



COURSE BOOK

Elective

(BUILDIN PHYSICS)

With

(BUILDING MATERIALS)

5th Year, Bachelor of Science

2 Hours in a Week

Group A + B

Lecturer

Dr. Salahden Ghareb Kadr

PhD Architecture

TU-Berlin-Germany

Contact

E-Mail salahkadr@yahoo.com
 Salahden.kadr@su.edu.krd

Tel. Nr. **00964 750 33 90 174**

COURSE OBJECTIVES

This course analyzes the state and operation of the building envelope like walls, roofs, Floors and foundation, as well as the physical process of heat, moisture and fire protection. These physical transport processes determine the performance of the building. It's essential for sustainability, passive planning and energy - efficient buildings with high levels of comfort and lifetime.

Building Physics will help us to anticipate the performance and consequences of alternative designs as well as determining technical solutions before critical design and construction decisions can be made.

Building physics is a design discipline to make less energy-hungry buildings for the built environment more sustainable, in order to protect our surroundings and our health.

PROBLEM PRESENTATION & THE AIM OF BUILDING PHYSICS SUBJECT

The climate zone in which we study has a very dry and hot condition (46 - 50) C° in summer and very wet cold weather (2-(-6) in winter time. The sky is often clear without clouds with long and strong daylight. The temperature different between day and night, summer and winter is relatively very big.

As we know the buildings in the region make people to depend mainly on technical power resources. The coast will be higher and put the environment under pressure. Therefore it is very important to build with climatic design. For that purpose help us the fundamentals of **Building Physics**.

The main duty of this Study is to keep itself busy with **thermal comfortable** and **energy saving** in the buildings, which create and provide us a healthy inside atmosphere, especially which has a good connection with correct environmental building system in the Region. We want to know which Optimize procedures reduce the inside temperature of the buildings in the summer or to protect the inside warm temperature in the winter.

FORMS OF TEACHING METHODS

Different forms of teaching will be used in the class. **Power point presentations** help us to realize some of aims of this course. The following explains the methods:

- Teaching, asking and discussion in the class with Power point presentations for the head titles, definitions and conclusions.
- Students will be permanent asked to understand the subjects
- Worksheet in the class let the chance for practicing the most important exercises together. If necessary, we can meet in another time to get the best understand of the subject.
- Report preparation in English language to represent environmental effects on a specific existing building to compare the optimized house with unoptimized realized objects.
- Classroom discussion about the reports, solves, analysis and evaluate problems to get the best of the course. Try as much as possible to participate in classroom discussions, to solve the assignments given in the course.
- Your attendance and activities in the class is very important to fulfill our aims

GRADING

The students required to monthly exams besides quizzes and weekly assignments about project solution in our climate.

- 30% Monthly Examine and Quizzes
 - 10% Quizzes
 - 20% Examine
- 10% Classroom activities, participation and attendance
- 10% Reports about physical project solution
- 50% Final exam

Classroom activities, assignments resolve and attending class will be evaluated by the lecture over the semester and used to determine the final grad.

COURSE MATERIALS

- 1- Kadr, Salahden, 2010, **Climate optimization of residential family houses in Iraqish Kurdistan**, TU-Berlin, Dissertation. (German-English) **نامه‌ی دکتورا**
- 2- Kadr, Salahden, 2013, **scientifically Building research for Kurdistan- Region**. First edition, Hawler-Kurdistan Region. Publisher Tafseer (Kurdish) **لێکۆڵینه‌وه‌ی بیناسازی زانستی بۆ هه‌رێمی کوردستان**
- 3- Kadr, Salahden Ghareb, 2019, **Building Physics and Energy save**. First edition, Hawler-Kurdistan Region. Publisher Tefseer (**Kurdish**) **فیزیای بیناسازی و پاشه‌كه‌وتی وزه**
- 4- Hens, Hugo, 2012, **Building Physics**, 2nd Edition, Verlag Ernst & Sohn, Gemany. (English)
- 5- Lechner, Nobert, 2009, **Heating, cooling, lighting, Sustainable Design Methods for Architects**, Third Edition, John Wiley & Sons, Inc, Hoboken, New Jersey, USA. (English)
- 6- Kreith, Frank, 2010, **Principles of Heat Transfer**, Cengage Learning; 7 Edition: Revised. (English)
- 7- Ernst Neufert, **Neufert**, Architects Data
- 8- Michail J crosbie, Donald Watson, **Time saver standards**, for Architectural Design
- 9- **Building and environment**, Copyright © 2014 Elsevier Ltd. All rights reserved
- 10- Hugo, hens, 2012, **Building Physics: Heat, Air and Moisture, Fundamentals and Engineering Methods with Examples and Exercises**, Second Edition, Publisher: Wiley-VCH GmbH & Co. KGaA

USEFUL INTERNET LINKS

- <http://www.buildingphysics.com>
- <https://www.fabricfirst.com.au/services>

COURSE PROGRAM

ELECTIVE, BUILDING PHYSICS

Week

1.0 CLIMATE

- 1.1 Basic concepts for Climate-Responsive Design
- 1.2 Definition of Environment
- 1.3 Outside Climate and Weather
- 1.4 The meteorological condition
- 1.5 Climate in Kurdistan Region
 - 1.5.1 Climate zones of the Region
 - 1.5.2 Components of outside Climate in the Region
 - 1.5.2.1 Outside air Temperature
 - 1.5.2.2 Humidity and Air - Moisture
 - 1.5.2.3 Relative air humidity ϕ (Phi) %
 - 1.5.2.4 Precipitation and Wind
- 1.6 Indoor Climate
 - 1.6.1 Room temperature, Feel temperature and Circumvallation temperature °C
 - 1.6.2 Ideal Inside room climate
- 1.7 Inside factors of thermal comfort

2.0 ENERGY

- 2.1 Definition of energy
 - 2.1.1 Heating energy
 - 2.1.2 Cooling energy
- 2.2 Influence of energy on our life
- 2.3 Energy and Building
 - 2.3.1 The main characteristics of the building to save energy
- 2.4 Energy house types in research
- 2.5 Thermal comfort and Energy in the buildings.....1

3.0 PRINCIPLES OF BUILDING PHYSICS

A BUILDING MATERIALS

A 1 Cement block stone

A 2 Brick masonry

A 3 Y-Ton or Thermo stone

3.1 HEAT & HEAT PROTECTION or HEAT SAVING

- 3.2 Fundamentals and purposes of the heat protection
- 3.3 Temperature (°C) (K)
 - 3.3.1 Heat protection and energy save
 - 3.3.2 Fundamentals of Building Physics (Heat protection)
 - 3.3.2.1 Heat transfer, Heat flow (Φ)
 - 3.3.2.2 Heat value, Thermal value (H)
 - 3.3.2.3 Heat quantity or Heat storage capacity (Q)
 - 3.3.2.4 Thermal conductivity (λ)

3.3.2.5	Heat flow density, Heat transfer density (q)	
3.3.2.6	Specific heat capacity or thermal capacity (c)	
3.3.2.7	Heat transmitting coefficient (Λ)	2

B BUILDING MATERIALS

B 1 Calcareous sand stone CSS

B 2 Polyvinylchloride PVC

B 3 Cork as a building material

3.3.2.8	Heat transmitting resistance (R)	
3.3.2.9	Heat transmittance resistance (R_T)	
3.3.2.10	Heat transmittance coefficient (U-value)	
3.3.2.11	Heat transmittance coefficient of windows (U-value)	
3.3.2.12	Heat convection coefficient (h)	
3.3.2.13	Heat convection resistance (R_S)	
3.4	Energy cost calculation with U-value.....	3

C BUILDING MATERIALS

C 1 Natural stone

C 2 Wood & Plywood as a building material

C 3 Tiles for wall and floor cover

3.3.2.14	Temperature profile in building components	
3.3.2.15	Temperature Amplitude Ratio TAR	
3.3.2.16	Temperature factor (fR_{Si})	
3.3.2.17	Thermal diffusivity (a)	
3.3.2.18	Heat penetrating coefficient (b)	
3.5	Thermal bridges	
3.6	Thermal mass or Heat storage capacity.....	4

4.0 SUMMER HEAT PROTECTION & WINTERHEAT PROTECTION

D BUILDING MATERIALS

D 1 Iron & Steel

D 2 Linoleum & Laminate for floor cover

4.1	Summer heat protection and the requirements
4.2	Winter heat protection and the requirements
4.3	Comparison of heat protection in summer and winter

5.0 THERMAL INSULATION IN THE BUILDING

5.1	Aim of thermal building insulation
5.2	Building and thermal insulation
5.2.1	Insulation materials
5.2.2	Insulation types
5.2.3	Internal & External insulation
5.2.3.1	Advantages & Disadvantages of Internal and External insulation

5.3	Research results.....	5
6.0	MOISTURE & MOISTURE PROTECTION	
E	BUILDING MATERIALS	
E 1	Cement as a building material	
E 2	Gypsum as a building material	
6.1	Moisture and Water	
6.2	The impact of moisture on the building	
6.2.1	Water and Moisture transport	
6.2.1.1	Water transport with diffusion	
6.2.1.2	Capillary	
6.2.1.3	Water evaporation	
6.2.1.4	Water transport during air	
6.2.2	Water and moisture barrier	
6.2.2.1	Aim of moisture protection.....	6
F	BUILDING MATERIALS	
F 1	Glas as a building material	
6.3	Fundamentals of moisture protection	
6.3.1	Saturation content of the air	
6.3.2	Relative humidity or Relative air moisture	
6.3.3	Absolute air humidity	
6.3.4	Condensation and Condensate temperature	
6.3.4.1	Internal condensation	
6.3.4.2	External condensation	
6.3.5	Water vapour pressure	
6.3.5.1	Water vapour partial pressure (p)	
6.3.5.2	Saturated water vapour pressure (p_s)	
6.4	Water-proof and Water vapour proof	
6.4.1	Water vapour diffusion Résistance coefficient	
6.5	Comparison of Heat protection and Moisture protection.....	7
G	BUILDING MATERIALS	
G 1	Clay as a building material	
6.6	Vapor and Moisture barrier	
6.7	Thermal insulation and moisture problems	
6.8	Water vapour diffusion	
6.9	Condensation water mass	
6.10	Glaser diagram	
6.10.1	Condensation period	
6.10.2	Evaporation period	
6.11	Summary of the Heat & Moisture protection.....	8
Total Study weeks		8