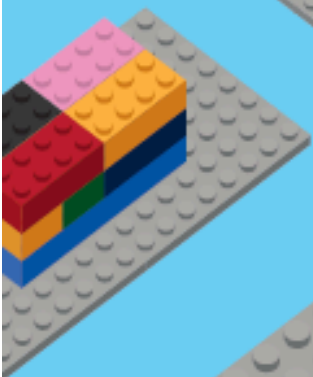
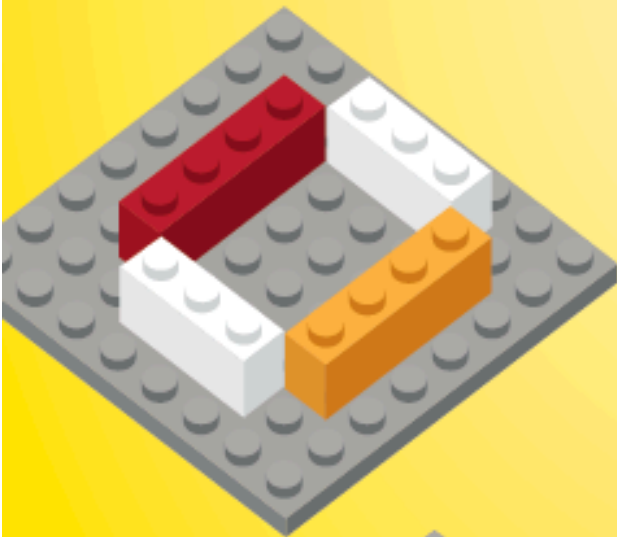


TEACHER EDITION

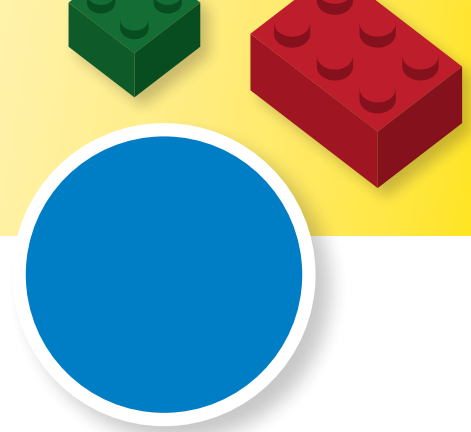


ADVANCED MEASUREMENT AND GEOMETRY

USING LEGO® BRICKS



Dr. Shirley Disseler



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- Suggested Brick Inventory
- Student Assessment Chart
- Baseplate Paper



SUGGESTED BRICKS

Size	Number
1x1	10
1x2	10
1x3	12
1x4	10
1x6	4
1x8	4
1x10	2
1x12	2

Note: Using a baseplate helps keep the bricks in place. One baseplate is suggested for these activities.

DISCOVERING THE FORMULA FOR PERIMETER

Students will learn/discover:

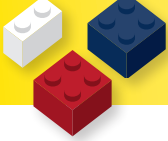
- How to find the perimeter of regular and irregular shapes
- The formula that applies to perimeter

Why is this important?

Understanding the meaning of perimeter is important in real-life problem solving, such as fencing a yard or building a pen for a pet. Discovering the formula for perimeter, instead of memorizing it, helps students relate perimeter to area and surface area. Formulating relationships among the topics of area, surface area, and volume all begin with a clear understanding of perimeter. In this chapter, students will discover the ways to write formulas to find the perimeter of both regular and irregular polygons.

Vocabulary:

- **Perimeter:** Distance around the outside of a shape
- **Polygon:** Any closed shape with three or more straight sides
- **Regular polygon:** A polygon with all angles equal and all sides equal
- **Irregular polygon:** A polygon that does not have all angles equal and sides equal
- **Sum:** solution to an addition problem



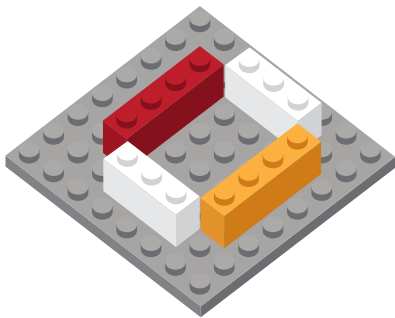
How to use the companion student book, *Advanced Measurement and Geometry Using LEGO® Bricks—Student Edition*:

- After students build their models, have them draw the models and explain their thinking in the Student Edition. Recording the models on paper after building them with bricks helps reinforce the concepts being taught.
- Discuss the vocabulary for each lesson with students as they work through the Student Edition.
- Use the chapter assessments in the Student Edition to gauge student understanding of the content.

Part 1: Show Them How

Ask students what they know about perimeter. Make sure students understand that perimeter is the distance around a given shape or space.

Note: Although perimeter was modeled differently in *Basic Measurement Using LEGO® Bricks*, this method of modeling rectangular shapes without corner studs is preferred in this book, when perimeter and area will often be considered together.

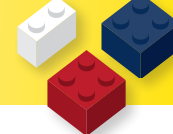


Problem #1: Perimeter of a regular shape

- 1.** Build a rectangle using two 1x4 bricks and two 1x3 bricks as illustrated. Have students build the same rectangle.
- 2.** Ask students how to determine the distance around the shape without counting studs (*answer:* add the sides together; $4 + 3 + 4 + 3 = 14$ studs).
- 3.** Ask students if there is a way to write this formula for perimeter more simply. Students should notice that in this shape, the opposite sides are equal. Point out that this is an attribute of all rectangles. *Note:* This is a good time to review shape attributes.

Since the two opposite sides are the same, multiplication can be used to write this in a simpler way:

$$2(4) + 2(3) = 14 \text{ studs.}$$



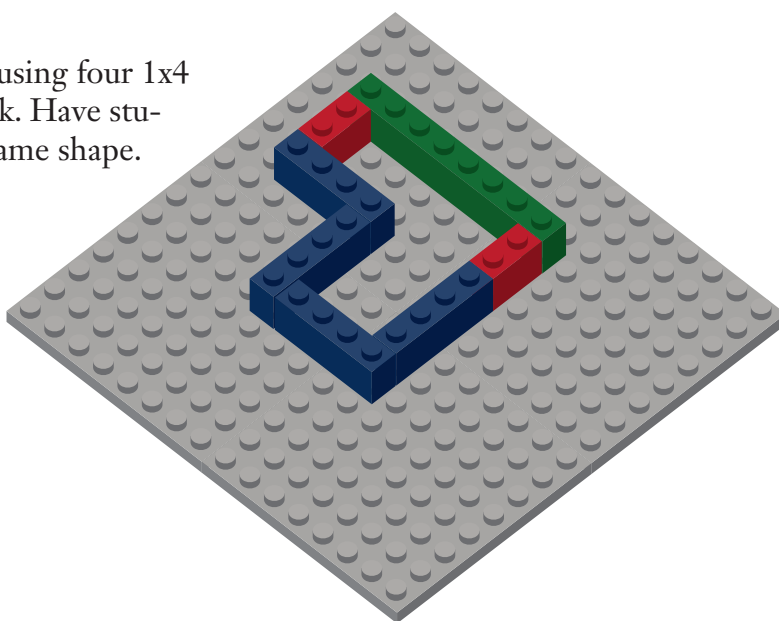
4. Since 4 and 3 are the lengths of the sides of the rectangle, show students how to use the letter S to represent a side.

Explain to students that the formula $2S + 2S = P$ works for all rectangles. *Note:* Remind students that squares are rectangles too!

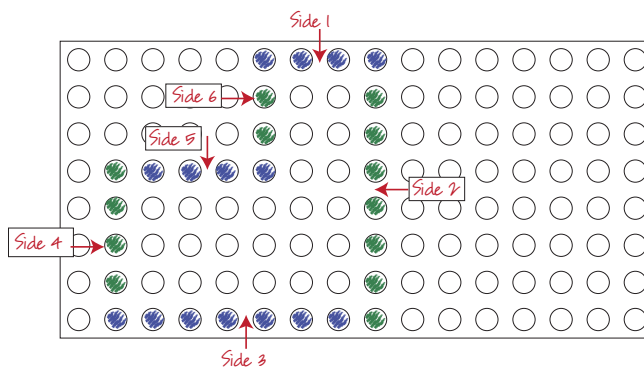
Problem #2: Perimeter of an irregular shape

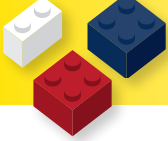
Note: When modeling irregular polygons with “interior” corners, use the same modeling technique as used in *Basic Measurement*. To determine perimeter from these models, studs at “exterior” corners will be counted twice, and studs at “interior” corners will be counted only once.

1. Build the irregular shape as illustrated, using four 1x4 bricks, two 1x2 bricks, and one 1x8 brick. Have students use the same bricks to build the same shape.
2. Ask students how to find the perimeter (*answer:* add all the sides).



3. Have student draw the model and number each side.





4. Have students record the length of each side in a chart as shown.

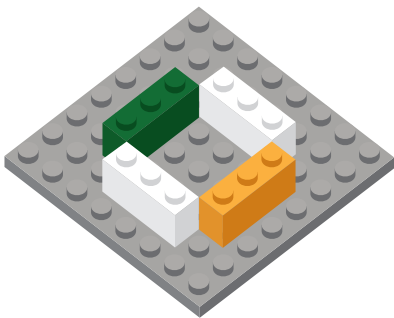
Sample chart:

Side	Length in studs
1	4 studs
2	8 studs
3	8 studs
4	5 studs
5	4 studs
6	3 studs

5. Ask students to find the perimeter of the shape by adding all the sides together (*answer*: perimeter = 32 studs).

Ask students to discover a formula for finding the perimeter of this shape (*answer*: $S + S + S + S + S + S = P$).

Note: Make sure students understand that if the shape is not a rectangle, all the sides must be added to get the perimeter or distance around the shape.



Problem #3: Perimeter of a square

1. Build a 3 x 3 square as illustrated. Have students build the same square.
2. Ask students to determine the length of each side (*answer*: 3 studs). Ask students to consider the formula for the perimeter of this shape, with all sides being the same length, and using the letter S to denote the length of the side (*answer*: 4 sides x number of studs in each side, or $4S$).

Have students substitute and solve the formula for the perimeter of this shape (*answer*: $4 \times 3 = 12$ studs).



Part 2: Show What You Know

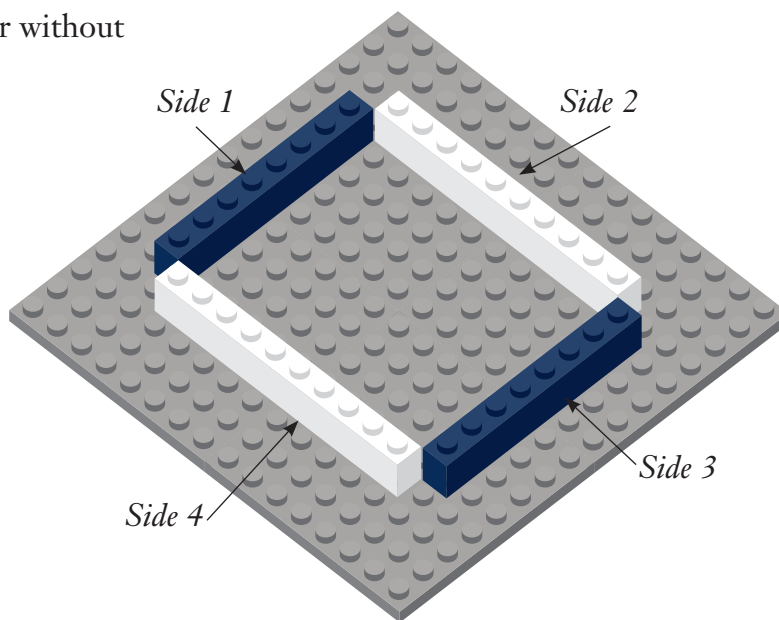
- Can you build a rectangle with sides of 8, 10, 8, and 10 studs? Draw your rectangle. Label the sides 1, 2, 3, and 4. Record side lengths in a table. Write a formula that shows the total perimeter of the rectangle.

Note: Rectangles can be modeled with or without corners.

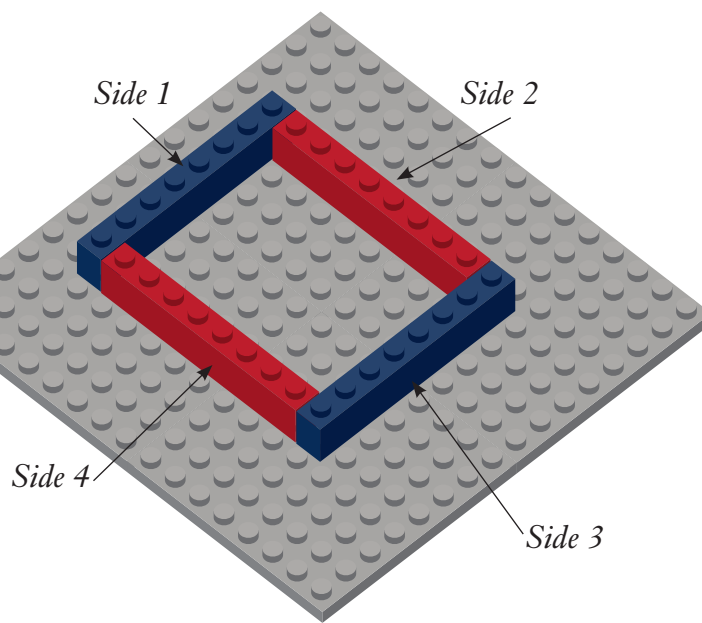
Possible solution:

Side	Length in studs
1	8 studs
2	10 studs
3	8 studs
4	10 studs

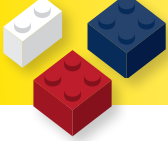
Formula: $2 (S) + 2 (S) = \text{perimeter}$
 $2 (8) + 2 (10) = 16 + 20 = 36 \text{ studs}$



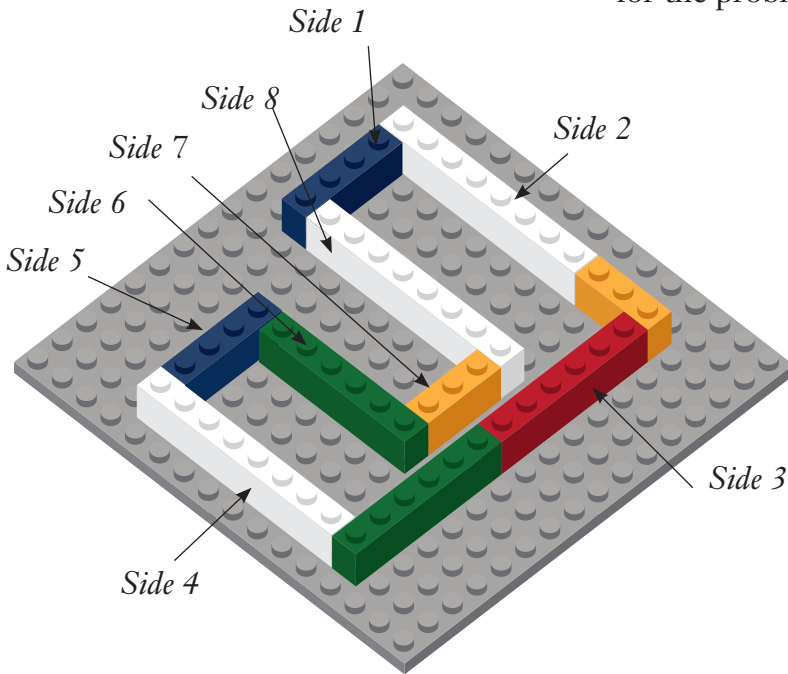
model without corner studs



model with corner studs



2. Can you determine the perimeter of the irregular octagonal shape shown? Draw and label the sides of the shape. Record the side lengths in a table. Write a math formula for the problem and show your answer.



Possible solution:

Side	Stud length
1	5 studs
2	11 studs
3	13 studs
4	9 studs
5	5 studs
6	6 studs
7	3 studs
8	8 studs

Total perimeter:

$$S + S + S + S + S + S + S + S = P$$

$$5 + 11 + 13 + 9 + 5 + 6 + 3 + 8 = 60 \text{ studs}$$

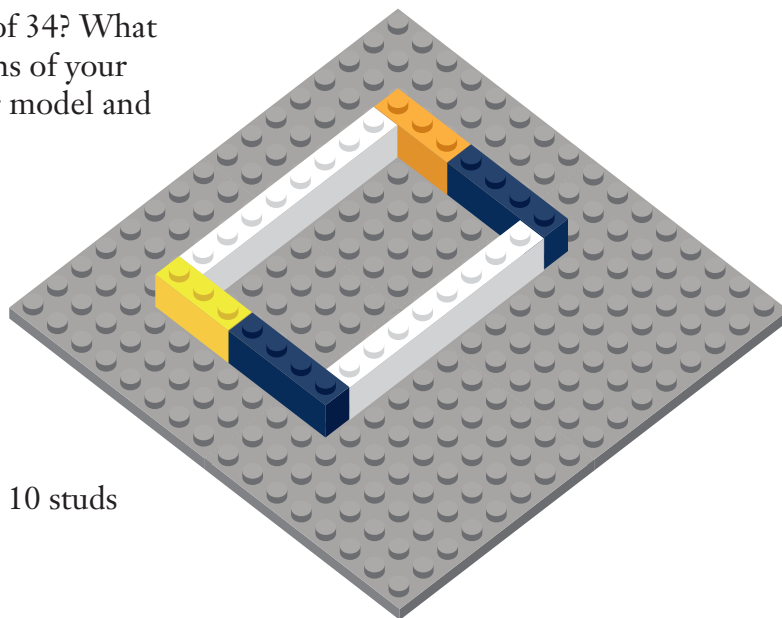


3. Can you create a shape with a perimeter of 34? What shape did you create? What are the lengths of your sides? Prove that $P = 34$ studs. Draw your model and explain your thinking.

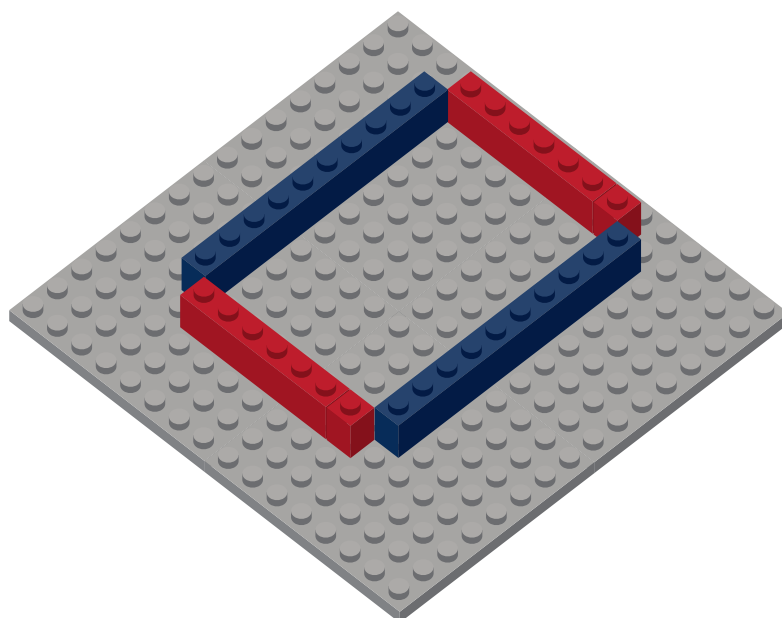
Solutions will vary.

Possible rectangle solution:

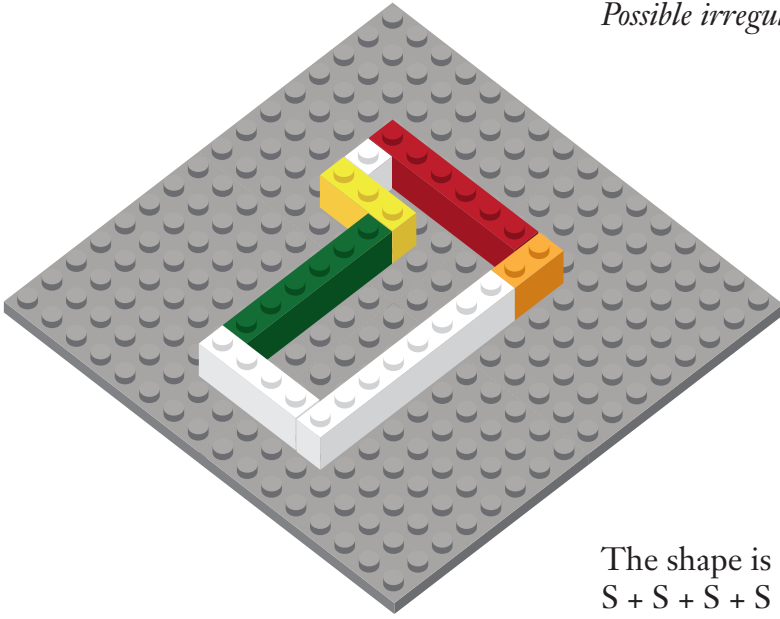
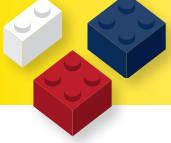
The shape is a rectangle.
Rectangle sides: 7 studs, 10 studs, 7 studs, 10 studs
 $2(7) + 2(10) = 34$ studs



model with corner studs



model without corner studs



Possible irregular polygon solution:

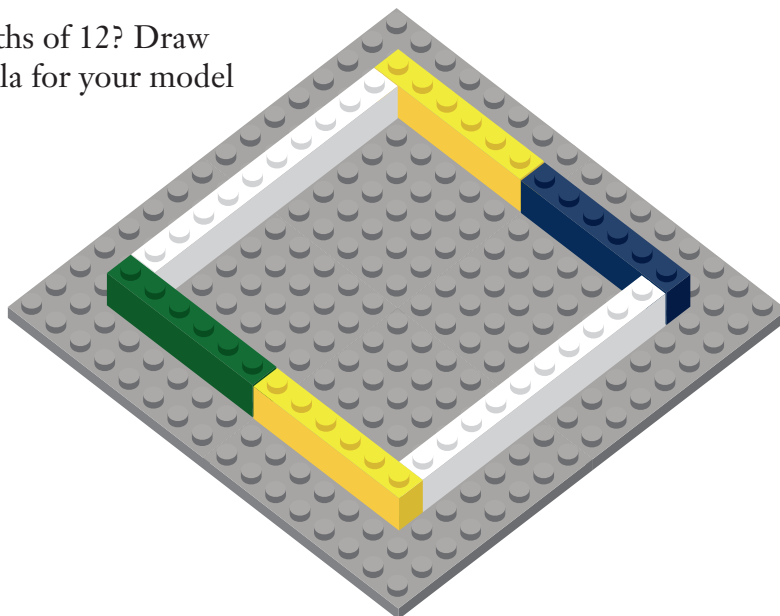
The shape is an irregular hexagon.
 $S + S + S + S + S + S = P$
 $3 + 7 + 10 + 5 + 7 + 2 = 34$ studs



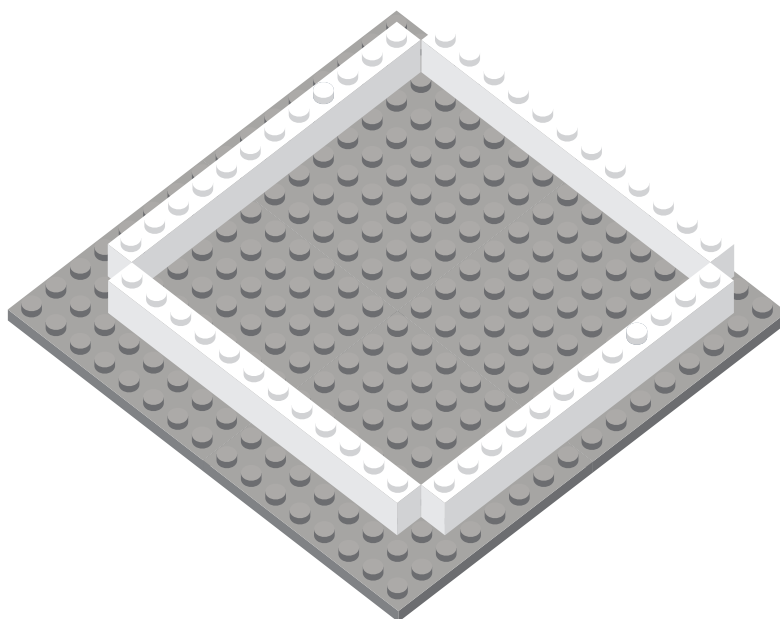
4. Can you create a square with side lengths of 12? Draw and label your model. Write the formula for your model and solve for P.

Solution:

$$4S = 4(12) = 48 \text{ studs}$$



model with corner studs



model without corner studs