AN EVALUATION OF BUILDING INTEGRATED WIND ENERGY

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Outline

• Changes in Power Generation Strategy
• Microgeneration of Power
• Criticism of Building Integrated Wind Turbines
• Proposal: Nano-generation via Re-generative Methods
• Discussion
Changes in Power Generation Strategy

- Early power stations were local
  - Bankside Power Station – London
  - Silahtarağa Power Station – İstanbul
- Increasing demand led to higher capacities, moving closer to sources of energy
  - Coal mine regions
  - Hydro/wind potential regions
  - Nuclear – strategic regions
- Distant power generation: up to 10% distribution loss
Microgeneration of Power

- Early power generation examples: microgeneration
  - Small communities (neighbourhoods, rural)
- Proliferation of power grid: downfall of microgeneration
- New power generation technologies: microgeneration
  - Solar (Photovoltaics)
  - Wind
  - Co-gen / Tri-gen (Fossil fuels)
- Benefits of higher efficiencies, lack of grid loss, reduced CO$_2$ emissions
Building Integrated Wind Turbines

• Wind energy in urban settings: an enigma
• Large turbines on buildings are problematic
  • Vibration and noise
  • Structural loads
  • User complaints
  • Under-performance
• Technical Problems

Strata Tower, London
Building Integrated Wind Turbines

- The wind patterns around buildings are not predictable
- Urban patterns are temporal, can change quickly
- High rise building façades are washed with chaotic, turbulent up-winds
- Vertical axis turbines for rooftops were proposed, but not working
- A sea-change in the integration of wind turbines to building façades is proposed
- Inspiration: regenerative braking
- Nano-generation: integration of numerous small wind-turbines doubling as ventilation devices
Energy Load of Building Ventilation

Projection of Building Services Energy Loads – Data from DOE (2012)
Regenerative Braking Analogy: Nano-generation

• Electric, hybrid, and petrol vehicles utilize energy saving regenerative brakes to save energy
• These systems generally use the same device for both locomotion and power generation (braking)
• We can distribute many small aerofoils across the building façade to provide both ventilation and power generation as needed
• A distributed network of such a system can theoretically reduce the overall energy load of building ventilation in time, and also blend with architecture
Regenerative Braking Analogy: Nano-generation

Super capacitor integrated automotive regenerative braking system overview (Weissler, 2013)
Regenerative Braking Analogy: Nano-generation

Flywheel based regenerative braking system KERS (Volvo Car Group, 2013)
Regenerative Braking Analogy: Nano-generation

Regenerative Braking

Regenerative Ventilation
Proposal: Nano-generation

PARTIAL ISOMETRIC VIEW

PARTIAL SECTION VIEW

- BYPASS OUTLET
- MOTOR & FAN
- STORAGE DEVICE
- VENTILATION INLET
Proposal: Nano-generation
Discussion

• An exploratory study, currently looking for funding

• Next steps:
  • Extensive literature review on stack effect and wind across building surfaces
  • Investigation of the economy and efficiency of low voltage, low speed nano-turbines
  • Consideration of the impact of pollution and air quality for the intakes
  • Utilization of parametric design tools for the creation of a building façade foil design
  • Empirical studies for collection of building façade wind data
  • Simulation of the proposal with CFD
References


Thank you

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