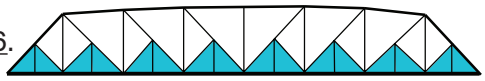
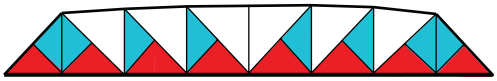
EWEEK SOLUTIONS

FEB. 21, 2023 ● SOLUTIONS TO CIVIL ENGINEERING PROBLEM SET

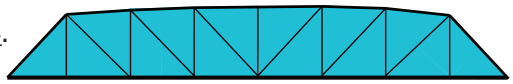
2.1 We can begin by counting the smallest triangles, of which there are 16.



Next, we can count the triangles of the next size up, half of which are composed of two of the smallest size triangle. Altogether there are 16 triangles of this size.

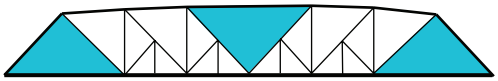


Of the next largest size triangle, there are 14.



Finally, there are 3 of the largest triangles, one on the left end, one on the right end, and one in the center.

Therefore, there are 16 + 16 + 14 + 3 = **49 triangles** in total.



2.2 We are told that each triangle in this section of the bridge is an isosceles right triangle. So, since GD = $4\sqrt{2}$ feet, we know that GC = $4\sqrt{2}$ feet as well. Since DC is the shared hypotenuse of triangles DEC and DGC, we can also say that ED = EC = $4\sqrt{2}$ feet. Since triangles DEB and DGA are isosceles, we also know that DE = EB = $4\sqrt{2}$ feet and AG = GD = $4\sqrt{2}$ feet. Since triangles DEB, DEC, DGC and DGA each have legs of length $4\sqrt{2}$ feet, it must be that these four triangles are congruent, meaning DC = DB = DA = 8 feet. Finally, since triangles FEB, FED, HGD and HGA each have a hypotenuse of length $4\sqrt{2}$ feet, it must be that these four triangles are congruent with legs BF = FE = DF = DH = HG = AH = 4 feet. Thus, $(6 \times 4\sqrt{2}) + (6 \times 4) + 8 = 24\sqrt{2} + 24 + 8 = 24\sqrt{2} + 32 \approx$ **65.9 feet** of steel will be needed.

2.3 Triangle DEF has the smallest area of a triangle in this section of the bridge, and triangle ABC has the largest area. These triangles are similar with corresponding sides in the ratio of $4/(8\sqrt{2})$. So, the ratio of their areas is $4^2/(8\sqrt{2})^2 = 16/128 = 1/8$. Therefore, the area of the smallest triangle is **1/8** that of the largest triangle.

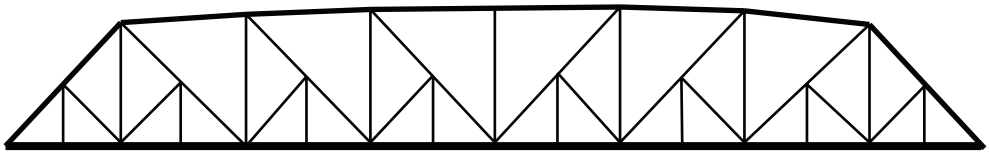
CIVIL

TUESDAY, FEBRUARY 21

E-WEEK ● CIVIL ENGINEERING

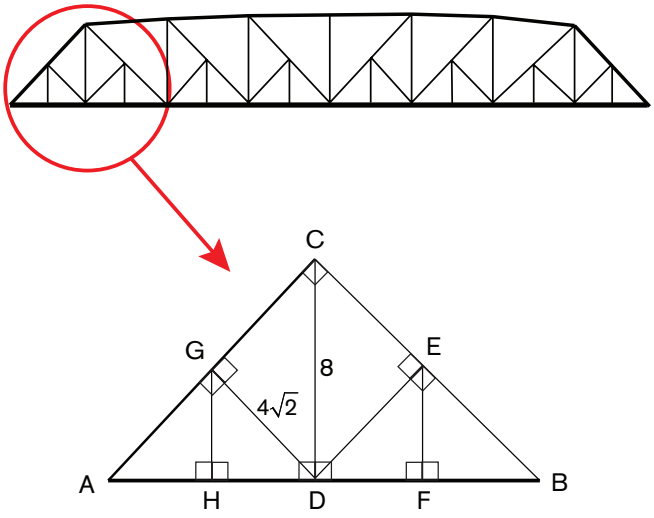
Civil engineers design and build all sorts of infrastructure projects, such as bridges, buildings, roads and railways. *Civil engineers must be precise and technical, creative and flexible to ensure the infrastructure people use every day is efficient and safe.*

A common type of bridge is called a truss bridge, which uses equilateral and/or isosceles triangles to strengthen its structure. Triangles can take weight from a single point and distribute it across a wide base, so it is a common shape used in constructing buildings and bridges. There are many different types of truss bridges with different designs and layouts of the triangles, one of which is called the Pennsylvania truss (shown here).



2.1 How many triangles of any size are there in the Pennsylvania truss bridge shown?

2.2 The triangles in the circled section of the bridge are all similar right isosceles triangles. Using the measurements provided here (in feet), how many feet of steel will be needed to construct this section alone? Express your answer as a decimal to the nearest tenth.



2.3 Refer to the previous enlargement of the circled section of the bridge. In this section of the bridge, the area of the smallest triangle is what fraction of the area of the largest triangle? Express your answer as a common fraction.