Project 2

Tower Design

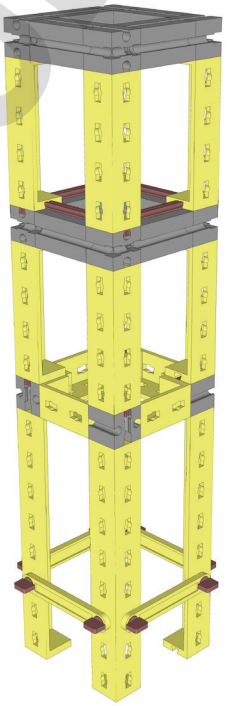
Tall structures require more sophisticated structural thinking and planning, though the basic approach is the same as those you considered in the post and lintel builds (bracing, orienting members to resist shear and bending). Here, you explore some tower design concepts through the construction of a couple of models.

Key Points

- Bracing is critical in towers. The taller the structure, the more tendency to bend.
- Bracing in towers can also serve as functional members (tall decking, for example).
- Note: there must be a balance of mass distribution. The more bracing you add , the stiffer the structure, and the faster the sway frequency becomes, so bracing can work against damping (adding mass at the top as you did with the previous project).

It's time to BUILD!

Modular Tower



Legend

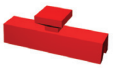
- STOP — Set assembly aside.
- x2 — Build the number shown.
- Rotate assembly.
- Flip assembly.

Materials you will need:

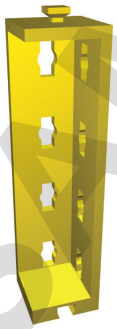

Building Block 30
(Qty 8)


Building Block 15
(Qty 12)


Rivet 4
(Qty 8)


Spring Cam
(Qty 8)


Angle Girder 120
(Qty 4)

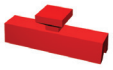

Angle Girder 60
(Qty 8)


Angle Girder 30
(Qty 4)

I-Strut 45
(Qty 4)

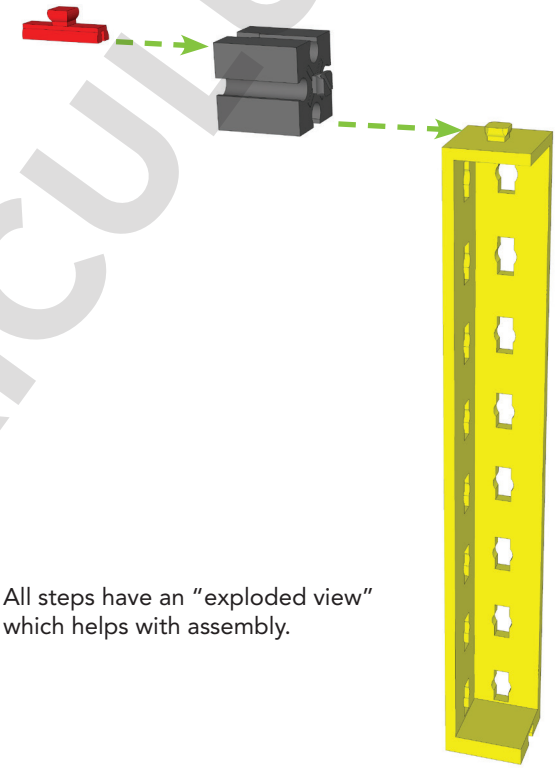

Spring Cam
(Qty 4)

1


x4


x4


x4

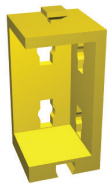


All steps have an "exploded view" which helps with assembly.

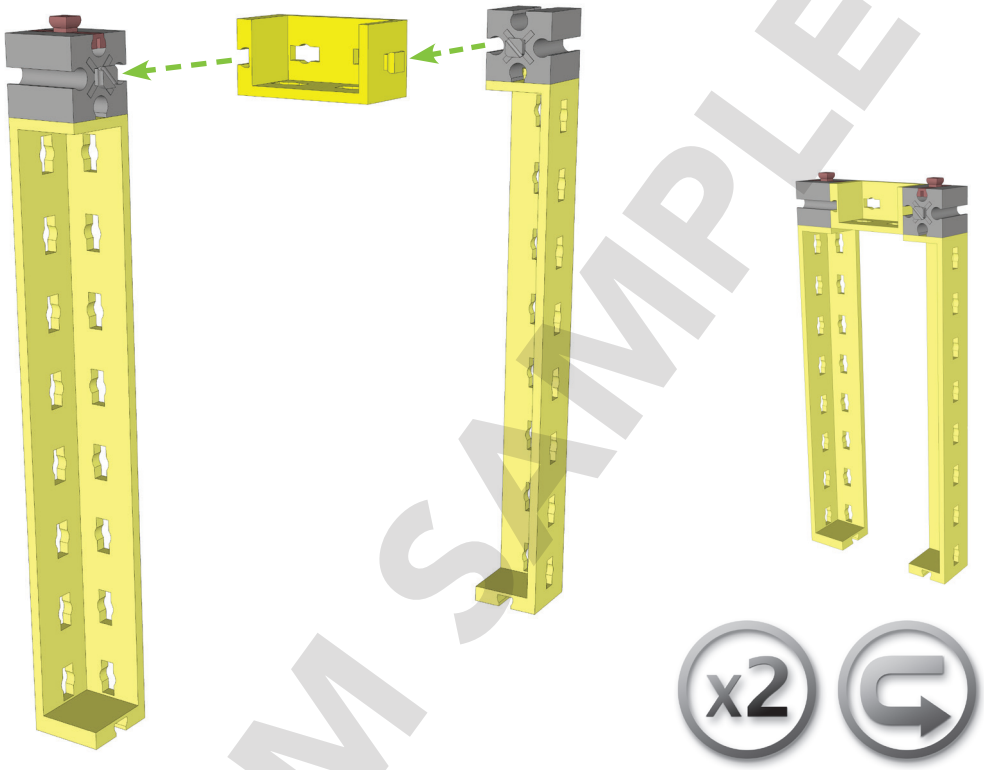
The assembly should look like this before going on to the next step.

x4

2

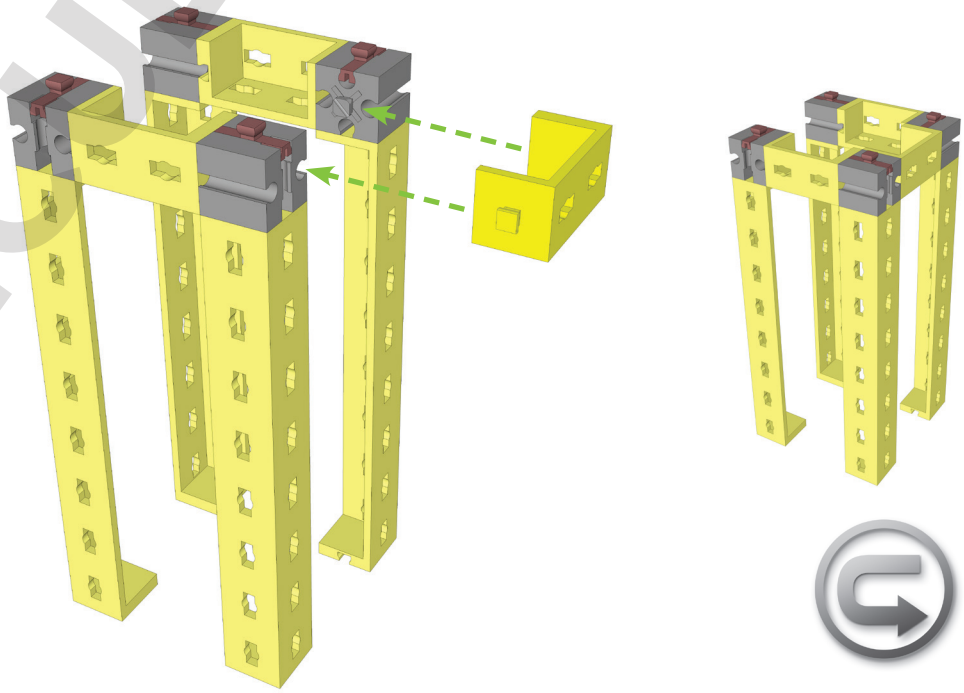


x2



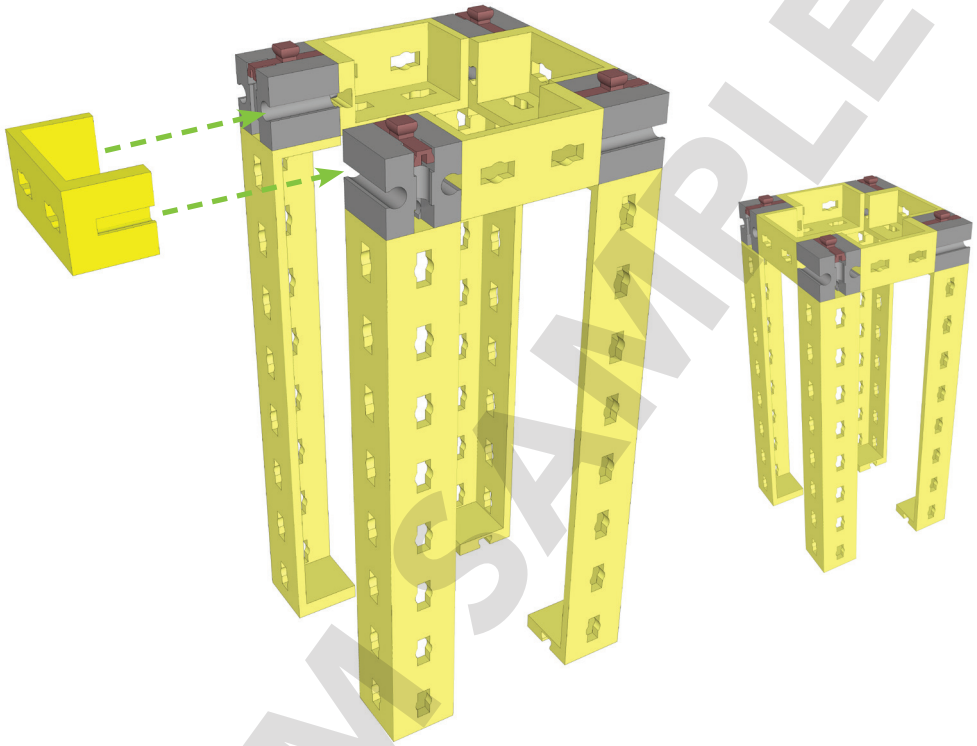
3

x1



4

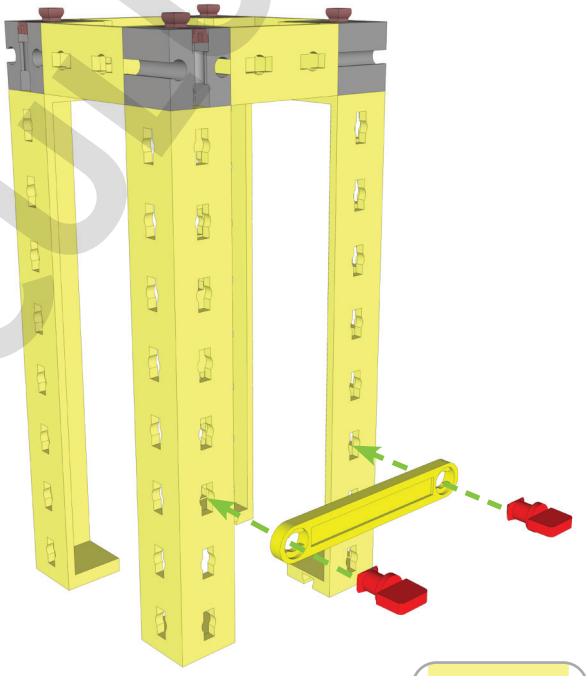
x1



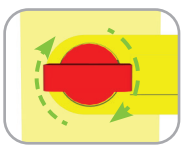
5

x2

x1



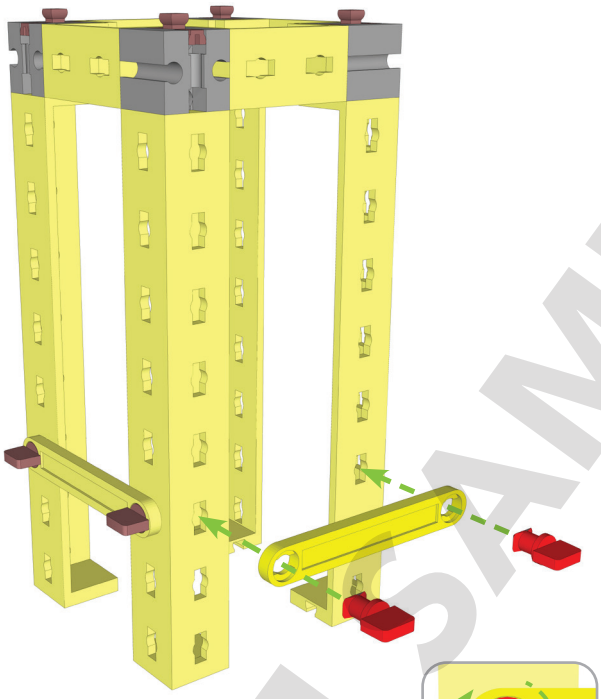
Twist the Rivet 4 to join the strut assembly to the Angle Girder 120s.

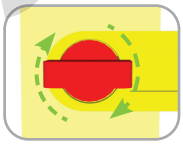


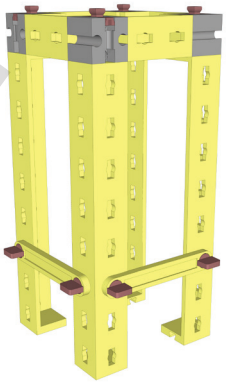
6

x2

x1





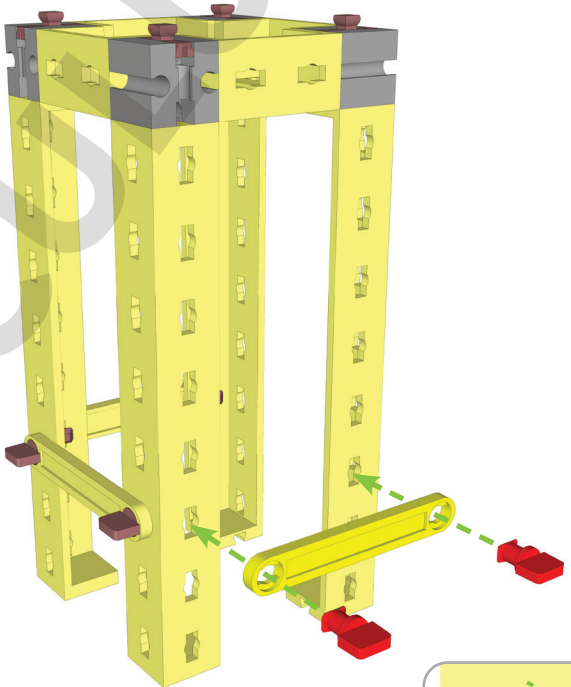


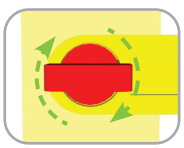
Twist the Rivet 4 to join the strut assembly to the Angle Girder 120s.

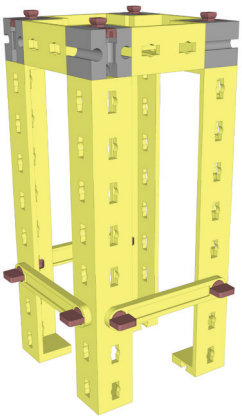
7

x2

x1





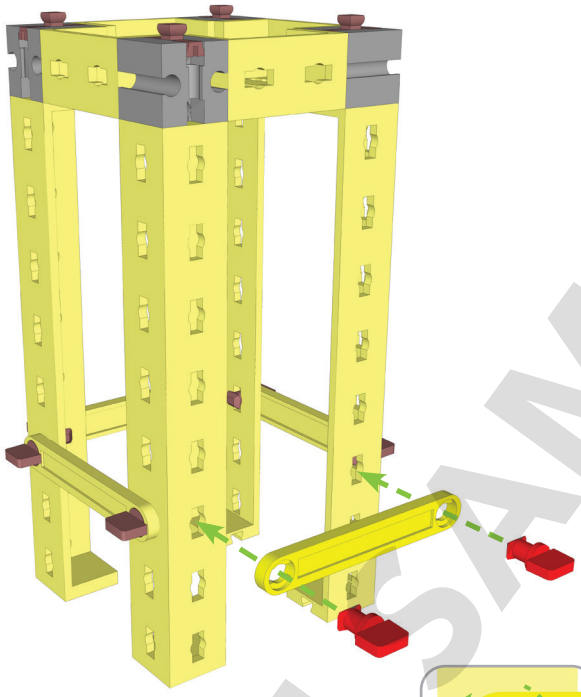


Twist the Rivet 4 to join the strut assembly to the Angle Girder 120s.

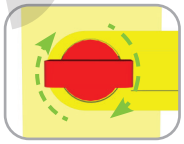
8

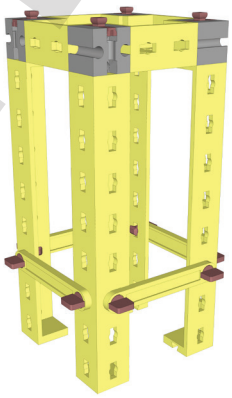
x2

x1



Twist the Rivet 4 to join the strut assembly to the Angle Girder 120s.





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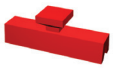
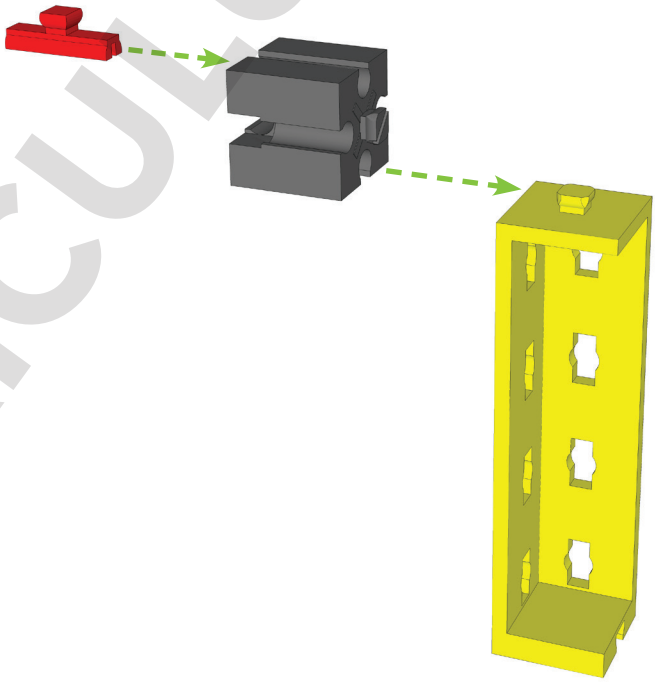
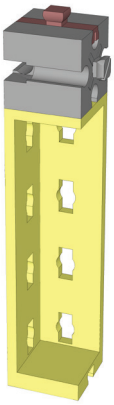


x4

x4

x4





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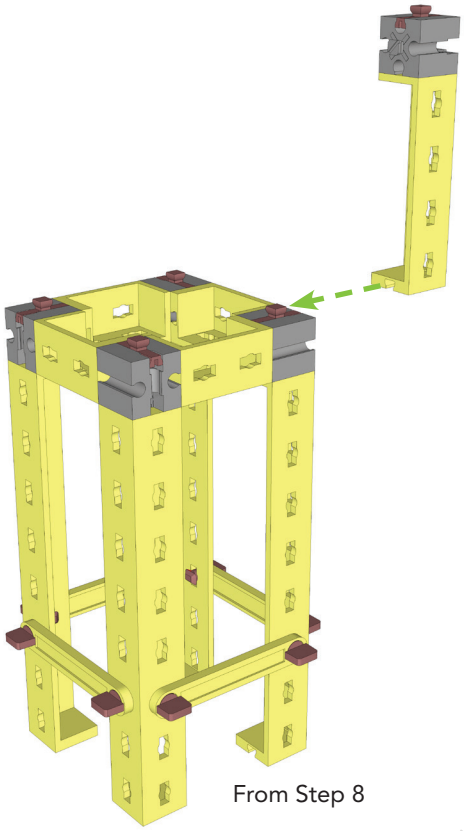

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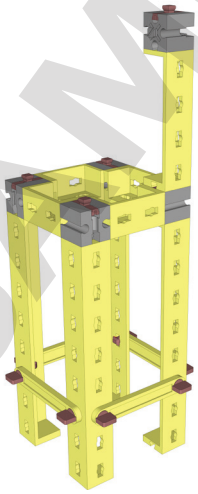

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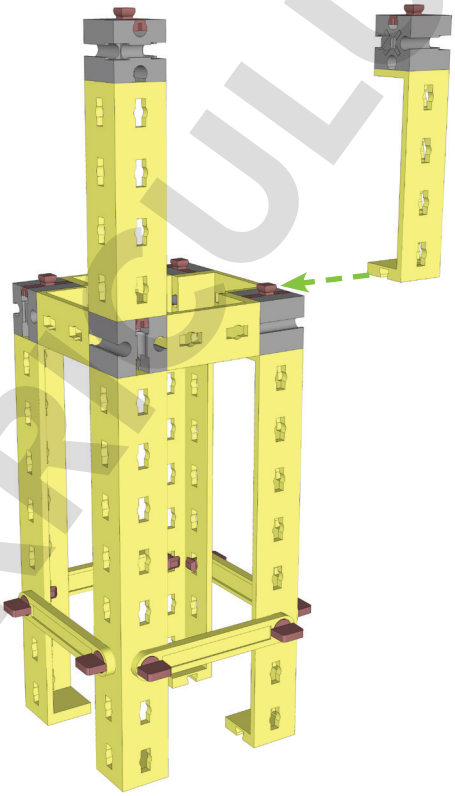

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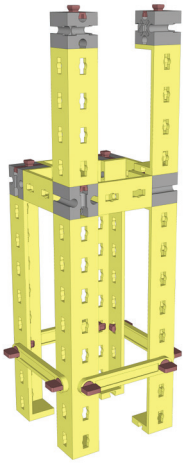

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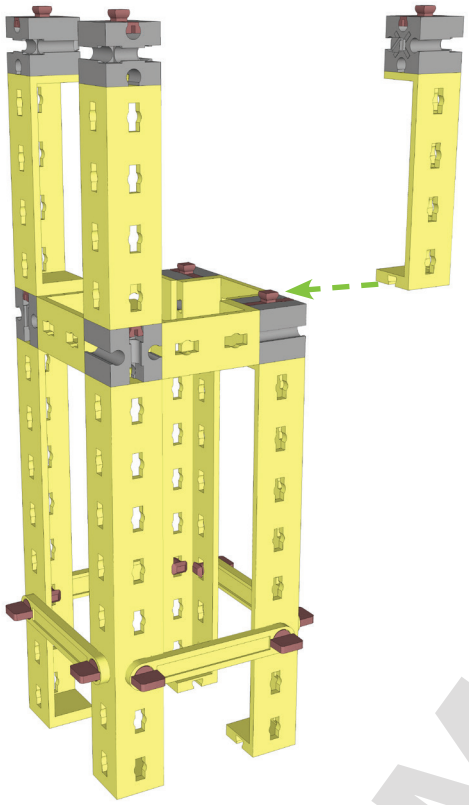

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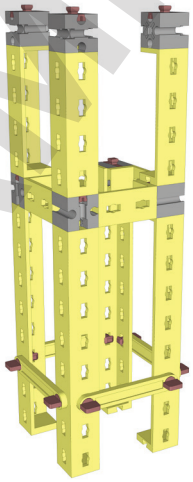

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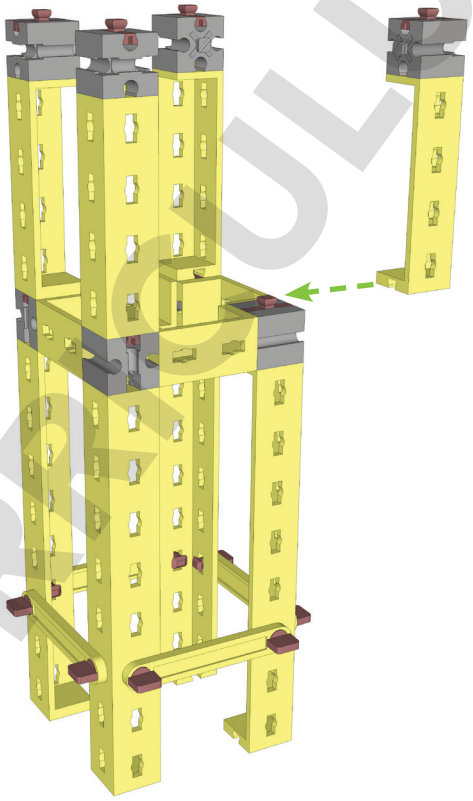

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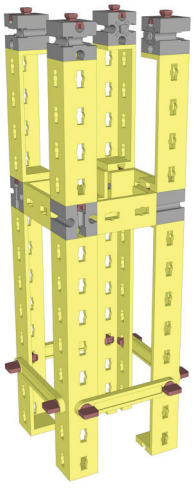
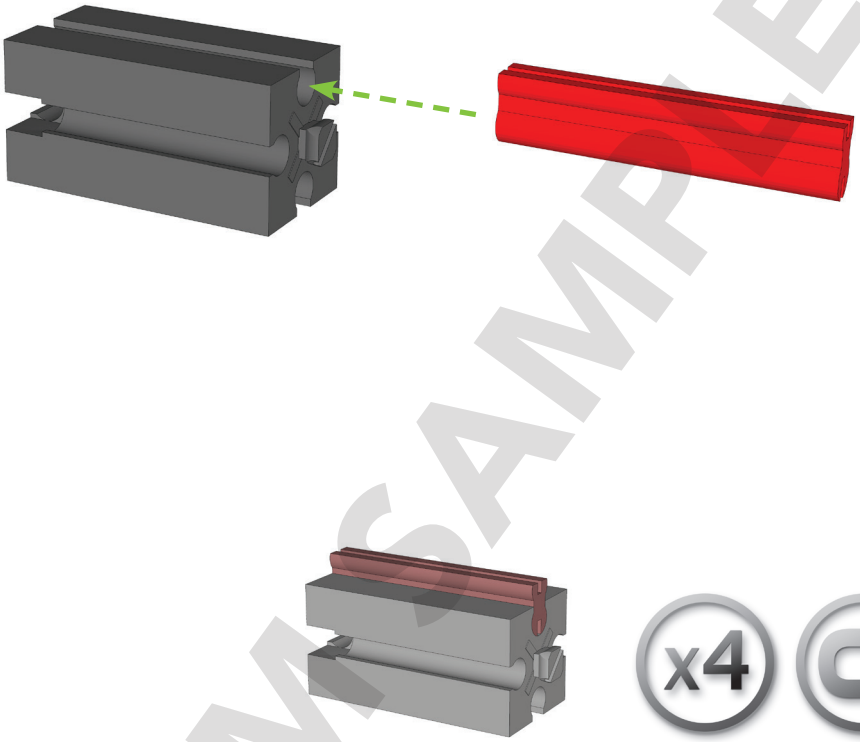


14

x4

x4



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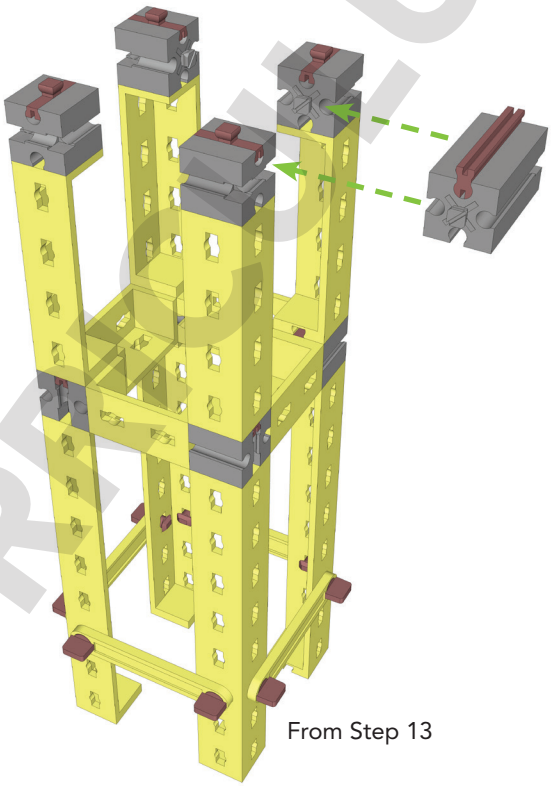

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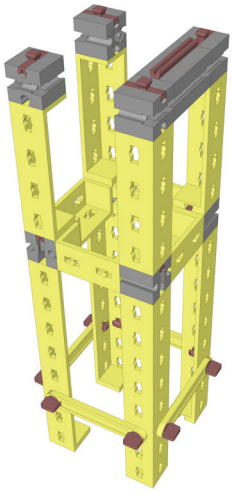

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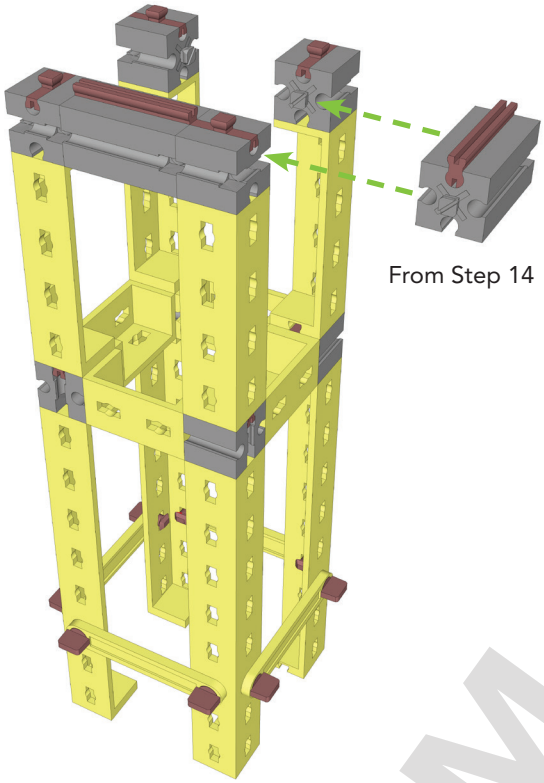

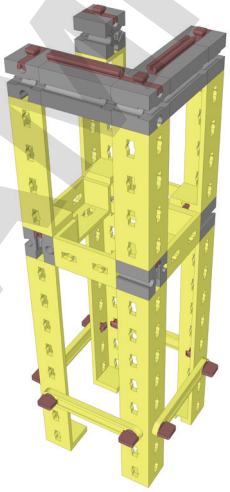

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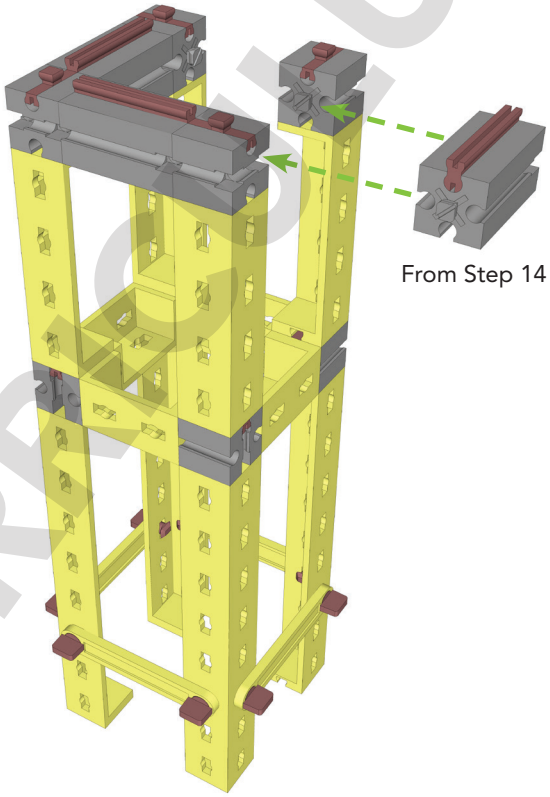

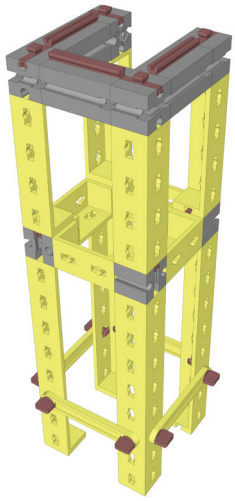

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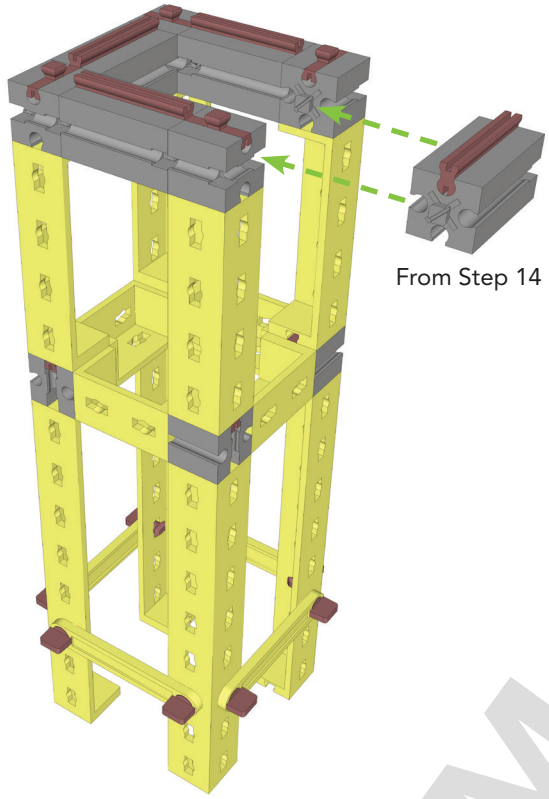
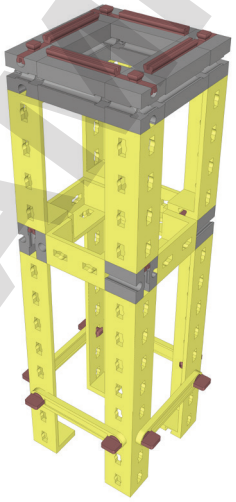
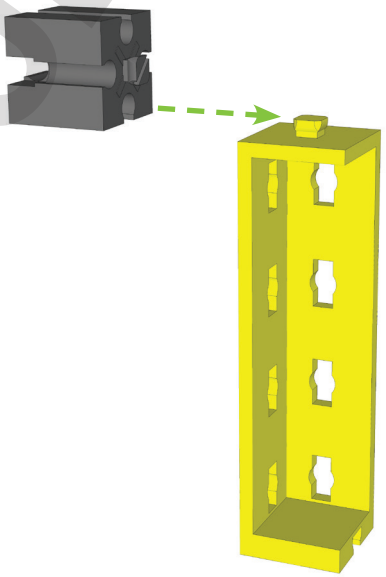


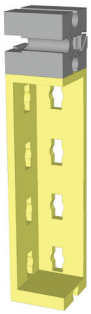


19

x4

x4





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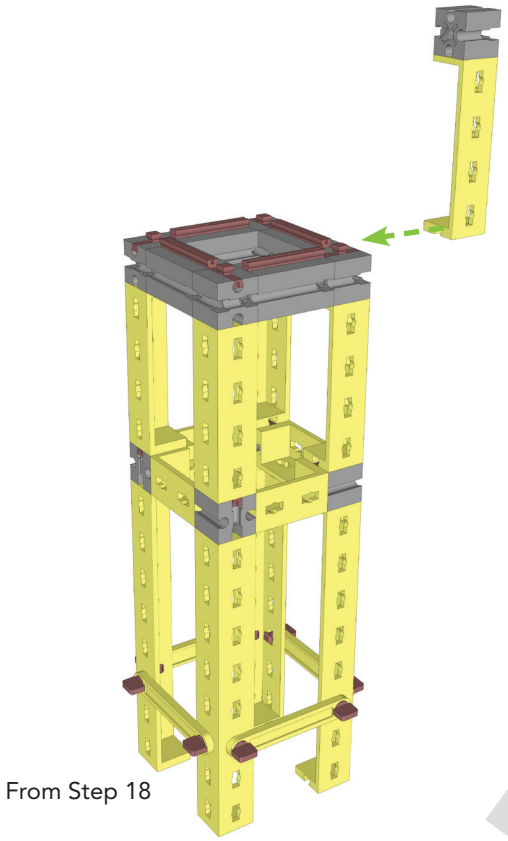
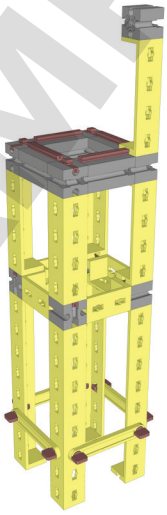


From Step 18



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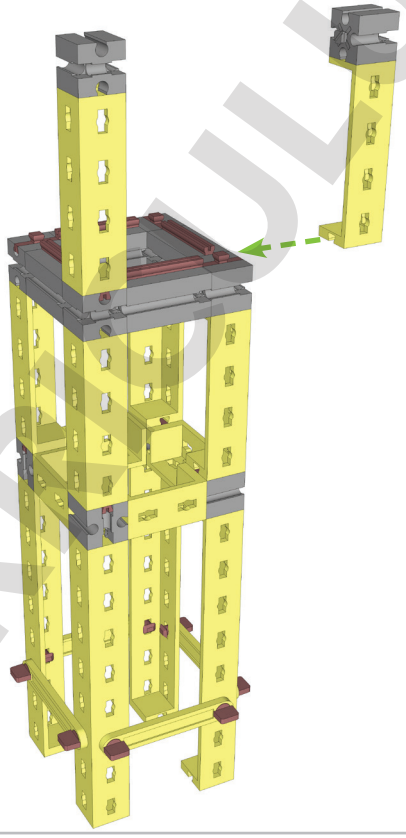
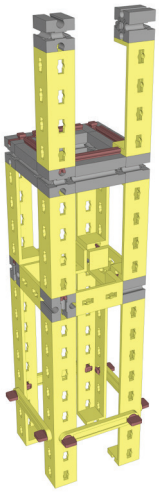


From Step 19



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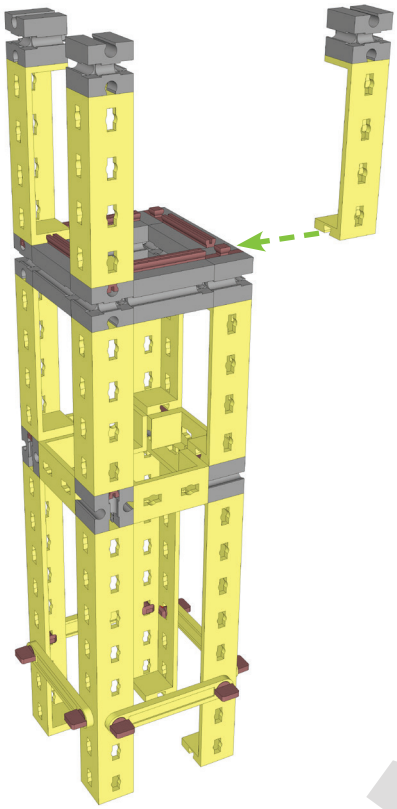
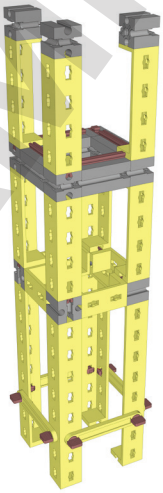


From Step 19



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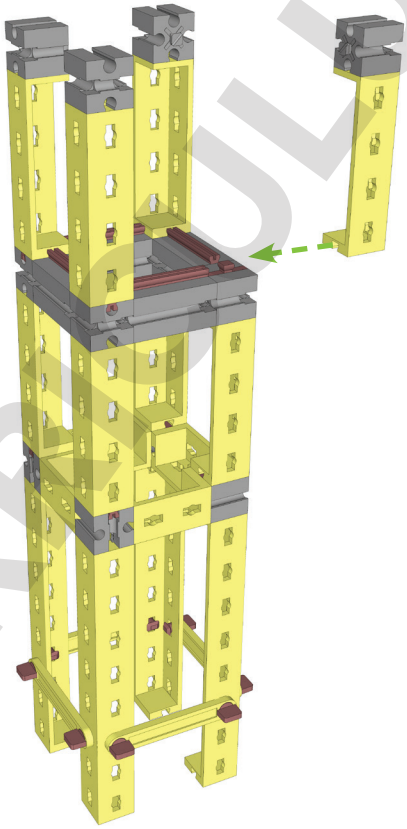

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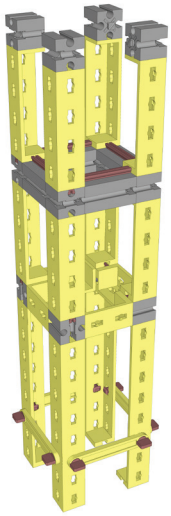
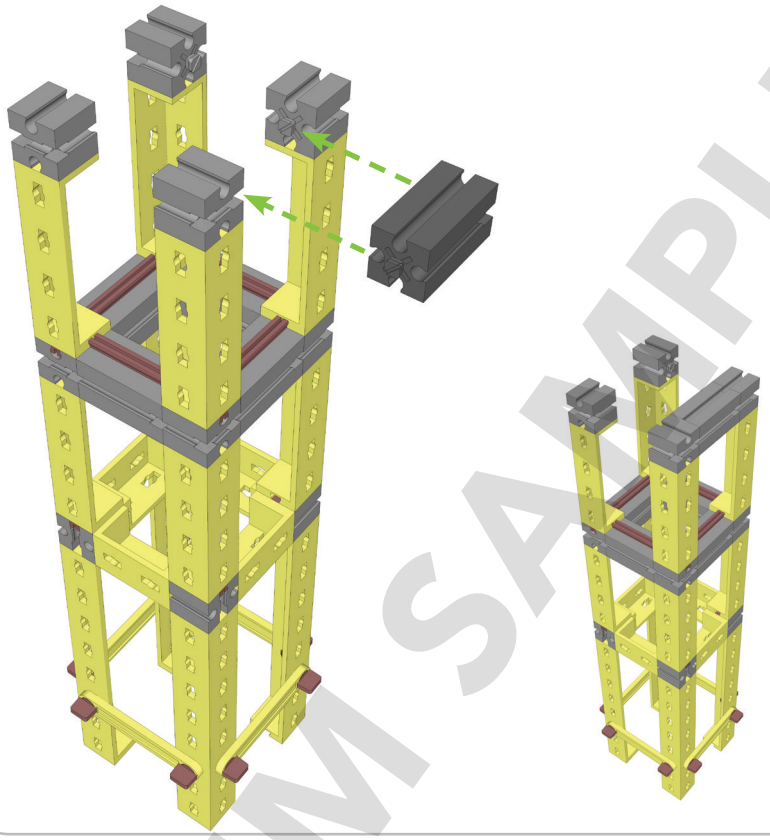


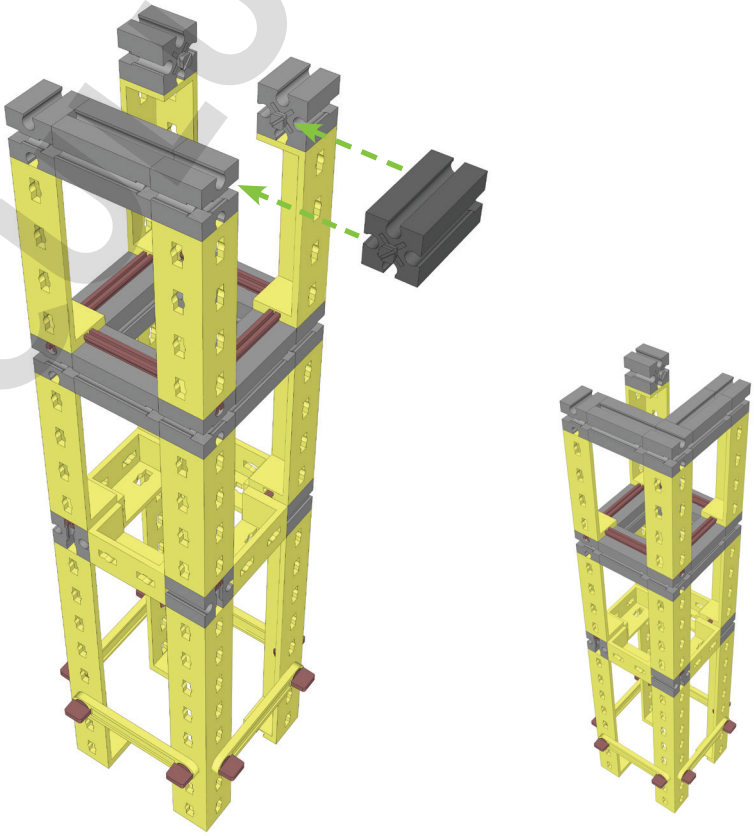
24

x1



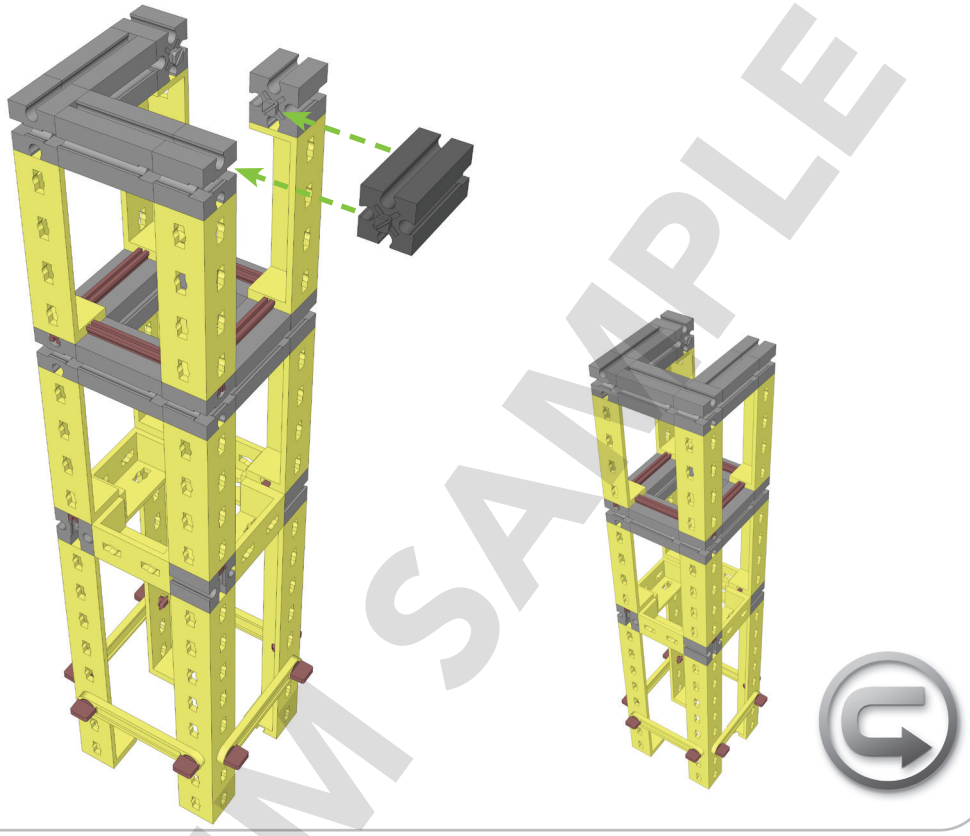
25

x1



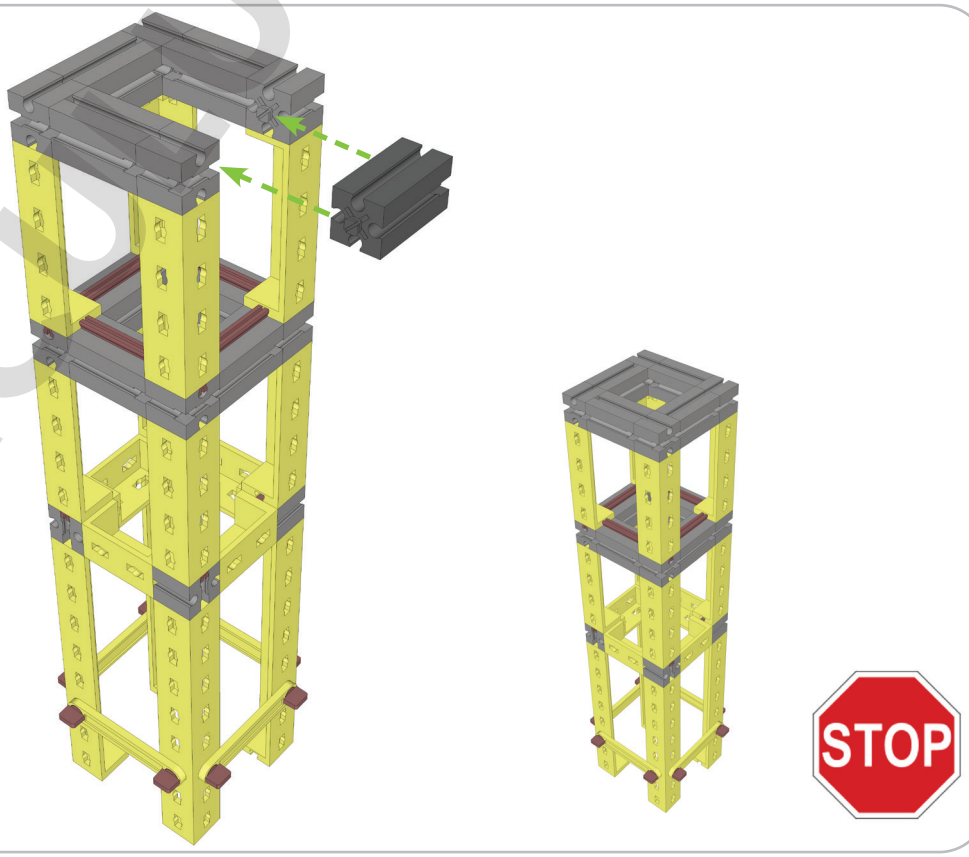
26

x1

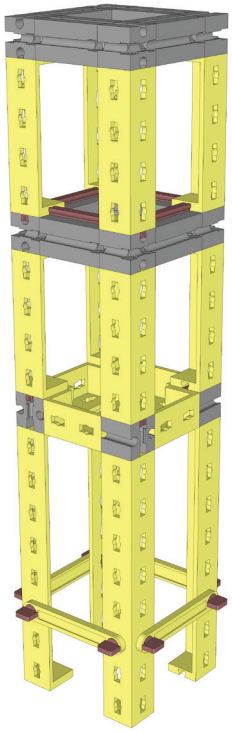


27

x1



Finished Model



You may have noticed that this structure applies the concepts you used in Level 1, (from your post and lintel models). In this case, like with most multi-story buildings, floor decks provide horizontal bracing. Note that no x-struts were used.

If you wish to make the tower even more sturdy, where might you put x-struts? Try a couple of configurations and see if you can determine which provides the most support and efficiency. Would x-struts help with efficiency? You may choose to modify the location of any elements in the tower build.

Think about the shaking frequency of your tower (as you might get from an earthquake). Your tower is probably too stiff to see this, but you might imagine that the more bracing you add, the stiffer it gets, and that a stiff object will wobble at a much higher frequency than a floppy object. This is something to consider when designing in an earthquake zone. Sometimes it's better to reduce the bracing (though usually not -- because there are other things to consider besides earthquakes).

Extension

If you choose to use either extension, be sure to focus your positive commentary on groups' willingness to share their ideas for the advancement of the whole class, rather than on specific groups' designs. Remember that it is paramount to continually foster a climate of collaboration. At the close of this extension, point out that everyone is applying one or more of these design strategies in their subsequent builds.

Option 1:

Present your team's braced tower, along with an explanation of why you thought that your bracing configuration was the most effective (think about strength and efficiency). Demonstrate the resistance to flexibility.

Option 2:

Each tower, with x-struts added, is displayed in the room. Teams of 2 do a gallery walk and select the bracing configuration that seems most effective, and the one that seems most efficient. Individual teams are asked to explain their choices to the group (why they thought the selected models were most efficiently braced).