Reactive forces for an unloaded beam (Item No.: P1000000)

Curricular Relevance

Area of Expertise:	Education Level:	Topic:	Subtopic:	Experiment:
Physik	Klasse 7-10	Mechanik	Kräfte, einfache Maschinen	Auflagekräfte beim unbelasteten Balken

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Easy	10 Minutes	10 Minutes	2 Students

Additional Requirements:

- Scissors

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional Information

The students should determine the load pressures on an unloaded beam with (1) symmetrical and (2) unsymmetrical beam suspension.
The beam supports have been replaced by suspending treads so that the forces can be better measured with spring balances.

Suggestion

The students should be sure that the loops on which the beam is to be hung are always slipped over the ends of the beam and moved against the desired pins. Hanging the pins in the loops results in a tilting of the beam.

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Task and equipment

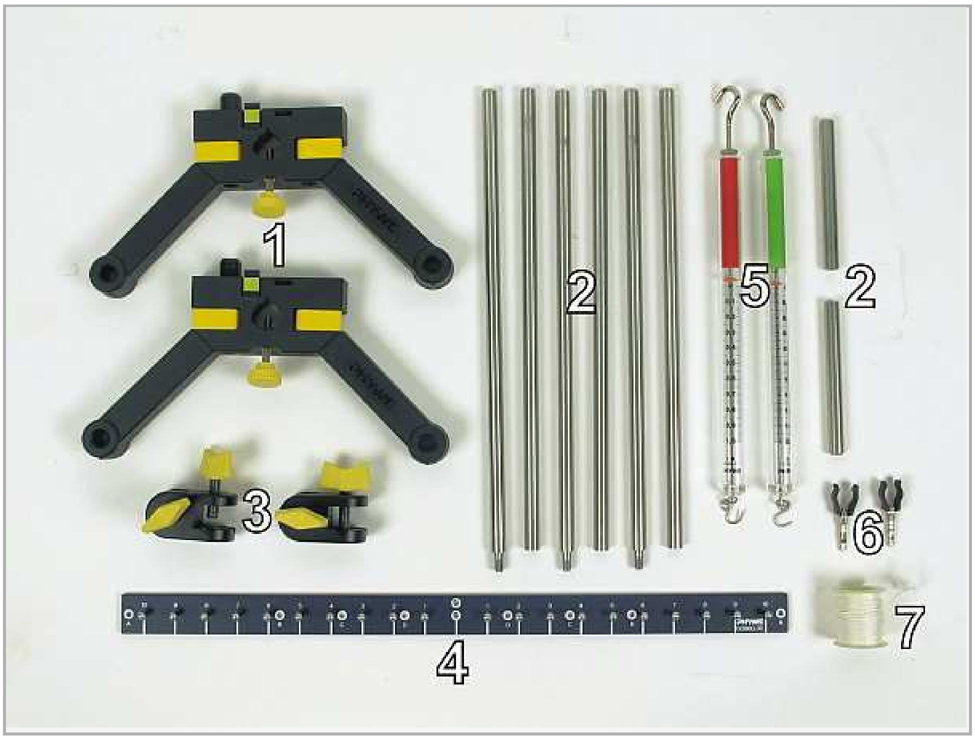
Task

How is the weight of a beam distributed on its supports?

The load pressures on an unloaded beam are determined with

1. symmetrical and
2. unsymmetrical beam suspension.

Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod with hole, stainless steel, 10 cm	02036-01	2
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	3
3	Boss head	02043-00	2
4	Lever	03960-00	1
5	Spring balance,transparent, 1 N	03065-02	1
5	Spring balance,transparent, 2 N	03065-03	1
6	Spring balance holder	03065-20	2
7	Fishing line, l. 20m	02089-00	1
Additional material			
	Scissors		1

Set-up and procedure

Set-up

- First screw the splitt support rods together (Fig. 1). Connect the two halves of the support base with the 60 cm support rod and tighten the locking levers (Fig. 2). Set the two 60 cm support rods into the support base halves, tighten them with the locking screws (Fig. 3).

Fig. 1

Fig. 2

Fig. 3

- Insert the spring balance holders into the short rods (Fig. 4). Fix the bosshead at the 60 cm support rod and clamp the short support rod in the bosshead. Clamp the two spring balances into place and adjust them to zero by using the adjustment screw (Fig. 5).

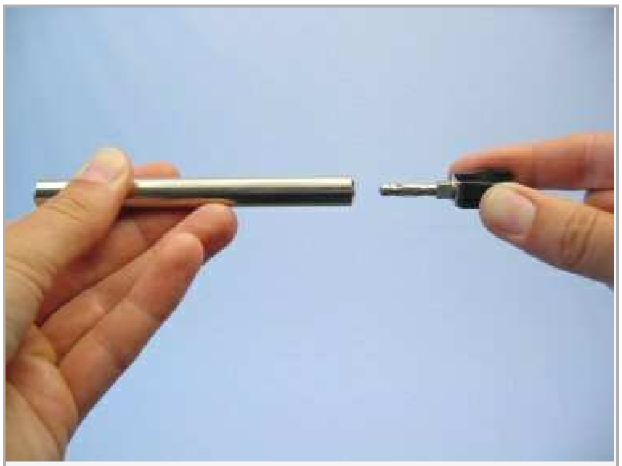


Fig. 4

Fig. 5

- Make two loops out of fish line, (thread length of each 10 cm), hang them on the hook of the spring balances (Fig. 6) and slip them over the ends of the beam (Fig. 7).

Fig. 6

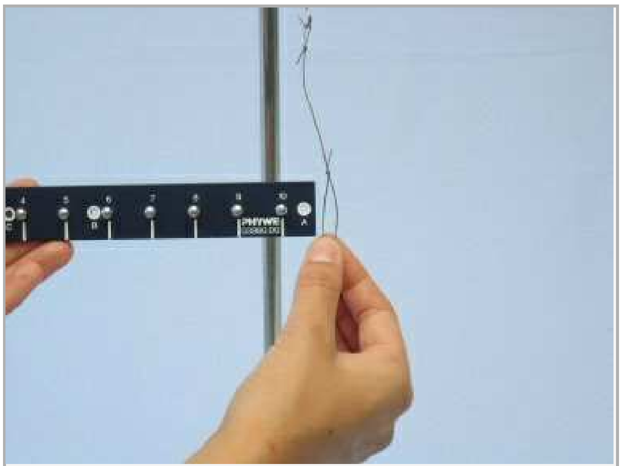


Fig. 7

- Move the two base halves so that both loops on the spring balances hang perpendicularly at the right and left 10 marks on the beam. Adjust the spring balances with the bossheads so that the beam hangs horizontally (Fig. 8).

Fig. 8

Procedure

- Be sure, that the beam is horizontal before each measurement.
- Slip the loops from the outer ends to the marking pins that you are using.
- Adjust the support base halves so that the spring balances and thread loops are perpendicular (Fig. 9).

Fig. 9

- Read both spring balances when the loops on both sides are on the 10 marks. Record the forces F_1 and F_2 in Table 1 on the Results page. In Fig. 10 it is shown how to name the forces.
- Move the loops (and the support base halves) one after another to the 6 and 3 marks (Fig. 11), read both spring balances and record the measured values in Table 1.

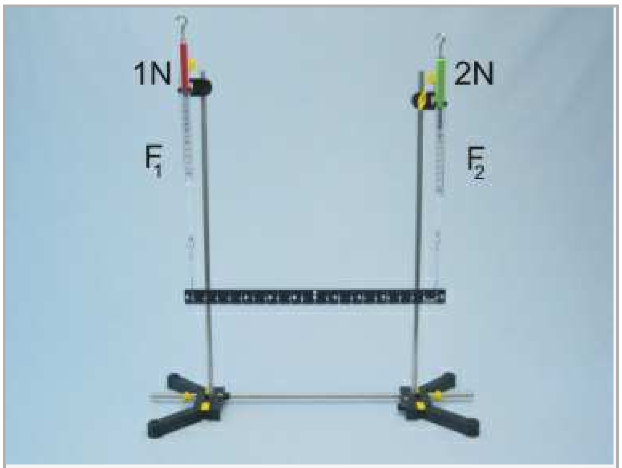


Fig. 10

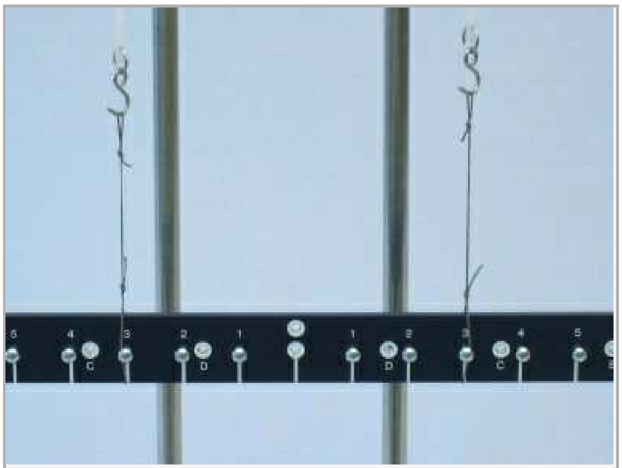


Fig. 11

- Determine the weight (force) F_B of the beam with the 2 N spring balance (Fig. 12) and record the value.

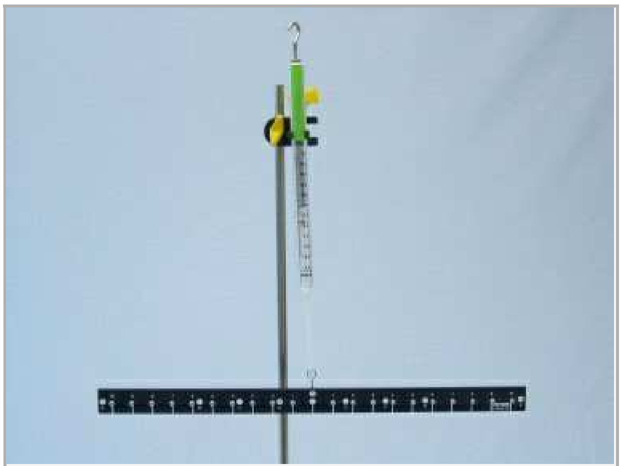


Fig. 12

- Return the beam to its original position (10 mark) and set the right spring balance in succession at the 8, 6, 4, 2 and 0 marks (Fig. 13). Read the two spring balances at each location and record the forces F_1 und F_2 in Table 2.

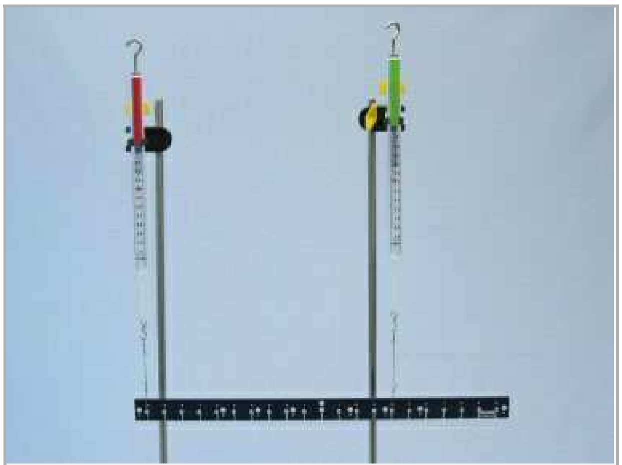


Fig. 13

Report: Reactive forces for an unloaded beam

Result - Observations 1

Enter the weight (force) of the beam F_B = ...N.

Result – Table 1

Enter measured value in the Table 1.

Calculate the sum of the forces $F_{tot.}$ using $F_{tot.} = F_1 + F_2$ and complete the table.

Mark No.		F_1 in N	F_2 in N	$F_{tot.}$ in N	F_1/F_2
M_{le}	M_{ri}				
10	10	1 ±0	1 ±0	1 ±0	1 ±0
6	6	1 ±0	1 ±0	1 ±0	1 ±0
3	3	1 ±0	1 ±0	1 ±0	1 ±0

Result – Table 2

Enter the measured values in the Table 2.

Calculate the sum of the forces $F_{tot.}$ using $F_{tot.} = F_1 + F_2$ and complete the table.

Mark No.		F_1 in N	F_2 in N	$F_{tot.}$ in N	F_1/F_2
M_{le}	M_{ri}				
10	8	1 ±0	1 ±0	1 ±0	1 ±0
10	6	1 ±0	1 ±0	1 ±0	1 ±0
10	4	1 ±0	1 ±0	1 ±0	1 ±0
10	2	1 ±0	1 ±0	1 ±0	1 ±0
10	0	1 ±0	1 ±0	1 ±0	1 ±0

Evaluation – Question 1

Compare the obtained values for $F_{tot.}$ with the weight (force) of the beam F_B. What do you notice?

Evaluation – Question 2

Compute the F_1/F_2 - ratio for both tables (Results page) and record the resulting values in the tables, too.

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Evaluation – Question 3

Compare the F_1/F_2 - ratio with the numbers of the divisions (M_{le} and M_{ri}). Do you notice anything?

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Evaluation – Question 4

Can you state a (physical) dimension instead of the division numbers, which corresponds to them?

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Evaluation – Question 5

What is the importance of the middle of the beam? What does it represent physically?

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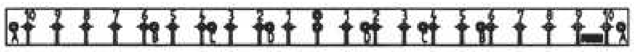
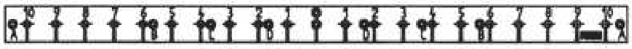
Evaluation – Question 6

Draw the forces on the beams for the measurement (2) in Table 1 in the Scribble field. Decide on a suitable scale before you begin drawing.



Evaluation – Question 7

Draw the forces on the beams for the measurement (5) in Table 2 in the Scribble field. Decide on a suitable scale before you begin drawing.



Evaluation – Question 8

In this experiment the beam is hung on two threads. Do the forces or their directions change, when the beam is resting instead on two supports at the respective divisions?

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