

Project #1 - K'NEX Truss

- The objective is to design, analyze, and construction a truss structure using K'NEX connectors and rods with that supports the design loads.
- All structures must hold the design load. Once the design load is sustained, structures with be evaluated based on the largest cost-adjusted strength-to-weight (*SWR*).



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- **Design Report**
 - A written report is required for each K'NEX structure submitted for evaluation.
 - The content and quality of the report will account for 70% of the project score.
 - The remaining 30% of the project grade will be determined by the strength of the structure based on the ultimate strength-to-weight ratio (*SWR*).

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- **Design Report**
 - There are two strength criteria for structures:
 1. all structures must support the design - pound minimum (15% all-or-nothing -- structures supporting 75 pounds or more receive 15 points; structures that do not support the load receive no points; and
 2. the structure with the highest *SWR* is awarded full points (15%) and the remaining structures will be awarded scores commiserate with their performance (first place will be awarded 15 points, second place 14 points, third place 13 points, etc. . .).
 - If a structure does not meet the construction rules, listed below, the submitting student will receive no strength points.

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- **Design Report**

The design report should include, but not limited to the following:

 - *Title page* - name, date and course information
 - *Introduction* - design and report requirements
 - *Structural Design* - a complete set of plans for the structure
 - *Structure Analysis* - a complete design and analysis of the structure including the force in each member for the applied load. Assume the modulus of elasticity of the K'NEX plastic is 377 *ksi*. Also, include a prediction of the ultimate load of your structure. Show evidence that you refined and optimized your structure during the design process.
 - *Summary* - summarize the strengths and weaknesses of your design and give a prediction for the ultimate load and *SWR*.

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- **Design Report**
 - If possible, all structural sketches should be produced using graphical software.
 - Although the progress report should contain all the components of the final report, the objective is to help students refine their designs.
 - Students are encouraged to turn in the progress report before the deadline so they can begin the final design analysis for the final report.

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- **Construction Rules**
 1. Structures must be constructed using only K'NEX pieces.
 2. Glue is not allowed in construction of the structure.
 3. K'NEX members cannot be coated or treated in any way.
 4. The structure must be designed to fit on the support shown in Figure 1.

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Construction Rules

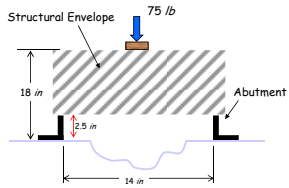
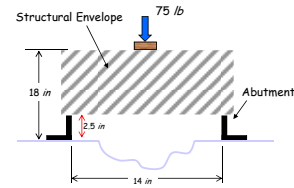


Figure 1. K'NEX structure loading scenario and dimensions

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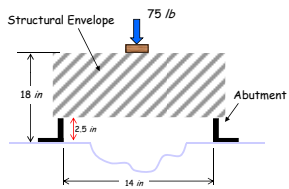
Construction Rules



- 5. Members may not brace off the any part of 14-inch by 2.5-inch bottom support, expect for the top of the abutments.

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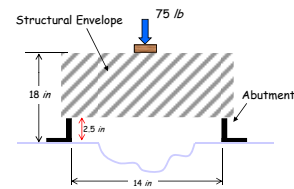
Construction Rules



- 6. The structure must not be taller than 18 inches above ground.

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Construction Rules



- 6. A 4-inch by 4-inch loading block will be placed on the top of the structure at the mid-point.

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- 7. All structures will be loaded to 75 pounds or to failure, whichever comes first. Failure is defined as the point when the structure can no longer support an increased load or collapse.
- 8. Each student may submit only one structure.
- 9. Structural performance will be measured by a strength-to-weight ratio computed in the following manner:

$$SWR = \frac{P}{W_{structure}}$$

where *SWR* is the strength-to-weight ratio, *P* is the ultimate load in pounds, and *W_{structure}* is the weight of the structure in pounds.

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- 9. The cost of each structure will be estimated using the following cost sheet. A cost factor will be computed as follows:

$$Cost\ Factor = \frac{Maximum\ Bridge\ Cost}{Your\ Bridge\ Cost}$$

- 10. An adjusted *SWR* computed as follows:

$$SWR_{Adjusted} = Cost\ Factor \times SWR$$

- 11. The structure with the highest *SWR* ratio will win the event.
- 12. Any modifications or repairs to the structure must be done before registration. Once the structure is registered, no other changes may be made.

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- Construction Rules

CONNECTORS		BEADS and TUBES	
Tan	\$10	Green	\$10
Gray	\$10	White	\$20
Orange	\$20	Blue	\$40
Lt. Gray	\$20	Yellow	\$60
Red	\$30	Dark	\$80
Green	\$50	Gray	\$90
Yellow	\$50	Gold	\$85
Blue	\$70	Large Blue	\$100
White	\$80	Large Gray	\$100
Purple	\$40	Large Red	\$100

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- Schedule

Date	Event
September 15, 2009	Rules and instructions
September 17, 2009	Initial design due
September 28-30, 2009	Prototype Testing (out of class)
October 1, 2009	Preliminary Report
October 8, 2009	Final report and testing

End of K'NEX Truss Project

Any questions?

