

6.Tall

towers

## Problem to be investigated

A tower is built by stacking rectangular bricks on top of each other. Some people argue that the maximum height of the tower is limited by the human skill to place the bricks gently; others may say that the limiting factor is non-perfect shape of the bricks. Perform experiments to outline the factors that limit the maximum height of such a tower.

# Contents of presentation

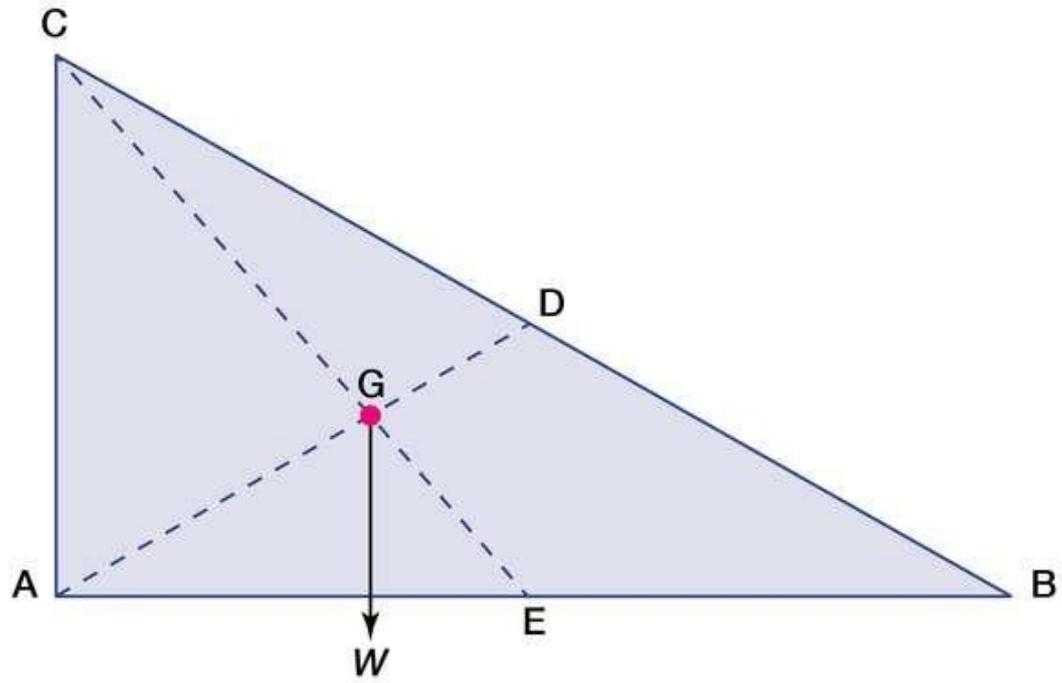
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# Theoretical background

# Gravity, center of gravity and body weight

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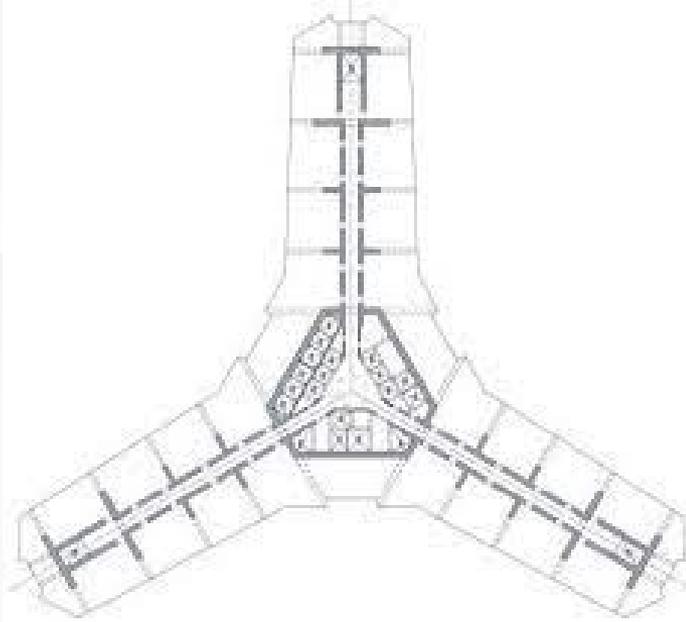
- ▣ Gravity is applied to every part of a body by pulling it towards the center of the Earth. Thus all the forces exerted on a body due to its reduction in relation to the radius of the Earth are considered parallel. The component of all this is called **body weight**.
- ▣ The point of application of this component on the body is called **the center of gravity** of the body. If the field of gravity is homogeneous throughout the space occupied by the body and the density of the body has a uniform distribution, the center of gravity is the same point as the center of mass of the body.
- ▣ The center of gravity is that part of the body that can be supported in order to balance under the energy of gravity.



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Centre of gravity. The red dot is the centre of gravity G.

# Buildings system



A system, known as the buttressed core, is a kind of a massively wide building and limited loss of space for structural elements. For this exponential cone it is possible to build tower of any high from any material. Of course this kind of needle is not possible to build and it does not make any sense to build, if we accept that final radius at maximum height 100 km equals 0.5 meter.

# Hypothesis

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- The stability of the human hand is going to determine the height of the tower
- The age is key factor
- The shape of the brick will differentiate the maximum height of the tower
- The building system and the structure of the base affects the height.

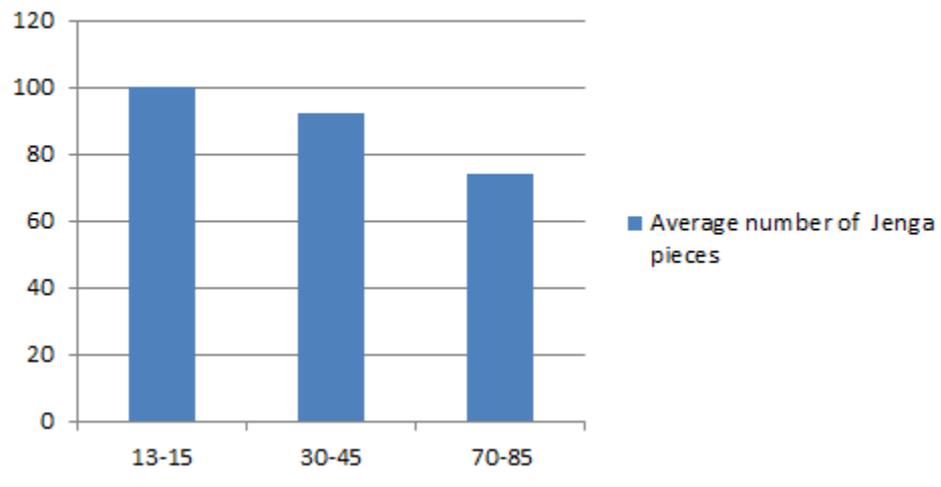
# Analysis of the experiment

1. We asked a few people of different ages, with any kind of diseases and from both genders to build a tower as high as possible. We recorded their measurements and wrote them down.
2. We used 3 Jenga towers and a paper mold so that we can exclude the parameter of the human skill and so that we can test if the shape of the pieces will affect the height. (we measured the shape of the pieces)
3. We also asked them to build it in a different way with different bases.

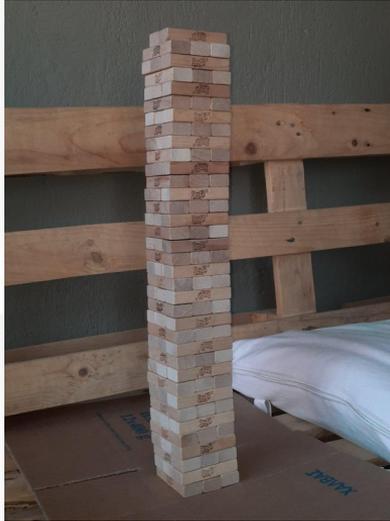
# The measurements of our experiment

Ages	Average number of Jenga pieces
13-15	100
30-45	92
70-85	74

### Average number of Jenga pieces



# Experiment process



13-15



30-45



70-85

## Experiment no.2

We asked the same people to build a tower by using a paper mold. We measured again the number of pieces and the shape of each.



Every brick was a 7.5 cm  
long



The tower built with the paper mold

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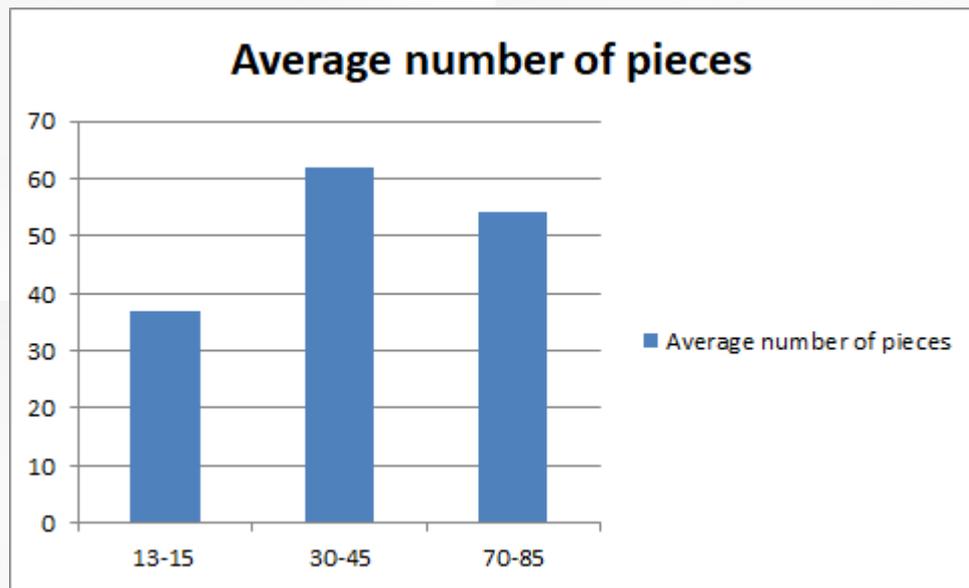
Every person that we experimented on managed to build the tower at his maximum height with the help of the paper mold, regardless of the age and the conditions.

## Experiment no.3

We asked again the same people to build a tower but this time with 2 pieces as a base and we measured the average number of pieces.



The tower with 2 pieces as a base



# Conclusions

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- When we used a two-pieces base as a building system the average number of pieces was reduced.
- The age did not play an important role in the third experiment so we realize that the building system plays the most important role.
- In the second experiment everyone managed to reach the maximum height of the tower so the stability of the human hand is a determinant factor.

# Conclusions

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- The age affects the maximum height of the tower, because of the stability of the human hand.
- The imperfect shape of the bricks is a determinant factor
- The wider the base, the higher the tower
- People who suffer from any kind of disease (for example Parkinson) that affects the stability of the human hand, built a shorter tower

# References

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- [https://www.google.com/search?q=buttressed+core&rlz=1C1GCEA\\_enGR956GR956&sxsrf=ALeKk02J06gxCZFWbCCa1Th7UodSWXsLdA:1623833136984&source=Inms&tbm=isch&sa=X&ved=2ahUKEwim\\_oLfq4ZvxAhUjhf0HHTHJD-AQ\\_AUoAXoECAEQAw&biw=1280&bih=577#imgrc=geW1UGQ0EzJCsM](https://www.google.com/search?q=buttressed+core&rlz=1C1GCEA_enGR956GR956&sxsrf=ALeKk02J06gxCZFWbCCa1Th7UodSWXsLdA:1623833136984&source=Inms&tbm=isch&sa=X&ved=2ahUKEwim_oLfq4ZvxAhUjhf0HHTHJD-AQ_AUoAXoECAEQAw&biw=1280&bih=577#imgrc=geW1UGQ0EzJCsM)
- <https://www.bloomberg.com/news/articles/2012-08-16/is-there-a-limit-to-how-tall-buildings-can-get>
- <https://www.sciencealert.com/what-s-the-tallest-thing-we-could-ever-possibly-build>
- <https://www.instructables.com/How-to-Build-a-Giant-Jenga-Set/>
- <https://www.britannica.com/science/centre-of-gravity>



**THANKS FOR YOUR  
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