

PARPEN Test bench

Construction by blocks stacking



A model / test bench

to manipulate and understand basis construction principles around reinforced concrete

- How are built buildings and structures ?
- What are the particularities of buildings of our environment ?
- Why a building don't falls down ?



Why exist different types of blocks ?

*real material
Real aspect
Scale 1 : 10*



*Grooved pedestal
to guide the mounting,
show the foundation interest.*

*assemble and disassemble "dry",
test different solutions,
store easily the material at the end
of course.*

Why blocks must be intersected ?

Why the vertical chaining ? Is it necessary ?

The foundations role.



How to make an opening ?
Different types of lintel.





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Student work document
Example of student work

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Student work document
Example of student work

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Student work document
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Student work document
Example of student work

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Student work document
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To make oneself mini-parpens 21

CDROM

This project CDROM is available in the A4 Company catalog (ref "CD PARP").

It contains :

- The folder under FreeHand (.FH9), PDF and Illustrator (.ai) formats
- Product photos, DXF format perspectives.
- 3D modeling with 3D format SolidWorks, Parasolid and eDrawings files.

This folder and CDROM are duplicable for students, for school internal use*

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Test bench presentation

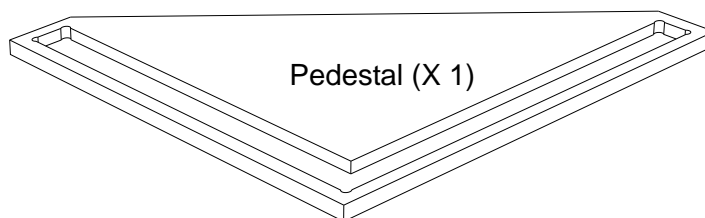
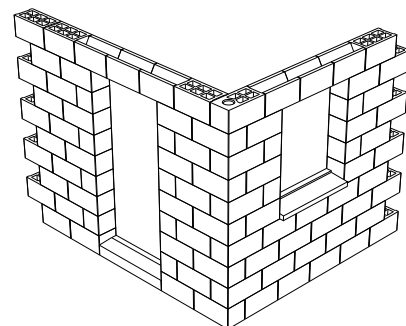
The BE-PARPAING test bench allows as simply as possible to work on the construction basis principles with stacked blocks.

The student performs at first a wall angle on a base as foundation. He changes then his construction to add a door and a window. Blocks will be simply placed dry for an immediate reuse of the material.

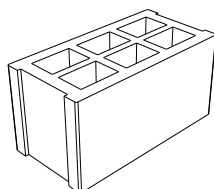
We can also use the special mortar soluble in water (ref COL-BRIQ) if time enough (one must prepare, put then let drying mortar). That allow in particular to use "chaining" blocks and steel bars provided for a lintel masonry and test with or without iron. (If not one can use the wooden lintels provided).

The test bench is provided with :

- 1 grooved pedestal that represent the ground with the foundation trench,
- Parpen scale 1 : 10 :
 - 44 parpens 25 x 25 x 50 cm at 1/10 scale,
 - 26 parpens multi-functions for chaining and frame,
 - 12 half-parpens,
 - 6 blocks of horizontal chaining and lintel,
 - 1 door sill,
 - 1 window sill,
- 2 25 x 25 x 150 cm wooden lintels gth 140 as concrete iron to put into the lintel.
- 2 PVC Ø 10 length 125 bars as vertical chaining bars for the window frame.
- 2 PVC Ø 10 length 230 bars as vertical chaining bars for the door frame.
- 1 PVC Ø 10 length 270 bar as vertical chaining bar for wall angle.

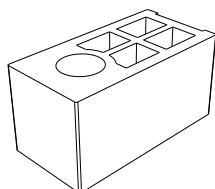


Pedestal (X 1)



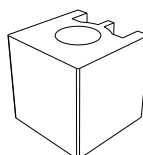
(X 44)

Parpen
25 x 25 x 50



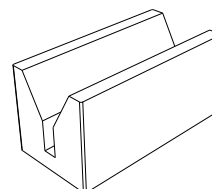
(X 26)

Parpen multi-
function



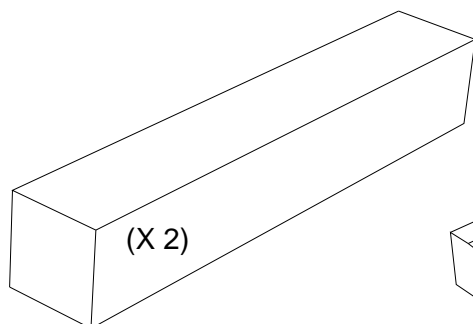
(X 12)

Half-parpen



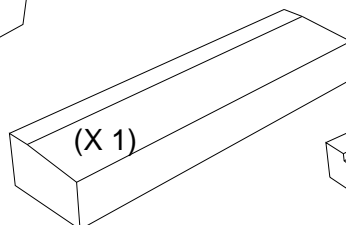
(X 6)

Block for
chaining



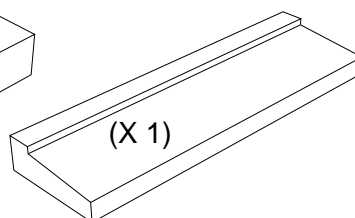
(X 2)

Wooden lintel



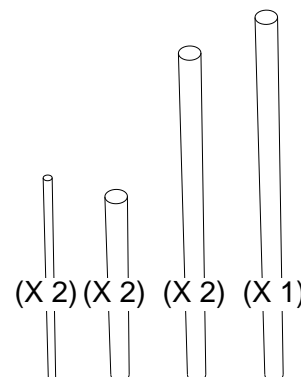
(X 1)

Door sill



(X 1)

Window sill



(X 2) (X 2) (X 2) (X 1)

Bars for chaining

Test bench presentation

Educational interest

This test bench allows from simple manipulations, to address the following interest fields : the built environment, technical functions/solutions, structure stability, performing a structural model. It allows to identify some functions and constraints associated and to test the specific technical solutions to the concrete block.

In the housing and structure field, it brings the following knowledge : foundations, blocks overlapping, the chaining, functions of various blocks, wooden or cast lintels (experience armed or not), the technical vocabulary, masonry tools.

Some added tracks permitted by this test bench : materials used to achieve blocks, parpen blocks industrial manufacturing, stacked blocks construction history. (profesional concrete history)

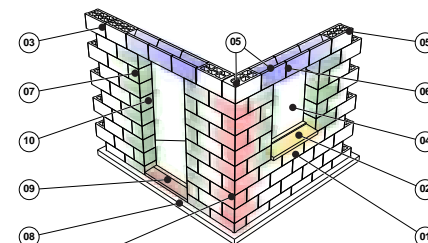
Links and supports useful :

<http://www.ducotedespros.tv/videos/lhistoire-du-beton> - <http://www.3mdb.com/>

<http://www.pointp.fr/documentation/maison-de-a-a-z-X39S686r471> - <http://www.infociments.fr/>

Activities, manipulations

The proposed manipulations are simple and fast to be made; blocks are simply dry assembled on top of each other. One can also glue them with the mortar Ref : COL-BRIQ include in the catalog. In this case the mortar setting should be taken into account during activities.



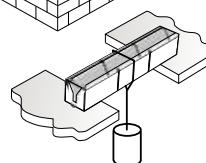
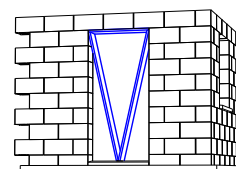
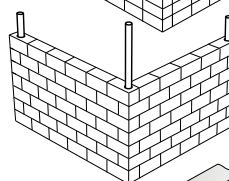
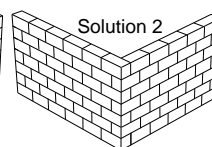
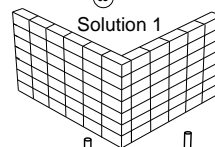
- Activity 1 : by assembling a wall angle, students will highlight the need of foundations and the blocks overlapping to obtain a wall rigid enough. They will answer to questions and complete drawings.

- Activity 2 : students will discover knowledge related to efforts and chaining. They could perform tests about efforts needed to destroy a wall according to the chaining.

- Activities 3 and 4: cast a lintel with or without metal reinforcement ; test it. Consider a lintel implementation and installation.

- Activity 5 : perform a wall angle with a door and a window. Give a technical voocabulary.

- Activity 6 : for further : horizontal chaining.



Performing very realistic models with miniature parpens

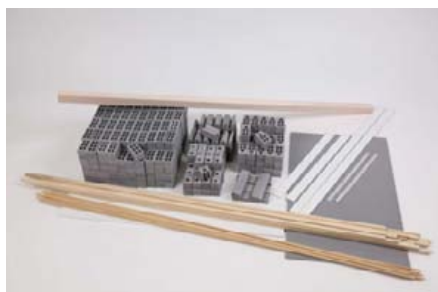
The test bench may be used to prepare the manufacturing of a very realistic 1:10 scale model, by using the mini-parpens. Set of parpens are available, as well as a molt to perform them yourself.

See our offers in the catalog on www.a4.fr.

Collective, ambitious et very representative of reality achievements , which generate multiple investigations and allow to mobilize capacities around simple and real problems.

The models produced can be kept as class materials for development activities or for equipment (alarm, home automation, etc).

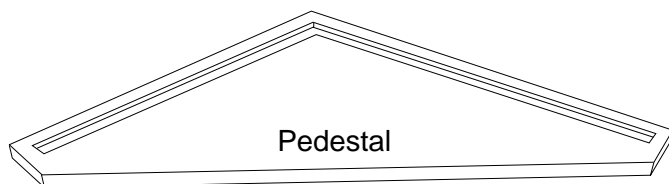
See page 18 : some useful materials



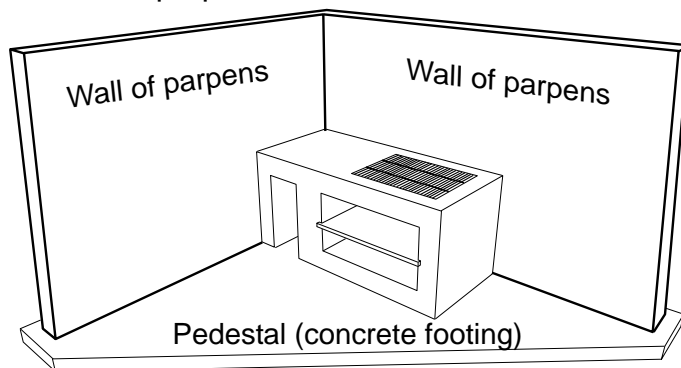
Activity 1 - Foundation and construction

Perform a double wall that would cut the prevailing wind to allow to install a barbecue.

- Mount on the pedestal which serves as foundation, six rows of parpens of 25 x 25 x 50 to make the wall angle as shown below.
- Test various ways to stack blocks and find a way to compare the wall strength so built.

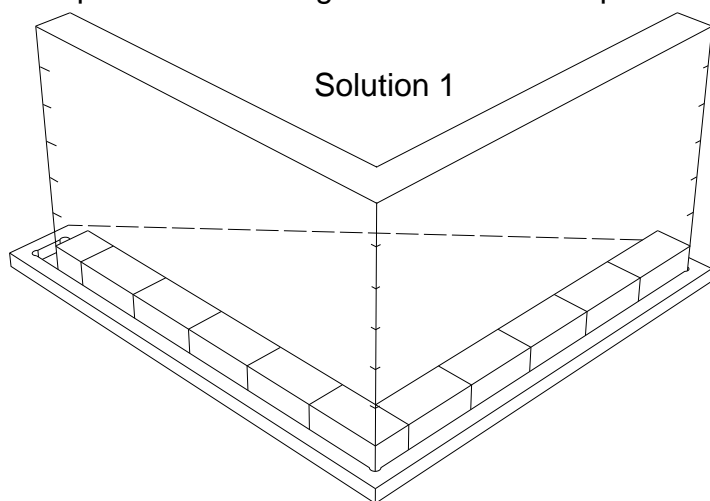


Pedestal

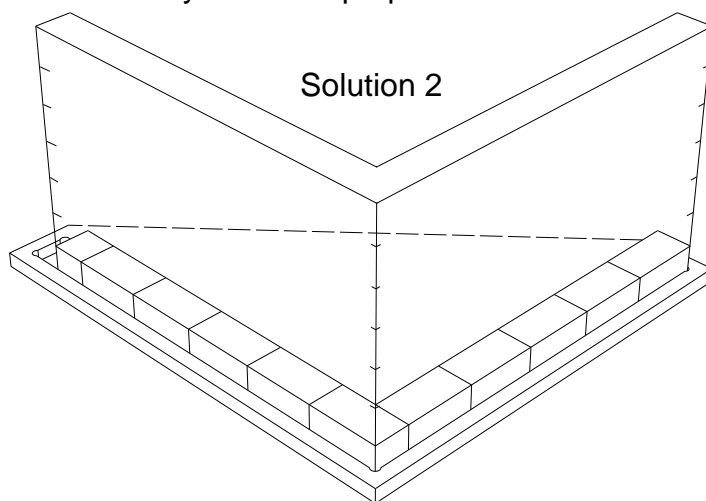


Pedestal (concrete footing)

Complete the following two sketches to represent 2 different ways to stack parpens.



Solution 1



Solution 2

What are the foundations used to (represented on the test bench by the grooved rigid pedestal).

What are the qualities of a well-built wall and what tools a builder should use for this ?

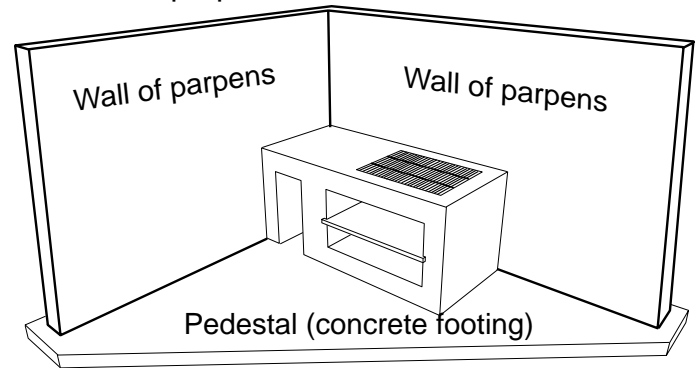
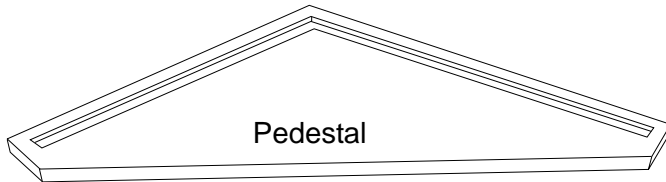
Describe how you have tested the strength of walls made from two different ways and give your conclusions.

Activity 1 - Foundation and construction

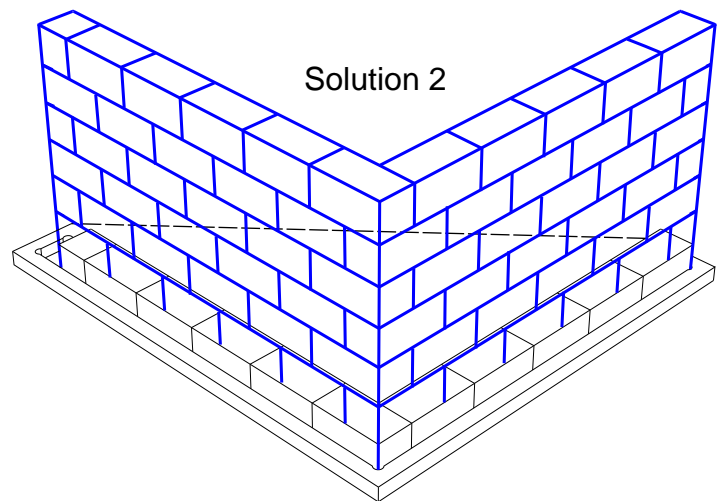
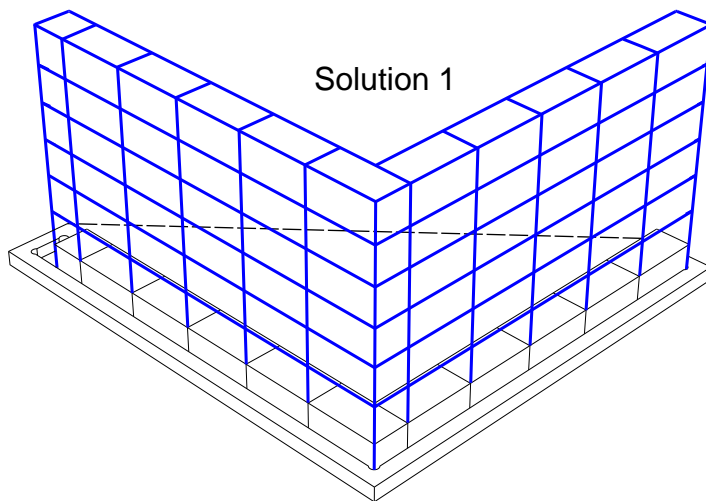
Example of student work

Perform a double wall that would cut the prevailing wind to allow to install a barbecue.

- Mount on the pedestal which serves as foundation, six rows of parpens of 25 x 25 x 50 to make the wall angle as shown below.
- Test various ways to stack blocks and find a way to compare the wall strength so built.



Complete the following two sketches to represent 2 different ways to stack parpens.



What are the foundations used to (represented on the test bench by the grooved rigid pedestal).

Foundations allow to anchor on the ground and position the structure on the field.

What are the qualities of a well-built wall and what tools a builder should use for this ?

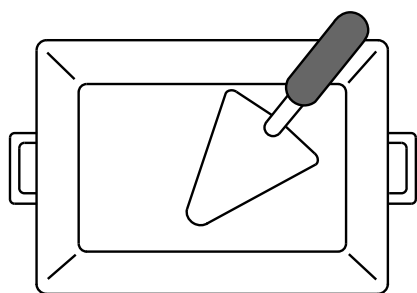
Block must be properly aligned, walls must be plan and vertical. The top of the wall must be horizontal. The mason will use in reality a plumb line, a level and a rule. He will also use mortar to bond blocks together.

Describe how you have tested the strength of walls made from two different ways and give your conclusions.

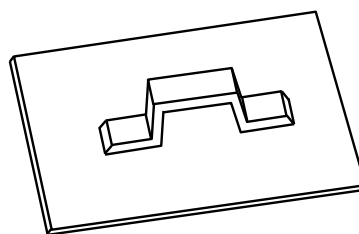
We can see that when we put blocks on each other without crossing them the wall is very fragile. But if we intersect blocks (the vertical joints are staggered in each row), the wall is much more cohesive, even without mortar, and is more resistant.

To test the walls strength, we have pushed on them with a plate or a rule to act on a surface and not on a single block. After several tries, we can estimate the comparative strength of each construction solution.

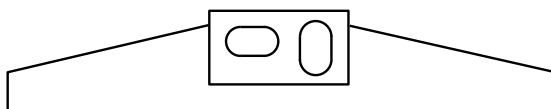
Activity 1 - Foundation and construction - Mason tools



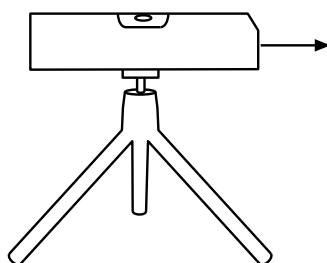
The trough and trowel to take the mortar



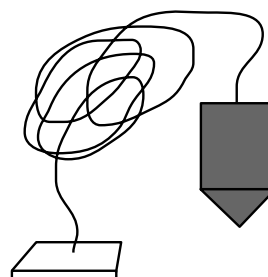
The clout to lay the mortar



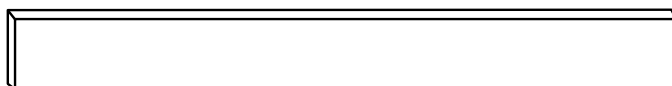
The level to verify if the surface is horizontal or vertical



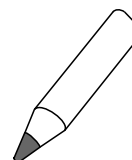
The laser level



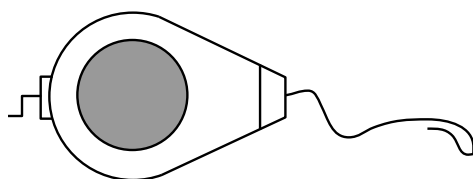
The plumb line to verify if the wall is vertical



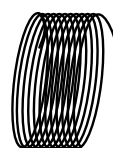
The rule to verify an alignment



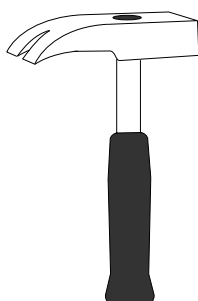
The pencil to draw marks



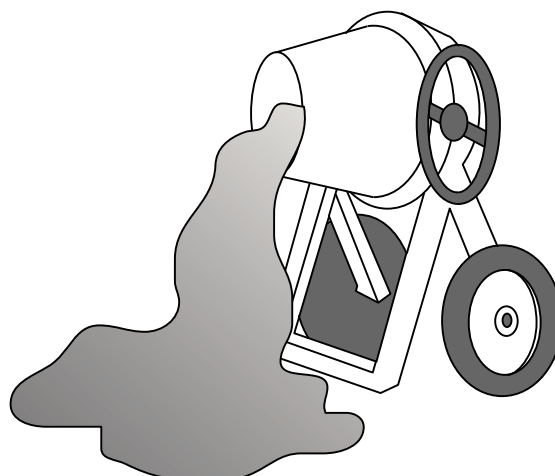
The chalk line (blue)



The string to stretch a cord



The mallet to cut and adjust parpens



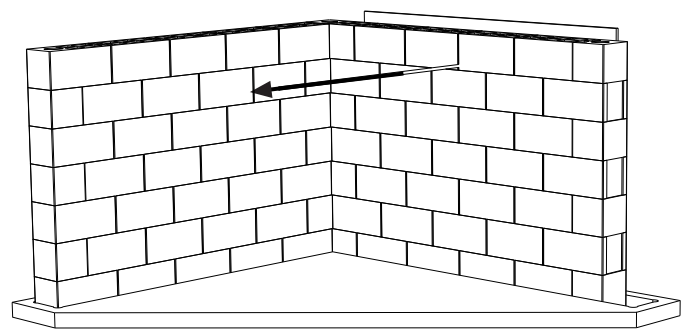
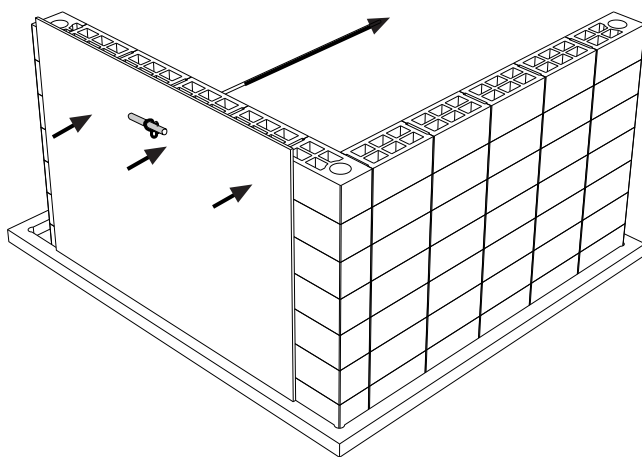
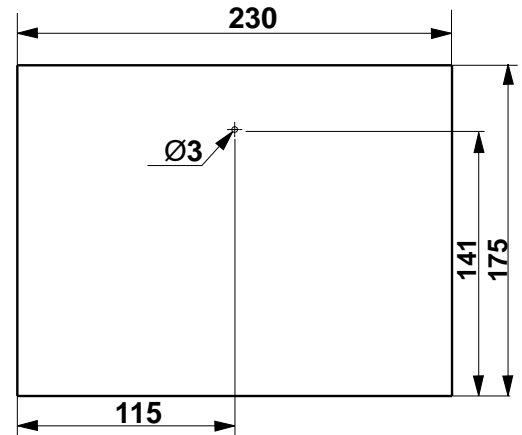
The cement mixer to mix the mortar

Activity 1 - Foundation and construction - To test the wall resistance

Two solutions to test a wall resistance

Solution 1 - Cut a PVC plate with dimensions below.

Let pass a string in the hole through the wall, pull on it as shown below.

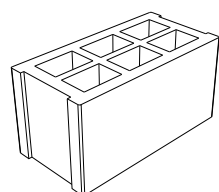


Solution 2 - Use the rule weightheld at a end to evaluate the pushing force on the wall.

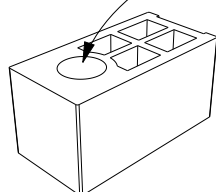


Activity 2 - Construction and chaining

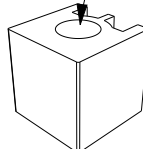
Here are the different parpens and red PVC bas which serve as reinforcement



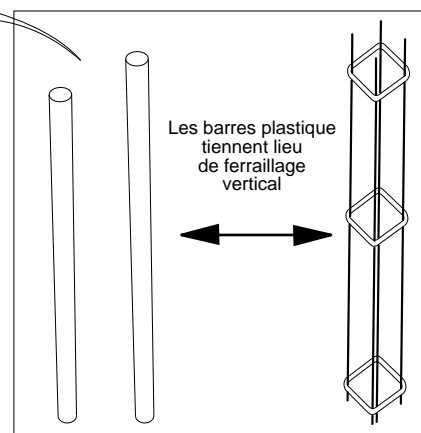
parpaing
25 x 25 x 50



parpaing
multifonction



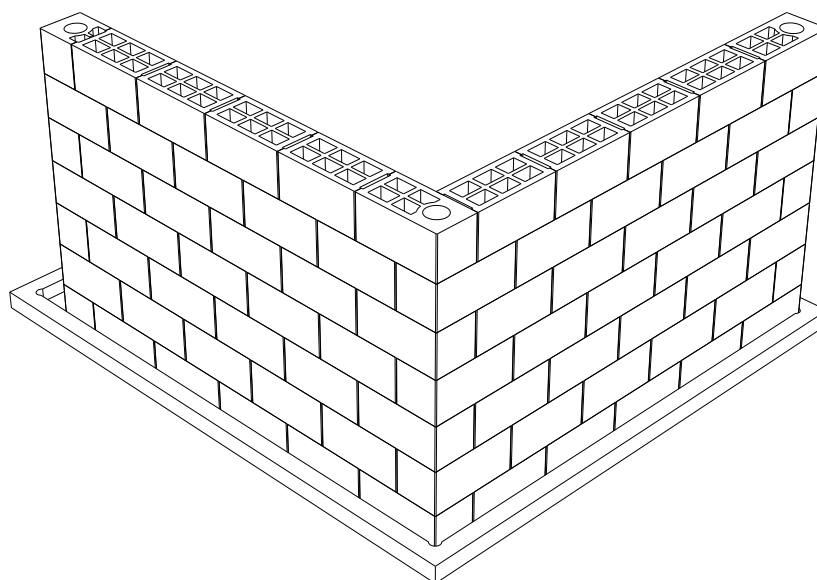
demi-parpaing



Perform strength tests of a wall corner built with or without reinforcement (vertical chaining). See drawing below. The wall corner must be rebuilt several times and test it up to its destruction. Explain how a reinforcement can make a wall more rigid ?

We can assemble the PVC rounds into the multifunction parpens cells (in the corner) and half-blocks (at the ends). This vertical chaining interconnects together the various rows of parpens and make vertical blocks very strong in the wall corner and ends. The middle of each wall stay fragile but is well supported by vertical side "blocks".

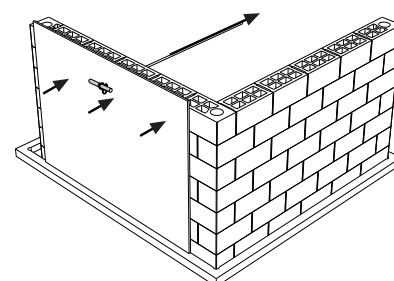
Complete this perspective by drawing the reinforce elements put in place.



Two ways to test a wall corner strength



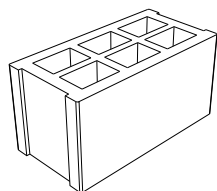
or



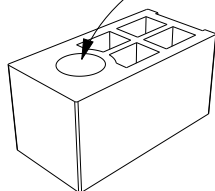
Activité 2 - Construction et chaînage

Example of student work

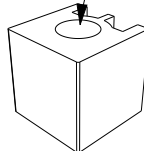
Here are the different parpens and red PVC bars which serve as reinforcement



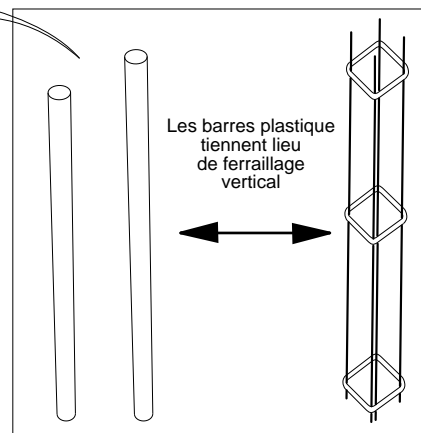
parpaing
25 x 25 x 50



parpaing
multifonction



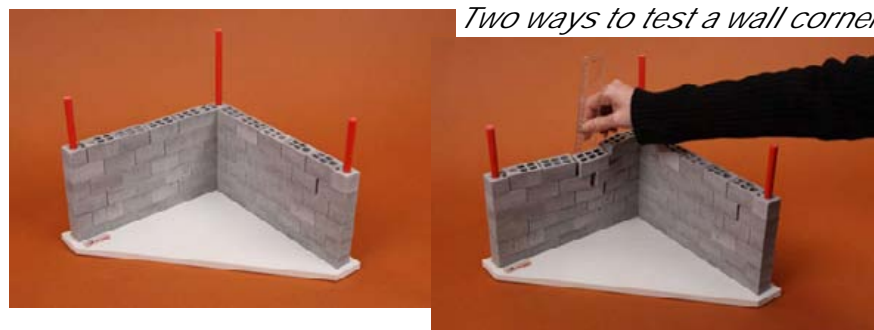
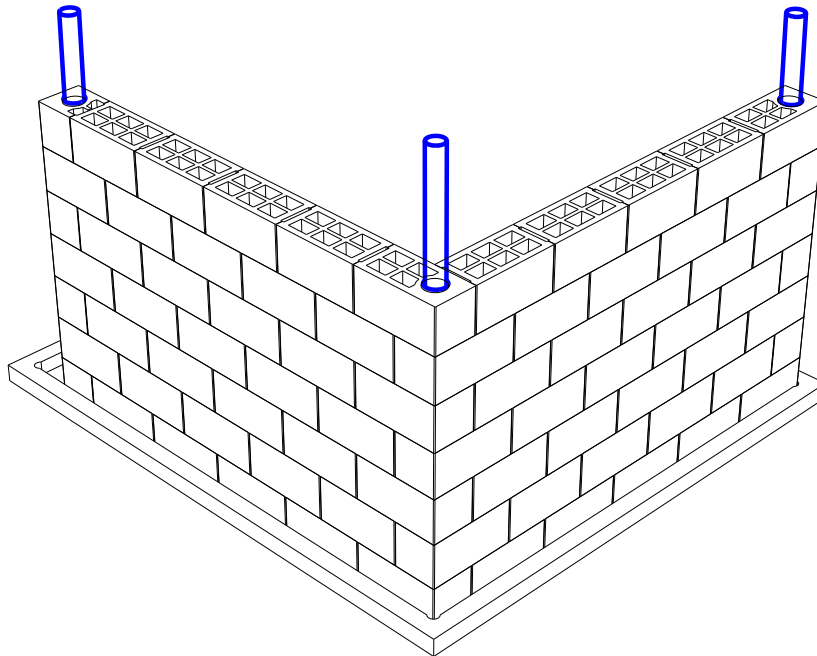
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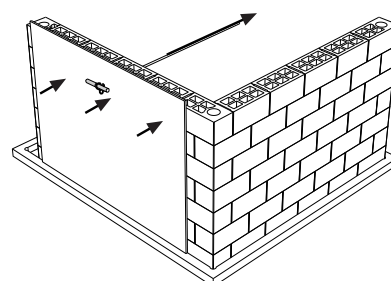
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Complete this perspective by drawing the reinforce elements put in place.



Two ways to test a wall corner strength

or

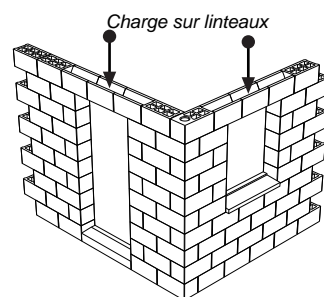


Activity 3 - To cast a lintel

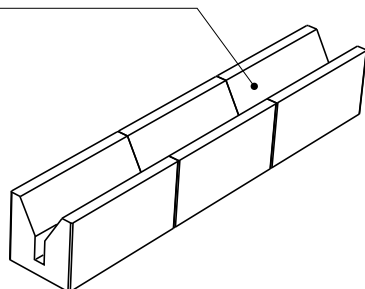
We have to make a portion of wall on the right side with a door and a window. Above the door and window lintels are necessary to support the elements located above them.

In the test bench we have wooden lintel and also elements to make masonry lintels : chaining blocks and metal bars designed to reinforcements. To make masonry lintels, the chaining blocks will be placed side by side and interconnected together with a mortar that is poured into the gutter they form.

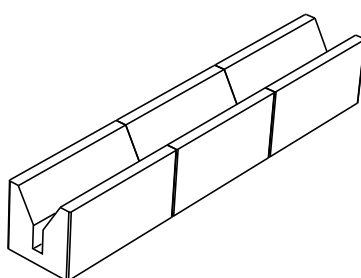
*We will use for our experiments the special mortar that may be rediluted ref. COL-PARP. Imagine and describe an experience allowing to prove the need to put metal bars as reinforcement. Complete the following perspectives (put a legend) and describe your experience.



Filling with mortar



Lintel 1



Lintel 2

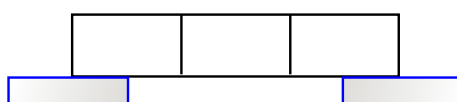
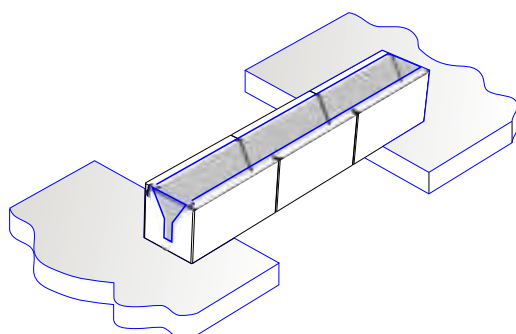


*Mixing mortar :
7 volumes of powder
for only 1 volume of water.*



What are the constraints, the difficulties met ?

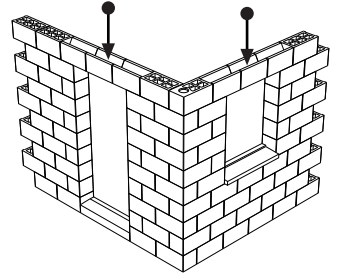
Complete views to explain the resistance test to breakage.
What conclusion can be extracted from our experiments ?



Activity 3 - To cast a lintel

Example of styudent work

We have to make a portion of wall on the right side with a door and a window. Above the door and window lintels are necessary to support the elements located above them.

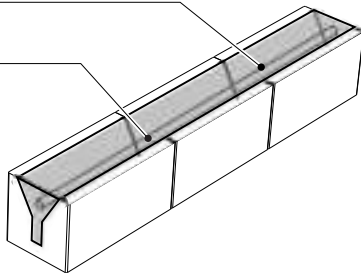


In the test bench we have wooden lintel and also elements to make masonry lintels : chaining blocks and metal bars designed to reinforcements. To make masonry lintels, the chaining blocks will be placed side by side and interconnected together with a mortar that is poured into the gutter they form.

We will use for our experiments the special mortar that may be reduluted ref. COL-PARP. Imagine and describe an experience allowing to prouve the need to put metal bars as reinforcement. Complete the following perspectives (put a legend) and describe your experience.

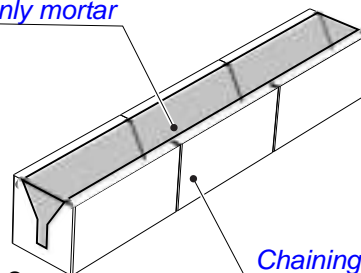
Filling with mortar

Metal bar



Lintel 1

Only mortar



Lintel 2

Chaining block



Mixing mortar :
7 volumes of powder
for only 1 volume of water.



We have performed two lintels one not reinforced and the other reinforced with a metal bar.

To verify the resistance, we will put the lintels on the extremity blocks and hang a mass more and more important on the middle block up to breakage.

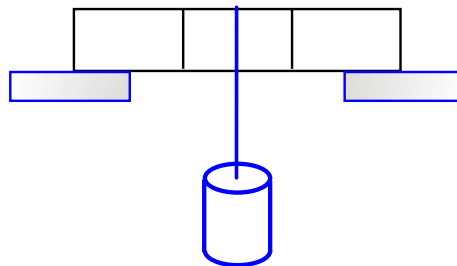
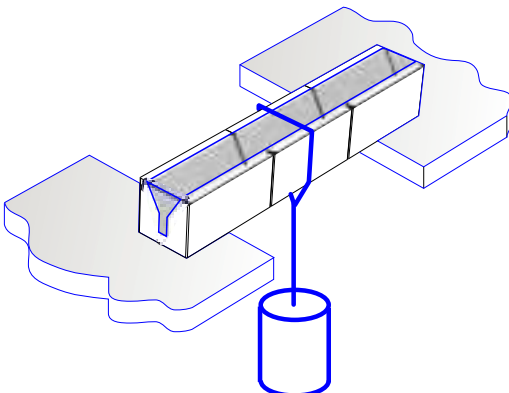
What are the constraints and difficulties met ?

The first difficulty was to find the requires amount of mortar to fill the lintels.

The mortar need to be pushed in the lintel hollow using a tool (spatula or mini trowel).

Wait until the mortar becomes hard (one day) to begin tests.

Complete views to explain the resistance test to breakage.
What conclusion can be extracted from out experiments ?



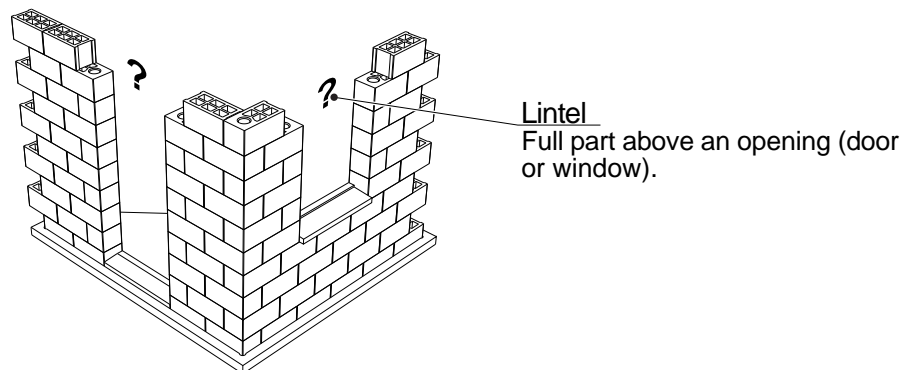
The lintel without metal bar breaks under effort of a 4kg mass while more than 7 kg are necessary to begin to deform the lintel with a metal bar.

The reinforced masonry lintels are more resistant, almost double.

The masonry lintels include always metal bar.

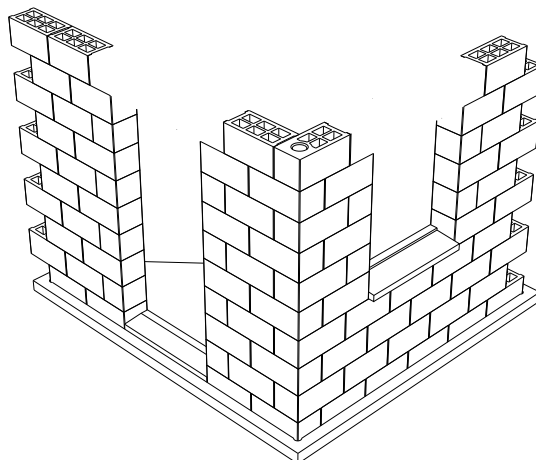
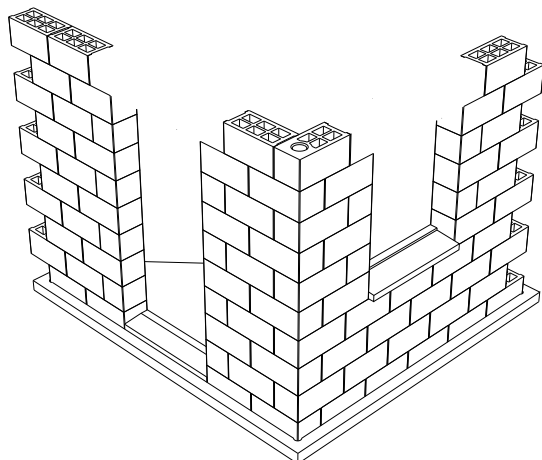
Activity 4 - To put a lintel

Perform a wall angle with openings as shown below.



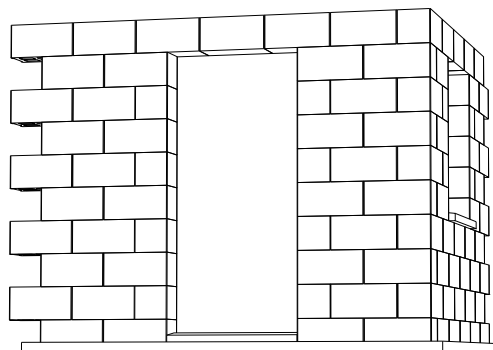
What are the possible technical solutions to perform lintels ?

Draw the two solutions on the two perspectives below.



Explain how to do to perform a lintel directly from 3 lintel blocks (one could prepare lintels on the ground and put them when the mortar is hard but that would delay the construction and would need to lift very heavy masses).

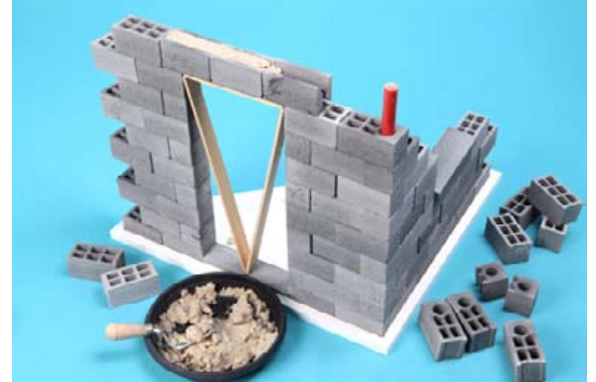
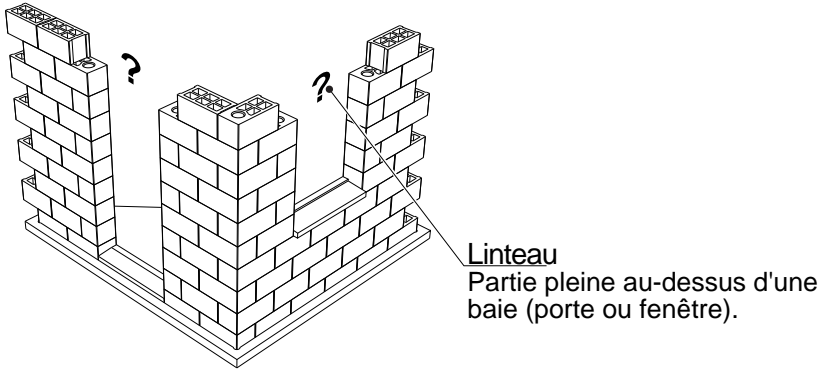
Draw your explication on the perspective right below, add a legend if necessary.



Activity 4 - To put a lintel

Example of student work

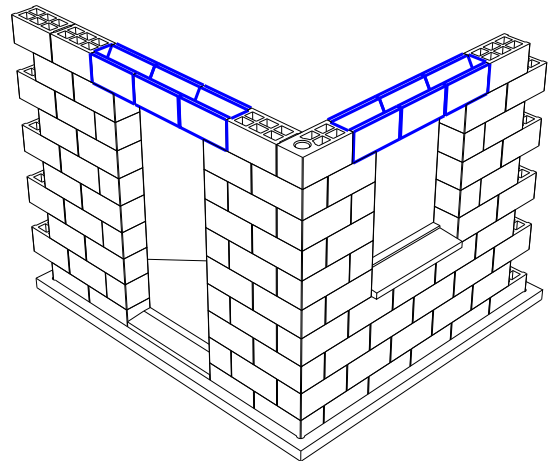
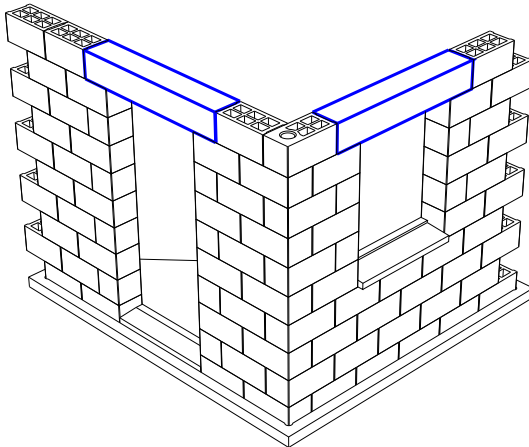
Perform a wall angle with openings as shown below.



What are the possible technical solutions to perform lintels ?

We have two possibilities with the provided material : masonry lintels with lintel parpens and wooden lintels.

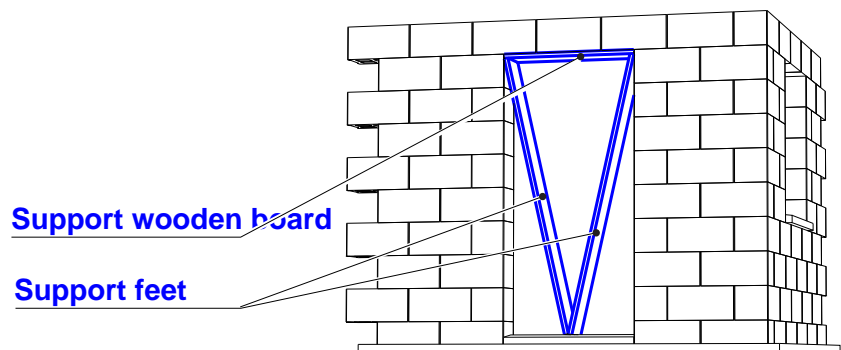
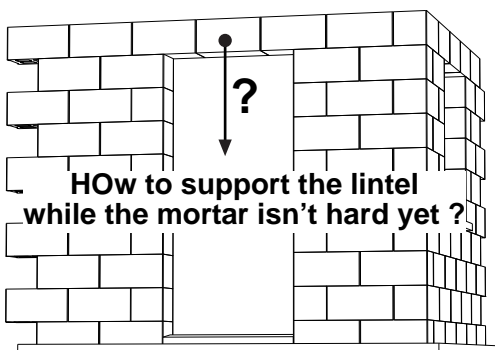
Draw the two solutions on the two perspectives below.



Explain how to do to perform a lintel directly from 3 lintel blocks (one could prepare lintels on the ground and put them when the mortar is hard but that would delay the construction and would need to lift very heavy masses).

To put in place the lintel blocks, they need to be supported with props then put the reinforcement and fill with mortar. If scaffolding is strong enough, the construction can be continued without waiting the complete hard mortar and the full lintel strength.

Draw your explication on the perspective right below, add a legend if necessary.



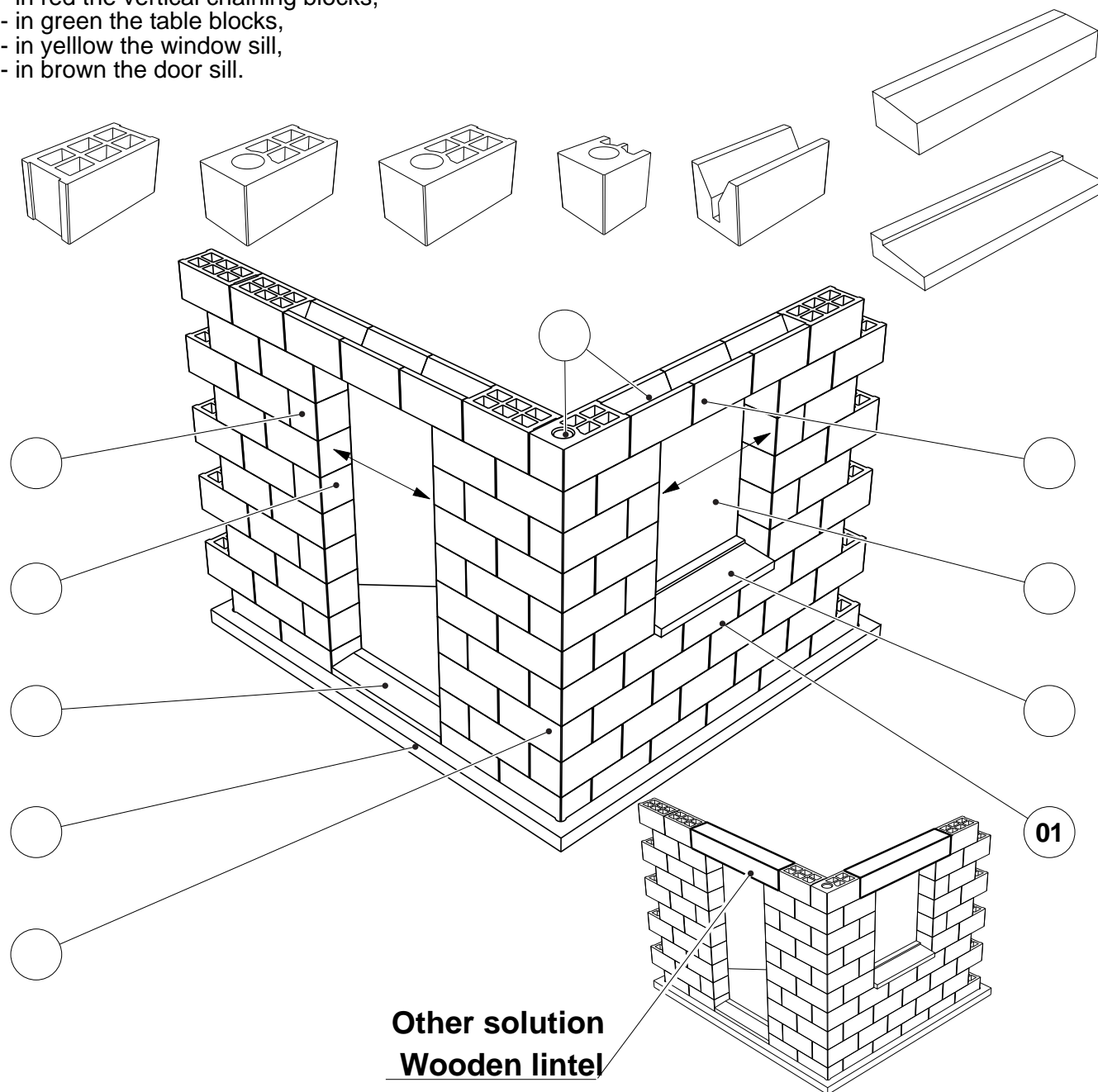
Activity 5 - The technical vocabulary

Work to be done :

Perform the mounting below using the wooden lintel or the cast lintel solution and using the vocabulary resource table at the bottom of the sheet, then complete the perspective with the good marks. (Example 01).

Highlighting with various colors, the blocs that have a particular technical function :

- in blue the horizontal and lintel chaining blocks,
- in red the vertical chaining blocks,
- in green the table blocks,
- in yellow the window sill,
- in brown the door sill.



Other solution Wooden lintel

10	Frame	Lateral face, toward the opening, of a bay jamb.
09	Sill	Élément located in the lower part of an opening slightly in slope for drainage.
08	Floor	Foundation element made of a reinforced concrete slab
07	Jamb	Masonry vertical part ,along a window or a door.
06	Lintel	Full part above a bay (door or window).
05	Reinforcement	Metal structure included in the masonry and ensuring the construction strength.
04	Bay	Opening in a full wall with a window.
03	Chaining	Connecting element arround all walls llt can be orizontal ourvertical.
02	Bay sill	Shelf culmination of a balustrade, slightly in slope for drainage.
01	Balustrade	Wall element between the floor level and the support of a bay.
Marks	Names	Definitions

Activity 5 - The technical vocabulary

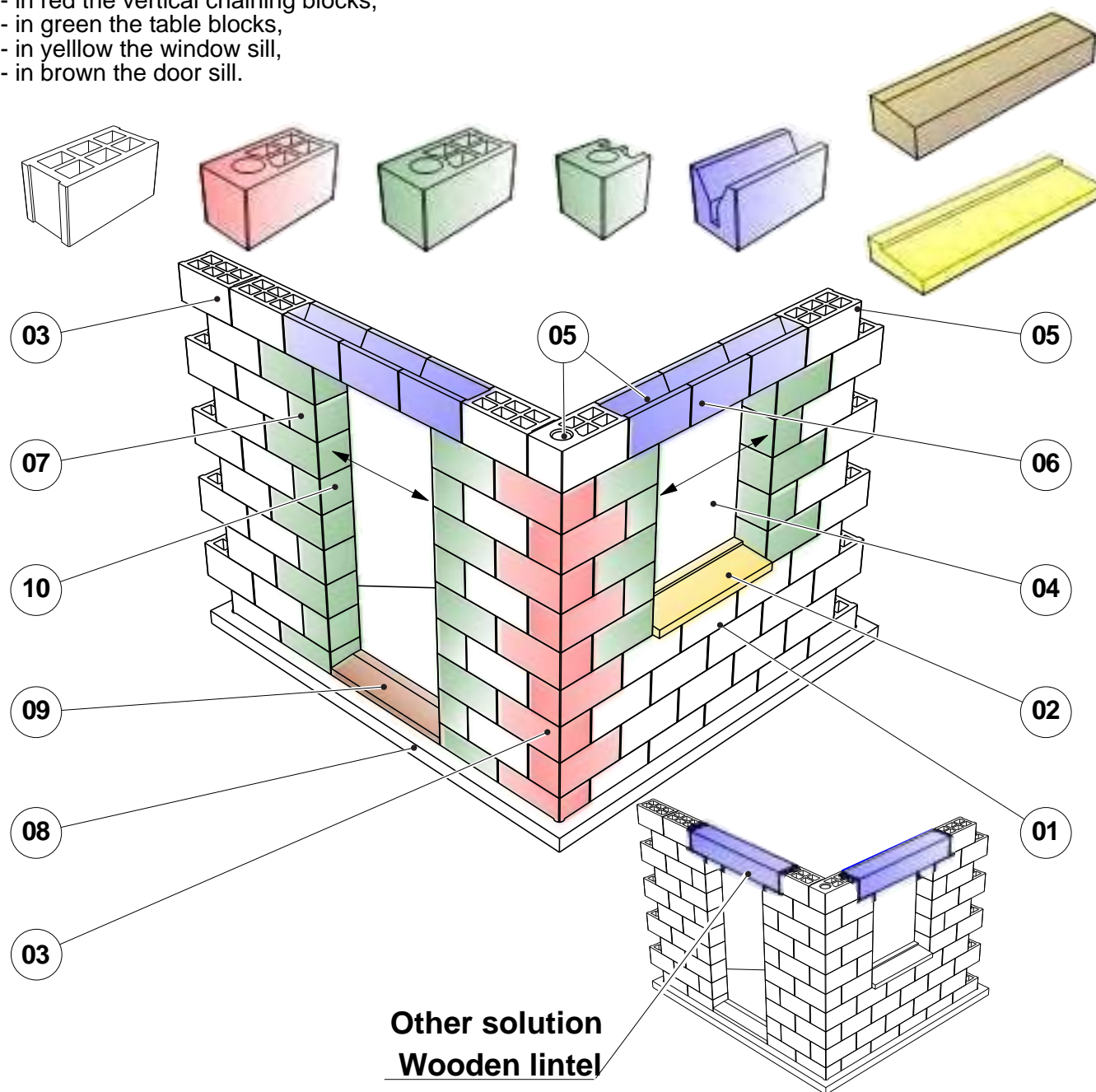
Example of student work

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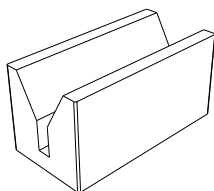


Other solution
Wooden lintel

10	Frame	Lateral face, toward the opening, of a bay jamb.
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Marks	Names	Definitions

6- To go further : horizontal chaining

Use horizontal chaining blocks to create a eighth row. Use metal bars of about 170 length or more for the chaining. To connect the horizontal chaining to the vertical one, you must drill the PVC Ø 3.5 bars at 185 and 190 from extremity (See figure below).



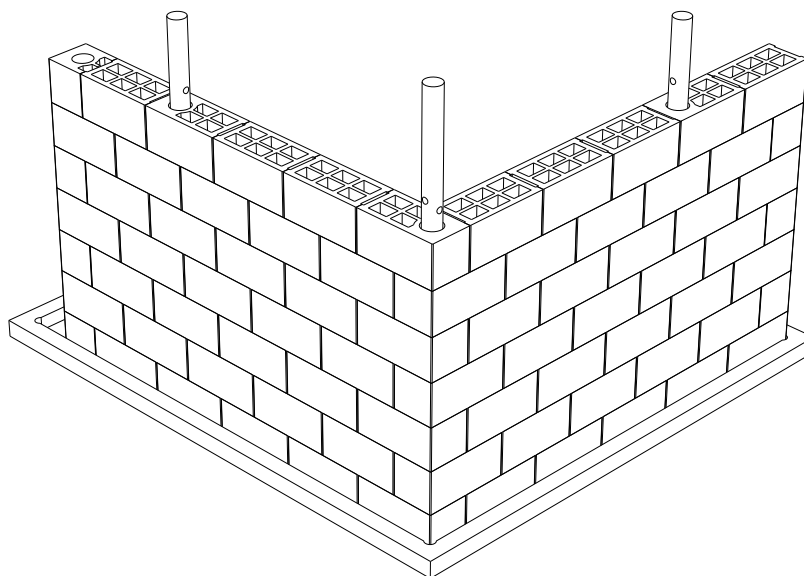
Chaining block



2 chaining steel
bars Ø 3 length
170 mm

Observe the vertical poles, why do we make holes in them ?

Assemble the wall as shown below. Put on the drawing the chaining blocks and the reinforcement elements.

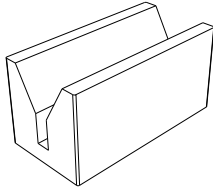


Test the wall strength. What can we see ?

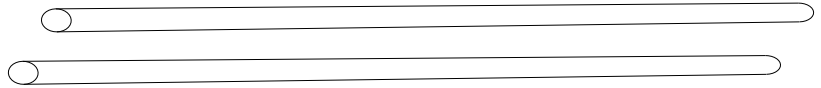
6- Pour aller plus loin : chaînage horizontal

Example of student work

Use horizontal chaining blocks to create a eighth row. Use metal bars of about 170 length or more for the chaining. To connect the horizontal chaining to the vertical one, one must drill the PVC Ø 3.5 bars at 185 and 190 from extremity (See figure below).



Chaining block

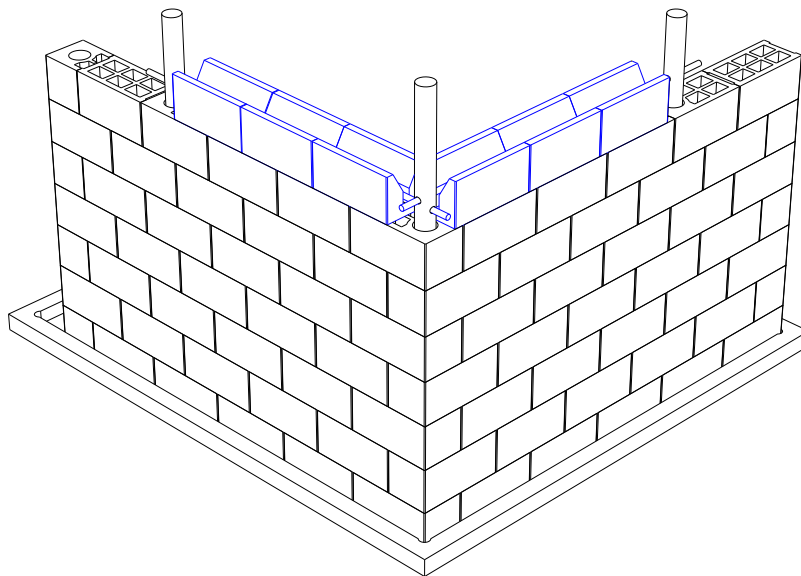


2 chaining steel
bars Ø 3 length
170 mm

Observe the vertical poles, why do we make holes in them ?

The holes in the poles will allow to connect the horizontal chaining to the vertical one. Thus, the wall would be normally more rigid.

Assemble the wall as shown below. Put on the drawing the chaining blocks and the reinforcement elements.



Test the wall strength. What can we see ?

We can see that the wall is now much more rigid with the horizontal reinforcement connected to the vertical one. The wall forms a whole, we can't collapse one part without destroying the whole. All is connected, which gives a very strong construction.

Activity 1 - Fondation et construction

Example of knowledge sheet

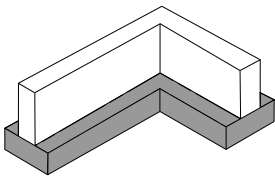
Foundations.

The foundation of a house or a structure corresponds to the part in contact with the ground.

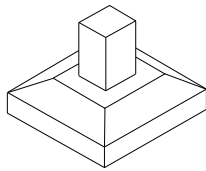
- It must receive and resist to loads that will press on it. It must not be too deformed.
- It transmits these loads to the ground which also must be as plus stable as possible. A study of this one is therefore important before any foundation completion.

Different types of foundation :

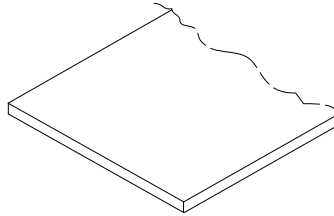
From the presentation above, we see that the foundation type will depend of the ground nature. Superficial foundations in the case of a stable ground, deep foundations otherwise.



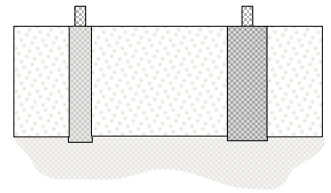
Continue flange



isolated flange



Floor

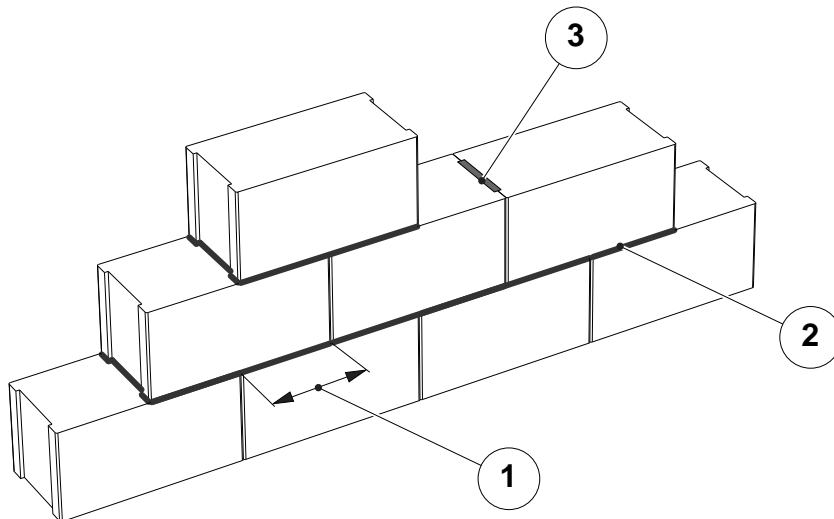
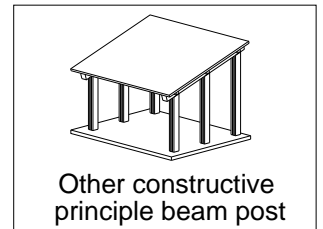


Posts or Well

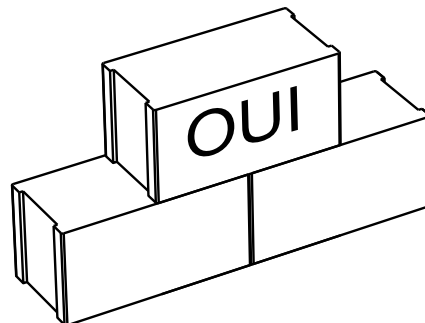
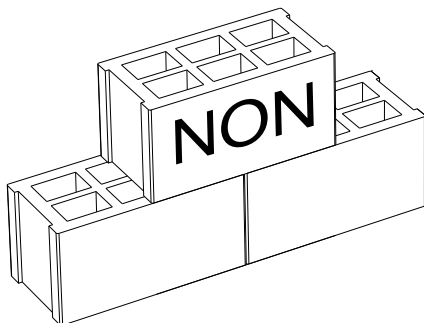
Constructive principle by blocks stacking on a wall.

Parpens blocks are bonded with mortar

- 1 : The blocks overlapping must be more than 1/3 of the block length
- 2 : The horizontal joint should be distributed on the whole contact surface
- 3 : The vertical joints making is done by filling pockets with mortar.



4: parpens are always bonded with hollow to the bottom

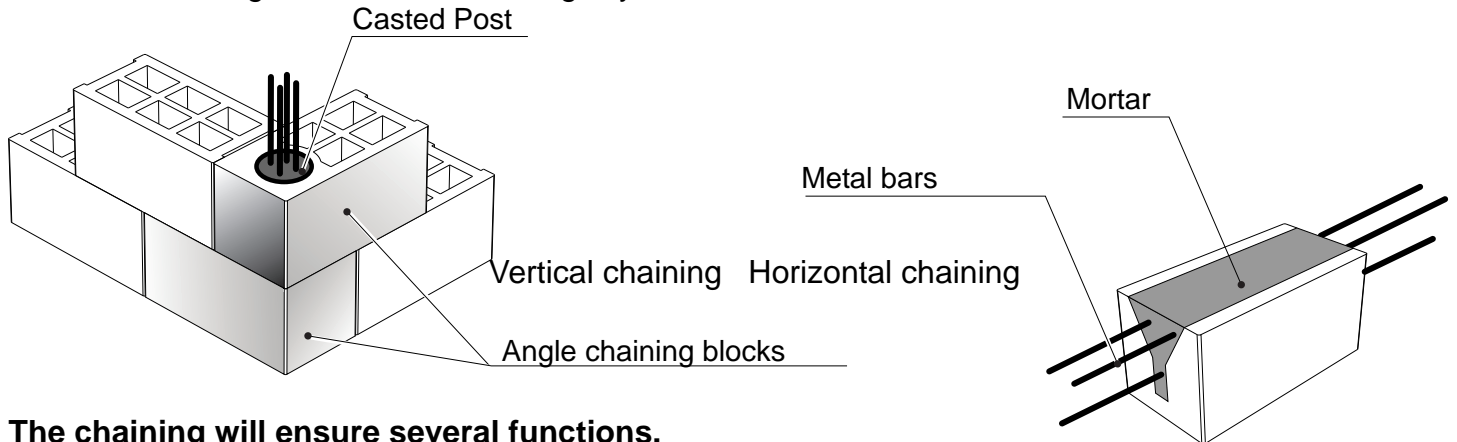


Activity 2 - Construction and chaining

Example of
knowledge sheet

Chainings :

They are made from metal bars embedded in the mortar. They will allow to connect various parts or various blocks together to ensure the rigidity of the structure or house.



The chaining will ensure several functions.

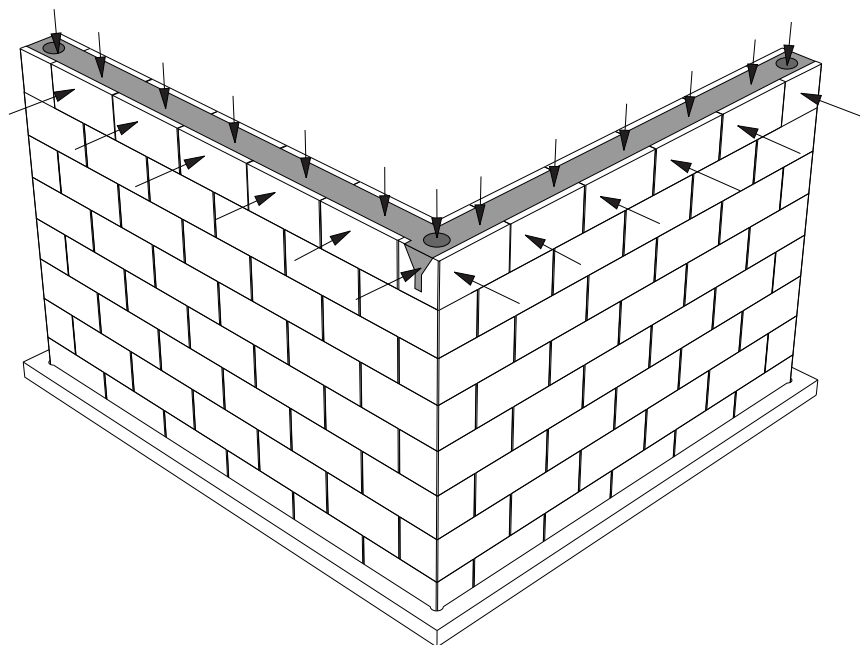
When it's vertical :

- it will ensure a certain wall mechanical rigidity, reinforce wall angles and extremities,
- it will help the wall to support the elements load located above,
-

When it's horizontal :

- it will distribute across the width the elements load located above,
- it will react against wall efforts outwar (wind, beams,...), it prevents the wall to "open",
- it also serves as lintel above door and window,

Both vertical and horizontal chainings are connected together in order to "block" all construction elements.

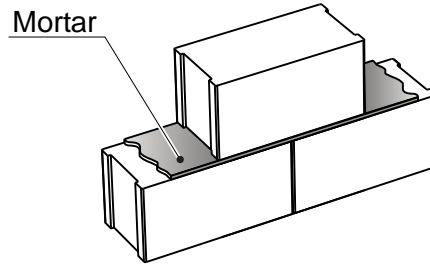


Activity 3 - To cast a lintel

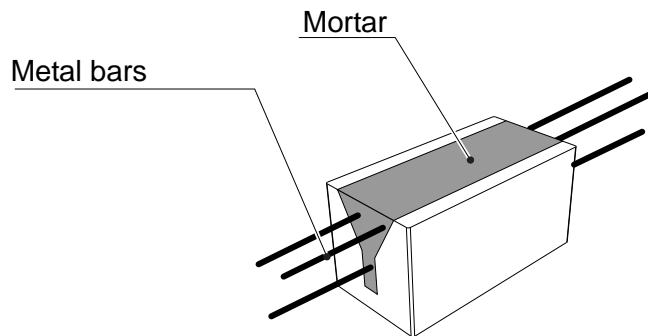
Example of
knowledge sheet

Mortar :

The mortar is used to “bond” blocks together, example two parpens. It's a mixture of cement, sand and water.



The mortar is particularly resistant to pressure and very badly to traction. Iron is added to it (resistant to traction) to make construction elements requiring a high resistance to bending (slabs, beams, posts...).



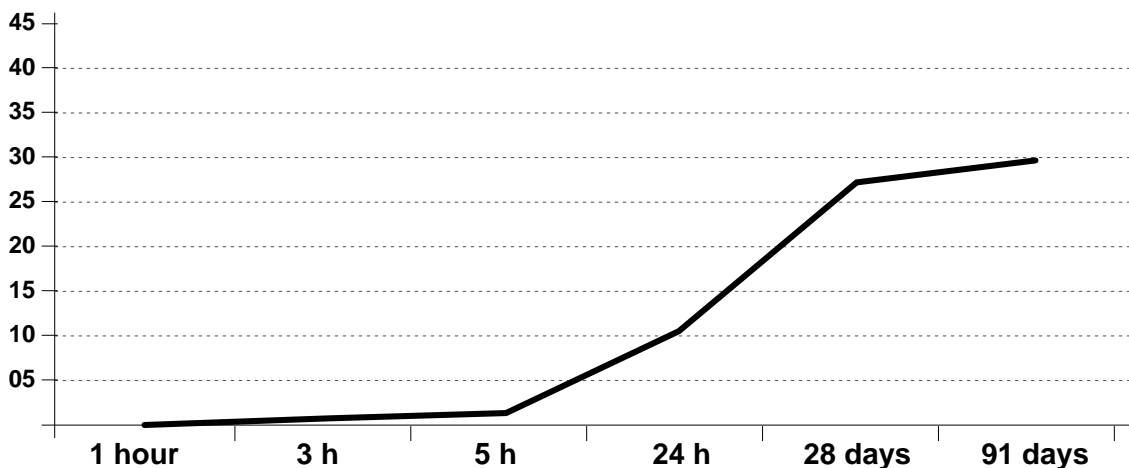
Concrete is a mixture of mortar and gravel.

The maximum concrete strength is reached progressively over time. We speak of setting time, which depends of the cement used and weather conditions, the aggregates quality (sand, gravel) and their proportion. After 7 days, and ordinary concrete has reached 40 to 60 % of its final resistance (only !). and from 60 to 80% after 28 days.

It's therefore not recommended to uncoffer too quickly the concrete slabs for example. It hardens when it's not moving and not because it becomes dry...).

The cement itself hasn't any resistance. It's the gravel, in the case of concrete, that gives some resistance (the sand in the case of mortar). It's therefore of prime importance to choose the good aggregates.

RESISTANCE TO COMPRESSION in Mpa at the end of setting, hardening begins...



To make oneself parpens

As explained in the test bench presentation (page 3), it's possible to use mini parpens to make models. A4 Company can provide mini-parpens ready to be used but also materials to make them oneself (molds, synthetic plaster, but also silicon fluid to make its own flexible molds (inodor fluid, skin contact). Refer to the catalog to see all materials and products available.

Download also "Realizations in mini-bricks" and "Parpens and bricks models" folders.

The mold.

A flexible silicon mold to cast parpens.

Ref. : MOUL-PARP-A.



The polyester synthetic plaster.

Is manipulated as plaster but gives a very hard material that resist to water.

Dilution : 1/4 water + 3/4 powder. Before setting, the very liquid mixture allows to fill easily mold. Setting in less than 15 minutes. White color first, it may be stained easily with a dye masonry.

Ref. : RESI-PLAPE-1K25-BC.



Black dye to color blocks



Réf. : COLO-N

Sand mortar.

Mixture of sand and food resin that dissolves in water. Is manipulated such as cement but present no risk for skin and can be rediluted in water, which allow to recycle all your models elements.

Ref. : COL-BRIQ-5K



Mini trowel.

Réf. : TRU-MIN-9CM



Mortar pan

CUV-MORT-D13



