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Increasing Productivity in HVAC Layout Work

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HVAC project engineers look at several aspect of a layout drawing to enable better planning and coordinaton. Some of these requirements are listed in **Table 1.** This article will examine how computerized layout making through ***Design*** based software can meet these requirements and increase the productivity.

CAD Vs CADD Software

An invoice can be prepared either on a word processor or an accounting software. When it is prepared on an accounting software the number of checks and calculations such as taxes, duties and totaling are done automatically. In addition, books are updated and trial

balance is prepared. The productivity of the system gets enhance greatly when an accounting software is used. Similarly, in HVAC ducting layouts one can get a quantum jump in productivity and enhance return on investment by using special design based software.

The drafting software is generally termed as Computer Aided Drawing (CAD) whereas the design based software is called Computer Aided Design & Drawing (CADD). In case of CAD software the inputs such as sizing are to be given by the user and it only enhances the speed of the drafting process. The CADD software performs groups of design operations and their results are used by the software to make the drawing and reports.

Table 1 : HVAC Engineer's needs

Layout Drawings	
Quiet Layouts	Fast Changes
Accurate BOQs	
Piece-wise Ducts	Diffusers, Grilles
Insulation Areas	
Acoustic	Thermal
Interference Checks	
Ducts Piping	Co-ordination
Fabrication	
Gauge wise area	3D Visualization
Installation	
3D Visualization	Supports...

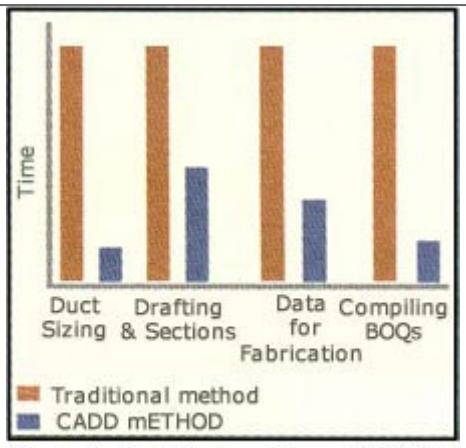

Fig. 1: Typical Time saviing with CADD software

The relative time saving with CADD software for various operations is shown in **Fig.1.** HVAC engineers can benefit not only from the saving of time for drafting but also from sizing. BOQs and compilation of data for both fabrication and intallation. The time saved

in operations other than drafting is quite substantial. When this time saving and the accuracy of information is considered together, the benefits are impressive.

Integrated Approach

Some softwares have separate modules for sizing, drawing and so on. When all the modules are integrated it is easier to design, draw and get the repots. The integrated software also allows you to interface the outputs with other MIS systems, check interferences and obtain detailed bill of quantities for the project. It is also possible to transfer the data from the drawing directly to the duct manufacturing factory. The integrated approach benefits various departments in the company as shown in **Table 2.**

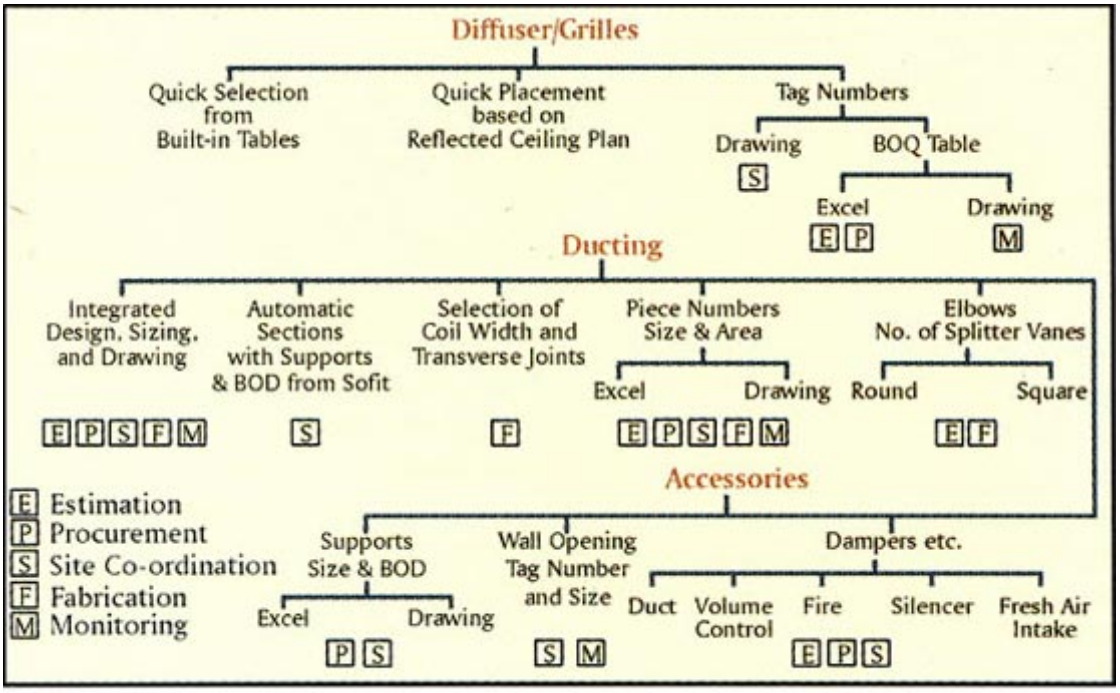

Table 2 - An example of Integrated CADD Software

Ease of Operation

In design based software the menus are simple and self explanatory e.g., Placing Diffuser, Single Line Routing and so on. These can be operated with ease even by those who do not have skills in computerized drafting. In one instance a manager without any prior experience of Auto CAC produced an actual drawing with just two hours of training.

The diffusers can be selected from built-in tables based on the airflow and the velocity. These can be placed rapidly on the drawing by clicking two pints - such as two corners of the room or the two end points of the corridor as in **Fig 2.** The routing can be indicated by drawing Single Lines.

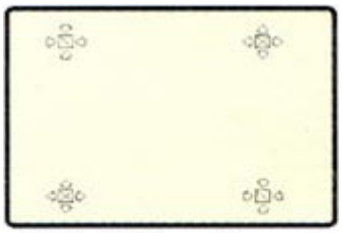

Fig. 2 : Diffuser Placement

The diffusers can be picked up in a group and connected to the required Single Line as shown in **Fig 3.**

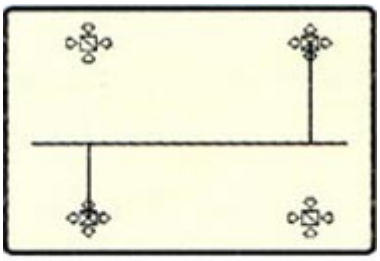

Fig. 3 : Single Lines Routing

Based on the friction factor, maximum velocity and height available, sizing is done automatically and shown on the Single Lines as indicated in **Fig 4**. These sizes can be changed, if required, at the Single Line stage itself.

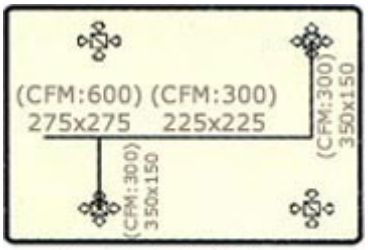

Fig. 4 : Auto Sizing on Single Lines

The Single Lines can be converted rapidly to Double Lines as shown in **Fig 5**.

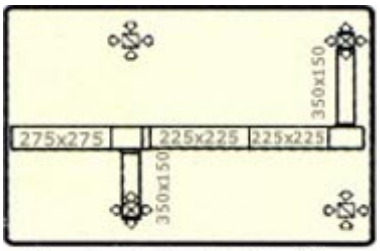

Fig. 5 : Auto Double Lines

The sections can be derived automatically by selecting the required area and indicating the direction. This ensures that the sections are based on the actual data of the Double Lines, including the height to Bottom of the Duct. A typical section is shown in **Fig 6**.

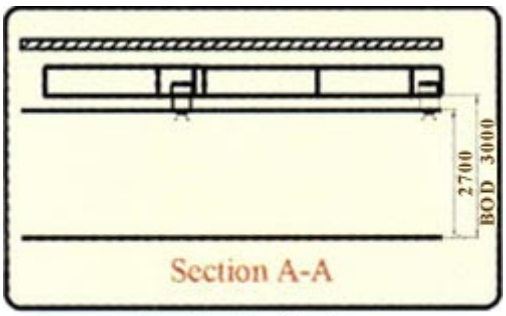

Fig. 6: Auto Sections

3D drawings are generated from the double line drawings automatically as in **Fig 7**. One can see the 3D drawing from different directions. You can also see the ducting and other services such as piping, if drawn in 3D. This improves visualization.

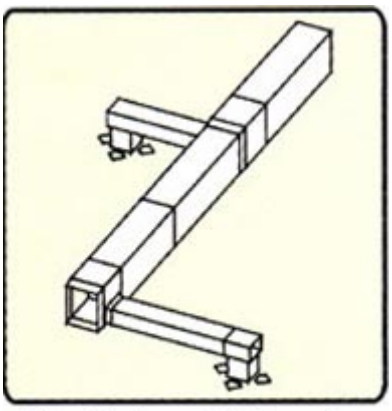

Fig. 7: Auto 3D Drawing

Bill of Quantities

CADD software provides extensive BOQs for various items. These items are shown the drawing. This ensures that no item is missed out for procurement. Typical BOQs are shown in **Table 3**.

Some of the BOQs available are:

- Ducting
- Insulation
- Diffusers/Grillers
- Linear Diffusers
- Plenums
- Wall cut-outs
- Duct Supports
- Dampers - VCD, Fire etc.
- Silencers
- Elbows + Splitter Vanes

Ducting BOQ

Each piece of a duct is tagged and the finished dimensions, height, width and length, along with the gauge of sheet are obtained from the drawing instantly. These BOQs are shown on standard software such as Excel. They can be combined together for several drawings and an accurate estimate of the gauge wise sheet area for the project can be obtained.

Sales Estimates

Approximate guage wise duct areas along with acoustic and thermal insulation areas can be obtained at the Single Lines stage. These can be used for more accurate sales estimates.

Standards for Guages

You can set your own tables so that the BOQs for the same drawing are obtained as per IS, SMACNA or any other standard.

Modified BOQs

When a layout is modified you can immediately get the new BOQs. This ensures that the revisions are taken into account. The accurate modified BOQs help in discussing in detail with the consultant or client the changes and their implications.

Typical BOQs from a design software are shown in **Table 3**.

Sheet or Coil Width

It is possible to set the sheet or coil width (2400 or 1200 mm). The drawing will automatically show the markings as per this setting. This helps in better co-ordination during installation.

Interface with MIS, ERP

The information generated from the CADD software can be transferred to other MIS systems including ERP. It minimizes delays and errors in compilation of data. It can be transferred directly to the MIS software. As the data used for project analysis is based on actual drawings, it leads to better co-ordination and planning.

Table 3 : Typical Bill of Quantities from a CADD software

Piece wise BOQ of Ducts								
No	**Type**	**CFM**	**Width 1**	**Width 2**	**Height 1**	**Height 2**	**Length**	**Gauge**
1	RO	3200	575		575		1195	G22
2	RC	3200	575		575		1195	G22

3	RD	2400	475	400	475	400	400	G22
4	EL	800	475	400	475	400	500	G22

Diffuser/Grille Summar

Ref.	Item	S/R	Type	Size	CFM	Qty.
SDF 1	Diffuser	S	4 Way	381 x 381	700	10
RDF 1	Diffuser	R	4 Way	381 x 381	700	10
SGR 1	Grille	S		305 x 150	150	5
PL 1	Plenum	S		1200x220x64	400	1

Piece-wise Areas of Ducts

No	G18	G20	G22	G24	Acc. Insulation	Th. Insulation
1			5.46		5.46	6.6
2			5.56		5.56	6.6

Guage-wise Summary

Surface Area (Sq. M)				Insulation	
G18	G20	G22	G24	Acoustic Area(Sq.M)	Thermal Area(Sq.M)
		11.02		11.02	13.2

Procurement

The above information can be used to plan, order and move materials to the site. Manual take-offs take enormous time on large projects. If these are changes in the layout drawing then it takes a lot more time to recalculate. CADD software provide accurate information along with tag numbers. The tag numbers help in ordering, and keeping track of the material movement to the project. It is also possible to customize the BOQs with the material codes.

Smart Software

Software which performs smart operations go a long way in project ordination. It is possible to check interferences with beams and other ducts abased on Single Lines, even before making double line layouts. This helps in reducing the changes after making the Double line layout. Rapid editing of Double line ducts can be performed with smart software. For e.g., if the false ceiling level changes at the last minute, then the software can automatically change the height of diffuser location and adjust the collars so that the Bill of Quantity reflects these changes immediately.

Factory Fabricated Ducting

The use of factory fabricated ducting on sites has several advantages. When the layouts are made on CADD software it is possible to send them electronically by email or floppy to the factory. The factory can pick up the data from the drawings directly and fabricate on the same day. This not only avoids mistakes in manual take-offs but also gives the designer the advantages of making required modifications till practically the last minute, without losing on the delivery schedule.

There is already a well established company offering factory fabricated ducting in India. Consultants and contractors can design layouts based on the CADD software and send the files electronically to this factory to take advantage of the benefits.

Fabrication at Site

The availability of accurate piece wise BOQ for the ducts makes it easier to monitor the fabrication and its progress. Now-a-days a computer is available on major project sites. It is possible to discuss with the fabricator the intricacies by showing the 3D ducting from different angles. Even those who are not formally trained to interpret the plans and sections can easily understand by looking at 3D drawings. This will avoid mistakes in conceptualization and fabrication. HVAC engineers can explain different groups involved in the project the implications of modifications by using the 3D drawings.

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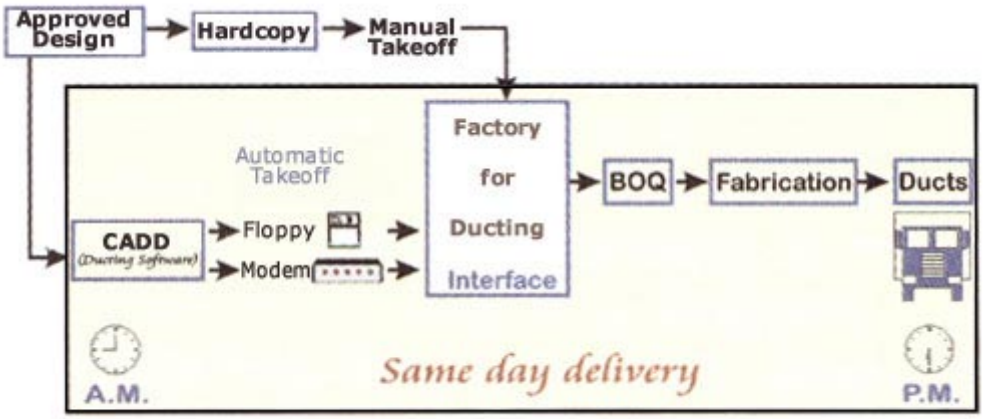

Fig. 8 : Flow chart for Factory Fabricicated Ducting

Building Layouts in 3D

CADD software modules allow quick conversion of 2D architectural drawings into 3D, with respect to the elements which are of importance to the HVAC layout. Seeing the beams and ducts in 3D helps in better visualization and leads to more efficient co-ordination.

Implementation

Drafting softwares are easier to implement. An organization can derive the benefits of a design software only when persons with vision and authority see its benefits, and take personal interest in implementing it. Quick implementation is easier when the operating managers have bands-on training on the software to understand the capabilities and enable them to guide others.

Selection of Basic System

It is advisable to go for standard platforms in computers (such as Pentium series) and basic CAD software such as Auto CAD. One should go for non-standard configurations only if there is a strong need for it.

System Requirements

Design softwares are available on different platforms such as Unix, Windows, NT etc. Most of the common applications can be performed on Windows NT/98 on Pentium based computers available currently in the market. Some CADD softwares have their own back-

end software and others operate on the most widely used software AutoCAD. They customize the Auto CAD so that benefits of design and drawing are available to the user easily and fast.

Selection of Software

It would be advisable to make a list of preferred options to short list the software. An example of such a check list is shown in **Table 4**. One should see a demonstration and samples of actual drawings produced using the software

When to Invest

One should modify existing methods to take advantage of new technology. It is easier to do this when there is some free time available - a lull in the projects. When the industry is facing the need to restructure, it is advisable to look at the current methods and the return on investment on the existing computers.

Investment Modes

You can invest in software and get depreciation benefits by purchasing outright. Today there are options for hire-purchase or even monthly rental.

You can choose the option most suited based on your usage and budget. Some companies allow you to start with basic modules and add on advanced modules as and when required.

Rental Option - the Flexible Way

The rental option is like having a draftsman in your office but paying him on a monthly basis only when you have actual work. Some softwares allow you rentals as low as the salary of a draftsman. If for some reason you do not wish to continue you can stop further rentals and yet retain the software so that when you need it again you can pay and activate it immediately. When you have a large project requiring several copies of the software for a temporary duration, you can tent the extra copies for that period.

Table 4 - Typical check list for selection of CADD software

- Suitable for Indian design conditions
- Operates on standard PCsImplemented in Indian companies

- Used on actual project in IndiaAccredited Developers (ADN)
- Customizable in India
- Cost-benefit analysis

Conclusion

Today there is growing awareness that more number of computers do not necessarily give higher productivity. Managers are also realizing that large investments in hardware do not give returns if they are used only for drafting. Innovative approach to rationalize the methods of working will result in both short term and long term benefits. More design can be done with less people and less computers.