

Educational case with design power improvement based on image training method

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ABSTRACT: Three-dimensional computer aided design (3D CAD) has become widely used as a standard CAD. However, a great change is occurring at the design site. In addition, because 2D drawings are not discarded even when the conventional tool is changed to 3D CAD, the drawing process itself, such as the writing of specifications, is still necessary. On the other hand, the improvement in design efficiency is being promoted owing to the application of 3D mechanical design, but this is applicable only to experienced designers, and therefore, it is considered that the objectives and concept of using 3D CAD have not yet been established among inexperienced designers. We provided education to improve design skill, using the image training method, for the purpose of solving the following problems. 1) Younger designers do not understand design methods. 2) They can create a shape model but do not have a clear design concept. 3) They lack the ability to understand 2D drawings. (1) Make designers understand that, within the design process, the designing of a concept is an important phase that determines the value of products. (2) Drawing a rough sketch is a technique of simplifying and representing original ideas and images created in the mind. Therefore, designers must understand that concepts cannot be drawn from the start by CAD. (3) Make designers understand the importance of reviewing their design by drawing a rough sketch of their images on a blank sheet, and even writing a list of parts required for assembly diagrams. We evaluated the results of the education and discussed the details of the achievements. **KEYWORDS:** three-dimensional design 3D CAD, design and drawing education,

1. INTRODUCTION

Efficiency improvement is being aimed at the mechanical design on business because of the practical use of three-dimensional CAD. However, it limited might be only organization, and be office. It is descriptive geometry + draft + CAD operation now so far though the descriptive geometry and the mechanical design drafting were studied in the educational institution. As a result, it appears one after another to the society the student who cannot read the drawing it is not possible to trace the plans as an engineer. As for them, a young man designer of these days doesn't understand the design approach from the mainstay designer, and the design plan is not clear, and it is synonymous with hearing of the understanding in 2-dimension drawing the voice such as low though shape model can be made.

It is educated only to operate CAD without educating the design, and, now, a corporate leaving will have the severe one in the future of Japan of the creation technology founding a state.

In the main discourse, the result is confirmed the example of the one thing of our image training method in which a vague strategy to acquire the design power, especially decision-decision of design-shape and the device of shape can be smoothly acquired, and, in addition, the skill improvement as the mechanical

architect is considered.

2. FOR WHAT IS IT THREE-DIMENSIONAL CAD?

The following factors are in the anxiety and the difficulty of feeling it vaguely at the first time.

1) Concrete difficulty concerning CAD operation and modeling.

2) The anxiety how it is necessary to advance the design mixes even if modeling can be done.

Three externals are made from figure in the sketch chart and the model is made drawing afterwards if it thinks only about modeling. There is assumption of having already completed this imagination of the shape of cross section in the head.

Therefore, it becomes only modeling in 3DCAD according to shape. After taking the operation training, everyone is such a conception. However, when the mechanism product in the machine device is designed, it becomes becoming the situation in which anything cannot be done in front of the screen. Deciding what shape to make the section in an actual like this product becomes a start of the design.

The question of modeling from the starting point of the conception will take notes of the content imagined from the head to three-dimensional data. Modeling

only has to do only the part decided while basically the same a complex product, and reading ahead. In a word, even if the modeling of difficult shape cannot be done, the design will be advanced if a basic design approach is mastered.

3. ABOUT THE STARTING OF THE MECHANICAL DESIGN

The engineer should invent very, design the unknown one, and search how it makes it. It is necessary to actually support the design power that makes the thing an embodiment.

The punch picture that expresses the parameter and the mechanism of the design based on the specification at the early stage of the design is made. In addition, it thinks about demanded various customers', it searches for the hint, and it makes it to the punch picture.

Only this process can be said that the starting point of the design, and 60% of the design ended at this stage.

4. DESIGN PROCESS AND CONTENT OF WORK

The product development is mass-produced through the design process shown in Figure 1 in general. The most important stage to design by the decision of the content of the product that will be developed in the future, in a word, the structure, the mechanism, the function, the performance, and the cost is a plan design. The plan design should be the one to set up the route that makes it an embodiment deciding the intention from various original ideas as for what the designer images, and even the abandonment of the product is devised recently, and it design it.

The design has various fields, and has a peculiar way to the field as for the design approach and the flow of the design to advance. Here, it squeezes to the design of the mechanism of a general machine and the main discourse is advanced.

A general machine indicates the equipment machine etc. of an automatic machine that assembles the product or the factory. The process from the order to the installation will be traced as shown in Figure 1 by the time one machine completes.

The designer need not be well informed of this all processes. However, the drawing that the designer drew runs in the trunk in all the processes. The person in charge of each sect believes drawing information as an accurate intelligence and proceeds work based on information in the drawing.

For instance, those who process it faithfully make information drawn in the drawing an embodiment as shape, except when he or she cannot process it.

Therefore, the designer will assume an indirectly or an immediate, some responsibilities in all the processes.

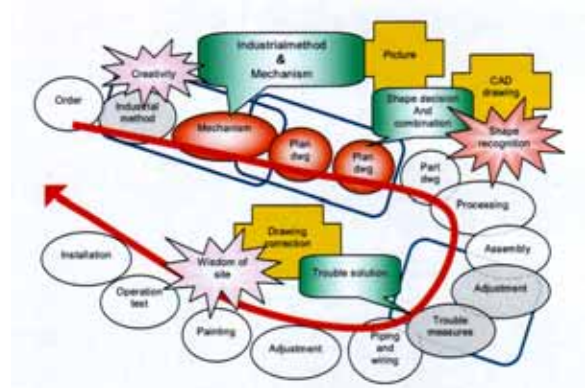


Fig 1 Process design of mechanism

4.1 Content of work

Producing for the specification that the customer presented to receive an order of work to exist, and in time for the delivery date for which this customers' needs are filled and it is specified by the one within the budget and functioning become the purposes of the design.

Next, because the machine does the work of something, the mechanism, the mechanism, and the mechanism to operate the movement are created (Refer to Figure 2). It is a mechanism with the ready-made technology or results, and the hint will be requested from the event of a drastic idea or nature at times.

Power of creativity or the conception is needed at this stage. The punch picture is concretely drawn on paper with the pencil, and the conception is drawn and will be stopped. A novel image might swell by chance when the desire is made to come round in work to draw this picture, and it be adopted.



Fig 2 The industrial method, the mechanism are considered

The punch picture of the lifting and lowering device drawn by an actual conceptual stage is shown here (Refer to Figure 3).

Thinking in the design's of the repetition one that the ready-made technology was taken increasing more than becoming the first, and a necessary technology the new element examination and designing has decreased though efficiency improvement and the cost performance of the design work are pursued recently. Moreover, it became an age when efficiency was prioritized.

Expressing the scene again in the character and the picture by a necessary element can say the best technique for concisely transmitting passive information even by other occupational categories regardless of the work of the design amplifying the possibility of the work branch in advancing work to the image of the idea.

It is training because it doesn't easily cost image training that sketches seeing the one, the sketch, and the imagination especially recommended to the young man design engineer. It doesn't work still sitting up to this stage ahead of CAD.

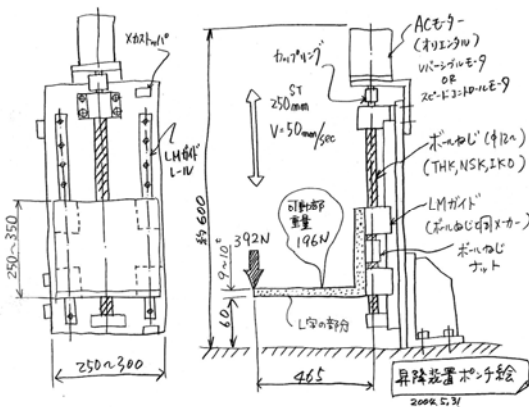


Fig 3 The image is made a picture

4.2 Brief calculation and selection of commercial item

It is decided that the industrial method is a mechanism and selects the commercial item etc. used while doing a brief strength calculation and the dynamometer calculation when it finishes drawing the punch picture. Next, the commercial item into which the size and shape do not change is modeled, other parts also model information on the minimum requirement degree, and shape is decided.

For instance, if it is round thing, it designs in the cross section. And, the plan chart and the plan chart are finished up while considering the processability and assembly.

As for a general machine, the size of the size value of design information, for instance, board thickness or the bolt is decided by a sight sense that is not the one in an initial design phase decided after it is completely made to the theory but rough or the experience. Because there is a limitation at time, and if something is not decided at the stage somewhere, it is not advanced.

Here decides shape while deciding original of designer's responsibility and one numerical value in the area of the balance design on not the theory design but the drawing and will proceed to the next step. Of course, a necessary part will do a strict examination and the calculation by the closing phase.

4.3 Shape cognition

The standard in the drawing was not that the age that had been drafted with the drafting machine changes into what had to be noted here until the one drawing finished depicting it. That is, assembling it with own sight balance doesn't change becomes possible.

However, it is necessary to decide the standard of the display in CAD the expansion reduction's being repeated considering the size numerical value of the one because of the balance. The shape recognition to the actual thing is needed at this stage.

In addition, it advances to production, it doesn't take customer's elevator by the closing phase of the process, and when the problem of no strength possession in the posture when device that cannot be carried in the device as there is a building height restriction in the road to the place of installation is lifted up etc. comes to light, an extra man-hour and cost will be generated. Therefore, it is necessary to recognize that the installation of the final process is designed by thinking at the early stage of the design.

4.4 Production drawing and processing

The production drawing to produce parts when the assembly drawing of the device is completed and it is approved is made. An enough check of drawing is needed because it is processed when it is important to pass on information on parts to the person who processes it not to mention the production drawing concisely and accurately, and finds the mistake by information as it is.

As for this production drawing, the size value, finish, and the allowance and the material will be decided to say nothing of the shape of the thing by mediated existence converted from the virtual image (drawing) into the real image (thing). Moreover, it is needless to say that the size value filled in from shape information in the drawing is given priority and processed.

4.5 Assembly

Not being often assembled occurs when becoming a stage where parts are assembled. The mistake of the production drawing of the mistake of the size or interference stands out in relief. When the mistake is found in the production drawing, obediently reflecting, correcting promptly, and solving the problem become important.

When the thing exist, work that the thing is adding processed or it tries to produce the thing becomes important. In a word, the leading part moves from the drawing to the thing

I think that I can understand if it thinks about serious of work to plane the change of board thickness on CAD by 1mm, and the thing by 1mm. Moreover, assembly is interrupted because it should be, a lot of work stops, and it will trouble you again toward from the outside to the center if it is an elaborate setup and the mistake is found in parts near contents (center) including the resolution.

In addition, confirming the delivery date of the commercial item at the plan stage of the design becomes important.

When the assembling work is generally completed, the operation test on each doing probe is executed, and the wiring plumbing will be examined in the entire function though it depends on the size of the device. Whether it meets the given specification here will be confirmed. Whether necessary movement is done by necessary power whether to have a necessary stroke are confirmed.

The machine doesn't often work smoothly if it doesn't do the assembly adjustment even if parts are produced accurately. In this adjustment work, a labor thoroughly to the design work or any more is needed. Skilled adjustment work is needed.

5. RESULT AND CONSIDERATION OF IMAGE TRAINING METHAD

It is also important that the design is only an analysis and is not making the drawing but also considers relativity with the other business segment in the work step, guesses the event that can be expected again, and include them at the stage of the design.

Therefore, the necessity of the education of strengthening the image power over the design process whole overall has risen. Moreover, there were a lot of consultations of not good drawing the drawing by the consultation and the hand that was not able to read the drawing from the trainee.

Figure 4 shows the example of the lesson executed in 2006 fiscal year. The first A4 edition is given as a

problem before original training and training is executed every morning.

The machine drawing is recalled and question 1 of this seat is drawn in the cubic diagram. This is training to white paper that has been always interested in the thing before to advance the design while imagining the already-known shape that has been seen, observes, and takes the shape into oneself when designing from one. When the appearance to sketch certain parts near oneself is seen, it is relieved. Question 2 makes the cubic diagram the drawing of two dimensions. Question 3 is the one that the cubic diagram is drawn based on the drawing of two dimensions. There is a purpose to improve the ability to draw drafting by the hand chiefly. Question 4 is the one that the production drawing of one part is drawn from the assembly drawing of two dimensions. It seems to be difficult for the trainee with a little experience of the design of this question 4.

The structure cannot be read from the assembly drawing, and there are a lot of trainees who submit the problem by a probabilistic answer, too. It is a caution needed.

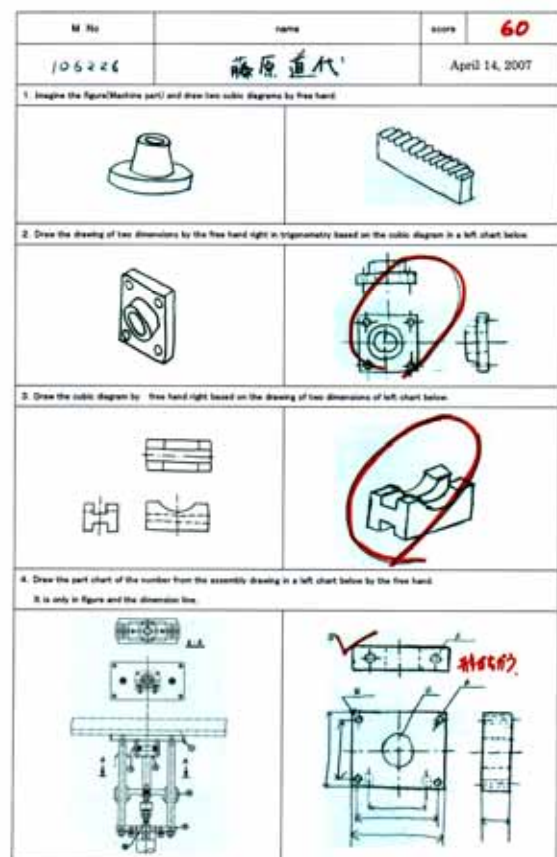


Fig 4 lesson by hand drawing

Figure 5 shows the effect of this lesson. This is a comparison of 2006 fiscal year 2005 fiscal year when the lesson was introduced and after it introduces it.

The content is the one that the expansion of the self-return point of the machine-made chart skill item was compared. The expansion of the point is a difference between the self-evaluation point when joining a company and the self-evaluation point after it trains.

There is the seat where engineer's named the skill map skill is evaluated by our company. There is a grade in the seat, and is a class of five ranks from E1 to experience E5 of 20 years when joining a company. And, the master item of about 12 items is set to each grade. The item that measures the expansion of this skill is the one that the expansion of the point was calculated about three items concerning the engineering drawing of 12 items of the E1 grade.

It is thought that trainee's master actually feeling level appears in the graph though no subjectivity strong, absolute measurement result because it is a self-return.

It imagines while still confirming it by eyes, and the training work to draw figure by the hand that firmly remains in the body appears.

In addition, the plan idea shown in Figure 6 as long as time permits is done and the lesson that shows the idea is done. This lesson considers the theme that doesn't give the problem but designs, creates the multiple plans, and draws the punch picture. And, each idea is self-graded and it develops with the assembly drawing and the part chart. Moreover, it has aimed at the development of a free and compound eye conception power without falling into a limited answer because the plan idea of about three ideas is created.

6.CONCLUSION

Three-dimensional CAD demonstrates the function full in a configuration design the flowing curved surface. In the design of a general machine, designer's conception and idea are important for the function of CAD to be made the best use of for the first time.

Young man designer's reading comprehension in the drawing is especially insufficient also of our company. Then, the training of the drawing by shortening all processes of technological training by about 5%, and drawing by the hand was introduced. This training is a lesson that the trainee of recognizing shape in the head and doing solid modeling feels not good. The young man designer is working through this training to understand indistinct part to draft the design, "Picture", and "Drawing". Moreover, the design decides shape by the compromise of the condition conflicting. It is likely to decide it vaguely in a word by the balance design by the sight sense.

It is necessary to develop relativity and a compound eye thinking ability before and after the design flow now advance by the subdivision of the design work. We will develop a variety of image training teaching materials to support those abilities in the future.

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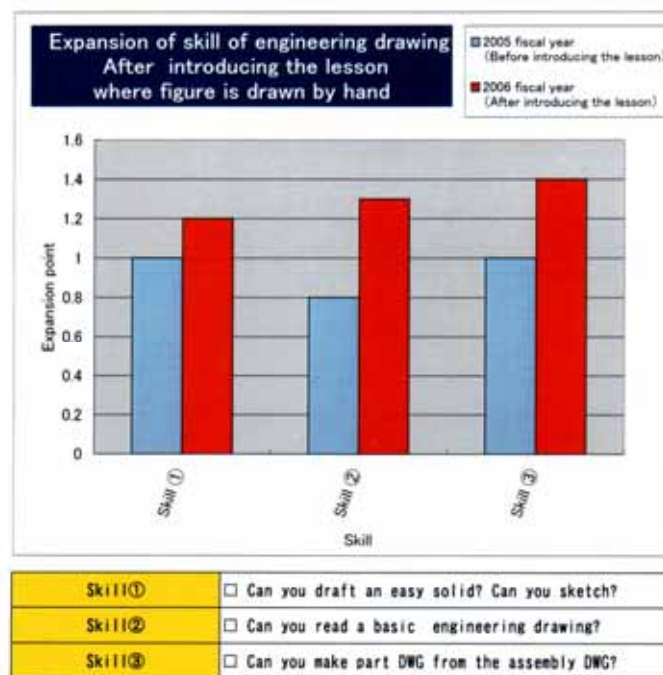


Fig 5 Expansion of skill of engineering drawing


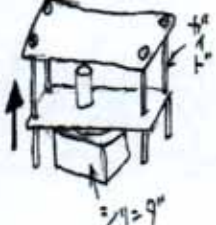
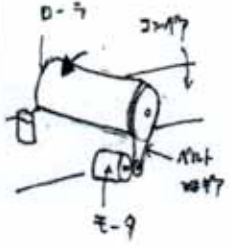
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① The demand function is satisfied.	A	◎	9	◎	9	◎	9
② The structure is easy.	A	◎	9	○	6	△	3
③ The performance is good.	A	○	6	○	6	◎	9
④ The adjustment is easy.	B	◎	6	○	4	○	4
⑤ The adjustment is easy.	B	◎	6	○	4	○	4
⑥ The adjustment is easy.	C	○	2	○	2	○	2
⑦ Maintenance is good.	B	◎	6	○	4	△	2
⑧ Externals are good.	C	○	2	○	2	△	1
⑨ The price is low.	A	◎	9	○	6	△	3
Merit		構造が簡単 価不各が安い		シリンダ数を増やせ 製品の性能を上げる		連続的に大量の 缶をつぶす事が可能	
Weak point		大量につぶす不向き 固い缶をつぶす不向き		缶の設置や取出し 機構が必要		装置が大きくなる	
Integrated evaluation point	60 ^A	55 point 91.7 %		43 point 71.7 %		37 point 61.7 %	
Importance A=3p B=2p C=1p		Evaluation point ◎=3point ○=2point △=1point					

Fig 6 Example of lesson of plan idea creation