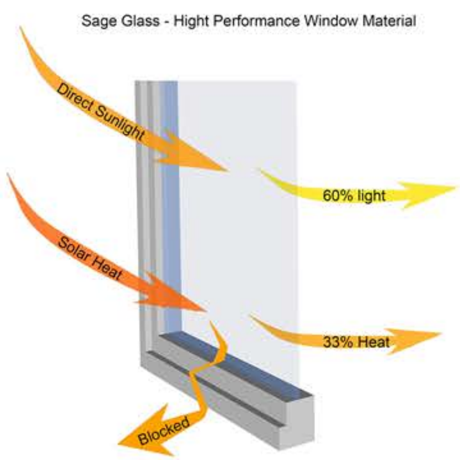
Initial complaints from the occupants of the main offices that line the east and west face of the building was the uncomfortable heat on sunny days. The west façade of the building was focused because there are more offices with the same layout and the occupants were more inclined to help with the investigation procedures. With this in mind, a brainstorm of numerous products and techniques emerged from research to combat the unwanted solar gain. The investigation was then divided into six possible routes that were viable in making the office space more comfortable. They follow: NanoTint, NanoPaint, SageGlass, Blue-Green glass, shading devices, and harnessing wind for ventilation. Only the NanoTint and NanoPaint product experiments were feasible during this investigation due to time constraints and product unavailability.

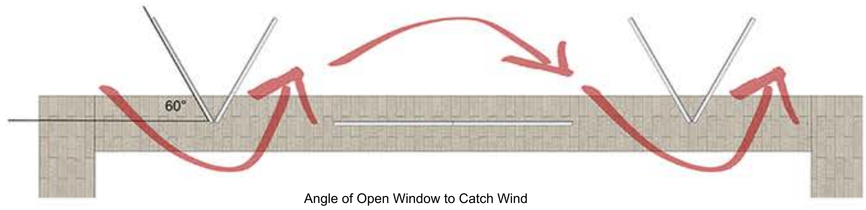
SageGlass

The SageGlass experiment would have potentially been a great success considering the product's intensive testing and reputation. Unfortunately, the product cost is too high for purchase, and samples were not allowed to be shipped. During the early stages of studying this product, detailed research explained how SageGlass worked as a system, and digitally replicated the properties of the double paned-glass. Even though we could test this product with software, we wouldn't be able to compare it to a physical control. Since we couldn't get a sample to do a small scale model or an actual full sized pane to install in the Shoup Hall, we set aside the SageGlass experiment for possible future testing.

SageGlass itself is electronically tintable glass for windows, skylights and curtain walls.It is beautiful and a



cost-effective way to control sunlight without shades or blinds, so you can manage glare and heat while maintaining a connection to the outdoors. This is why the company says their glass isn't designed for buildings, it's designed for people. Early cost analysis for the potential installation of the product on all the windows on Shoup Hall predicted a staggering $88,000 with ~1,500 sq ft of glass required. With this cost estimate, the time it would take for the SageGlass to pay itself off would be around two and a half years considering Shoups already high energy bills.

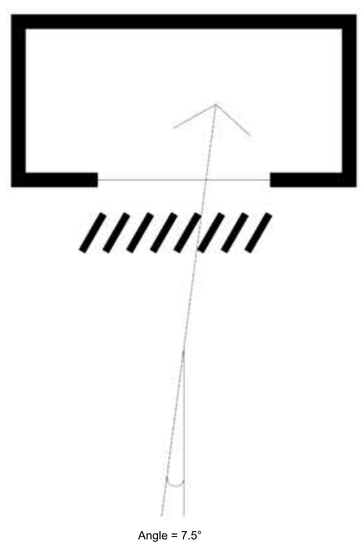


Angle of Open Window to Catch Wind

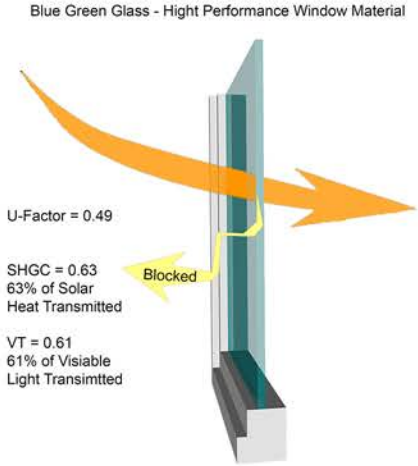
Shading Device, Blue-Green Glass, Wind Channeling

Another obvious solution to controlling solar gain would be to utilize the simple technique of shading through various forms and materials. Since the focused study prioritizes the west façade, the orientation of the potential shading louvres would be vertical in order to shade against the sun when it is lower in the sky as it is setting. Various materials could act efficiently as louvers such as perforated metal and glass. Blue-Green glass was another solution to controlling how much radiation enters the space, but was not tested due to unavailability. The site offered a unique venture effect because of Shoup Hall's juxtaposition with a neighboring dormitory. Research and analysis through wind simulating programs identified the perfect angle a window would need to open to channel the most wind into the space. As the wind enters through the first pane of the each room's glazing system, the airflow would potentially ventilate the room as it leaves the third window pane at the other end of the system. This experiment could not be conducted however because the existing windows can't open to 60 degrees, and the third window pane can't rotate the desired direction to facilitate aerodynamics.

Shading Device for Western Side of Shoup



Blue Green Glass - Hight Performance Window Material



HY-TECH Thermal Solutions

ThermaCels ™ - Ceramic Additive that makes paint insulate.

With the building consisting of single pane glass windows and CMU block exterior walls, a method was needed to help insulate the offices from the outside climate. A prime experiment which was performed was with the use of "Nano Paint." There is where Thermal Cels ™ were added to paint and then applied to the CMU block. One office has the exterior side painted while the other office was painted on the inside. Very little square footage was CMU, but the insulating properties on the Nano paint was worth the test. Testing was done for two weeks of these two offices along with two controls. The results were not that surprising. Due to the minimal wall coverage of the exterior wall which was paintable, predictions were that the overall effect would be hardly noticeable. The results show …

Energy

Shoup Hall is heated from the local steam plant that resides on campus. Over a million pounds of steam are used each year in this building. It is used for heating during the winter and also for the hot water. The electrical load of the old dormitory runs 50,000 kWh per year, which has been dropping over the last couple years due to the replacement of energy saving lighting. Only a few offices have a window AC unit installed, but generally the building doesn't have a cooling system for the summer.

Adding PVs onto the roof of Shoup Hall could also bring in some potential power. The system size for the roof would be 61.9kW which would produce an average of 82,690kWh per year.

Drywired Liquid Nano Tint

With the amount of solar heat gain into the offices, another experiment was brought into the mix. The company Drywired, had a product which potentially would block 100% of UV, 95% of Infrared, yet maintain 90% visible light. The liquid is applied to the glass and only takes 14 days to cure and has low VOC's. Product testing showed results of lowering cooling costs for buildings, so it was worth a try. If successful, the pricy product could become a great solution for older buildings which would be too costly to fully renovate.

Another office of the western side of the second floor was chosen and the windows were cleaned, primed, and tinted. With the products claims, we were expecting great results. In the first two weeks, thermal data showed that the glass was warmer than neighboring untreated glass. So the heat was being trapped at the glass, but was it passing through? Further testing showed that the room (was/was not) …

What we Learned

Various strategies were used and tested to determine the appropriate method or methods to creating better cooling without the assistance of active systems. After collecting all the data and processing it, it can be said that the most effective and cost efficient strategy is to simple plant trees for shading. Results of the control one room showed that by having lower temperatures inside the room and cooler temperatures on the exterior surfaces.

The next best solution was the …