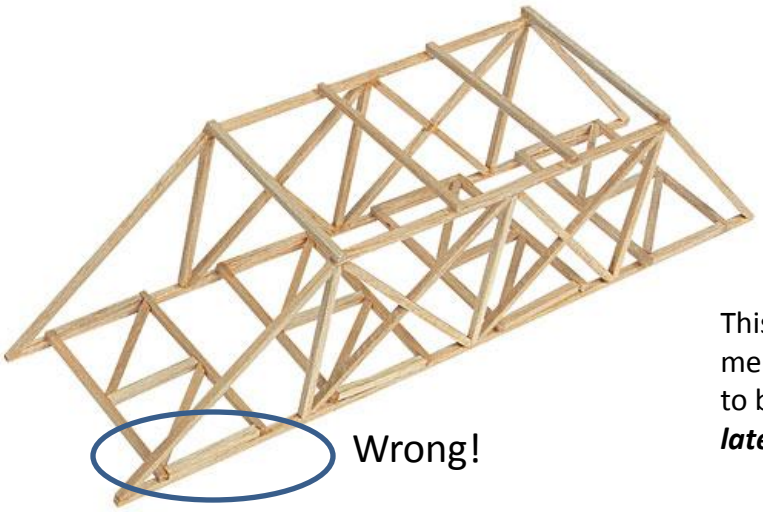
WHITEBOX LEARNING

Structures 2.0 Upgrade Notes

There is a common misunderstanding about how to properly load a physical bridge. Specifically, some bridges are built and tested such that the web members along the roadbed are experiencing a “lateral” or shear load. This is incorrect and undermines the strength of the bridge (and the overall value of the STEM activity). The latest release of Structures 2.0 addresses this problem by expanding the bridge activity to include an emphasis on floor design. This is essential because a proper floor will ensure that the trusses are loaded as intended.

What is this common misunderstanding about loading the bridges?

In general, the members of a truss are slender and can support little lateral load; all loads therefore, must be applied to the various joints and not to the members themselves. To accomplish this on a bridge, a floor system must be included which, through the use of stringers and floor beams, transmits the load to the joints.



This is a flawed design because the “floor” rests on top of the web members of the truss. These web members – which are only intended to be in compression or tension - are thus experiencing an additional ***lateral*** (shear) load.

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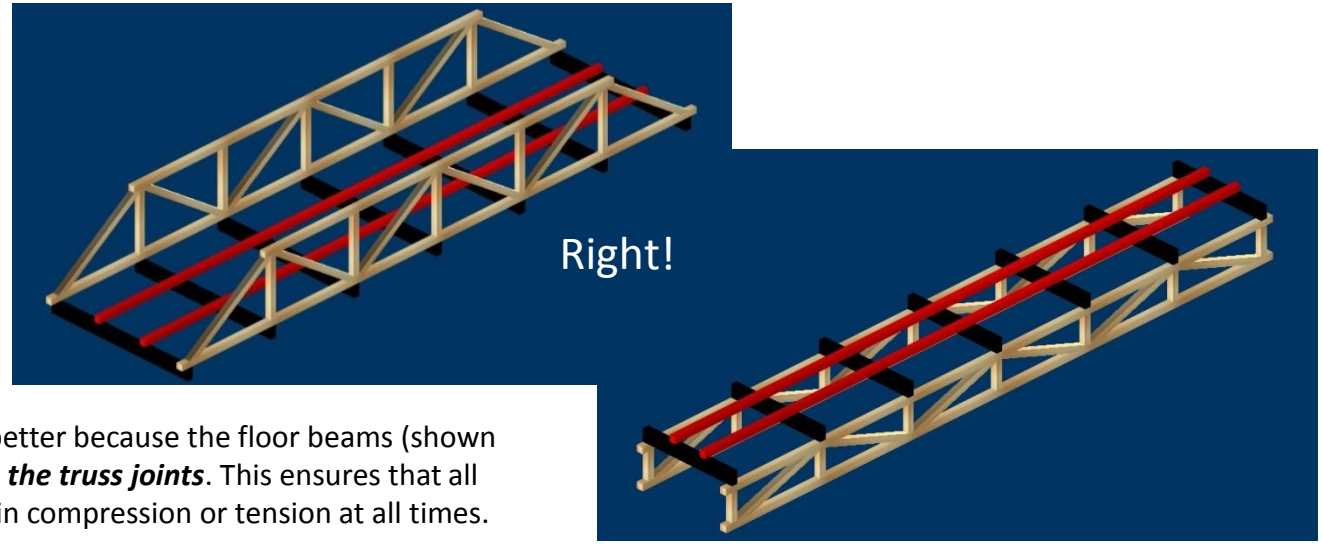
How does a proper floor ensure that the bridge is loaded properly?

- The system automatically designs a “proper” floor. The floor will include floor beams (shown in black), and stringers (shown in red). A proper floor will carry load applied on the roadbed out to the truss joints.
- Students will have the ability to laminate the floor beams or add or remove stringers.
- The application will automatically calculate the capacity of the floor and this will be revealed to the student in the analysis tools.
- The overall capacity of the bridge will now be either the capacity of the floor or the capacity of the truss set (whichever is weaker). Thus students will need to consider both the floor and truss systems as they search for an optimal design.



These designs are much better because the floor beams (shown in black) are ***aligned with the truss joints***. This ensures that all web members are either in compression or tension at all times.

Structures 2.0 Upgrade Notes

Additional (related) changes

- The ***side truss configuration*** will now have ***only*** one truss on either side of the roadbed. We've removed the ability to add multiple trusses on either side of the roadbed because our tests show that the applied load is not transferred to the outside trusses. Thus, any additional trusses on the sides are just "window dressing" and add little to no value to the bridge.
- For the ***side truss configuration***, we've also removed the ability to attach additional trusses below the roadway. These trusses were attached to the underside of the floor beams and therefore their purpose was simply to support the floor as opposed to increasing the capacity of the truss system. Stringers will now accomplish the needed floor support much more efficiently (and much less confusingly from a STEM learning perspective).
- The ***deck truss configuration*** is unchanged (other than that it now has a proper floor). Students may have multiple deck trusses.

This is a typical Side Truss design. It is much simpler in that there are only 2 trusses and a floor. This is much more representative of real world designs and its simplicity draws more focus to the underlying STEM.