AMBIGUOUS CYLINDERS

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I found a class of cylindrical surfaces that appear to be quite different when they are seen from two special viewpoints. An example is shown in Fig. 1. This is a scene of a garage with a mirror behind. The roof and its mirror image give quite different appearances. The true shape of the roof is different from either of the two appearances.
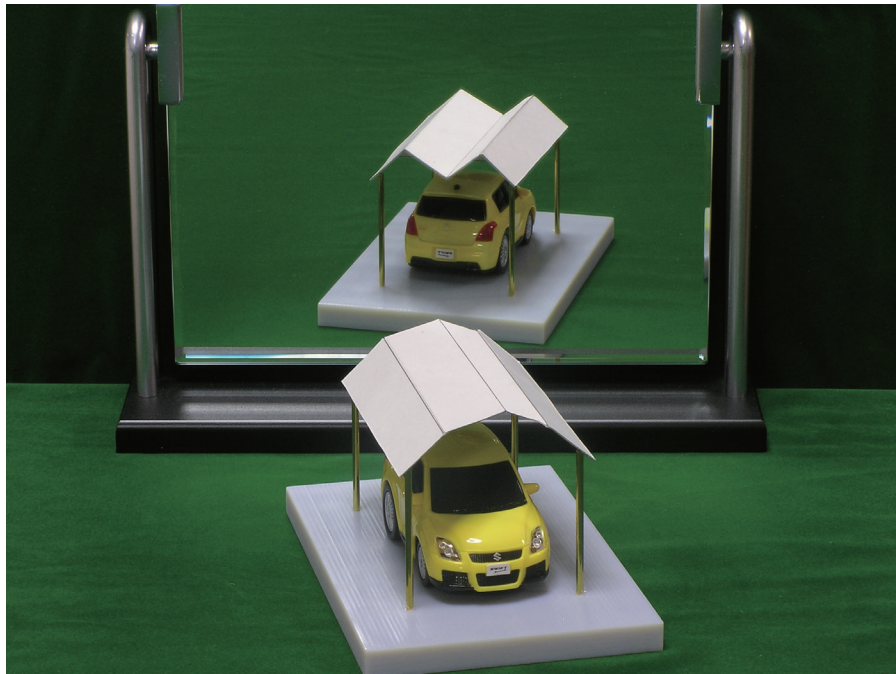

Fig. 1. Ambiguous garage roof.

By a "cylindrical surface" I mean a surface swept by a line segment with a fixed length and a fixed orientation that moves in space. The cylindrical surface will be an ordinary "closed" cylinder if the line segment comes back to the start position again at the end of the sweeping. The garage roof is not "closed", but we also call it a "cylindrical surface," or just a "cylinder" for short.

Although we know in our logical part of our brains that we are looking at the same object directly and through the mirror, our brains usually do not correct this kind of contradictory perception. This is a typical character of optical illusion.
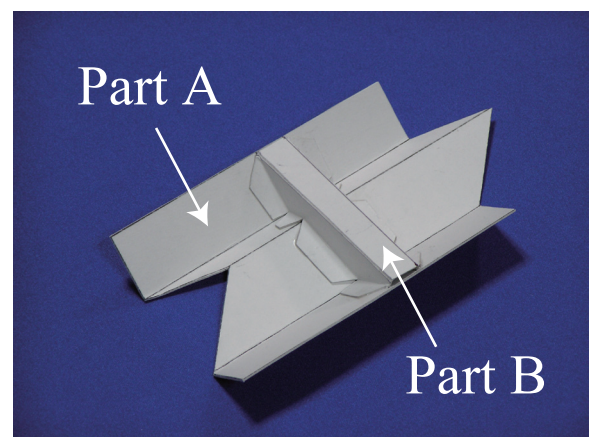
I conjecture that our brains interpret the image as the cylinder whose section is generated by a perpendicular cut, that is, the section is the intersection of the cylinder and a plane perpendicular to the axis of the cylinder. The actual edge of the cylinder is a space curve which is not embedded in a single plane.

How to Make an Ambiguous Roof

1. Copy the diagrams on a sheet of cardboard.
2. Cut parts A and B apart, and fold along the lines; solid lines imply mountain fold and broken lines imply valley fold.
3. Draw all the fold lines of part A on the other side of the paper by solid lines (which make the illusion stronger because what we see is the rear side).
4. Glue B to A to make the structure rigid; areas with the same characters should be glued together.
5. Place the roof horizontally, and see it in the direction forming 20 degrees both horizontally and vertically from the cylinder axis.

Part A
(roof)

a b c d

e f g h
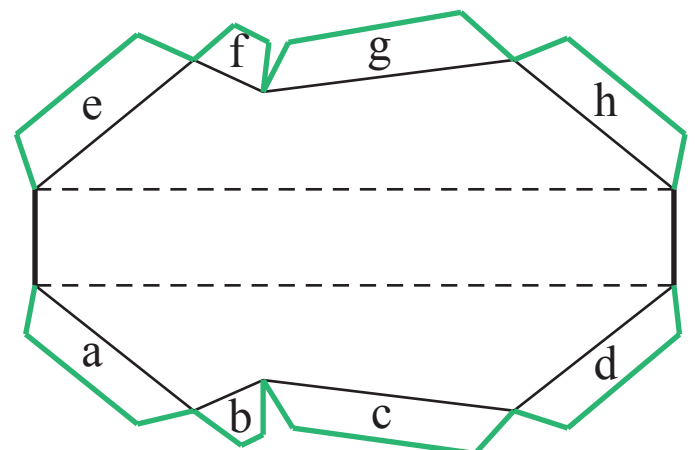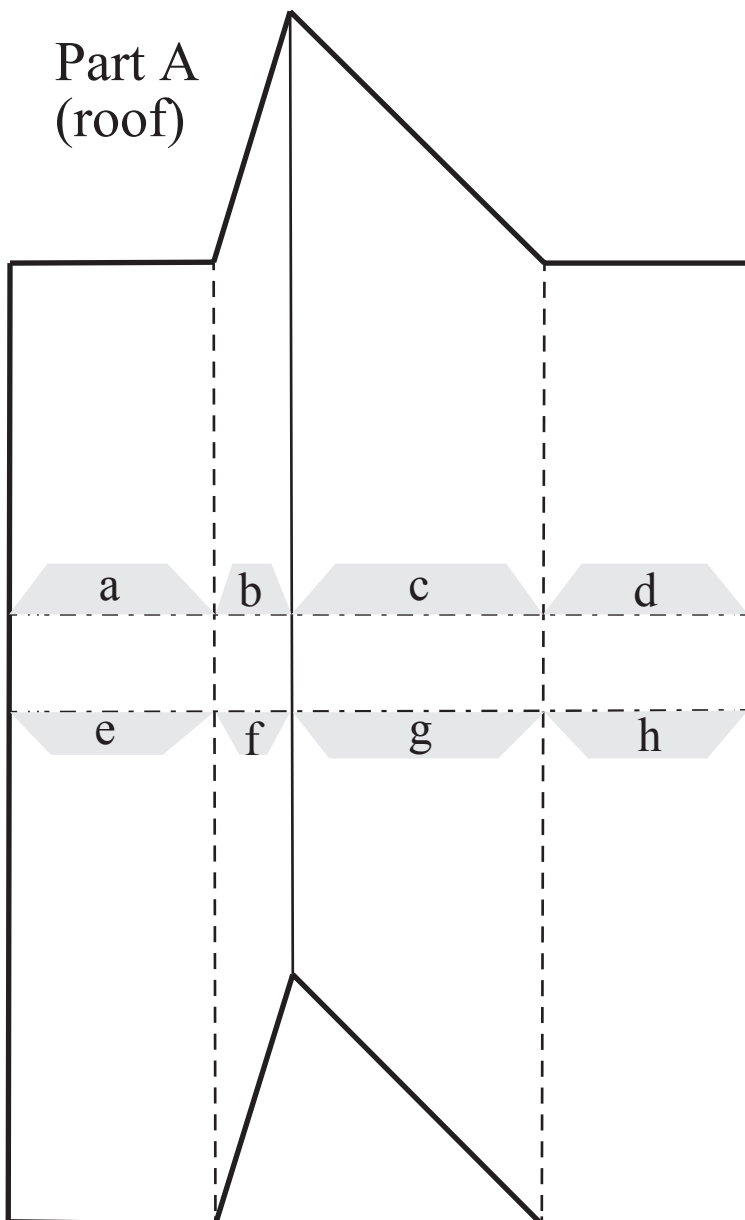
Part B (invisible support)

f g

e h

a d

b c

Part A

Part B

Rear side of the structure