Urban Cooling Analysis for Residential Blocks in the City of Ningbo, China

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The work is undertaken with a group of 20 students at UNNC and is expected to develop as a conference/journal paper during the next quarter.

The study involves study and analysis of selected residential blocks in the City of Ningbo. A remodeling approach was undertaken based on environmental performance analysis (lighting, insolation and the wind environment), green infrastructure and building layout/pattern.

Case Study 1

Selected Blocks

These two blocks are the center and mixed used area in the Yinzhou CBD district. There are many potentials and problems.

Potentials: These two blocks are adjacent to the Yinzhou garden, the sunshine, ventilation and the view are good compared to other blocks.

Problem 1: There is no sufficient green area in the centre of the CBD. Therefore, the heat island effect will be a big issue for these two blocks.

Problem 2: From the daylight analysis, the high density of the building layouts is not good for the buildings located in the northeast. The ventilation is also not good in summer.

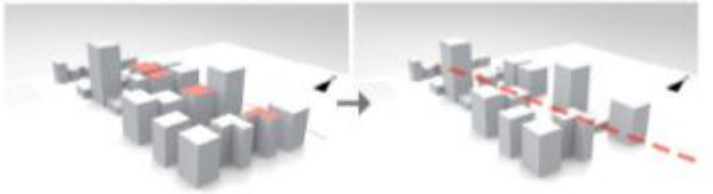
Precedents Study_ City Green Corridors

I did some precedents study, learned some strategies to design the block more green and comfortable. One way is the "City Green Corridor", the idea is put the green space in the center of the district and bring the cool winter to this area and cool down the city.

Remodelling the Blocks

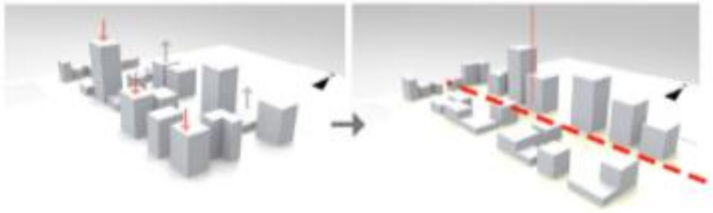
Step 1. Creating a corridor to connect these two blocks, therefore the layout is not the grid but two groups with the inner garden.

Create the gap between high buildings



Step 2. The most of the south side buildings are lower than 35 meters (10 floors), they are designed to be the commercial area including shopping, eating and playing. The north side buildings are higher, for financial centre, office building and residential buildings.

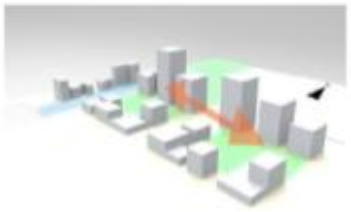
Chage the height Levels

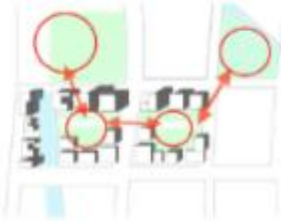


Step 3. Re-design the Green Space, the idea is connect the new garden with the initial river and Yinzhou Garden (Northwest). The air will flow more easier, the heat will be took away in summer.

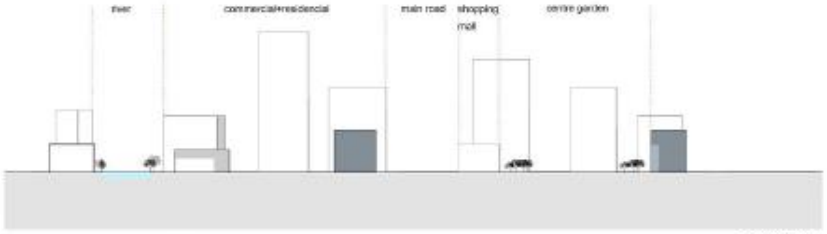
Green Infrastructure

Build/Connect the City Green Corridor

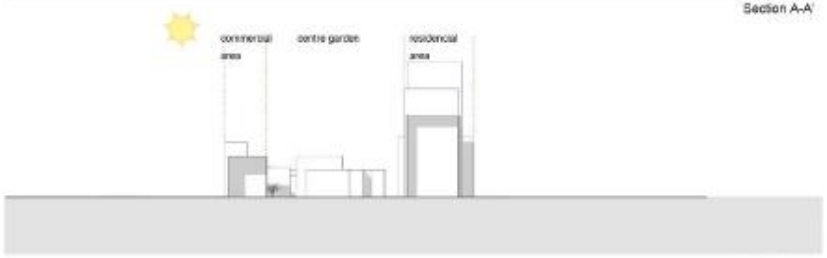




Key Sections



Section A-A'

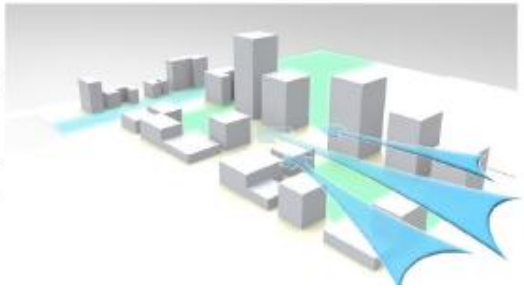


Section B-B'

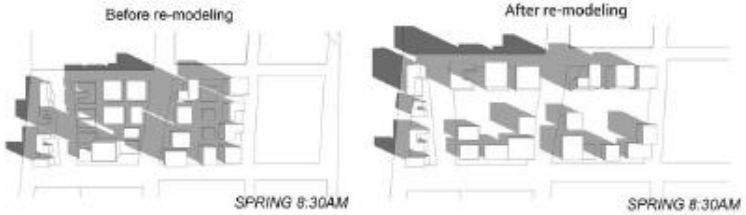
New gardens create amount of space between the high buildings, besides, the buildings in the south side is lower. Thus, all buildings can get efficient sunshine in winter. The garden is also the space where people can communicate with others. The relationship between these two sides will be enhanced by the gardens.

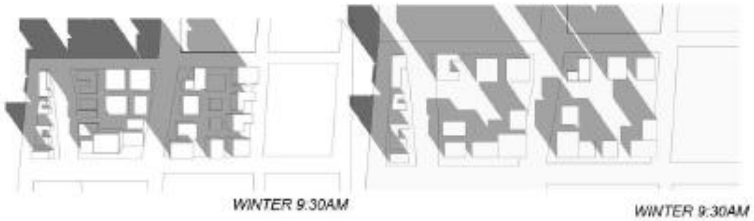
Urban Cooling Performance

The city green corridor can bring the cool wind from east (northeast) to the center of the CBD, thus the air flow will take the heat through the green and void space to the outside. Besides, the tall building can stop the cold wind flowing to the center directly. Therefore, this layout can make people feel more comfortable.



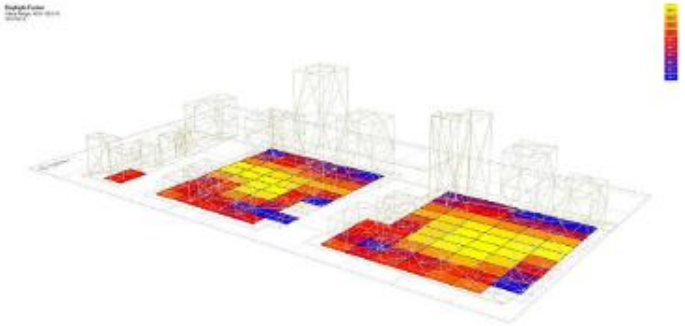
Shadow Analysis





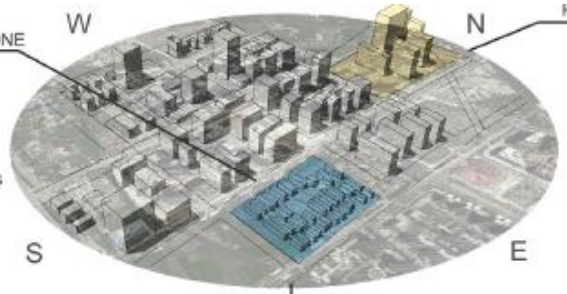
After re-modeling the two blocks, the over shaded problem is solved due to the centre garden and the level changing from south to north. This will ensure most of the buildings can have get sufficient sunshine in winter. In addition, the view will be improved, the river and garden view can be seen from any buildings in these two blocks.

Lighting Analysis_ecotect



RESIDENTIAL AREA ONE

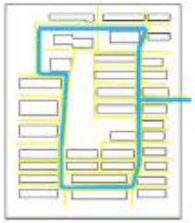
6 FLOORS



RESIDENTIAL AREA TWO

FEI FAN

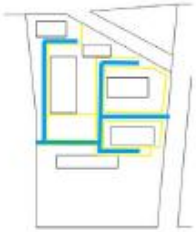
47 FLOORS



Circulation:

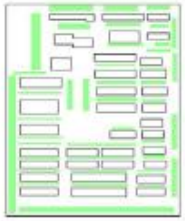
As the image shows, the road for vehicles is roughly cover the area. Meanwhile, there is a small activity space for inhabitant. The pedestrian path can reach each building in the site.

But the layout of buildings is not so clear and regular. The layout needs to improving and there can be a bigger space as a square for people to enjoy this area.



Circulation:

As the image shows, there are less building than the other area. All the buildings are high-rise buildings. So vehicle paths is not a circle in the site. In this condition, it is more easier to create a square for local people within the area.



Green infrastructure:

Green space is well shown in the site. Green space fills each gap between the buildings. Besides, there is an unutilized space at the corner of the site. This can be improved so that the whole site can become more effective.

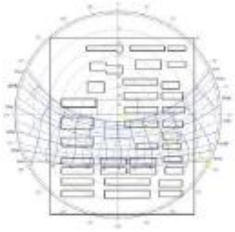
Green infrastructure:

Because the empty space is more than the other, So it is necessary to create green infrastructure for this area. However, green space is not well designed so that the area does not work effectively.

SUNPATH AND SHADOW:

Some buildings are located too close to others. So builds influence others because of sunpath of Ningbo.

WIND DIRECTION



SUNPATH AND SHADOW:

Shadow is the most important element which needs to be considered. High-rise building will create a large area of shadow. Therefore, the distance between buildings need to be longer.

WIND DIRECTION

EE2IDB: **INTEGRATED DESIGN IN ARCHITECTURE 2B**

6509844
FEI FAN

PLAN

SQUARE

Firstly, there is a larger square located in the canter of the site. The circulation is more regular which is similar to rectangular form.
Meanwhile, the distance between the buildings enlarges a little to solve the shadow problem. From the 3D image, building would not effect other buildings a lot.

Firstly, the corner of the site need to be used. Therefore, there is a bridge as a connection.
Also, in the center, there is a square which is surrounded by those high-rise buildings.
Secondly, the distance is increased which can well avoid the shadow influence.
Meanwhile, the green infrastructure is designed surrounding the buildings or square. This makes a better experience for people.

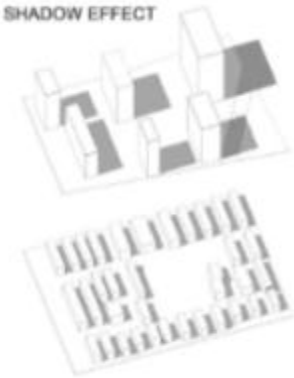
GREEN INFRASTRUCTURE

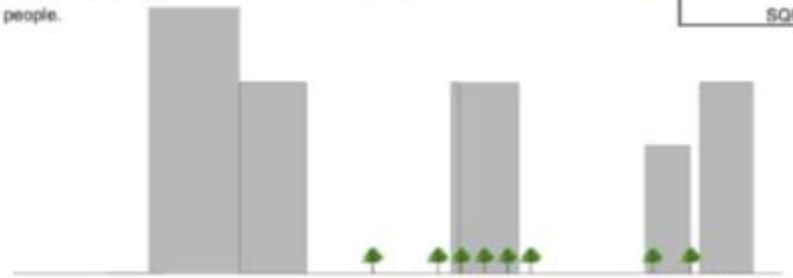
PLAN

SQUARE

GREEN INFRASTRUCTURE

SHADOW EFFECT

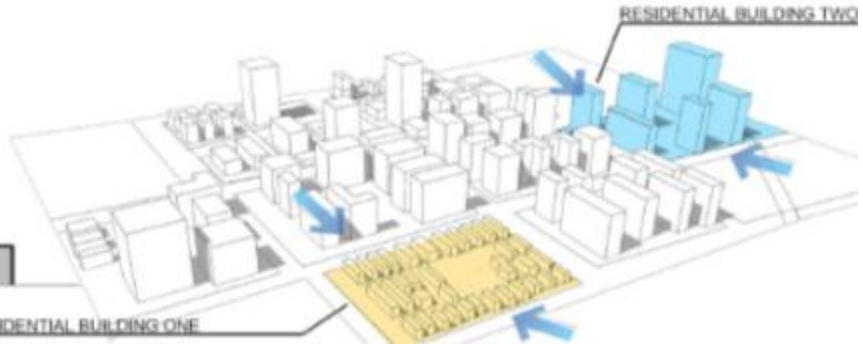




SECTION

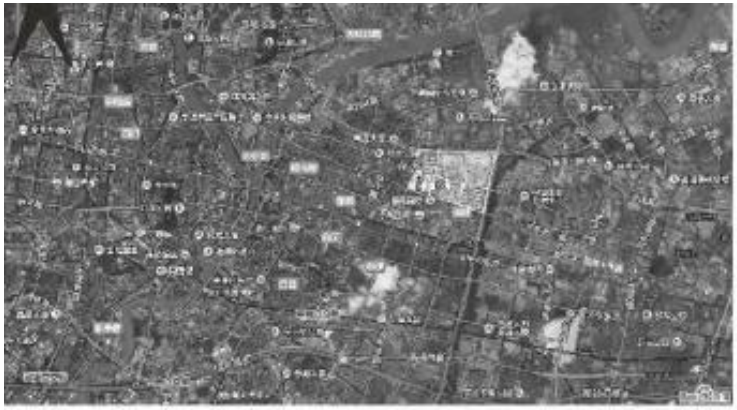
SECTION

RESIDENTIAL BUILDING TWO



RESIDENTIAL BUILDING ONE

Case Study 2

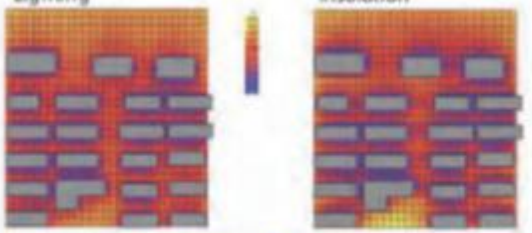


The site is located in Jiangdong district, which is one the most importance districts in Ningbo. Jiangdong district had been belonged Yin town before Republic of China, was set up after Republic of China. In addition,the Jiangdong district was selected as fast development area in Ningbo in 2010. So after 2010, more and more constructions have been taken in Jiangdong district.

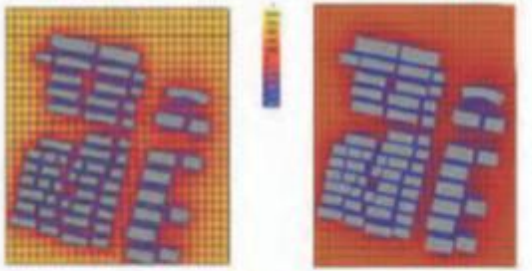
The area of site : 1.5 km2
The circumference of site: 5Km
The height of highest building: 28 floors
The height of lowest building: 2floors

Lighting

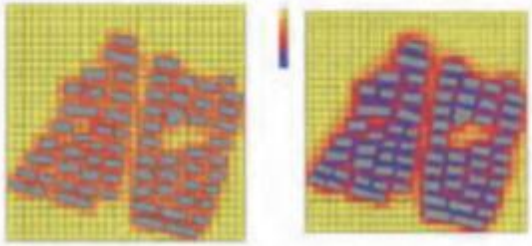
Insolation



properly lighting in community1



space between buildings has little lighting as a reason of high density of buildings and high rise



most area have properly lighting in community3, while still some area lack of sunlight

Overshadowing

Spring Equinox

Summer Solstice

Winter Solstice

Spring Equinox

Summer Solstice

Winter Solstice

Spring Equinox

Summer Solstice

Winter Solstice

The overshadowing diagram show the shadow at 12pm in different season. We can see the community2 have a lot of shadow space in winter. Community 1 has a good layout that each family can have enough sunshine no matter what seasons. On the other hand, community 3 has too many blank no shadow space, maybe can plant more trees in community3 to make people have more shadowed outdoor activity space.

Wind

Spring Summer Autumn Winter

The high rise buildings at Southwest corner block summer wind, while in winter, the North-east direction only have low rise building cannot block cold winter wind.

.. Lantinglvyuan

oor area ratio: 1.35
reen rate: 35%
nd area: 90000 M²

lain Gate of Lantinglvyuan

2.Xintiandi

floor area ratio 2.99
Green rate: 31%
land area: 92000 M²

Main Gate of Xin tiandi

Urban layout and form

1.Mobility
Entrances are unevenly distributed in the block. Lan' s entrances locate in north facing the Minan road and west and Xintiandi's main entrance face west side, Cang hai road, a quite road. However, considering people living far from the entrance, they usually have to walk more than 500m to get out of community. In addition, there are happened to be traffic jam in morning and afternoon rush hour, due to just one or two entrances.

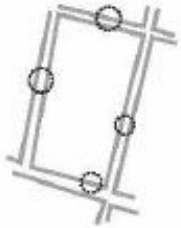
2. Over shade
Lan's FAR is 1.35 and another one is 2.99, which all reach the lowest standard of government residential policy. However the distance between each two buildings is too low and each building have more than 5 floors. So Lan belongs to multi -stories residential and Xintiandi belongs High-rise residential, which got over shade.It resulting in that somewhere can not get light and residents feel depressed.

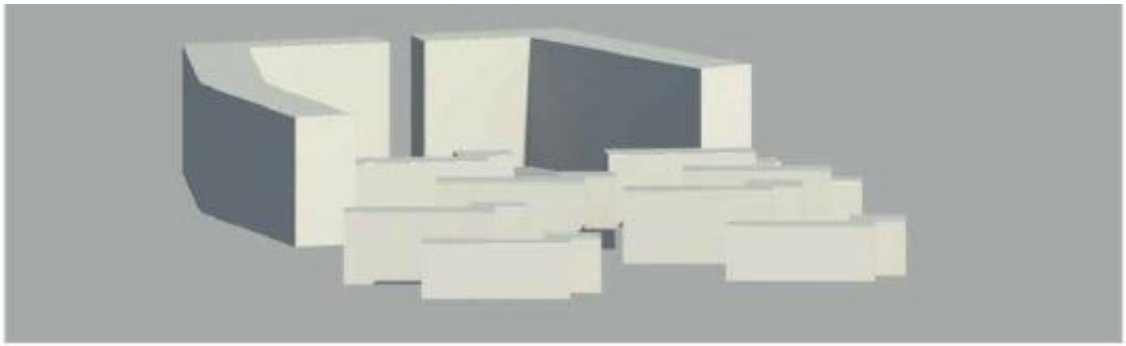
3.Wind
In summer, wind is from southeast, and in winter, wind is from northwest, though, the high building block the summer wind into block to raise heat in community and get strong cold wind in winter.

Green & cooling infrastructure

1.lack of sub center green area
each community just have one green land for whole block people relaxing ,which means more than thousands of people share one small park. Plenty of trees are planted along the street, which can not play big role.

Add more entrances,four side of block





Intergrated building and make enough space open and nature, refere to precedent Linked hybrid

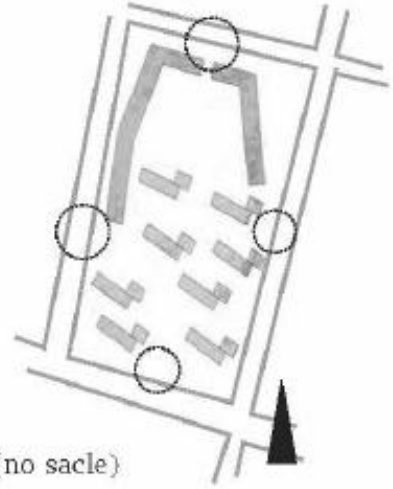
Shade test

Precedent

LINKED HYBRID
Beijing, China, 2003-2008

The 220,000 square meter pedestrian-oriented Linked Hybrid complex, sited adjacent to the site of old city wall of Beijing, aims to counter the current privatized urban developments in China by creating a new twenty-first century porous urban space, inviting and open to the public from every side.The middle of project is a quite comfortable square and public space to relax

Conmbine two building into one and rotate it to get more sunshine and good ventilation



Proposal 1 plan (no sacle)

Urban layout, form and orientation

I try to develop the entrance to connect each road and enlarge the public or green area, so integrated the some multi-stories building into high-rise buildings, which are refere to linked Hybrid as residential with commercial. Therefore high-rise building can served as shop restaurant and also can be house to living in.

Considering the rest part of block, it is hard to say that similar to previous one, because of quality of community as residential.So I combine two building into one and shift and rotate it to improve indoor ventilation.

In addition, Improving quality of outdoor, I arrange low-rise building in south side and high-rise in north side to avoid colder wind and afternoon light.