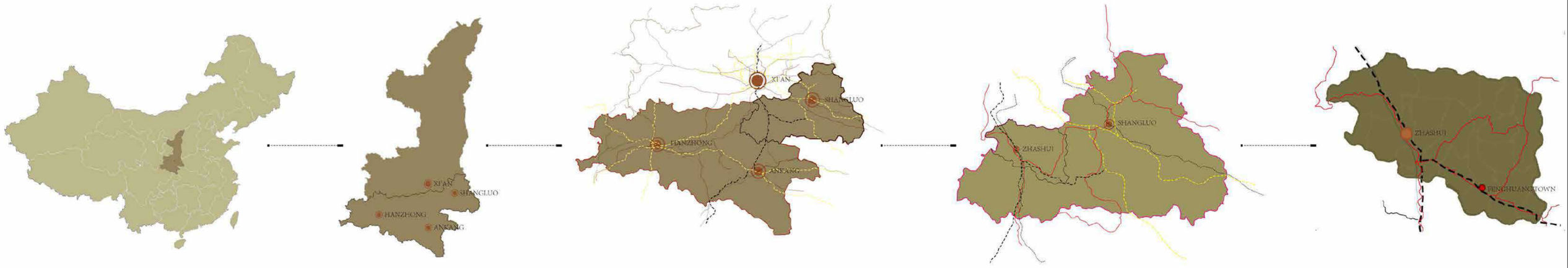


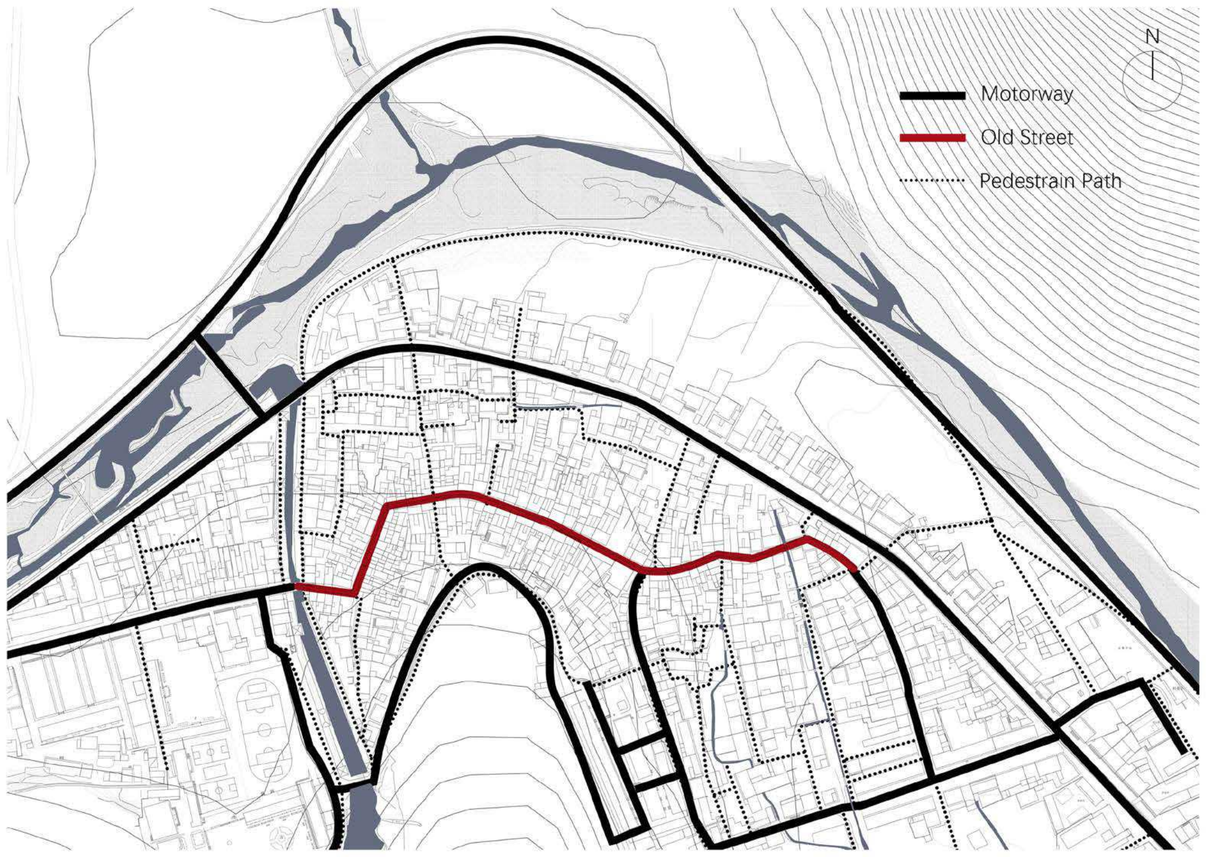
Shannxi · China

Shannan · Shannxi

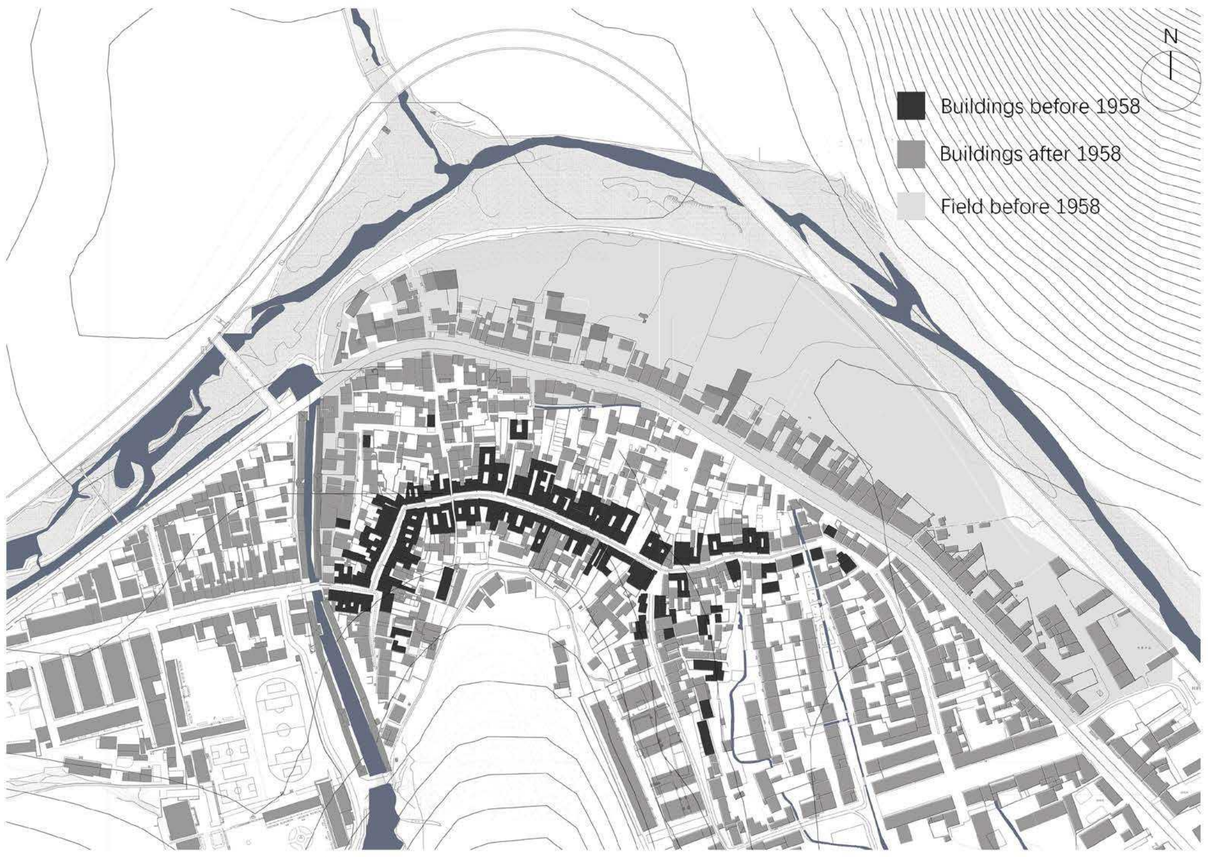
Shangluo · Shannan

Zhashui · Shangluo

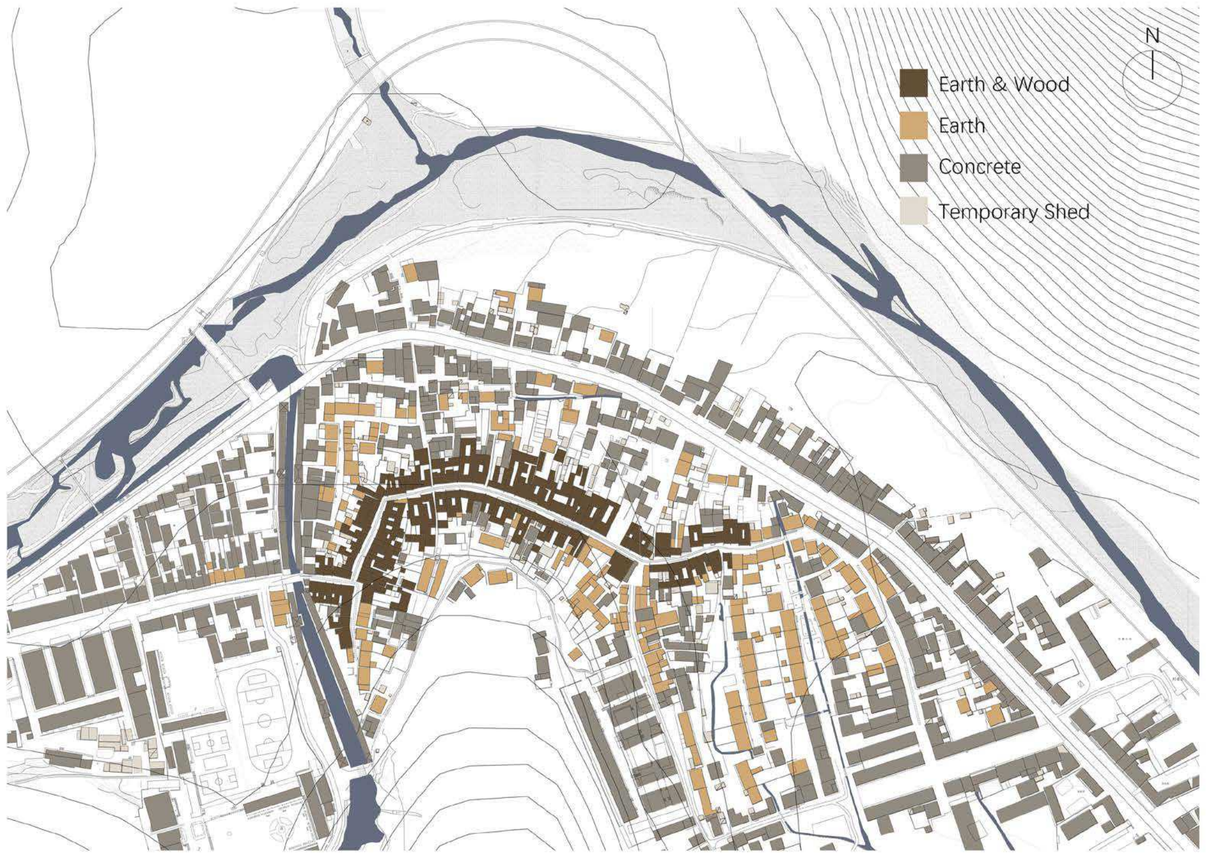
Fenghuang Ancient Town · Zhashui



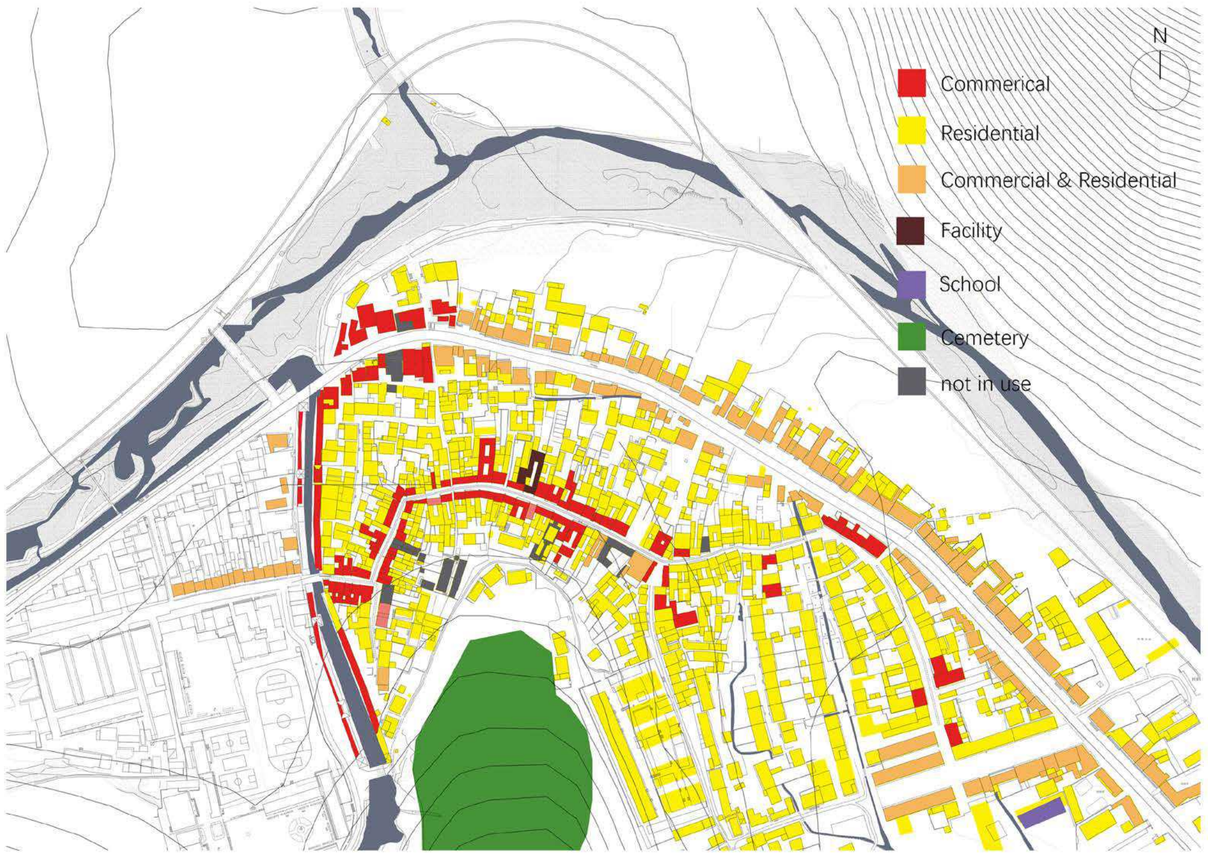
Network (Source: POLIMI-XAUAT Workshop, May 2018)



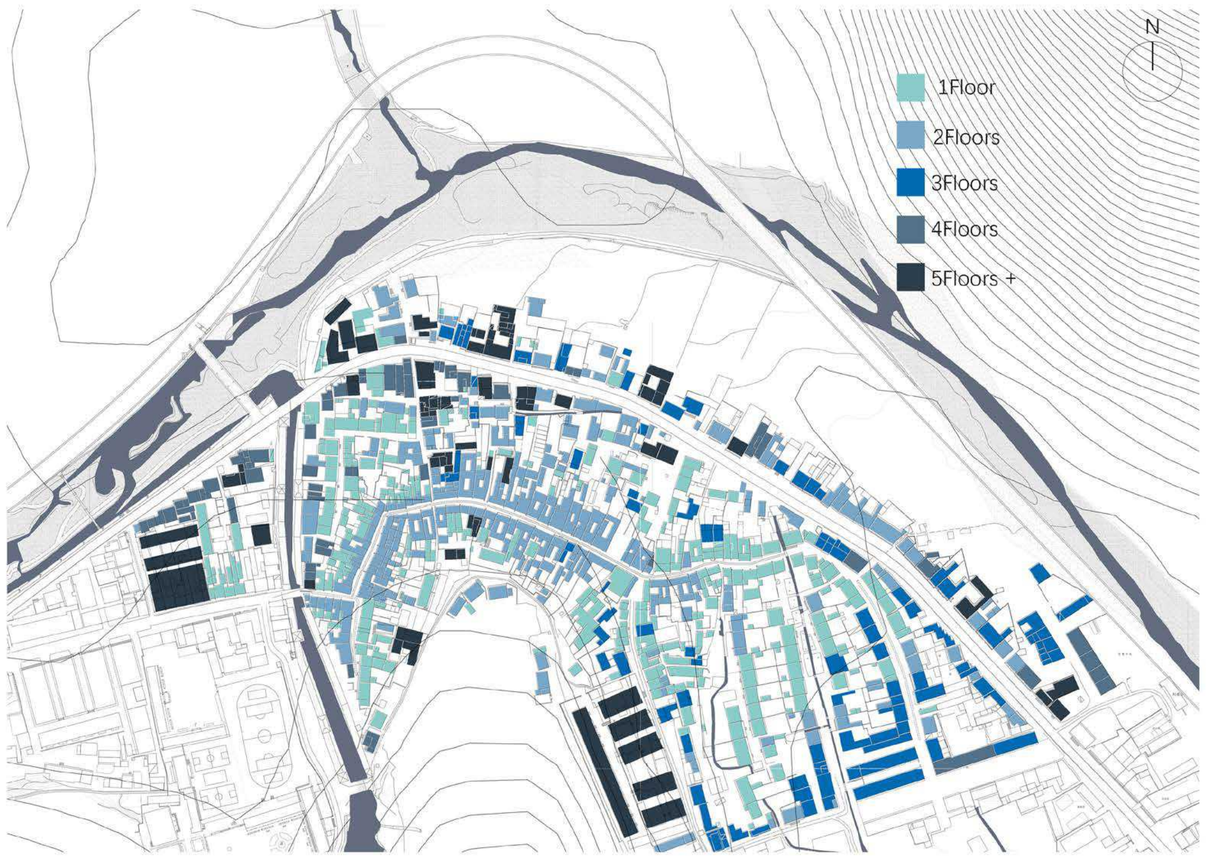
Building History (Source: POLIMI-XAUAT Workshop, May 2018)



Building Material (Source: POLIMI-XAUAT Workshop, May 2018)

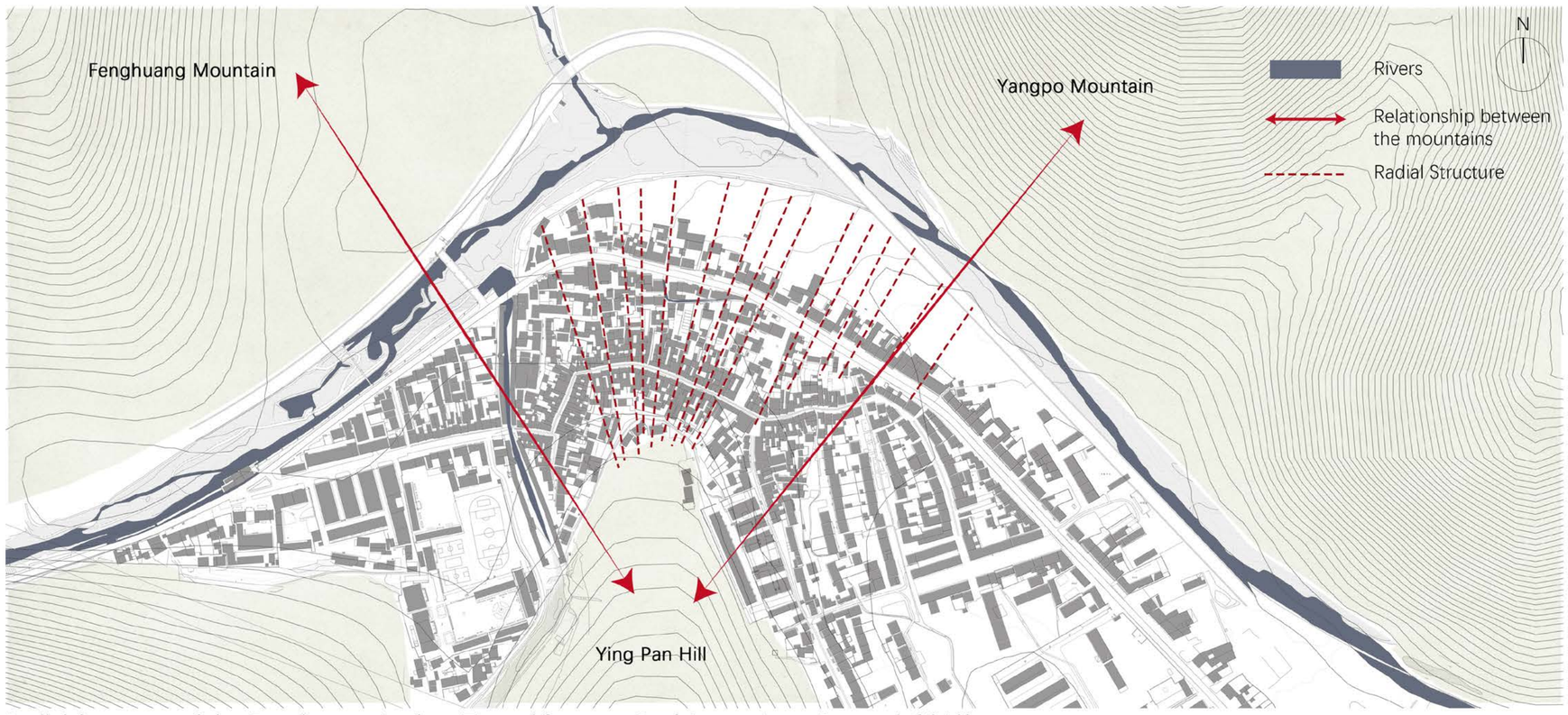


Building Function (Source: POLIMI-XAUAT Workshop, May 2018)



Building Floor (Source: POLIMI-XAUAT Workshop, May 2018)

Greenery (Source: POLIMI-XAUAT Workshop, May 2018)

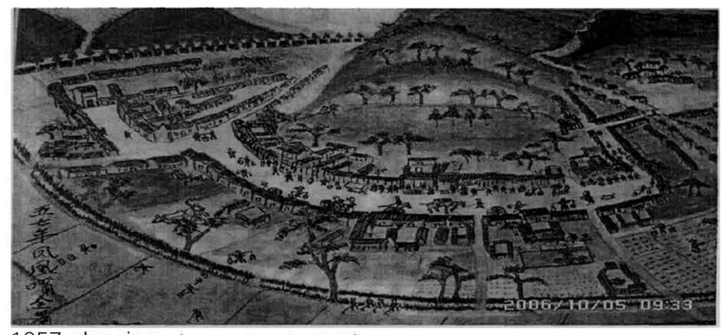


Radial Structure of the Fenghuang Ancient Town (Source: Prof. Laura Anna Pezzetti, 2019)

Element of the Radial Structure--Traditional Dwellings (Source: Prof. Laura Anna Pezzetti, 2019)

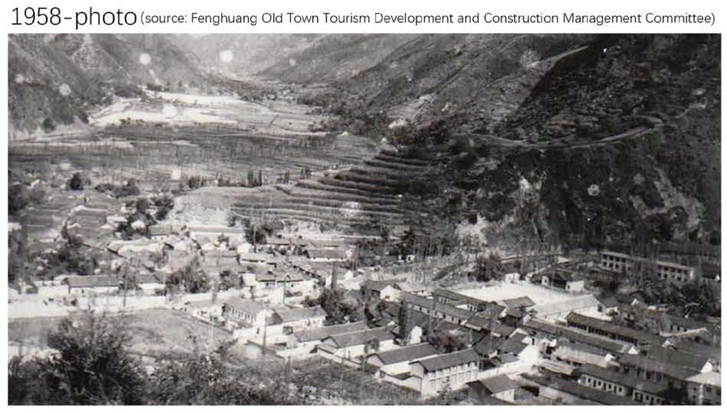
Element of the Radial Structure--The Old Wall (Source: Prof. Laura Anna Pezzetti, 2019)

Element of the Radial Structure--The Yard (Source: Prof. Laura Anna Pezzetti, 2019)



1957-drawing (source: Gao Lin. 2008)

1958-photo (source: Fenghuang Old Town Tourism Development and Construction Management Committee)



1958-photo (source: Fenghuang Old Town Tourism Development and Construction Management Committee)

2019-photo (source: POLIMI-XAUAT Workshop, May 2018)

Development of Fenghuang Ancient Town

View A

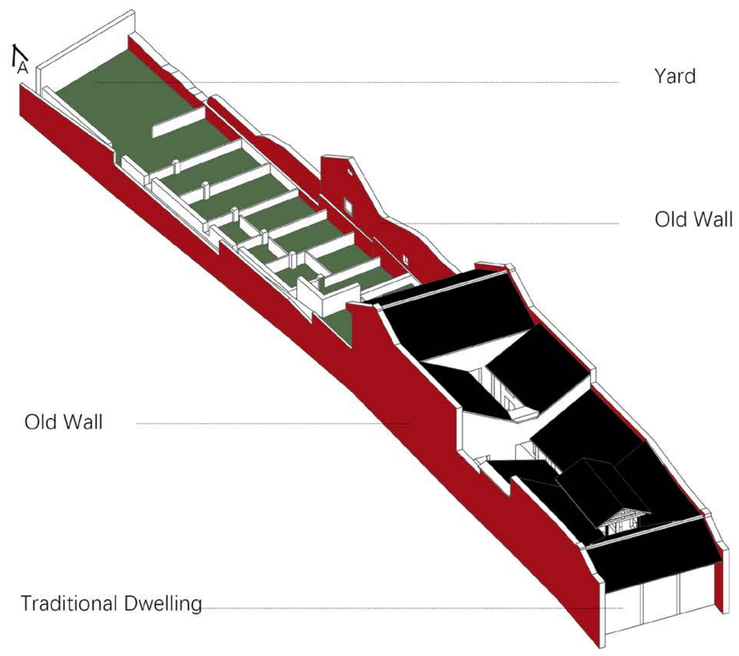


Diagram of the Three Elements
(Source: Prof. Laura Anna Pezzetti, 2019)

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN THE CASE OF DANG YARD

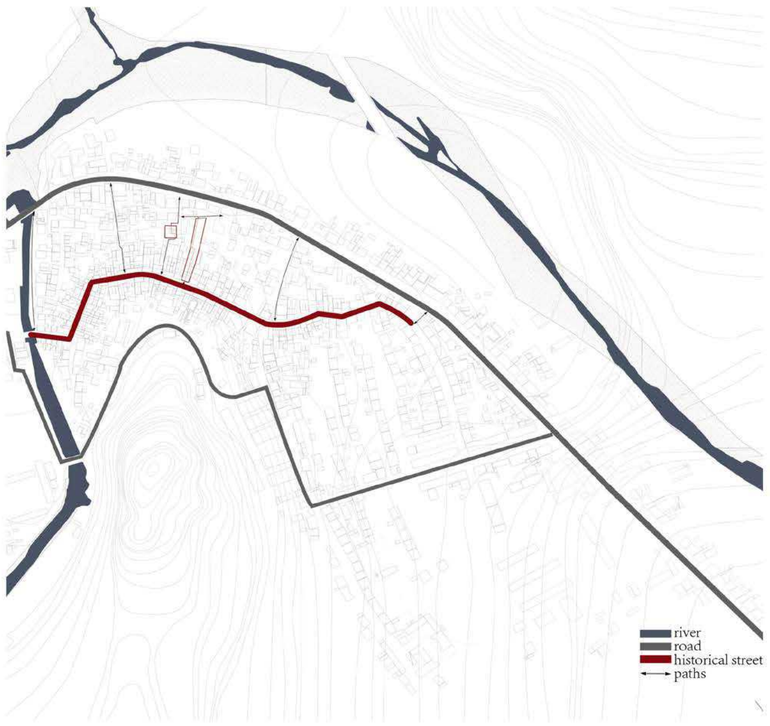
Final Delivery: 06/07/2020

Radial Structure and Main Elements

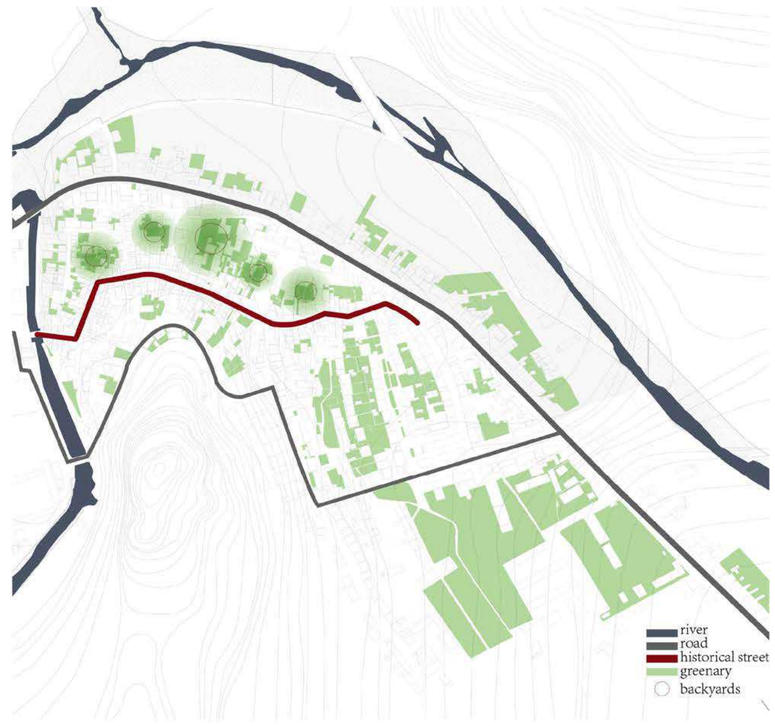
02

SITUATION

Behavior :
---a pattern of "business infront and live behind"
---few residents live in the ancient dwellings
---the backyard is abandoned

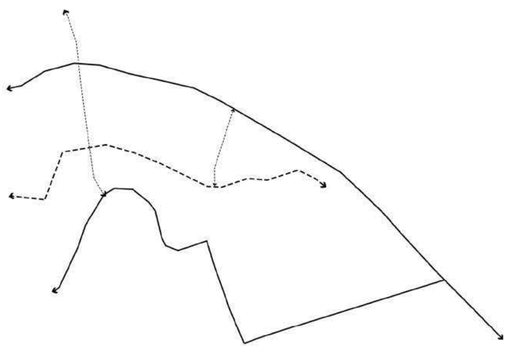


Accessibility:
---two main streets, one is new and one is ancient
---the ancient one is mostly visited
---the accessibility between the two streets is weak
---some "paths" have potential to guide

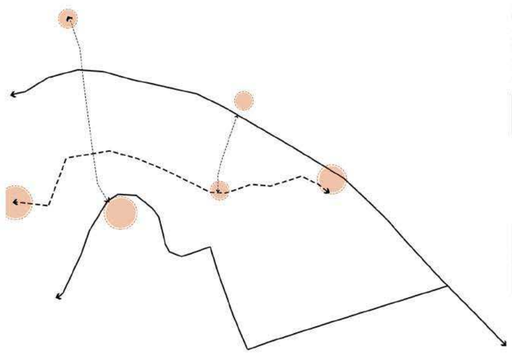


Greenery:
---the backyard and open spaces have an impact on each other
---influence the surrondings in a horizontal direction
---connect the two streets in a vertical direction

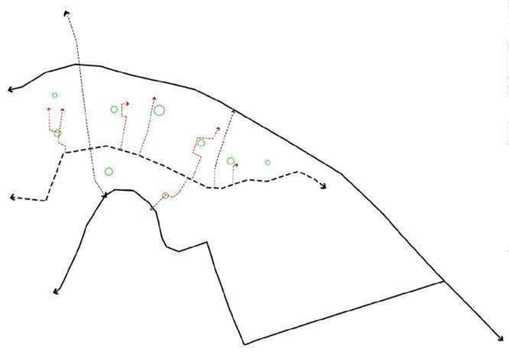
STRATEGY



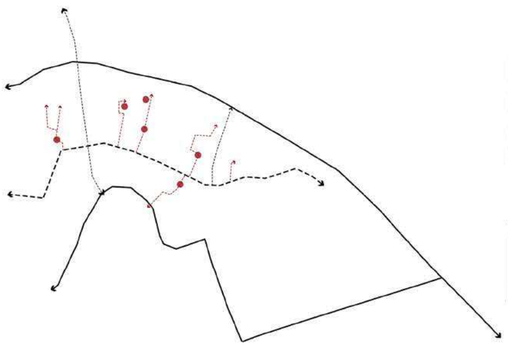
IMPROVE CONNECTION
---break the unachievable of two streets
---guide people to the new street to active the whole town



ENHANCE MAIN POINTS
---the yards are the value for the ancient town
---make use of the wasted yards
---active in order to let people to find the hinden value



DEVELOPE THE SECONDARY SYSTEM
---connect two streets by the new paths
---through the yards.
---yards can be used well



TRANSFORM HISTORICAL DWELLINGS TO ATTRACTIVE POINTS
---Find the potential traditional dwellings
---transform into some attractive points
---effective the secondary road system

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

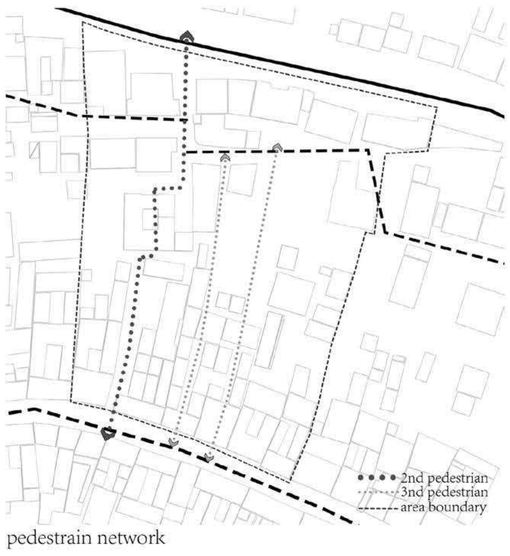
GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

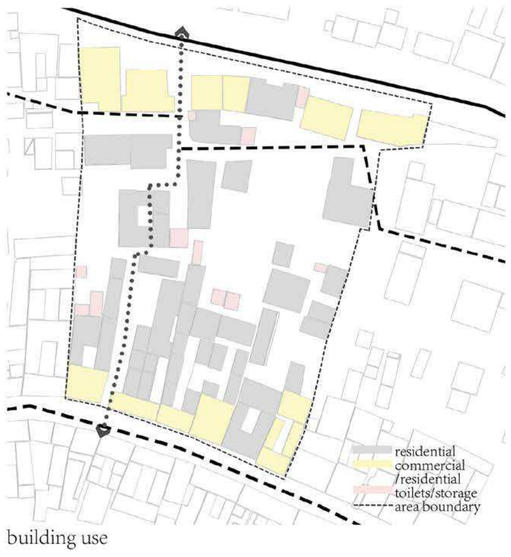
Revitalization in Fenghuang Ancient Town

Final Delivery: 06/07/2020

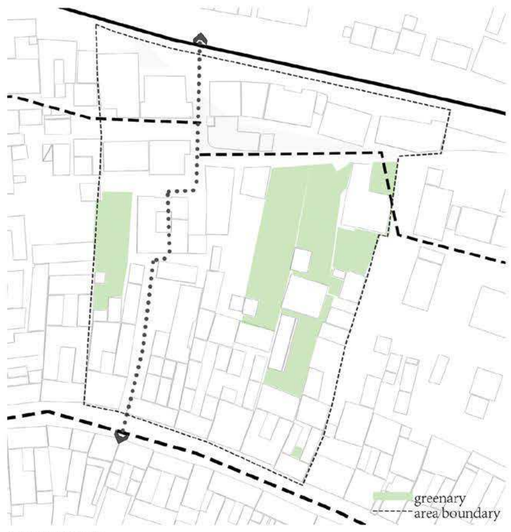
SITUATION



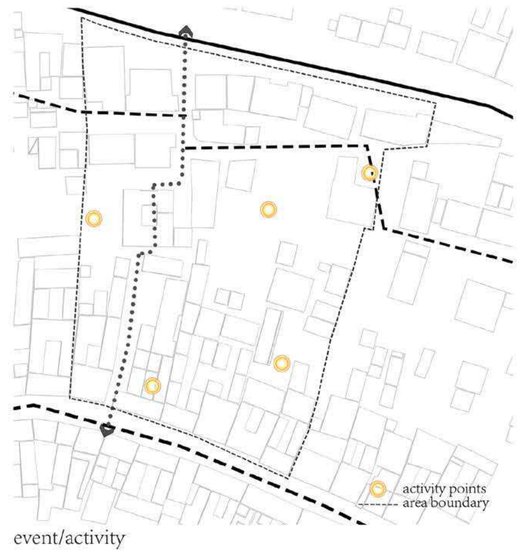
pedestrain network



building use

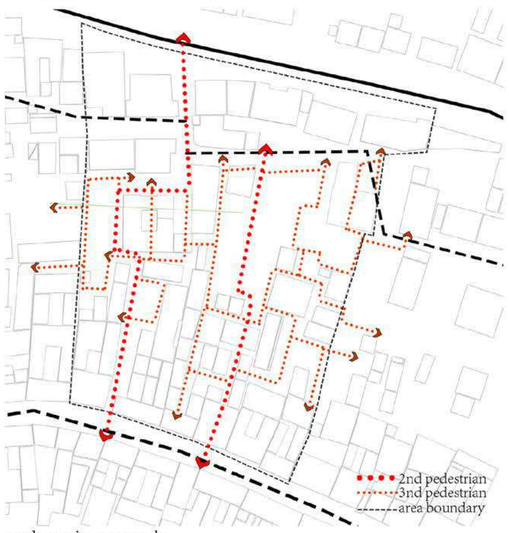


open space



event/activity

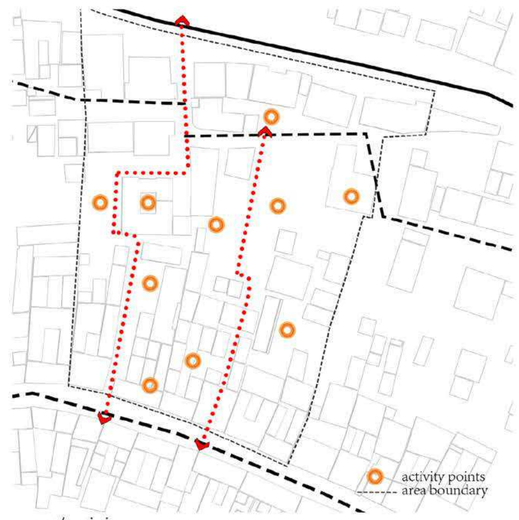
STRATEGY



pedestrain network

building use

open space



event/activity

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

Final Delivery: 06/07/2020

Overwriting Strategy of the Area

04

AEROPHOTO

INFRASTRUCTURE NETWORK

NORTH STREET FACADE

ROOF BOUNDARY

MAT

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

Final Delivery: 06/07/2020
Scale 1:500
Features of the Area

05

FLOOR

BUILDING AGE

SOUTH STREET FACADE

FUNCTION

GREENARY

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

Final Delivery: 06/07/2020
Scale 1:500

Features of the Area

06

CLASSIFICATION NUMBER

H-buildings which were built during Ming&Qing Dynasty with traditional material

O-buildings which were built after Ming&Qing Dynasty with traditional material

N-buildings which were built with new materials and structure

EVELUATION CONCLUSION

SUGGESTED TRANSFORMATIONS

LOCATION & PROPERTY

GROUND PLAN

NUMBER:
H-01

MAIN MATERIAL:
EARTH & WOOD

FUNCTION:
RESIDENTIAL & COMMERCIAL

FLOOR:
2F

RENT:
YES

DEMOLISH:
NO

DESIGN:
NO

ROOF

AXONOMETRY

LOCATION & PROPERTY

GROUND PLAN

NUMBER:
H-04

MAIN MATERIAL:
EARTH & WOOD

FUNCTION:
RESIDENTIAL & COMMERCIAL

FLOOR:
2F

RENT:
YES

DEMOLISH:
NO

DESIGN:
YES

ROOF

AXONOMETRY

LOCATION & PROPERTY

GROUND PLAN

NUMBER:
N-01

MAIN MATERIAL:
CONCRETE

FUNCTION:
RESIDENTIAL & COMMERCIAL

FLOOR:
6F

RENT:
YES

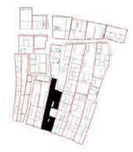
DEMOLISH:
NO

DESIGN:
NO

ROOF

AXONOMETRY

LOCATION & PROPERTY



GROUND PLAN

NUMBER:
H-03

MAIN MATERIAL:
EARTH & WOOD

FUNCTION:
RESIDENTIAL & COMMERCIAL

FLOOR:
2F

RENT:
NO

DEMOLISH:
NO

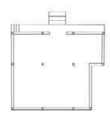
DESIGN:
YES

ROOF

AXONOMETRY

LOCATION & PROPERTY

GROUND PLAN



NUMBER:
N-06

MAIN MATERIAL:
CONCRETE

FUNCTION:
RESIDENTIAL

FLOOR:
2F

RENT:
NO

DEMOLISH:
NO

DESIGN:
NO

ROOF

AXONOMETRY

LOCATION & PROPERTY

GROUND PLAN

NUMBER:
O-04

MAIN MATERIAL:
EARTH & WOOD

FUNCTION:
RESIDENTIAL

FLOOR:
2F

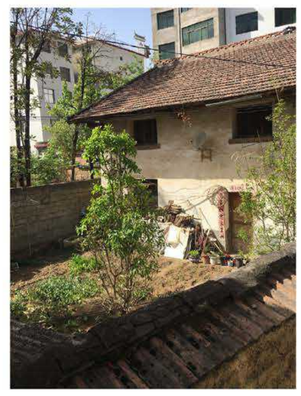
RENT:
NO

DEMOLISH:
NO

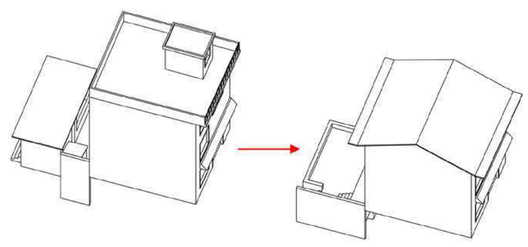
DESIGN:
NO

ROOF

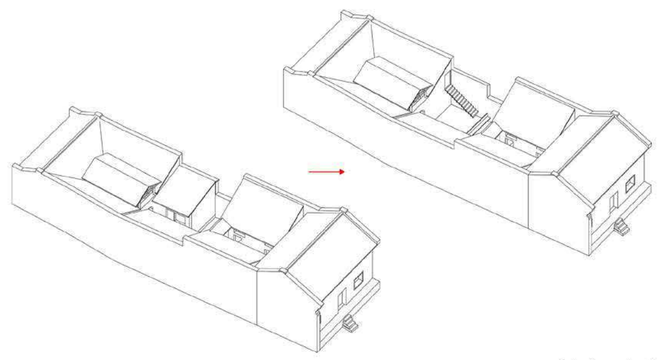
AXONOMETRY



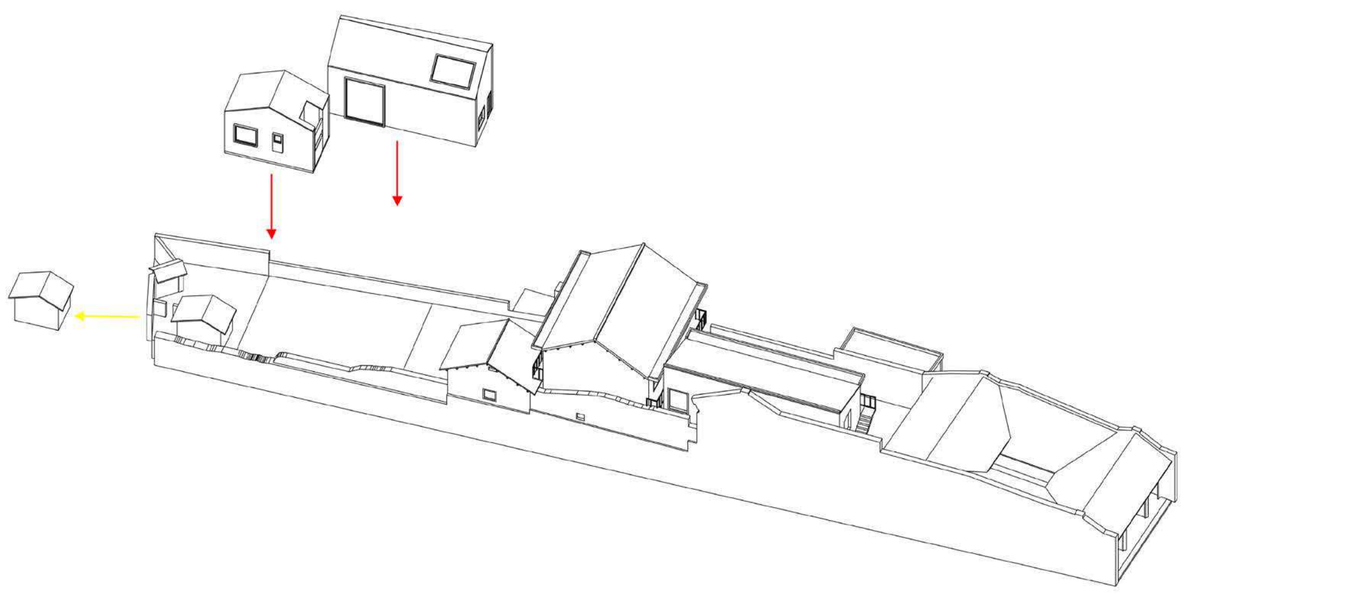
BUILDING INFORMATION



transform flat roof to slope roof



reuse into homestay hotel



add new blocks into backyard

REDESIGN PROPOSAL

INFRASTRUCTURE NETWORK

1 residential
2 commercial in front, residential behind
3 residential
4 winemaking workshop - boshengrong
5 commercial - fengshengchang
6 restaurant - meng yard
7 commercial in front, residential behind
8 residential
9 restaurant
10 residential
11 kitchen
12 storage
13 unoccupied
14 abandoned livestock area
15 residential
16 residential
17 residential
18 storage
19 residential
20 storage
21 storage
22 kitchen
23 residential
24 residential
25 residential
26 residential
27 toilet
28 residential
29 toilet
30 toilet
31 residential
32 abandoned area
33 abandoned area
34 residential
35 residential and kitchen
36 residential
37 storage
38 storage
39 storage
40 livestock area
41 residential
42 kitchen
43 residential
44 commercial downstairs, residential upstairs
45 commercial downstairs, residential upstairs
46 commercial downstairs, residential upstairs
47 residential
48 storage
49 commercial downstairs, residential upstairs
50 residential
51 storage
52 toilet
53 toilet
54 toilet
55 residential
56 commercial downstairs, residential upstairs
57 commercial downstairs, residential upstairs

GROUND FLOOR PLAN

SECTION A-A

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN THE CASE OF DANG YARD

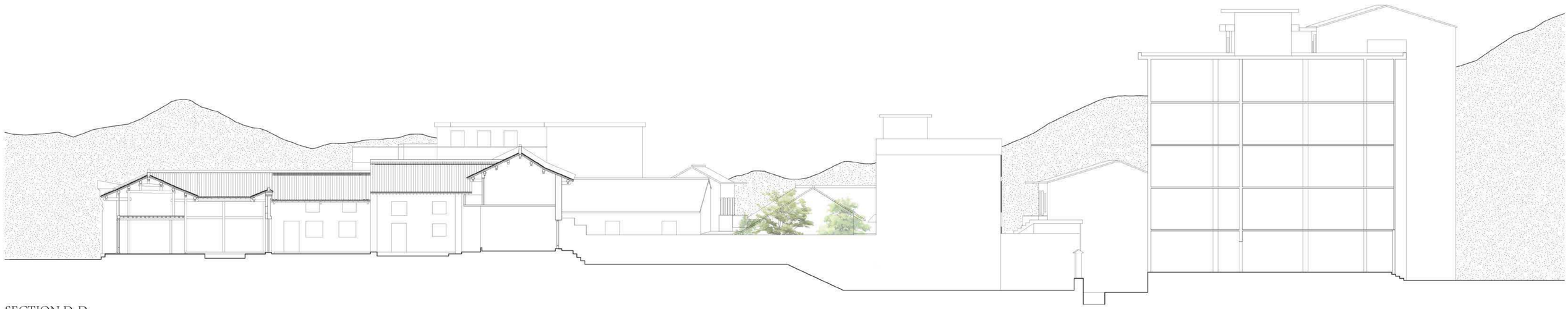
Final Delivery: 06/07/2020
Scale 1:200

Fundamental Features of the Area

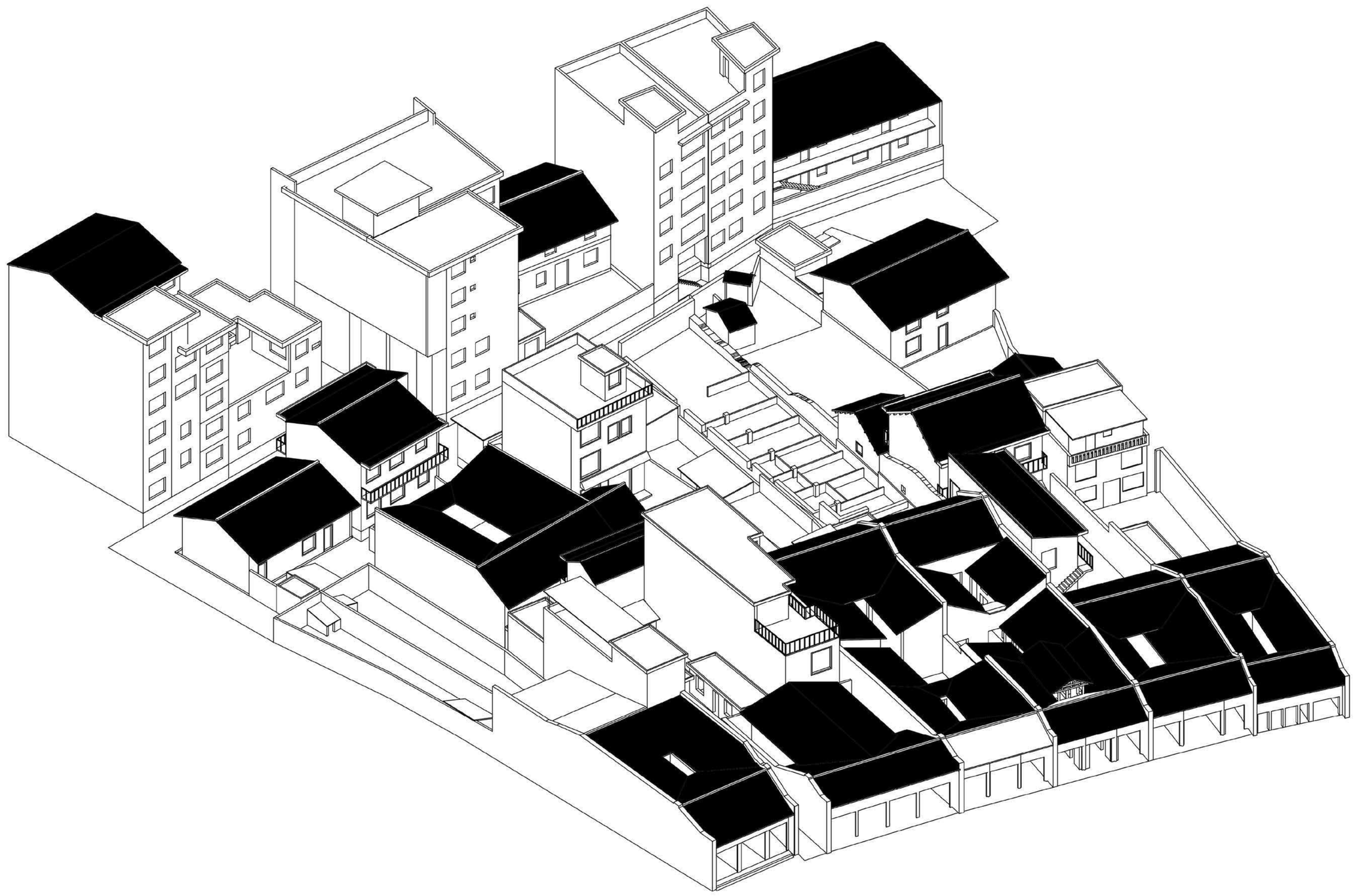
08

SECTION B-B

SECTION C-C



SECTION D-D



AXONOMETRY

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

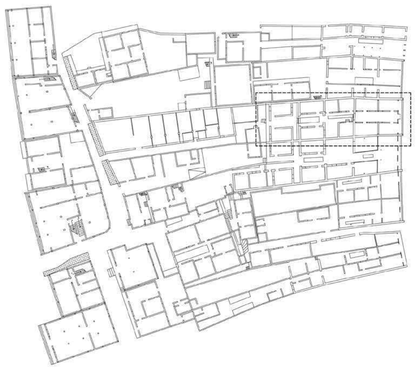
CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

Final Delivery: 06/07/2020
Scale 1:200

Fundamental Features of the Area

GROUND FLOOR PLAN 1:50

LOCATION



CUTTING HEIGHT

N

LEGEND

NOT MEASURED

NOT MEASURED

0 50 100 150 200 m

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

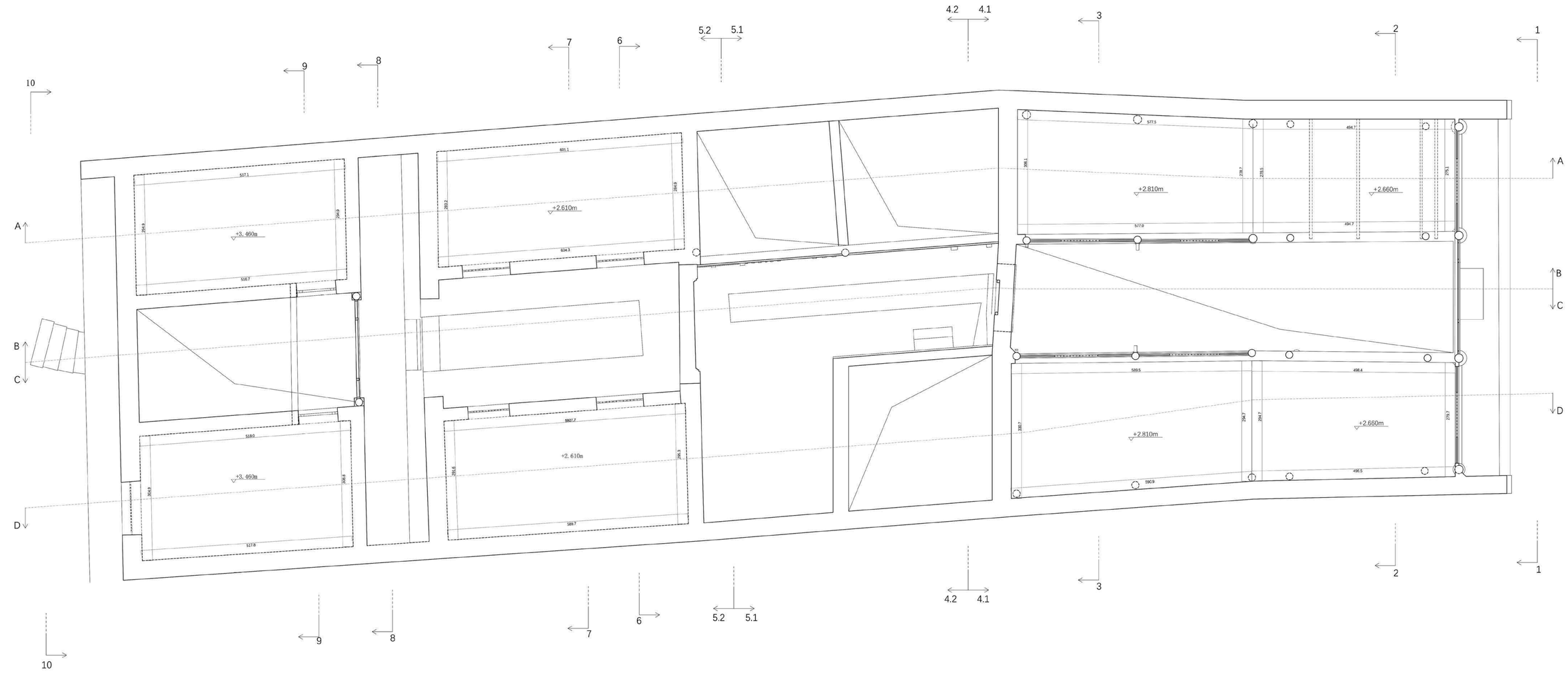
ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

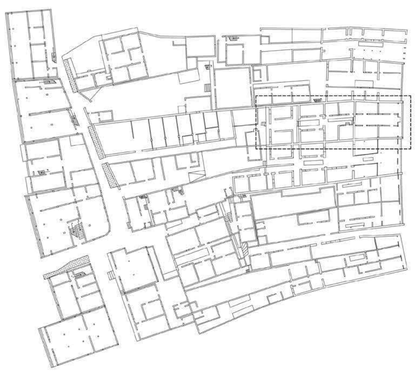
Final Delivery: 06/07/2020
Scale 1:50

Conservation of Dang Yard Building



1ST FLOOR PLAN 1:50

LOCATION



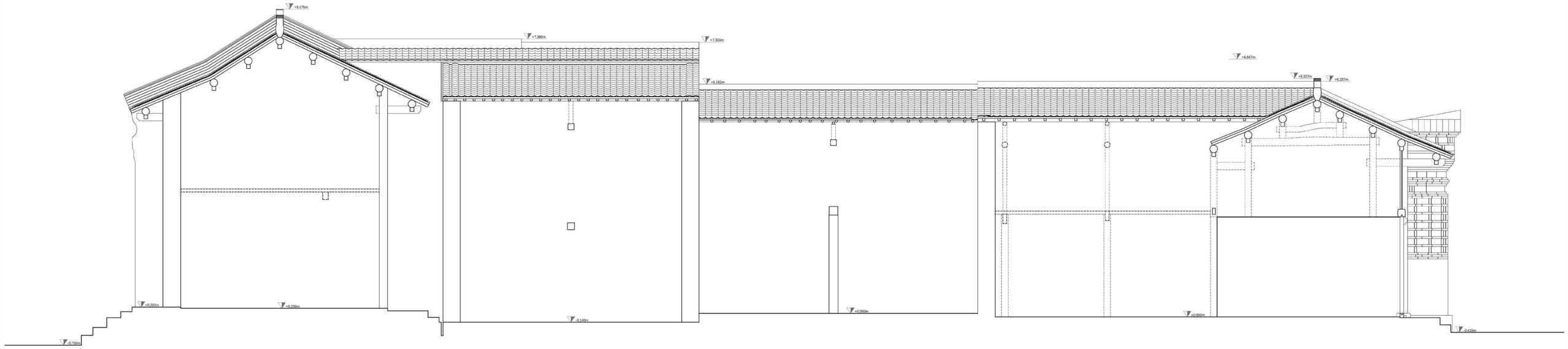
CUTTING HEIGHT

LEGEND

NOT MEASURED

NOT MEASURED

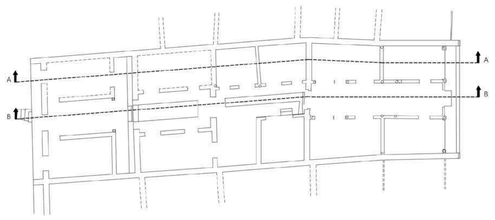
0 50 100 150 200 m



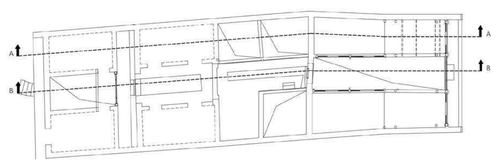
LONGITUDE SECTION A-A 1:50

LONGITUDE SECTION B-B 1:50

GROUND FLOOR SECTION LINE



1ST FLOOR SECTION LINE

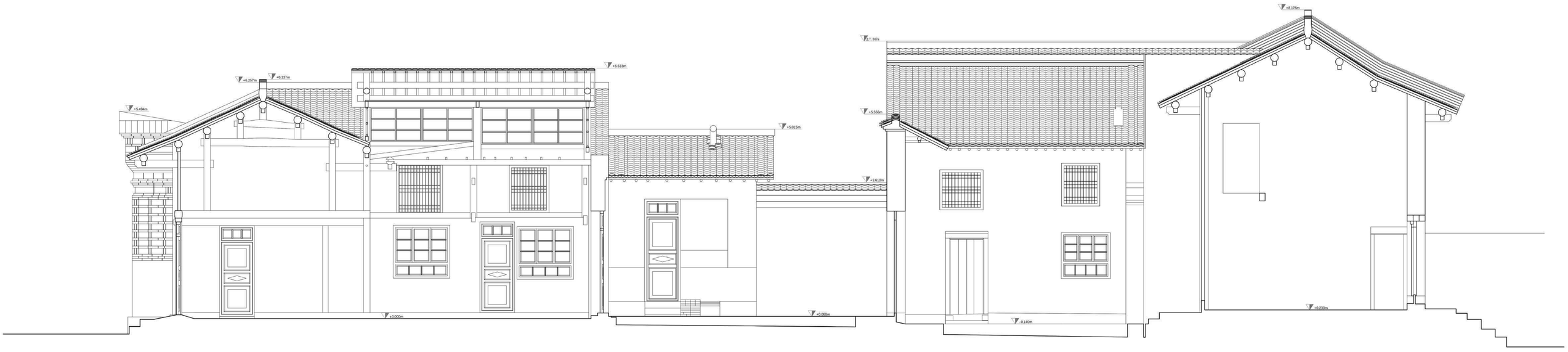


LEGEND

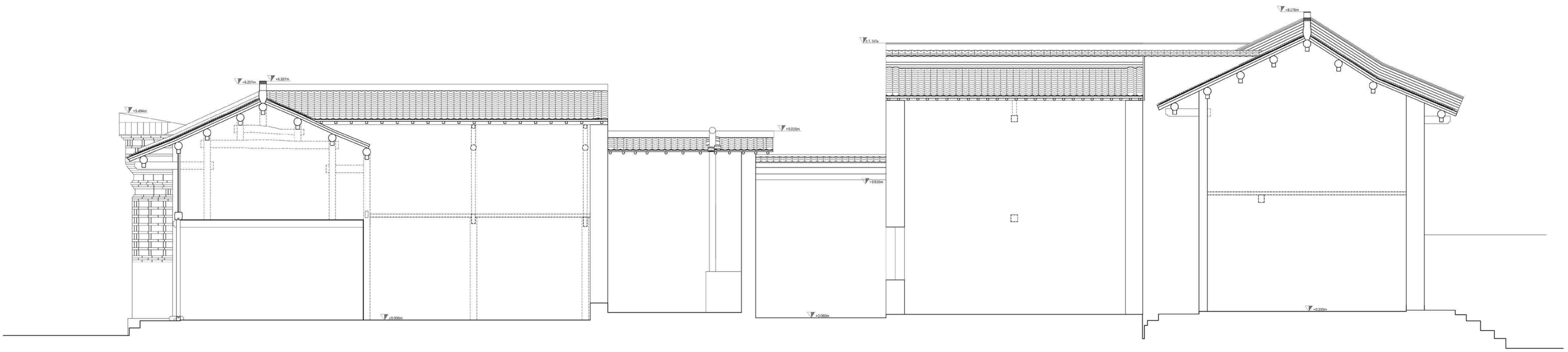
NOT MEASURED

NOT MEASURED

0 50 100 150 200 m

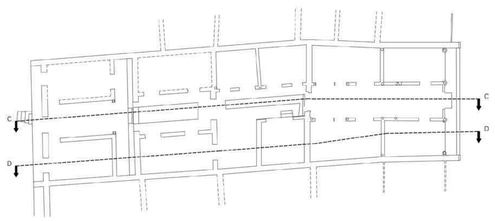


LONGITUDE SECTION C-C 1:50

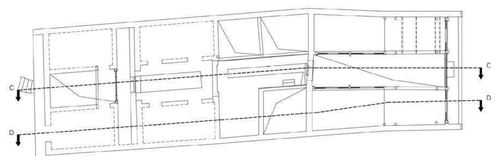


LONGITUDE SECTION D-D 1:50

GROUND FLOOR SECTION LINE



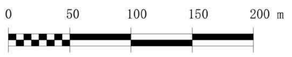
1ST FLOOR SECTION LINE



LEGEND

NOT MEASURED

NOT MEASURED



POLITECNICO MILANO 1863

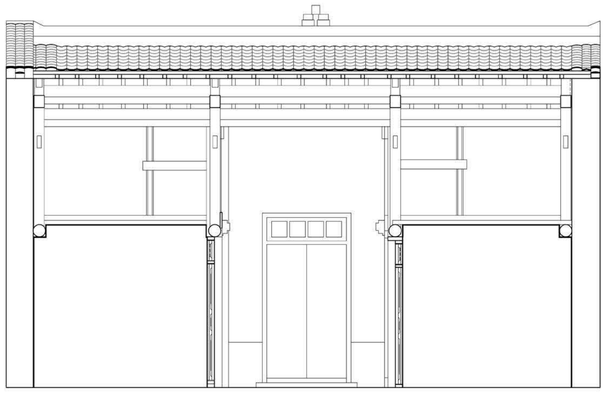
ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

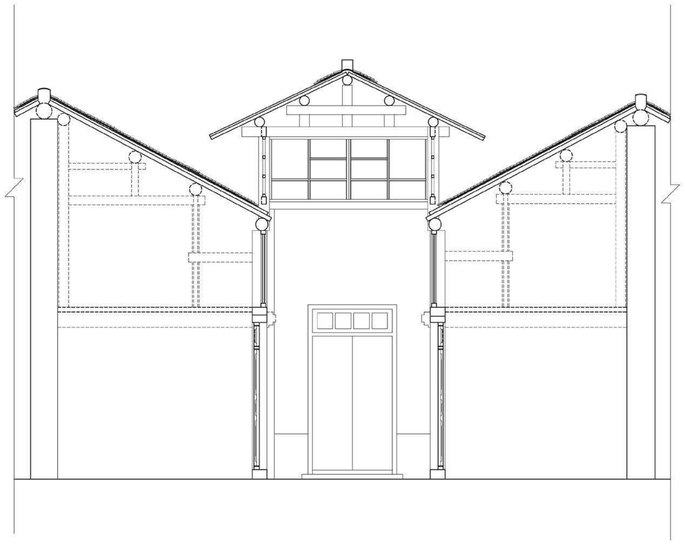
GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

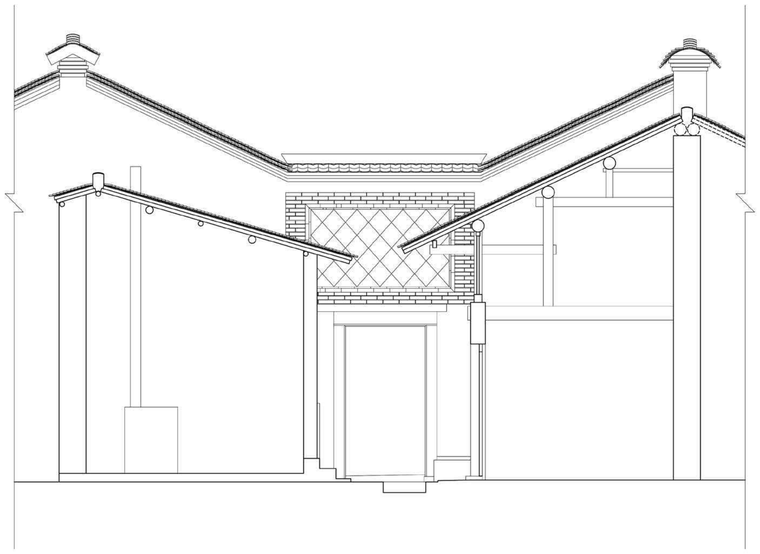
TRANSVERSAL SECTION 1-1 1:50



TRANSVERSAL SECTION 2-2 1:50

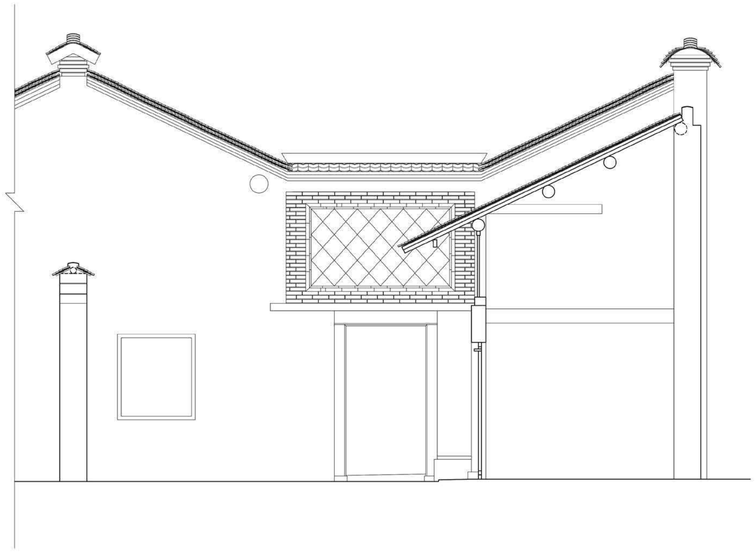


TRANSVERSAL SECTION 3-3 1:50



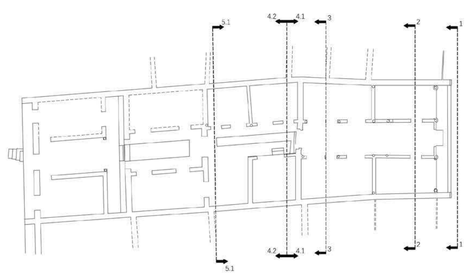
TRANSVERSAL SECTION 4.1-4.1 1:50

TRANSVERSAL SECTION 4.2-4.2 1:50

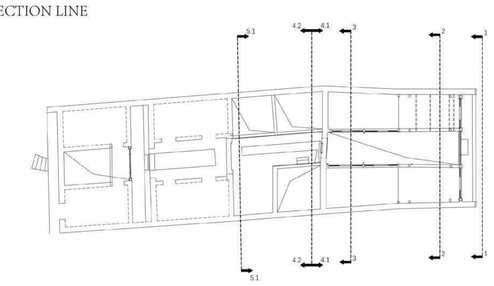


TRANSVERSAL SECTION 5.1-5.1 1:50

GROUND FLOOR SECTION LINE



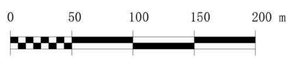
1ST FLOOR SECTION LINE

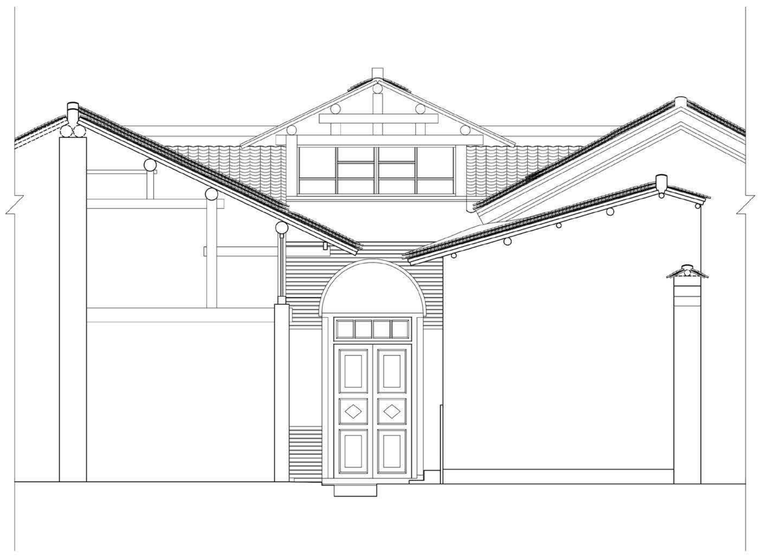


LEGEND

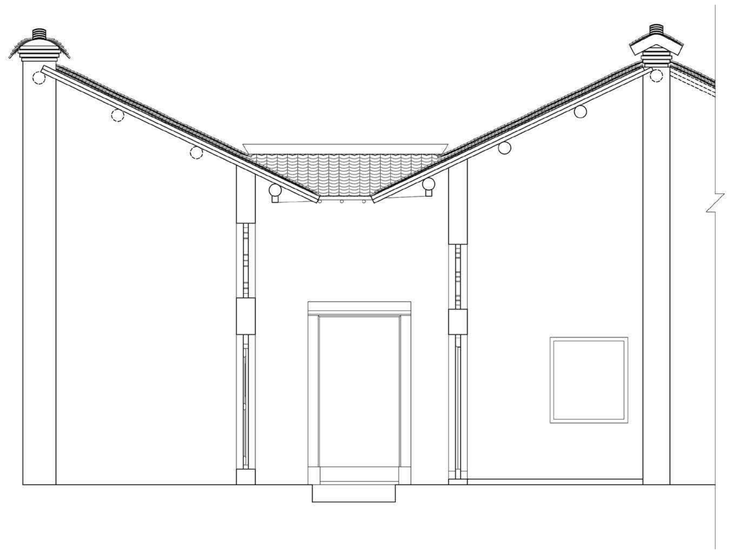
NOT MEASURED

NOT MEASURED

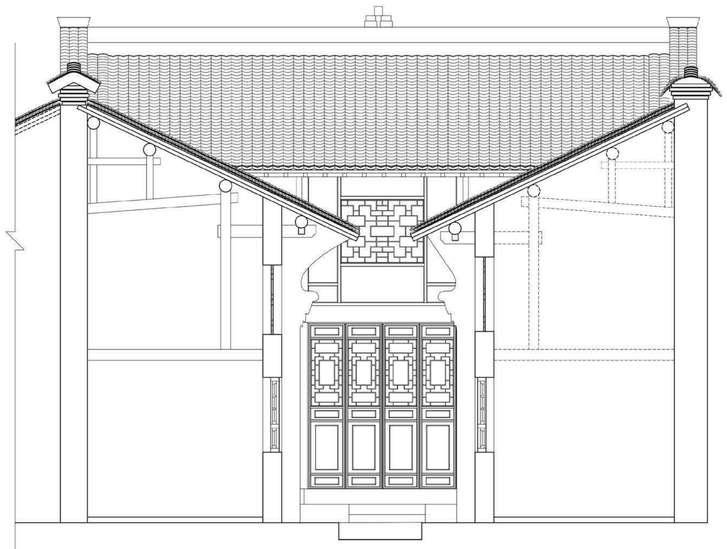




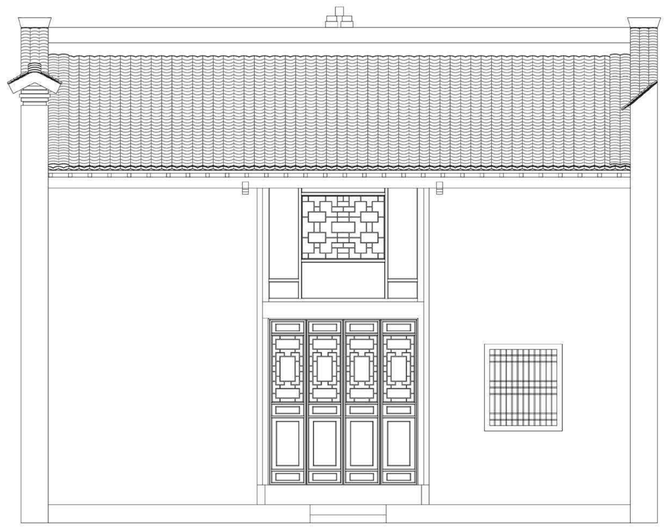
TRANSVERSAL SECTION 5.2-5.21:50



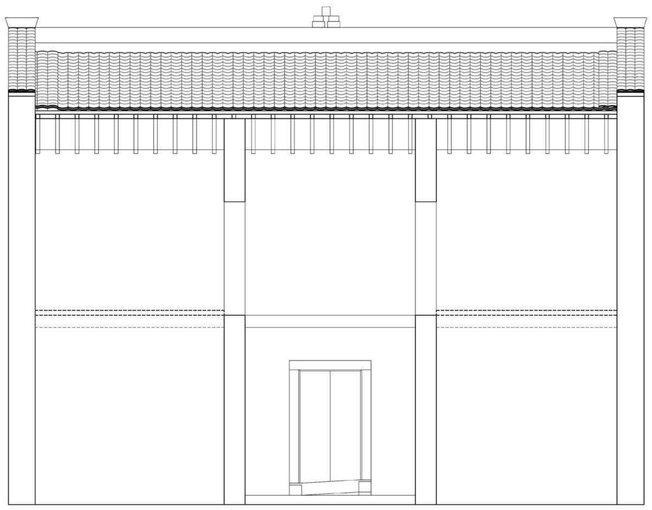
TRANSVERSAL SECTION 6-6 1:50



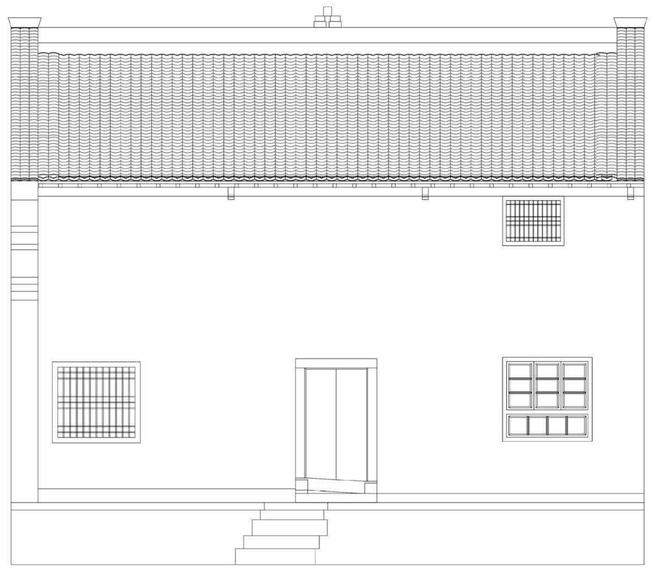
TRANSVERSAL SECTION 7-7 1:50



TRANSVERSAL SECTION 8-8 1:50

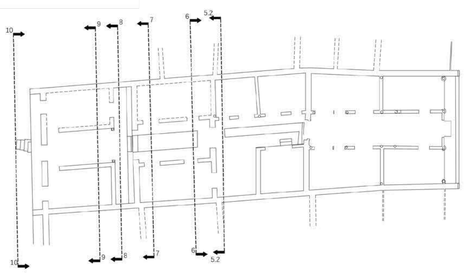


TRANSVERSAL SECTION 9-9 1:50

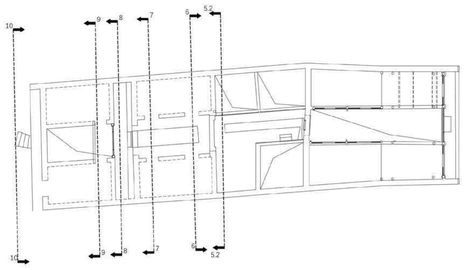


TRANSVERSAL SECTION 10-10 1:50

GROUND FLOOR SECTION LINE



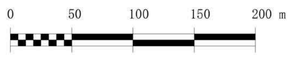
1ST FLOOR SECTION LINE



LEGEND

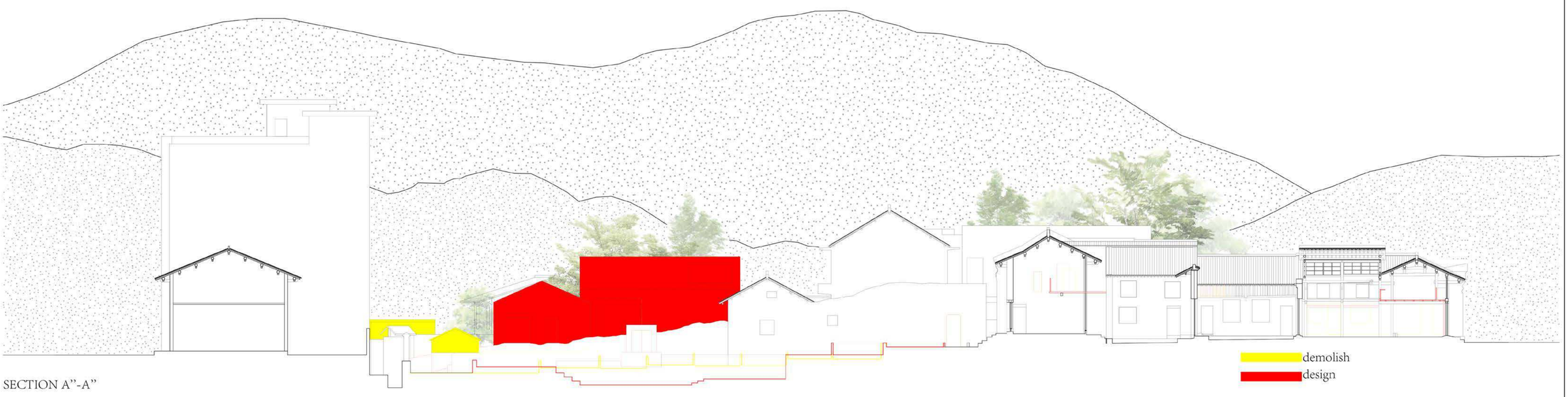
NOT MEASURED

NOT MEASURED



GROUND FLOOR PLAN

SECTION A''-A''



POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

Demolish and Design of the Ground Floor

Final Delivery: 06/07/2020
Scale 1:200

MASTERPLAN

SECTION

POLITECNICO
MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

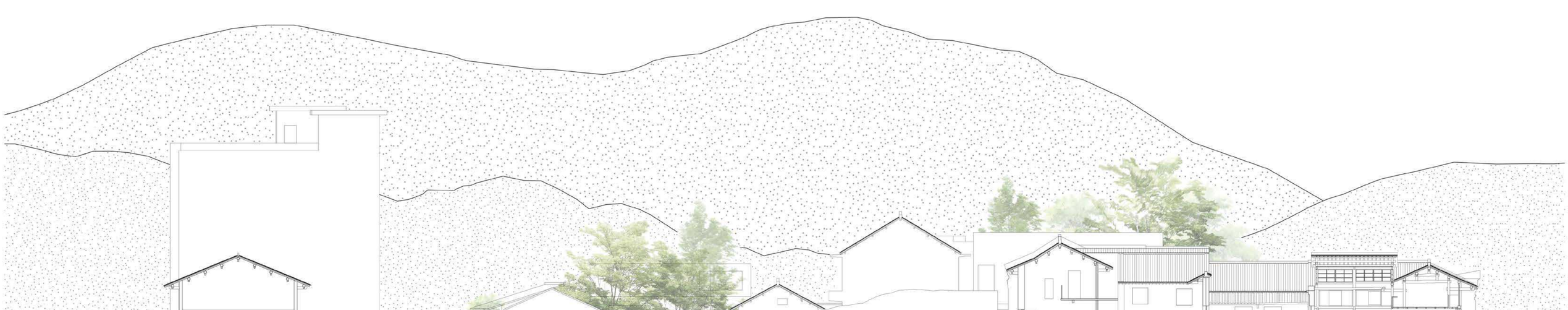
GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

Final Delivery: 06/07/2020
Scale 1:200
Integration of the Area

1 residential & farm house
2 commercial in front, residentail behind
3 residentail
4 winemaking workshop - boshengrong
5 commercial - fengshengchang
6 restaurant - meng yard
7 homestay hotel
8 residential
9 restaurant
10 residentail
11 kitchen
12 residential
13 residential
14 residential
15 residential
16 room of homestay hotel
17 residential
18 room of homestay hotel
19 residential
20 room of homestay hotel
21 room of homestay hotel
22 room of homestay hotel
23 dining & entertainment
24 museum
25 farmhouse
26 residential
27 commercial downstairs, residential upstairs
28 commercial downstairs, residential upstairs
29 commercial downstairs, residential upstairs
30 tea shop
31 commercial downstairs, residential upstairs
32 commercial downstairs, residential upstairs
33 commercial downstairs, residential upstairs

GROUND FLOOR PLAN



SECTION A'-A'

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

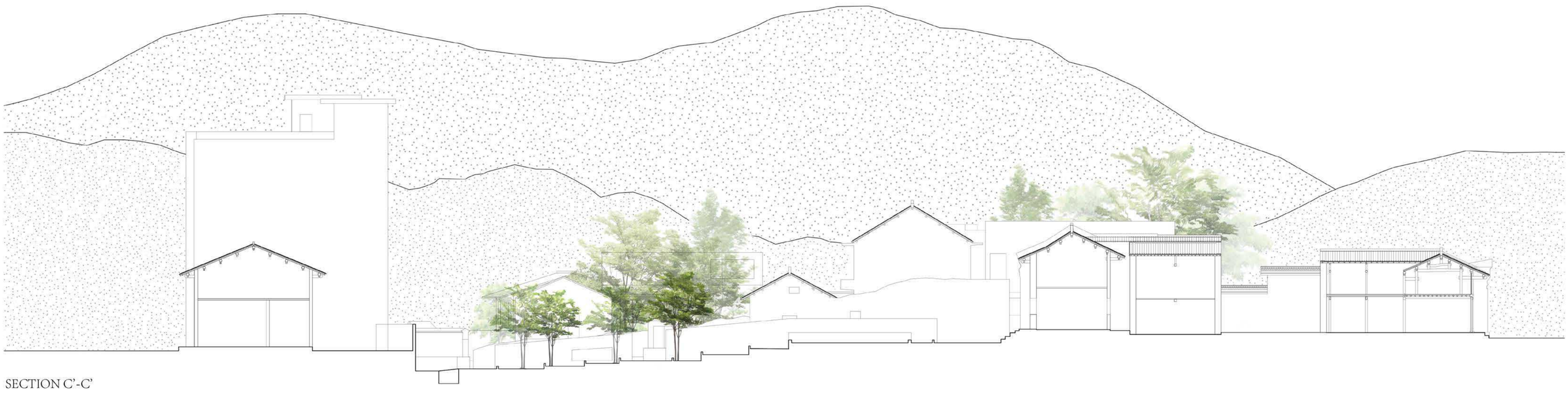
ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

Final Delivery: 06/07/2020
Scale 1:200
Overwriting the Area

SECTION B'-B'



SECTION C'-C'

SECTION D'-D'

AXONOMETRY

POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO
D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN
THE CASE OF DANG YARD

Final Delivery: 06/07/2020
Scale 1:200

Overwriting the Area

PHOTO 1:50

MATERIAL 1:50

Object | Clay1 (deep layer of clay,usually covered by a plaster, used for wall inside the house) | Clay2 (used to build the main wall of the house, it was not covered by plaster) | Wood-Door | Wood-Window | Wood-board | Wood-Cover of pillar&beam | Wood-Inside pillar&beam | Glass | Concrete | Masonry | Stone | Plaster

DECAY 1:50

Object

Crack
Individual fissure, clearly visible by the naked eye, resulting from separation of one part from another.

Blistering
Separated, air-filled, raised hemispherical elevations on the face of stone resulting from the detachment of an outer stone layer. This detachment is not related to the stone structure.

Disintegration
Detachment of single grains or aggregates of grains.

Alveoliazation-Caving
Formation, on the stone surface, of cavities (alveoles) which may be interconnected and may have variable shapes and sizes (generally centimetric, sometimes metric).
Sub-type:
Coving : erosion feature consisting in a single alveole developing from the edge of the stone block.

Missing Part
Empty space, obviously located in the place of some formerly existing stone part. Protruding and particularly exposed parts of sculptures (nose, fingers..) are typical locations for material loss resulting in missing parts.

Discoloration
Change of the stone colour in one to three of the colour parameters : hue, value and chroma

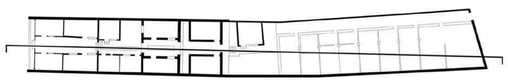
Efflorescence
Generally whitish, powdery or whisker-like crystals on the surface. Efflorescences are generally poorly cohesive and commonly made of soluble salt crystals.

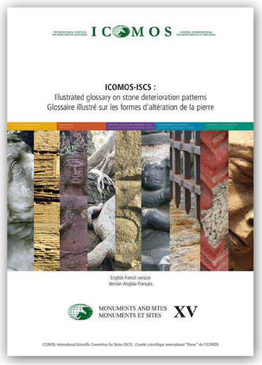
Graffiti
Engraving, scratching, cutting or application of paint, ink or similar matter on the stone surface.

Patina
Chromatic modification of the material, generally resulting from natural or artificial ageing and not involving in most cases visible surface deterioration.

Soiling
Deposit of a very thin layer of exogenous particles (eg. soot) giving a dirty appearance to the stone sur- face.

Plant
Vegetal living being, having, when complete, root, stem, and leaves, though consisting sometimes only of a single leafy expansion (e.g. Tree, fern, herb).





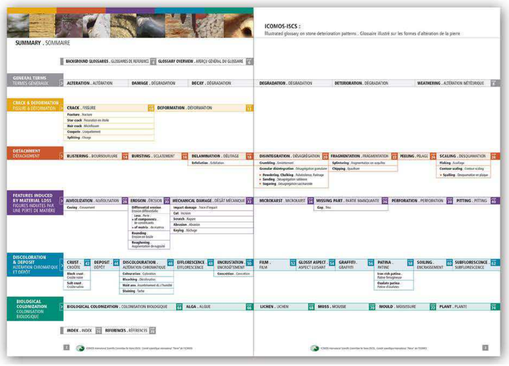


PHOTO 1:50

SECTION A-A

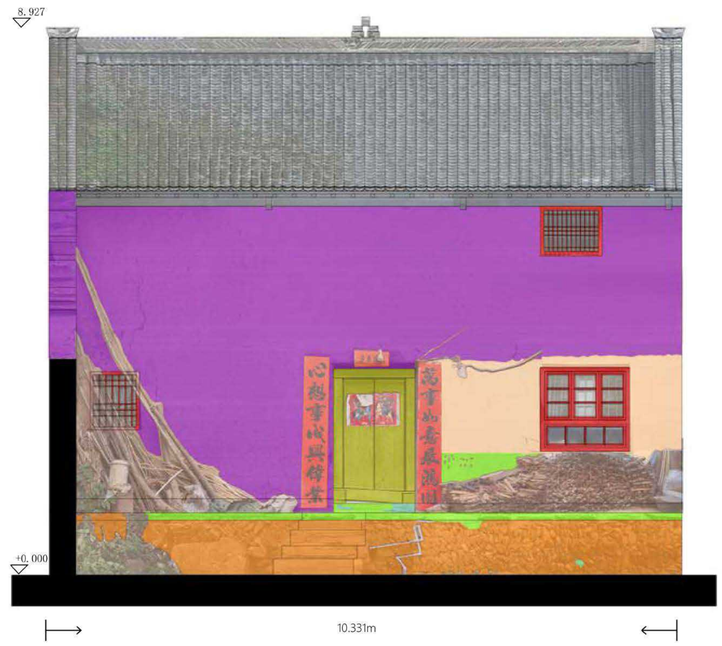
SECTION B-B

SECTION C-C

MATERIAL 1:50

SECTION A-A

SECTION B-B



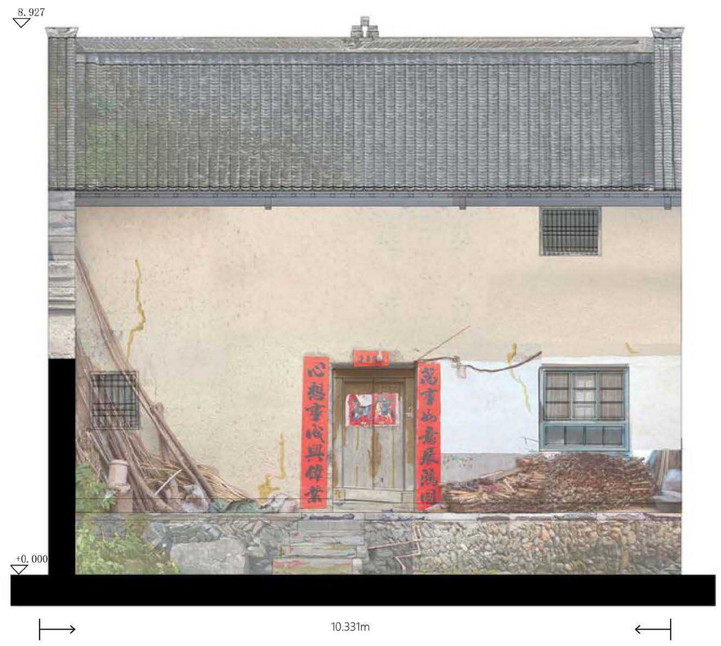
SECTION C-C

Object | Clay1 (deep layer of clay,usually covered by a plaster, used for wall inside the house) | Clay2 (used to build the main wall of the house, it was not covered by plaster) | Wood-Door | Wood-Window | Wood-board | Wood-Cover of pillar&beam | Wood-Inside pillar&beam | Glass | Concrete | Masonry | Stone | Plaster

DECAY 1:50

SECTION A-A

SECTION B-B



SECTION C-C

Crack | Blistering | Disintegration | Alveoliazation-Caving | Missing Part | Discoloration | Efflorescence | Graffiti | Patina | Soiling | Plant

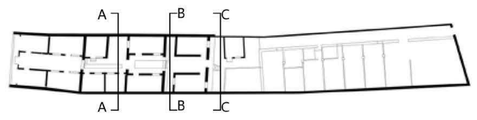
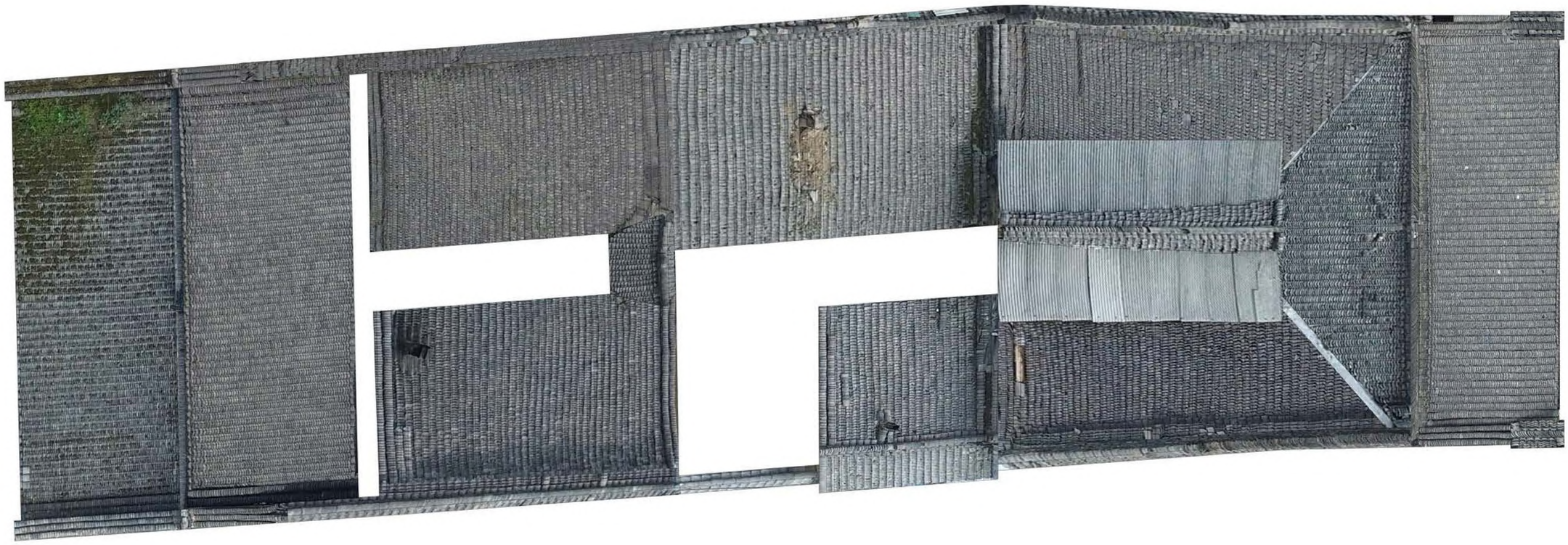
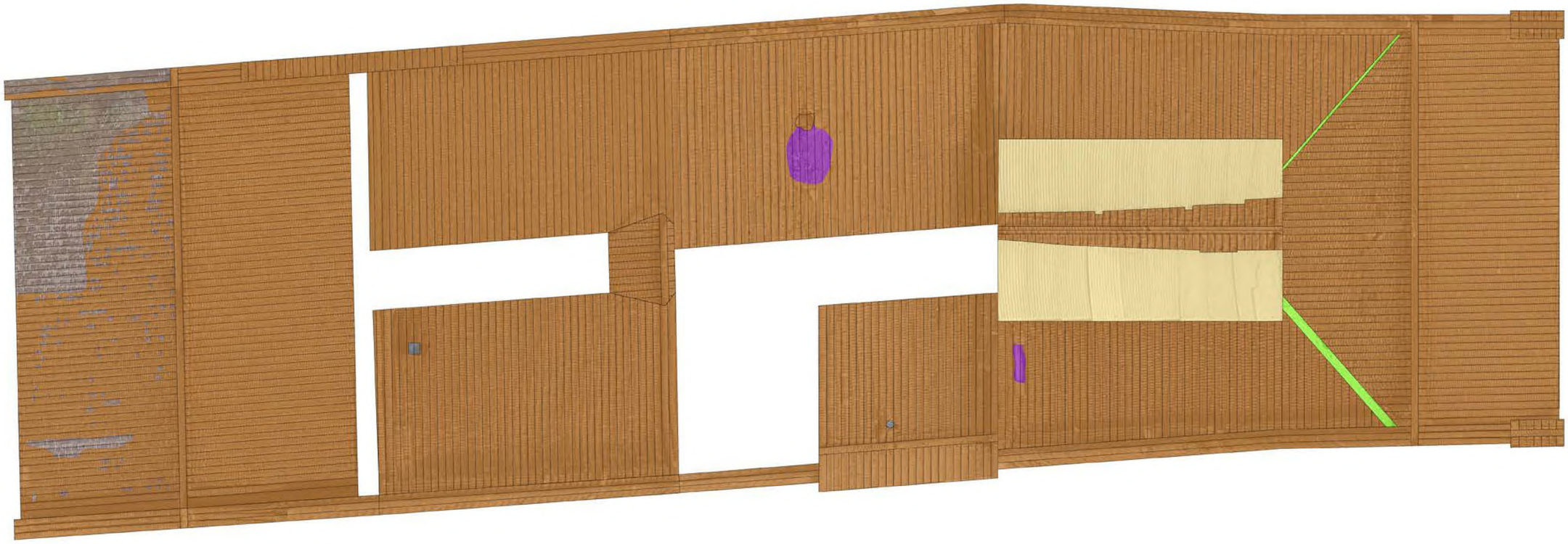


PHOTO 1:50



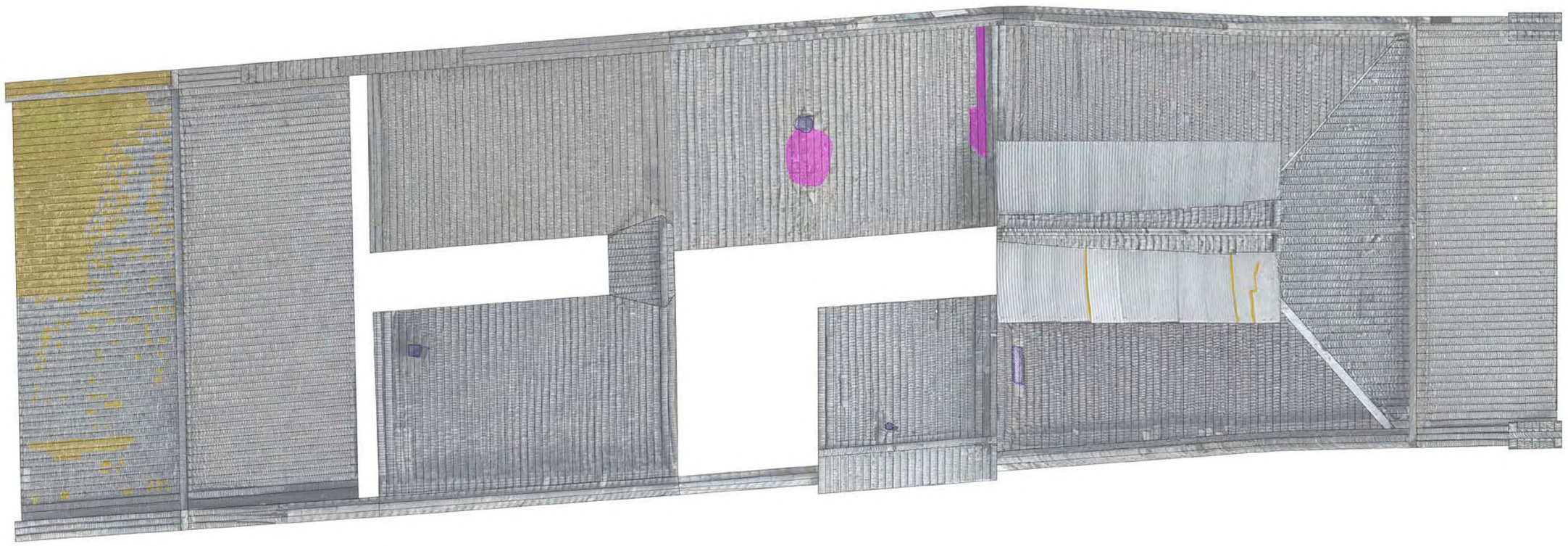
MATERIAL 1:50

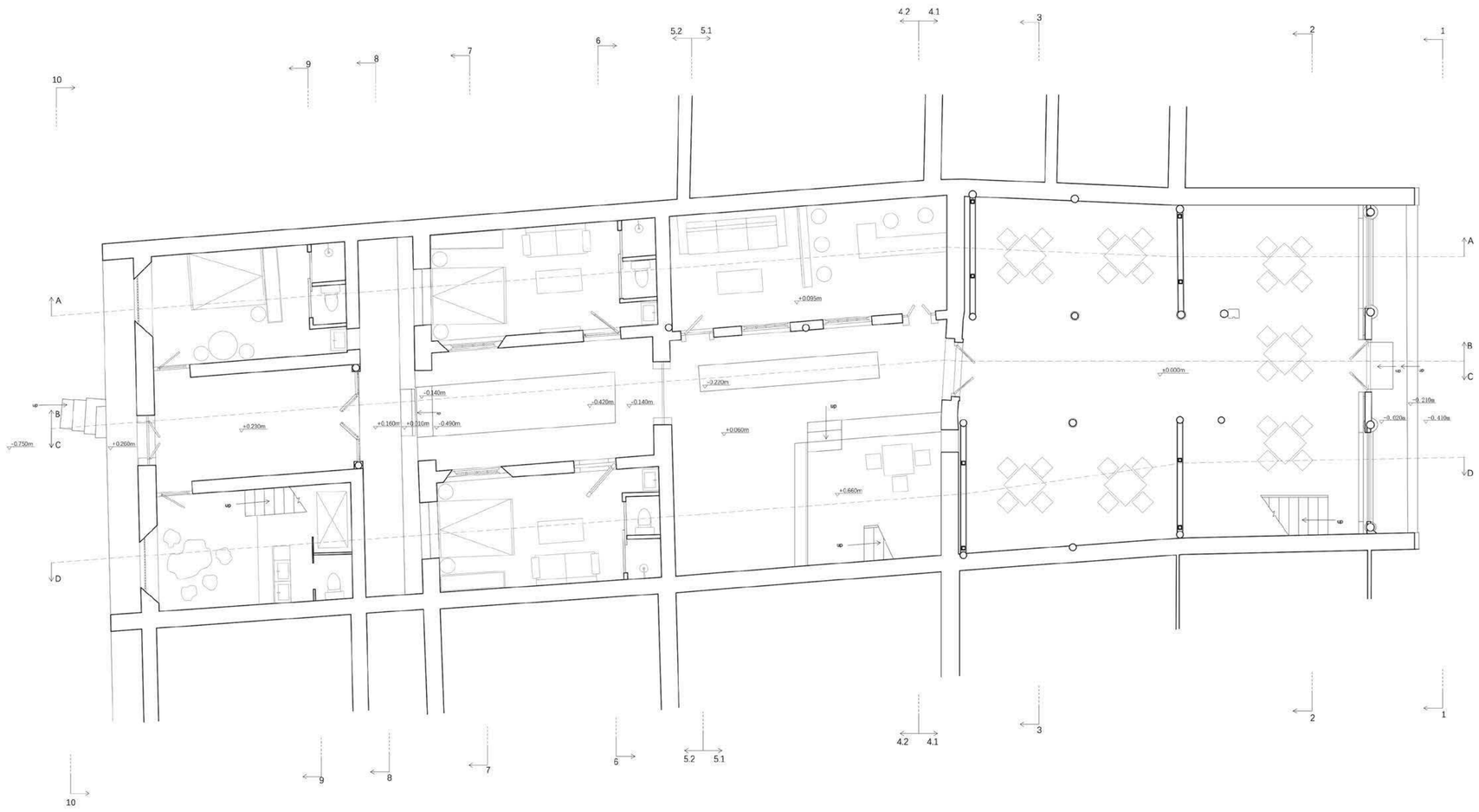
- Object
- Fired Clay
- Steel Plate
- Clay2



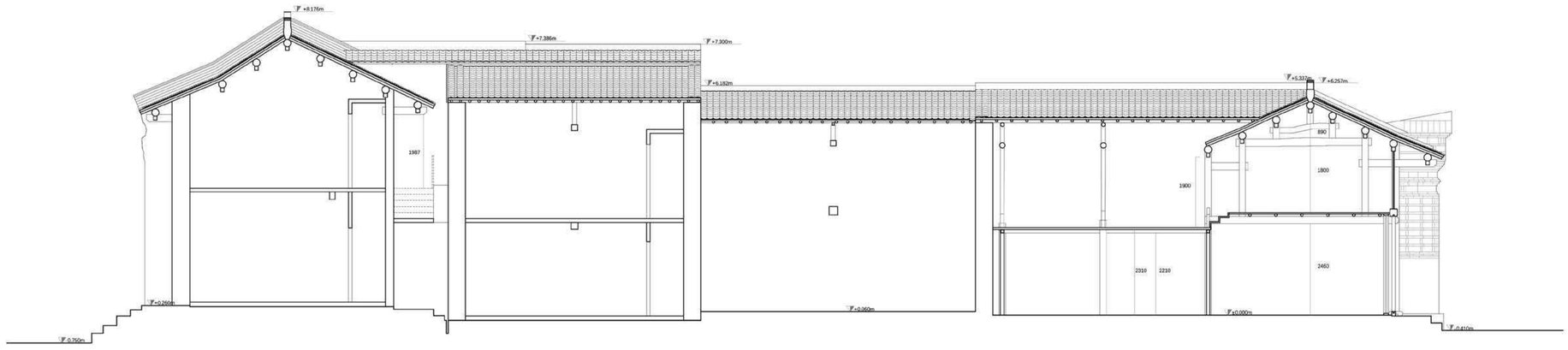
DECAY 1:50

- Soiling
- Crack
- Plant/Moss



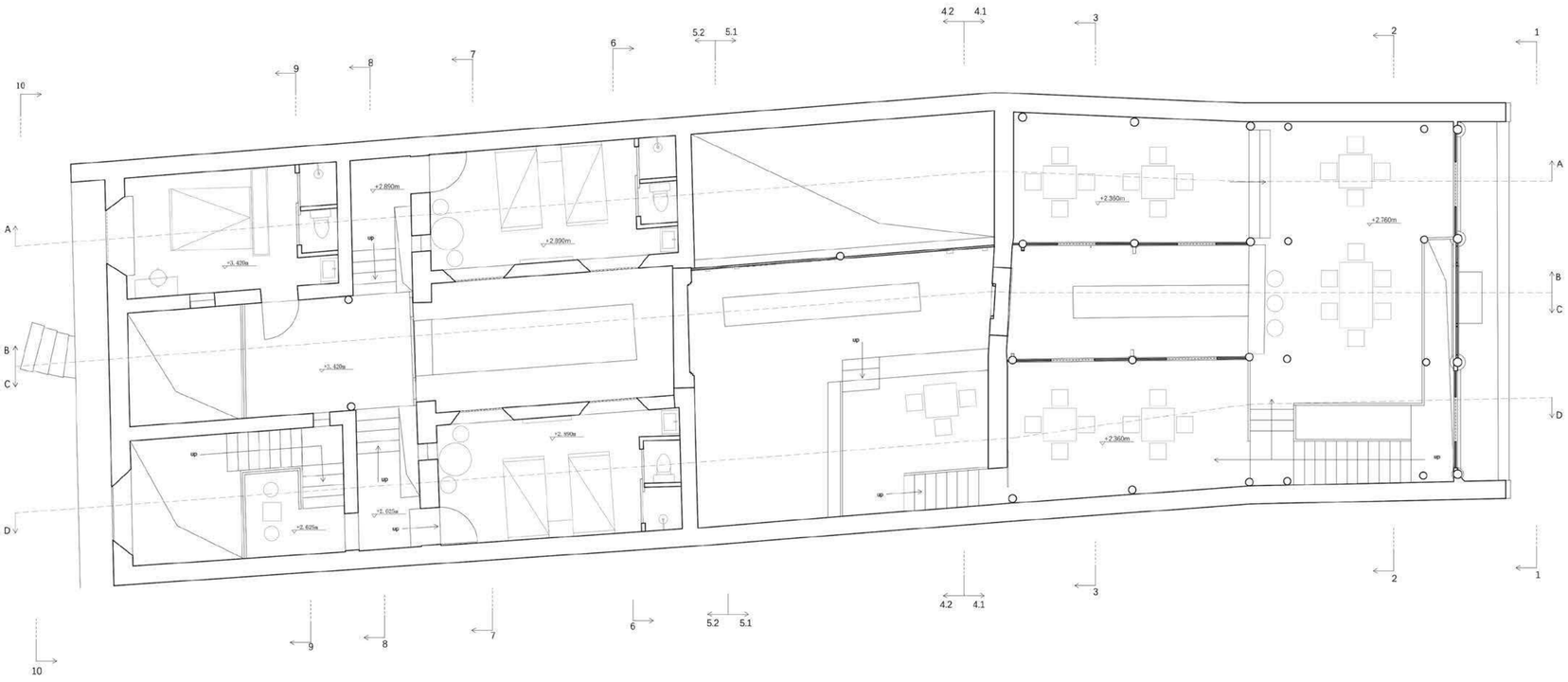


GROUND FLOOR PLAN 1:100

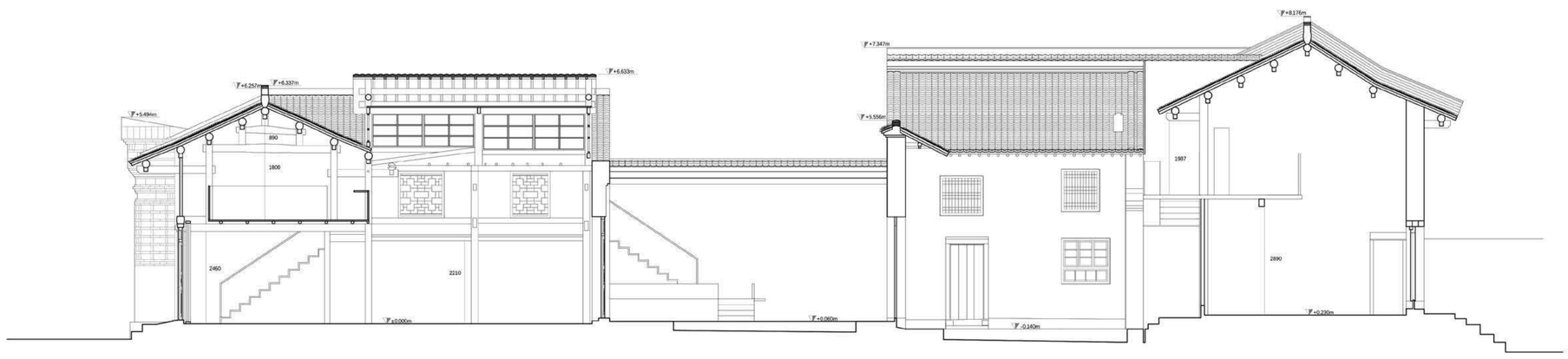


LONGITUDE SECTION A-A 1:100

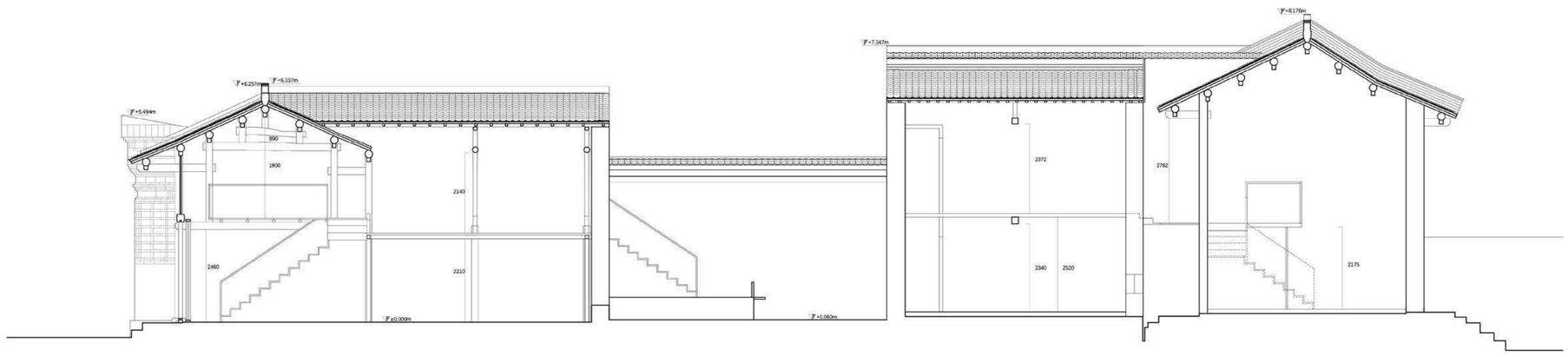
LONGITUDE SECTION B-B 1:100



1ST FLOOR SECTION 1:100

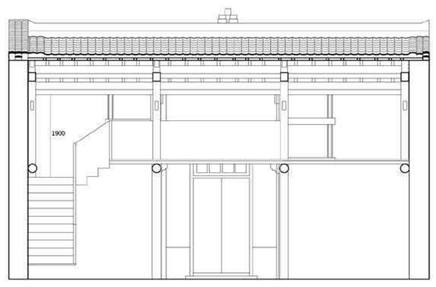


LONGITUDE SECTION C-C 1:100



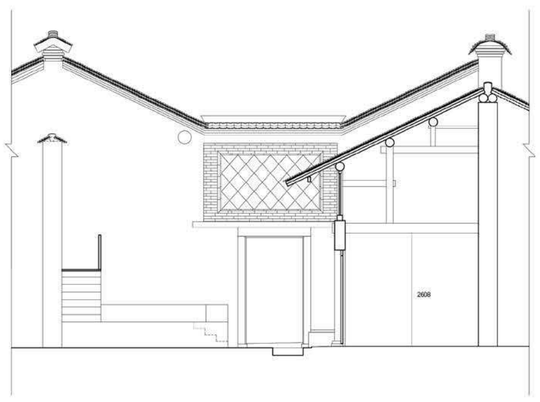
LONGITUDE SECTION D-D 1:100

TRANSVERSAL SECTION 1-1 1:100



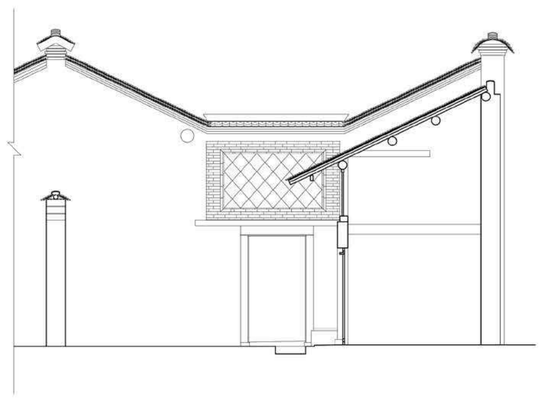
TRANSVERSAL SECTION 2-2 1:100

TRANSVERSAL SECTION 3-3 1:100



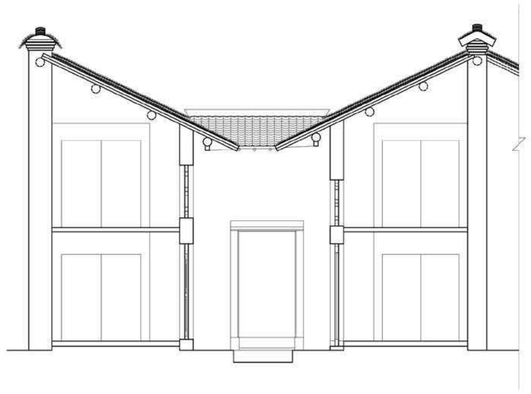
TRANSVERSAL SECTION 4.1-4.1 1:100

TRANSVERSAL SECTION 4.2-4.2 1:100

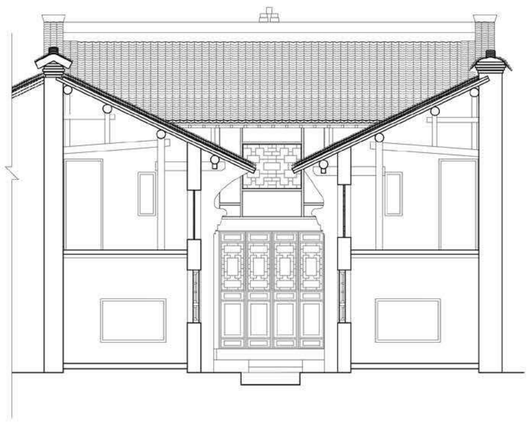


TRANSVERSAL SECTION 5.1-5.1 1:100

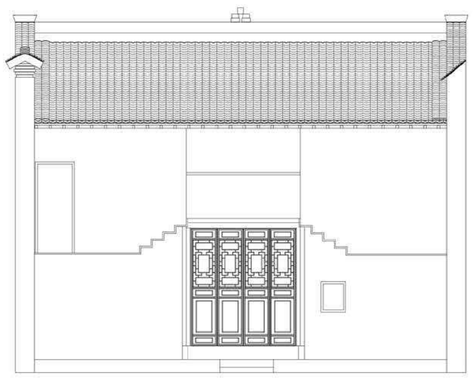
TRANSVERSAL SECTION 5.2-5.2 1:100



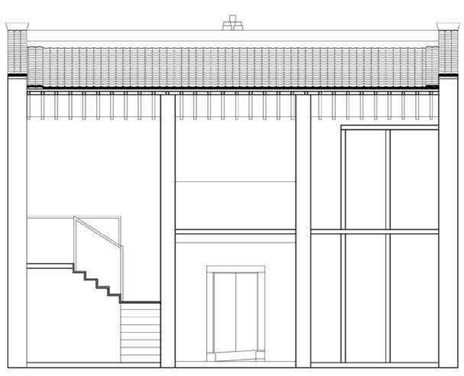
TRANSVERSAL SECTION 6-6 1:100



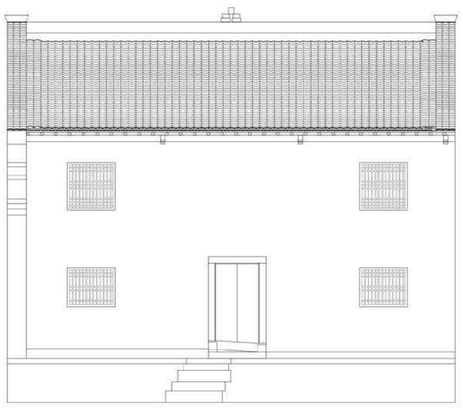
TRANSVERSAL SECTION 7-7 1:100



TRANSVERSAL SECTION 8-8 1:100

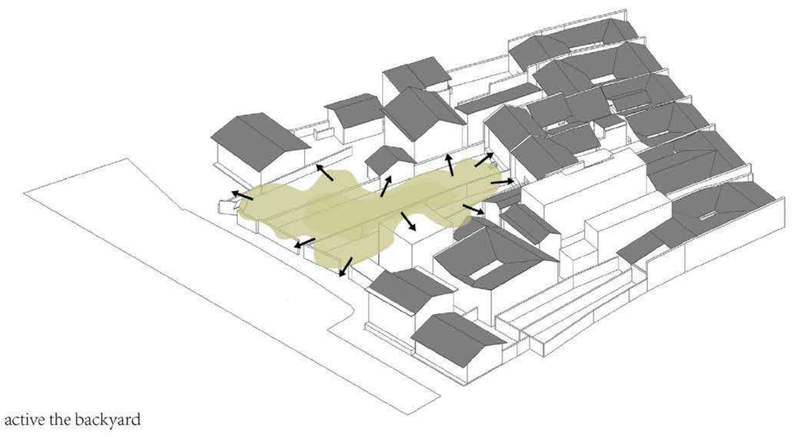


TRANSVERSAL SECTION 9-9 1:100

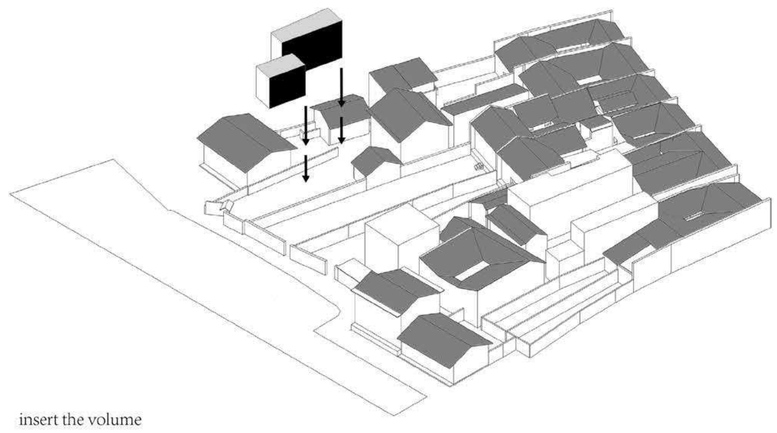


TRANSVERSAL SECTION 10-10 1:100

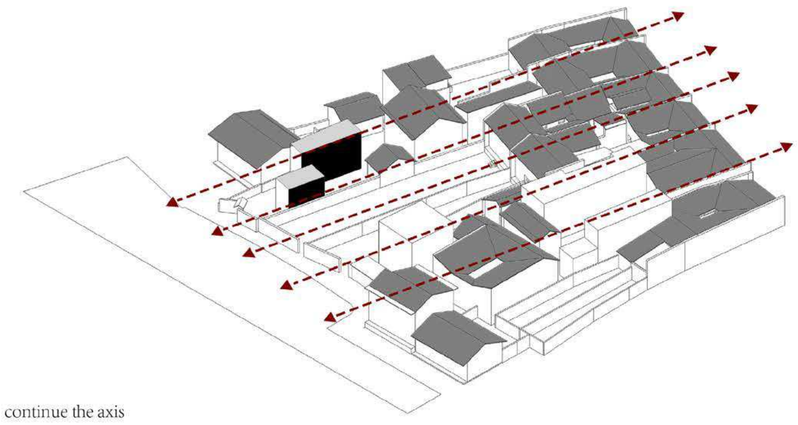
MASTERPLAN 1:100



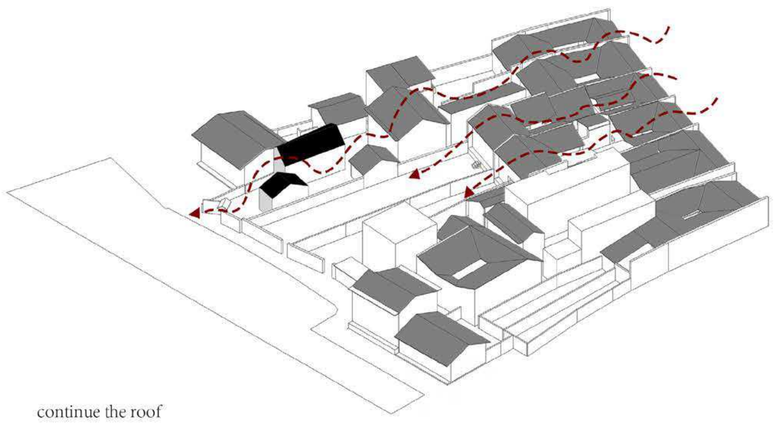
active the backyard



insert the volume



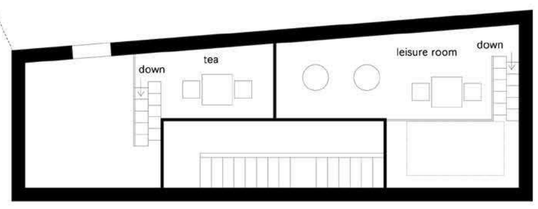
continue the axis



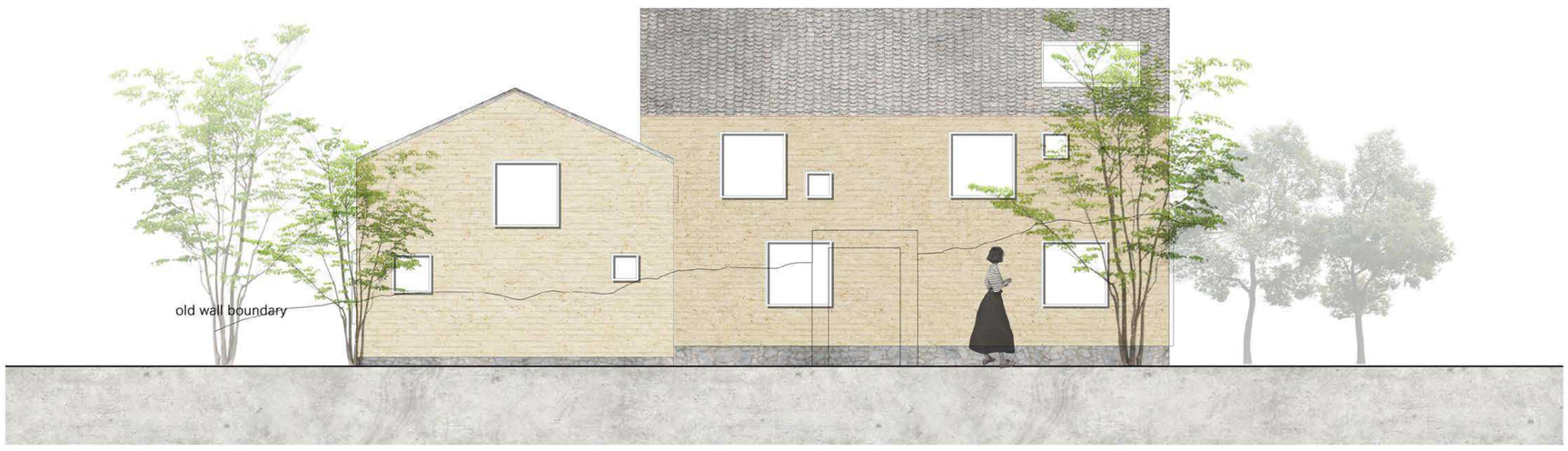
continue the roof

GROUND PLAN 1:100

1ST FLOOR PLAN 1:100



2ND FLOOR PLAN 1:100



FACADE 1:100

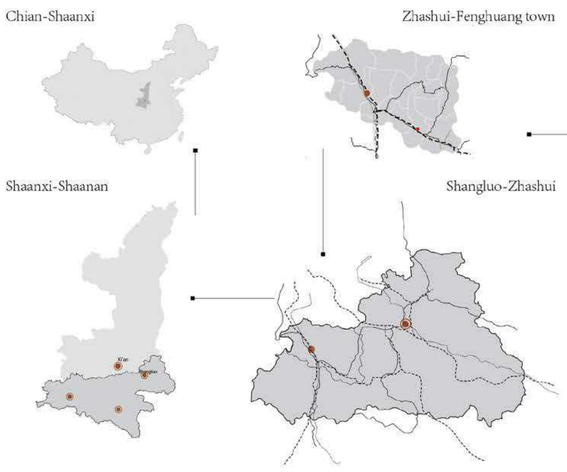
LOCATION

Chian-Shaanxi

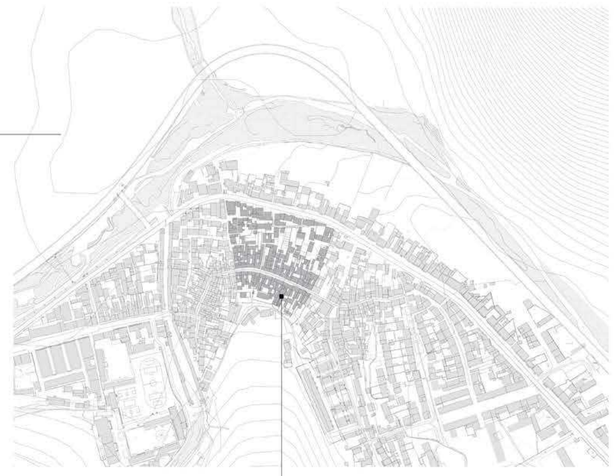
Zhashui-Fenghuang town

Shaanxi-Shaanan

Shangluo-Zhashui



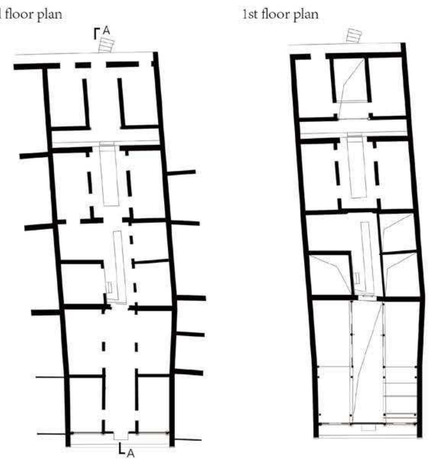
CHINA--FENGHUANG ANCIENT TOWN



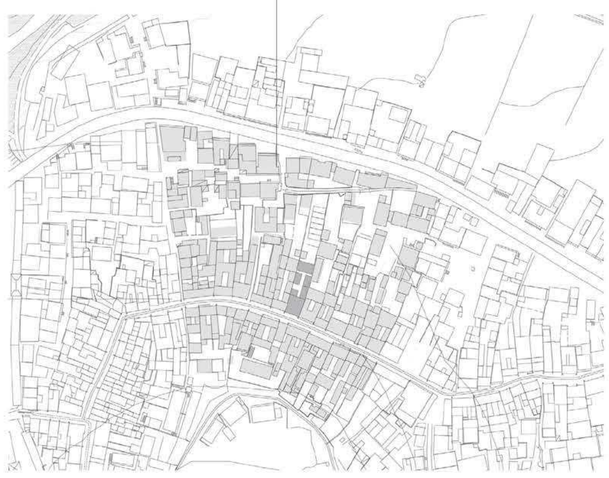
FENGHUANG ANCIENT TOWN

ground floor plan

1st floor plan

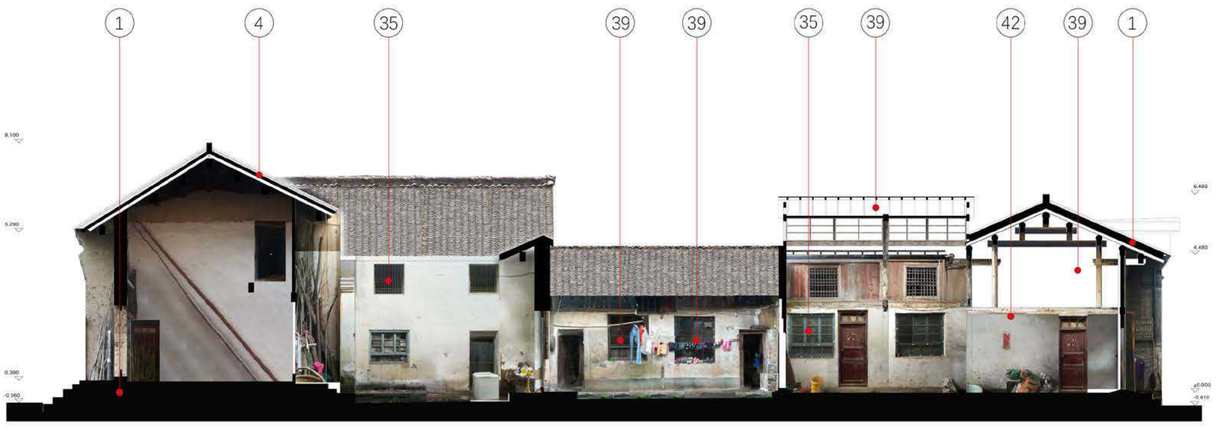


ARCHITECTURE PROJECT

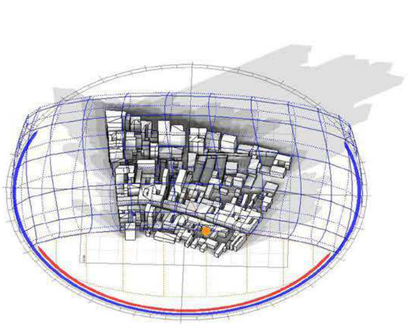


AREA PROJECT

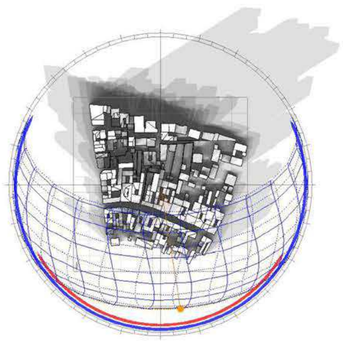
SECTION A-A



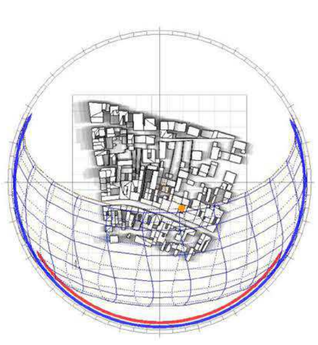
SHADOW ANALYSIS OF AREA



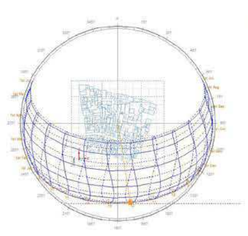
AREA SHADOW

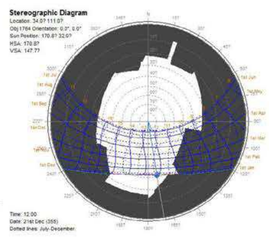


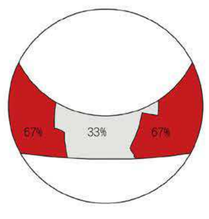
WINTER SOLSTICE



SUMMER SOLSTICE

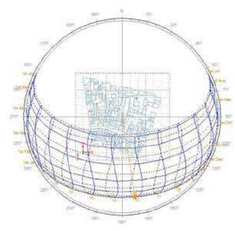


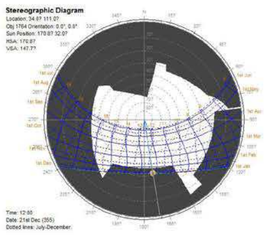


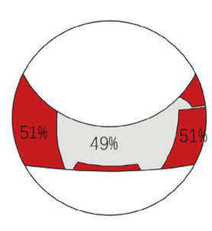


MONTH	TIME(LIGHT)	TIME RANGE	TATAL
JAN	11.50--15.10	noon&afternoon	3.3hour
FEB	11.00--15.20	noon&afternoon	4.3hour
MAR	11.00--15.30	noon&afternoon	4.5h
APR	10.25--16.25	noon&afternoon	6.0h
MAY	9.50--16.30	morning&afternoon	6.6h
JUN	8.10--16.40	morning&afternoon	8.5h
JUL	8.05--16.50	morning&afternoon	8.9h
AUG	8.20--16.30	morning&afternoon	8.1h
SEP	10.00--16.20	morning&afternoon	6.3h
OCT	10.40--15.30	noon&afternoon	4.8h
NOV	11.10--15.20	noon&afternoon	4.1h
DEC	10.55--15.10	noon&afternoon	4.0h

POINT B SHADOW ANALYSIS This point has a good lighting condition in a whole year. Swimming pool can be put in this area.

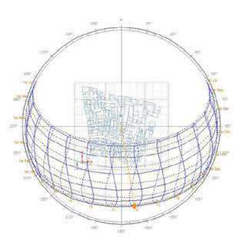


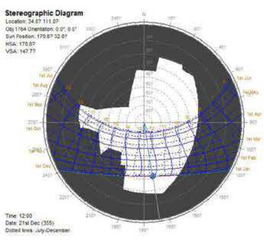


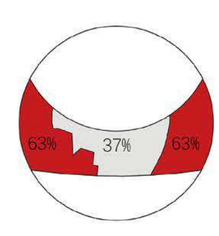


MONTH	TIME(LIGHT)	TIME RANGE	TATAL
JAN	9.30--10.40	morning	1.6h
	15.00--15.30	afternoon	
FEB	9.20--14.00	morning&afternoon	6.2h
	14.55--15.50	afternoon	
MAR	8.50--16.05	morning&afternoon	6.9h
APR	8.00--16.20	morning&afternoon	8.3h
MAY	6.50--16.30	morning&afternoon	9.3h
JUN	6.55--16.55	morning&afternoon	10.0h
JUL	6.55--16.55	morning&afternoon	10.0h
AUG	6.50--16.50	morning&afternoon	10.0h
SEP	7.50--16.20	morning&afternoon	8.1h
OCT	8.30--16.05	morning&afternoon	7.5h
NOV	9.05--16.00	morning&afternoon	7.0h
DEC	9.30--10.50	morning&afternoon	1.8h
	15.00--15.30	afternoon	

POINT A SHADOW ANALYSIS This point has a good lighting condition in a whole year. Public activities can be put in this place.



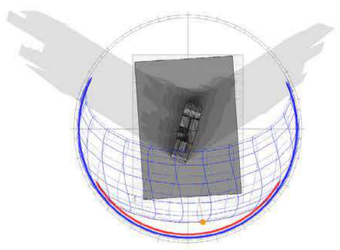




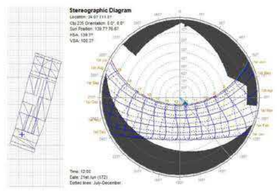
MONTH	TIME(LIGHT)	TIME RANGE	TATAL
JAN	10.30--14.00	noon&afternoon	4.5h
FEB	10.20--14.05	noon&afternoon	4.4h
MAR	9.50--14.20	noon&afternoon	4.1h
APR	9.05--15.50	morning&afternoon	6.9h
MAY	8.30--17.25	morning&afternoon	8.9h
JUN	8.10--17.40	morning&afternoon	8.9h
JUL	8.05--17.55	morning&afternoon	9.0h
AUG	8.20--17.30	morning&afternoon	8.5h
SEP	8.55--15.55	morning&afternoon	8.0h
OCT	9.30--14.20	morning&afternoon	4.8h
NOV	10.10--14.05	noon&afternoon	3.9h
DEC	10.30--14.00	noon&afternoon	4.5h

POINT C SHADOW ANALYSIS This point has a good lighting condition in a whole year. The greenery place and walking path can be designed in this area.

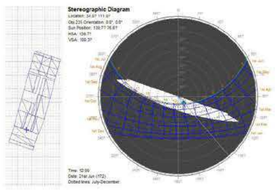
SHADOW ANALYSIS OF ARCHITECTURE



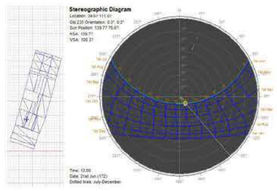
WINTER SOLSTICE



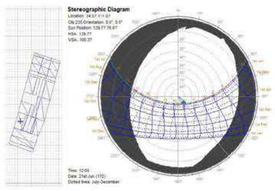
point 01 shadow analysis



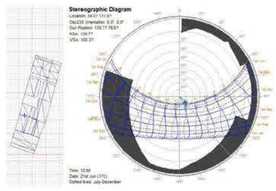
point 02 shadow analysis



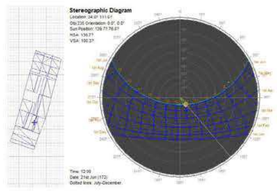
point 03 shadow analysis



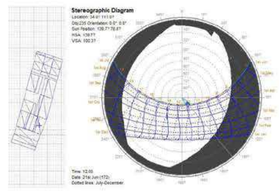
point 04 shadow analysis



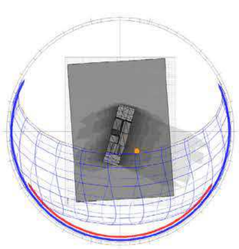
point 05 shadow analysis



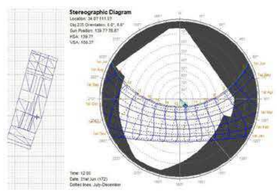
point 06 shadow analysis



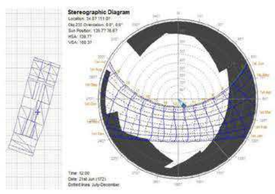
point 07 shadow analysis



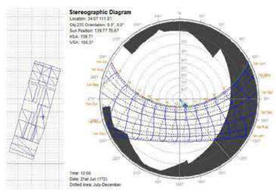
WINTER SOLSTICE



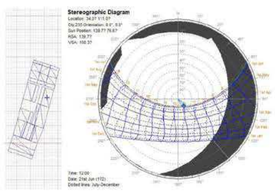
point 01 shadow analysis



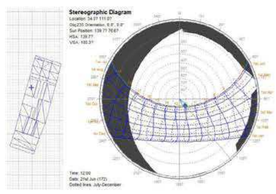
point 02 shadow analysis



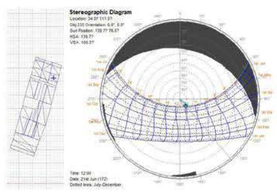
point 03 shadow analysis



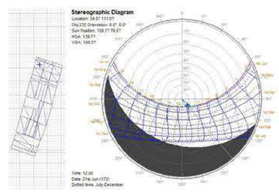
point 04 shadow analysis



point 05 shadow analysis



point 06 shadow analysis

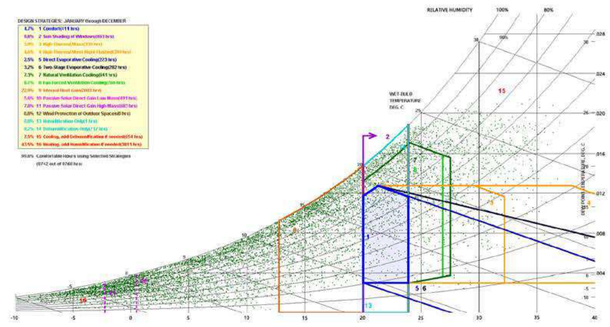


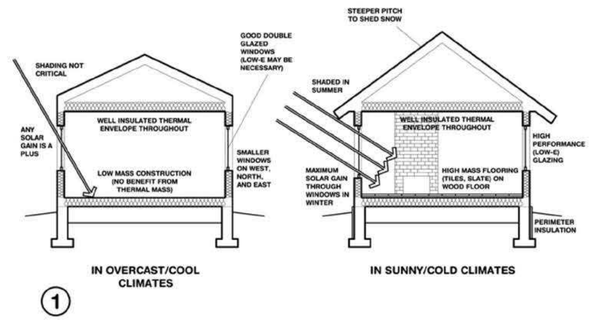
point 07 shadow analysis

Out Come: The point 2/3/6 have too much shadow. The other points have good lighting conditions. Therefore, the windows on the roof can be set around these points according to inner spaces' function.

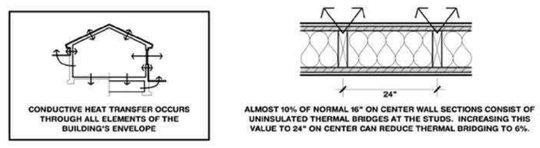
CLIMATE ANALYSIS

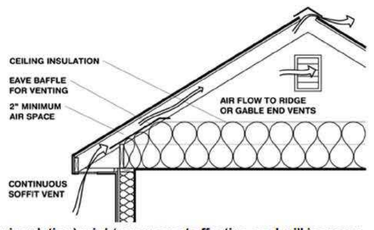
LOCATION: Lushi, Henan, CHN
Latitude/Longitude: 34.05° North, 111.03° East
Time Zone from Greenwich: 8
Data Source: CSWD 570670 WMO Station Number
Elevation: 568m



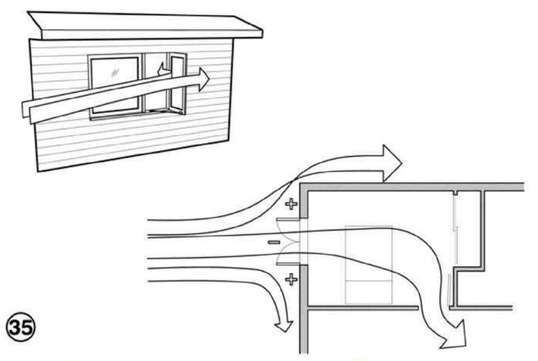


Tiles or slate (even on wood floors) or a stone-faced fireplace provides enough surface mass to store winter daytime solar gain and summer nighttime 'coolth'

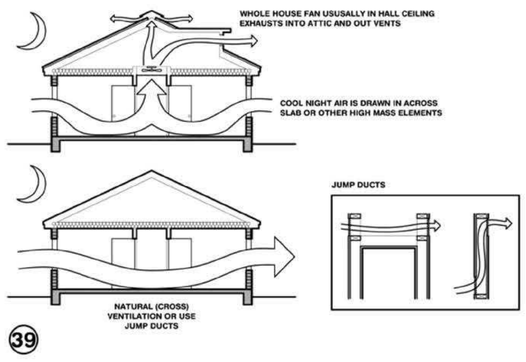




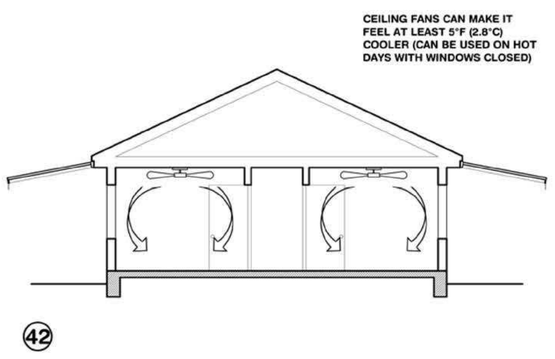
Extra insulation (super insulation) might prove cost effective, and will increase occupant comfort by keeping indoor temperatures more uniform



Good natural ventilation can reduce or eliminate air conditioning in warm weather, if windows are well shaded and oriented to prevailing breezes

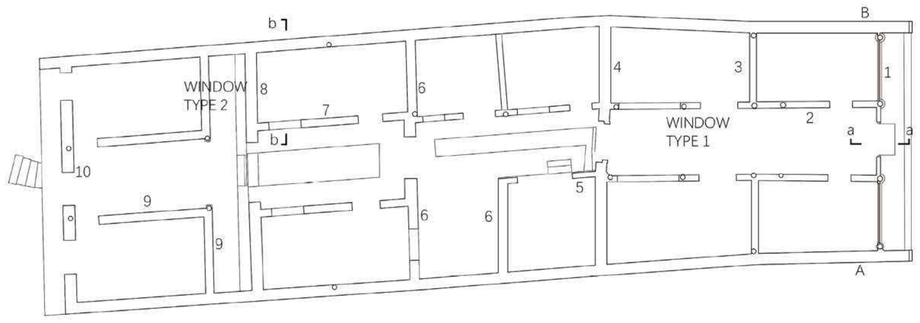


A whole-house fan or natural ventilation can store nighttime 'coolth' in high mass interior surfaces (night flushing), to reduce or eliminate air conditioning



On hot days ceiling fans or indoor air motion can make it seem cooler by 5 degrees F (2.8C) or more, thus less air conditioning is needed

U-VALUE OF EXISTING BUILDING



THE WALL

	description	thinkness(mm)	thermal conductivity[w/mk]	U-value(W/m2k)	
extenal surface					0.06
Wall	A	440	0.75	1.3	
	B	460	0.75	1.26	
	1	30	0.15	2.63	
	2	240	0.75	2	
	3	264	0.75	1.88	
	4	465	0.75	1.25	
	5	220	0.75	2.11	
	6	380	0.75	1.46	
	7	310	0.75	1.69	
	8	460	0.75	1.26	
	9	340	0.75	1.58	
	10	475	0.75	1.23	
internal surface					0.12

THE ROOF

	description	thinkness(mm)	thermal conductivity[w/mk]	U-value(W/m2k)	
layer	tile ceramic	34mm	1	1.67	
	wood board	50mm	0.15		
	wood beam	9.87mm	0.15		

THE FLOOR

description	thinkness(mm)	thermal conductivity[w/mk]	U-value(W/m2k)	area A （m2)	exposed perimeter P(m)
ground floor	20mm水泥砂浆	0.93	1.47	20.9	19.265
floor	wood broad80mm	0.15	1.2		
	9mm wood beam	0.15			
	8.7mm wood liang	0.15			

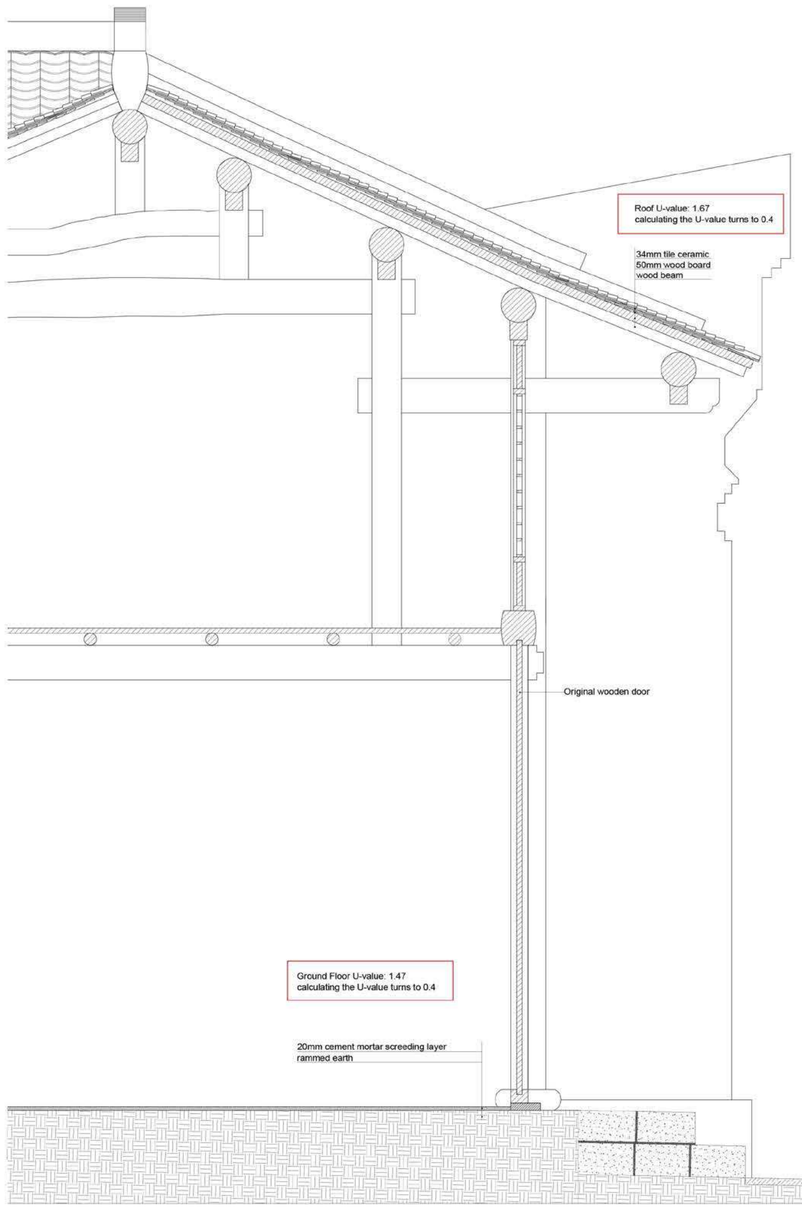
THE WINDOW

type 1	area	conductivity	U value	Af/Aw	
wood frame	0.554	0.15	25.4	39%	
air	0.866	0.0267			

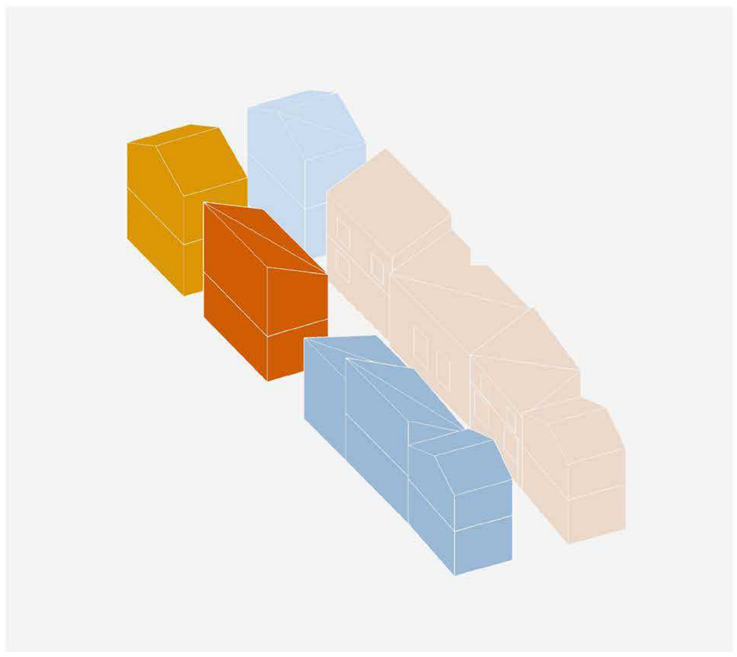
type 2	area	conductivity	U value	Af/Aw	
wood frame	1.117	0.15	4.05	51%	
glass	1.067	0.76			

EXISTING ENVELOPT DESIGN DETAILS

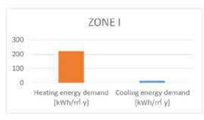
SECTION a-a



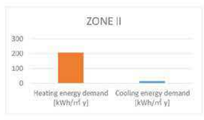
ENERGY DEMAND OF EXISTING BUILDING



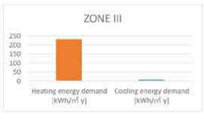
ZONE I	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone1	2875930	26347.4	15.9		
Thermal Zone3	2848190	0	21		
Thermal Zone5	5249760	731057	15.9		
Thermal Zone9	4256710	514972	21		
Thermal Zone11	4645980	28279	15.7	Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	19876570	1300655.4	89.5	222.084581	14.53246257



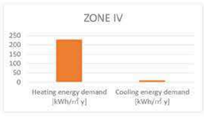
ZONE II	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone2	2314950	8849.81	15.8		
Thermal Zone4	3798410	669308	15.8		
Thermal Zone6	2676250	0	19		
Thermal Zone7	7878250	86936.2	26.8		
Thermal Zone8	3973610	517597	19		
Thermal Zone12	2778750	0	20.6		
Thermal Zone13	5033650	698020	20.6	Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	28453870	1980711.01	137.6	206.7868459	14.39470211



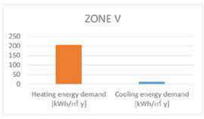
ZONE III	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone17	3457890	0	18.6		
Thermal Zone10	5175980	338805	18.6	Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	8633870	338805	37.2	232.093296	9.10756129



ZONE IV	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone15	3532650	0	19.4		
Thermal Zone18	5327610	387590	19.4	Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	8860260	387590	38.8	228.3572165	9.98943299



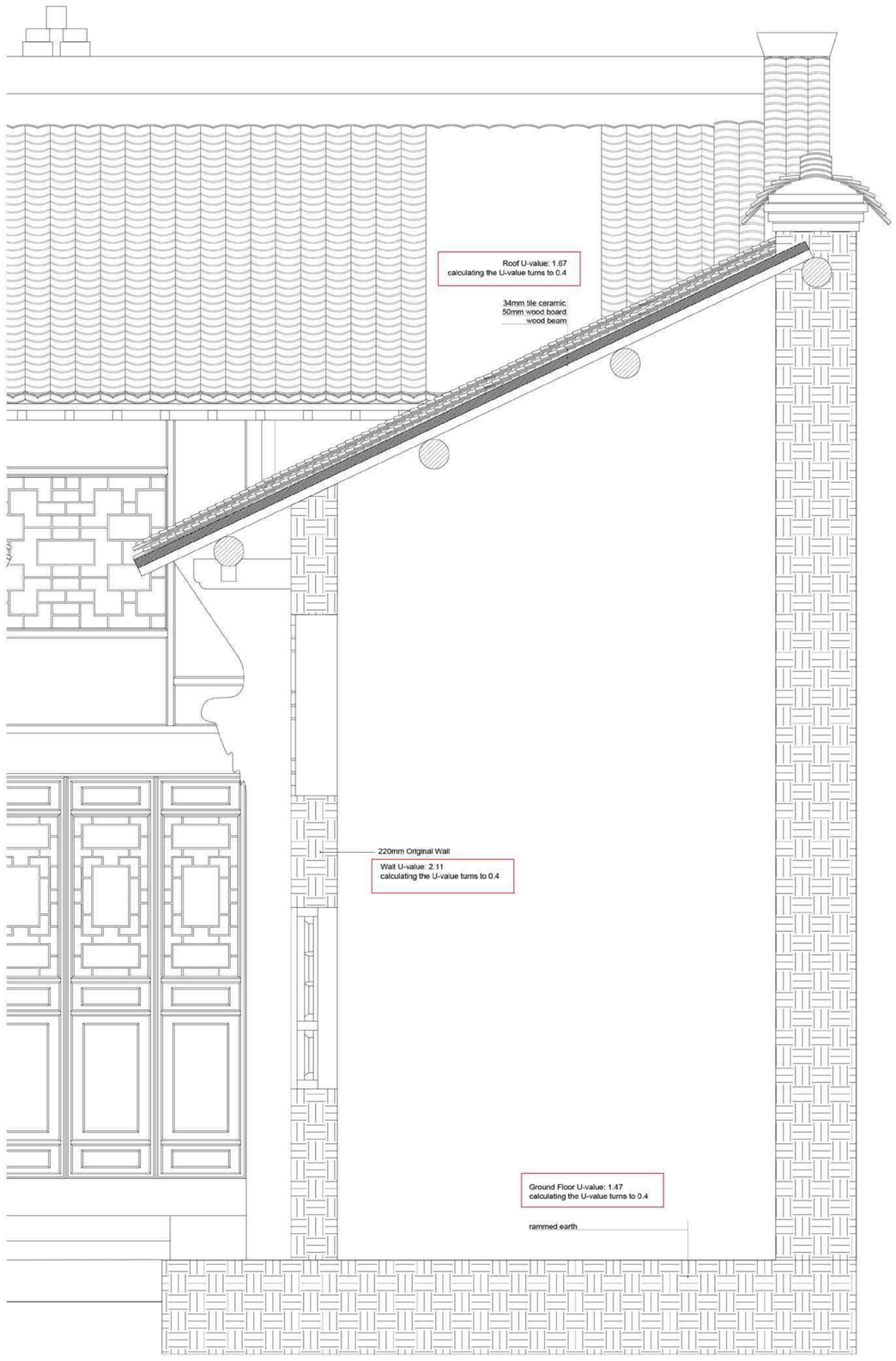
ZONE V	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone14	3121500	0	20.9		
Thermal Zone16	5448510	552447	20.9	Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	8570010	552447	41.8	205.0241627	13.21643541



Total	74394580	4560208.41	344.9	215.6989852	13.22132781

	w	KW
max heating peak load [W]	31208.69	31.20869
max cooling peak load [W]	12096.17	12.09617

SECTION b-b



POLITECNICO MILANO 1863

ARCHITECTURE DESIGN STUDIO D-A.A 2018/19

ARCHITECTURAL COMPOSITION - Pezzetti Laura Anna (053010)
BUILDING PHYSICS - Adhikari Rajendra Singh (053044)

GROUP
WU RUI
ZHAO JIAYING

CONSERVATION, REUSE AND OVERWRITING THE MORPHOLOGICAL UNIT OF FENGHUANG ANCIENT TOWN THE CASE OF DANG YARD

Final Delivery: 06/07/2020
Scale 1:25

Analysis of Existing Envelope

U-VALUE OF BUILDING AFTER TRANSFORMATION

The Wall

原墙面original wall		取上表值	
干粉状建筑胶粘剂Construction adhes	10mm		
翻包玻纤网格布Fiberglass mesh			
EPS	70mm	0.036	
嵌固带，锚固件Anchor			
干粉状抹面胶浆Varnishing glue			
高强度玻璃纤维网格布Fiberglass mesh			
抹面砂浆(石灰水泥砂浆)Smoothing m	6mm	0.87	
饰面涂料Finish paint			

注：计算220earth墙，U值为0.41，目标值小于0.40
P.S. caluculating the 220mm wall, the Uvalue truns to 0.41

description		thinkness(mm)	thermal conductivity[w/mk]	U-value(W/m2k)		
extenal surface					0.06	
Wall	A	440 + 80	0.75	0.37		
	B	460+80	0.75	0.36		
	1	30	0.15	2.63		
	6	380+80	0.75	0.38		
	7	310+80	0.75	0.39		
	8	460+80	0.75	0.36		
	9	340+80	0.75	0.39		
	10	475+80	0.75	0.36		
internal surface					0.12	

The Ground Floor

description	thickness (mm)	thermal conductivity (w/mk)	U-Value(w/m²k)	
素土夯土earth				
水泥砂浆找平Cement mortar	20mm	0.87	0.48	
SBS防水层SBS Waterproof layer	4mm	0.23		
绝热保温层Insulation	80mm	0.07(泡沫混凝土)Foam concrete		
地暖层Floor heating	40mm	1.58(碎石混凝土)Crushed concrete		
室内木地板Indoor wooden floor	15mm	0.15		

注：计算得到U值为0.48，目标值小于0.4
P.S. caluculating the Uvalue truns to 0.74

The Floor

description	thickness (mm)	thermal conductivity (w/mk)	U-Value(w/m²k)	
纵梁Stringer	8.7mm	0.15	1.62	
横梁beam	9mm	0.15		
OSB板垫层OSB Cushion	12mm	0.13		
地暖层Floor heating	40mm	1.58(碎石混凝土)Crushed concrete		
室内木地板Indoor wooden floor	15mm	0.15		

注：计算得到U值1.62，目标值小于0.4
P.S. caluculating the Uvalue truns to 0.96

The Roof

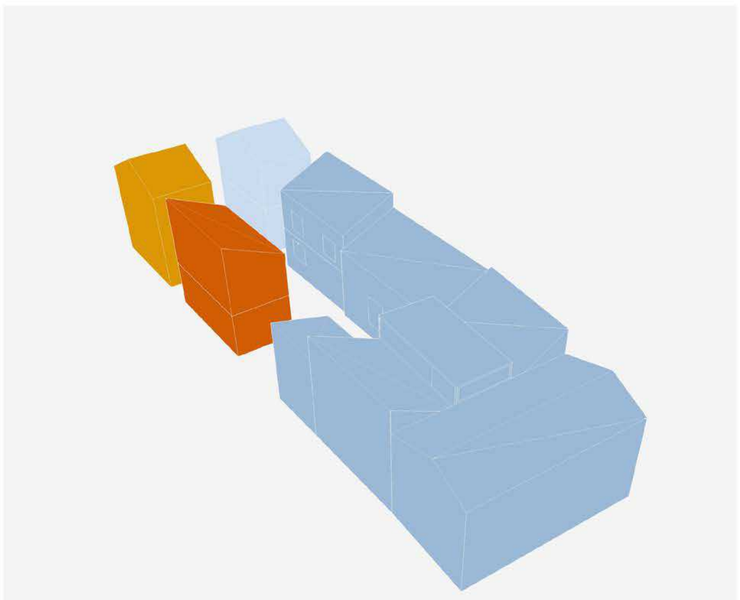
description		thickness (mm)	thermal conductivity (w/mk)	U-Value(w/m²k)
屋顶做法	青瓦tile ceramic	34mm	1	
	SBS防水层SBS Waterproof layer	4mm	0.23	
SIPs	OSB板垫层OSB Cushion	12mm	0.13	0.4
	XPS挤塑苯板保温层	60mm	0.03	
	OSB板垫层OSB Cushion	12mm	0.13	
	檩wood beam	9.87mm	0.15	
	（吊顶内饰面）(Ceiling interior)			

注：计算得出U值为0.4，目标值小于0.4
P.S. caluculating the new roof, the Uvalue truns to 0.4

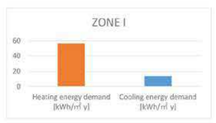
The Window

new window type 1	U-value		Af/Aw	SHGC	透射率
	2.69		30%	0.84	0.7
new window type 2	U-value		Af/Aw		
	2.9		45%	0.84	0.7

ENERGY DEMAND OF BUILDING AFTER TRANSFORMATION

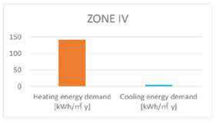


ZONE I	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone19	9504180	3110070	208		
Thermal Zone7	4797090	440407	53.6		
Thermal Zone12	1188980	112029	20.6		
Thermal Zone13	1686440	441727	20.6	Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	17176690	4104233	302.8	56.7261889	13.55427015



ZONE III	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone17	2040120	54379.7	18.6		
Thermal Zone10	2447040	196534	18.6	Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	4487160	250913.7	37.2	120.6225806	6.744991935

ZONE IV	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone15	5486850	188350	38.8		
				Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	5486850	188350	38.8	141.4136598	4.854381443



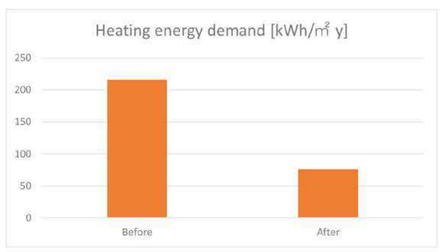
ZONE V	Sum(Heating/Wh)	Sum(Cooling/Wh)	Area/㎡		
Thermal Zone14	2021740	109587	20.9		
Thermal Zone16	2842980	322974	20.9	Heating energy demand [kWh/㎡ y]	Cooling energy demand [kWh/㎡ y]
Total	4864720	432561	41.8	116.3808612	10.34834928

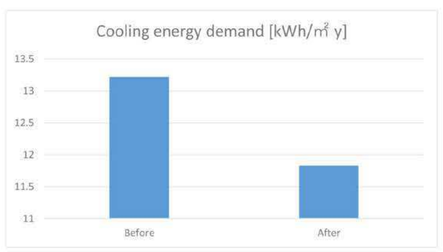
TOTAL					
	32015420	4976057.7	420.6	76.11844983	11.83085521

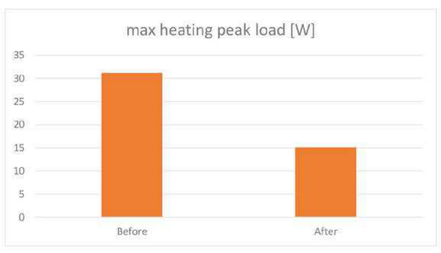
	W	KW
max heating peak load [W]	15135.31	15.13531
max cooling peak load [W]	9728.572	9.728572

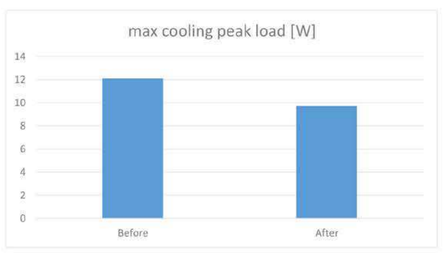
ENERGY DEMAND COMPARISION

	Before	After
Heating energy demand [kWh/㎡ y]	215.69	76.11
Cooling energy demand [kWh/㎡ y]	13.22	11.83
max heating peak load [W]	31.2	15.13
max cooling peak load [W]	12.09	9.72



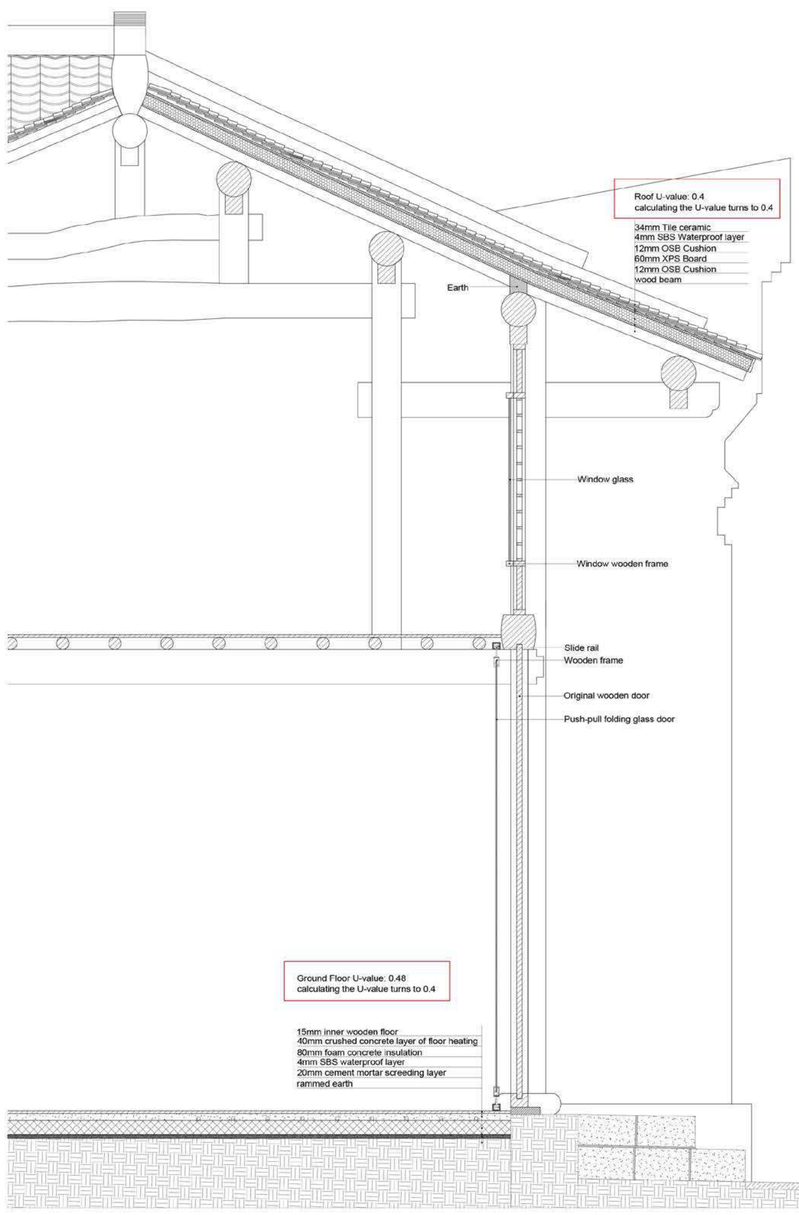




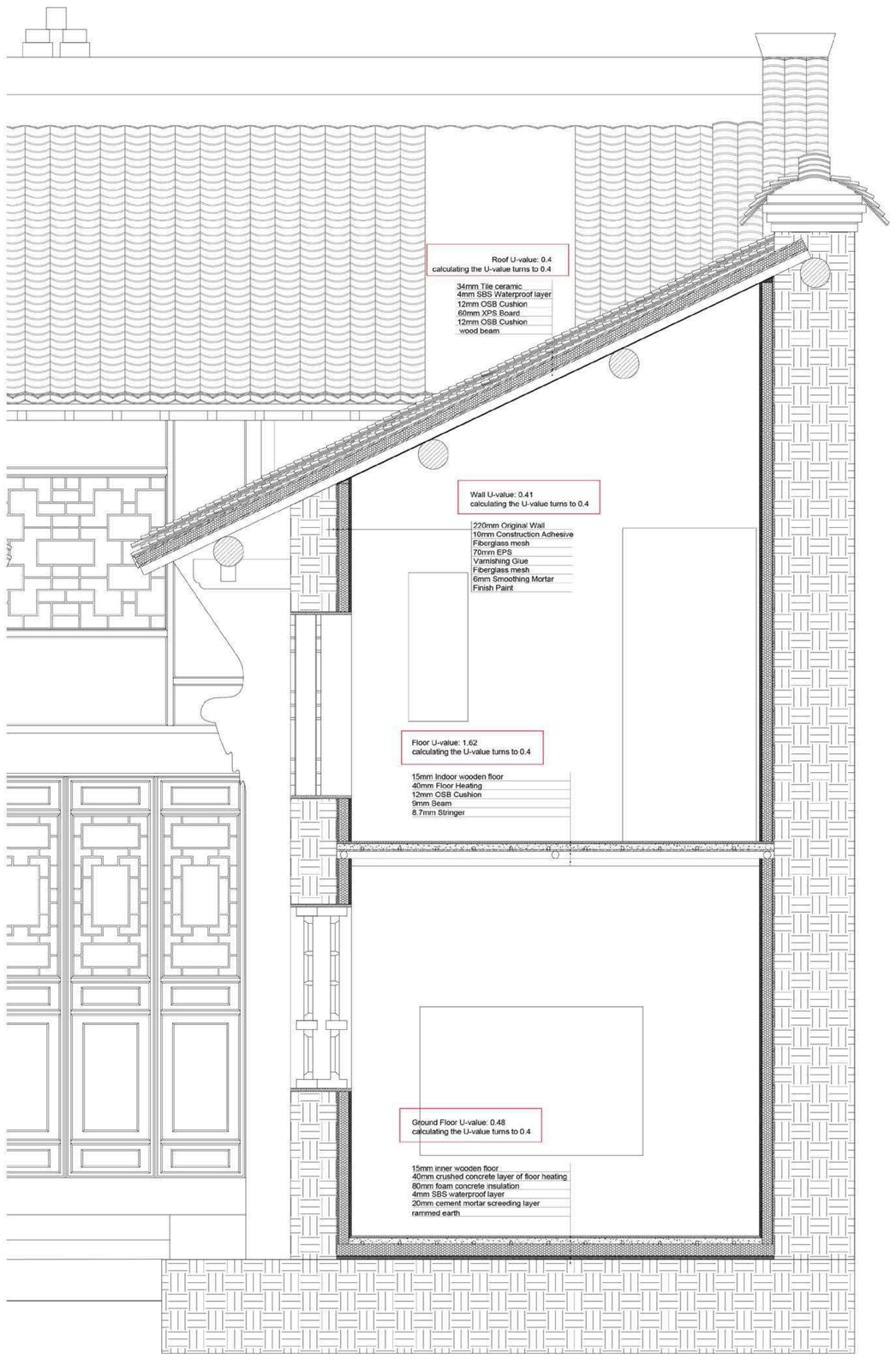


ENVELOPE DESIGN DETAILS AFTER TRANSFORMATION

SECTION a-a



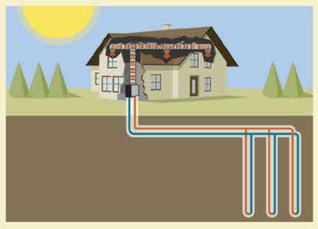
SECTION b-b



ENERGY DEMAND ESTIMATION

1. HEATING AND COOLING(PUMP)

Vertical (Drilled) Closed Loop



Vertical Loops are used extensively where land area is limited or soil conditions prohibit digging horizontal loops. A pair of pipes with a special U-Bend assembly at the bottom are inserted into a bore hole that averages between 150 to 300 feet deep per ton [13 to 27 meters per kW] of equipment. These holes are then backfilled with a special grout solution to ensure good contact with the earth.

TRANQUILITY® PACKAGED SYSTEMS

A Family of Geothermal

TRILOGY® & TRANQUILITY® PACKAGED SYSTEM COMPARISON

Packaged Series ● Standard ○ Optional		Trilogy® 45 Q-Mode® (QE)	Tranquility® 30 Digital (TE)	Tranquility® 22 Digital (TZ)	Tranquility® 20 (TS)
Efficiency	Cooling	45 EER	29.6 EER	23.7 EER	21.9 EER
	Heating	5.1 COP	5.0 COP	4.1 COP	4.3 COP
ENERGY STAR® Designation		Most Efficient			Tier 3
Compressor		Variable	Two Stage	Two Stage	One Stage
Q-Mode®—Free Cooling		●			
Communicating System		iGate CONNECT	iGate	iGate	
iGate® ClimaZone™					
Advanced Monitoring and Diagnostics		●			
Wi-Fi Communicating Thermostat		●			
Non-Communicating Electronic Controls					
Hot Water Generation		Dedicated Full Time	Part Time	Part Time	Part Time
Front Panels		Stainless Steel	Stainless Steel	Powder Coated	Stainless Steel
Air Filter		2" MERV 11	2" MERV 11	1" MERV 8	2" MERV 11
vFlow Internal Variable Water Flow		●	○	○	
Indoor Fan	Variable Speed	●	●	●	○
	Single Speed				●
Configuration	Vertical Upflow	○	○	○	○
	Horizontal	○	○	○	○
	Vertical Downflow	○	○	○	○
Air Coil		Micro-channel	Tin Plated*	Tin Plated	Tin Plated**
Warranty—10-Year Parts; 5-Year Labor Allowance		●	●	●	●
Warranty—10-Year Parts; 10-Year Labor Allowance		○	○	○	○

*TE026~049 uses Micro-channel aluminum coil
** TS024~048 uses Micro-channel aluminum coil

ClimateMaster: Declare your personal energy independence.

RETScreen® Heating and Cooling Load Calculation - Ground-Source Heat Pump Project

Site Conditions		Estimate	Notes/Range
Nearest location for weather data		Wuhan	See Weather Database
Heating design temperature	°C	-6.9	-40.0 to 15.0
Cooling design temperature	°C	32.5	10.0 to 40.0
Average summer daily temperature range	°C	5.7	5.0 to 15.0
Cooling humidity level	-	Medium	
Latitude of project location	°N	34.1	-90.0 to 90.0
Mean earth temperature	°C	13.5	Visit NASA satellite data site
Annual earth temperature amplitude	°C	22.4	5.0 to 20.0
Depth of measurement of earth temperature	m	0.0	0.0 to 3.0

Building Heating and Cooling Load		Estimate	Notes/Range
Type of building	-	Residential	
Available information	-	Energy use data	
Design heating load	kW	15.1	
	million Btu/h	0.052	
Annual heating energy demand	MWh	32.0	
	million Btu	109.2	
Design cooling load	kW	9.7	
	ton (cooling)	2.8	
Annual cooling energy demand	MWh	4.9	
	million Btu	16.7	Return to Energy Model sheet

Version 3.1 © Minister of Natural Resources Canada 1997-2005. NRCan/CETC - Varennes

RETScreen® Energy Model - Ground-Source Heat Pump Project Training & Support

Site Conditions		Estimate	Notes/Range
Project name			See Online Manual
Project location		Nova Scotia, Canada	
Available land area	m²	427	
Soil type	-	Light rock	
Design heating load	kW	15.1	Complete H&CLC sheet
Design cooling load	kW	9.7	

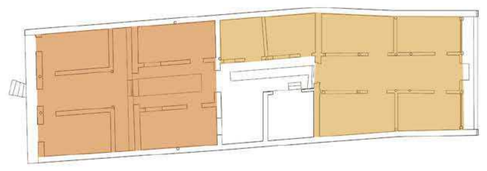
System Characteristics		Estimate	Notes/Range
Base Case HVAC System			
Building has air-conditioning?	yes/no	No	
Heating fuel type	-	Electricity	
Heating system seasonal efficiency	%	100%	55% to 350%
Ground Heat Exchanger System			
System type	-	Vertical closed-loop	
Design criteria	-	Heating	
Typical land area required	m²	88	
Ground heat exchanger layout	-	Standard	
Total borehole length	m	303	
Heat Pump System			
Average heat pump efficiency	-	User-defined	See Product Database
Heat pump manufacturer		Climate Master	
Heat pump model		TS20	
Standard cooling COP	-	6.42	
Standard heating COP	-	4.30	
Total standard heating capacity	kW	13.1	
	million Btu/h	0.045	
Total standard cooling capacity	kW	19.8	Oversized
	ton (cooling)	5.6	
Supplemental Heating and Heat Rejection System			
Suggested supplemental heating capacity	kW	0.0	
	million Btu/h	0.000	
Suggested supplemental heat rejection	kW	0.0	
	million Btu/h	0.000	

Annual Energy Production		Estimate	Notes/Range
Heating			
Electricity used	MWh	8.3	
Supplemental energy delivered	MWh	0.0	
GSHP heating energy delivered	MWh	32.0	
	million Btu	109.2	
Seasonal heating COP	-	3.9	2.0 to 5.0
Cooling			
Electricity used	MWh	1.2	
GSHP cooling energy delivered	MWh	4.9	
	million Btu	16.7	
Seasonal cooling COP	-	4.2	2.0 to 5.5
Seasonal cooling EER	(Btu/h)/W	14.4	7.0 to 19.0
			Complete Cost Analysis sheet

Version 3.1 © Minister of Natural Resources Canada 1997 - 2005. NRCan/CETC - Varennes

For building heating and cooling , GHSP is choosen, using the underground of the back yard. the detail data are in former slide.
Using the pump , it needs 8.3 MWh electricity for heating and 1.2 MWh electricity for cooling, which can be provided by Solar PV .

2. ARTIFICIAL LIGHTING AND EQUIPMENTS



residential commerical

Best Practices (European Standards)		
	kWh/m²year	kWh/m²year
Building type	Lighting	Equip./appliances
Residential	3	15
Commercial	15	20

The total residential area is 159.18 ㎡

The total commercial area is 217.64 ㎡

ELECTRICITY CONSUMPTION		
	kWh /year	kWh /year
Building type	Lighting	Equip./appliances
Residential	477.54	2387.7
Commercial	3264.6	4352.8

The total electricity demand for artificial lighting and equipment is 10482Kwh,i.e. 10.482MWh.

3.DHW AND SHW

Energy Demand for Hot water in Residential Building

For residential buildings, (T_w = 45 °C), The demand for domestic hot water ranging from 35 l/person (low comfort) to 50 l/person (average comfort) to 75 l / person (high comfort)

The energy requirements are estimated based on the number of users and the per capita water consumption.

The data required for this assessment are:

number of persons (P);
daily consumption per person (Cg = 50 l /person);
water inlet temperature (T_m: 10 °C);
temperature of the water use (T_w: 45 °C).

The daily energy demand = [J]

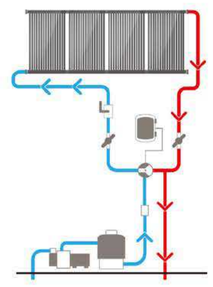
$$L = (T_w - T_m) \times P \times Cg \times \rho \times C_p * 1.1$$

Where ρ is the density of water 1 kg/l
C_p is the specific heat of water 4187 J/kg °C

Rajendra Adhikari POLITECNICO DI MILANO

According to the formula, the daily energy demand is 112839650J,i.e. 0.031Mwh.

It means that it needs 0.031Mwh electricity to meet the need of the hot water.



Collector Data

Collector Model	HC-50	HC-40	HC-38	HC-30
Size, Nominal	4' x 12.5'	4' x 10.5'	4' x 9.5'	4' x 8'
Width	46.56"	46.56"	46.56"	46.56"
Length	151.44"	127.00"	114.84"	91.00"
Aperture Area	48.32 sq ft	40.68 sq ft	36.68 sq ft	29.15 sq ft
Manifold Diameter	2"	2"	2"	2"
Dry Weight	22 lbs	19 lbs	18 lbs	15 lbs
Volume Capacity	3.7 gal	3.1 gal	2.8 gal	2.4 gal
Working Pressure	90 psi	90 psi	90 psi	90 psi
Burst Pressure	270 psi	270 psi	270 psi	270 psi
Typical Flow	5 - 7 gpm	4 - 6 gpm	3 - 5 gpm	3 - 4.4 gpm

HC-30 Solar Insolation

Water Temp. Minus Air Temp.	Category T(°F)	2,000 BTU/ft²	1,500 BTU/ft²	1,000 BTU/ft²
	A (-9)	61.22	46.64	34.98
	B (+9)	29.15	17.49	5.83
	C (+36)	2.92	0	0
	D (+90)	0	0	0

Thousands of BTU's per day per panel

RETScreen® Energy Model - Solar Water Heating Project Training & Support

Site Conditions		Estimate	Notes/Range
Project name		bath	See Online Manual
Project location		wuhan	
Nearest location for weather data		Wuhan	Complete SR&HL sheet
Annual solar radiation (tilted surface)	MWh/m²	1.18	
Annual average temperature	°C	16.3	-20.0 to 30.0
Annual average wind speed	m/s	1.9	
Desired load temperature	°C	27	
Number of months analysed	month	3.50	
Energy demand for months analysed	MWh	0.73	

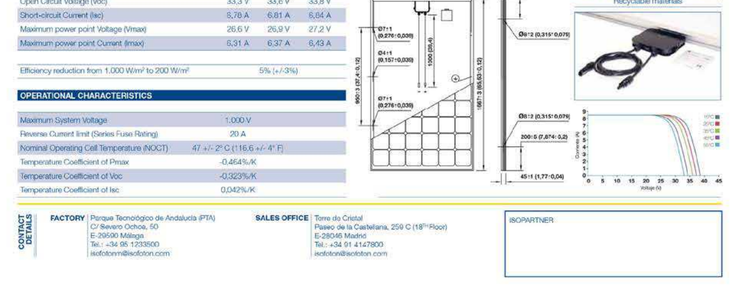
System Characteristics		Estimate	Notes/Range
Application type		Swimming pool (outdoor)	
Base Case Water Heating System			
Heating fuel type	-	Electricity	
Water heating system seasonal efficiency	%	250%	50% to 190%
Solar Collector			
Collector type	-	Evacuated	See Technical Note 1
Solar water heating collector manufacturer		Heliocol	See Product Database
Solar water heating collector model		HC-30	
Gross area of one collector	m²	2.73	1.00 to 5.00
Aperture area of one collector	m²	2.70	1.00 to 5.00
Fr (tau alpha) coefficient	-	0.85	0.40 to 0.80
Fr UL coefficient	(W/m²)/°C	11.56	0.30 to 3.00
Temperature coefficient for Fr UL	(W/(m²°C)²)	0.00	0.000 to 0.010
Suggested number of collectors		2	
Number of collectors		1	
Total gross collector area	m²	2.7	
Balance of System			
Heat exchanger/antifreeze protection	yes/no	Yes	
Heat exchanger effectiveness	%	85%	50% to 85%
Suggested pipe diameter	mm	31	8 to 25 or PVC 35 to 50
Pipe diameter	mm	50	8 to 25 or PVC 35 to 50
Pumping power per collector area	W/m²	0	3 to 22, or 0
Piping and solar tank losses	%	1%	1% to 10%
Losses due to snow and/or dirt	%	3%	2% to 10%
Horz. dist. from mech. room to collector	m	5	5 to 20
# of floors from mech. room to collector	-	2	0 to 20

Annual Energy Production (3.50 months analysed)		Estimate	Notes/Range
SWH system capacity	kW_th	2	
	MWh	0.002	
Pumping energy (electricity)	MWh	0.00	
Specific yield	kWh/m²	37	
System efficiency	%	8%	
Solar fraction	%	14%	
Renewable energy delivered	MWh	0.10	
	kWh	101	
			Complete Cost Analysis sheet

One collector could meet the need of hot water.
But the appearance of the collector is much too different from the original roof which would have a negative influence from the architecture point of view.

FINAL ENERGY CONSUMPTION

Total energy consumption=D(heating&cooling)+D(DHW)+D(lighting &equipments)
=8.3+1.2+0.031+10.482MWh
=20.013MWh



RETScreen® Energy Model - Photovoltaic Project Training & Support

Site Conditions		Estimate	Notes/Range
Project name		residential	See Online Manual
Project location		wuhan	
Nearest location for weather data	-	Wuhan	Complete SR&SL sheet
Latitude of project location	°N	30.6	-90.0 to 90.0
Annual average temperature	°C	16.3	-20.0 to 30.0

System Characteristics		Estimate	Notes/Range
Application type	-	On-grid	
Grid type	-	Central-grid	
PV energy absorption rate	%	100.0%	
PV Array			
PV module type	-	mono-Si	
PV module manufacturer / model #		ISF_235-40-45	See Product Database
Nominal PV module efficiency	%	14.2%	4.0% to 15.0%
NOCT	°C	45	40 to 55
PV temperature coefficient	% / °C	0.40%	0.10% to 0.50%
Miscellaneous PV array losses	%	5.0%	0.0% to 20.0%
Nominal PV array power	kWp	22.00	
PV array area	m²	154.9	
Power Conditioning			
Average inverter efficiency	%	90%	80% to 95%
Suggested inverter (DC to AC) capacity	kW (AC)	19.8	
Inverter capacity	kW (AC)	72.0	
Miscellaneous power conditioning losses	%	0%	0% to 10%

Annual Energy Production (12.00 months analysed)		Estimate	Notes/Range
Specific yield	kWh/m²	134.4	
Overall PV system efficiency	%	11.7%	
PV system capacity factor	%	10.8%	
Renewable energy collected	MWh	23,143	
Renewable energy delivered	MWh	20.829	
	kWh	20,829	
Excess RE available	MWh	0.000	
			Complete Cost Analysis sheet

Version 3.2 © Minister of Natural Resources Canada 1997 - 2005. NRCan/CETC - Varennes

RENEWABLE ENERGY PLANTS-SOLAR PV

The plan area is 193.07 ㎡ ,the roof area is larger than 193.07 ㎡ .
To meet the total demand for electricity(heating and cooling, lighting and equipment) ,it needs 154.9 ㎡ PV array area. Almost all the roofs are be used.
But from architecture point of view , for now ,products we could find on the market is not suitable . For the appearances and color is really different from the original roof which is a conflicting to restoration.

NET BUILDING ENERGY CONSUMPTION

Total energy consumption=D(heating&cooling)+D(DHW)+D(lighting &equipments)
=8.3+1.2+0.031+10.482MWh
=20.013MWh

renewable energy=De (SHW)+De(PV)
=0.10+20.829MWh
=20.929MWh

Net building energy consumption=20.013-20.929=-0.916MWh

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Solar Water Heating Project

Use GHG analysis sheet? Yes Type of analysis: Standard

Background Information
Project Information: Project name bath; Project location wuhan
Global Warming Potential of GHG: 1 tonne CH_4 = 21 tonnes CO_2 (IPCC 1996); 1 tonne N_2O = 310 tonnes CO_2 (IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Natural gas	5.5%	56.1	0.0030	0.0010	45.0%	8.0%	0.491
Coal	68.6%	94.6	0.0020	0.0030	35.0%		0.983
#6 oil	7.6%	77.4	0.0030	0.0020	30.0%		0.937
Large hydro	18.3%	0.0	0.0000	0.0000	100.0%		0.000
Electricity mix	100%	212.5	0.0051	0.0065		0.4%	0.773

Base Case Heating System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t_{CO2}/MWh)
Heating system						
Electricity	100.0%	212.5	0.0051	0.0065	250.0%	0.309

Proposed Case Heating System (Solar Water Heating Project)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t_{CO2}/MWh)
Heating system						
Electricity	0.0%	212.5	0.0051	0.0065	100.0%	0.000
Solar	100.0%	0.0	0.0000	0.0000	100.0%	0.000
Heating energy mix	100.0%	0.0	0.0000	0.0000		0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (t_{CO2}/MWh)	Proposed case GHG emission factor (t_{CO2}/MWh)	End-use annual energy delivered (MWh)	Annual GHG emission reduction (t_{CO2})
Heating system	0.309	0.000	0.10	0.03
			Net GHG emission reduction t_{CO2}/yr	0.03

Complete Financial Summary sheet

Version 3.1 © United Nations Environment Programme & Minister of Natural Resources Canada 2000 - 2005. UNEP/DTIE and NRCan/CETC - Varennes

The Greenhouses gases emission reduction for SWH is 0.03

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Photovoltaic Project

Use GHG analysis sheet? Yes Type of analysis: Standard

Background Information
Project Information: Project name residential; Project location wuhan
Global Warming Potential of GHG: 1 tonne CH_4 = 21 tonnes CO_2 (IPCC 1996); 1 tonne N_2O = 310 tonnes CO_2 (IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Natural gas	5.5%	56.1	0.0030	0.0010	45.0%	8.0%	0.491
Coal	68.6%	94.6	0.0020	0.0030	35.0%		0.983
#6 oil	7.6%	77.4	0.0030	0.0020	30.0%		0.937
Large hydro	18.3%	0.0	0.0000	0.0000	100.0%		0.000
Electricity mix	100.0%	212.5	0.0051	0.0065		0.4%	0.773

Proposed Case Electricity System (Photovoltaic Project)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Electricity system							
Solar	100.0%	0.0	0.0000	0.0000	100.0%	4.0%	0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (t_{CO2}/MWh)	Proposed case GHG emission factor (t_{CO2}/MWh)	End-use annual energy delivered (MWh)	Annual GHG emission reduction (t_{CO2})
Electricity system	0.773	0.000	19.996	15.45
			Net GHG emission reduction t_{CO2}/yr	15.45

Complete Financial Summary sheet

Version 3.2 © United Nations Environment Programme & Minister of Natural Resources Canada 2000 - 2005. UNEP/DTIE and NRCan/CETC - Varennes

The Greenhouses gases emission reduction for PV is 15.45

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Ground-Source Heat Pump Project

Use GHG analysis sheet? Yes Type of analysis: Standard

Background Information
Project Information: Project name -; Project location Nova Scotia, Canada
Global Warming Potential of GHG: 1 tonne CH_4 = 21 tonnes CO_2 (IPCC 1996); 1 tonne N_2O = 310 tonnes CO_2 (IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Natural gas	5.5%	56.1	0.0030	0.0010	45.0%	8.0%	0.491
Coal	68.6%	94.6	0.0020	0.0030	35.0%		0.983
#6 oil	7.6%	77.4	0.0030	0.0020	30.0%		0.937
Large hydro	18.3%	0.0	0.0000	0.0000	100.0%		0.000
Electricity mix	100%	212.5	0.0051	0.0065		0.4%	0.773

Base Case Heating and Cooling System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t_{CO2}/MWh)
Heating system						
Electricity	100.0%	212.5	0.0051	0.0065	100.0%	0.773

Proposed Case Heating and Cooling System (Ground-Source Heat Pump Project)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t_{CO2}/MWh)
Heating system						
Electricity	100.0%	212.5	0.0051	0.0065	387.7%	0.199
Cooling system						
Electricity	100.0%	212.5	0.0051	0.0065	421.0%	0.183

GHG Emission Reduction Summary

	Base case GHG emission factor (t_{CO2}/MWh)	Proposed case GHG emission factor (t_{CO2}/MWh)	End-use annual energy delivered (MWh)	Annual GHG emission reduction (t_{CO2})
Heating system	0.773	0.199	32.0	18.35
Cooling system	0.000	0.183	4.9	-0.90
			Net GHG emission reduction t_{CO2}/yr	17.45

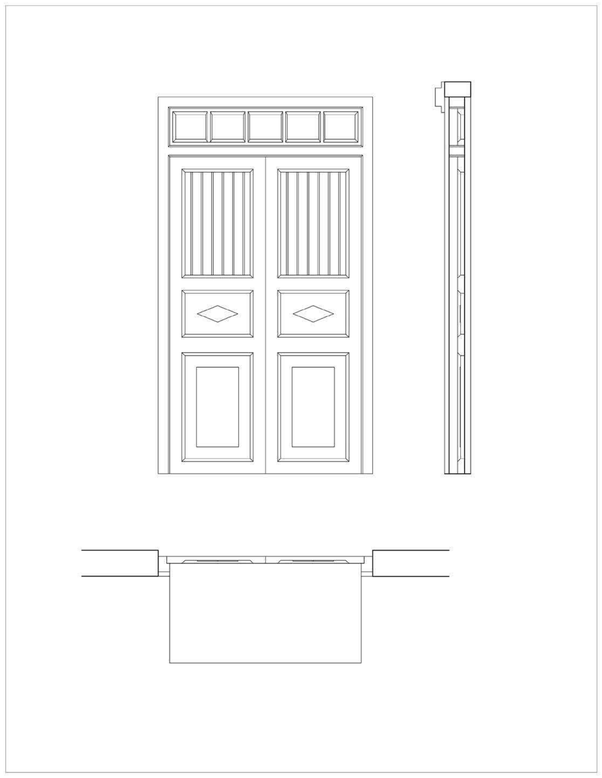
Complete Financial Summary sheet

Version 3.1 © United Nations Environment Programme & Minister of Natural Resources Canada 2000 - 2005. UNEP/DTIE and NRCan/CETC - Varennes

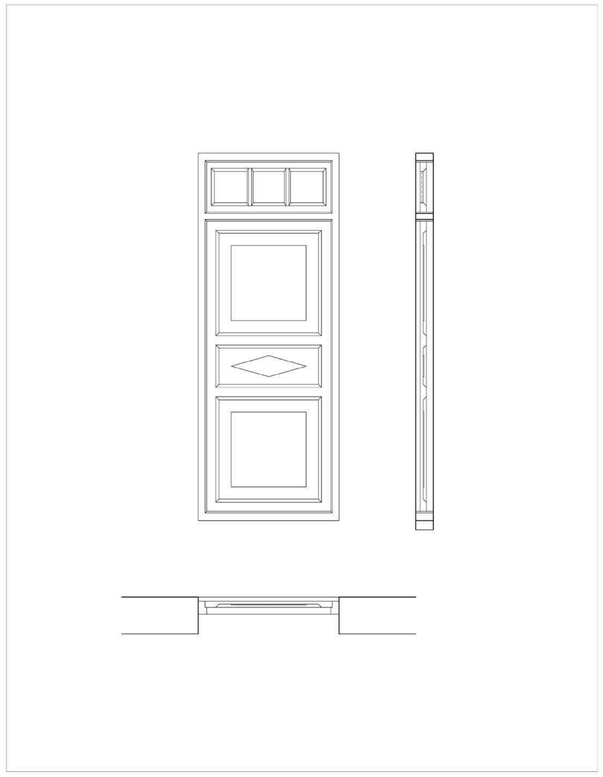
The Greenhouses gases emission reduction for GSHP is 17.45

TOTAL GREENHOUSES GASES EMISSION REDUCTION

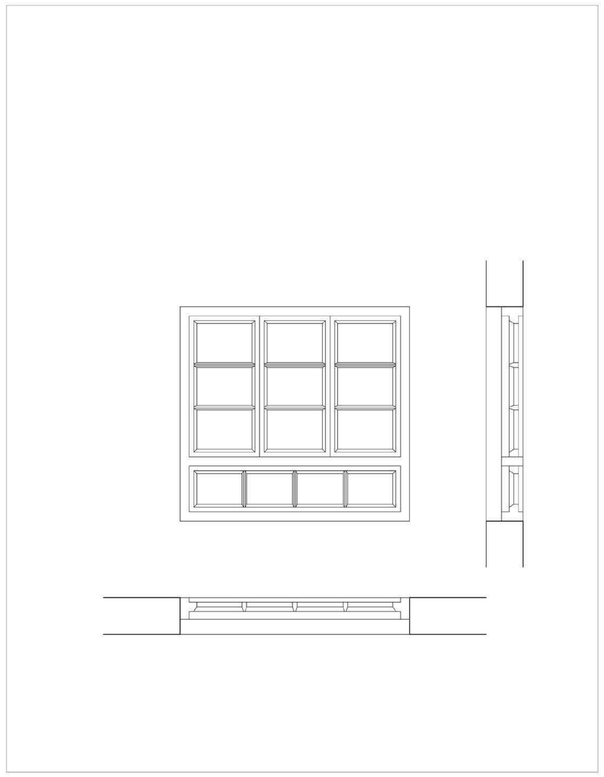
Total greenhouses gases emission reduction=
R(SWH) + R(PV) +R(GSHP)
=0.03+15.45+17.45
=32.93 tCO2/yr



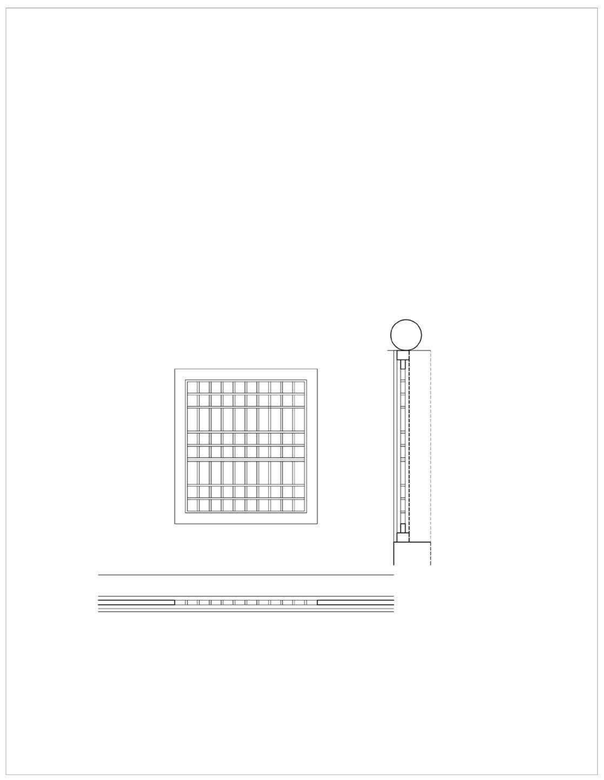
ELEMENT 1-1 1:20



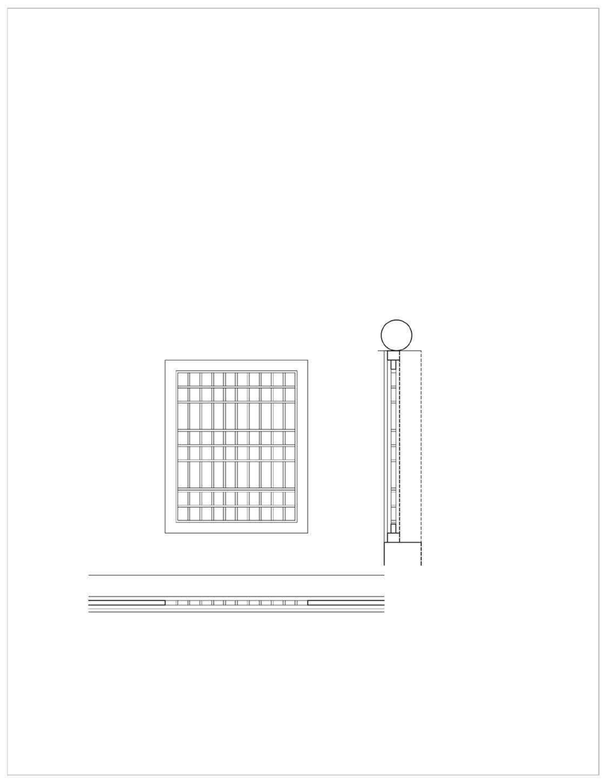
ELEMENT 1-1-R1/L1 2-1-R2/L2 1:20



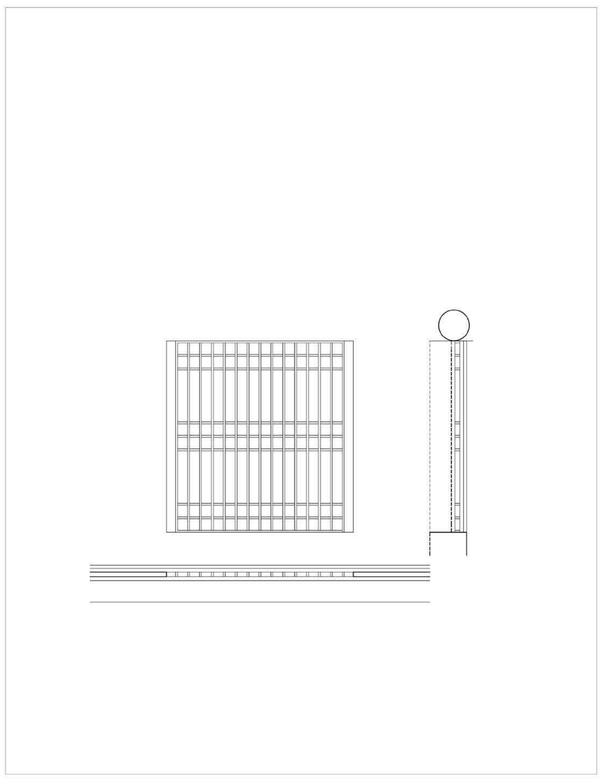
ELEMENT 2-1-R1/R3 2-1-L1/L3 1:20



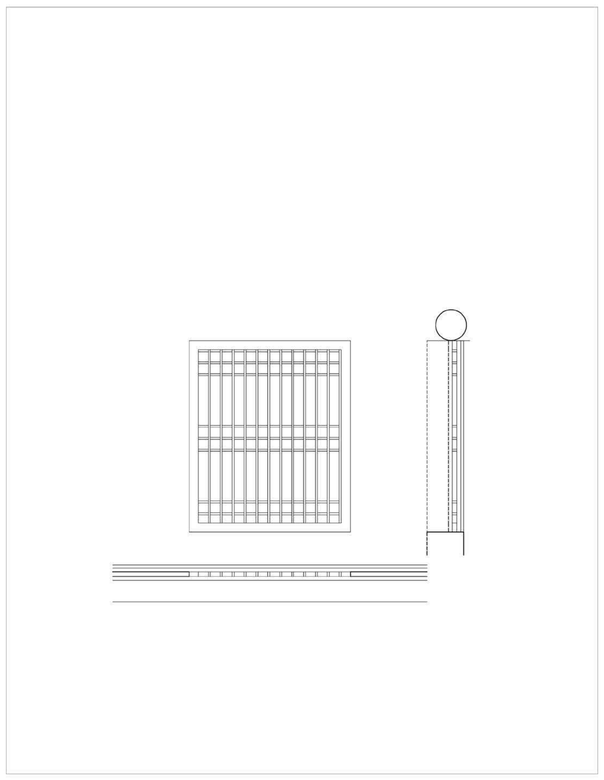
ELEMENT 2-2-R1 1:20



ELEMENT 2-2-R2 1:20

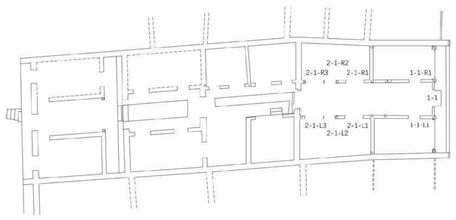


ELEMENT 2-2-L1 1:20

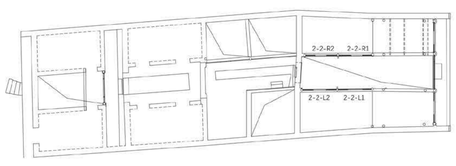


ELEMENT 2-2-L2 1:20

GROUND FLOOR ELEMENTS LOCATION

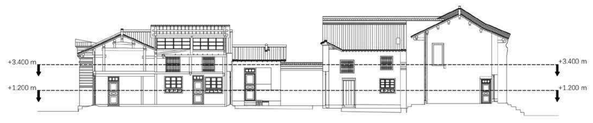


1ST FLOOR ELEMENTS LOCATION



SECTION B-B CUTTING HEIGHT

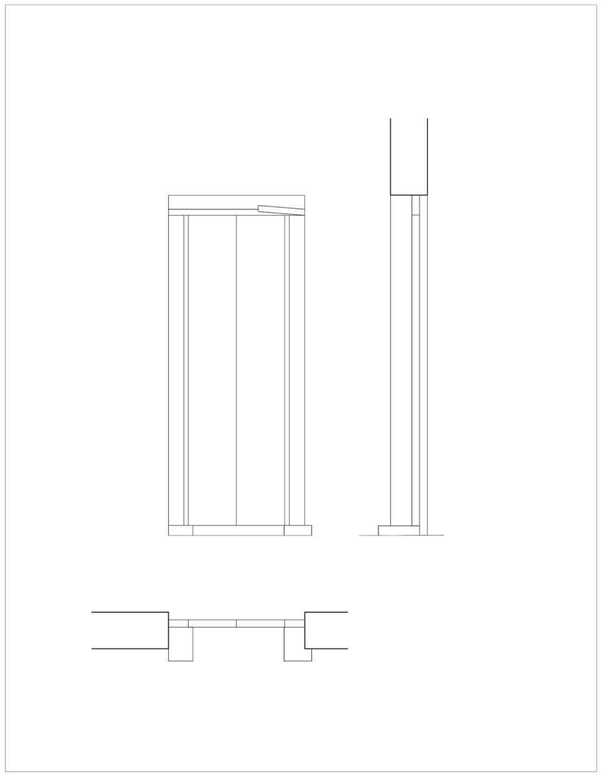
SECTION C-C CUTTING HEIGHT



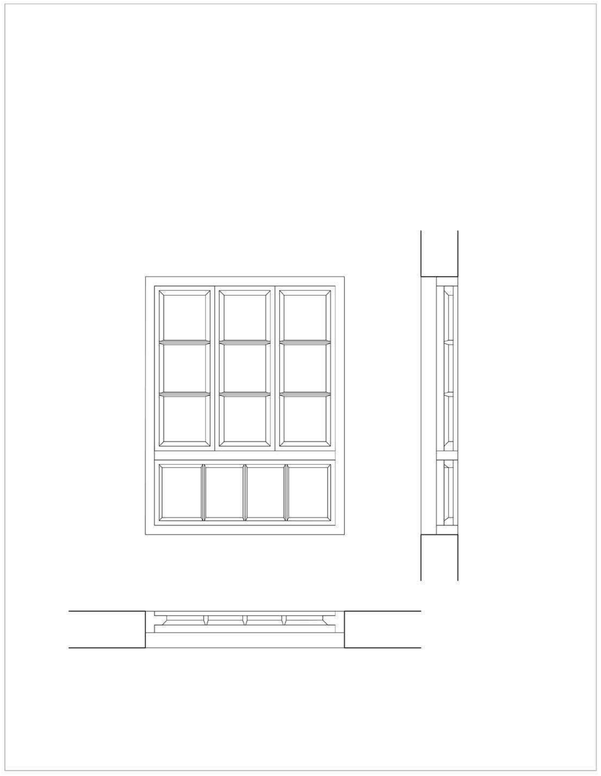
LEGEND

NOT MEASURED

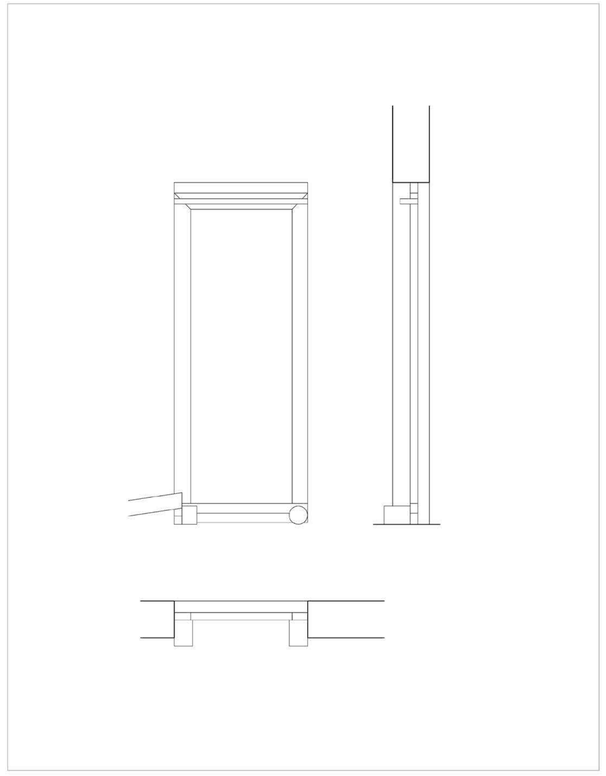
NOT MEASURED



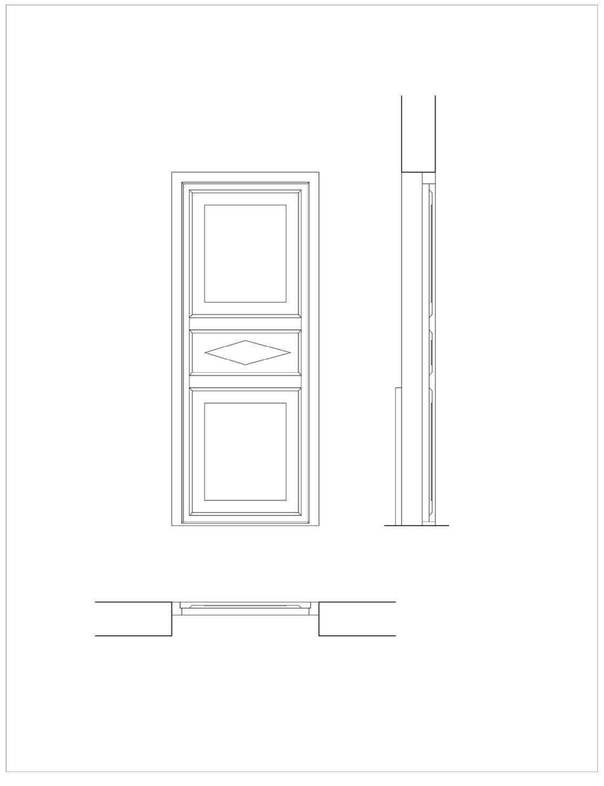
ELEMENT 3-1-R1 1:20



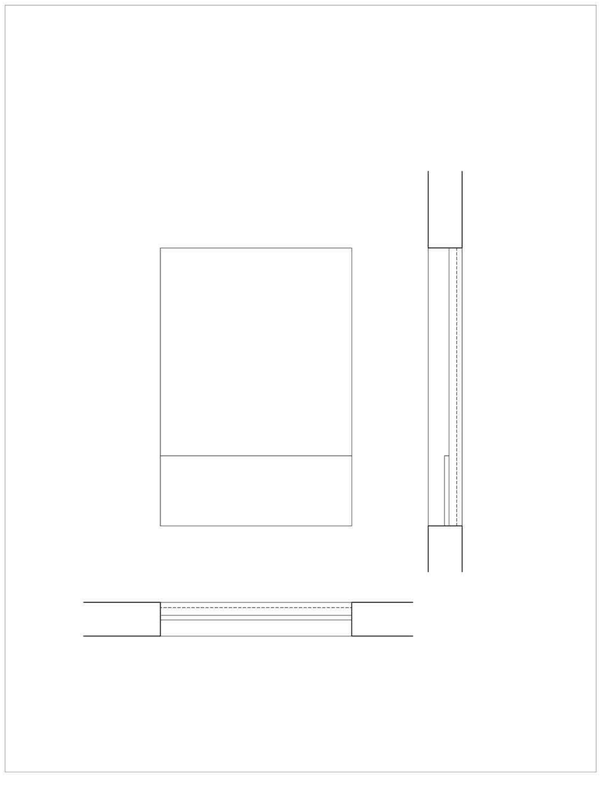
ELEMENT 3-1-R2/R3 1:20



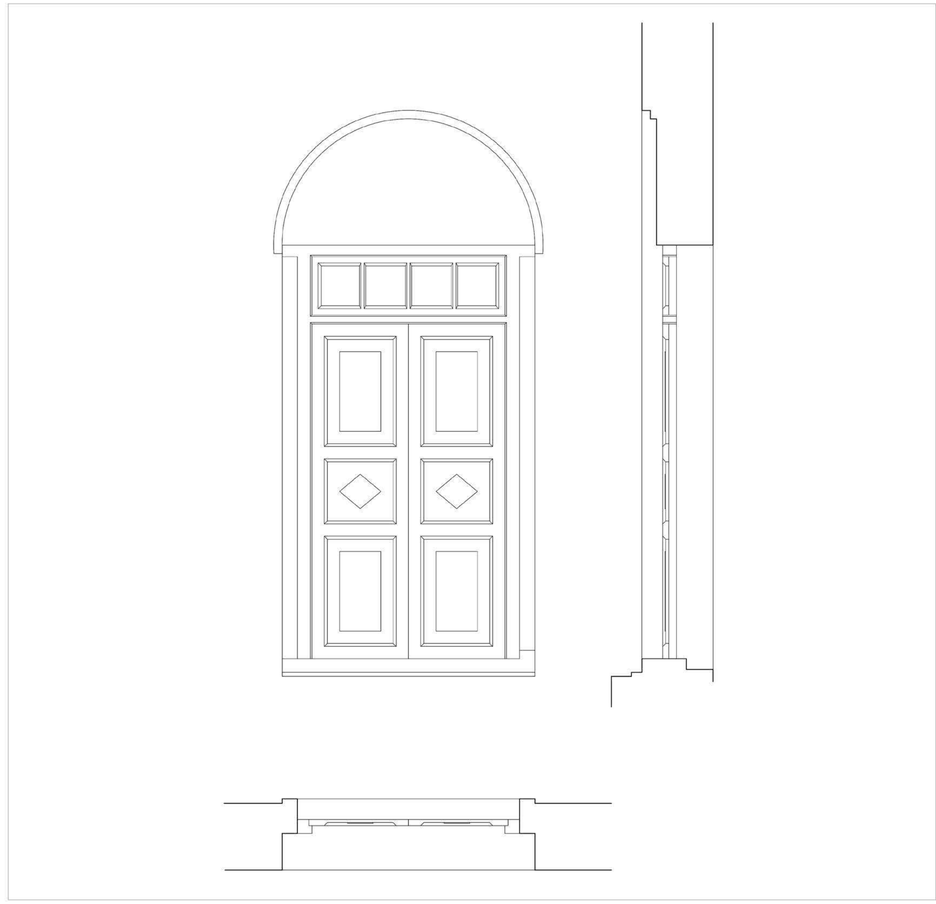
ELEMENT 3-1-R4 1:20



ELEMENT 3-1-L1 1:20

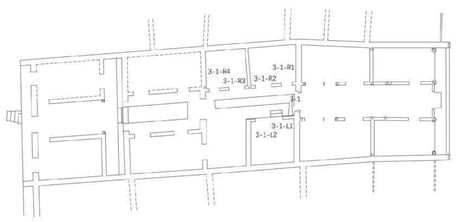


ELEMENT 3-1-L2 1:20

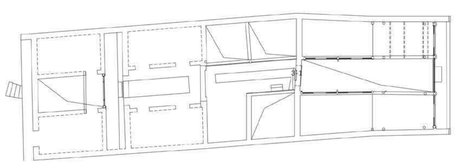


ELEMENT 3-1 1:20

GROUND FLOOR ELEMENTS LOCATION

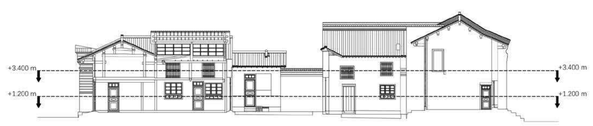


1ST FLOOR ELEMENTS LOCATION



SECTION B-B CUTTING HEIGHT

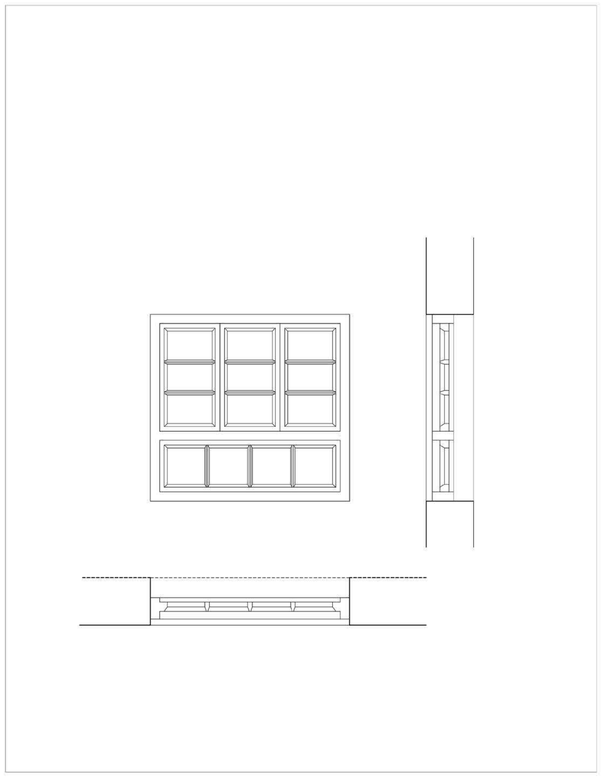
SECTION C-C CUTTING HEIGHT



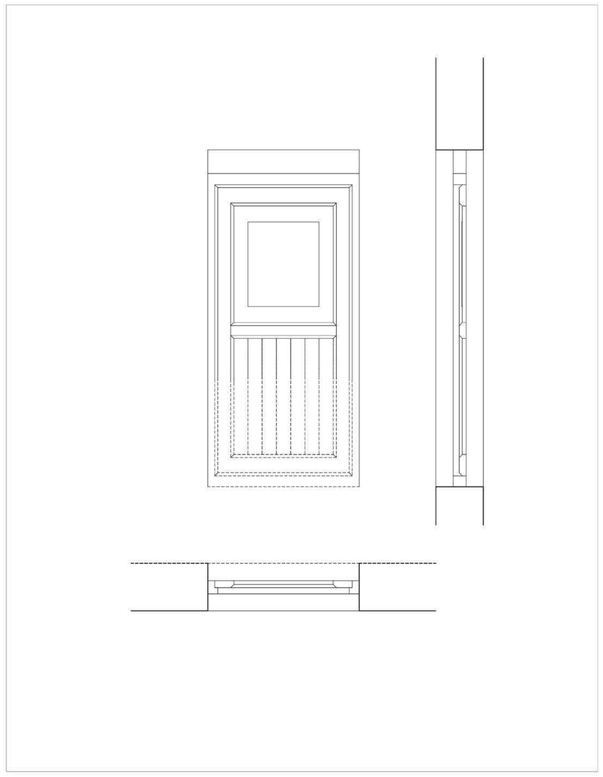
LEGEND

NOT MEASURED

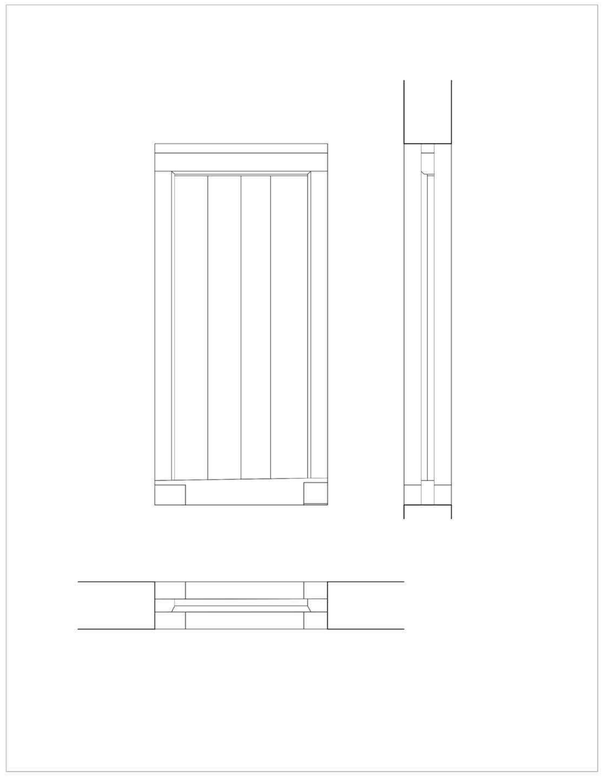
NOT MEASURED



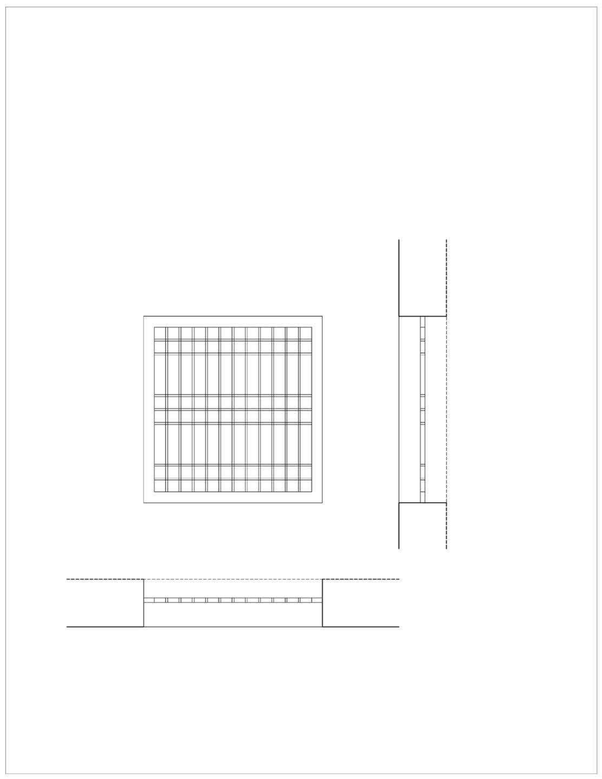
ELEMENT 4-1-R2/L2 1:20



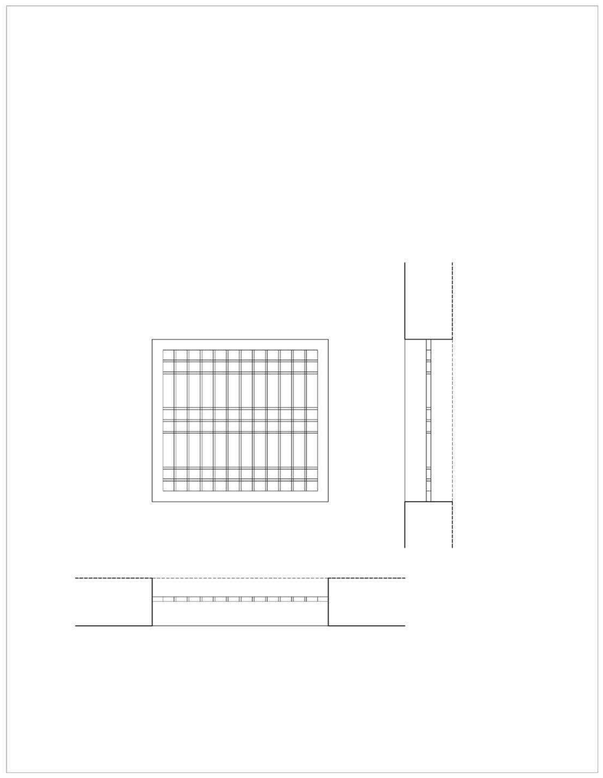
ELEMENT 4-1-R1 1:20



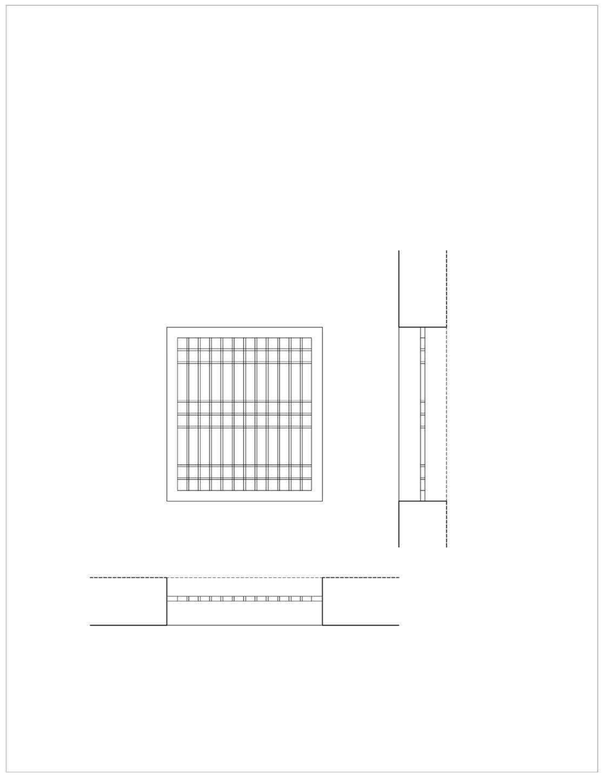
ELEMENT 4-1-L1 1:20



ELEMENT 4-2-R1/R2 1:20

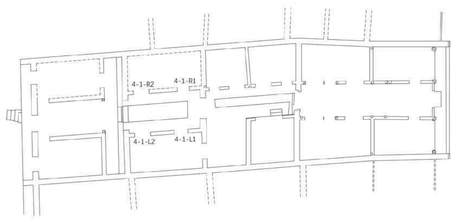


ELEMENT 4-2-L1 1:20

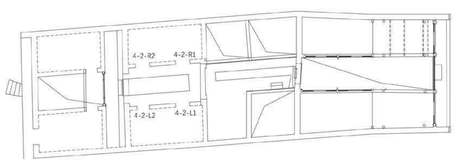


ELEMENT 4-2-L2 1:20

GROUND FLOOR ELEMENTS LOCATION

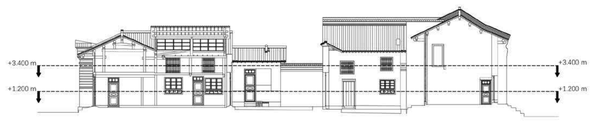


1ST FLOOR ELEMENTS LOCATION



SECTION B-B CUTTING HEIGHT

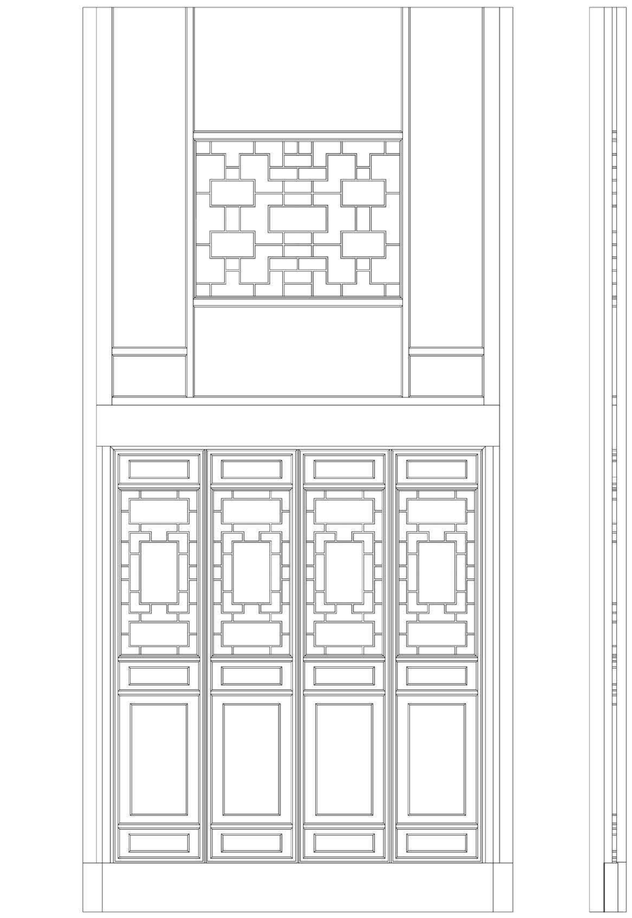
SECTION C-C CUTTING HEIGHT



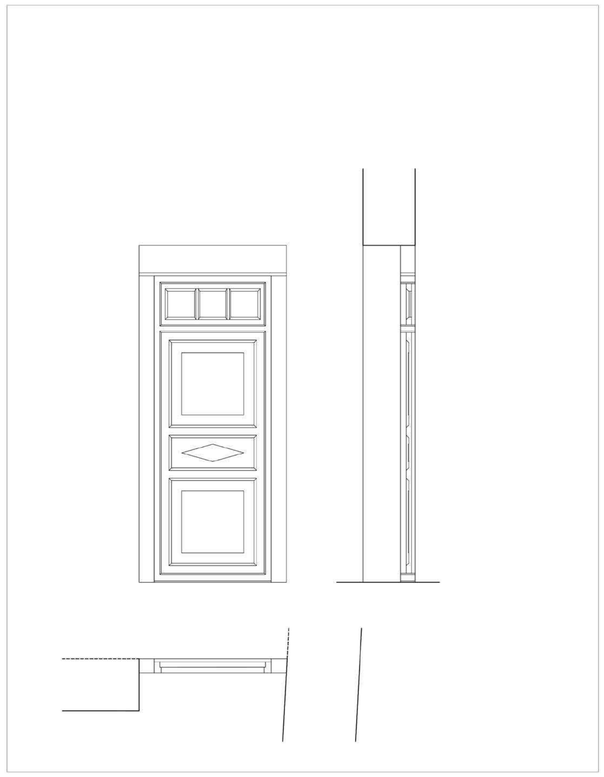
LEGEND

NOT MEASURED

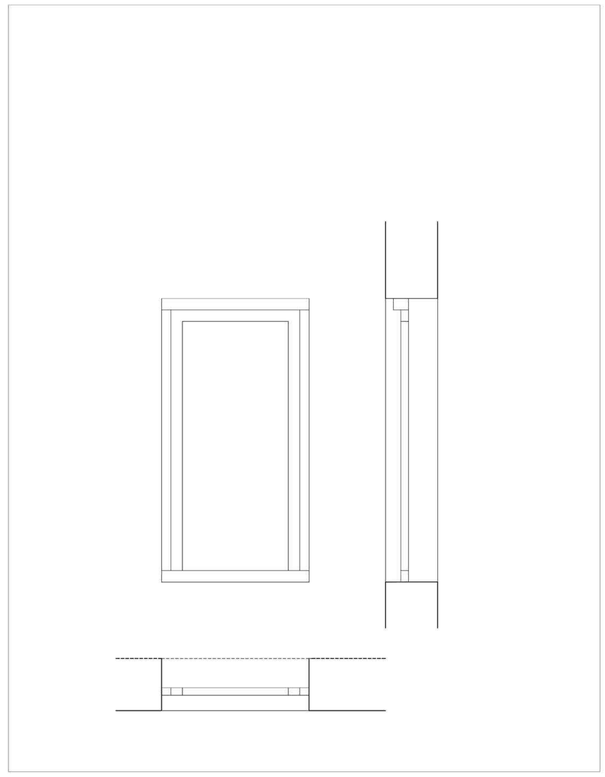
NOT MEASURED



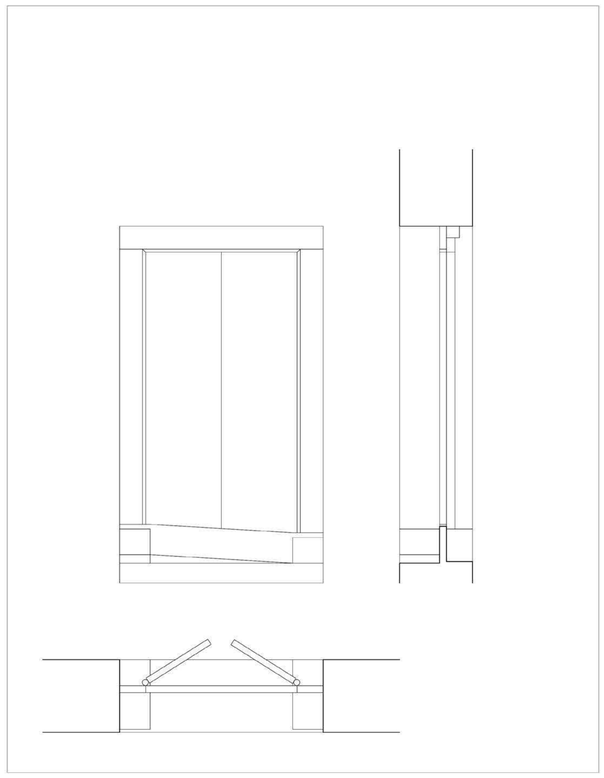
ELEMENT 5-1 1:20



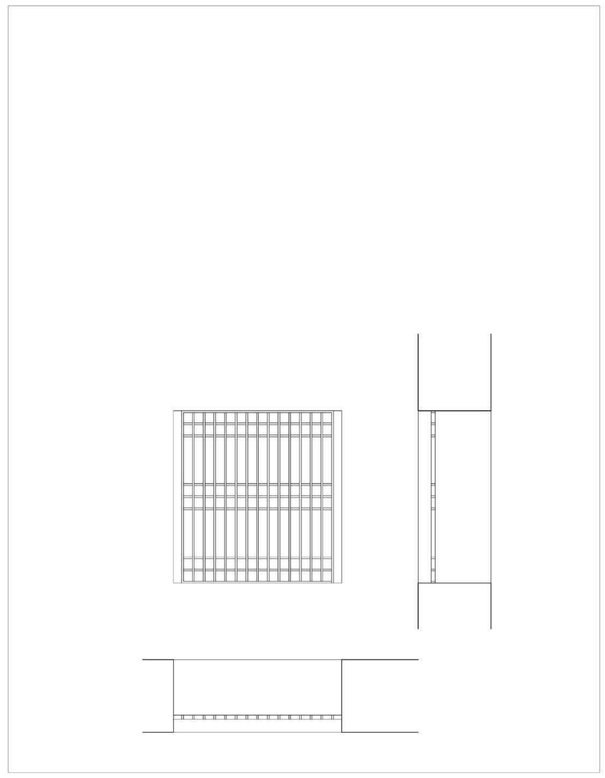
ELEMENT 5-1-R1 1:20



ELEMENT 5-1-L1 1:20

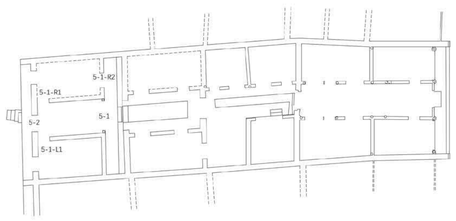


ELEMENT 5-2 1:20

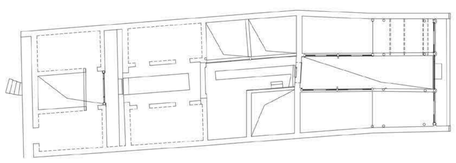


ELEMENT 5-1-R2 1:20

GROUND FLOOR ELEMENTS LOCATION

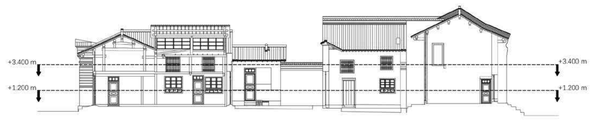


1ST FLOOR ELEMENTS LOCATION



SECTION B-B CUTTING HEIGHT

SECTION C-C CUTTING HEIGHT



LEGEND

NOT MEASURED

NOT MEASURED