PRGR 631 Low Energy Architecture and Passive Building Design

Catalog description: (2 credit)

This course centers on issues surrounding the integration of sustainable and passive design principles, into conceptual and practical Building design. Topics will include: solar geometry, climate/regional limitations, natural lighting, passive design and sustainability initiatives, insulating and energy storing material. Bioclimatic design and concepts. Case studies will be used extensively as a vehicle to discuss the success/failure of ideas and their physical applications.

Textbook: Handouts, research articles.

References:

- Thermal analysis and design of passive solar buildings by A. K. Athienitis and Mat Santamouris.

- Passive building desing by N.K. Bansal, G. Hauser, and G. Minke.

- Passive design building technologies applied in Belo Horizonte, Brazil by Angela Negromonte Scheibe.

- Passive cooling and buildings by Mat Santamouris.

- Solar Energy for Building by Keith Robertson and Andreas Athienitis.

Coordinator: TBA

Educational Objectives/Learning Outcomes:

On successful completion of the course, students will be able to:

1- Develop green buildings strategies for energy efficiency and sustainability in buildings.

2- Estimate effects of design parameters on energy efficiency in the three areas of lighting, heating and cooling.

3- Show discernment in choice of building materials based on environmental impact.

4- Evaluate and demonstrate life-cycle cost for buildings.

5- Propose energy efficient alternatives in a building refurbishment project.

Topics covered:

- Introduction to passive and sustainable building designs

- Environmental impact of building materials (life cycle costing; embodied energy in building materials; renewable materials; recycled materials; environmental construction impact; demolition and refurbishment)

- Passive solar heating (heating cycle, solar geometry and shading, solar gains)

- Passive cooling (Natural ventilation, air circulation routes; evaporative cooling; solar cooling; ground cooling)

- Energy storage and restitution

- Lighting and day lighting (factors affecting daylight in buildings; room shapes; window shape, size and position; daylight factors; daylight distribution and uniformity; combination of artificial and day lighting)

- Assessment of building energy performance

- Energy efficiency standards for building design (LEED, BREEAM, HQE,BBC)

Assessment and grades:

Term project: 30%

Midterm: 30%

Final Exam: 40%

Computer usage: MS Office, energy simulation software, life cycle assessment software.