Pearl River Tower
Guangzhou, China

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Overview

- Introduction
- SOM’s Role & Approach
- Technologies Implemented
- Results
- Lessons Learned
Pearl River Tower

- Located in Guangzhou, China
- 71 Story Building
- 2.2 Million Square Feet
- 1,016 Feet Tall
- Features Office and Conference Facilities
- Developed/Owned/Occupied by: China National Tobacco Corporation
- Broke Ground in August 2006
- Completed in March 2011
Project Initiation and Purpose

- Chinese government goal of reducing carbon emissions by 10% by 2010
- Guangzhou was focus of this policy
- China National Tobacco Company (CNTC) decided to locate their new headquarters in Guangzhou
- CNTC asked for submissions for “High Performance Super Tower”
- A U.S. Company Skidmore, Owings, & Merrill LLP (SOM) responded with a Net Zero Proposal
Project Approach

- SOM believes in uniqueness of each project and environment

- Analyzed wind speed, wind direction, solar angles, air quality, temperature, and humidity profiles which all impacted the design

- Generated team of experts in various specialties

- Integrated the architecture, structural, mechanical and electrical systems which were previously thought to be independent layers.
SOM’s Proposal

- Reduction
- Reclamation
- Absorption
- Generation
Reduction

- Reduced the building’s energy consumption by reducing HVAC and Lighting needs by addressing:
  - Site Orientation – to the East
  - High Performance Building Envelope
  - Day-lighting
  - Building Control Systems
Absorption and Reclamation

• Reclaims energy by using thermal barrier of hot air for mechanical floor for passive dehumidification

• Chilled Slab concrete vaulted ceilings
  ▫ Enhances daylight
  ▫ Cools for underfloor ventilation system

• Wide-scale PV System

• Reusing harvested energy
Generation

- 3 Power Generating Technologies
  - Wind
  - Integrated PV
  - Micro Turbines

- Curvilinear structure forces air through turbines

- Increases speed of air 1.5-2.5 times

- Results in 15x more power than freestanding wind turbine
Technologies Implemented: Overview

- Wind Turbines (4)
- Radiant Slabs
- Micro turbines
- Geothermal Heat Sinks
- Solar Panels
- Sun-Shields
- Smart Lighting
- Water-Cooled Ceilings
- Ventilated Facades

- Waterless Urinals
- Integrated Photovoltaics
- Condensate Recovery
- Daylight Responsive Controls
- Wind Energy Capturing Systems
- Building Management System
Technologies: Wind Centric

- Building sculpted to maximize speed of wind entering pinch points @ 1/3 & 2/3 building height
- Curvilinear structure also relieved stress from wind loads
Technologies: Wind Centric

- Darrieus Rotor – Quiet Revolution Based Design (35% Eff.)
- 4 x 10m dia Turbines
- 10,000 kWh / YR / Turbine
- Power production sourced from wind of varied speed & direction
Technologies: Radiant Cooling

Air space between the two layers of the façade traps heat, which is vented out of each.
Technologies: Exterior Facade

- Duel glazed double wall systems
- 3 x 3.9 meter panels
- 50mm wide perforated blinds
- 200 mm cavity
- Photocell blind control
- Natural heat dissipation system
Technologies: Exterior Facade

Cross Section of Air Temperatures at Perimeter Zones

27°C

23°C
Energy Savings From Large Scale Sustainable Design Strategies
Costs

- According to SOM the additional cost of the improvements increase the cost of construction by $13 million.

- In a investigation by the BBC almost 40% of bribery cases in China involve property development.
Payback occurs in 4.8 years.
Results

• Additional $13 Million to Construction Costs

• Earned Back Within 5 Years because of Savings From:
  ▫ Reduced Electricity Bills
  ▫ Lower Maintenance costs
  ▫ Extra Rent from Space Not Used for Air Conditioning Ducts

• Will reduce energy consumption by about 60%

• Hu Baiju (Chief Engineer) – Cut Carbon Dioxide Emissions by 3,000 tons per year
Lessons Learned

• Understand Uniqueness of Project and Environment to Implement Best Solution

• Sometimes Regulations Prohibit Projects from Achieving Net Zero

• Integrate Architecture, Mechanical, Engineering and Electrical Systems and consider their interaction
References

- http://www.som.com/content.cfm/pearl_river_tower
- http://www.rwdi.com/project/pearl_river_tower