

Tatami Maker: A Combinatorially Rich Mechanical Game Board

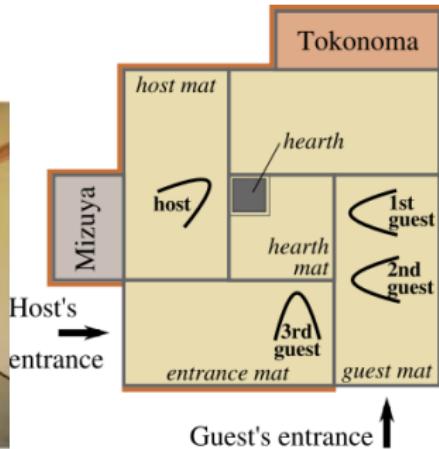
Alejandro Erickson

University of Victoria
Bridges 2013, Enschede, the Netherlands

July 27-31, 2013

Japanese Tatami mats

Traditional Japanese floor mats made of soft woven straw.



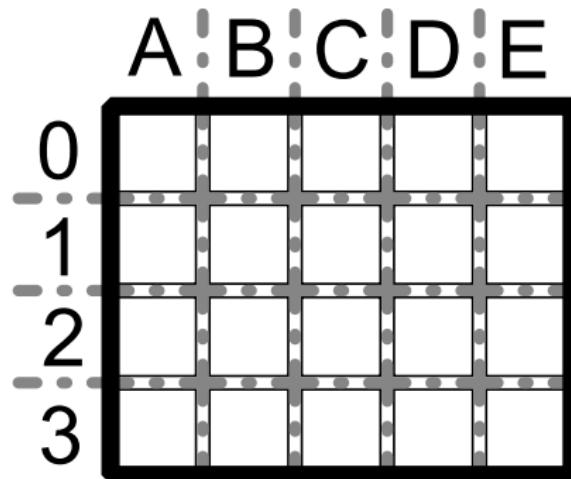
A 17th Century layout rule:
No four mats may meet.

Let's play a game

Tatami restriction

No four tiles meet (e.g. at grid intersections).

Tatami-cover the 4×5 grid with dominoes,  and , and monominoes, . Add or remove a tile.



Mathematical history

No four dominoes (mats) may meet

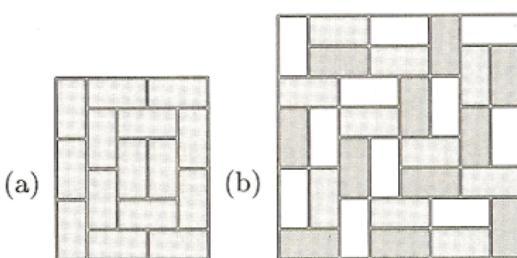
Tatami coverings of rectangles were considered by Mitsuyoshi Yoshida, and Don Knuth (about 370 years later).

215. [21] Japanese tatami mats are 1×2 rectangles that are traditionally used to cover rectangular floors in such a way that no four mats meet at any corner. For example, Fig. 29(a) shows a 6×5 pattern from the 1641 edition of Mitsuyoshi Yoshida's *Jinkōki*, a book first published in 1627.

Find all domino coverings of a chessboard that are also tatami tilings.

Fig. 29. Two nice examples:

- (a) A 17th-century tatami tiling;
- (b) a tricolored domino covering.



Tatami research

- ▶ Ruskey, Woodcock, 2009, *Counting fixed-height tatami tilings.*

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- ▶ E, Ruskey, 2013, *Enumerating maximal tatami mat coverings of square grids with v vertical dominoes*.

Tatami research

Hold your questions, there are no known applications.

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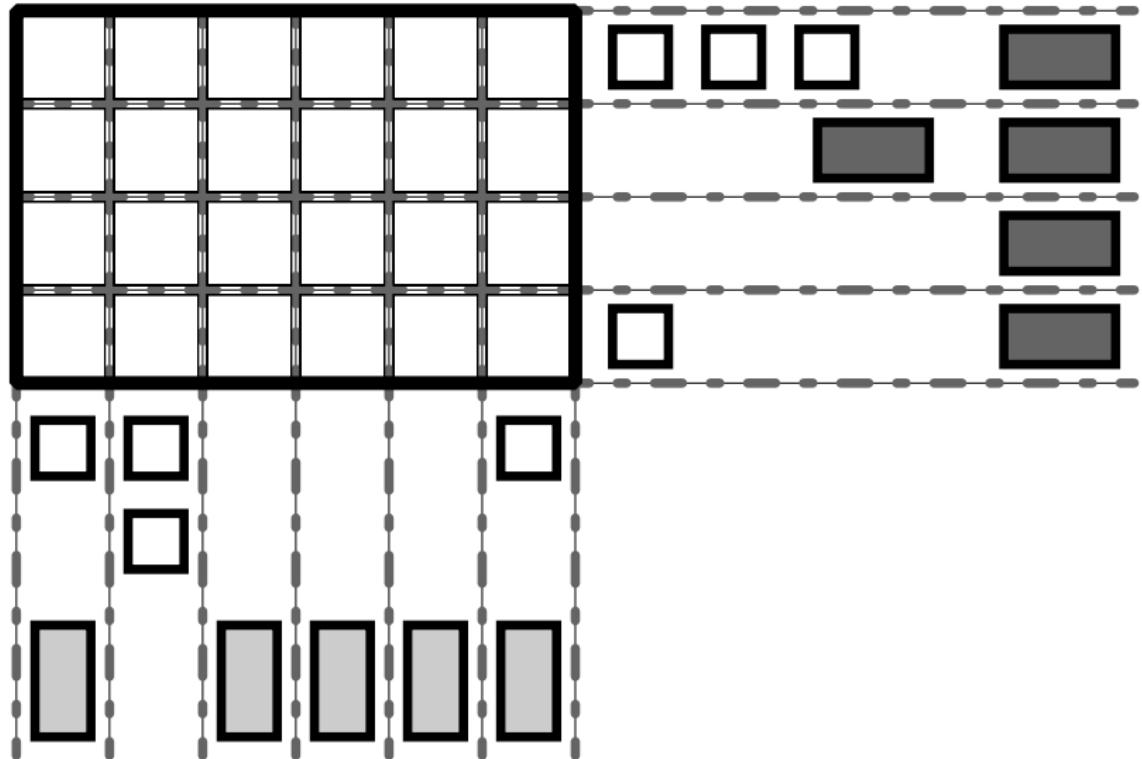
Tatami coverings are **only known to be** applicable to
games and art

Tatami research

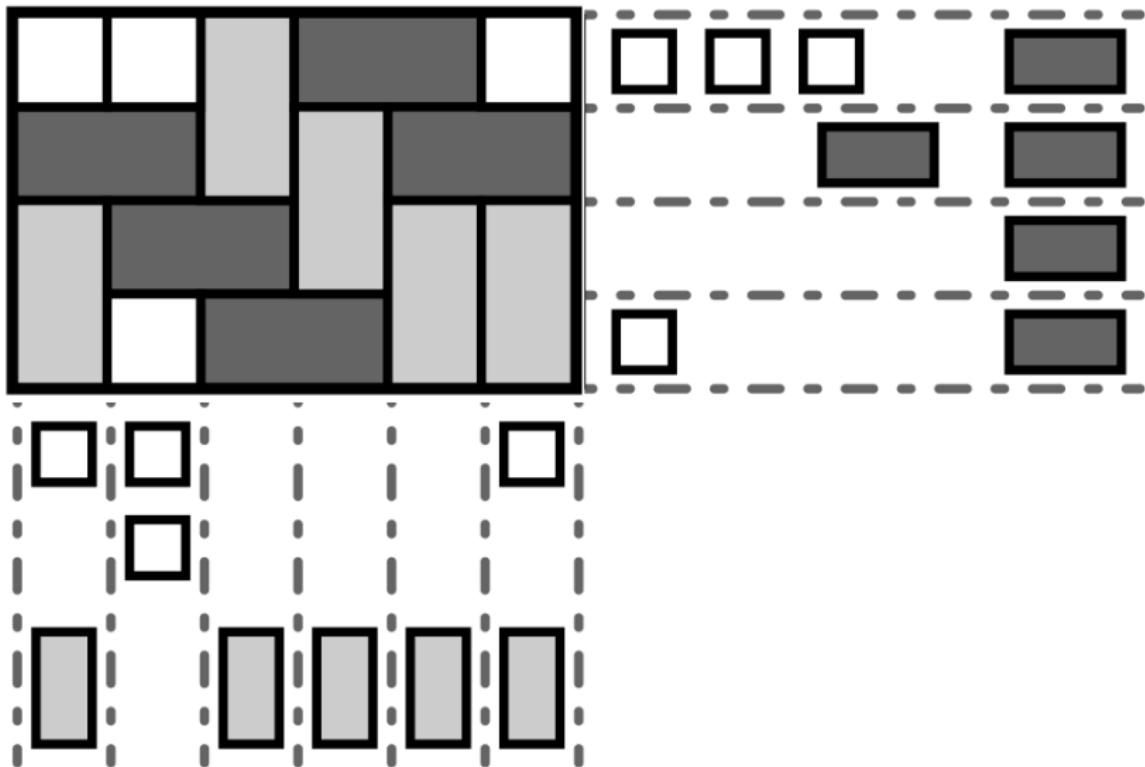
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Tatami coverings are
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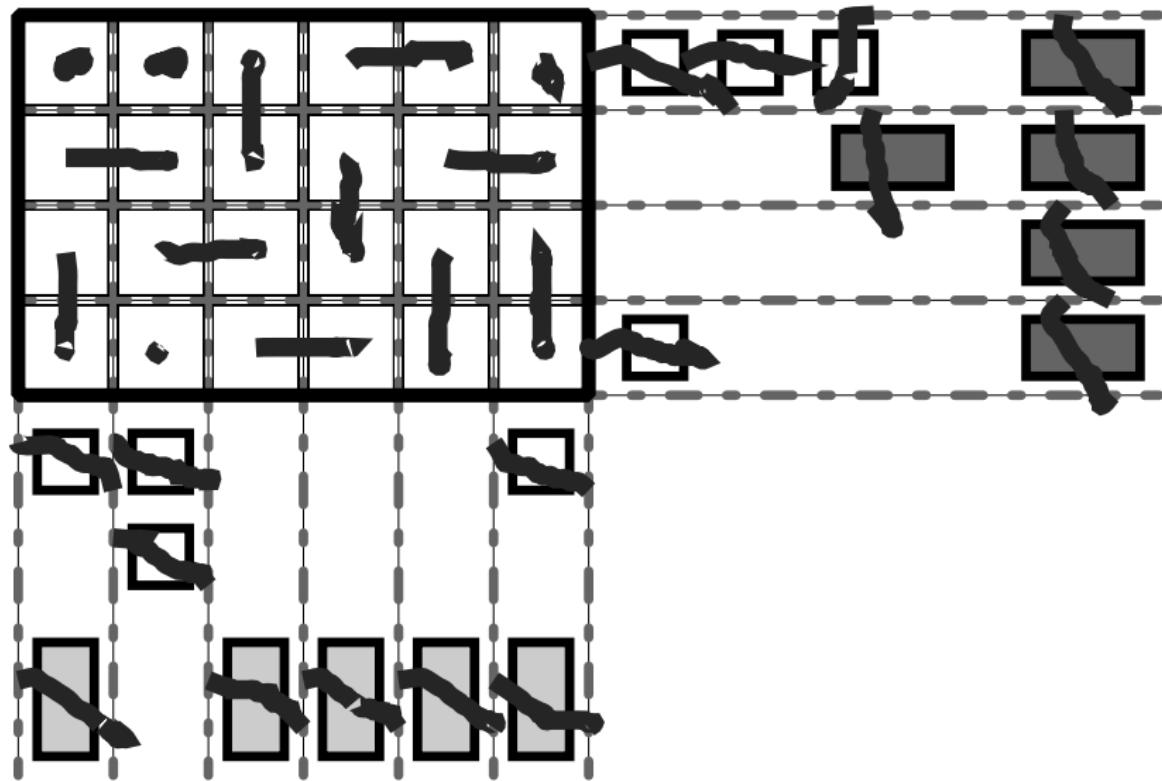
Tomoku!



Tomoku!



Tomoku!



Tomoku!

Pen-and-paper falls short

- ▶ Solution is not aesthetically appealing.

Tomoku!

Pen-and-paper falls short

- ▶ Solution is not aesthetically appealing.
- ▶ May require backtracking and erasing.

Tomoku!

Pen-and-paper falls short

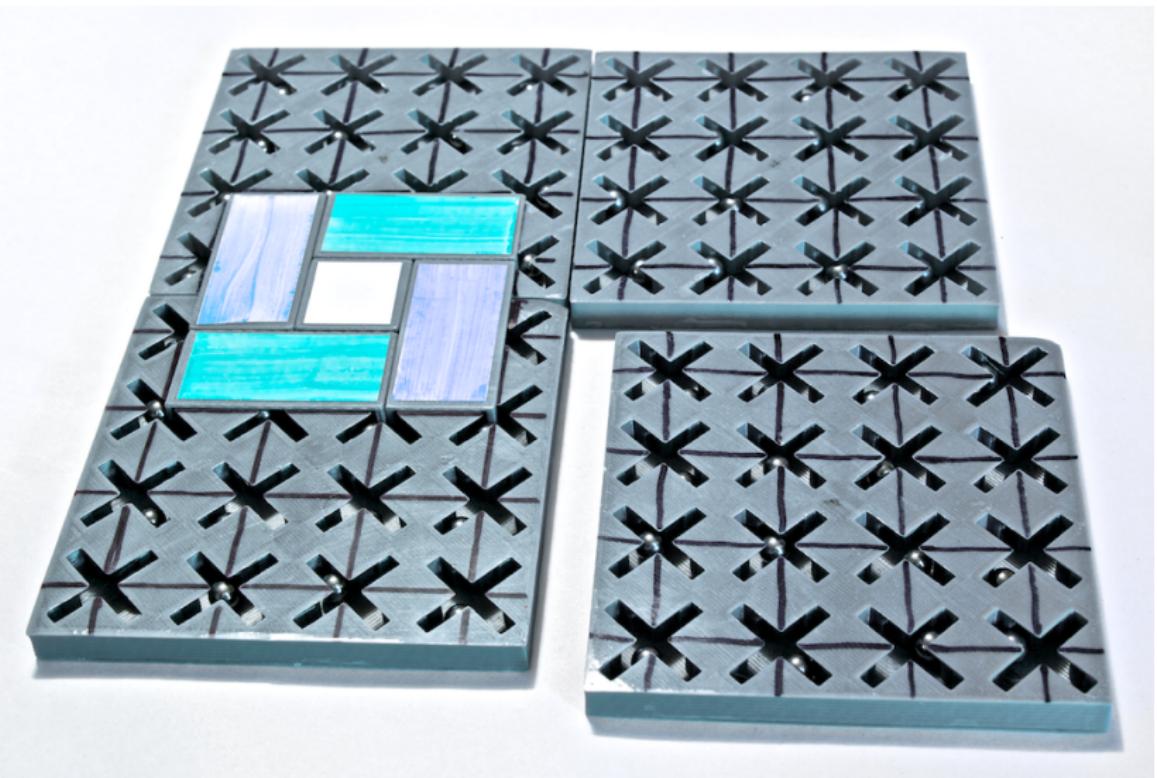
- ▶ Solution is not aesthetically appealing.
- ▶ May require backtracking and erasing.
- ▶ Easy to forget the tatami restriction.

Tomoku!

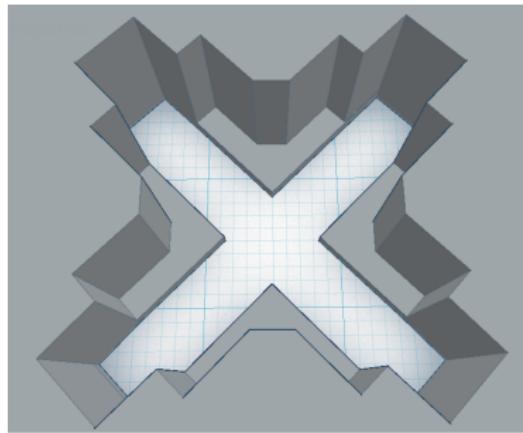
Pen-and-paper falls short

- ▶ Solution is not aesthetically appealing.
- ▶ May require backtracking and erasing.
- ▶ Easy to forget the tatami restriction.
- ▶ Tatami Maker solves these problems.

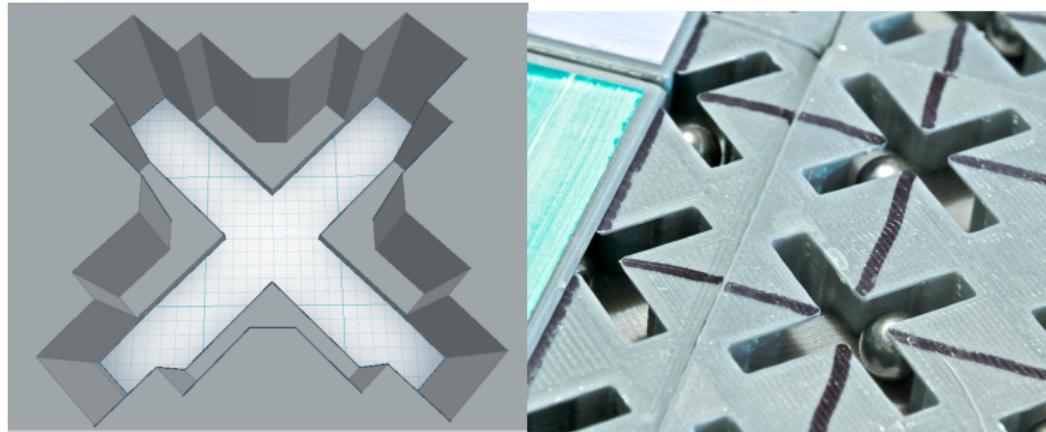
Tatami Maker



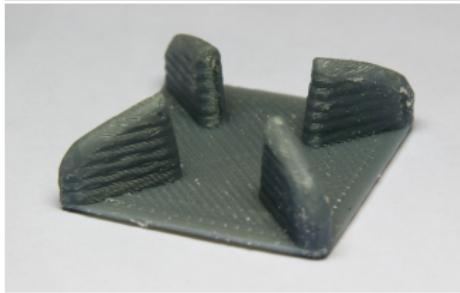
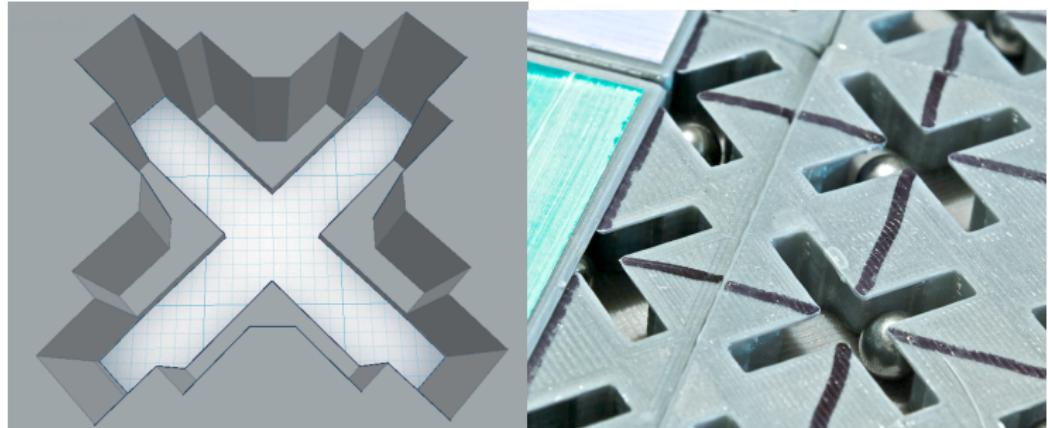
Tatami Maker



Tatami Maker



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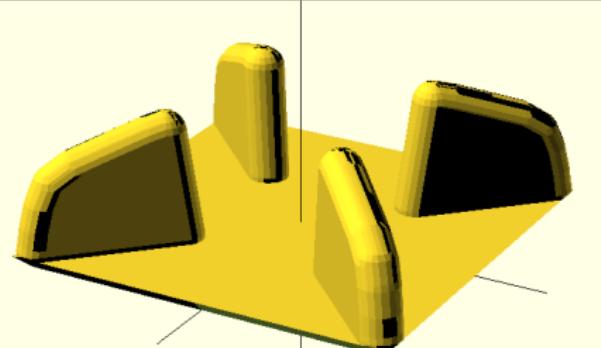
Tatami Maker

OpenSCAD – footprofile_v4.scad

```
$fn=20;

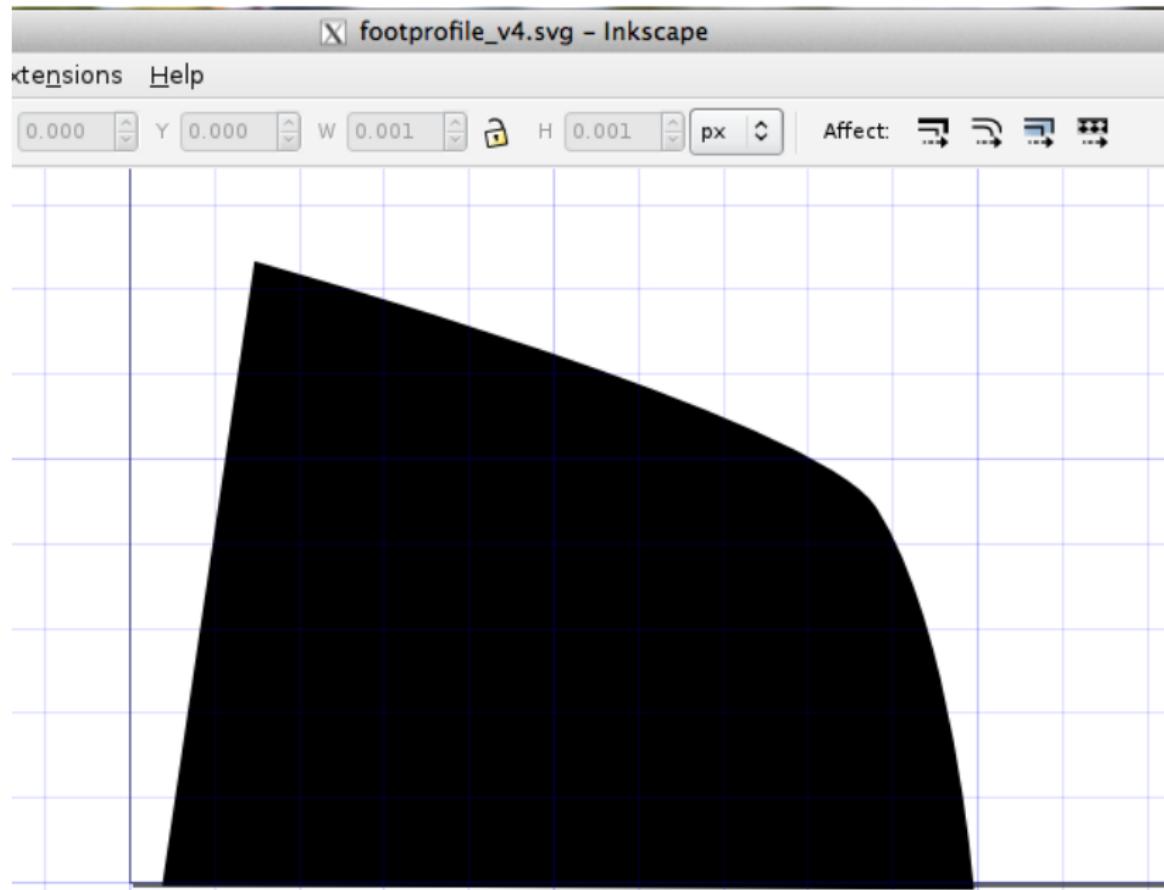
module foot(a)
minkowski(){
  translate([6,6,1]) rotate([90,0,45]) scale([100,100,1])
  linear_extrude(height=0.1)
    import("footprofile_v4.dxf",convexity=5);
  sphere(a);
}

module cO{
difference(){
  union(){
    cube([14.75,14.75,1]);
    difference(){foot(1.5); translate([0,0,-3]) cube([16,16,3]);}
  }
  translate([0,13.75,0]) rotate([-45,0,0]) cube([15,2,3]);
  translate([13.75,0,0]) rotate([0,45,0]) cube([2,15,3]);
}
}
//cube([6,6,10.68]);
cO;
mirror([1,0,0]){cO;}
mirror([0,1,0]){cO;}
mirror([1,1,0]){cO;}
```

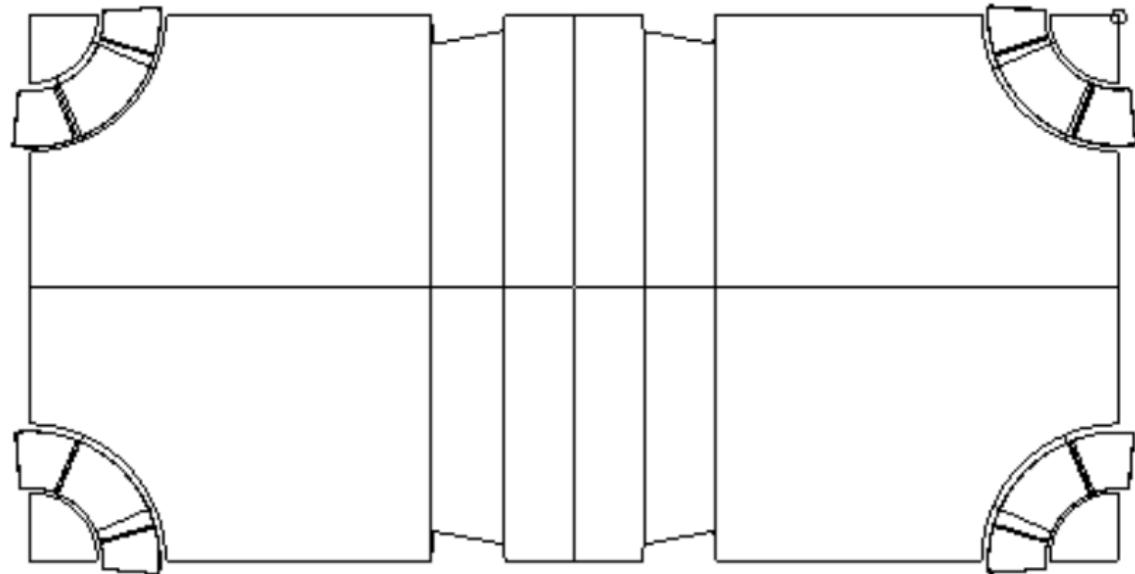


The image shows a 3D rendering of a yellow-colored component, likely a part of a tatami maker machine. The component has a central vertical cylindrical post and two symmetrical side flaps or supports. It is displayed against a white background with a small coordinate system (x, y, z) at the bottom left.

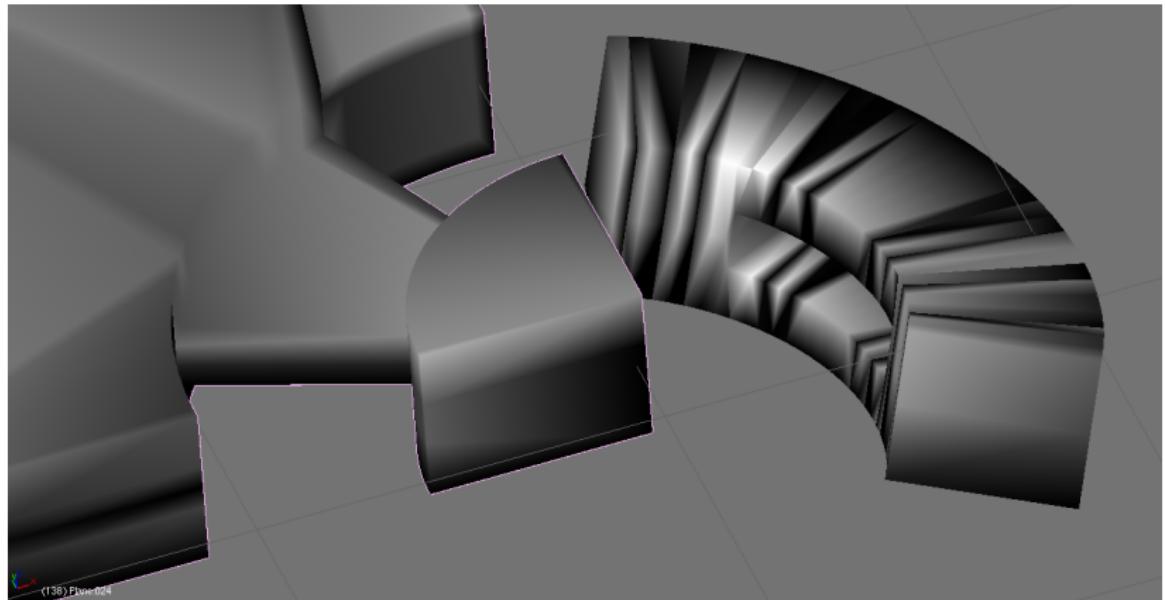
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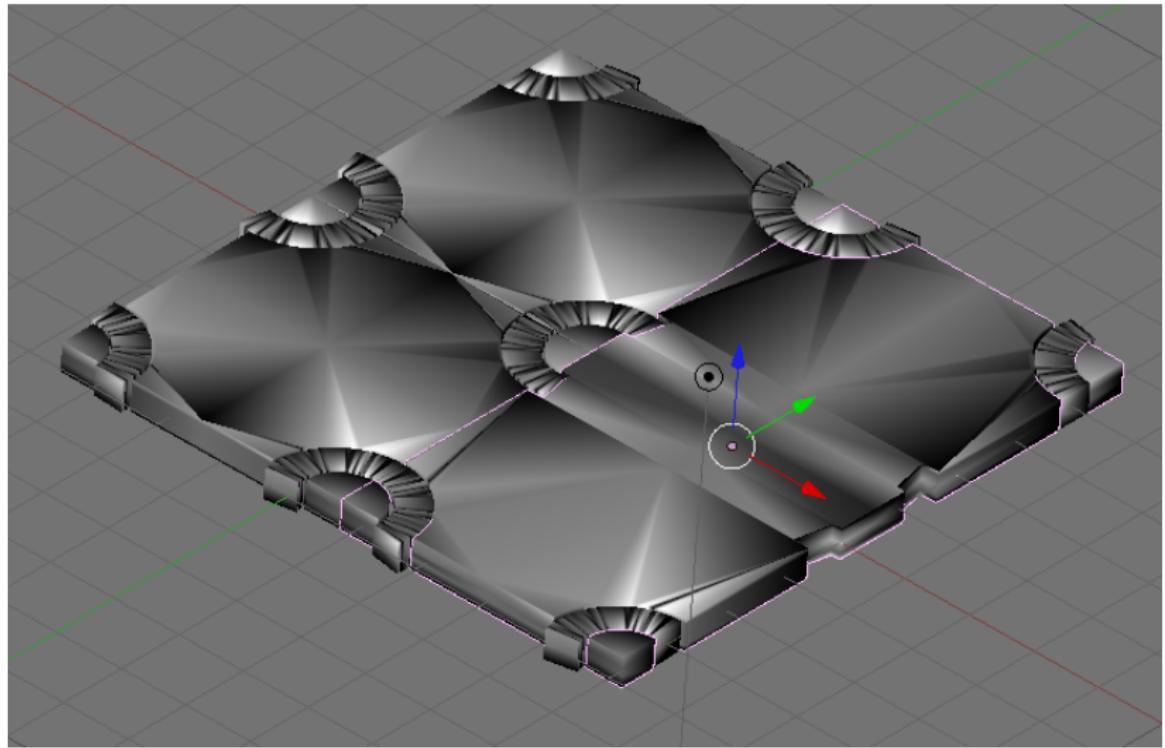
Design iterations



Design iterations



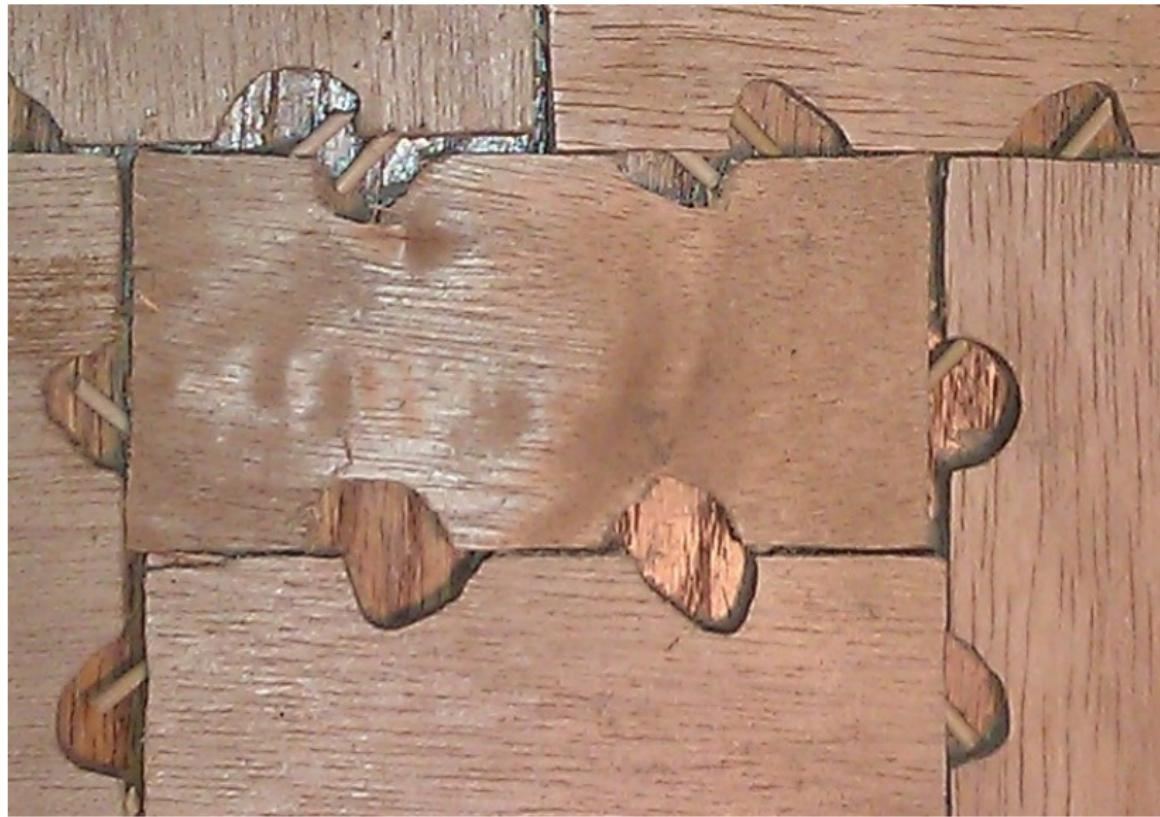
Design iterations



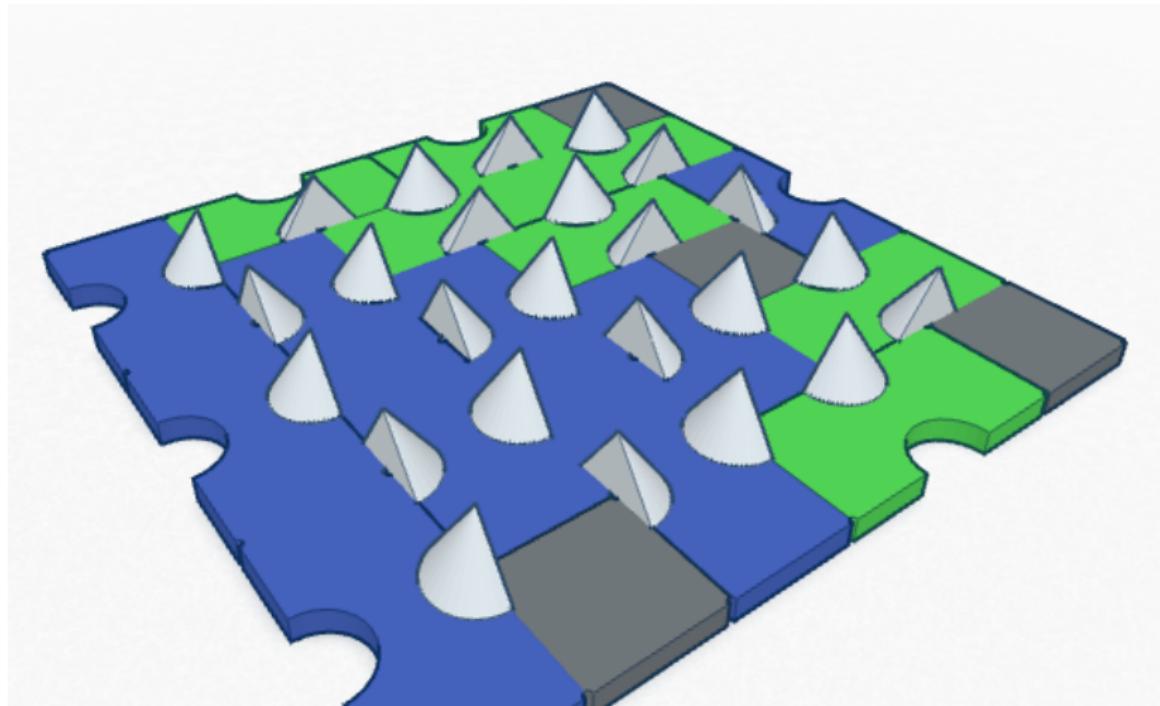
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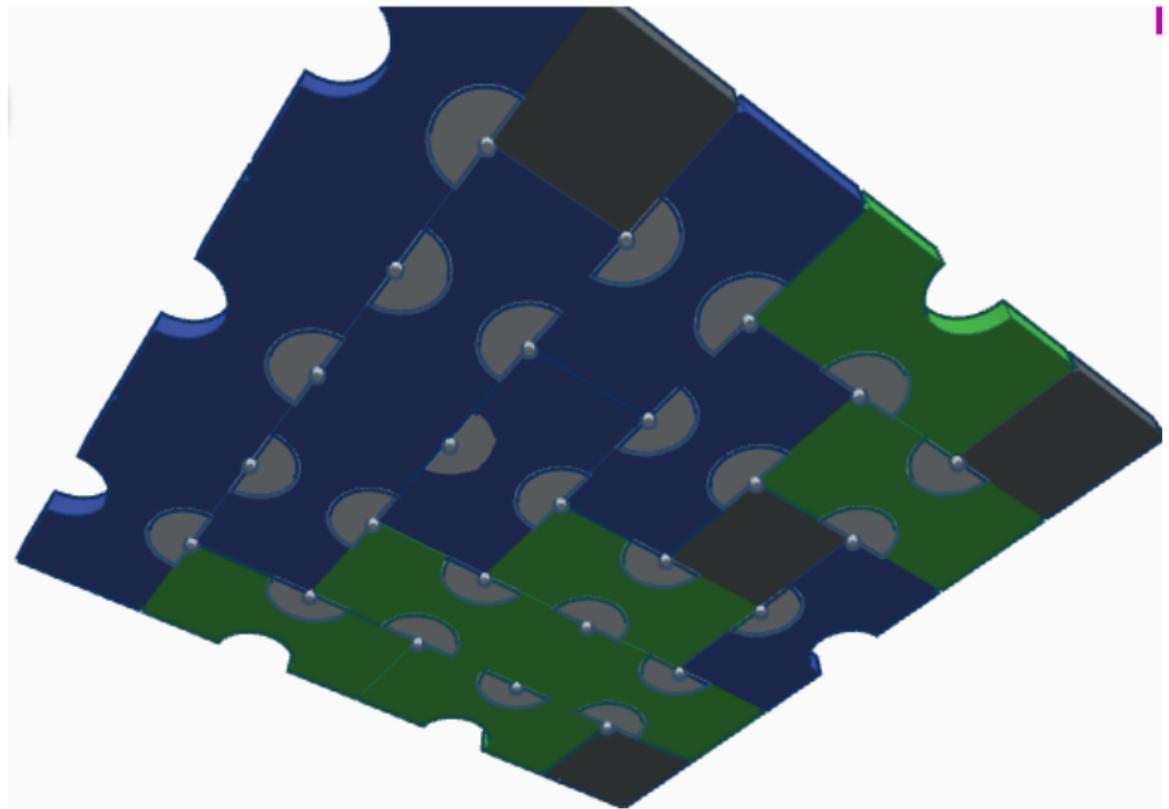
Design iterations



Design iterations

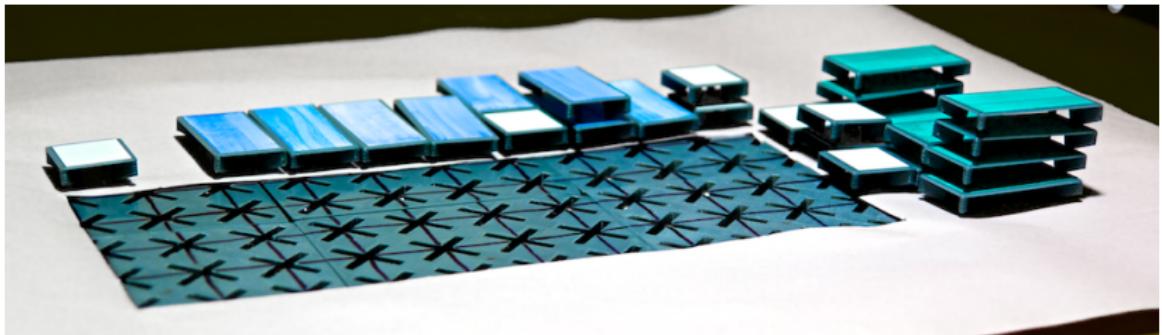


Design iterations



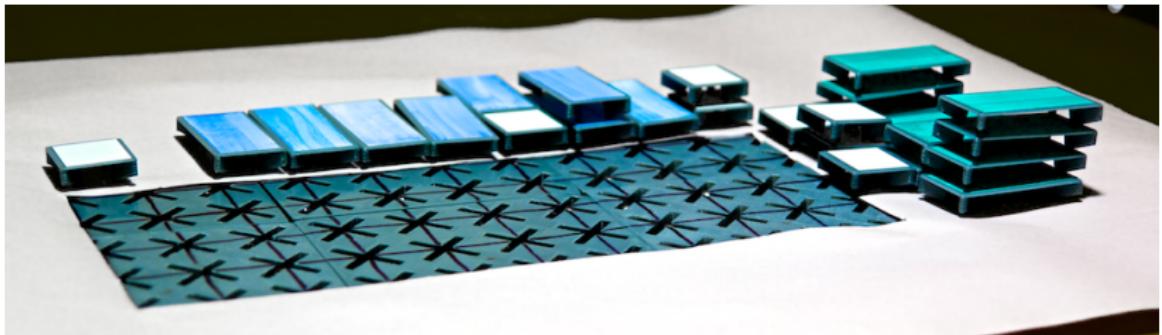
Wish list

- ▶ Overcome the manufacturing flaws in the prototype.



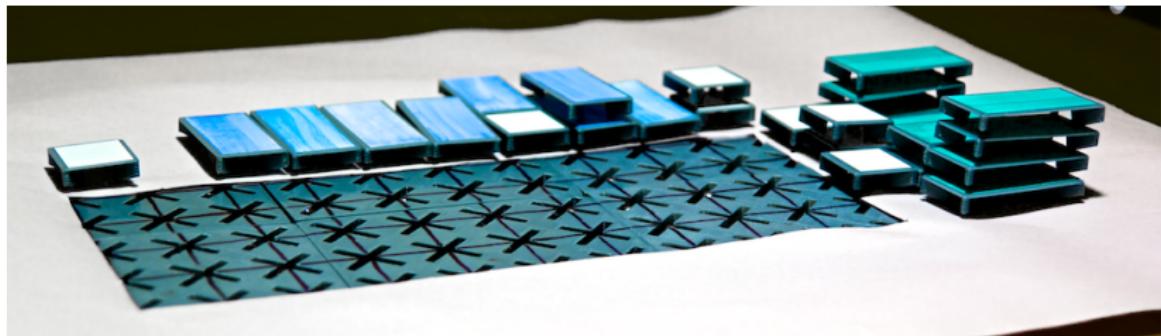
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- ▶ Perfect the overlays and game play.

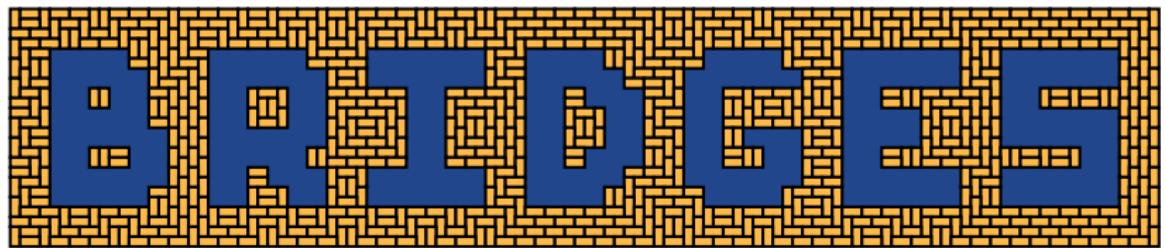


Wish list

- ▶ Overcome the manufacturing flaws in the prototype.
- ▶ Perfect the overlays and game play.
- ▶ Patent Tatami Maker and publish a game?



Thank you



Slides at alejandroerickson.com