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Urban Resilience and Adaptation for India and Mongolia

Curricula, capacity, ICT and stakeholder collaboration to support green & blue infrastructure and nature-based solution

Report on:

Lecture Material

Environmental Design and GIS

Partner number: P12

Nirma University, Gujarat, India

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Course Name: Environmental Design and GIS Application
Number of credits: 2 ECTS

Period: Spring semester

Coordinator	**Dr Aparna**
Credits	2
Lecturers	**Dr Aparna, Peeyush Purohit and Prof. Purvi Jadav**
Level	Bachelors
Host institution	Nirma University
Course duration	15 Weeks

Summary

This is a 2 ECTS course which will be provided as an elective to Bachelors of Architecture students. This course will introduce various parameters of environmental design as well as applications of GIS (Geographic Information System) to BArch students.

Target student audiences

Bachelors students majoring in Architecture

Prerequisites

NA

Aims and objectives

The main course objective is to understand the guiding principles for the successful design of urban public spaces through contextual analysis of various parameters related to climate, topography, culture, and human behavior.

Urban Form

Urban Space

Urban Environment

We create a space were living environment give us satisfaction .

Urban design :

- Creating or giving a character to space with built and un-built spaces.
- Talking about urban – it is not about single building but accumulation of spaces whatever is happen in total a place as a whole which gives space a character which connects people.

e.g Ahmedabad is not known of a single building but collective sort of character for which its is known for . rather for its old city .

Even if we go to Paris its not only for Eiffel tower but the open street spaces and street and the open spaces forming the squares which gives the better quality of life .

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If this is smart -

Does that mean our old have been "DUMB" All along ?

Can we say tradition – Anti Modernity

Is this the progress or growth ?

One must understand - What should be the critical threshold to design certain things rather than the compulsion or going with the trend.

Jaipur

Kolkata

Kerala

- **Increasing Population** - world's population is not evenly spread on Earth's land mass
- **Urbanization** - an increasing in no. of cities and megacities in world . There are more than **20** so called megacities and **400 cities** world wide having excess of 1 million population.
- Europe ,China and Asian subcontinents are categorized under higher population density . It is different for different country like wise .
- 20 highest density urban cities in the world, 16 are in India, with the rest in China, Bangladesh and North Korea.

Urban density

- New york 1750 Individual/sq.km
- London 5100 Individual /sq.km
- Delhi 10,700 Individual /sq.km
- Mumbai 20,000 Individual/sq.km

Urban densities is paralleled by an increase in " sprawl' or 'Outward' urban development .

Urban Expansion occurs in either one of three dimensions :

- Outward
- Upwards
- Infill

Outwards expansion : is more urban land area and occurs at the expense of other land uses i.e. conversion and loss of forest and cropland.

Upwards by way of vertical growth : Vertical expansion results in more multistory and taller buildings , more floor space per area and an increase in urban built up density

Infill development : is unused , abandoned or underutilized lands within existing urban areas are developed or rehabilitated .

So, when we say design for space it has to be looked at from :
Multiple perspective

- Aesthetic (Timelessness)
- Socio Cultural (appropriateness)
- Environmental (Resource management)
- Economic (Affordability)
- Structural (Strength and stability)

Space design cannot be about finding
one answer to **one question** rather its about asking and finding
many answers to **many question** and applying the
One most appropriate that answer to many question .

It is about adding value and appropriateness to the place, its people as well as time

Urban form

Its impact on microclimate

Temperature

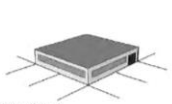
Wind

State of sky

Evaporation

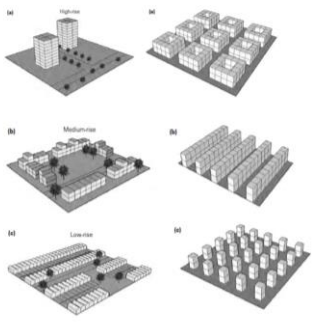
Building density and urban morphology

- Building density has an intricate relationship with urban morphology; it plays an important role in the shaping of urban form.
- Different combinations of plot ratio and site coverage will manifest into a variety of different built forms.
- Three settlements with the same residential density of 76 dwellings per hectare, but in different urban forms: multi-storey towers, medium-rise buildings in central courtyard form, and parallel rows of single-storey houses.
- the three layouts are different in many aspects; nevertheless, in terms of urban land use, the proportion and organization of ground open space is of particular interest.



Plot ratio = 1,
Site coverage = 100%

Plot ratio = 1,
Site coverage = 25 %



Same density in different layouts:
(a) multistorey towers; (b) medium-rise buildings in central courtyard form; (c) parallel rows of single-storey houses

Three different urban forms:
(a) courtyard; (b) parallel block; (c) tower

Cities

Compact	Sparse
High Density	**Low Density**
▪ The very high-density city appears to be very efficient in land use and in the use of some resources, such as transport.	▪ low-density city also has the ability to collect and generate enough energy for home.
▪ High-density city has its own draw back is they still need a neighborhood to supply it with the required resources. As compact cities has less open spaces to grow its own agriculture food and dump the waste generated .	▪ neighborhood give an option to grow their own food in their backyard using their own waste generated as fertilizer making city self reliant and more sustainable .
▪ For both activity they need to depend on the far farmland on the country side, which requires more transport and consumes oil	

Urban Precipitation, Moisture, and Wind Effects

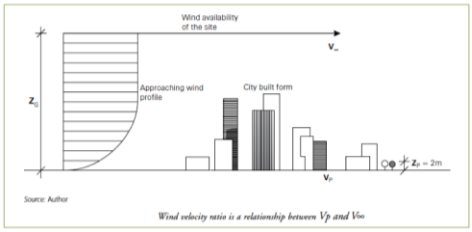
- Precipitation can be enhanced by the downwind of highly urbanized areas
- Buildings within a city provide a source of lift for air, which, combined with a destabilized environment due to the heat island, leads to cloud development and precipitation
- A study based on regional climatic model analyzing precipitation in Tokyo, Japan, and Baltimore-Washington metropolitan area found that precipitation in the city is enhanced by urbanization,such as the presence of buildings, paved roads and mass vehicle use, influence rainfall patterns

Wind :

Wind flow :Urban spaces less ventilated .

Urbanization is the growing number of buildings.

It increases the roughness of the surface underlying the atmosphere and exerts a drag on the low-level winds.



Wind velocity ratio is a relationship between Vp and V∞

Wind speed near the ground decreasing in the long run.

air paths | deep street canyons | street orientations
ground coverage ratio | building height differentials.

Temperature :

Long term temperature increase : Urbanization bears on the long term temperature , the effects is more on the daily minimum than on he daily maximum .

Increase in thermal capacity of urban area where concrete stores the heat absorbed during the day and releases it during night .

Urbanization is often associated with elevated surface and air temperature referred as **Urban heat island**. Urban center and cities are several degree warmer than their surrounding areas. Due to low albedo of urban surfaces, the trapping of radiation within urban canopy , differential heat storage and greater surface roughness, cities trap heat .

Factors Leading to UHI

- Reduction in evaporation due to impervious surface.
- High density urban environment – release anthropogenic heat within small spatial scale
- Urban infrastructure such as transport and energy

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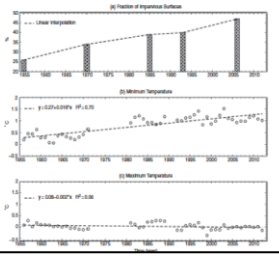
Keywords	Urban heat island effect, urban growth, impervious surfaces, minimum temperature increase
Population (Metropolitan Region)	2,061,000 (UN, 2016)
Area (Metropolitan Region)	161.38 km² (Brussels Statistics, 2015)
Income per capita	US$46,010 (World Bank, 2017)
Climate zone	Cfb – Temperate, without dry season, warm summer (Peel et al., 2007)

- Belgium has experienced a rapid transformation of agricultural land and natural vegetation to built areas (e.g., buildings, impermeable pavements) over the past century.
- Acceleration of urban growth is linked to widespread use of the car as a new mode of transport.
- The results indicate a sharp increase in impervious surfaces areas, nearly a doubling from 26% in 1955 to 47% in 2006.



Case study Hong kong

Unfortunate event of severe acute respiratory syndrome (SARS) in Hong Kong in 2003, there have been calls from the community for measures to improve the quality of our urban living environment.

A qualitative review of the existing urban fabric in Hong Kong by a number of experts invited to Hong Kong in 2004

- A lack of well-considered networks of breezeways and air paths towards the prevailing wind;
- Tall and bulky buildings closely packed together forming undesirable windbreaks to the urban fabric behind; uniform building heights resulting in wind skimming over the top and not being re-routed into the urban fabric;
- Tight, narrow streets not aligning with the prevailing wind, and with very tall buildings on both sides, resulting in very deep urban canyons;
- A lack of general urban permeability: few open spaces, no (or minimal) gaps between buildings or within large and continuous buildings, and excessive podium structure reducing the air volume at pedestrian level;
- Large building lots with insufficient air spaces, and with buildings on them not generally designed for wind permeability and forming wind barriers;
- Projections from buildings and obstruction on narrow streets further intruding into the breezeways and air paths; and a general lack of greenery, shading and soft landscape in urban areas.

Environmental Impact and Urban Living

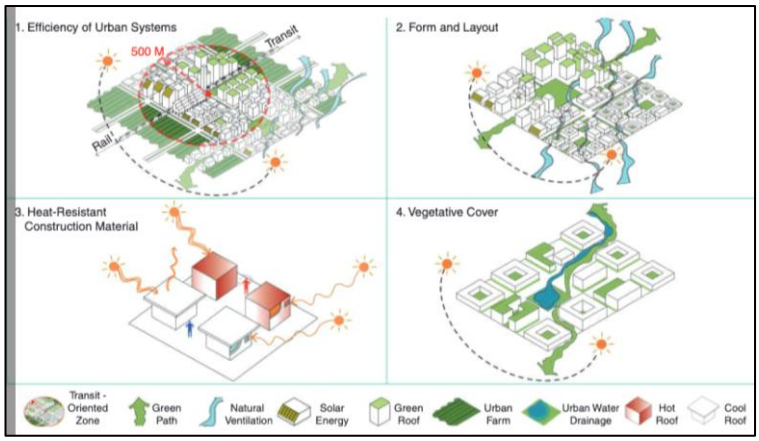
State of sky : Increasing suspended particulates thrown by human activities – reduced visibility – lesser solar radiation reaching ground . It could also be particulates formed from combustion products (e.g. vehicle exhaust, kitchens and power generation)

E.g. `large consumption of energy within Hong Kong itself, which invariably involves combustion of one form or another with its attendant emissions, thus turbidity is locally generated by the urban form of living practiced here.

Leung et al (2004a) also reported that the **annual mean cloud amount** observed at the Hong Kong . Observatory headquarters has been increasing at a rate of 1.8 per cent per decade during the period 1961 to 2002. One potential cause is increase in the concentration of **condensation nuclei in the air (a factor favorable to the formation of cloud),** which is known to be associated with urbanization. Increased turbidity and increased cloud amount reduce the amount of solar radiation reaching the ground thus resulted in reduced illumination in building increasing dampness and reduces ability to kll germs potentially harmful to human being .

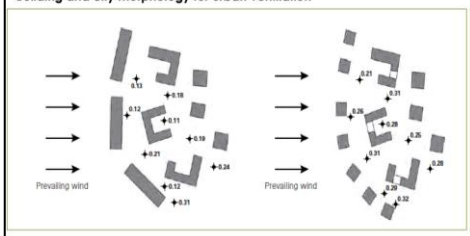
Environmental Impact and Urban Living

Evaporation : Decreasing trend of evaporation . It could attribute to decreasing prevailing wind speed and reduced amount of solar radiation reaching the ground during day . another signature of urbanization. It could mean damp corners remaining damp more than before, providing a favorable environment for germs.



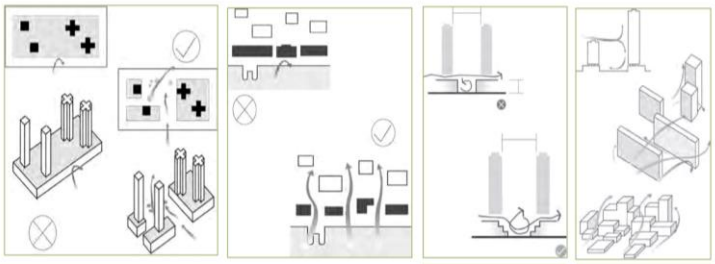
Designing for Urban Ventilation

Building and city morphology for urban ventilation



Two urban layouts with different wind velocity ratios: (left) lower velocity ratios due to higher building blockage; (right) higher velocity ratios due to more ground level permeability

Breezeways and air paths when planning a city are better for city air ventilation



Reducing ground cover and breaking up building podia is better for city air ventilation

Buildings with gaps along the waterfront are better for city air ventilation

Improving air volume near the ground with stepping podia is better for city air ventilation

Varying building heights is better for city air ventilation