

## Analysis of Structure Type of Stacking Chair<sup>1</sup>

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### ABSTRACT

As life style changes, the demand for stacking chairs are increasing as the use of event halls or outside furniture where people gather in crowd is increasing. Early stacking chairs were mainly made to pile up a great amount and store, but in modern days it also has a decorative purpose.

Besides, the development of various new materials and applied technology of furniture manufacture, the structure and design of stacking chair is becoming more interesting. Basically, according to the structure of the leg, the form and method of piling up is decided. The structure of the leg means the location of the leg connected to the seat, and according to the location, it can be piled up as upper, front, or rotational type. Such is the way how stacking chairs are classified according to the location of the leg, with its basis; the structure of stacking chair is reviewed.

Now, chair for piling up is overcoming its simple function, which aesthetic beauty or arrangement of color after piling up is being considered. Also, according to storing, moving, and the place of use, various designs are demanded. As people's interest in stacking chair is increasing, various research regarding design should continue.

**Key words:** Chair, Pile up, Leg, Structure, Location of leg, Variety.

### INTRODUCTION

#### *Purpose of the Research*

In proportion to the speed and variety of rapid social development, modern people live with much conflict and stress. Such psychological conflict and burden are relieved through the enjoyment of cultural art. Modern art is developed into various genres, and the audience, through each one's taste or through the experience of new culture, feels relief.

In this context, one looks for art halls and music concerts as a relief which one can enjoy rest, and using active leisure time, one listens to various lectures for self development. Various things are provided in concert halls and lecture halls for the convenience of audience, and one of the necessary things is the chair. Also, as the necessity of outside furniture increases due to the increase of open cafes, pensions, and so on, the demand for outside chairs are increasing.

Like this, stacking chair was made for the convenience of outside furniture or crowd gathering place. The greatest merit of stacking chair is that it can have much amount piled up and stored in a small space. Of course, in the aspect of space saving, there is the folding chair other than the stacking chair, but these two are strictly different in structure. Folding chair is a folding type chair and should have a hinge. Therefore, its manufacturing procedure is fastidious and its durability

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cannot help being weak. And, the stacking chair offers more splendid design than the folding chair. Therefore, the users tend to prefer the stacking chair to the folding chair.

The research focuses on the stacking chair, reviewing what kind of structure the stacking chair has on the basis of the condition of piling up.

#### *Range of Research and Method*

Stacking chair has its basic types, the arm chair which has a typical style back rest or with a arm rest, and other various designs made on the basis of a stool, and so on. Its material is also various. Especially, the stacking chair made by molding method can be found easily around us. However, such plastic chair is thin and can be folded easily like a cup, which has no other meaning in reviewing the structure.

Therefore, the stacking chair to be reviewed in this research is limited to the chair with a frame of wood or metal. Also, since the research is about form and structure, its link to the age will not be in consideration. The data for review are generally the previous documentation and the furniture currently on sales.

## GENERAL REVIEW OF STACKING CHAIR

### *Concept*

The chairs for convenient moving and storage in much amount are stacking chair and fold chair. The chairs are mainly used in event halls where people gather in crowds regardless of in and outside.

Therefore, it is not always installed, and it is used only when necessary and after using, it is removed. At this time, the basic purpose for the moving type chair is designing it to have much amount stored efficiently.

Before the explanation of the concept of stacking chair, brief explanation of the folding chair will be held. First, folding chair (Fig. 1 Reference) mainly uses hardware such as the hinge, and so on, and it can have the least area because it can be folded with the seat and leg being attached to each other. However, the more one uses the chair by moving or sitting the chair, impact becomes frequent and therefore the hardware becomes weak, and it can be broken easily. Therefore, it cannot help being weak in durability compared to the stacking chair (Fig. 2 Reference) which has its leg, seat, and back as one. Compared to this, the stacking chair is made with the leg, seat, and back fixed, so its durability is stronger than the folding chair, which means, it can be used for a long time.

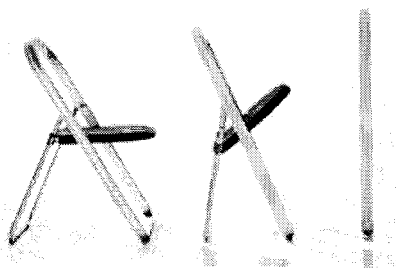


Fig.1. Ori. Toshiyuki Kita.

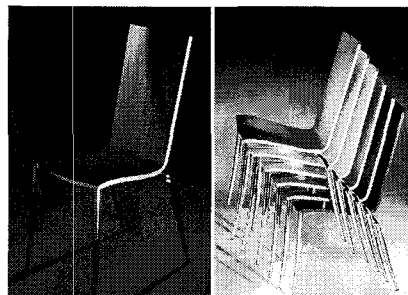


Fig.2. Olly Tongo. Philippe Stark. 1994.

The dictionary meaning of 'stack' is piling something up, heap and etc. So, stacking chair means a chair which can be piled up and stored. Therefore, in the aspect of storing, folding chair is

stored horizontally to the wall, but stacking chair is stored vertically. Therefore, it can save more space in the floor than the folding chair.

### *Structure Principle*

Generally, a chair is structured by seat, back, and the leg which supports them. The leg is separated from front to back and starts from the bottom part of the seat except for special forms, and the back leg forms one figure from the back to the floor. Also, the seat is structured as the upholstery, board, and aggregate.

Compared to general chairs, the important point of a stacking chair is that the location and angle of the leg should not depend on the seat and become folded.

The most common form is the design which enables folding because the inclination becomes broader as the leg goes down. This is the same as a cup having broader bottom than the upper part so that it can be piled up and stored. That is, viewed from the front, the front leg's width has the same width or becomes wider as it goes down, having a protruding structure to the front part. In the case of the back leg, it changes according to the form of the seat, but generally, it is protruded to the back part and also to the side and front, just like the front leg. Like this, the leg or the back should have proper angle to be piled up as well as to have no waste of space.

## CLASSIFICATION OF TYPE

When designing a stacking chair, the leg should be structured to be easily moved and stored. When not in use, its structure should enable less space use and its design and material should enable less burden of weight when moving. In addition, considering the case of installing outside, water proof and durability should be considered.

As the demand for stacking chair increases, new ideas and combination of various materials enable unique designs overcoming various limits. In the research, various designs and structures of stacking chairs are focused to be reviewed in the following classifications.

### *TYPE-A*

The width of front and back of the seat is almost regular, and the front leg is located in the inside of the seat frame, and the back leg in the outside. The front leg cannot have much change because of its limit of starting from within the seat. However, the back leg out from the seat frame can have changes in form such as inclining to the back, curving, and so on. Also, because the back leg is protruded to the outside from the seat, the chair can be piled up as the seat becomes inserted in between the back leg. It is one of the many structures.

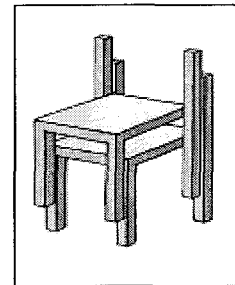


Fig.3. Structure of leg TYPE-A.

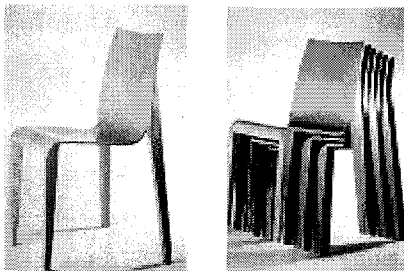


Fig.4. Pauline. Thierry Poubeau.

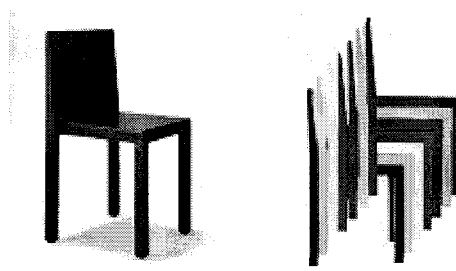


Fig.5. R606 Uno stacking chair. Bartoli Design.,

Fig. 4 shows that the seat and the back is structured as one Molded Plywood, which the back leg seems to be cut and leaned to the back. Therefore, the back leg connected to the back is naturally located to the outside of the seat. The protruding back leg can be called the basic TYPE-A. The leg has intensified structure by attaching thin Plywood to the leg.

Fig. 5 has flexible seat and back by making the back, seat, and the leg with metal, and finished held by Polymer. The thickness of the leg and seat is the same, and the back is closed. The back seems to have one form with the back leg. The back leg has the same thickness as the seat and the front leg, but the back part is headed to the upper part, having reduced thickness, enabling the chair to be held comfortably with remaining space as well as having fewer burdens visually.

Fig. 6 and 7 shows a chair with complete basic element and structure. Fig. 6 is far from the fixed form with its curving factor added in the back leg, and especially, its angle is not over exaggerated, which enable less waste of space efficiently. The seat and the back are finished by softwood, with comfort added by inserting a cushion like material in between the bottom part and the wood with patterns.<sup>3</sup> Fig. 7 is made for the purpose of piling up by selecting thin material.

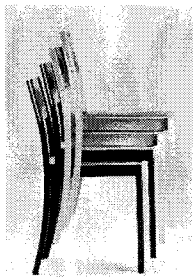


Fig.6. Less. Marco Ferreri, 1993.



Fig.7. Spring, 2007, Damian Williamson.

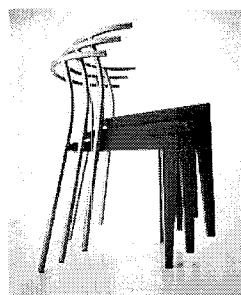


Fig.8. Dr Glob chair, Philippe Starck, 1988.

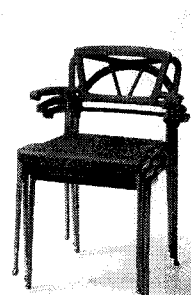


Fig.9 Sora • Toki • Yume, Toshivuki.

The selection of light material is one of the necessary elements of stacking chair. Therefore, steel pipe is also a preferred material. Fig. 8 shows metal finishing paint in the back leg and back, and wood finishing paint in the seat and the front leg, which is a design showing brief combination of the two materials.

Fig. 9 is an arm chair with arms seeming to be floating in the air. The arm starts from the part where each different back ornament ends, and though the back has different three shapes, half circle, sector, and so on, but because the rest of the basic structure is the same, it can be the same chair. Also, the seats itself make an angle to the back and makes a narrow width. Regarding the seat design, it is special to reduce the area visually. Such attempt to change the design found its way to settle the structural aspect as well as stimulating the interest of form.

#### TYPE-B

Both front and back legs have a structure protruding out from the seat. Compared to the leg starting from the bottom part of the structure which supports the seat or upholstery, its exposure to the outside seat visualizes the starting part of the leg. Compared to other structures, it shows much

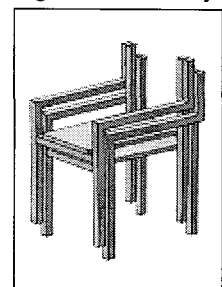


Fig.10. Structure of leg TYPE-B.

<sup>3</sup> Mel Byars, 50 Chair-prodesign Series. Roto Vision SA. p.26

frames, so the connection should be taken care of, and it is possible to have a design having an upholstery on. This structure is used much in arm chairs.

The upholstery of Fig. 11 had its back width reduced by visually curving the front part. And, it is a design with the frame exposed as if the upholstery is slightly on the seat frame. And, the leg starts from the edge of the exposed frame. The reduced upholstery enables convenient back leg piling up. The arm chair also has the same structure as the chair with no arms, and with its arms attached from the back line, smoothness is emphasized.

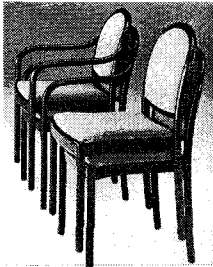


Fig.11. Parco, Hartmut Elberfeld.

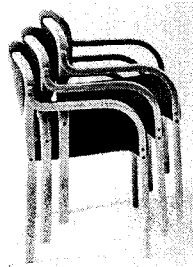


Fig.12 Laminova, Sven Lvar Dysthe.



Fig.13. Skandia Stacking, Rud Thygesen & Johnny Sorensen.

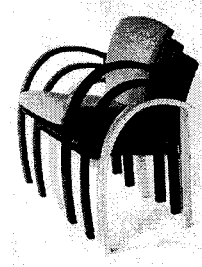


Fig.14. Marvin's Chair, Peter Danko.

Structure with arms starting from the back is the same for the following Fig. 12, 13 and 14. Because the arms start from the outside of the back frame, they become wider in left and right than the back leg connected naturally from the back and the seat. At this time, the back leg penetrates the space between the arm and the seat.

Such structure is shown in Fig. 12 by the conspicuous use of hardware. The whole structure of Fig. 12 is a design which the leg is vertically headed down, but with Molded Plywood method, the connection of arms and the back leg are made more smoothly with natural curve. Such Molded Plywood method is also used in Fig. 13, and the start of the arms, which is the same as the start of the frame, makes it simpler. However, due to the limit of the space which enables penetration between the arms and the seat, it has a deficiency of piling up limit of 6 or more.<sup>4</sup>

Fig. 14 The material of the whole frame structure such as the leg and arms of the chair is beech Bent wood. Its bold curving enriches the volume, and when piled up, it is rather visually burdening. However, the burden of piling up and releasing is reduced because the thickness of the back leg is narrower than the thickness of the front leg.

Figs. 15 and 16 are different circular seats from the square ones previously. Both chairs have back seats and the four legs are located outside the seat frame. In the case of circular seat, because there is no space for the back leg, it does not pile up like the square seat. Therefore, it can be piled up by circling each in the direction according to the thickness of the leg, enabling added fun regarding the arrangement of the legs and rotating back when piled up.



Fig.15. Stacking chair, Curtis Erpelding.

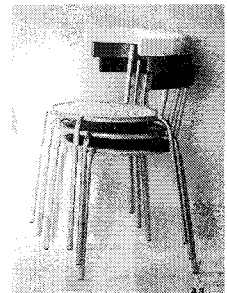


Fig.16. Korpo, Lars Norinder.

<sup>4</sup> Vicki Brooks, 1986. Portable Furniture. The Main Street Press, NJ, USA. P.26

*TYPE-C*

The interval of the two back legs is more or less narrower than that of the front legs, and the boundary of the back and the seat has space, enabling pile ups by making the legs penetrate the space. General stacking chairs have legs piled up to the outside of the seat, and in this respect, TYPE-C went through an in depth research regarding the structure to make a change in the monotonous piling method.

In Fig. 18, the seat and the back are made of veneered plywood, having a body structure, and the space in the part where the back is linked from the seat enables the leg to go in to pile up. With the boundary of vertical center of the seat and the back, the remaining space left and right confirms the interval of the back leg. Such part is structured for piling up as well as visual delight.

Fig. 19 also has a structure of seat, back and arms as one body, but the empty space in each side of the seat enables the leg to come in when piling up. The empty space is maximized to be put in the edge of the seat to widen the back leg, and with this, the back leg itself comes down inclining, having secure feeling. Fig. 20 also has a structure of having space between the seat and the back, letting the leg in when piling up, but due to its limit of thickness, only 4 can be piled, which is its deficiency.<sup>5</sup> Such problem does not only occur in Fig. 20, but fewer amounts which can be piled up is the limit of the structure of TYPE-C.

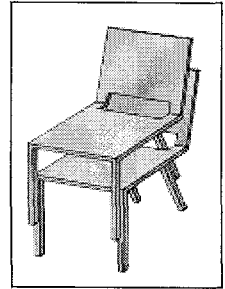


Fig.17. Structure of leg TYPE-C.



Fig.18. Jason chairs, Carl Jacobs, 1950.

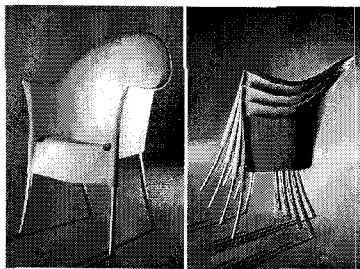


Fig.19. Lord Yo, Philippe Stark, 1992.

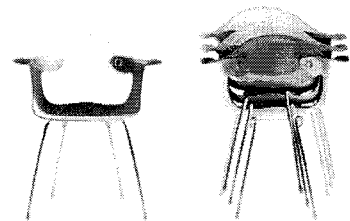


Fig.20. Bluebelle, Driade.

*TYPE-D*

The connection of the front-back legs naturally makes the seat frame, and this frame is exposed to the left and right, which is its structure. Normally, most of the chairs are made of steel pipe or aluminum molding. Such structure is simple in the thickness of legs as well as in the form, which the most appropriate for piling up. The chairs previously reviewed cannot help protruding to the front according to the thickness of the back legs or the back as it is piled up. However, TYPE-D can be piled up vertically one by one, which means it can save surface space.

Fig. 22 does not specially require piling up structure because the legs are not from the seat. Fig. 23 has steel pipe continuously bending from the seat to

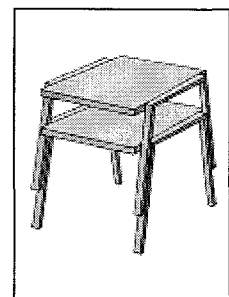


Fig.21. Structure of leg TYPE-D.

<sup>5</sup> www.driade.com

the leg, and leg to the foot, and foot to the leg and the back, which seems like a Moebius loop. The legs become broader as it goes down from the seat, and with the steel pipe curving with delicate angle coordination, it shows the aesthetics of piling up as it is arranged.

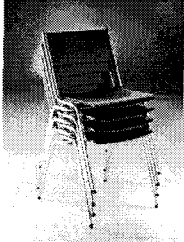


Fig.22 Altek, 2005.

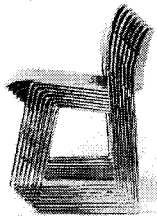


Fig.23. David Rowland, 1963.

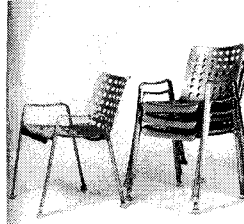


Fig.24. Landi, Hans Corav, 1938.

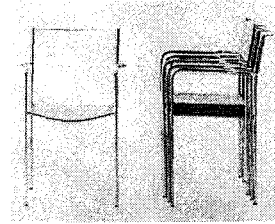


Fig.25. Spagetti stacking chair, Giandomenico.

Figs. 24 and 25 show a structure having the same one as the previous two, but the leg steel pipe is more expanded to the upper part connected to the arm.

Fig. 25 is a very simply structured arm chair, using a light polyvinyl stringing in the thin steel pipe, seat, and back, having less volume and light feeling even much is piled up. The upper part of the back and the arm in the back part are curved to give unified sense in decoration and the curve in the arm offer space for the leg to come in.

#### TYPE-E

TYPE-E is a cantilever type stacking chair, and just like most of the general cantilever chairs are, it uses steel pipe or nonferrous metal for the leg. Especially, Fig. 26 has the back leg omitted, and different from general cantilever chairs which have a structure of having the back leg connected to the floor. Such structure, compared to general stacking chairs which becomes a burden when piling up because the legs protrude to the front, it has an effect of lessening the volume visually as well as providing convenient work space even when moving.

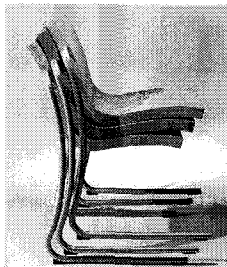


Fig.26. Magic, Ross Lovegrove, 1998.



Fig.27. Bolero, Garpa.

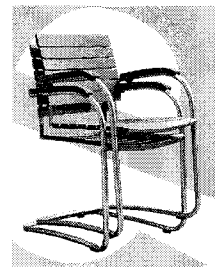


Fig.28. Pinch, Mark Holms.

Fig. 27 has a structure of each side of steel pipe's width getting narrower after the leg becomes curved down to the floor. It is piled up from the front rather than from up.

Fig. 28 has a frame structure having connection from the back to the seat. The width of each side of the frames of back, back leg, and floor is the same, and the width of the front legs and the seat is the same, and the width of the front leg and the seat has removed of its thickness of the legs from the previous width, which enables piling up.

*Miscellaneous*

Fig. 28 has a frame of thick rattan with 'Pitrit'<sup>6</sup> rattan weaved. With thick rattan it is made to have maximum security having the greatest angle for curving. Also, there is a space in the back for easy holding. It is structured as one body and the part from where the seat is connected to the leg, and to the floor, it can have its whole area broadened for piling up. It used traditional south eastern rattan method as well as modern sense in structure and design.



Fig.28. JalanJalan, Mark Gutjahr, 2003.

Fig. 29 shows Molded Plywood material as a whole, and the seat and the leg are unified, with the back part separately manufactured and connected. Its Molded Plywood processing made it thin like a plastic product, but though it is wooden material, it is hard and can be piled in a large amount like a plastic molding chair.

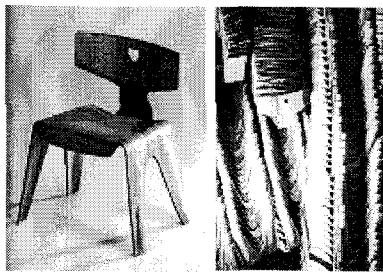


Fig.29. Children's Chai. Charles and ray Eames, 1945.

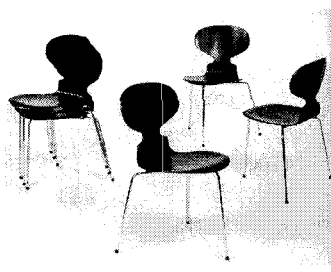


Fig.30. Ant-Model no. 3100, Arne Jacobsen, 1952.

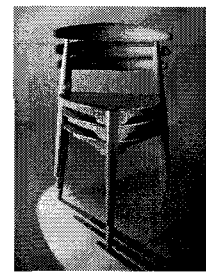


Fig.31. Stacking Chair, Hans Wegner, 1952.

Generally, in the case the legs of a chair is three, if there are two legs in the back part, it is secure in weight shifting. Compared to this, if there are two legs in the front part, it is hard to maintain balance. In such context, Figs. 30 and 31 consider physical aspects and thoroughly kept the basic structure of a chair. Fig. 30 has a three steel pipe leg structure. When seen from the floor, the steel pipe legs are located in the three equally dividing points of a circle, and in the center of the bottom part of the seat. In addition, there is a little stretch as the legs go down. All the legs have the same angle of stretch, so each leg can be piled up in front of one another. This is the same as TYPE-A. Fig. 31 used wooden material and kept the basic structure thoroughly, having the three legs stretch in the same angle, so it can be piled up in the same interval.

<sup>6</sup> Pitrit : A kind of rattan fiber that the diameter is under 3mm



## CONCLUSION

The area of activity expanding according to the change of modern life made various products necessary. Stacking chairs are in the same context, which became high in use. Not only for simple event hall or outside furniture use, it is being increasingly kept in general households for preparation. This is why furniture with new forms after being piled up as well as when used individually, and not for storing purpose, is being researched.

Stacking chair in the early times were made of molding boards or molding plastics as the main material, but as time passed by, the development of new material and furniture manufacturing technology enabled various attempts in structure and design. Combining metal material and rubber material, or the development of innovative resin broadened the possibility.

Along with this, introduction of various colors due to the development of resin and paint and varnish, change of color when combined became a factor for stimulating interest. Actually, among the products currently in sales, just changing the material with new ones or various coloring enable new production.

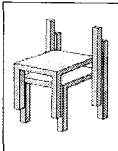
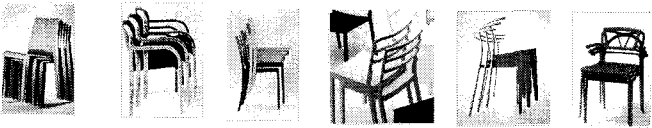
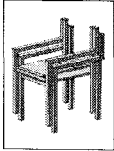

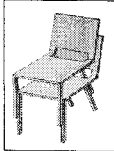




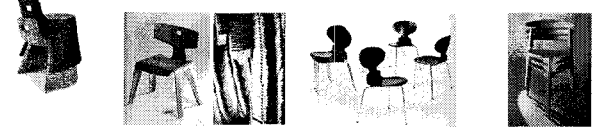
Looking at various colors in front of a cafe, chairs amusingly piled up, and so on, it can be seen that stacking chairs are not only for piling up, but also decorative use. Such as this, today stacking chairs are demanded as decorative purpose overcoming its functional use.

To meet such requirements, creative designing and development from the simple functional step is necessary.

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- [www.stark.com](http://www.stark.com)
- [www.driade.com](http://www.driade.com)

Table 1: Summary of different types of chairs

TYPE	Structure of leg	DATA
A		
B		
C		
D		
E		
Miscellaneous		

### Picture Data

- Fig.1. Ori, Toshiyuki Kita - 1000 New Designs, 78p.  
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