

Talking Tall: Greening Supertalls

The Green Retrofit Programs of the Empire State Building and Taipei 101



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Paul H. Rode
Paul H. Rode is a Project Executive for the Solutions Division of Johnson Controls, Inc. where he leads a team comprised of mechanical engineers, electrical engineers, and project managers, to develop large infrastructure projects in the New York Metro area. This work includes energy performance contracting, energy savings guarantees, distributed generation, and operations studies. Mr. Rode has been with Johnson Controls for 15 years and has held a variety of positions from Senior Project Manager, Performance Contracting Team Leader, Development Engineer, and Business Development Director. Prior to joining Johnson Controls, he worked on foreign project management assignments involving the construction of cogeneration stations in Zimbabwe, South Africa, Brazil, Russia, and Saudi Arabia. Mr. Rode is a professional engineer with a Bachelors Degree in Chemical Engineering from Manhattan College, New York. He is regular contributor of white papers and articles covering the energy efficiency industry.

Harace Lin
Harace Lin, Chairman and President of Taipei Financial Center Corp., is the person who leads the team to invest and build Taipei 101, which comprises of an office tower that was the world's tallest building until early 2010. Mr. Lin obtained a Bachelor of Science degree in Chemical Engineering from the Tamkang University, Taipei, Taiwan. Mr. Lin has over 30 years of experience in the real estate development field. He has done many large scale housing developments and office buildings in the past, and is now involved with several good quality projects in and outside of Taipei city.

Creating the best business precinct and the most attractive retail environment to accommodate the needs of financial and high-end international labels was obviously Harace Lin's professional ambition, but creating a multifunctional environment with a sense of place is probably closer to what he had in mind with his wish "to build something that I could pass on to future generations."

"The Empire State Building and Taipei 101 prove that green retrofitting of tall buildings requires a team effort for the smart implementation of practical solutions for unique buildings with unusual challenges."

An interview with Paul Rode (Johnson Control Inc.) and Harace Lin (Taipei 101) by Jan Klerks, CTBUH Communications Manager

The world's tallest buildings have always been more about expression rather than necessity or a solution to any problem. For centuries, ambitions, the search for boundaries, the urge to express oneself and the desire for a unique address have been typical drivers of supertall buildings. Being the visible landmarks that they are, these towers have represented the aspirations of those who commissioned them, the capabilities of those who built them and the place and time in which they have been built. Today, they are incorporating a new message; that of green leadership.

Many new tall buildings are incorporating sustainable features in their design. But new buildings make up just 2% of the total building stock. Setting an example is one thing but for ambitions to make an impact, one needs to look at existing buildings as well. Recently many tall building owners have announced greening programs.

The Empire State Building in New York City and Taipei 101 are two former world's tallest buildings that have started implementing green retrofit programs. To learn more about these programs we speak with Harace Lin, Chairman and President of the Taipei 101 Corporation, and Paul Rode, based in New York City as a project executive for the Empire State Building Greening project on behalf of Johnson Controls Inc. I recently spoke with both about their greening programs and their experiences so far.

Empire State Building

To many, the Empire State Building in New York City is one of the most iconic skyscrapers in the world. Being a product of economic, technical and personal prosperity, the tower

embodies all that is the United States of America ever since it was erected. Rode, who has 16 years of relevant experience under his



Empire State Building, New York

belt with a major energy provider, is a well informed and enthusiastic representative for the project.

How did you get involved in the greening program for the Empire State Building?

When the Clinton Climate Initiative was looking for a signature project to represent the opportunities of a green retrofit, the Empire State Building was at the top of their list. They approached the owners of the New York City landmark to find out if they were interested in becoming an icon not only for the US, but also for sustainability through green retrofitting. Through a competition, which included thorough questioning about our practical and professional capabilities and also where we

stand on the general philosophy of sustainability, we were selected to conduct a greening study of the Empire State Building. Jones Lang LaSalle and the Rocky Mountain Institute were selected as the project manager and design partner respectively.



Installing insulated reflective barriers behind radiator units on the perimeter of the Empire State building

So when you want to turn the Empire State Building into a green building, where do you start?

The first thing we did was conduct a thorough assessment of the current state of the building. The tower was designed at a time in which natural lighting and ventilation were very common because of inefficiencies of artificial lighting and cooling technologies. As a result, the building has relatively high ceilings and is ventilated naturally through operable windows. Unfortunately many of the natural effects were offset by the installation of mechanical cooling systems and lowered ceilings in the 1950's.

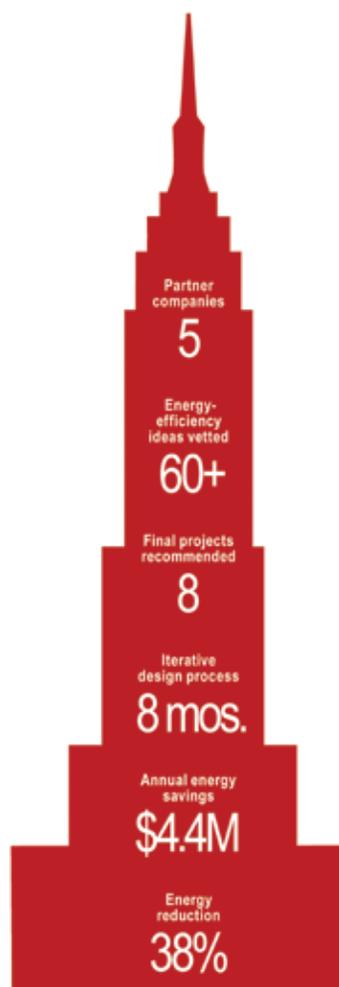
What is the main greening strategy for the Empire State Building?

In the eight months after our initial assessment, more than sixty ideas were modeled and analyzed for their greenhouse gas reduction potential, financial costs and payback time. Out of these, eight main strategies were chosen based on their efficiency and return. One of the main strategies concerns the 6,514 windows in the building. Instead of replacing these with new windows, they are being refitted by applying a thin film on the surface and a gas fill in between the double-glazing to reduce heat gains in the summer and heat loss in the winter. Through experience we know that glazing can have an influence on cell phone signal. The film substance which is used to coat windows is either ceramic or aluminum based. The latter is the most used one, but it

also affects the strength of the cell phone signal. The installment of reception repeaters may be necessary because of it. It's an example of being aware that everything you do may have unexpected side effects.

What other projects make up the greening strategy?

Next to refitting the windows, the installation of insulated reflective barriers behind the radiator units, and optimizing day lighting, artificial lighting and electrical plugs are part of the first step in the greening strategy to reduce the energy needs. These three recommendations helped to reduce the cooling load, which as a result requires a much cheaper retrofit of the chillers instead of replacing them with new ones. These recommendations turned out to be the biggest cost saver. In addition to this, a new air handling layout has been suggested with floor mounted variable air handling units. ✈



Empire State Building green retrofit project facts

...the clients

“It's always about the clients. Without good clients you can't have good architecture.”

Steven Holl discussing the innovative projects from the time he came to New York in 1977.
Source: "By the Architects, for the People" by Nicolai Ouroussoff, NY Times, May 4, page C7

With the efficient technology in place, the final step of the plan is to install controlling devices to monitor the use of energy. A Demand Control Ventilation System will be installed to measure CO2 concentrations and to determine how much fresh air is needed. Also the HVAC systems will be optimized by installing new building controls. Finally, tenants will have access to energy use data so they can benchmark themselves.



Taipei 101, Taiwan

Taipei 101

Around the time that the Burj Khalifa reached world record heights, the owners of the Taipei 101 skyscraper embarked on a greening mission that should establish the tower as the tallest green building in the world. In November 2009, the Taipei 101 Corporation announced that it will apply for the new LEED-EBOM certification, which is the rating system for Existing Buildings: Operations and Maintenance. Talking to us from literally the other side of the world, Harace Lin tells us all about Taipei 101's greening program.

Taipei 101 is a fairly new building, having been completed in 2004. What does that mean for your greening ambitions?

We looked at the green retrofit programs of other tall buildings, but concluded that we had to come up with our own scheme because our building stands out in age, climate and culture. A preliminary study showed that the tower already had several green elements installed during the original design and construction. For example, our double Low-E glass curtain wall can block 50% of the heat and UV rays. We had also installed a waste recycling program, grey water system and Building Energy Management and Control System. So we are already quite an energy efficient building. Actually, we found out that



Green Belt around the building

Other Case Studies

The Empire State Building and Taipei 101 are not the only existing skyscrapers that have launched green retrofits. This is an overview of other green retrofits of tall buildings.

Willis Tower

In 2009, the office of Adrian Smith + Gordon Gill Architecture presented their study for a greening and modernization program for Chicago's Willis Tower. This aims to reduce the building's electricity use by 80% and its water use by 24,000,000 gallons (90,850,000 liters) annually. One of the most basic yet beneficial improvements is re-glazing the building's 16,000 single-pane windows. This creates effective day lighting and ultimately 40% less lighting energy consumption. This is a big move away from the original heat-by-light system, whereby lighting fixture heat was trapped and piped through ducts to warm the building's rooms. When the outdated HVAC, elevator, and plumbing systems are replaced, they will operate as much as 50% more efficiently. The new plan also integrates wind turbines, solar hot water panels and green roofs, which are being tested to withstand high-altitude wind conditions on the tower's set-back rooftops. Currently, the Willis Tower greening project is still under consideration.

Deutsche Bank Greentowers

Being part of an industry which is characterized for long term thinking, it makes good sense that financial companies take leadership in environmental development. Possibly inspired by their competitors, the Deutsche Bank's head office, being a prominent 155-meter twin tower complex in Frankfurt, are undergoing Europe's largest building renovation "to become one of the most environmentally friendly skyscrapers in the world," according to the Web site dedicated ⇨



Taipei 101's Rain Harvesting System

the building scored very high on the Energy Star rating.

What new greening strategies did you come up with?

TAIPEI 101's greening program consists of numerous practical building modifications, check-ups and facility improvement measures. It includes checking the lighting systems for energy-saving light bulbs and tubes replacement, checking water efficiency of all plumbing fixtures, the replacement of toilet flush valves, a chiller plan optimization program, the implementation of an energy audit, measurement of air flow and the installation of humidity sensors.

What strategy is expected to be the most effective?

We expect the policies aimed at improving the energy efficiency to have the biggest impact on greening. We also found that green cleaning, which costs only a bit more but really helps to improve the indoor environment, is one of the most efficient policies worth implementing.

Experiences

To learn about the similarities and differences between the greening programs of both skyscrapers, I asked both Lin and Rode the following same set of questions.

What strategies were researched but not implemented?

Rode: The conservation and reclamation of the annual 80 inches of snow and three million gallons of rain water on site is a policy that we

chose not to be implemented. As it turned out, this would require a system which was probably not going to be economically feasible. The idea to install chilled beams was abandoned because of logistical issues. Because you're working in a building that is in operation, measures that require a temporary relocation of tenants may turn out to be infeasible just because of the costs and planning issues. Because of this we learned it is very important to involve the tenants early in the process. Naturally, we also looked at greening the roofs. But being a tall building the effects of it will be modest because of the relatively small size of the roof compared to the total program. Also research showed that grass is being picked by pigeons, who also like to pick up pebbles which they then drop from the air. We concluded that painting the roof in an effective color, which is dark for cold climates, light for warmer ones, is more cost and energy effective.

Lin: We decided not to add green space on site as we found it is more economical to adopt a green park nearby. Also, those policies that would entirely depend on tenants to be successful were not selected. In the early stages, all tenants are willing to participate and cooperate but the initial enthusiasm tends to fade away after money or habits come into play. We learned that we need to provide extra incentives for them to stay more actively involved.

Rode: I agree that there is a limit to what you can do when the tenants are involved. Some of our larger tenants are sub-metered, so for them there is a financial incentive to be able to monitor the utility costs, but in the end it is up to them on how they want to play along.

Was being a showcase leader the main reason to start the greening programs or were there other motives involved as well?

Rode: In the end we're all in the business to make money. Obviously there are gains in lowering costs. The shorter the payback time, the easier it is to sell these investments. Our greening program is estimated to save 38% of the building's annual energy consumption and US\$4.4 million annually against a US\$13,200,000 investment. ➔

to the greening project. This is also an example of a greening program that involves a tenant owned building, which allows for a more far reaching implementation of greening policies. The project targets a reduction of heating energy (67% reduction), electrical power (55%), water usage (75%) and CO2 emission (89%). Furthermore, it aims to recycle 98% of the used materials and to increase occupancy efficiency by 20%. Deutsche Bank aims its headquarters to become the world's first renovated skyscraper with a LEED Platinum Certificate.

The Transamerica Pyramid

The greening of the iconic Transamerica Pyramid in San Francisco has become a city wide subject of promotion. After some ten years of green upgrading, the tower was awarded the LEED Gold Certificate by the U.S. Green Building Council. It was the mayor of San Francisco himself who announced the completion of the green retrofit program in 2009. As San Francisco saw its LEED certified square footage increased five-fold in 2009, he also claimed the city to be ahead of New York or Los Angeles in terms of cities with the greatest number of green buildings.

The Pyramid now has a water-use reduction program that has resulted in a 50% reduction, which includes high-efficiency toilets, installing a drip irrigation system in the landscaping and planting drought-tolerant plants. A newly installed cogeneration plant, provides up to 70% of the Pyramid's electricity needs. It saves US\$600,000 a year in utility costs, and reduces the buildings' greenhouse gas emissions by 750 million tons per year. Also, tenants were educated on LEED certification requirements, ie., the eco-friendliness of each tenant's office furniture and sustainable alternatives, such as re-use of the previous tenant's furniture. The building also promotes the usage of green cleaning products.



Taipei 101's Waste Recycling System

Lin: TAIPEI101 will invest almost US\$2 million for improvements which will take roughly 20 months to implement. The project is estimated to save close to US\$650,000 in energy costs each year after the transformation is complete.

Rode: There are also indirect gains. The retrofit will also place the Empire State Building in the top 10% of energy efficient buildings of its size. That's something worth mentioning. But we also want to create an environment in which people are more productive, and we want to invest in the name and fame of the building. Being green allows the Empire State Building to continue to position itself as an icon for the future.

How are you promoting the program?

Lin: When we started this program our goal was to obtain LEED Gold certification, but now we decided to try to obtain a LEED Platinum certificate. We chose to further reduce energy consumption to provide a good indoor environment for our tenants and to get recognition through LEED certification. Hopefully this will encourage other buildings to make the same commitment to contribute to the improvement of global warming. Also, we learned that only 24 buildings in the United States have received LEED-EBOM platinum rating and these are all relatively smaller buildings, with only two of them containing over 700,000 square feet (65,000 square meters). TAIPEI 101 offers more than 2,000,000 square feet (185,800 square meters), so we consider it a challenge to rise above them all. Obtaining LEED Platinum would require an additional US\$1,500,000 investment.



Taipei 101's Energy Saving Light Tubes

Rode: We're aiming for LEED Gold as this is the level which we find most realistic at the moment. The Empire State Building even has a Web site dedicated to the greening project, so others can learn from the experience of developing a replicable model for retrofitting pre-war buildings in a cost-effective way. The annual three million visitors to the observatory of the Empire State Building are considered to be a great target audience for the promotion of sustainable policies. As part of the visiting experience a "sustainable kiosk" will be built to inform visitors about the greening program of the Empire State Building and sustainability in general. But it's not only visitors that are being targeted. Green retrofitting is definitely a team effort, which requires everyone involved to be aware of what he or she is working on. Projects like these require a holistic way of thinking, and I would argue that there is space for education in the work field. On the other hand, we found that many workers are proud to work on this project. It's the kind of enthusiasm which creates good energy.

Conclusions

The Empire State Building and Taipei 101 prove that green retrofitting of tall buildings requires a team effort for the smart implementation of practical solutions for unique buildings with unusual challenges. The Empire State Building's greening strategy of reducing loads, installing efficient technology and using controls is an excellent blueprint for the greening of older buildings, while Taipei 101 shows that newer buildings also have room for improvement as many small and practical policies and measures can add up to great effects.



Taipei 101's Grabage Disposal System

Retrofits of tall buildings are getting much attention because of their size and visibility, but the end result is determined by what's best not only for the planet, people and promotion, but also for profit. Going by the numbers, both the Empire State Building and Taipei 101 are looking at a payback time of somewhere between three and five years. Such a fast payback should convince more building owners to invest in green practices.

These projects also show that, next to LEED certification for the buildings, there ought to be a personalized kind of rating system for end users and their habits as well. As such, a green retrofit is only a tool which makes a sustainable way of life in tall buildings more feasible. Continued education and promotion of green habits is also necessary to really make a difference in the end. ■

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