Townhouse Tribulation

Using the townhouse worksheet, determine the number of square feet of brick needed for...

1 townhouse
2 townhouses
3 townhouses
10 townhouses
N townhouses

Grade Levels 6 - 8

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Context

This task was given to sixth grade students who had just finished a unit on functions and algebra. Students previously had studied the area of polygons.

What This Task Accomplishes

This task allows students to find a rule for determining the number of sides connecting townhouses will have. It also provides them with a problem-solving situation to apply concepts and skills for finding areas of polygons.

Time Required for Task

1-2 hours

Interdisciplinary Links

This task brought up an interesting discussion on why townhouses or condominiums tend to be less expensive than building single-family homes. Students who live in townhouses shared that they know that only one wall exists between two townhouses in that they can usually hear everything that happens next door. So as you can see, this task can link to construction and the pros and cons of cutting corners, or in this case, walls.

Teaching Tips

Students had a prior week of instruction on looking at patterns and creating function tables and rules based on the patterns. This provided students with some problem-solving skills with which to approach the task. Students who were not able to find an algebraic rule were still able to use logic to solve the problem. To make the task less complicated, you can provide the areas of one, two and three townhouses, but I wanted students to apply their prior knowledge of geometry so I could recheck for mastery.

Suggested Materials

- Pencil
- Paper
- Calculators
- Townhouse worksheet (see page 4)
- Formula sheet (Some students needed to refer to this for finding the area of triangles.)

Possible Solutions

- Area of three sides of townhouse = (25' x 20') = 500 x 3 = 1500 square feet
- Area of front of townhouse = 500 - 19.5 (area of door and windows) = 480.5 square feet
- Area of roof peeks: (.5) (25') (20') = 250 x 2 peeks = 500 square feet
- Total area of one townhouse = 2480.5 square feet
- Two townhouses = 2480.5 - 500 for shared wall = 1980.5 square feet + first townhouse 2480.5 = 4461 square feet
- Three townhouses = 2480 + 1950.5 + 1950.5 = 6441.5 square feet
- Rule for any number of townhouses is 1980.5N - 500 = square feet of bricks needed for any townhouses where N = number of townhouses.

Benchmark Descriptors

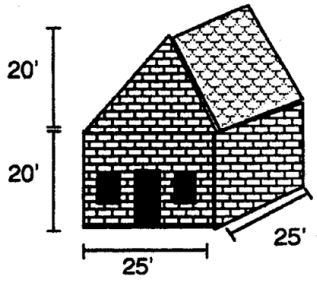
Novice
Few or no parts of the task are correct. Little math reasoning is used. Attempts at using math language may be present, but rudimentary.

Apprentice
Some parts of the solution are correct, but the student is unable to correctly solve for N and 10. Representations are accurate for the student's solution. Some work is missing. Some correct math language is used.

Practitioner
All work is shown. Math representations and language communicate the student's solution. Answers are correct for all parts. The approach used is clearly explained.

Expert
All work is shown, labeled and organized. Math representations are used to solve and communicate the solution. The student shows/explains the derivation of the rule for N townhouses. Algebraic notation is used correctly. All parts of the solution are correct.

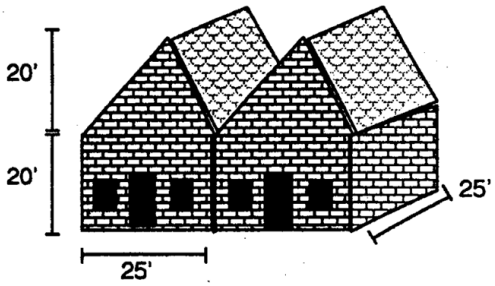
Townhouse Tribulation



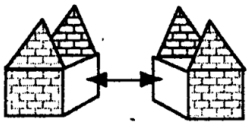
1 Townhouse

Note: Roof is made of shingles, not bricks.

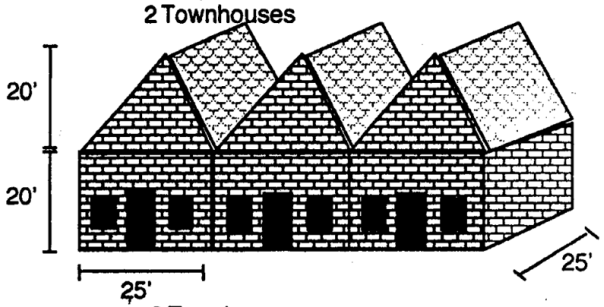
Note:
Dimension of door: 2' x 6'
Dimension of windows: 1.5' x 2.5'



2 Townhouses



Note: Only one solid wall of bricks is needed where 2 townhouses join.



3 Townhouses

Novice

# of townhouses	tri	Rec	total
1	2	4	6
2	4	6	16
3	6	8	14
10	20	22	42
n	2n	$2n^{+2}$	$4n^{+2}$
100	200	202	402
1000	2000	2002	4002

Few or no parts of the task are correct.

8000 n=10

3.75 The total # of Bricks for 1 townhouse is 7996 Bricks for 2 it is 23985 for 3 it would take 31,966 bricks for ten

Little math reasoning is used.

Attempts at using math language and representations are present.

Apprentice

Townhouse tribulation

Some parts of the solution are correct, but the student is unable to correctly solve for N and 10.

function table

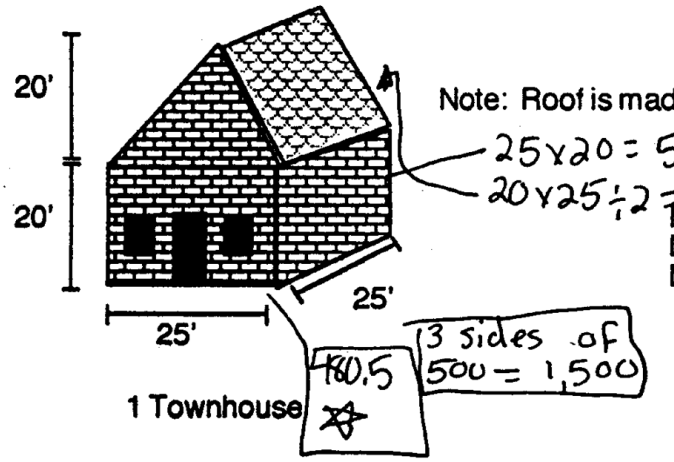
Some work is missing on how the student achieved areas for one, two and three townhouses.

section	roofs	sides	back	front	total
1	500	1000	500	480.5	2480.5
2	1000	1500	1000	961	4461
3	1500	2000	1500	1441.5	6441.5
N	500N	$500N+$500	500N	480.5N	2480.5N
10	5000	$500	5000	4805	24805
100	50,000	$5000	50000	48050	248,050

Some correct math language is used.

The representations are accurate and appropriate to the student's solution.

Practitioner



Note: Roof is made of shingles, not bricks.

25x20 = 500 sq. ft. of bricks.

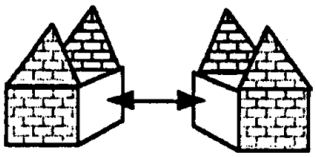
20x25÷2 = 250 sq ft. of bricks

Note:
Dimension of door: 2' x 6' 12
Dimension of windows: 1.5' x 2.5' 3.75

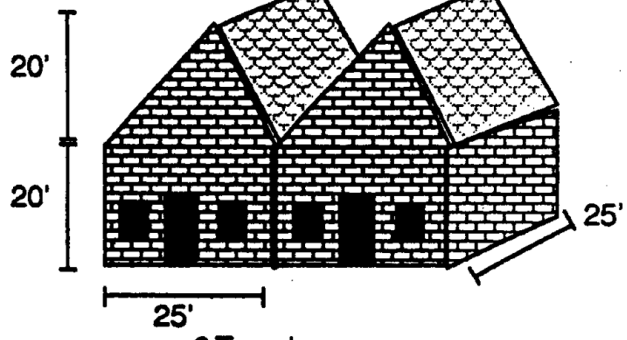
3.75+3.75=7.5

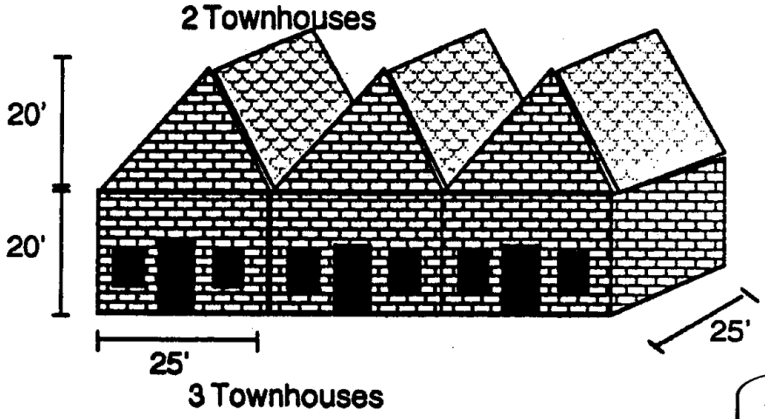
160.5

3 sides of 500 = 1,500



Note: Only one solid wall of bricks is needed where 2 townhouses join.

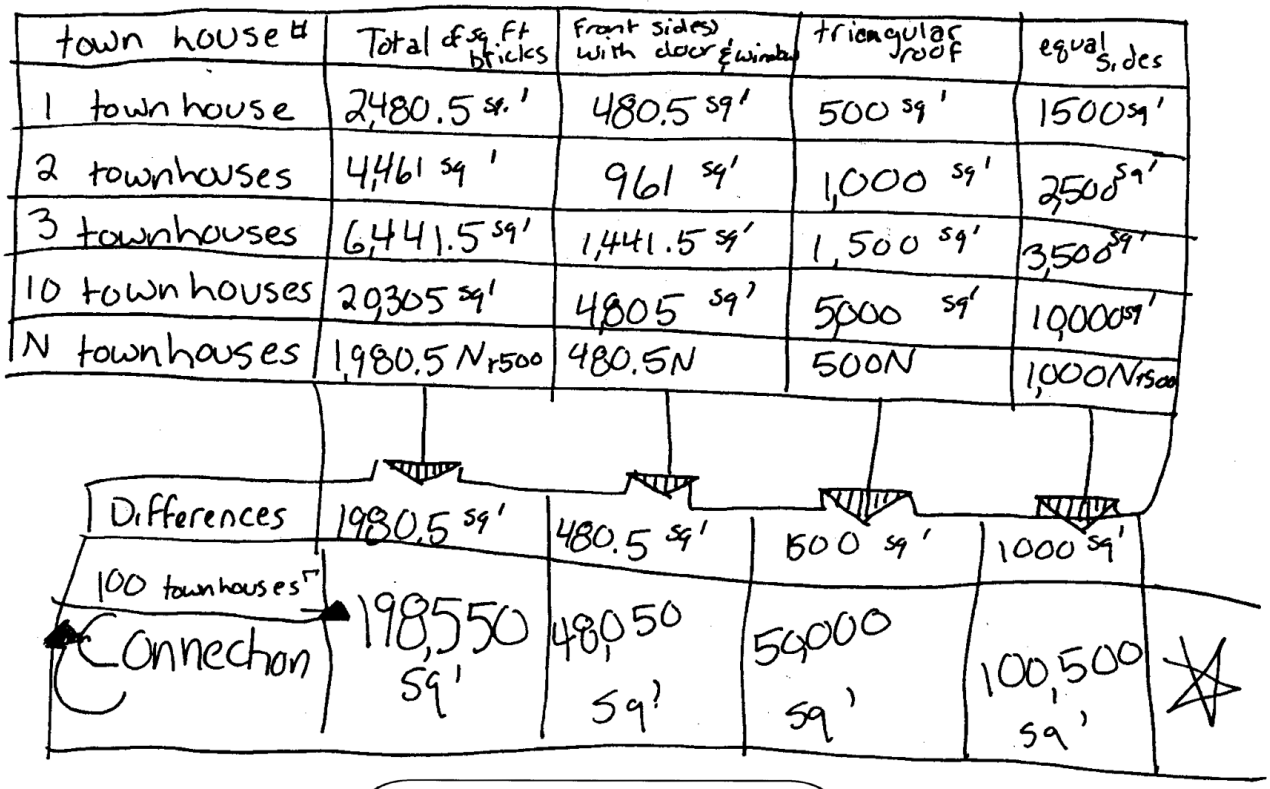




All work is shown.

Math representations and language communicate the solution.

Practitioner



town houses #	Total # of sq. Ft bricks	Front sides with door & window	triangular roof	equal sides
1 townhouse	2480.5 sq.'	480.5 sq'	500 sq'	1500 sq'
2 townhouses	4,461 sq'	961 sq'	1,000 sq'	2500 sq'
3 townhouses	6,441.5 sq'	1,441.5 sq'	1,500 sq'	3,500 sq'
10 townhouses	20,305 sq'	4805 sq'	5000 sq'	10,000 sq'
N townhouses	1,980.5 N + 500	480.5N	500N	1,000N + 500

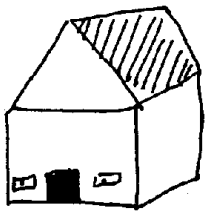
Differences	1980.5 sq'	480.5 sq'	500 sq'	1000 sq'
100 townhouses	198,550 sq'	48,050 sq'	50,000 sq'	100,500 sq'

Connection

The student extends the solution to 100 townhouses.

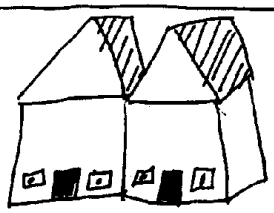
Townhouse Tribulation

Practitioner



Key= =shingles
=bricks
=door
=window

Townhouse #1:
The 3 sides that are the same dimension add up to 1500 because they all have a measure of 20'x25'? The side with the doors/windows is 20'x25' but you have to subtract 19.5' because of the windows/door? The triangular part of the roof is 20'x 25' → which equals: 500' You add all these answers together and it will come out as 2480.5 sq'?

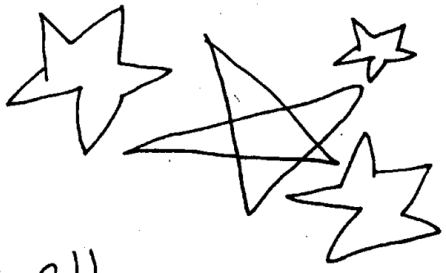


Townhouse # 2:
The 5 sides that have the same dimension add up to: 2500 sq'. The sides with the doors/windows is 20' x25' x2 -19.5'. This comes out to be 961 sq'. The triangular→

Correct work is shown throughout.

Practitioner

parts of the roof all equal 500 so multiply by 4 so,: 1000 sq' ▽ When you add all these together, it comes out as 4461 sq' ▽



Townhouse #3:

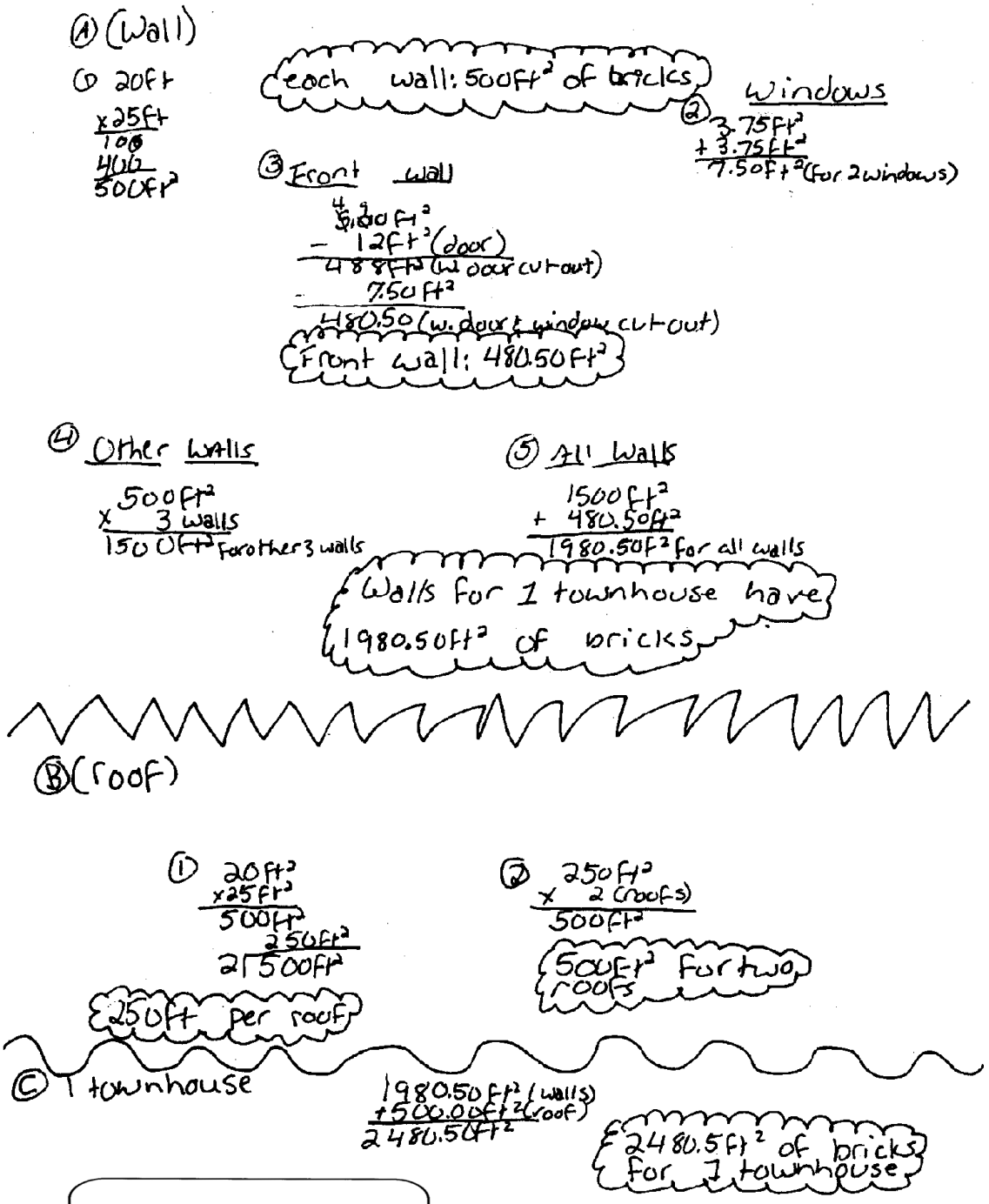
The 7 sides that all have the same dimension equal 3,500 sq' ▽ The sides with the doors windows is 20'x25'x3-19.5' which equals 1441.5 sq' ▽ The triangle parts are added up to: 1500 sq' ▽ When you add 24 these together, it comes out as 6441.5 sq' ▽

N and 10 townhouses:

You would figure N by finding the difference between each number of square footage in bricks. You will find the differences - and answers on the separate paper ▽ When you find N you can find 10 townhouses Connection on other page too ▽

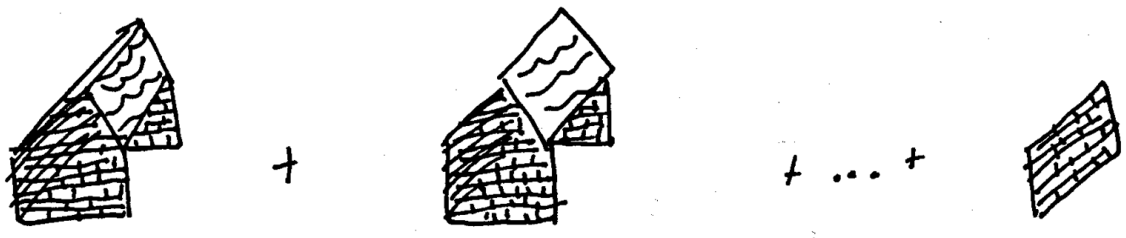
The student explains the approach used to solve the problem.

Expert



All work is shown, labeled, and organized.

Expert



1 front wall (480.5ft²)
1 left wall (500ft²)
1 back wall (500ft²)
2 roofs (500ft²)
1980.5ft²

+

1 front wall (480.5ft²)
1 left wall (500ft²)
1 back wall (500ft²)
2 roofs +(500ft²)
1980.5ft²

+ ... +

1 right wall (500ft²)

Funtion Table

townhouse	wall (500ft²)	frontwall (480.5ft²)	roof (250ft²)	total
1	3	1	2	6
2	5	2	4	11
3	7	3	6	16
N	2N+1	N	2N	

The student shows the derivation of the rule for finding for N number of townhouses.

Math representations are used to solve and communicate the solution.

① Wall
$(2N+1)(500ft^2) = 1000Nft^2 + 500ft^2 x$

② Front wall
$(N)(480.5ft^2) = 480.5Nft^2$

③ roof
$(2N)(250ft^2) = 500Nft^2$

④ $1000Nft^2 + 500ft^2 \times 1$
$480.5Nft^2$
$+ 500Nft^2$
$1980.5Nft^2 + 500ft^2$

Expert

(E) Funtion Table

townhouse	wall (500ft² each)	frontwall (480.5ft² each)	roof (250ft² each)	total
1	1500ft²	480.5ft²	500ft²	2480.5ft²
2	2500ft²	961ft²	1000ft²	4461ft²
3	3500ft²	1441.5ft²	1500ft²	6441.5ft²
4	4500ft²	1922ft²	2000ft²	8422ft²
5	5500ft²	2402.5ft²	2500ft²	10402ft²
N	(2N+1)(500ft²)	(N)(480.5ft²)	(2N)(250ft²)	[(2N+1)(500ft²)]+[(N)(480.5ft²)]+[(2N)(250ft²)]
10	10500ft²	4805ft²	5000ft²	20305ft²
100	100500ft²	48050ft²	50000ft²	198550ft²

(F) Write-up

First, I figured out the dimensions of the walls for 1 townhouse. I found, the square footage for 1 wall, the found the square footage for three walls and for the last wall I subtracted the area of the doors and windows. I did the same for the roof and added them together. Next, for 'Visual 'N'' I drew pictures of the townhouses. Since there is only one wall in between two townhouses, each townhouse would be missing a right wall. The left wall of the second townhouse would be the right wall of the first. All that you would have to do is add a right wall on at the end. I prove this with the math below the

The student achieves correct answers to all parts of the problem.

Algebraic notation is used correctly.

Expert

drawing. In section E (Function Table) I put all the information I already used in to the graph. For N it was relativly simple because it was what I had in the proving of the picture times the square footage of one ~~th~~ part: of the house.