The FUTURES Channel®

MOVIE GUIDE

MOVIE NUMBER 4010

The ABC's of Architecture

The Movie:

When Penn Station needed a new front entrance, they called upon architect Frances Halsband, and she called upon her knowledge of geometry. Featured: Frances Halsband, architect. *(Movie length: 3:11)*

Background:

The icons of civilization are the structures that men and women build to hold it, and it seems this is true of every era. Babylonian ziggurats, Egyptian pyramids, Greek temples, the Roman Coliseum, Moslem mosques, medieval cathedrals, modern office buildings, malls, museums, and concert halls—each such edifice represents a substantial investment of time, materials, money and labor. Large buildings, apparently, have great value.

But that value is not just a matter of size and utility. Buildings can also be beautiful, and though it may cost significantly more money to make them that way, we sometimes do it anyway. Or more accurately, we ask our architects to do it.

The word "architect" means, in Greek, "chief worker". And indeed architecture is far from an ivory tower profession: the architect is finally responsible, not just for the way a building looks, but for how well it fulfills its function, the integrity of the structure and materials, and the bottom line cost of construction. It all adds up to a very challenging and rewarding career, and, occasionally, an opportunity to build an icon.

Curriculum Connections:

Measurement (length, area), Ratios, Decimals 1

Suppose that you are going to build a doghouse. The floor, sides and roof will be made of plywood. There will be carpeting on the floor and shingles on the roof.

First you will need to decide how much material to buy and how much it will cost.

a) Make a scale model of your doghouse, with all of the dimensions on it. (It is up to you to decide how big to make the doghouse.)

b) Use the data below to calculate how much it will cost to build and paint:

- Each 4' x 8' sheet of plywood costs $15.16.
- The kind of carpet you will use costs $4.53 per square foot.
- Each of the shingles you will use will cover 64 square inches of roof area, and they cost $1.42 each.
- One gallon of paint costs $19.46 and will cover 300 square feet with one coat.

Ratios, Measurement (length conversion) 2

This photograph shows the Arc de Triumph, in Paris. Based on the dimensions given, create accurate front, side and top view drawings of the building at a scale of 1/16" = 1'.

Height = 50 meters

Width = 45 meters

Thickness = 22 meters

Width of arch = 10 meters

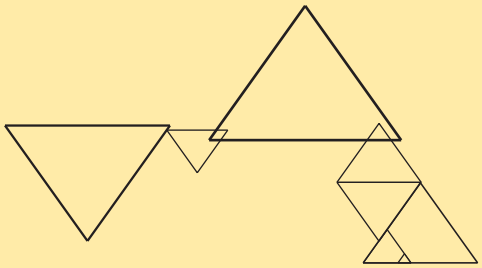
Height of arch = 35 meters

(Top of arch is semicircular in shape)

Ratios, Geometry (polygons, similar figures) 3

The drawing below shows the basic structure of a building designed by architect Frank Lloyd Wright. It is called the Palmer House, and is located in Ann Arbor, Michigan.

You can see that this structure is based on a collection of similar equilateral triangles.

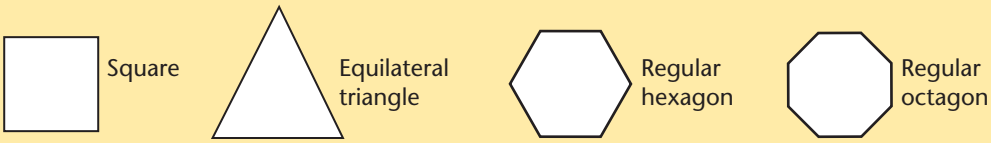


Design an apartment building based on the use of similar regular hexagons. Show what one floor of the building might look like with a hexagonal outer wall and several hexagonal apartments with hexagonal rooms.

Use the fact that the interior angles on a hexagon are always equal to 120° to make your drawing.

Geometry (polygons) 4

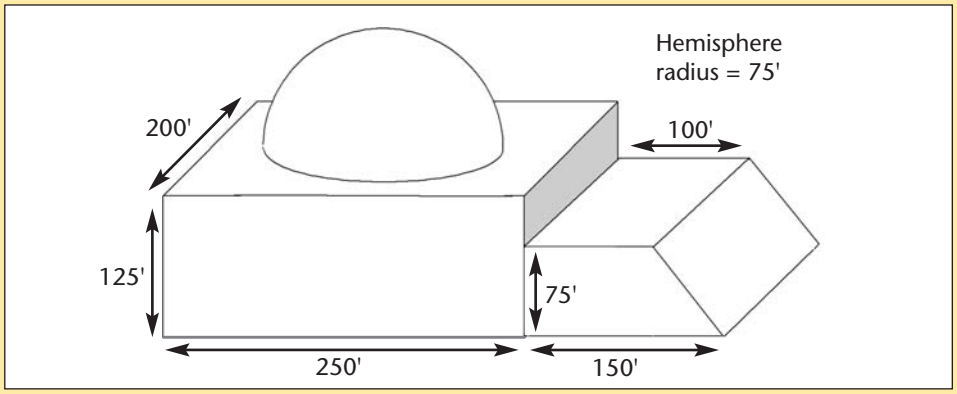
Suppose you have enough materials to build a wall 120 feet long. Which of the shapes below would you build in order to enclose as large an area as possible?



(Note: The area of an equilateral triangle with sides of length S is $\frac{\sqrt{3}}{4} S^2$.)

Geometry (volume) 5

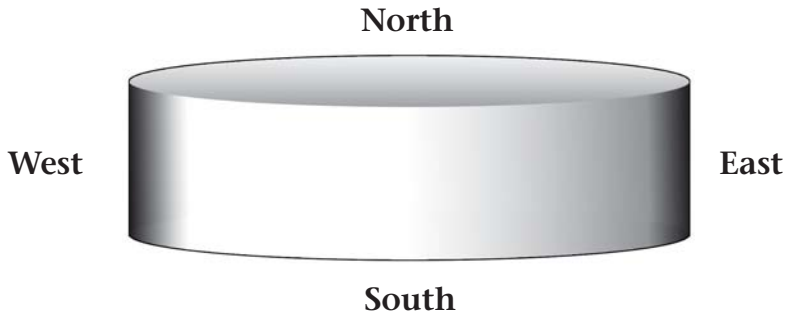
In order to select the proper air conditioning equipment for a building, you must know the building's total volume. Find the volume of this structure:



SkyHighScrapers

To: Structural Engineering Team #5
From: R. Shreve, Chief Architect

We just got back the data from wind tunnel testing for our proposed "double-decker" sports arena.



The "Double-Decker"

The table belows shows the pressure when the wind blows from the west and from the north.

The pressure, of course, increases with higher wind speed. Theoretically, we expect that the relationship is quadratic:

$$p = av^2 + bv + c$$

Can you help us out?

- For the east wind data, graph the data, then find the values of *a, b,* and *c* for the quadratic equation that gives a good fit to the data in the table. Draw the graph of your equation on top of the graph of the original data, so I can see how well it matches. Use that equation to give us an estimate for the pressure for wind speeds for 5 mph and 100 mph.
- Do the same thing for the north wind data.

Rich

East Wind		North Wind	
Wind speed (miles per hour)	**Pressure (pounds of force per square foot)**	**Wind speed (miles per hour)**	**Pressure (pounds of force per square foot)**
10	1	10	2
20	1.6	20	3
30	2.8	30	4.5
40	4.3	40	6.5
50	5.9	50	10
60	8.1	60	13
70	11	70	16.5
80	14	80	22

Teaching Guidelines: SkyHighScrapers
Math Topics: Algebra (quadratic equations)

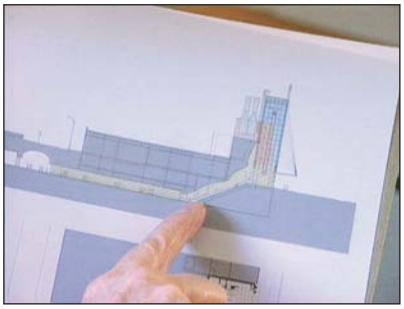
Procedure:

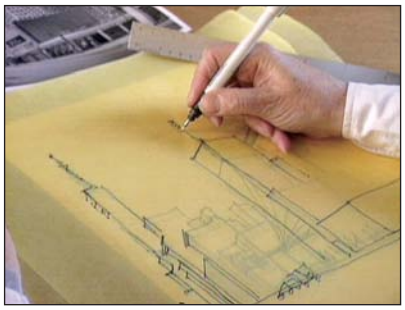
This activity is best done by students working individually or in teams of two.

Distribute the handout and discuss the task. Make sure that students understand the two variables involved (speed of the wind, and the pressure against the side of the building). Discuss how those variables might be related (as speed increases, pressure would increase) and other factors that might affect that relationship (shape of the building, direction of the wind).

To find the values of a, b, and c, students will need to choose three data points. When they have done this once, you may then wish to have them determine a, b, and c for different data points and see how closely those values match, and then perhaps use the averages of the values of a, b, and c as their proposed function.

In wrapping up, you may wish to discuss why the pressures seem lower for the west wind.



If you enjoyed this Futures Channel Movie, you will probably also like these:

Inventing with Polygons, #1007	This inventor uses polygons to build amazing expandable structures.
The Art Director, #4004	A set is a place where actors can be placed for filming. Creating a set where everything fits just right calls for an understanding of area.
Geometry and Structural Engineering, #1009	Structural engineers use shapes to design huge buildings and bridges.