National Graphene Institute

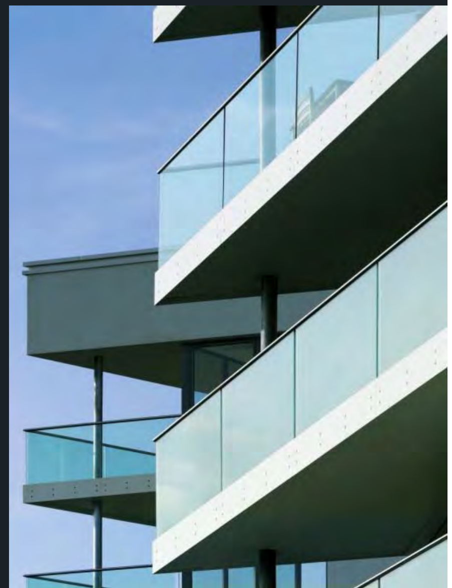
University of Manchester

Graphene & 2D Material International Conference + Exhibition, Montreal

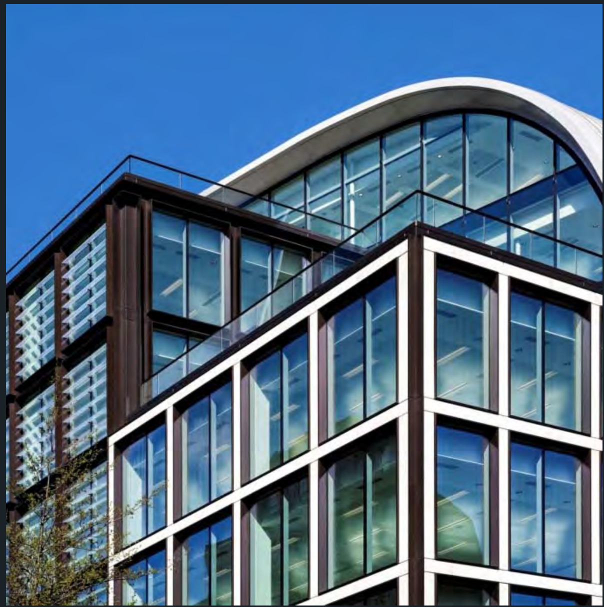
jestico + whiles

jestico + whiles

Education



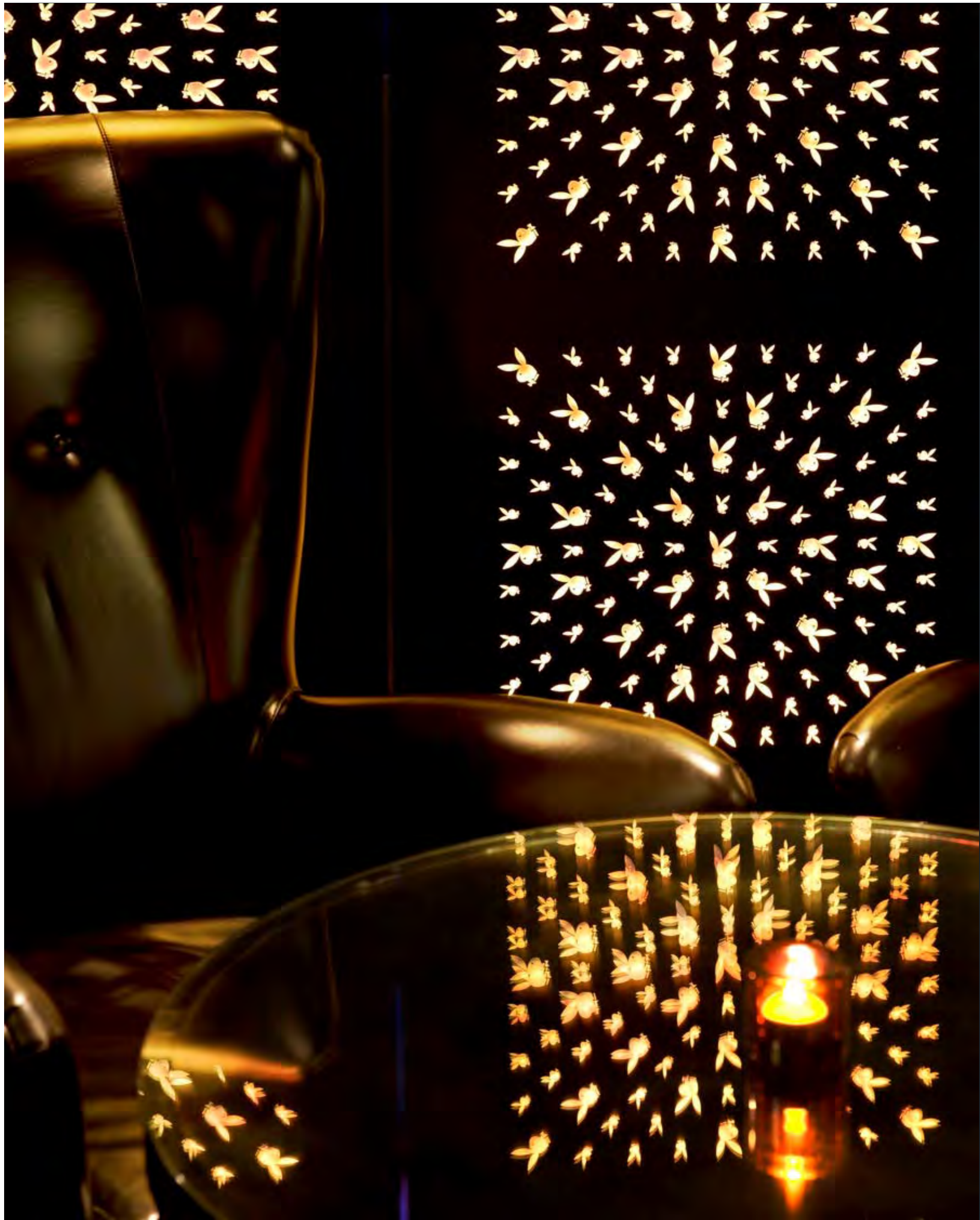
Housing



Offices

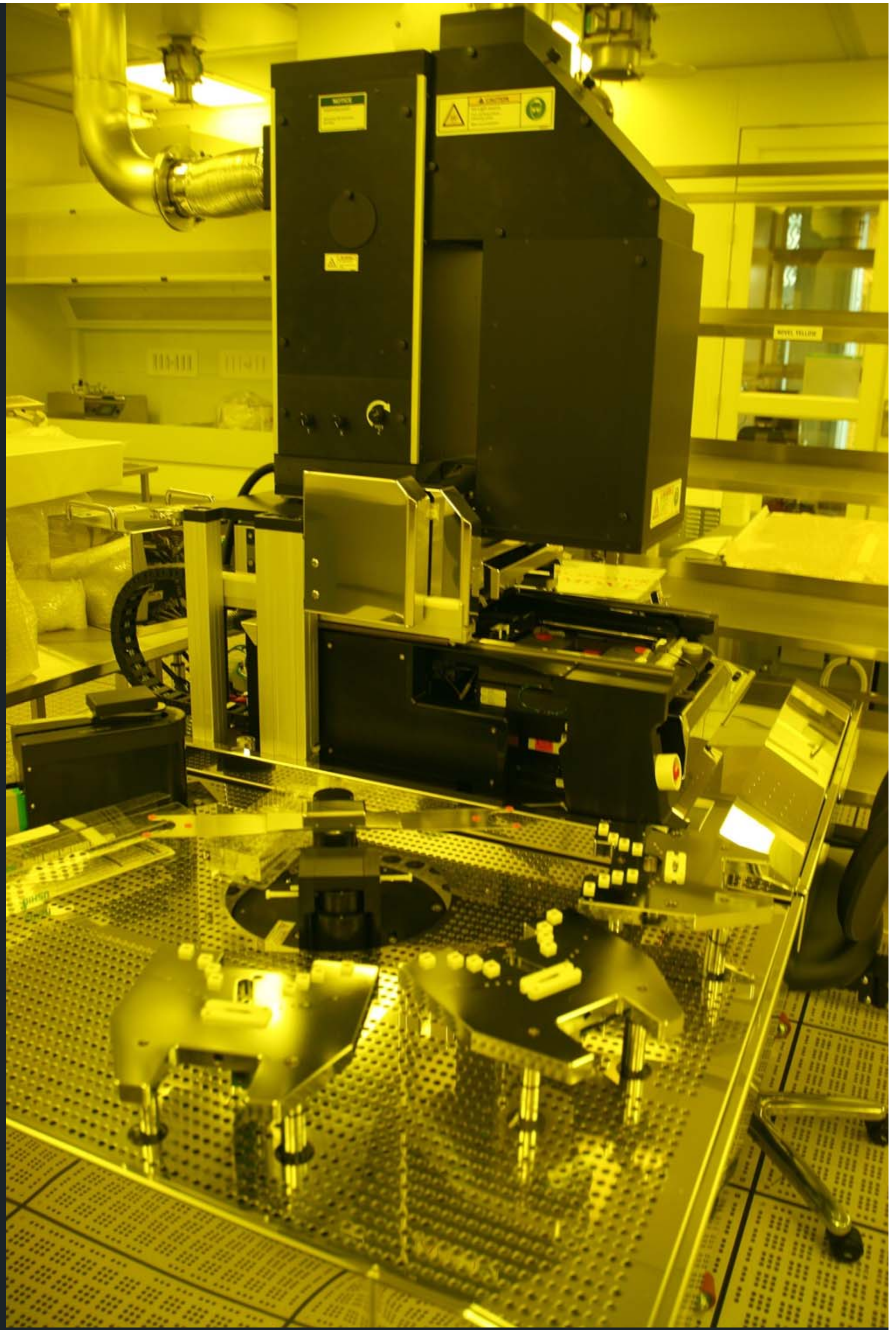
Hotels

Retail

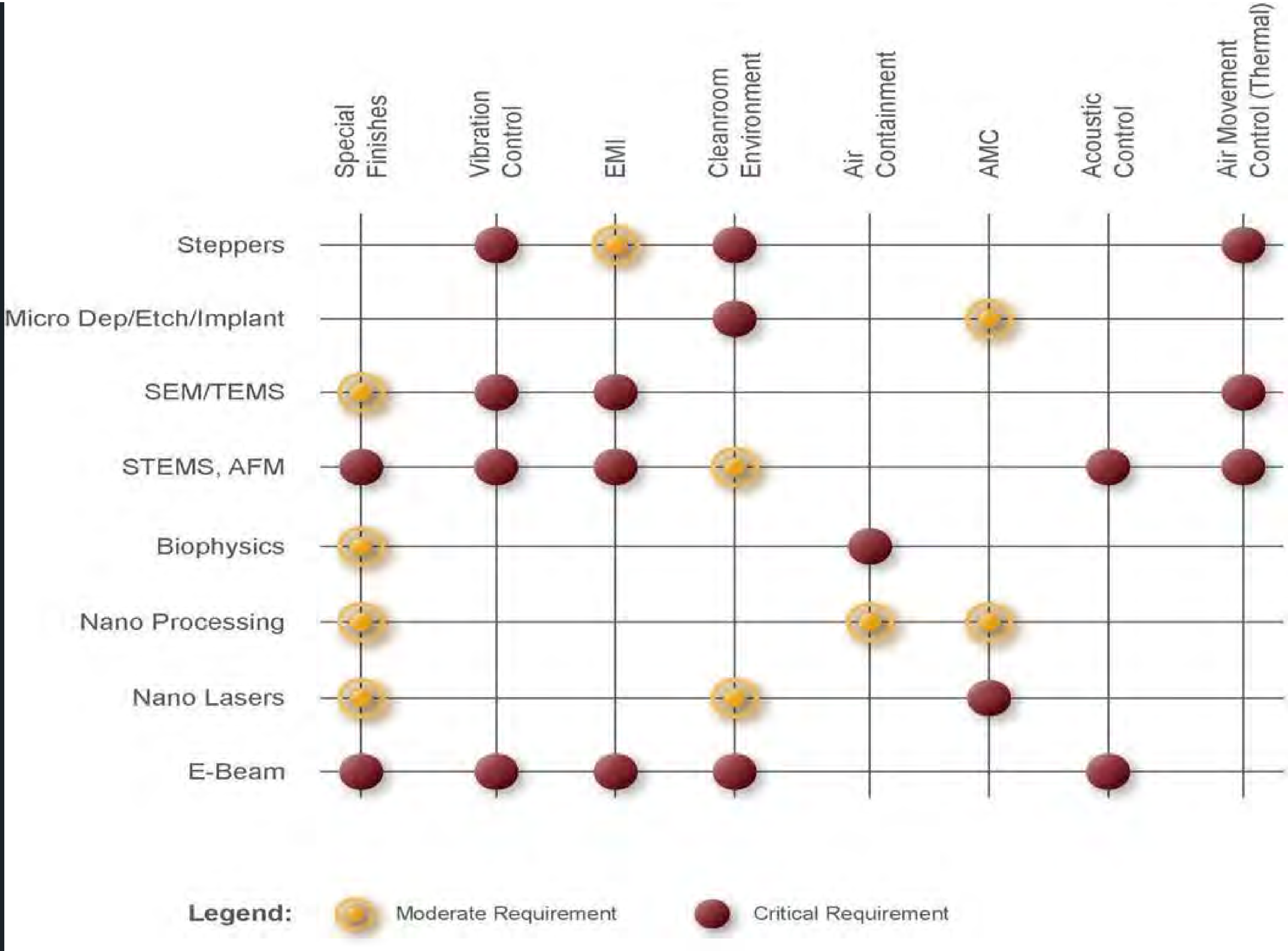


Interiors

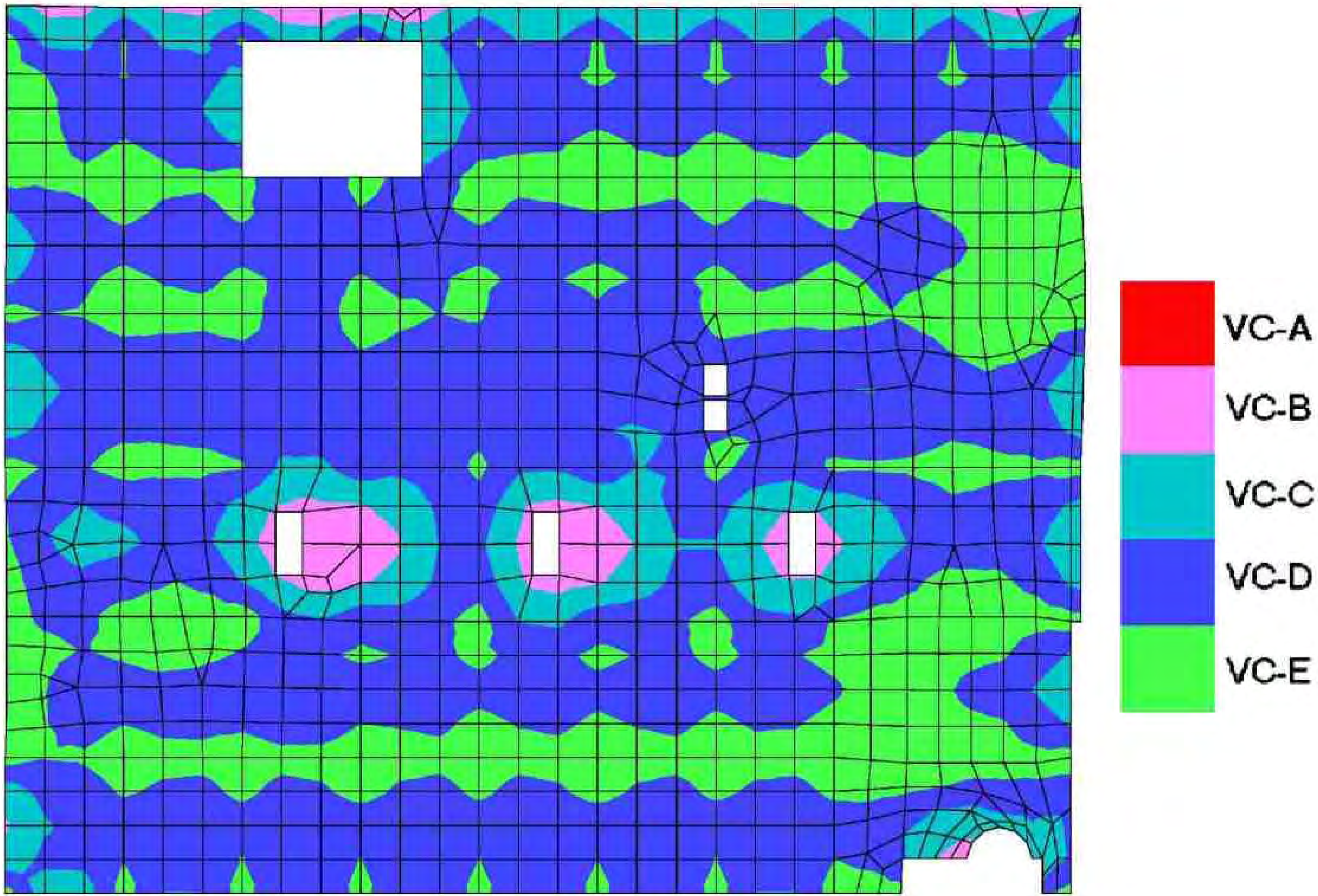
World leading research facilities



Tools



Environmental requirements



Vibration

Cleanroom operating principles


Personnel Route
OPTIONAL
HPM / Equipment Route

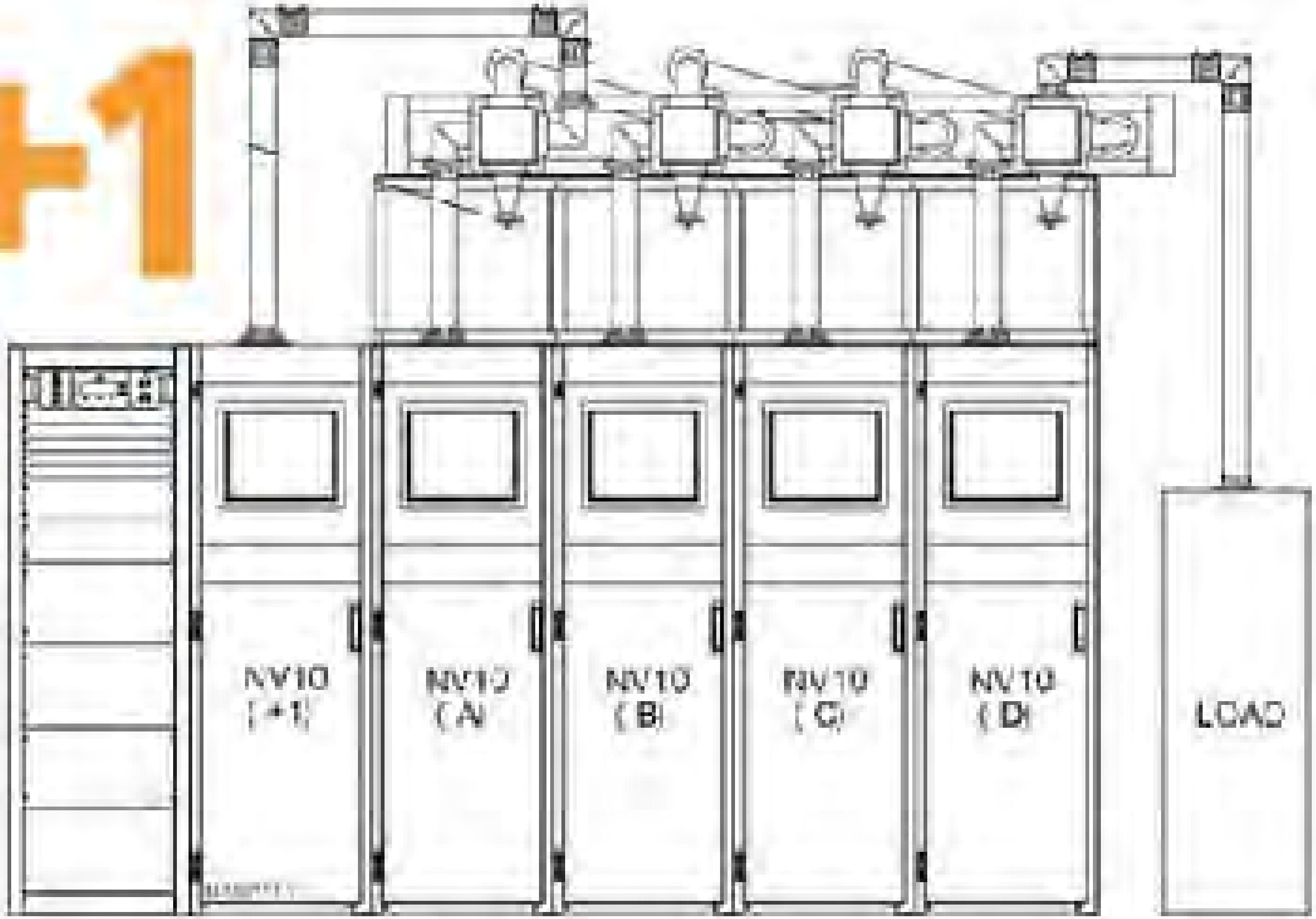
Raised floor and walk-in plenum

Protocols

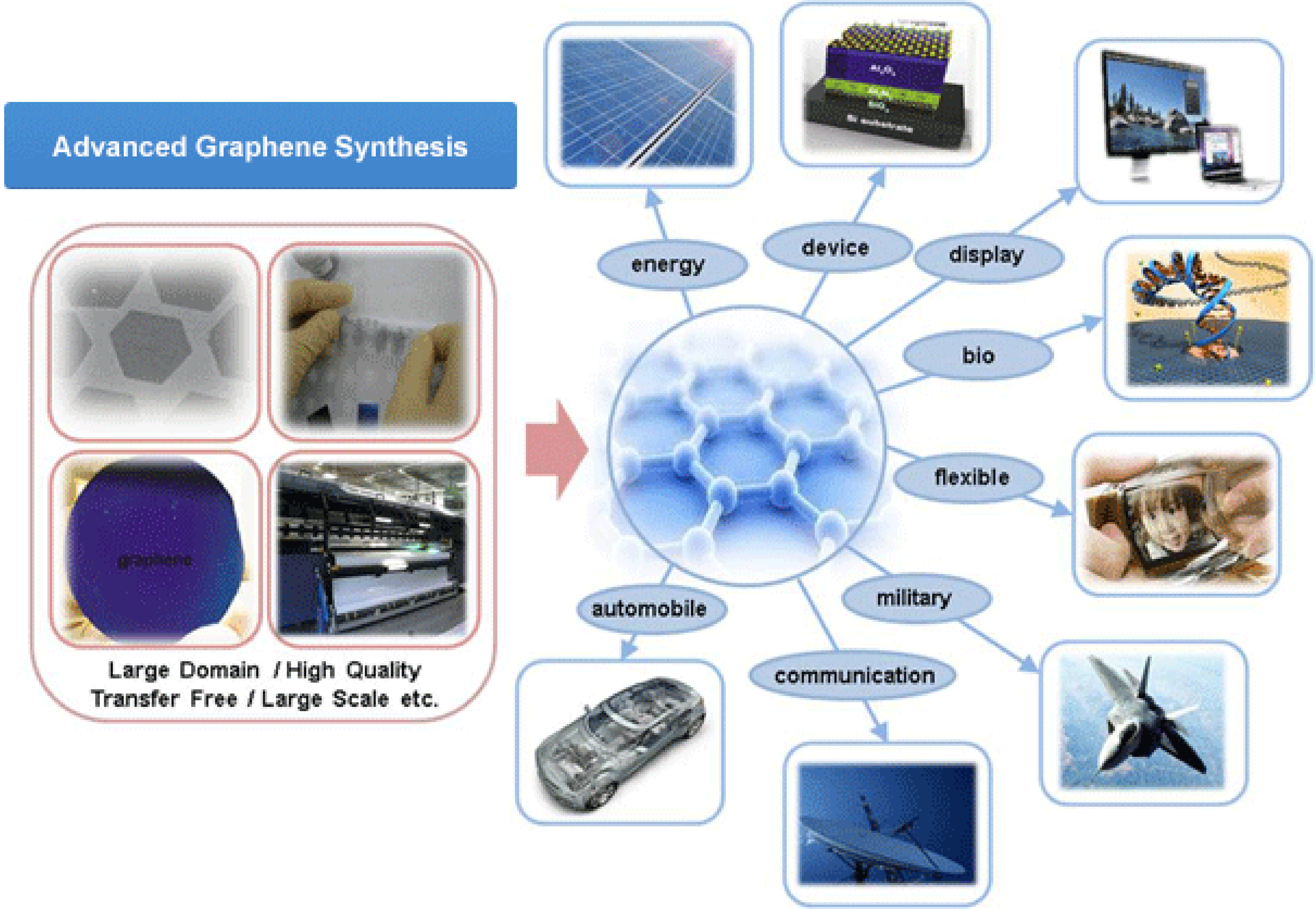
Electricity consumption of a **typical** clean room with ancillary offices

106 KWhrs / m^2 / annum

N+1



Redundancy & Resilience



Advanced Graphene Synthesis
graphene
Large Domain / High Quality
Transfer Free / Large Scale etc.
energy
device
display
bio
flexible
military
communication
automobile
Si substrate

Andre Geim

Konstantin Novoselov

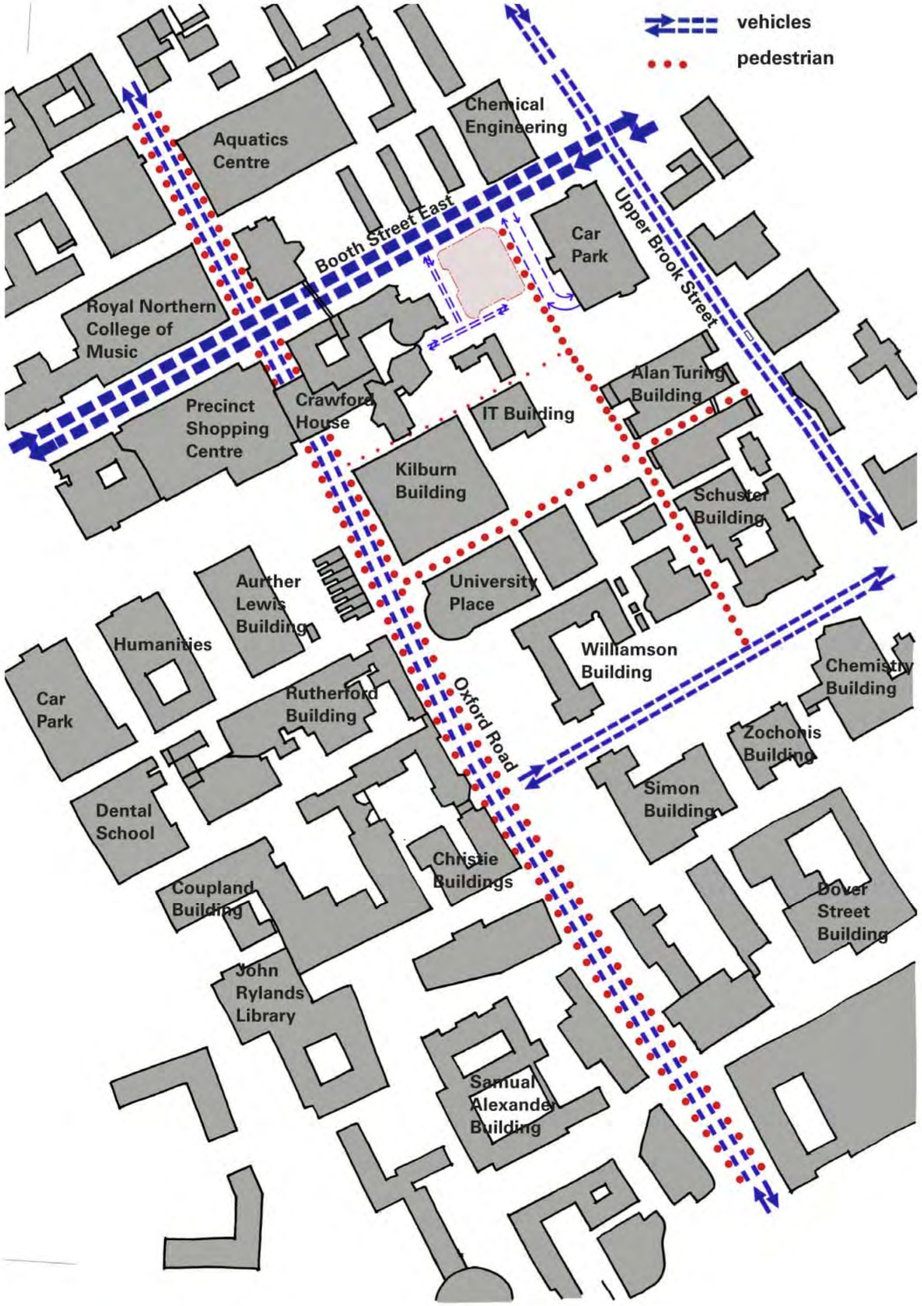
The Site

Alan Turing Building

Campus Square

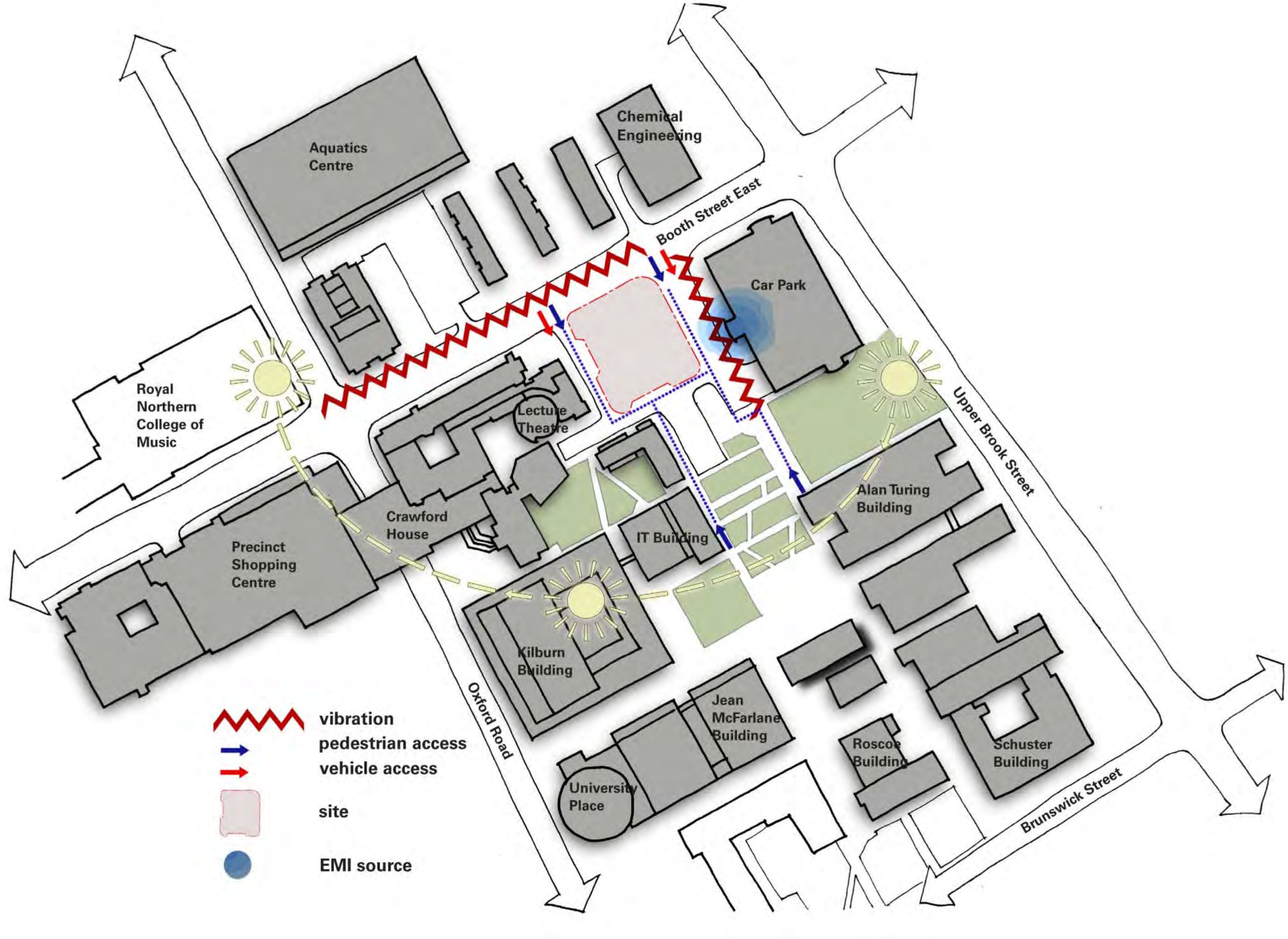
Multi-storey carpark

Jean McFarlane Building

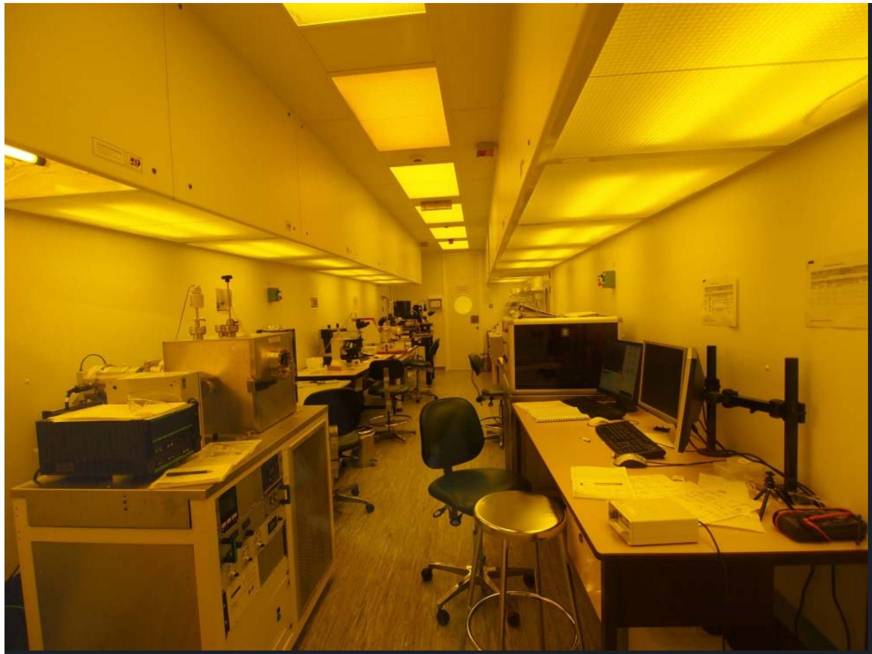


Campus Contex

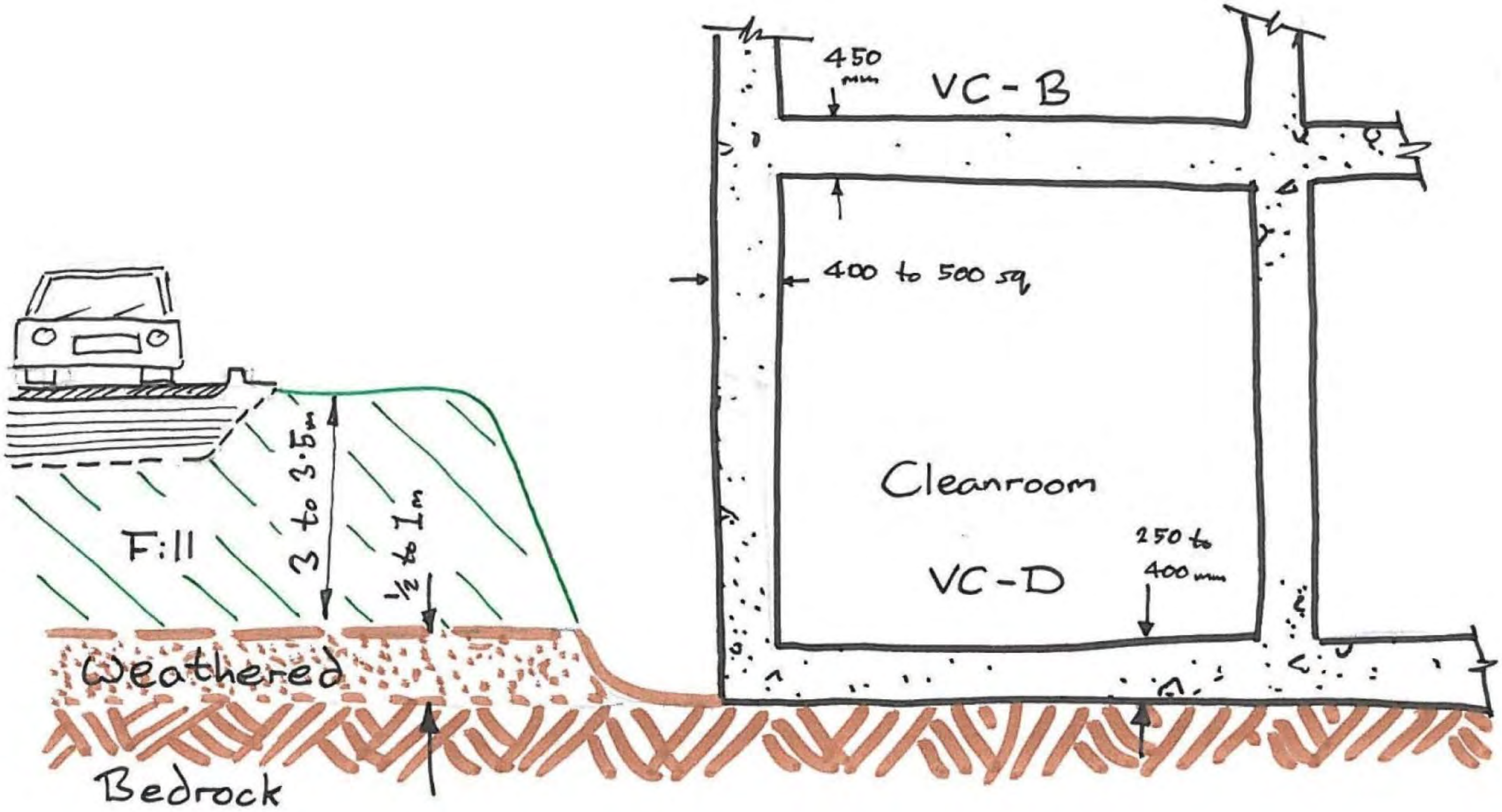
Routes



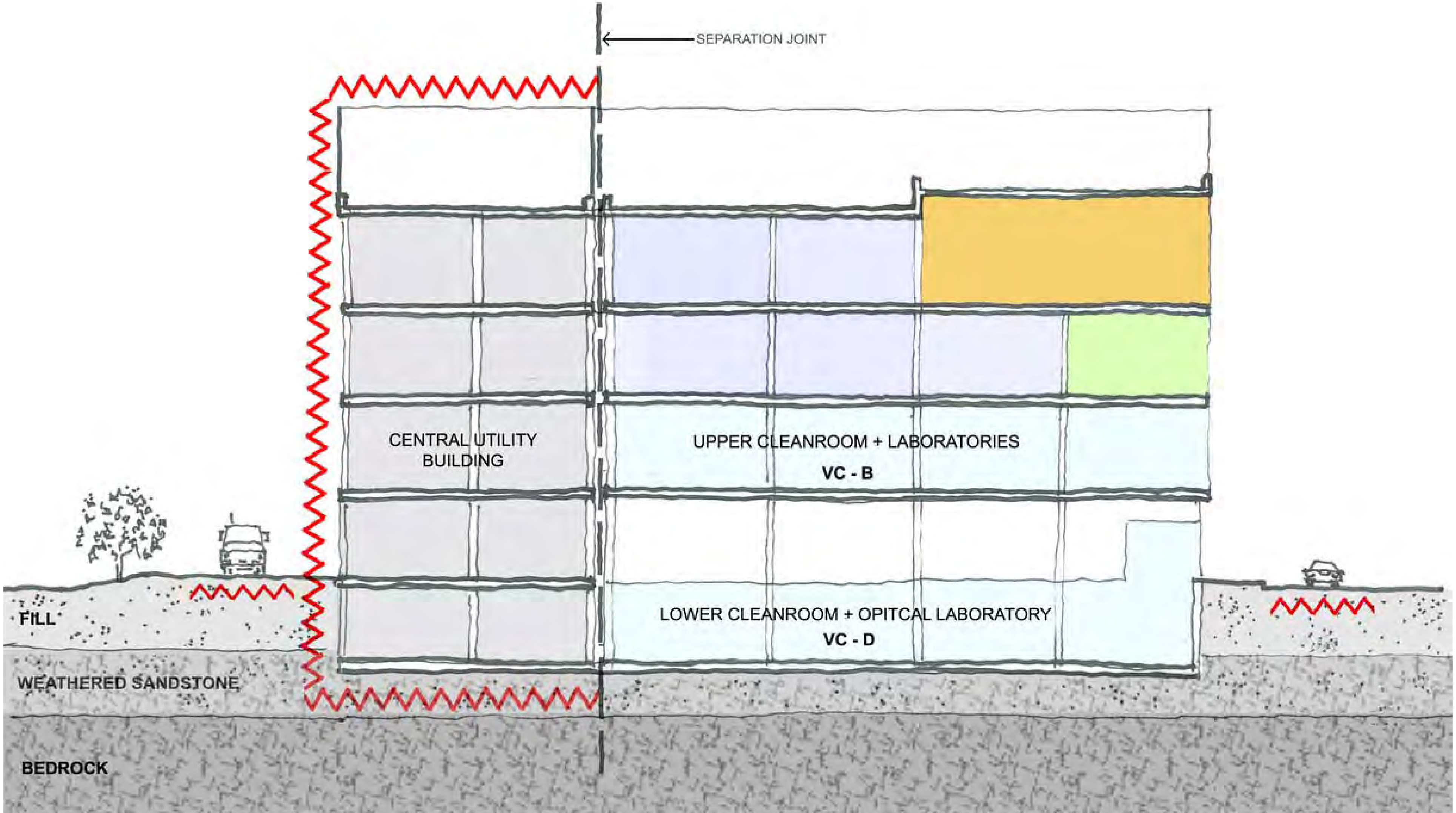
Constraints



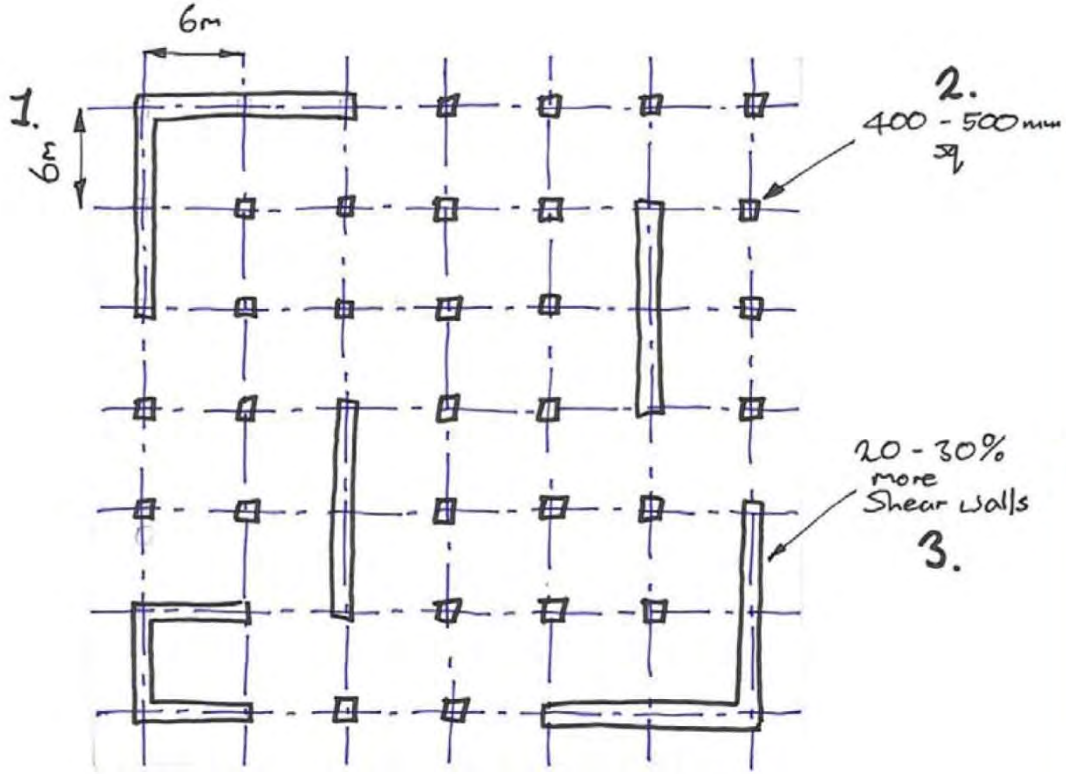
Existing Facilities

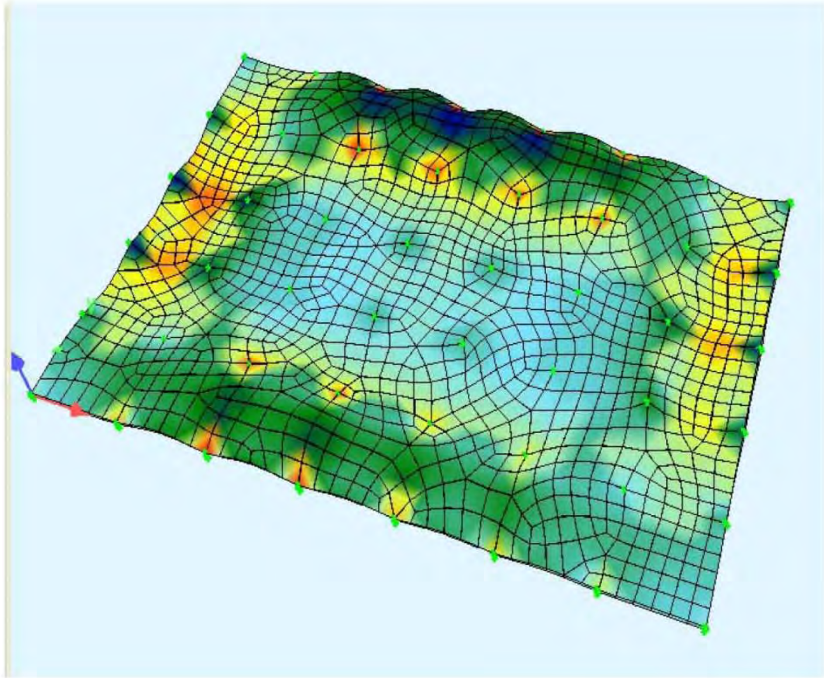


Basement Cleanroom

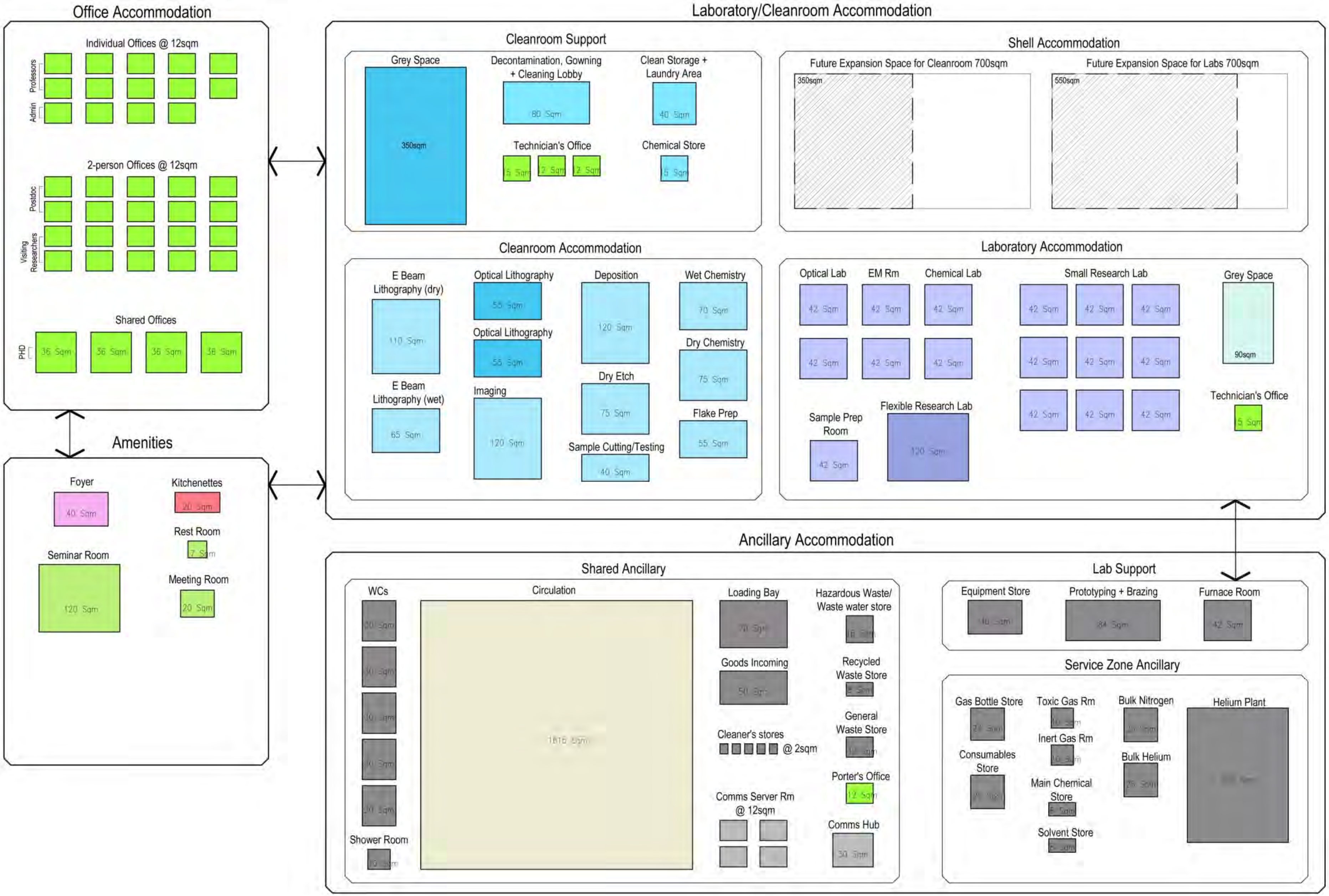


Structural Separation

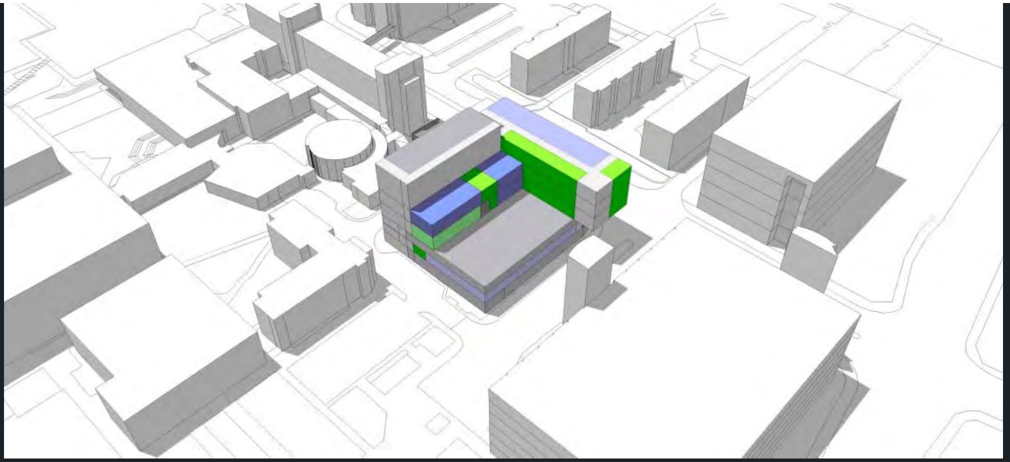


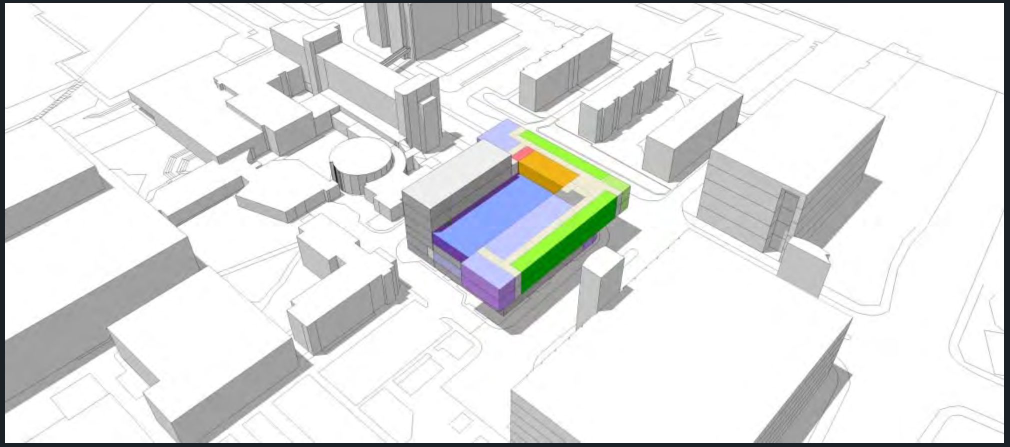


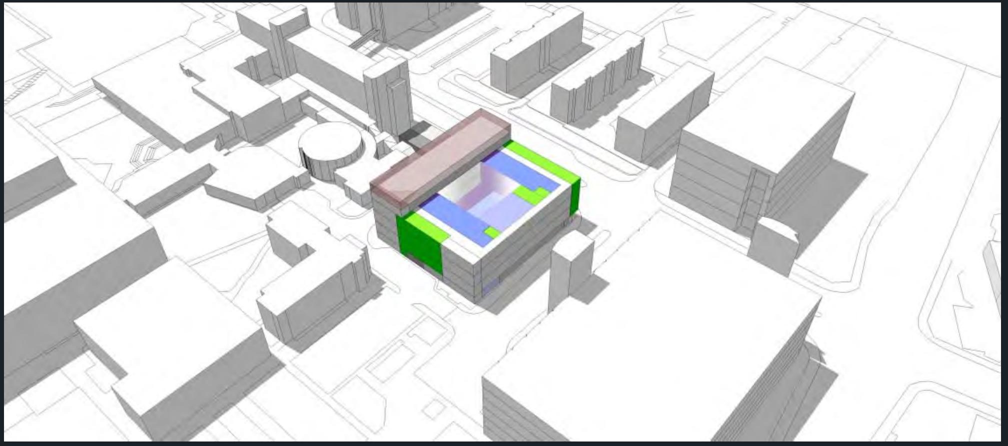
1. Limit column grid 6m to create a ‘stocky’ structure
2. Columns sized at 400 to 500mm sq to enhance stocky grid spacing
3. Provide 20 to 30% more shearwall length (over say an office type building) to deal with horizontal inputs (typically wind gusts)



Schedule of Accommodation





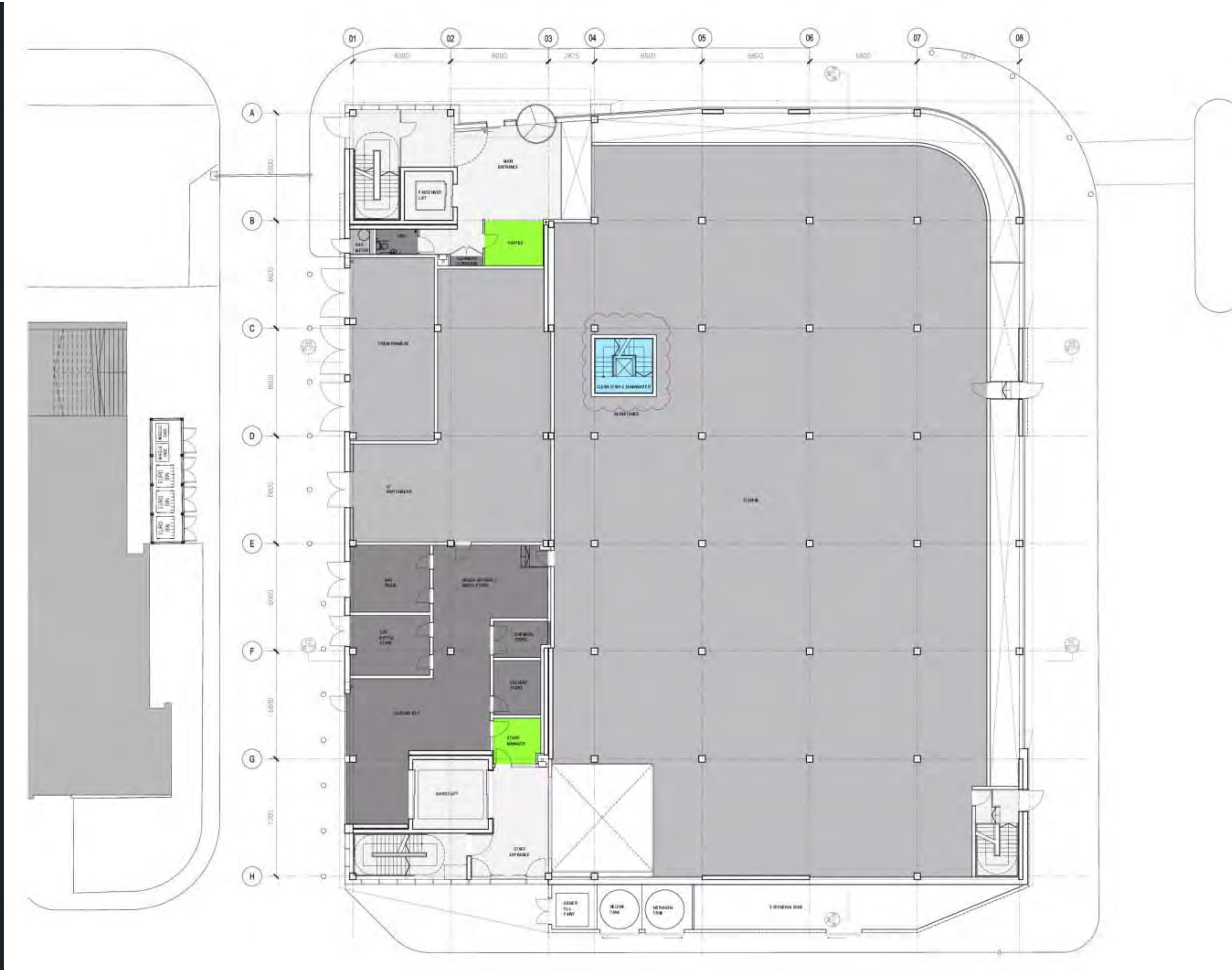


Massing Options

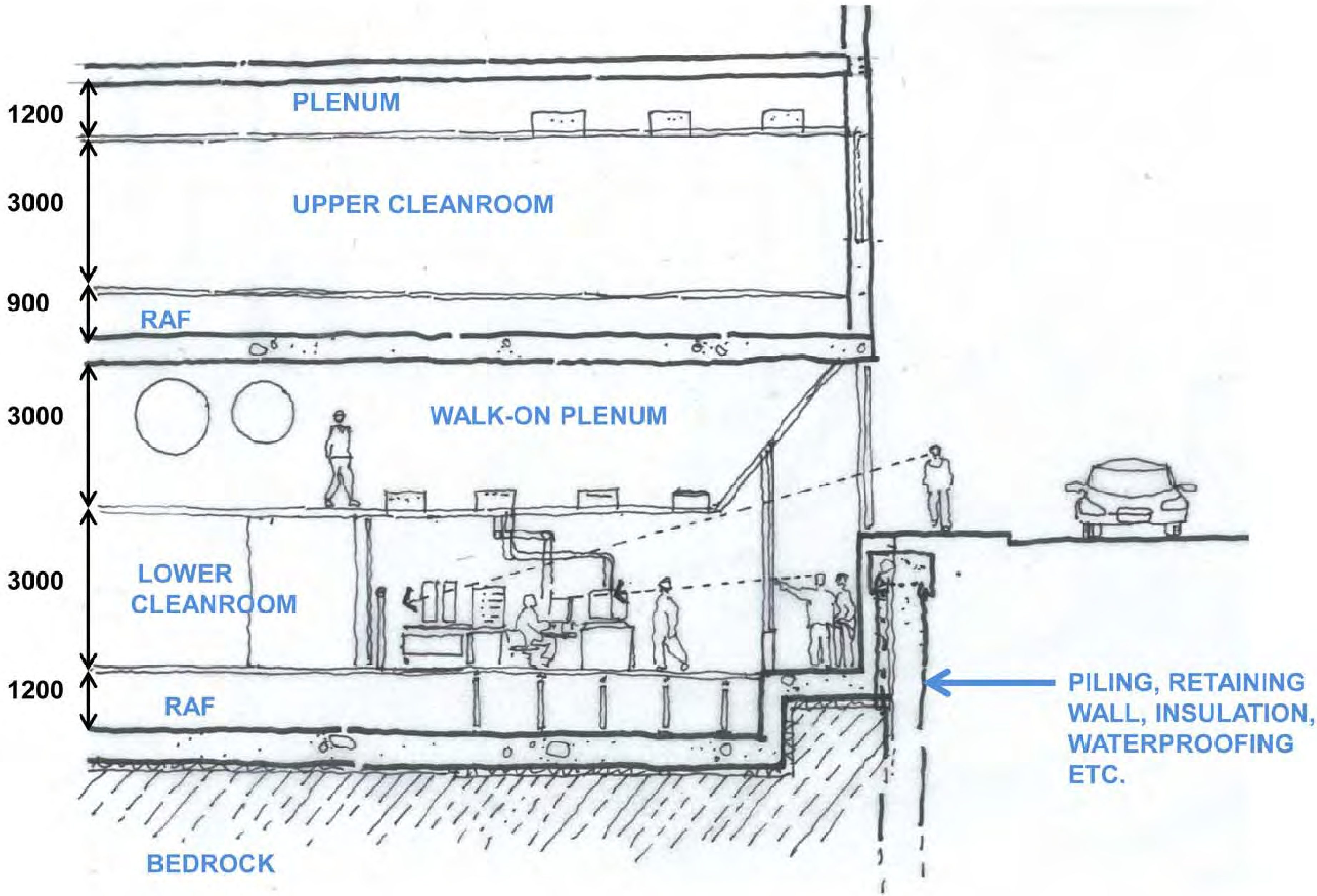
BOWDEN COURT
JAMES CHADWICK BUILDING
BOOTH STREET EAST
MAIN ENTRANCE
ACCESS CONTROL BARRIER
REFUSE STORE
LOADING
STAFF ENTRANCE
ACCESS CONTROL BARRIER
MULTI-STOREY CAR PARK
CYCLE STORE
CAR PARK
CRAWFORD HOUSE
PROSPECT HOUSE
ST. PETER'S HOUSE CHURCH AND CHAPLAINCY
PUBLIC SQUARE

Site Plan

Basement



Ground



Basement Cleanroom

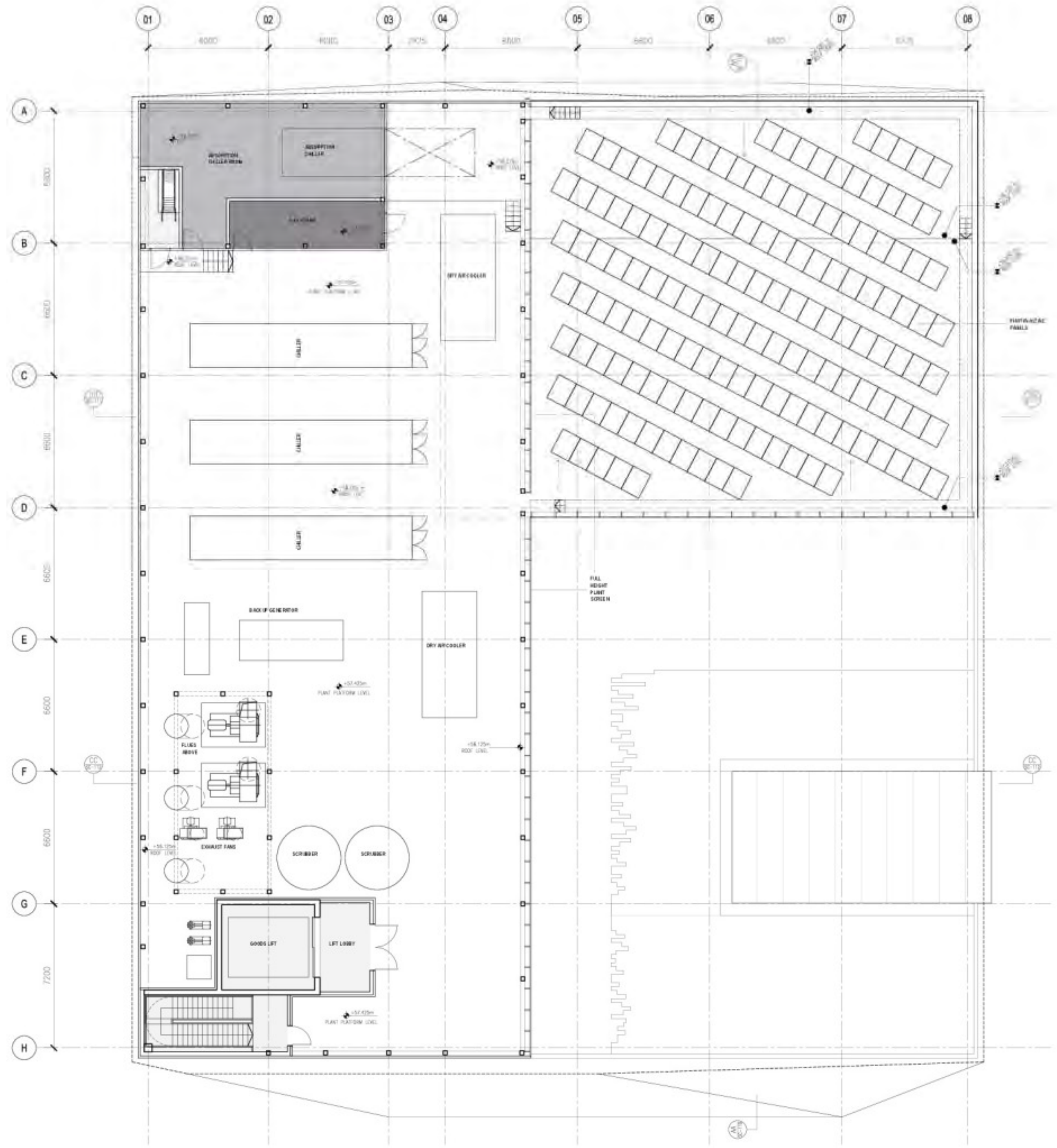
1st

2nd


ARGON
OXYGEN
CLEAN DRY AIR
UTILITY NITROGEN


01
02
03
04
05
06
07
08
6000
6000
2825
6600
6600
6600
6275
A
B
C
D
E
F
G
H
PASSENGER LIFT

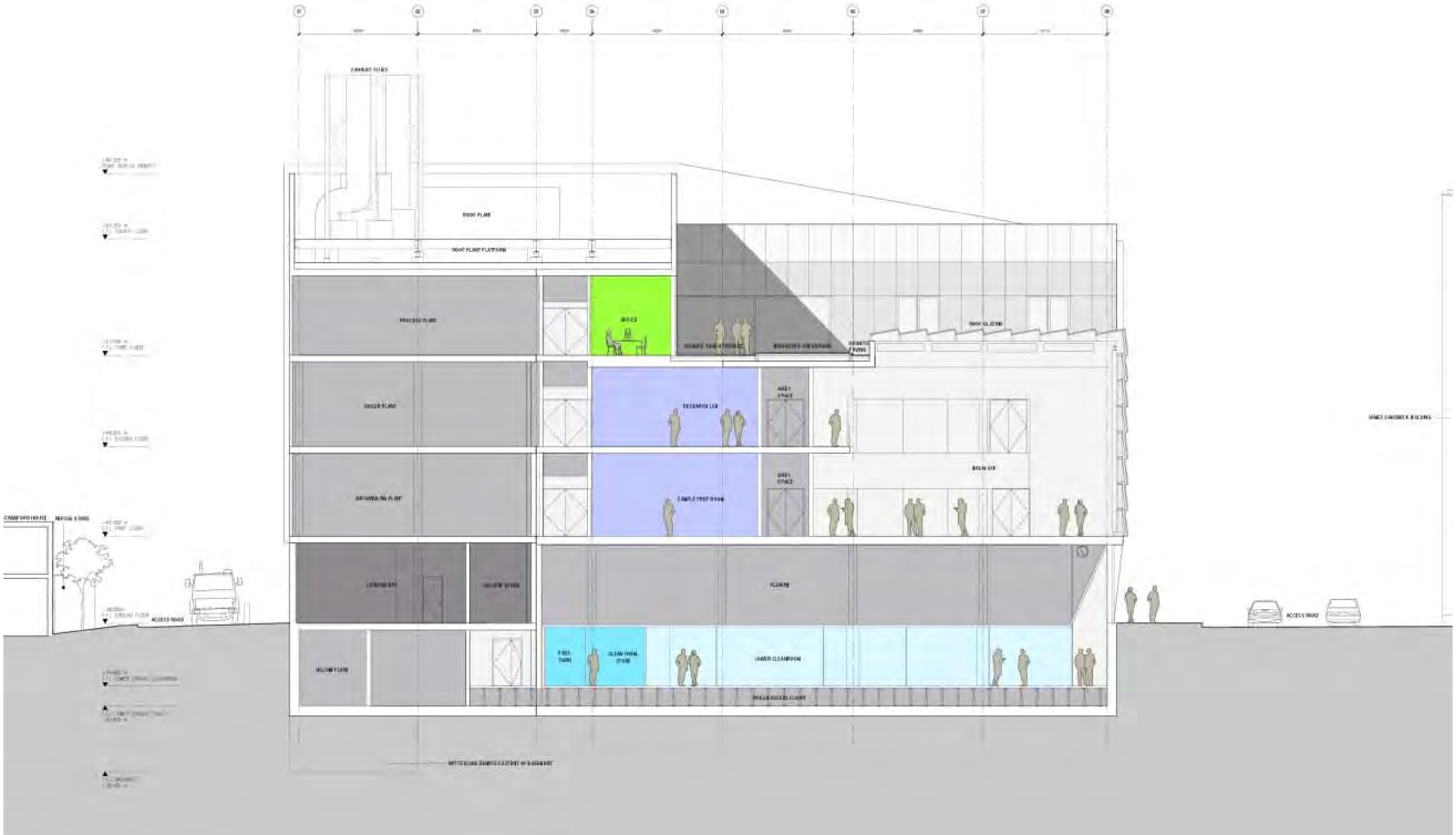
3rd



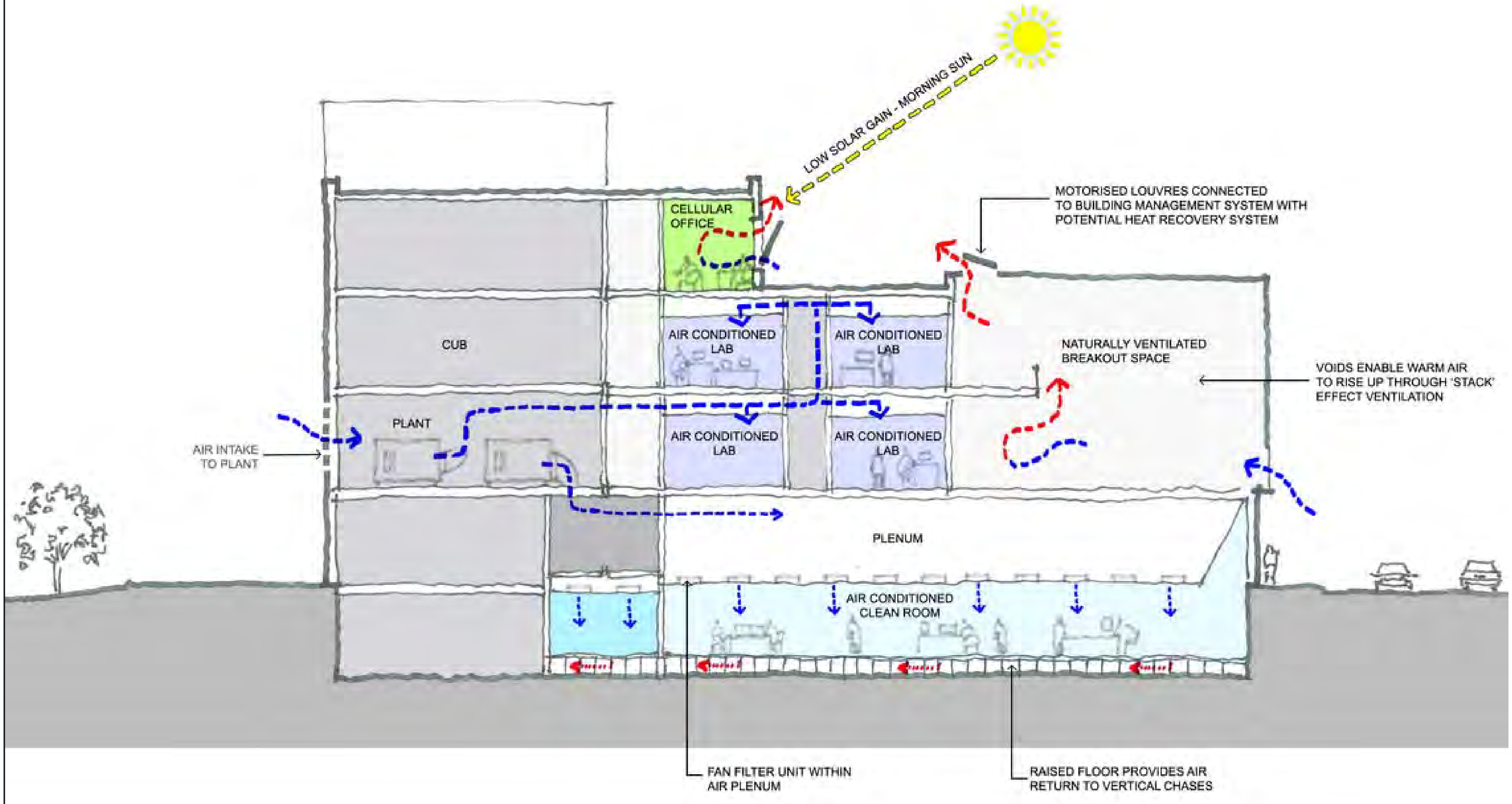
01
02
03
04
05
06
07
08
A
B
C
D
E
F
G
H
CHILLER
CHILLER
CHILLER
BACKUP GENERATOR
DRY AIR COOLER
DRY AIR COOLER
SCRUBBER
SCRUBBER
EXHAUST FANS
GOODS LIFT
LIFT LOBBY

4th

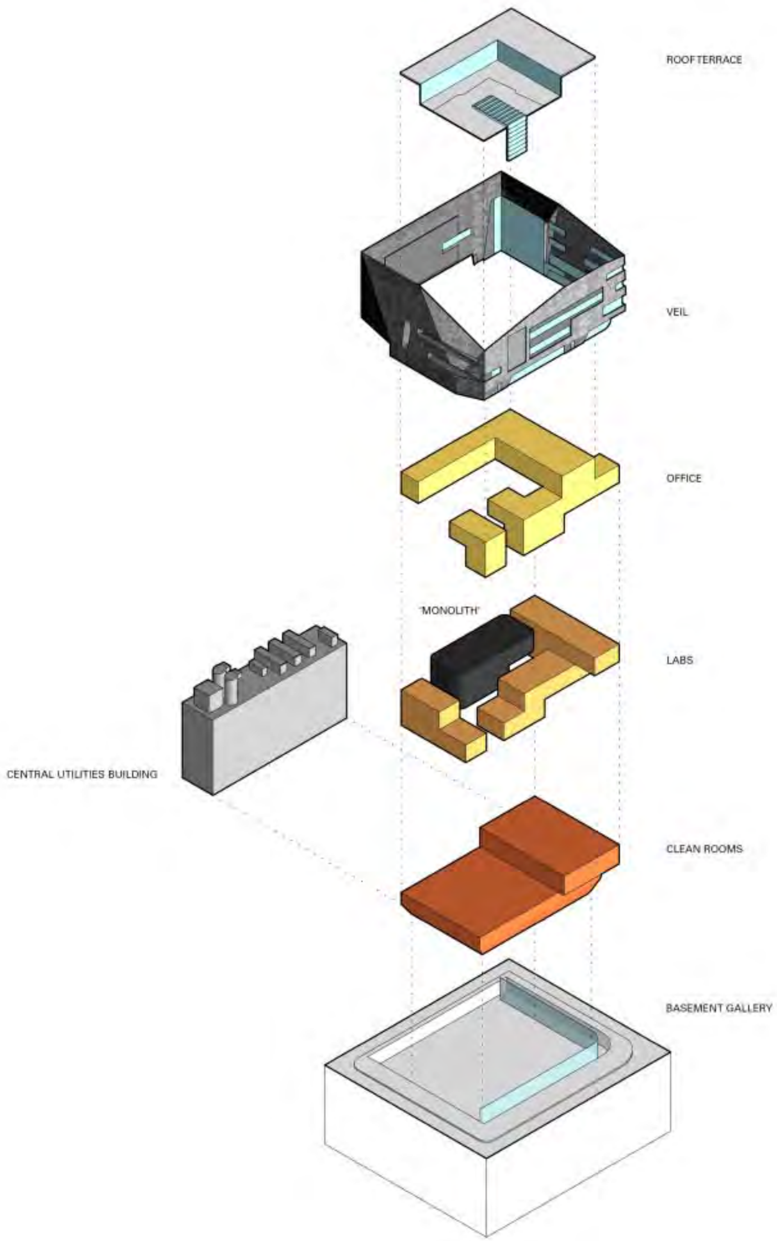
North-South Section

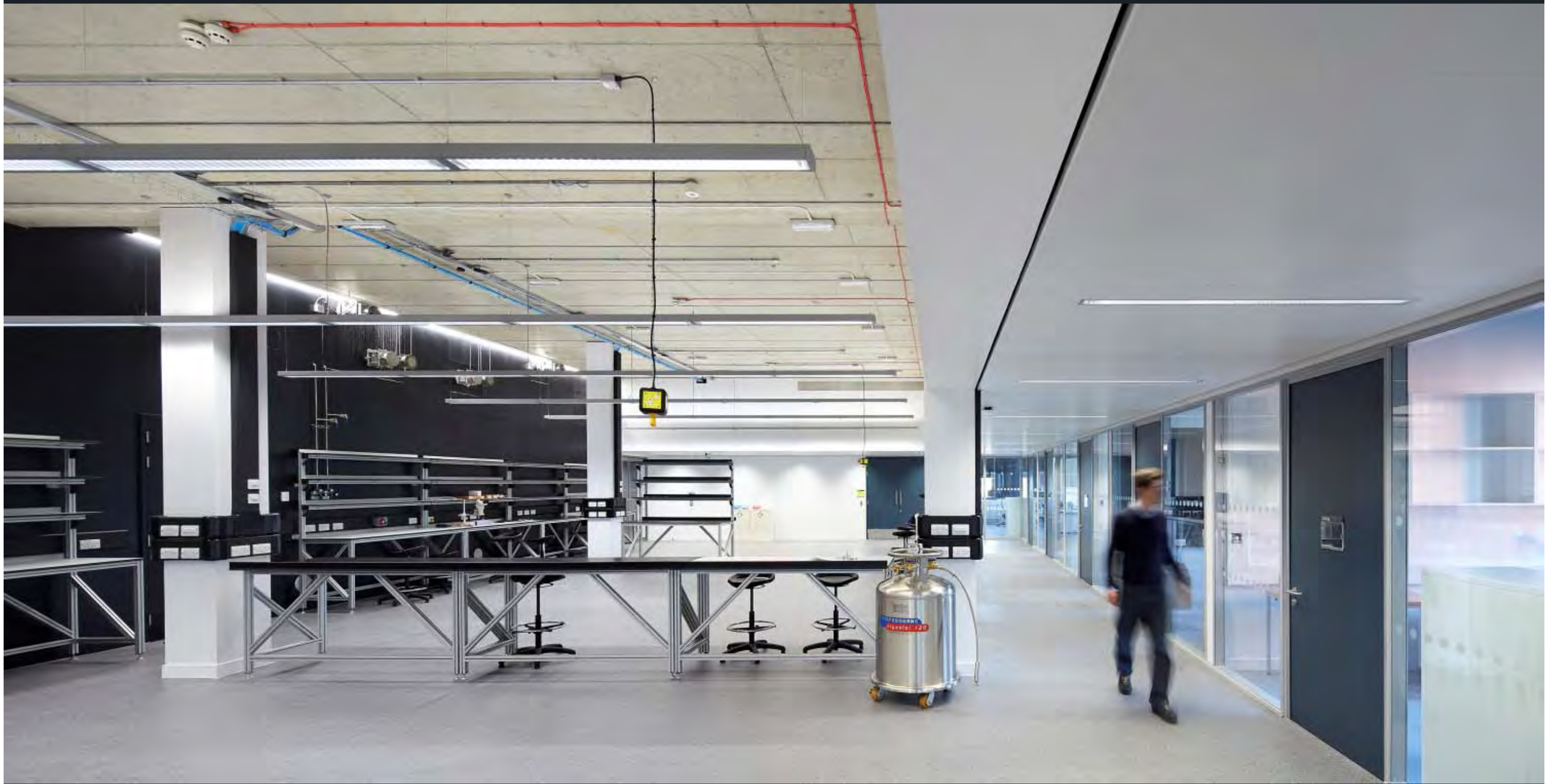


East-West Section



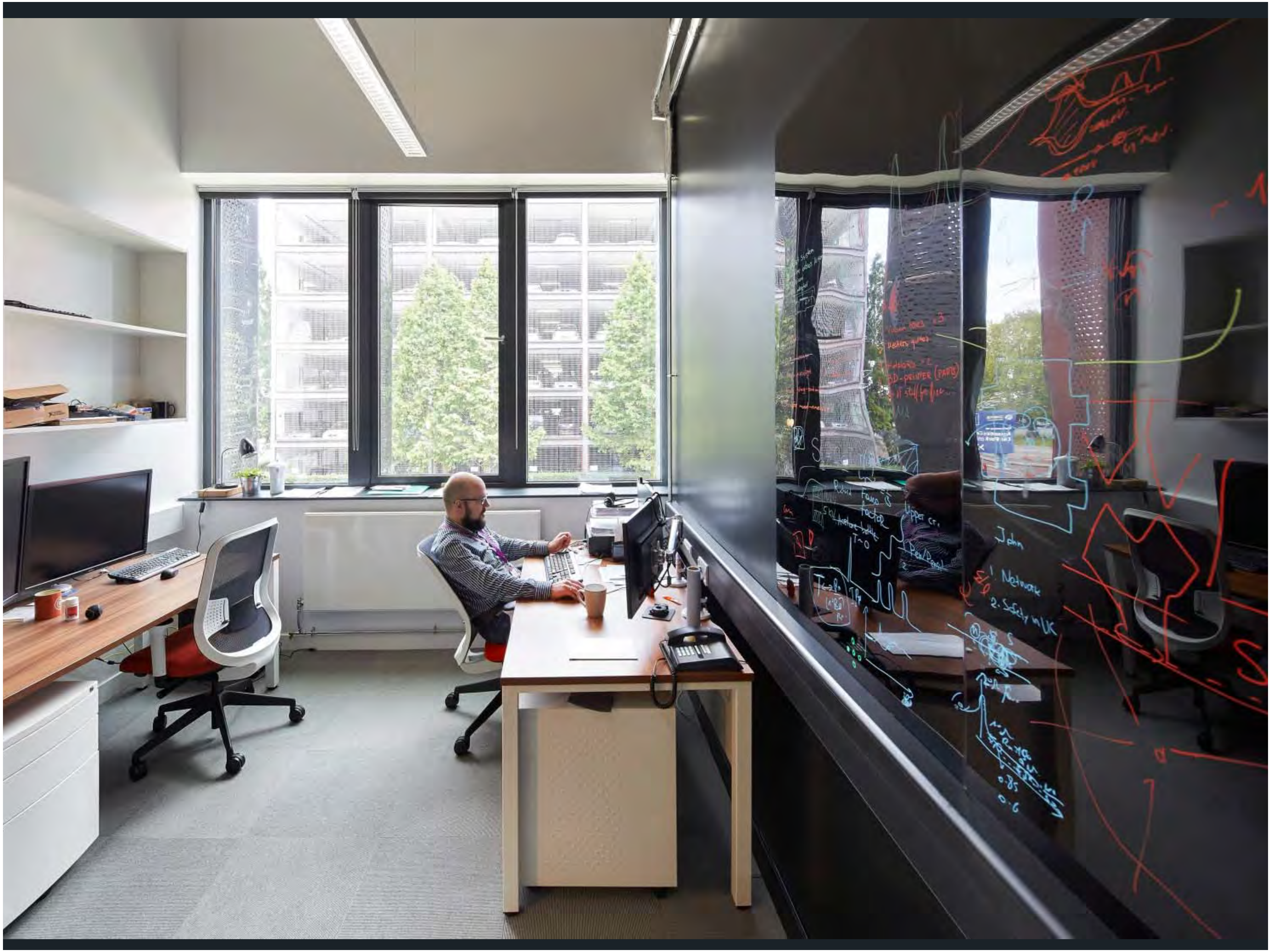
Ventilation Strategy


ROOFTERRACE
VEIL
OFFICE
'MONOLITH'
LABS
CENTRAL UTILITIES BUILDING
CLEAN ROOMS
BASEMENT GALLERY

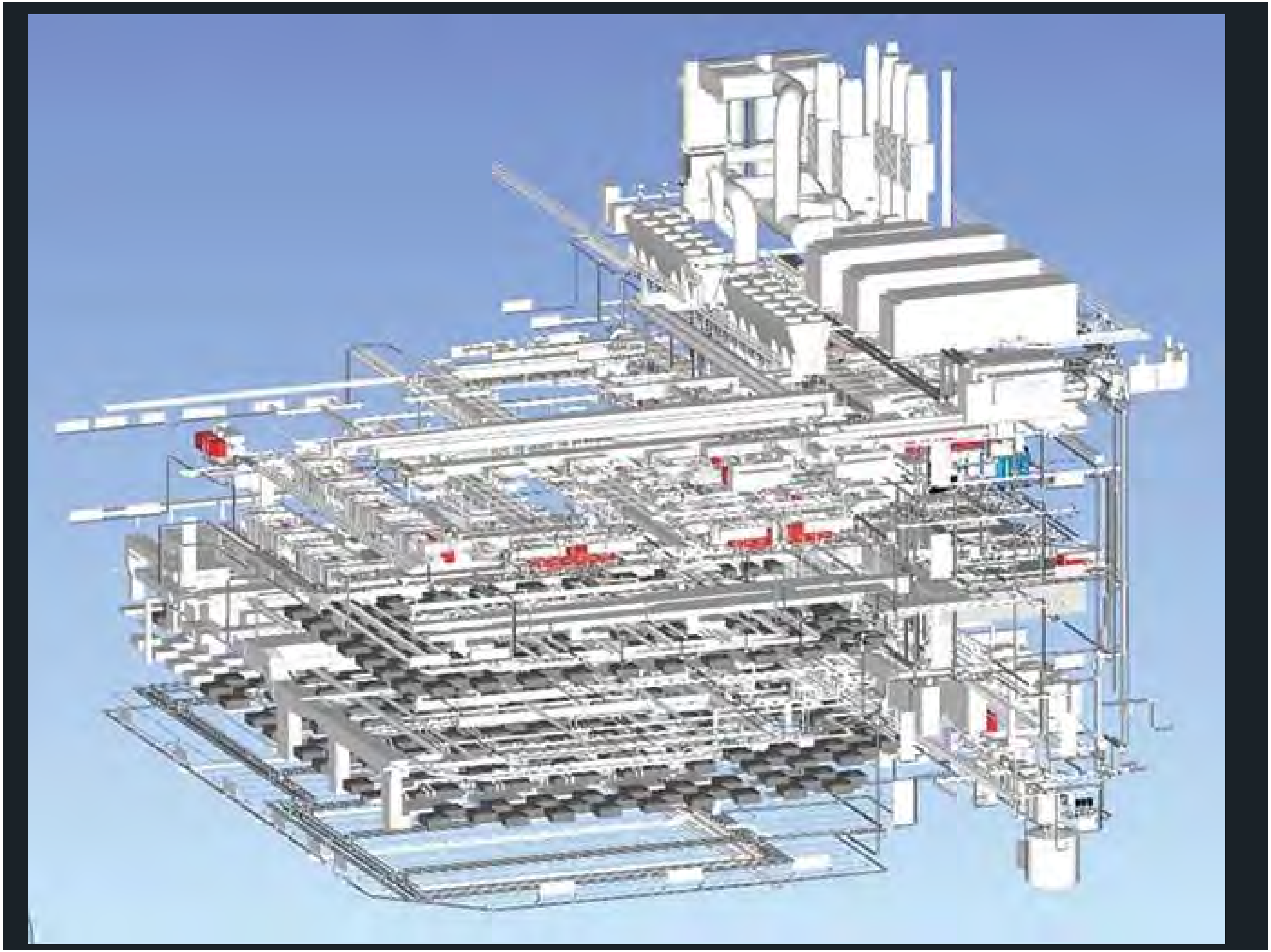


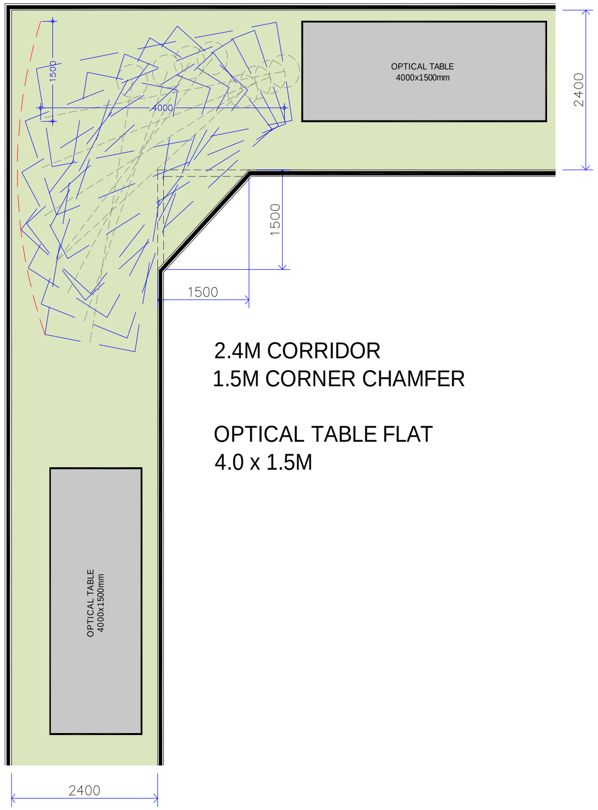
Writable corridor


e = mc
National Graph


John
Network
2. Safety in UK
3D-PRINTER (PARTS)

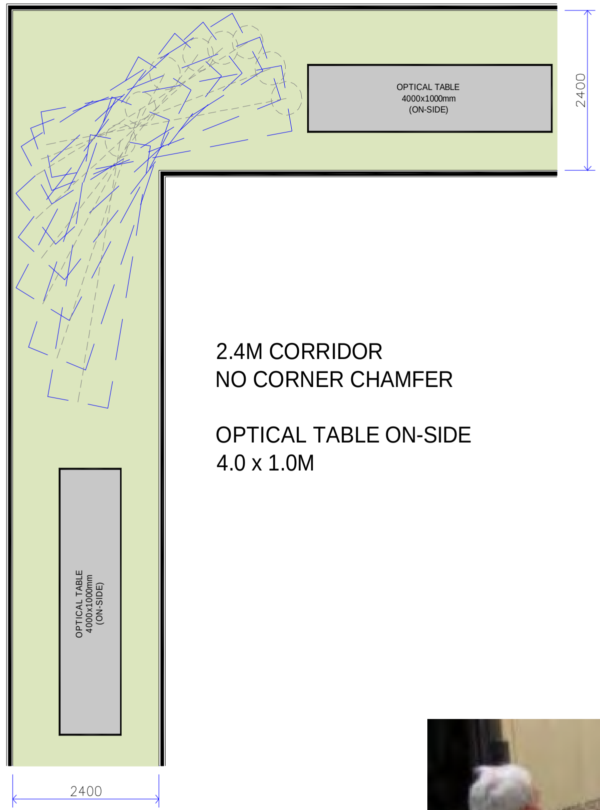

2





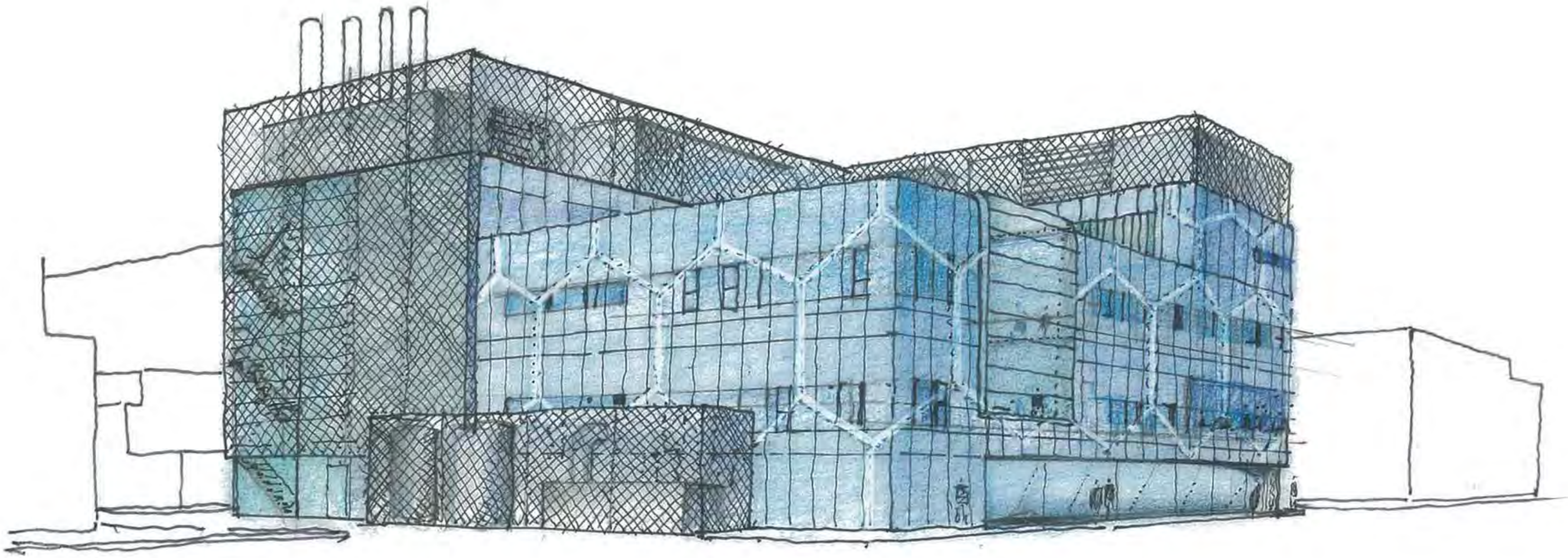
2.4M CORRIDOR
1.5M CORNER CHAMFER

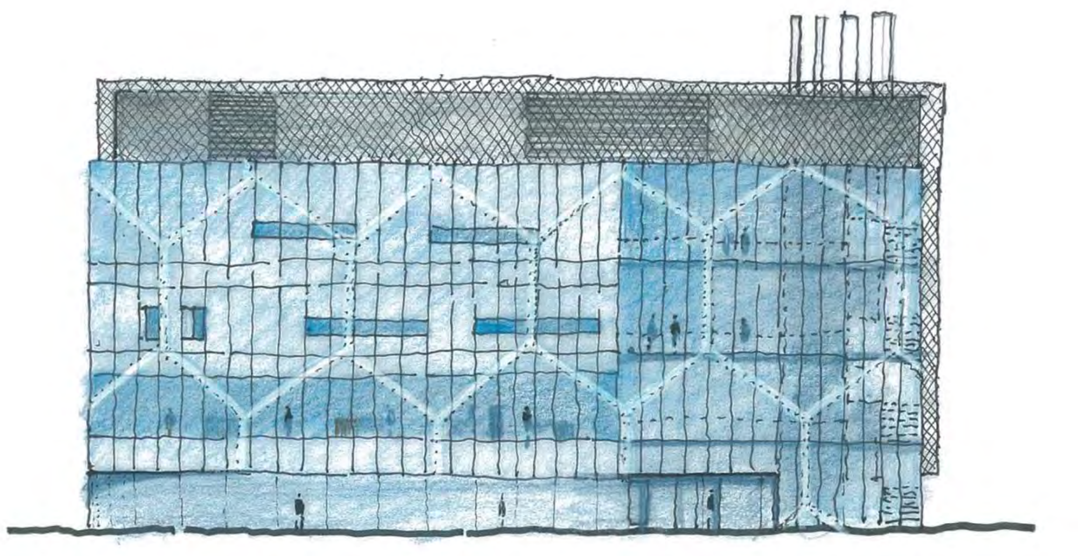
OPTICAL TABLE FLAT
4.0 x 1.5M



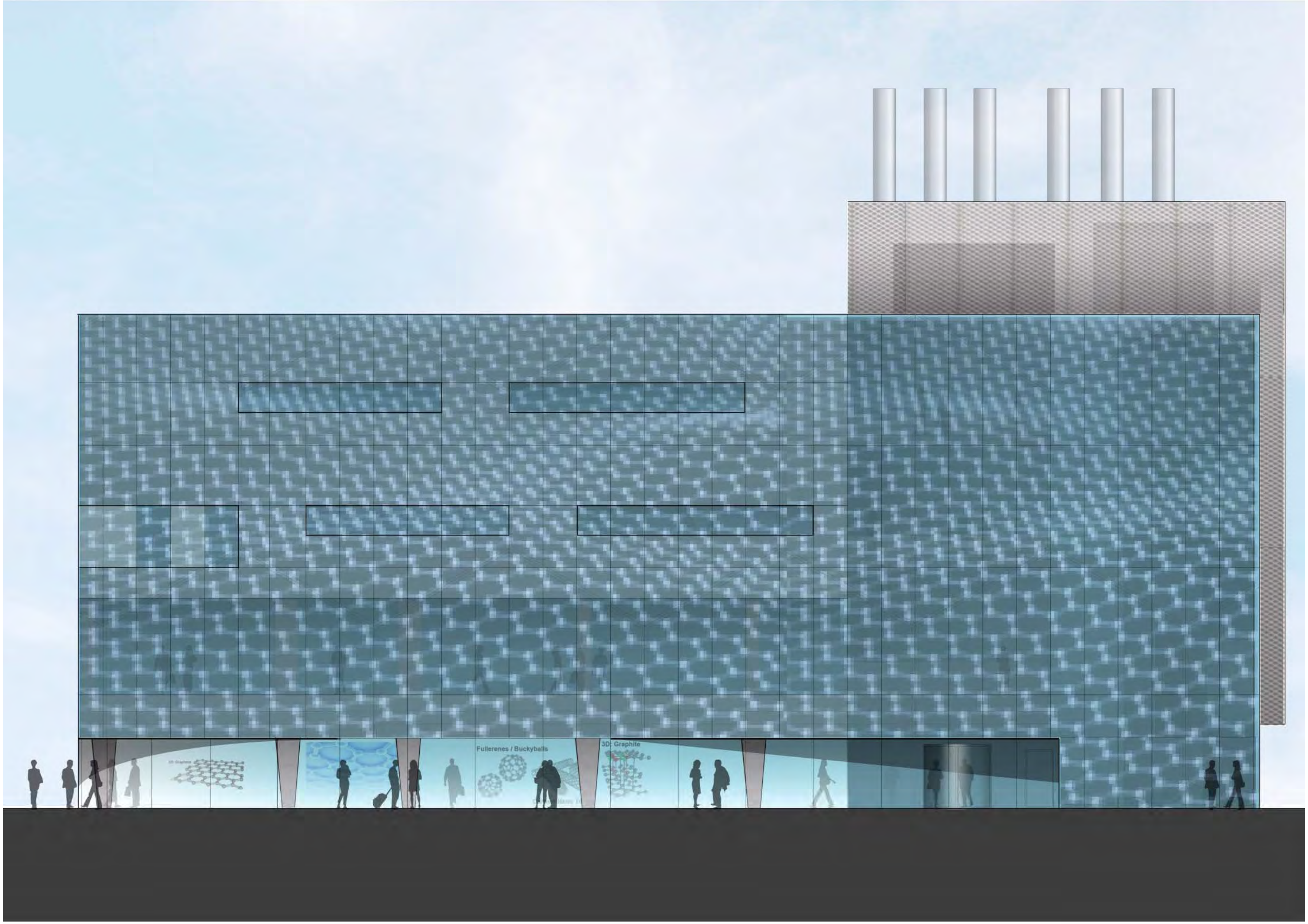
2.4M CORRIDOR
NO CORNER CHAMFER

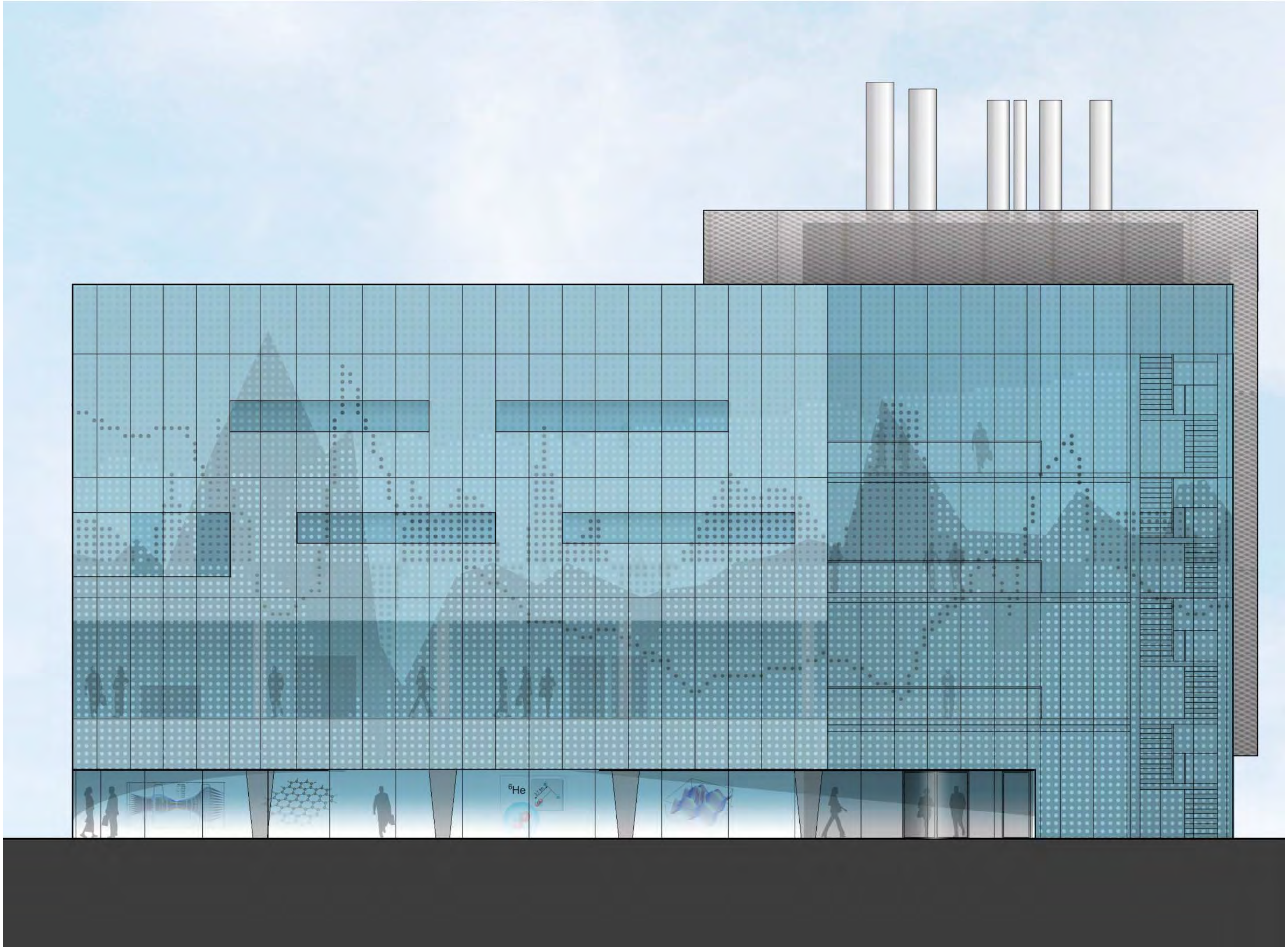
OPTICAL TABLE ON-SIDE
4.0 x 1.0M



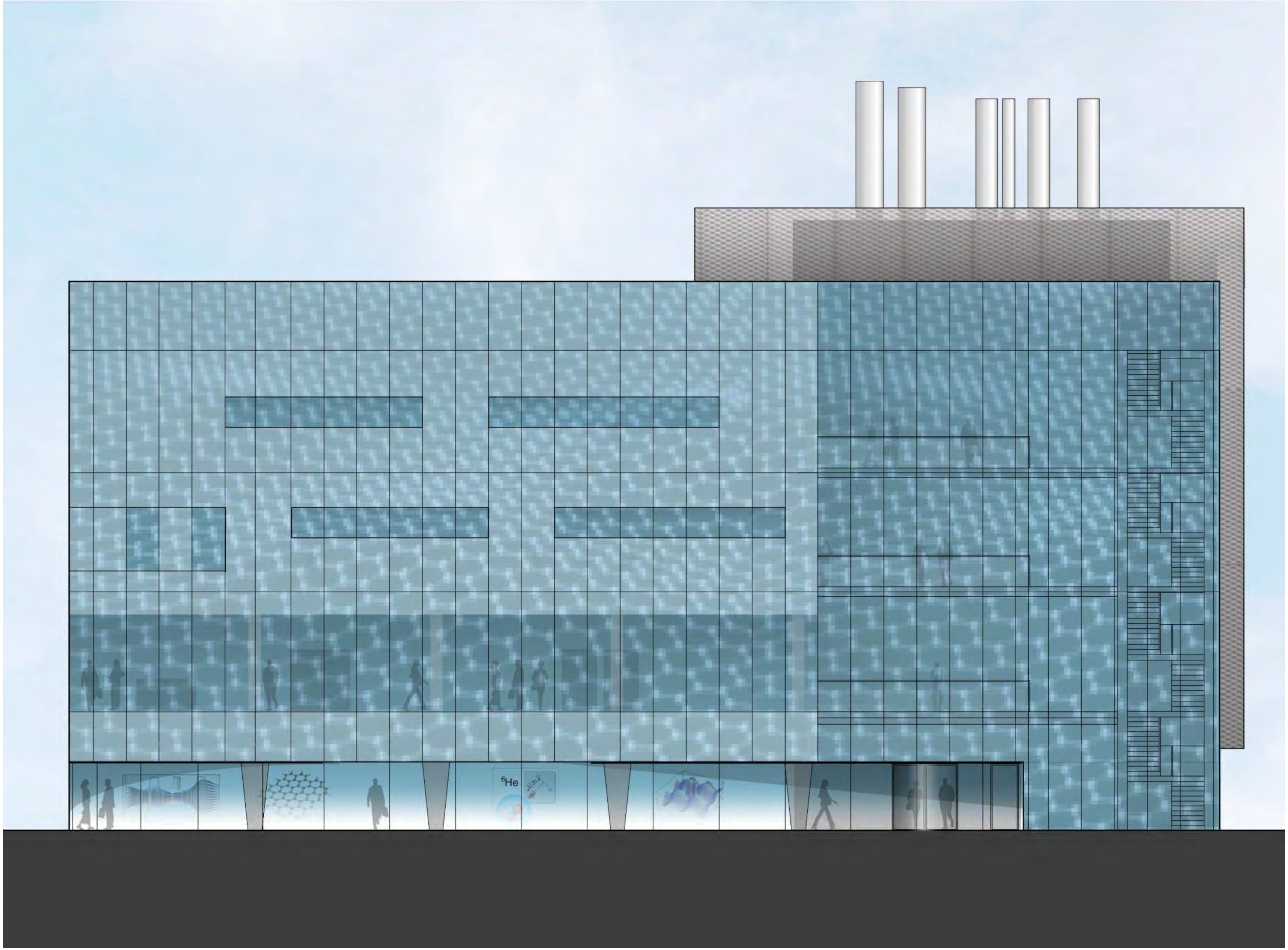


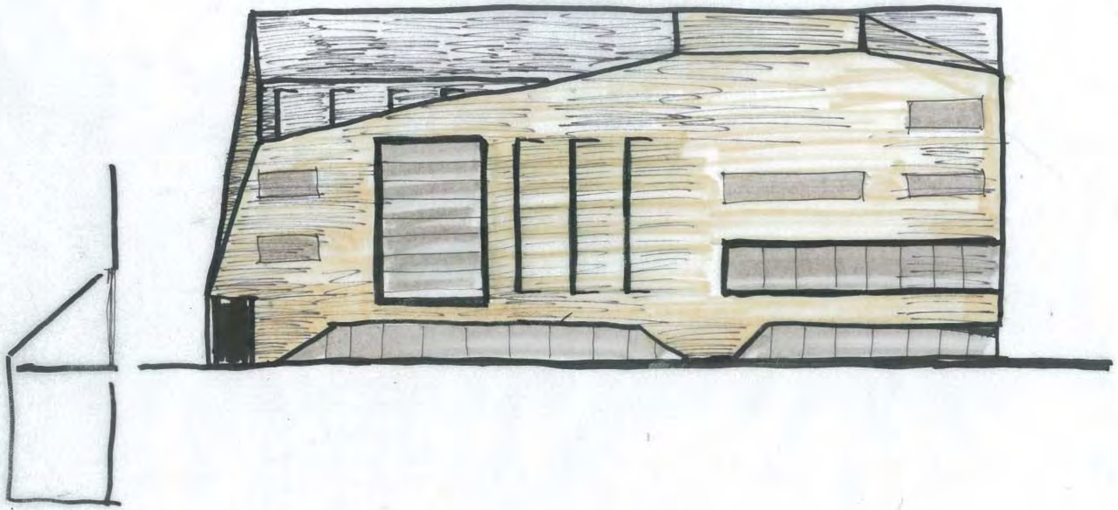
Concept studies

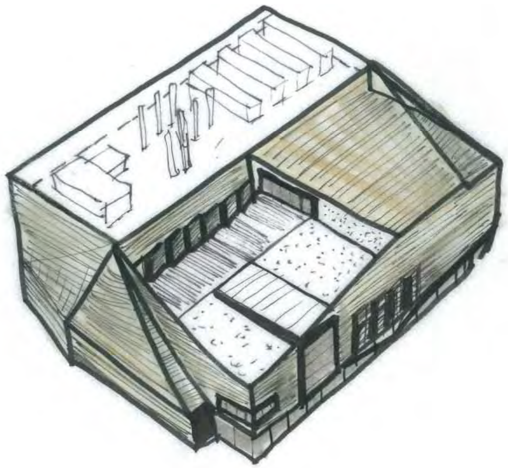

Fullerenes / Buckyballs
3D: Graphite

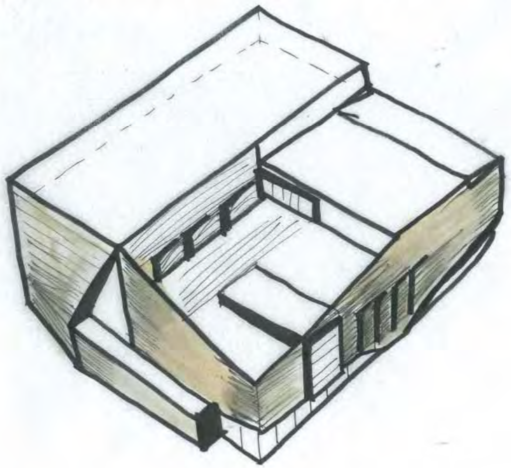


^{6}He

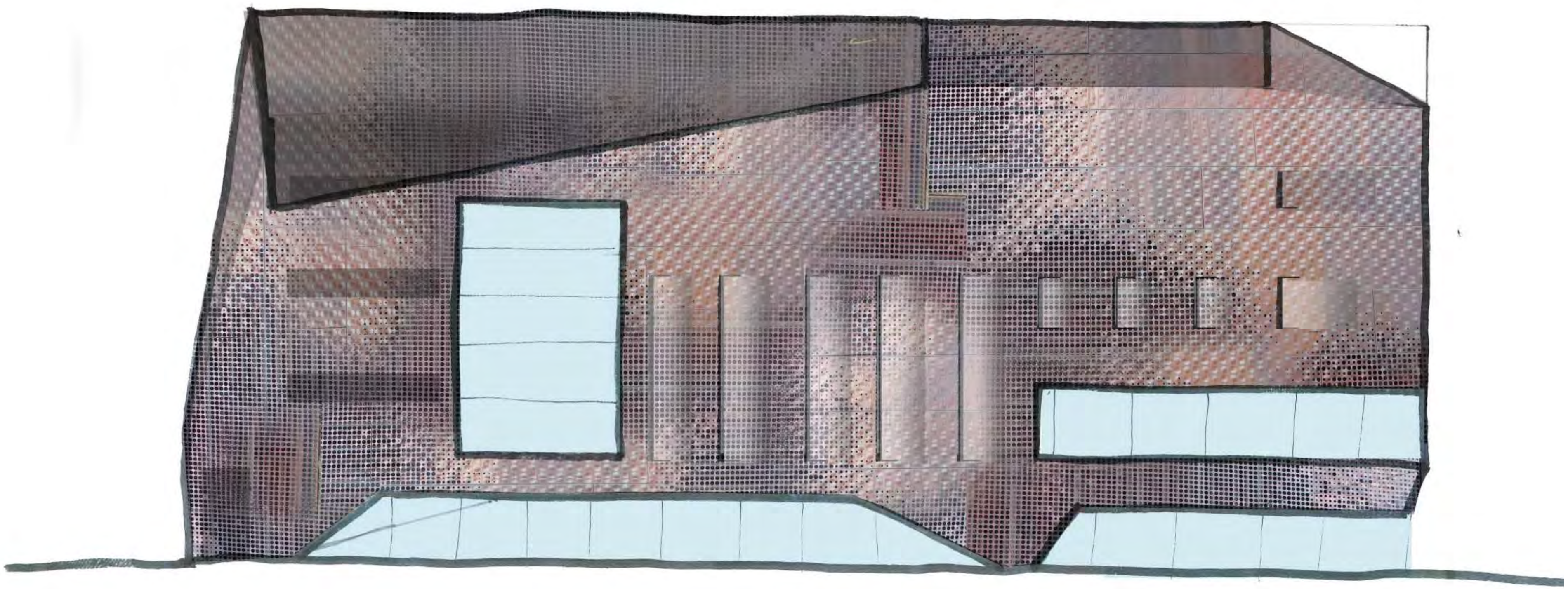

^{6}He



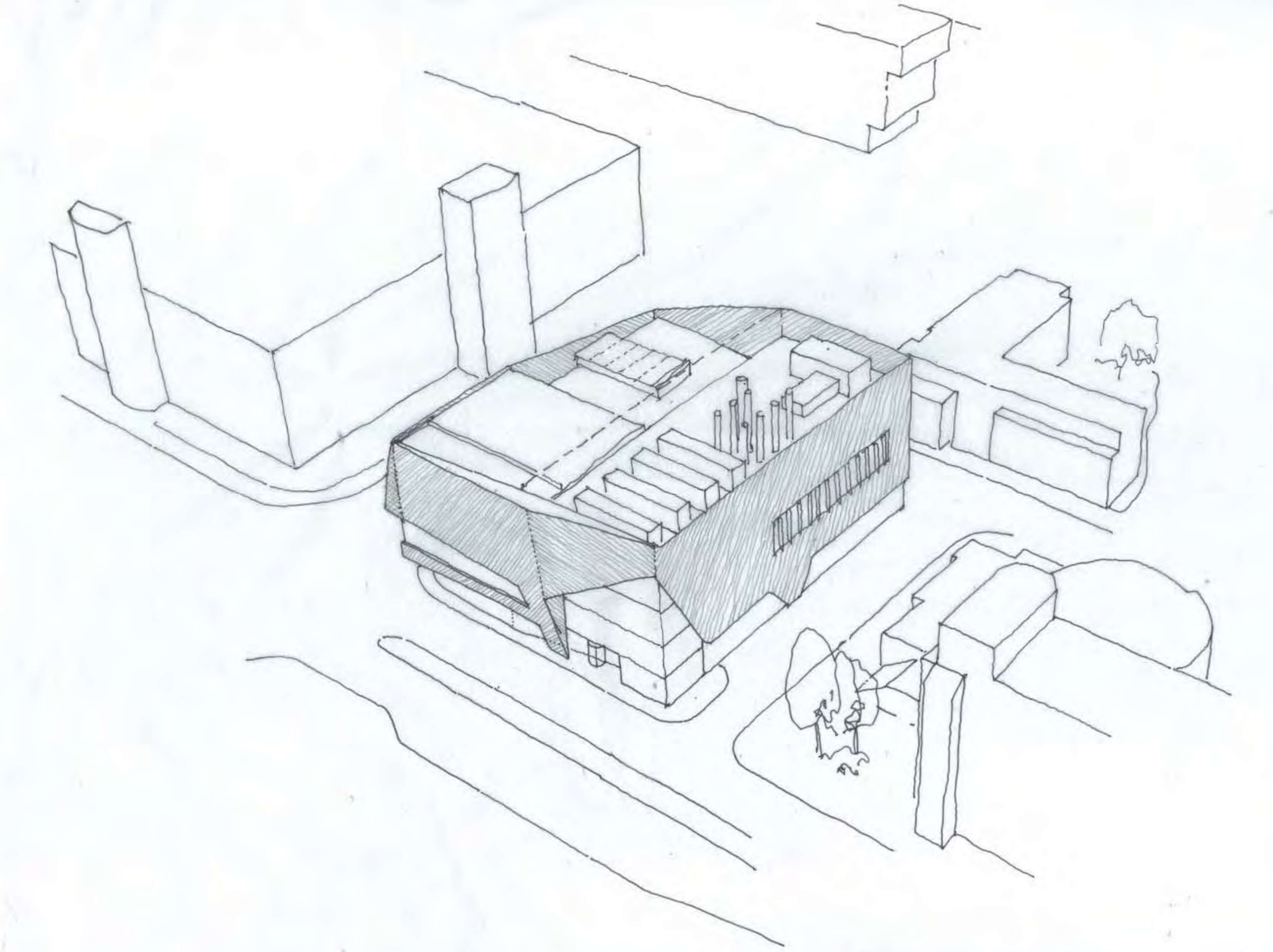




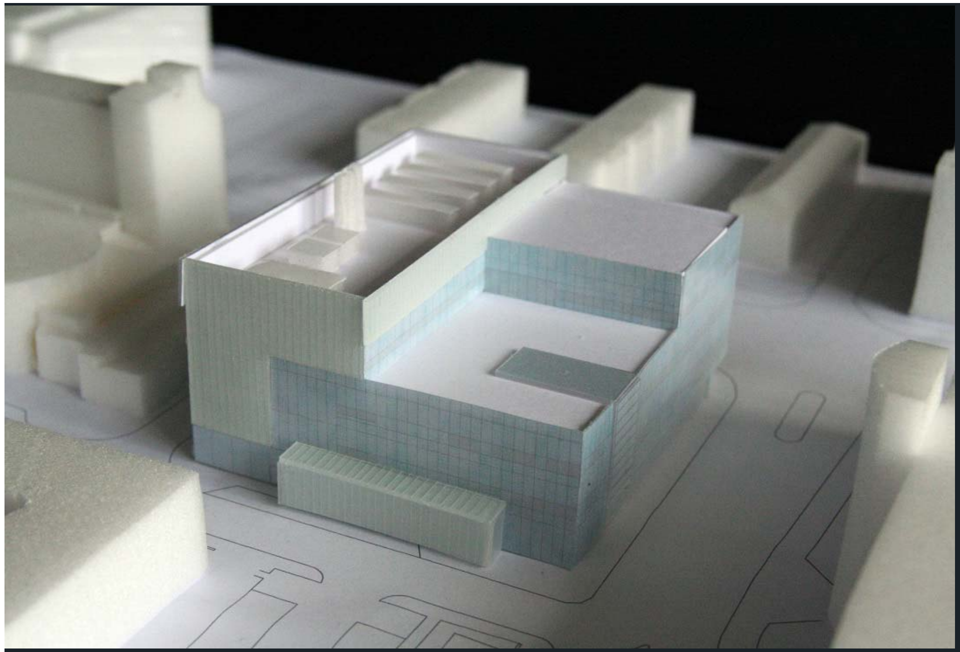
Concept Sketches

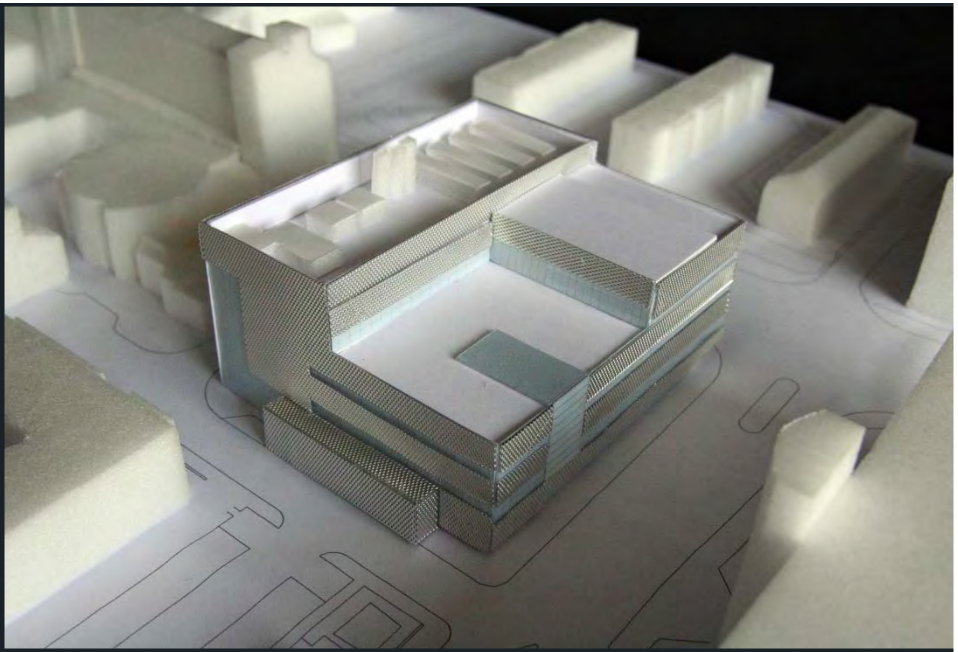


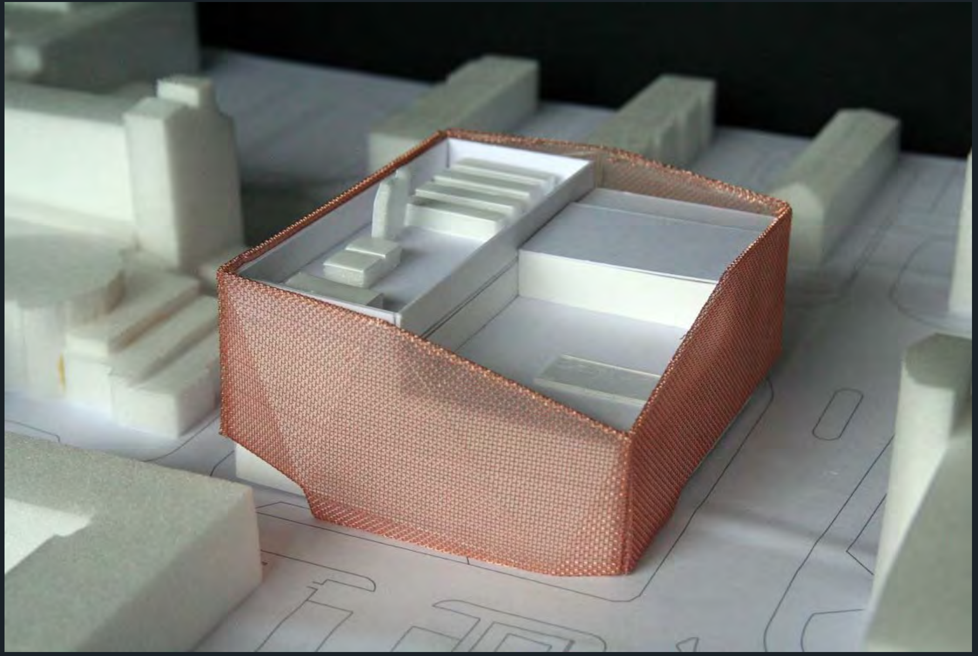
Concept Sketch



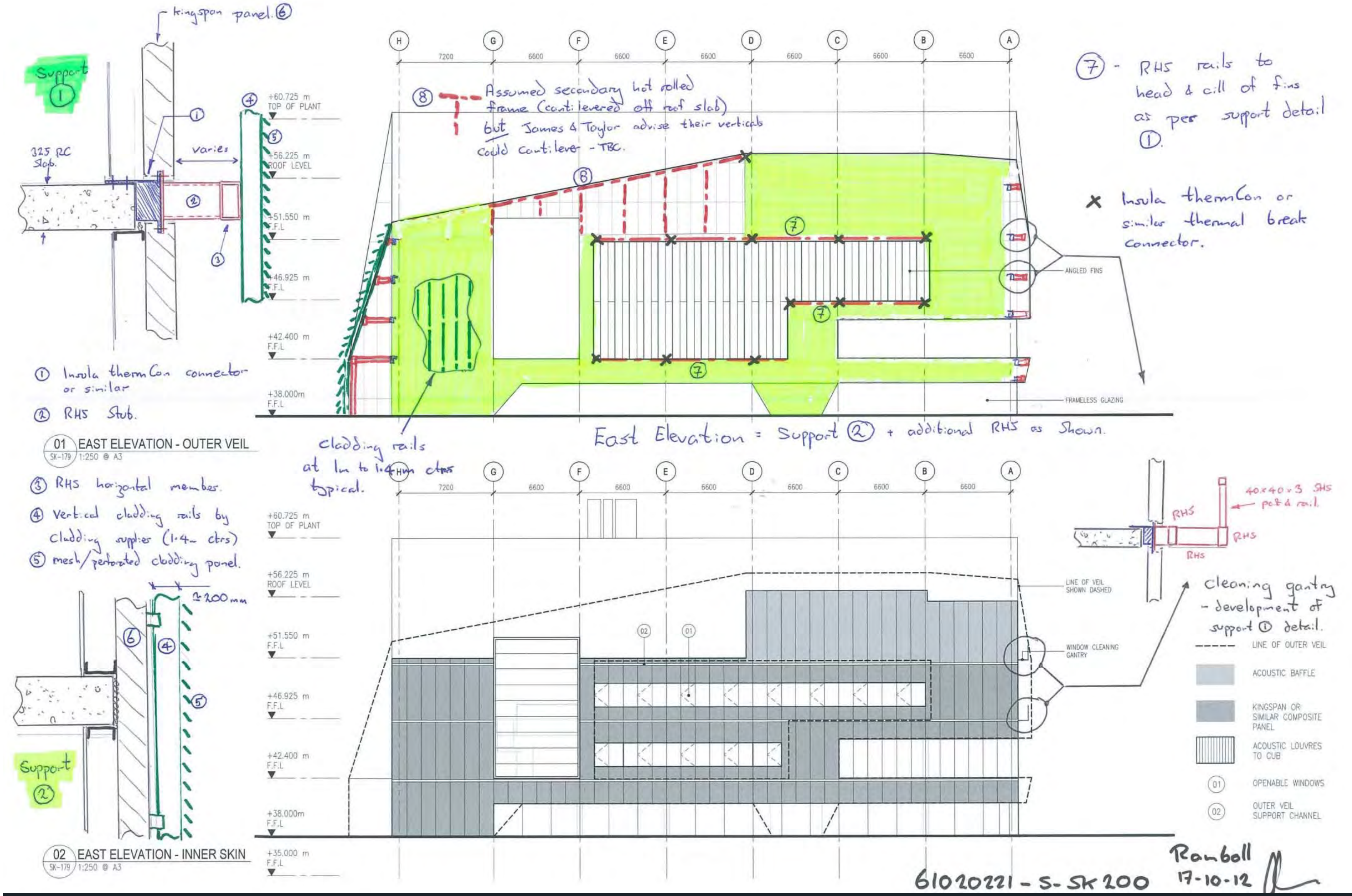
Cladding Options



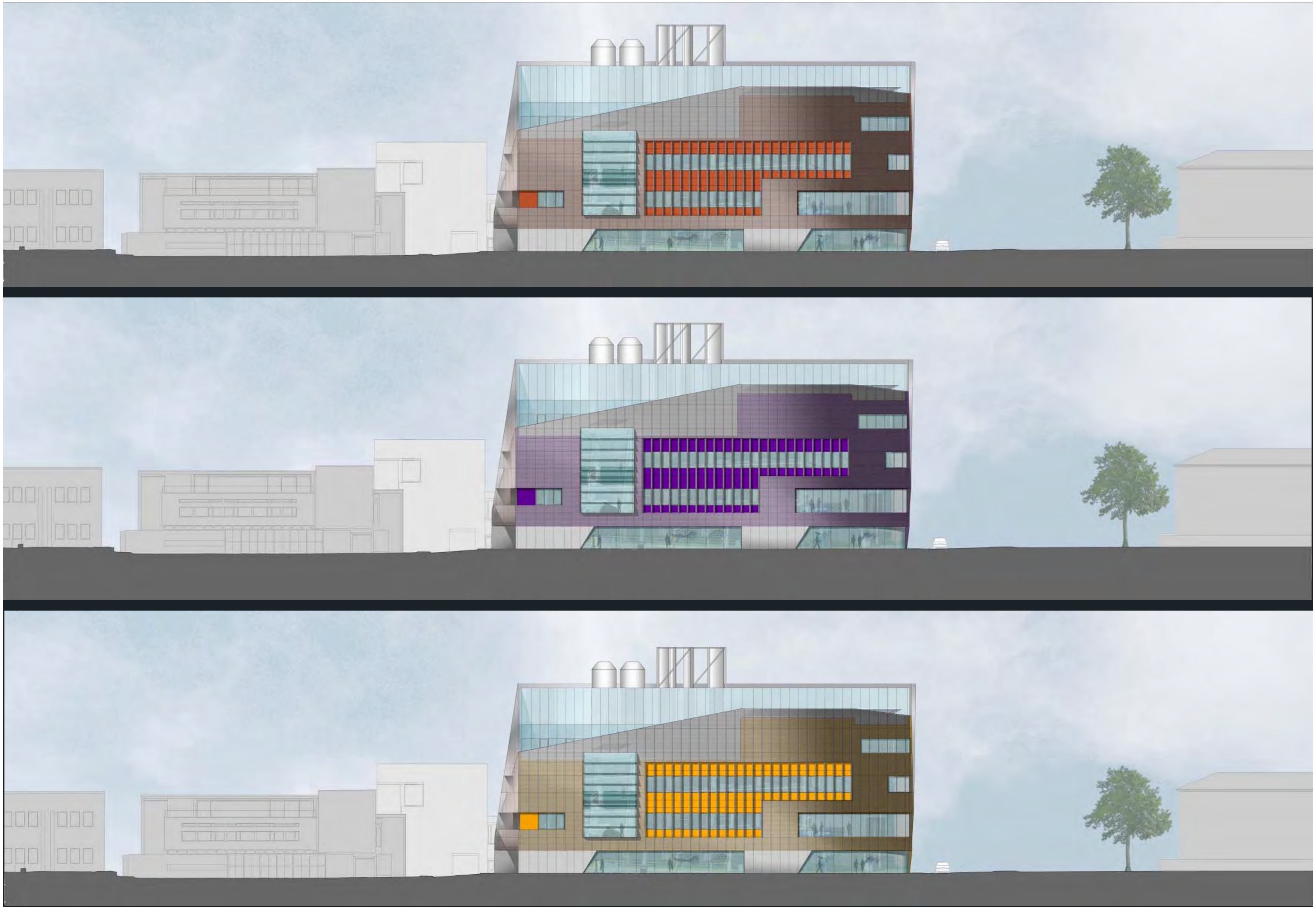




Models

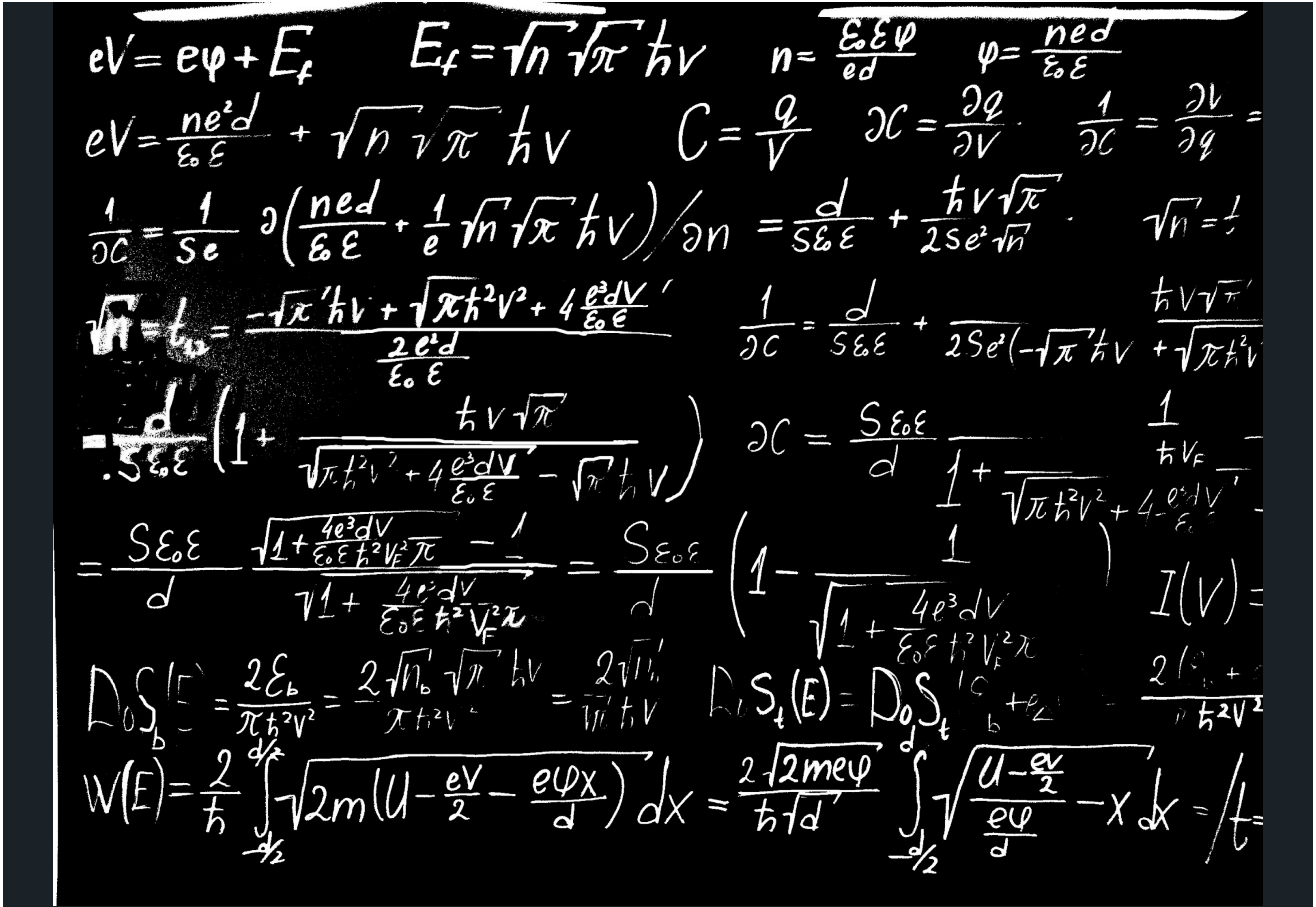


Structural support for cladding



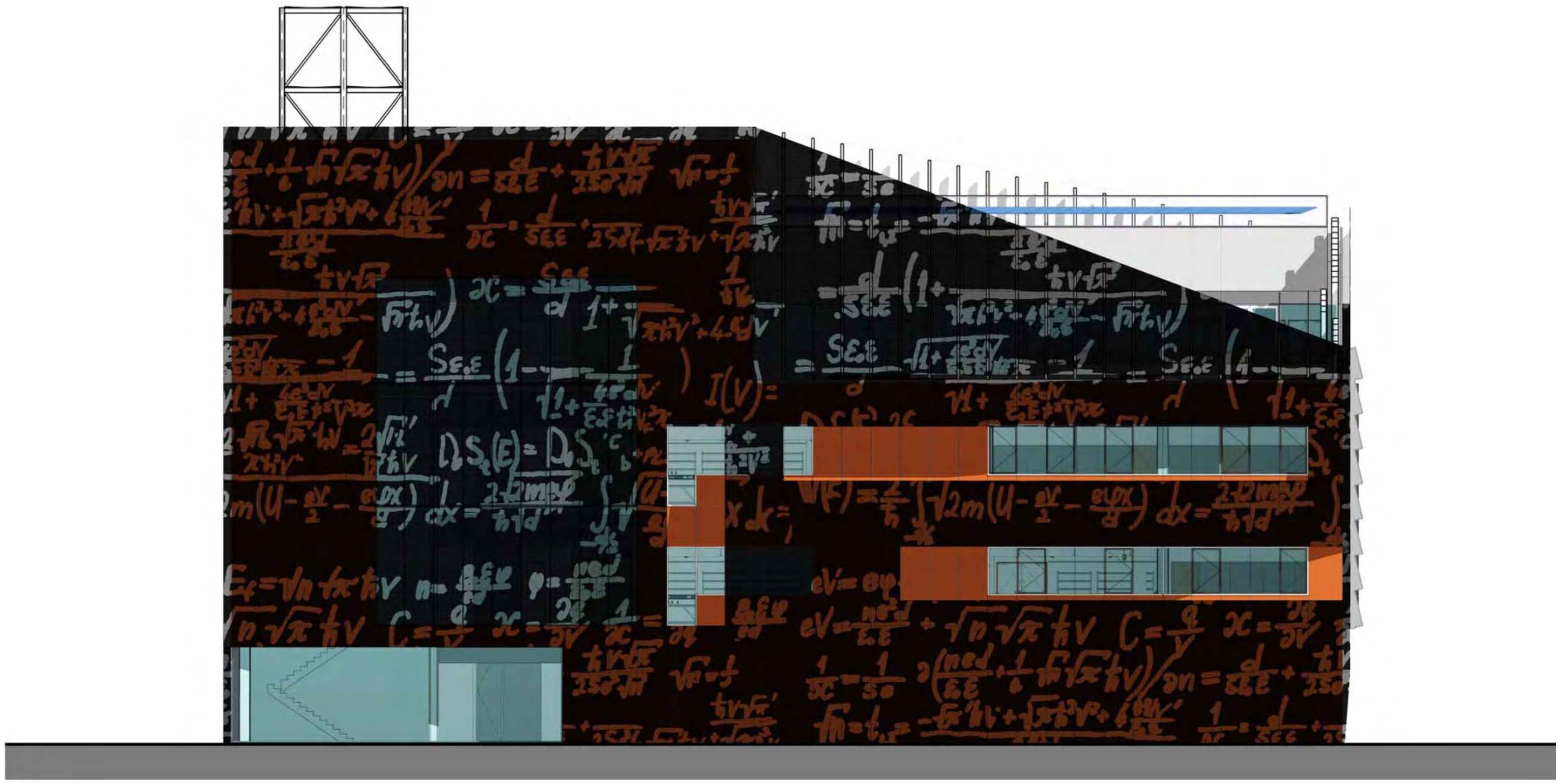
Cladding Colour Options

End-User Engagement

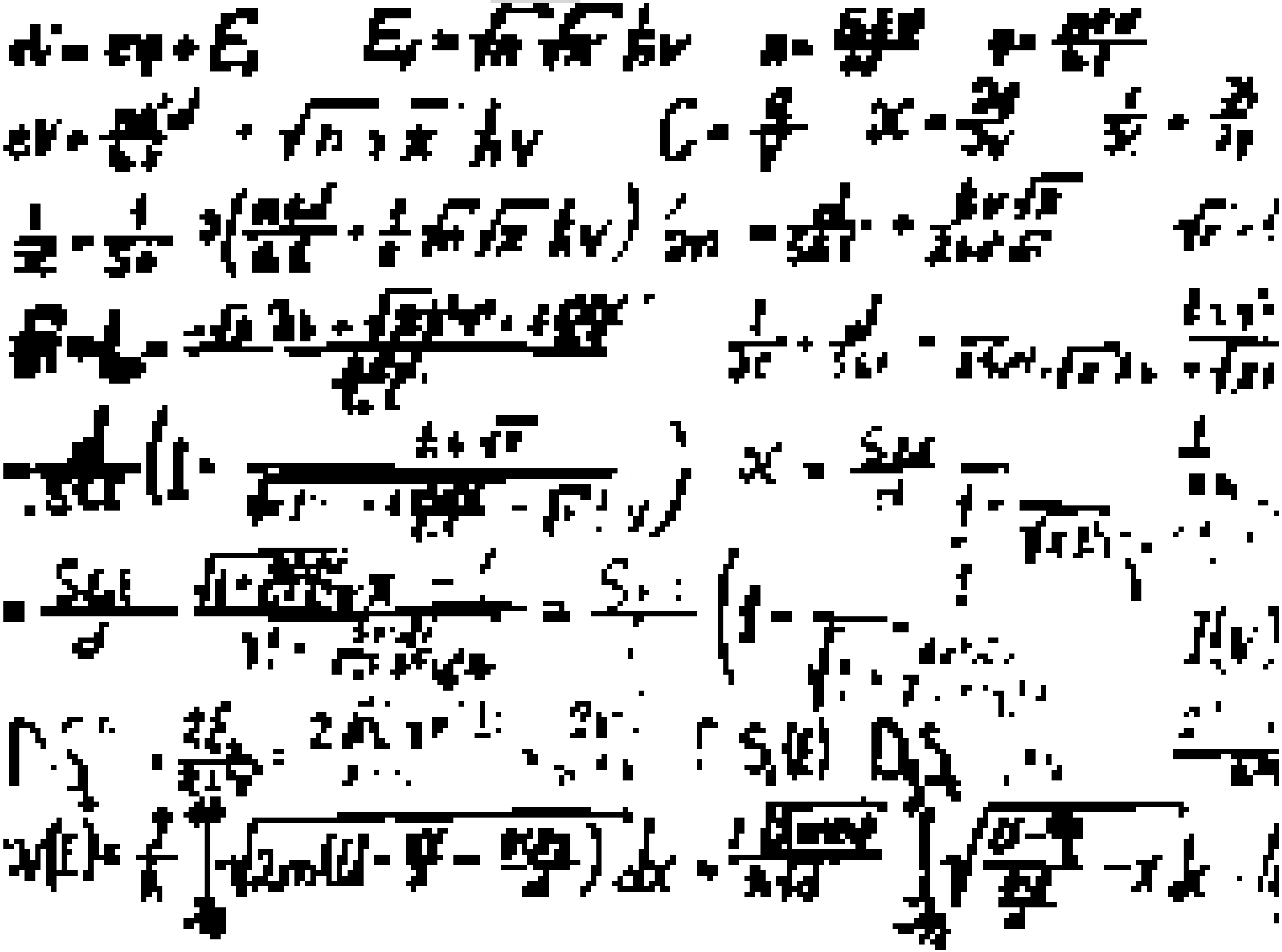


Formula Handwritten by Kostya

Graphic development of formula pattern



Hand written equations



[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Abstract equations

Abstract equations

$$eV=e\varphi+E_f \qquad E_f=\sqrt{n}\sqrt{\pi}\,tv \qquad n=\frac{\varepsilon_o\varepsilon\varphi}{ed} \qquad \varphi=\frac{ned}{\varepsilon_o\varepsilon}$$

$$eV=\frac{ne^2d}{\varepsilon_o\varepsilon}+\sqrt{n}\sqrt{\pi}\,tv \qquad c=\frac{q}{v} \qquad \partial c=\frac{\partial q}{\partial v} \qquad \frac{1}{\partial c}=\frac{\partial v}{\partial q}$$

$$\frac{1}{\partial c}=\frac{1}{Se}\varphi=\left(\frac{ned}{\varepsilon_o\varepsilon}+\frac{1}{e}\sqrt{n}\sqrt{\pi}\,tv\right)\Big/\partial n=\frac{d}{S\varepsilon_o\varepsilon}+\frac{tv\sqrt{\pi}}{2se^2\sqrt{n}}$$

Typeface Formula

$$\varepsilon(p)=\pm(1/2)\gamma_1 \pm\sqrt{(1/4)\gamma_1^2+v_F^2p^2}$$

should be \gamma_1 (greek letter gamma as the normal text and 1 as a subscript)

\gamma

$$E_N=\pm\hbar\omega_c\sqrt{N(N-1)}$$

$$v_F=\frac{\sqrt{3}}{2}\frac{\gamma 0^a}{\hbar}$$

$$\hat{\pi}=\hat{p}_x+i\hat{p}_y$$

0 as a subscript, "a" as a normal text

proportionality symbol

$$m=\frac{\gamma 1}{2v_F^2}$$

1 as a subscript

$$\hat{H}_J\,\alpha\begin{pmatrix}0 & (\hat{\pi}^+)^J\\ \hat{\pi}^J & 0\end{pmatrix}$$

$$\omega=\frac{eB}{m}$$

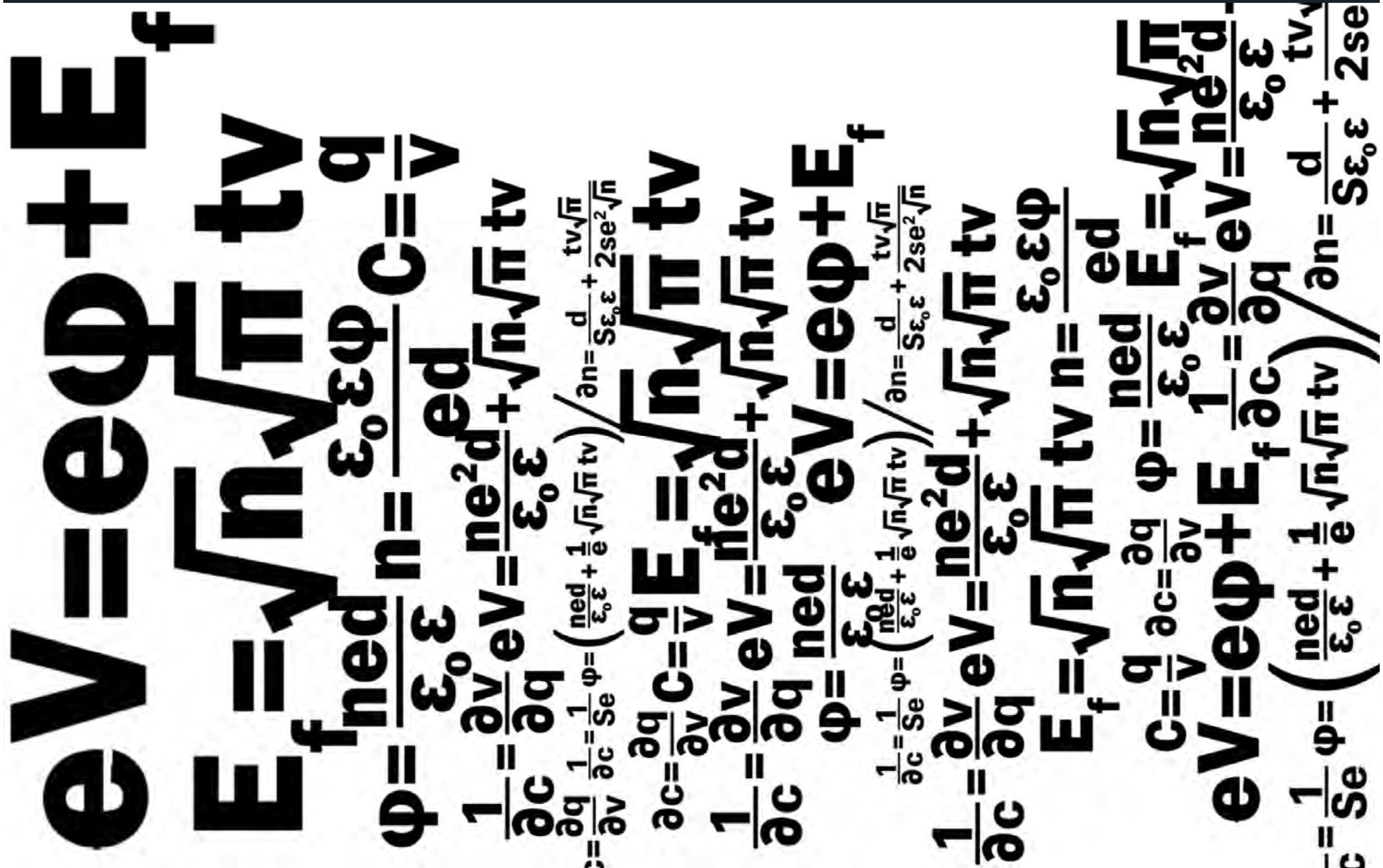
$$\hat{H}_j=\varepsilon(p)\vec{\sigma}\cdot\vec{n}(\varphi)$$

$$\hat{H}_2=-\frac{1}{2m}\begin{pmatrix}0 & (\hat{p}_x-i\hat{p}_y)^2\\ (\hat{p}_x+i\hat{p}_y)^2 & 0\end{pmatrix}$$

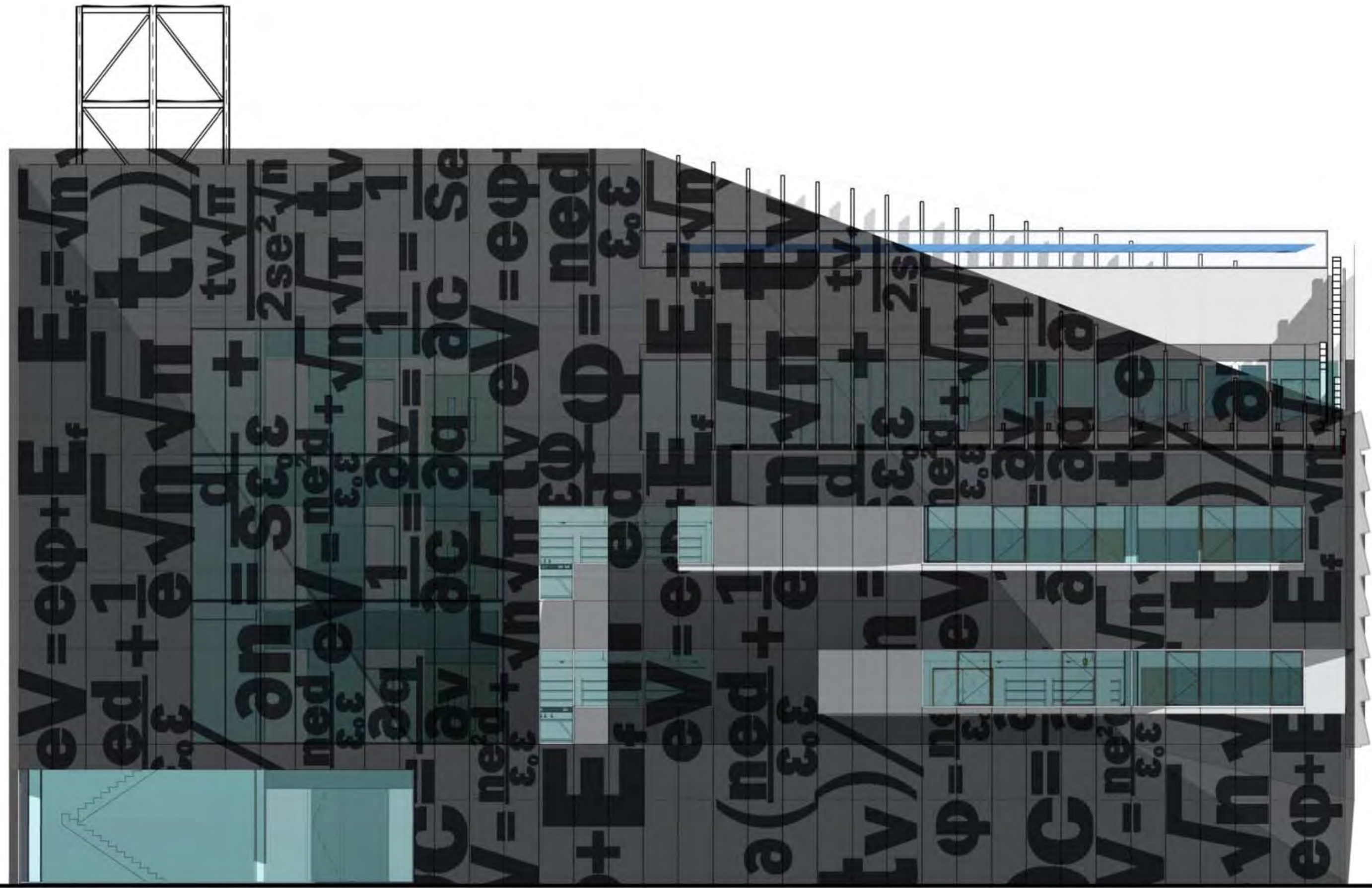
$$\vec{n}(\varphi)=-(\cos J\varphi,\sin J\varphi)$$

all p should be in

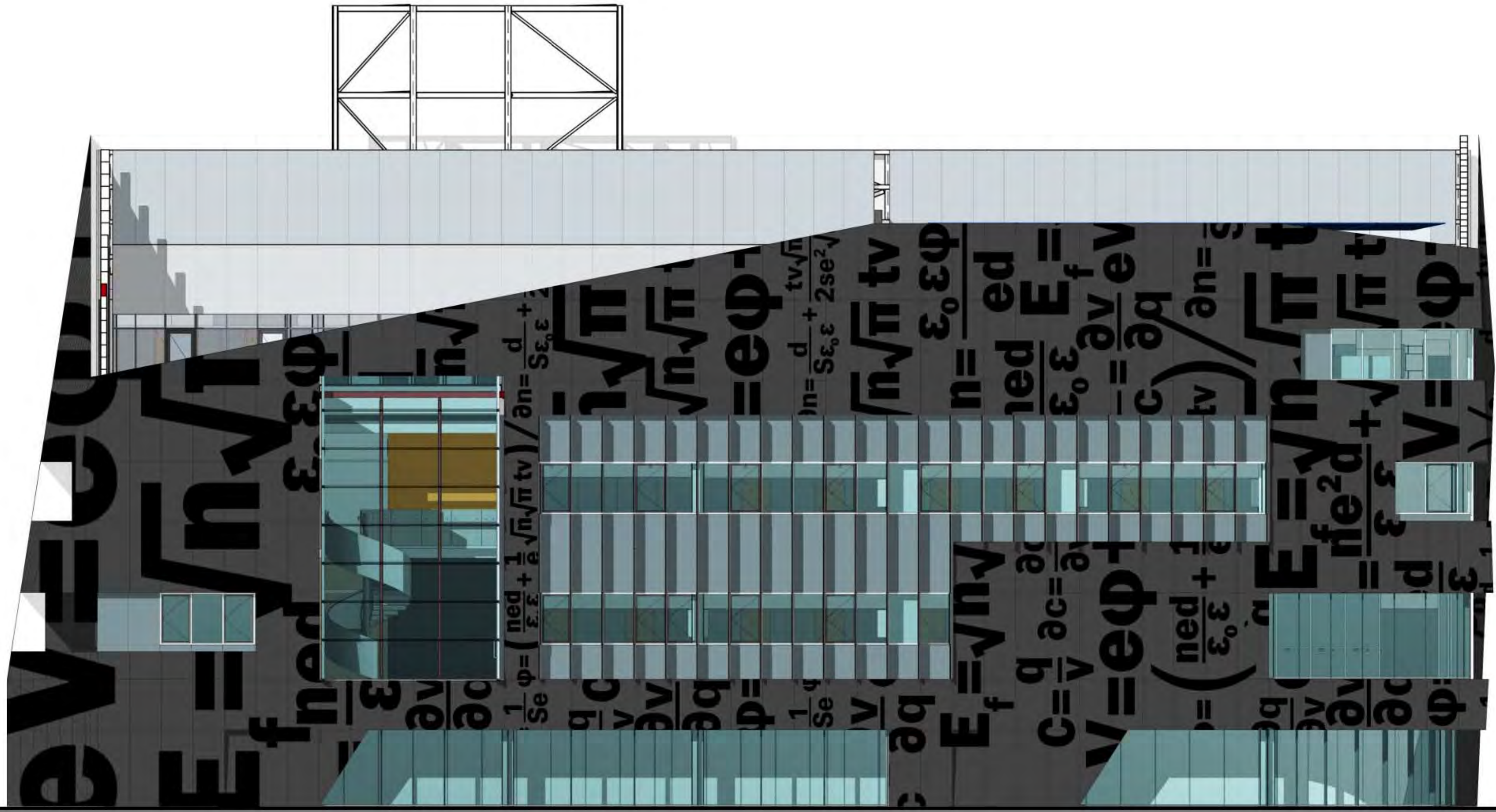
Kostya's corrections



Equations – adopted scheme

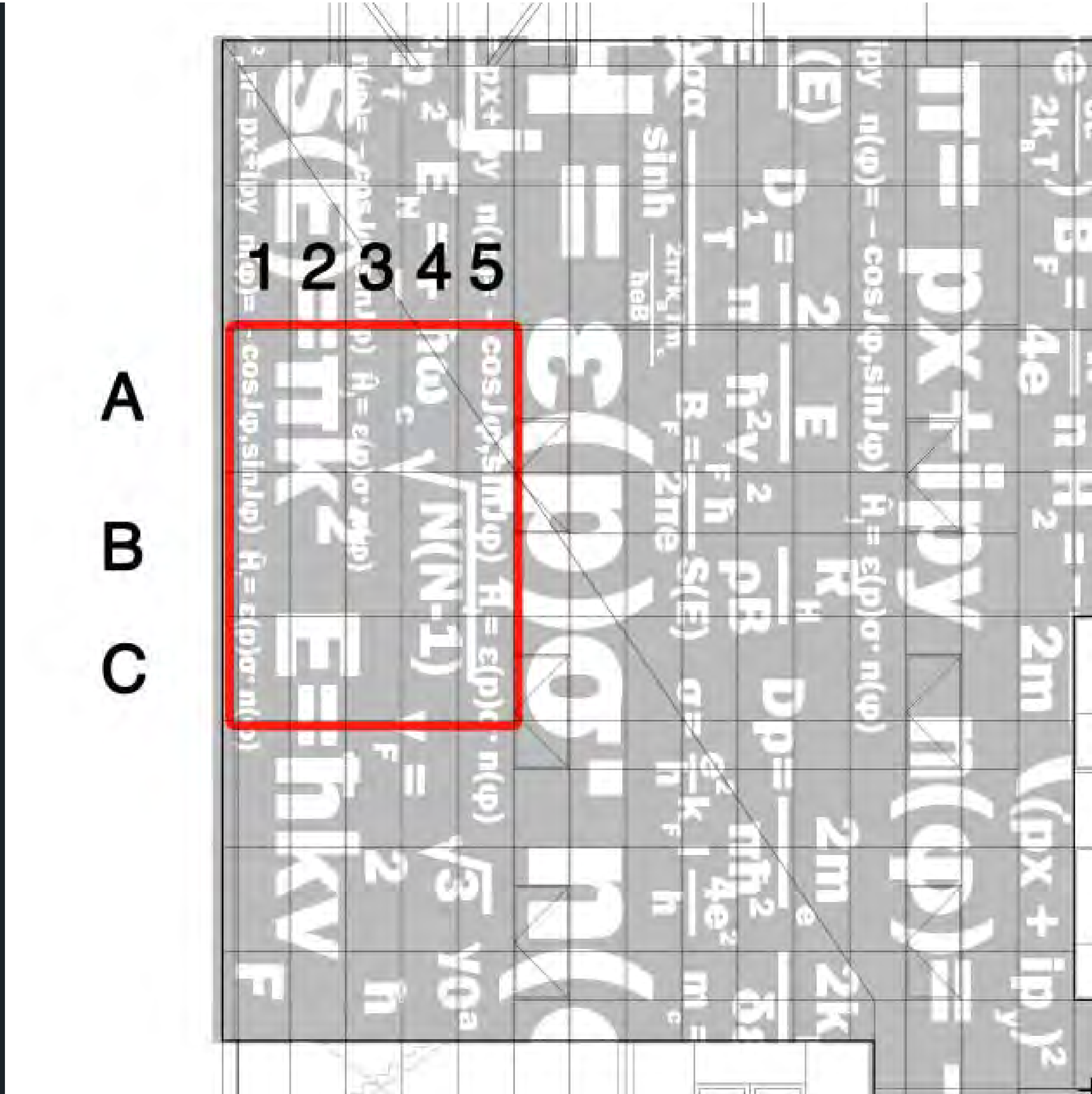


South Façade

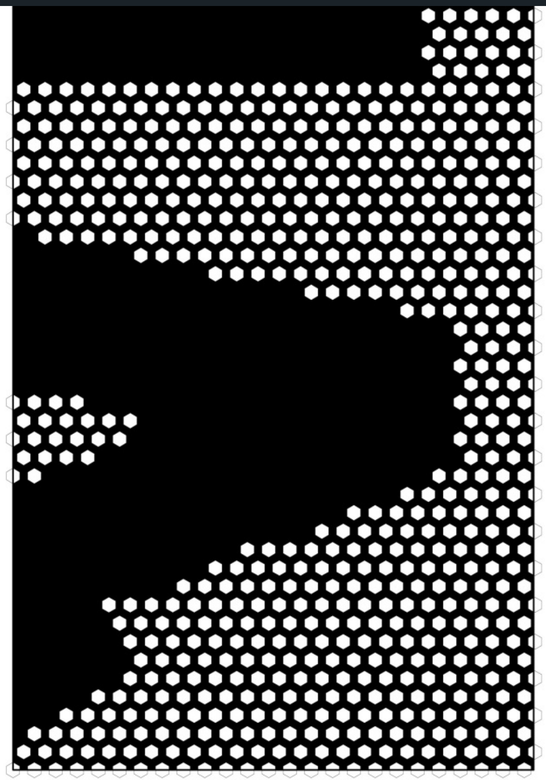


East Façade

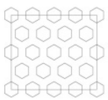
North Façade



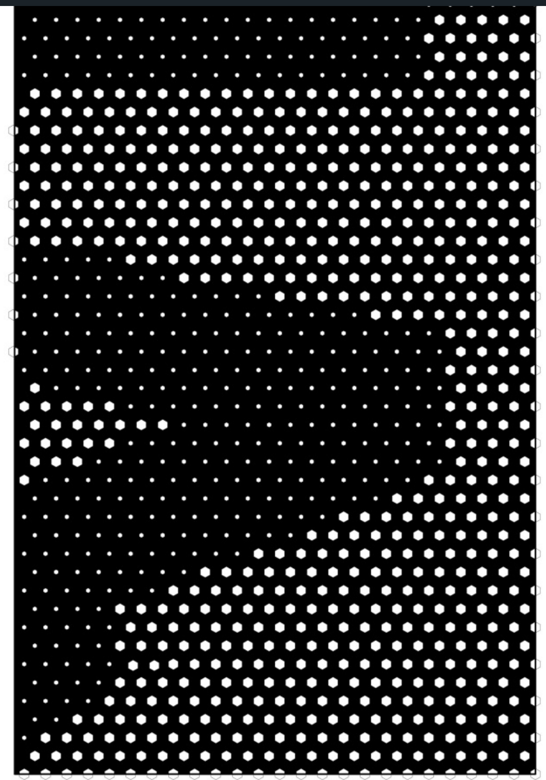
Equation pattern – final design



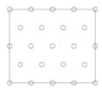
20%
perforated



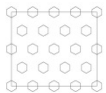
28mm diameter
% open = 39.6



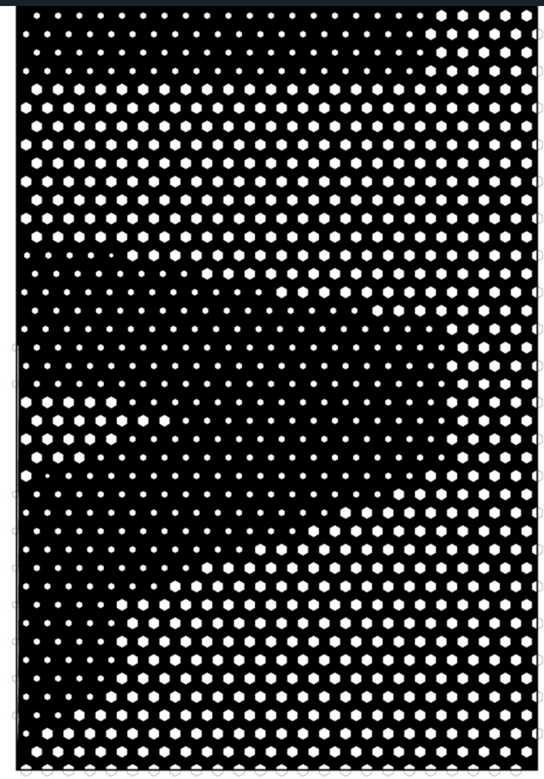
15%
perforated



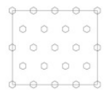
9mm diameter
% open = 3.9%



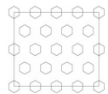
20mm diameter
% open = 20.3



20%
perforated

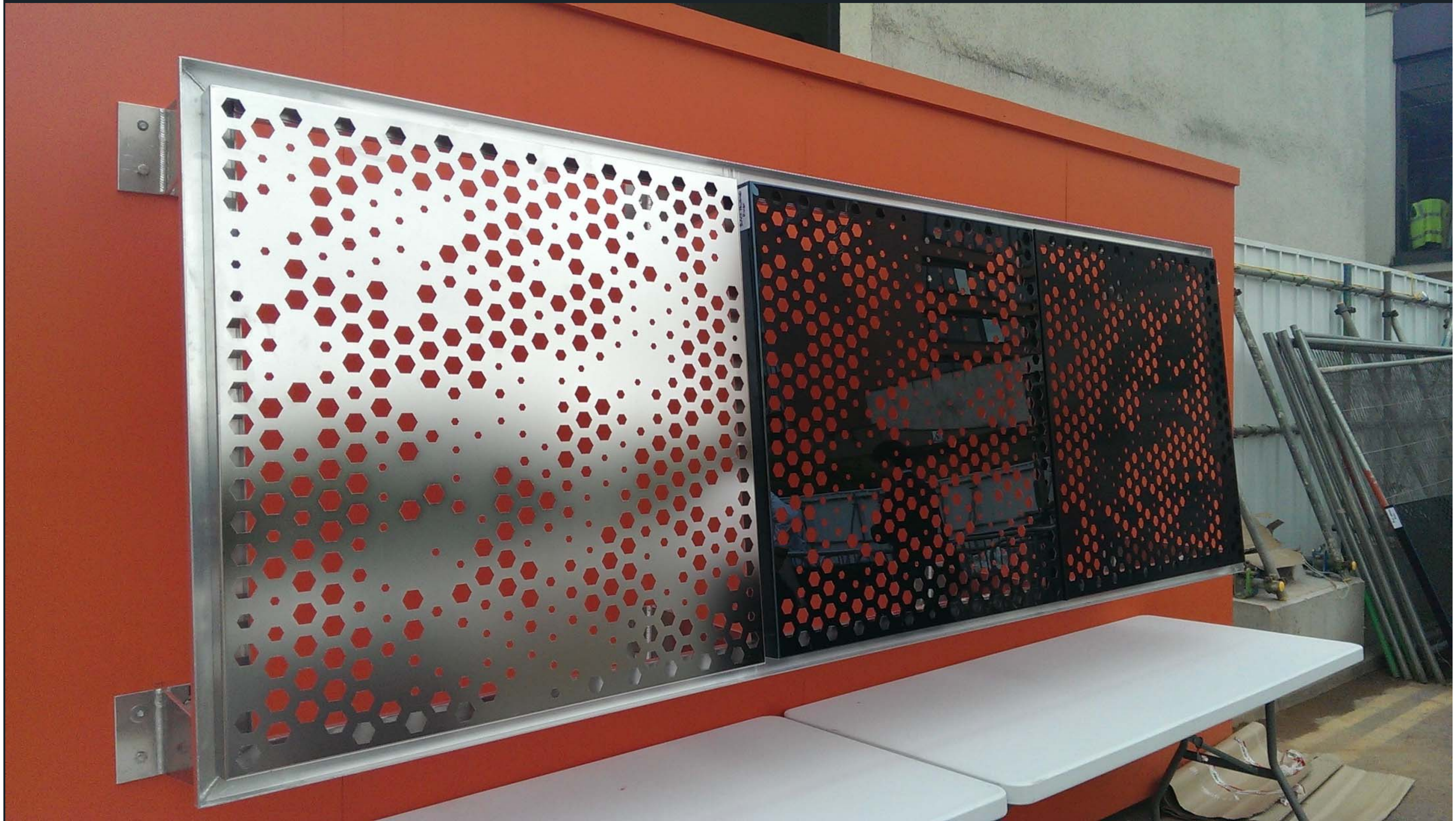


13mm wide
% open = 8.2%



22mm wide
% open = 24.3

Perforation density studies



Cladding Material Options

East Façade Detail

North Façade Detail

Engels’ Sink (maybe)

Questions