GREEN CITIES – To Attain Sustainability

4th GRIHA Regional Conference on Innovations in Sustainable Habitats

November 15th & 16th, 2013
Bangalore

SPACE MATRIX
Space Matrix Architects and Planners

The Challenge

Urban lands will triple in area in the first three decades of the 21st century, suggests research published Sept. 17, 2012, in the journal PNAS.

Shown here, an astronaut image, taken Aug. 10, 2011, of the lit-up cities across north-western Europe.

Credit: ISS Crew Earth Observations experiment and Image Science & Analysis Laboratory, Johnson Space Center

SPACE MATRIX

The Challenge

Urban development is set to triple in the first three decades of this century, the largest cityscape expansion in human history..
Source - Livescience

By 2030, 6 out of every 10 people will live in a city..
Source – UNHABITAT report

This sprawl will swallow up a landmass nearly equivalent in size to South Africa..
Source - Livescience

Majority of predicted urban growth (55 percent) is expected to occur in Asia, including a 1,800 km east coast urban corridor in China plus seven state capitals throughout India.
Source - Livescience

This will consume Bio Diversity hotspots leading to the extinction of 139 amphibian, 41 mammalian and 25 critically endangered bird species.
Source - Livescience

By 2030 we will need to produce *50%* more food and energy, together with *30%* more fresh water.
Source –Population Institute

SPACE MATRIX

The Challenge v/s the **present**

Excessive…

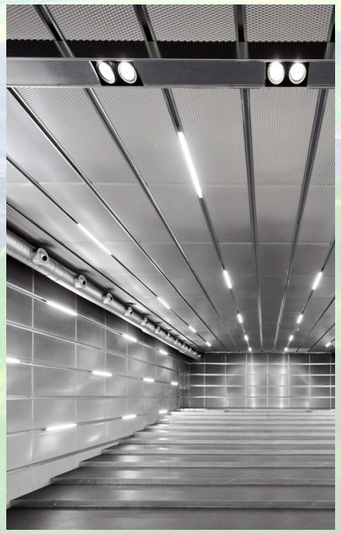
…number of High Rise's

…use of steel and glass

SPACE MATRIX

The Challenge v/s the **present**

Excessive…



…use of artificial light

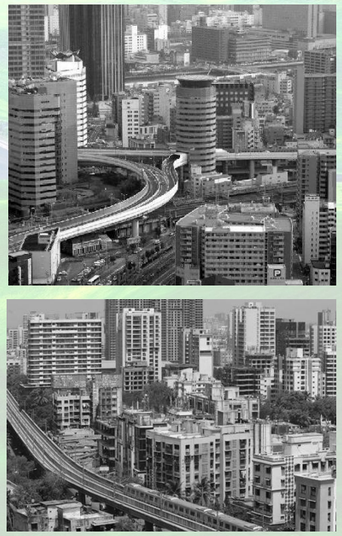
…heat from glass
…stress on air conditioning

SPACE MATRIX

The Challenge v/s the **present**

Excessive…

…gated and golf communities



…stress on infrastructure

SPACE MATRIX

The Challenge v/s the **present**

Excessive…

…cars on the road

…carbon footprint

SPACE MATRIX

The Challenge

The **future…**

1.Will be about Electronics and Communication

2.Will be about the symbiotic approaches of Biotechnology.

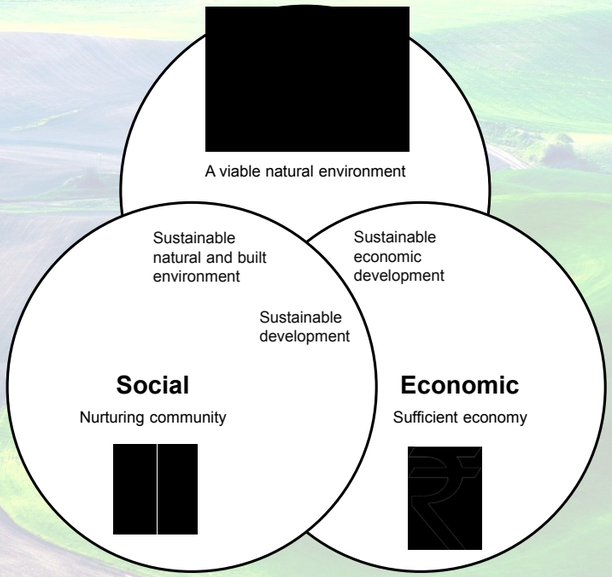
3.Will be about the Carbon freedom by use of Wind and Hydrogen.

4.Will be about the high efficiency of Nano Technology.

5.Will be about being Passive Right.

SPACE MATRIX

The Challenge : The path to sustainable development



SPACE MATRIX

The Challenge : The path to sustainable development

Zero Carbon	Making building more energy efficient and delivering all energy with renewable technologies.
Zero Waste	Reducing waste, reusing where possible, and ultimately sending zero waste to landfill.
Sustainable transport	Encouraging low carbon modes of transport to reduce emissions, reducing the need to travel.
Sustainable materials	Using sustainable and healthy products, with low embodied energy, sourced locally, made from renewable or waste resources.
Local and sustainable food	Choosing low impact, local, seasonal and organic diets and reducing food waste.
Sustainable water	Using water more efficiently in buildings and in the products we buy, tackling local flooding and water course pollution.
Land use and wildlife	Protecting and restoring existing biodiversity and natural habitats through appropriate land use and integration into the built environment.
Culture and heritage	Reviving local identity and wisdom, supporting and participating in the arts.
Equity and local economy	Creating bioregional economics that support fair employment, inclusive communities and international fair trade.
Health and happiness	Encouraging active, sociable, meaningful lives for good health and well being.

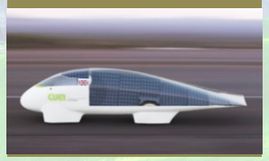
SPACE MATRIX

Meeting the Challenge

DESIGN STRATEGIES

The largest energy Reduction can be achieved through design.

TECHNOLOGIES & SYSTEMS



Including on-site renewable energy systems.

OFF-SITE RENEWABLE ENERGY

20% maximum.

The Challenge

Life is divided into three terms –

that which was, which is, and which will be.

Let us learn from the past to profit by the present, and from the present, to live better in the future.

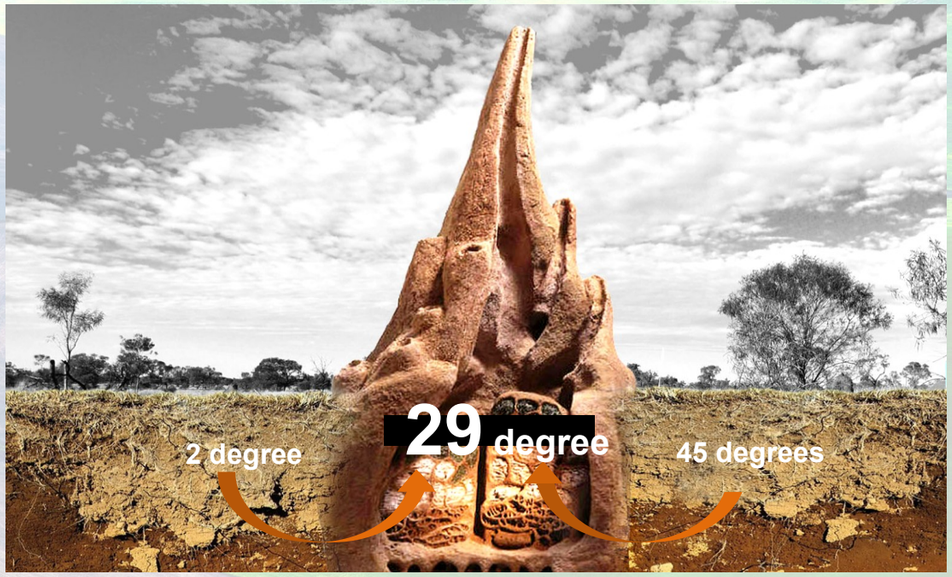
William Wordsworth

Meeting the Challenge

PRESENT Right FUTURE Ready

SPACE MATRIX

Nature : Mentor, measure, model



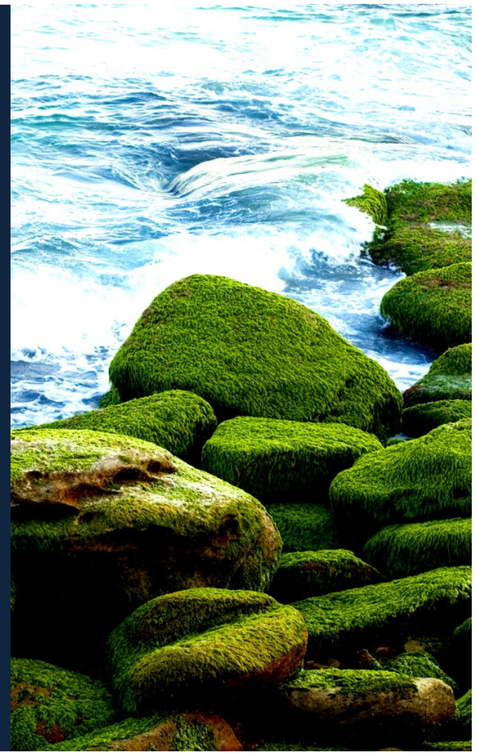
With 3.85 billion years of experience the natural world is the only global and reliable guide we have to judge our actions.

SPACE MATRIX

Case study

Central University of Tamil Nadu

Thiruvarur
Site Area : 517 Acres
Built up area : 27,00,000 sqft



Challenge

The challenge was to formulate design guidelines that conserved and recharged the land as a pattern of existing natural elements such as water and vegetation in a manner that sustainability was intrinsic to design and created a place where production and consumption can co-exist.

Strategy

The master plan responds to the land as a pattern of natural elements and the architecture seamlessly imbibes and infuses formal and informal learning processes.

With less than 4% of the land built upon, this residential campus aspires to push the envelope by promoting urban agriculture, zero food miles as a way of life by involving the local community and triggering a regional response.

Result

The built form and the landscape areas are the driving attributes of the campus architecture and the master plan exaggerates the importance of the landscape in the living environment. This is reflected by landscape urbanism being the precedential element of design and the buildings as accidental to the landscape.

Students, usually enrolled into this university at an influential age of 16, study and grow in a campus where sustainability is intrinsic to its design, balancing the production - consumption equilibrium such that it becomes a way of life, thus learning the best lessons experience has to offer.

SPACE MATRIX

Concept

CAMPUS AND BEYOND

THE 5 HYPOTHESIS

DELTA URBANISM

COLLABORATIVE SPACES

IDENTITY

ENVIRONMENTAL SUSTAINABLITY

CAMPUS AGRICULTURE

1.EFFICIENT RESOURCE UTILIZATION

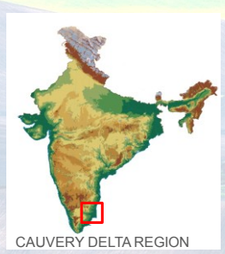
2.MAKING OF THE CAMPUS

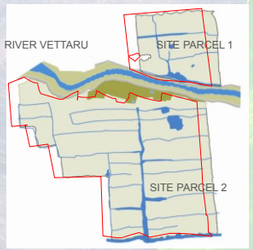
3.REGIONAL RESPONSE

SPACE MATRIX

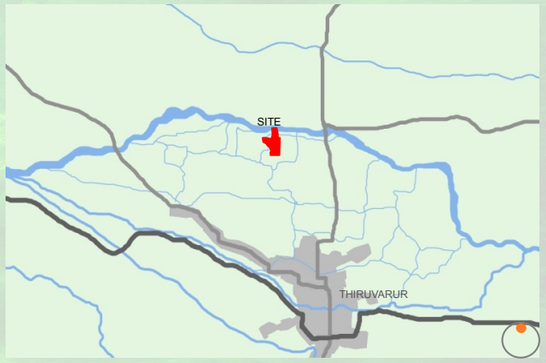
Site Analysis I Delta urbanism

CAUVERY DELTA REGION – SITE LOCATION





CENTRAL UNIVERSITY SITE

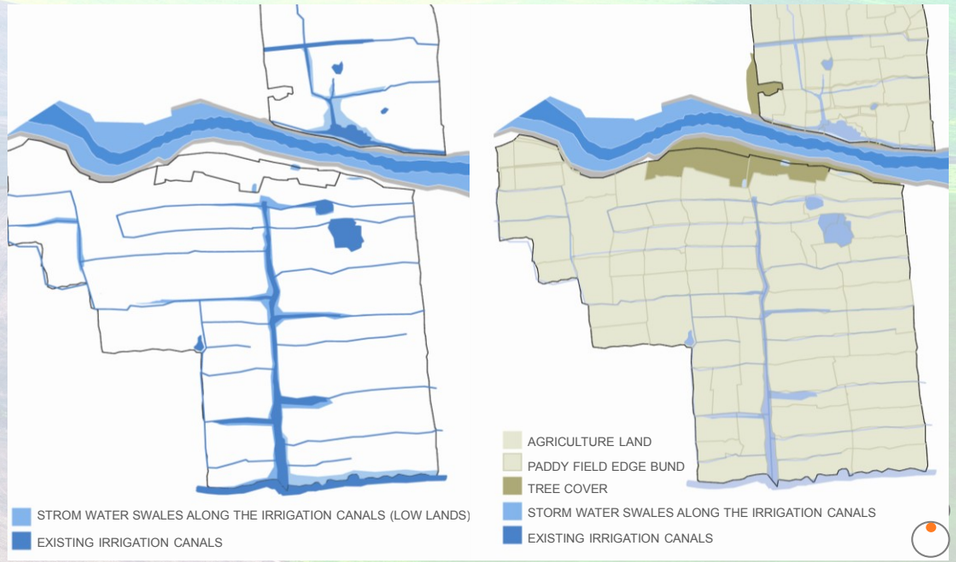


SPACE MATRIX

Site Analysis I Delta urbanism

NATURAL SYSTEM – HYDROLOGY WETLANDS [WATER]

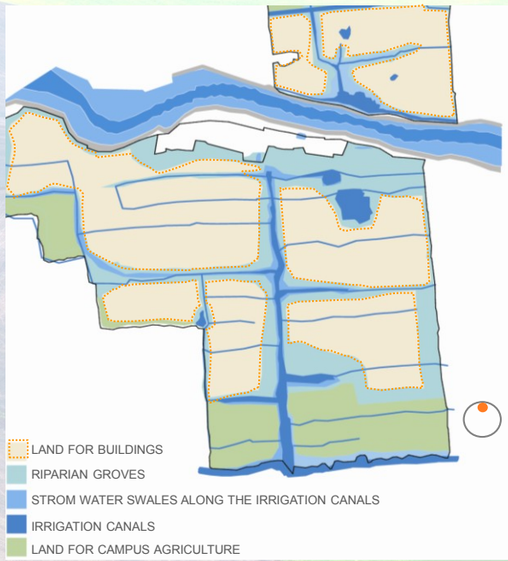
NATURAL SYSTEM – AGRICULTURE SYSTEM [LAND]



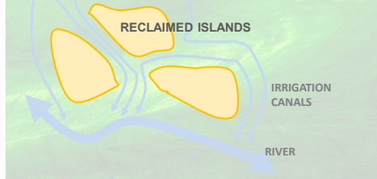
SPACE MATRIX

Site Analysis I Delta urbanism

NATURAL SYSTEM – COMPREHENSIVE LAND DEVELOPMENT PLAN



LAND FOR BUILDINGS
RIPARIAN GROVES
STROM WATER SWALES ALONG THE IRRIGATION CANALS
IRRIGATION CANALS
LAND FOR CAMPUS AGRICULTURE



LAND ACCUMULATION CONCEPTS FOR CONSTRUCTION ACTIVITIES

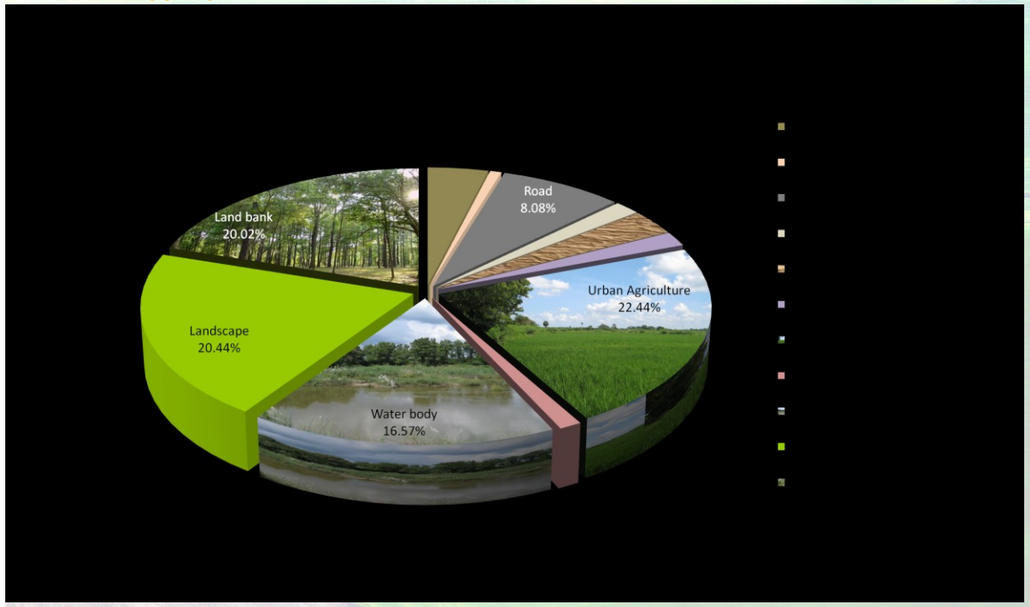
STRATEGIES AND JUSTIFICATION

SERIES OF RECLAIMED ISLANDS ALLOWING THE LOW LYING WATER SYSTEM TO SEAMLESSLY CONNECT ACROSS FROM THE MAIN WATER NETWORK OF THE PLACE

SPACE MATRIX

Campus Making I Master plan

LAND ALLOCATION



SPACE MATRIX

Campus Making I Master plan

MASTER PLAN – PHASE [2040]

LEGEND

1. SECURITY
2. ADMINISTRATION
3. CAMPUS AVENUE
4. ADMISSION/EXAMINATION
5. ACADEMIC
6. SEMINAR COMPLEX
7. KNOWLEDGE GROVE
8. CENTRAL OPEN SPACE
9. CAFETERIA
10. LIBRARY
11. BROWSING CENTRE
12. REPROGRAPHY
13. HOSTEL
14. LADIES' HOSTEL
15. BOYS' HOSTEL
16. MARRIED STUDENTS' HOSTEL
17. FLATLETS
18. SHOPPING COMPLEX
19. VEGETABLE MARKET
20. HEALTH CARE
21. STATIONARY STORE
22. BUS DEPOT
23. CONNECTING BRIDGE
24. FACULTY HOUSING
25. LECTURERS
26. VILLA
27. STAFF QUARTERS
28. CLUBHOUSE
29. CRECHE
30. PRIMARY HEALTH CENTRE
31. SCHOOL
32. PARKING
33. INCUBATION CENTRE
34. SECONDARY ENTRY
35. GUEST HOUSE
36. VILLAGE
37. CRICKET GROUND
38. SPORTS COMPLEX
39. LANDBANK
40. POND
41. CAMPUS AGRICULTURE
42. RESIDENTIAL ENTRY
43. RETAINED IRRAGATION NETWORK

SPACE MATRIX

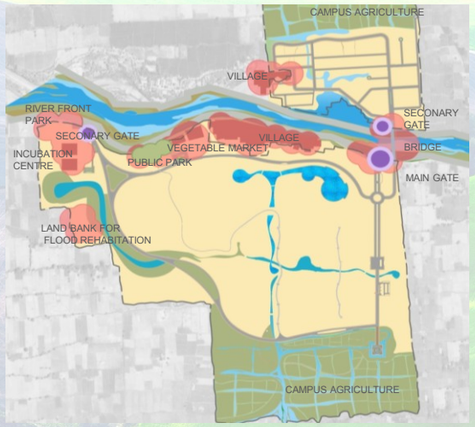
Campus Making I Master plan

MASTER PLAN – PHASE [2040]

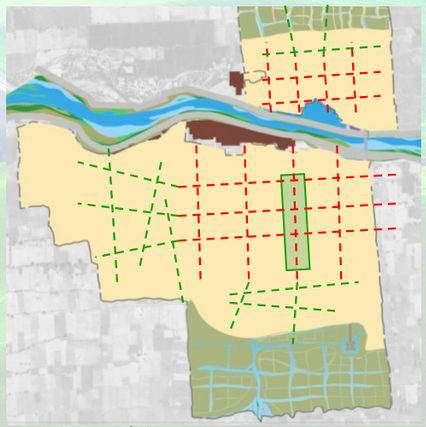
SPACE MATRIX

Campus Making I Collaborative spaces

GENISIS OF COMMUNITY



DESIGN GRID - PLACE VS PLACELESSNESS



FORMAL GRID

(PLACE) EMPHASING THE ORGANISED PLANNING LANGUAGE AT THE HEART OF THE CAMPUS. THE MODULES ARE ORIENTED TO THE AGRICULTURE PATTERN IN THE SITE

INFORMAL GRID

(PLACELESSNESS) EMPHASING THE RESPONSE OF THE BUILT ENVIRONMENT TOWARDS THE AGRICULTURE ACTIVITY AROUND.

SPACE MATRIX

Campus Making I Collaborative spaces

ZONING STRATEGY

- ACADEMIC ZONE
- RESIDENTIAL / HOSTEL ZONE
- ADMINISTRATION & ADMISSION ZONE
- SPORTS & AMENITIES ZONE
- COMMERCIAL ZONE
- SCHOOL & HOSTITAL ZONE
- CAMPUS AGRICULTURE/ RIPARIAN GREEN

OPEN SPACES – ARTICULATED NATURAL LANDSCAPES

SPACE MATRIX

Campus Making I Collaborative spaces

OPEN SPACES - ORNAMENTAL LANDSCAPES

OPEN SPACES

ARTICULATED NATURAL LANDSCAPE

+

ORNAMENTAL LANDSCAPE

= CAMPUS LANDSCAPE

SPACE MATRIX

Campus Making I Environmental sustainability

A CHAMPION OF ENVIRONMENTAL STEWARDSHIP

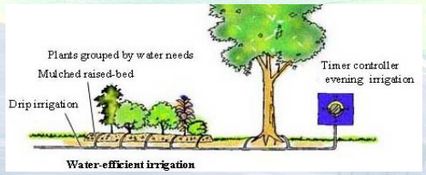
- SUSTAINABLITY INTRINSIC TO DESIGN
- INNOVATIVE USE OF NATURAL RESOURCES
- A PLACE WHERE PRODUCTION AND CONSUMPTION CO-EXIST
- CENTRE FOR ECOLOGICAL EDUCATION
- CENTRE FOR ORGANIC FARMING

ENVIRONMENT

SPACE MATRIX

Campus Making I Environmental sustainability

WATER EFFICIENT LANDSCAPE DESIGN AND IRRIGATION SYSTEMS



Irrigation system	Efficiency
Micro, drip	85%
Micro, spray	80%
Multiple sprinkler	75%
Sprinkler, large guns	70%
Seepage	50%
Crown flood	50%
Flood	50%

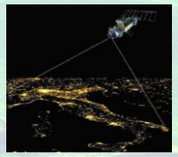
- Appropriate planting and efficient irrigation systems can reduce irrigation water use by 50% to 70% and overall water consumption by up to 25%.
- Group plants with similar water requirements on common zones to match precipitation heads and emitters.
- Use drip irrigation for trees, shrub beds and areas of groundcover to eliminate evaporation losses.
- Choose low-volume, low-angle sprinklers for lawn areas.
- Program automatic controllers for night irrigation to reduce losses due to evaporation and wind drift.
- Select controllers with adjustable watering schedules and moisture sensors to account for seasonal variations, and calibrate them during commissioning.
- Where possible, use grey water for irrigation. Use barrels at the bottom of rainwater leaders for manual irrigation of trees and shrubs.

SPACE MATRIX

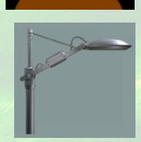
Campus Making I Environmental sustainability

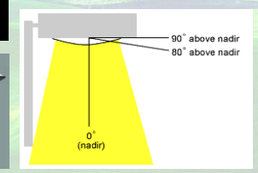
NIGHT SKY POLLUTION AND OUTDOOR LIGHTING EFFICIENCY

Outdoor light ON/OFF control (Infrared switch)



Luminaries classification	Range of allowable lamp lumens emitted upward	Range of allowable lamp lumens emitted between 80 and 90
Full cutoff	0	0 - 11%
Cutoff	0 - 16%	0 - 11%
Semi cutoff	0 - 31%	0 - 22%





Light source	Minimum allowable luminous efficacy (lm/W)
CFL (compact fluorescent lamps)	50
FL (fluorescent lamp)	75
MH (metal halide)	75
HPSV (high pressure sodium vapour) lamp	90

lm/W – lumen/watt

- **Outdoor Landscape area to be lighted: 486281 sqmts.**
- **Total lighting connected load for outdoor lighting with LED and Fluorescent Hybrid system: 50 KW.**
- **Reduction in energy consumption: 50%.**
- **Return of Investment time for extra capital cost: 4 years**

SPACE MATRIX

Campus Making I Environmental sustainability

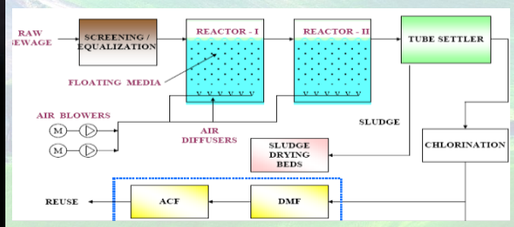
WATER MANAGEMENT

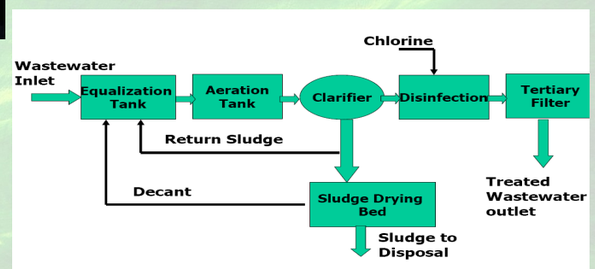
Water use at source

CAN BE REDUCED BY 25 – 40%

by using water efficient sanitary fixtures

FAB REACTOR BASED TREATMENT SYSTEM



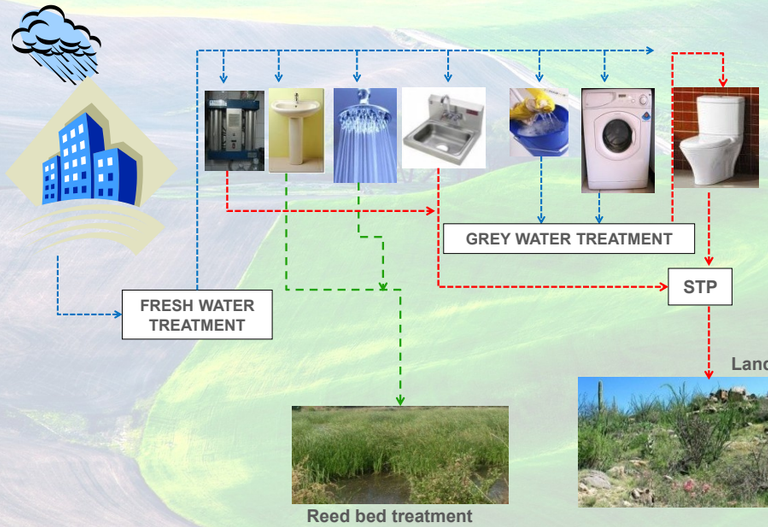


Treated water to be used for **FLUSHING, LANDSCAPE WATERING** and for **WATER COOLED HVAC** system

SPACE MATRIX

Campus Making I Environmental sustainability

WATER MANAGEMENT



Water efficient fittings will be conserving 47% water usage at source

SPACE MATRIX

Campus Making I Environmental sustainability
SOLAR ENERGY

SOLAR THERMAL

Provide **100% hot water**

All of the total hot water needed in this development can be provided with1,900 sq m, which as about **6%** of the total roof area.

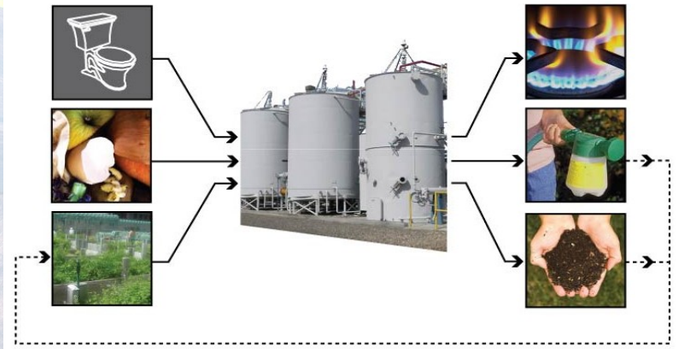
PHOTOVOLTAIC

Provide **100% lighting energy**

With the remaining roofing area, the project can generate about **420 MWh/ yr**, which is approximately the energy needed for lighting.

SPACE MATRIX

Campus Making I Environmental sustainability
BIOGAS PRODUCTION



- Biogas Generation
- Black water Treatment
- Compost & Fertilizer Production
- Typical USA/EU Payback 3-5 years
- http://www.onsitepowersystems.com/

Provide **60%** **of the energy needed for cooking.**

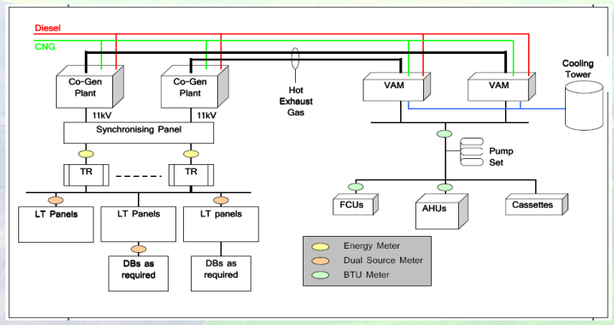
Landscape waste, food waste, and human waste will generate about 800,000 kg/year. With innovative digester technology, this can generate about 2 tera-joules of energy, which is approximately the total energy demand for cooking.

SPACE MATRIX

SUSTAINABILITY

Campus Making I Environmental sustainability

ENERGY FOR COOLING



A/C Load reduced with the following measures:

Orientation, Shade, Efficient glass

Air conditioned spaces:
All Faculty houses bed rooms
Research staff
Visiting faculty
30 bed room guest house
Director and Dean's residences
200, 400 seat Lecture Hall, Auditoriums
Faculty offices
Reception, Discussion, Conference halls and server rooms

A/C for Admin block	A/C for Academic block	A/C for Residential block	A/C for All the blocks
Typical: 378 TR	Typical: 173 TR	Typical: 447 TR	Typical: 998 TR
Actual: 252 TR	Actual: 115 TR	Actual: 319 TR	Actual: 686 TR
SAVINGS 33%	SAVINGS 33%	SAVINGS 28%	SAVINGS 31%

SPACE MATRIX

Campus Making I Environmental sustainability

REDUCTION IN CARBON EMMISSIONS

SOLAR THERMAL
100% Reduction of the total hot water by solar thermal.

SOLAR PV
100% Reduction of common area and outdoor lighting on Solar PV.

BIO GAS
60% Reduction in cooking energy by Bio-gas.

EFFICIENCY
30% Reduction in HVAC, including bioclimatic design.
40% Reduction in Lighting, including day lighting design

TRANSPORT
80% Reduction due to reduced car usage and bicycle transit network.

70% reduction in global carbon-dioxide emission compare to conventional case.

SPACE MATRIX

MAKING OF THE CAMPUS

IDENTITY

SPACE MATRIX

Campus Making I Identity

SPACE MATRIX

Campus Making I Identity

SPACE MATRIX

Campus Making I Identity

SPACE MATRIX

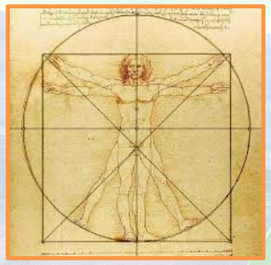
The **future…**

Is about creating

Livable and Sustainable Communities

SPACE MATRIX

Livable Communities……..10 principles



Design on a Human Scale

Provide Choices - variety

Encourage mixed use development

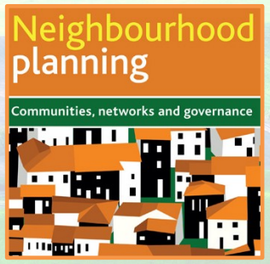
Efficient urban transport

Preserve Urban Centers

SPACE MATRIX

Livable Communities……..10 principles

Build Vibrant public spaces



Create a neighborhood identity

Protect environmental resources

Conserve landscapes

Design Matters

SPACE MATRIX

PASSIVE Right FUTURE Ready

SPACE MATRIX


‘The future of Architecture is in its expression as city structure, not just as buildings, and in its self – conscious ecological awareness.’
Richard Register
SPACE MATRIX
Space Matrix Architects and Planners