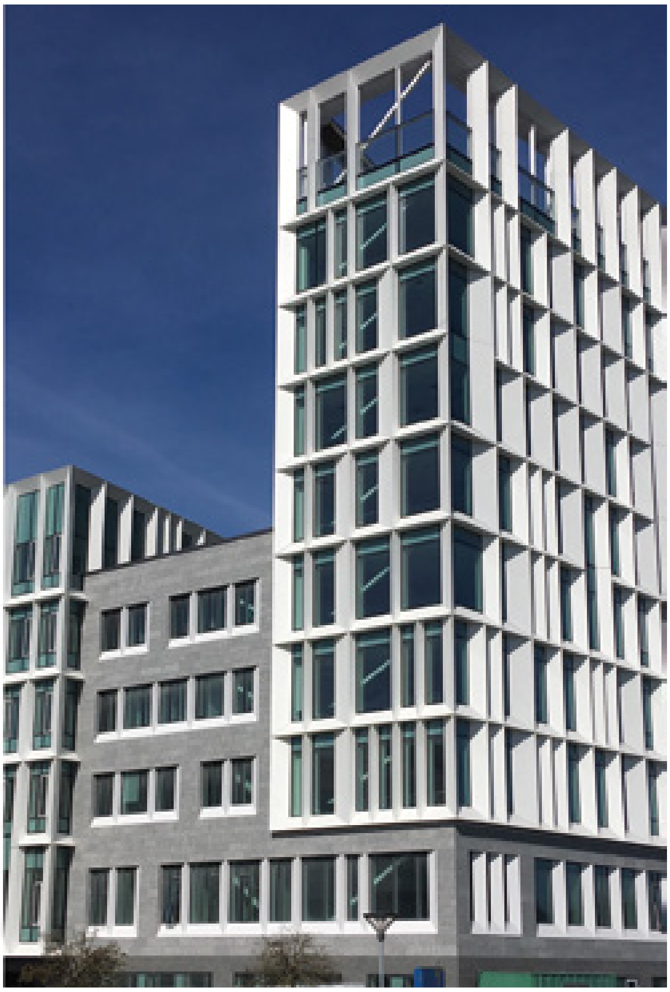
Software development: In July 2017 SSF ESBO program for building simulation transferred its calculations to the fully spectral version. On January 31 2018 IDA ICE also went into fully spectral mode. In a fully spectral calculation the energy transmission and reflectance is calculated for each wavelength, not as an average. This method is described in EN 410 and is more accurate that earlier arbitration methods.

Sommer Global of Rosenheim has had this type calculation for some time in their calculation tools, but ESBO is a freeware and is thus more spread and also accepted for the popular Miljöbyggnad certification. In Sweden the biggest advantage of ESBO is the possibility to build a solution in the freeware and then export it as an idm-file and send it to the consultant that performs the full building simulation. She can then just import the file into her model and get the full result.

In other countries where non-spectral tools like Transsolar have a high market share, this type of communication is not possible. I can share my experiences of successful project like the award winning Regionens Hus that has proven its performance in end-user surveys, but the building simulation softwares used by local consultants will block any learning curve.

To cut to the point: High reflective shaders and low reflective solar control glass give vast improvement in performance of the solution. Xtreme 70/33 ECLAZ in TGU plus the highest reflective Verosol Silver Screen would have landed at g-tot approximately 0,22 in old style calculation, now it gets down to 0,11 in the best case. For DGU it is even more effective, g-tot can get down to 0,10 or less. For TGU we have a 65/31 solution that drops to 65/11 with inside shading. In the DGU case 70/33 drops to 70/10 with inside shading. Magnificent values that include glare control and a lowering of operative temperature in the area near the window exposed to direct sunlight.

In short solar shading entered a new era with these calculations. With the combination of selectivity over 2 and low reflection the Xtreme 70/33 is outstanding in performance together with inside shading.



Regionens Hus in Gothenburg and Axis head office in Lund both use Xtreme 70/33 plus interior roller shade. Other advantages are less cold bridges with inside shading (Regionens Hus) and increased design possibilities (Axis).
Regionens Hus became unique building to be rewarded Miljöbyggnad Gold without external shading.

Picture shows SKN 154 DGU without interior roller shade (g-value 0,28) and with Verosol Silver Screen (g-sys 0,13). Please note that in TGU SKN 154 and Xtreme 70/33 have very similar g-tot values for TGU you can choose between 64/13 and 46/12. In DGU Xtreme 70/33 even outperforms SKN 154. Behold the power of the fully spectral calculation.

DESIGNING A SYSTEM

What demands should be written in the first pre-study specifications for a facade? The case can be made for having these on a sketch level to provide an outline for the rest of the project. But in fact at early stages there is a better view of the system that makes up the façade. The u-value, LT-value and g-total value add up to a delicate balance. If fine tuned from the start a smaller margin of error can be used and this in turns gives a lower and more precise budget, especially if the HVAC-system choice is included in the equation. The specified combination of glass and shader should be set in a way that the whole system must be proved again by any stake holder who changes his or her bit. This requires a deeper knowledge of the products found in the huge data base jungle of ESBO.

On top of that comes the demands of for instance BREEAM that can be interpreted as prohibiting PVC screens. And the Swedish building materials classifier Byggvarubedömningen has for a long time allowed PVC in outside shaders but not inside shaders. The flame protection of some shaders have been put in question. The confusion for BVB seems to be coming to an end as they adapt to approving fabrics with the Öko-Tex third party cerification.

To provide a short cut to anybody confused by the ESBO database I have designed a smorgasbord of recommended products for different demands. In close cooperation with Markisol for inside shaders, Shüco for frames and Somfy for automation we have taken cost effective products we recommend and provided values for different window sizes in an Excel table, topped with a link to the idm-file describing that system. The idm-file is compatible with ESBO and IDA ICE tools from Equa Simulation. The idm-file is a powerful and easily communicated way of explaining what system you have chosen, to change one part the system must be secured with an alternative idm-file.

In conclusion; the more precise the first consultants study is, the better the chances for the solution to survive all the twists and turns of the project, the sub optimization by cost cutting at various stages of a project. If legislation or certification levels are secured already at this level a lot of cost and discussion and potential failures and consultant costs down the road should be possible to avoid. Due to the continuous development of these solutions I will not publish the recommendations here but publish it on the landing page. https://pl.saint-gobain-building-glass.com/pl/Oskar-Storm

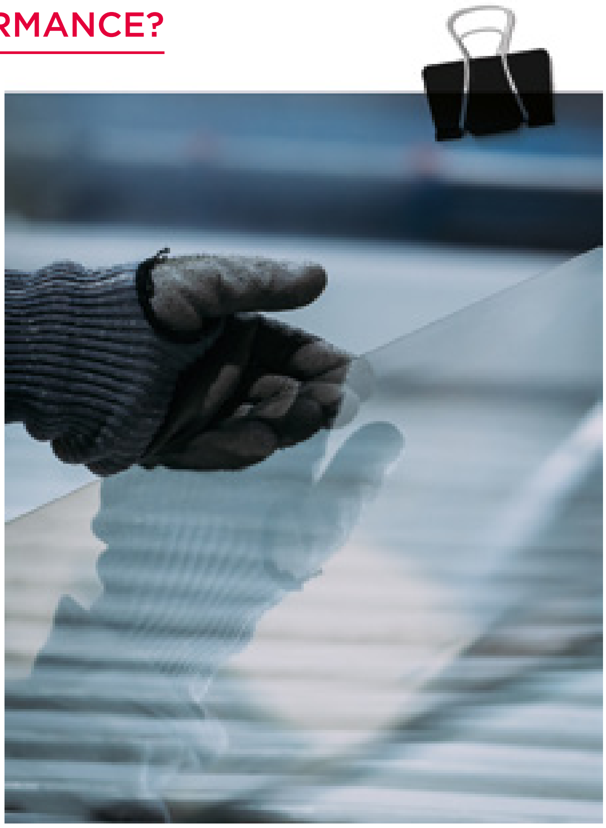
DESIGNING FOR COMPLIANCE OR PERFORMANCE?

How well do we trust the numbers presented in the ESBO calculations? It is the difficult task of the consultant to choose what safety margin to apply in the calculation. If the design is for compliance it means that the project need meet some demands only on paper. Maximum values in SSF ESBO tool can be used.

If the design is for performance, measurement when building is in use will be needed to prove the design. Here a margin on the systems values is advisable, to give room for some tolerances. The insecurities can be divided by:

1. Glass product
2. Shader product
3. Calculation tool

The effects of these insecurities are fairly small, all inside a few percentage points. But when glass+shader values go below 0,15 the insecurities grow in importance. I will go through the drawbacks one by one but would first like to point out that the relative differences between the product combinations are always stable.



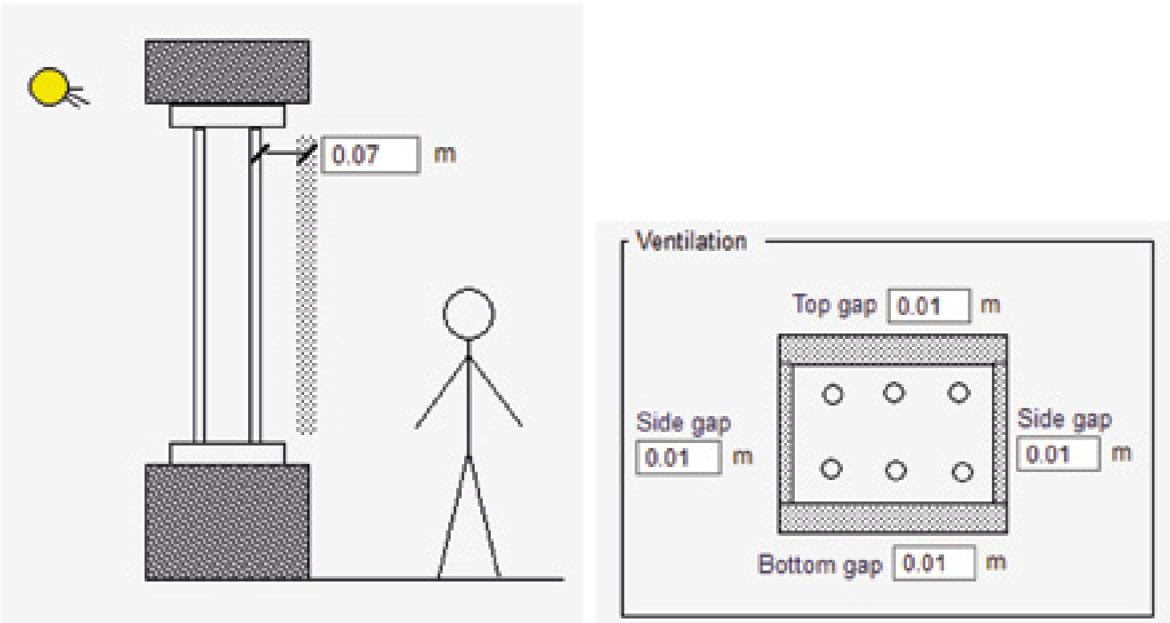
GLASS PRODUCT:
The first calculations for a façade are generally made with thin glass, TGU 6+4+4. And with the general values for g and LT given by the glass suppliers spectral files. Very often IGUs are made from thicker glass and laminated glass to meet the demands of the specific project. For daylight calculations it is good to calculate 2 percentage points lower than the maximum values due to this. And to be aware that thicker glass has a lower g-value for the glass, but a higher g-tot value for glass plus inside shader. This drawback can be calculated in the ESBO tool.

For commercial buildings we should assume some difficult demands already from the start. If we calculate a glass type with 8+5+44.1 that will sustain 7 m2 glass surface and sound reduction levels for glass up to Rw 45 dB, it is my best guess that this will be valid for >80% of facades. For this case the light transmission drops by 1,5 percentage points and the glass plus shader efficiency (g-tot) is also negatively affected and rises by about one percentage point.

SHADER PRODUCT:
The glass coating is set inside the IGU in a stable, dry environment and the values are stable for the life time of the glass. The shader fabric has the reflectiveness to the outside as it's main variable for g-tot performance. This reflective coating is exposed to the air of the building and can be damaged by glass cleaning chemicals. The performance over time could contain some uncertainty.

In addition the values presented in ESBO are seldom tested and approved by a third party. But the main issue to consider is the edge effect for the glass plus inside shader.

CALCULATION TOOL:
The window model of the ESBO tool takes into account the distance from glass to shader and the ventilation between shader and frame, but does not consider edge effects. In this way window properties are calculated as if the glazing/shading system were infinitely large or infinitely thin. What part of the sunrays that can actually return out through the glass is mainly determined by relation between the window size and the distance from glass to shader, but to some extent also by the color and geometry of the window sill, reveal and frame. Hereunder I will simply call these parts "frame".



Settings of the ventilation gaps and the distance between glass and shading in the ESBO tool.

A long distance from glass to shading means the that solar radiation at an oblique incidence angle will partly be reflected by the shading to the frame instead of out through the window. These rays are then either reflected or absorbed by the frame depending on color. If the frame is then dark it will heat up and give off long wave radiation that cannot escape through the glass. The bouncing patterns of the light can be very complicated. Long wave radiation emitted by the frame cannot be transmitted through the glass, since glass is opaque for thermal radiation. And if the shading mounting method creates big ventilation gaps around the edges most of this absorbed heat will be transferred into the room. This in turn means that solar heat finally reflected or transmitted depends on the relation between glass area and the distance between glass and shading. With bigger glass panes more rays are reflected directly out. With shading fabric closer to the glass more rays are reflected directly to the outside.

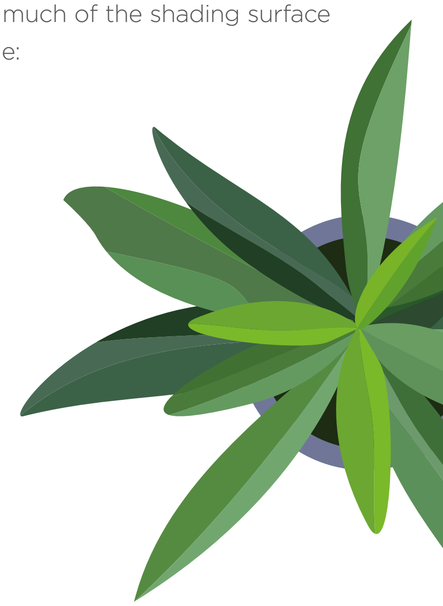
If you comply with demand on paper and have cooling installed, the deviations between calculated and realized g-tot is not a big matter. But if you have no cooling, like in a standard school classroom, the effects can be the difference between comfortable and too hot temperature. The more advanced your glass plus shading solution is, the more it loses out on glass size and mounting distance. I have made calculations with four scenarios:

Standard glass + advanced shader	Advanced glass + advanced shader
SKN 183 TGU + Niesen 190 Black	Xtreme 70/33 TGU + Niesen 190 Black
Standard glass + simple shader	**Advanced Glass + simple shader**
SKN 183 TGU + Volt 6600	Xtreme 70/33 TGU + Volt 6600

LT 69%, g-tot 15%	LT 65%, g-tot 11%
LT 69%, g-tot 21%	LT 65%, g-tot 17%

Now you have what you need for documentation for Miljöbyggnad or other certification for compliance. For performance there are some estimations still to be done:
Glass thickness: You will loose one or two percentage points if glasses are thick due to size or sound reduction demands.
Edge effects: If we assume a spring time case with a fairly low sun we can calculate how much of the shading surface actually helps the window. This varies depending on the solar angles, but here is one example:

- The sun is placed at 30 degrees above the horizon and the sun hitting the window from a 45 degrees azimuth angle.
- Some of the rays will be reflected away directly at the surface of the glass, but we do not consider that effect.
- The reflection in the shading is assumed to be specular.
- The window frame is light grey and absorbs or misdirects 75% of the rays that are reflected from the shading and does not hit the glass directly and reflects 25% of these to the glass.



Size / distance	20	70	120	170	220
1200 x 2700	97%	89%	82%	75%	67%
600 x 2700	95%	81%	67%	54%	42%

Size of glass and distance from glass to shading are written in mm.

With a narrow window and a deeply set shading we should maybe consider it as if only 42% of the glass is helped by the shading. This is a very complicated universe and I hope there will soon be a tool in IDA ICE to better estimate said effects.

Side effects on the glass of bringing the shader closer to the glass:

Very often the issue of thermal breakage of the glass is discussed as a reason for keeping a safe distance between glass and shader. Some façade makers issue a disclaimer for shaders within a certain distance of the glass. Each case has to be calculated individually, but there are some rules for avoiding breakage:

- Solar control glass: Always use a solar control glass to absorb energy at the outside, before it hits the screen.
- Ventilation: Have a ventilated screen, at least at the top and bottom.
- Heat pocket: Beware of any unventilated heat pocket between the ceiling and the top of the glass. Here temperatures can get high.
- Edge treatment of glass: Poor cutting is found to be the reason for thermal breakage in real cases. Edge treatment of the inner pane, fine ground edge is best (but expensive for laminated glass), will minimize the risk in most cases.

Side effects on the shading of bringing it closer to the glass:

Mounting the shading inside the window frame means the motor and electric installation becomes individual for every window:

- Use a bigger window size to lower the cost.
- Don’t go narrow. For interior roller shade less than one meter wide and more than 2 meters tall it is difficult for the fabric to roll up correctly.

CONCLUSION:

Glass plus inside shading is still a great solution. But it is not the solution for every situation. The edge effects mean we have to regard the whole system, as usual:

1. Horizontal window bands respond a lot better to inside shading than floor to ceiling windows separated by floor to ceiling spandrels.

2. If cooling is installed the thermal comfort of the room is still possible to sustain if the cooling system has been correctly dimensioned.

3. The shading contract must be included earlier in the building process and worked out in parallel with the façade contractor. This is easier said than done, because installation of façade and shading system can be many months apart and done by players that do not know of each other today.

QUALITY OF FABRIC:

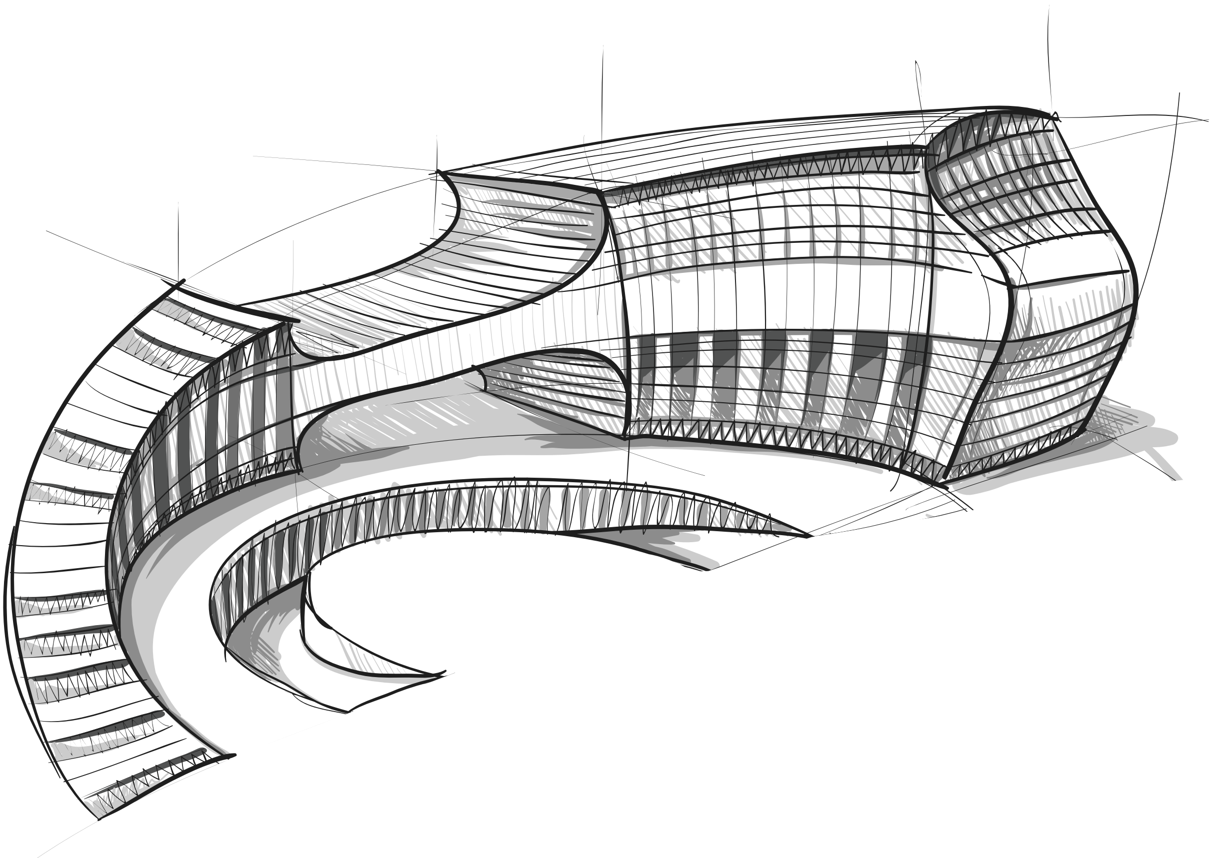
The thermal analysis of the shaders focus on the reflectance and the openness factor. But for the individual project many other factors should be considered:

Size: How well does the size of the glass fit to the max width and height of the fabric? How well does the fabric stay on the roll? You do not want to stitch together 2 rolls of fabrics, and you do not want it to roll up in a messy way.

Glare control and view to outside: These are very subjective values that are hard to specify in numbers. The openness factor and the inside color are important factors, but not enough to determine how the light diffuses through the fabric.

Sustainability: Do we need PVC in the fabric? Can it be recycled? Is it certified by third party like Ökotex? Is the metallic coating protected by additional coating to ensure a long life span?

Noise: How do you mount the fabric in a way that ensures efficiency and at the same time avoids a disturbing noise level when the motors are running?



VENETIAN BLINDS BETWEEN PANES

Insulating glass with integrated blinds are marketed under the brand names Climaplus Screen (IGU) and Climatop Screen (TGU). The blind of choice for Saint Gobain is ScreenLine® made by Pellini. The blinds are well protected from the climate and other external influences like dust, dirt and people. With closed blinds the g-value drops very low, around 0,08. With the help of solar control glass and the V95 slat which was especially designed for glass units using selective coatings, g-tot value as low as 0,05 can be achieved.

When visiting a bigger project with integrated blinds it is striking to see how mild and comforting the light is in such a building. The glare control of blinds is the best of all shading solutions. For thermal comfort the blinds need to be automized. It is recommended that local switches are mounted to allow control at the individual work station. Then the employee can adjust the blind to the desired angle.

Special projects may require special handling. After production of units with integrated blinds, the blinds are lowered and tilted open overnight to allow any remaining moisture to be absorbed by the desiccant in the spacer bars. Afterwards the blinds are raise to the so-called transport mode. When unitized facades are being used it is recommended to lower and tilt the blinds open during storage periods.

Overall it is important to approach each project individually when it comes to integrating blinds into IGUs. I am happy to support any such project.

FAÇADE CONTROL SYSTEMS

The remaining product for discussion in this booklet is SageGlass. It always gives a view to the outside, so it is important to discuss control systems for shaders first because the disadvantages with control systems are one big advantage with this product. The view to the outside is a very basic need in mammals, and the blocking of this view imposes a serious drawback of many shading systems.

The first thing to know about control system is that they have to be automatic to make it possible to use the full ESBO calculated benefit in building simulation programs. Manual systems are corrected with a factor, generally 0,5.

The automation need becomes obvious if we look at the east façade case: In Stockholm and Oslo the sun hits a building from the north east at 4 am in the morning on an average day in June. Who is there to lower shaders at that time of the day? And heat entering the building in the morning stays all day, only at night standard ventilation can cool a building.

Still this is the first mistake in many constructions, the desire to save the cost and the headache caused by building automation.

Manual **glare** control at Hekla Building in Kista on a grey day January 2020

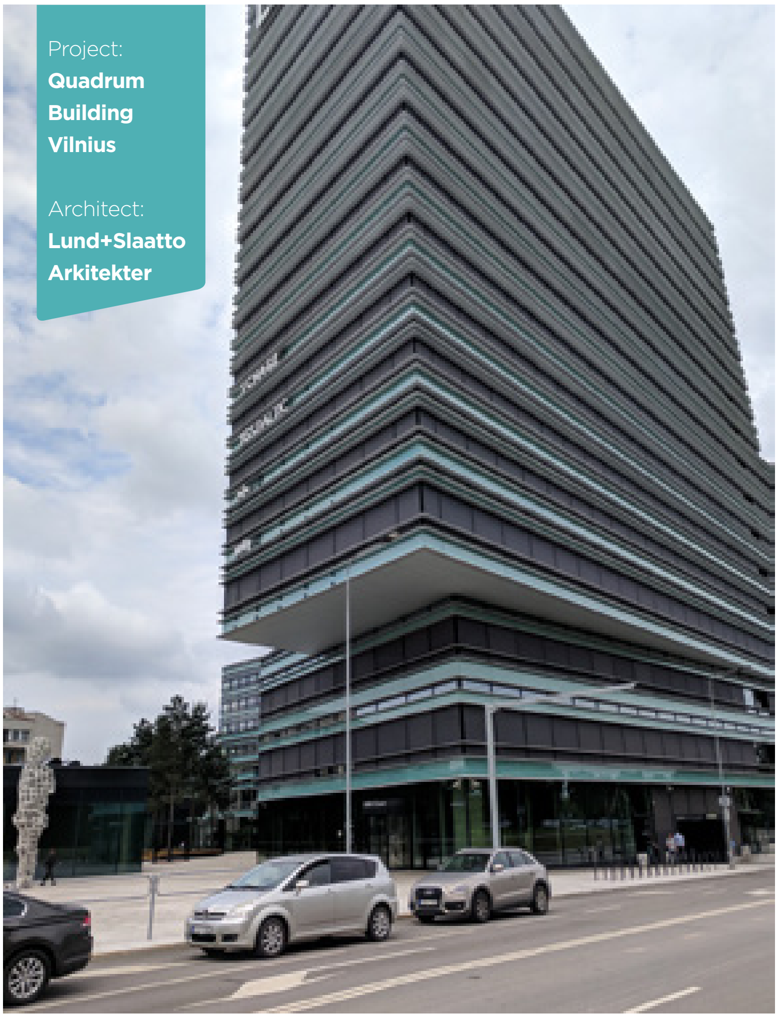
THERMAL COMFORT OR GLARE CONTROL?

In building simulation the trick is to keep more or less the same comfortable temperature all the time without using too much energy for cooling or heating. To avoid cooling the obvious action is to close the shaders when the sun hits the façade on a summer day. But with a well insulated office with good daylight the low spring, fall and even winter sun can cause overheating during most parts of the year. And at the same the sun can also help heat the house in the winter if the shaders are up.

The harvesting of heat in the winter has to be balanced against the visual comfort of glare control. The formula 1/3/10 says you can have 3 times the light level of your desk from sources of light coming in at 45 degrees angle and 10 times the light level in the corner of your eye. The individual conception of glare is the reason behind individual override possibilities for shader system, and at the same time a very tricky issue to handle in open office landscapes, where the same window have different placements on the 1/3/10 scale for different desk locations.

The EN 17037 norm for daylight separates thermal comfort from glare control, and does not really consider glare in daylight autonomy calculations. That makes it easier on paper, but the shader systems were generally developed for glare control. The amount of lux that hits a building is decisive for when shaders are activated, not the amount of watts.

This focus on light level makes it tricky to make decisions on outside shaders in Sweden. Because here we use the outside shaders for thermal comfort, they are not enough for glare control, glare control is handled by additional inside shaders. And the discussions at coffe break are generally about the weather and about the strange movements of the shaders.



External screens down around the building on a cloudy day...

Inside shaders combine thermal comfort and glare control and should hence be easier to set. But still it is important to discuss the angle of the sun to the façade before activation of shaders. In ESBO tool generally activation of inside shaders is commanded before the sun gets into glare angle.

Facade automation systems also perform other tasks, like raising shaders when the fire alarm goes off, or (in outside case) raising them when the wind is too strong or when frost can stiffen the fabric. They reset the shaders during the day or in the evening, making the façade look tidy and preparing it for the coming hours or coming day.

To learn more about shader operation it is recommendable to read the 76 pages short book "Solar Shading – How to integrate solar shadings in sustainable buildings" ISBN 978-2-930521-02-2 and to connect with a local Somfy representative.

Somfy supplies façade automation motors and hardware/software. They are the driving force behind the release of SSF ESBO and ESSO ESBO and they have recently developed the most flexible control system on the market, with three main drivers behind flexibility:

1. The motors are not controlled over cables, but wifi, all motors are part of a cloud and the when and why the motor is activated can be changed fairly easily.

2. All facades of many buildings can rely on one advanced weather station on a roof.

3. A 3D-model of the house and its surroundings clarify when a window is shaded by another building – a signal to raise the shader.

Still this fancy system cannot guarantee user comfort. If and how to design manual overrides is a very difficult decision to take. And an important one, because there are so many personal preferences. Looking at the MT Högaard main office below, I think there will be some increased worker efficiency by the possibility to influence the venetian blinds.

MT Höjgaard head office in Denmark. Staff can adjust blinds themselves in groups of three.

Try to find out how many different choices have been made on this east façade. And notice the façade sensor on the top floor in the fourth white field counting from the left.

Inside view from the same building. 3 different slat positions visible.

CONCLUSION

The list of glass I specify is very short and a good way to end the chapter on dynamic facades:

ECLAZ low-e glass for north positions and where maximum daylight is required. Normally I set the TGU light transmission to 75%, because the maximum 77% is quickly cut back by lamination and sound reduction and size demands. But for extreme cases the light transmission can be pushed up above 80% using a non reflective and very expensive middle pane called Vision-Lite. For S/E/W positions I recommend use together with outside shading systems, inside shading has thermal stress issues for a glass with such high g-value.

SKN 183 is the brightest solar control glass. It can reach close to 70% light transmission in special build-ups, but I recommend not to move above 67-68%. I recommend it in combination with ECLAZ for best looks and performance. In combination with outside shading it gives better comfort than low-e glass, and in combination with inside shading it can solve thermal comfort for bigger office landscapes.

Xtreme 70/33 is the brightest glass in the so called “triple-silver” group of solar control glass that blocks out the infrared direct transmission completely. For me it seems silly to go to lower g-values because further solar load reductions are only made by cutting back on visible light. Xtreme 70/33 does not really look like a solar control glass and is very efficient in combination with inside shaders.

Xtreme 50/22: If there is no possibility for a dynamic façade, the 50/22 glass combines OK light transmission and reflection values with a g-value below 0,20.

PRODUCT	daylight	energy
TGU ECLAZ + ECLAZ	>75%	60%
TGU SKN 183 + ECLAZ	>67%	37%
TGU XTREME 70/33 + ECLAZ	>63%	31%
TGU XTREME 50/22 + PLANITHERM XN	>40%	19%

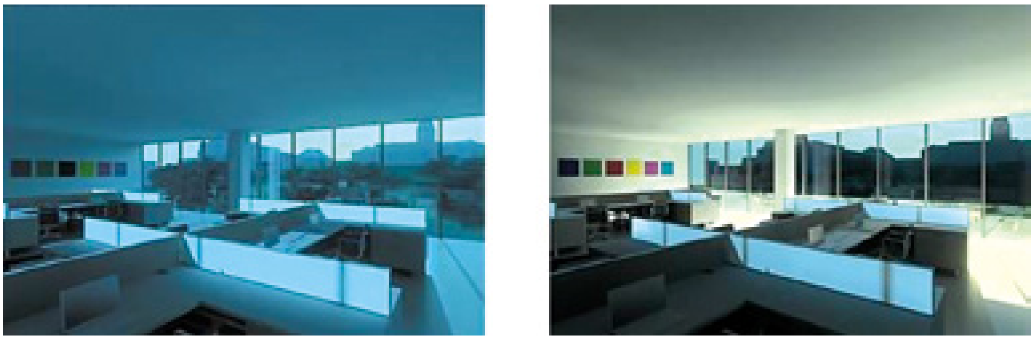
The four types I mainly work with.

SAGEGLASS

The solution resists any climate loads that can have a negative impact on the function of the shading system. In fact, SageGlass is the only shading option where you can estimate a life cycle cost for the façade without having to replace some components at some point. The advantage of SageGlass is that it is dynamic.

Electrochromic glass is the only solution that guarantees a permanent view to the outside in all tint states. As for the positive effects of views and daylight, researchers agree: Everything is true from enhanced patient well-being resulting in earlier release and decreased medical costs to higher efficiency and productivity among office workers . SageGlass is a dynamic glass that tints as low as 1 % light transmittance, hence it can replace other glare control.

Each sun shading solution comes with its benefits and drawbacks. Electrochromic glass has been criticized for the blue color of the tinted panes. It is recommended to use SageGlass LightZone and SageGlass Harmony that offer the possibility to divide the glass into various in-pane tinting zones. Studies have shown that if only 10 % of the glass is left clear, it will compensate for the color of the tinted panes. SageGlass' newest edition to the in pane zoning is SageGlass Harmony which provides a gradient transition from the top to the bottom of an IGU. It adds visual comfort compared to the strict lazer cut zoning.



Rendered effect of the coloring index in a room when comparing a single zone IGU with a multiple zone IGU. Only 10 % of clear glass is enough to stabilize the coloring index in the room.

In some ways, SageGlass is easier to handle than standard glass in specification because it combines full flexibility in some areas with strict limits in other areas:

No need for different solar controlled glasses: SageGlass offers variable light transmission from 54 % to 1 % of light transmission for a TGU and 60 % to 1 % light transmission for a DGU.

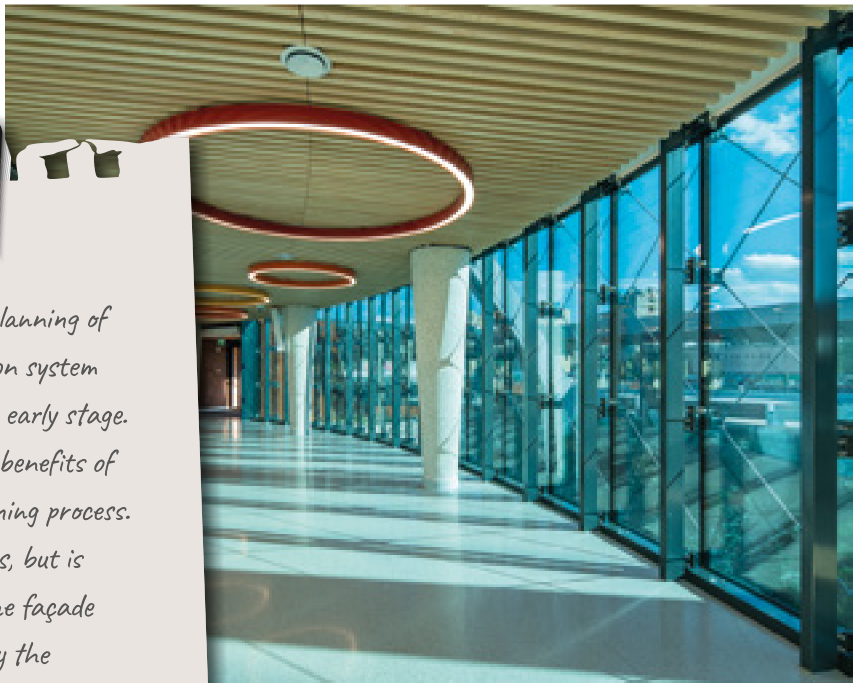
Sizes: With a maximum dimensions of 1828 x 3048 mm for rectangles and the outer glass laminated with Sentryglass, SageGlass is versatile enough to fit into any space. The glass should resists harsh weather conditions such as strong winds and heavy snow loads.

Project:
Bus Station, Poland

Architect:
M. Kamiński
B. Bojarowicz
Architekci s.c.

When ordering SageGlass, there is some complexity perceived by the façade contractor. A detailed planning must be made in advance on the control system and the automation. For sure, the SageGlass technical staff provide the façade contractor with the control architecture and wiring diagrams, supervise the installation and aim to make sure the system runs smoothly. But it is not the standard way of dealing with facades.

The reason for this perceived complexity is that the façade maker have to handle many entreprenades. The shading system and façade automation system normally belongs to other stake holders further down in the chain of building industry suppliers. Decisions on these systems are normally taken much later in the building process. When choosing SageGlass it is important that the whole glass/shader/automation system is planned simultaneously, not forcing the façade maker to drive an uncommon process.



In my opinion, the detailed planning of the glass/shading/automation system should always be made at an early stage. I have mentioned above the benefits of including it early in the planning process. It goes for all façade systems, but is especially important when the façade automization is performed by the IGU itself.

DESIGNING GLASS FACADES

SPANDRELS

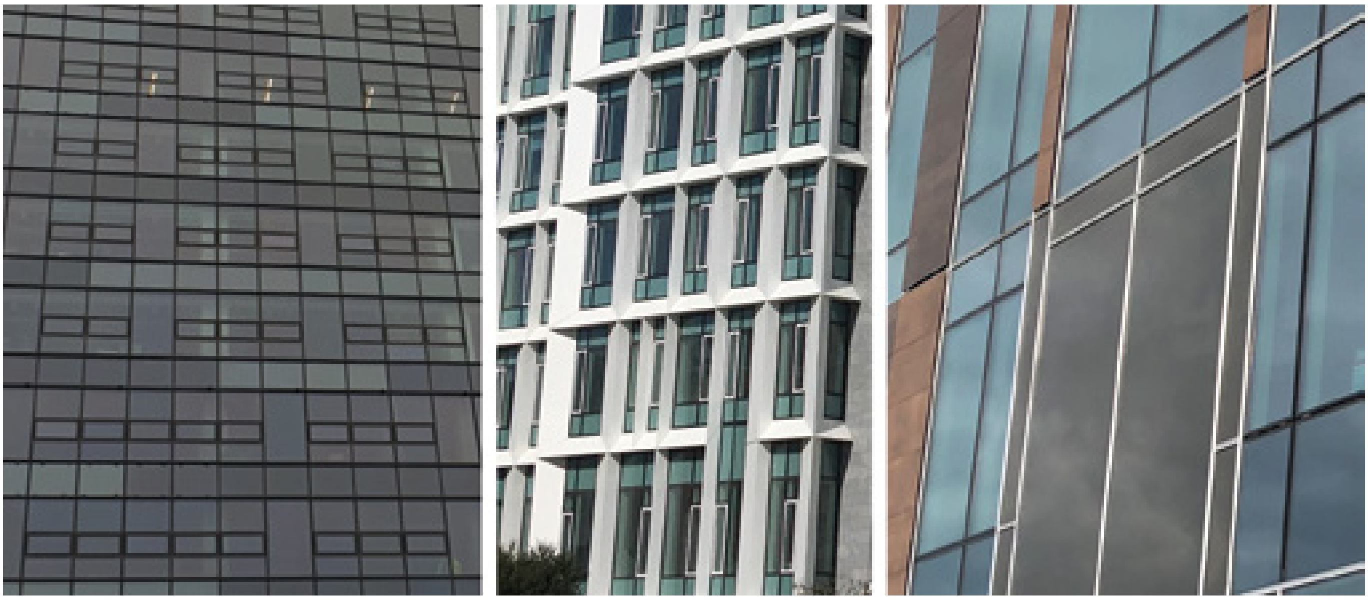
In conclusion to the façade let us finish with a discussion on spandrels. I have written articles about look alike facades and patterened glass in facades that are available online at my landing page.

BE AWARE

Look alike spandrels should always be darker than you think. Because with a 1% daylight factor behind the glass and shrinking window to wall ratios, the standard low reflective solar control glass will look very dark, darker than standard float in many angles. My general bet is for a double glass unit the same solar control glass as in the triple glass windows and a dark grey enameled glass with enamel #4. On a standard mock up people will look through the glass and not realize what the correct color is.

Gårda Vesta mock up inspection – how to guess spandrel color? Photo courtesy of ACC Glas och Fasadrådgivare

This part of Malmö Central station is a good example of the type of building we imagine when we look at a standard mock up. This building has several different glass types but the look is defined by the fantastic daylight factor.



Left to right: Nivy Tower Xtreme 70/33+RAL 7043, Axis Xtreme 70/33+RAL 7038, Tullhuset Xtreme 50/22+RAL 7026

The need for solar control glass in spandrel I have challenged a lot, but on a rainy day in Helsinki we did a mock up samples inspection that convinced me:

Outer pane left to right: Xtreme 70/33 Diamant   Float   Xtreme 70/33 Diamant / Planiclear laminated

This picture tells you that the float pane might look the same in perpendicular view but will have a much higher reflection in the angular view. The first pane decides the image from the outside, the float glass has 2 sides with 4% reflection, rising at an angle. The 70/33 glass has 4% reflection on outer surface and 0,5% on inner surface of outer pane. Up to a point the difference becomes bigger the bigger the angle.

Another theme is the use of high reflective spandrels to improve daylight calculations:

Many governments or other organizations realize the risk that close to zero buildings will become unattractive due to the low share of glazed surface, and so add daylight requirements, usually some type of daylight factor.

Here it should be mentioned that the daylight factor must be checked in detail. For Sweden the required daylight factor is 1% whereas in Norway it is 2%. This sounds like a huge difference, but in fact the Norwegians calculate average daylight in the room, and in Sweden it is about a single point half way into the room at desktop level one meter from a wall. With no benefit of the strong glare found next to the window boosting the Norwegian average calculation, the Swedish and Norwegian rules are in fact more or less the same.

Back to the topic: The daylight factor in densely built places (like cities) has a very strong correlation to any building shading the new construction. White is becoming a favorite in cities to bring more light all the way to the first floor. Introducing high reflective spandrels into the game (Mirastar or IGU with ST Bright Silver #2 and Diamant RAL 9003 #4) gives better reflectance of the façade and could tilt the daylight calculation in the right direction:

For an important project in Oslo we had discussions with consultant responsible for daylight. She complained about difficulties in getting enough daylight on ground floor. “What light transmission do you need?”, I asked. “200%” she replied.

For a new care building at Malmö Hospital the architects have brighter and brighter materials higher up in the building. To make the building blend in with older buildings of bricks at the street level but the gradually become brighter and sort of vanish into the sky. This is a very old trick, and it releases the glass advisors fantasy:
ST Bright Silver spandrels and/or Xtreme Silver at the top, shimmering spandrels from patterened glass (although difficult to calculate the reflection for these) and double printed enamel spandrels slowly moving from dark to bright.

For spandrels moving from dark to white it is important to point out the the move should not be made from 0% white to 100% white in one smooth move. Everything in the design happens somewhere between 40 and 60% white. So for a more subtle building use smaller steps in coverage differences from floor to floor, starting with some 40% white.

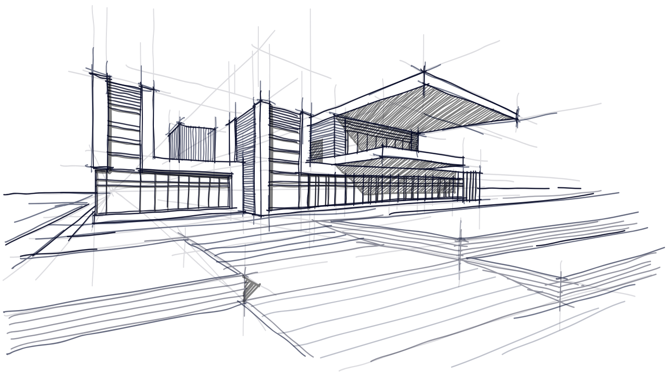
In any case it is feasible to predict that the days of facades with 90% window surface are over. In Sweden I see glass shares from 30-50%, sometimes up to 65%. To reach daylight targets without loosing out on contemporary U-value demands for the entire façade down to 0,5, a fully glazed façade is very difficult.

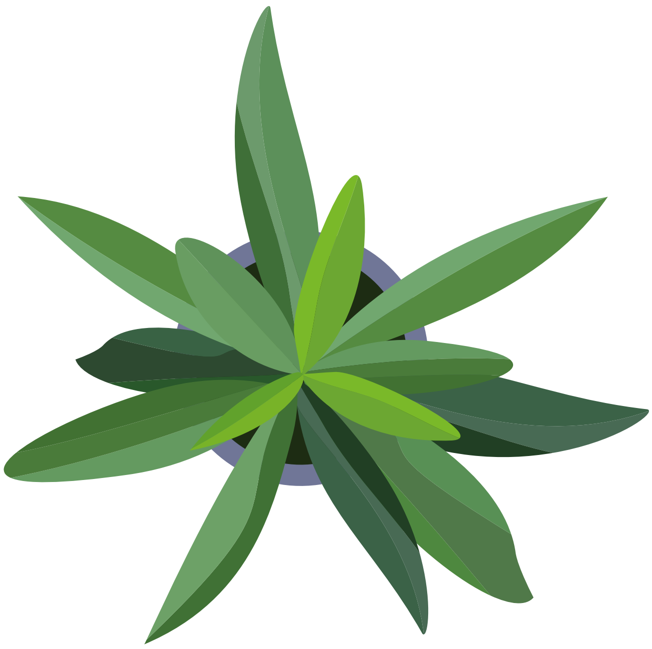
For Saint-Gobain this means a stronger focus on finding and specifying interesting spandrel solutions. When facades are not fully glazed anymore, we have a lot of different materials to choose from When looking at Regionens Hus it has advanced solar control glass Xtreme 70/33, but the most expensive glasses are cornerpiece spandrels; the bent four side stepped silicone sealed IGUs with outer pane enameled first with green pattern and then with full white print compatible with DC3362. Printed in Lithuania, bent in Austria and assembled in Latvia.

To save some money Diamant glass option was sadly taken out in favour of standard float. Looking at the yellowish RAL 9010 mock up glass at perpendicular view there was no worries about greenishness. Standing below the façade and looking up at a strong angle the greenishness becomes a little more apparent.

Kronprinsen building in Malmö (right) is a great 1960's example of making a building vanish into the sky. He mosaic wall cladding slowly gets brighter towards the top of the building. Regionens Hus in Gotheburg is more obvious in the shift. Kronprinsen is closer to 40/60 and Regionens Hus is more of a 0/100 example.

In order to maximize glass share in future facades we finally need to draw attention to the benefits of bigger glass panes. Bigger quadratic panes (not necessarily oversize) and fewer profiles allows for a much lower u-value that a fashionable façade of narrow glasses known as "stading French fries", given the same share of window surface. Regionens Hus only has 30% glass share and huge spandrels of over 4 m2 to minimize u-value.





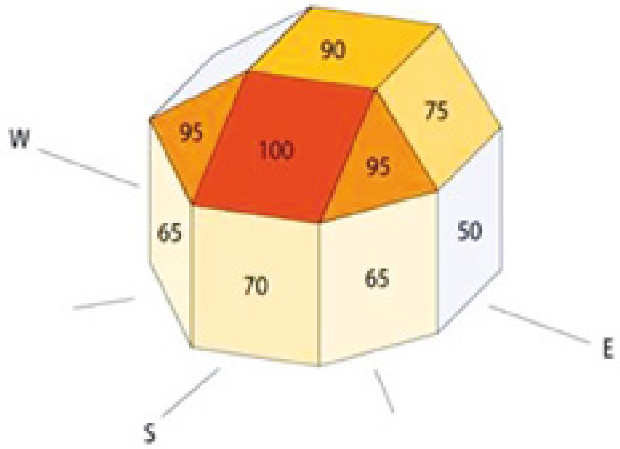
DESIGNING GLASS FACADES

BIPV

Spandrels can be seen as a waste of space, just a wall with nothing but decorative function. The enameled glass usually enclosed cannot be used in a circular economy, at the end of life it must be downgraded. Those are insights I have made in recent days. An interesting option is to put building integrated photovoltaics – BIPV – between the windows instead of decorative items.

DESCRIPTION

The positive thing about BIPV is that the price for the standard silicate cell has come down enormously in recent years. It is getting more and more possible to make the calculation work on vertical positions and also on facades not facing completely south.



If BIPV are positioned in more directions than one, they have a higher chance of fulfilling the energy demand of the building for large parts of the day.

The negative thing about BIPV is that they want to absorb all the energy. In doing so they give no reflection and often seem dull, like an old fashioned single glass enameled spandrel at best, and like a standard PV-module at worst. There is some room for improvement without removing to much of the PV efficiency:

Painting the silver: If the silver connectors are painted black with ink or other means then you have created a fairly black piece of paper for continued design. The PV cells themselves are different shades of dark blue.

Solar patterened glass: There are some patterened glass called Solar Glass designed to lead angled light into the PV, thus improving efficiency by 1-2 percentage points. Here you would hope for some shimmer in the patterened glass but usually you are disappointed. The reflection of the flat back side of the patterened glass is very important from angles and it is removed by the PV laminated to the back of the glass. There are some possibilities still:

Albarino P*: The small pyramides of the surface are not really visible. But they play a trick on the eye; the blueish PV cells become more or less invisible from a perpendicular view, but are seen very well from an angle, because the glass surface tilts the angle of the glass.

Visiosun: The vertical pattern brings about a shimmer not unlike water, even though it is dulled a bit by the back side.

Project:
Project under construction: Nationalarenan 3

Architect:
White Arkitekter

The Nationalarenan 3 building next to Friends arena in Stockholm is **the first zero-energy** hotel in Scandinavia, with geothermic heating and 2500 m2 of BIPV and solar panels. The façade system is made from recycled aluminium Hydro Circal. And the BIPV produced by ML System are made from Visiosun, Satinovo and a small one (under the windows) of digitally printed Satinovo. The BIPV look very different in different light and weather conditions; the Visio Sun creates an unique shimmer in the BIPV when the sun hits and enhances the energy production comparedto standard float glass.

Digitally printed ceramic frit: When you burn an enamel into the glass you block some of the energy of course. But the darker the color and the thinner the print, the lesser the energy loss. It is a matter of trial and error. With Visiosun it is not difficult to create moire effects with the combination of print and pattern. Not always pretty but always different depending on lighting conditions and viewing angle.

Size and BIPV: The chosen spandrel size can have a bigger impact on the BIPV than the frit or the glass choice. The most affordable cells are squares with the side of 150 mm. They are placed at a set distance from each other. For the sake of the connectors on the back you should choose an even amount of rows of cells. For each size and shape of glass you have to build a puzzle of cells and for the width you move in steps of 30+some centimeters. If your spandrel is 55 centimeters wide there is a risk that you use less than half the surface for BIPV as an example.

BIPV FOR SOLAR CONTROL

With more and more advanced producers of BIPV the possibility increases to use silicate cells as solar shading. Sometimes a frit is used in an IGU to try to block out the sun from a certain area of the glass:

1. In a glazed staircase the solar heat load needs to be reduced more the higher up in the staircase you get.

2. With floor to ceiling windows you can get rid of cold bridges when demands on façade U-values are extreme, but the light that comes in below desktop level is useless for daylight factor calculations and the heat is harmful to the energy consumption.

   By laminating BIPV inside the outer pane you can change the energy blocked out to plus energy for the building. High skilled BIPV producers can even combine soft coated solar control glass with the integrated PVs, creating the floor to ceiling window of the future in my opinion.

   There are other types of BIPV: Based on thin film technology or colored silicate cells for instance. They seem pretty cool, but have not experienced the price drop of the standard silicate cell, so I do not discuss them in this booklet. But they are important to follow, because the carbon footprint of the silicate wafers seems to be very high.

Mock up From Orkanen Malmö. The 8 pieces of Visiosun in the mock up would look more or less the same as BIPV.

DESIGNING GLASS FACADES

SHOP FRONTS

A special case of the modern façade is the shop front. I stated earlier that modern solar control glass gives an excellent view to the outside, also in a triple glass unit. But the triple glass unit has drawbacks when it comes to the view from the outside in – the shop front.

Shop front windows used to be much more expensive than regular glass, You see, the standard drawn glass we know from old windows is somewhat irregular in its structure, and this did not please shop owners, who wanted unobstructed views to the merchandise. Instead, glass for shop fronts was produced in the same way like glass for mirrors and vehicles: The glass was first cast online some 10 mm thick. Then polished down to 6-7 mm thickness with even structure and parallel surfaces. You can imagine the extra costs incurred. This tradition stopped when the float glass gained momentum in the 1960's. Shop fronts was made cheap by using 6 mm float glass cut to size. You can still see a lot of those old shop fronts walking through any city shopping street.

This type single glass with parallel surfaces is still seen as a standard by shop owners and they fight to keep it that way. On the other side near zero energy buildings need at least double glass and prefer triple glass. Shop owners instinctively feel that DGU/TGU obstruct the view to the inside and they are right: Glass is a glossy material, each glass surface adds 4 percentage points of mirror effect from a perpendicular view. A single glass shop front mirrors 8% of the light, and an uncoated double glass unit mirrors 15%, triple 20% of the light, obscuring the view to the inside.

So once again we must consider shop front glass as more exclusive than standard glass. In order to promote the view to the inside without failing to build in a sustainable way. The answer to this riddle is to use non-reflective coatings on glass. These coatings can be standard low-e or solar control coatings, but also specialized and expensive non-reflective glass mainly used in museums. With this help we can move beyond the old shop front (8% mirror) to near zero reflective shopfronts. At Ikea in Altona, Hamburg, such an investment brought the store from not visible to the best display in town. 2x low iron glass with one low e coating is generally accepted as the clearest possible glass. With non reflective coatings he mirror image gets blueish, but taking rflection down from 12% to 3% is a drastic improvement in View to inside.

This low reflective type of glazing can help rent out the difficult ground floor locations to commercial activities.

Ikea Altona before and after change of glass.

Foajen Malmö has TGU ECLAZ with 8% reflection on ground floor and standard 14% reflection on second floor and up. The difference is remarkable, but also very dependent on the viewing angle and indoor daylight factor. Look closely at the picture, it holds all the answers.

Saint-Gobain Glass has set up a matrix of glass alternatives for different situations. They are based on the assumption that a shop front never moves over 8-9% reflection. And that in inner city stores we should move beyond this border to stand out. With shop fronts reflecting 3% or below, a company can stand out and make a bold statement of it's brand, even in locations where colors and logo are not allowed on the outer façade.

PRODUCT	LT%	g-value	u-value	LRE%
DGU Vision-Lite II + ECLAZ/Vision-Lite*	92%	0,73	1,1	2,0%
TGU Vision-Lite/ECLAZ + Vision-Lite II + ECLAZ/Vision-Lite*	86%	0,60	0,6	2,5%
DGU Vision-Lite/Xtreme 70/33 + Vision-Lite II + ECLAZ/Vision-Lite*	78%	0,35	1,0	3,3%
TGU Vision-Lite/Xtreme 70/33 + Vision-Lite II + ECLAZ/Vision-Lite*	73%	0,34	0,5	3,7%
Stadip 44.2 laminated float	90%	0,80	5,6	8%
DGU ECLAZ + ECLAZ*	83%	0,63	1,1	8%
TGU 6mm Xtreme 70/33 + 6mm Vision-Lite II + 44.2 ECLAZ*	68%	0,32	0,5	9,2%

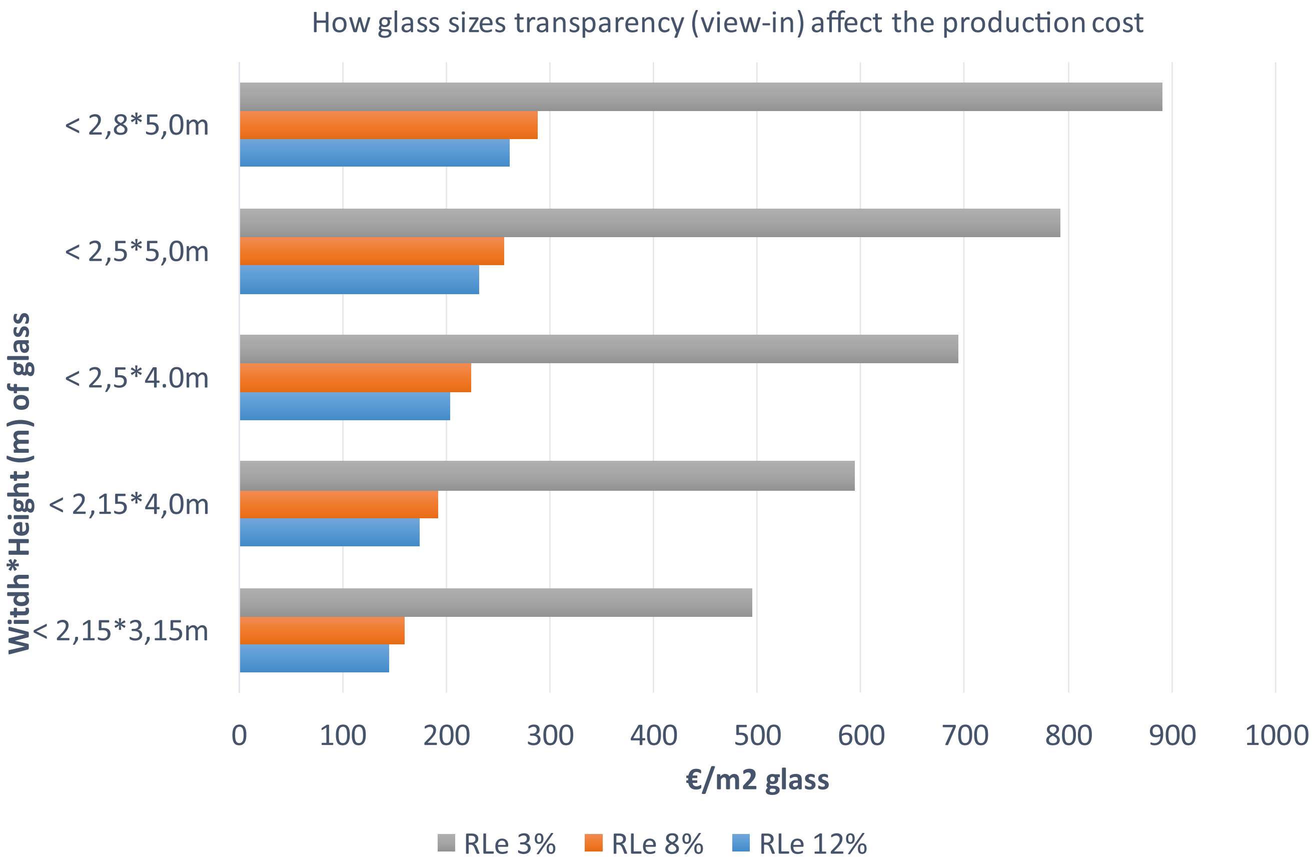
* Coating: Vision-Lite antireflective, ECLAZ low-e, Xtreme 70/33 solar control

When it comes to the view to the inside aspect of daylight becomes very important.

View to inside is improved vastly if light enters the room from 2 directions. Car dealers tend to put the newest release in a corner of the show room for best effect.

View to inside has problems when the shop front allows for no glazed corner and is facing north. Sun shining on the opposite façade will make it a bright mirror image distorting views to inside. This is exactly the Altona case. The level of acceptable reflection in a shop front varies from case to case, and must be evaluated individually. He general rule is that price goes up as reflection goes down. But it does not apply to DGU with coating on both inner and outer glass. Here low-e or solar control coatings with low reflection as a side effect to chasing light transmission, can be applied to lower reflection at a marginal effect on cost.

There are cost issues in using non-reflective glass as indicated at the top. For a shop front project we made calculations. As long as we use the standard coatings for solar control and low-e there are no real cost increases. Using 2xECLAZ in DGU is a very small surcharge over 1xECLAZ. But when we start adding Vision-Lite there is a cost increase. And since it is expensive raw material, the cutting waste matters. In this case study it was a matrix based on measurements that applied, but best is to try and fit the necessary measurements onto PLF measurements (like 3 m x 6,21 m) and see the actual outcome.



Blue is DGU with 1xECLAZ, Orange is DGU with 2xECLAZ for single glass impression and grey is DGU where 2xVision-Lite is laminated to 2xECLAZ, eliminating all reflective surfaces to get the “Altona look”

DESIGNING GLASS FACADES

IMAGE OF GLASS

Connected to the shop front case is the question of the image of glass and evaluation of façade mock ups. It is important to understand that different light conditions and different inside daylight level has a great impact on the image of the glass. Here below a few examples with light transmission in glass a bit over 60%. This type type glass is dominating the markets, but looks different from project to project. Some pictures below tell the story. It is important to find the correct daylight level behind the glass in a mock up and to see it under cloudy conditions. Most glass looks poor when viewed in direct sunlight.

Foajen south façade in direct sunlight. Very dark image except the top part where shader is semi-lowered for white/light grey impression.

Foajen west façade sunny day but shadow on the façade, green reflection from building across the square, blue from the sky, a shaded façade will reflect sun lit objects strongly. Ground floor is 8% reflection using Vision-Lite II middle pane.

Project:
Foajen, Malmö

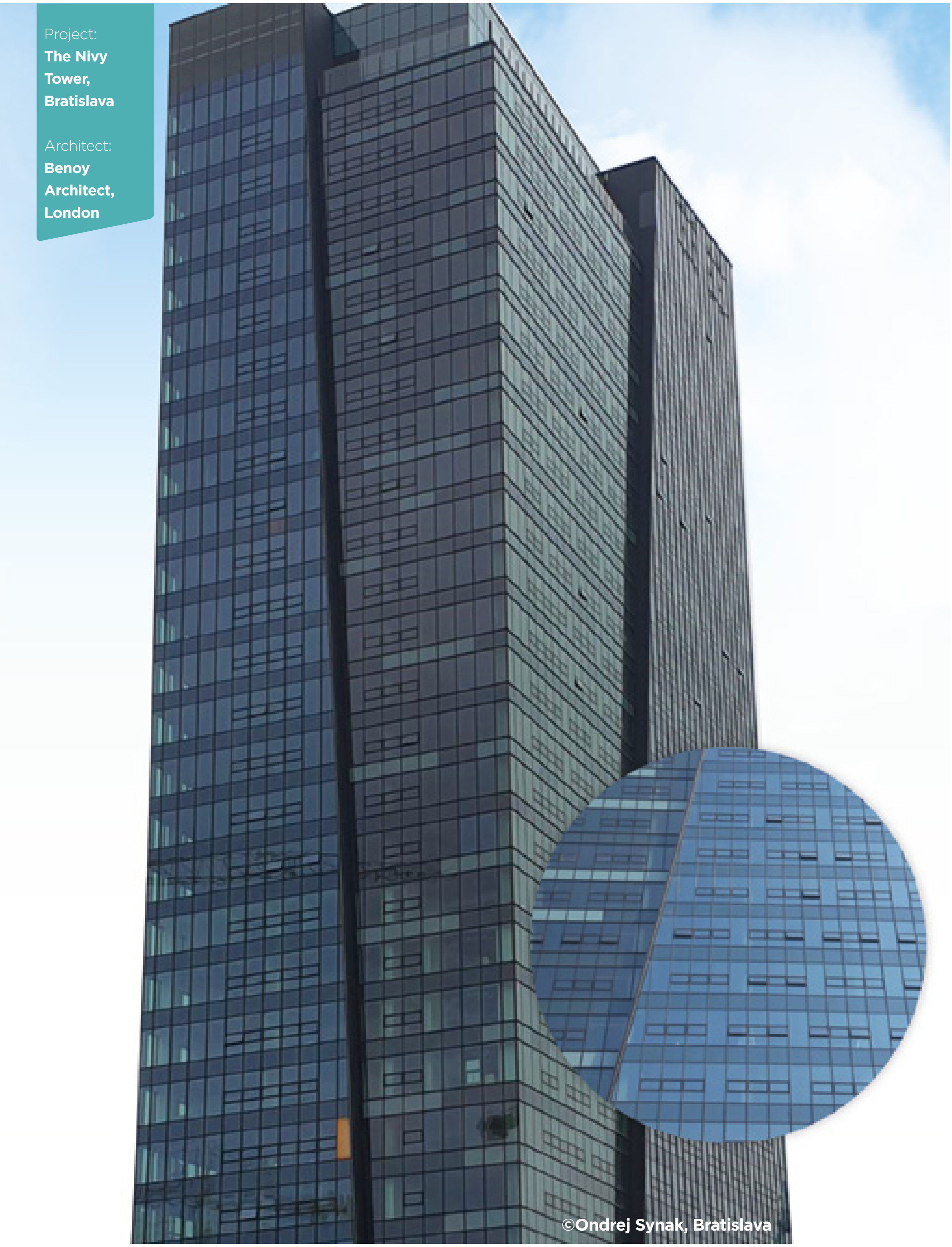
Architect:
Fojab

@felixgerlach_fotograf

Project:
Domaiewska Office Hub, Warsaw

Architect:
DDJM

Domaniewska Office Hub Warsaw, pictures taken at dusk. Blueish in upper left hand corner reflecting the glass pane, after that black when reflecting dark wall, then light grey when reflecting the sky. When the light is on inside glass looks fully transparent. Next time you see a reference picture of a nice project, chances are that the pictuire is taken at dusk with lights on inside the building. These precious minutes of the day is the only time the building can approach the rendering in look.



The Nivy Tower in Bratislava is a masterpiece of my Checz colleague Pavel Necas. Demand on light transmission was >60% and g-value <32%. And 2 different images. TGU SKN 176+ECLAZ ONE inner pane gives 17% reflection and blueish tint, the Xtreme 70/33+Planitherm XN sets 13% reflection with slightly greenish tint. From a distance the difference in color is there, but in many angles the differences in reflection is what strikes you. These subtle differences make the building stand out without compromising the comfort of the users. It needed a computer renderingto convince the investor, because in a standard mock up with full daylight behind the glass, it would never have shown.

This is an actual photo of the Malmö Arena Hotel, believe it or not. The lower façade was supposed to have the same 70/40 glass as the standard windows, 13% reflection. But only g-value was written in the spec, so author found cheaper solution to sell with 30% reflection. In this case it emphasized the exciting design of the façade, so no harm done. It was not a shop front. The picture puts great focus on the importance of indoor daylight level to the view to inside. On the left the façade turns he corner and is transparent. On the right the 30% reflection turns into a perfect mirror.

AWARDS AFTER LONG PROJECTS JOURNEY

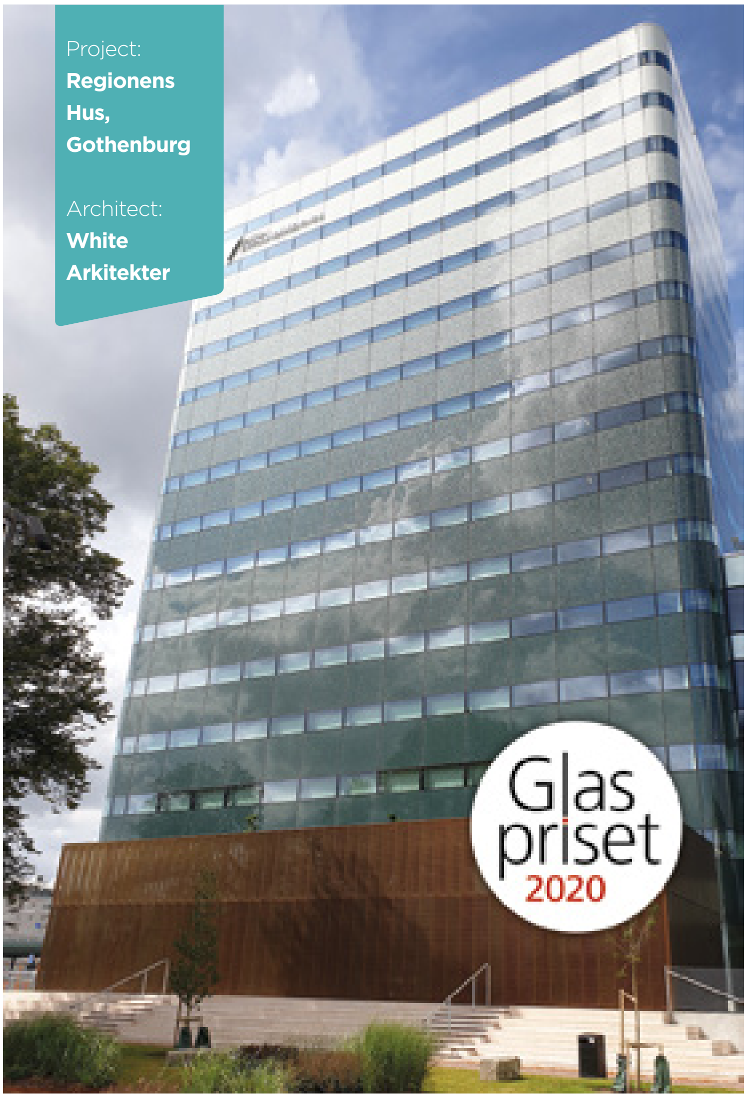
I have been working with specification since 2014 and since 2016 I have followed the systems view on my work, including shaders and other parts of the façade. In 2020 this had lead to many realized projects that received awards:

STORA GLASPRISET 2020

Regionens Hus in Gothenburg and White Arkitekter received this award, part of the motivation:

"...The new office spaces has extremely low use of energy. The fully glazed facades have horizontal window bands with solar control glass. Between the horizontal window bands opaque bands of spandrels run with a screen printed gradient. .... All In all a very impressive project that develops the contemporary glass architecture in an impressive and independent way."

Regionens Hus is glazed with Xtreme 70/33 that has a complementary inside shader to achieve the desired g-tot value. It was a unique project in reaching Miljöbyggnad Guld certification without an outside shader. We made a movie about the award and I could enjoy the fully glazed ground floor of the building on a very hot August day. At lunch I challenged the architect in her black dress to sit in the direct sunlight through the window and it worked. The strong light from the glass was not accompanied by the expected heat. It was almost a spooky feeling but it made the lunchtime experiment work, the thermal comfort was good enough to last us through the meal.



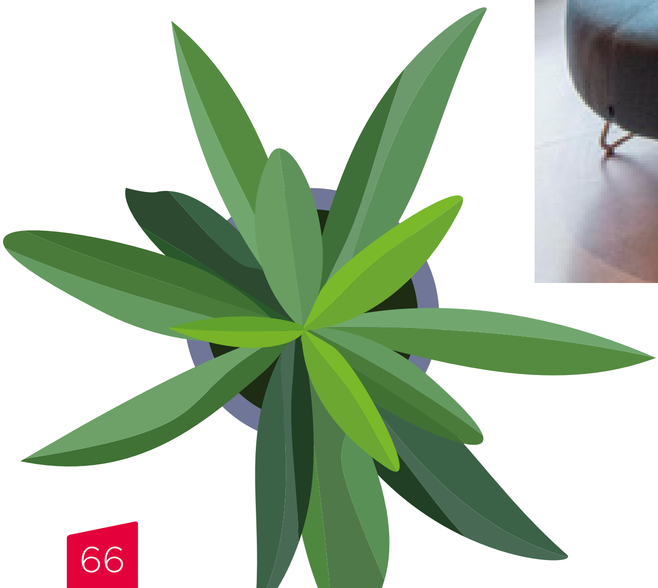
SWEDEN GREEN BUILDING COUNCIL BREEAM AWARD 2020

Foajen Malmö and Fojab Arkitekter received this award, here is the motivation:

"With a central location in Malmö the ambition of the property owner was to create a green and inviting block with many meeting points where people like to work, nest and live. Significant for Foajen has been the committed cooperation between the investor and the general contractor, with a big focus on building a common organization that supports implementation and follow up of the certification."

BREEAM has less glass focus than Miljöbyggnad on daylight. But I take credit for convincing Hent to go with a light solar control glass (Xtreme 70/33) together with inside shader instead of using a dark solar control glass (Xtreme 50/22) without any shader.

Also the ground floor shop fronts with non-reflective glass is my invention, the TGU look like single glass used in shop fronts up until recently.



Project:
Foajen, Malmö

Architect:
Fojab


Bona
Handelsbanken
RAMBOLL

The central impression of Foajen is that it looks like a brick house with big windows, not a glass and brick façade like so many other new houses in that part of Malmö.

It sounds like a contradiction that the most exclusive glass does not give a distinctive look, but I am proud of this short conclusion.

COMPETITION: OSLO BYS ARKITEKTURPRIS 2020

Munch Brygge and Lund+Slaatto Arkitekter won this award, here is the motivation:

"Munch brygge is a city project consisting of 2 blocks with shops and cafés on the ground floor, a kindergarden and 158 apartments. The property relates to important city spaces, like the entrance square to the Munch museum and the west facing shoreline for the outflow of the Akerelva, with open citylike functions. The buildings are all mede from light red bricks and have an active geometry. The collected impression adds warmth and variation to the city."

Here again we have the Xtreme 70/33 glass with a complementary inside shader. And in turn a brick house with big windows, not a glass and brick façade. If you stand on the public roof of the opera house in the morning it is fully possible to see what people have for breakfast inside the apartments – low reflective glass in combination with a glazed corner next to the balcony turns the living rooms into light and crisp show cases.

Lund+Slaatto Arkitekter @lundslaattoarkitekter

Project:
Munch Brygge, Residential Complex

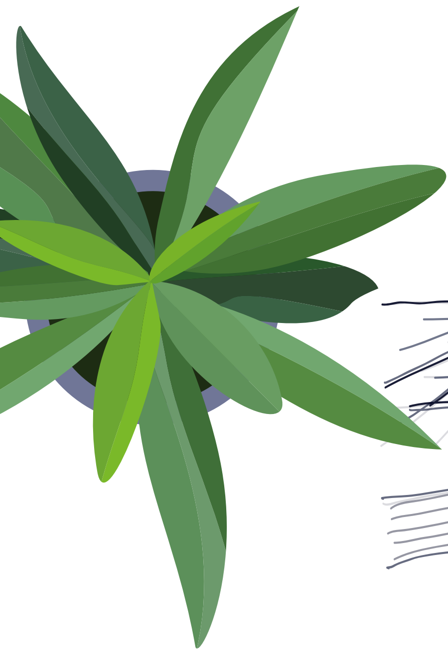
Architect:
Lund+Slaatto

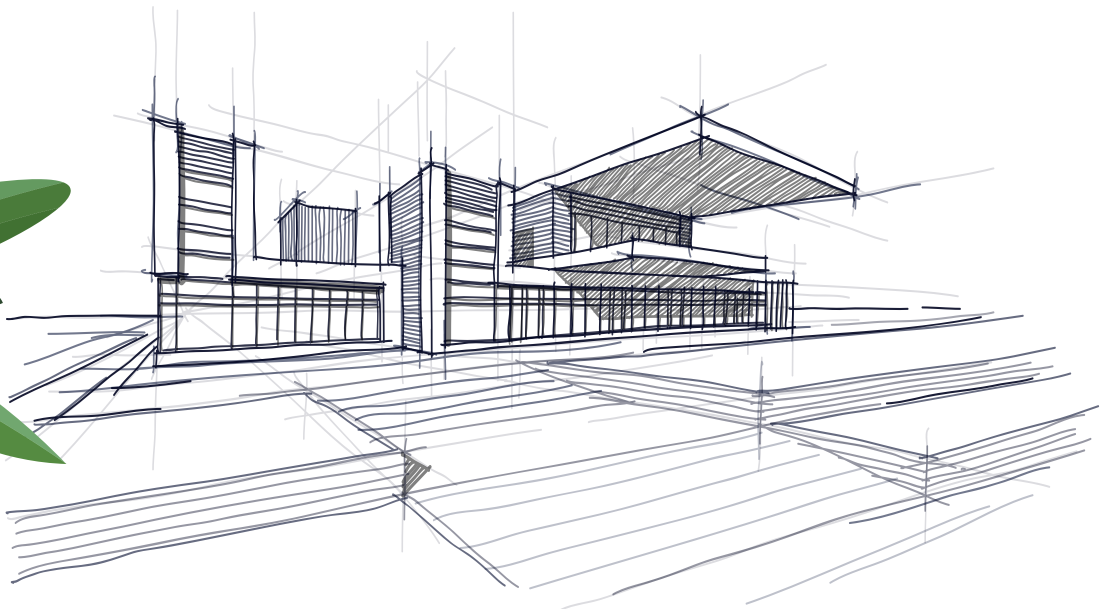
Lund+Slaatto Arkitekter @lundslaattoarkitekter

GLASPÄRLAN 2020

This new award was given to Gärsnäs Möbel, a classic furniture company on the countryside in southern Sweden.

The motivation speaks a lot about the ten meter long mirror wall connecting the old exhibition room with the old storage space turned into gallery. I specified Mirastar in 2017. I specified the reflective glass to replace the white old wall with an image of the surrounding fields, inspired (?) by my own Mirastar wall known from "Oskar pratar om Glass" movies.





PRESS ARTICLE
AXIS 'NEW HEAD OFFICE IN LUND

Text: Mikael Ödesjö | Photo: Felix Gerlach

The head office is the company's face to the outside and consists of a connected building that is divided into several building bodies at varying heights and in interaction with each other.

- We have wanted to create a profile building for Axis, with identity and strong character, which at the same time contributes to Lund's diversity and social sustainability, says Andreas Jentsch, commissioned architect at Fojab. The main entrance is located in the corner of the block, which faces the Ideon Area. Inside, a large, bright common entrance square opens with space for exhibitions, meetings and mingling. A wide staircase leads to Axis restaurant and further up to the common, green courtyard. At the very top there is a sky lounge and a large roof terrace with 360 degree views of the South Swedish landscape.

Glazed for high transparency

– It has been a stimulating assignment with several challenges. Not least the site itself, next to a motorway and traffic junction, places high demands on noise protection and other risk assessments. Despite this, we have managed to create a very good acoustic sound environment for the workplaces here. We have been able to glaze the facades to achieve a high degree of transparency, both from the outside and from the inside, and still have managed to handle the high demands on solar heat loads. There we have had excellent expert help from Oskar Storm, Saint-Gobain and the facade contracting company KGC, Andreas informs.

Sheet metal slats for sun protection

The façade consists of a heavy natural stone-clad base in two lower levels with light glass facades framed by white, angled sheet metal slats that occasionally act as sun protection on sunny days. Once inside the building, visitors and employees are greeted by a flowing light, which is a recurring theme, while local, natural materials such as limestone and wood give a warm and cozy feeling. The office space is tailored to Axis' needs, with preferably traditional cell offices as research in an undisturbed environment is desirable, but also open office landscapes with substantial light.

Sky Lounge and roof terrace with a 360 degree view of the surrounding flatlands.

The glass house is located on a multi-storey stone plinth, with the glass elements deeply sunk into the facade.

The glass façade is unitized and made with standard products. Every floor has its own carrying structure, so if you want to change the façade in a hundered years that is possible.

Extreme glass for sun protection and neutrality

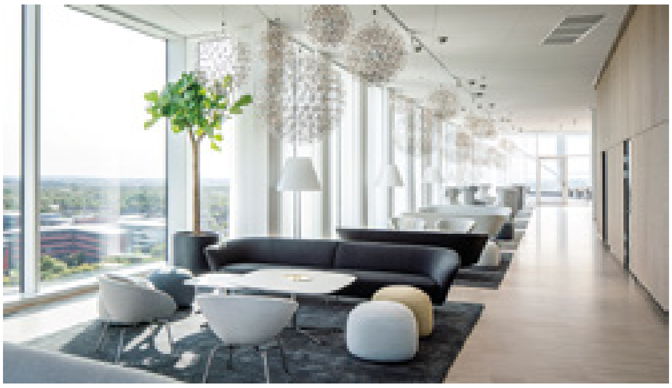
- The light in the building has a supporting role and function. Daylight should flow everywhere and it does. We managed to get prescribed Saint-Gobain's Cool-lite Xtreme 70/33, a sunscreen that combines effective sun protection with high neutrality, so that colors do not change in light transmission - through the glass. The glass also has high selectivity, it lets in a lot of daylight without negative effects of solar heat, which contributes to a bright and natural indoor environment.

"Home at work"

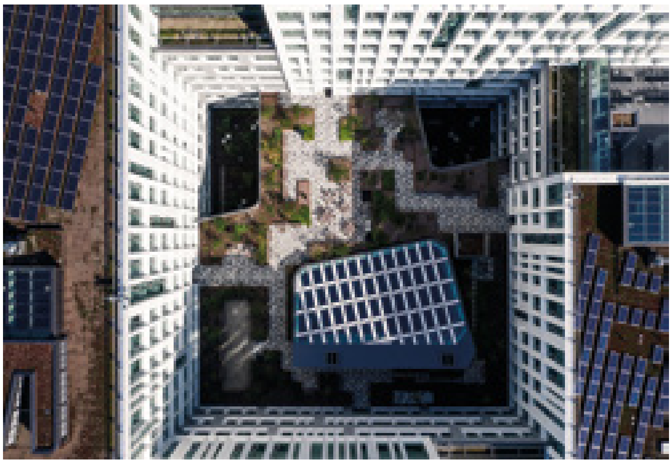
Andreas Jentsch also describes a vision for the Axis Office, which Fojab calls Home at work.
- We have a conceptual mindset with this. If the outside of the office is more an urban interpretation of a contemporary office in a challenging place it is contrasted by of the inside, where wood and rounded shapes speak to the human body and mind in a different way. It's softer and more humane. Here we also want to create as much physical activity as possible, therefore the stairwells are well sized, so that it should be easy, even tempting, to take the stairs rather than the elevator.

Patios like oases

- The light indoors also plays an important role for well-being and when you move, you must always be on your way to the light. This takes place in corridors with glass, through skylights and lanterns and of course windows in each office, openable ones. Home at work also means that we have several interior oases in the form of patios, an all-green courtyard, roof terraces and a sky lounge. And the fact is that despite the location next to the motorway, no disturbing sounds reach here. The move took place in September and the house has been received very positive of the employees on site, it really pleaases Andreas.
- It is for them that the house and the environment have been created,... and maybe a little also for Lund and the benefit to society here, he says.



The block with the new Axis office is part of the city planners to change the Ideon area to a town with well cut off blocks and sunny meeting spots for all who work, do research in or visit the Ideon area.



The common green courtyard. The glass roof lanternin that lies in one part of the inner courtyard renders a big light opening to the entrance square. On large parts of the roof there are solar cell modules.

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