

# **Lintels in a dry-stacking system for masonry**

MSc Thesis in Building Technology

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# **Lintels in a dry-stacking system for masonry**



Lintel = a beam in wall

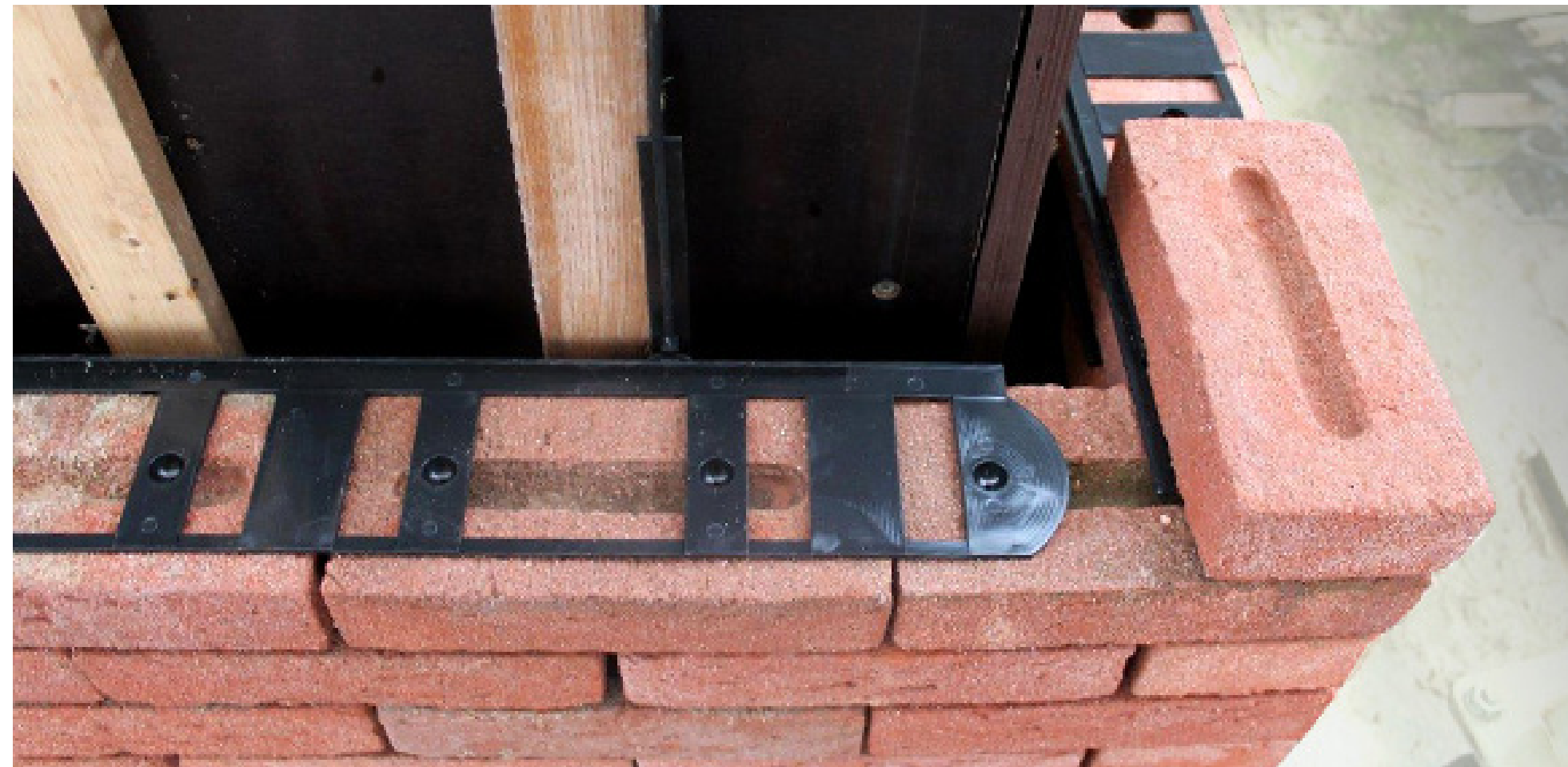
## **Lintels in a dry-stacking system for masonry**





Dry-stacking = Stacking without glue

## Lintels in a dry-stacking system for masonry





# Lintels in a dry-stacking system for masonry



+





**Why is this research relevant?**



*If you think of Brick, you say to Brick, ‘**What do you want, Brick?**’*

*And Brick says to you, ‘**I like an Arch.**’*

*And if you say to Brick, ‘**Look, arches are expensive,  
and I can use a concrete lintel over you.  
What do you think of that, Brick?**’*

*Brick says, ‘**I like an Arch.**’*

— Louis Kahn

Transcribed from the 2003 documentary ‘My Architect: A Son’s Journey by Nathaniel Kahn’. Master class at Penn, 1971.







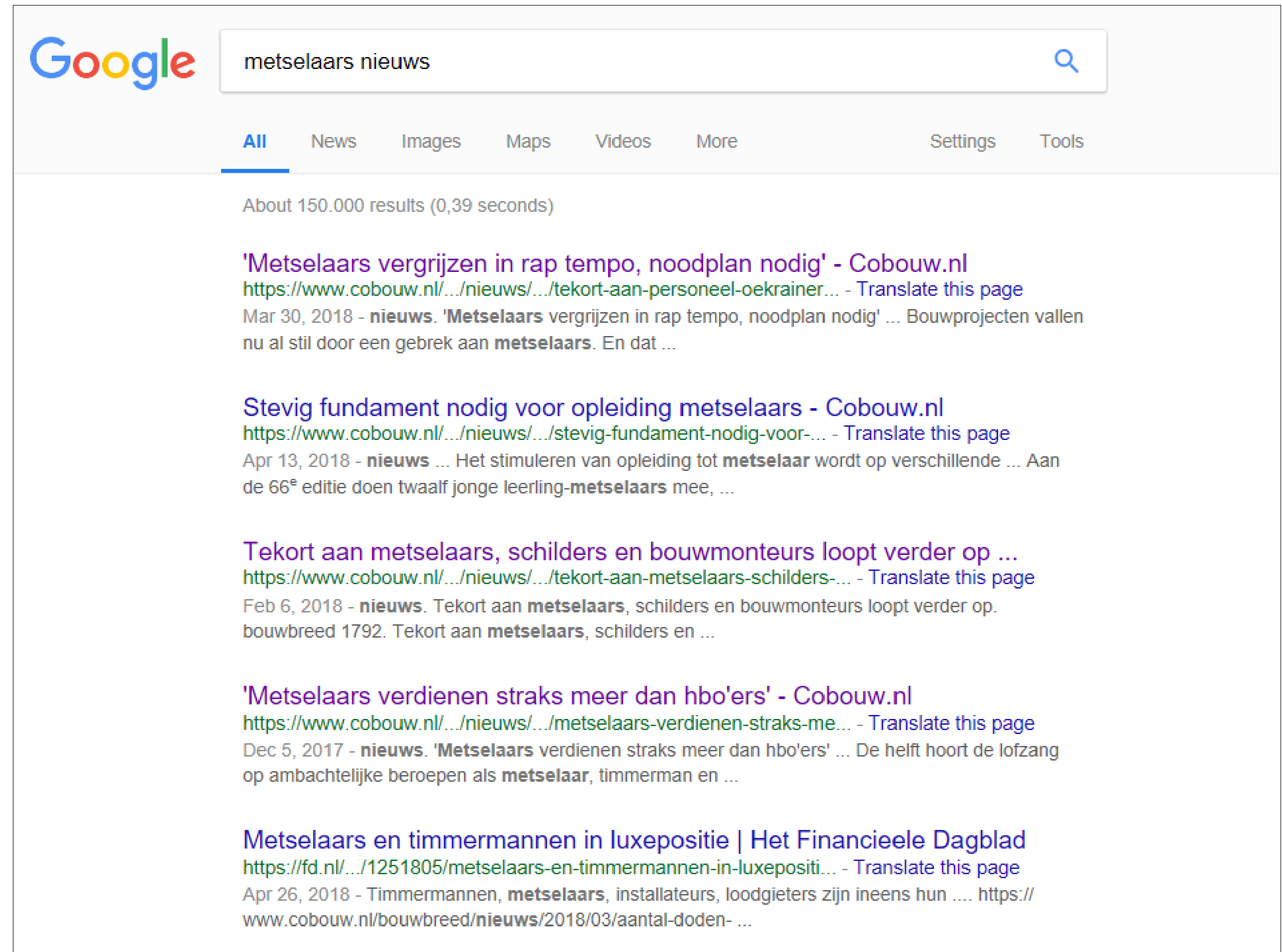




# Background: Shortage of skilled masons

Price of masonry rises

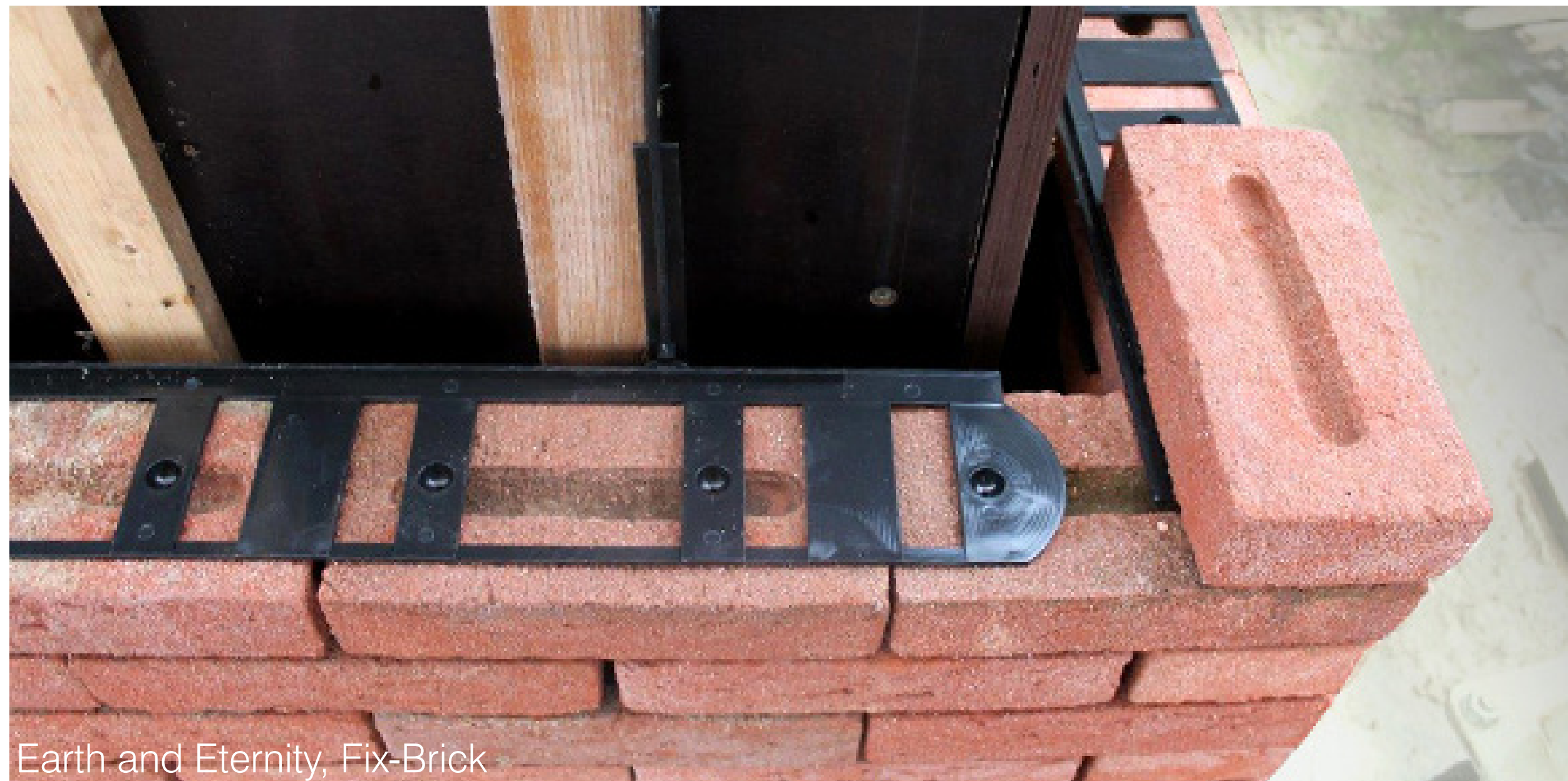
Risk of delays increases



The screenshot shows a Google search for 'metselaars nieuws'. The search bar contains the text 'metselaars nieuws' and a magnifying glass icon. Below the search bar, there are navigation tabs for 'All', 'News', 'Images', 'Maps', 'Videos', 'More', 'Settings', and 'Tools'. The search results are displayed below, showing 'About 150.000 results (0,39 seconds)'. The first result is titled 'Metselaars vergrijzen in rap tempo, noodplan nodig' - Cobouw.nl, with a URL starting with 'https://www.cobouw.nl/.../nieuws/.../tekort-aan-personeel-oekrainer...'. The second result is 'Stevig fundament nodig voor opleiding metselaars - Cobouw.nl', with a URL starting with 'https://www.cobouw.nl/.../nieuws/.../stevig-fundament-nodig-voor-...'. The third result is 'Tekort aan metselaars, schilders en bouwmonteurs loopt verder op ...', with a URL starting with 'https://www.cobouw.nl/.../nieuws/.../tekort-aan-metselaars-schilders-...'. The fourth result is 'Metselaars verdienen straks meer dan hbo'ers' - Cobouw.nl, with a URL starting with 'https://www.cobouw.nl/.../nieuws/.../metselaars-verdienen-straks-me...'. The fifth result is 'Metselaars en timmermannen in luxepositie | Het Financieele Dagblad', with a URL starting with 'https://fd.nl/.../1251805/metselaars-en-timmermannen-in-luxepositi...'. Each result includes a date and a brief description of the article's content.



# Dry stacked masonry





*Research question*

How can a lintel be made, which is native to a dry-stacked system?

*Performed as a case-study on H-block*



A photograph of two men from behind, looking at a brick wall. The man on the left has short grey hair and is wearing glasses and a dark jacket. The man on the right has short brown hair and is wearing a dark jacket. The background is a wall of reddish-brown bricks. The entire image is framed by a white border.

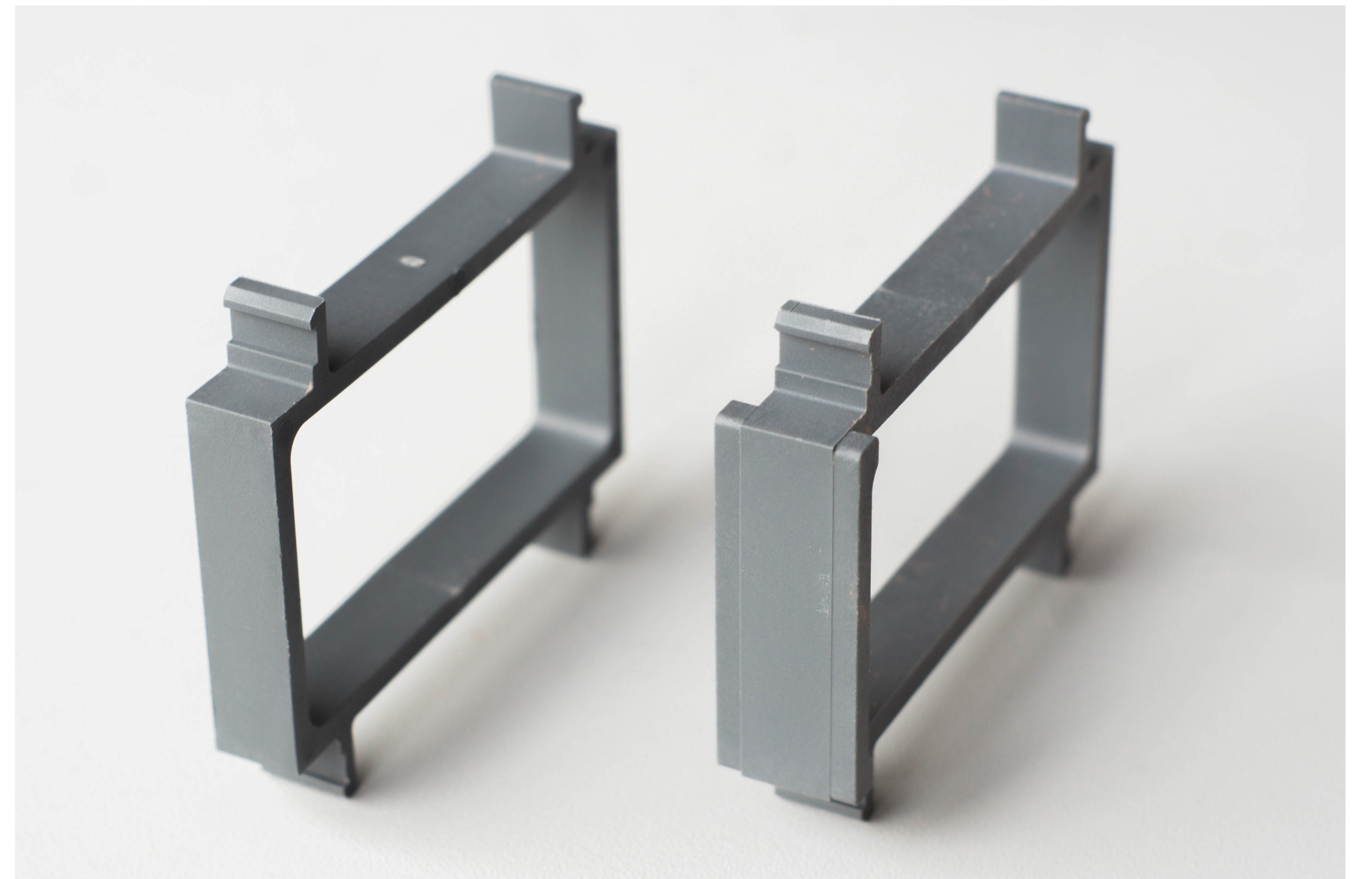
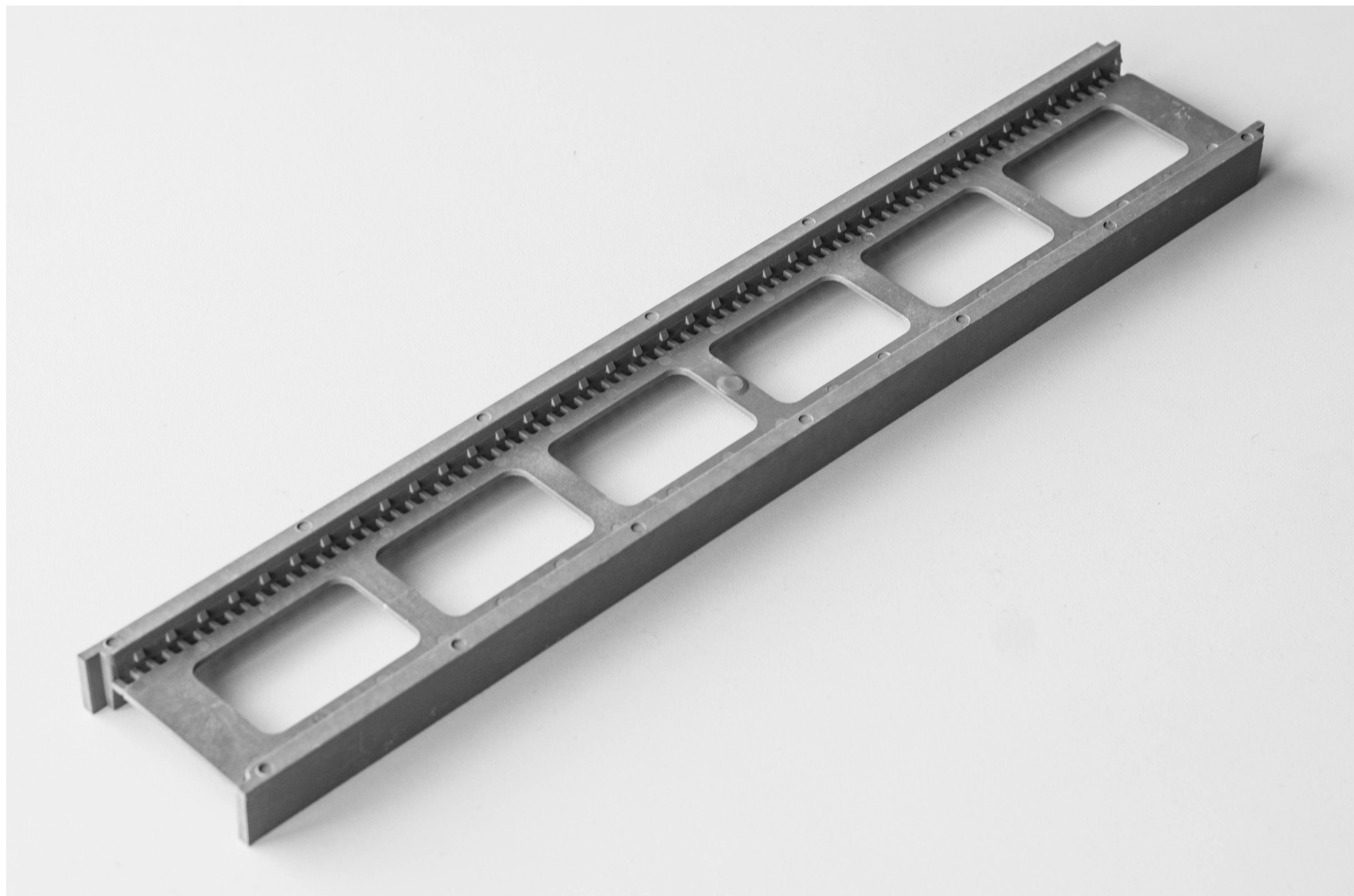
**H-block / Drystack**







# Components



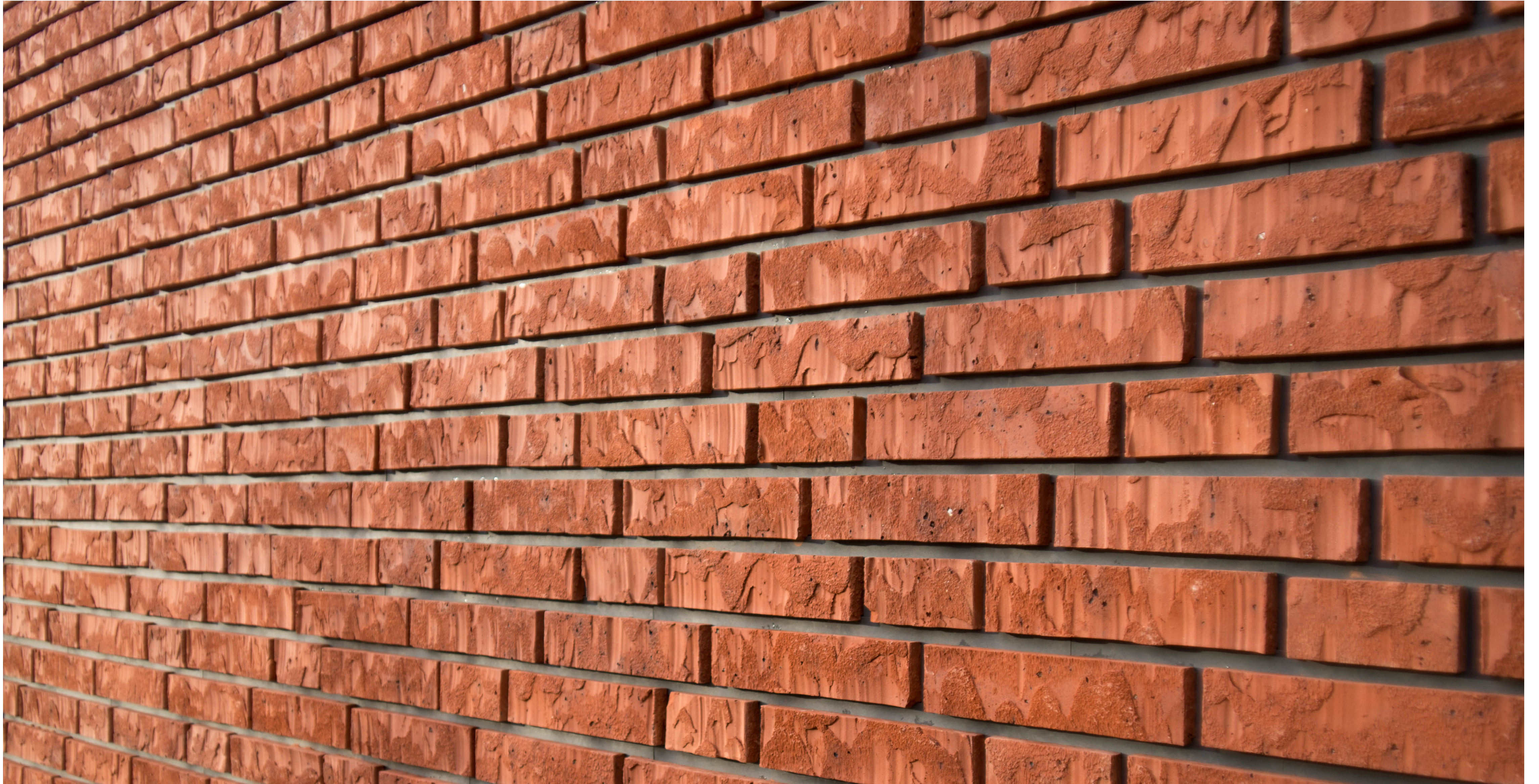












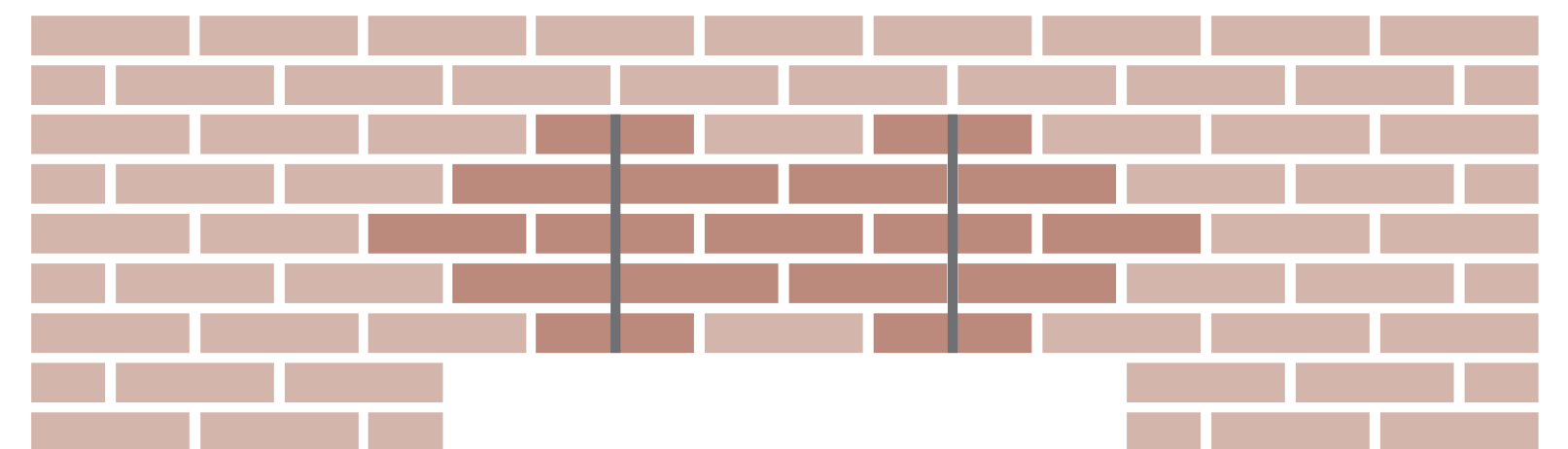
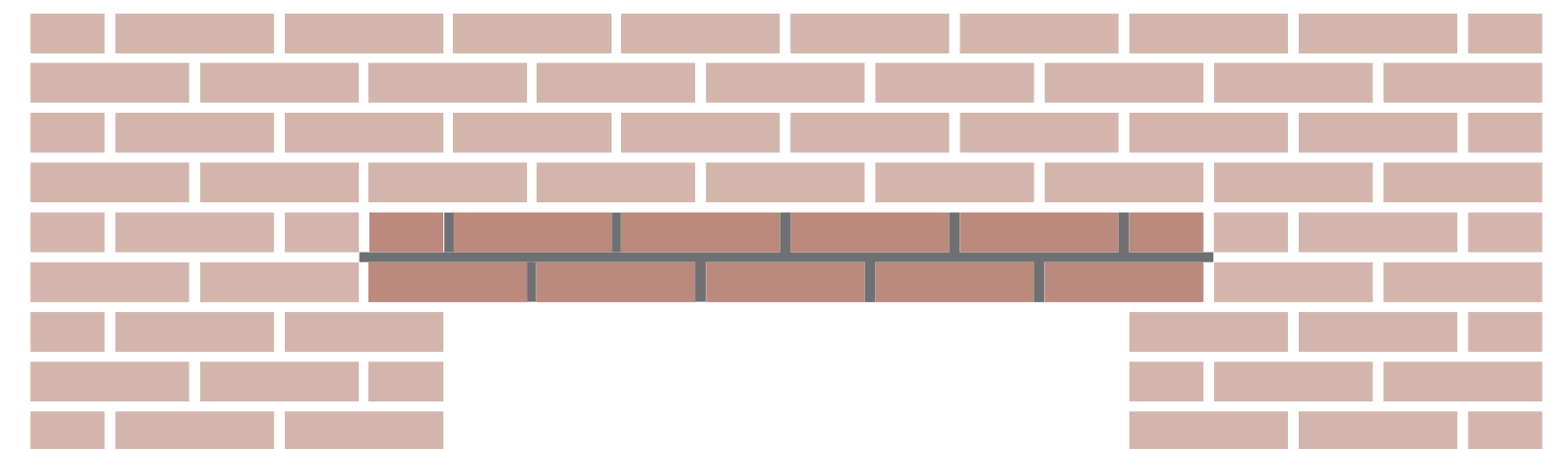
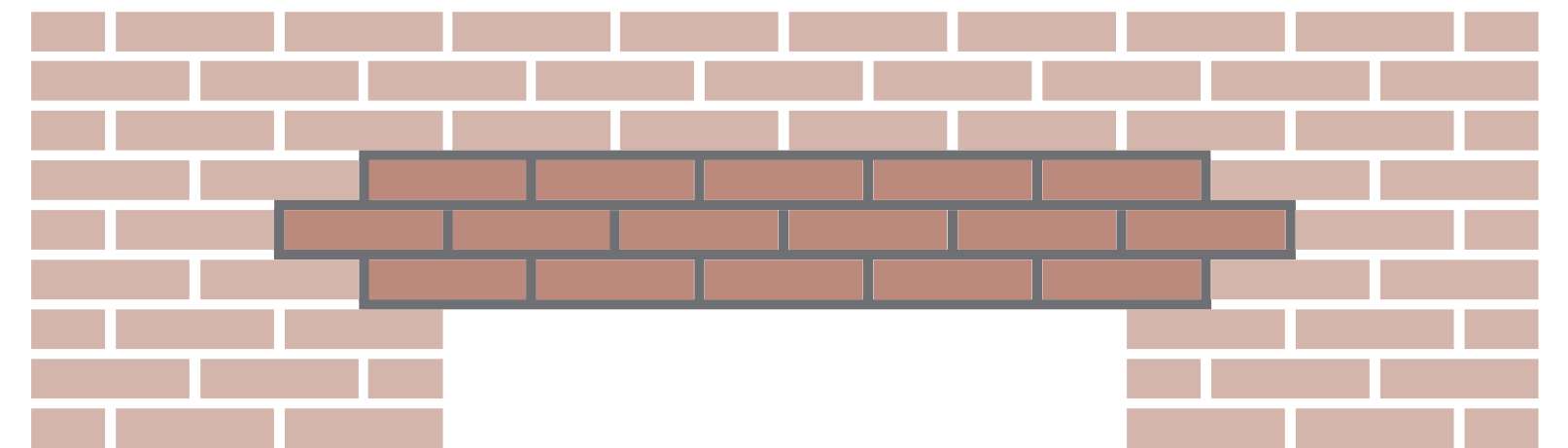
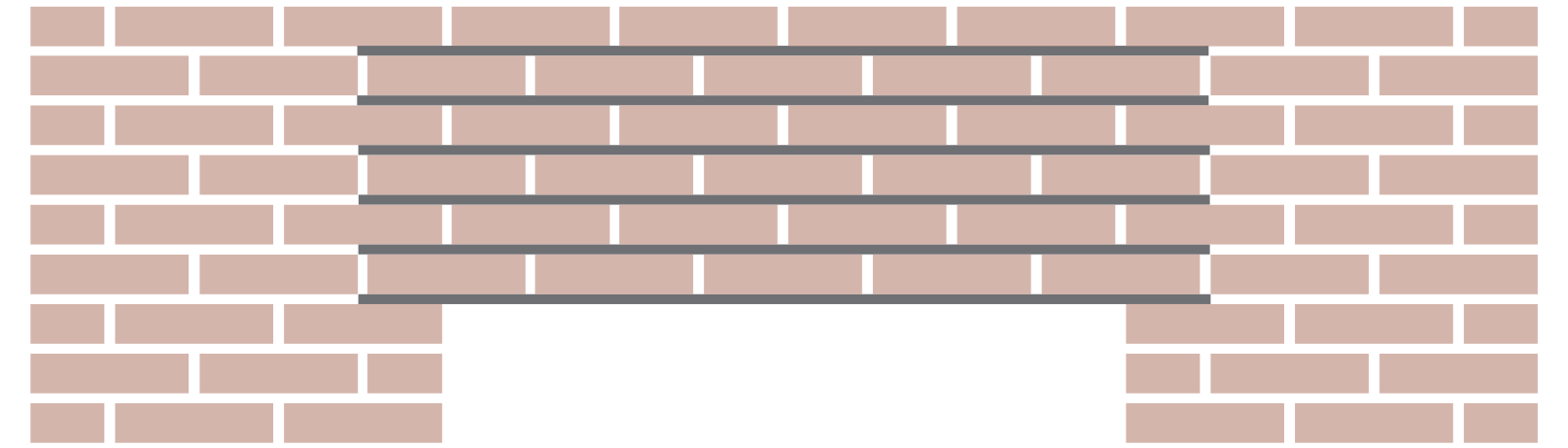
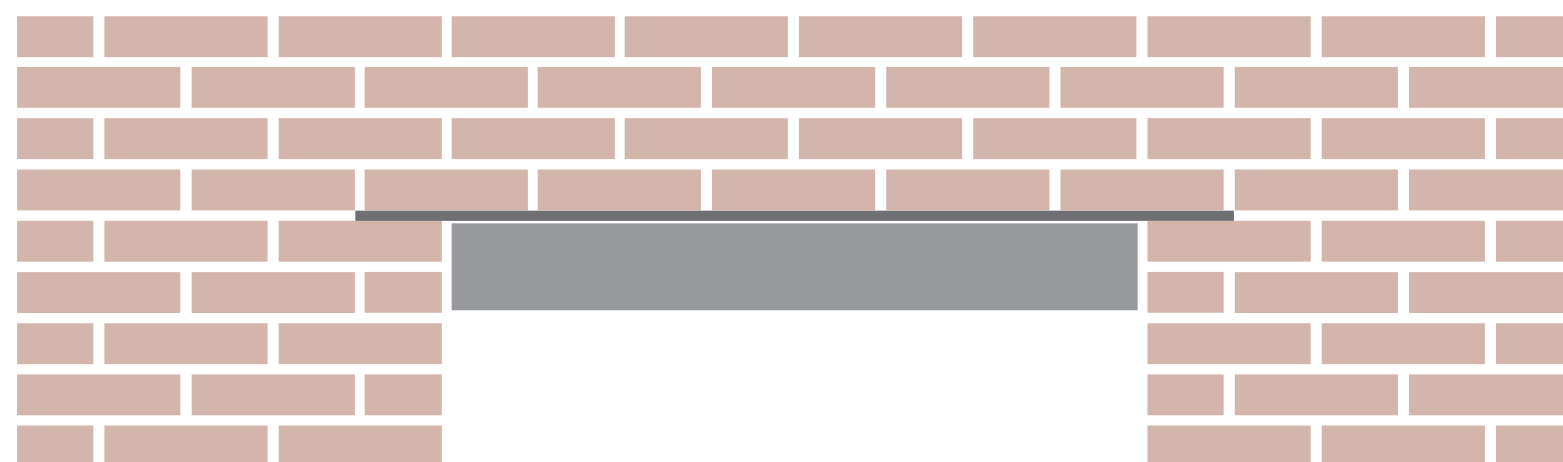
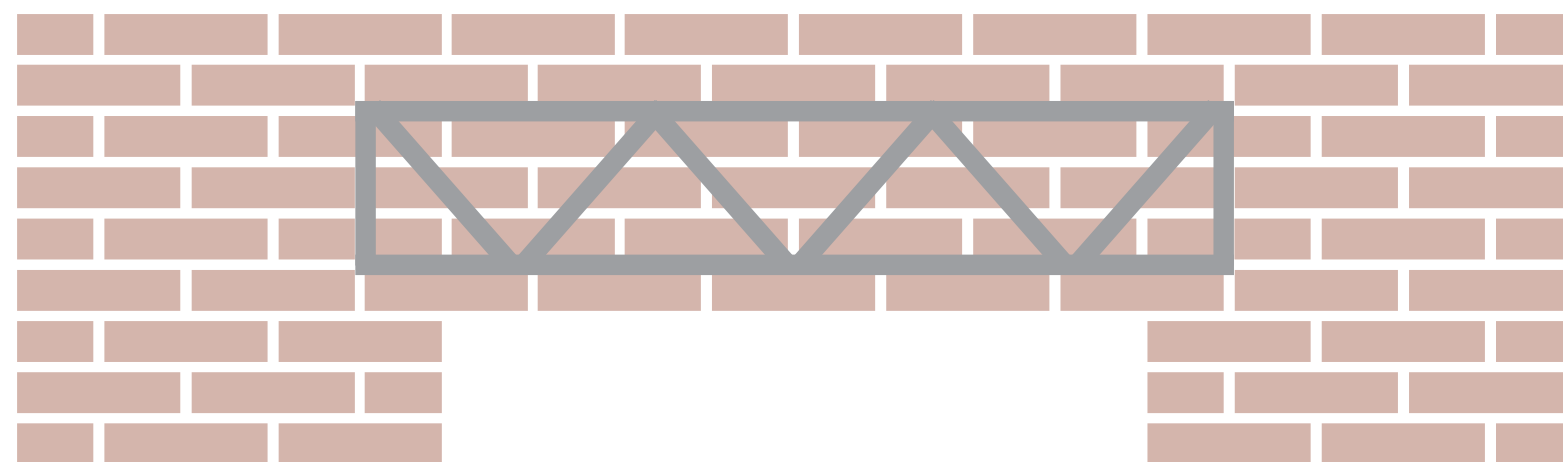
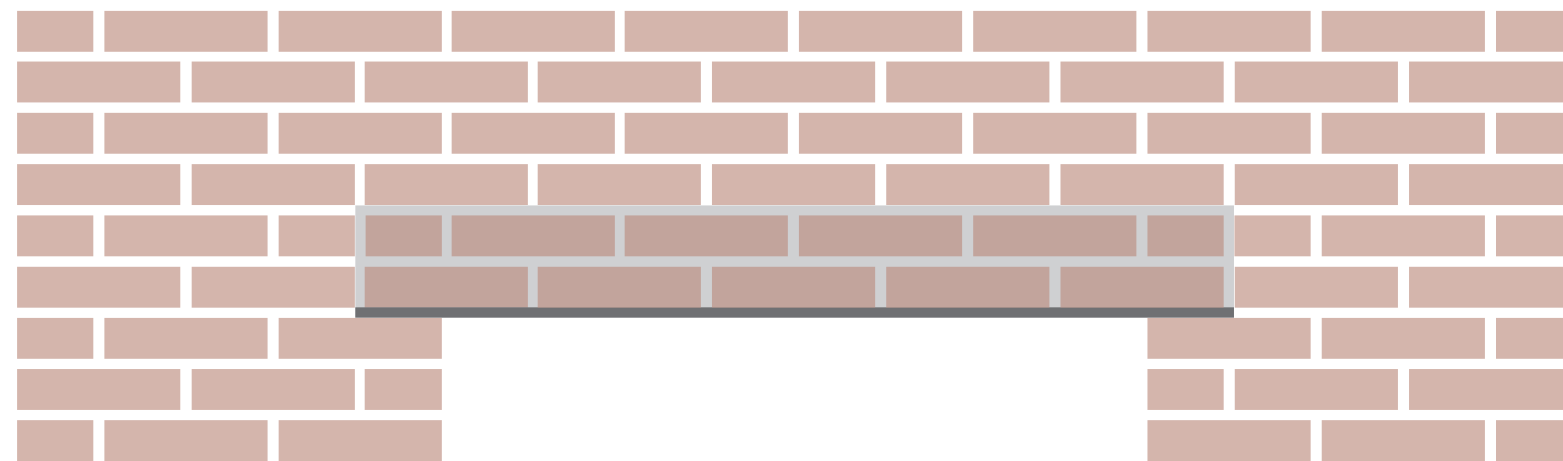
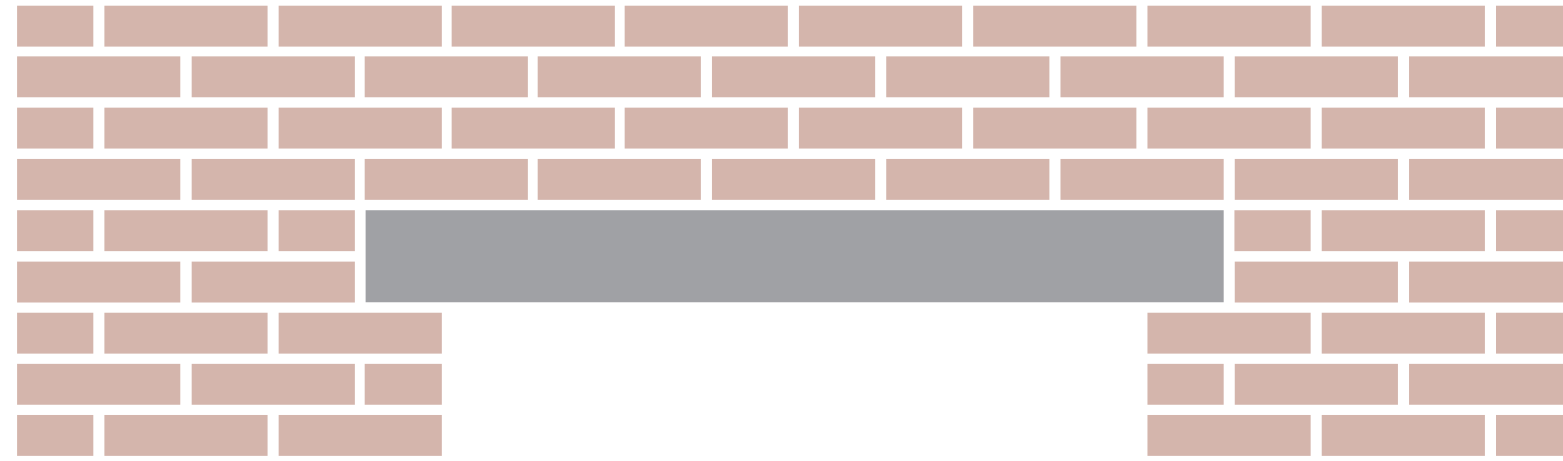


A photograph of a desert landscape. In the foreground, there is a large, smooth, white sand dune. The background consists of a rugged, reddish-brown rock wall. The word "Research" is centered in the middle of the image in a bold, black, sans-serif font.

# Research



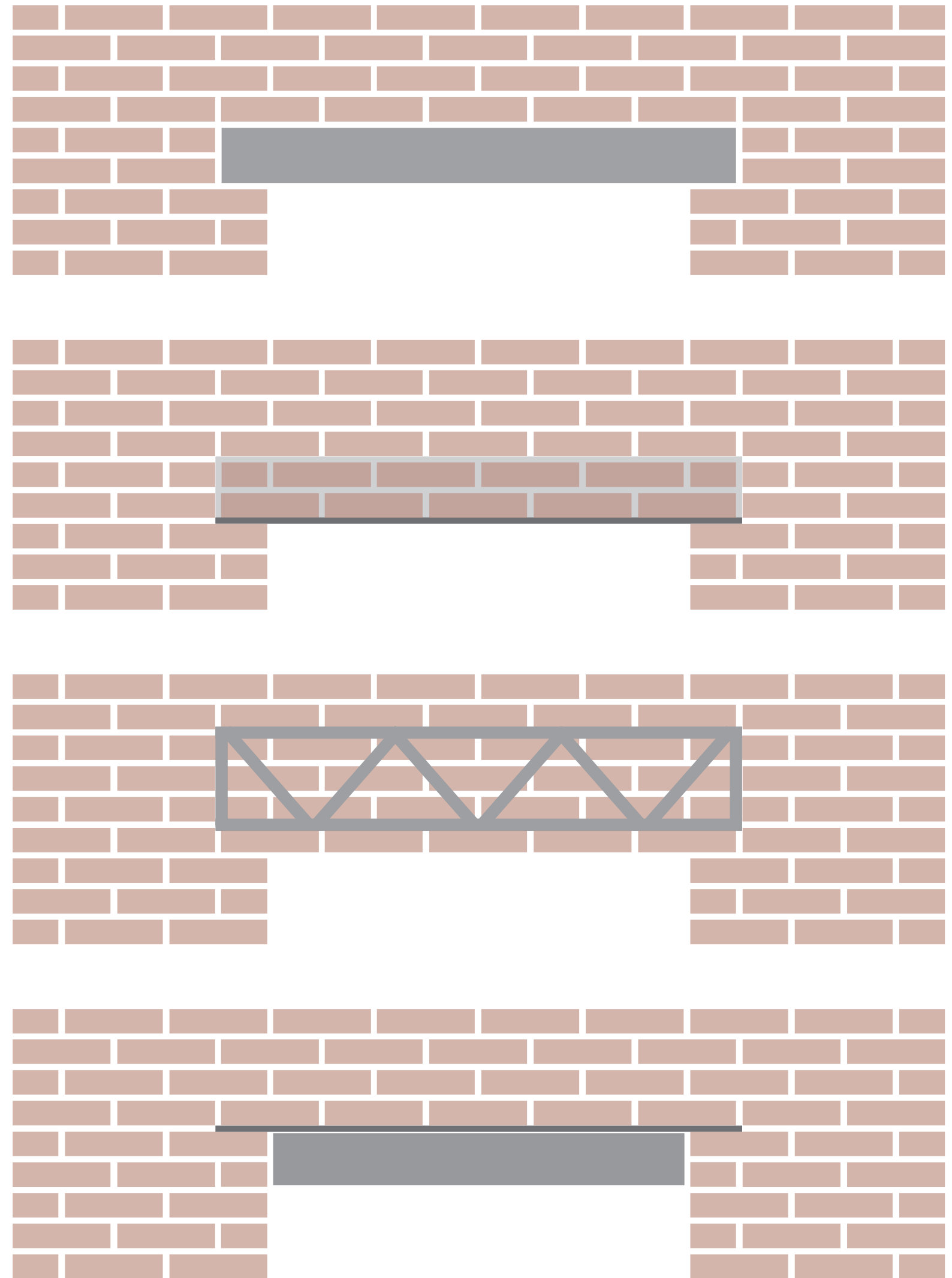
# Typologies



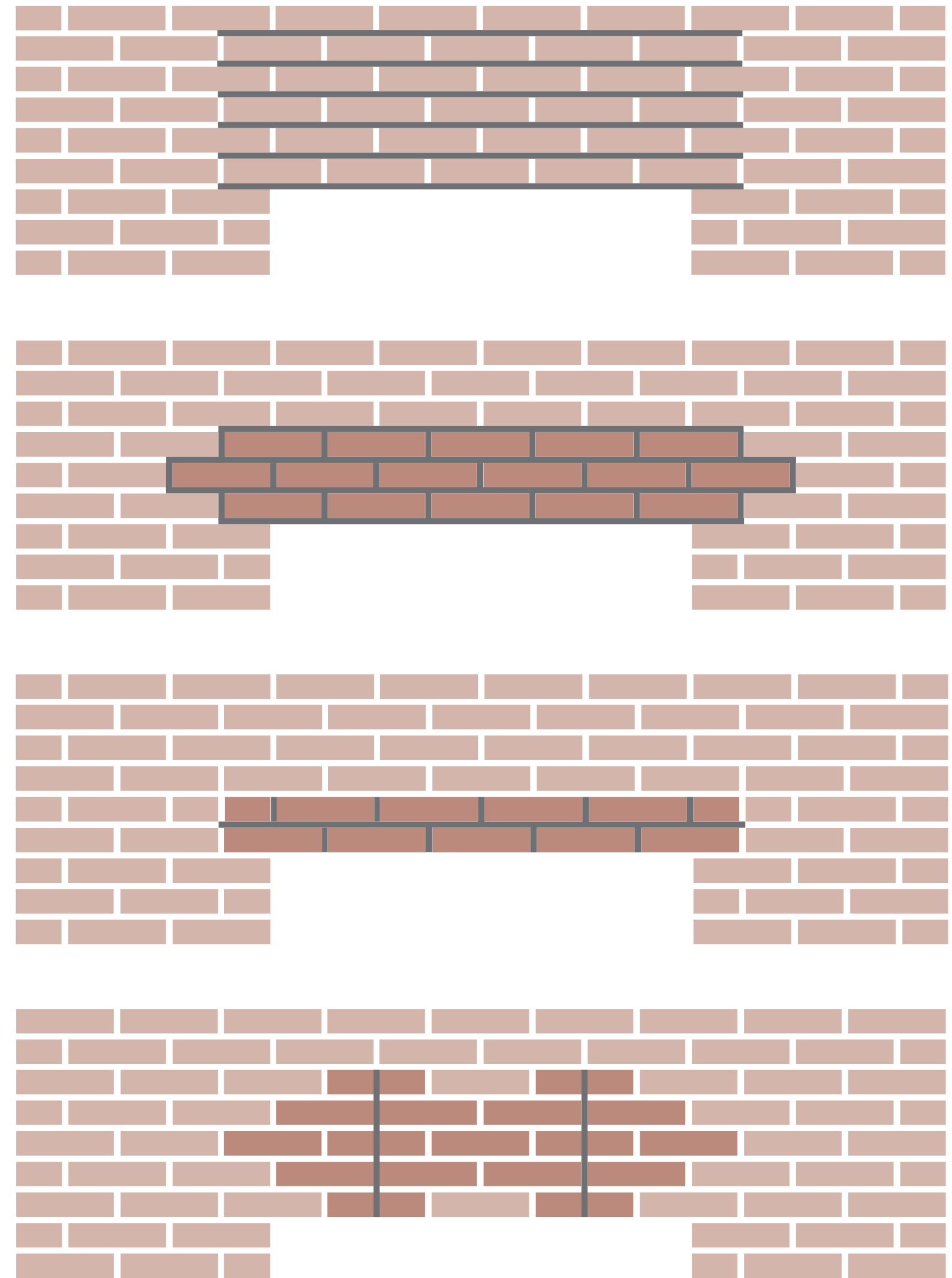


# Typologies

## Lintels

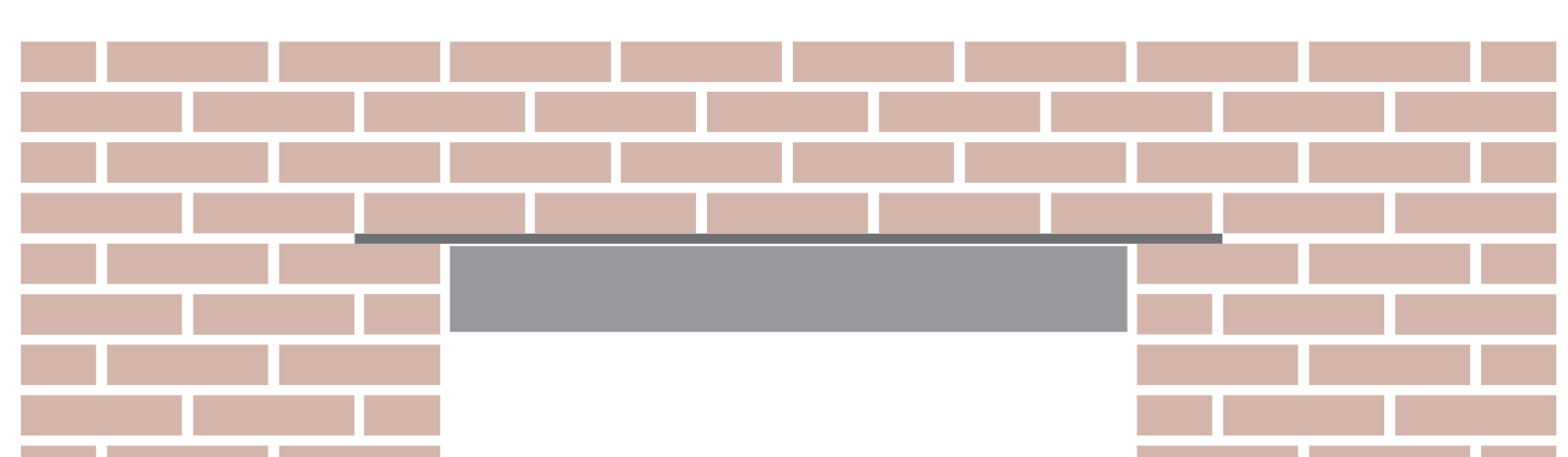
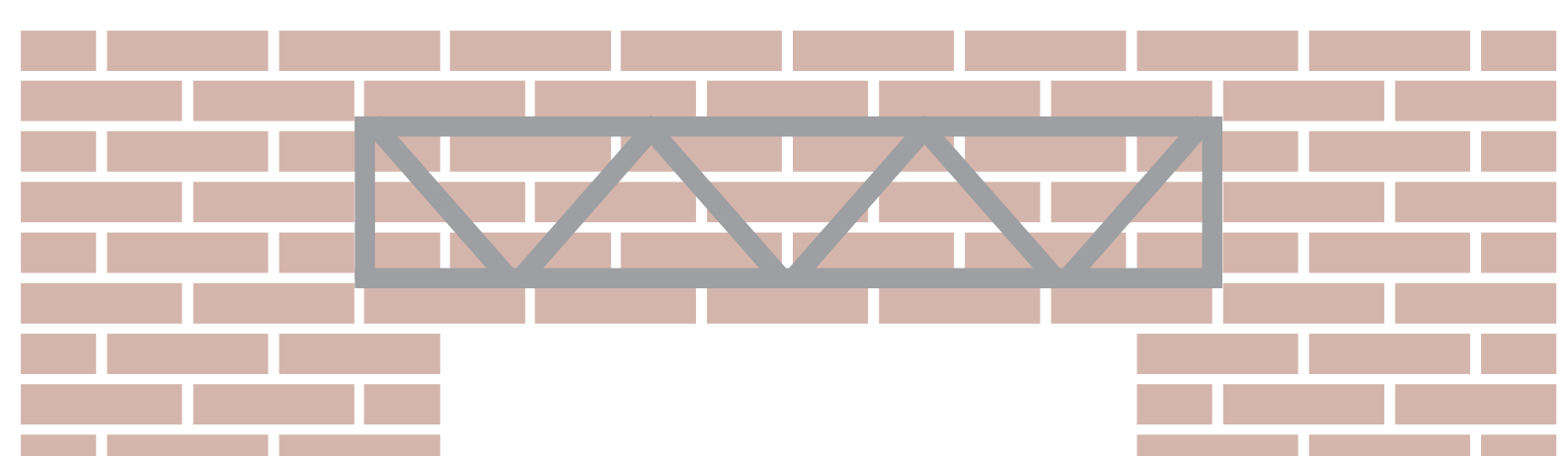
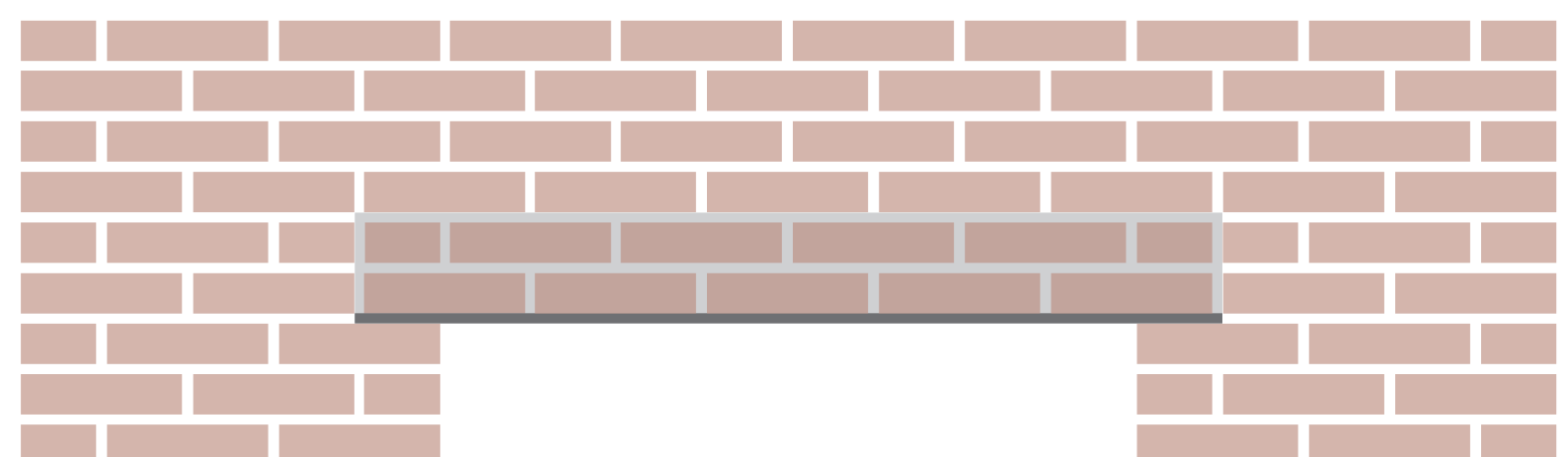
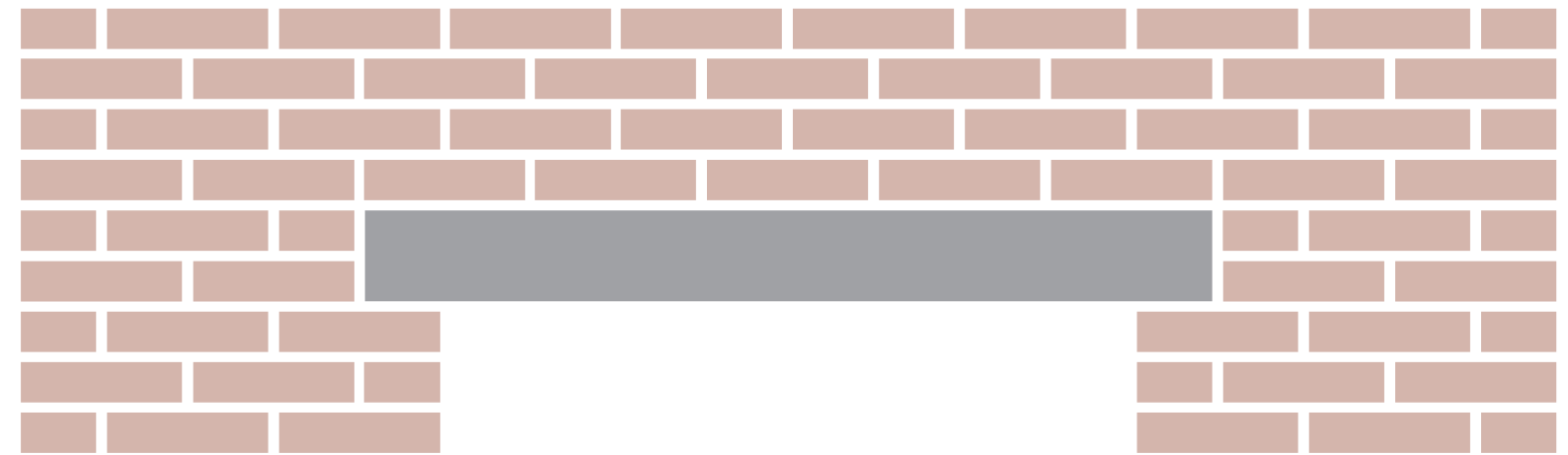


## Structural masonry



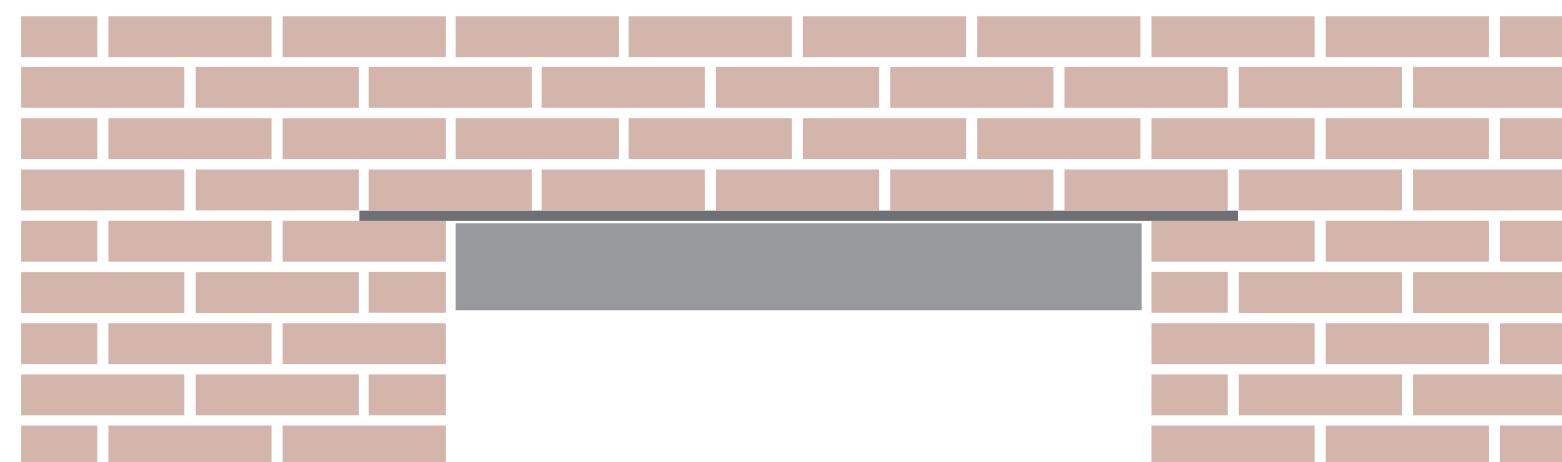
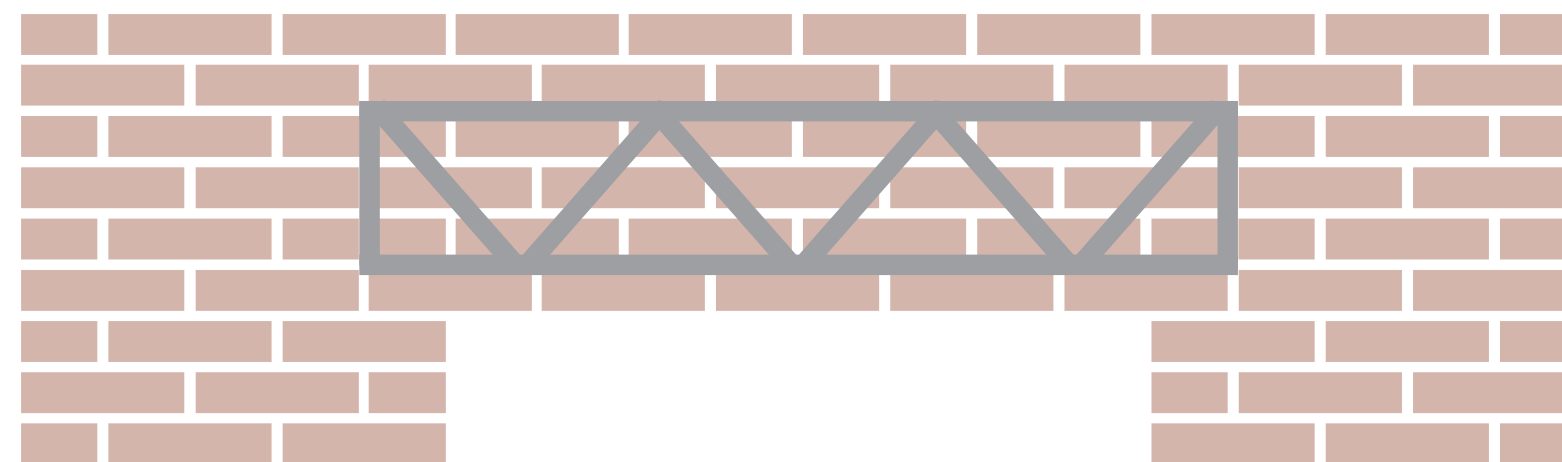
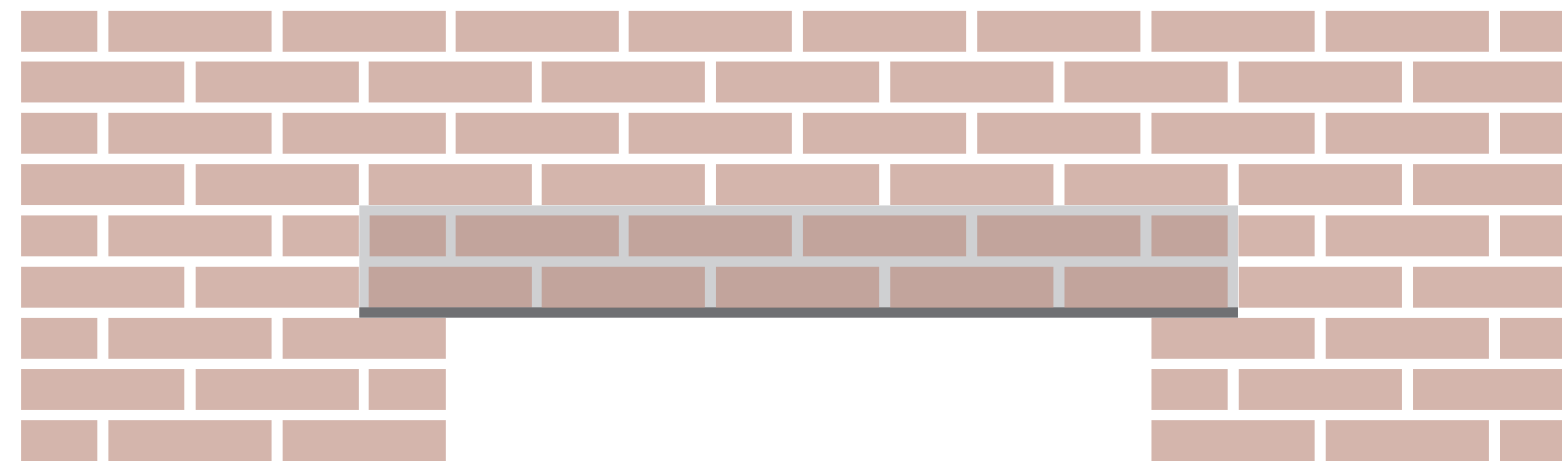
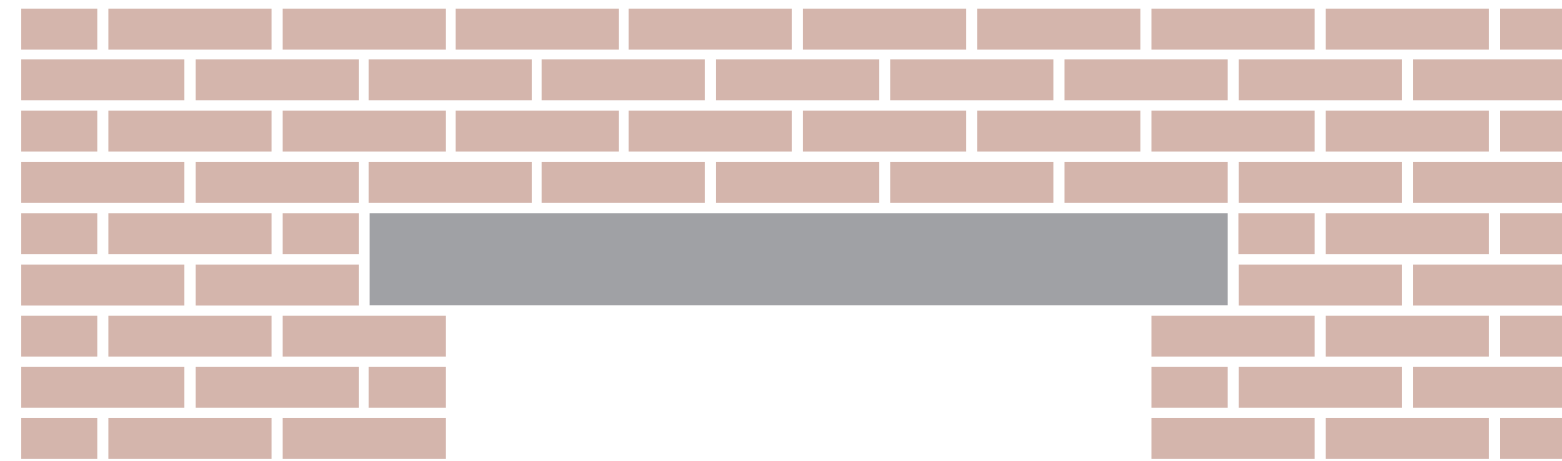


# Lintels





# Lintels

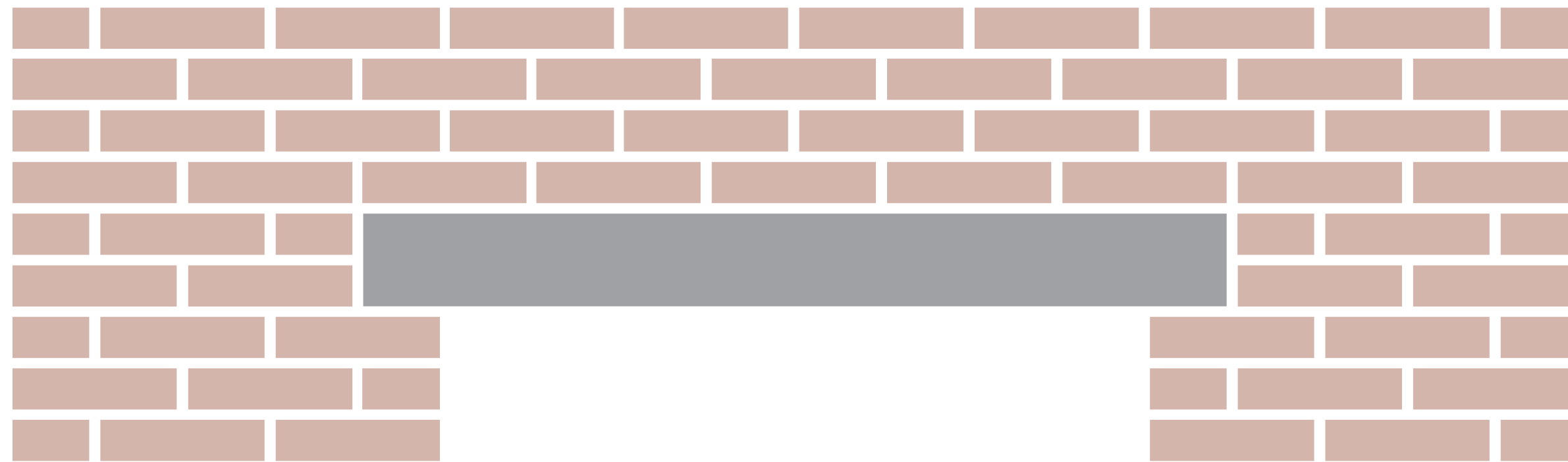


**Integrating existing products**

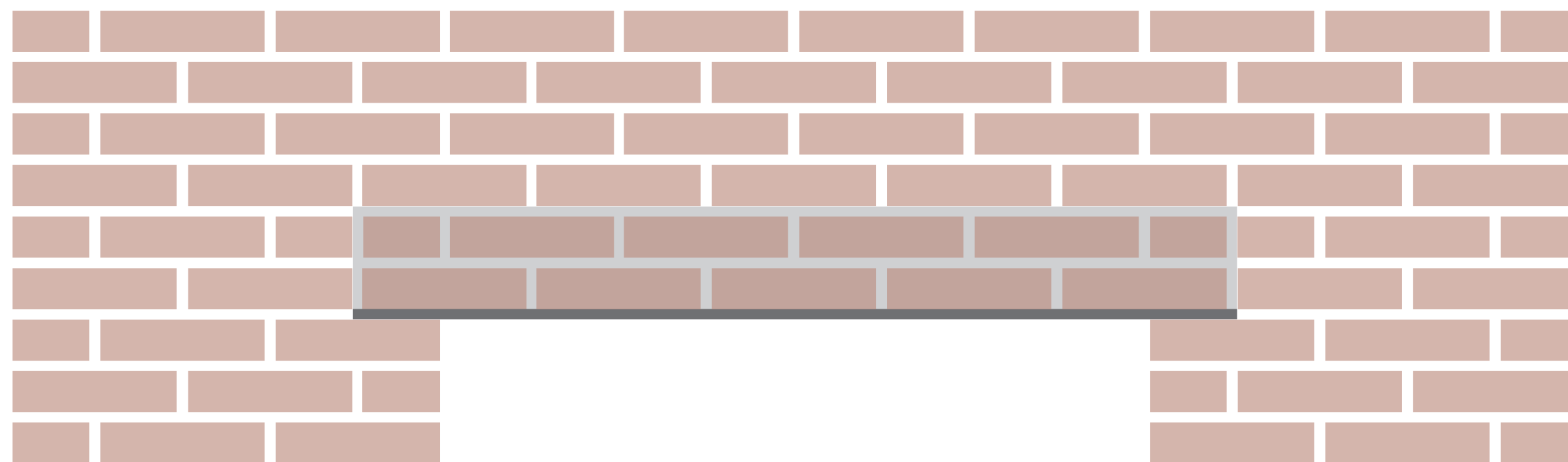
**New lintels inspired by H-block**



# Integrating existing products



**1. Need to fit with the layer height**



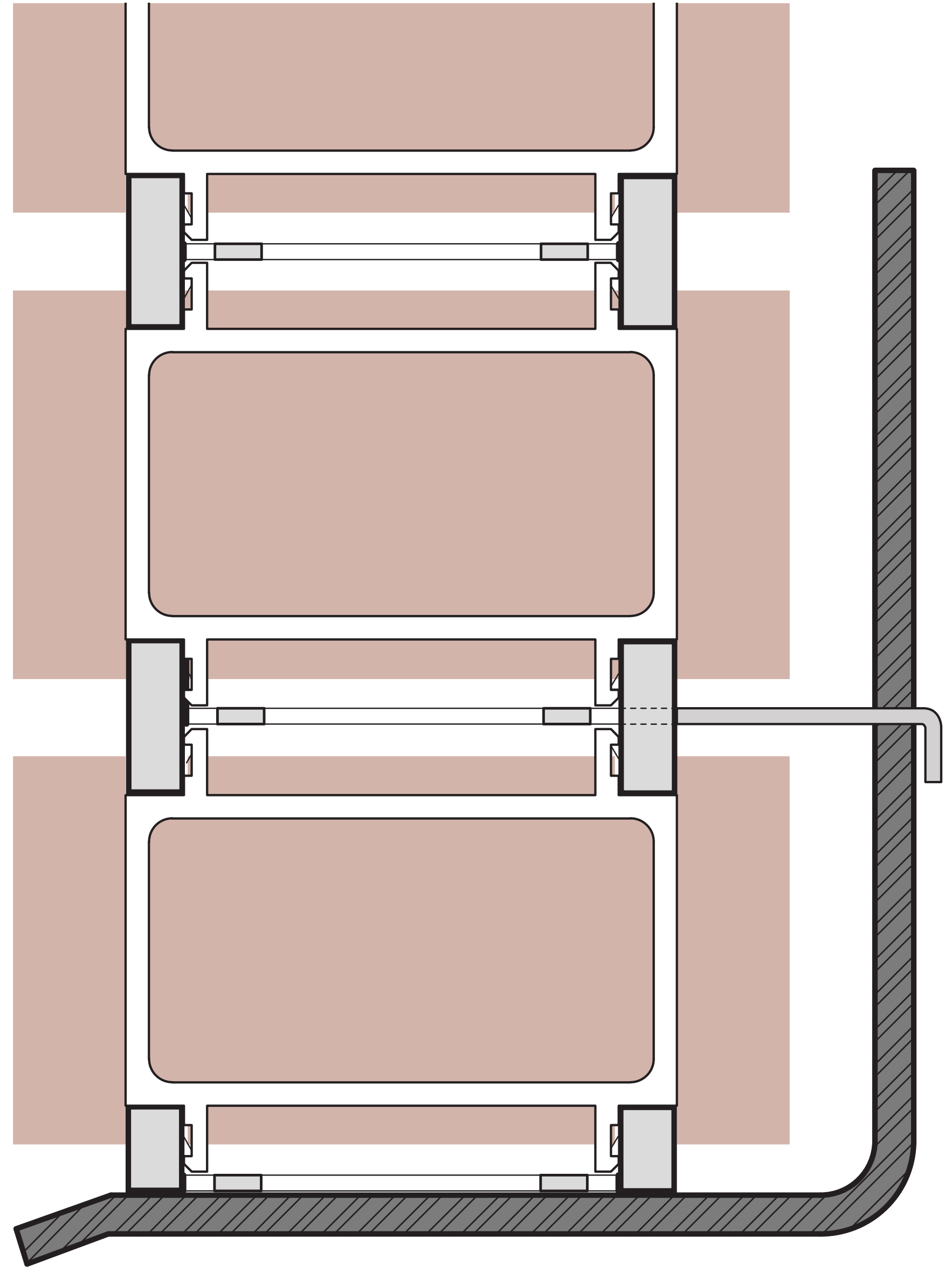
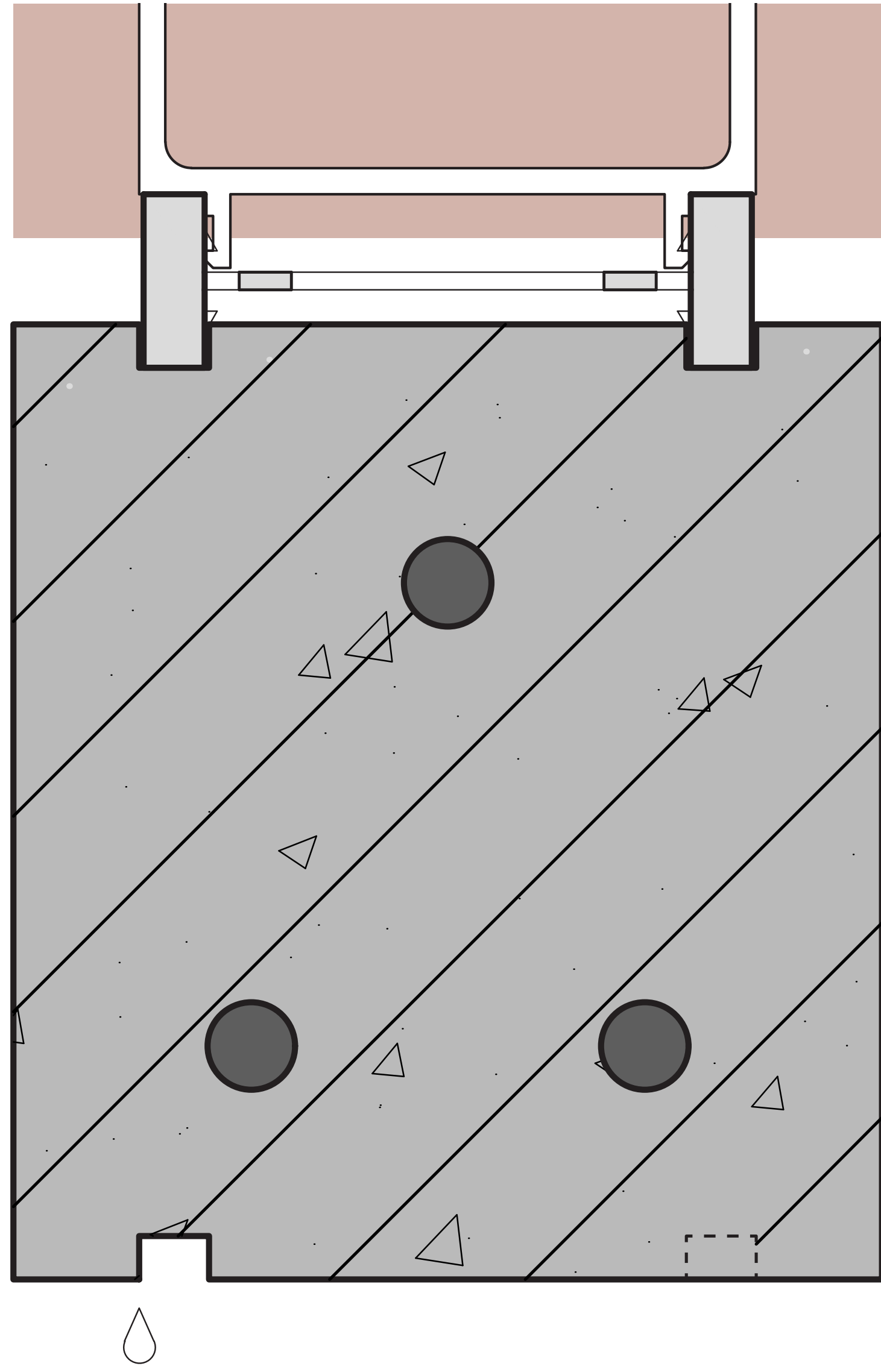
**2. Transfer precision of the system**



# Integrating existing products





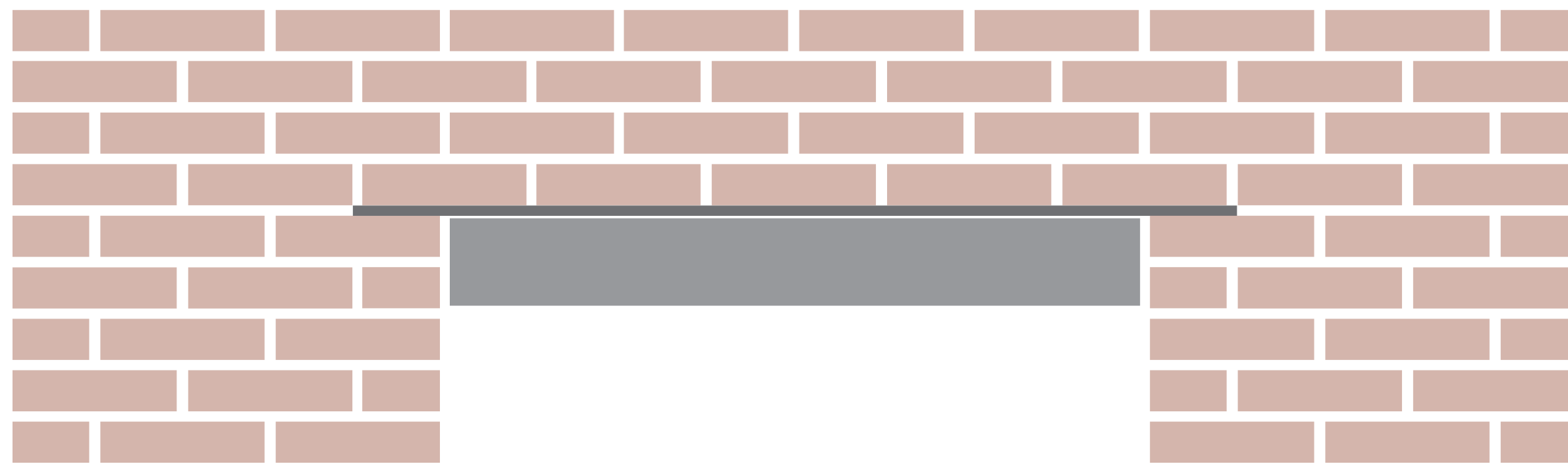
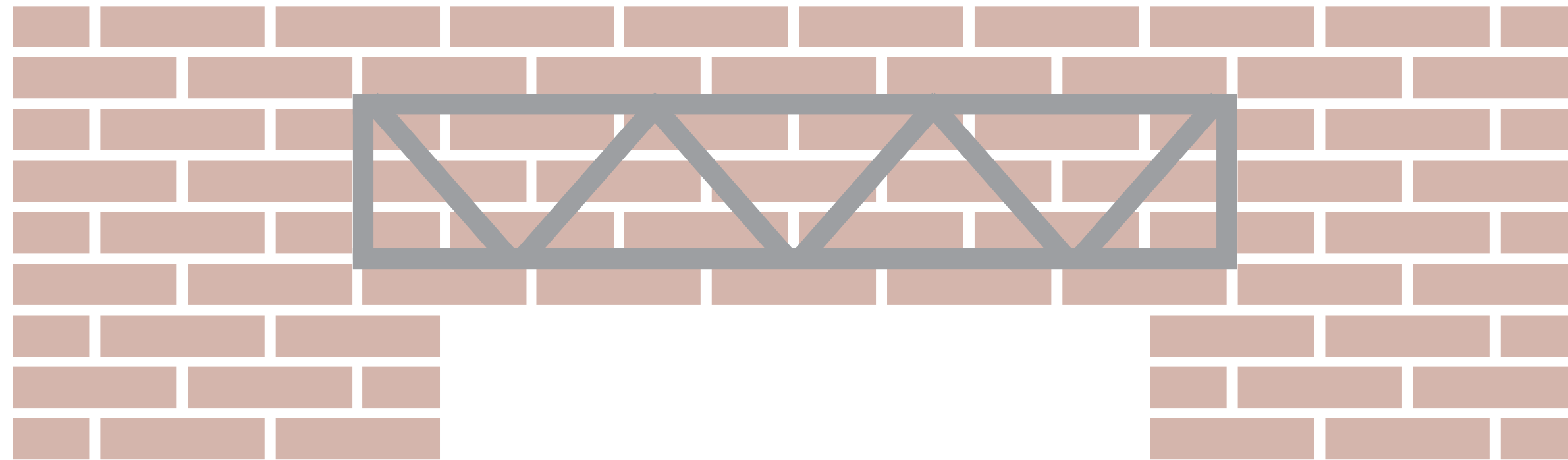






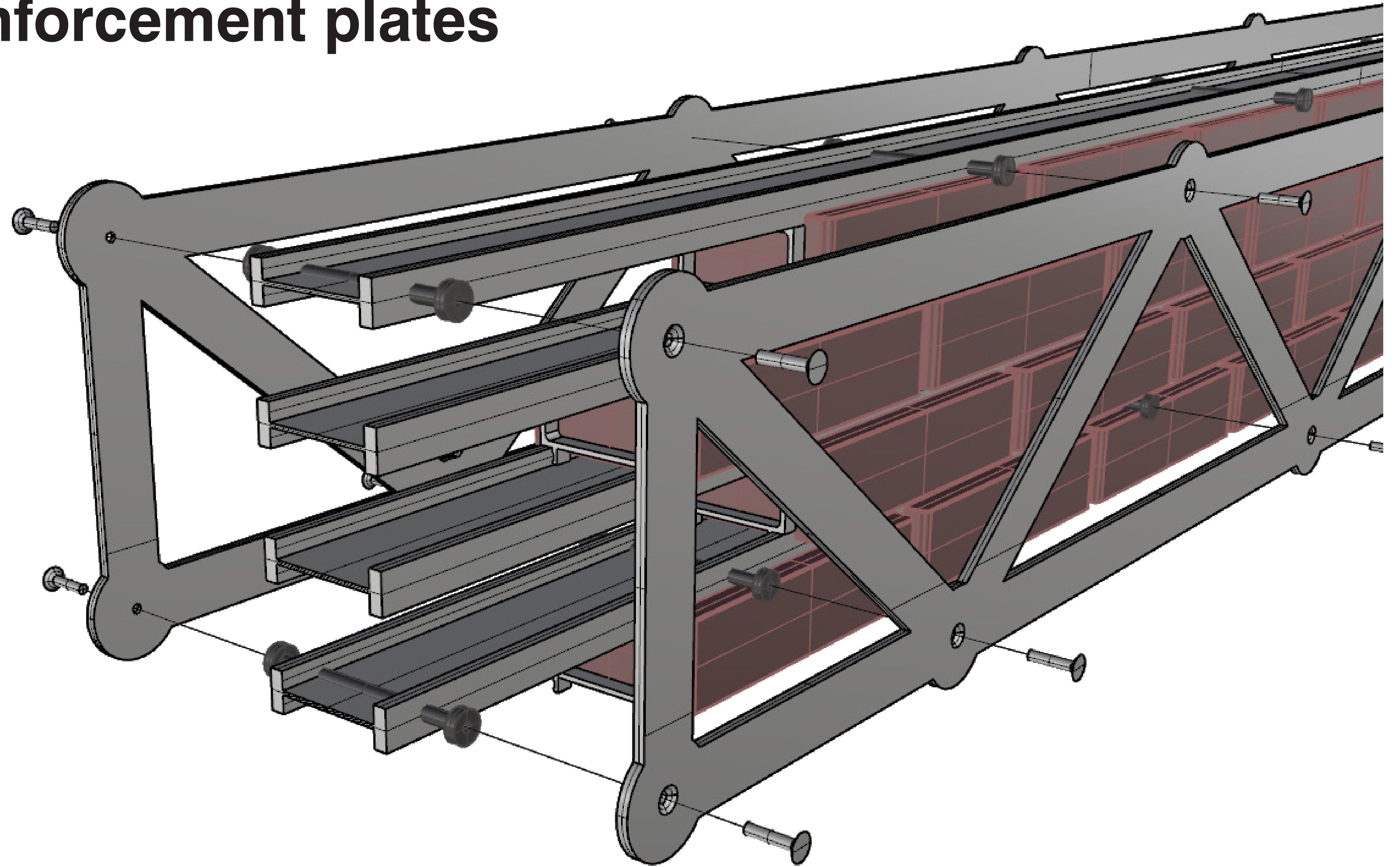


# New lintels inspired by H-block

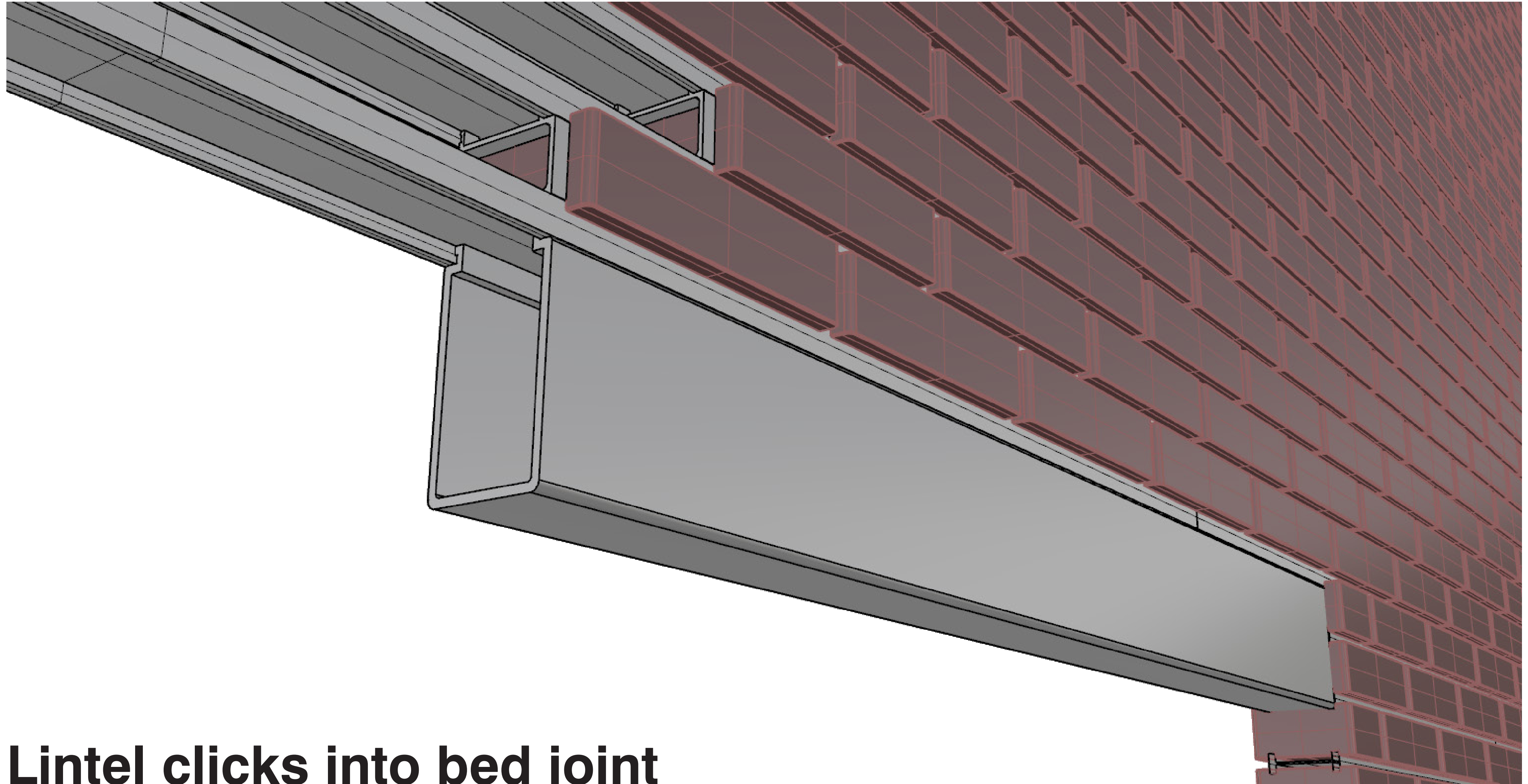




# Custom reinforcement plates



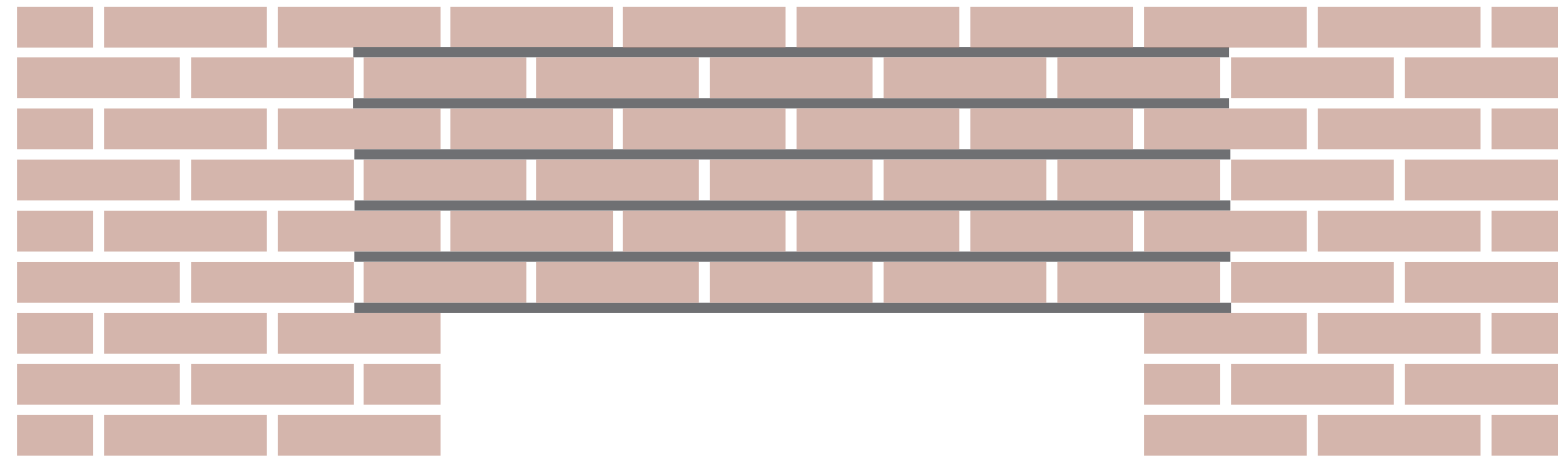




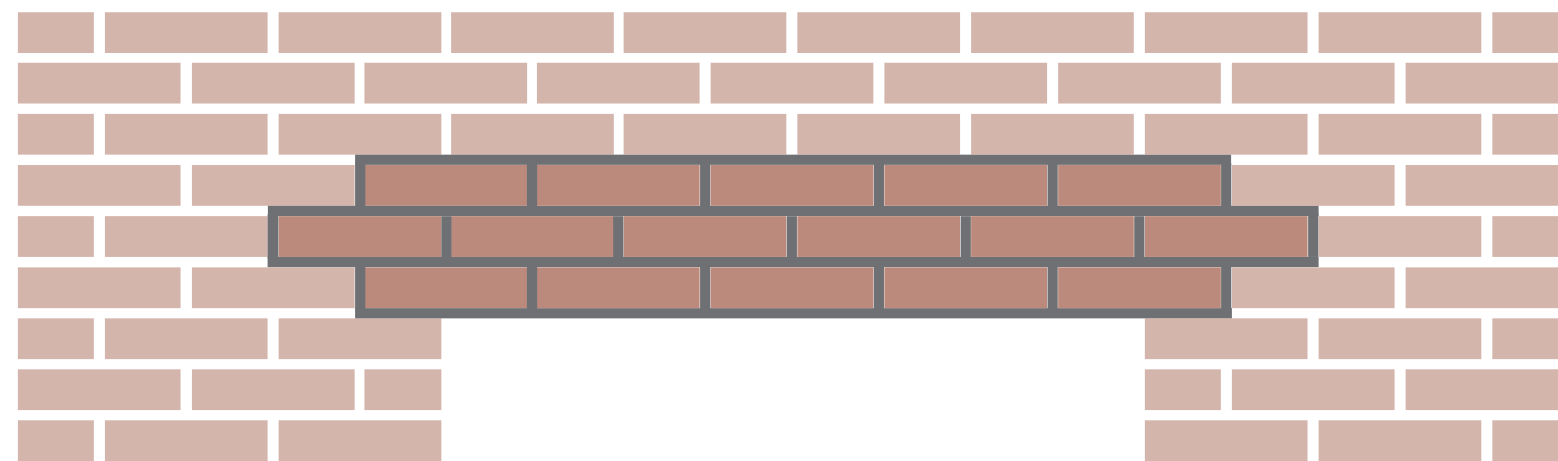
**Lintel clicks into bed joint**



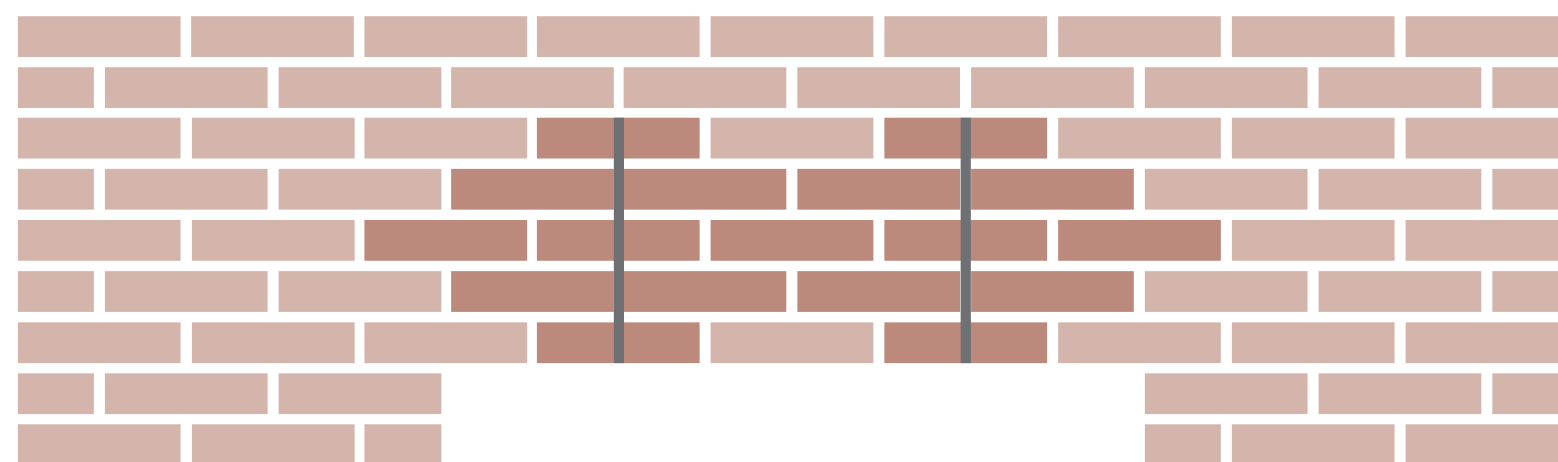
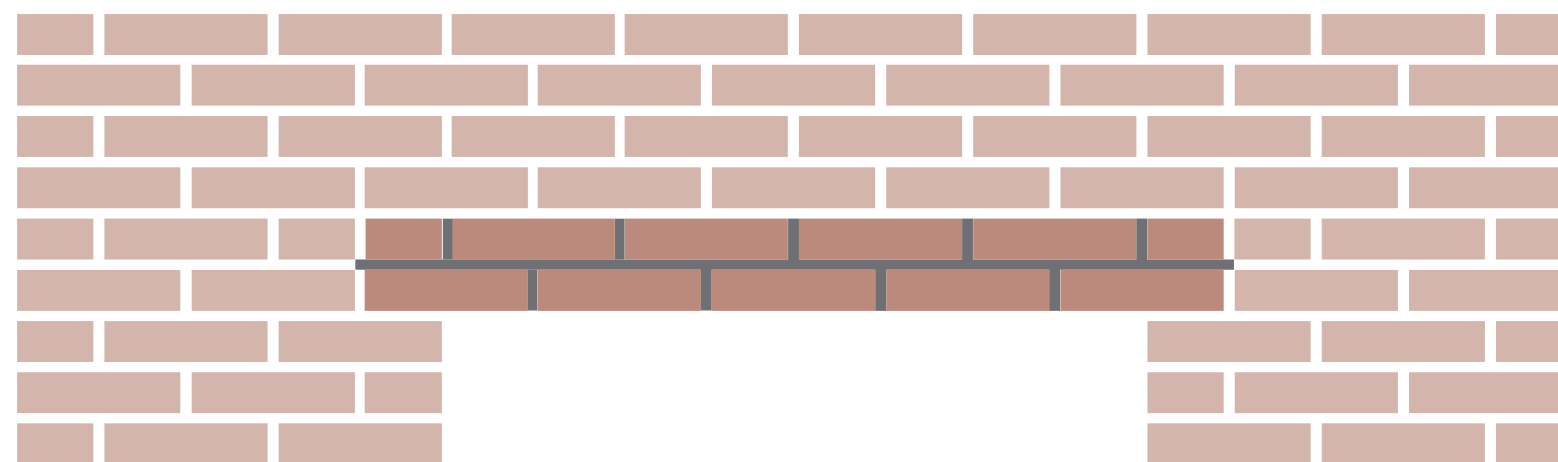
# Structural masonry



**Strength of the system itself**

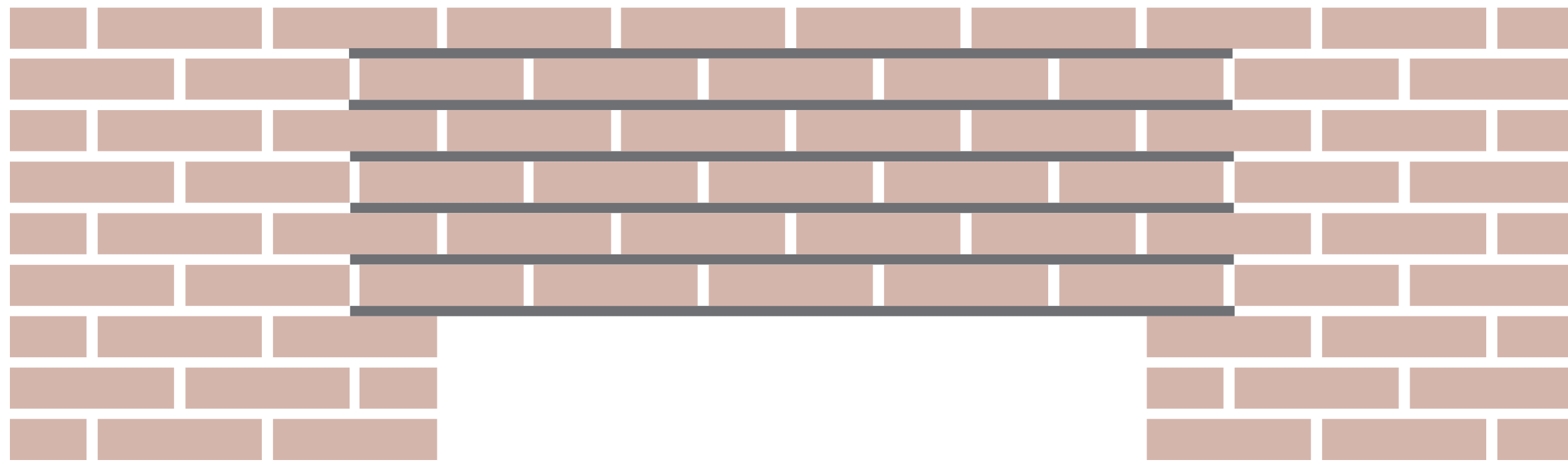


**System with added components**

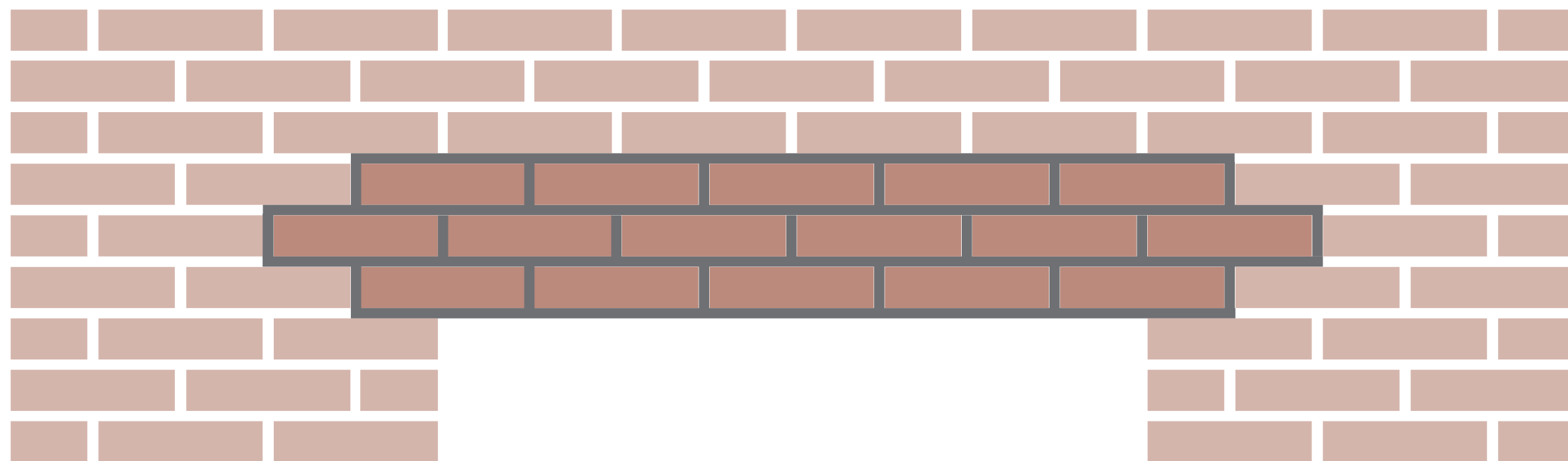




# Stength of the system itself



**Bed-joints as lintels**



**System all together**

















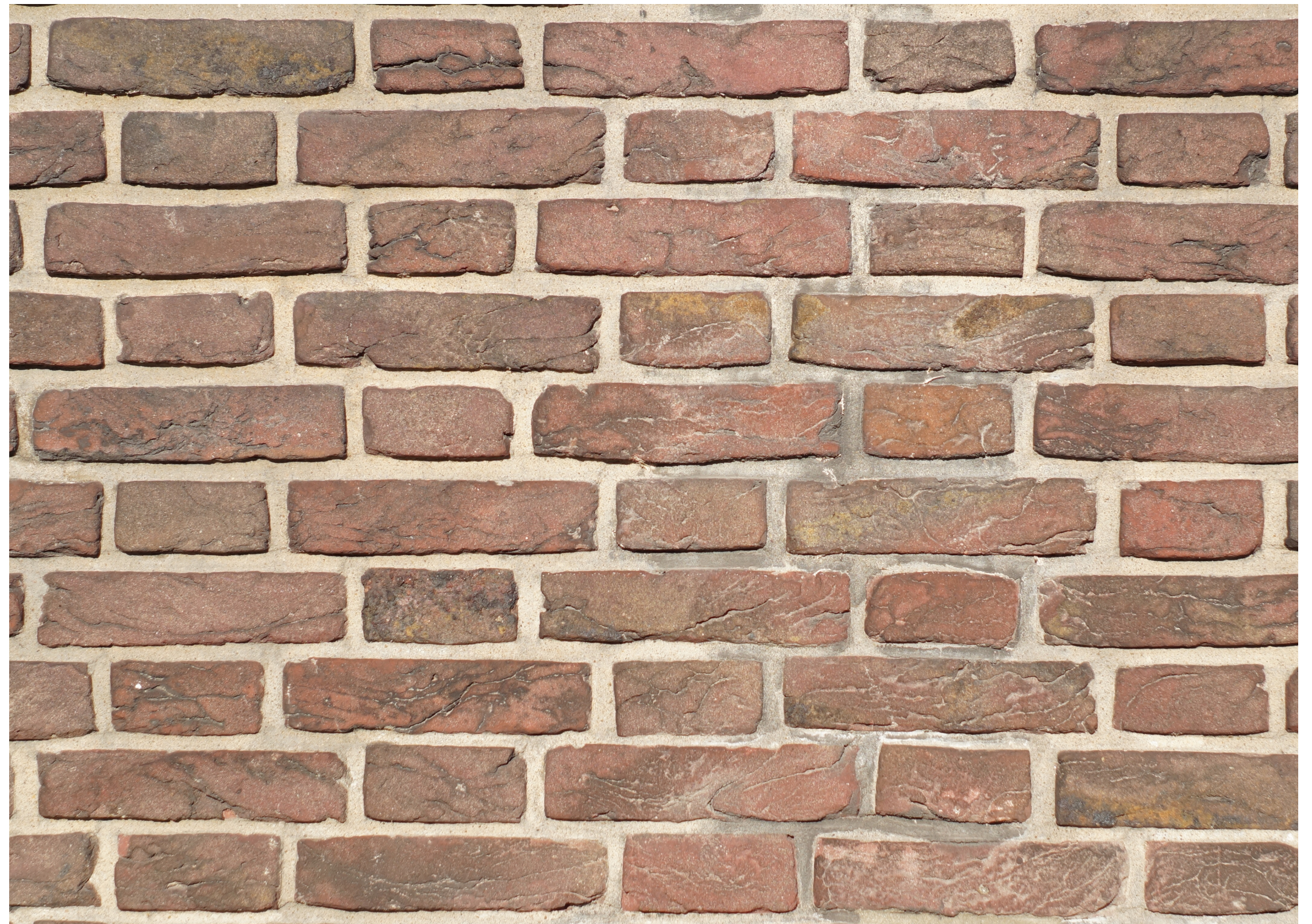


# Structural masonry - Traditional masonry

**Bricks fixed in three directions**

**Mortar take up all the slack**

**Limited strength in tension**





# Structural masonry - Dry stacked masonry

**Bricks not fixed in three directions**

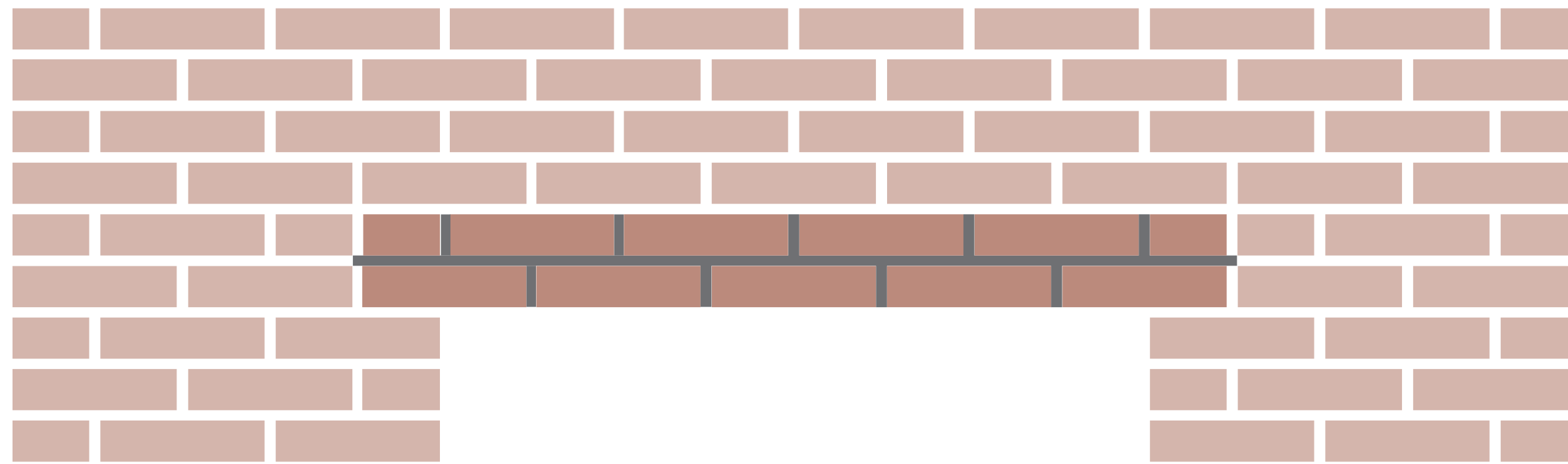
**Many components with tolerances**

**Potentially components that can take tension**

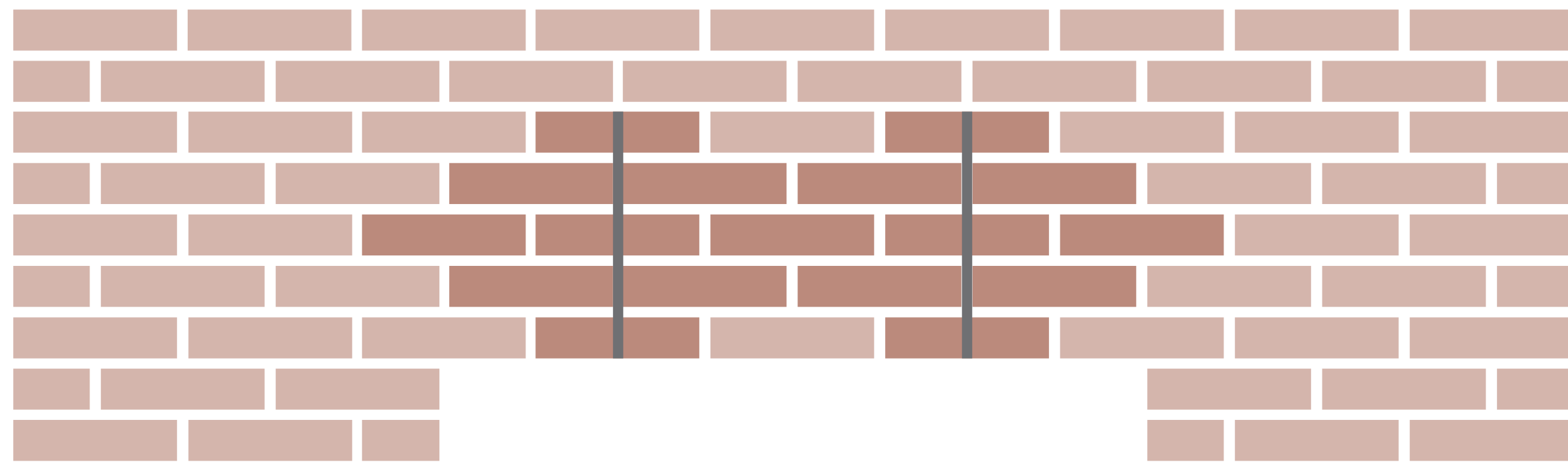




# System with added components



**Horizontal prestress**



**Vertical prestress**

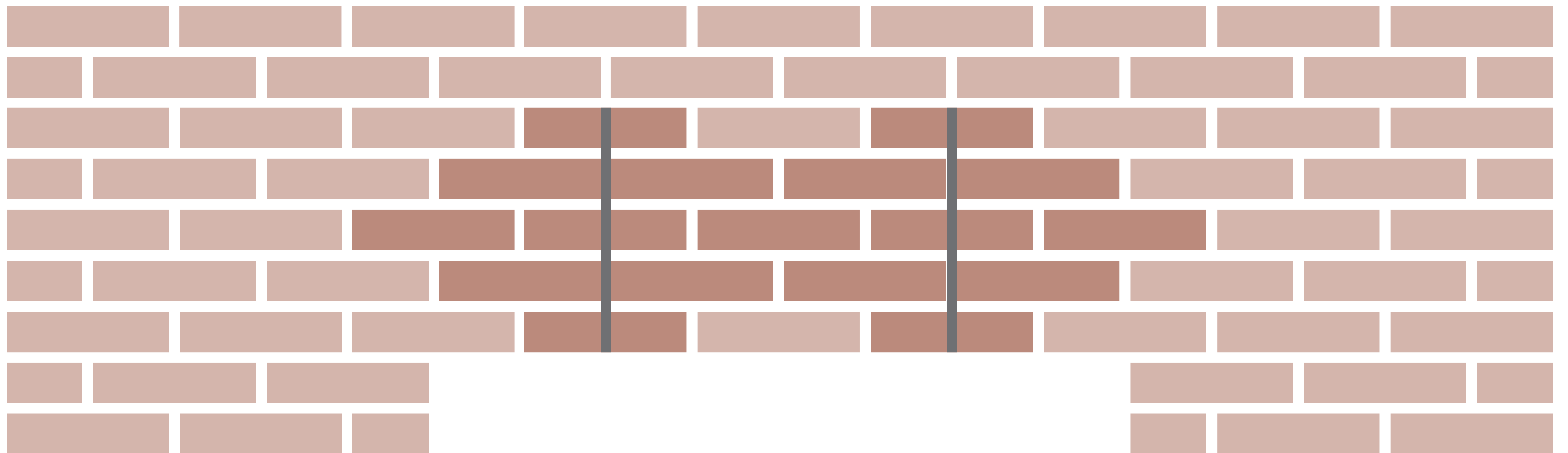


# Horizontal prestress



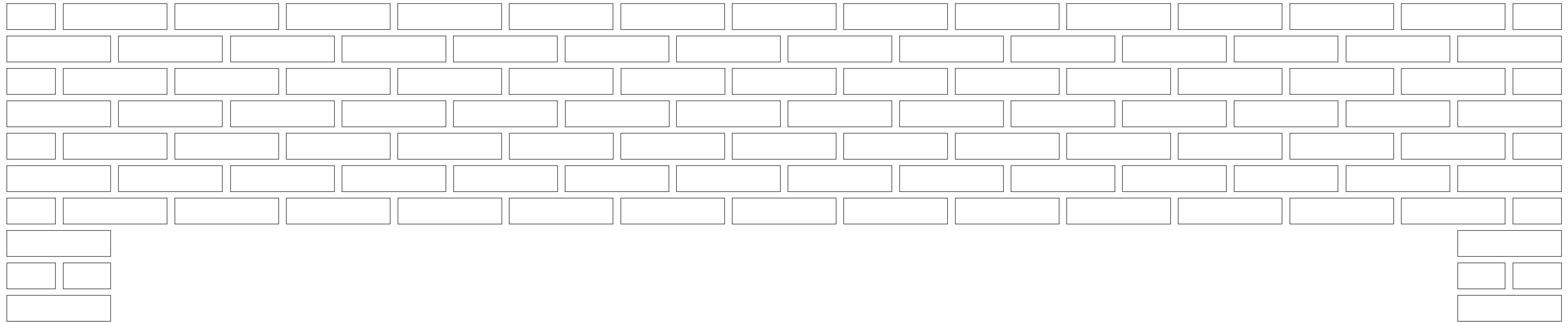


# Vertical prestress



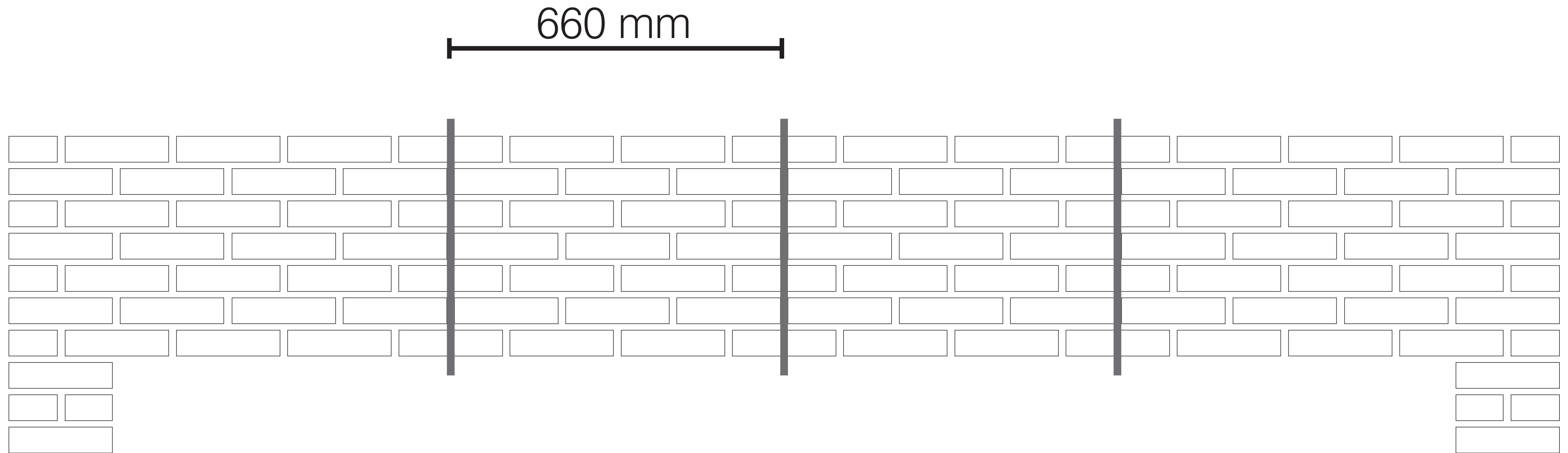


# Vertical prestress



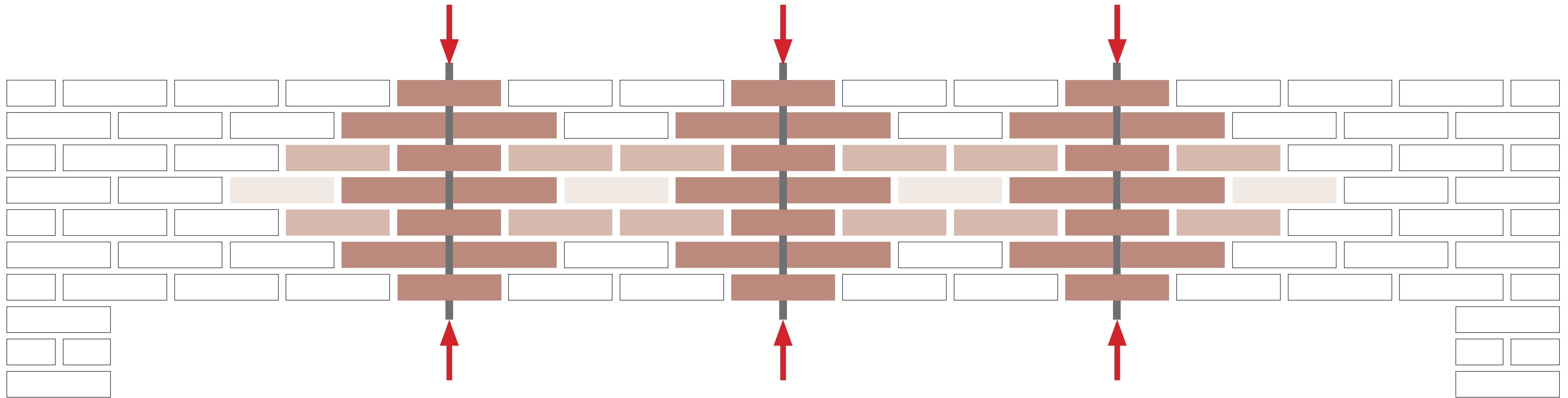


# Vertical prestress





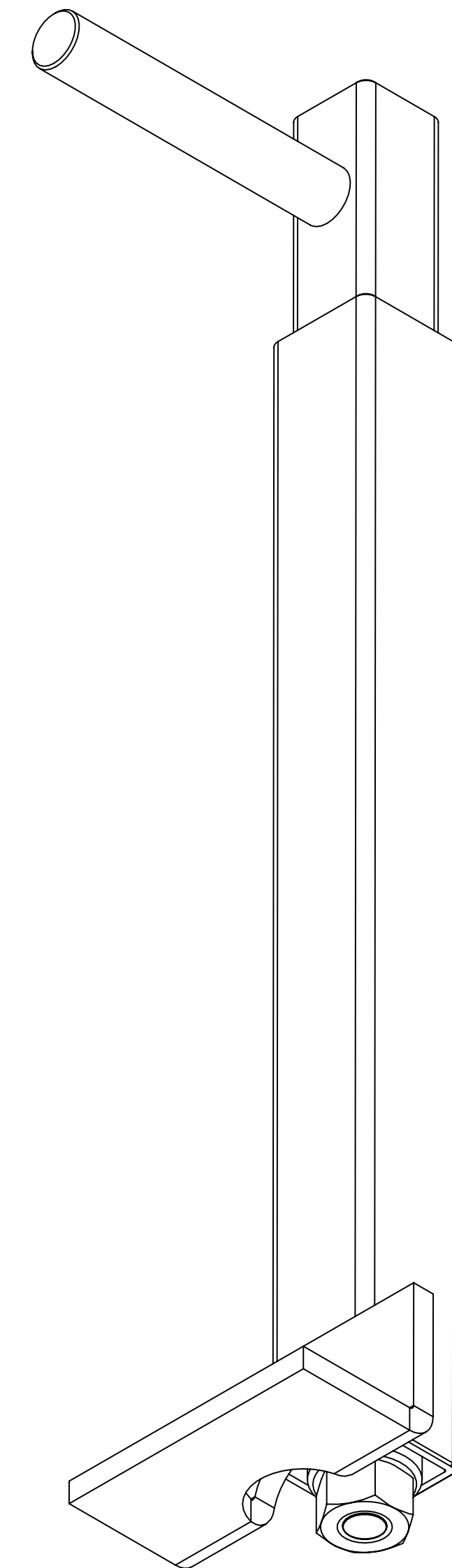
# Vertical prestress





# Precedent: Gevelklemmen

Rule: clamp 7 courses, every 700 mm

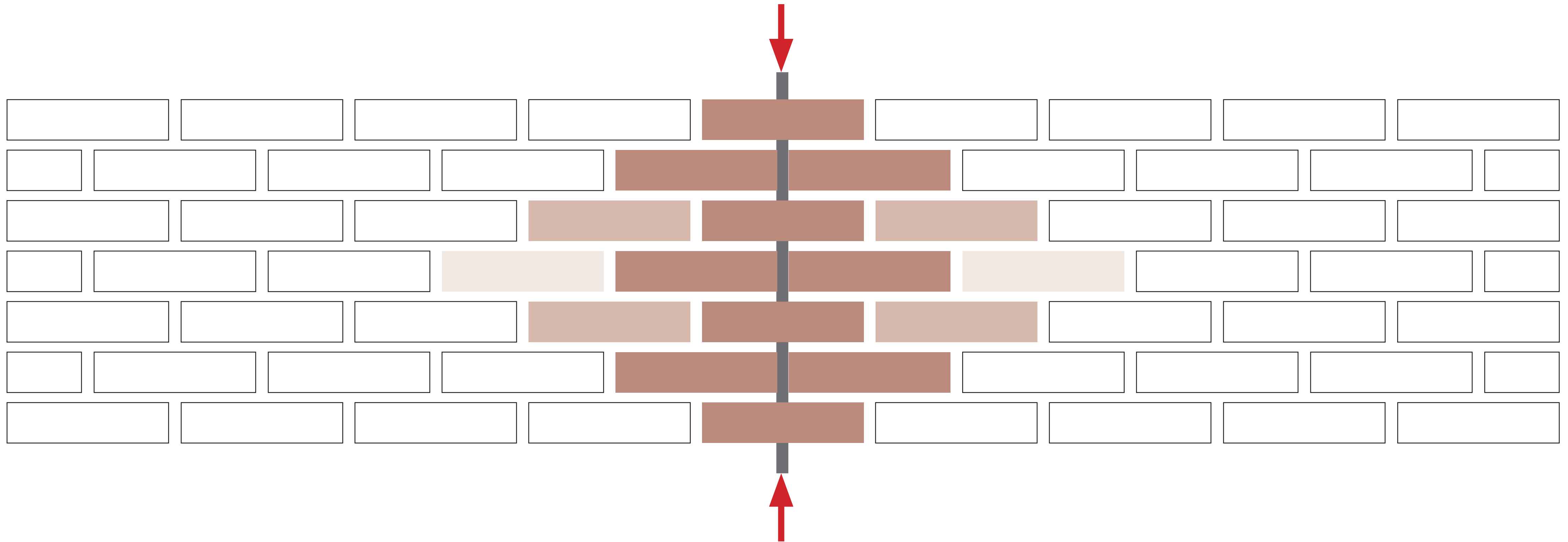




**How does it work?**

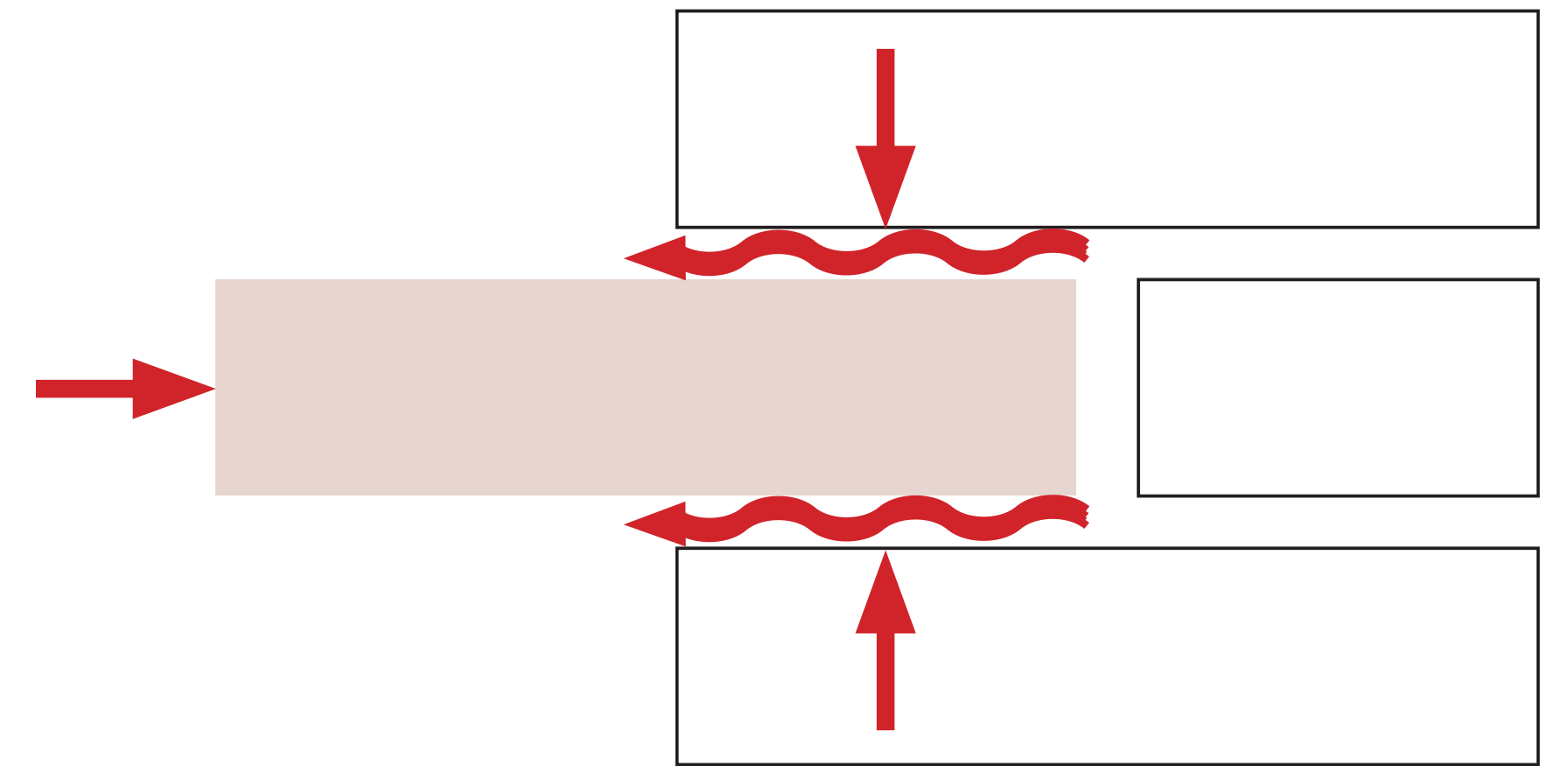
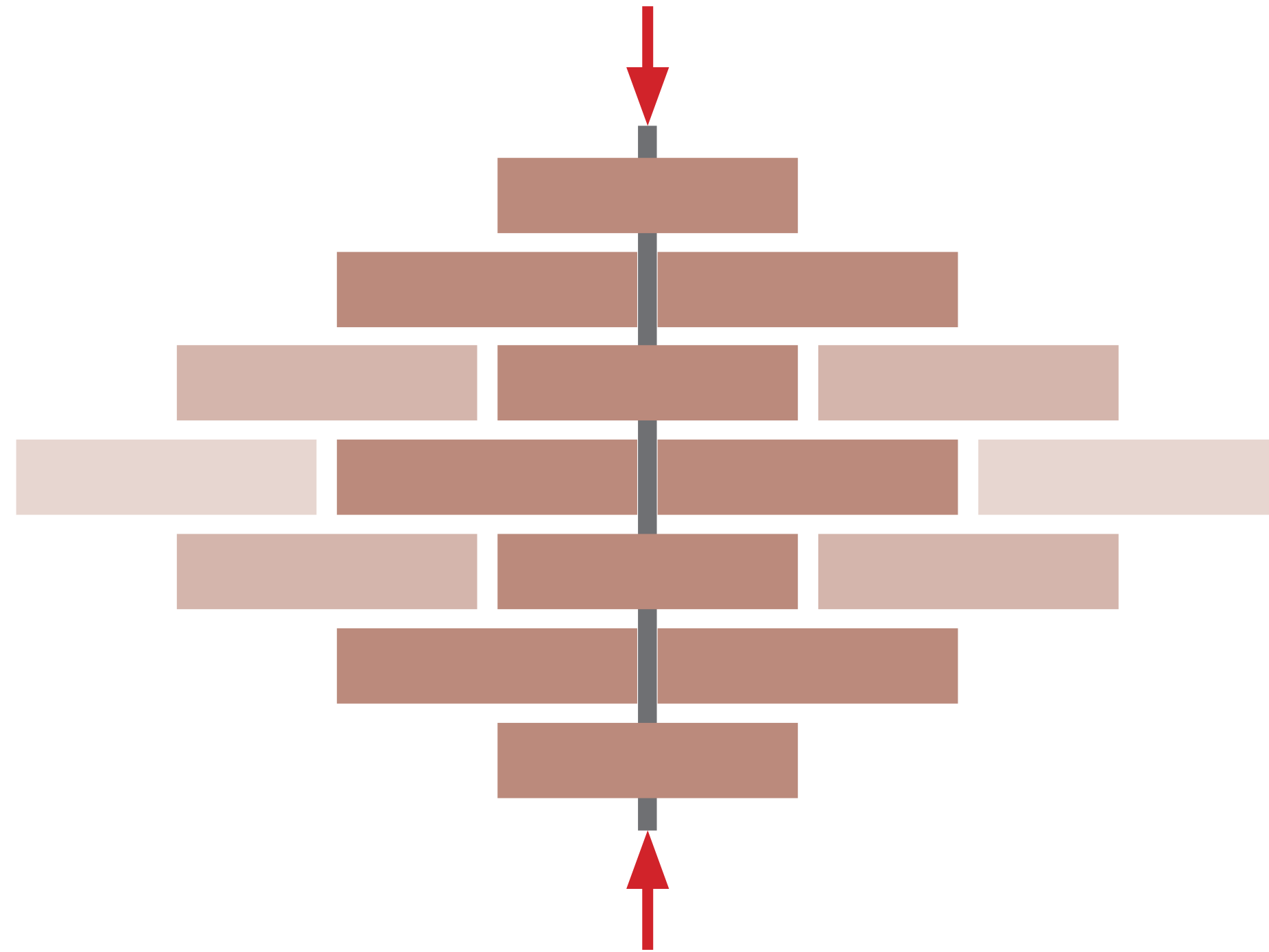


# Prestressing masonry



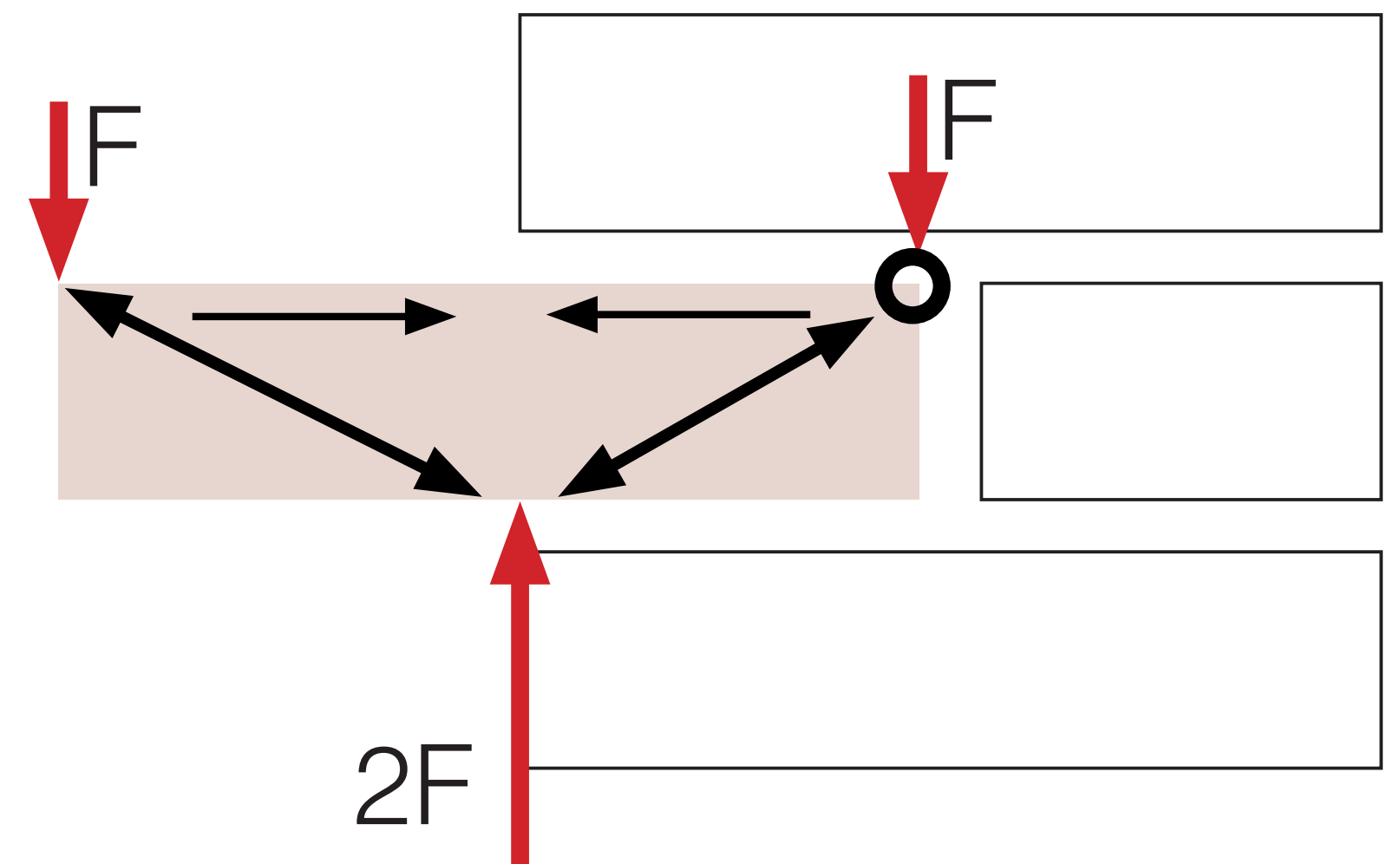
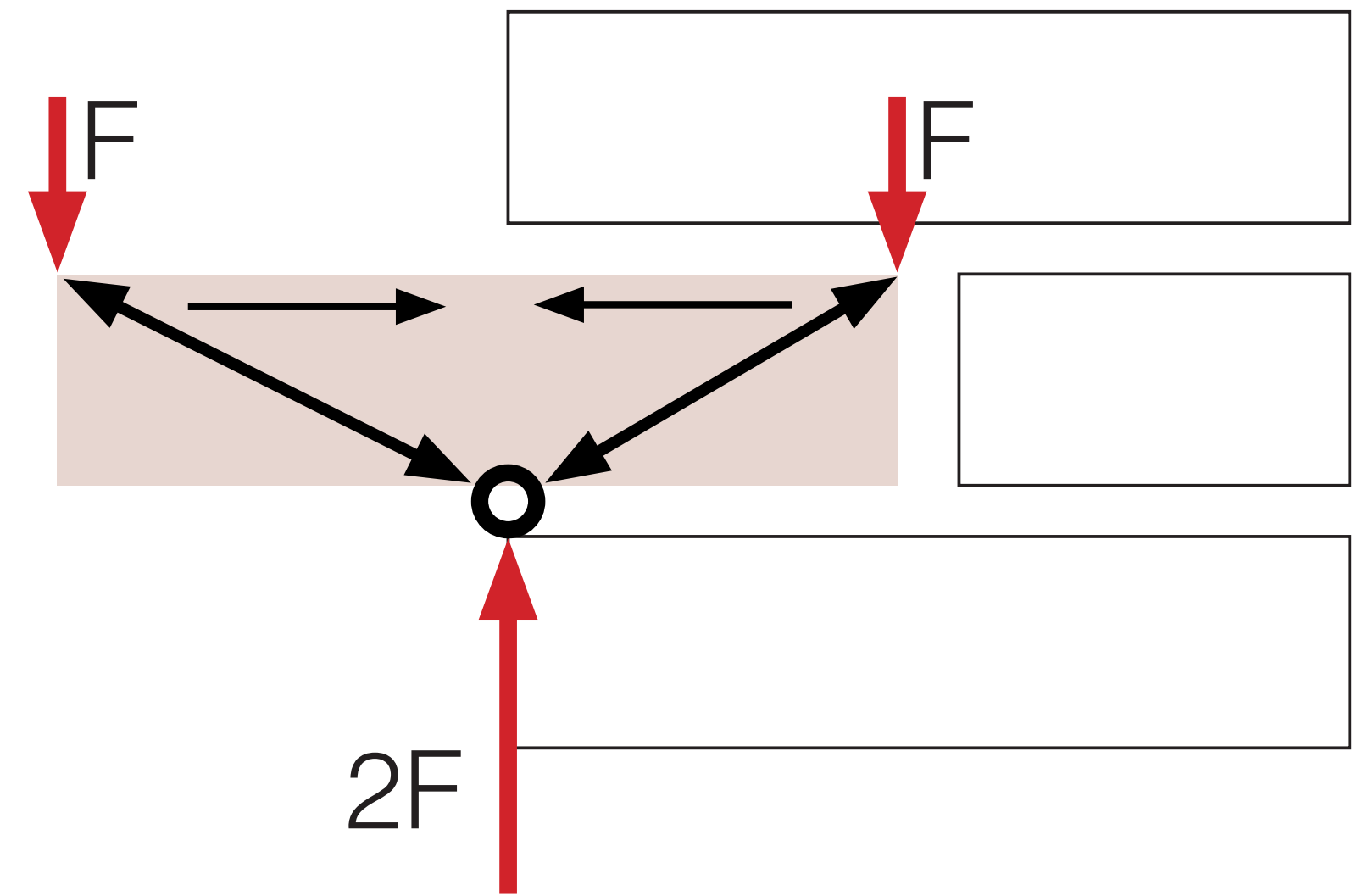
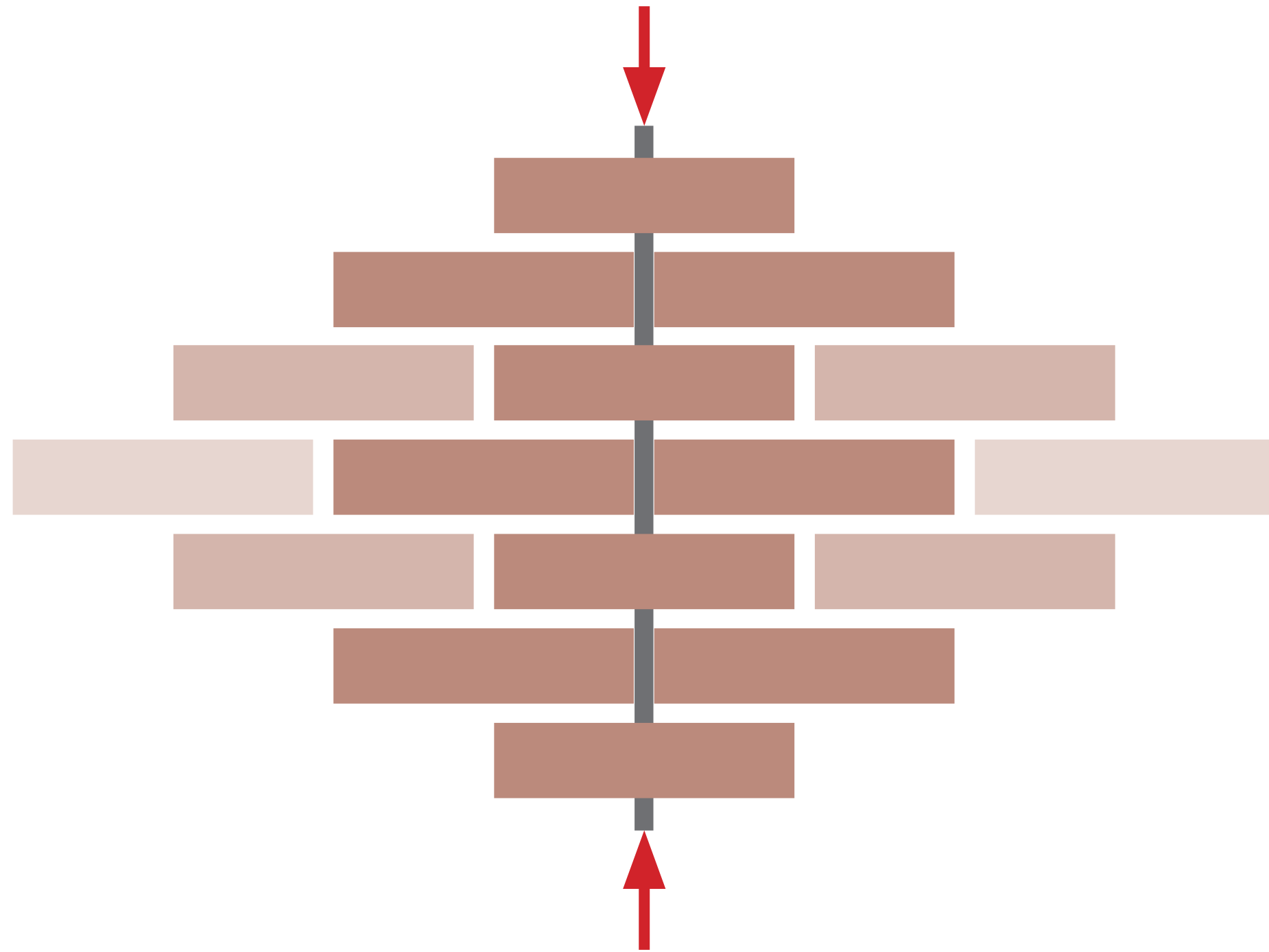


# Prestress increases friction



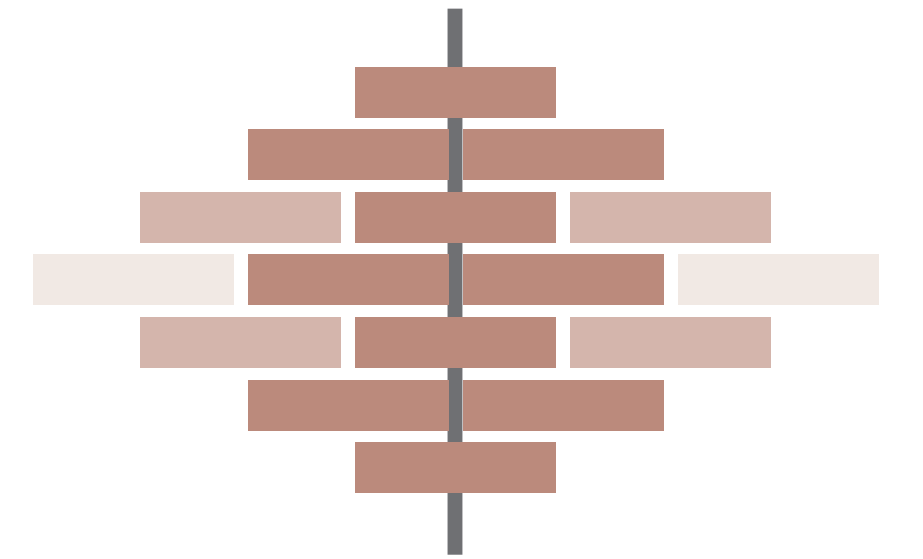
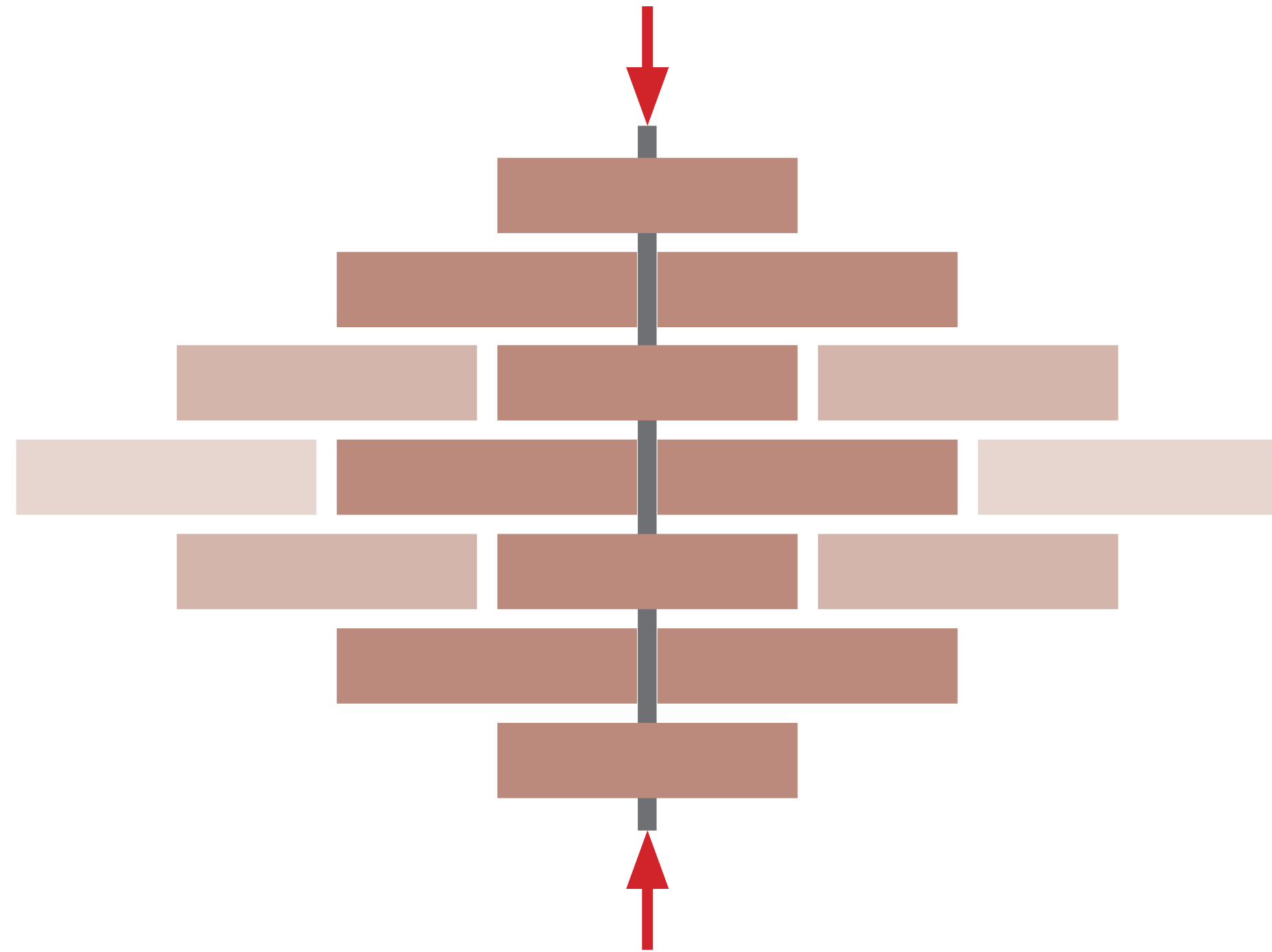


# Prestress prevents rotation



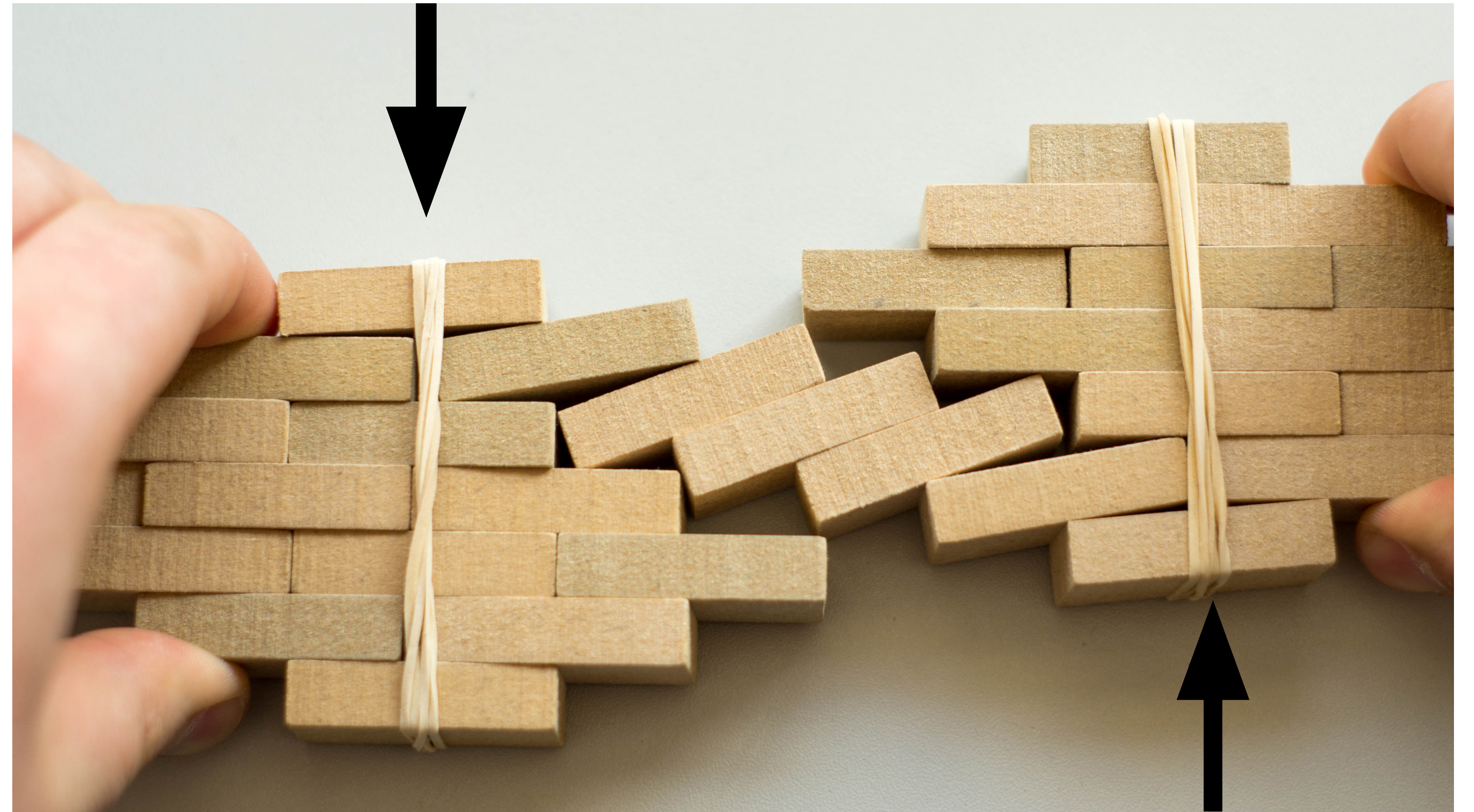
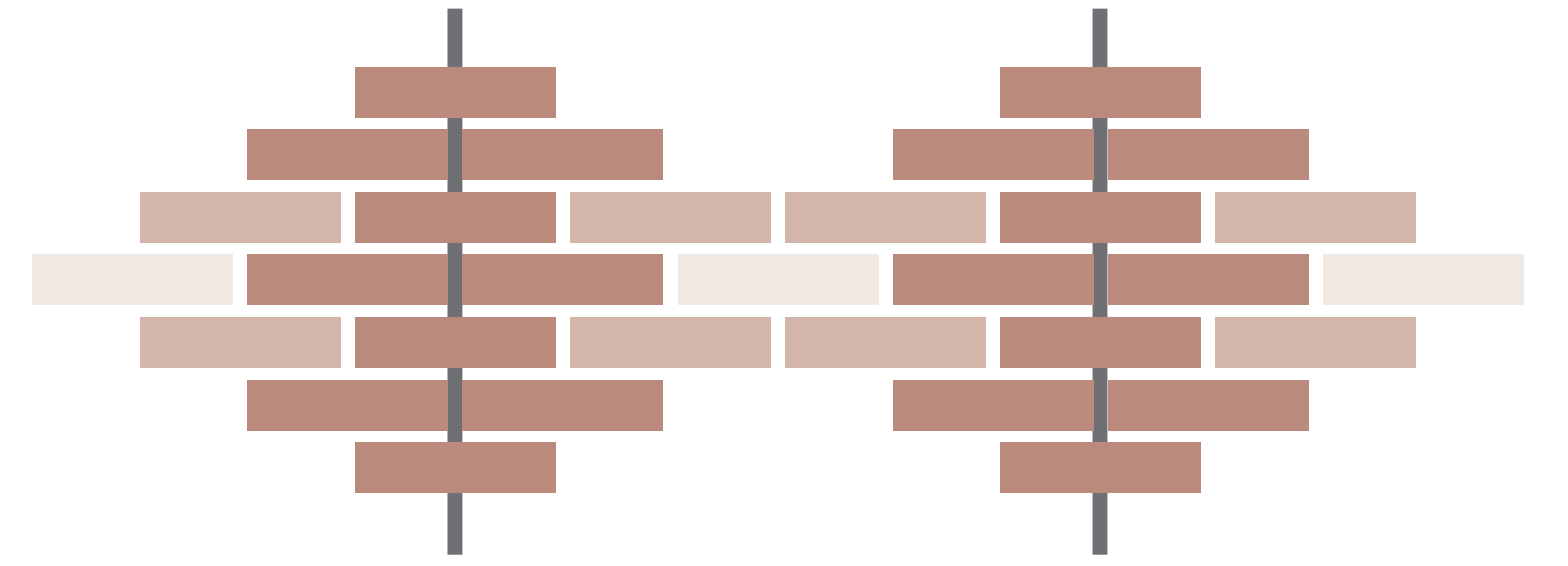


# Multiple levers in sequence



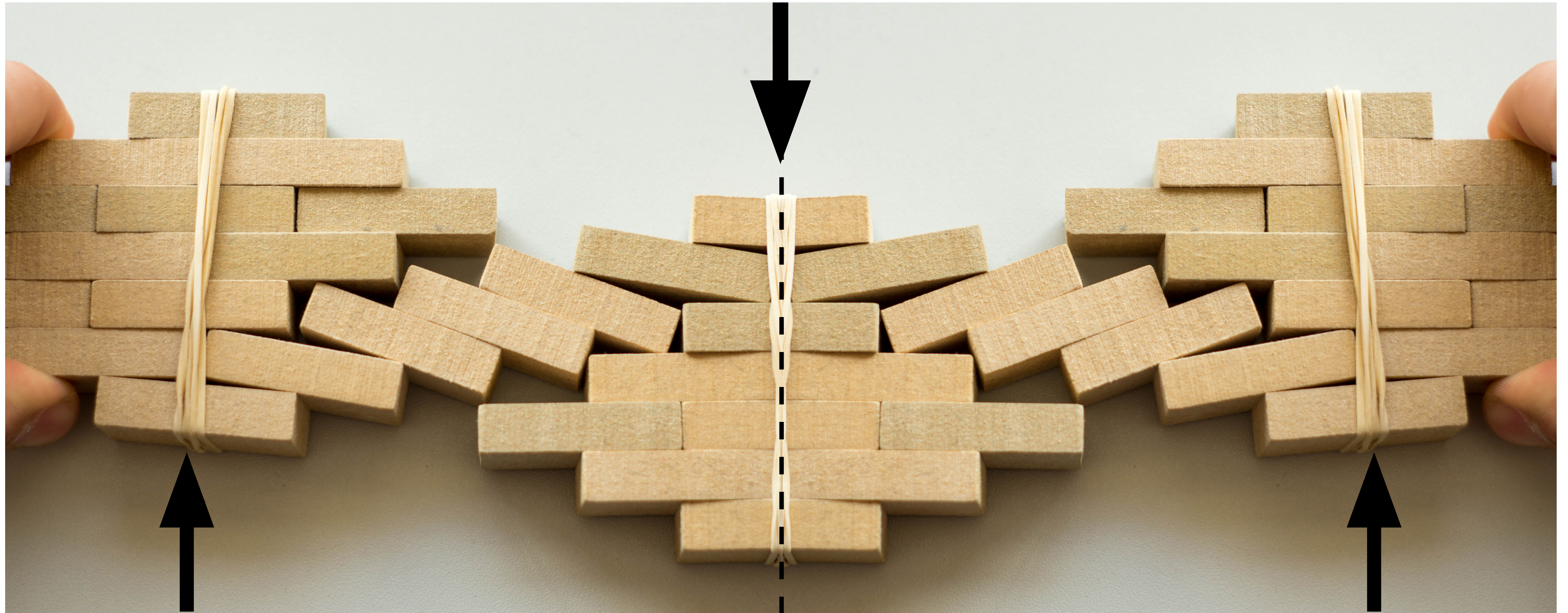
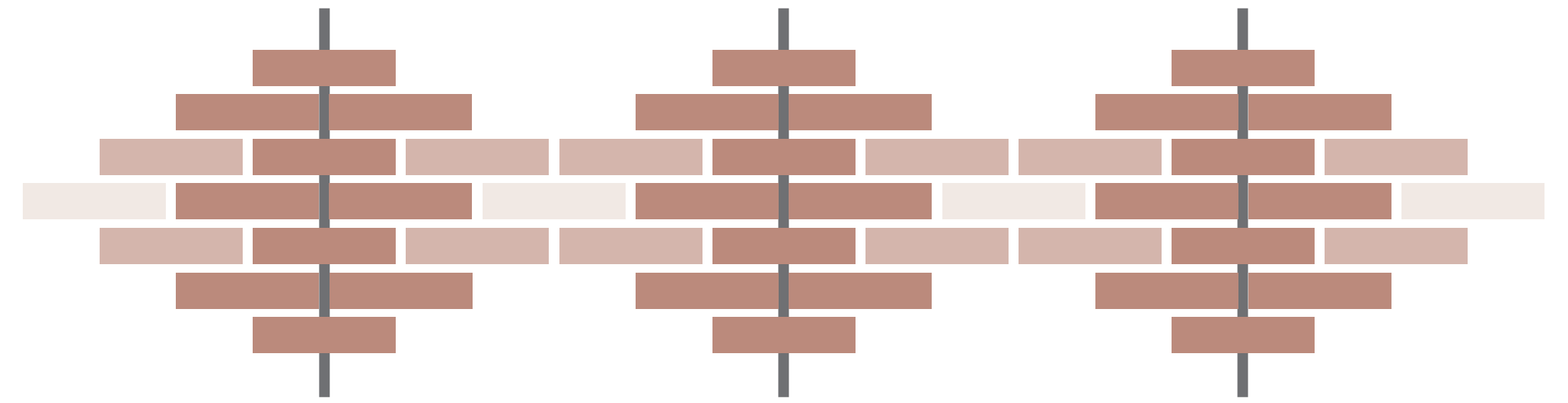


# Prestressing masonry



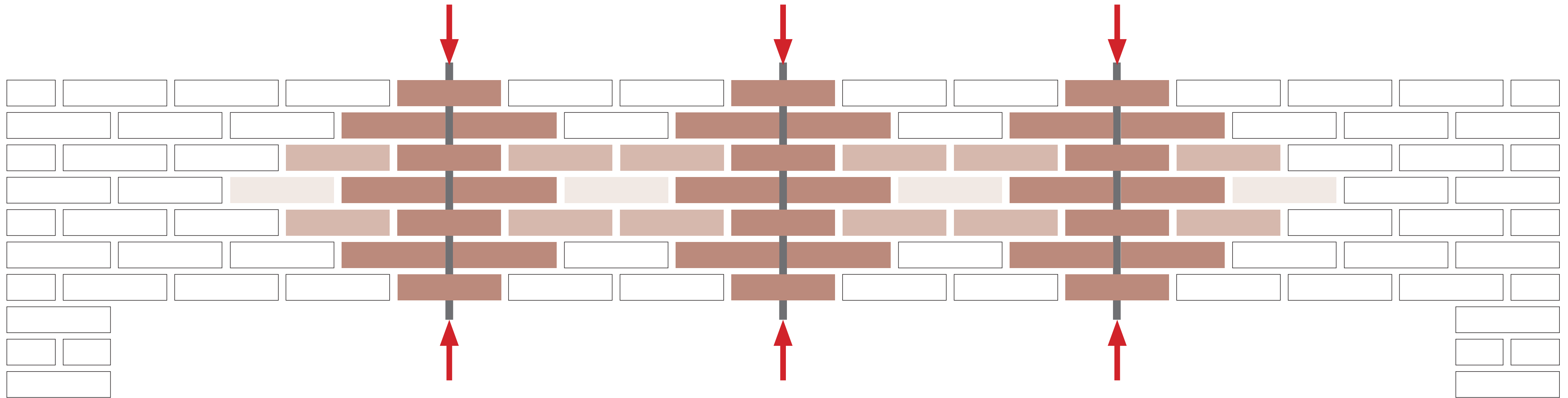


# Prestressing masonry

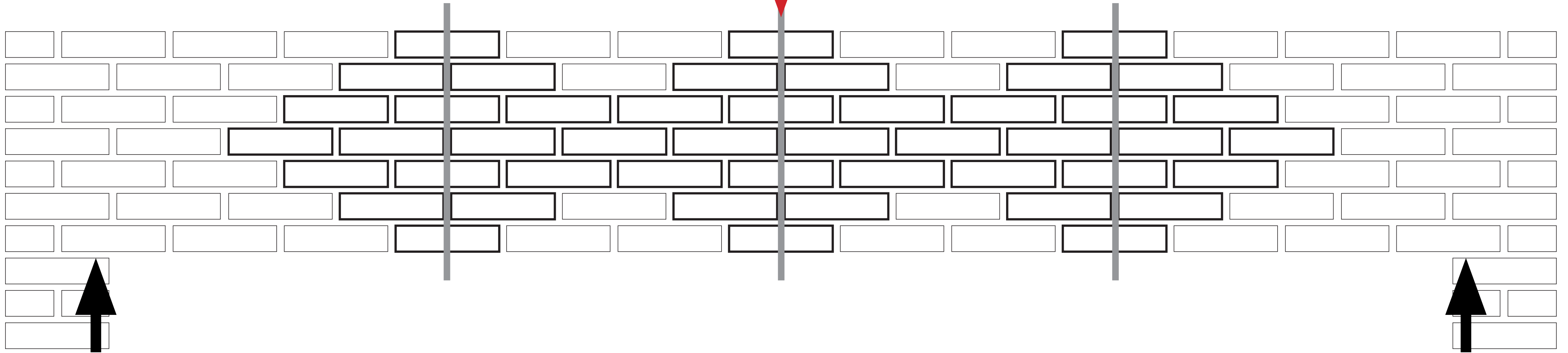




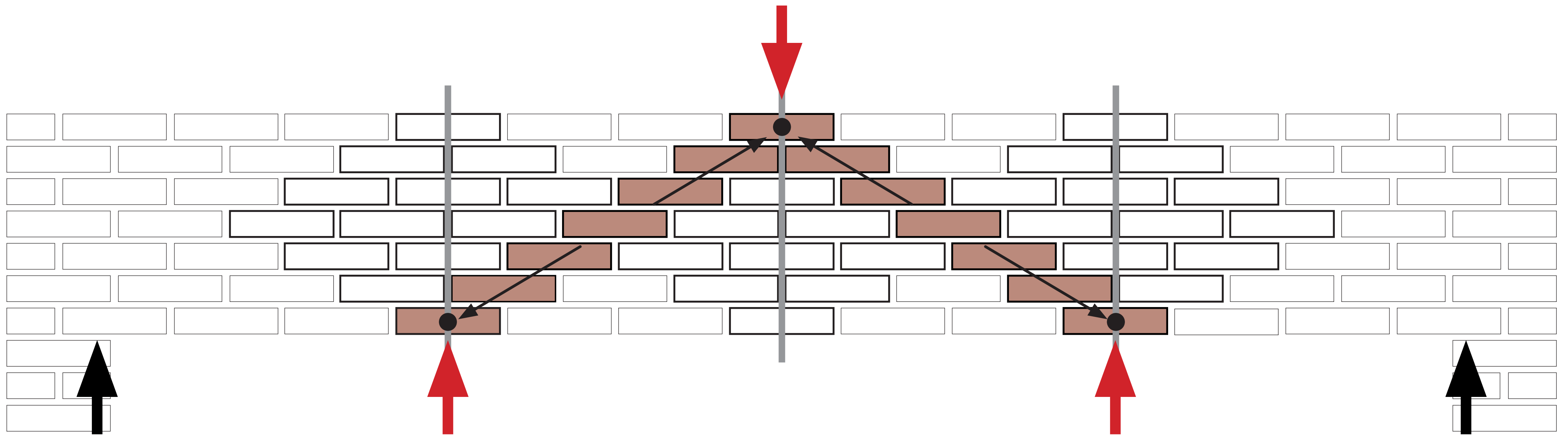
# Prestressing masonry



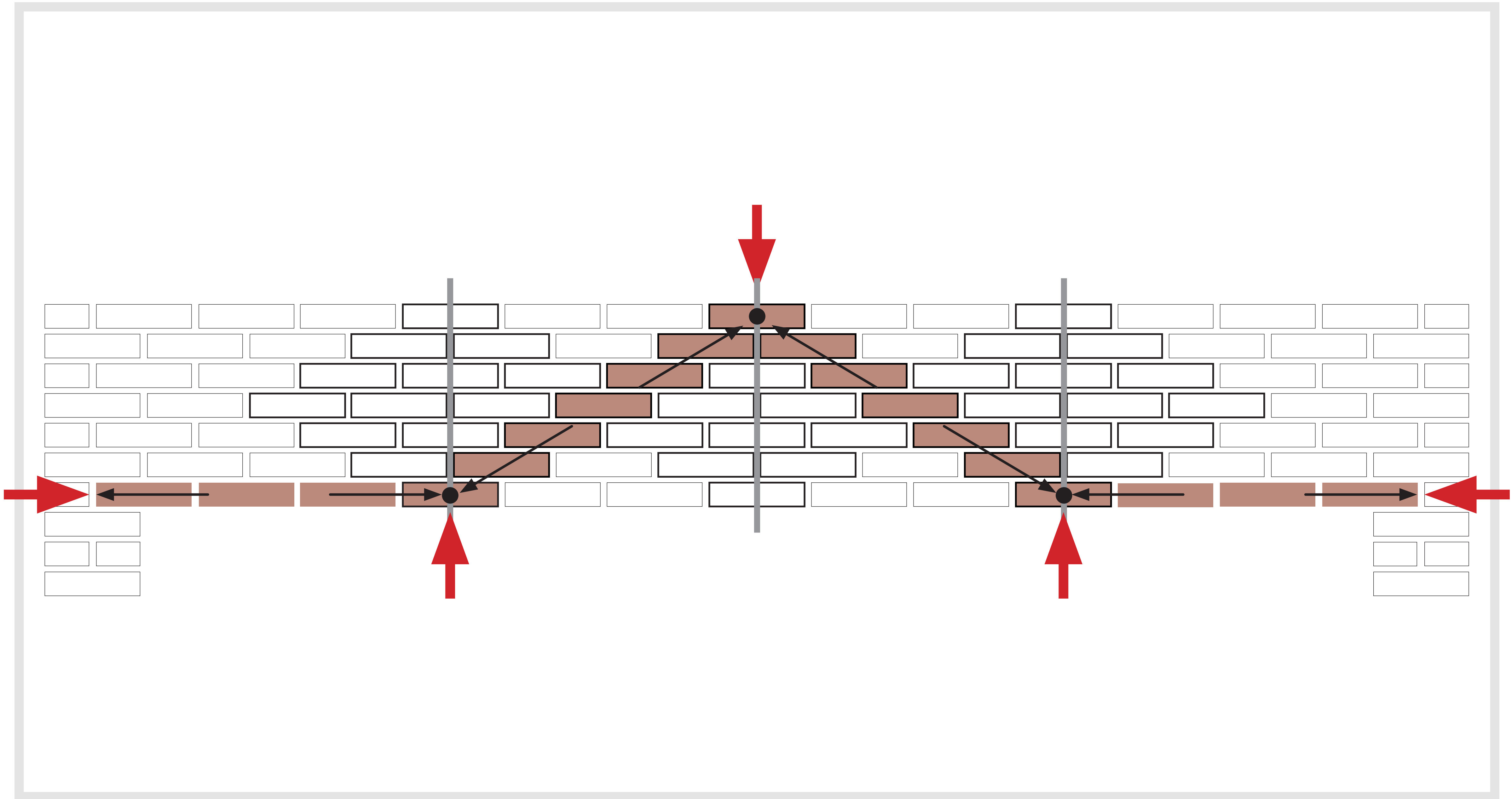




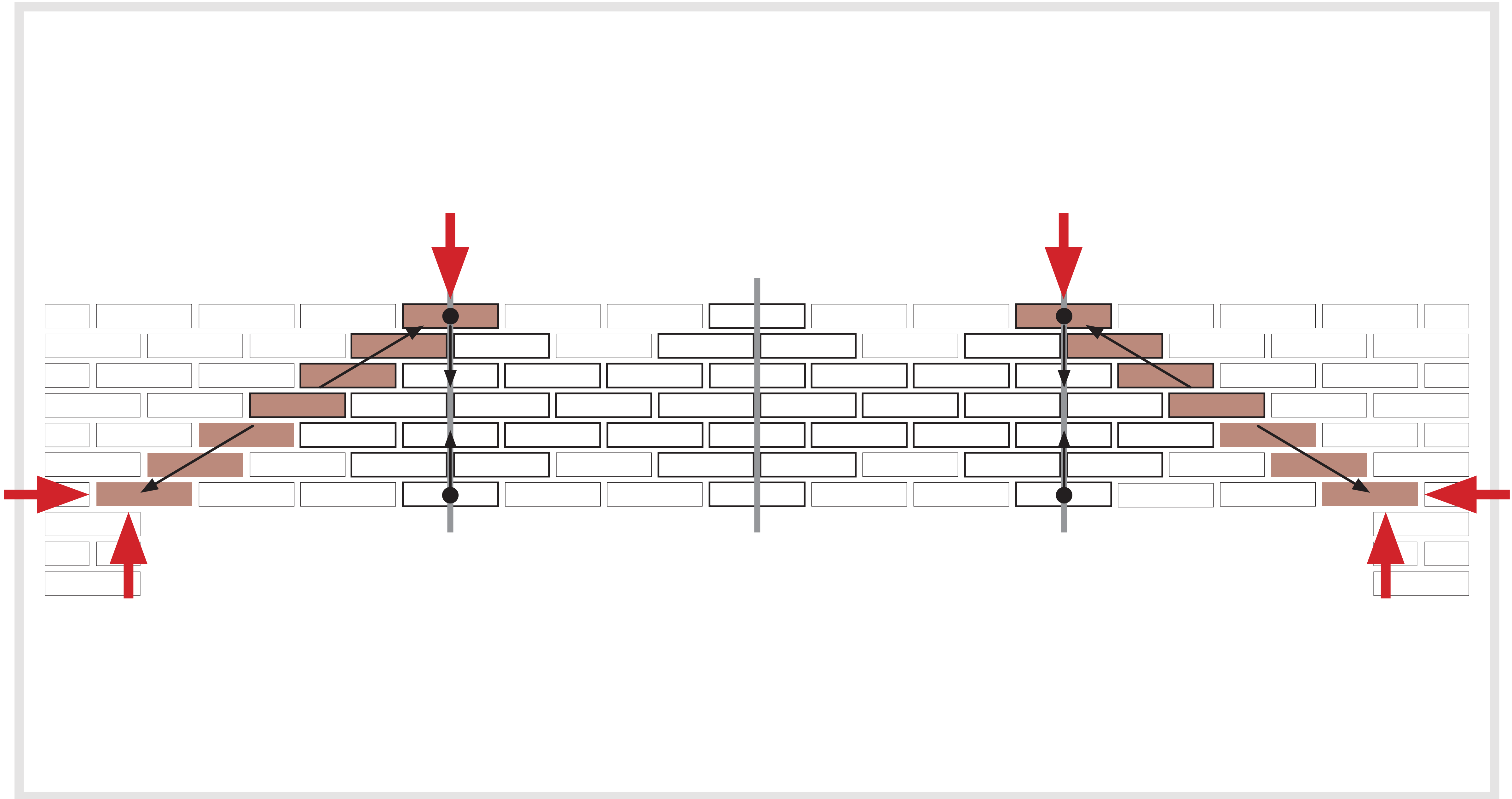




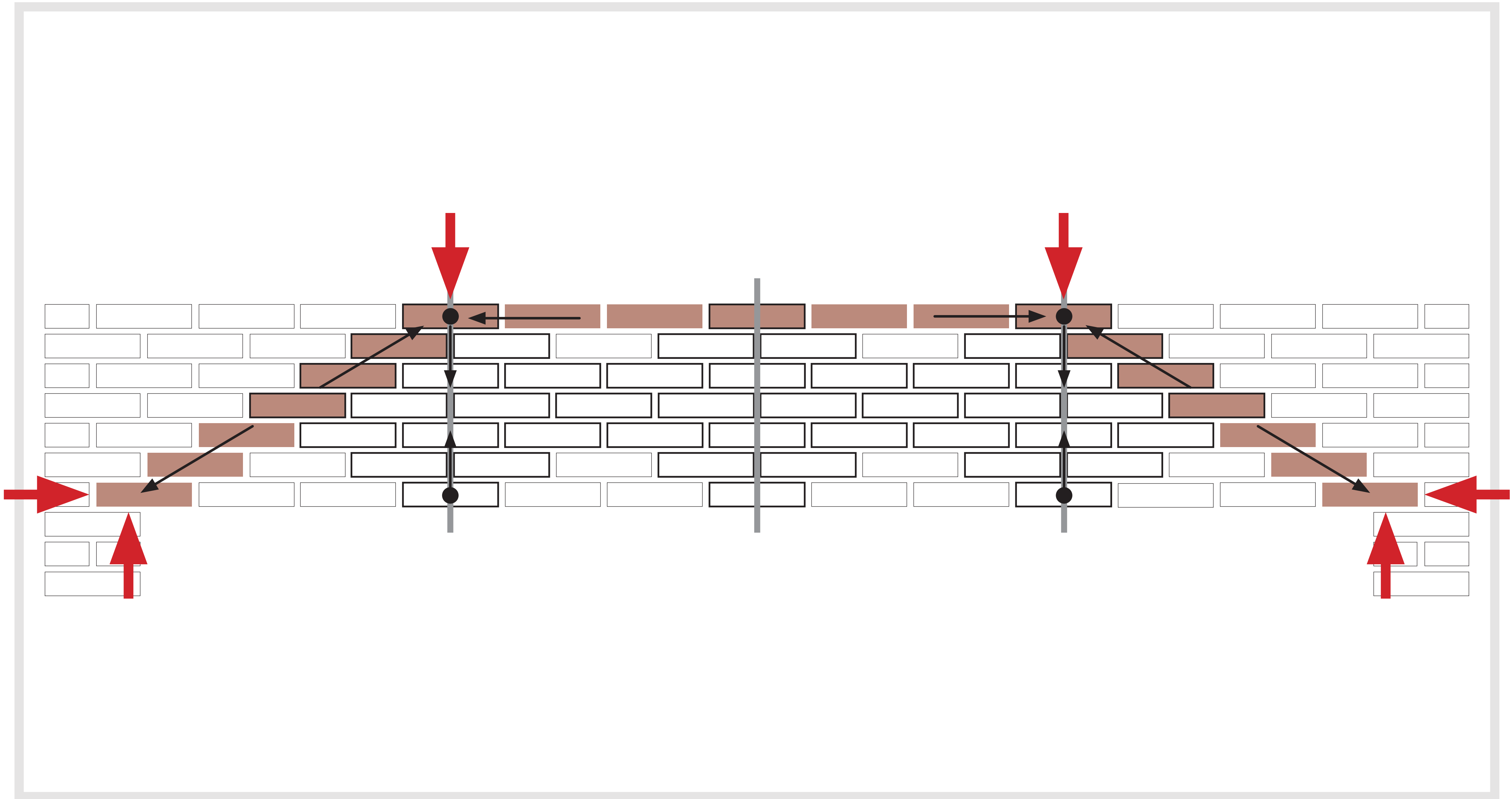




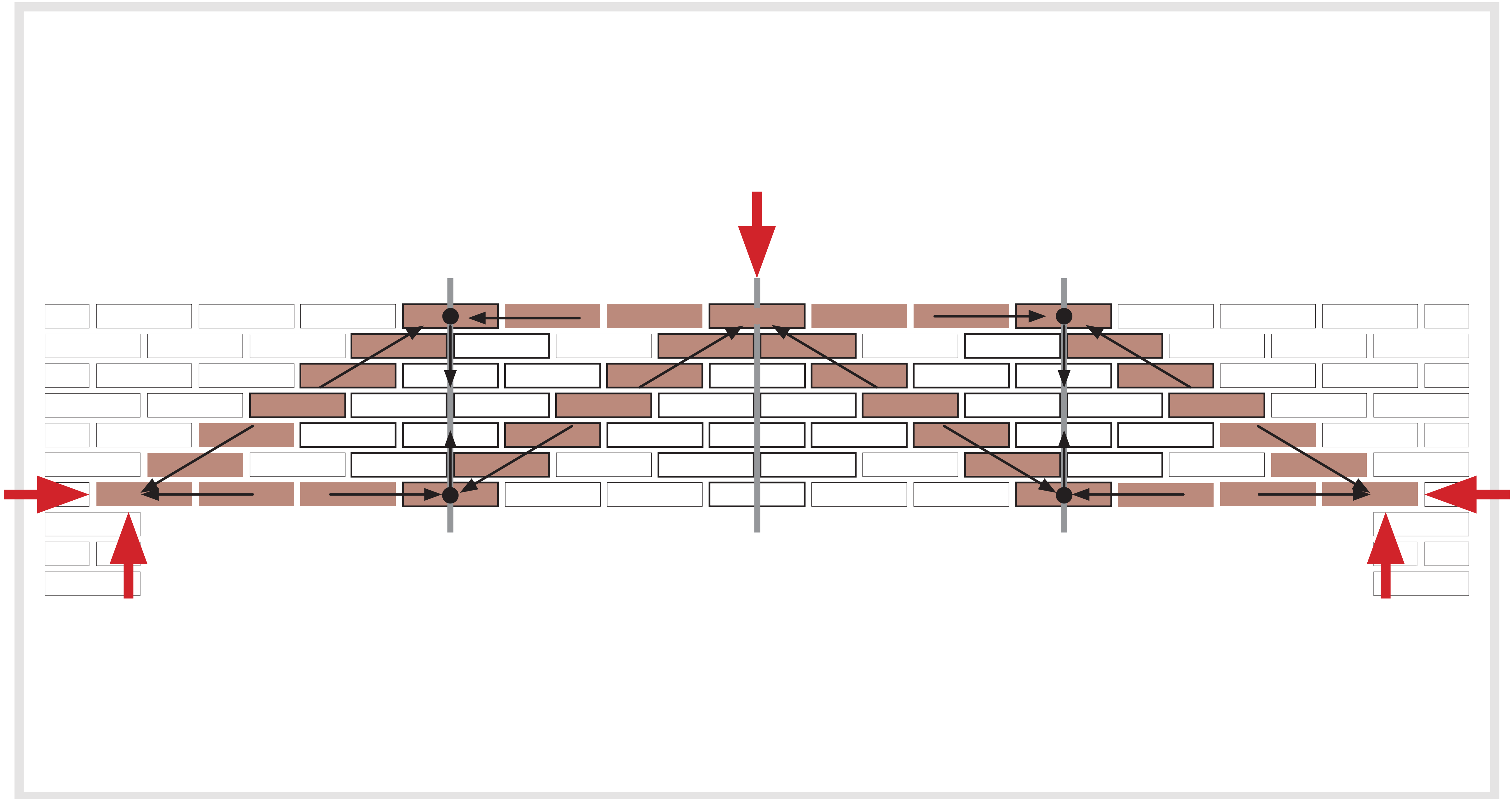




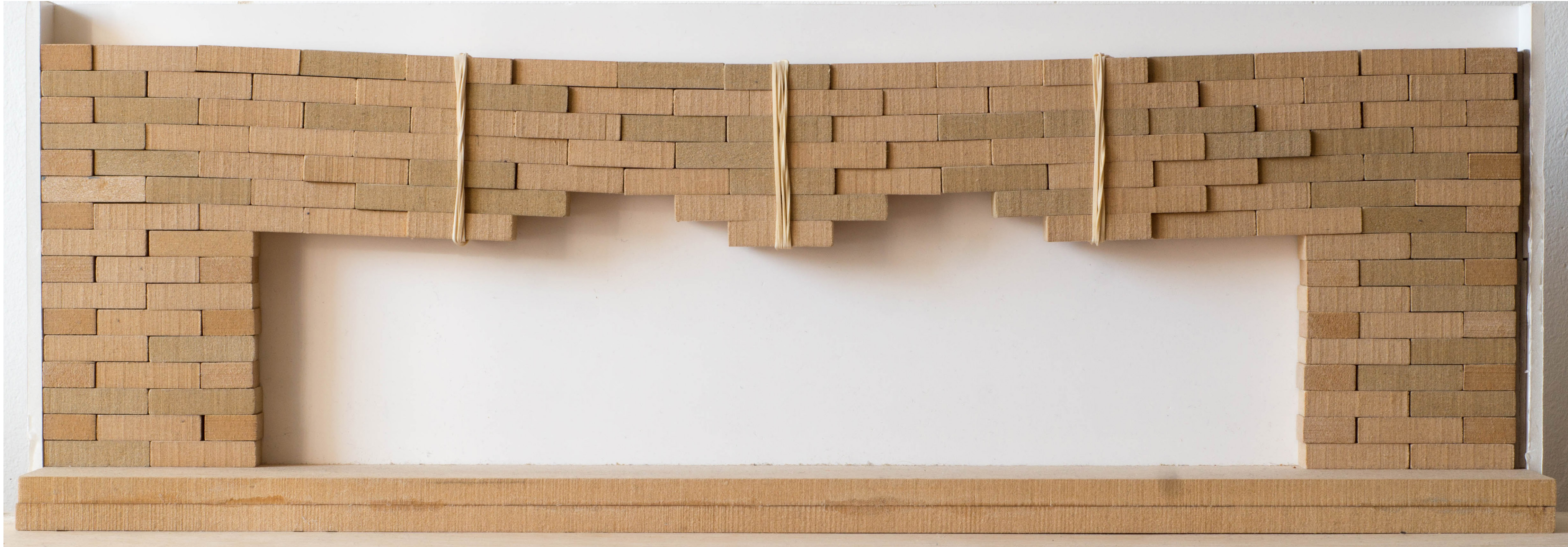




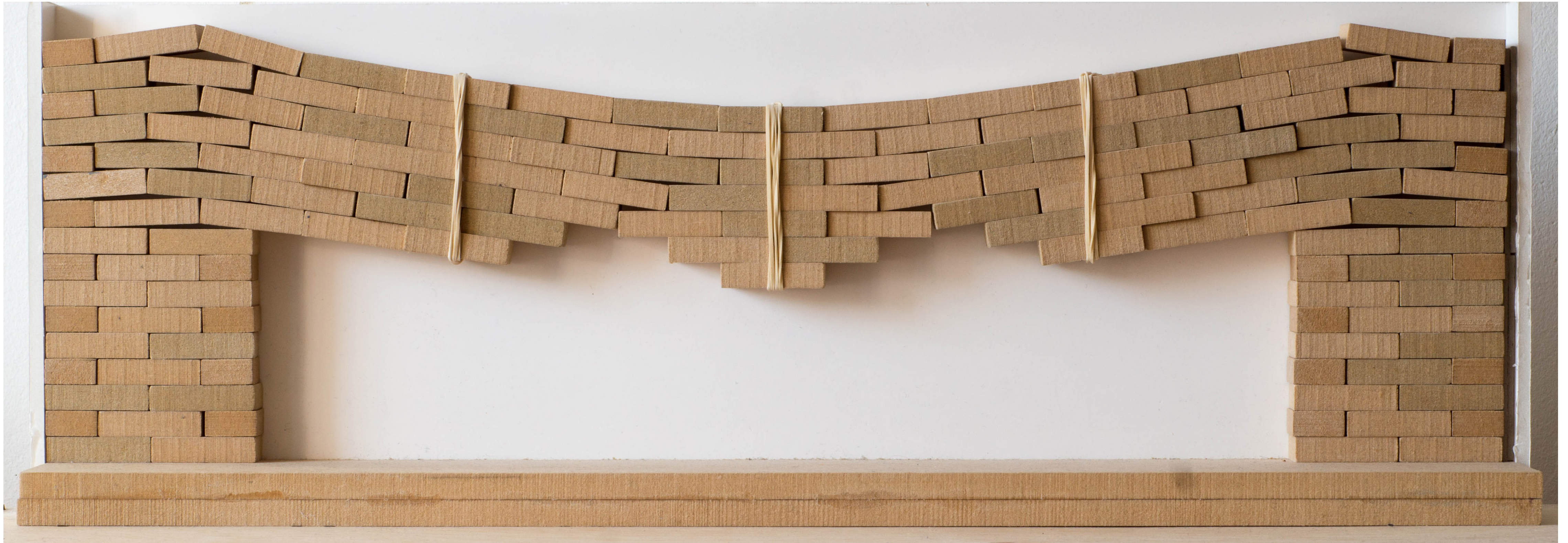




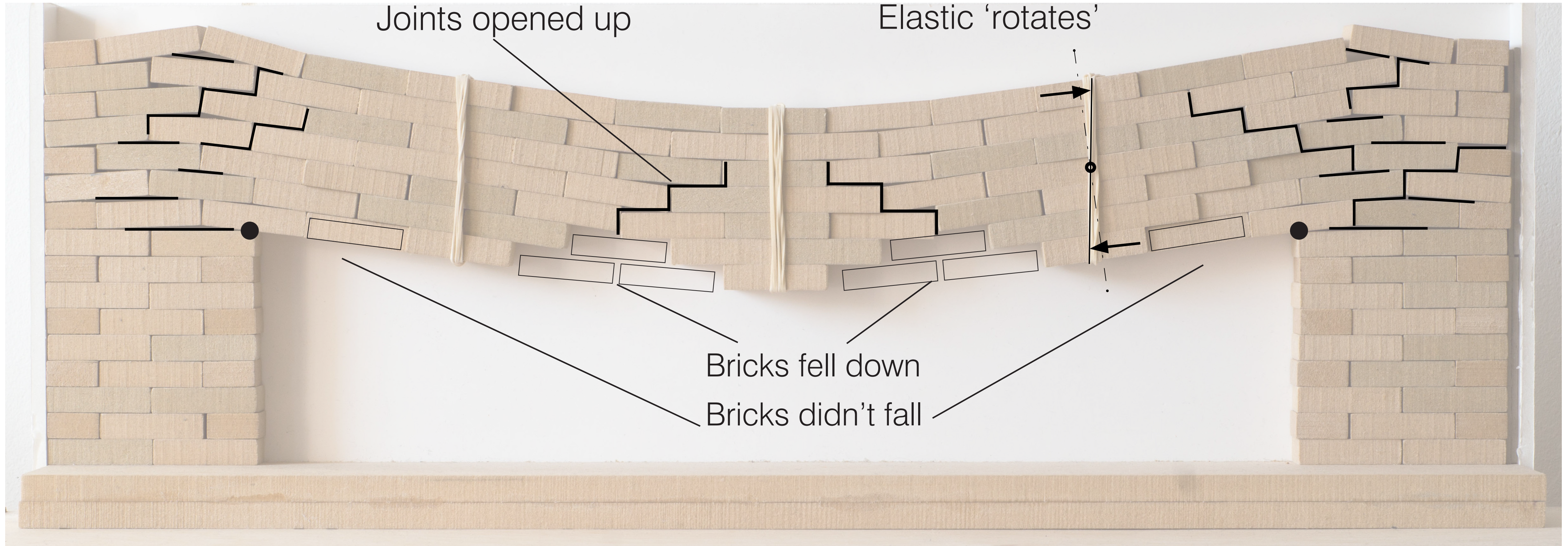












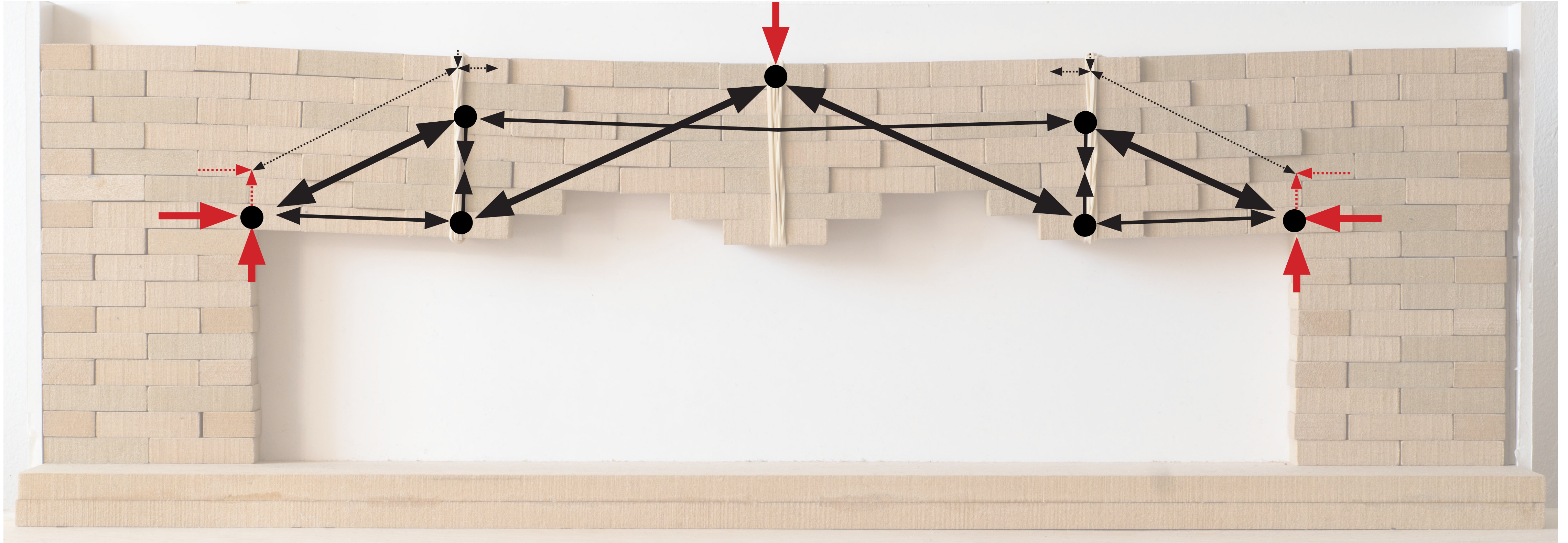
Joints opened up

Elastic 'rotates'

Bricks fell down

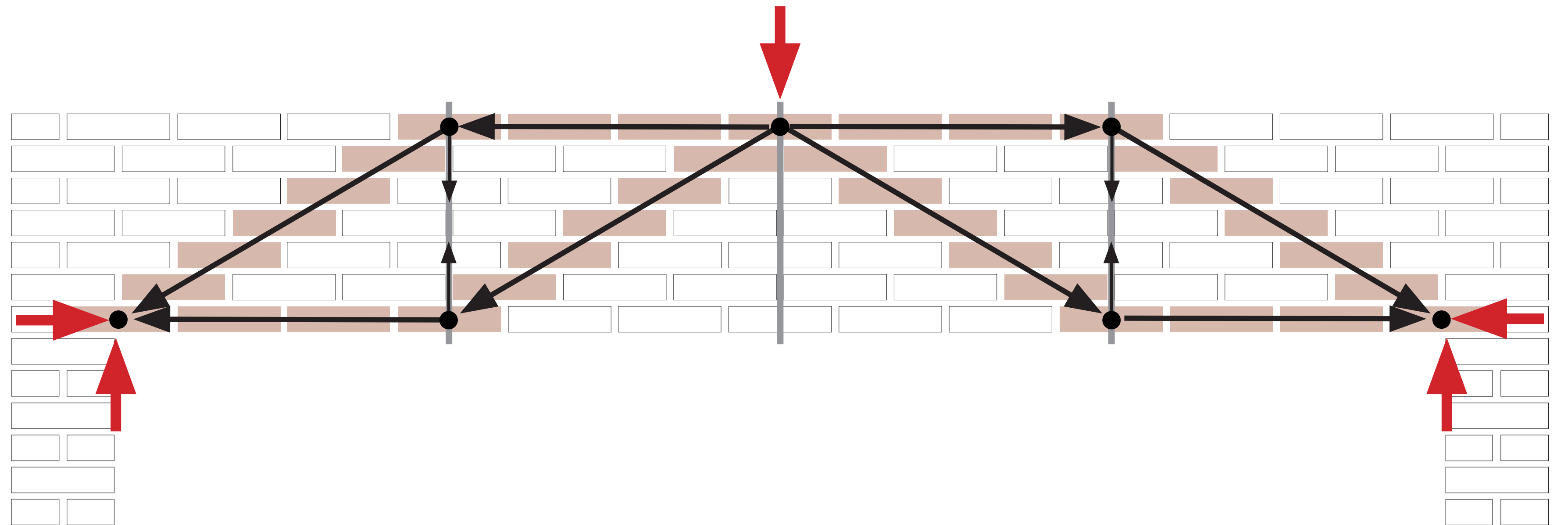
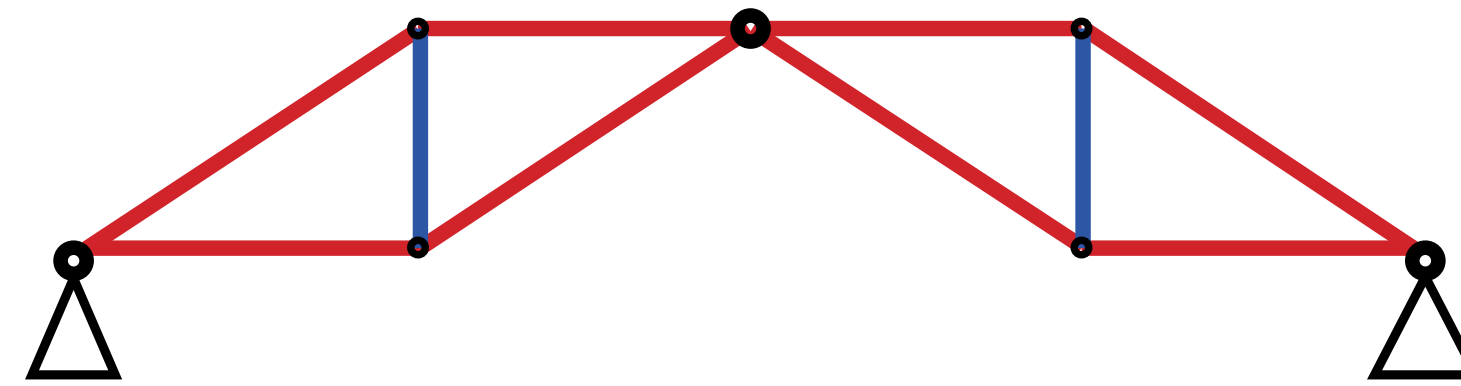
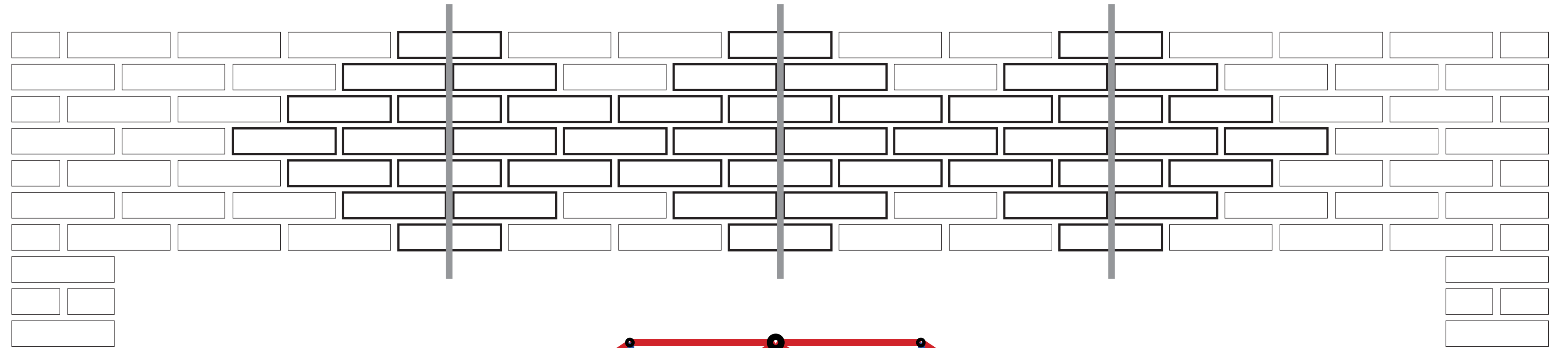
Bricks didn't fall





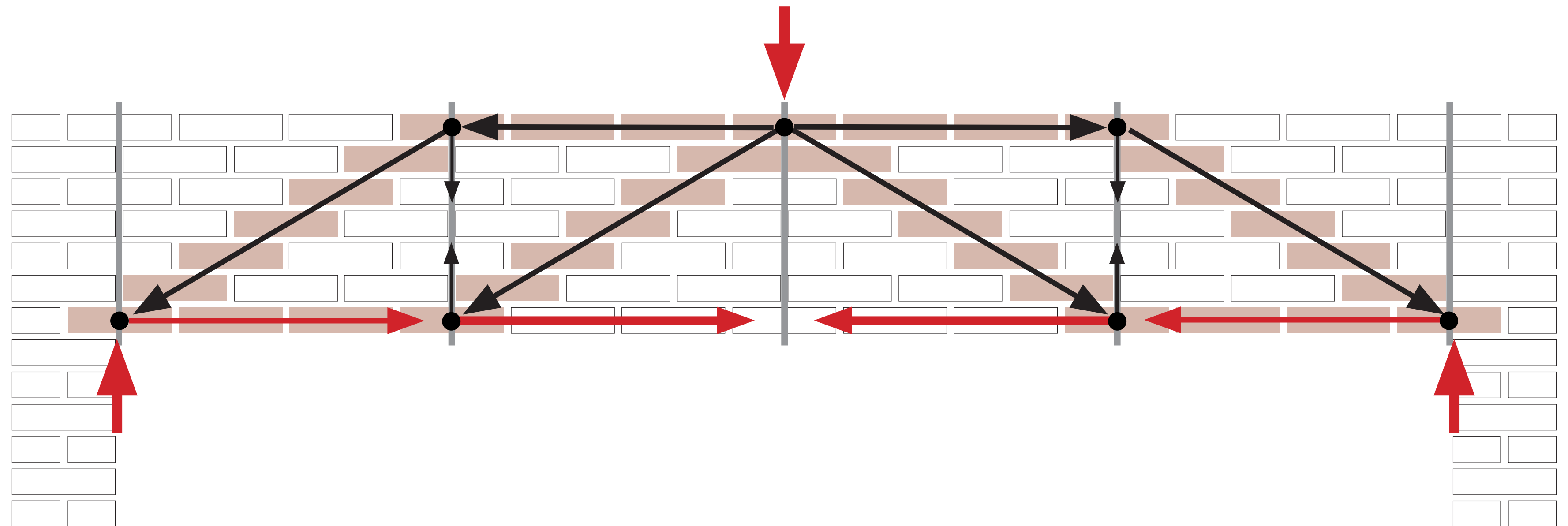
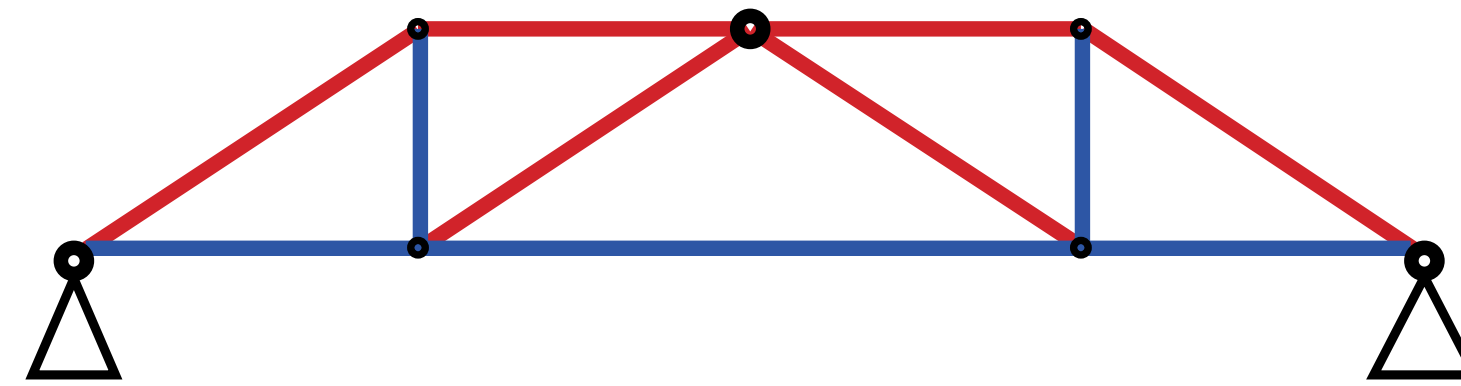
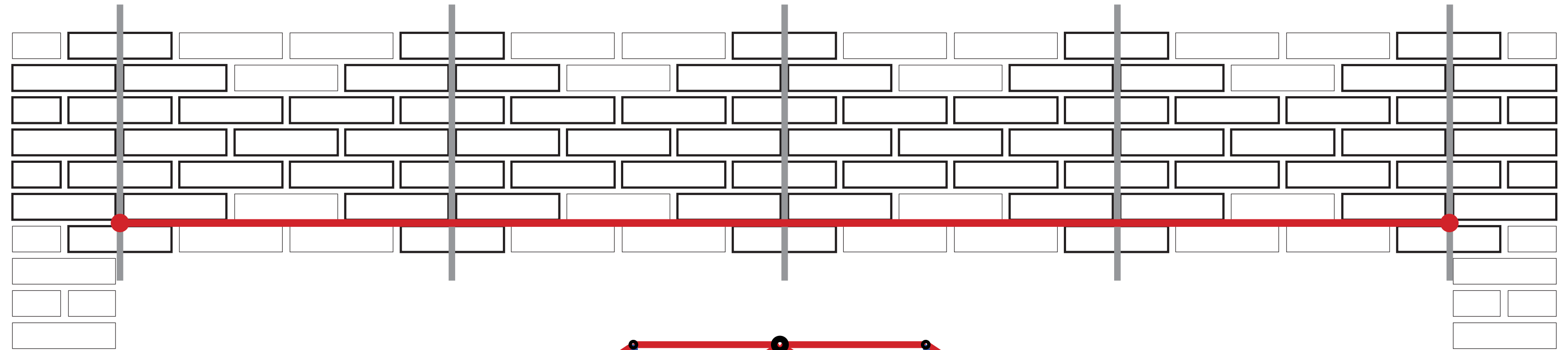


# Thrust in supports





# Add tension member





**Now in practice**























