Problem Statement
Air quality and high density high-rise environments.

Research Question
How urban ventilation in Mong Kok, Hong Kong, can be triggered by architectural design.

Design Goal
Sustainable high-rise in a high density city with a healthy urban climate.
SARS: Amoy Gardens Residential Development
SARS: Amoy Gardens Residential Development

Wind Technology Design

Fascination

Evita M.M. Pronk 4010965
Government Requirements GCR/ Air Pathways


Breezeways for fresh air to penetrate into the city.
P3 conclusions

Air Quality  Living Environment  Infrastructure  Construction

Wind  Park/ Green Areas

Climate  Facade/Floorplan

Livelihood at street level
Wind Technology: Macro Climate
Macro Climate

Westelijke winden

koude lucht valt

Noord-oostelijke winden
warme lucht stijgt

Zuid-oostelijke winden

koude lucht valt

Westelijke winden

Polaire Cel
Jet-stream, van west naar oost

Gematigde Cel (Ferrel Cel)

Subtropische hoge-druk zone

Subtropische Cel (Hadley Cel)
Equatoriale Lage-druk zone (ITCZ)

EVENAAR
Regional Climate of Hong Kong

Please specify type:
Mean Daily Maximum/Minimum Air Temperature

Please specify period:
Annual

Meso Climate
Ref: Hong Kong Observatory Statistics
/ Normals and Extremes / 1981 - 2010

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Meso Climate

Ref: Hong Kong Observatory Statistics / Normals and Extremes / 1981 - 2010

Hong Kong 1981 - 2010
Number of Days with Strong Monsoon Signal

Hong Kong <> Vlissingen 1981 - 2010
Monthly mean wind speed (m/s)

Hong Kong <> Vlissingen 1981 - 2010
Monthly means of relative humidity (%)

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Figure 7. Monthly means of prevailing wind direction and mean wind speed recorded at the Observatory and Waglan Island between 1981-2010
Meso Climate

Ref: Hong Kong Observatory Statistics / Normals and Extremes / 1981 - 2010

Wind Technology

Design
## Wind statistics

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### Fascination

| July 3, 2014 |
| Evita M.M. Pronk 4010965 |

### Wind Technology

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| 0.027 |
| 0.0142 |
| 0.012 |
| 0.009 |
| 0.009 |

### Design

| 0.0712 |
| 0.2472 |
Figure 27: Wind rose for annual, non-typhoon winds for Mong Kok, corrected to 500 m
Meso-Micro Climate

Ref: Hong Kong / Mong Kok (Experimental site wind availability study for Mong Kok – CUHK 2008)

Figure 26: Wind rose for annual, non-typhoon winds for Mong Kok, corrected to 200 m

Figure 24: Wind rose for annual, non-typhoon winds for Mong Kok, corrected to 50 m
Meso-Micro Climate

Ref: Hong Kong / Mong Kok
Experimental site wind availability study for Mong Kok – CUHK 2008

Figure 11a: Wind characteristics, Mong Kok, 90°
Micro Climate: Nathan Road, Mong Kok

Fascination  Wind Technology  Design
Mong Kok: Air Quality

Weakness

Ref 1: Environmental Protection Department of Hong Kong (2012)
Ref 2: Experimental site wind availability study by the Chinese University of Hong Kong

Figure 1: Location of EPD’s Air Quality Monitoring Stations (2012)
Exchange of Air


(a) Isolated roughness flow

(b) Wake interference flow

(c) Skimming flow

Fig. 1. The flow regimes associated with air flow over building arrays of increasing H/W.
Mong Kok: Streetlife Quality

Strength

Photograph from Sheraton Hotels and Resort (20'13) Ladies Market, Mong Kok
Nathan Road Street View: No/Little Green
Weakness
Wind Engineering

Urban Aerodynamics: Air Quality

Living Environment: Street Quality


The Street Interface Density has to be at least 70% for a ‘good’ street (for pedestrians).

In the diagram above you can see that the top part of the street has a higher interface density than the bottom. Only the first 10 m from the ground up should be taken in account.
Nathan Road: Street Interface Density

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Air Quality: Urban Configuration
Frontal Area Density: Extrusion Outside
FAD 61%
Air Quality: Wind Speed with Extrusion Outside
Set 2C at 2m height
Frontal Area Density: Extrusion Inside
FAD 63%
Air Quality: Wind Speed with Extrusion Inside
Set 2B at 2m height
Park/Green Areas: Protective Barrier
Park/Green Areas: Wind Comfort

At 115m height with a 5m high protective barrier
Park/Green Areas: Conclusion

Fascination  Wind Technology  Design
Architectural Impression
Living Environment: Ventilation
Living Environment: Hexagonal Apartment
Section Hexagonal Apartments and Retail Area
Living Environment: Apartments
Architectural Impression
Thank you

Robert Nottrot
Gregory Bracken
Zhou Yu – Guest Researcher from Tianjin University
Huib Plomp
Lourens Aanen – Peutz

Reinier Maas – Actiflow
Ying Ying Ip – Royal Haskoning DHV
Bas de Bont – ZRi
Arend van Waart
Sander Mulders