



Feasibility Study of Retractable Louver System on Museum Tower

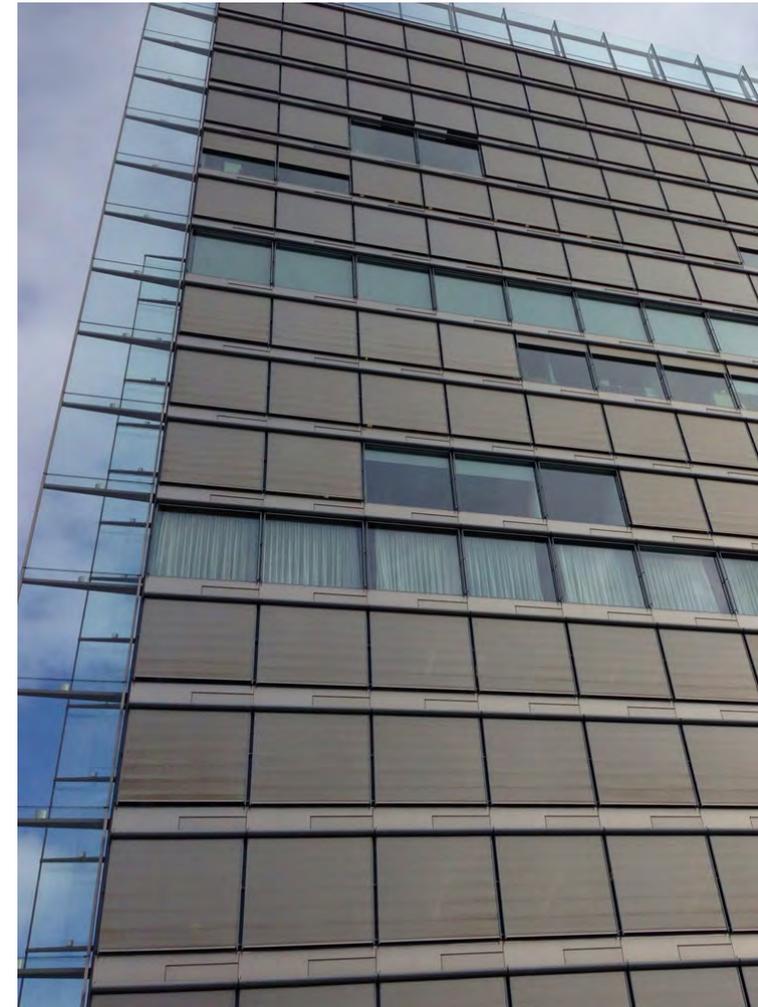
November 20, 2012

A Review of our Work on Retractable Louvers as a Potential Solution

Museum Tower's technical team has undertaken the task of studying a retractable louver system as suggested by the Nasher. To date our activities include:

- Discussions with Clauss Markisen (manufacturer of the proposed louver system) representatives.
- Review of engineering drawings.
- Review of wind tunnel tests specifications.
- Employed DEC (engineers for Museum Tower curtain wall) to perform structural calculations.
- Study of the NOAA National Weather Service wind records for Dallas.
- Consulted with insurance underwriters and consultants.
- Consulted with legal experts to evaluate the potential liabilities that might arise from owners to the public if there were catastrophic failures of the louvers.
- Participated in many technical meetings.
- Visited a recent louver clad project by Clauss Markisen in Singen, Germany.

Hegau Tower
 Singen, Germany
 October 17, 2012





Critical Issues Reviewed and Conclusions

Wind Related Issues

- Wind Tunnel Test data from the manufacturer indicates that the louver system is approved for applications with a maximum wind speed of **53 mph**.
- In 2011, the National Weather Service recorded **29** days with wind speeds that reached **between 50 and 80 mph**.
- Additionally, wind speeds increase dramatically around high-rise towers.



Extreme Winds
at 42 stories

*29 days in 2011
with wind gusts
over 50 mph
(at ground level)*

Wind Related Issues

CONCLUSIONS:

- Retractable louvers have not been proven reliable for gusty winds in Dallas, TX. The inability to guarantee that the louvers will stay attached to Museum Tower during windy conditions could be potentially hazardous to the public and neighboring buildings.
- Windy conditions can cause the louvers to vibrate, make noise and potentially detach from the building.
- Insurance underwriters have identified wind is a significant risk factor.
- Louvers will not descend in windy conditions, and are therefore, not a 100% solution to reflected light.

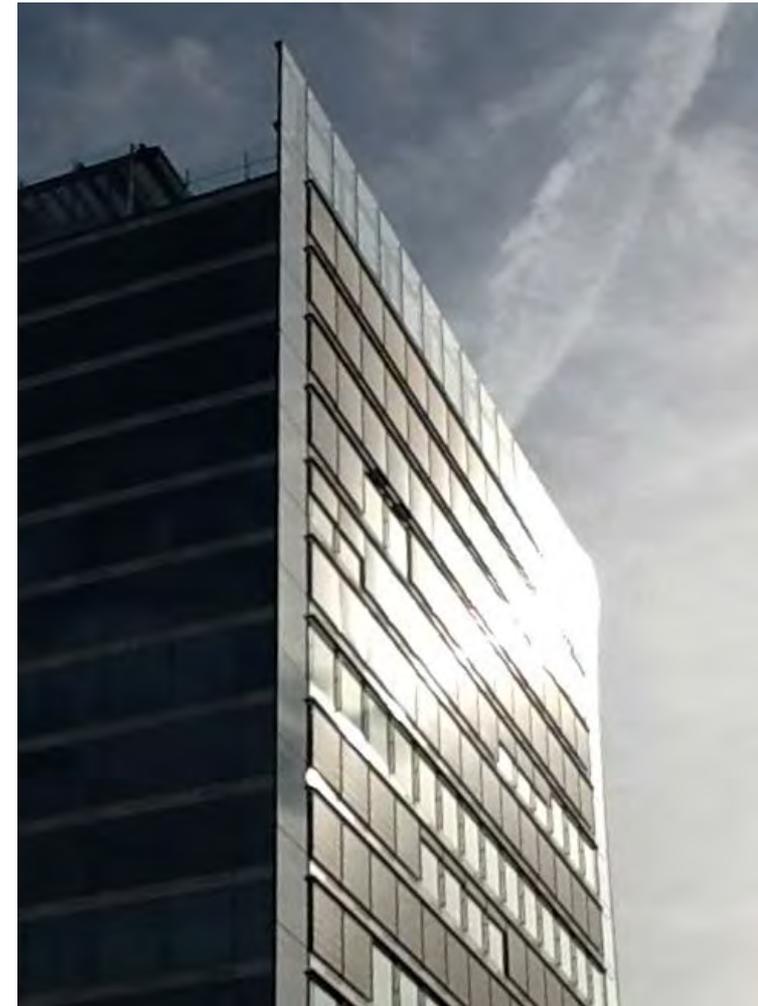


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Louvers Not Designed to Mitigate Reflected Light

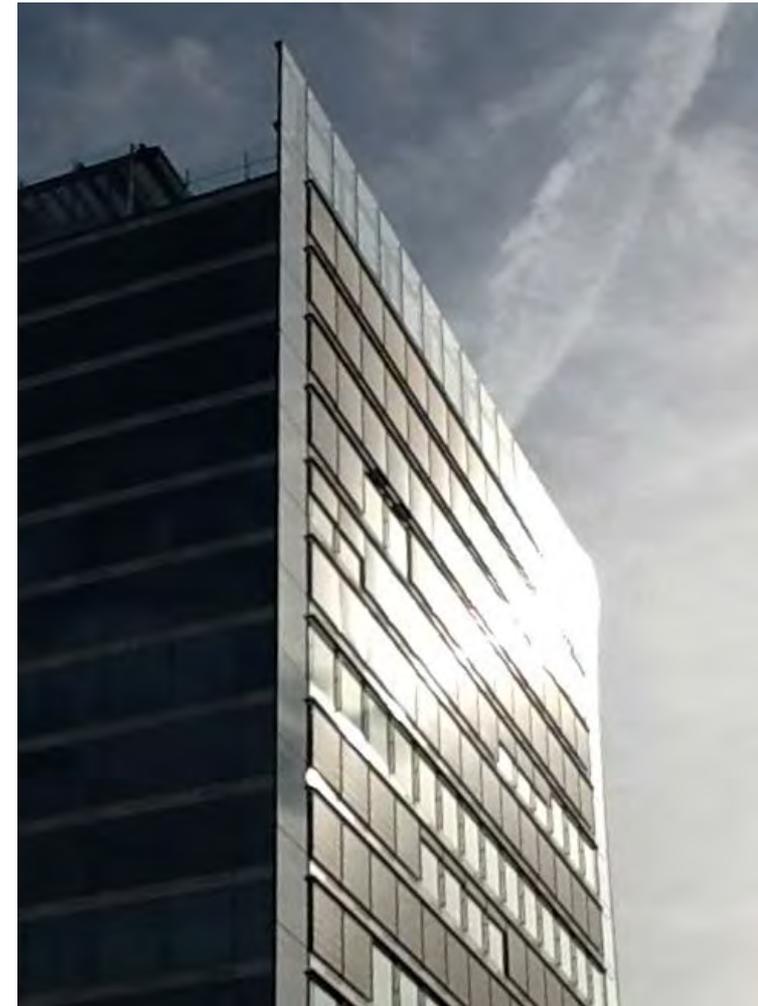
- According to Clauss Markisen, retractable louvers were designed to decrease the amount of solar heat entering the building and limit incoming ambient light.
- **This louver system reflects sunlight.**
- According to the manufacturer, this would be the first proposed application for a louver system to mitigate reflection. No test data, modeling or engineering reports exists for this new application.
- Current louver system is manufactured from reflective stainless steel. Louvers with low reflectance qualities are currently unavailable in the marketplace.
- Clauss Markisen has attempted to fabricate “darkened stainless steel” (to reduce reflectivity) louvers, but ran into fabrication problems.



Louvers Not Designed to Mitigate Reflected Light

- Clauss Markisen has an aluminum louver fabric system in development, but the aluminum would not be as strong or durable as stainless steel, and there are currently no wind tunnel tests or engineering reports for this new product available for study.
- Control of the louver system will require the development of a customized computer program. The manufacturer will not warrant a program developed by another vendor.

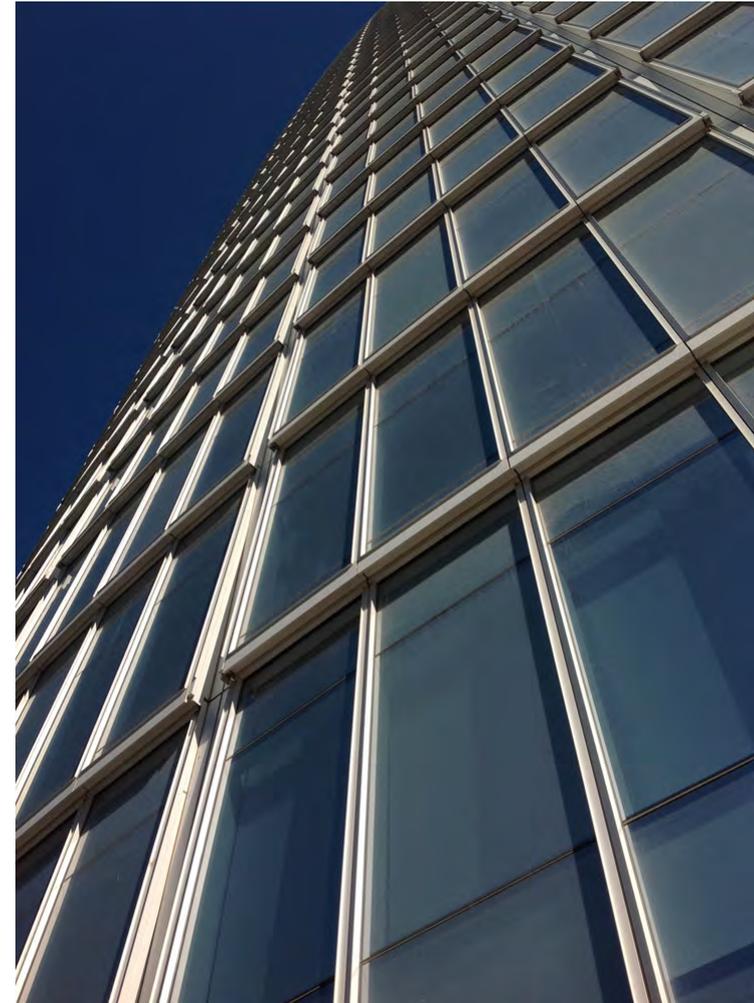
CONCLUSION: This stainless steel louvered system reflects light. It is not designed to mitigate reflected sunlight. No computer control system exists to address the unique requirements for a louver system on Museum Tower.



Other Technical Implementation Concerns - Waterproofing

- Retrofitting a louver system for a 42-story tower will create more than 20,000 holes in the current water-tight exterior glass wall system.
- Insurance underwriters have expressed concern that this presents risk for chronic water seal problems and ongoing moisture damage issues.

CONCLUSION: The attachment of retrofitted louver system presents significant risk of exposure to moisture and water damage, and ongoing maintenance problems, making it extremely costly and practically impossible to obtain insurance coverage.



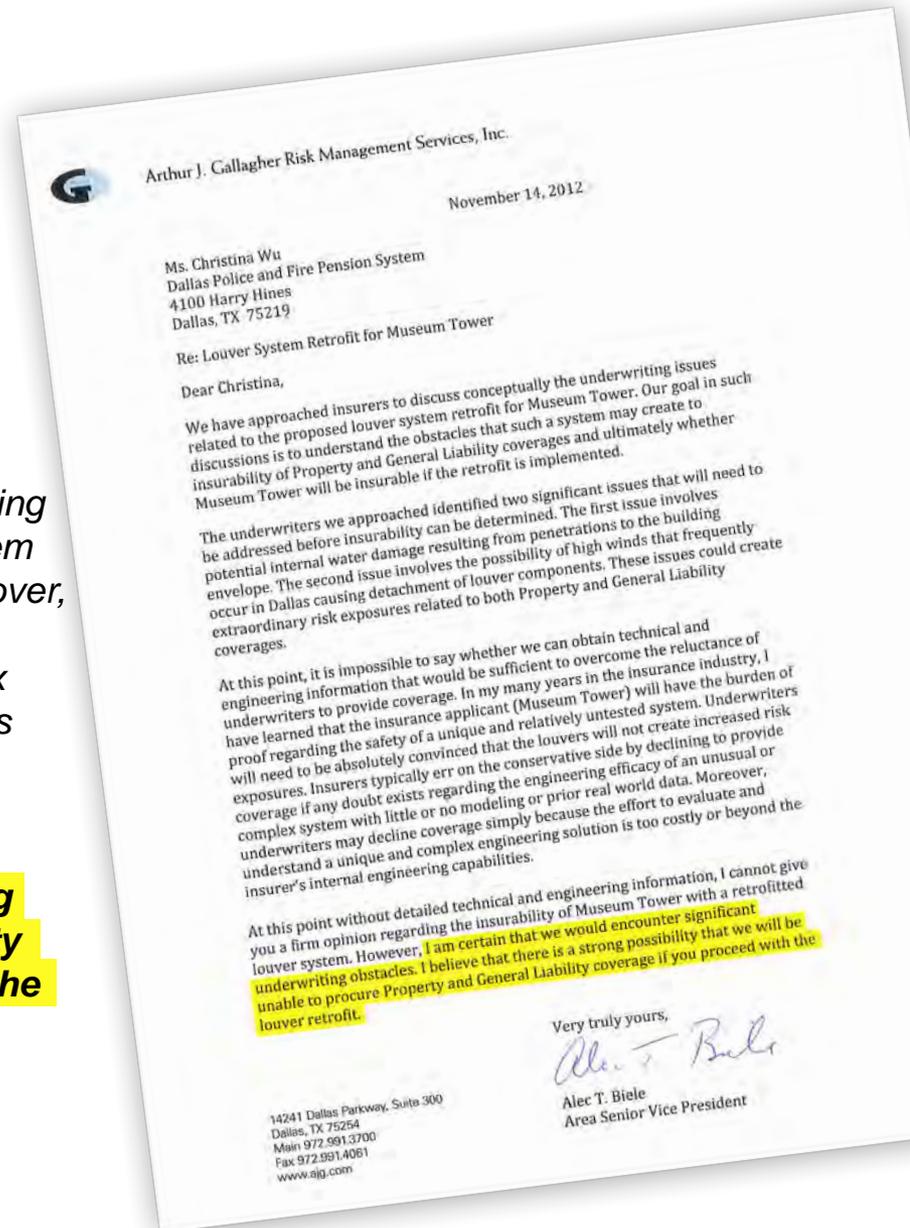
Insurability

“The insurance applicant (Museum Tower) will have the burden of proof regarding the safety of a unique and relatively untested system. Underwriters will need to be absolutely convinced that the louvers will not create increased risk exposures.

“Insurers typically err on the conservative side by declining to provide coverage if any doubt exists regarding the engineering efficacy of an unusual or complex system with little or no modeling or prior real world data. Moreover, underwriters may decline coverage simply because the effort to evaluate and understand a unique and complex engineering solution is too costly or beyond the insurer’s internal engineering capabilities.

“I am certain that we would encounter significant underwriting obstacles. I believe that there is a strong possibility that we will be unable to procure Property and General Liability coverage if you proceed with the louver retrofit.”

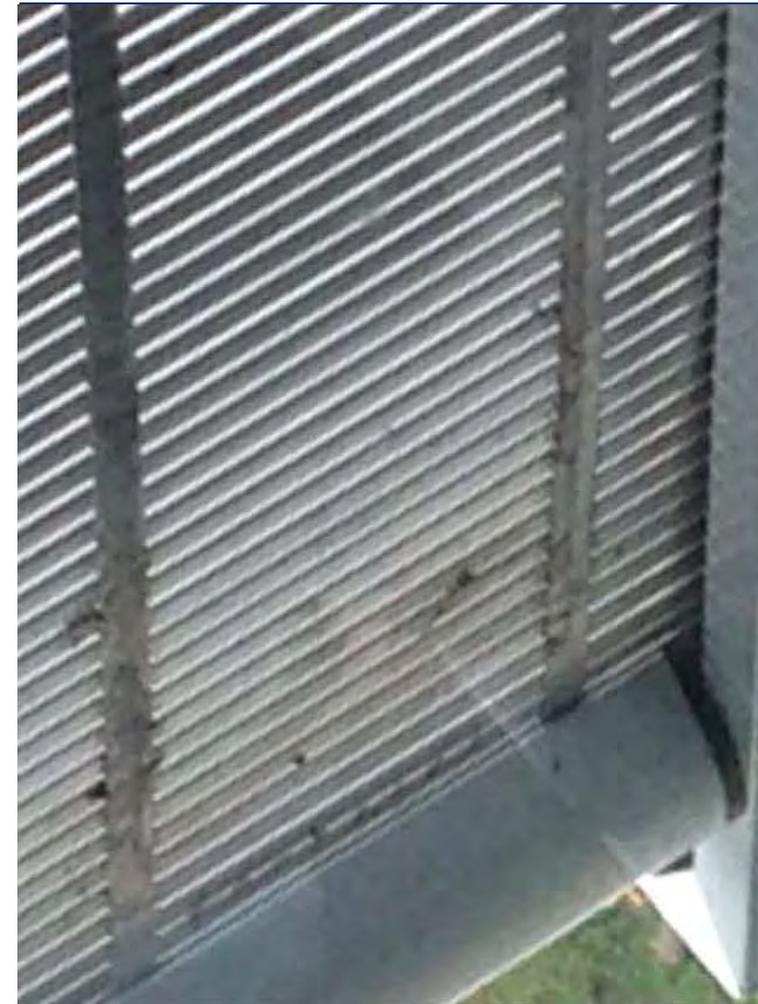
Alec T. Biele, Area Senior Vice President
 Arthur J. Gallagher Risk Management Services, Inc.
 November 14, 2012



Maintenance

- Observations from the Hegau Tower show that the housing headers (rectangular boxes) protruding from curtain wall surface and the louvers themselves require frequent cleaning for dirt, debris, bird nests and droppings. The headers attract birds as a roosting site.
- Louver headers and tracks may interfere with current window washing equipment and may require modification.
- Louver interior surface can only be cleaned by removing the louvers.

CONCLUSION: Louver system will require a continuous, expensive, laborious effort to clean and repair to prevent it from becoming a visual eyesore for owners as well as those in the Arts District.



Appearance and Impaired View

SELLING A WORLD-CLASS LUXURY RESIDENTIAL PROPERTY

- Louver system requires a substantial (9"x12") architectural "head" (rectangular box) that protrudes from the existing curtain wall and obscures the glass shingle system as designed.
- Vertical louver tracks on two sides of each panel will protrude from mullions, modifying the current flat wall design to a deep wall design.
- Louvers alter visibility and lighting levels within residences.
- Louvers minimize interior views down (to the landscape below) and up (to the sky).



Appearance and Impaired View

CONCLUSION:

Museum Tower was specifically designed as world-class architecture complementing the Dallas Arts District.

The unattractive appearance of the louvers on the building, the impaired views for homeowners make the louver system an aesthetically unpleasant treatment for both the Arts District and the owners of Museum Tower.

The louver solution is not acceptable to home buyers.



From the manufacturer's representative:

“Clauss Markisen has confirmed that they have not installed the system on a building as tall as the Museum Tower.”

“Clauss Markisen have undertaken quite a large number of retrofit projects but not on any tall buildings.”

Hegau Tower
Singen, Germany
October 17, 2012

From the manufacturer's representative:

"I am not aware of any projects where the specific intention of the system was to deal with reflection.

All the projects that I know of are ones where the system is used for solar and light control."

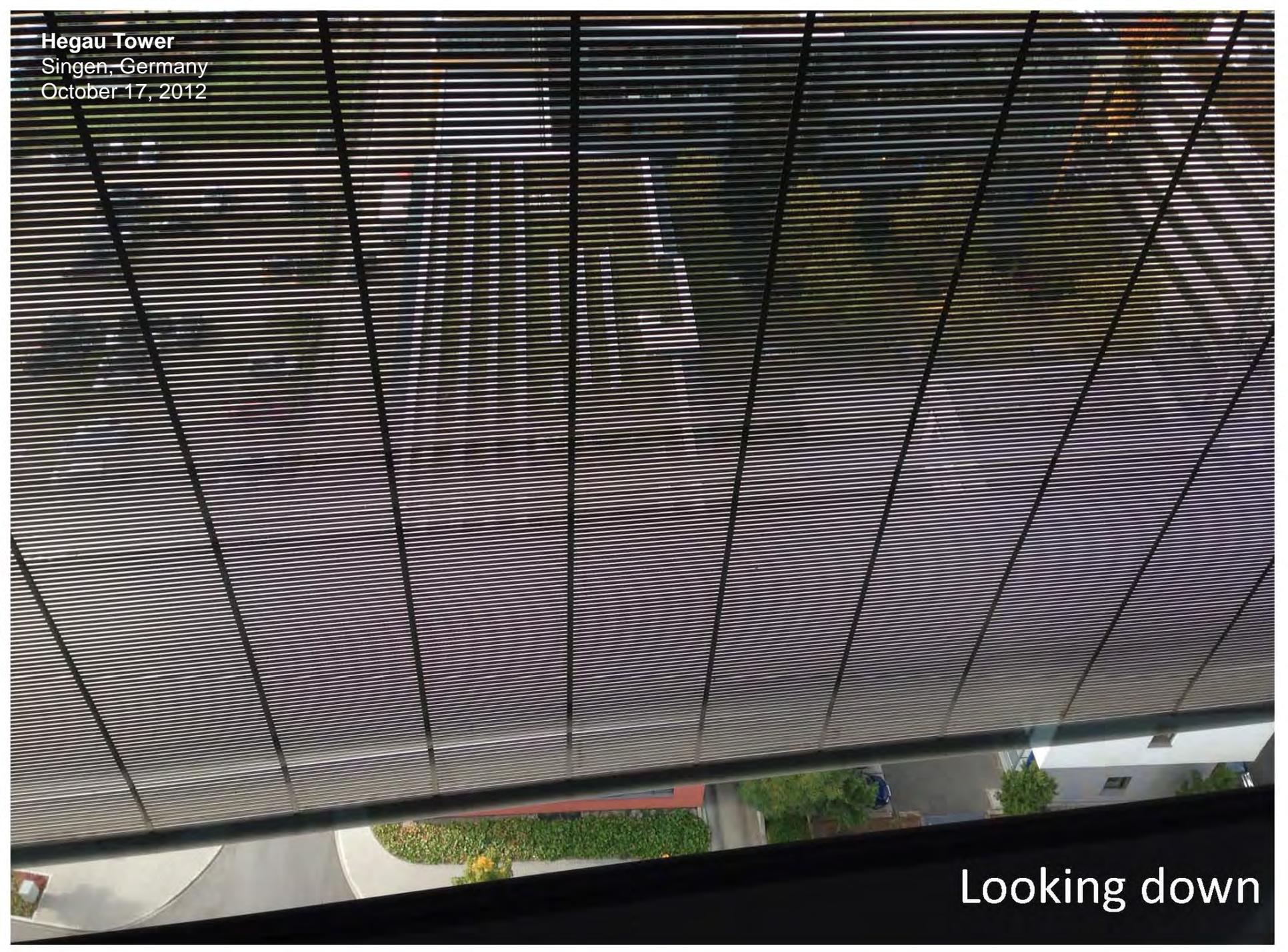
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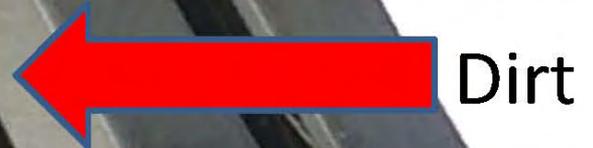
Looking up

Hegau Tower
Singen, Germany
October 17, 2012

Looking down



Hegau Tower
Singen, Germany
October 17, 2012



Dirt



Dirt and stains visible
on louvers

Hegau Tower
Singen, Germany
October 17, 2012



Glare from the Louvers

Hegau Tower
Singen, Germany
October 17, 2012



Summary:

According to our research, retractable louvers have many technical and engineering challenges, most notably, the inability to insure that the louvers will remain attached to Museum Tower under gusty wind conditions that may exceed the louver manufacturer's maximum wind speed tolerance.

Insurance underwriters appear unwilling to insure the building because of 1) the ongoing problems of waterproofing 20,000 holes in Museum Tower's façade to attach the louvers, and 2) the risk of louvers detaching from Museum Tower, and the possibility of damage to surrounding buildings and people in the Arts District.

Museum Tower has invested significant resources into the research of other options.



mtf
museum tower