

# Integration as a Strategy for Energy Efficiency

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National Conference on Green Design

7<sup>th</sup> Jan 2011

New Delhi

# Socio-Economics of Innovation

**High Technology** – Integration of complex technological platform requiring high investment in R&D and production infrastructure. Eg. Special glazing technology

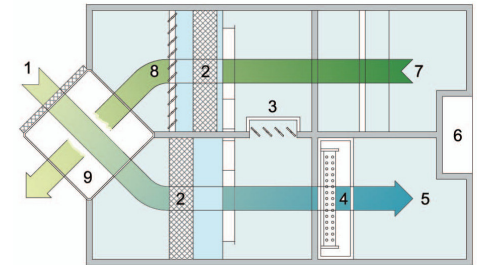
Intermediate Technology

**Simple Technology**- Use of scientific knowledge to make simple products to obtain enhanced environmental and functional performance—involving low investment in R&D and production infrastructure.

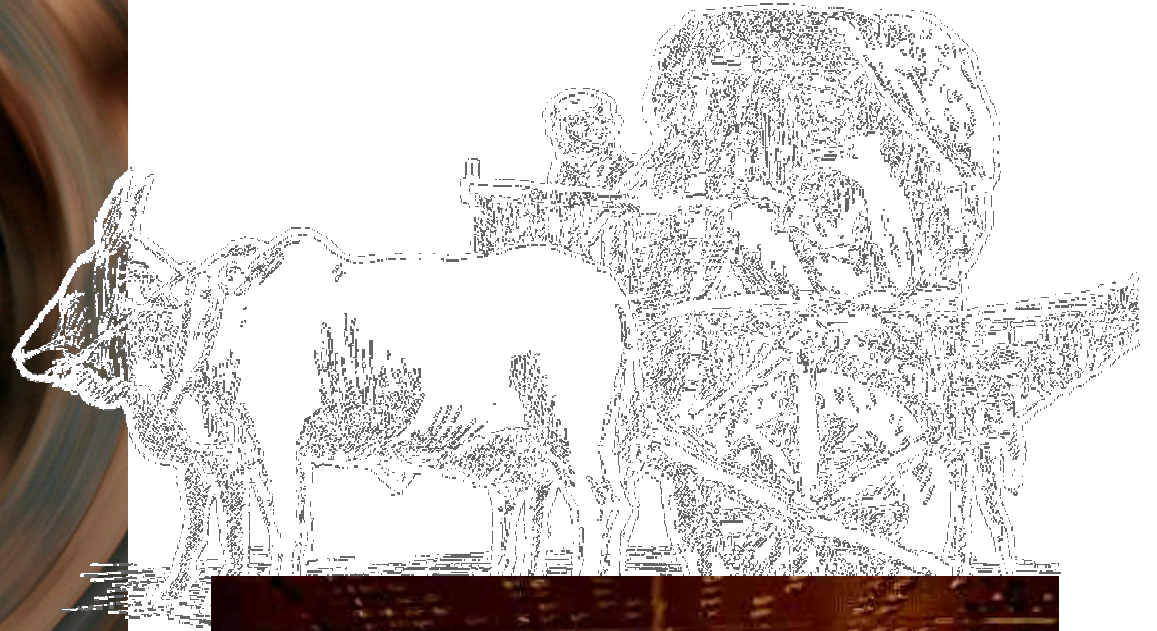
**Dependence on import and expensive technology transfer.**  
**Limited affordability**  
**Wealth concentrating?**

**“ Small is beautiful ”**  
- E.F. Schumacher

**Income distributive and knowledge enhancing locally.**  
**Widely affordable.**



# DNA of Building Systems



## Archetypes of Integration

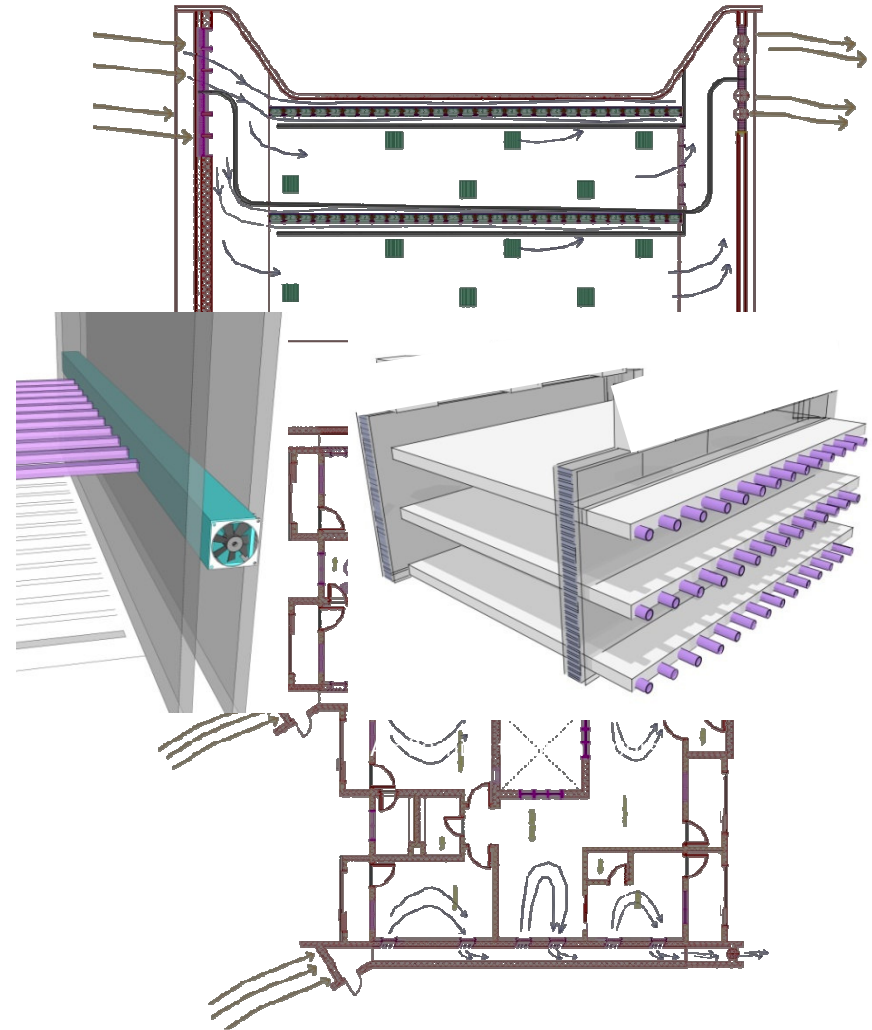
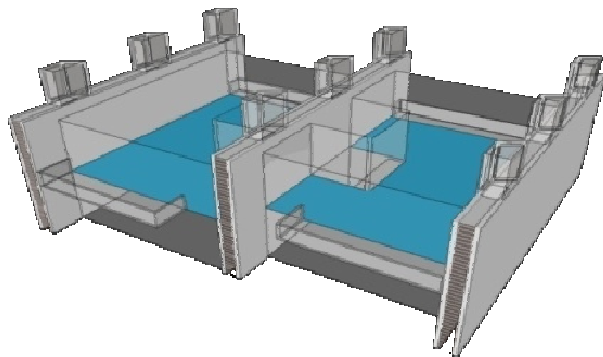
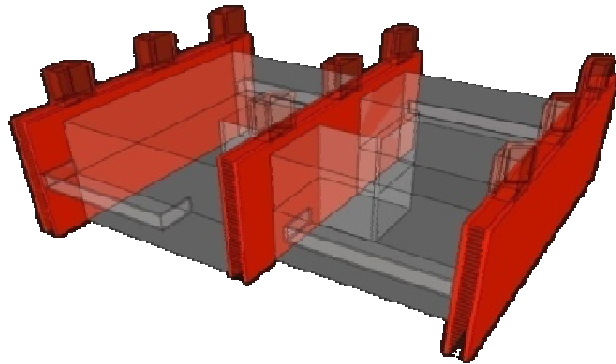
- Pottery
- Weaving
- Bullock Cart



# DNA of building Systems:

# Textile(weaving)

Weaving interaction of building structure and spatial envelope with movement of fluids for modulating thermal performance





**Sustainable Residential Colony, ACC Bellary**

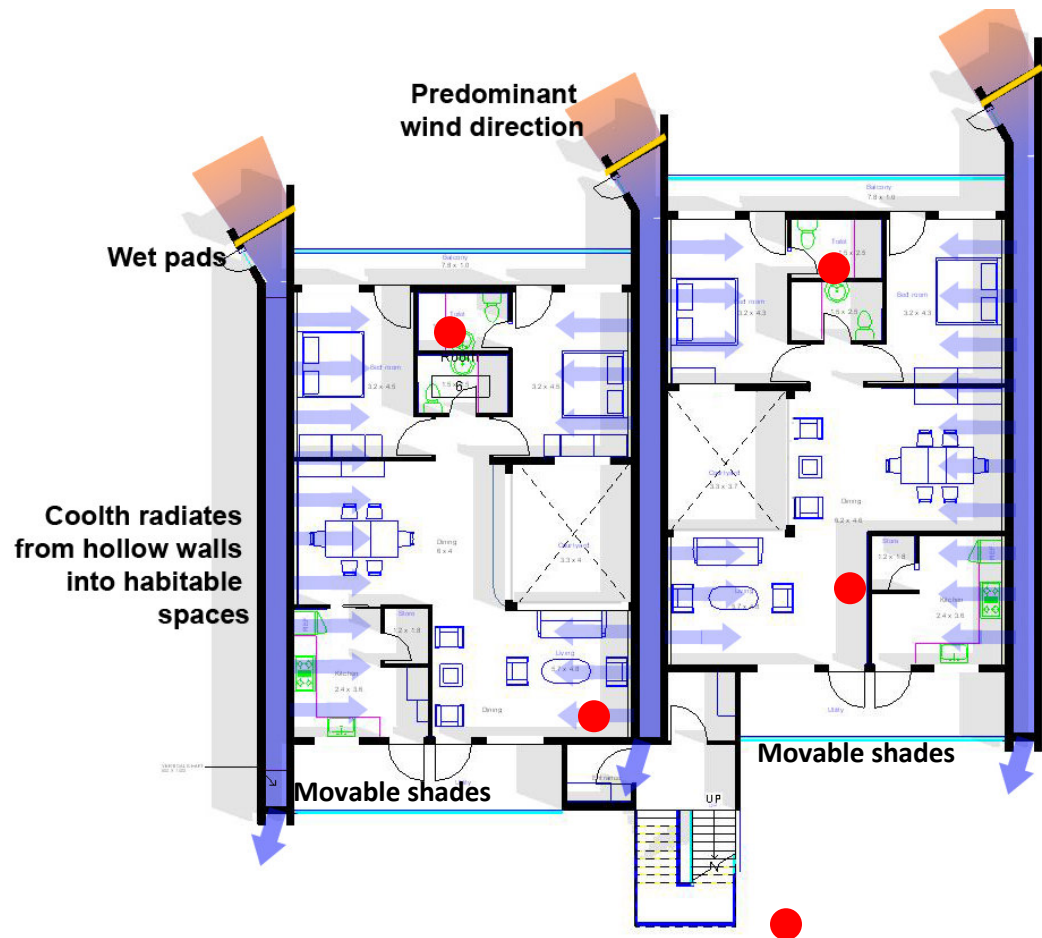
# Mind-Body-Tool Continuum

## The strategy

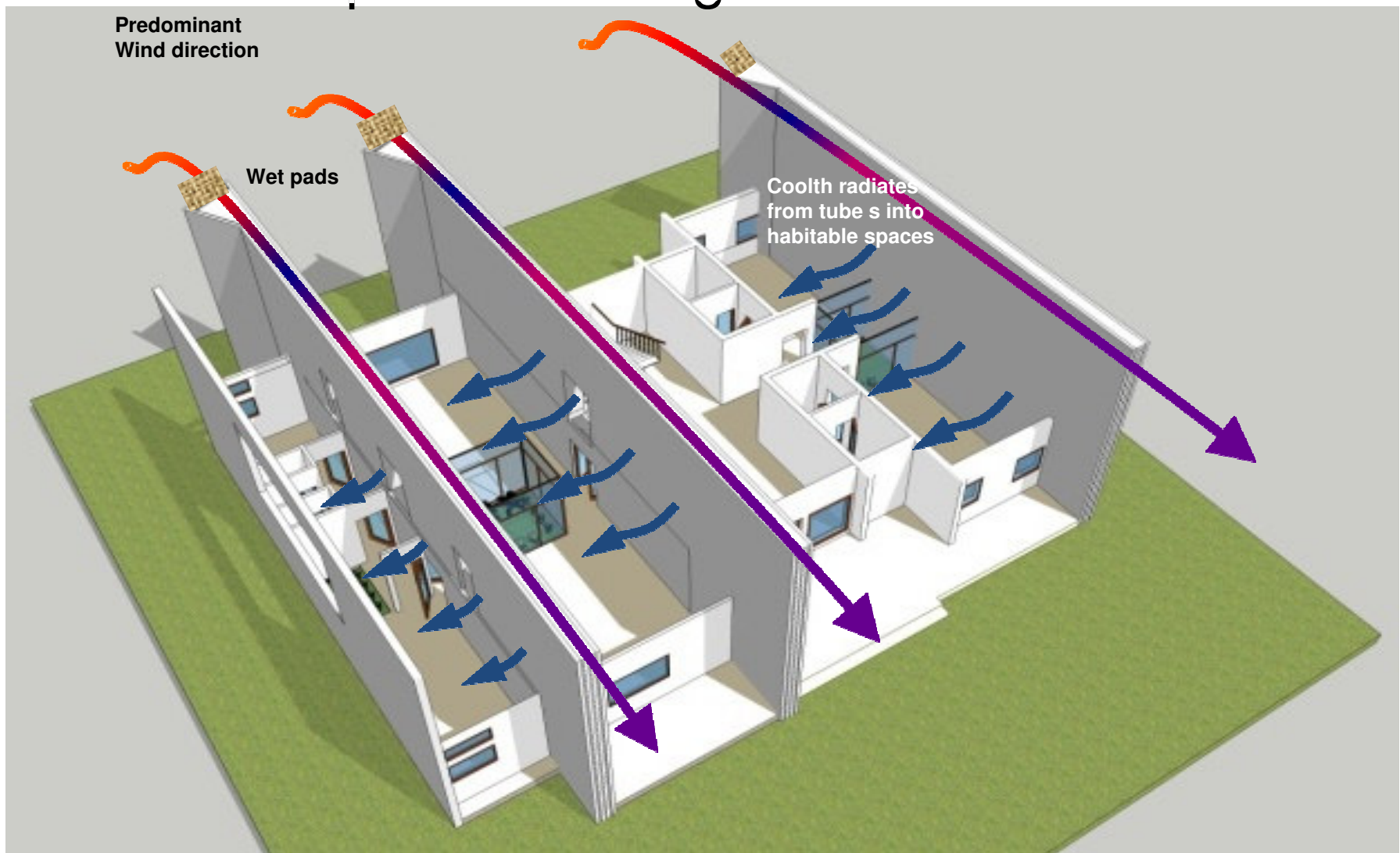
## First: optimize thermal performance using passive technologies first

**Next: allow the occupant a range of convenient modulating devices to respond to seasonal and diurnal variations**

**Finally: provide cybernetic prompts to optimize modulation and to warn against excessive resource consumption**

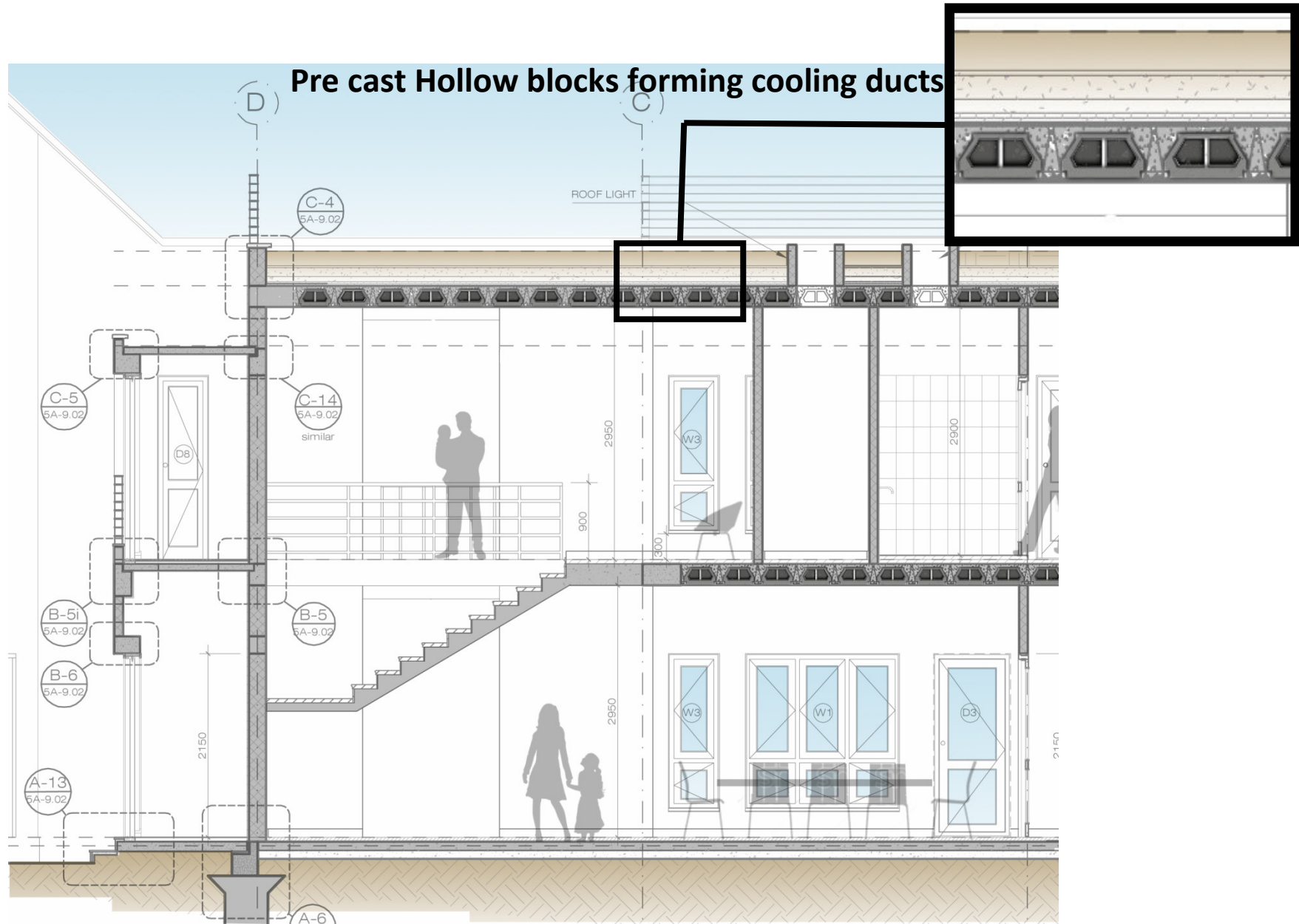


# Climate Responsive Design

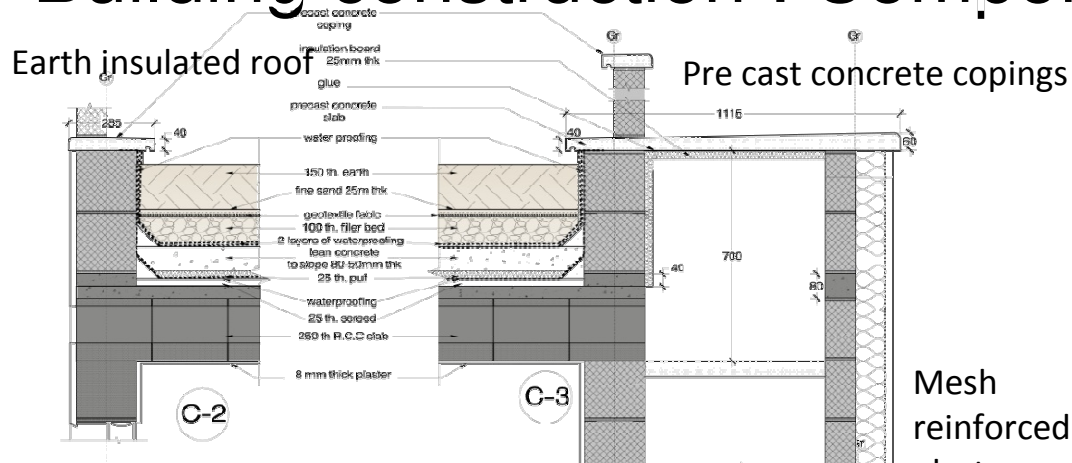


Typical construction of residential buildings; showing water filled cavity walls / 'cooling tubes' along living spaces.

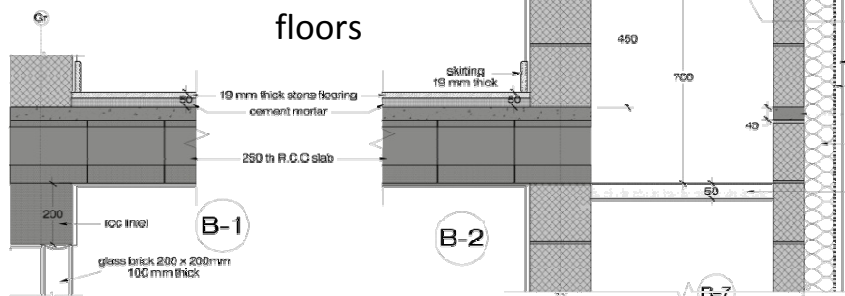
# Building construction : Coc. Slabs



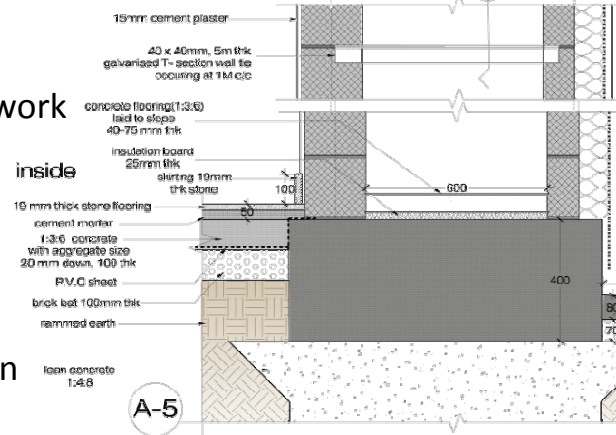
# Building construction : Components and Process



**Pre Fab concrete hollow floors**



**Cement Block work**



**Lean concrete strip foundation**

**Mesh reinforced plaster**

panels laid to slope  
nominal size 600x900mm  
50mm thick

40 x 40, 5mm thick galvanised T-section

rough cast plaster  
9.5 mm

galvanised lath

40 mm concrete pad

insulation board  
100mm thick

precast concrete panels  
nominal size 600x900mm  
50mm thick

**B-4**

**Pre cast concrete plinth protection**



# Junior Staff Quarters

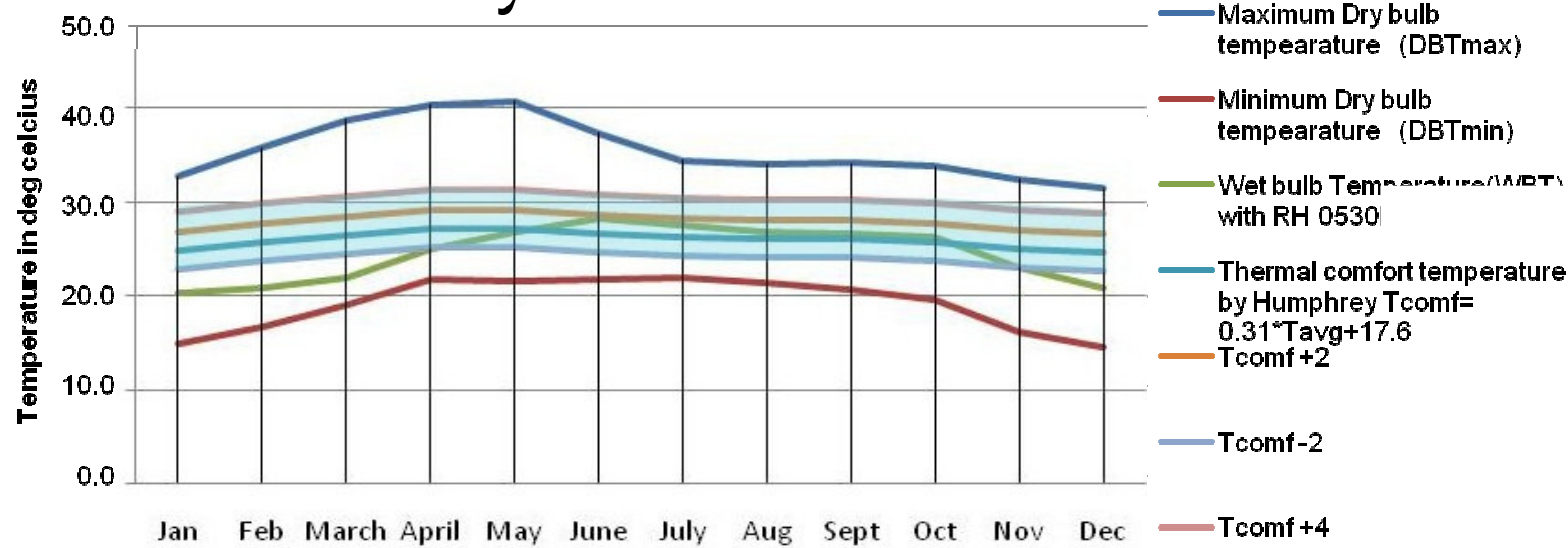


SOUTH ELEVATION



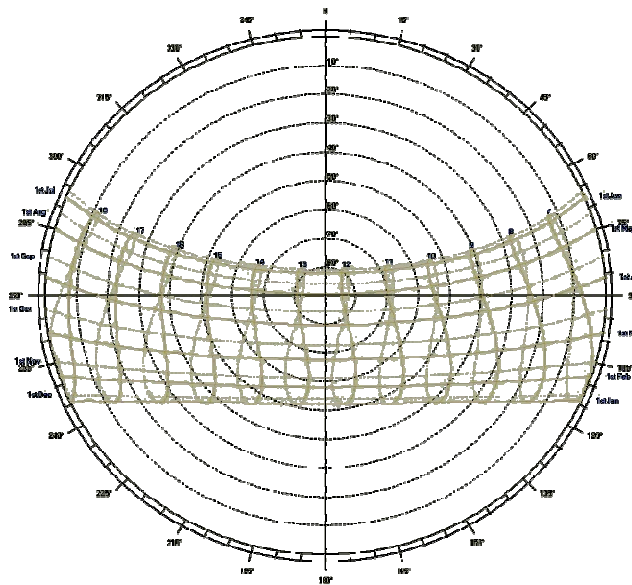
NORTH ELEVATION

# Climatic Analysis



Graph showing relation of outside air Temperature to Internal Comfort zone

Adaptive comfort range – basis of design for thermal comfort



Sun-path diagram for Bellary latitude

**Protection From direct Solar radiation most important ;**

- Correct Orientation
- Shading

**Overall low relative humidity ;**

- Good potential for using evaporative cooling

**High diurnal range & cool night sky;**

- Storage of coolth at night
- Direct/indirect evaporative cooling
- Radiative cooling

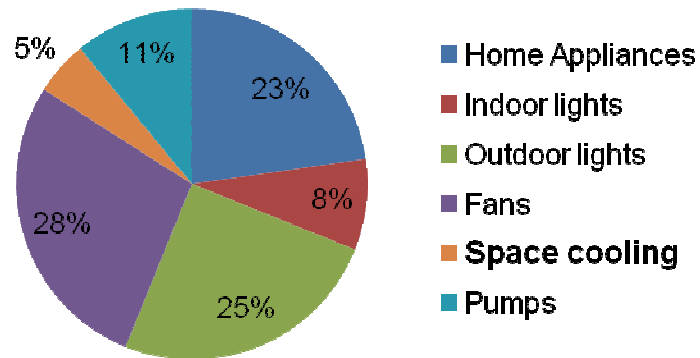
**Dominant wind direction Northwest to Southeast**

- Configuration to facilitate natural ventilation

## ELECTRICITY CONSUMPTION

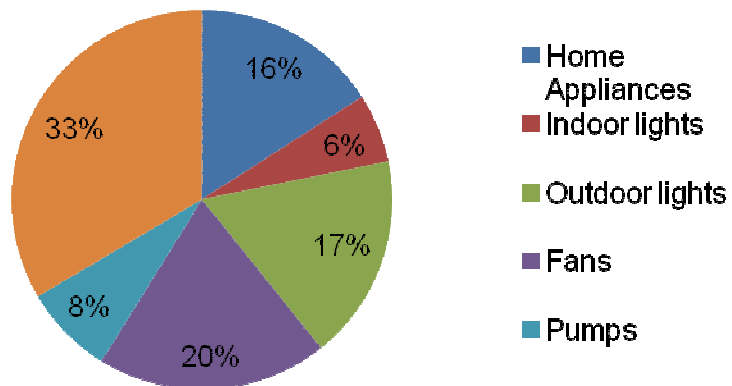
### Annual Electricity Consumption Distribution by use

#### With Low energy space cooling 284592 Kwh



**The estimated annual electricity requirement for cooling is 14185 Kwh**

#### With Air conditioning 406727 Kwh



**Air- Conditioning = 10 times evaporative +  
radiant / mechanical systems proposed**

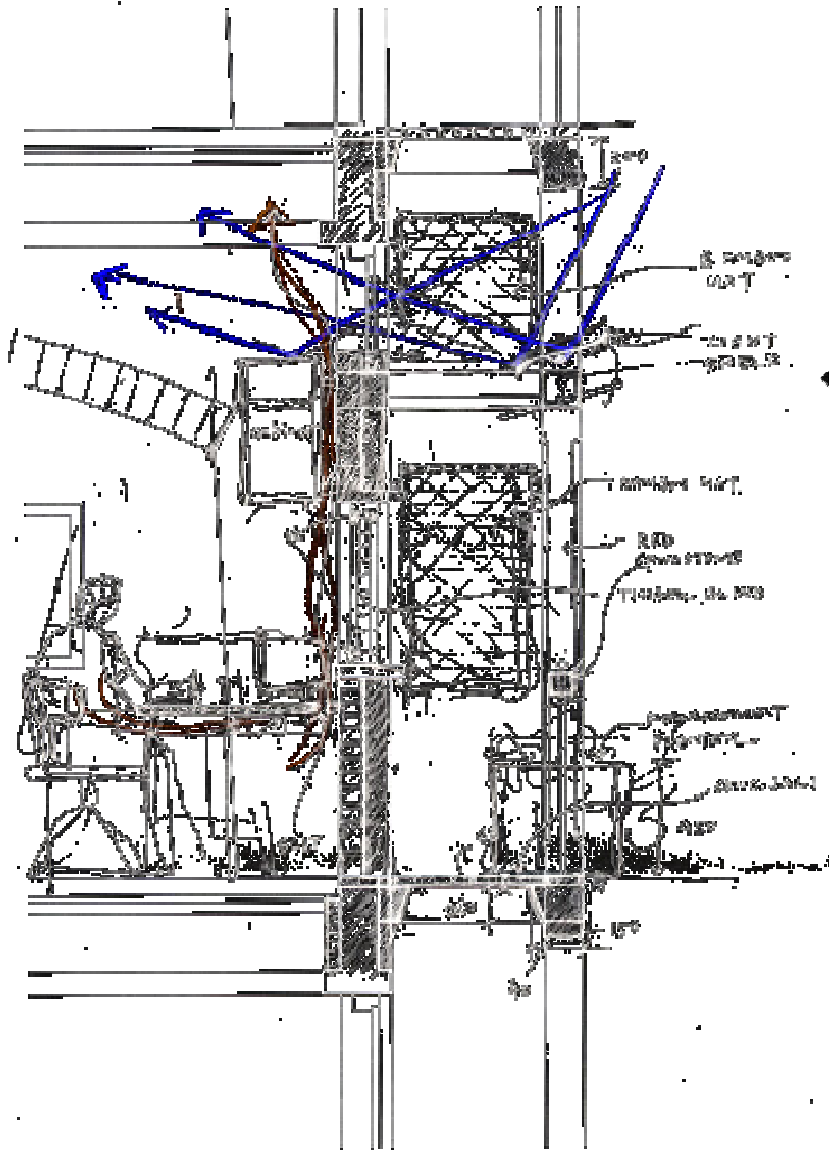


**Development Alternatives World Headquarters, New Delhi**

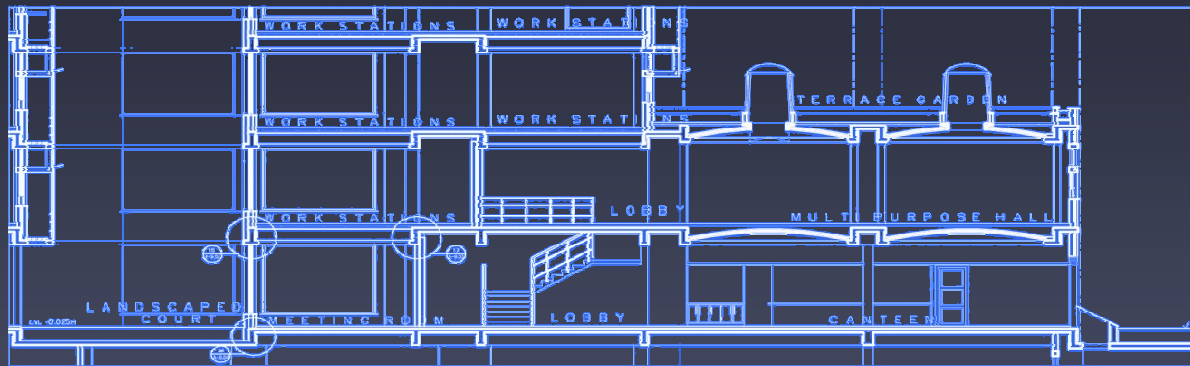
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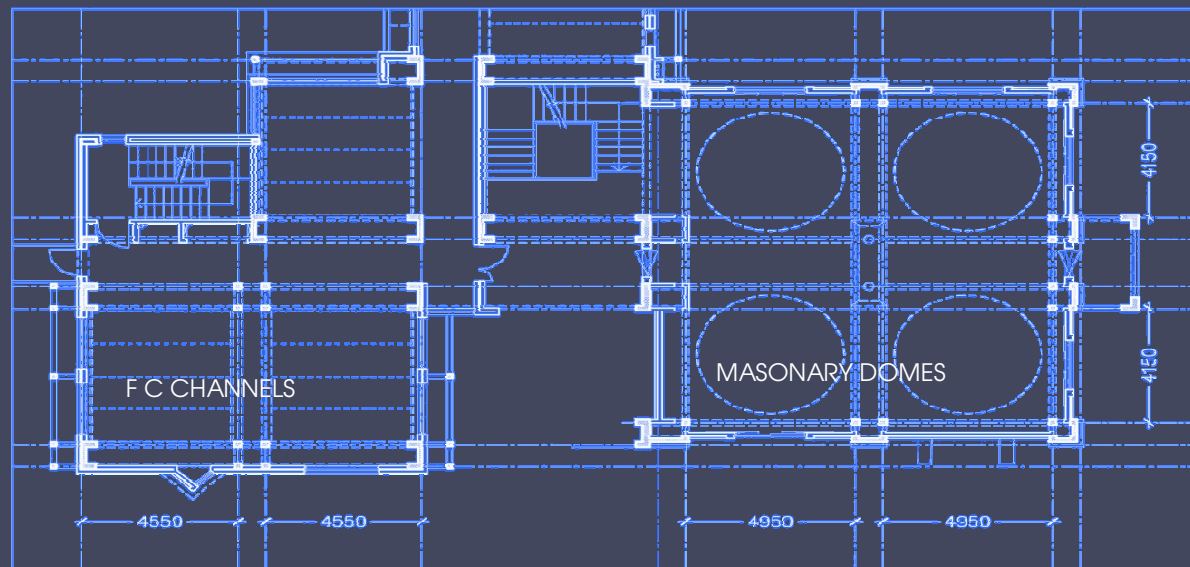
Weaving interaction of building structure and spatial envelope with movement of fluids for modulating thermal performance



# STRUCTURE



SECTION



PLAN

RCC frame

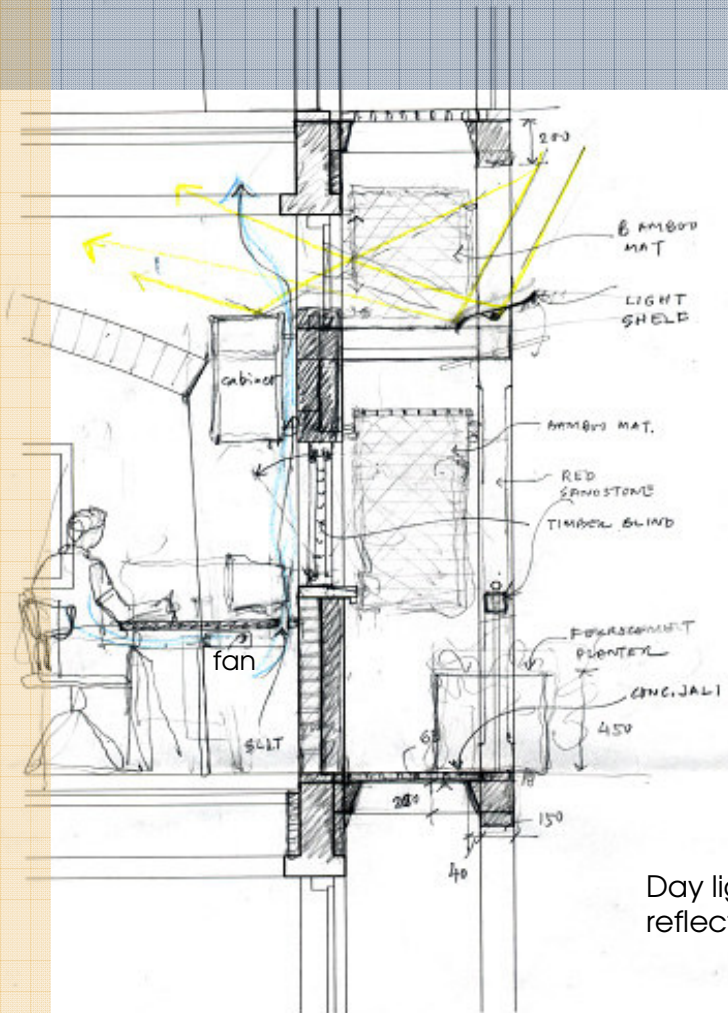
Ferro cement channels

Shallow domes

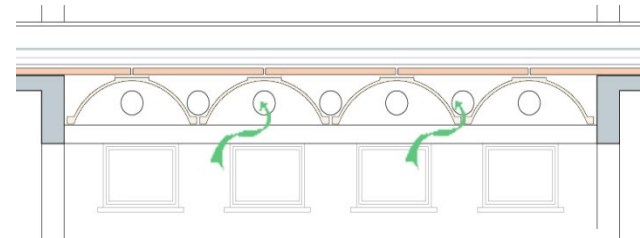
# ENVIRONMENTAL PERFORMANCE

## Systems Integration

Indoor climate control  
+  
Building fabric  
+  
Work place

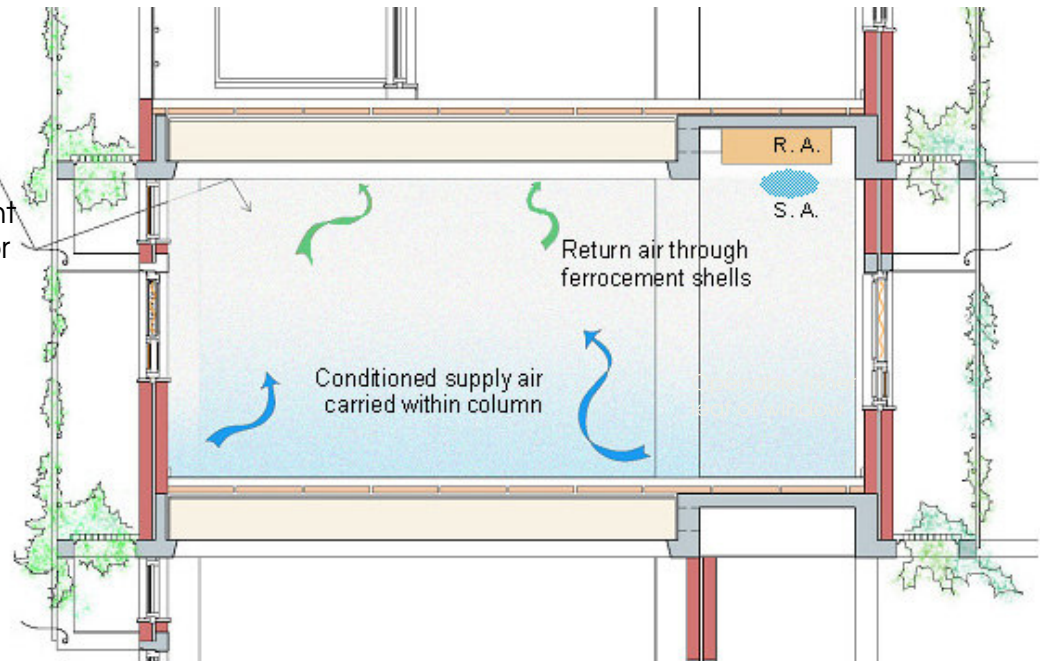


Mud block inner leaf of wall  
acts as humidity fly wheel



Large mass internal fabric  
insulated from outside interacts  
with conditioned air flow to act  
as thermal fly wheel and store

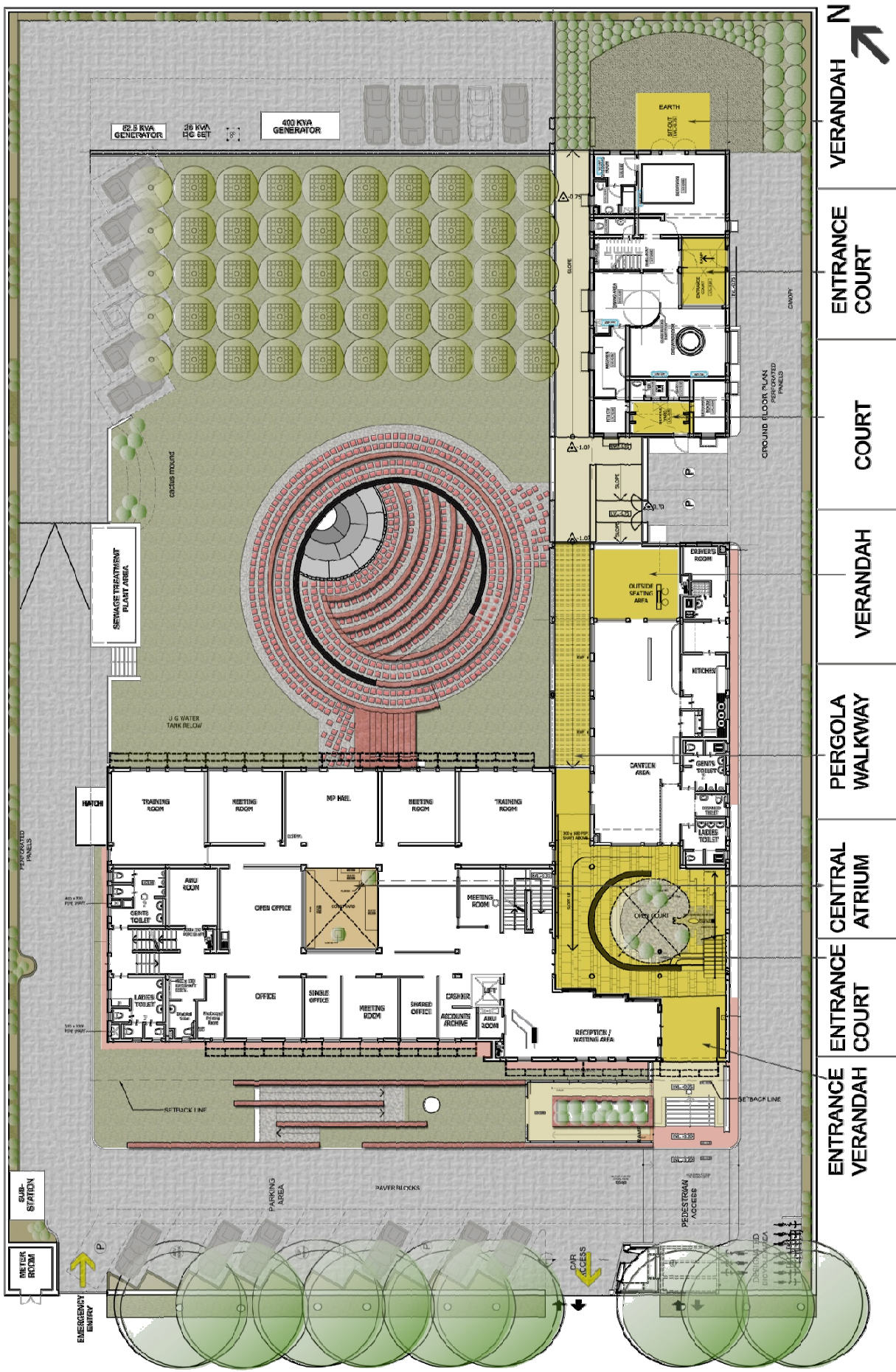
Day light  
reflector







**IRRAD, Sehgal Foundation, Gurgaon**



VERANDAH

COURT

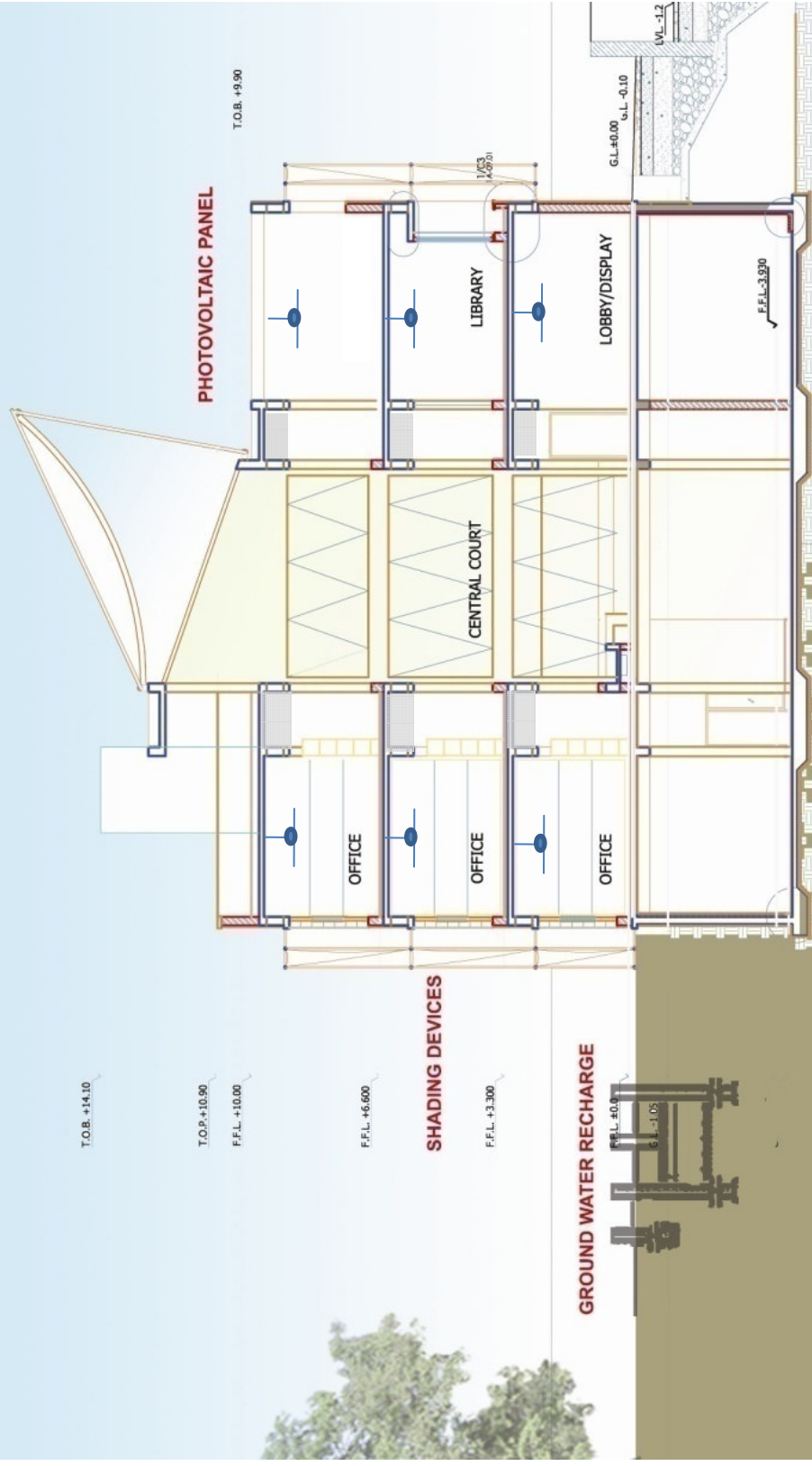
VERANDAH

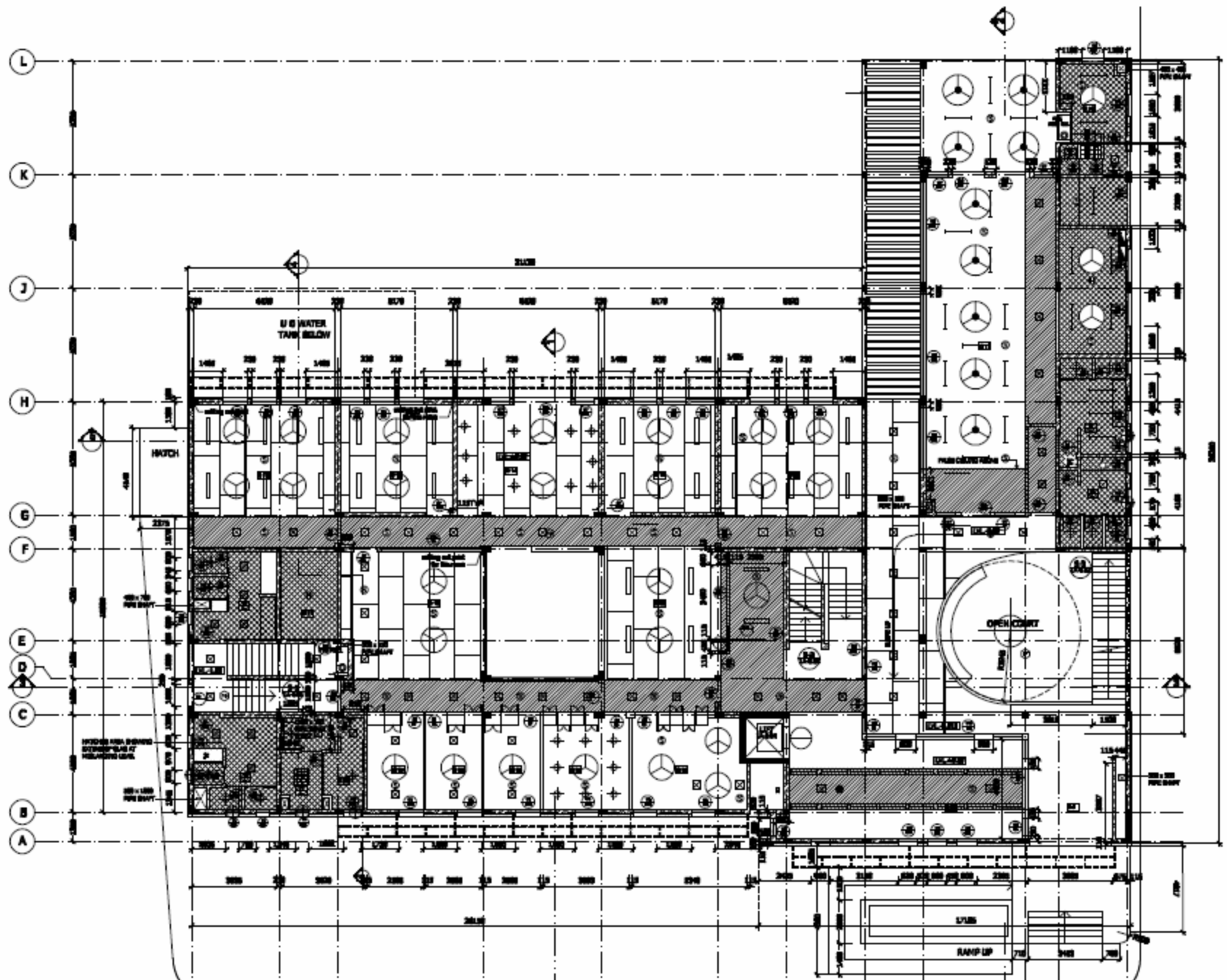
PERGOLA WALKWAY

CENTRAL ATRIUM

ENTRANCE COURT

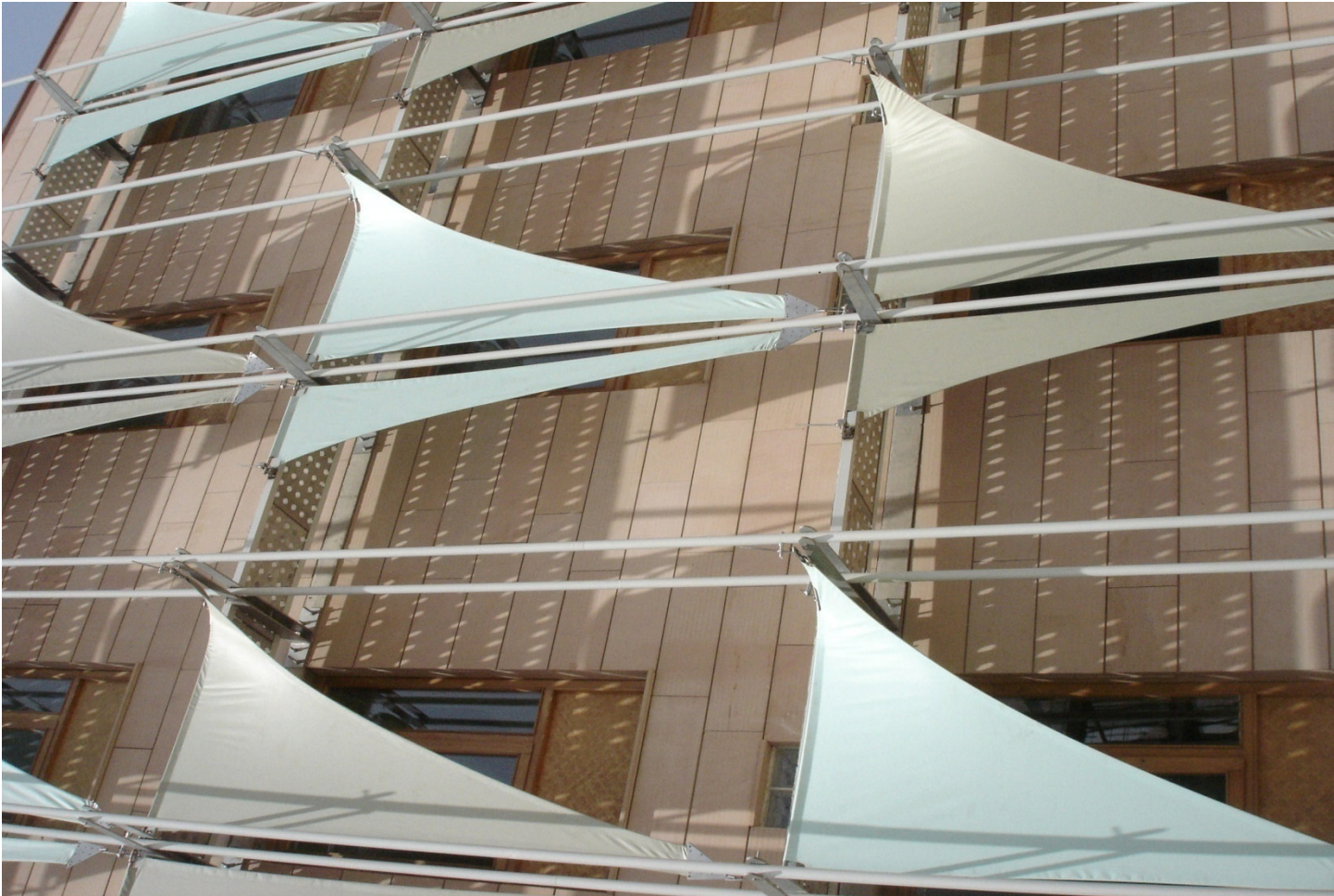
VERANDAH





Reflected Ceiling Plan – IRRAD Phase 1



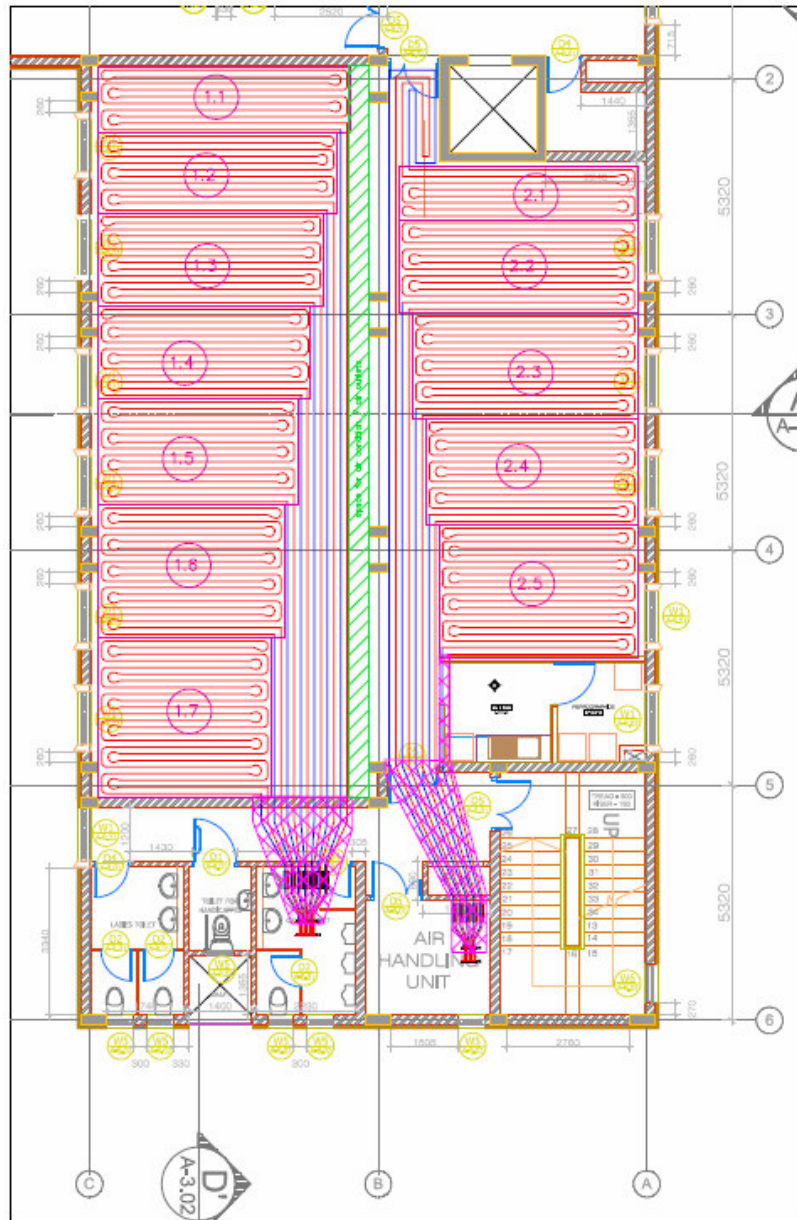




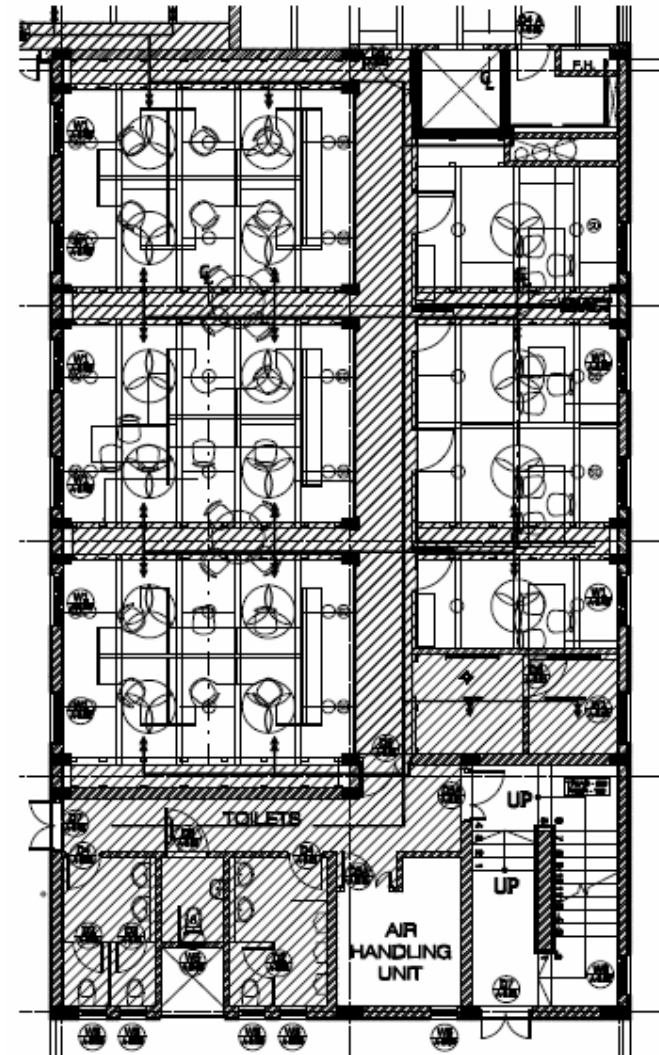
Office Space – IRRAD Phase 1



IRRAD PHASE 2



Radiant Cooling Pipes

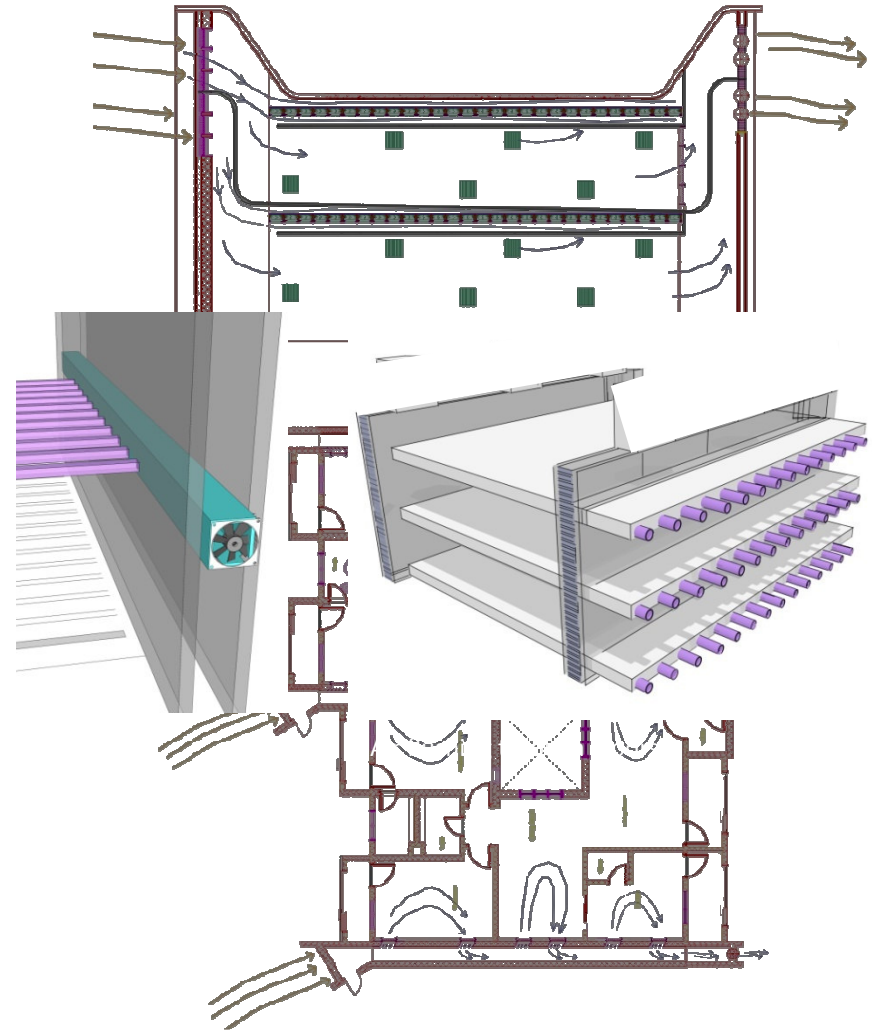
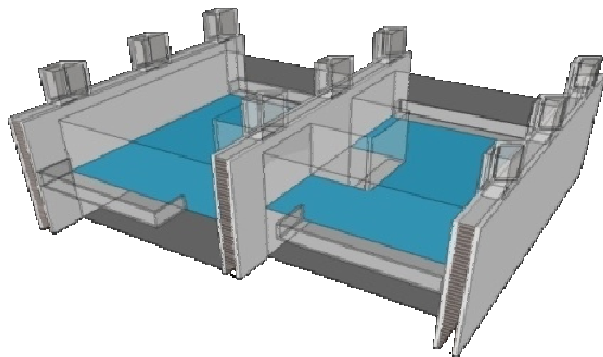
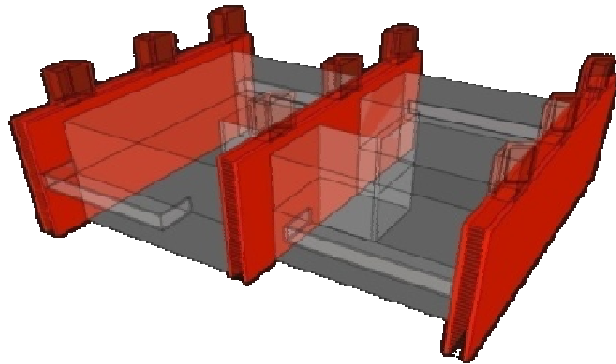


Reflected Ceiling Plan – Phase 2

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