

Fabric Designs Testing for Solar Chimneys

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Aim

Explore novel fabric-based designs for tall Solar Updraft Towers

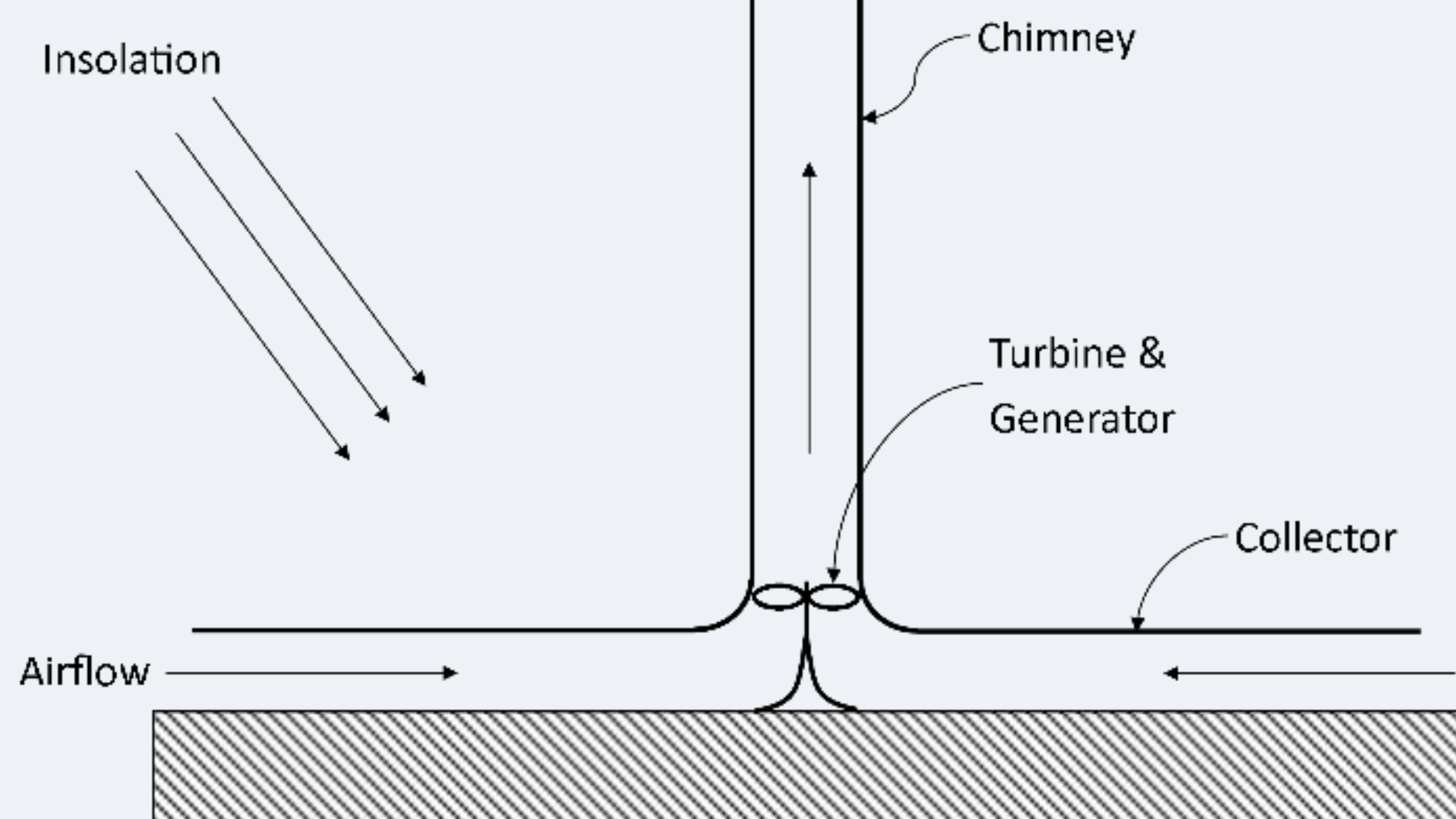


Diagram of a solar Updraft Power Plant

Background

What is a Solar Updraft Tower Plant?

- Emerging renewable energy generation technology
- Air flows through a green-house structure (1→2)
- Air heated by the sun rises up the tower (2 → 3)
- Turbines at base of tower extract electricity from flow (2)

Challenge with Solar Updraft Tower Plants?

- Plant efficiency related to height of tower
- Studies show this technology is only viable if the tower is more than 1000m high
- This is an obvious engineering challenge

Project objectives

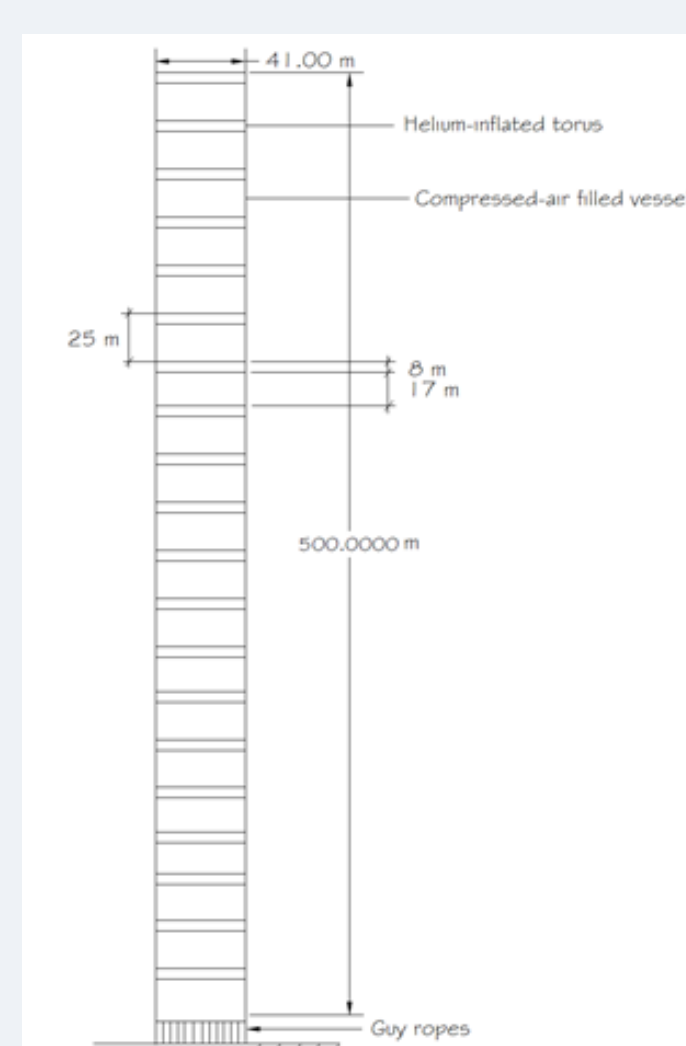
Investigate the possibility of building the tower out of fabric supported by lighter-than-air gas. Two phases:

- Conceptual Design
- Prototype building and testing

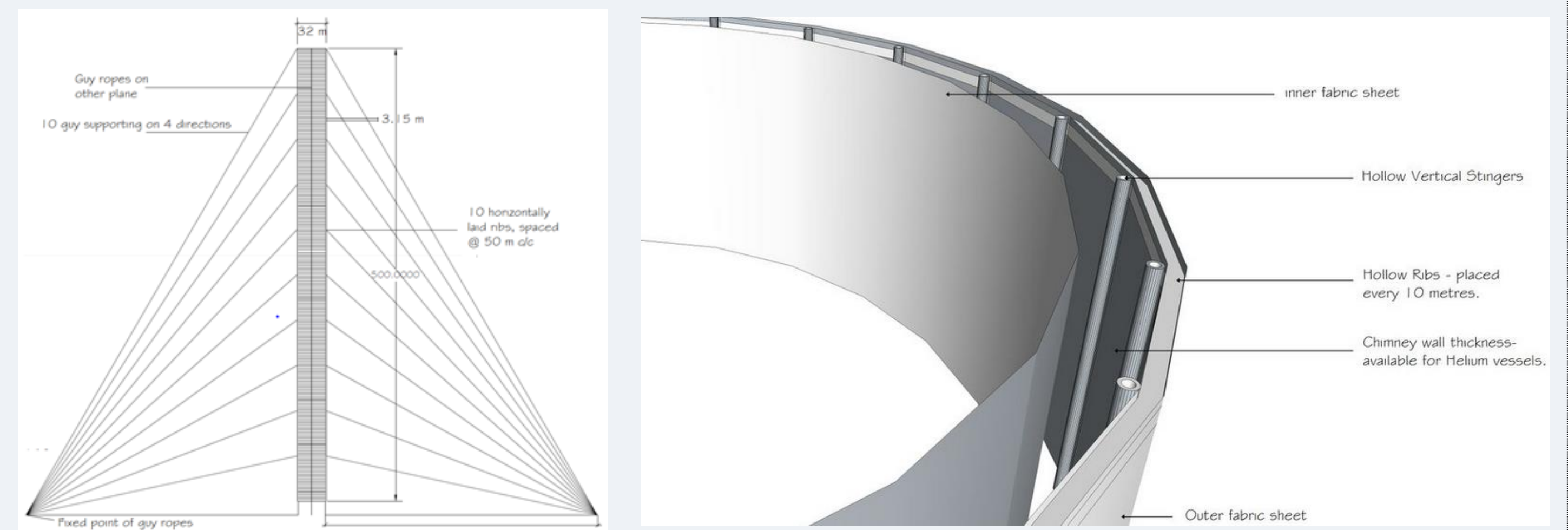
Conceptual Designs

Three Designs investigated:

- free-floating stacked tori
- floating tower restrained laterally by guy cables
- floating tower reinforced by vertical plastic stiffeners and compressed air rings



Free-Stacked design



Guy-cable design

Rib-reinforcement design

Prototype Building and Testing

Prototype: 60 cm tall; built from 6 inflatable PVC rings stacked and glued together

Lateral testing to check stiffness and strength

- Static tests – varying uniform lateral load and internal pressure
- Wind-tunnel tests varying speed and internal pressure



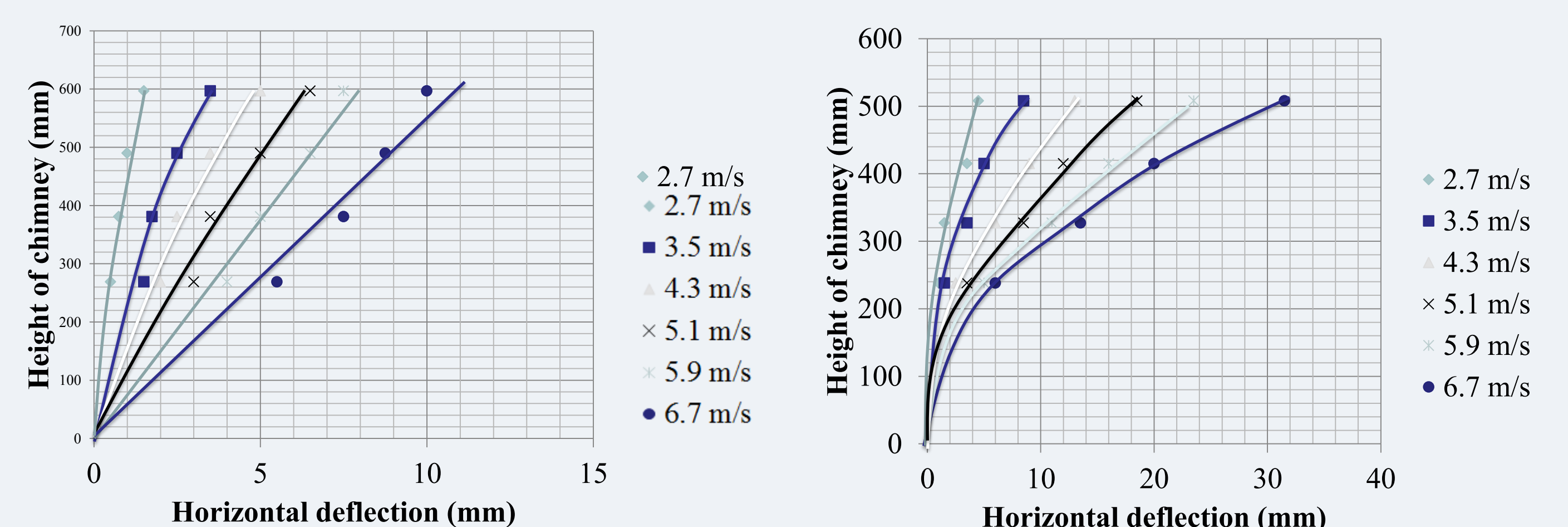
Prototype



Wind Tunnel

Experimental Results

- Deflected shape for varying parameters. Change of behaviour from shear to bending as internal pressure changes.
- Wind induced oscillation observed in tunnel tests



Horizontal deflection recorded for varying wind velocities and internal pressure

Conclusions

- Conceptual design concluded Stacked-ring High was only viable option
- Lateral Stiffness assessed for varying internal pressures
- Scaling and lessons learnt for next 5m tall prototype