

Planning recommendations for urban neighborhoods to regulate thermal fluxes in a Hot-Humid climatic region: Case Study of Kolkata

Broad Area:

Planning and Policy

Need for the Study in the Context of Future of Cities

Concern for the environment is reflected in policies for urban development. These policies are implemented at varying scales from component to perspective level planning. Evidence based on historical meteorological and satellite based land-resource observations show that, major changes such as melting of polar ice cap and permafrost, receding glacial snouts and perturbations in climatic pattern, and increased frequency and intensity of natural calamities, are interrelated. Global warming as a result of Greenhouse Gas (GHG) emission that trap heat in the atmosphere, is identified as a precursor to these changes. Global warming would consequentially lead to deterioration in air quality, food insecurity, damaging effects on forests, ecosystems, coastal areas, water resources, and adverse bioclimatic comfort conditions, thereby affecting human health and quality of life. Strategies for abating carbon emissions and reducing energy footprint include developing materials low in embodied energy, recycling and efficient use of materials. Prior to construction, the building's performance should be analyzed at four levels, i.e. site and impact on ecology, building envelope, component and material specification for new as well as retrofitting existing ones.

Another aspect of sustainable design strategy is the planning of the city itself. The structure of a city, determines trips generated for work, recreation and other needs. The intensity of development dictates convenience, cost and level of infrastructure which is intrinsically connected to energy use and carbon emission. Additionally, anthropogenic-induced changes in land-cover has resulted in microscale and mesoscale increases in temperatures in comparison to adjacent rural regions which is known as the urban heat island (UHI) effect, altering thermal comfort conditions. This necessitates expending more energy to achieve thermal comfort. Paved surfaces in urban areas increases thermal storage and runoff, altering ambient air temperature and creating flash floods as a consequence of precipitation and also reduces ground water recharge potential. Whereas, trees and green biomass can reduce ambient air temperature due to high albedo and evapotranspiration effects, thereby lowering the sensible heat component of the net incoming solar insolation, apart from carbon sequestration and storage potential. In this context, there is a need to develop an understanding of planning norms and standards for Indian cities, especially in the hot humid climate and arid climates, to negate in part the undesirable impacts of urbanization and climate change.

Objective and Scope of Work

The objectives of the study shall include the following aspects:

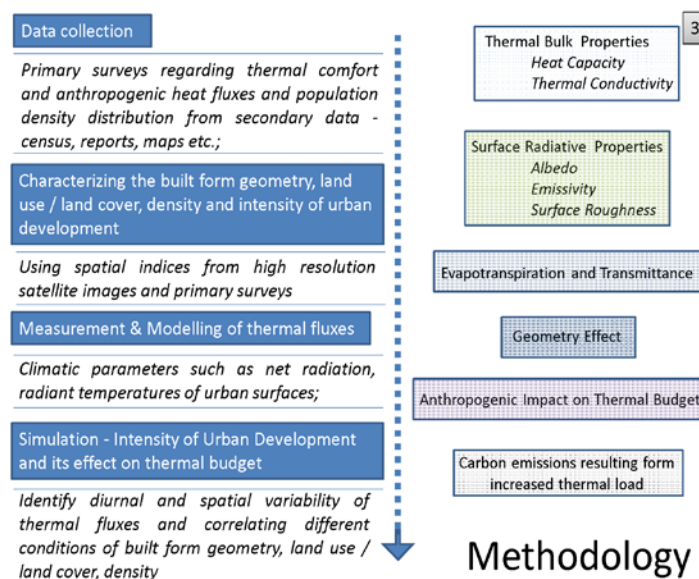
- 1) Assess diurnal variations of urban thermal energy fluxes near the surface in urban built-up areas;
- 2) Investigate the spatial variability of energy flux components observed over different surfaces in urban neighborhoods;
- 3) Assess the peri-urban versus CBD energy fluxes; and
- 4) Assess the impact of built form, urban density and landuse/landcover on thermal fluxes and thermal comfort.

Methodology

The following steps are indicative of the methodology to be followed in this research:

- 1) Data collection – questionnaire surveys regarding thermal comfort and anthropogenic heat fluxes and secondary data from census, maps etc.;
- 2) Monitoring thermal fluxes and climatic parameters such as net radiation, radiant temperatures of urban surfaces;
- 3) Characterizing the built form geometry, landuse/ landcover, density and intensity of urban development in sample neighbourhoods using indices; and
- 4) Identify diurnal and spatial variability of thermal fluxes and correlating different conditions of built form geometry, landuse/ landcover, density and intensity of urban development.

The following schematic flow chart is indicative of the steps involved:



Outcomes/Deliverables

The deliverables shall include:

- 1) Development of guidelines and planning recommendations for design of urban neighbourhoods;
- 2) Three research articles and workshop to disseminate the findings of this research among urban planners;

Team Composition

Principal Investigator	
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