SAMPLE OF COOLING LOAD ESTIMATION WITH HAP
HOURLY ANALYSIS PROGRAM (HAP)

- HAP SYSTEM DESIGN FEATURES.
- HAP ENERGY ANALYSIS FEATURES.
- USING HAP TO DESIGN SYSTEMS AND PLANTS.
- USING HAP TO ESTIMATE ENERGY USE AND COST.
- WORKING WITH PROJECTS.
- GENERATING INPUT DATA REPORTS.
- USING THE REPORT Viewer.
HOW TO START?

- From **START MENU** choose Hourly Analysis Program (**HAP**).
Click on (HAP) starting window will appear.
Create a New Project

Choose new on the PROJECT MENU this creates a NEW PROJECT a project is the container which holds your data.
New project will be established which will be contain" SAMPLE DATA. " 
Choose **Save** on the Project menu; you’ll be asked to name the project from here on, save the project periodically.
Click on the “Weather” item in the tree view in the main program window. The Weather input form will appear.
### Weather Properties - [Cairo]

<table>
<thead>
<tr>
<th>Region</th>
<th>Middle East</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Egypt</td>
</tr>
<tr>
<td>City</td>
<td>Cairo</td>
</tr>
<tr>
<td>Latitude</td>
<td>30.1°</td>
</tr>
<tr>
<td>Longitude</td>
<td>-31.4°</td>
</tr>
<tr>
<td>Elevation</td>
<td>73.8 m</td>
</tr>
<tr>
<td>Summer Design DB</td>
<td>40.0 °C</td>
</tr>
<tr>
<td>Summer Coincident WB</td>
<td>20.6 °C</td>
</tr>
<tr>
<td>Summer Daily Range</td>
<td>13.3 °K</td>
</tr>
<tr>
<td>Winter Design DB</td>
<td>7.2 °C</td>
</tr>
<tr>
<td>Winter Coincident WB</td>
<td>3.2 °C</td>
</tr>
</tbody>
</table>

- Atmospheric Clearness Number: 1.00
- Average Ground Reflectance: 0.20
- Soil Conductivity: 1.385 W/m/K
- Design Clg Calculation Months: Jan to Dec
- Time Zone (GMT +/-): -2.0 hours
- Daylight Savings Time: Yes
- DST Begins: Apr 1
- DST Ends: Oct 31

Data Source: User Modified
Select MIDDLE EAST region.
Weather Properties - [Cairo]

Design Parameters

Region: Middle East
Location: Africa
City: Middle East
Latitude: 30.07 N
Longitude: 31.24 E
Elevation: 73.8 m

Design Temperatures

Atmospheric Clearness Number: 1.00
Average Ground Reflectance: 0.20
Soil Conductivity: 1.385 W/m/K

Calculation Months: Jan to Dec

Time Zone (GMT +/-): -2.0 hours
Daylight Savings Time: Yes
DST Begins: Apr 1
DST Ends: Oct 31

Summer Design DB: 40.0 °C
Summer Coincident WB: 20.6 °C
Summer Daily Range: 13.3 K
Winter Design DB: 7.2 °C
Winter Coincident WB: 3.2 °C

Data Source: User Modified

OK Cancel Help
from location menu select EGYPT.
### Weather Properties - [Cairo]

<table>
<thead>
<tr>
<th>Design Parameters</th>
<th>Design Temperatures</th>
<th>Design Solar</th>
<th>Simulation</th>
</tr>
</thead>
</table>

| Region: | Middle East | | Atmospheric Clearness Number: 1.00 |
|Location: | Egypt | | Average Ground Reflectance: 0.20 |
|City: | Bahrain, Cyprus | | Soil Conductivity: 1.385 W/m/K |
|Latitude: | Egypt | | Design Clg Calculation Months: Jan to Dec |
|Longitude: | Iran, Iraq | | Time Zone (GMT +/−): -2.0 hours |
|Elevation: | Jordan, Kuwait, Lebanon | | Daylight Savings Time: |
|Summer Design DB | 40.6 °C | | DST Begins: Apr 1 |
|Summer Coincident WB | 20.6 °C | | DST Ends: Oct 31 |
|Summer Daily Range | 13.3 °K | | Data Source: User Modified |
|Winter Design DB | 7.2 °C | | |
|Winter Coincident WB | 3.2 °C | | |

OK  Cancel  Help
from CITY MENU select CAIRO.
Press the OK button on the Weather input form to save the data and return to the main program window.
Enter Space Data General (General)

Click on the “Space” item in the tree view in the main program window. Space information will appear in the list view. Double-click on the “<new default space>” item in the list view.
Enter data for your space.

- Naming the space.

- Input floor area, average ceiling height and building weight.
Name: H1007-Training

Floor Area: 40.6 m²

Avg Ceiling Height: 3.3 m

Building Weight: 341.8 kg/m²
INTERNAL LOAD
**Overhead Lighting**
- **Fixture Type**: Recessed, unvented
- **Wattage**: 26.00 W/m²
- **Ballast Multiplier**: 1.08
- **Schedule**: Room Lighting

**People**
- **Occupancy**: 12.0 People
- **Activity Level**: Office Work
- **Sensible**: 71.8 W/person
- **Latent**: 60.1 W/person
- **Schedule**: Meeting people

**Task Lighting**
- **Wattage**: 0.00 W/m²
- **Schedule**: (none)

**Miscellaneous Loads**
- **Sensible**: 0 W
- **Latent**: 0 W
- **Schedule**: (none)

**Electrical Equipment**
- **Wattage**: 6000.0 Watts
- **Schedule**: Equipment

**Buttons**: OK, Cancel, Help
Entering overhead lighting

- select recessed unvented as fixture type, as lighting intensity and ballast multiplier as default.
Create Schedules.

- When entering overhead lighting data, you must choose a schedule. In the schedule drop-down list, choose the "create new schedule"
Schedule Properties - [Room Lighting]

Schedule Name: Room Lighting

Schedule Type:  
- Fan/Thermostat
- Utility Rate Time-of-Day
LIGHT SCHEDULES WINDOW WILL APPEAR.
Choose a profile from the dropdown list and edit it by dragging the bars with the mouse, by using the arrow keys, or by entering data in the text fields directly. Navigate between profiles with the Tab key: navigate within a profile with the arrow keys.
There are two different profiles which the space working
Working day profile
Day off profile

[Image of a profile chart with a line graph showing various data points]
Finally choose ROOM LIGHTING schedule
CREATE SCHEDULES, when entering equipment data, you must choose a schedule. In the schedule drop-down list, choose the "create new schedule"
Schedule Name: equipment

Schedule Type:
- Fan/Thermostat
- Utility Rate Time-of-Day

OK  |  Cancel  |  Help
There are two different profiles which the space working
Choose a profile from the dropdown list and edit it by dragging the bars with the mouse, by using the arrow keys, or by entering data in the text fields directly. Navigate between profiles with the Tab key: navigate within a profile with the arrow keys.
Finally choose equipment schedule
Create Schedules, when entering people data, you must choose activity level.
Create Schedules.

- when entering equipment data, you must choose a schedule. In the schedule drop-down list, choose the “create new schedule”
There are two different profiles which the space working
Choose a profile from the dropdown list and edit it by dragging the bars with the mouse, by using the arrow keys, or by entering data in the text fields directly. Navigate between profiles with the Tab key; navigate within a profile with the arrow keys.
Finally choose PEOPLE schedule.
ENTERING WALL, WINDOWS AND DOORS DETAILS

- choose direction of exposure
  wall
<table>
<thead>
<tr>
<th>Exposure</th>
<th>Wall Gross Area (m²)</th>
<th>Window 1 Quantity</th>
<th>Window 2 Quantity</th>
<th>Door Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>14.6</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Construction Types for Exposure: 2 (S)
- Wall: South, North Wall
- Window 1: Horizontal slider4
- Shade 1: (none)
- Window 2: (none)
- Shade 2: (none)
- Door: (none)
CHOOSE LAYERS OF WALL
## Wall Properties - [South, North Wall]

- **Wall Assembly Name:** South, North Wall
- **Outside Surface Color:** Dark
- **Absorptivity:** 0.900

### Layers: Inside to Outside

<table>
<thead>
<tr>
<th>Layer</th>
<th>Thickness (mm)</th>
<th>Density (kg/m²)</th>
<th>Specific Ht. (kJ/kg/K)</th>
<th>R-Value (m²·K/W)</th>
<th>Weight (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside surface resistance</td>
<td>0.000</td>
<td>0.0</td>
<td>0.0</td>
<td>0.12064</td>
<td>0.0</td>
</tr>
<tr>
<td>Gypsum board</td>
<td>15.880</td>
<td>800.9</td>
<td>1.09</td>
<td>0.09862</td>
<td>12.7</td>
</tr>
<tr>
<td>Air space</td>
<td>0.000</td>
<td>0.0</td>
<td>0.0</td>
<td>0.16026</td>
<td>0.0</td>
</tr>
<tr>
<td>102mm face brick</td>
<td>101.590</td>
<td>608.7</td>
<td>0.84</td>
<td>0.26681</td>
<td>61.9</td>
</tr>
<tr>
<td>102mm common brick</td>
<td>101.590</td>
<td>2002.3</td>
<td>0.92</td>
<td>0.07626</td>
<td>203.5</td>
</tr>
<tr>
<td>102mm LW concrete block</td>
<td>0.000</td>
<td>0.0</td>
<td>0.0</td>
<td>0.05864</td>
<td>0.0</td>
</tr>
<tr>
<td>203mm LW concrete block</td>
<td>219.060</td>
<td>0.78</td>
<td>278.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Overall U-Value:** 1.280 W/m²·K
ENTERING ROOF DATA
Window Properties - [Horizontal slider4]

Window Details
Name: Horizontal slider4
Detailed Input: √
Height: 2.60 m  Width: 4.50 m
Frame Type: Aluminum with thermal breaks
Internal Shade Type: None
Overall U-Value: 2.610 W/m²K
Overall Shade Coefficient: 0.726

Glass Details
<table>
<thead>
<tr>
<th>Glazing</th>
<th>Glass Type</th>
<th>Transmissivity</th>
<th>Reflectivity</th>
<th>Absorptivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Glazing</td>
<td>6mm clear</td>
<td>0.792</td>
<td>0.079</td>
<td>0.129</td>
</tr>
<tr>
<td>Glazing #2</td>
<td>6mm clear low-e</td>
<td>0.639</td>
<td>0.116</td>
<td>0.245</td>
</tr>
<tr>
<td>Glazing #3</td>
<td>not used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gap Type:</td>
<td>13 mm Air Space</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
choose direction of roof.
<table>
<thead>
<tr>
<th>Exposure</th>
<th>Roof Gross Area m²</th>
<th>Roof Slope (deg)</th>
<th>Skylight Quantity</th>
<th>Construction Types for Exposure: 1 (not used)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>not used</td>
<td></td>
<td></td>
<td>Roof: (none), Skylight: (none)</td>
</tr>
<tr>
<td>2</td>
<td>not used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>NNE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NE</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>ENE</td>
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<td></td>
<td>ESE</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
choose layer of roof.
# Roof Properties - [TOP ROOF]

**Outside Surface Color:** Dark  
**Absorptivity:** 0.900

<table>
<thead>
<tr>
<th>Layers: Inside to Outside</th>
<th>Thickness mm</th>
<th>Density kg/m²</th>
<th>Specific Ht. kJ/kg/K</th>
<th>R-Value m²·K/W</th>
<th>Weight kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside surface resistance</td>
<td>0.000</td>
<td>0.0</td>
<td>0.00</td>
<td>0.12064</td>
<td>0.0</td>
</tr>
<tr>
<td>Steel deck</td>
<td>0.853</td>
<td>7833.0</td>
<td>0.50</td>
<td>0.00002</td>
<td>6.7</td>
</tr>
<tr>
<td>Board insulation</td>
<td>25.400</td>
<td>32.0</td>
<td>0.92</td>
<td>1.22291</td>
<td>0.8</td>
</tr>
<tr>
<td>Built-up roofing</td>
<td>9.540</td>
<td>1121.3</td>
<td>1.47</td>
<td>0.05847</td>
<td>10.7</td>
</tr>
<tr>
<td>Outside surface resistance</td>
<td>0.000</td>
<td>0.0</td>
<td>0.00</td>
<td>0.05864</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>35.793</td>
<td></td>
<td></td>
<td>1.46</td>
<td>18.2</td>
</tr>
</tbody>
</table>

**Overall U-Value:** 0.685 W/m²·K
ENTERING INFILTRATION DATA
### Infiltration Settings

Enter infiltration rate in any column:

<table>
<thead>
<tr>
<th></th>
<th>L/s</th>
<th>L/s/m²</th>
<th>ACH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Cooling</strong></td>
<td>18.61</td>
<td>1.27</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Design Heating</strong></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Energy Analysis</strong></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Infiltration occurs:
- ![Radiation symbol](icon.png) Only When Fan Off
- ![Radiation symbol](icon.png) All Hours
ENTERING FLOOR TYPE DATA
Floor Type

- Floor Above Conditioned Space
- Floor Above Unconditioned Space
- Slab Floor On Grade
- Slab Floor Below Grade

Floor Above Conditioned Space

No Additional Inputs
ENTERING PARTITION DETAILS
### Partition 1

- **Ceiling Partition**
- **Wall Partition**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>U-Value</strong></td>
<td>2.839</td>
<td>2.839</td>
</tr>
<tr>
<td><strong>Unconditioned Space Max Temp.</strong></td>
<td>23.9</td>
<td>23.9</td>
</tr>
<tr>
<td><strong>Ambient at Space Max Temp.</strong></td>
<td>35.0</td>
<td>35.0</td>
</tr>
<tr>
<td><strong>Unconditioned Space Min Temp.</strong></td>
<td>23.9</td>
<td>23.9</td>
</tr>
<tr>
<td><strong>Ambient at Space Min Temp.</strong></td>
<td>12.8</td>
<td>12.8</td>
</tr>
</tbody>
</table>

### Partition 2

- **Ceiling Partition**
- **Wall Partition**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>U-Value</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unconditioned Space Max Temp.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ambient at Space Max Temp.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unconditioned Space Min Temp.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ambient at Space Min Temp.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Click on the "System" item in the tree view in the main program window. System information will appear in the list view.

Double-click on the "<new default system>" item in the list view. The System input form will appear.
General

Naming the system
Air System Name: system(H1007)

Equipment Type: Chilled Water Air Handling Units

Air System Type: VAV

Number of Zones: 1
Select “Chilled Water Air Handling Units” as equipment type.
Select “VAV” as air system type
Air System Name: system(H1007)

Equipment Type: Chilled Water Air Handling Units

Air System Type: VAV

Number of Zones:
- CAV - Bypass Multizone
- CAV - Dual Duct
- CAV - Tempering Ventilation
- CAV - Four Pipe Induction
- VAV
- VAV - 1-Fan Dual Duct
- VAV - 2-Fan Dual Duct
- VVT
SYSTEM COMPONENT DATA

Ventilation air system
Ventilation Air

Ventilation Air Data

- Airflow Control: Proportional
- Design Airflow: 10.00 L/s/person
- Minimum Airflow: 0%
- Unocc. Damper Position: Closed
- Damper Leak Rate: 5%

Central Cooling
Supply Fan
Duct System

Options:
- Economizer
- Vent. Reclaim
- Precool Coil
- Preheat Coil
- Humidification
- Dehumidification
- Return Fan
Central Cooling Data
SUPPLY FAN
Supply Fan

- **Fan Type**: Forward Curved
- **Configuration**: Draw-Thru (selected)

**Total Static**: 0 Pa

**Overall Efficiency**: 54 %

<table>
<thead>
<tr>
<th>% Airflow</th>
<th>100</th>
<th>80</th>
<th>60</th>
<th>40</th>
<th>20</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>kW</td>
<td>100</td>
<td>81</td>
<td>61</td>
<td>46</td>
<td>33</td>
<td>21</td>
</tr>
</tbody>
</table>
Duct System Data
Air System Properties - [system(H1007)]

**General**
- Ventilation Air
  - Duct System Data
    - Supply Duct Data
      - Duct Heat Gain: 0 %
      - Duct Leakage: 0 %
    - Return Duct or Plenum Data
      - Return Air Via
        - Ducted Return
        - Return Air Plenum
      - Wall Heat Gain to Plenum: 10 %
      - Roof Heat Gain to Plenum: 70 %
      - Lighting Heat Gain to Plenum: 30 %

**System Components**
- Economizer
- Vent. Reclaim
- Precool Coil
- Preheat Coil
- Humidification
- Dehumidification
- Central Cooling
- Supply Fan
- Duct System
- Return Fan

**Zone Components**

**Sizing Data**

**Equipment**
Zone Components

Space Assignments
Spaces

H1007-Training

Zone

Zone 1

H1007-Training
Air System Properties - [system(H1007)]

**Thermostat and Zone Data**

- **All zone T-stats set the same**
  - Zone: [Dropdown]
  - All of 1

**Zone Name**
- All Zones

**Cooling T-stat Setpoints**
- occ. 23.9 °C
- unocc. 29.4 °C

**Heating T-stat Setpoints**
- occ. 21.1 °C
- unocc. 15.6 °C

**T-stat Throttling Range**
- 1.67 K

**Diversity Factor**
- 100%

**Direct Exhaust Airflow**
- 0.0 L/s

**Direct Exhaust Fan KW**
- 0.0 KW

**Shared Data**

**Thermostat Schedule**
- THERMOSTAT

**Unoccupied Cooling is**
- [Radio Button] Available

[OK] [Cancel] [Help]
Sizing Data

Sizing Specification
ZONE SIZING
## Zone Sizing Data

**Zone Airflow Sizing Method**: Peak zone sensible load

**Space Airflow Sizing Method**: Individual peak space loads

### Sizing Data is
- **Computer-Generated**
- **User-Defined**

### Zone 1

<table>
<thead>
<tr>
<th>Zone</th>
<th>Supply Airflow</th>
<th>Zone Htg 1 Init</th>
<th>Reheat Coil</th>
<th>FPMBX Fan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OK**  
**Cancel**  
**Help**
From Reports menu choose (Print/View Design Data)
The output Reports window will appear and we choose any output data
<table>
<thead>
<tr>
<th>Reports</th>
<th>Table</th>
<th>Graph</th>
<th>Time Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Sizing Summary</td>
<td>✓</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Zone Sizing Summary</td>
<td>✓</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>System Load Summary</td>
<td>✓</td>
<td>✓</td>
<td>Peak</td>
</tr>
<tr>
<td>Zone Load Summary</td>
<td>✓</td>
<td>✓</td>
<td>Peak</td>
</tr>
<tr>
<td>Space Load Summary</td>
<td>✓</td>
<td>✓</td>
<td>Peak</td>
</tr>
<tr>
<td>Hourly Air System Loads</td>
<td>✓</td>
<td>✓</td>
<td>July</td>
</tr>
<tr>
<td>Hourly Zone Loads</td>
<td>✓</td>
<td>✓</td>
<td>July</td>
</tr>
<tr>
<td>System Psychrometrics</td>
<td>✓</td>
<td>✓</td>
<td>Peak</td>
</tr>
</tbody>
</table>