

EuHPN Workshop 2023

Augmented Healthcare Design of the Future

LINK Arkitektur





Jan Buthke

Head of LINK IO
Digital Innovation Lead
Architect

LINK Arkitektur is a leading architectural group in Scandinavia, specialised in healthcare design, climate-smart construction and computational optimisation

3 countries / 15 cities / +500 employees / more than 2M sq.m. of hospital architecture /

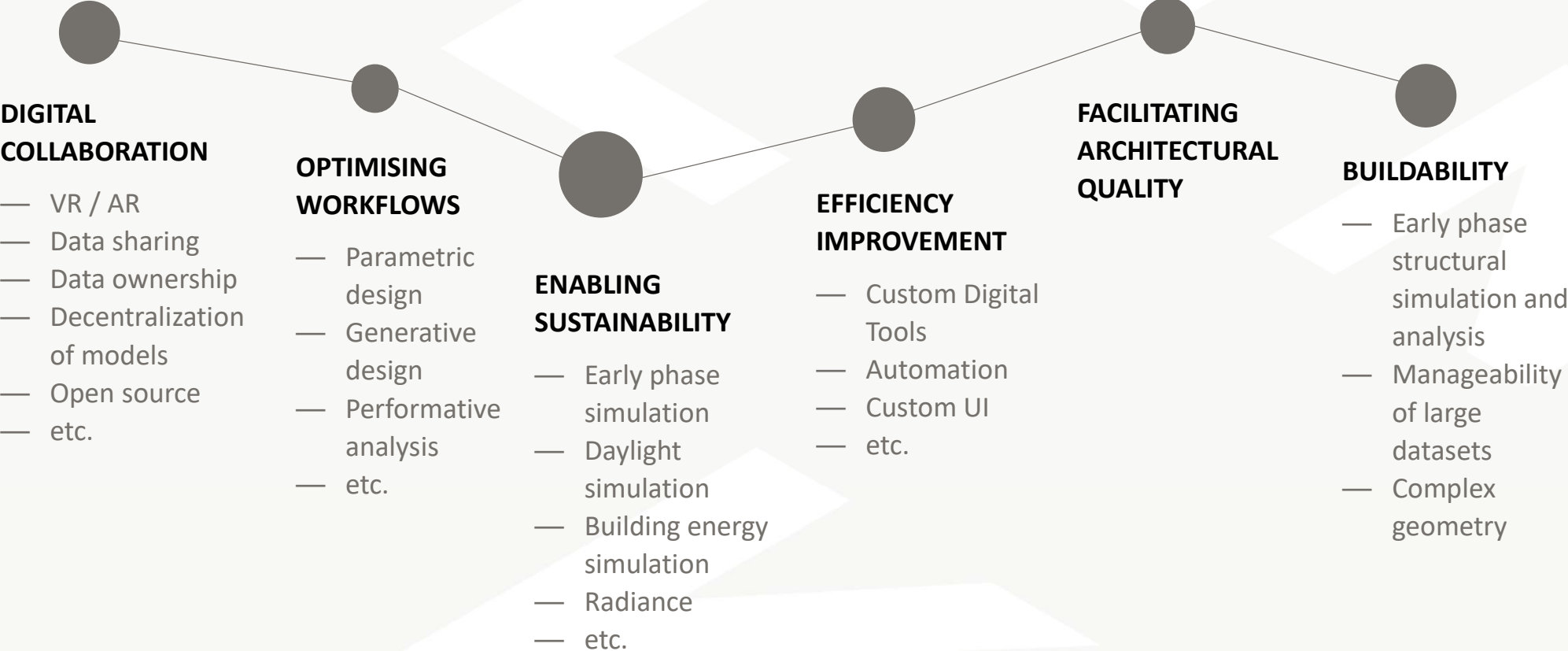
The New North Wing at Rigshospitalet, Copenhagen, DK

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**World
Architecture
Festival 2021
Winner**

Designing for tomorrow



Sustainability – Impact architecture

LINK contributes to achieving the UN's sustainability goals – through LINK Kompass®. A working methodology for ensuring sustainable architecture.



Augmented Healthcare Design of the Future

The inscription of the architect into the algorithm. Value based architecture, can only to a certain extent be based on scientific facts, but has to a substantial degree to relay on *the designer's experience and empery.*

Architectural quality (LINK Arkitektur)

VS

AI and digital technology (LINK IO)

Compatible or incompatible?

LINK IO.

We are solving tomorrow's global challenges on a local level through the advantages of a computational network of human experts. Local knowledge. Global experts. Better projects.

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It is essential for us to combine evidence based scientific research with empirical knowledge, accumulated within our department for healthcare over time.

Scientific research. Empirical knowledge.

The augmented Architect.

To automate and assist actions related to the planning of large hospital projects through the visualisation of data and insights.

Case study

The North Wing

Area: 88 900 m²

Designed: 2010

Inaugurated: 2020

Collaborators:

3XN, Nickl & Partner, Sweco, Kirstine Jensens Tegnesteue

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Redesign slide

Jan Buthke; 2022-09-15T07:19:25.715



Case study

The North Wing

Area: 88 900 m²

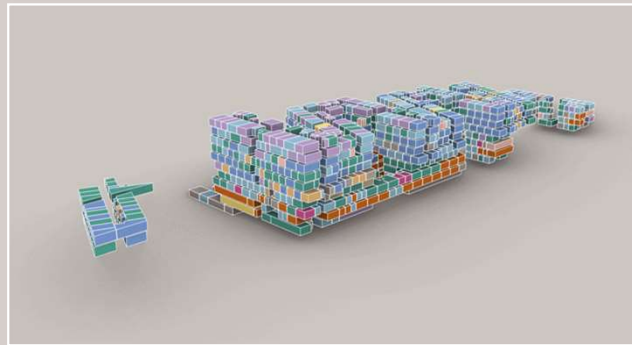
Designed: 2010

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Examples



Example 1
Early phase design



Example 2
Building in operation

Example 1

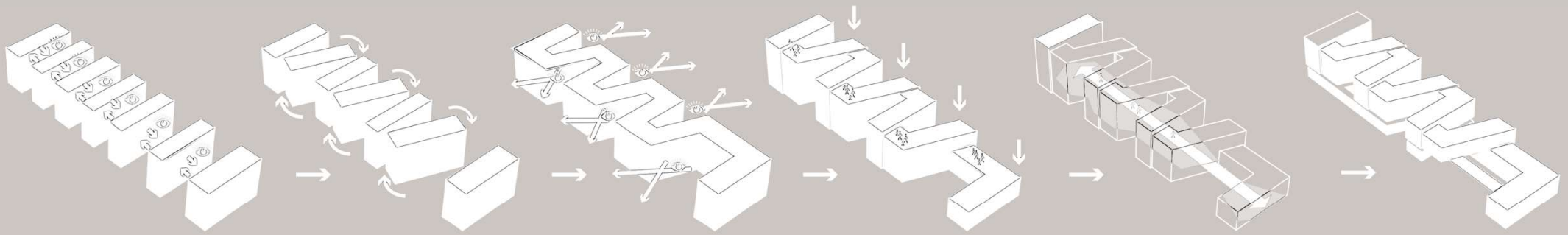
IO Healthcare planner

Roomulator. Spaceplanner. LCA

Guestimator. Climate-smart Hospital

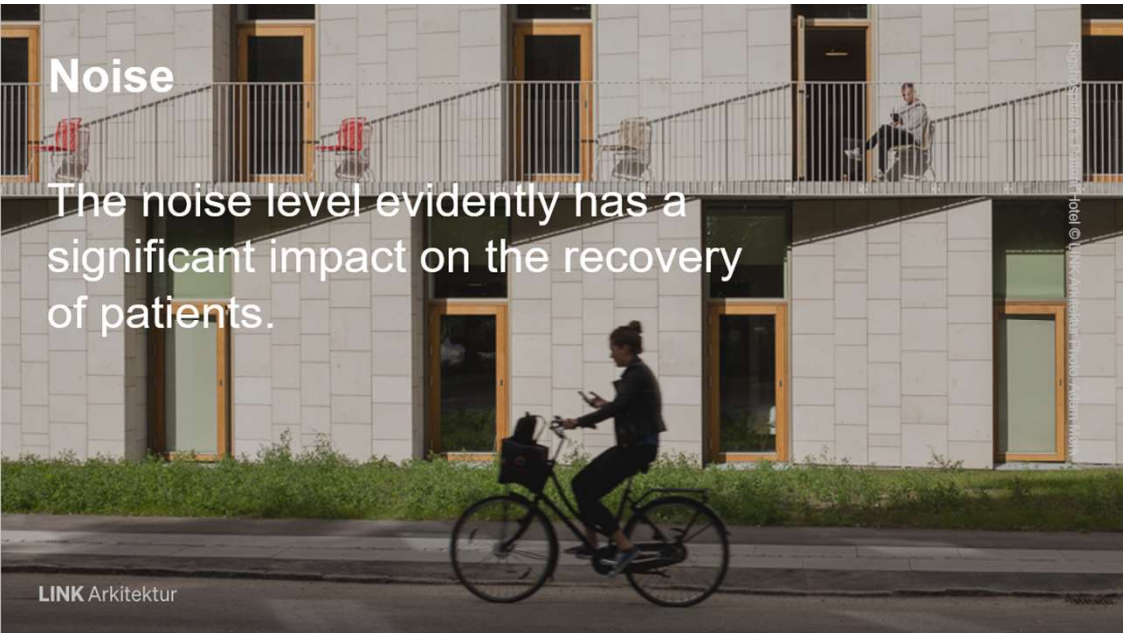
Design

#1 - *conceptual design*



#7 – Analysis

- Views
- Noise
- Distance
- Spatial Variation
- Daylight
- **Etc.**



Noise

The noise level evidently has a significant impact on the recovery of patients.

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Rigshospitalet's New North Wing © LINK Arkitektur Photo: Adam Mark



Daylight

Daylight evidently has a significant impact on the recovery of patients.

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Rigshospitalet's New North Wing © LINK Arkitektur Photo: Adam Mark



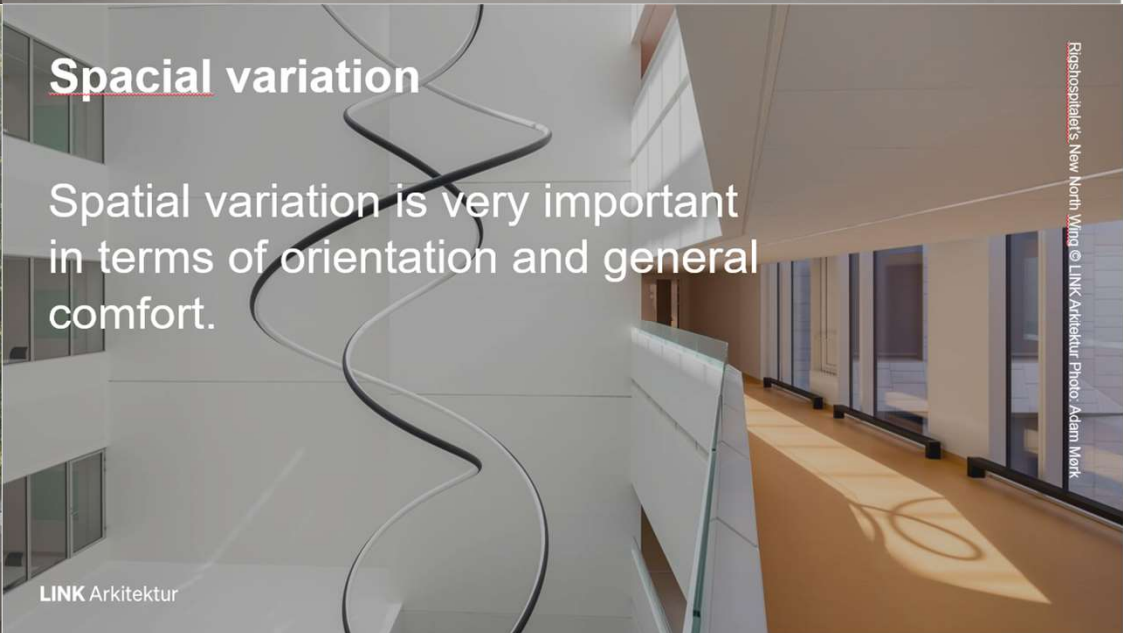
Views

Views evidently have a significant impact on the recovery of patients.

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Rigshospitalet's New North Wing © LINK Arkitektur Photo: Adam Mark



Spatial variation

Spatial variation is very important in terms of orientation and general comfort.

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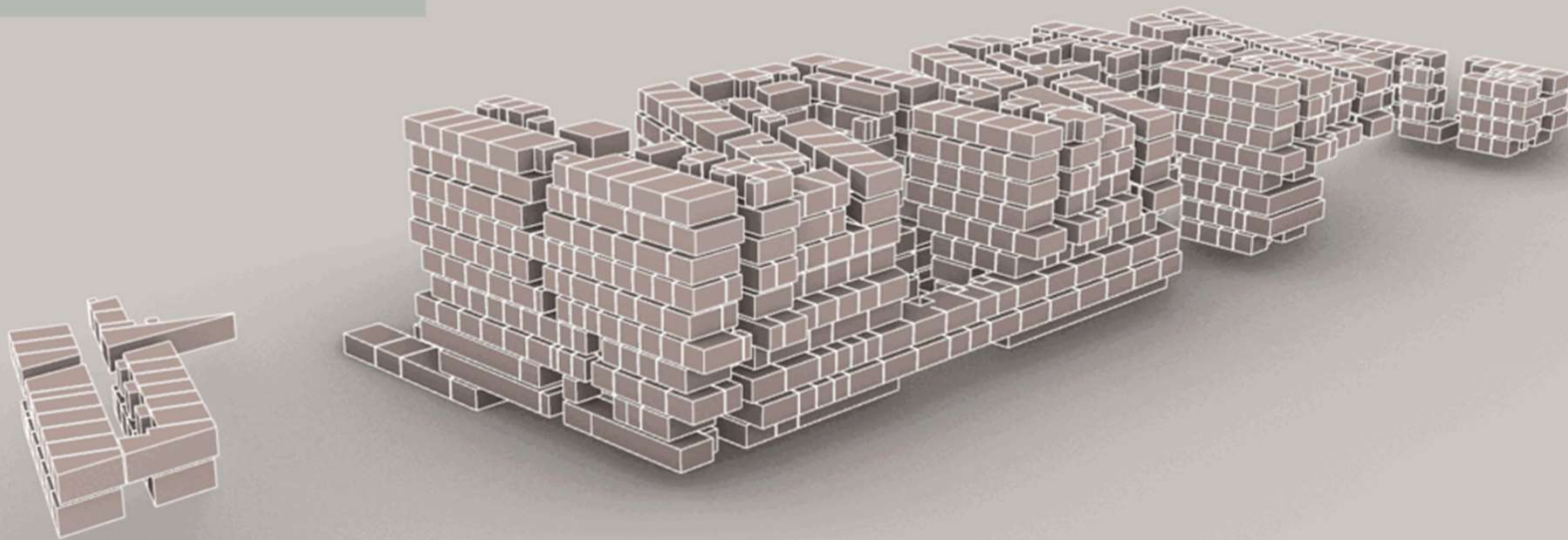
Rigshospitalet's New North Wing © LINK Arkitektur Photo: Adam Mark

Step #7 – Analysis

Room based emissions

Concrete

Massive Wood



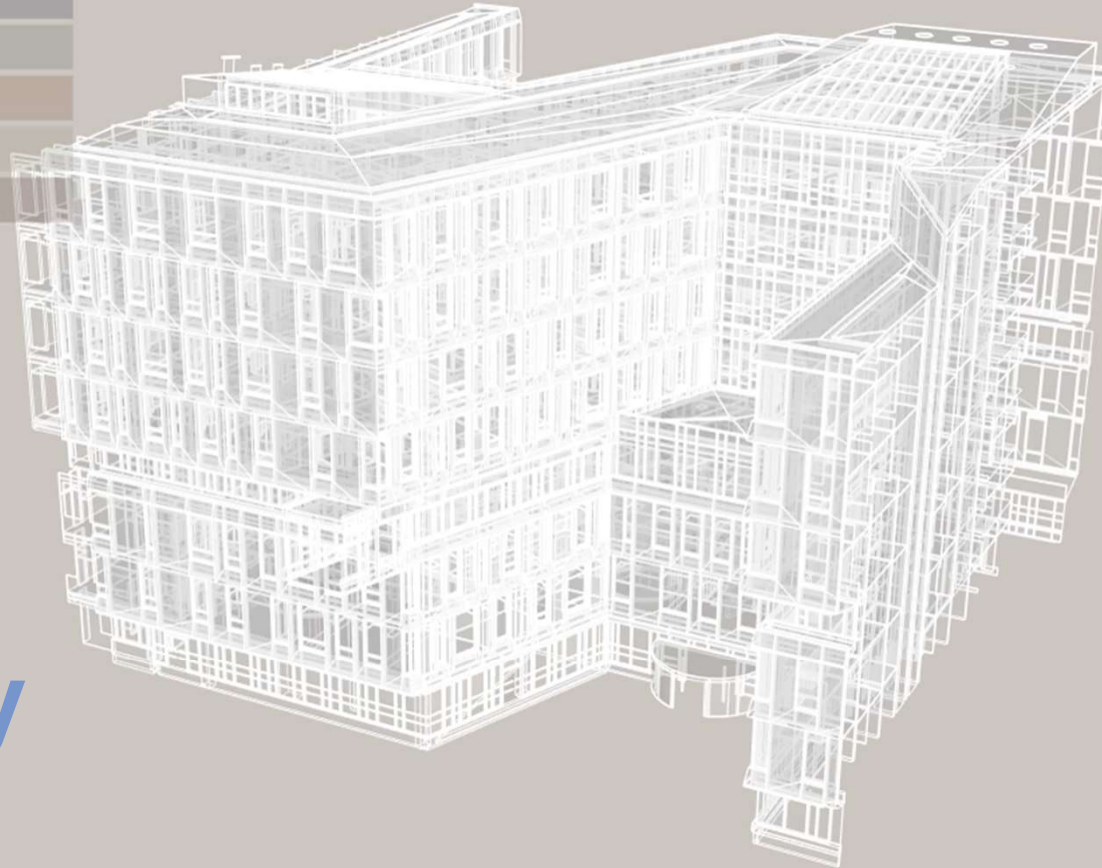
Concrete



Massive wood

Step #8 – LCA Guesstimating

- + Walls
- + Roofs
- + Windows
- + Slabs
- + Foundation



Materiality



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Can we cut upfront carbon by 50% today?

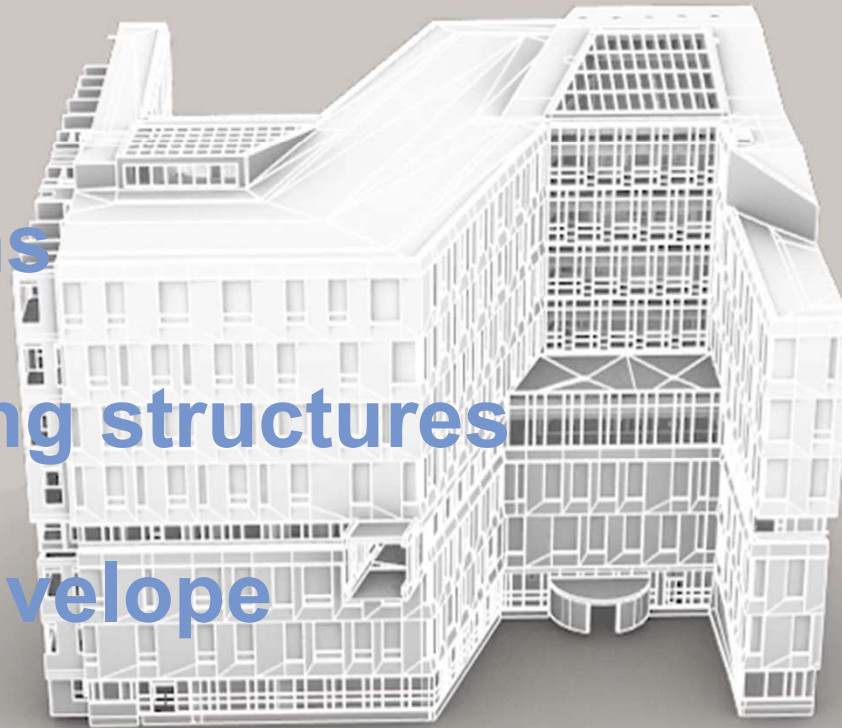
Vaxjö Styrhus in collaboration with Skanska, Arkitema, Arkitektbolaget

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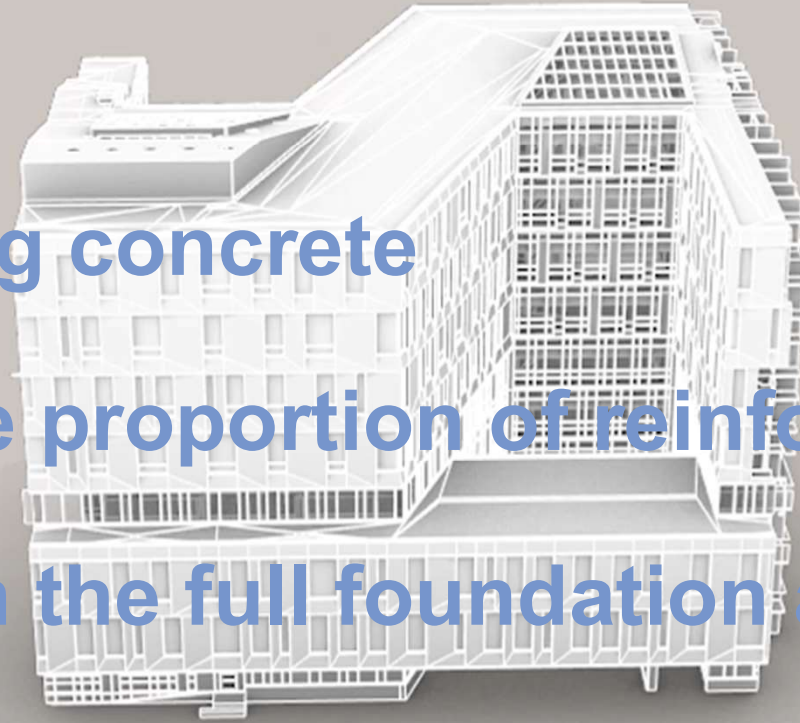
Building elements

- Foundations
- Load bearing structures
- Building envelope
- Interior walls and surfaces



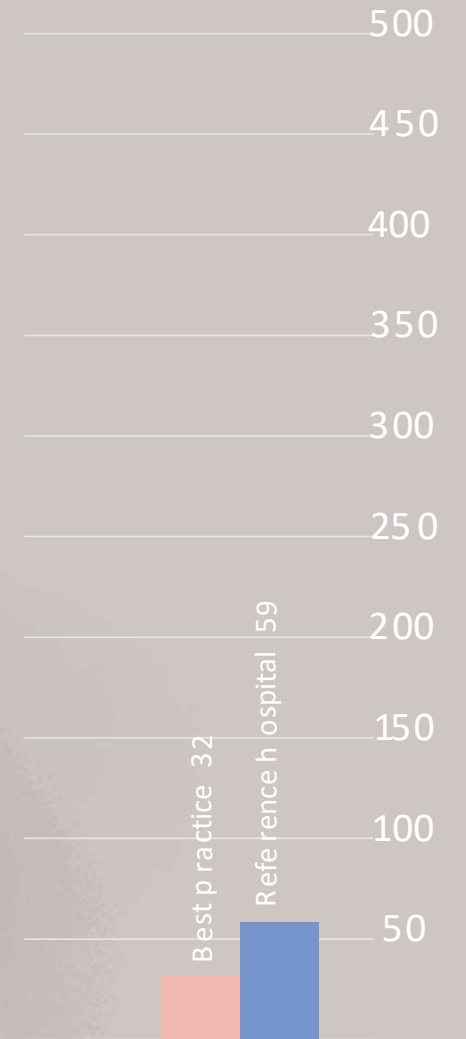
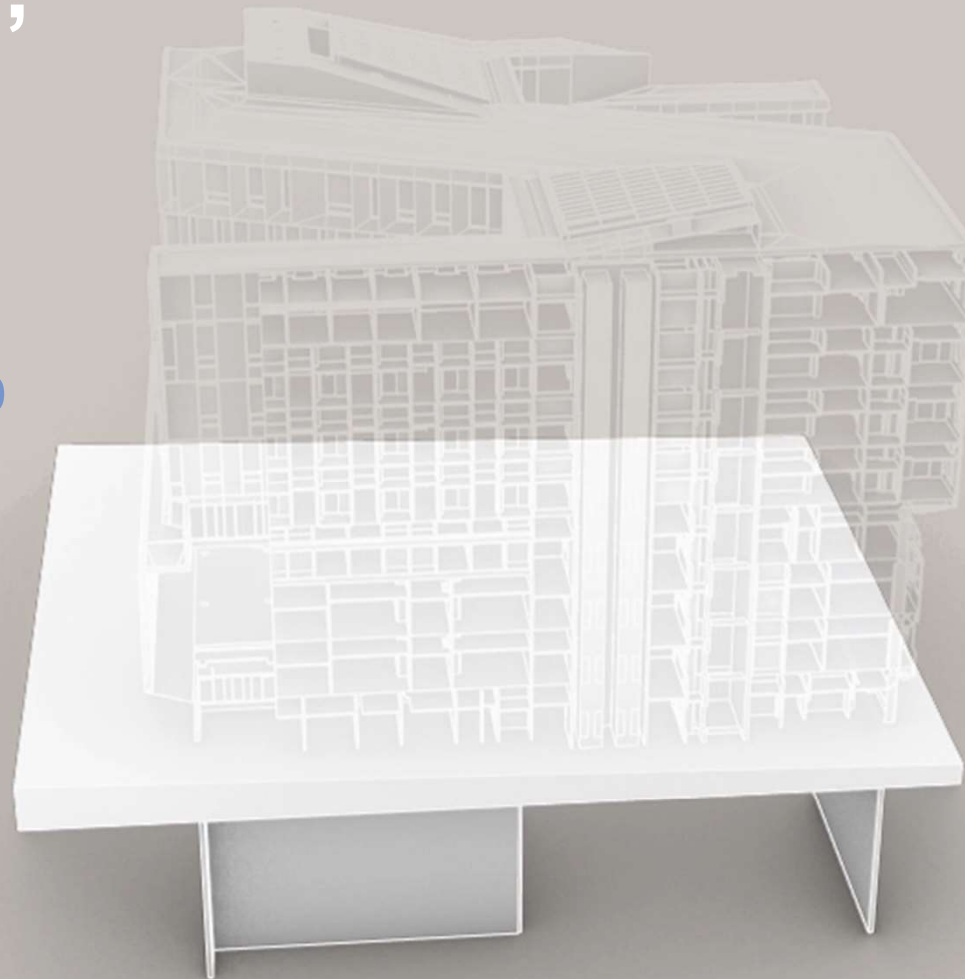
Foundations

- **Low-emitting concrete**
- **Increase the proportion of reinforcement**
- **Optimise on the full foundation and its materials**



Foundations, results

Minus 49 %



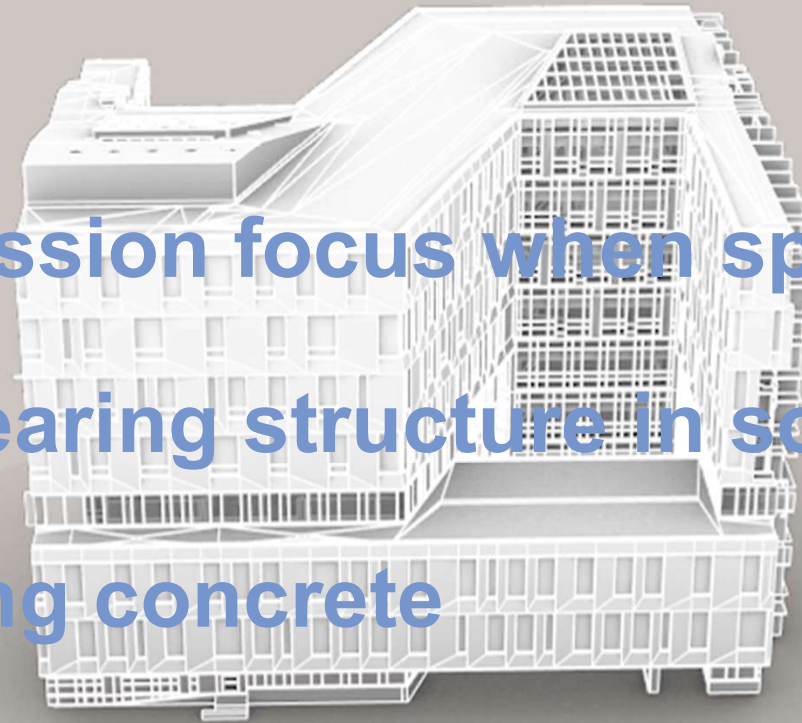
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Reference hospital vs. Best practice kg CO2/Gross area m2

Found at ions

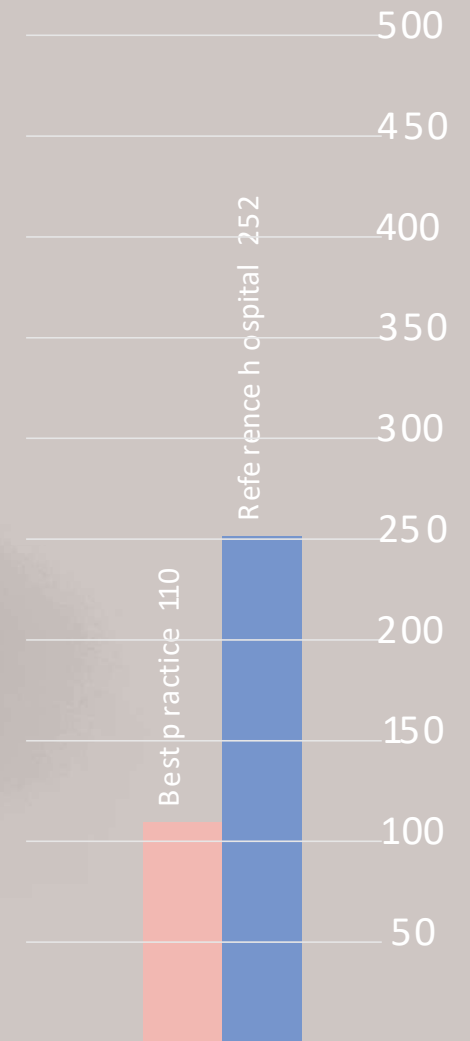
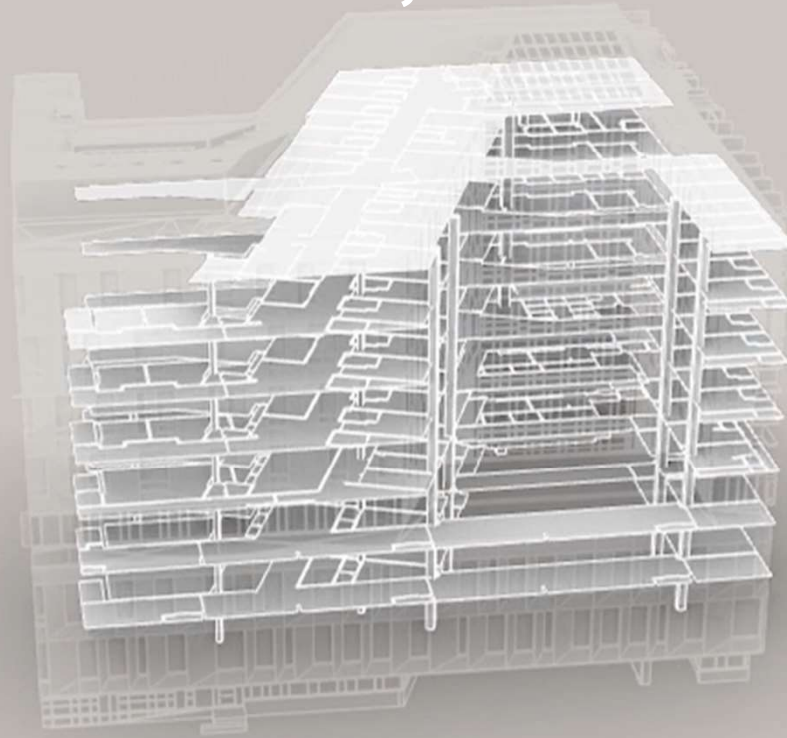
Load bearing structures

- Carbon emission focus when spaceplanning
- 30% load bearing structure in solid wood
- Low emitting concrete
- Sequestered carbon

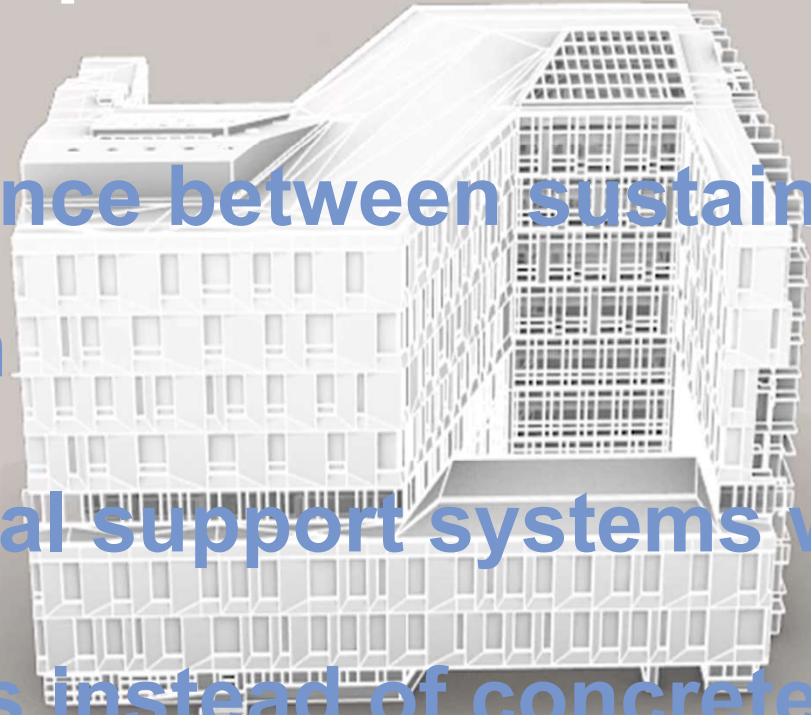


Load bearing structures, results

Minus 51 %

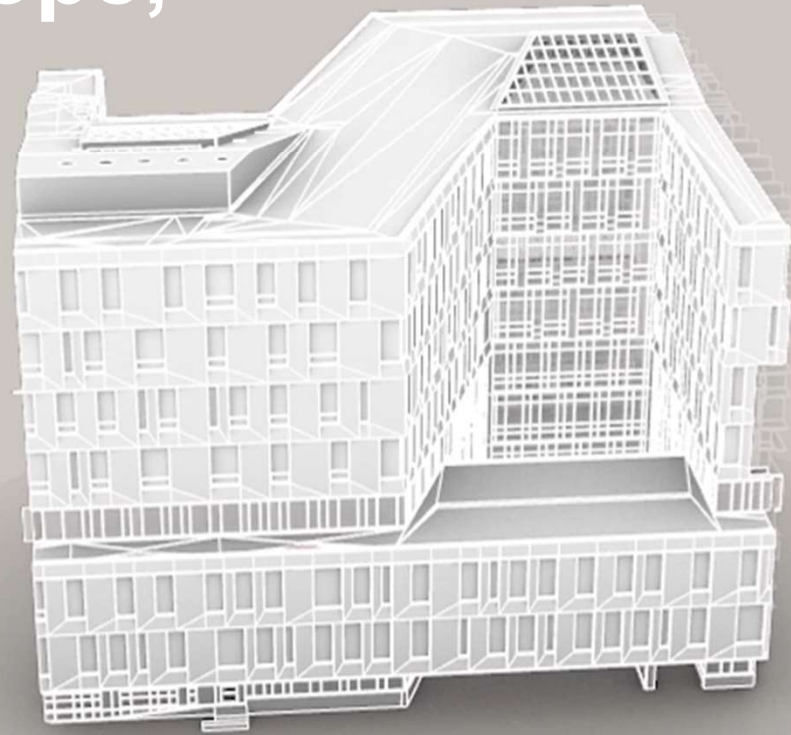


Building envelope

- Holistic balance between sustainability, form and function
 - Replace metal support systems with wood
 - Curtain walls instead of concrete
 - Use recycled materials for cladding
- 

Building envelope, results

Minus 60 %

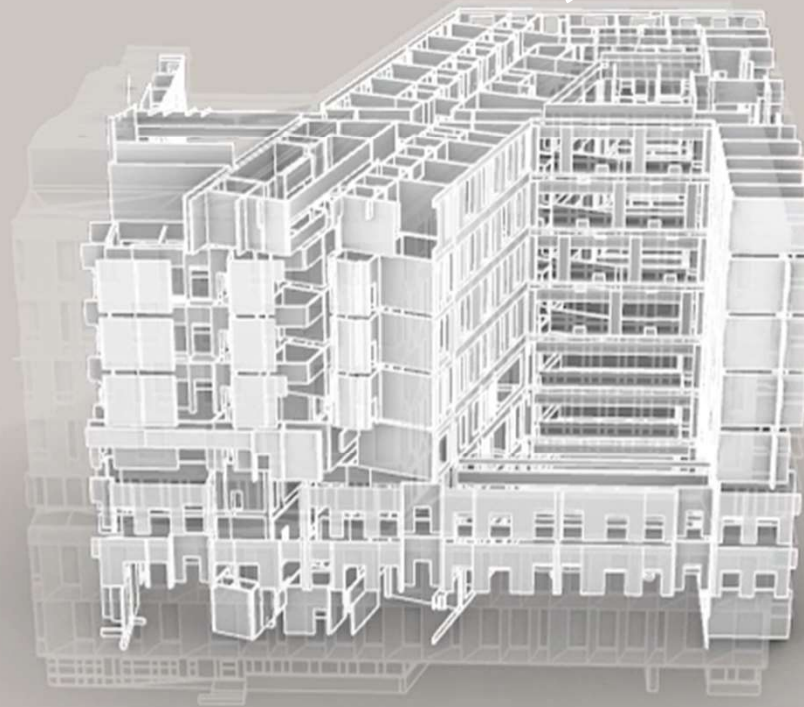


Interior walls and surfaces

- Solid wood sections instead of steel or aluminum
- Reduce the number of glass sections
- Reduce the use of suspended ceilings
- Replace plasterboard with wooden boards

Interior walls and surfaces, results

Minus 25 %

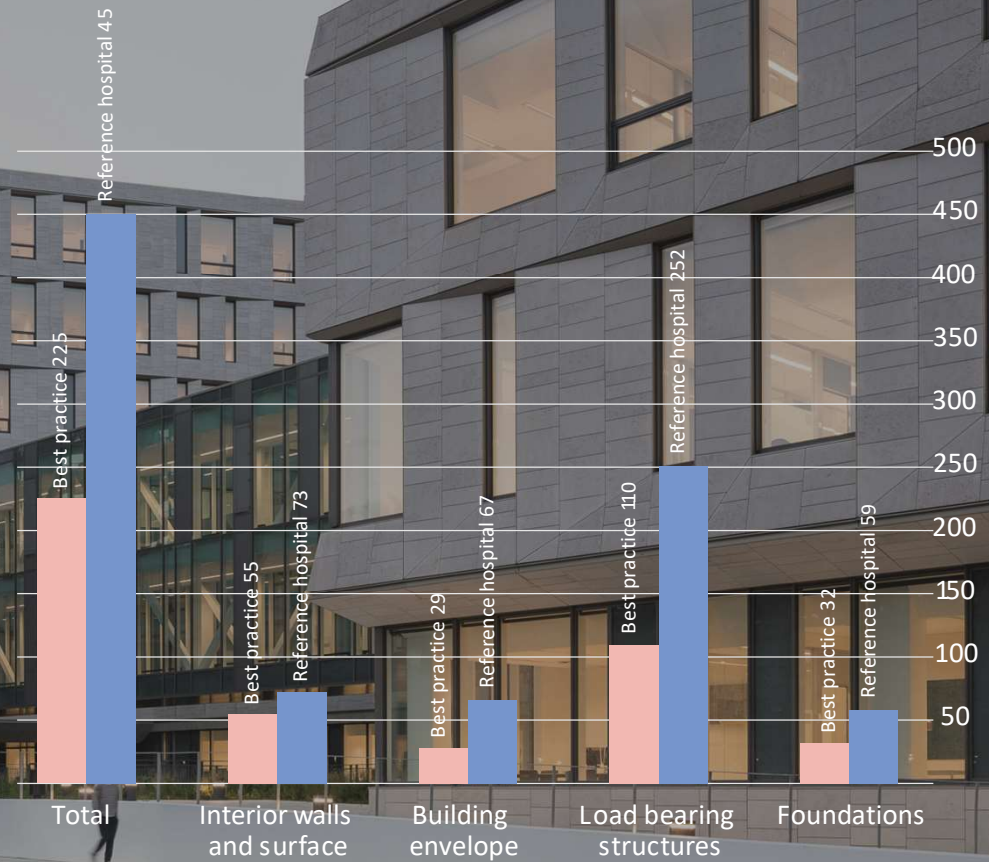


Reference hospital vs. Best practice

kg CO2/Gross area m2

Minus more than 50 % upfront carbon

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Växjö Hospital, Växjö, SE

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NORRA ENTRÉN

Växjö Hospital in collaboration with Arkitektbolaget, Skanska and Arkitema

Växjö Hospital, Växjö, SE

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Växjö Hospital in collaboration with Arkitektbolaget, Skanska and Arkitema



Växjö Hospital, Växjö, SE

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Växjö Hospital in collaboration with Arkitektbolaget, Skanska and Arkitema

Växjö Hospital, Växjö, SE

Växjö Hospital in collaboration with Arkitektbolaget, Skanska and Arkitema

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Example 2

Augmented Optimisation.

Tools to improve the operation of hospitals through AI driven spacial and programmatic optimisation.

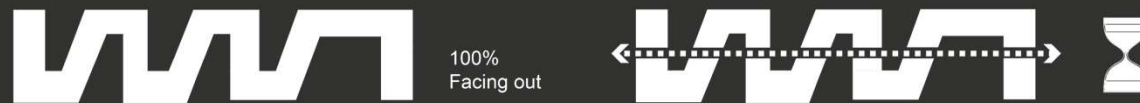
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JB0

04 skal være 02

Jan Buthke; 2022-09-15T07:23:02.984

Optimisation of flow and intensity



Data

Input Data:
Room program

| Name | Count | Area | Comments |
|--------|-------|------|---------------------|
| Room 1 | 1 | 20 | Lorem ipsum |
| Room 2 | 1 | 50 | Sed ut perspiciatis |
| Room 3 | 2 | 10 | At vero eos et |
| ... | ... | ... | ... |



Historical data

AI Based Data
parsing and
classification



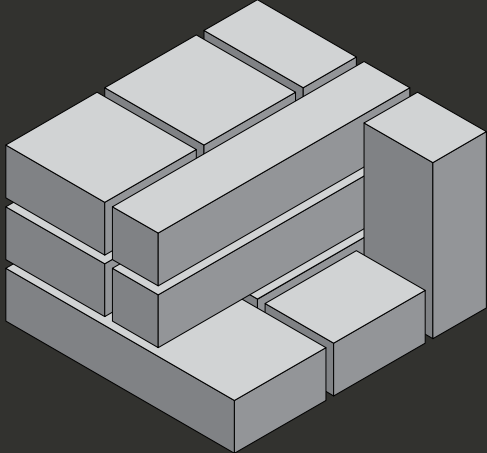
Augmented Data

Additional information to be added

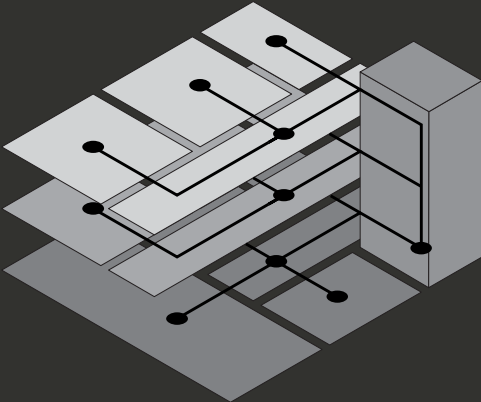
| Traffic | Noise | Inventory | ... |
|---------|-------|-----------|-----|
| 1 | 1 | [List] | ... |
| 2 | 1 | [List] | ... |
| 2 | 2 | [List] | ... |
| ... | ... | ... | ... |

Design data

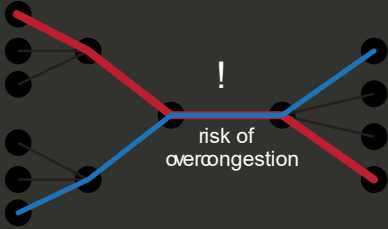
Divide by program



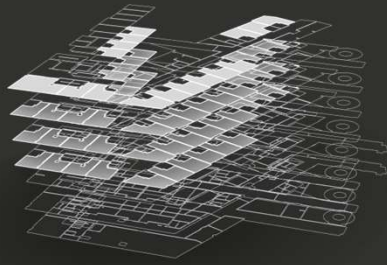
Track usage



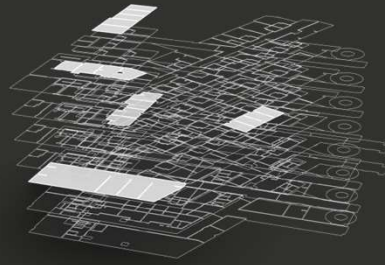
Find congestion



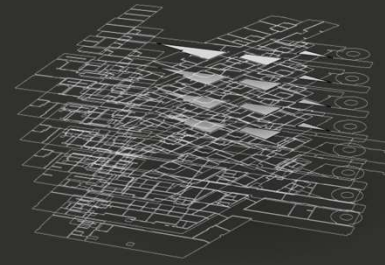
Programs



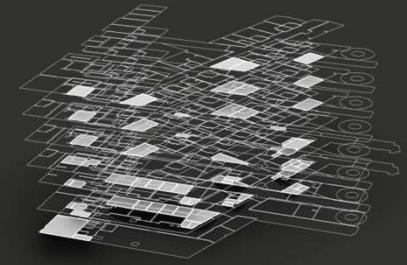
Patient



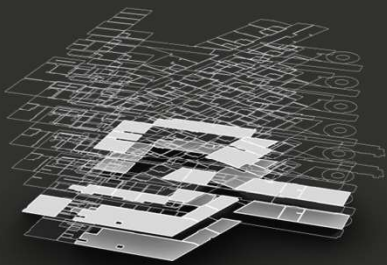
Office



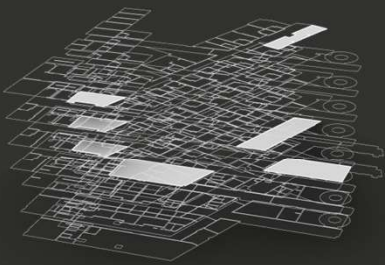
Uphold Space



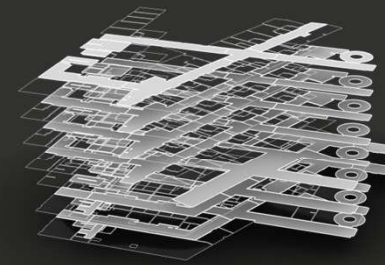
Storage



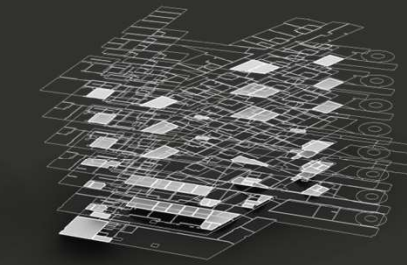
Medical



Auditorium/
Conference



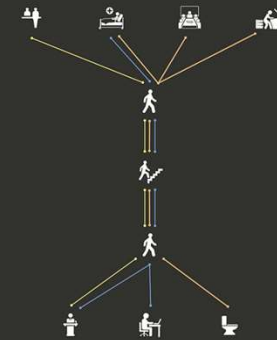
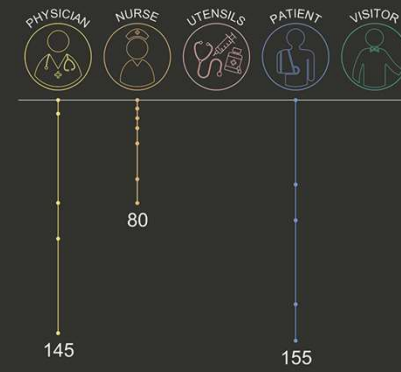
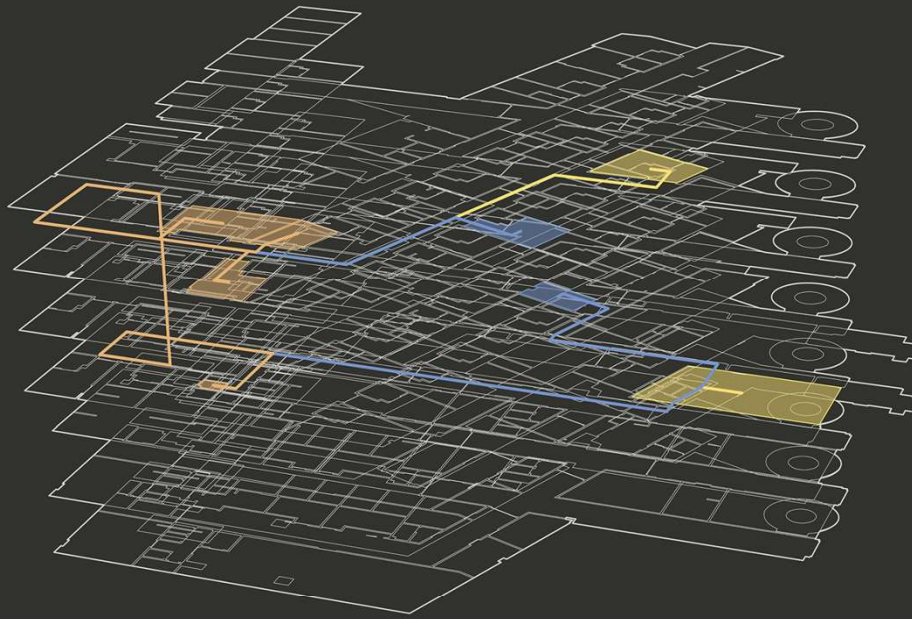
Circulation



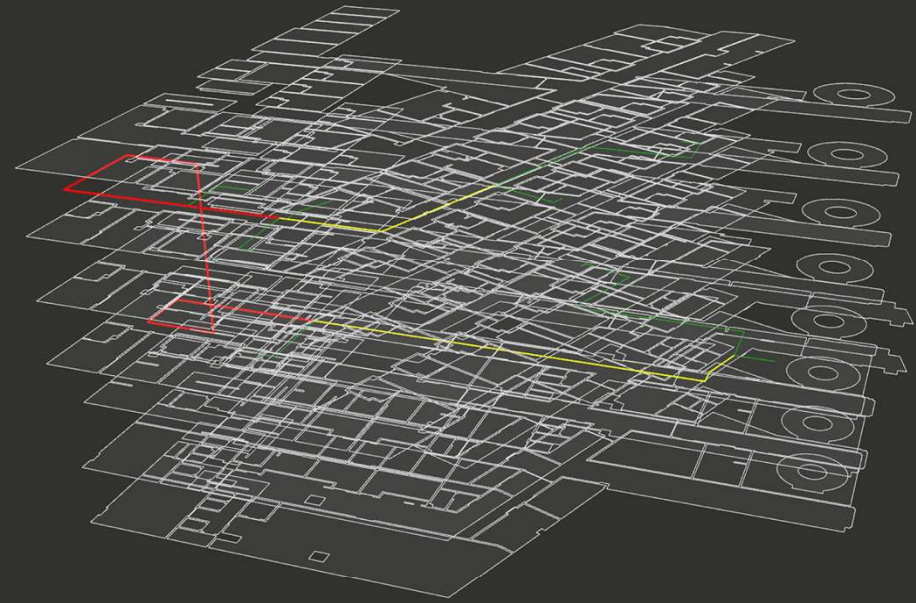
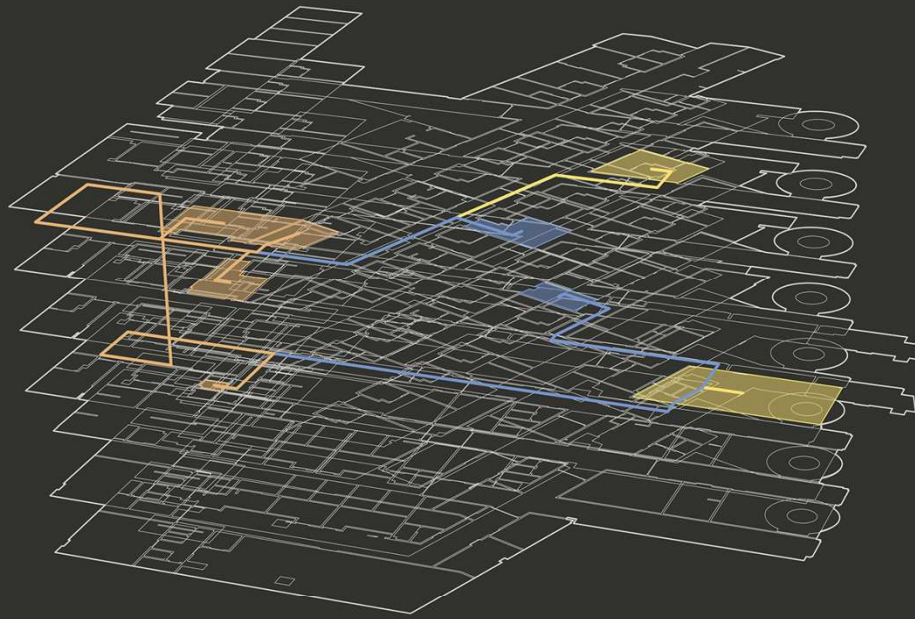
Back of House

Augmented Optimisation

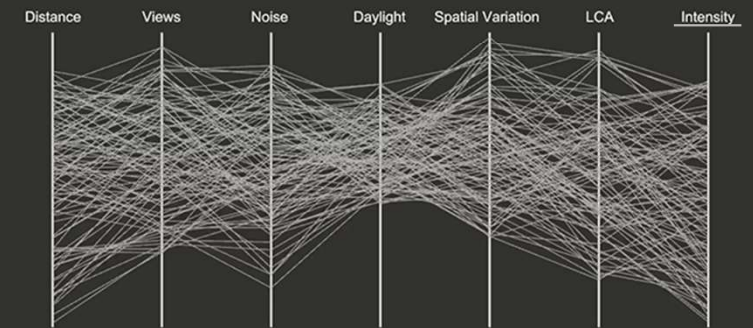
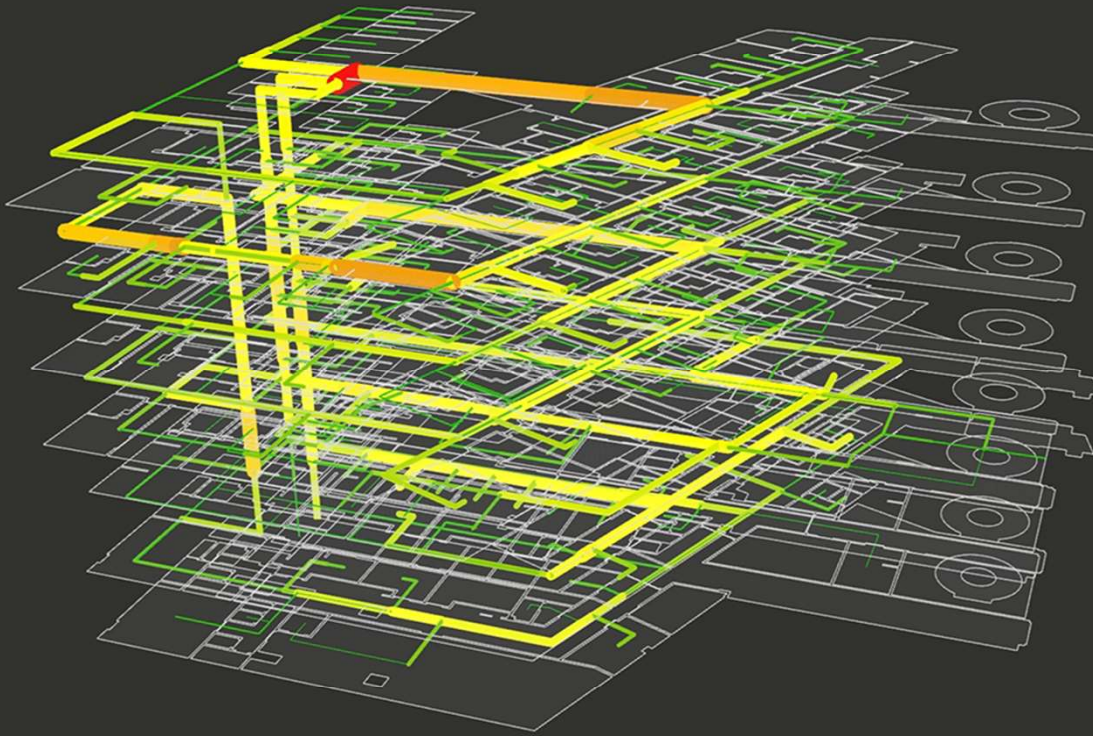
Flow analysis



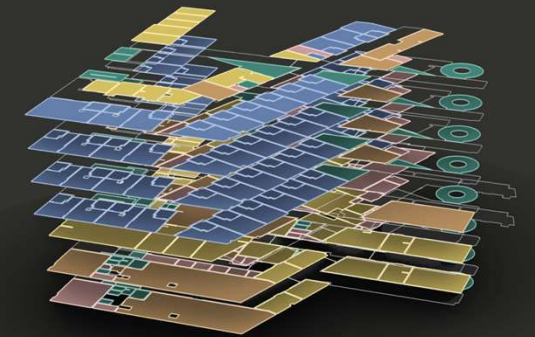
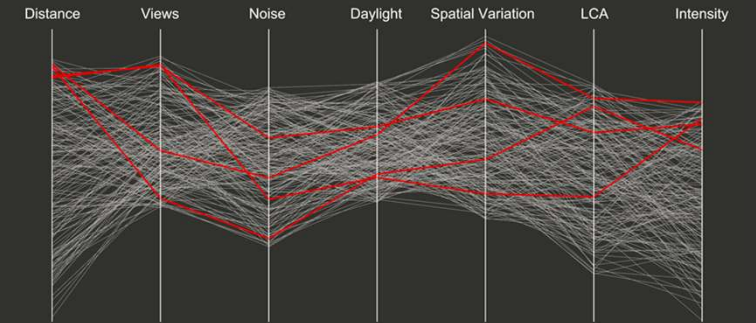
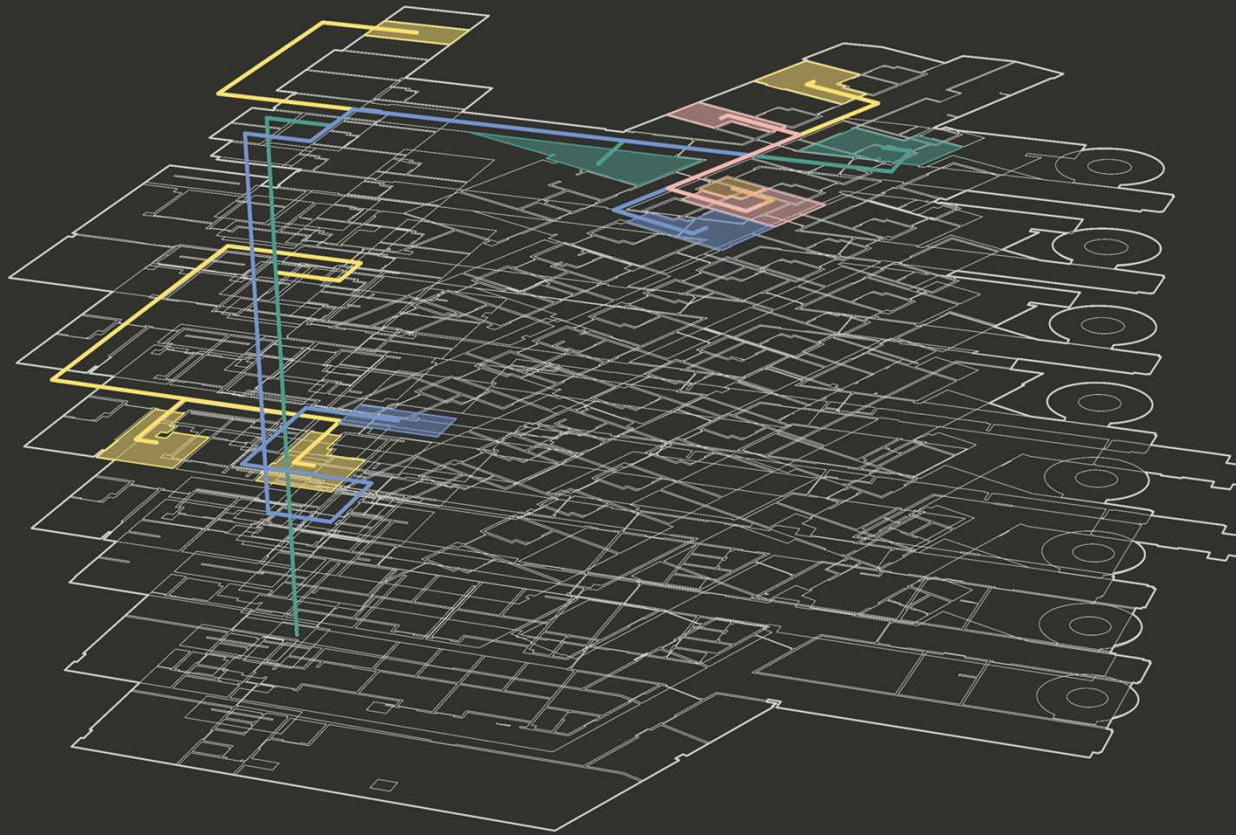
Flow intensity analysis



Flow intensity optimisation

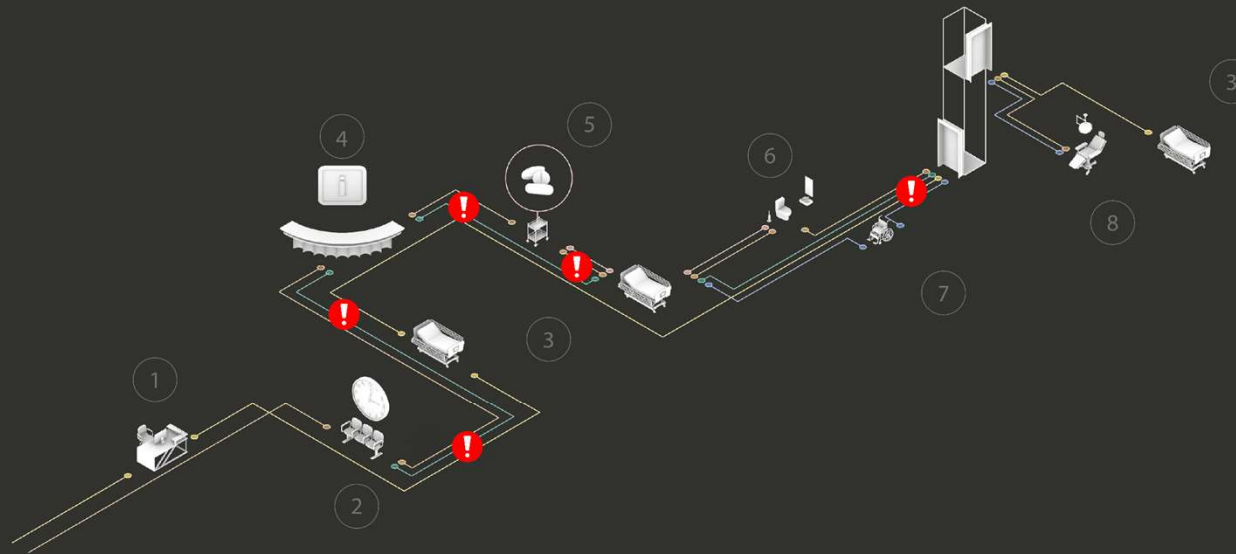
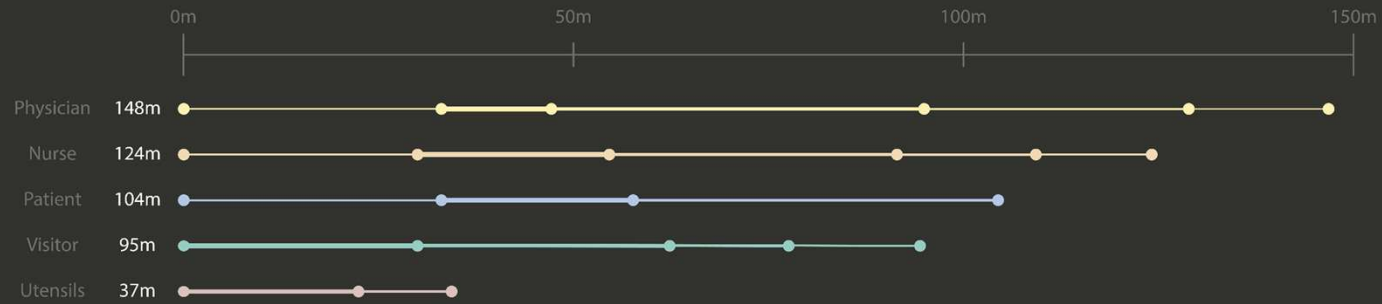


Before optimisation



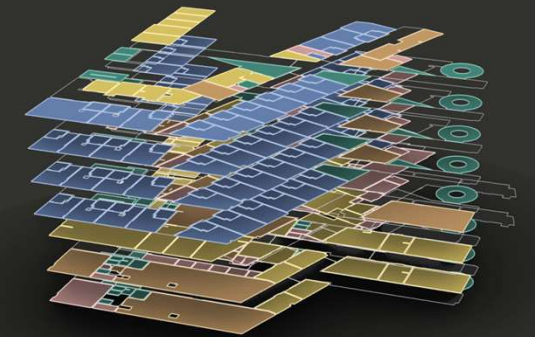
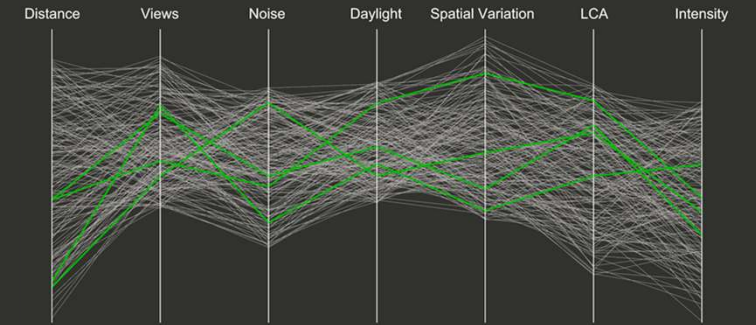
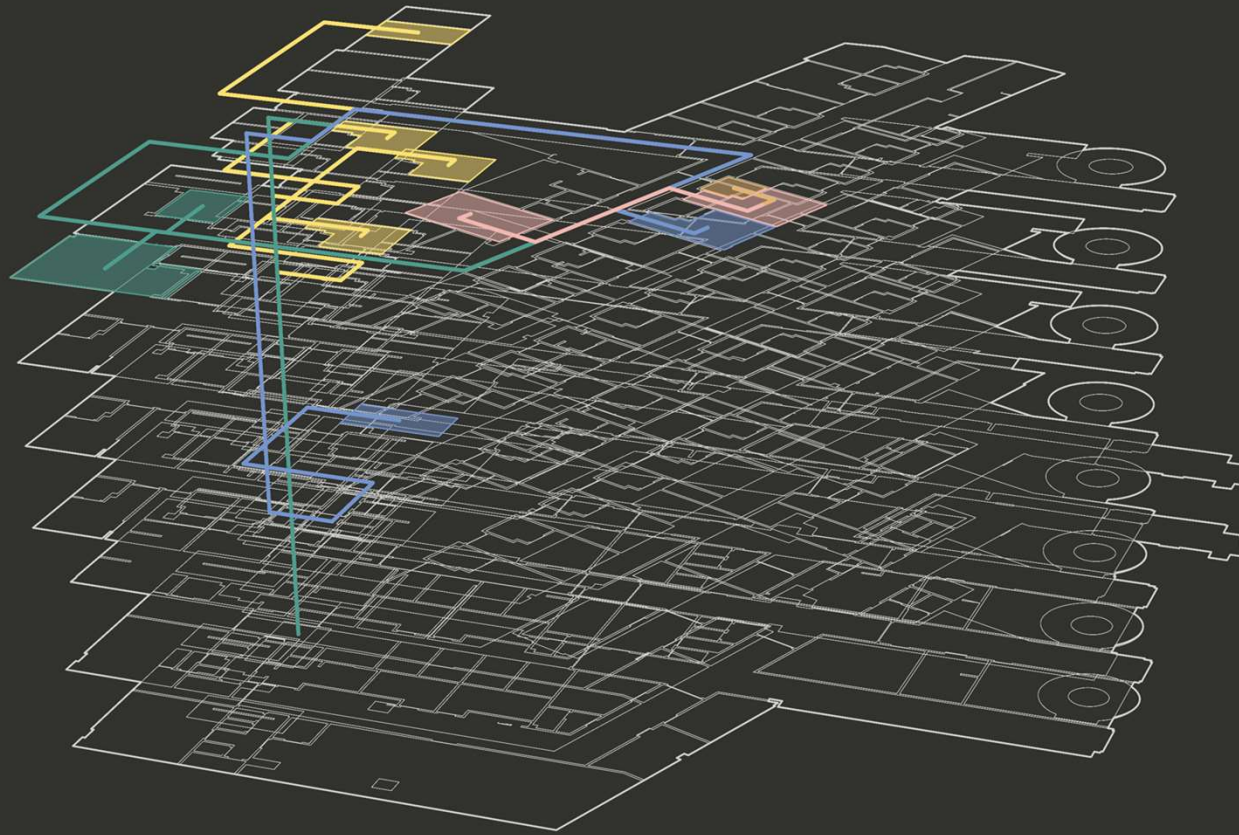
Before optimization

Before optimisation



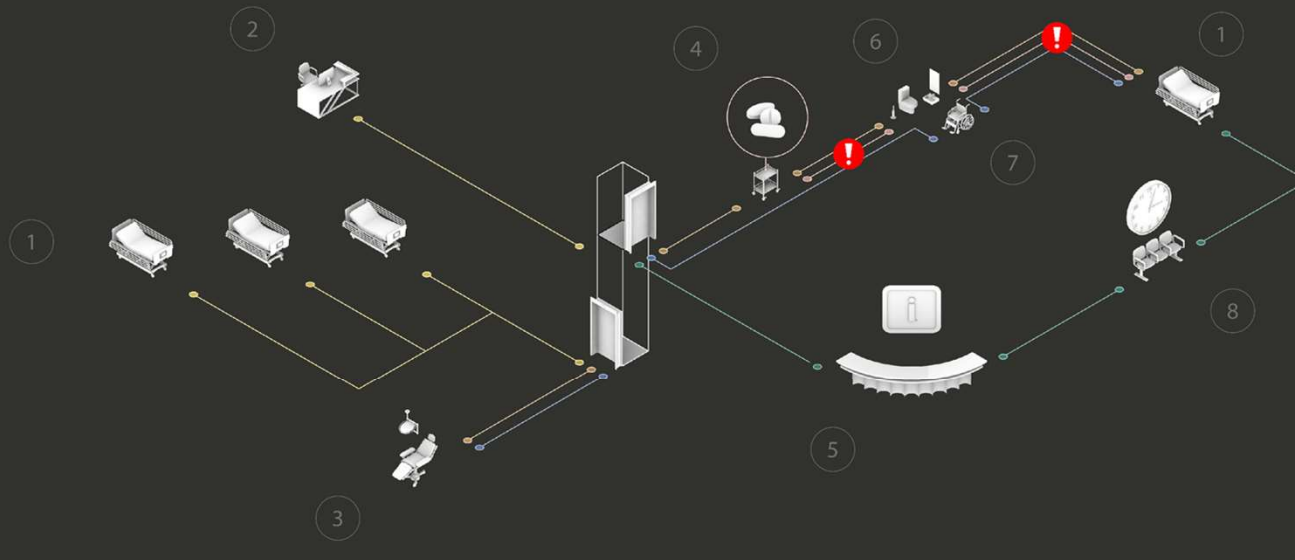
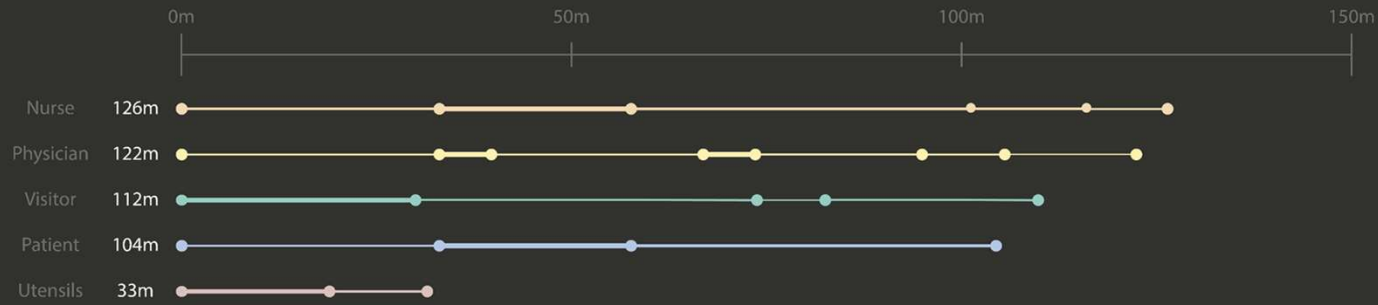
- 1 Office
- 2 Uphold Space
- 3 Patient Room
- 4 Reception
- 5 Storage
- 6 WC
- 7 Corridor
- 8 Medical Room
- 3 Patient Room

After optimisation



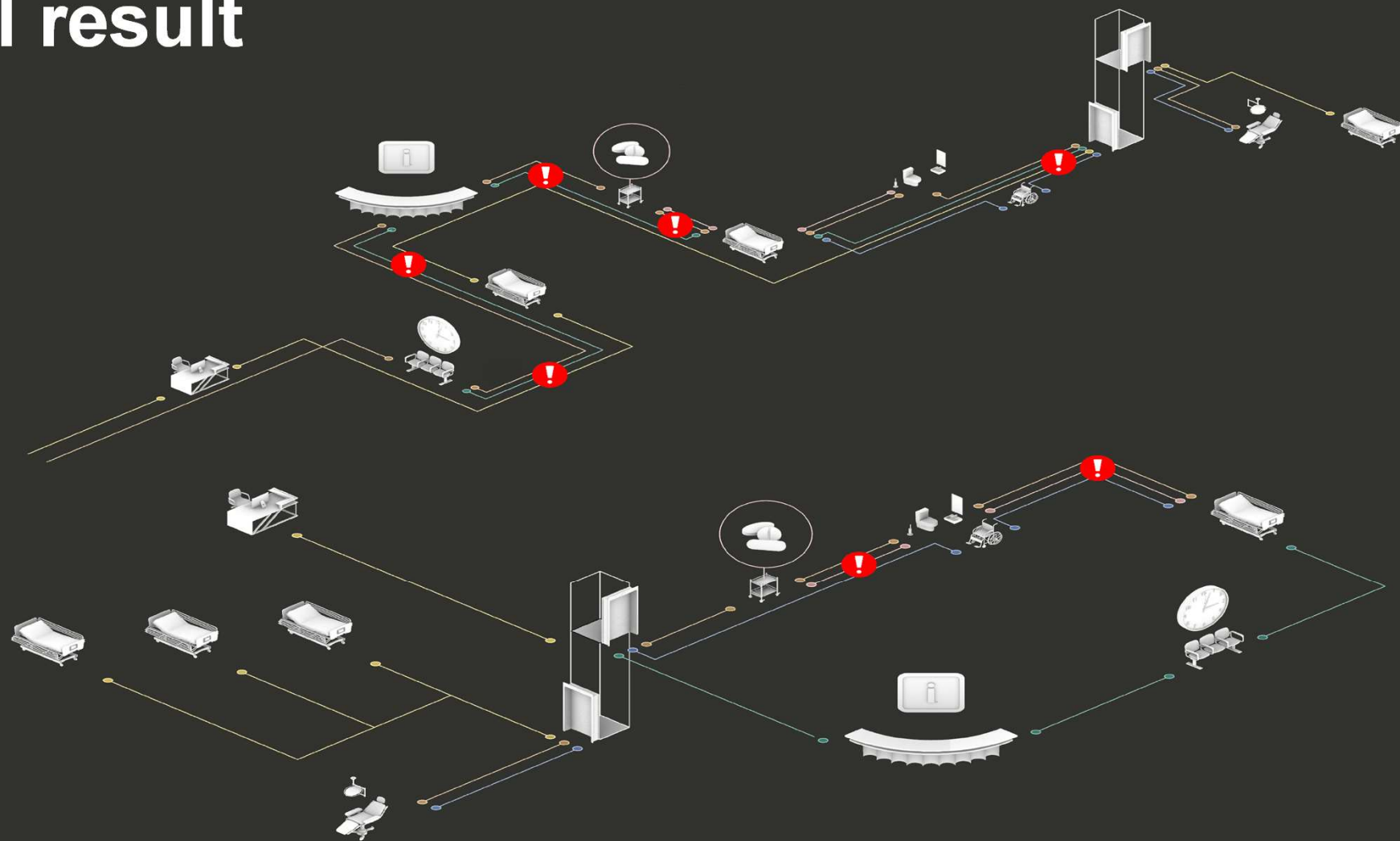
Before optimization

After optimisation



- 1 Patient Room
- 2 Office
- 3 Medical Room
- 4 Storage
- 5 Reception
- 6 WC
- 7 Corrido
- 8 Uphold Space
- 1 Patient Room

Total result



Augmented Optimisation

Conclusion

Augmented healthcare design of the future – the augmented architect - successfully weaves the powerful potentials of artificial intelligence with the empirical knowledge built up through experience.

Thank you - come talk to us!



Jan Buthke

Head of LINK IO
Digital Innovation Lead, Architect
jb@linkarkitektur.dk



Mette Dan Weibel

Director of Healthcare
Architect
mdw@linkarkitektur.dk