Implementing Sustainability

Creating a Platform for Sustainable Design

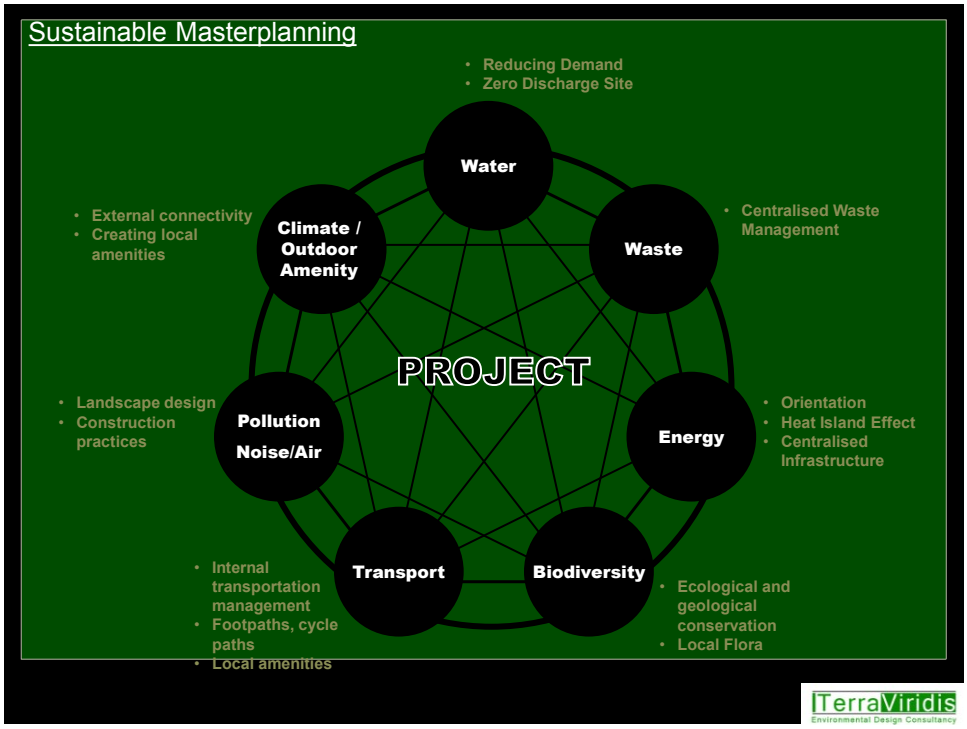
Swati Puchalapalli Reddy
Terra Viridis

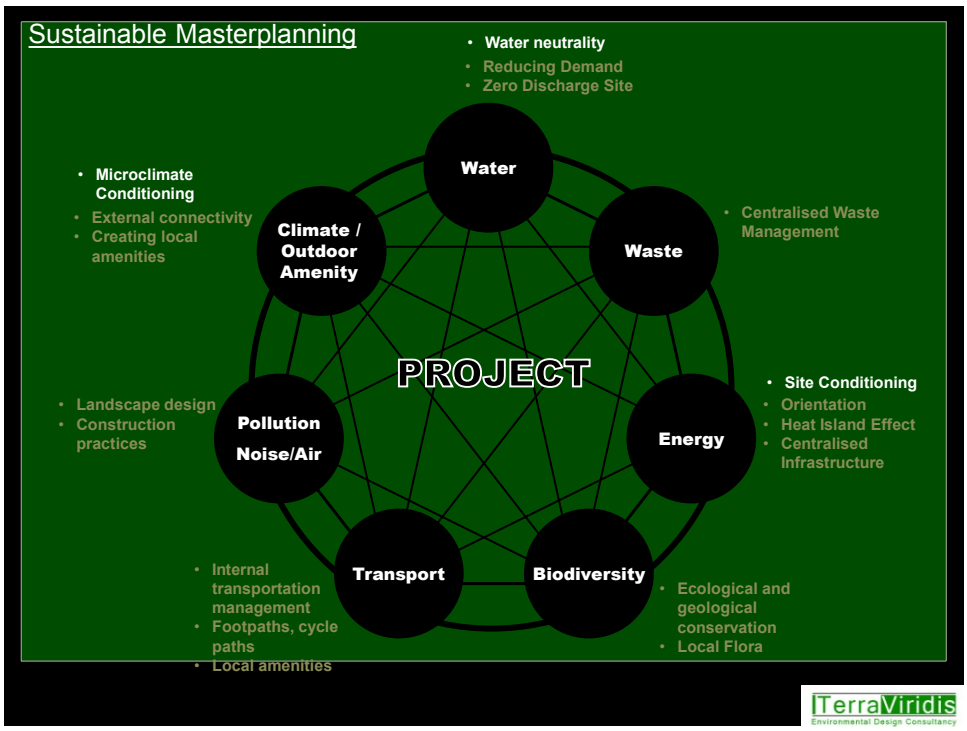
GRIHA National Summit
New Delhi
16th Jan 2014

TerraViridis
Environmental Design Consultancy

A Sustainable Master plan
is a means to creating a sustainable campus,
not the end

TerraViridis
Environmental Design Consultancy


Sustainable Masterplanning
• Reducing Demand
• Zero Discharge Site
Water
Waste
Climate / Outdoor Amenity
Pollution Noise/Air
Energy
Transport
Biodiversity
PROJECT
• External connectivity
• Creating local amenities
• Centralised Waste Management
• Landscape design
• Construction practices
• Orientation
• Heat Island Effect
• Centralised Infrastructure
• Internal transportation management
• Footpaths, cycle paths
• Local amenities
• Ecological and geological conservation
• Local Flora
TerraViridis
Environmental Design Consultancy


Sustainable Masterplanning
• Water neutrality
• Reducing Demand
• Zero Discharge Site
Water
Waste
Climate / Outdoor Amenity
Pollution Noise/Air
Energy
Transport
Biodiversity
PROJECT
• Microclimate Conditioning
• External connectivity
• Creating local amenities
• Centralised Waste Management
• Landscape design
• Construction practices
• Site Conditioning
• Orientation
• Heat Island Effect
• Centralised Infrastructure
• Internal transportation management
• Footpaths, cycle paths
• Local amenities
• Ecological and geological conservation
• Local Flora
TerraViridis
Environmental Design Consultancy

Water Neutrality

Enhancing water neutrality by

- Reducing Demand
- Increasing onsite rain water collection

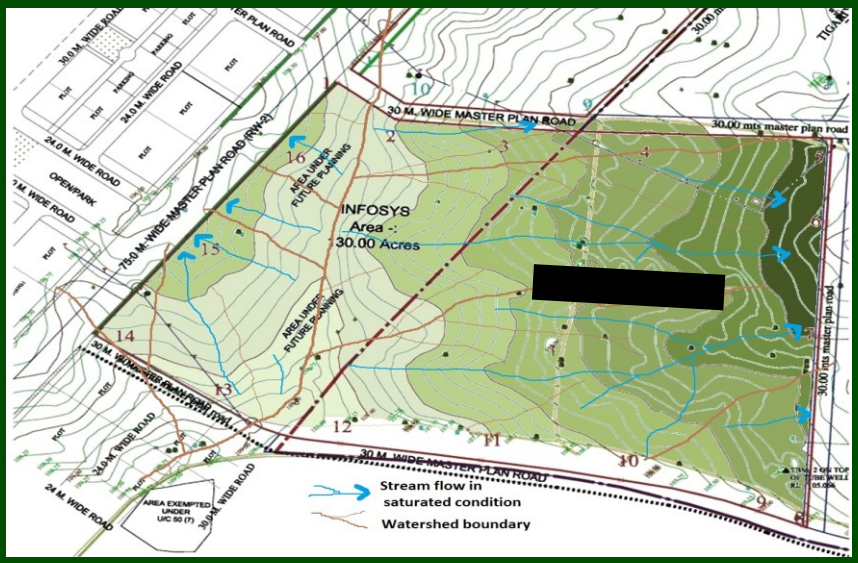
TerraViridis
Environmental Design Consultancy

Water Neutrality

Infosys Indore Design Approach

TerraViridis
Environmental Design Consultancy

Infosys Indore – Edifice Architects



Runoff pattern and Lakes formation

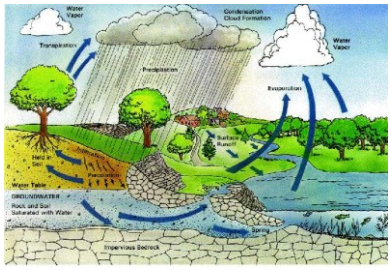
TerraViridis
Environmental Design Consultancy

The Site

TerraViridis
Environmental Design Consultancy

Enhancing Water Neutrality:

We Looked at **Improving Rain Water Collection** / Detention and **Minimizing Water Demand** by Various Methods



Black Cotton Soil property:

Water Retained = 60%
Water Percolated Under Ground = 10%
Water Available for Run-off = 30%
(Considering effective Cleaning of Leafs from ground)

Longer the Distance and Duration of Run-Off is Equally Proportion ate to Loss of Water.

Hence for Better Water Management, the Key to **bring down Run-off distance and time**

EDIFICE TerraViridis Environmental Design Consultancy

Enhancing Water Neutrality:

Standard Scenarios:

Roof Water: Friction &
Other Loses = 10-15%
Evaporation Loss = 5%

Open Standard Swale.
Percolation 10%,
Other Loses= 30%

Rain Water Collection Ponds.
Percolation 10%,
Other Loses= 30%

EDIFICE TerraViridis Environmental Design Consultancy

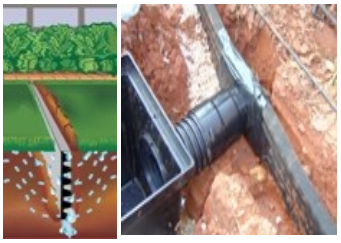
Enhancing Water Neutrality:

Reducing Friction Losses

Canopies

Smoother roof surfaces to reduce friction losses

Subsurface drains under groundcover and lawn areas



Strip Drains to increase surface water and sub surface water collection

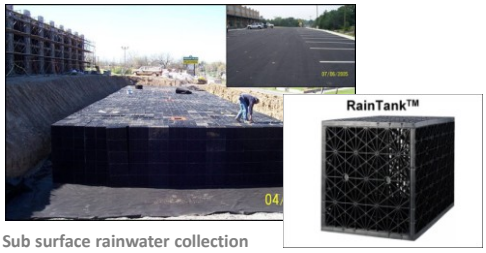
EDIFICE TerraViridis Environmental Design Consultancy

Reducing Percolation Losses by reducing runoff time

Effective Water Detention. Series of interconnecting swales running parallel along the slope with a maximum Spacing of 100m. Water is detained intermediately on its way to the lower most part of the site. This ensures reduction of run-off time resulting in higher level of water detention.

EDIFICE TerraViridis Environmental Design Consultancy

Enhancing Water Neutrality:
Reducing Evaporation Losses



Sub surface rainwater collection tanks

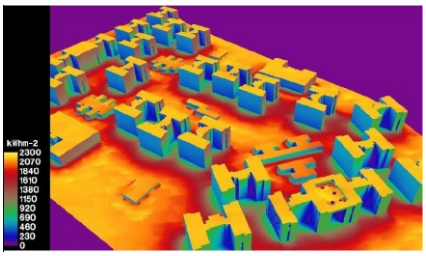
Underground Tanks

Shading tanks with Solar panels or trees

Creating wind barriers around the tanks

Water tanks around and under food courts so that they can act as heat sinks without evaporation losses

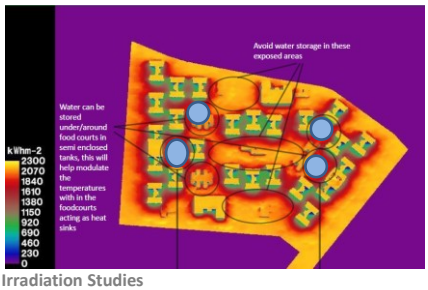
Enhancing Water Neutrality:
Reducing Evaporation Losses



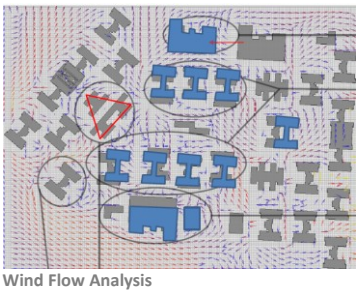
Wind Flow analysis & Irradiation Studies are done.

This Also Helps in establishing **Location of Built forms**,

& Identification of **Appropriate Location for Water Bodies**



Irradiation Studies



Wind Flow Analysis

Enhancing Water Neutrality:

Minimizing Water Demand: Internal

Consumption per day can be Optimized to 25li/per/day

WCs:
Pocharam = 6/3 Li
Proposed = 4/2 Li Dual Flush

Faucets:
Pocharam = 1.2 li/min
Proposed = Same

Urinals:
Pocharam = 0.5 – 1.5 Li
Proposed = Waterless Urinals (nano coating)

Washing Machines:
Standard Machines = 50 -70 li/ cycle
Steam Washing Machines (with solar steam generators) = 20-30li/cycle

Dishwashers:
Standard Machines = 14 li/cycle
Steam Dish washers (with solar steam generators) = 9 li/cycle

Showers:
Pocharam = 6 li with Aerators
Proposed = Same

EDIFICE TerraViridis Environmental Design Consultancy

Enhancing Water Neutrality:

Minimizing Water Demand: By opting for low water consuming Plants and Irrigation methods

Ground Cover

Plants

Trees

Drip Irrigation

Micro Sprinkler

Natural Habitat with no irrigation demand

EDIFICE TerraViridis Environmental Design Consultancy

Enhancing Water Neutrality:

The Occupancy Count:

SN	DESCRIPTION	BASECASE	TARGETED
1	Water requirement in Ltrs per person per day	61.07	39.85
2	Water requirement in Cum per person per day	0.061	0.040
3	Water requirement in Cum per person per annum	17.099	11.158
4	Water Collected, Cum / Anum	207440	235029
4	**Water Neutrality can be achieved for**	**12132**	**21064**

EDIFICE TerraViridis Environmental Design Consultancy

Master-Plan Layout

58,200 Occupants

EDIFICE TerraViridis Environmental Design Consultancy

Recap:

CAMPUS FEEL

THE CAMPUS EXPERIENCE IS ENVISAGED AS A WALK THROUGH A 42 ACRE FOREST AND LAKE PARKLAND, MEETING POROUS ARCHITECTURE TO EFFECT A SOFT TRANSITION BETWEEN THE CAMPUS AND THE BUILT ENVIRONMENT

•Phase-1

4036 Occupants

EDIFICE

TerraViridis
Environmental Design Consultancy

•**Phase-2**

12172 Occupants

EDIFICE TerraViridis Environmental Design Consultancy

Water Neutrality for Phase 1 and 2:

Sl.no	Particulars	Occupancy	BASELINE: Water requirement in Ltrs/head/day	BASELINE: Fresh Water Requirement (Liters)	BASELINE: Recycled water requirement (Liters)	TARGET: Water requirement in Ltrs/head/day	TARGET: Fresh Water Requirement (Liters)	TARGET: Recycled water requirement (Liters)
	Water Balance for Phase 1 & 2 Buildings							
A	**SDB**							
1	SDB- for (Domestic Only)	12,127	30	363,810		16	194,032	
2	SDB - for (Flushing Only)		15		181,905	9		109,143
B	**Food Court**							
1	Canteen's (Food Court) - (Kitchen & Domestic)	12,127	19	230,413		14	169,778	
2	flushing		6		72,762	2		24,254
C	**ECC**							
	Fresh water for 245 residents (1 Key for every 100 campus occupants and 2 occupants per key)	243	90	21,829		76	18,433	
	(drinking-5, bathing-55, clothes-20, cleaning house-10 = total-90 ltr)							
	Recycled for ECC		45		10,914	14		3,396
	Kitchen with dining facility							-
D	**HVAC Requirements**							
	HVAC Requirements				315,000			315,000
E	**IRRIGATION**							
	Forest	262,990	3.00		788,970	-		-
	Lawn	15,779	6.00		94,676	6.00		94,676
	Orchard, garden, avenues, etc	47,338	4.00		189,353	4.00		189,353
F	Laundry			100,000			100,000	
a	**Treated Water Requirement**			**716,052**	**1,653,581**		**482,243**	**735,822**
b	RAW water Requirement for Filters BackWASH (4%)			29,835	-		20,093	-
c	RO Reject from Domestic Water (30%)			114,340	-		84,196	-
d	RO Reject from Flushing Water (30%)				**135,000**			**135,000**
	Grand Total of water Requirement			**860,227**	**1,788,581**	Grand	**586,533**	**870,822**
	Total Water Requirement per Day			**71**	**147**		**48**	**72**
	Total Water Requirement per Annum @ 269 working days			**19,081**	**39,674**		**13,010**	**19,316**
	RO Water Requirement			**266,794.00**	-		**196,457.40**	-
		Domestic in flow to STP (90%)			873,647			554,076
		HVAC blowdown to STP (20%)			63,000			63,000
		RAW water Requirement for Filters			29,835			20,093
		Total Inflow to STP			**966,482**			**637,169**
		Output from STP (95%)			**918,158**			**605,311**
		Water available from RO Reject			**249,340**			**219,196**
		Recycled Water Requirement			1,788,581			870,822
		Shortfall/Excess-(a+d)			**(621,082)**			**(46,315)**

Reduction in Fresh Water Demand by 32%
- 48li/per/day

Reduction of Recycled Water Demand by 51%
- 72li/per/day

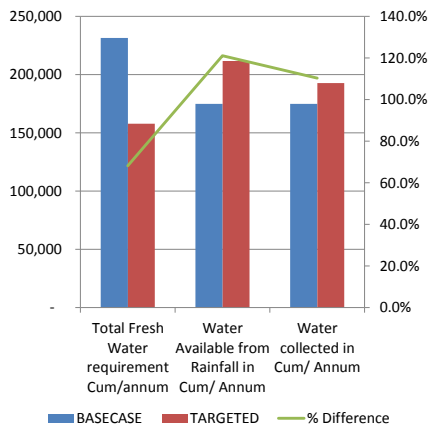
Includes

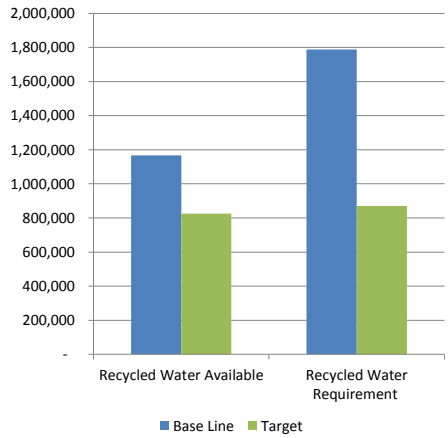
1. Offices for 12,127 per
2. Food court for 12,127 per
3. ECC/ Accommodation for 245 per
4. Landscaping and development of forest areas

EDIFICE TerraViridis Environmental Design Consultancy

Water Neutrality for Phase 1 and 2:

The Occupancy Count: 12,172





Deficit of 24% Reduced to an excess of 22%

Deficit Reduced from 35% to 5%

EDIFICE TerraViridis Environmental Design Consultancy

Microclimate Conditioning

Enhancing the Microclimate
to
maximise the ability to Naturally Ventilate buildings

TerraViridis Environmental Design Consultancy

Microclimate Conditioning

Maximise self shading
Reduce wind tunnel effect
Avoid still air zones
Landscape design
Reduce air and noise pollution

TerraViridis
Environmental Design Consultancy

Microclimate Conditioning

Infosys Indore Design Approach

TerraViridis
Environmental Design Consultancy

Recap: the Site

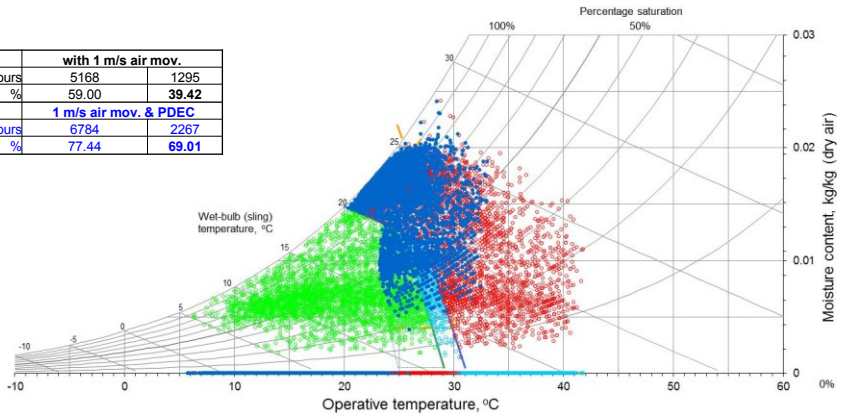
TerraViridis
Environmental Design Consultancy

Climatic Study

FREQUENCY OF THERMAL COMFORT				
	Ashrae Summer		Szokolay	
	24 hours	from 8 to 18	24 hours	from 8 to 18
hours	3829	776	4264	1034
%	44	**24**	49	**31**
	with PDEC		with PDEC	
hours	4872	1422	5074	1575
%	55.62	**43.29**	57.92	**47.95**

	with 1 m/s air mov.	
hours	5168	1295
%	59.00	**39.42**
	1 m/s air mov. & PDEC	
hours	6784	2267
%	77.44	**69.01**

NV – 24%
Fans - 40%
Evaporative Cooling – 44%
Evaporative Cooling + Fans – 69%



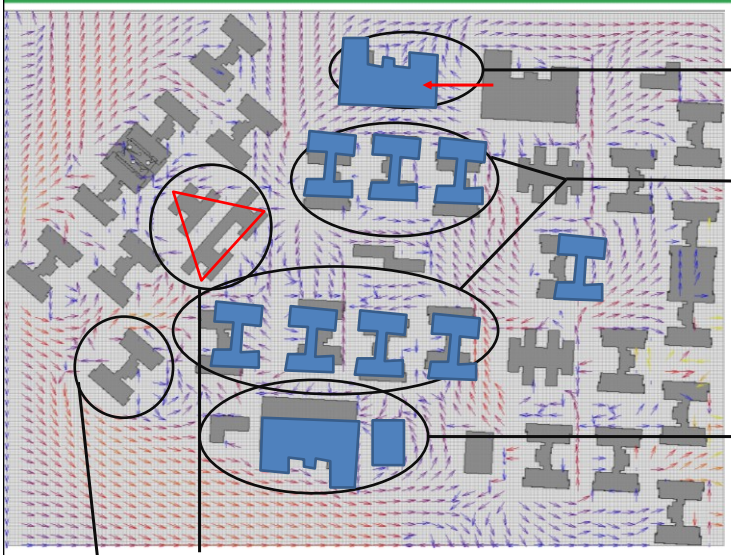
TerraViridis
Environmental Design Consultancy

Recap:

CAMPUS FEEL

THE CAMPUS EXPERIENCE IS ENVISAGED AS A WALK THROUGH A 42 ACRE FOREST AND LAKE PARKLAND, MEETING POROUS ARCHITECTURE TO EFFECT A SOFT TRANSITION BETWEEN THE CAMPUS AND THE BUILT ENVIRONMENT

Wind Flow @1200mm



moving this service building will improve windflow through the site, especially in the cooler months

These building could be looked at as a set of linear buildings that will allow for better windflow through them and also create positive and negative pressures that will enhance natural ventilation through them

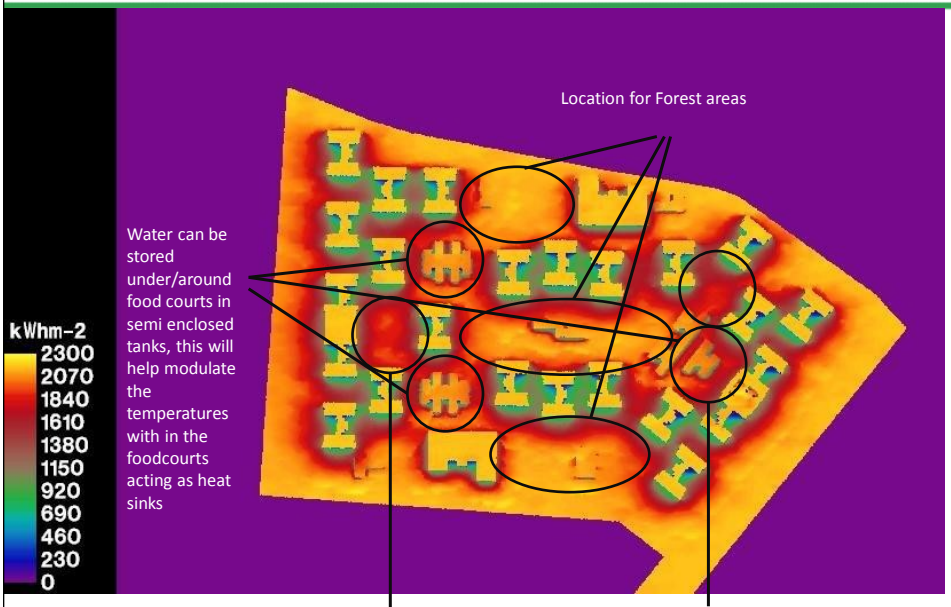
moving the MLCP and placing the services here improves the windflow through the SDB's and food courts.

This has to be relocated/removed to ensure better flow through the site

This group of buildings need to be more aerodynamic as indicated in red to improve the air flow at pedestrian level

TerraViridis
Environmental Design Consultancy

Irradiation - Top view



Indicated places are ideal for location of water bodies as the rate of evaporation will be low due to shading from the nearby buildings.

TerraViridis
Environmental Design Consultancy

Microclimate Conditioning

Manipal University Jaipur Hostels

TerraViridis
Environmental Design Consultancy

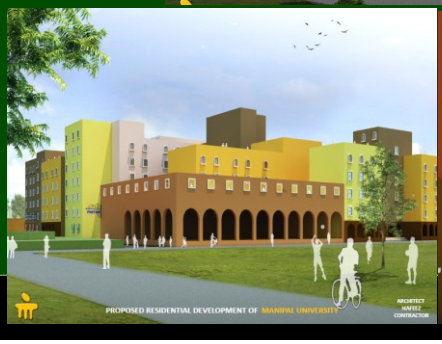
Manipal University Jaipur Hostels –Architects Hafeez Contractor

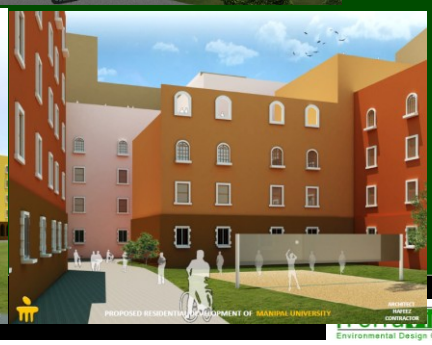
TerraViridis
Environmental Design Consultancy

Manipal University Jaipur Hostels –Architects Hafeez Contractor

TerraViridis
Environmental Design Consultancy

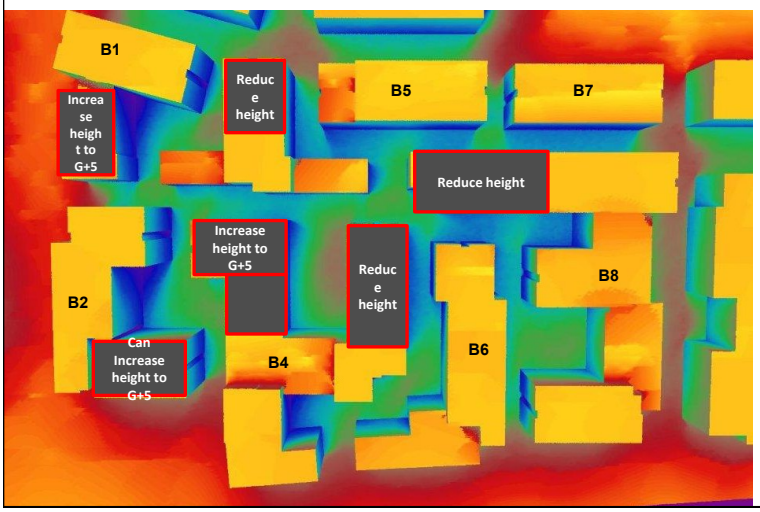
Manipal University Jaipur Hostels –Architects Hafeez Contractor

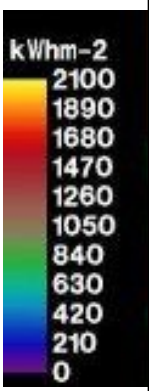




TerraViridis
Environmental Design Consultancy

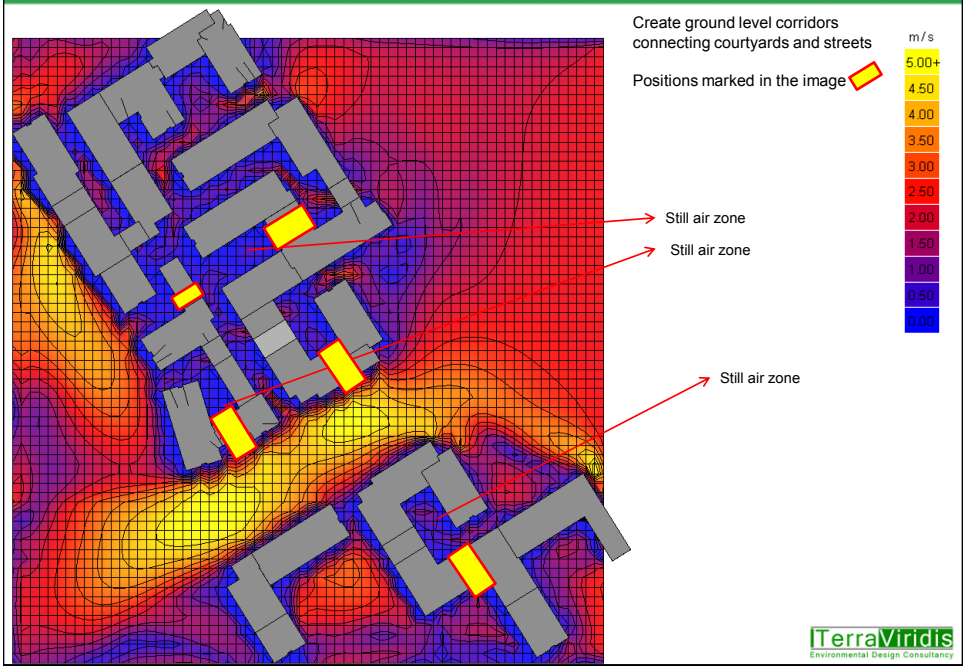
Irradiation Studies



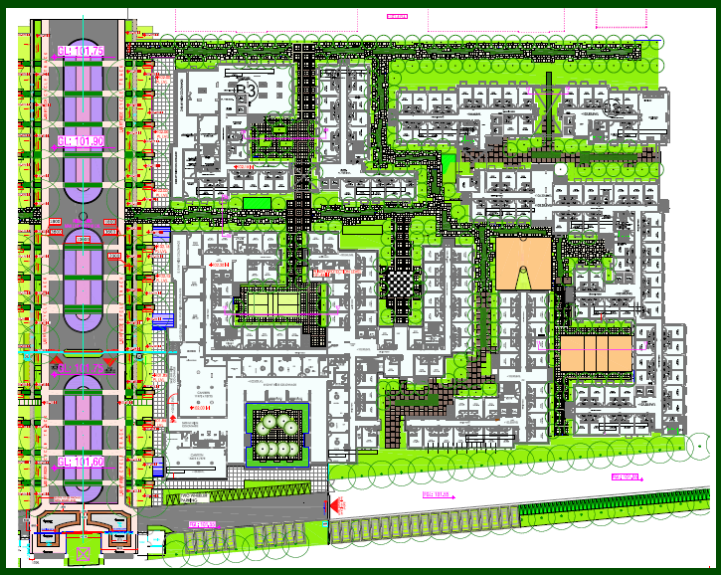


TerraViridis
Environmental Design Consultancy

Ground level – Wind Studies



Manipal University Jaipur Hostels –Architects Hafeez Contractor
Landscape Consultants - Masterplan



TerraViridis
Environmental Design Consultancy

Site Conditioning

Gradual adaptation between external and internal, air conditioned spaces

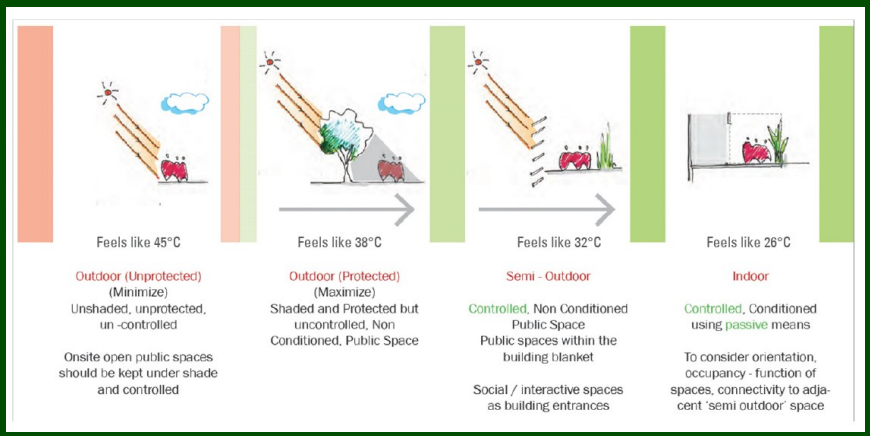
Prevailing wind can be used to enhance pedestrian comfort, particularly at Ground / Entrance Level as well as in public areas

Design of Ground Level can be optimised to improve on external comfort conditions

Category	Mean Wind Speed to be exceeded for no more than 5% of time	Activity
Pedestrian Sitting	4m/s	Sitting for a long duration e.g. sitting at an external café or other comparable amenity area.
Pedestrian Standing	6m/s	Standing or sitting for a short time e.g. during window shopping; waiting at bus stops; within building entrances.
Pedestrian Walking	8m/s	Normal walking or strolling as in sightseeing.
Business Walking	10m/s	Walking from one place to another quickly or where individuals pass rapidly through local areas around buildings.

TerraViridis
Environmental Design Consultancy

Site Conditioning



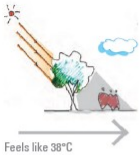
TerraViridis
Environmental Design Consultancy

Site Conditioning

TerraViridis
Environmental Design Consultancy

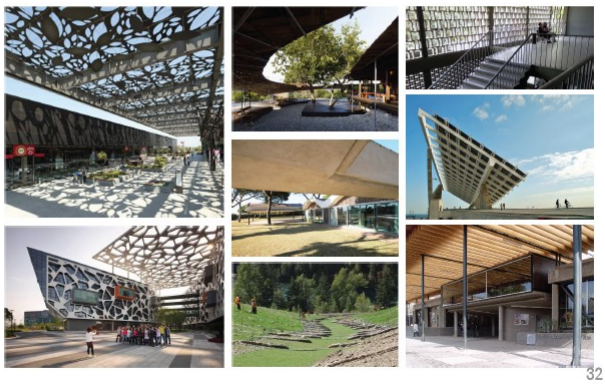
Site Conditioning

OUTDOOR SPACES - DESIGN OPPORTUNITIES - TRANSITIONAL SPACES



Feels like 38°C

External spaces with protection from rain and direct solar gains to occupants



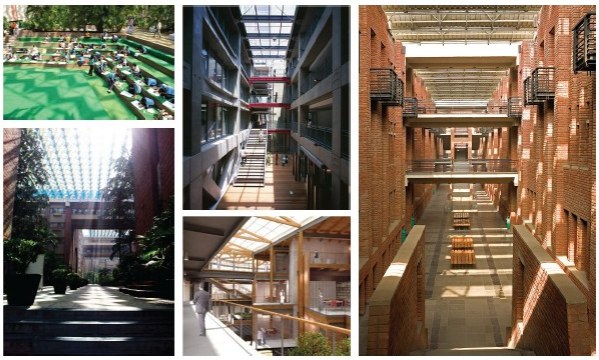
32

TerraViridis
Environmental Design Consultancy

Site Conditioning

OUTDOOR SPACES - DESIGN OPPORTUNITIES - TRANSITIONAL SPACES

Spaces adjacent to buildings (public semi open spaces) with vegetation and shading design features to provide thermal and visual comfort

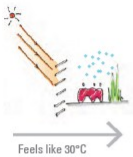


33

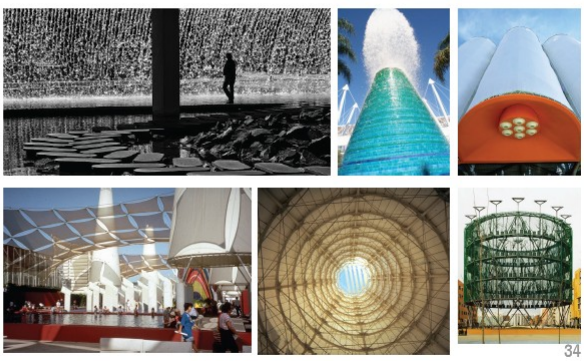
TerraViridis
Environmental Design Consultancy

Site Conditioning

OUTDOOR SPACES - DESIGN OPPORTUNITIES - TRANSITIONAL SPACES



Buffer / transition spaces controlled and conditioned by passive cooling elements like water features, spray ponds, PDEC (Evaporative cooling towers), etc



34

TerraViridis
Environmental Design Consultancy

Thank you

Sustainable Masterplanning

A means towards sustainable development, not the end

TerraViridis
Environmental Design Consultancy