

King Fahd University of Petroleum & Minerals
College of Environmental Design
Architectural Engineering Department

ARE 345
Principles of HVAC

Design Assignments

The assignments for this course will be design based. You will have a building that you will start with and perform semester assignments for that building. The objective is to expose you to a complete HVAC design process throughout the semester utilizing the same base building.

You will be asked to submit each assignment in a specific date. The assignment will be checked and given back to you with specific feedback for improvement. Accordingly you will have a chance to improve as you go along the semester towards your final project on the same building. However, the assignments are general dependent on each others as they constitute different phases of the design process. Therefore, delays in any of the assignments will impact the whole and you need to pay special attention to that.

Study the building carefully and perform the required calculations and design requirements as required for each assignment related to the selected building. Submit each assignment in a regular paper size in a neat format with a cover page that includes your name, assignment number and title, the course number and semester, and date of submission. Always keep your work neat and in good order.

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Assignment #1
Building Selection and Description
Due _____

Choose an appropriate and simple commercial building to be used as the base for your semester design assignments as well as your final project for his course. Provide full description of the building that you have chosen as follows:

BUILDING DESCRIPTION should include at least the following:

Building Physical Characteristics:

Building Location

Building Shape

Building Function

Building Construction:

Walls

Roof

Floor

Glass

Doors

Building construction should include description as well as sample cross section drawings of each component.

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Assignment #2
Building Physical, Thermal, and Operational Data
Due _____

For your building, perform the following:

- Perform all area take-offs necessary for thermal load calculations of the building;
- Calculate the heat transfer coefficients (U-values) for the building envelope;
- Find other glazing parameters required for the calculations;
- Find all operational characteristics of your building, including:
 1. Occupancy Schedule;
 2. People operational information;
 3. Lighting information;
 4. Ventilation requirements;
 5. Infiltration information;
 6. Miscellaneous thermal loads.

Submit all calculations in **tabulated format** whenever possible with the building plans showing all useful information in a neat format. **State all assumptions** that you may have made in the calculations.

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Assignment #3
Design Data, Thermal Zoning, and HVAC System
Due _____

- Find indoor and outdoor design conditions data;
- Show thermal zoning of your building with justifications;
- Indicate the type of HVAC system(s) to be used in your building with justifications.

Note:

Submit all calculations in **tabulated format** whenever possible with the building plans showing zoning and other useful information in a neat format. **State all assumptions** that you may have made in the calculations and **show all steps** of calculations.

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Assignment #4
Manual Thermal Design Load Calculations
Due _____

For your building, perform the following manually:

- Design heating load calculations of the building;
- Design cooling load calculations of the building;
- Plot the distribution of loads for the different components of the building;
- Air volume flow rates (L/s) required to satisfy space sensible cooling loads.

Note:

Submit all calculations in **tabulated format** whenever possible with the building plans showing zoning and other useful information in a neat format. **State all assumptions** that you may have made in the calculations and **show all steps** of calculations.

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Assignment #5
Computerized Thermal Design Load Calculations
Due _____

For your building, perform the following:

Using Carrier II-20 load calculation program available in the ARE computer lab., perform all the following:

- Design heating load calculations of the building;
- Design cooling load calculations of the building;
- Plot the distribution of loads for the different components of the building;
- Air volume flow rates (L/s) required to satisfy space sensible cooling loads;
- Compare the results with your manual calculations from previous assignment and discuss the sources of discrepancies.

Note:

Submit all calculations in **tabulated format** whenever possible with the building plans showing zoning and other useful information in a neat format. **State all assumptions** that you may have made in the calculations and **show all steps** of calculations.

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Assignment #6
Site Visit

Due _____

Based on the site visit conducted, prepare a report containing the following:

1. Description of the building (project) visited.
2. Description of the HVAC system used.
3. Pictures, sketches, layouts, etc of the system used and its main components.
4. Critical review of the HVAC system used and its suitability to the building (project), and why?
5. Lessons learned from the visit.

Submit all your work on a regular paper in a neat and clear format.

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Assignment #7
Air Distribution

Due _____

For your building that you completed design cooling and heating loads calculations for in the last assignment, perform the following:

1. Calculate the (corrected) sensible cooling load and heating load per unit floor area (q_s/m^2) for each zone.
2. Calculate (corrected) air volume flow rate (L/s) required to satisfy sensible cooling loads for each zone.
3. Layout the diffusers. Use ceiling and/or side wall diffusers and assume the most suitable ceiling grid for your building. You might need to draw the grid before you layout the diffusers. Use actual manufacturer's catalog data (if available). Check for acoustical criteria.
4. Check the ADPI for typical diffusers.
5. If you have decided to use VAV system, then:
Select VAV boxes from manufacturer's catalogs (if available). The number of VAV terminal units is a function of economics and the level of individual comfort control desired. Generally, three or four similar rooms may be assigned to a thermostat, hence a common VAV box.
6. Submit all your design calculations along with building floor plans showing all diffusers and ductwork between diffusers and VAV boxes when applicable.

Submit all your work on a regular paper in a neat and clear format. Indicate all assumptions made in your design.

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Assignment #8
Pressure Losses Calculations

Due _____

As discussed and described in class, perform the following calculations for this assignment:

1. Static pressure losses for the critical path.
2. Dynamic pressure losses for the critical path.
3. Any additional losses from diffusers, sound attenuators, coils, filters, etc along the same path.

Submit all your work on a regular paper in a neat and clear format. Indicate all assumptions made in your design.

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Assignment #9
Duct Design

Due _____

For your chosen building that you have completed diffuser and duct layout for, use the Equal Friction Duct Design method to find the total pressure losses (friction and dynamic) for a typical floor of your building starting at the supply fan discharge side.

Submit all your work on a regular paper in a neat and clear format. Indicate all assumptions made in your design.

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Final Project

Due _____

For the building you have performed HVAC design calculations for throughout the semester, compile all your assignments related to your chosen building and submit a final report on your design in a neat and complete format. The report should include at least:

1. Introduction, design basis, any assumptions, design summary, recommendations and conclusions;
2. Detailed building description and drawings;
3. Detailed design calculations;
4. All input and output data;
5. Psychrometric analysis;
6. Building plans and other necessary sketches with details on them;
7. Detailed air distribution, diffuser and duct layouts;
8. Sketches of the air handling units (AHUs) and related information;
9. Manufacturers data cut sheets for all your equipment;
10. Any other necessary and/or useful information.

Utilize computer in all your calculations and/or drawings as much as you can in order to submit a complete and neat thermal design report for the building.

Make sure to cite the proper references whenever applicable.