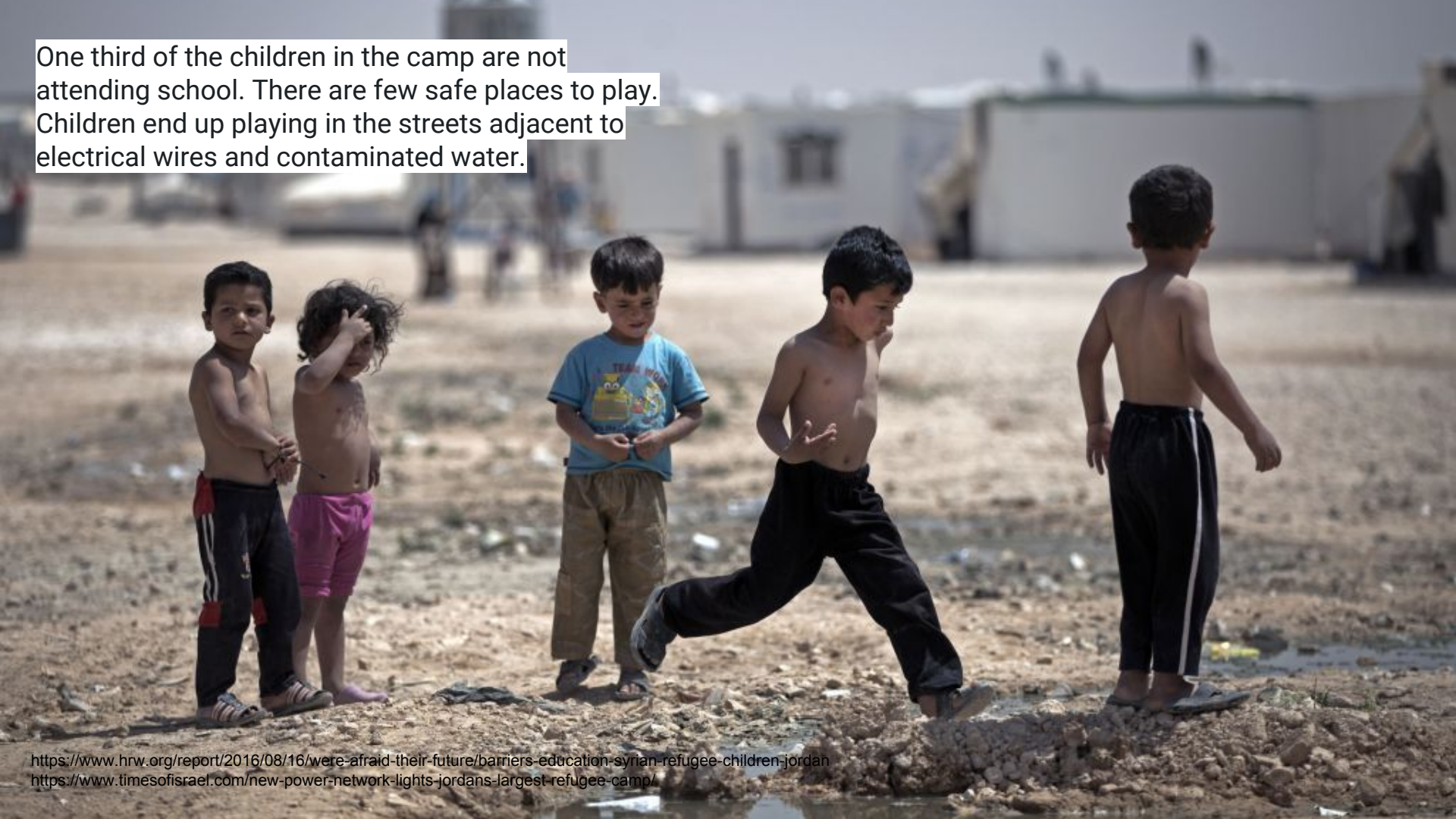
TEAM A | Communal Housing

Gautam Tanwar, Idil Gumruk, Felix van der Weijst, Ujjwal Dawar and Hayley Bouza

Defining the Problem

“The consequences of family separation are significant, and in addition to financial burdens, expose refugees to serious protection risks, including harsh child labour, broken social networks, parenting challenges, and changes to familial roles. Furthermore, decades of research connect damaged social networks to poor physical and mental health.” http://testsite.jordaningoforum.org/wp-content/uploads/FMRsyria2018.pdf



One third of the children in the camp are not attending school. There are few safe places to play. Children end up playing in the streets adjacent to electrical wires and contaminated water.

https://www.hrw.org/report/2016/08/16/were-afraid-their-future/barriers-education-syrian-refugee-children-jordan
https://www.timesofisrael.com/new-power-network-lights-jordans-largest-refugee-camp/

Inadequate infrastructure has led to stormwater and wastewater accumulating along roadsides and adjacent to dwellings.


There is an abrupt transition from private to public zones in the camp.
https://learningenglish.voanews.com/a/refugee-camp-in-jordan-is-biggest-in-middle-east/2902262.html
Reuters

Learning from Refugee Solutions


Families group caravans and tents together to form private family units. Tarpaulins and tents are used to create private outdoor spaces.
http://time.com/4063674/zaatari-camps-empty-syria/


Families continue to follow their culture and traditions as much as possible. Many eat lunch together and chip in to prepare the meals.
https://www.sbs.com.au/topics/life/culture/explainer/what-life-really-women-inside-zaatari-refugee-camp

Refugees have planted gardens and trees. Vegetation is a reminder of home and vegetable gardens provide additional sustenance.

https://www.wfpusa.org/articles/secret-gardens-syrian-refugee-camps/

Project Focus:

Social Problems

- Broken social networks
- Poor living conditions for children
- Inadequate safety and privacy

Infrastructural Problems

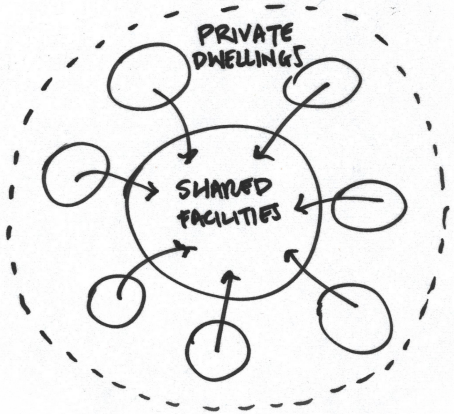
- Stormwater and wastewater is not adequately managed

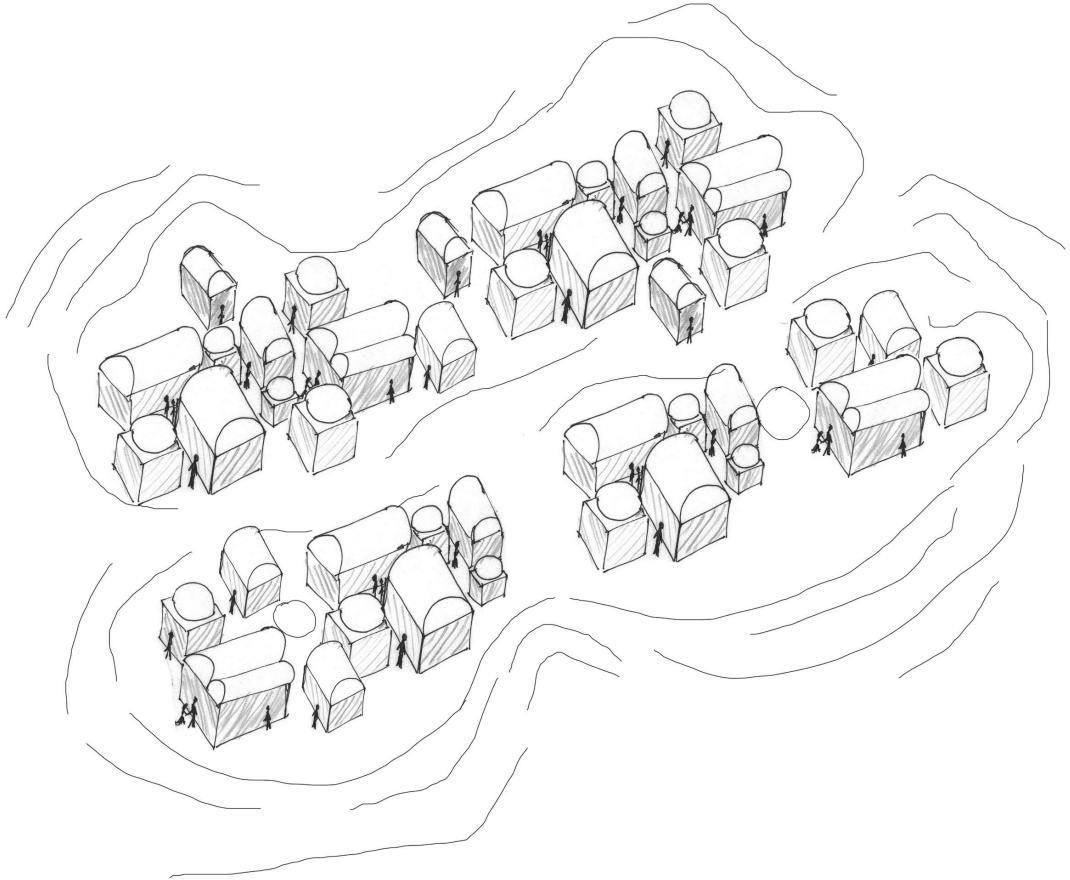
Solutions

- Communal housing with shared facilities for families in need of extra support
- Provide space for single parents to work at home while caring for children
- Create safe indoor and outdoor play areas for children within the home
- Elevate earthen housing structures to avoid deterioration from water and to increase privacy from street level
- Include planted swales and retention basins in the surrounding landscape to absorb wastewater and stormwater

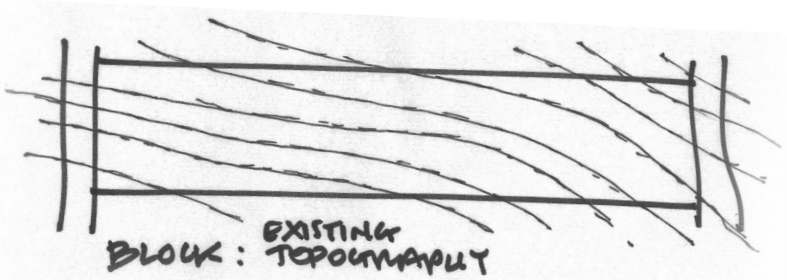
Form Strategy

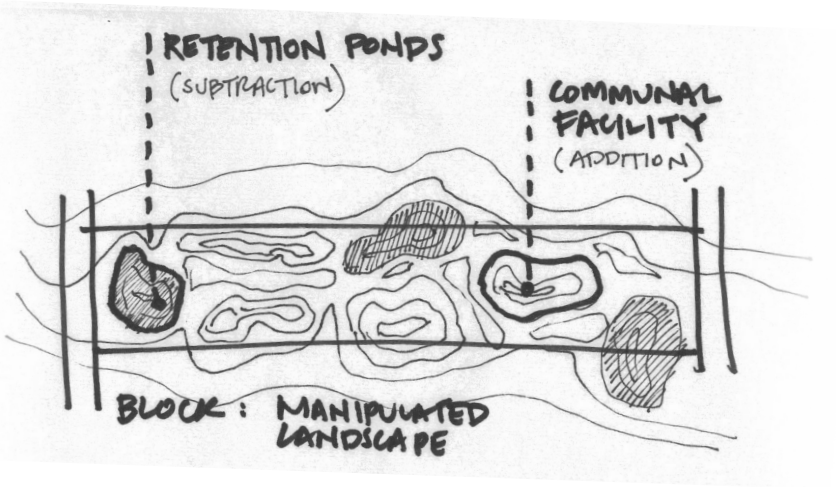
The communal housing is composed of shared facilities on the ground floor, with private dwellings placed above

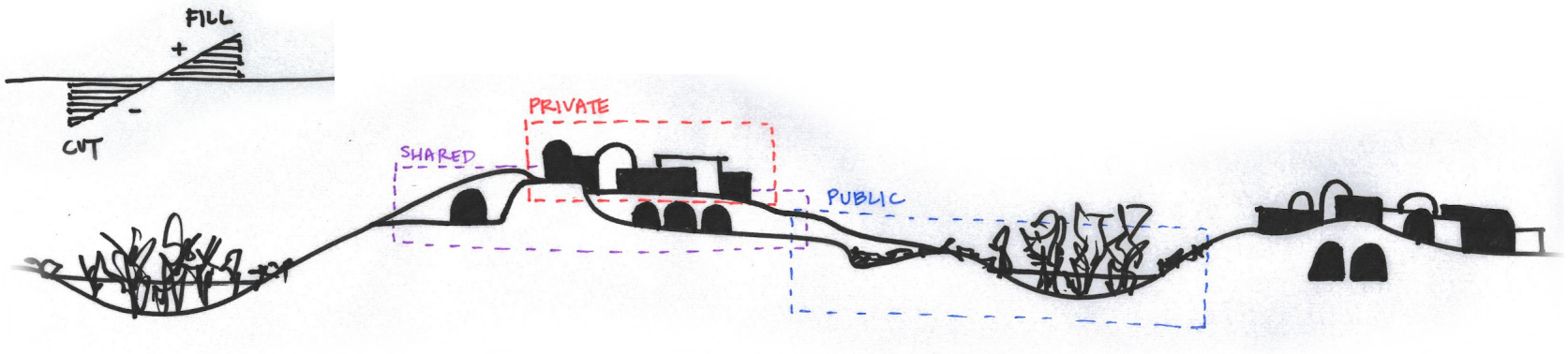




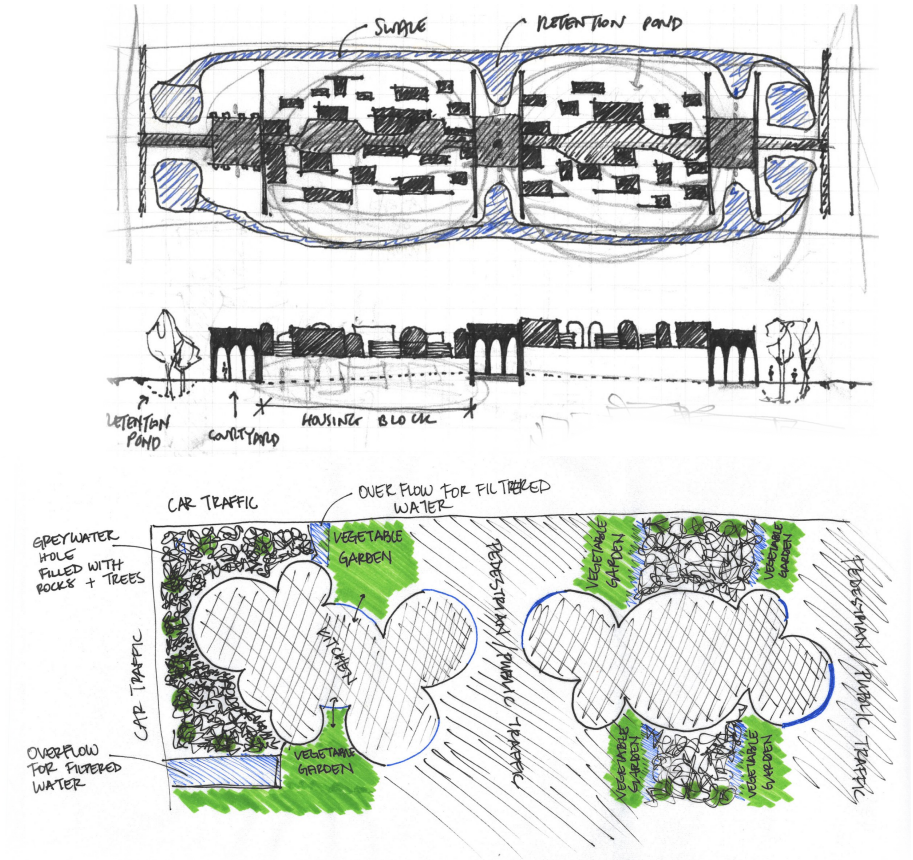
The topography of the site is manipulated to create elevated private zones (dwellings) and to manage stormwater on the site







The landscape around the site includes swales, retention ponds, and greywater gardens



Landscape Diagrams

Grey water hole is filled with gravel.

- An overflow is made where the filtered water flows after it is overuse.

Trees are planted on top of the gravel bed.

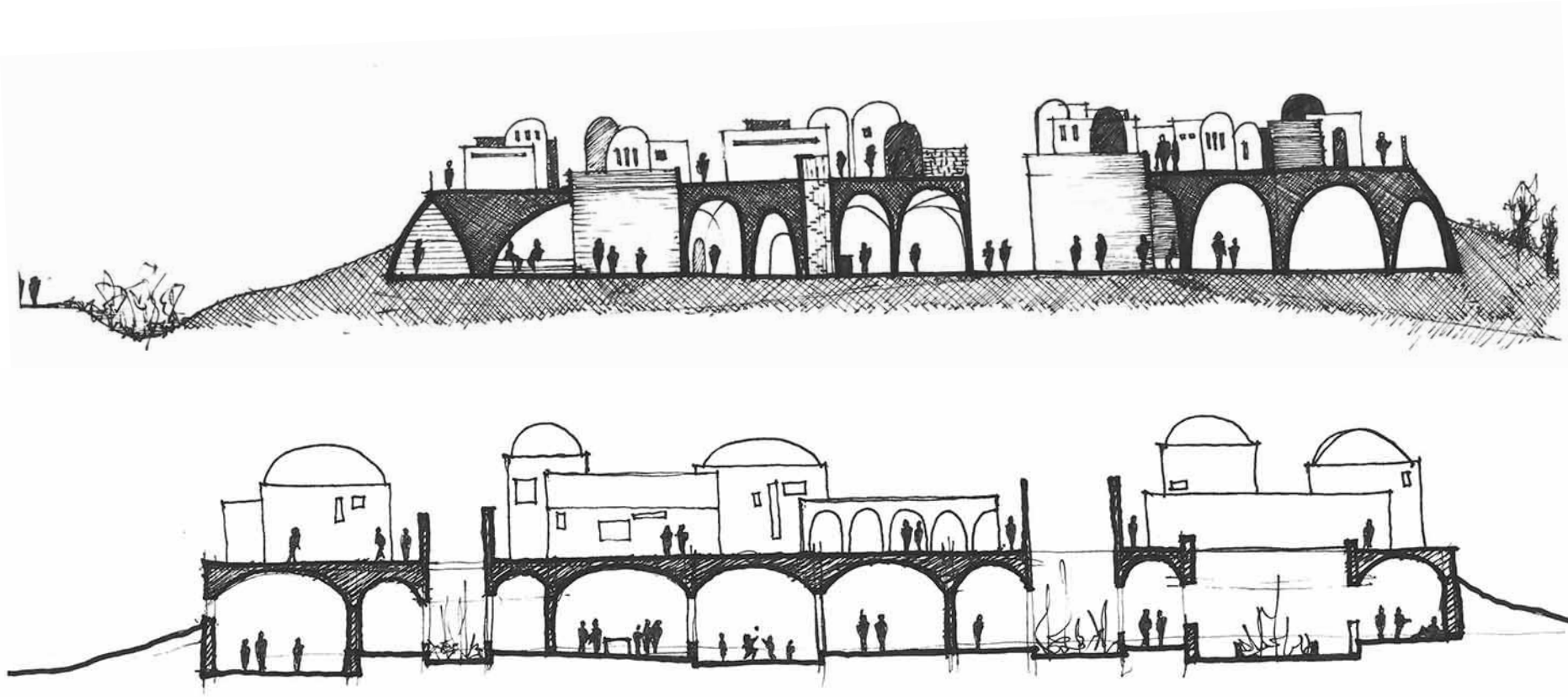
- The trees suck up the polluted water for irrigation purposes.

Vegetable garden.

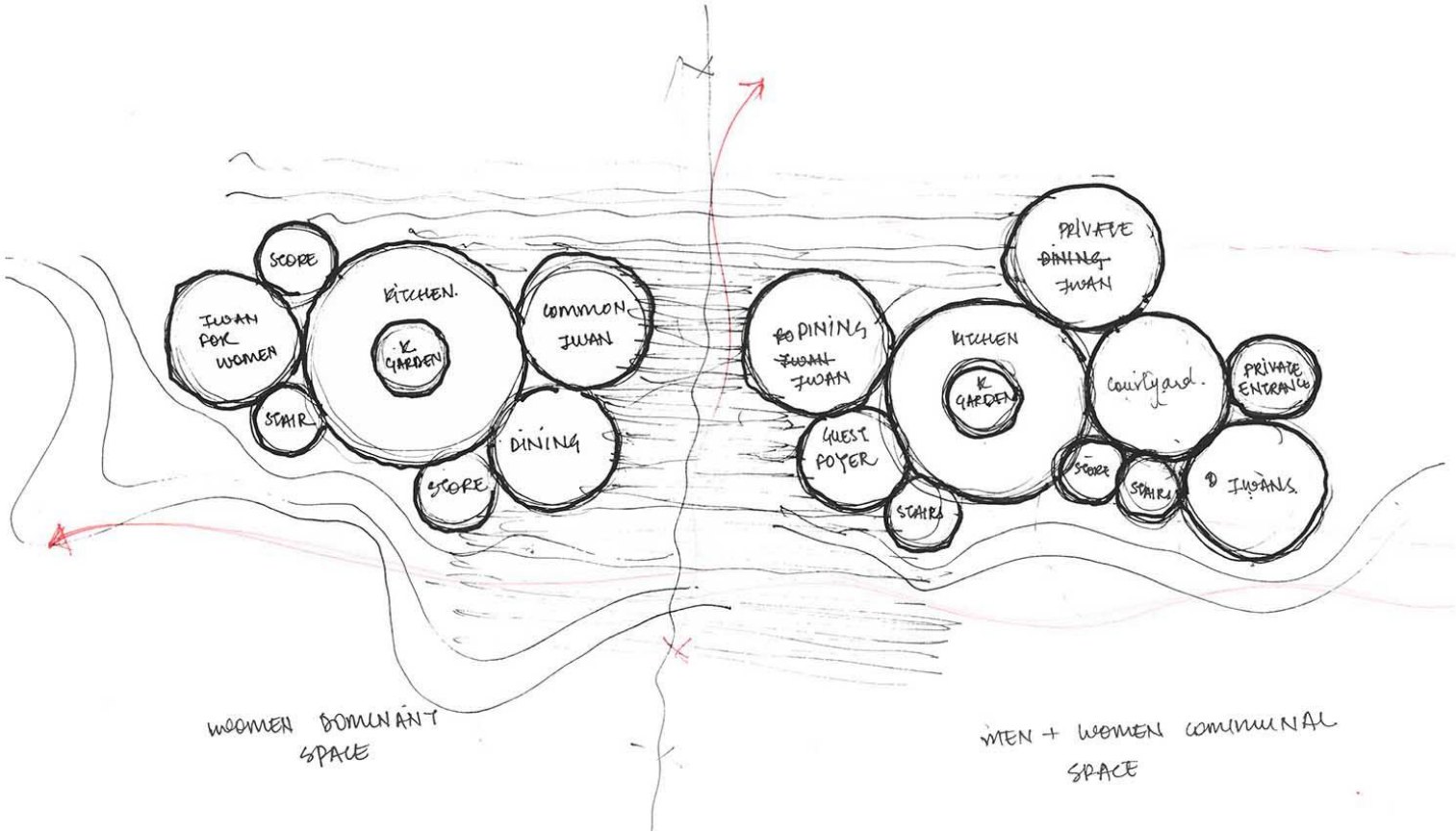
- The overflow delivers filtered water that can be used for veg etable gardens.

Image: Rightful Landscape, Robert Kruijt

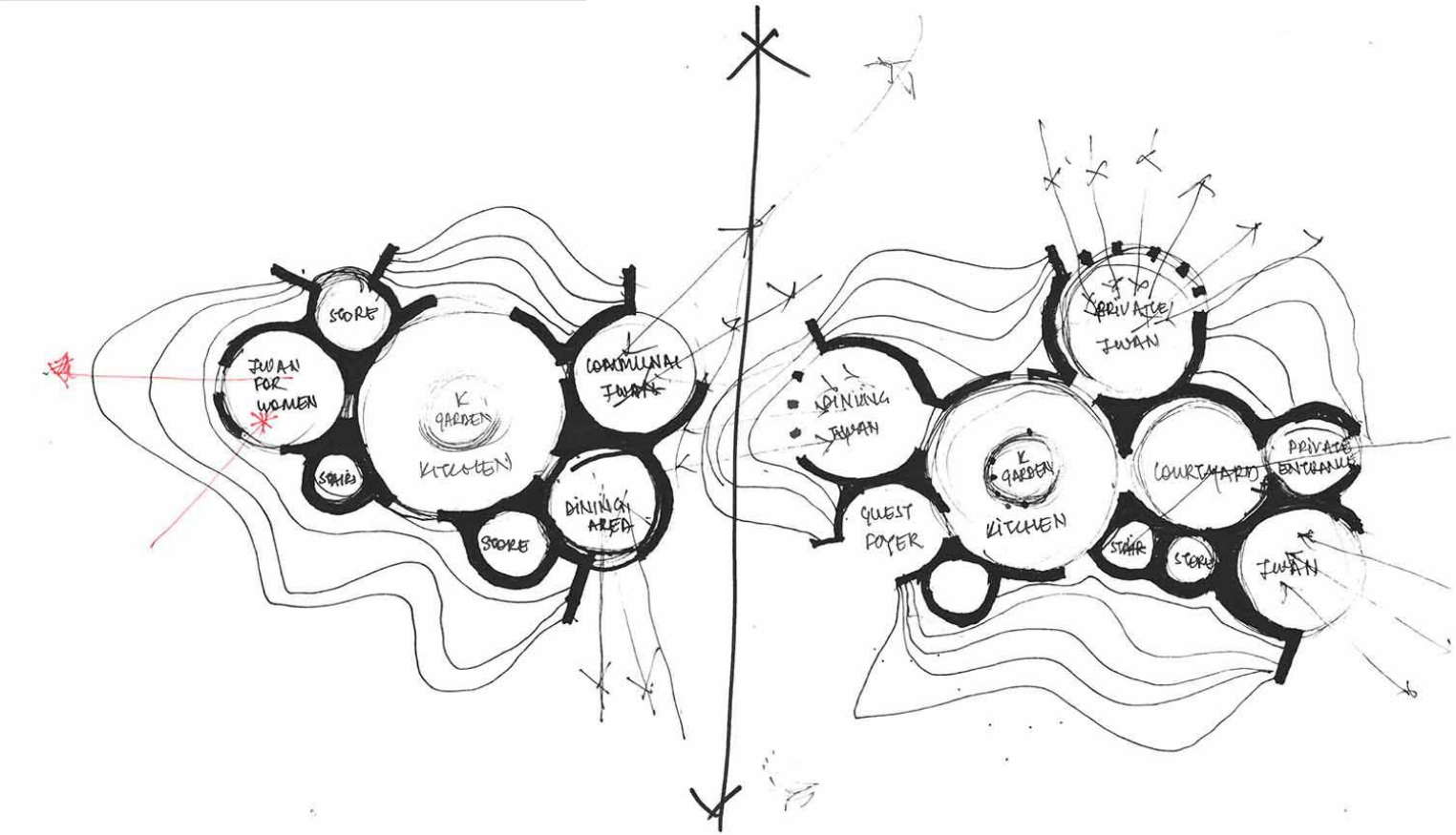
Conceptually, the design focuses on levels of transparency. As people move from the public realm into the building, the form of the building transforms from a fluid landscape to rectilinear dwellings.



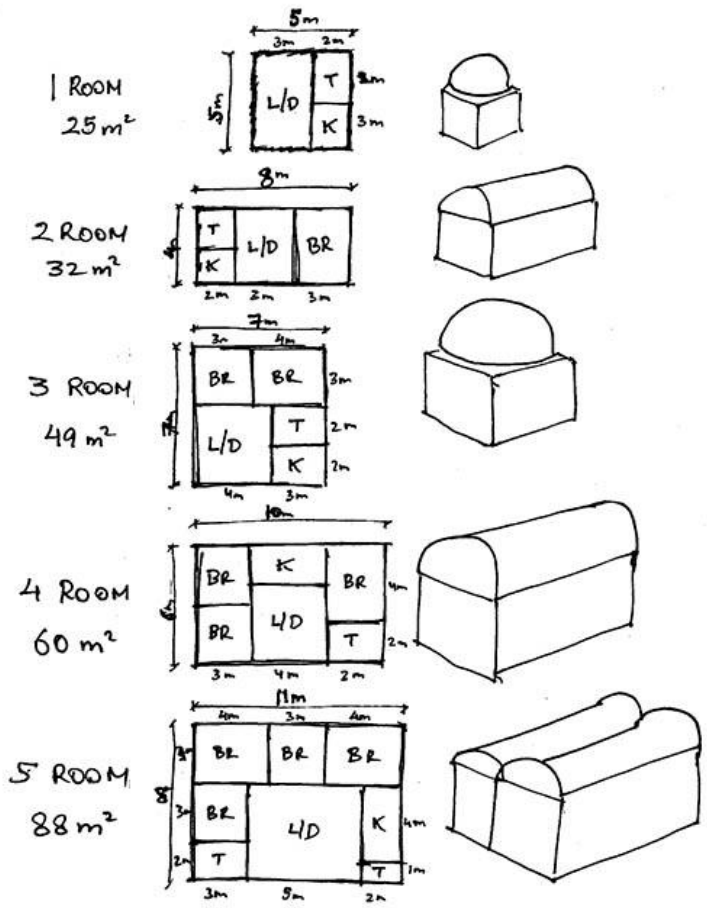
Bubble diagram of ground floor communal space

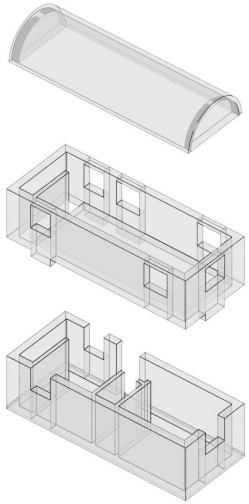


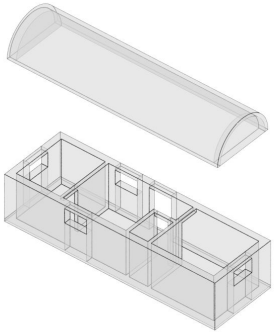
Initial ground floor layout of communal space

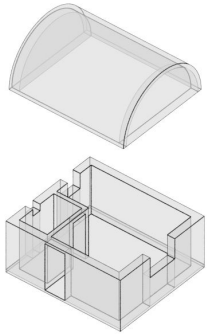


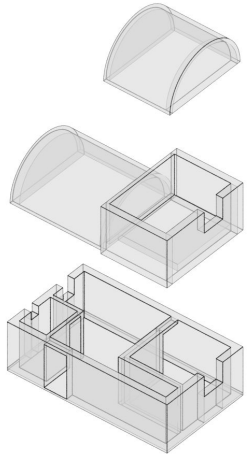
Modules of dwelling units



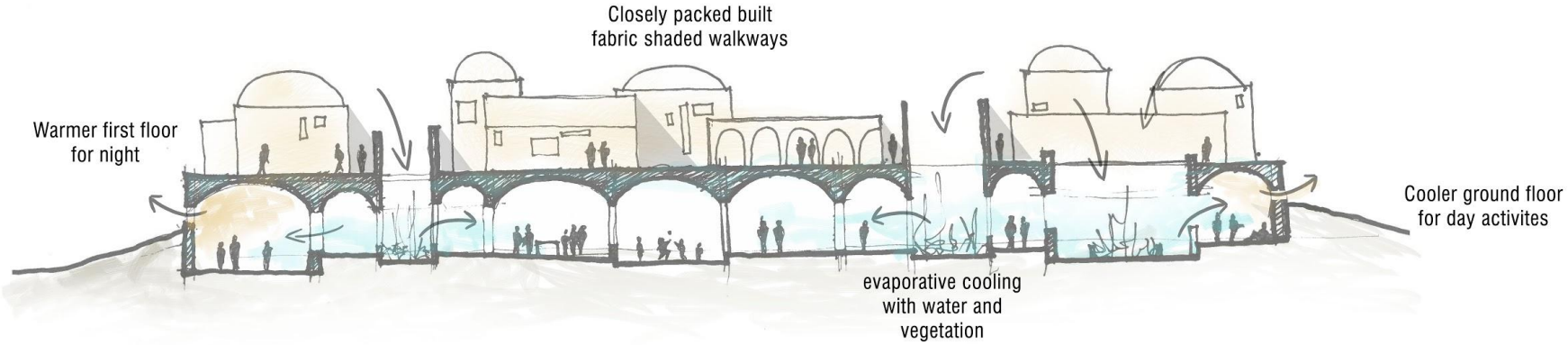






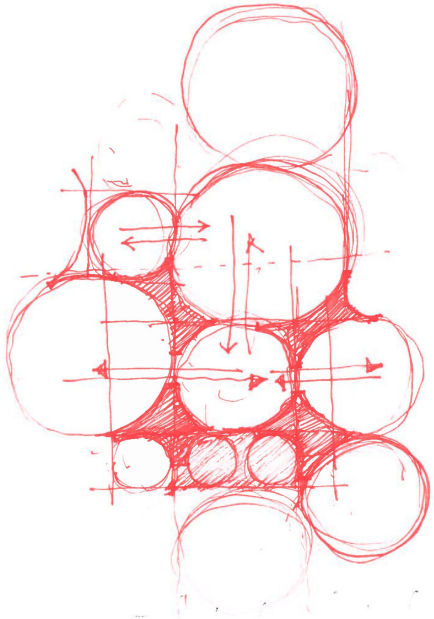


Climate

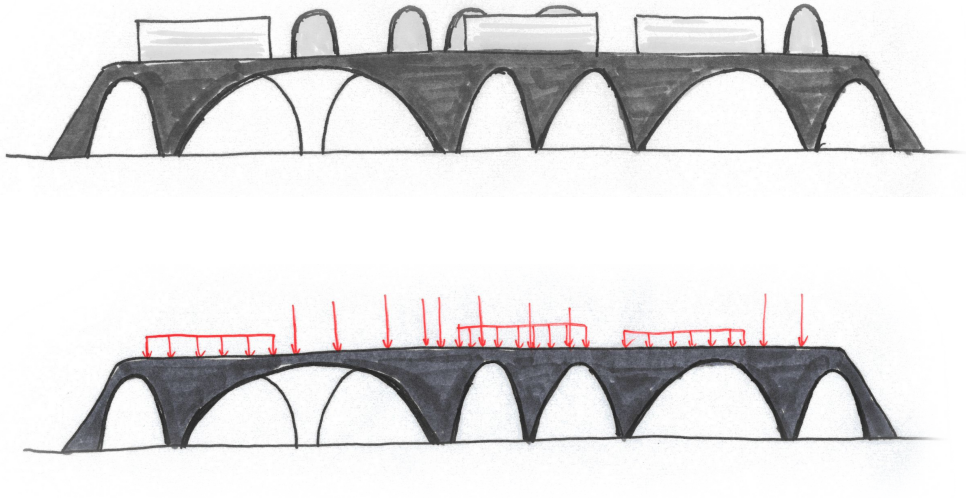

Closely packed built
fabric shaded walkways
Warmer first floor
for night
Cooler ground floor
for day activites
evaporative cooling
with water and
vegetation

Structural Strategy

The next phase of the design will focus on modifying the form to perform structurally. The dwellings on the upper level are placed along structural gridlines formed from the layout of communal spaces below. The load of the dwellings and the infill soil is then applied and the form of the lower structure is adjusted to accommodate these loads.



Grid overlaid on ground floor layout
(**Refer CAD Attachment**)

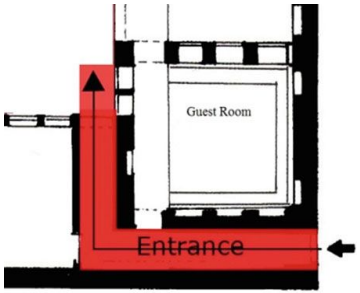


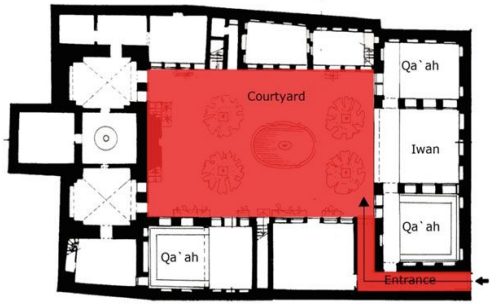
Section diagrams of structural concept

Appendix A: Research

Guidelines for Syrian vernacular housing:

- Iwan (summer casual living space) facing north, always in the middle, never at corner of courtyard
- Main living room near the entry where it doesn't disturb daily household
- Separate rooms for male and female kids
- Entrance should face a wall or curtain, not looking directly into the house
- Living room for women near the kitchen or first floor
- Courtyard size changes according to number of connections it has, the ratio of height to width should stay between 1:1 to 1:1.5
- Bedrooms shouldn't have direct access from courtyard, must be a Liwan (semi open lobby) in between
- Modules adjust size on one axis to fill gaps and make space for entrance into a room (corner module gets bigger or middle module gets smaller)
- Or corner module can only share sides with one of the adjacent rooms and a lobby is introduced.
- Kitchen and Iwan can be adjacent
- Riwaq along a courtyard for shaded movement between regularly accessed areas
- Rooms adjacent to Iwan can get access through Iwan

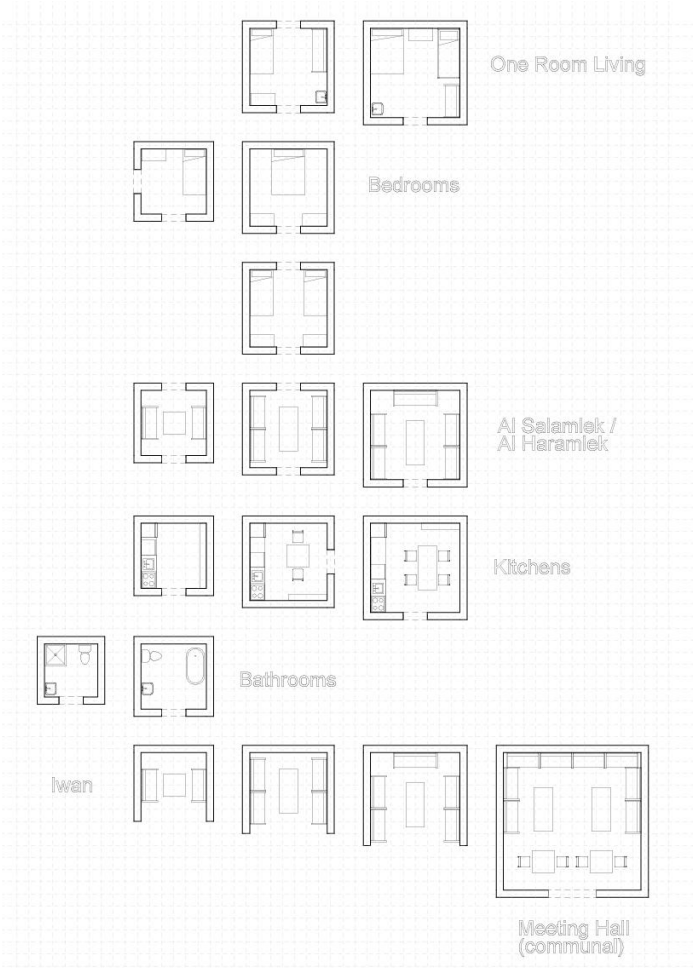




Appendix B:
Initial Form Studies

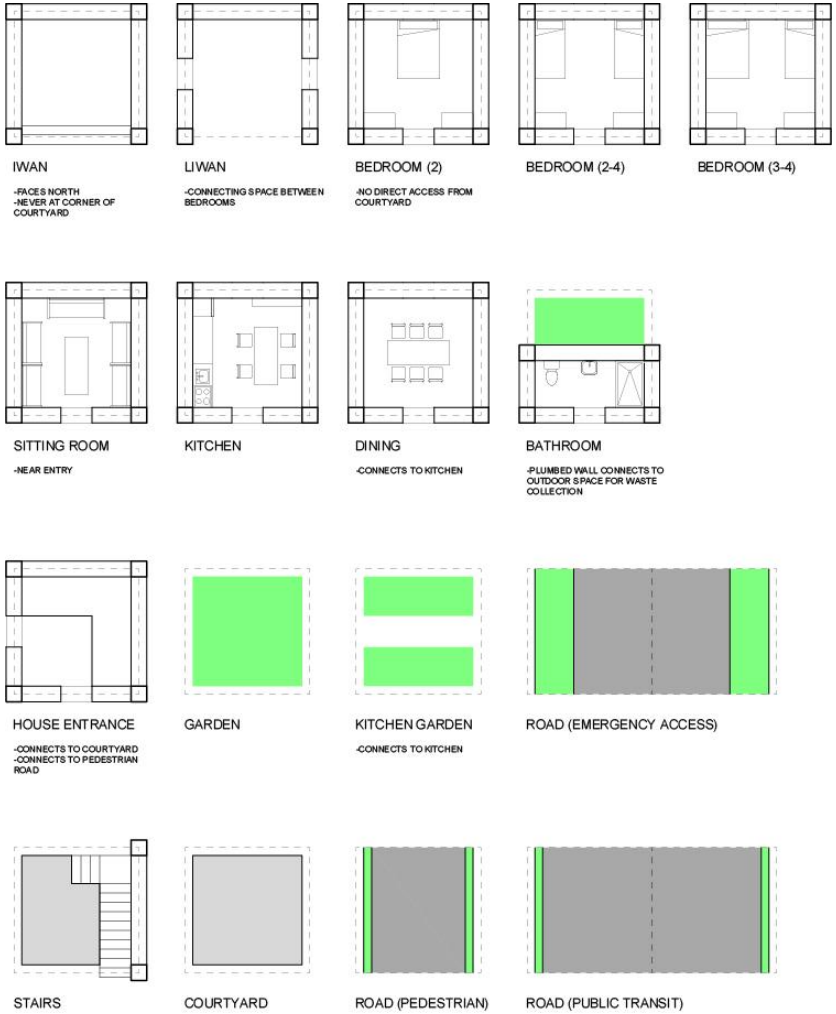
Programmatic Modules for Interior Spaces and Rooms

- A series of functional spaces were determined to be designed; bedrooms, living rooms, kitchens, bathrooms and iwans.
- A series of spatial modules in different scales were designed per function
- These spatial modules were to be combined based on the household size and relationship.



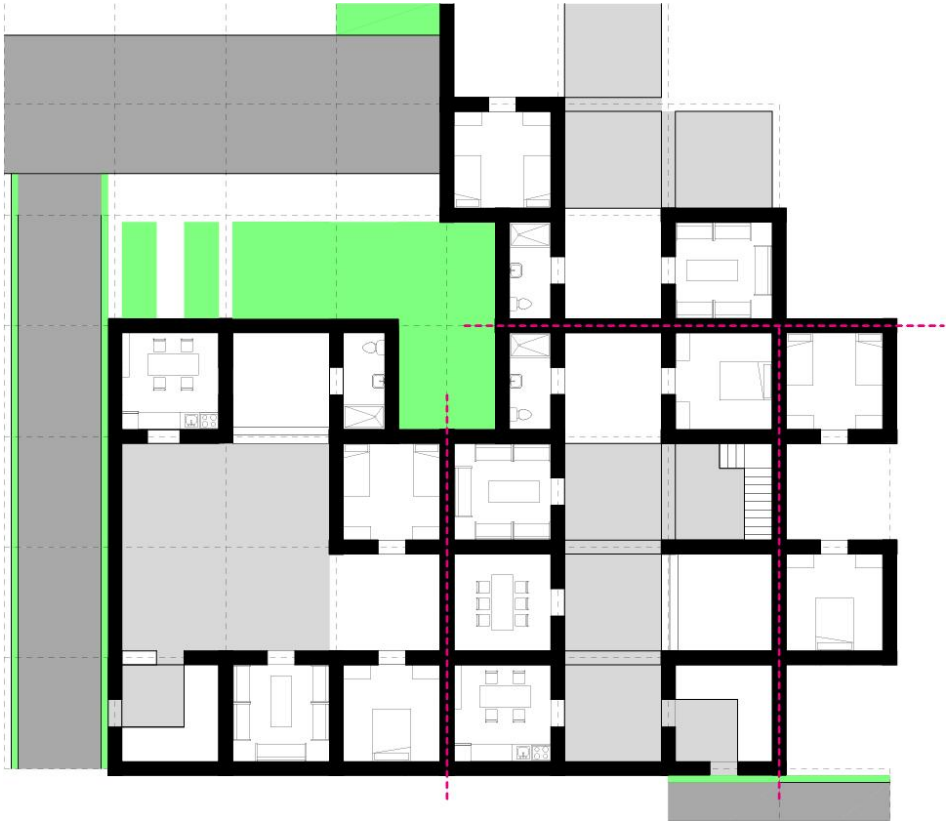
Fitting Modules into a Grid

- Previously designed modules are fitted into a uniform grid size to provide an easier combination of each module
- A series of public space modules such as gardens, stairs, courtyards and roads are added to the collection of units.



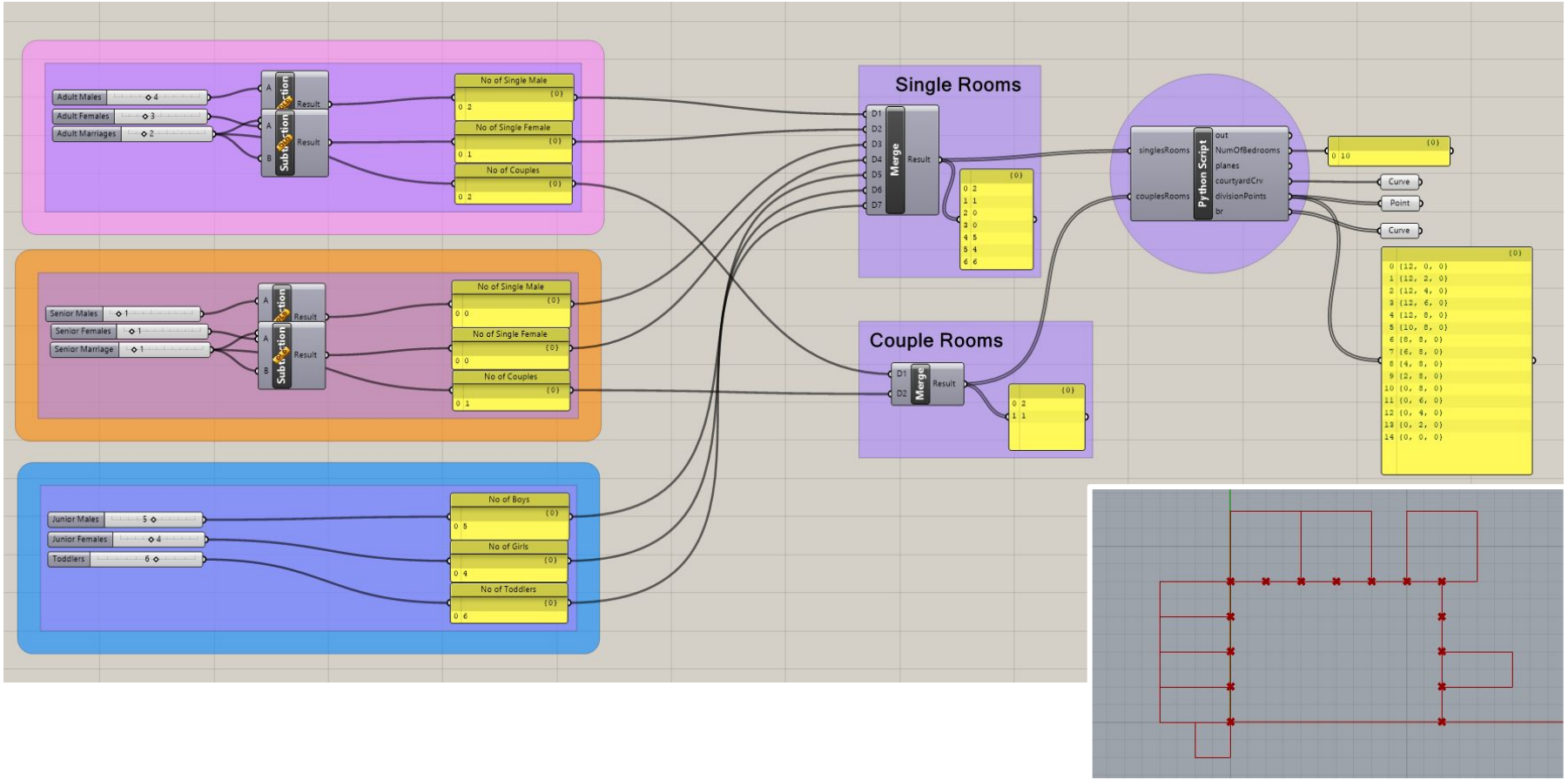
Combining Modules on Grid

- The predetermined set of modules placed on a grid based on a logic behind program and circulation



Appendix C:
Computation Studies

Generating courtyard housing typologies: Grasshopper script



Generating courtyard housing typologies: Pseudocode

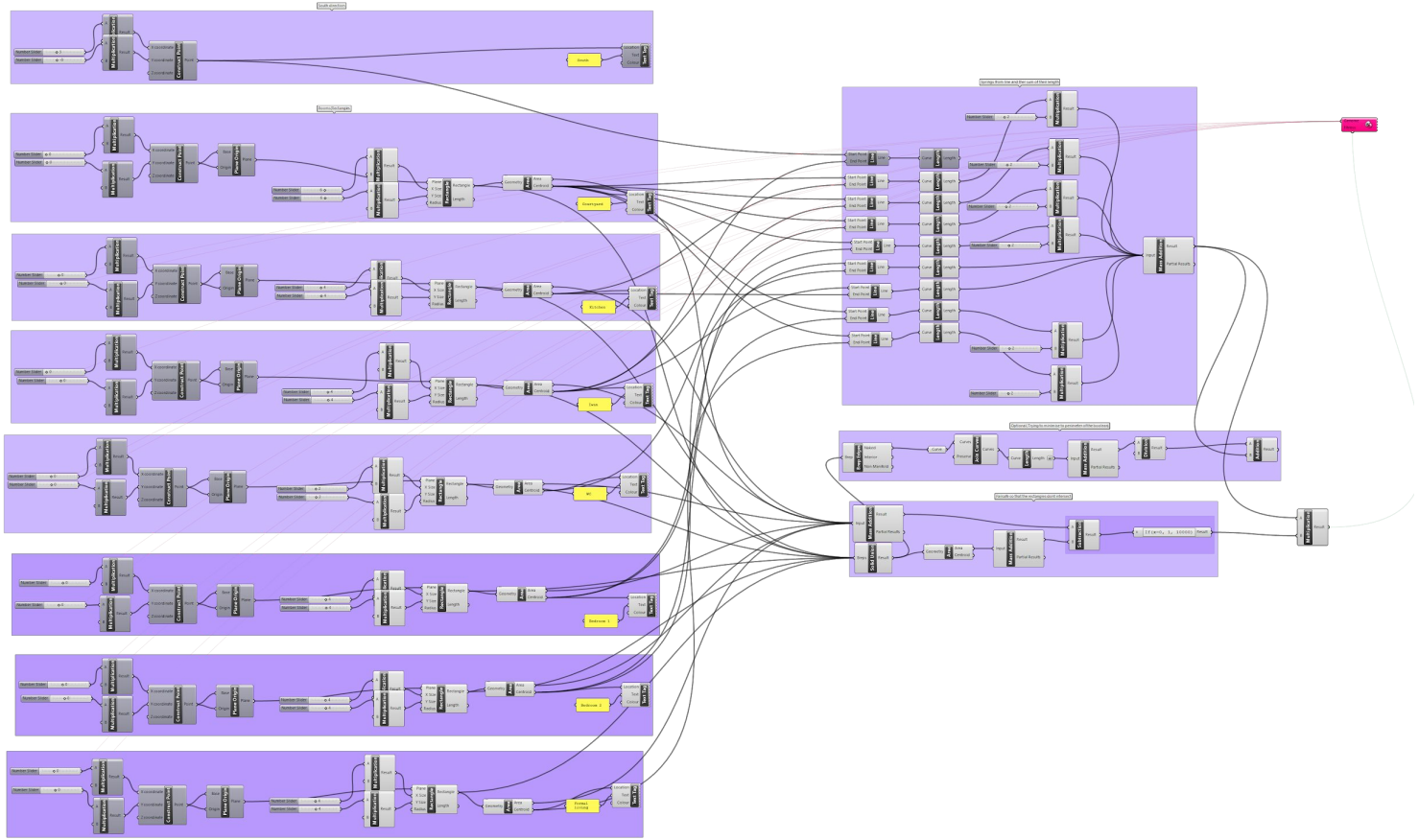
```
###this code intends to receive the number of people in a unit,
          determine the courtyard and bedroom sizes and place the bedrooms
          around the courtyard
###there are issues with the code that need to be resolved

#create the single rooms

          function createSingleRooms(x)
          a=sqrt(3.5*x)
          room_dimension1 = ceil(a)
          room_dimension2 = floor(a)

          room_dimensions1 = list
          room_dimensions2 = list

          add room_dimension1 to room_dimensions1
          add room_dimension2 to room_dimensions2


#combine input with createSingleRooms(x)

          for every number in singles_rooms
          if i>4
          x=i/2
          room1 = ceil(x)
          room2 = floor(x)

          count_room add ceil(x/2)

          createSingleRooms(room1)
          createSingleRooms(room2)

          elif i=0

          count_room add 0

          else

          x=i
          count_room add i
          createSingleRooms(x)

          totalNumSinglesroom = sum(count_room)
```

```
#define rounding to even because the grid is 2m and each

          if x is divisable by 2
          return x
          else return x+1

#Vector scale of each room

          VectorScaleX = roundToEven (room_dimensions1)
          VectorScaleY = rountToEven (room_dimensions2)

          delete value if VectorScaleX = 0
          delete value if VectorScaleY = 0

#create couple rooms

          a=sqrt(7)
          room_dimension1 = ceil(a)
          room_dimension2 = floor(a)

          add room_dimension1 to room_dimensions1
          add room_dimension2 to room_dimensions2

          VectorScaleX = roundToEven (room_dimensions1)
          VectorScaleY = roundToEven (room_dimensions2)

#creating the courtyard

          sumOffset = sum (VectorScaleY)

          if sumOffset < 28
          create a rectangle (x=sumOffset-16 , y=8)
          else
          create a rectangle (x=sumOffset-20 , y=10)

#divide courtyard circumference

          shift courtyard corners to create the courtyard curve on the
west-north-east side
          create polylineCurve between courtyardCorners
          divisionPoints = divide curve into 2.0 meters
```

Generating courtyard housing typologies: Pseudocode

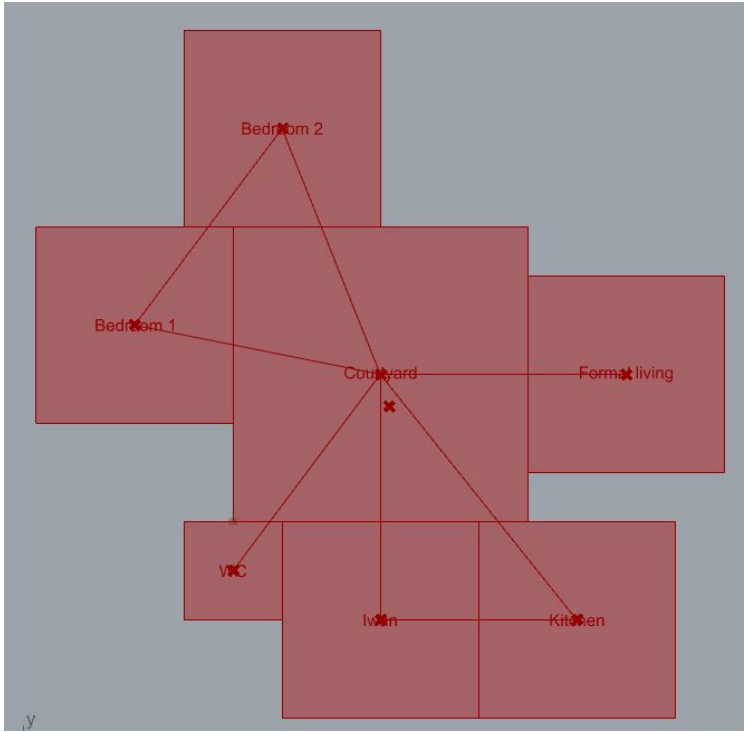
```
#creating planes

          if list length of division points is divisable by 2
          lenDivisionPoints = length of division points
          else
          lenDivisionPoints = length of division points - 1

          IF sumOffset < 28

          divisonPoints (0 to 5)
          planesA:
                    origin = divisionPoints
                    LocalVectorX = GlobalXaxis
                    LocalVectorY = GlobalYaxis

          divisonPoints (5 to lenDivisionPoints-5)
          planesB:
                    origin = divisionPoints
                    LocalVectorX = GlobalYaxis
                    LocalVectorY = -GlobalXaxis

          divisonPoints (lenDivisionPoints-5 to lenDivisionPoints)
          planesC:
                    origin = divisionPoints
                    LocalVectorX = -GlobalXaxis
                    LocalVectorY = -GlobalYaxis


          else sumOffset > 28

          divisonPoints (0 to 6)
          planesA:
                    origin = divisionPoints
                    LocalVectorX = GlobalXaxis
                    LocalVectorY = GlobalYaxis

divisonPoints (6 to lenDivisionPoints-6)
          planesB:
                    origin = divisionPoints
                    LocalVectorX = GlobalYaxis
                    LocalVectorY = -GlobalXaxis

          divisonPoints (lenDivisionPoints-6 to lenDivisionPoints)
          planesC:
                    origin = divisionPoints
                    LocalVectorX = -GlobalXaxis
                    LocalVectorY = -GlobalYaxis

planes = divisionPointPlanes

bedroom = rectangle
(divisionPointPlanes[int(originPointOffset[x]/2-1-originPointOffset[0])],roomX
Vector[x],roomYVector[x])

bedrooms = add bedroom
```

Courtyard house spatial planning 1.0

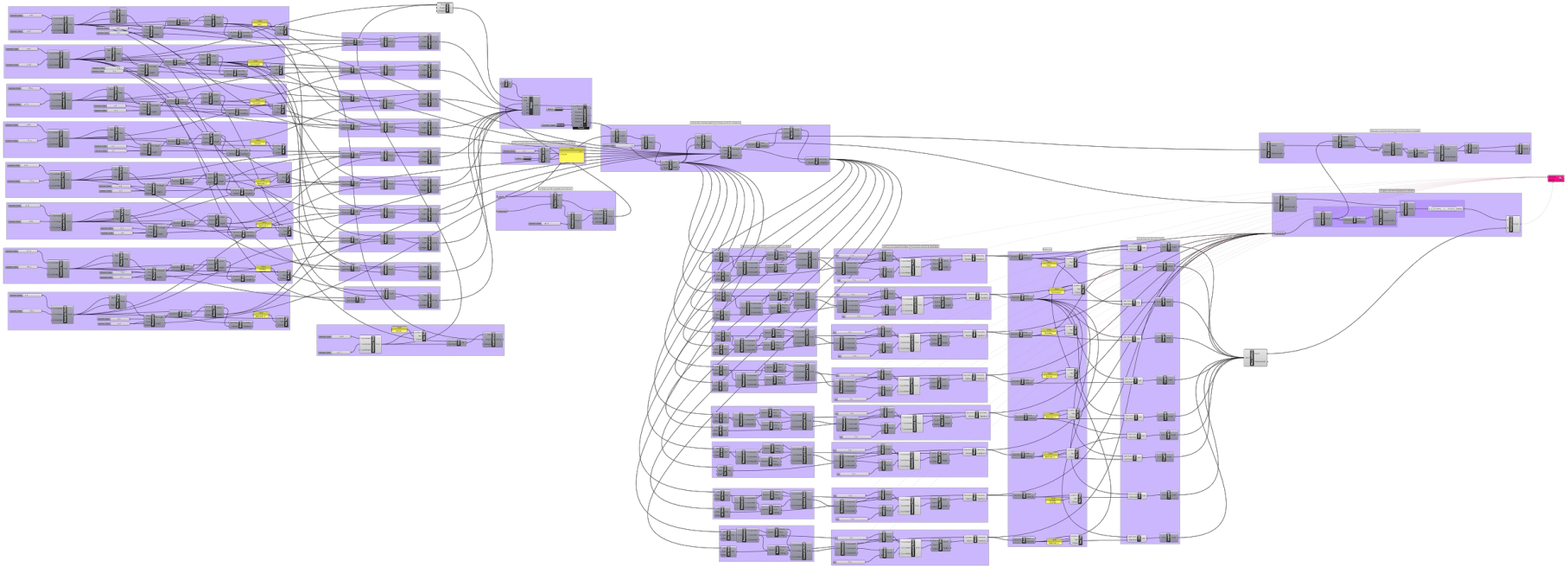


Courtyard house spatial planning 1.0

1. Rectangular rooms and courtyard are defined.
2. Connection between spaces are established.
3. Annealing solver in Galapagos is used to pack all Rectangles together.
4. Galapagos tries to minimize the fitness value that is the sum of length of lines connecting the rectangular rooms.
5. There is a fail safe so that the rectangles do not intersect, the difference between sum of area of the rectangles to the area of the boolean of rectangles should be zero otherwise the fitness value is multiplied with a very high number(in this case 10000). Galapagos rejects these big values as it is trying to minimise the result.

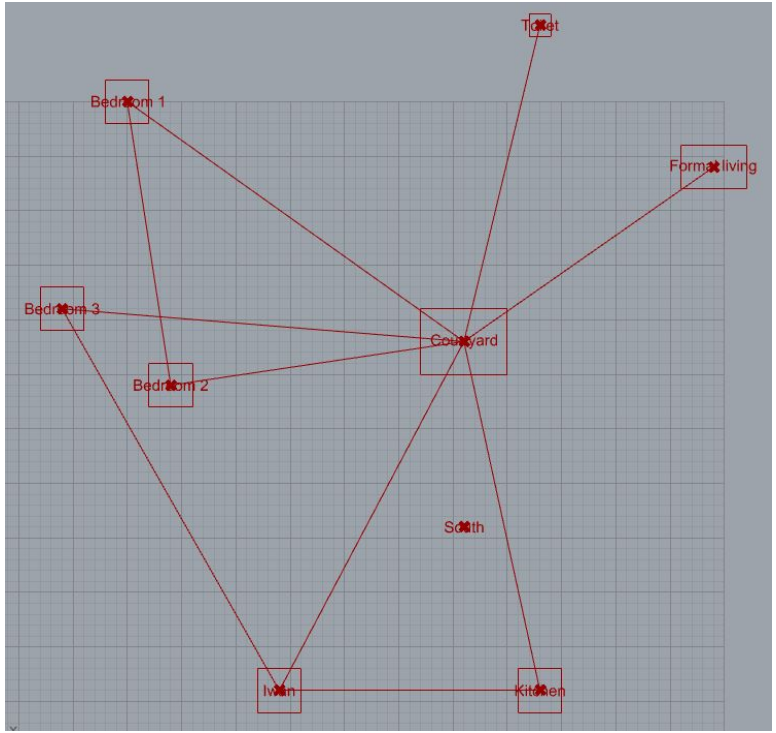


Courtyard house spatial planning 2.0



Courtyard house spatial planning 2.0

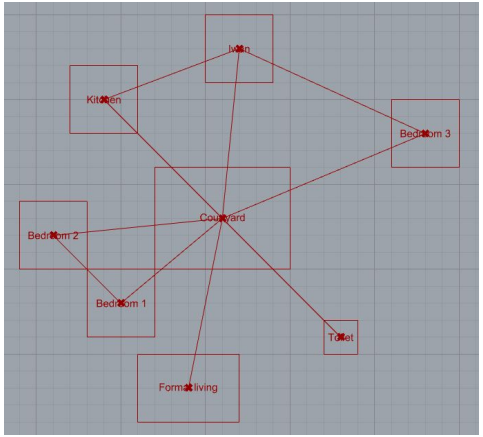
1. Rectangular rooms and courtyard are defined.
2. Connection between spaces are established.

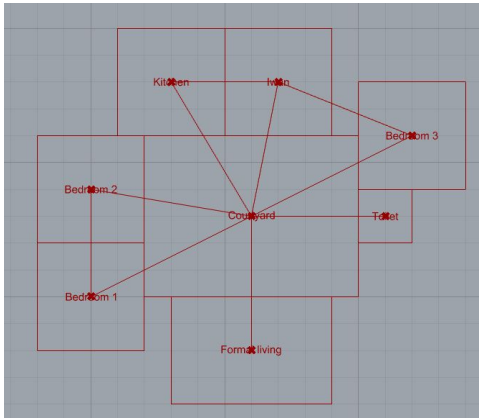


3. Connection lines are converted into springs through ‘Length’ component from Kangaroo 2.
4. Rest lengths of spring is set as the sum of diagonal of the two rectangle which are connected to each other.The position of the courtyard is fixed as the anchor point.
5. A Python code is used to calculate the sum of diagonal of every rectangle to each rectangle and this is used to input as lower limit into ‘clamp length’ component form Kangaroo 2, so that the Rectangles do not intersect with each other.
6. Kangaroo 2 Solver is run to get a configuration of Rectangles placed at desired positions as per the connections.

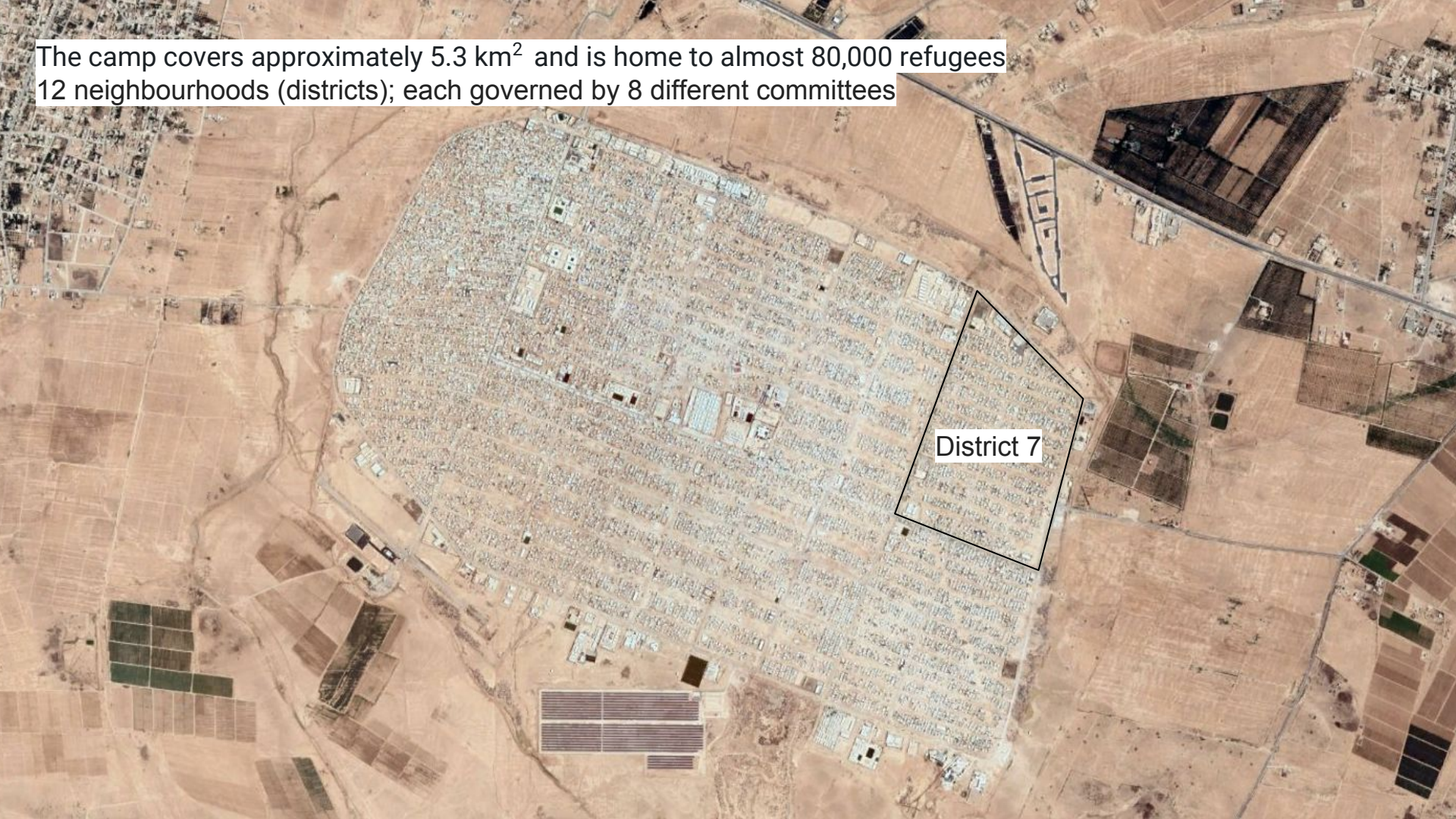
Courtyard house spatial planning 2.0

7. Annealing solver in Galapagos is used to pack all Rectangles together.
8. Galapagos tries to minimize the fitness value that is the sum of length of lines connecting the rectangular rooms.
9. There is a fail safe so that the rectangles do not intersect, the difference between sum of area of the rectangles to the area of the boolean of rectangles should be zero otherwise the fitness value is multiplied with a very high number(in this case 10000). Galapagos rejects these big values as it is trying to minimise the result.





Appendix D:
Site Information


The camp covers approximately 5.3 km^2 and is home to almost 80,000 refugees
12 neighbourhoods (districts); each governed by 8 different committees
District 7


District 7, Block 4 is selected for a case study of replacing caravan structures with communal housing
District 7
Block 4

The existing landscape is sloped, with a variation in elevation of up to 20 meters across the camp

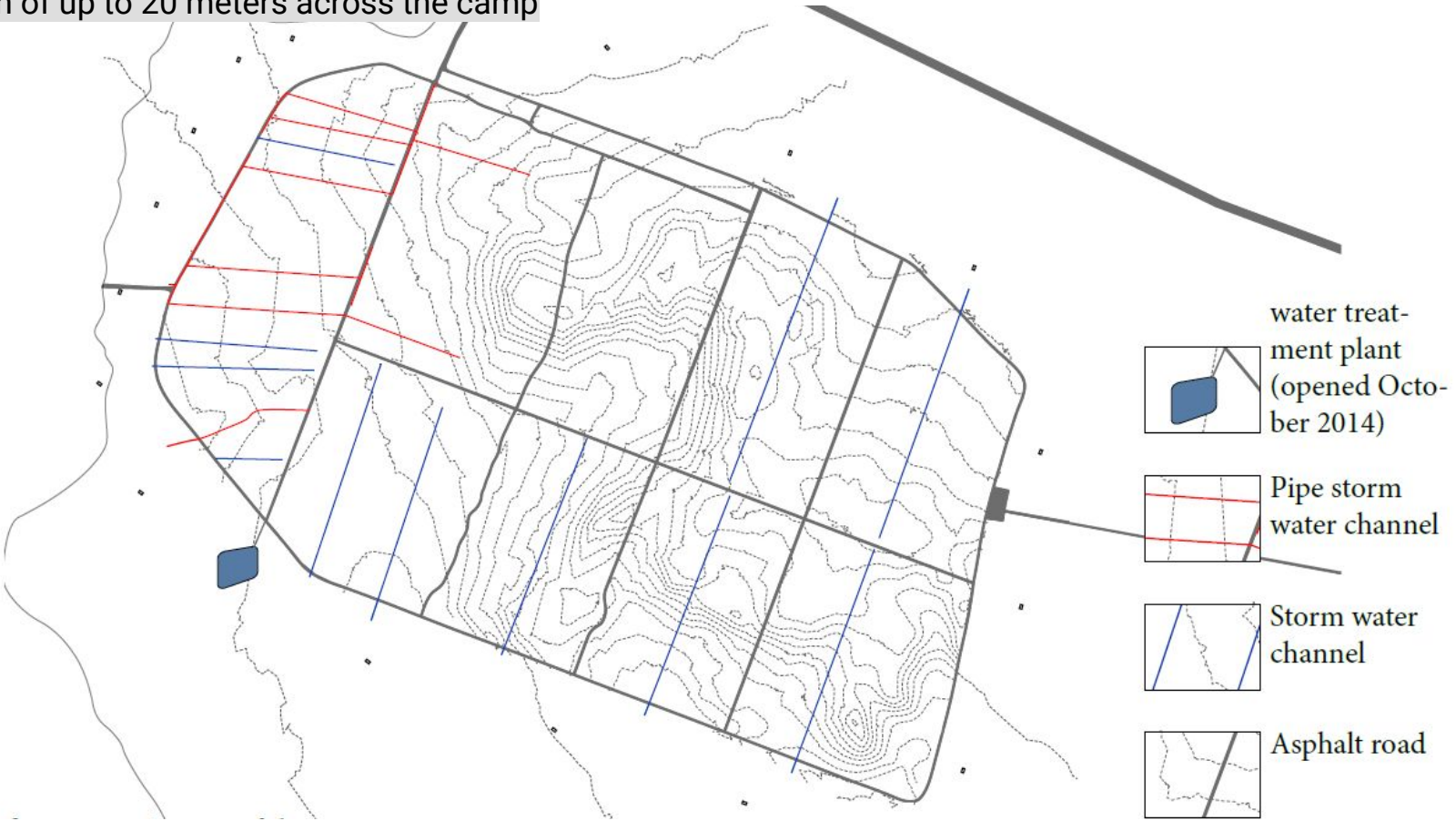


Image: Rightful Landscape, Robert Kruijt