A Class Perspective on Façade Renovation

Delight in Greener Daylight

A Publication based on the outcomes of the Fall 2009 ‘Daylighting’ class
Exhibition sponsored by swissnex Boston - The Consulate of Switzerland

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1. Introduction
Daylighting is inherent in architectural design and is one of the main drivers of a building’s technical performance and its resulting human comfort and health.

Students in the Fall 2009 Daylighting class taught by Marilyne Andersen, Associate Professor at MIT, worked in interdisciplinary teams to analyze designated portions of the second floor extension to the swissnex Boston building in Cambridge MA. With the aim of developing integrated solutions for façades on every side of the building, they focused on issues of glare, illumination, overheating, the ensuing energy requirements and the visual interest of the spaces.

This publication documents the creative solutions that the students developed to answer this multi-faceted problem using models, data analyses, and simulations. Their work illustrates how challenging and inspiring it can be to answer a seemingly simple question, “What is good daylighting?”
2. Six keys to Daylighting
2.1. Why daylighting matters

Impacts and benefits

Daylighting reveals and structures built volumes. Not only must lighting respond to our needs for visual comfort and a healthy environment, but it also must be ecologically viable.

The potential of energy savings is undisputable: buildings represent about one-third of total energy use. In commercial buildings today, up to 40 percent of this energy is dedicated to lighting. Managing solar gains on a seasonal basis can also lead to significant cost reductions in warming and cooling. Beyond these environmental considerations, numerous surveys have shown a strong preference for views and daylight over electric lighting, and positive impacts on patient outcomes in daylit healthcare facilities have been observed.

If daylight is properly controlled, a potential increase in productivity or sales could deliver major financial returns. Advances in photobiology also indicate a strong influence of exposure to light on our circadian rhythms—or biological clock—and thus on our alertness, immune system, and other vital functions. Not surprisingly, all these findings position daylight as the ultimate green, healthy, and delightful source of light.
Daylight is the ultimate green, healthy, and delightful source of light.

Photos: Marilyne Andersen
2.2. Is more always better?

Achieving the right balance

More light is not necessarily better, but it can be. The amount of daylight needed will depend on how the space is used and where it is located.

While sufficient light is needed for vision to minimize the use of complementary electric lighting, light penetration must be limited to avoid glare and visual discomfort. This balance must be achieved without inappropriate shading strategies that would ultimately result in even higher electric lighting needs and user dissatisfaction.

Depending on the climate, solar gains should be rejected during cooling months and welcomed during heating months. This calls for controlled solar gains input that can be adjusted on a seasonal basis. Recent findings also indicate that we need to regulate our circadian rhythms, yet this system differs from our visual one in terms of spectral and temporal sensitivity.

First, we must determine our need for light and how to prioritize illumination, glare risks, control of solar gains, and privacy. Depending on latitude, weather, surroundings, and orientation, we can assess our access to daylight—and then design an effective solution that integrates all these aspects.
Assessing how we use daylight and how we access it
2.3. Dynamic yet variable

Maximizing an ever-changing resource

One of the biggest challenges of using daylight resides in its inherently dynamic nature: light varies with location and weather, changes over time, is uneven over a space, and even ranges in color. The sun disc is hundreds of thousands times brighter than the blue sky around it.

Every minute of every day of the half-year, sunrays reach us from a different position in the sky. When clouds get in the way, the amount of light we receive is decreased tenfold. From inside our buildings—where we spend 90 percent of our time—daylight is typically reduced to only 2 to 4 percent of what we get outdoors, but it undergoes the same relative fluctuations.

How can we use such an uncontrollable source to achieve tasks that have a limited range of favorable conditions?

We can seclude ourselves from daylight altogether in windowless classrooms or offices. However, the need to reduce energy consumption—combined with findings on light’s impact on alertness, well-being, and human satisfaction—has put daylight in a central design position. It also has led to a growing range of strategies and technologies for making the best use of whatever light we can get.
Transforming uncontrollable variability into manageable illumination
2.4. Designing with daylight

Making design decisions when they count

There are essentially three means of using natural light: collecting it from the sky, transporting it toward the place where it can be most useful, and distributing it in the way we want it to be used. Thus, how well a space will ultimately be daylit depends on the careful design of its daylight delivery system.

The key decisions are made very early on in a design project and typically relate to orientation, massing, and the openings’ position, size, type, and shading strategy. For example, high apertures will enable daylight to penetrate deeper than similarly sized apertures lower on the wall.

Perimeter zones will consistently get better daylight access, making deep plan spaces much harder to daylit without resorting to sophisticated light-guiding technologies. North and south orientations tend to be easier to shade than east and west, where sunlight is almost normal to the façade. This requires creative building form or shading strategy responses to climate and site constraints.

To evaluate how these decisions can be made despite the number of parameters involved, more involved evaluation methods are being developed and applied.
Daylighting performance depends on a delicate balance of design decisions.
2.5. How do we evaluate daylight?

Applying performance metrics to a multifaceted question

For decades, daylighting has been assessed from the perspective of a worst-case scenario, using the ratio of inside and outside light levels under a static overcast sky.

Because this metric discards essential daylighting parameters such as orientation, latitude, sunlight penetration, and climate, important efforts are being made to come up with alternatives.

Daylight can be quantified on an annual basis by incorporating climate data over the entire year to produce light distribution maps. Typically, these are spatial maps, showing how light levels vary within a space at a given moment or over the whole year.

Another approach is the temporal map, which keeps an emphasis on annual and daily variations so that the influence of sun position, weather, and time of day can be considered.

A designer’s objectives relating to daylight can be diverse, from maximizing energy savings to producing dramatic visual effects. Thus, a successful design can be considered one that best fulfills the highest priorities and adequately fulfills the other objectives—so long as the latter do not conflict with broader priorities such as energy efficiency and human health.
Climate-based metrics assess daylight over time and space
2.6. What more is there to learn?

Ongoing daylighting research at MIT and beyond

In daylighting research, a shared objective is to make sustainability issues, as they relate to harvesting daylight, an inherent part of a building’s design process.

Today, the question of daylighting metrics has become a key design issue: how can one evaluate the daylighting performance of a space in both a comprehensive and condensed way?

On the other hand, recent findings in photobiology show that essential functions of our body respond to light through our eyes, yet with a sensitivity that differs from our visual system. Work on incorporating these findings toward refined design guidelines for architectural spaces has a way to go.

The future of advanced façades seems to lie in smart glazing, automated shading, and light-redirecting materials. While low-emissivity (low-e) coatings have enabled great energy benefits, greater savings and increased visual comfort could be expected from angularly selective materials.

At MIT and beyond, many new tools, methods, instruments, and metrics are being developed to equip designers and manufacturers with the means to combine the many performance criteria involved in a successful architectural solution.
Combining metrics, methods, and instruments to reveal good daylighting
3. A Class Perspective on Daylighting
Bruno Bueno
Master of Science in Building Technology (SMBT)

Sam Cheng
Hong-Kong University Undergraduate Exchange Student

Cristen Chinea
Bachelor of Science in Art and Design (BSAD)

Shreya Dave
Master of Science in Technology and Policy (TPP) Building Technology

Justin Hipp
Master of Architecture (MArch)

Kian Yam Hiu Lan
Master of Architecture (MArch)

Juliet Hsu
Master of Architecture (MArch)

Christelle Huberty
University of Liege in Belgium Guest Student

August Liau
Master of Architecture (MArch)
3.1. Course objectives

The 18 students of the Fall 2009 Daylighting course (4.430), taught by Marilyne Andersen, learned about the response of buildings to sun course and weather dynamics, the balance between enough and too much light, and the effective integration of energy-efficient, beautiful, and dynamic daylight in the overall design process, or renovation, of a building.

Working in interdisciplinary teams of three to four, undergraduate and graduate students in engineering and architecture analyzed designated portions of the second-floor extension to the Swissnex building in Cambridge, Mass., from a daylighting perspective.

Each group was assigned an area comprising two offices or a shared space and facing at least two different orientations.
North East ‘Goldilux’
A. Love, M. Taub, K. Thuot

South East ‘Minimalism in Daylighting’
J. Hipp, Y. Yang, T. Zakula

South ‘Screening Light’
S. Dave, J. Hsu, J. Qian, S. Rockcastle

South West ‘Parametric Shading Spine’
S. Cheng, A. Liau, A. Mehchaca, J. Tapia

North West ‘Sky Shift’
B. Bueno, C. Chinea, K.Y. Hiu Lan, C. Huberty
3.2. Swissnex Boston - a case study

Operating as a public-private partnership, swissnex Boston connects the dots between two global hubs of science, technology, innovation, and education: Switzerland and Boston. Their mission relies on linking people, companies, and universities to their cross-Atlantic counterparts. In doing so, knowledge exchange is cultivated and mutually beneficial networks are created — open-source diplomacy for the needs of the 21st century.

The swissnex building includes a green pavilion atop a brick building. Muriel Waldvogel, the design architect, says: “The rooftop is a serene, gravel-and-moss garden. Concave and convex corners create softening contours: a delicate, lucent object deposited in a garden. Its facade and interior partitions are all in glass, whose panels are treated with different techniques effecting subtle changes in their transparencies. Together, these glass panels create a sensual pattern, admitting the sun’s natural rays to ignite bold ideas and inspire pioneering visions. Interior glass partitions allow for visual connections throughout the pavilion.

Despite the acoustic privacy, all spaces are visually connected, evoking information transparency and sharing—a microcosm of the swissnex mission.”
3.3. Analysing daylight

Students took a series of measurements on-site and then proposed improvement objectives based on occupant feedback and analysis results, focusing on glare, illumination, overheating risks, and visual interest of the spaces.

A first design proposal that would offer an integrated solution to the raised concerns was then tested through scale-model measurements, and a second iteration through simulation methods.

The breadth of proposed solutions illustrates not only how challenging it is to work with daylight, but also how open our minds should be when doing so.
Detailed analysis of existing conditions informs potential for improvement.
4. Design proposals
North East Offices

‘Goldilux’ by A. Love, M. Taub & K. Thuot

If appropriately insulated, highly glazed north façades can provide abundant yet soft and diffuse daylight.

Sun pouring in from the east can be an issue, however, if it falls on the desks of occupants. For this difficult combination, the “Goldilux” team proposed a sober, well-integrated façade treatment – not too much, not too little – daylighting that’s “just right.”

The team designed a set of offset wall elements to create vertical bands of alternating brightness resulting from indirect light penetration, combined with skylights and translucent panes for greater light uniformity.

A series of wall planes, gradually offset and increasing in width from north to east, allows the control of morning sunlight, while daylight flows in through the north glazing and skylight. An interesting range of brightness is generated from wall-washing light penetration, and is celebrated with a moving shadow of the Swiss cross.
Grazing sun patterns provide dynamic visual interest to the space without disturbing task performance at the desks. Simulation models (top right) and a physical model (bottom right) were built and used to assess daylight penetration over the year.

Quantitative analyses revealed that the original conditions (left) varied from too bright near the window to too dark in the back corner under overcast conditions. The proposed design (right) enabled a more uniform light distribution by combining skylights, vertical shades, and translucency.
South East Offices

‘Minimalism in Daylighting’ by J. Hipp, Y. Yang & T. Zakula

While the corner consul office benefits from abundant northern daylight and experiences only occasional glare issues, its adjoining southeast office suffers from a nearby building that obstructs sky access, glaring morning sunlight penetration, and overall greater contrasts.

A rather discrete and “minimalist” retrofit proposal emerged from these considerations. Retractable horizontal louvers were designed for the two curved corners, complemented by a skylight to brighten up the back of the second office. Glare risks and disturbing contrasts were significantly reduced, while maintaining transparency and outside views.

The major obstruction to both sky access and open views is created by the building next door. Sunlight still reaches those northeast and southeast offices in the early morning and midday, respectively, creating high contrast levels and glare issues at those times.
The original design (left) is subject to excessive midday or early morning lighting on the main desk in each office, as indicated by the red color on the graphs. These graphs display how light levels vary over the year for the local climate: horizontally from January through December, vertically from sunrise through sunset. The new design (right) proposes retractable horizontal shades for both southeast and northeast offices. With all blinds down, the graphs show acceptable conditions (yellow) or insufficient light (blue). But louvers will be retracted in the afternoon, in fact resulting in more light than originally thanks to the skylight.
The addition of horizontal retractable louvers minimizes glare and high contrasts on the desks, while still allowing some sunlight to penetrate the spaces in order to maintain visual interest and desirable dynamics.

Luminance maps were generated to quantify contrast levels from the viewpoints of occupants. High-dynamic range images were captured in the building and falsecolor renderings were created to verify that the new contrast ratios were acceptable.
South-Facing Lounge

‘Screening Light’ by S. Dave, J. Hsu, J.Qian & S. Rockcastle

The central lobby is an informal space mainly used for meetings and presentations. Although a comparatively dim space due to its restricted window area, it provides an opportunity for more drastic renovation proposals.

A “screen” of self-shading cells was designed to carefully control sunlight penetration, while increasing indirect daylight access and producing powerful visual effects.

The lobby openings vary in size and depth as a response to preferred view directions and critical sun angles. A series of north-facing skylights complements the space and increases its overall brightness.
Illuminance (light level) maps were generated for the proposed renovation (middle) and compared to the original design (left) under an overcast sky, considered a worst-case scenario. The results show a significant overall increase in brightness and a visible decrease in contrasts. Temporal maps (right) show how closely performance goals are met based on annual weather data. Months are plotted horizontally, and time vertically. The original design (top) is usually overlighted in the afternoons (red), whereas the proposed design (bottom) generally fulfills the goals (yellow).

The façade was designed to prevent direct sunlight from entering the space during the most active part of the day. In the afternoon, grazing rays produce a dramatic pattern of floating sunlight patches, creating dynamic visual interest throughout the area.
Heliodons can be used to reveal qualitative light variations with physical models. A time-series was created by tilting the model and tracking a peg’s shadow on a sundial. This was used to verify that the screen successfully controlled sunlight while allowing indirect daylight penetration.
South West Offices

‘Parametric Shading Spine’ by S. Cheng, A. Liau, J. Tapia, and A. Menchaca

A desk that faces the sun every afternoon in a highly glazed office presents a challenging situation. Working elegantly with the curves already found in the building’s plan, this team proposed an adjustable system that would track the sun along its course – a “parametric shading spine”.

Thin vertical fins – just long enough to block unwanted sunrays, but flexible enough to maintain views in both offices – rotate and retract over the afternoon to protect the occupants from glare and reject undesirable heat gains.

The parametric shading spine acts as a continuously adjustable shading system – it is never fully open (left) or fully closed (right). Gradually rotating vertical louvers only block sunlight where and when it is harmful to visual or thermal comfort.
Interior renderings were generated for the fully closed configuration to optimize the dimensions of the louvers and to ensure that no harmful sunlight penetration would occur during the year.

As revealed by this series of illuminance (light level) maps for sunny conditions, even if all fins were fully closed, there would still be enough daylight penetration to work comfortably. No direct sunlight would reach the desks of occupants in either office.
North West Offices


Keeping both brightness and views in a west-facing office can be a challenge.

A set of fanning-out fins was designed to block out afternoon sunlight in the warm summer months, while keeping the opportunity for outside views. To maintain overall brightness, northern glazing expanses were complemented by two strips of gently curved, south-facing skylights.

Their extended overhangs only let in winter sunrays – allowing a “shift” from northern to southern daylight within the spaces.

Large north-facing openings are combined with a subtle penetration of direct sunlight that bounces off the inside of curved skylight strips. Using the actual sun as the light source and a sundial, physical models can be tilted to reproduce a series of sun angles throughout the year.
Proposed facade renovation simulated by means of computer simulations (Ecotect)

Predicted electric lighting distribution in the renovation proposal.
5. The Wolk exhibition
Delight in Greener Daylight

Daylighting is a key element in architectural design and is one of the main drivers for both building technical performance and its resulting human comfort and health. Students in the Fall 2009 Daylighting Class taught by Marilyne Andersen, Associate Professor at MIT, worked in interdisciplinary teams to analyze design and portions of the second floor within the campus building in Cambridge, MA. With the aim of developing integrated solutions for façades on every side of the building, they focused on issues of glare, illumination, overheating, energy efficiency, and the visual interest of the spaces.

The students modeled, data analyzed, and simulations offer creative solutions to a multi-faceted problem, and illustrate how challenging and important it can be to answer a seemingly simple question, "What is good daylighting?"
Wolk Gallery

School of Architecture + Planning
Massachusetts Institute of Technology
Plan and wall layout for ‘Delight in Greener Daylight’ exhibit
April 27 to July 30, 2010
A Class Perspective on Façade Renovation

Delight in Greener Daylight

Daylighting is inherent in architectural design and is one of the main drivers of a building’s technical performance and its resulting human comfort and health. Students in the Fall 2009 Daylighting class taught by Marilyne Andersen, Associate Professor at MIT, worked in interdisciplinary teams to analyze designated portions of the second floor extension to the swissnex Boston building in Cambridge MA. With the aim of developing integrated solutions for façades on every side of the building, they focused on issues of glare, illumination, overheating, the ensuing energy requirements and the visual interest of the spaces.

The students’ models, data analyses, and simulations offer creative solutions to a multi-faceted problem, and illustrate how challenging and inspiring it can be to answer a seemingly simple question, “What is good daylighting?”
A Day in the Life of the Building - An outside/inside time-lapse animation from sunrise to sunset
Why daylighting matters
Impacts and benefits
Daylight is the ultimate, green, healthy, and delightful source of light.

Daylight's importance cannot be overstated. It improves productivity, enhances mood, and promotes health. In buildings, daylight is a key component of sustainable design, reducing energy consumption and improving occupant satisfaction.

Daylight affects our visual and non-visual experiences, influencing our health, mood, and productivity. It is a fundamental aspect of our built environment, contributing to the design of healthy, productive, and enjoyable spaces.

Is more always better?
Achieving the right balance
Achieving the right balance of daylight is crucial.

Daylight is not necessarily better in all cases. The amount of daylight can be expressed in terms of its exposure and its contribution to the overall indoor environment.

Daylighting needs to be balanced with other factors, such as comfort, energy efficiency, and visual comfort. The right balance ensures that the space is illuminated in a way that meets the needs of the occupants without compromising the quality of the natural light.

Dynamic yet variable
Maximizing an ever-changing resource
Daylighting is dynamic and variable, influenced by weather, time, and location.

Daylighting must be designed to adapt to these changes, ensuring that spaces are illuminated in the most effective way possible. This requires careful planning and design to ensure that the spaces are comfortable and functional.

Designing with daylight
Making design decisions when it matters
Daylighting performance depends on the careful balance of design decisions.

Lighting systems must be designed with specific locations and conditions in mind. This requires a deep understanding of how to incorporate daylighting into the design process, ensuring that the spaces are comfortable and functional.

How do we evaluate daylight?
Applying performance metrics to a multifaceted question

Daylighting evaluation methods have significantly evolved to address the multifaceted question of how to evaluate daylight performance.

Understanding daylighting performance requires a combination of analytical tools, such as computer simulations, and real-world testing. The performance metrics must be tailored to the specific needs of the space and its occupants.

What more is there to learn?
Ongoing daylighting research at MIT and beyond

Continuous research and development are essential to improve our understanding of daylighting.

The latest research is contributing to the development of new technologies and methodologies for analyzing daylight performance. This research is essential to improving the accuracy and reliability of our evaluation methods.

A class perspective
Student views on daylight-driven façade renovation

Student perspectives provide valuable insights into the impact of daylight-driven façade renovations.

The students' views are important for informing future design decisions. They provide a fresh perspective on the challenges and opportunities associated with daylighting.

Swissnex Boston
Zooming in on the second floor of the Consulate of Switzerland

Swissnex Boston is a high-performance building that incorporates daylighting strategies into its design.

This building is an excellent example of how daylighting can be used to create a healthy, productive, and enjoyable workspace. The design strategies used in this building can serve as a model for future projects.

Conclusion
Daylighting is not just a matter of aesthetics. It is a fundamental aspect of sustainable design, improving the health, productivity, and comfort of occupants. Therefore, it must be considered in every aspect of the design process.
Display of five student projects (physical models with simulated sun position, audio narrative and project summary panels) with original Swissnex model and “Walkthrough” video-projection.
Swissnex existing building

Narrated by Jaime Lee (Teaching Assistant) - Model designer: Gerhard van der Linde

“The swissnex building is located between Central Square and Harvard Square in Cambridge. The second floor of the building is a recent addition which has a façade that is almost entirely made of glass. For their projects, our students were divided into five groups and each group was assigned one or two rooms on the second floor, each with different problems and conditions.

The first group studied the main common area. This is the only room that does not have a glazed façade, so even though it faces south, this space doesn’t get enough light.

The next group assessed two offices, both facing southeast. The major problem that these students had to deal with was glare. They also needed to address the issue of light uniformity across the space.

The third group was assigned two offices; these students had to deal with two fairly different conditions, as the southeast-facing office received almost too much daylight, whereas the northeast-facing office didn’t receive enough.

The next group dealt with one northeast-facing office and one northwest-facing office. These students were interested in maintaining high enough light levels in the spaces while also managing potential heat loss through the glass in the winter.

The final group examined two offices. The southwest-facing office offered many challenges. This office had problems with glare and became noticeably hot during the afternoons, particularly in the summer.”
Goldilux

by Andrea Love, Mallory Taub and Kevin Thuot

“The first zone we investigated was a small office on the main façade facing the street in the northeast direction. The main problems with this space were inadequate light levels in the back of the office, temperature fluctuations that caused occupant discomfort, and a floor plan that created an awkward furniture arrangement. To address these issues, we added clerestories in the back of the office to bring light deeper into the space, a translucent panel in the lower third of the glazing which increased the thermal performance in the envelope and eliminated the cutout in the space.

The second zone we investigated is the corner office that faces northeast and southeast. The southeast façade is shaded part of the time by an adjacent building; however, there is an overabundance of light and direct light on the occupant and desk, particularly in the mornings. To address these issues, we designed a wall that is made up of a series of planes that are offset to allow diffused light and direct light only adjacent to the walls and away from the desk.

To maintain the view and to add visual interest, in one of the panels we placed a Swiss flag made of clear and frosted glass. Because the primary light for the space would now also be from the northeast, we also added clerestories to ensure even illumination. Through our scale model testing and computer simulations, we observed that direct sun was eliminated from the work area and more even illumination levels were achieved throughout both offices.”
Minimalism in Daylighting

by Justin Hipp, Yang Yang and Tea Zakula

“Our team’s areas of focus within Swissnex Boston are two dynamically different spaces affected by diverse daylighting conditions.

Anchored on the east end of the building, our zones consist of a large open office for the Swiss Consul, perhaps the best office in the space with the entire office requiring very little alteration, and then a smaller office that houses two office workers requiring much more revision. The large office primarily faces north, gaining comfortable, diffuse light, but as the façade wraps towards the east, it is plagued by glaring sun in the early morning. Conversely, the smaller office must deal with a southern exposure, producing blinding light around midday throughout the year. Further complicating the conditions of these diverse facades is a tall adjacent building, which only selectively blocks the sun during part of the morning. In order to tackle these issues and maximize existing views, we propose a minimalist design solution that creates a consistent architectural language across the diverse and dynamic spaces.

For the large office, our objectives were to create access to the roof garden and to prevent direct sunlight from the east in the early morning. So we proposed to add a door to the roof and retractable, horizontal louver shading systems on the eastern façade. For the small office, our objectives were to prevent the bright southern sun that enters the building morning to noon, to brighten up the back office, and to enlarge the cramped space, so we proposed to add retractable louvers across the southern and eastern façade, install a skylight, and rotate the northern wall to increase space.”
Screening Light

by Shreya Dave, Juliet Hsu, Jie Qian and Siobhan Rockcastle

“The central lobby on the second floor of Swissnex headquarters is primarily used as an informal meeting space. Overall, the lobby is dull and dimly lit compared to the surrounding offices. The alternating clear and translucent glass between the offices and the lobby produce issues of glare as areas of bright sunlight are contrasted against areas of diffuse sunlight. Despite the challenges presented by the surrounding offices, the space is thermally regulated and doesn’t currently experience overheating.

Our design goals were to incorporate a greater control and a dramatic use of daylight in the space without disrupting occupant comfort through the addition of unwanted heat gain. Because the space is sometimes used for meetings and conferences, we wanted to eliminate any glare sources in the center of the space. We wanted to limit the amount of direct light that enters the space, which is not easily accomplished with added light from the surrounding offices. A dramatic use of light would make the lobby space feel more interesting and might encourage occupant use and interaction.

The redesign that we proposed involves three main components: First, we eliminate the alternating clear and translucent glass between the lobby and the offices, replacing it with mostly translucent glass with clear glass portions aligned to the door threshold. Second, we added north facing skylights on the roof to admit more illumination to the center of the space. Third, we opened up the southwest façade to add a screen of shading components whose openings varied based on external context and solar position. We feel that the additional screen-like shading components added a visual interest to the lobby space.

To evaluate our design, we used a combined approach of physical modeling and digital simulation. We found that our design did in fact increase the overall light level and reduce glare sources. Our rough calculations indicate that, although we increased the exterior fenestration by 50%, the combination of solar heat gains and heat loss through the windows results in almost exactly the same thermal performance. Finally, simulating different times of the year with qualitative images show dramatic use of light in the afternoons when small patches of direct sunlight penetrate the space. Overall, we were pleased with the results.”
The central lobby is an informal space mainly used for meetings and presentations. Although a comparatively tiny space due to its restricted window area, it provides an opportunity for more creative renovation proposals.

A "screen" of self-shading cells was designed to effectively control sunlight penetration, while increasing indirect light access and producing powerful visual effects. The lobby openness varies in size and depth as a response to preferred view directions and critical sun angles. A series of north-facing skylights complements the lobby and increases natural brightness.

South "Screening Light"

A large area used for conferences and presentations.
Parametric Shading Spine

by Sam Cheng, August Liau, Alejandra Menchaca and Jason Tapia

“We were assigned to investigate the lighting and thermal conditions of the southwest and northwest corner offices of SwissNex. Interviews with the current occupants, onsite measurements, scale model experimentation, and computer simulations revealed a number of problems with the quality of daylight in the space and the potential for excessive solar heat gains.

Our design objectives were first to reduce the incidence of direct solar radiation, also to improve thermal comfort in each of the offices, also to create a design that fused with the existing building geometry while not compromising the openness and transparency of the offices.

Our design solution uses the concept of a snail along whose back a series of vertical louvers and an overhang sit just beyond the existing façade. The louvers would be fully computer-automated to slowly track and block the sun’s direct light over the course of both a day and the year.

The height and position of the louvers were optimized taking into account: One) the addition of the overhang, two) the sightlines of the occupants while sitting at their desks, and three) the surrounding buildings and trees. Simulation software demonstrated all of our performance objectives were achieved and renderings show our design adds an interesting and dynamic new element to the neighborhood.”
North West Proposal: Sky Shift

by Bruno Bueno, Cristen Chinea, Kian Yam Hiu Lan and Christelle Huberty

“When we first visited swissnex with our class, we were delighted to see how comfortable the spaces were. Our offices faced northwest, north, and northeast, and they have perhaps the fewest noticeable problems out of the offices there. Both occupants kept the blinds open and hardly ever used the electric lighting during the day. After we analyzed the spaces, however, we realized several things. First of all, the only sun penetration that is significant to the spaces comes in the summer, when it is unwelcome as it will only add heat to the space. Also because there are windows from the floors to the walls, there’s a lot of heat loss from the excessive amounts of glazing. Secondly, when electric lighting is needed, it is inefficient and not bright enough.

We defined several of our goals from our initial diagnostic. First of all, in order to guarantee comfortable working conditions, the most important improvement is to reduce the glare and sunlight penetration. Second, we wanted to preserve the current open and collaborative atmosphere. For that reason, we propose to maintain a minimum illuminance level of 500 lux for the worst-case scenario electric lighting should provide a minimum level of 300 lux on the desks.”
Welcome by Adèle Naudé Santos, Dean of the MIT School of Architecture + Planning

Marilyne Andersen, Associate Professor and Exhibit curator

Pascal Marmier, Swiss Consul