Peitan bridge
(Wind and Rain Bridge)

5-12-2023

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Original bridge

- September 2015 - March 2016
- Jiang, Hejia (Team Leader),
  Man Ho Kwan,
  70 HKU Architecture Students
- Community space
- Computer design
- Locally sourced timber
- Made under supervision of traditional carpenters

20 sqm

Steps of analysis

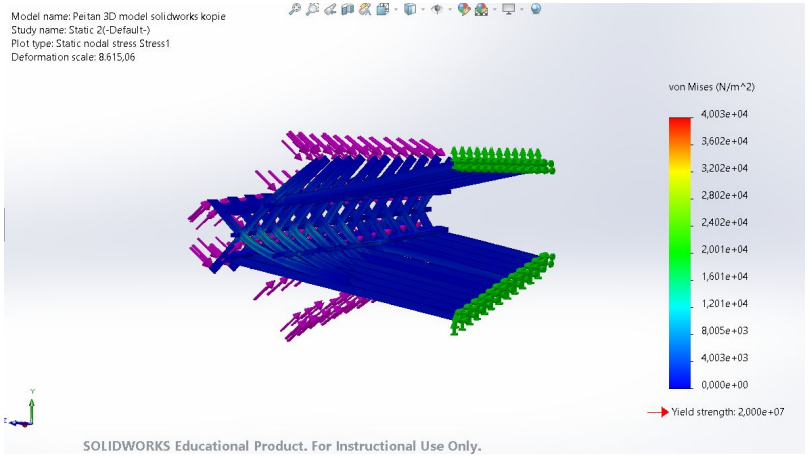
1. Analysis bridge
    a. overall geometry
    b. important connections
    c. measurements
2. Further analysis important components
    a. Finite Element Method (FEM) analysis for stress and strain
    b. extra information about wooden connections
3. Online 3D model
    a. determining correct measurements
    b. overview of all elements and their measurements
4. Building plan
5. Physical 3D model

1. Analysis bridge

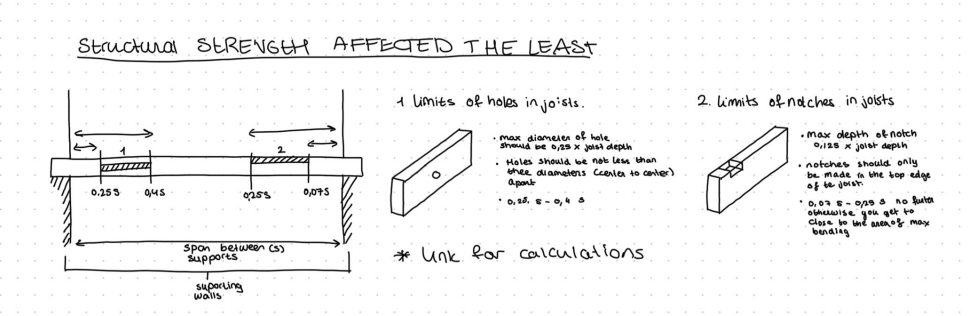
The Landings

2. Further analysis important components

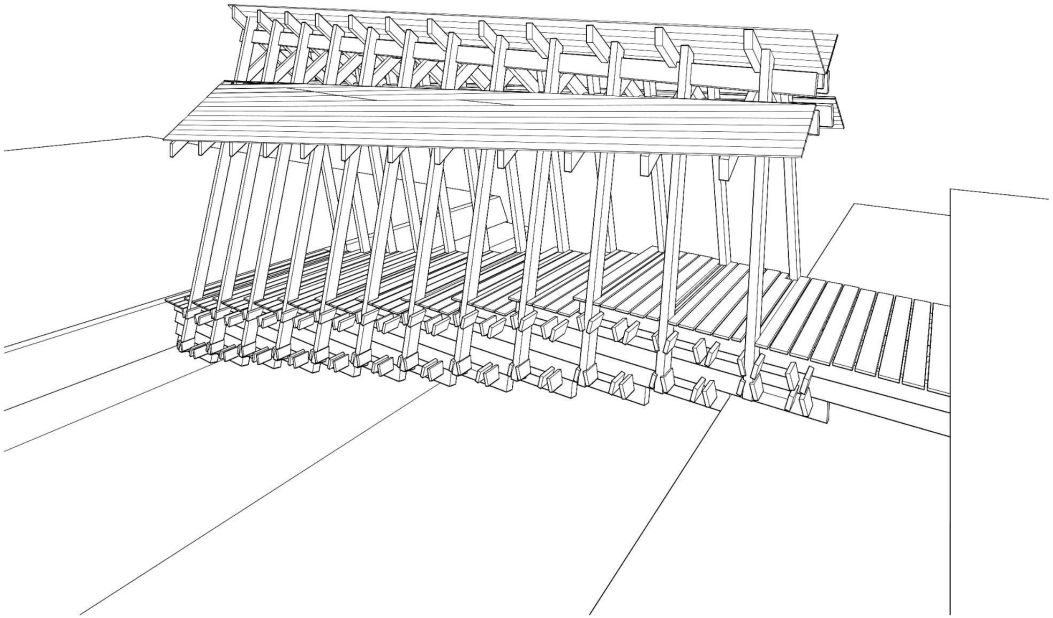
FEM-Analysis



Additional findings: Wood connections

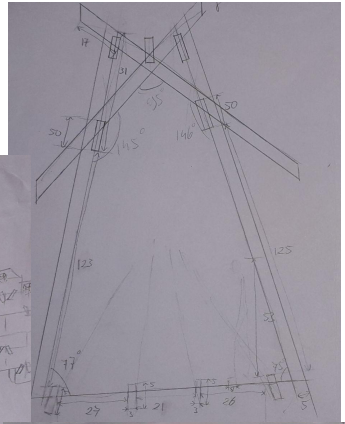


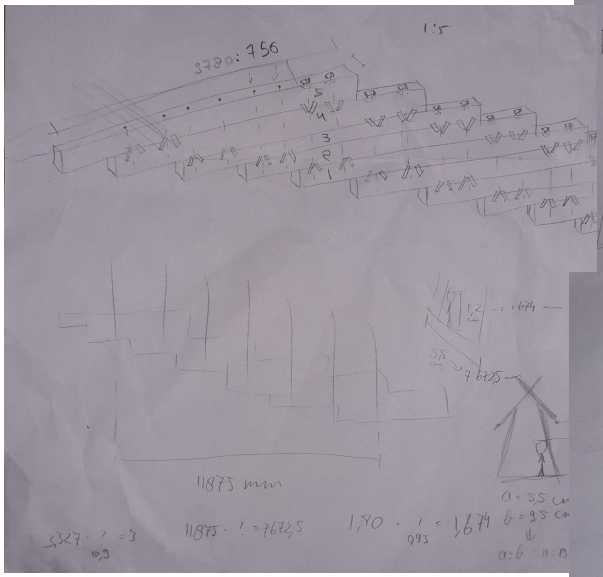
3. Online 3D model

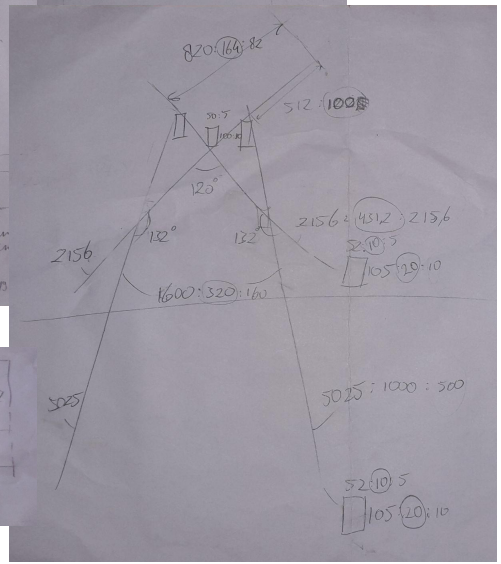


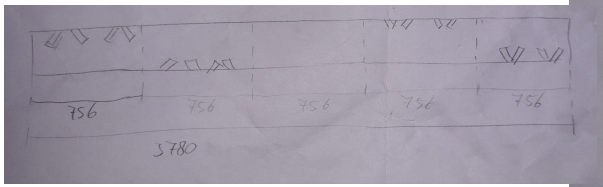
1. Existing online model.
2. Altering this to the correct estimated measurements and adding missing components.
3. Inventory of all the components and orderliness.
4. Making the measurements of all the components and cuts to recreate the bridge.

Altering the model

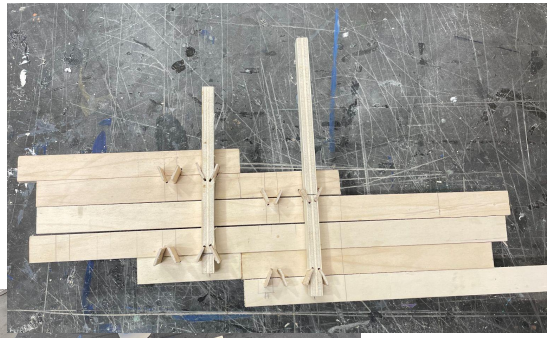




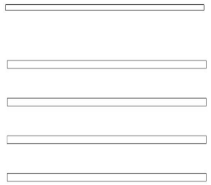




Try it yourself challenge



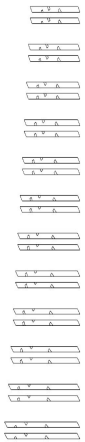
Inventory and orderliness.



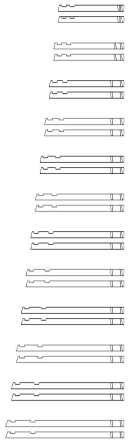
Horizontal roof beams

Inside deck beams

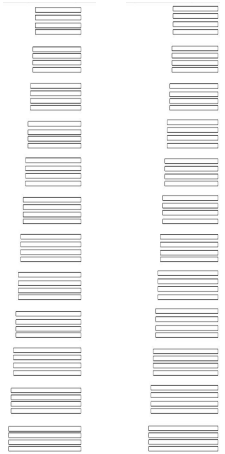
Outside deck beams



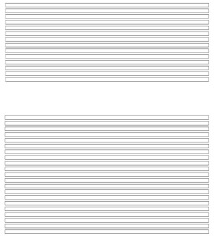
Diagonal beams



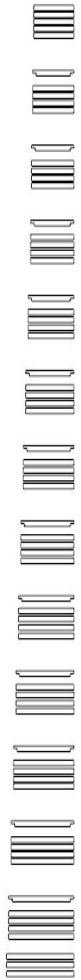
Vertical columns



Dovetail deck beams

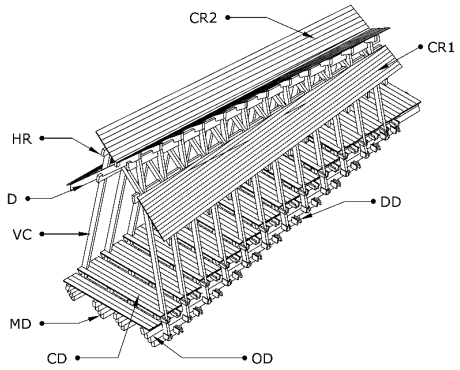


Roof cladding

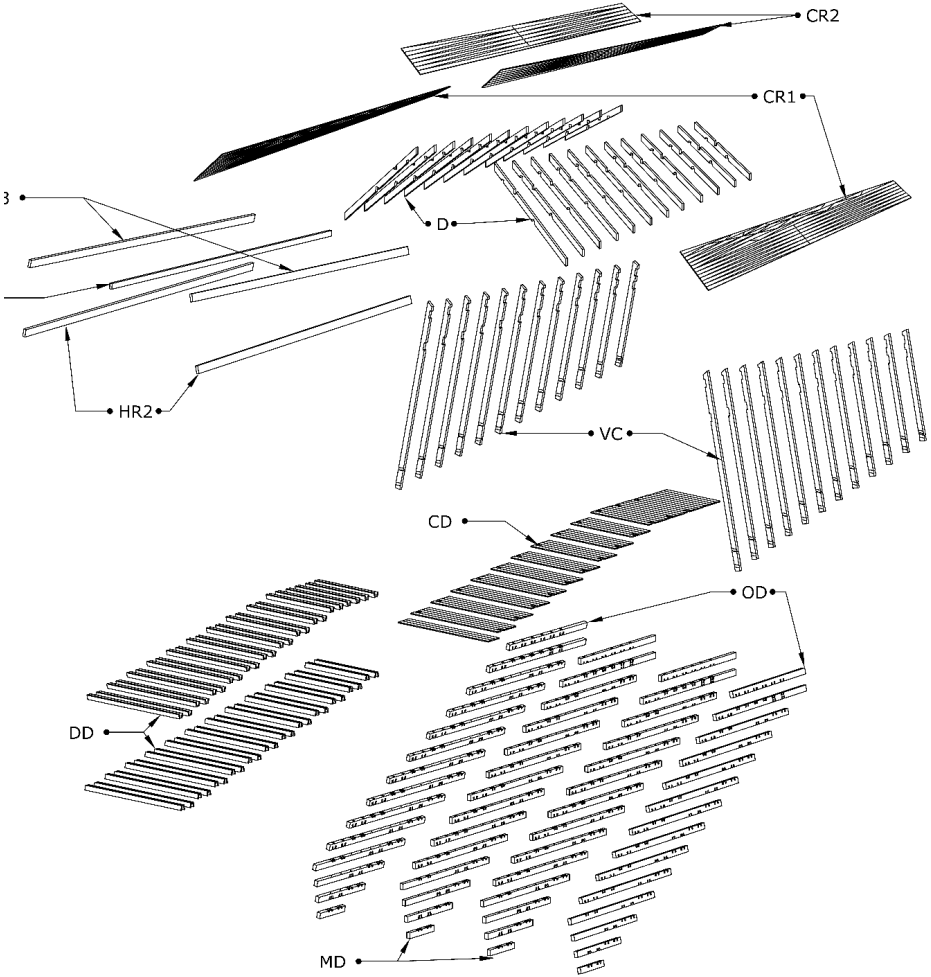


Deck cladding

Inventory and orderliness.

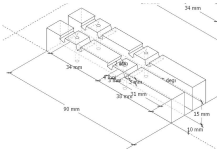


Code	Amount	Description	Intersection (mm)	Length (mm)
OD	28	Outside deck beams	106x160	988-3829
MD	28	Inside deck beams	106x60	988-3829
DD	96	Dovetail deck beams	35x126	2021-3261
VC	24	Vertical collumns	75x160	2969-5342
D	24	Diagonal beams	75x150	2242-3398
HR1	1	Horizontal roof beams Middle	75x150	3039
HR2	2	Horizontal roof beams Bottom	75x210	9057
HR3	2	Horizontal roof beams Top	75x210	9064
CD	68	Cladding deck	25x150	1820-3050
CR1	21	Cladding roof Bottom	20x100	9080
CR2	14	Cladding roof Top	20x100	9100

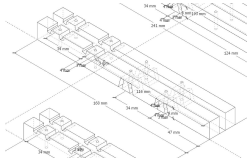


Measurements for recreation

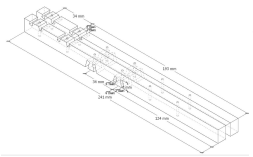
Inside deck beams



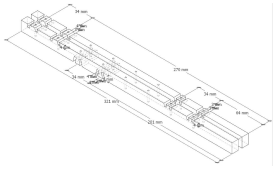
2 x MD1



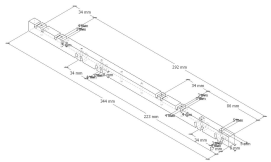
2 x MD2



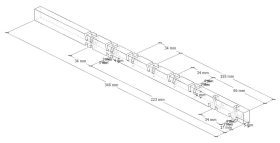
2 x MD3



2 x MD4



16 x MD5



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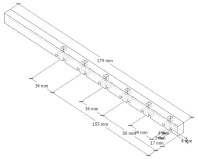
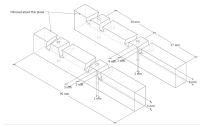
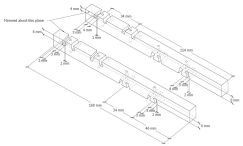


2 x MD6

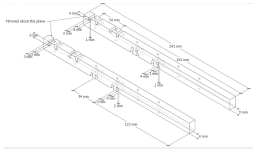
Outside deck beams



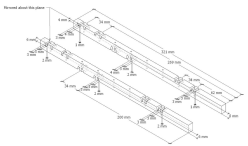
2 x OD1



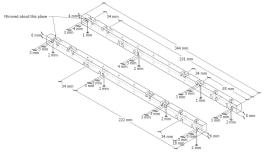
2 x OD2



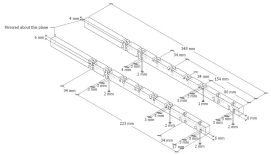
2 x OD3



2 x OD4



16 x OD5



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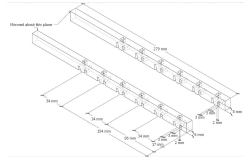
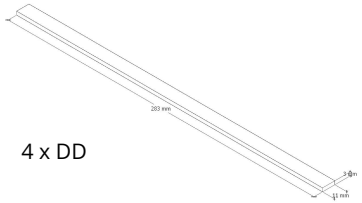


2 x OD7

Dovetail deck beams



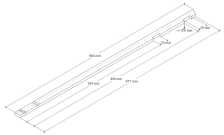
4 x DD

	DD1B	DD2B	DD3B	DD4B	DD5B	DD6B	DD7B	DD8B	DD9B	DD10B	DD11B	DD12B
Length (mm)	296	287	277	267	257	247	237	227	217	207	197	187

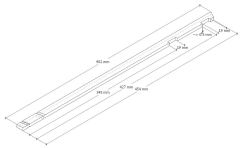
	DD1T	DD2T	DD3T	DD4T	DD5T	DD6T	DD7T	DD8T	DD9T	DD10T	DD11T	DD12T
Length (mm)	283	274	265	255	246	236	226	217	208	197	188	184

Measurements for recreation

Vertical columns



2 x VC1



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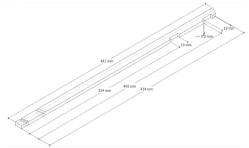

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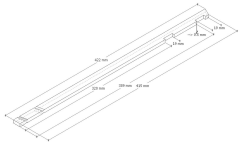

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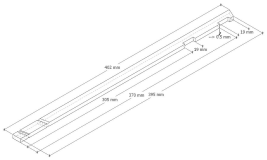
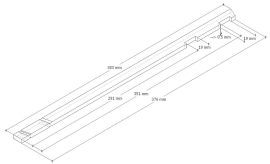
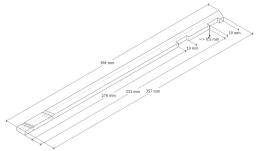


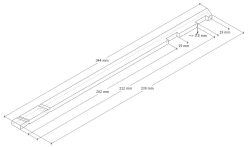
2 x VC5



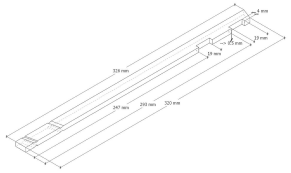
2 x VC6



2 x VC7



2 x VC8



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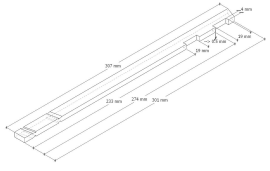
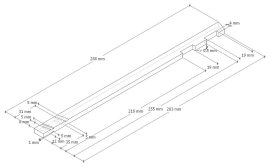
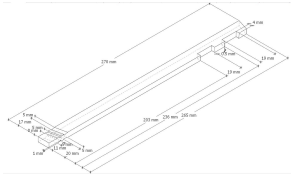


2 x VC10

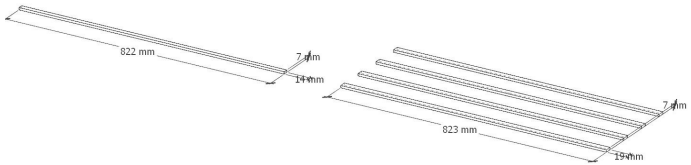


2 x VC11



2 x VC12

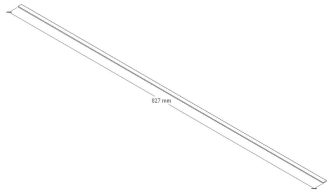
Horizontal roof beams



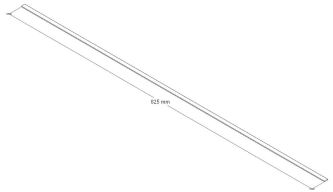
1 x HR1

4 x HR2

Cladding roof



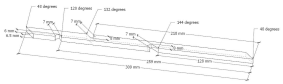
21 x CR1



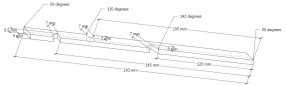
14 x CR2

Measurements for recreation

Diagonal beams



2 x D1



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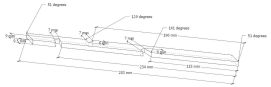
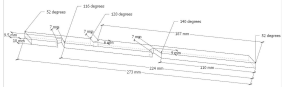
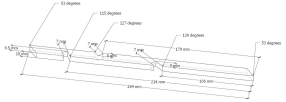


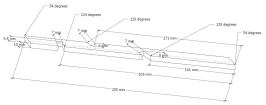
2 x D3



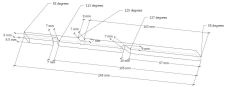
2 x D4



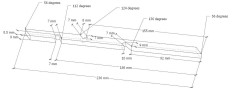
2 x D5



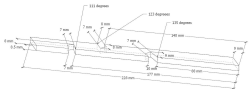
2 x D6



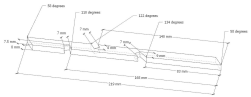
2 x D7



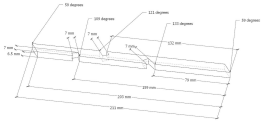
2 x D8



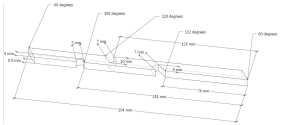
2 x D9



2 x D10

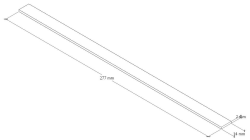


2 x D11

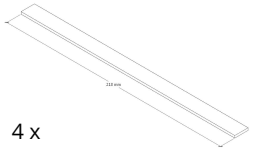


2 x D12

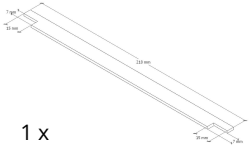
Cladding deck



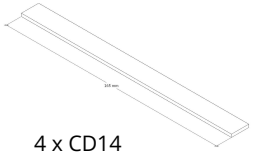
3 x CD1



4 x



1 x

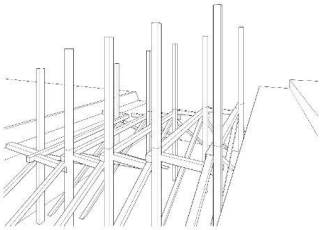


4 x CD14

	CD2	CD3	CD4	CD5	CD6	CD7	CD8	CD9	CD10	CD11	CD12	CD13
Length (mm)	268	258	248	238	228	218	208	198	188	178	175	170

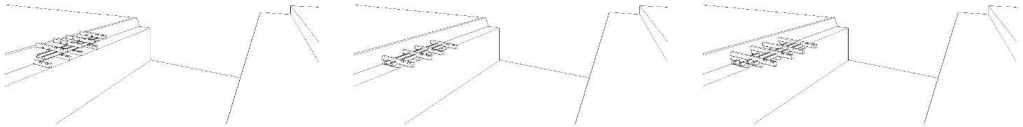
5. Building plan

1



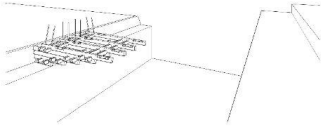
Construct temporary support structures (stiffers) using leftover wood, ensuring they are robust enough for construction but not part of the final bridge structure.

2 3 4



Layer the four beam rows in the right place and secure them by leaning them on the supporting structure below and adding the dovetail beams in the perpendicular direction. Do this for every layer until you reach the fifth layer.

5



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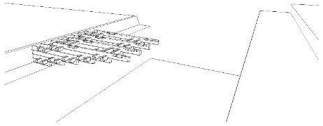

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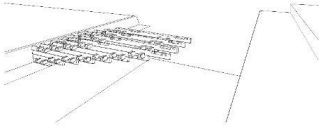

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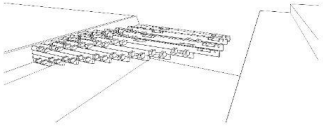
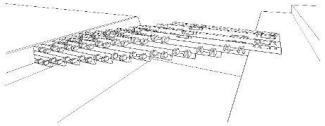


When reaching the fifth layer of beams, you will need to bolt the five rows together. These bolts are pre-made between the dovetails. Continue this with each layer added to the structure. Do this process until you reach the end of the floor structure.

* Note: These bolts and dovetails are not placed in a way that would support the strength of the beams efficiently. The placement of the bolts makes the beams weaker. However, when looking at the total stacking of the beams, they are necessary to keep the structure together; the imperfections from the cutting make some of the construction slip out of place. This bridge has thus a lot of weak points. When placed differently, the bolts would not make the bridge sturdier either because of the division of those weak points.

9



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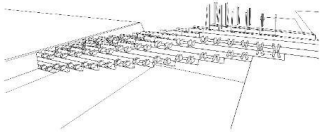
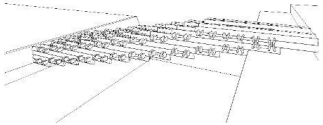
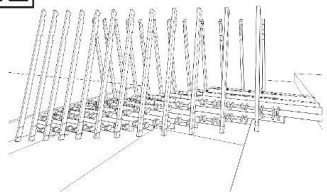


11



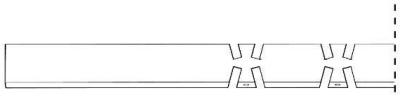
12



When the complete deck has been assembled and bolted, the vertical beams can be wedged in between the dovetail pieces. This will make it so that the beams are fitted exactly to the angle that the beams are supposed to be in.

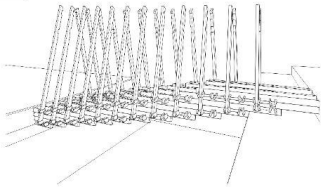
Note: When making the model, to decrease the amount of work, the pieces can be wedged in between the dovetails without extra cuts to fit this exactly, giving us a better error margin.

Note: The deck beams have a point in them that would not be recommendable to do in later bridges. The wood was cut out too much, and this makes this weak point even weaker.



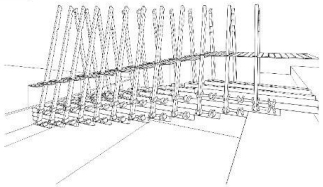
Detail 1:20 weak point beam (A3 printed)

13

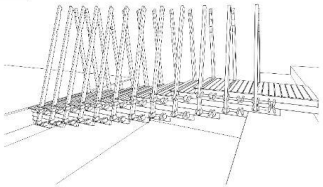


The deck planks or boards can be placed after adding the vertical beams. However, in the model, it would be best to do this last. When avoiding the additional cutting of the exact angles of the beams, these pieces are still able to rotate. Step 14 would be done at the last point model-wise.

14

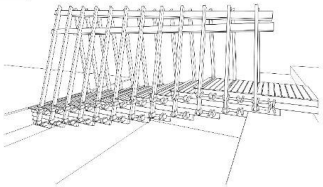


15

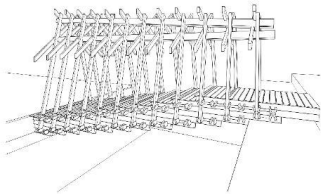


Next is to attach the horizontal beams to the vertical columns. This can be done by exact fitting them to the columns or by people holding them in place on site. This is mostly dependent on the scale

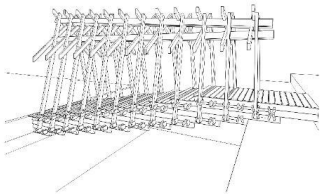
16



17



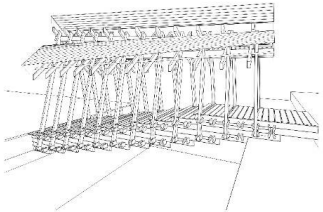
18



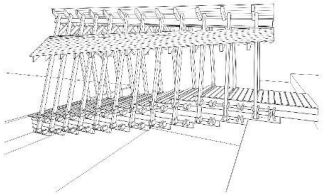
After adding the horizontal beams in place, the diagonal beams can be wedged in place. In the real process, this is done by placing the beams on one side of the beam; this is also done in making the model to save time. However, to make the construction more stable, one beam on each side of the column would be best.

When all the diagonal parts are in place, the last horizontal beam is placed on top of these beams to keep everything in place.

15

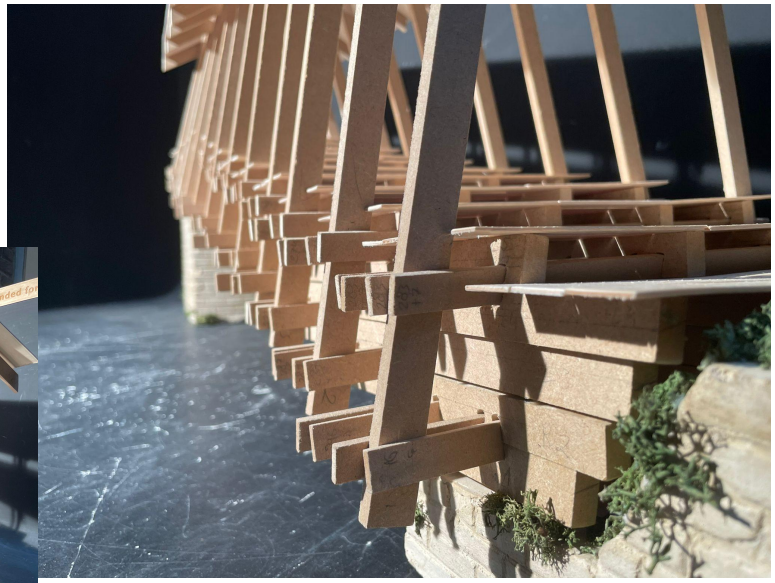


20



The last two steps of this process involve adding the roof cladding and removing the supporting structure. This structure had been shown only in the first step but had been removed from every step afterward to keep the drawings clear. However, it can only be removed now.

6. Physical 3D model



The floor is now yours...