

2019

17 B (Indian Institute of Technology, Bombay) structural audit declares the building unsafe to inhabit (collapse of the balcony)

2000

2005

1995

1960

1947

1920s

1869

1867-1869

1862

1858

1853

1845

1800

1687

1668

1534

1343

Rowan van der Poel & Gizem Batur

Watson Hotel purchased and converted into a hotel by the Esplanade Management.

In the state of Bombay, Maharashtra and Gujarat got split. Bombay became the new capital of Maharashtra.

Bombay independent from Britain.

Watson hotel bought by the TATAs and was used as housing for their workers and drivers.

Opening Suez Canal and opening Bombay to the rest of the world.

The old British fort walls had been brought down, freeing huge swaths of land in the heart of Bombay and sold in auction.

Control of Bombay passed back to the Crown.

First railway connection between Bombay and Tahne.

SEVEN ISLANDS TO MUMBAI CITY

The seven isles are merged into one single mass.

East Indian Company made Bombay their Indian headquarters and within a century it had become the gateway of India

King Charles II of England leased the isles to the East India Company and that's when the city was named Bombay

Porteguse seized the isles from Bahadur Shah of Gujarat and remained in their control until 1661.

The kingdom of Gujarat annexed the seven islands.

## BUILDING STATE

Mike de Jong

### Building state

The Watson's Hotel is part of an UNESCO group of monuments, labelled as a grade II-a heritage. The current state of the building is in poor taste, after the numerous cheap and temporary fixes. Parts of the building have collapsed, and much is to be deemed unusable. Some details are missing or damaged.

## STRUCTURE

Anahi Iparraguirre

### Structure

The stability of the building arises from portal frames which consists of the joining of columns and beams. The columns are joined by bolts and have brackets which hold the beams. Small beams are joined to the brackets by blind rivets. Also, strips of iron were attached to the flangs of the beams and were clasped on the brackets of the connecting column. Altogether, a stiff structure remains.

There are some insecurities about the structure caused by incomplete documentation. First of all, it is unknown how the foundation is built. Also, it is unknown how the big beams are connected to the columns. Over time adjustments have been made to enforce the strength of the structure. Among which, extra columns and a reinforced concrete roof. Despite these measurements the structure is currently about to collapse.

## CLIMATE & COMFORT

Anahi Iparraguirre  
Tijan Verkerk

### CLIMATE GRAPH // WEATHER BY MONTH MUMBAI

### Rising sea levels pose more threat to Mumbai New Projection for 2050

### Climate

In Mumbai reigns a monsoon climate. This climate consists of three seasons among which one with extreme rainfall. The temperature in Mumbai is constantly high with an average temperature between 24 and 30 °C. Every year the city floods because of the heavy rainfall.

It is expected that there will be an extreme uptake in rainfall in the future because of the three times increase in the last 30 years. The place where the hotel is at does not seem at risk at this moment.

The sea also has an influence on the city's water problems. Climate change causes the sea to arise, and cities are becoming below sea level. It is expected that parts of the city of Mumbai will be permanently under water by 21 if no measures are taken. At this moment, Watson's hotel is not at risk for permanent flooding, but it is for seasonal flooding. By 2050 there is an expected rise in sea level. The Watson's hotel is at risk of flooding at least once every year when the sea is at high tide.

## LOCATION ANALISTICS

Raquel Caldeira Marques  
Gizem Batur

## CONCLUSION

Gizem Batur

With over 40% of India's population being below the age of 20, the demand for higher education is on continual rise. Thus, there is a desperate need for quality, safe, and standardised accommodation in India. At least 45 percent of the students in Maharashtra are women, according to the survey. Maharashtra, which has the second highest number of colleges in the country, has a fairly large share of female students in its educational institutions, according to a survey by the All India Survey on Higher Education (AISHE) 2017-18. It is a benefit that Mumbai is one of the safest cities in India when it comes to women. Relative to other cities, it's fairly common for women to go home alone late at night after work, dinner, a meeting or a party. Day or night, women often safely travel alone in Mumbai.

### Comfort Anahi Iparraguirre

Measures to minimize heat gain have been applied in the building design of the Esplanade Hotel. This includes the high ceilings on each level combined with the natural ventilation openings between the partition walls. Both measurements are regularly applied in tropical climates. High ceilings help the building minimize heat because hot air goes up and is able to escape through the ventilation openings. Because of this people are not in the middle of the hot air and thus do not suffer from the heat. The ventilation openings in the partition walls in the Esplanade hotel are 18 inch (45,72 cm). Despite it being helpful with minimizing heat gain there were complaints about the noise that came through the gaps and the view people had inside the room from the stairs. Not only does the airflow help with regulating heat but it also decreases the extreme humidity rate (~80%) during the monsoon season.

### Nuisance by ventilation openings

### Meet The Group

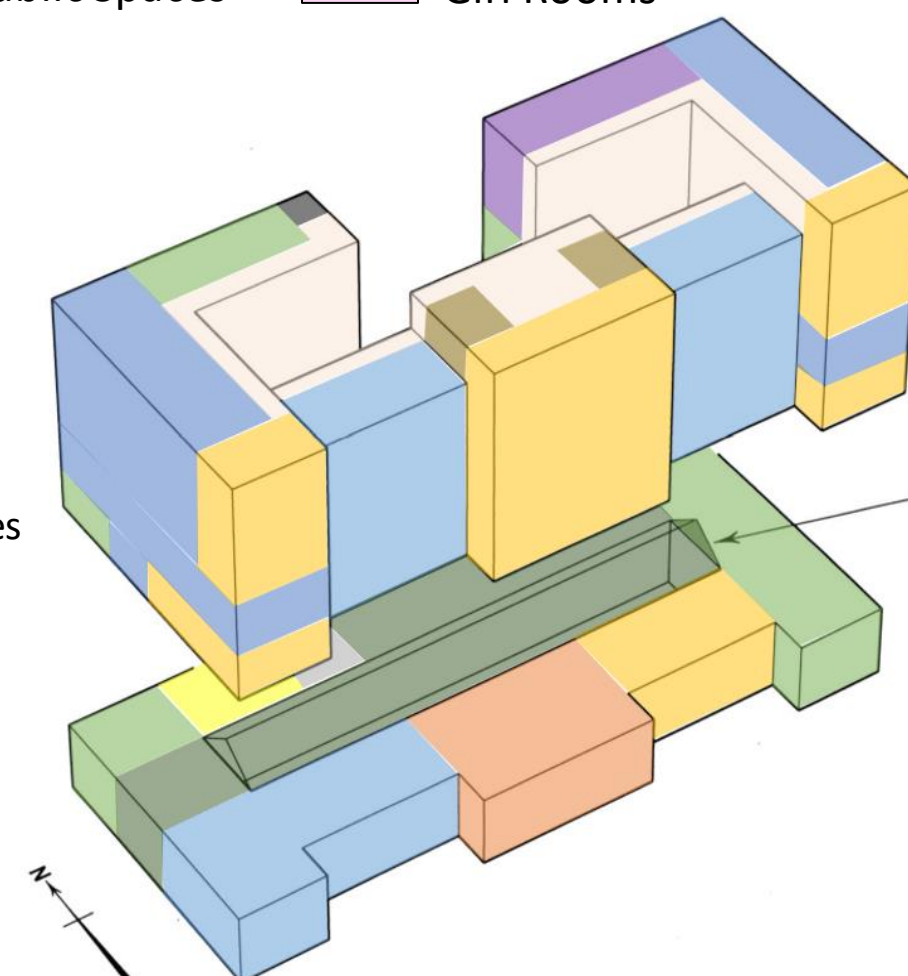
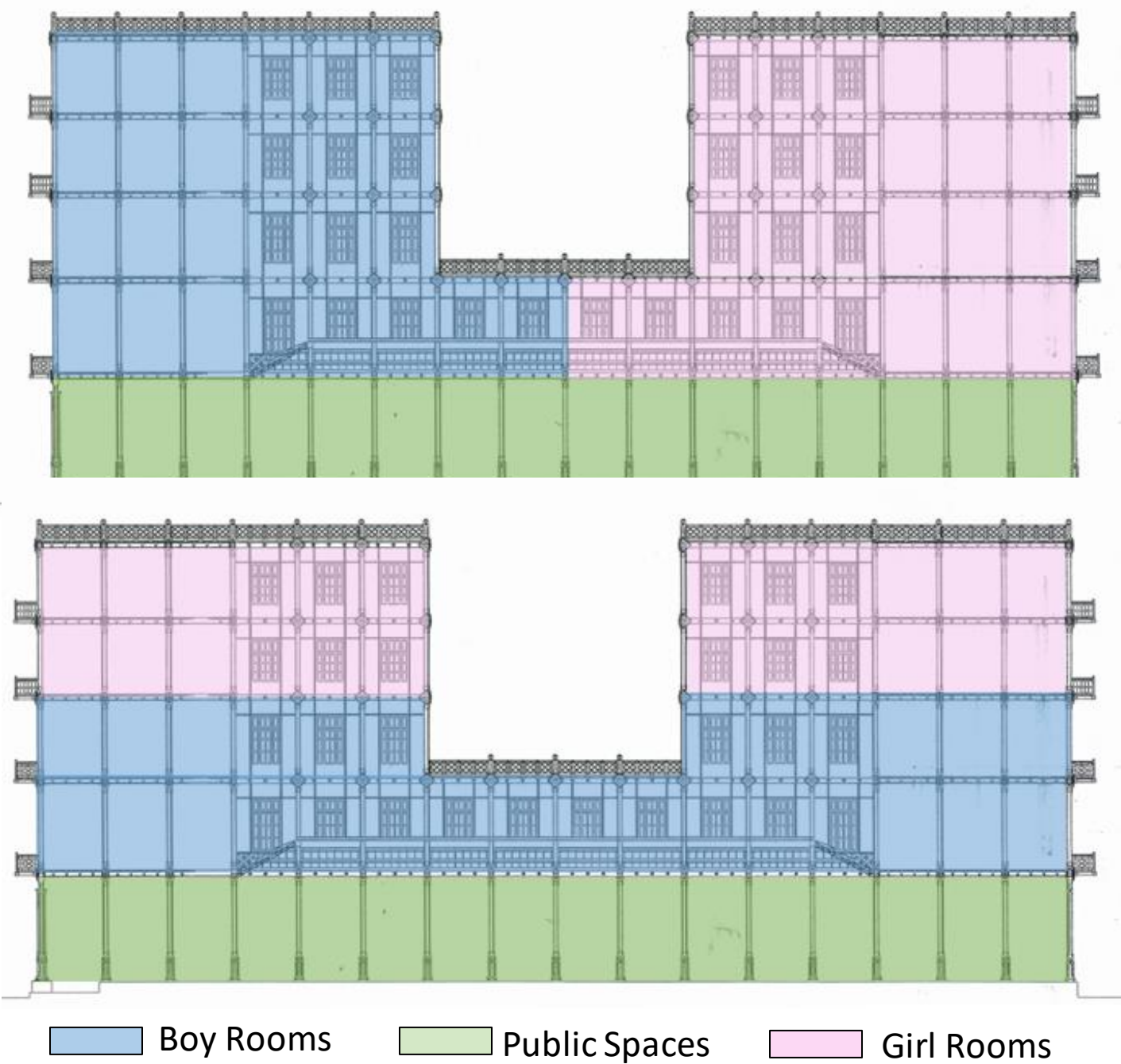


# THE WATSON'S HOTEL IN MUMBAI

## CONCEPT

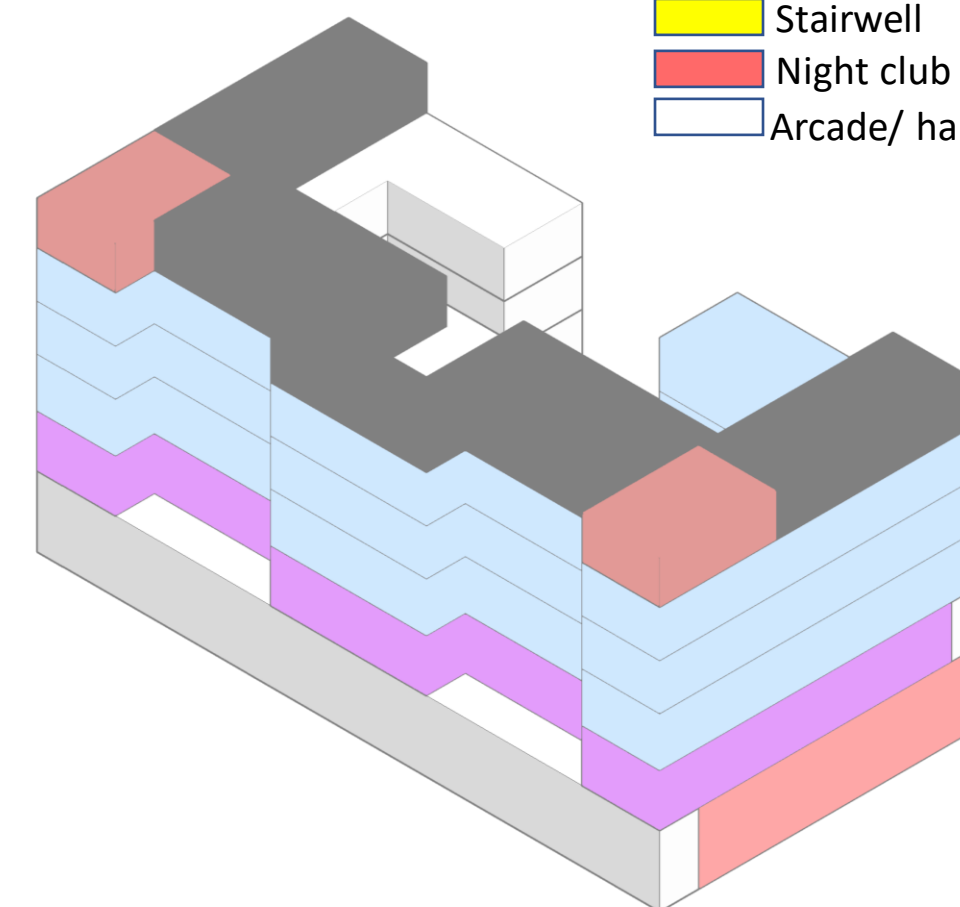
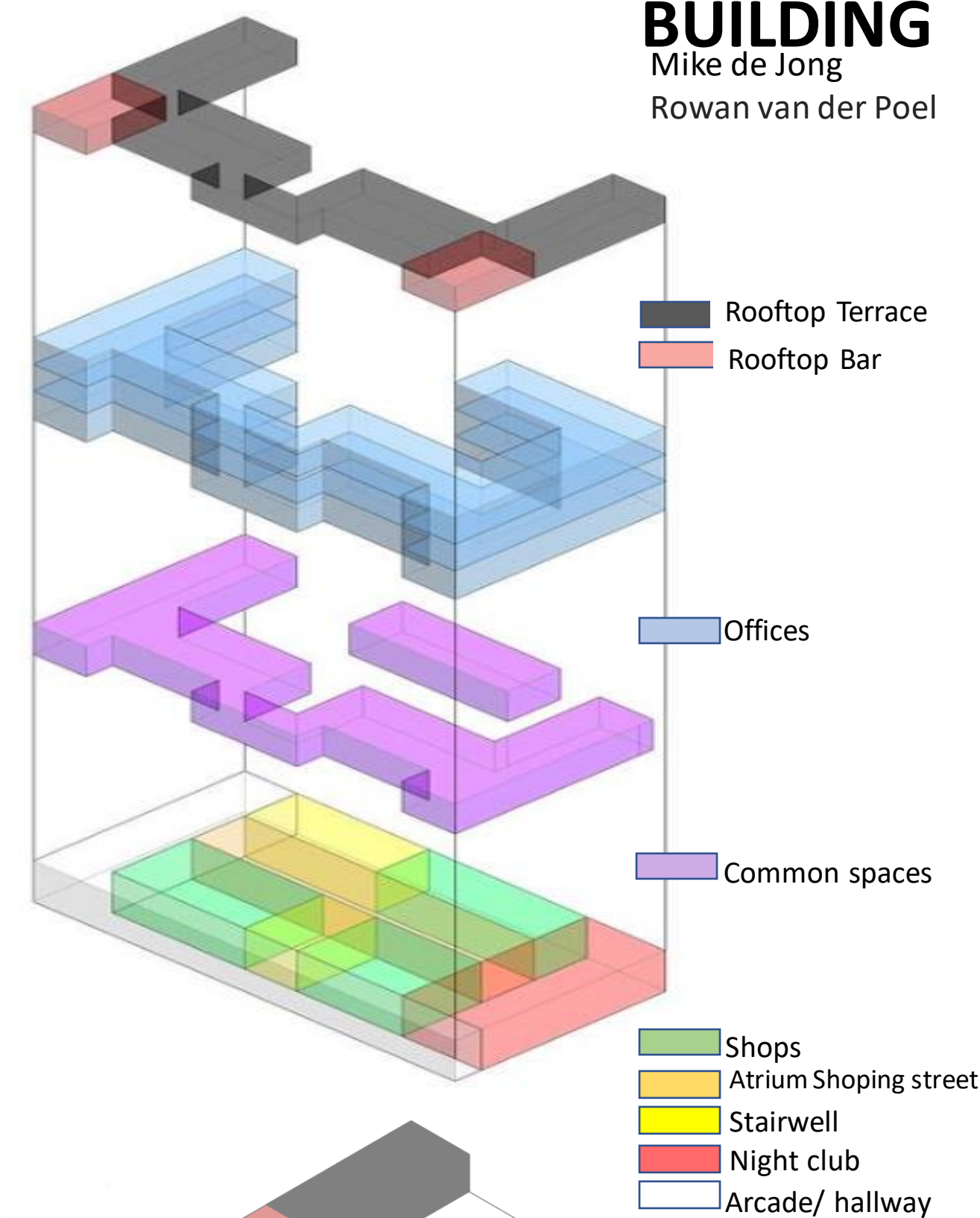
### VARIANT 1: STUDENT HOUSING

Raquel Caldeira Marques  
Gizem Batur



### VARIANT 2: OFFICE BUILDING

Mike de Jong  
Rowan van der Poel



## MATERIALS

Gizem Batur  
Raquel Caldeira Marques

### Facade



#### Option 1:

The existing facade is made of brickwork. The first option would be to restore the existing bricks and reuse them on the facade. If desired to make the construction of the facade easier, stone strips can be applied. This is less traditional in Mumbai, but because the port is nearby, it would be easy to import and cheaper when bought in bulk.

#### Option 2:

The second option would keep the colours of the building but change the materials. Materials like stone can be applied, which would give a luxurious appearance, but also keep the building cool.

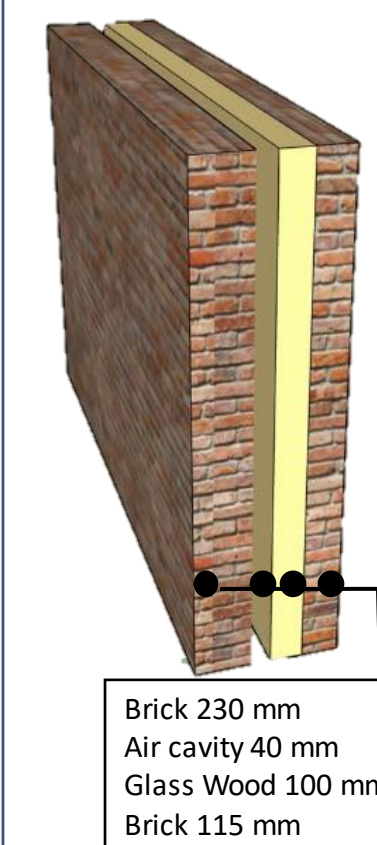
### Flooring

Engineered wood flooring is made of a high-quality plywood core with a thin layer of hardwood flooring on top. Because it's made in layers, engineered wood flooring has a good stability, which means it's less prone to shrinking or warping. It is fire-resistant and a good choice in high-moisture environments, but the floor can be damaged if water is allowed to soak into it.

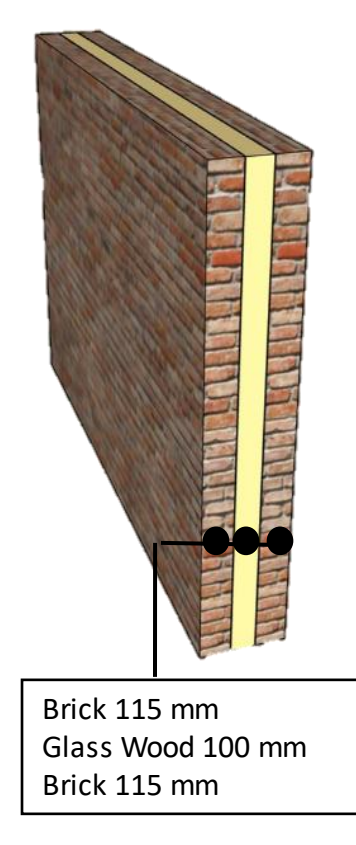


Sandstone is a natural choice for flooring. It is one of the most used kind of flooring in India. Due to its durability, many choose this type of tile, especially in high-trafficked areas. Also, sandstone is resistant to fire and heat. Under fire it emits no smoke or toxic substances. As sandstone is a natural material, it is more expensive than concrete.

### Outside wall



### Dividing wall

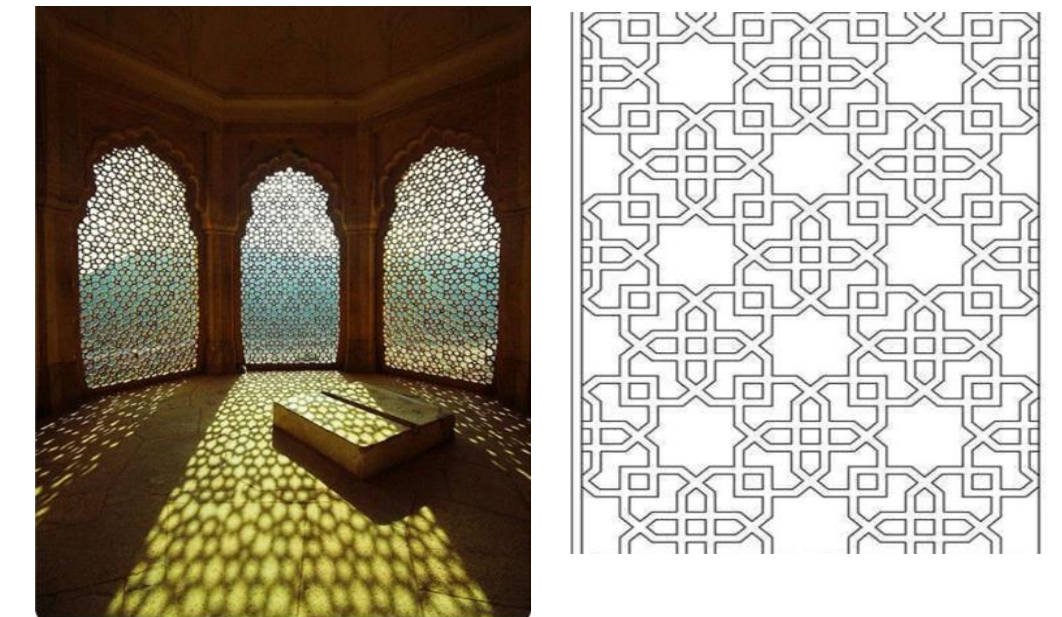


### Conclusion

For the concept of the building, we choose to apprehend variant 1, but for the layout we choose to combine the 2 variations, because we want to make the building a welcoming place for everyone on the ground floor.

We decided to choose the stone strips as the facade for the building, because this is less expensive and less heavy than natural stone. Also, it is already used in the original model. For the flooring we choose engineered wood flooring. We choose this because of the light weight and the fire-resistance. It is also a good choice in high-moisture environments, so it fits well in Mumbai. Because of the heavy rainfall in India, we must consider that the wood can be damaged. We prevent that with varnishing the wood. We changed the walls after feedback from students from India.

## REFERENCE



We used this design above the window frames on the ground floor. We used this because it adds character to the building, and it gives a nice shadow inside. Also, it doesn't let in much sunlight as windows does.

We used the slats near the window frames against sunlight/heat. It also muffles sound.

### Mechanical ventilation

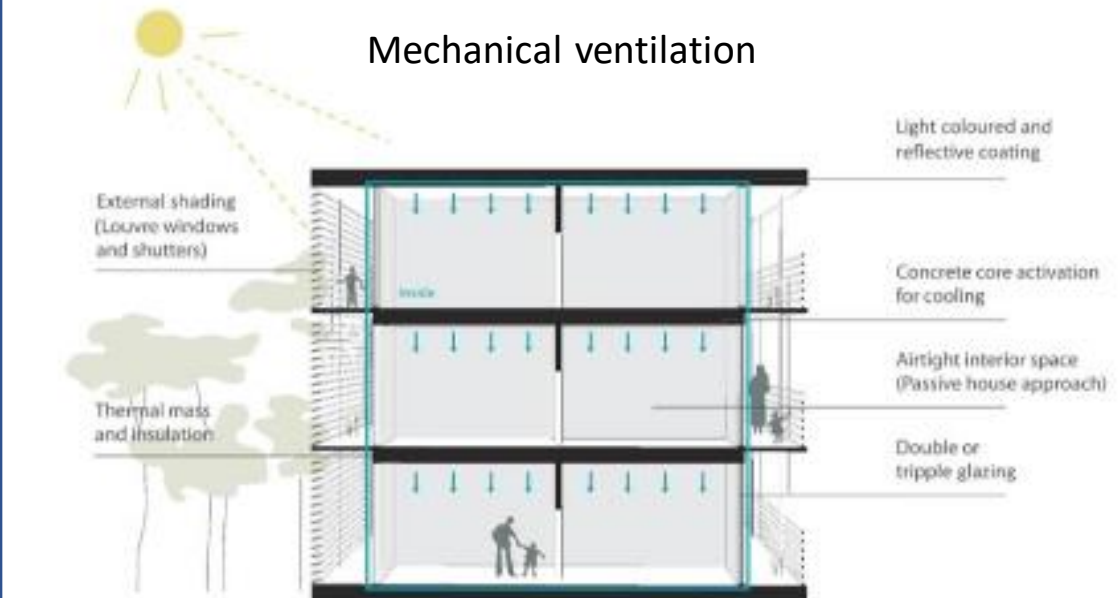


Figure 6: Closed building type in hot humid climate (Source: PEB, 2019)

### Cross ventilation



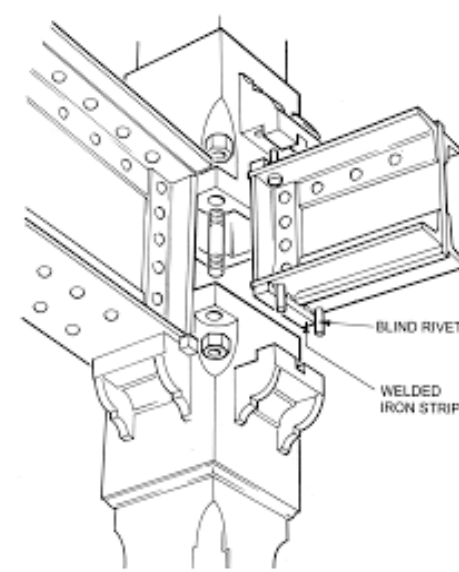
Figure 5: Open building type in hot humid climate (Source: PEB, 2019)

## CONSTRUCTION

Tijan Verkerk

#### Variant 1:

The construction will be completely restored to its former state, thus maintaining the original look. By means of sandblasting we will remove the superficial rust, which will then be coated and painted. The places with irreparable corrosion will be repaired by applying other steel profiles or will be repaired with local welding. When everything is repaired it will be coated, for decades of protection.



#### Variant 2:

Another option for the construction is to partially take over the steel construction. The first floor including the pillars on the outside will be restored. From the second floor we will work with timber frame construction, which will take over the forces of the steel construction. This is a durable and lightweight construction. It is resistant to moisture and easy to assemble in the current situation.



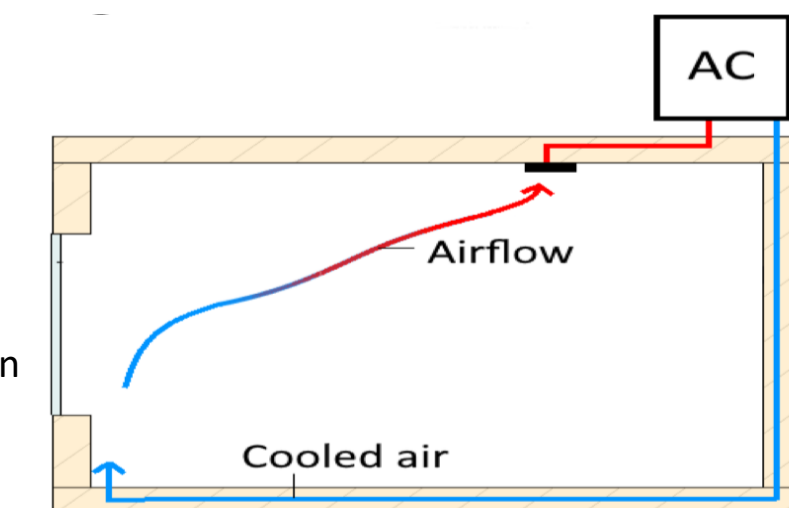
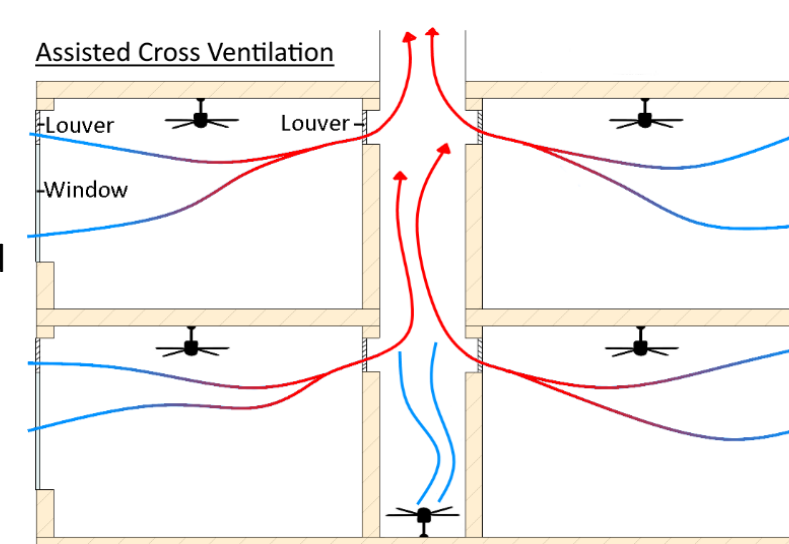
## BUILDING PHYSICS

Anahi Iparraguirre

### Ventilation

One of the options is assisted cross ventilation in combination with ceiling fans. Wind comes in through windows and louvers and goes out through a louver into a shaft. A single fan per shaft is needed to force the outgoing airflow outside, making it an energy efficient way of ventilating.

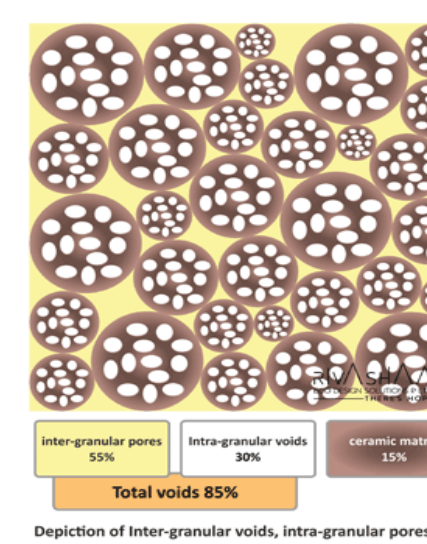
The other option is a completely mechanical ventilation system. This option adds the most comfort but is not energy sufficient and relatively expensive. If this option is chosen it is necessary to use thermal insulation to keep the indoor temperature as controlled as possible.



### Insulation

Glass wool is an ideal insulation in hot-humid climates. It is a sustainable thermal insulation made of sand and has a low energy fabricating progress. The plus side is that it absorbs no moisture, nor does it deteriorate from it and is fireproof. The downside is that hazardous substances are released during the fabricating progress.

Another interesting option is Expanded Clay Aggregate. This product is produced in India and made by firing clay at 1200 °C. It results in hard round spheres with a size from 0-30 mm. This form of insulation is a good choice for the roof as it can be mixed with binders to make it sturdy enough to walk on.



Rules for life and fire safety are included in the NBC volume 1, part 4. The regulations differ per occupancy and include requirements for openings, lamination, number of exits etc. A more general rule is that all floors have to be zoned in compartments which have a fire resistance of 120 min between each other.

## CONCLUSION

### Construction

For the construction of the building, we choose to restore the construction to the original state, so variant 1. We remove the rust of the columns, which will then be coated and painted. We choose for this variant, because we wanted to keep the building as similar as possible, and the structure is an important and defining part of this. Also, this is much more simple and cheaper.

### Building physics

For the ventilation we choose to combine the cross ventilation and mechanical ventilation. We combine it because mechanical ventilation is too expensive to apply over the entire building and it is not energy sufficient. For the restaurant, shops and the common spaces however, it is a necessity. We also use cross ventilation, because it is very energy efficient, and it costs much less than mechanical ventilation. Also, it is healthier, and it is enough for the students to live with. So, for the ground and first floor we use mechanical ventilation and the other floors we use cross ventilation.

### Insulation

For the insulation we make use of glass wool for the wall, floor and roof construction, because it is a sustainable thermal insulation. It absorbs no moisture, nor does it deteriorate from it and is fireproof. For a country with a monsoon climate, this really fits well within the building. It has also a good acoustic function. We also use expanded clay aggregate for the roof, because we have a terraces and this insulation makes the roof sturdy enough to walk on.



# THE WATSON'S HOTEL IN MUMBAI

## RENDERS

Raquel Caldeira Marques



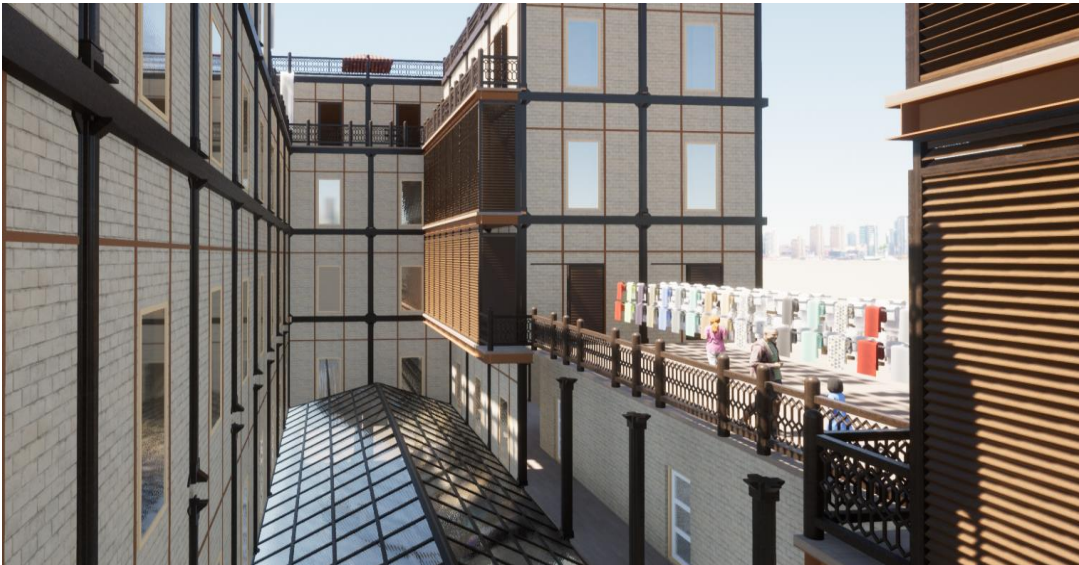
Facade made with natural tones to respect the environment and the trends in Mumbai



Cafe- Restaurant & bar for the office workers in the area and the public and the students



Two Communal Kitchens in each level for the girls and the boys



Terrace can be used as a place to dry the students clothes or as a communal meeting place



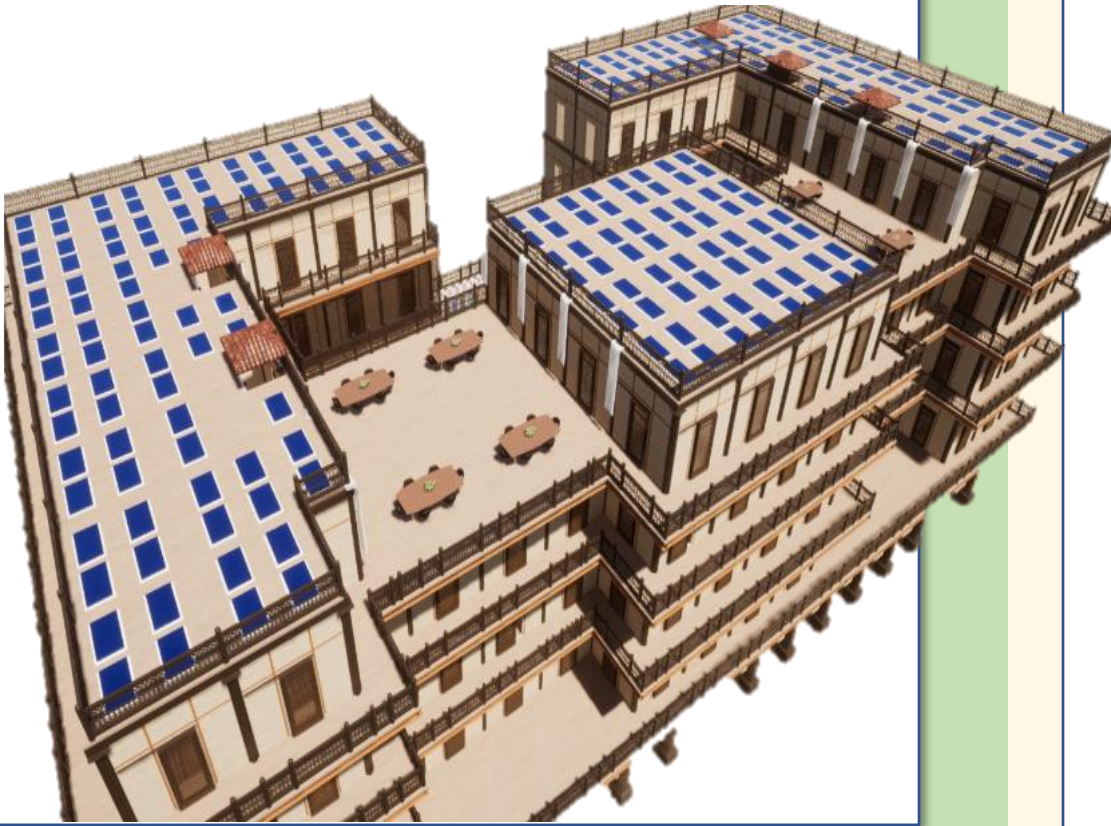
Atrium is an open space with stores and shops and connects to the first floor with three stairwells



Rooms are divided by gender and shared with a maximum of 4 people to lower the rent cost

We investigated the most used colours for buildings in Mumbai and the colours that we saw were beige, red, yellow (orange) and brown. Because we wanted the building to fit in its surroundings and for it to keep its historical value. We chose beige, brown and a darker orange.

On the roof we made a communal area that can easily be stored away on rainy days or put in the shade on hot days. We also make use of solar panels.



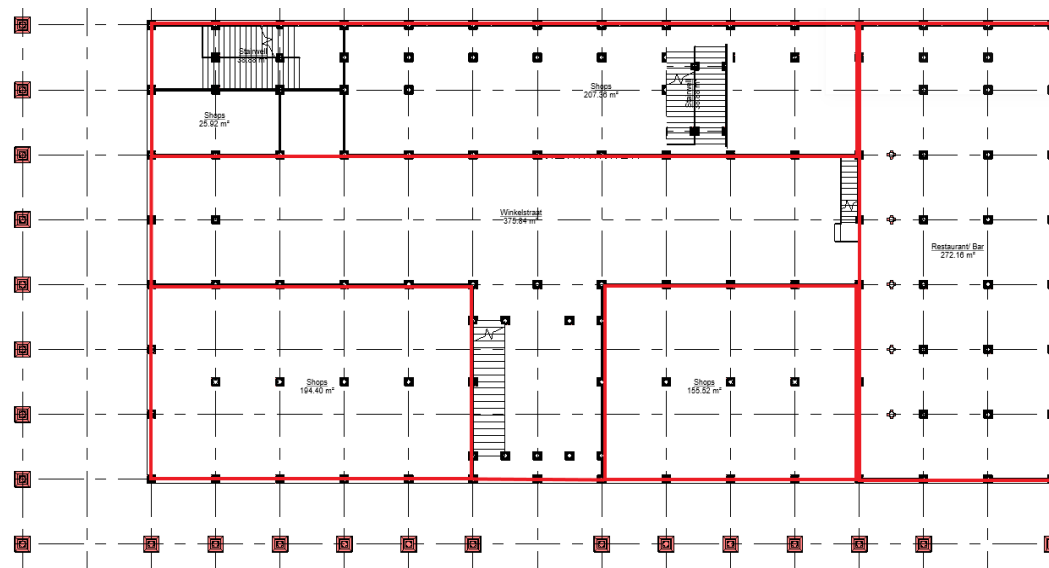
## FLOOR PLAN

Mike de Jong & Gizem Batur

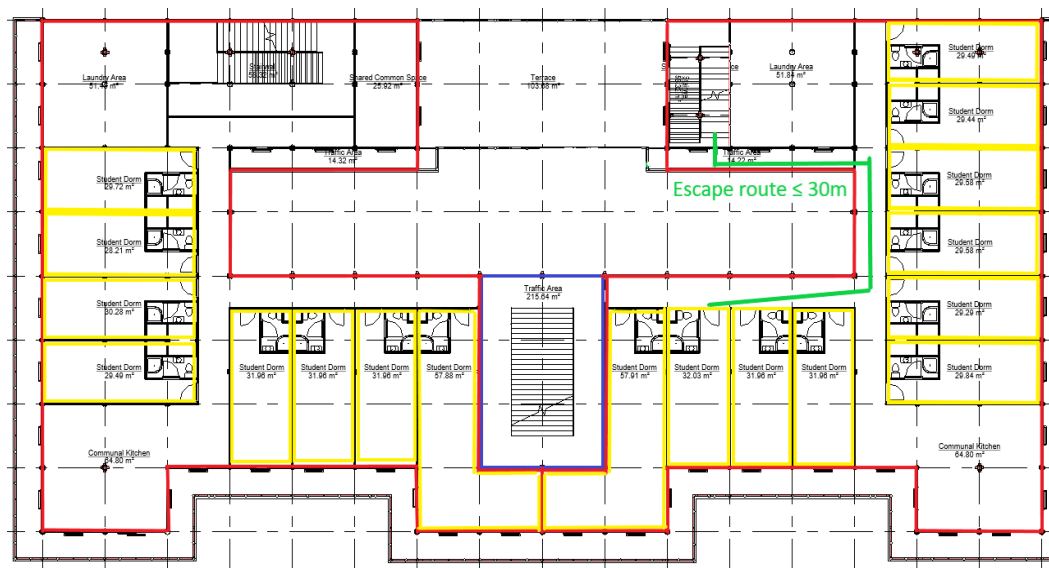


## FIRE COMPARTMENT

Rowan van der Poel



Ground Floor  
= fire compartment



Mazzanine Floors  
= fire compartment  
= protected Subfire compartment  
= Extra protected escape route

- Fire measures (Anahi)
- Non-flammable insulation
  - Panels with 120 minutes fire resistance
  - Door closers
  - Fire resistant doors of at least 120 minutes
  - Sprinkler system on the first two floors
  - Intumescent coat on the indoor steel structure.
  - Smoke detectors in every room and communal kitchen
  - + other measures (NBC)

## COMFORT

Anahi Iparraguirre

Two different ventilation system are applied in our building design. We chose to do this because there are very different needs for ventilation in the public spaces and the student dorms.

From the third floor up there is assisted cross ventilation. Also, every student dorm has a ceiling fan of its own. As a result of these two measures there is always a wind flow regardless of the wind strength.

These measures are not applied on the ground, instead there is a natural air supply through louvers in the façade and a mechanical output. We chose to apply this because the air shafts for assisted ventilation are big and limit the freedom of layout. Also, it is expected that these lower floors are more crowded, so a more controlled environment is preferable.



It is also possible to apply assisted cross ventilation on the commercial floors without decreasing the freedom of layout too much. This can be done by extending the ventilation shafts until about half a meter under the first floor.

This is possible but it must be considered that the shafts may form an obstacle for the stairs and extra support might for the hanging shaft on the ground floor might be needed.

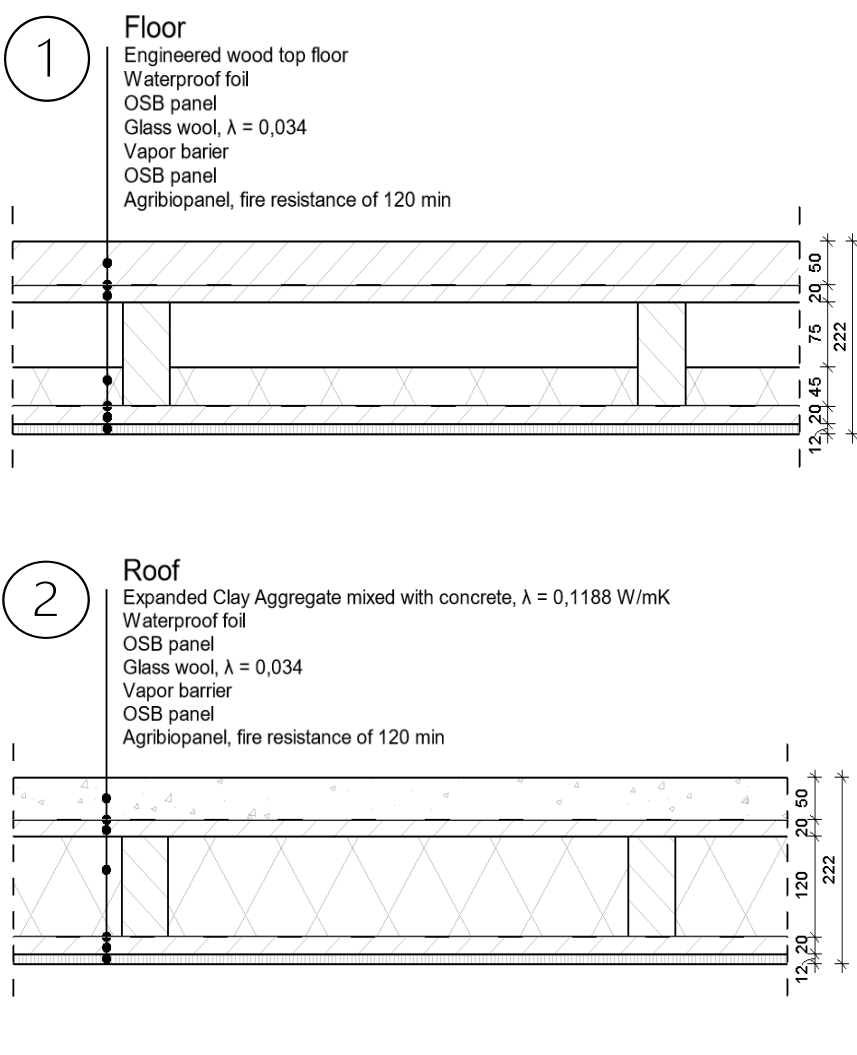
## DETAILS

Anahi Iparraguirre

In every detail an AgriBioPanel is applied. This panel is an innovative, sustainable alternative for construction boards. It comes in 3 different grades and varied thickness. It is made from 90% straw and 10% binders and comes in 3 grades in varying thickness. Also, it is designed and produced by an Indian company. Because some of the panels are not sensitive to moisture and vapor it is an excellent choice for the hot-humid climate Mumbai has.

The floor consist of a wood construction which is laid on steel beams. It is soundproofed with glass wool. Although glass wool is water resistant it is sensitive to vapor. Because of this a vapor barrier must be applied.

The roof also has a wood construction but has a higher thermal insulation standard because this is advised in the ECBC Residential. The total roof has a U-value < 1,2 W/mK. The insulation consists of glass wool and expanded clay aggregate on top.



The function of the partition wall is to provide sound isolation between rooms and ensure fire resistance. This is provided by the thin layer of glass wool and the AgriBioPanel.

The façade wall is designed to ensure fire resistance and soundproofing. This is done by applying glass wool and the AgriBioPanel. The needed thickness of insulation should be included in further research. Because the building needs soundproofing but not necessarily needs a lot of thermal insulation because of the chosen ventilation system. The hollow brick is placed between the structure. The rest of the build-up is located on the interior side, when applying there must be taken care of interruptions in the isolation. This might be a concern because of the structure.

## BUILDING LOGISTICS

Tijan Verkerk

The building is located in a crowded area, this creates limited storage space around the building and causes difficulties for loading and unloading of the commodities. Several adjustments are needed that require various solutions in logistics.

The steel construction will be returned in its original state. If possible, some local restorations will be made and in the case of severe corrosion new steel profiles will be placed. By means of a construction hoist these new steel profiles will be transported to the preferred floor, further transportation and installation will be conducted by manpower. (The profiles will be around 400 kg so manpower is possible)  
The same procedure will be followed for the bricks.

For the vertical transportation two construction hoists will be present. Horizontal transportation will be conducted using wheelbarrows, forklift and a pump truck. As well as around the entire building and within the atrium a scaffolding will be placed, the scaffolding within the atrium will be removed when the glass and windows are replaced.

Trucks can drive across the adjacent road and unload their commodities on the side of the road with some fences for safety.

