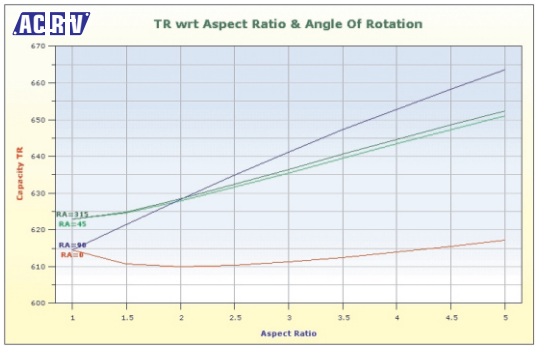

SIMULATION

The Ultimate Design Tool!

Instant Answers

Simulation Graphs

System Wide Optimisation

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Way back, in 1985, I developed the initial version of this software for simulation of HVACR systems. Since then, with increasing insights into software and ACR systems and ever-better availability of hardware, the software has been upgraded over 100 times. Here, I would like to share with you, my experience in doing this, as also and more importantly, in using this software, to design & build HVACR systems. Systems which are innovative, energy efficient, compact and easy to use & service.

It was in 1985, that I first used the then 123 Release 1A. I also had access to the original manual, which really helped me in understanding its capabilities. Based on final year specialisation in ACR [with Prof M R Khadilkar to teach the fundas], plus over 4 years & literally hundreds of repeatative heat loads & equipment selections / design calculations, while working for Blue Star Ltd and having glimpsed the enormous potential of drastically reducing the owning & operating costs for customers like Glaxo, Garware and Century Enka - the 123 capabilities really fired my imagination.

In 1985, I was renting PC @ Rs100/hr. The 4.77 Mhz PC didnt have a hard-disk and the floppy drive was 128 KB. The simulation program + 123 + DOS use to fit on this 128 KB disk very easily. I hope this gives you an idea, how primitive & costly the software development environment was in 1985.

This is what I could do with the initial version of this program . . . . .

The system could simulate the AC + Ventilation + Cold Room loads simultaneously for all three seasons ie for Summer, Monsoon & Winter. Being 123 based you could do the these additional things. These were the basic features required for **'Instant Answers'** and **'Simulation Graphs'.**

You change the Indoor DB & RH . . . .And the Revised Heat Load is ready. SHR, **ADP**, C F M & TR all included. For all 3 seasons!

You change the products to be stored in the Cold Rooms . . . and /or the indoor / outdoor DB, enable/disable the ante-room. Again you had **Instant Answers!**

You change the city code & directions . . . Its like **taking your AC area on a rotating trip across 66 destinations across India**. You had a graph of TR / CFM while the area was on this super-fast trip!

In those days, a DMP took 20 mins to print this graph. But it was worth the wait!

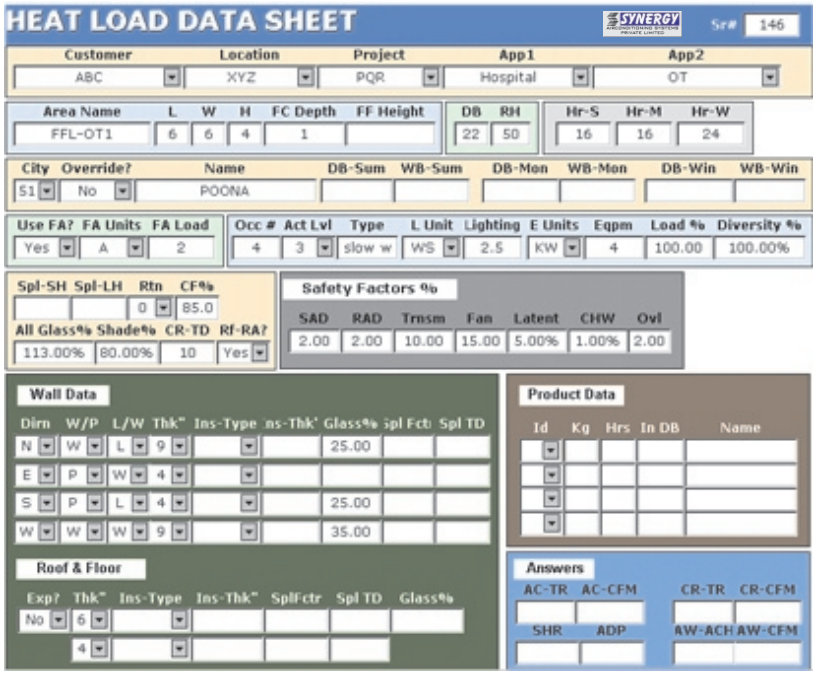
With the initial concept of the simulation system, getting implemented sucessfullly, the Idea was then extended to do more. As of Aug 05, the simulation software INTEGRATES the complete design process!

The following examples will highlight this integrated approach . . . .

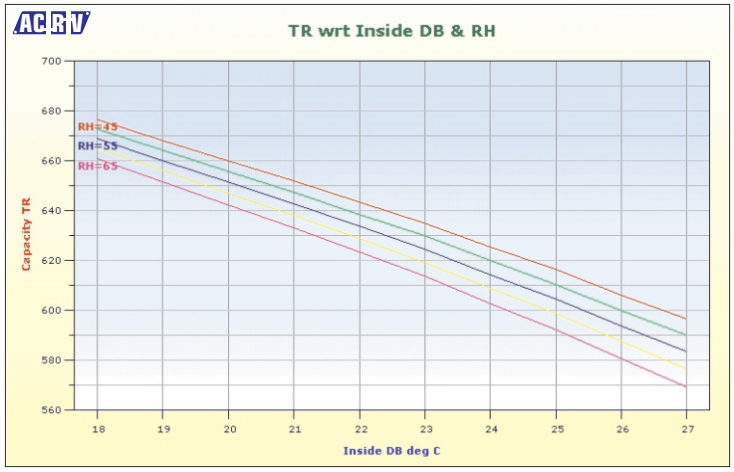
You change the Evaporation & Condensing Temps . . . .As before you have **Instant Answers** but which **now include** revised system design with Compressors, Chillers, Condensers, Cooling & Heating Coils, Expansion Valves, Capillaries, Pumps & Water Piping.

If you have finished optimizing the overall design, you can **then** switch to your CAD program for layout generation & /or assembly in 3D. If you have taken the prior effort of generating a library of 3D drgs for compressors, blowers, pumps etc, on switching to CAD your **optimised components are pre-loaded** for you to do your **space optimisation**.

As of Aug 05, the HVACR System Simulator looks & feels like this . . .



ABC - XYZ / FFL-OT1 / PQR			
SYNERGY SYSTEMS SYNERGY SYSTEMS			
COOLING LOAD ANALYSIS SHEET [AIRCONDITIONING]			
SEASON ..	SUMMER	MONSOON	WINTER
HOUR...	16	16	24
A.	NORTH WALL GAIN	901.8	750.1	(792.2)
B.	NEAST WALL GAIN	0.0	0.0	0.0
C.	EAST- WALL GAIN	2,134.3	751.0	(1,422.9)
D.	SEAST WALL GAIN	0.0	0.0	0.0
E.	SOUTH WALL GAIN	1,600.7	563.2	(1,067.2)
F.	SWEST WALL GAIN	0.0	0.0	0.0
G.	WEST- WALL GAIN	1,073.7	942.2	(394.4)
H.	NWEST WALL GAIN	0.0	0.0	0.0
I.	ROOF GAINS	0.0	0.0	0.0
J.	FLOOR GAINS	5,021.9	1,767.0	(3,347.9)
K.	GLASS GAINS	16,616.8	12,596.0	5,385.4
L.	F.A.SENS.GAIN	667.3	234.8	(444.8)
M.	OCCUP.SENS.GAIN	1,160.0	1,160.0	1,160.0
N.	LIGHTING LOAD	3,303.4	3,303.4	3,303.4
O.	EQUIPMENT LOAD	13,640.0	13,640.0	13,640.0
P.	SENS.SFT.FACTOR	10,575.3	7,807.2	2,559.4
Q.	SPECIAL LOAD	0.0	0.0	0.0
R.	TOTAL SENSIBLE	56,695.1	43,514.9	18,578.7
S.	FA-QTY(CFM)	127.1	127.1	127.1
T.	F.A.LATENT LOAD	422.6	1,123.0	(393.8)
U.	OCCUP.LAT.GAIN	840.0	840.0	840.0
V.	SPECIAL LATENT	0.0	0.0	0.0
W.	LAT.SFT.FACTOR	69.5	104.5	28.7
X.	TOTAL LAT.LOAD	1,332.1	2,067.5	474.8
Y.	TOTAL ROOM HEAT	58,027.2	45,582.4	19,053.5
Z.	S.H.R. [vv]	97.7%	95.5%	97.5%
AA.	A.D.P.[vv]	51.0	50.9	51.0
AB.	C.F.M.[vv]	2,999.6	2,286.3	982.5



This shows the typical User Interface [UI] for the simulation system. The data sheet [although the web forms are different] is the UI for defining the simulation data. The output UI shows a multi-season heat load and the graph simulates the behaviour of the system under varying conditions.

The Equipment design UI is combined for data-input & Instant Answers, allowing change of ALL design parameters for system optimisation.

Here's a list of a few more things you can do with the ACR Simulator . . .

Airconditioning Heat Load Simulation . . .

- Create compact database of all data entry. Approx 1 million data sets on 1 std CD.
- Search data sets with stats analysis on areas/customers/applications etc.
- Use std ISHRAE weather data & / or Over-ride data as needed for climatic changes.
- **Get Instant Answers for change in these and many more variables**

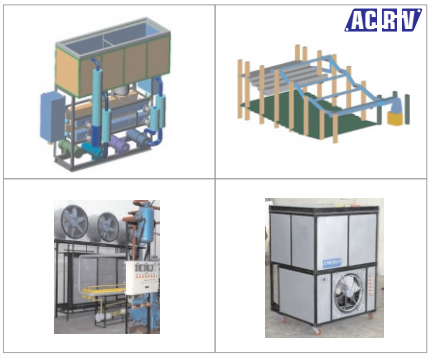
Room Dimns	In/Out door Conditions	Hourly varying internal load
Safety Factors	Direction/Rotation	Exposures / Glass
Areas/types	Special SH / LH	Product types & loads
Insulation type & thkness		

- Multi-season heat loads. Easily comparable. For Hr-of-the-day of your choice.
- Various ratios : CFM / TR, Sqft / TR, Eqpm Load / TSH etc for quick check.
- Enable / disable FA load. If enabled use ACH, cfm/person or CFM.
- Enable / disable LH calculation as per Bry-Air factors for Low-RH applications
- Enable / disable altitude correction to air-qtys

Equipment Design [R22 based Systems] . . .

- Select & add multiple compressors across manufacturers / models / qtys and operating conditions even for a single combo-system
- Optimise Chillers / Condensers [water / air / evaporatively cooled] & Heat Recovery Condensers [desuperheaters] with simultaneous updation of pumps / fans etc.
- Use multiple /multi-circuit heat exchangers with con-current changes in pumps/fans.
- Change the tube material / ODs & geometry for all Heat Exchangers.
- Con-currently design /select pumps, wtr piping, Exp Valves, Capillaries etc.
- Con-currently design /select CHW & HW coils as needed.
- Select & add multiple pumpsets across manufacturers / models / qtys and operating conditions even for a single combo-system.
- Simulate the performance of geometrically similar blowers / fans using std data.
- Simulate the compressor discharge temp & the extent of superheat for HRC.
- Simulate the power consumption of cmps, pmps, blowers & fans for optimisation.
- Simulate the system weight & space for optimisation.

Using the HVACR System Simulator . . . . .



Since the simulator INTEGRATES the entire system design process, we have used it extensively for ALL our system design needs. We have addtionally incorporated special heat exchanger design programs for slim-fin coils, evaporative condensers & rectangular shell & tube exchangers to cater to our manufacturing needs.

The images here should give you the idea as to how we have used the simulation system to design & build std YET customised systems.

Log On & Use the FREE Services . . . . .

Thanks to the Web, the results from the simulator are available FREE!. Download re-usable Input Data Sheet in Excel format from www.acrv.net and email the data. The answers are emailed back at the address given by you.