al-qadisiya, kuwait city
sustainable urban retrofit and design

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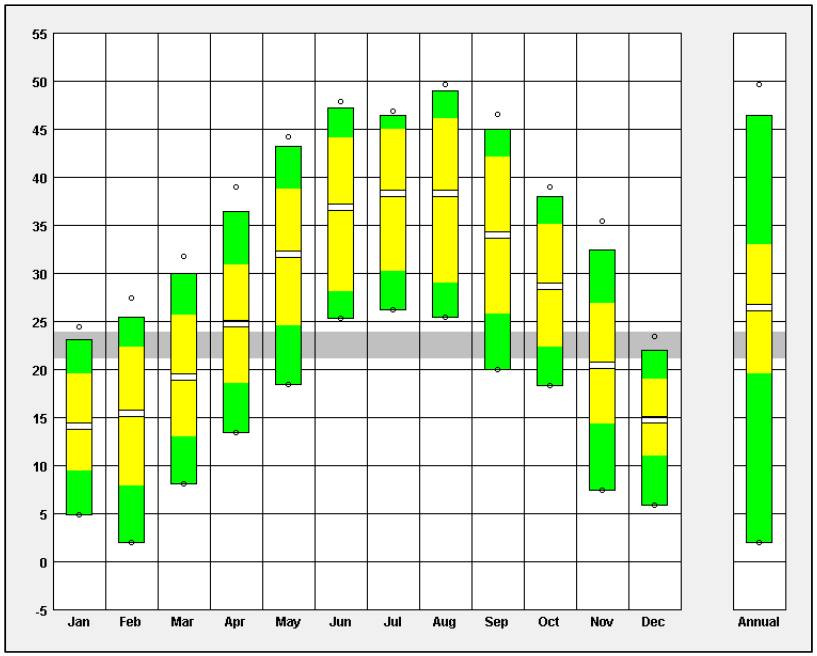
growth in the desert

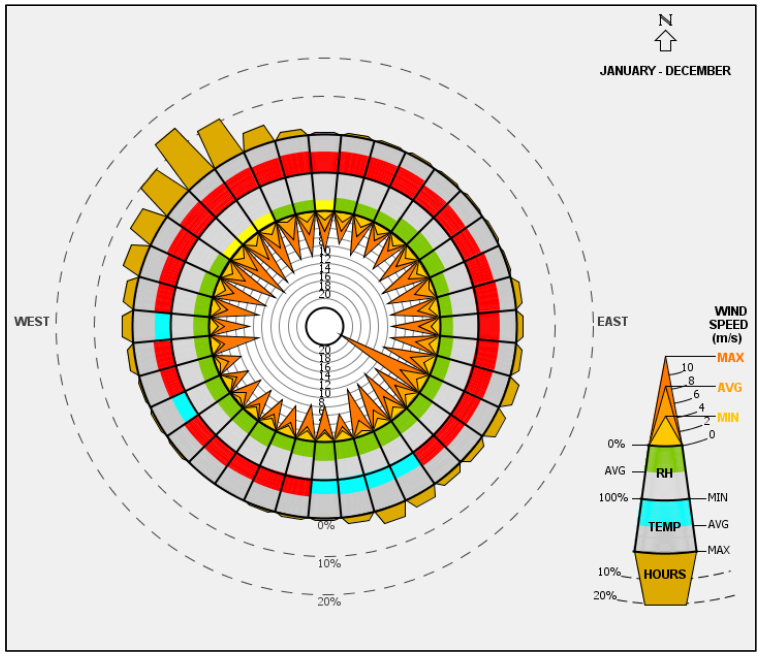
- growing population
  - 1.25 million citizens
  - 2.25 million non-citizens
- housing waiting list
  - 110,000 currently waiting
  - growing by 8000/year
- planned expansion
  - 5 new cities in the next 10 years
  - partnership through *Kuwait-MIT Center for Natural Resources and the Environment*

source: Third Kuwait Master Plan, 2005

desert climate



temperature ranges



wind: temperature, velocity and direction

al-qadisiya

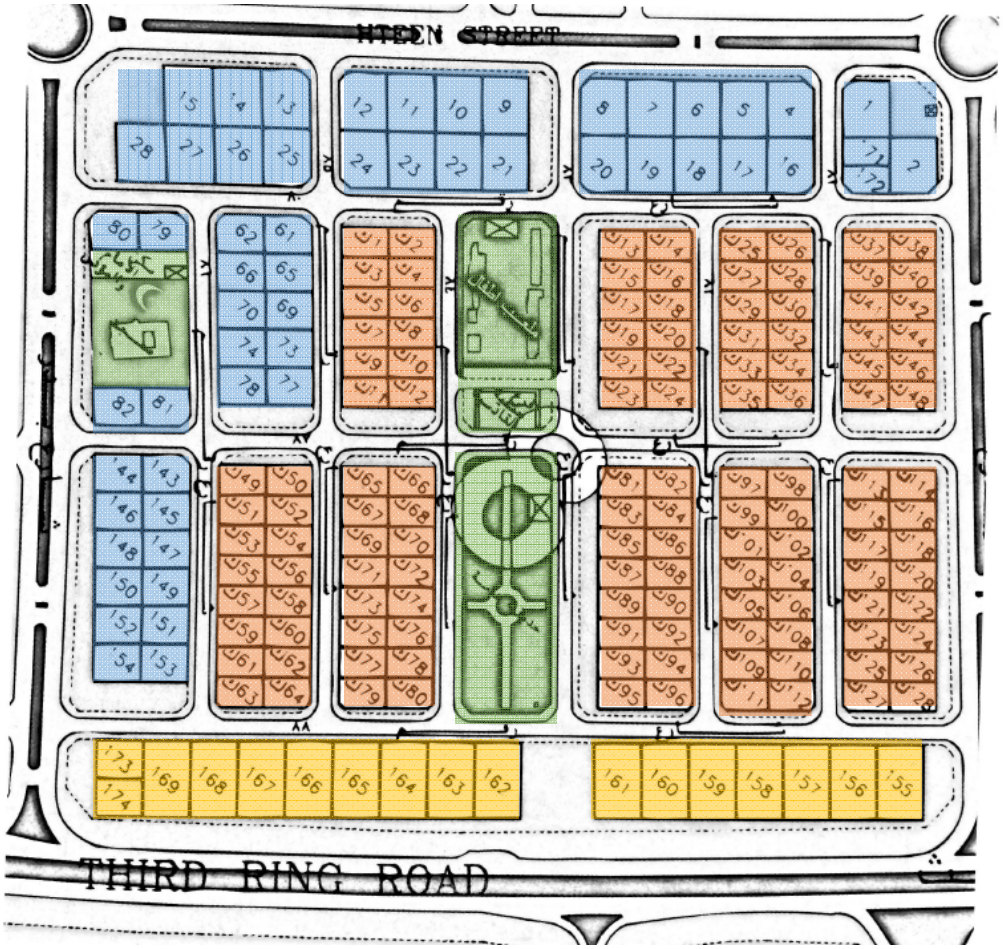
- low-density residential neighborhood
  - 1 central service core
  - 8 residential blocks
- near Kuwait city center
  - accessible by car
  - separated by busy roads

- population 20,893
- area 1,745,000 m^2
- density 0.012 pp/m^2

al-qadisiya block 8

- smaller service locations within this block
  - park
  - youth center
  - mosque
  - cooperative store
- varying degrees of affluence in this block

- 200 villas
- area 202,440 m^2
- population >2000



housing typologies

government housing

constructed in the 1950's and 60's for limited income families

abuts neighbors

include internal courtyard

retrofit

renovated government villas

usually include new windows and façade treatments

replacement

detached modern construction

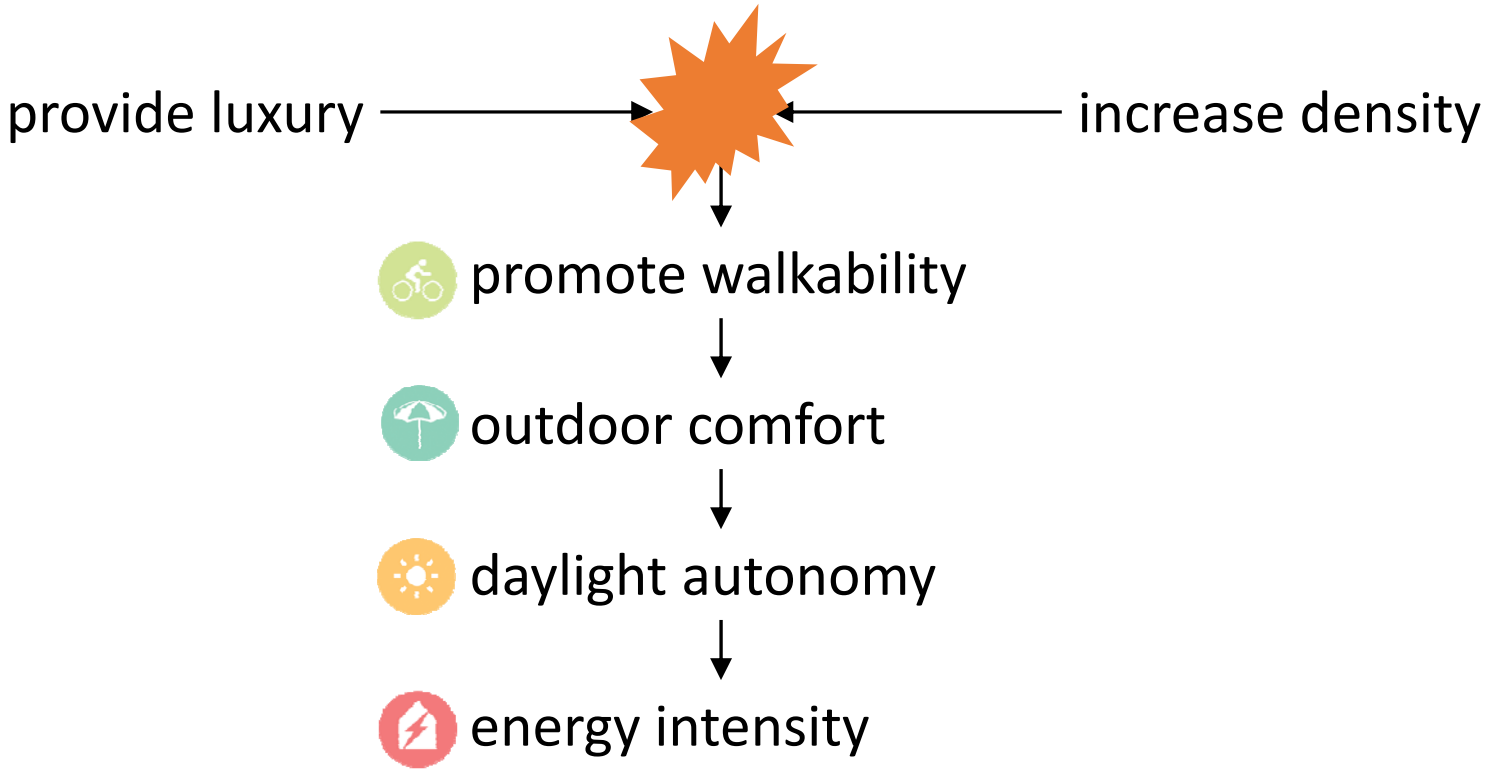
redevelopment of government lots after demolition of older villas

private villas

expansive, luxurious villas constructed privately with government loans

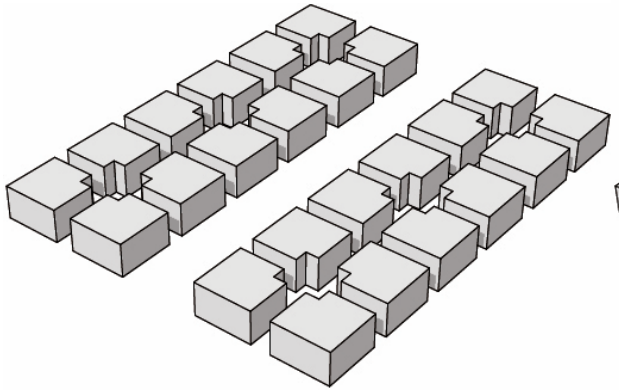
large lots, detached structures

goals

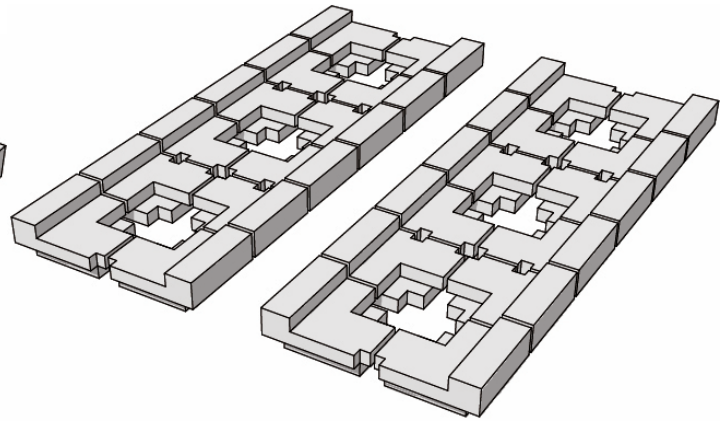

provide luxury
increase density
promote walkability
outdoor comfort
daylight autonomy
energy intensity

proposed typologies

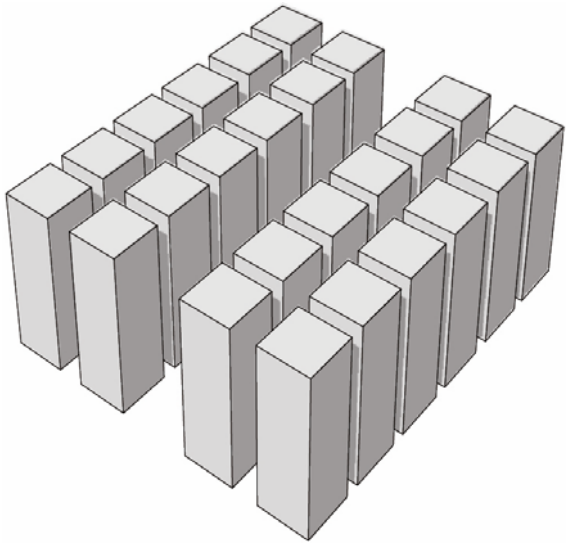
provide luxury ⟷ increase density



type I
detached
FAR 1.4

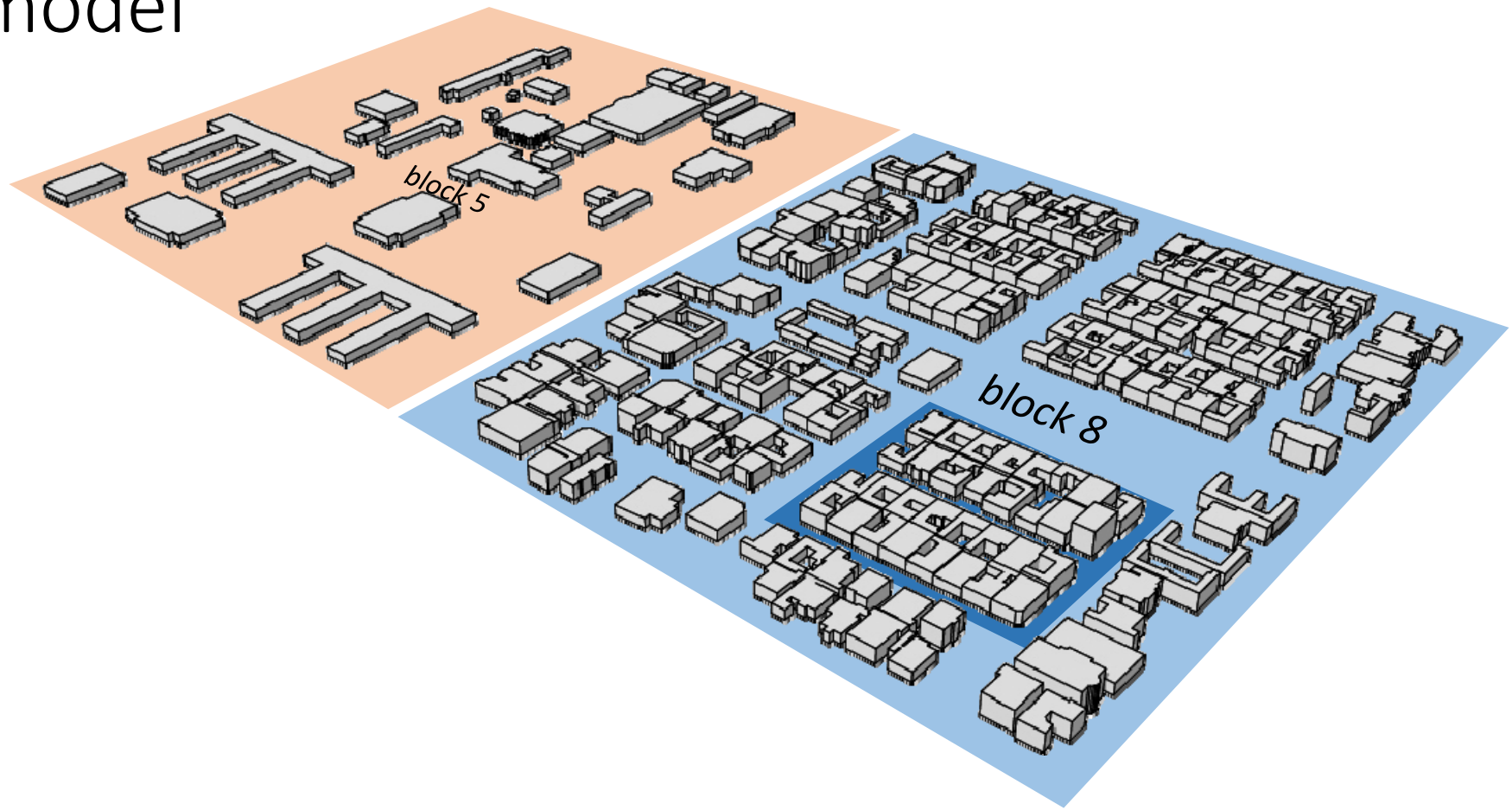


type II
overhang
FAR 1.4



type III
highrise
FAR 5.5

model



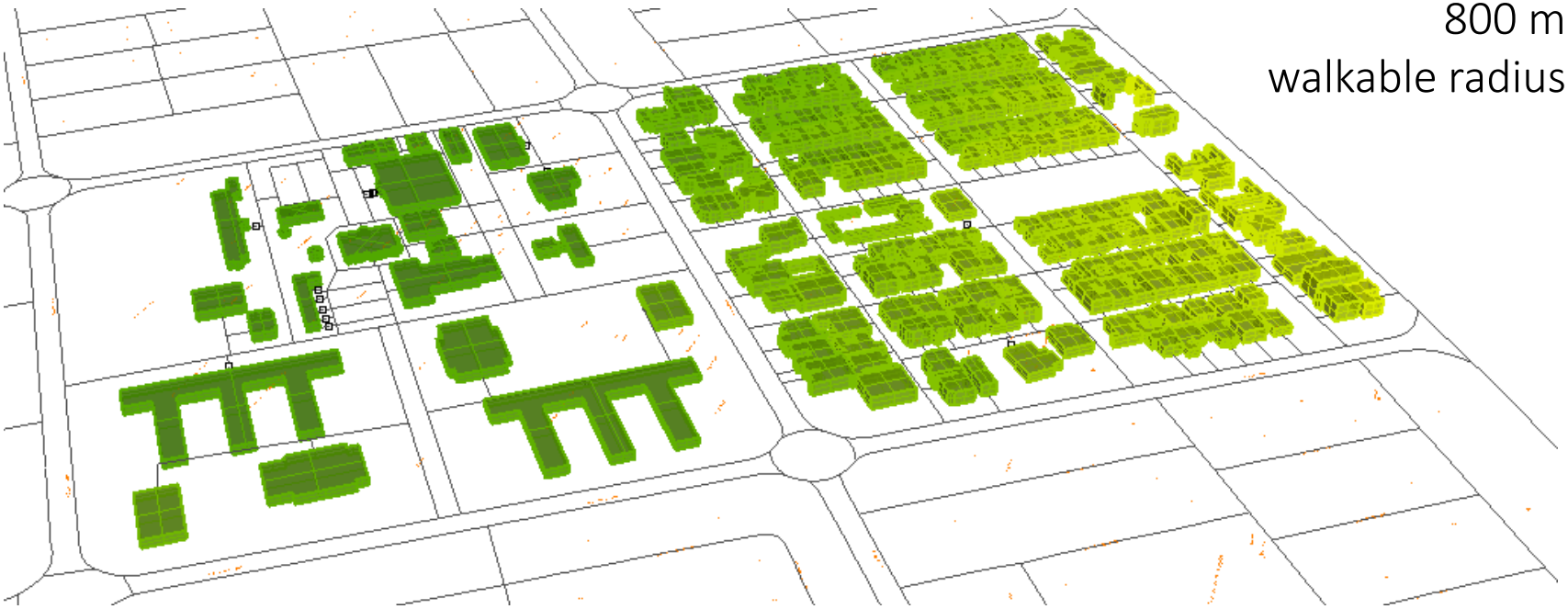
promote walkability

outdoor comfort

daylight autonomy

energy intensity

walkability



800 m
walkable radius

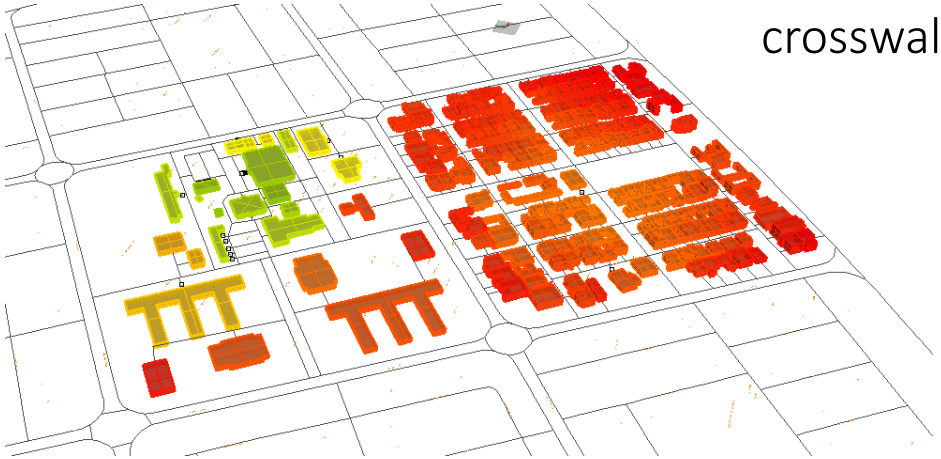
good — bad

walkability

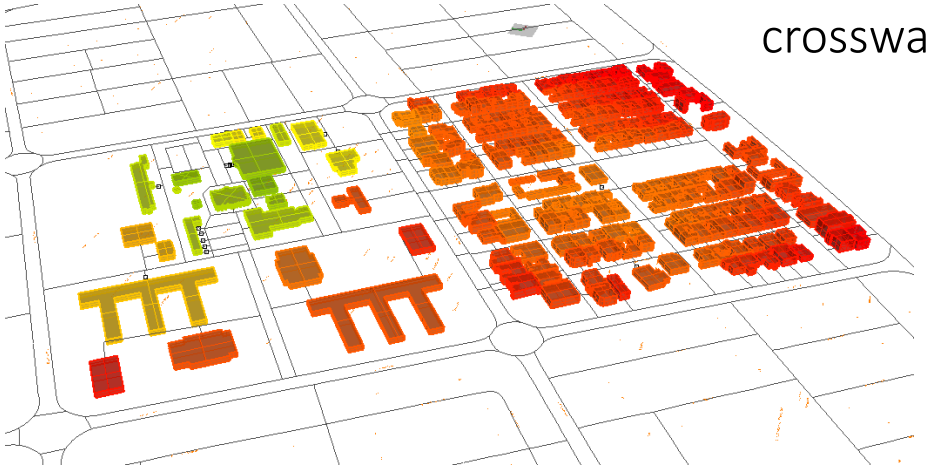
- 200 m walkable radius
- block 5 amenities unreachable from block 8
- crosswalks help

good — bad

without crosswalks



with crosswalks



walkability

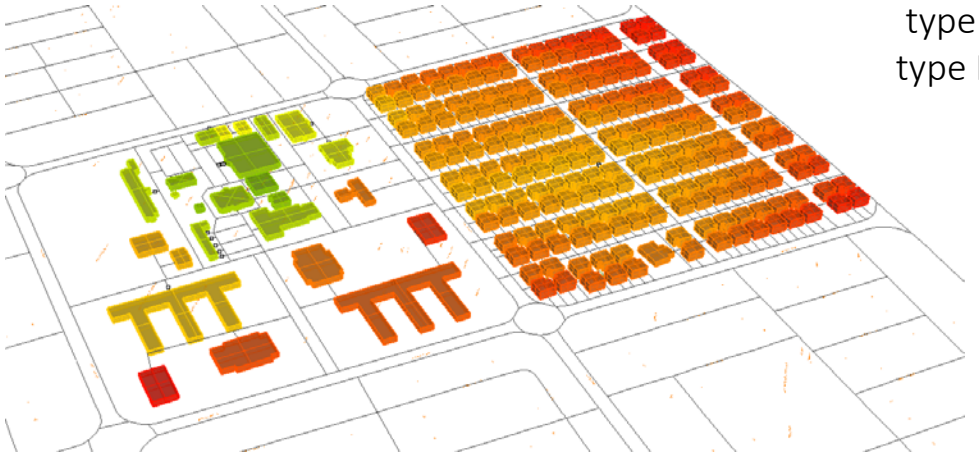
- block lengths must be shorter than walkable radius
- pedestrian paths within blocks for comfortable movement
- accompany increased density with additional amenities

good — bad

low density

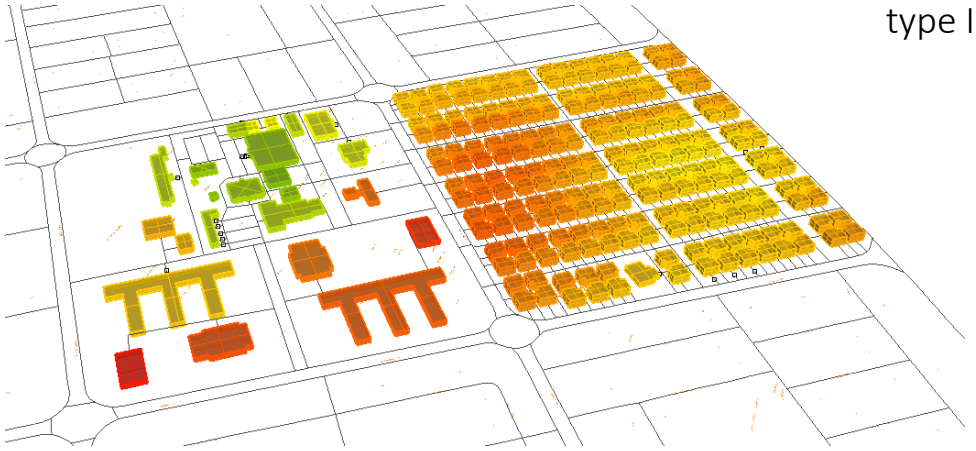
type I

type II

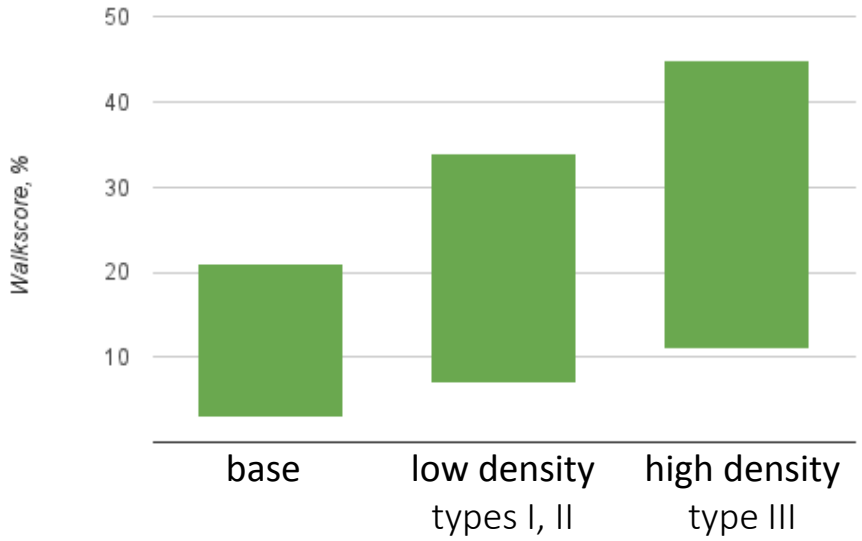


high density

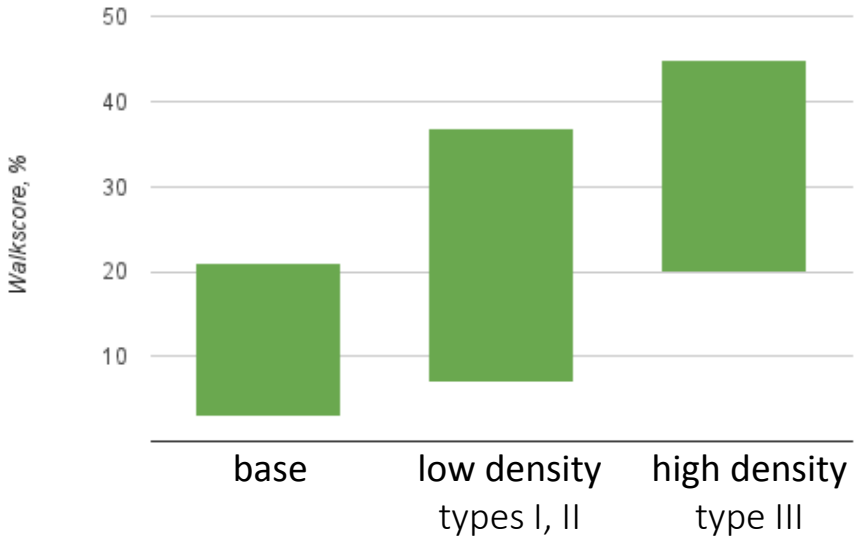
type III



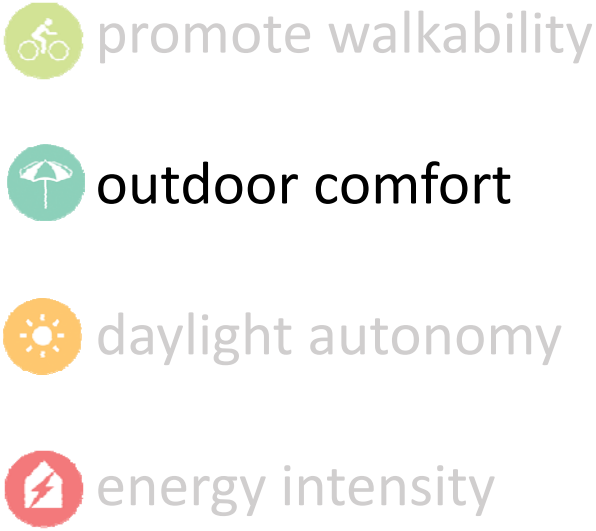
walkability



without crosswalks

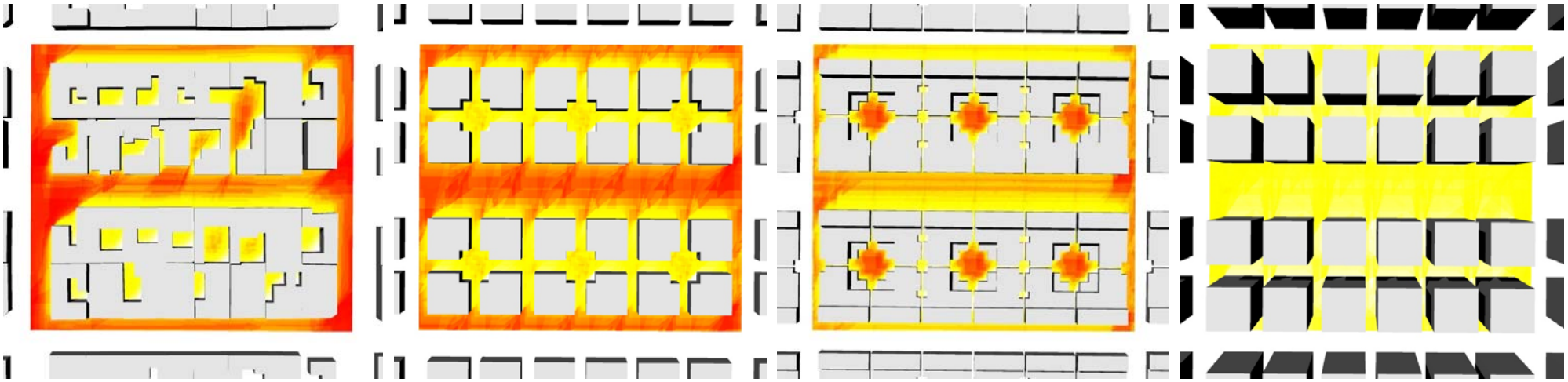


with crosswalks


promote walkability
outdoor comfort
daylight autonomy
energy intensity

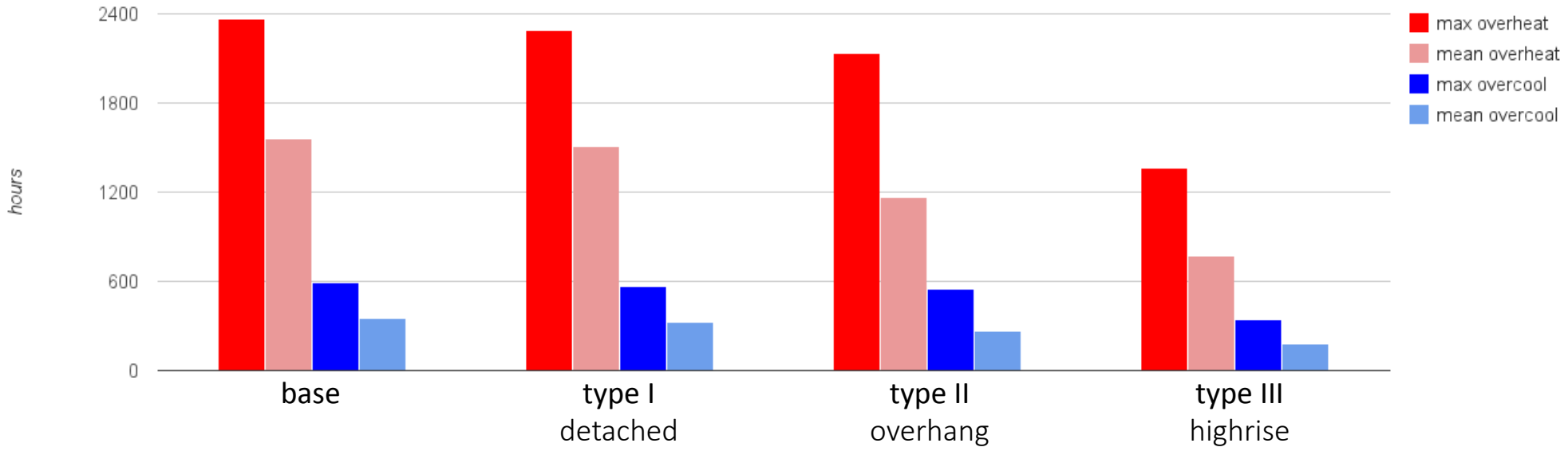
outdoor comfort

comfort overheat

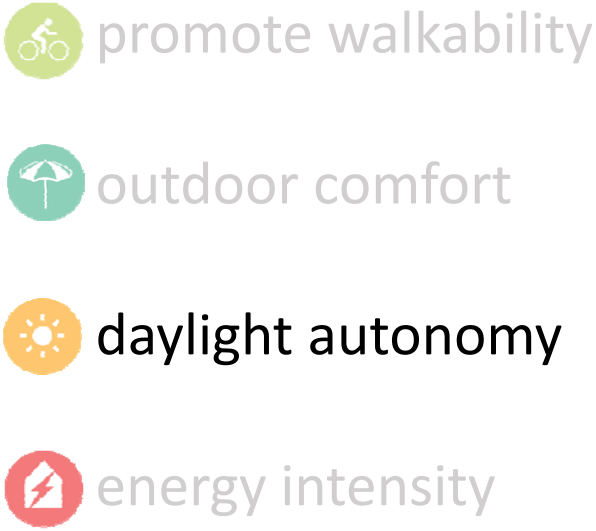


base	type I	type II	type III
street too hot	street too hot	overhangs keep street comfortable	outdoor area remains cool
smaller courtyards remain comfortable	courtyards remain comfortable	courtyards overheat	urban heat island?

outdoor comfort



uncomfortable hours per year


promote walkability
outdoor comfort
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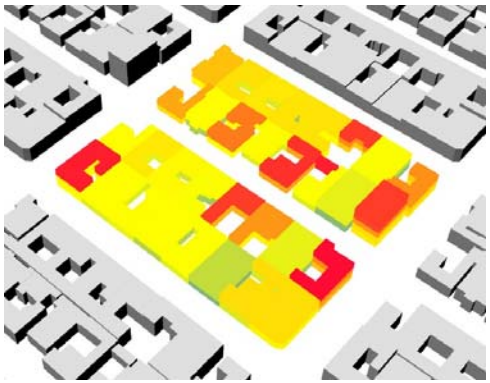
energy intensity

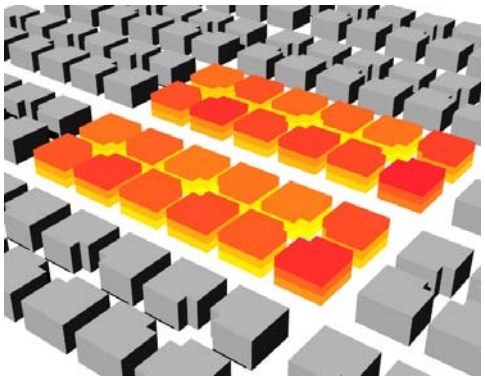
daylight autonomy



base

highly variable

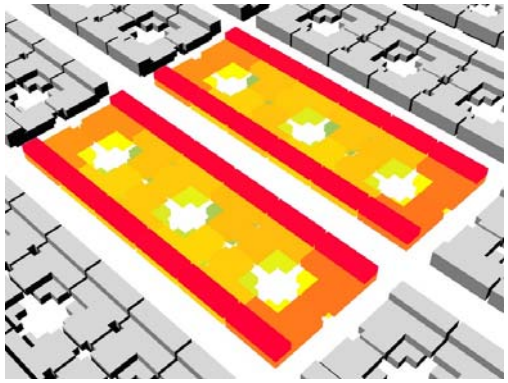
self-shading common



type I

courtyards expose lower floors

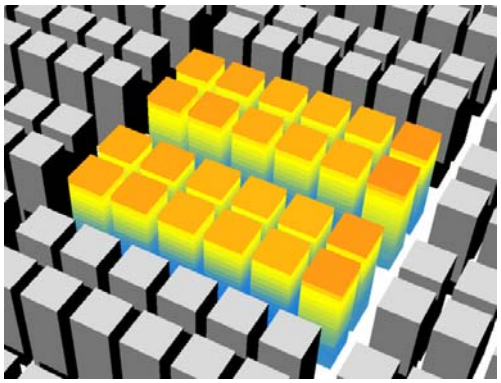
reduced self-shading



type II

shaded exterior areas

skylighting potential

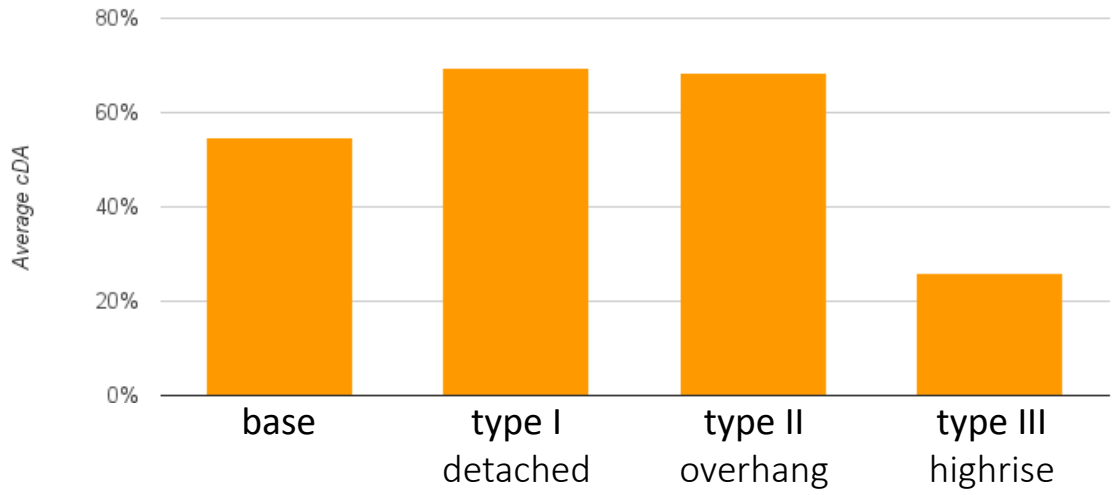


type III

significant self-shading

limited view to sky

daylight autonomy



interior daylighting potential

promote walkability

outdoor comfort

daylight autonomy

energy intensity

energy use templates

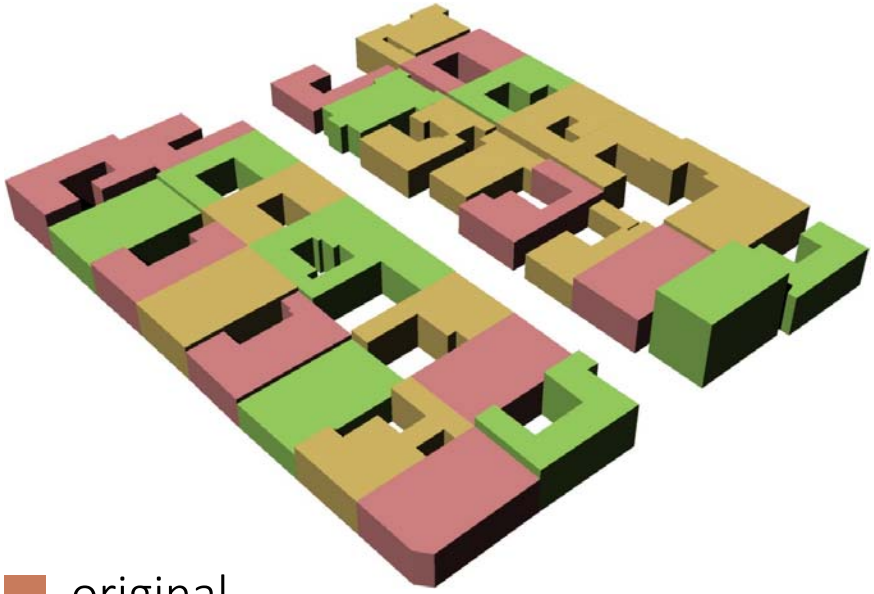
- original
  - mass produced government constructed villas
  - poor construction
  - no insulation
  - single pane glazing
- retrofit
  - improvements made on the original homes, often by the homeowners
  - cosmetic renovations to the façade
  - generic double pane glazing

energy use templates

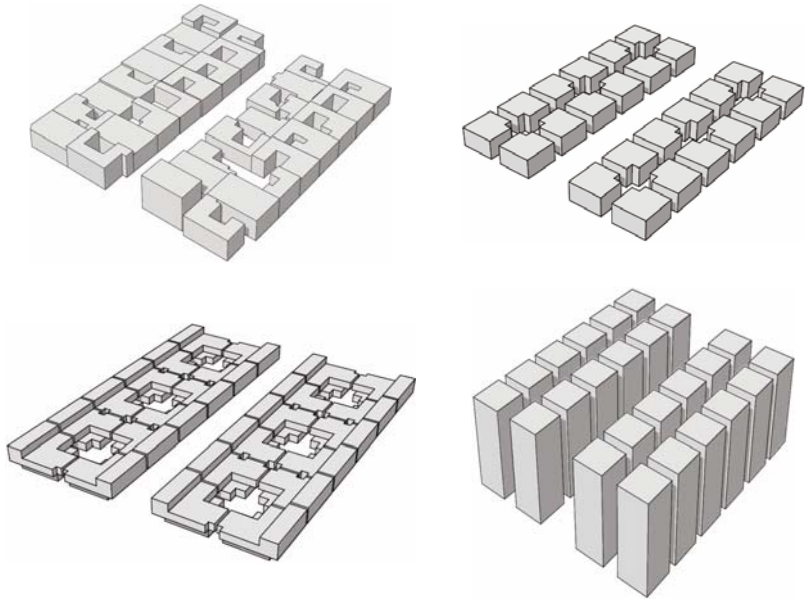
- modern
  - privately built new construction
  - insulated
  - double pane glazing

- revised
  - based on 2010 Building Code
  - not yet applied to villas in the neighborhood
  - increased insulation
  - coated windows

energy use

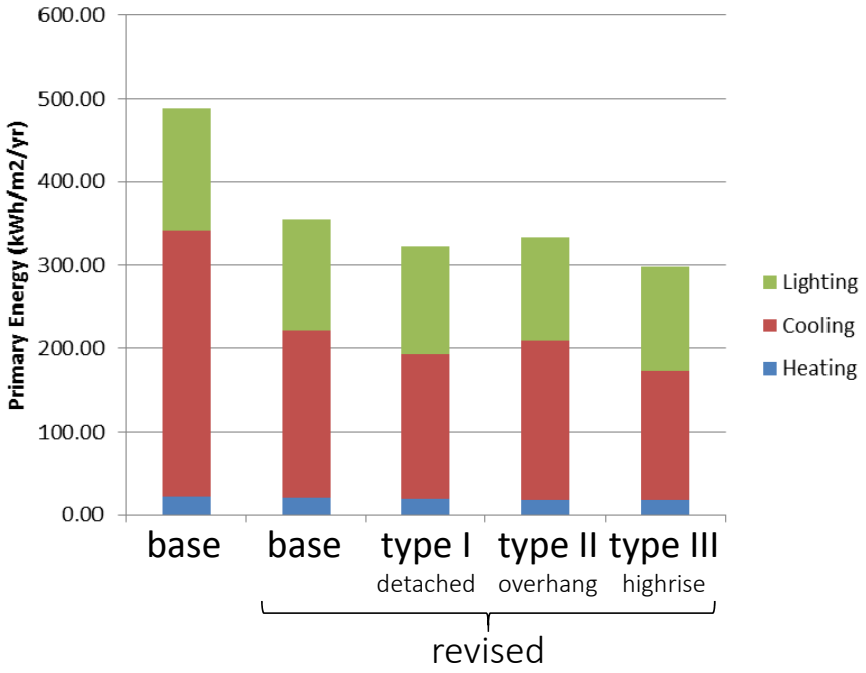


original
retrofit
modern



revised

energy use



operational energy use

embodied energy

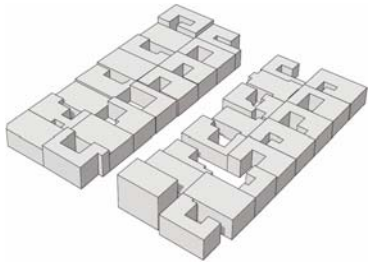
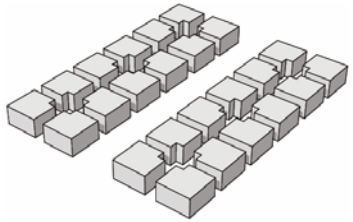
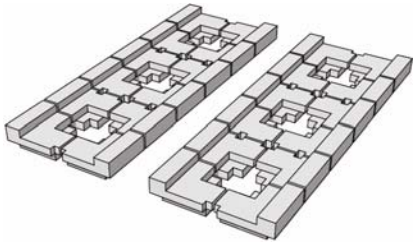
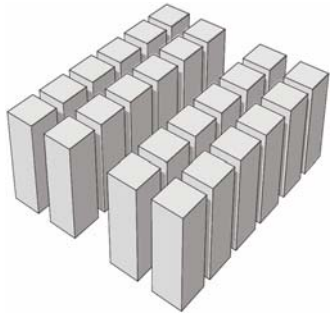
promote walkability

outdoor comfort

daylight autonomy

energy intensity

summary

		energy use kWh/m²/yr	walkability min - max	outdoor comfortable hours	daylight average cDA	embodied kWh/m²/yr
base FAR 1.4		488	3 – 21%	78%	55%	25
type I detached FAR 1.4		321	7 – 37%	79%	69%	17
type II overhang FAR 1.4		333	7 – 37%	84%	68%	22
type III highrise FAR 5.5		298	20 – 45%	89%	26%	16

thank you