Our stilt house

Focus on Technology

Stimulate problem solving	**Gold**	**Stimulate entrepreneurship**	**Bronze**
Stimulate creativity	**Gold**	**Informal learning enviro.**	**Platinum**
Stimulate critical thinking	**Silver**	**Technology use**	**Platinum**
Stimulate group work	**Gold**		

Practicalities

Preparation: 2u

Duration: 4u

Material needs:

- Building platform with pole
- A fan with different speeds
- Building materials

(for more details see materials box on last pages)

Group size range: 26
Ideal sub-group size: 4

Workshop made for: 12-16
Easily transferable to workshops for ages between: 16+

Environment FabLab necessary: No

Educational area:
* Engineering
* Mathematics
* Science
* Technology
* (Visual) Arts

Precognition for the educator

In this workshop the participants will make a pole house, a house that is balanced around one central stilt that keeps the building above ground. The two main goals are to work in group and to communicate well between the different roles that every participant will get, as well as to train the problem-solving skills of everyone in the group. The participants will have to use their problem-solving techniques because they will encounter a variety of problems throughout the workshop.

It's essential for the coach to have some knowledge about:

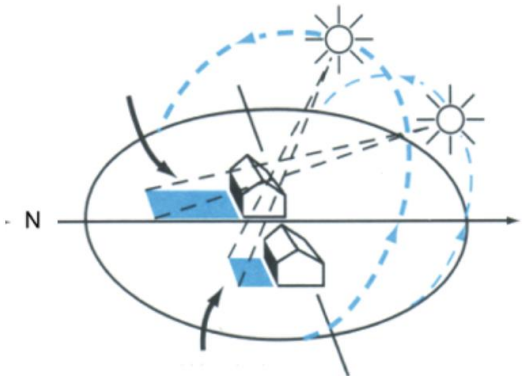
- Working with machines at the Fablab like a woodcutter, a 3D-printer, ect;
- Balance and a basic understanding of the **center of gravity**;
- **Scales** and how to use them to make plans and& prototypes;
- Coordination of groupworks
- Make drawings in programs like Sketchup, Fusion 360, etc.

If you think you don't have enough information about some topics, you can have a look at the content links at the last pages of these workshop guidelines.

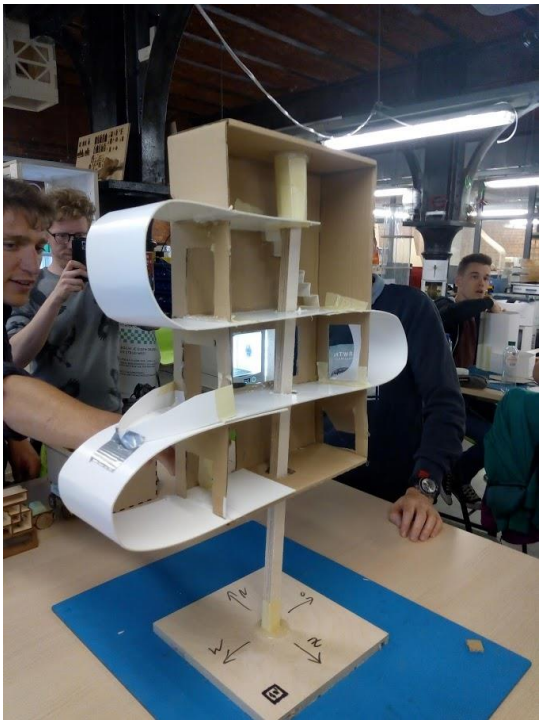
Preparation

For this workshop to work it is essential to have the materials so that the participants can construct a ***testing platform****: boxes with different types of underground (sand, silt, clay, loam and a* PVC drain pipe of min 20 cm.

- Make clear where the different cardinal directions (North, East, South and West) will be. For example with a clip or with tape. You can also find this picture as an appendix so you can hang it in your room.



- Lastly, don't forget to collect and prepare construction materials for the houses of the participants. See 'materials' in the next section.



Picture: example of the pole (here without soil) and the cardinal directions.

Workshop Guidelines

Phase 1: Orientation and Instruction Phase

Material needs:
Essential: Pictures of pole houses
Optional: /

Goals:
Skill Goals (**Blue**)
(S1) Social Skills: Knowing your own strengths in a group
(S2) Social Skills: Be able to find an agreement that everyone supports

Background story:

The central structure of the activity is a role-playing game. You should split the group in little groups of 4 Participants. All the participants will get a role in the role-playing this workshop. There is an architect, a bank clerk, a city employee and a client who wants to build a house. A good way to distribute the roles is to let the group decide who is going to play what role by asking some very open suggestive questions (e.g. "I need someone who is good with numbers").

In case the number of participants is not divisible by 4, you can solve this by either letting someone take up two separate roles, or by having some roles played by two group members at the same time, whichever comes more naturally.

Story: The client wants to build a house on a piece of land he bought, but because of the challenges related to climate change, the land is in danger of flooding. He will have to build this house elevated above the ground. To do this, the local government installed a single pole for them to build a house on, so he will need to find a way to make use of this pole to keep his house 'floating' in the air, all the while still complying with his own desires and wishes from the house design.

Apart from that, all other participating roles also want to have a say in how this house will eventually be built.

The workshop is divided in 4 parts in which every participant will get a little note with an extra instructions about his demands for the building.

The details of each phase and each description can be adapted to your liking, but for a basic version, see the documents in appendix.

Goals	Activities	Duration
S1, S2	Instead of dividing the group as you want, we're going to do it at random with a little investigation. Give every participant a little box with a bit of soil. The participants have to do little investigations to determine which type of soil they have. The clue is to find their teammates by concluding which soil they have in their box. They can do all kind of investigations they want. Some examples: put it under the microscope, sift it, taste it, dissolve the soil in water, etc. When the participants are divided in groups, the all need a specific role. Give a description of a role without saying what the role will be, in this way they will have to divide the roles. For example: * Someone that wants to make his/her dreams come true (client)	20''

	* Someone that likes to look at copper and gold but likes notes even more (Bank Clerk) * Someone who wants that all rules will be followed (Government) * Someone who wants to express himself in a non-verbal way (Architect)	

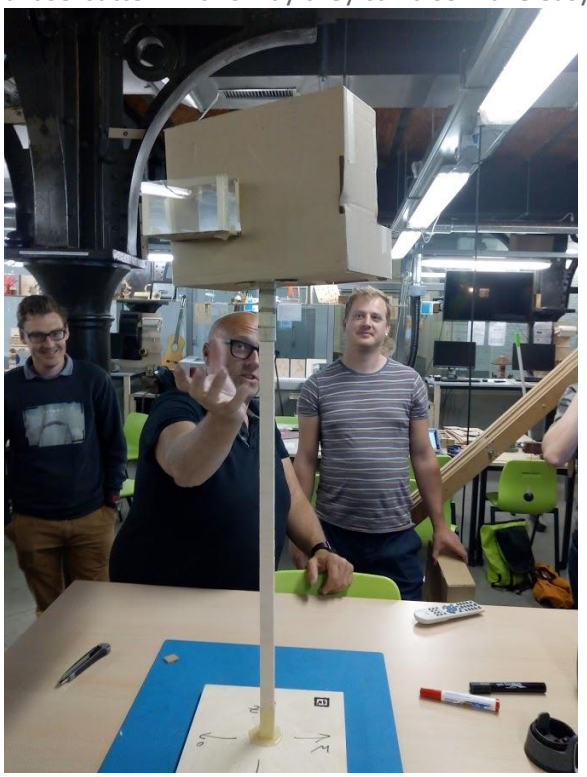
- *Make sure that the pipe is completely spirit level. Do this for the different angles.*

Phase 2 & 3 & 4: Designing & making & operational phases (iteratively)

Material needs:
Essential: *Graph paper,* cardboard boxes, watering can, hot glue gun, Scissors, utility knife, etc.
Platform with pole that is fairly stable.
Optional: *2 Lego figures or similar to test light distribution.*
Optional: *Microcontroller and light sensor.*
Optional: *Wood and woodcutting tools*
Optional: *Computer with Google Sketchup*
Optional: *A light bulb symbolizing the sun going around the platform in an arc of 270 degrees.*

Goals:
Skill Goals (**Blue**)
(S1) Abstraction of an idea to a 2-dimensional sketch
(S2) Abstraction of an idea to a 3-dimensional virtual sketch
(S3) Make a ground plan
(S4) Search the center of gravity of an object.
(S5) **Optional focus technics:** Argue the choice for a specific type of soil for a foundation.
(S6) Leveling an object.
(S7) Making changes to a design based on new information
(S8) Deal with failure (Trial and error)
(S9) **Optional focus technics:** Working with basic electronics
Content Goals (**Green**)
(C1) Work with scales on a 2 or 3-dimensional prototype
(C2) Indicate where the center of gravity of a simple object lies.
(C3) Investigate the strengths and weaknesses of different supporting materials
(C4) **Optional focus science** Explain the incidence of light and reflectiveness of surfaces

Goals	Activities	Duration
S1, S2, S3	After the participants have read their first set of instructions (Round 1, see appendix) they start to sketch their first drawings of the house on a 3D-program. Based on their level they can use for example TinkerCAD (easy) or Fusion360 (difficult). You can help the participants with some plans of existing houses. You can also give them perspective drawings. An important aspect of the design is to think about a practical way to put the rooms next to each other. To help them for this, there is an infosheet at the end of this guideline. Let them make a little 3D-print of their house and let them present it to the others of the group. You can give the participants a specific scale so they can compare all the models of the groups.	45’ 45’

C2, S4, S6, S7, S8	Second round starts, all participants get an update according to the role they are playing. One of the most important aspects of the second round is that the house must fit on a given pole as provided by the organizers, but the participants can only make use of that pole one single time each round. So they cannot rely on trial-and-error for the stabilization of their house, but should actually take into account the positioning of the center of gravity of their building. The basic rule here is to put the center as low as possible and it should be above the place of contact between the ground and the house. Participants discuss how to make adaptations to their current design and how to fit all the new requirements. During the discussion they build and try to make a new design based on the new context in light wood. The most easy way is to cut it with a lasercutter. In this way they can also make easy adaptations for the next rounds.  Again, after the adaptations the result of this round is presented to the organizers. Again they check if the prototype fulfills all the proposed design requirements.	45’
S6, S7, S8 C3	The third round the balance of the house will be challenged. A fan will produce an extra side-wind that will try to put the house off balance. As extra exercise they will have to work with the lighting inside and outside the house as well. They need to make some of the walls transparent or they need to make the light reflect on some surfaces in order to fulfill the conditions related to lighting and transparency. Again, after the adaptations the result of this round is presented to the organizers.	20’

	Again they check if the prototype fulfills all the proposed design requirements. 	
	(Optional focus technic) Round of light distribution testing: the model is put on the pole and the design requirements on light distribution are checked. 1 Lego figure should be always in the light and 1 should only have light on the midday hour. The participants can play with opening or covering places at the house, work with mirrors, etc. If necessary design adaptations are made.	
S9	***(Optional focus technic)*** *Skilled participants can optionally make more advanced system to check the lighting conditions using microcontroller and light sensors. For example a control led that lights up when a lightray is detected inside the room. You can also measure the luminous intensity at various places.*	60’
	The last round is there for the finishing touches. They will have to make the house waterproof. This can be tested with a watering can or a similar system. Apart from that they have another big design challenge: they will have to try to reduce the floor area of the total building by 20%, all the while keeping the other design requirements and the stability intact. Finally, after the adaptations the final design is presented to the organizers. They check if the prototype fulfills all the proposed design requirements, and if so they declare the house as a suitable house to be built on the spot.	
S9	***(Optional focus technic)*** *Skilled participants can optionally make more advanced system to check the moisture conditions using microcontroller and sensors.*	60’

Phase 5: Evaluation Phase

Material needs:
Essential: *Platform with poles and a light bulb symbolizing the sun going around the platform in an arc of 270 degrees. See preparation for details.*
Evaluation documents
Optional: *Optical chips that can be placed inside the house to check the lighting requirements.*

Goals:
Skill Goals (**Blue**)
(S1) Give an oral explanation of the design choices that were made
(S2) **Optional:** Give a presentation about their product
Content Goals (**Green**)
(C1) Find the center of gravity and support of a material
(C2) Investigate the strengths and weaknesses of different supporting materials
(C3) Explain the incidence of light and reflectiveness of surfaces

Goals	Activities	Duration
S1, C1 C2 C3	Participants present their final design to the classroom. Explaining the general buildup of the house and the design choices that they made. They also give a short explanation what adaptations were the most challenging and how they came up with solutions to these challenges	5 min per group
S2	***(Optional focus technic, economics)*** *Participants present their house and advertise the different aspects of the house: the functionality, the aesthetics, the balance, lighting conditions, etc.*	5 min per group
S2	***(Optional focus ICT)*** *Participants make a website with the basic information and some pictures of their constructed pole house like it would be a immo website listing. They present this website/listing and other participants can vote on which house they would buy*	1 hour + 5 min per group for the presentation

Pedagogical tips

Search a cool way to divide the participants into different groups and to give each participant his role in this workshop.

You can combine the roles of the participants with specific functions. The client can be the master of the materials (The only participant that can go to take stuff elsewhere in the room), the architect can be the master of drawings and scales, the Government can be responsible for a report.

How to transfer to (non-)Fablab environment

Transfer to non-fablab environment is very feasible, as long there is a working testing setup available (with the pillars and the 'sun' going round).

The materials used for construction of the houses is dependant on the available resources.
Participants can at a minimum construct houses out of cardboard and paper or light wood like popsicle sticks.
When more tools are available, some small woodworks and glue can be used for the building as well.
Participant can also draw their house on a dxf-format and cut their houses with a laser cutter.

Evaluation of achievements

At the end of the workshop you can give the different groups achievements.
For example for

- The most stable prototype
- The prototype with the most beautiful decoration
- The prototype with the best sustainable materials
- The prototype that would be the most livable (best deviation and orientation of the rooms)
- ...

Content links

You can find interesting links about the following subjects here:

Scales
https://www.wikihow.com/Draw-a-Floor-Plan-to-Scale

Climate Change
https://www.nationalgeographic.com/environment/global-warming/global-warming-overview/

Pole houses
https://en.wikipedia.org/wiki/Pole_house

Centre of gravity
https://www.grc.nasa.gov/www/k-12/airplane/cg.html

Orientation of rooms
http://www.level.org.nz/passive-design/location-orientation-and-layout/room-layout/

Types of soil
https://www.soils4teachers.org/physical-properties/

3D-Drawings on the computer

Google Sketchup
https://www.sketchup.com/

Fusion 360
https://www.autodesk.com/campaigns/fusion-360-for-hobbyists

TinkerCAD
https://www.tinkercad.com/

Materials

Essential:
Pictures of pole houses
Sketching materials: paper, pens and rulers
Craft materials: paper, cardboard, popsicle sticks, Styrofoam, acrylic glass ...
Craft tools: Stapler, scissors, glue
Light reflectors: Tiny mirrors, aluminum foil,
Platform with poles and a light bulb symbolizing the sun going around the platform in an arc of 270 degrees. See preparation for details.
2 Lego figures or similar to test light distribution
Platform with poles and a light bulb symbolizing the sun going around the platform in an arc of 270 degrees. See preparation for details.
Evaluation documents

Optional:
Computer with Google Sketchup, Fusion360 or TinkerCAD.
Wood cutter, Saw, Hammer and nails,
Laser Cutter, 3D-printer, Styrofoam cutter
Microcontroller and light sensor.
Optical chips that can be placed inside the house to check the lighting requirements.

Information sheet - Pole House

What do you have to consider when you divide the rooms in a new house?

1) Orientation with the cardinal directions

It is very important to look at the cardinal directions of the rooms you want to make in your house. As we all know the sun rises in the East and goes down in the West. In the afternoon the sun will shine on the Southern part of the house.
There are many consequences considering this information. A room that may not become too warm like a storeroom would lay the best in the North. Places where you want to enjoy a lot of sunlight should be in the south and when you want to make a patio, a good place would be in the West.

2) Private – public part of your house

Most people divide their house in 2 big parts namely a private part where only people who live there can come and a part where they can receive guests.
Things to think about then will be:

- Which rooms do you want to keep private? Make sure that visitors can walk from the front door to living and to the visitors toilet without passing private rooms.
- The children sleep rooms shouldn't be too close to the living room so the children so they can sleep will without too much noise coming from the living room.

3) Functional groups

a) The wet group

Kitchen, Bathroom, toilet, laundry room, etc. Form rooms in which water supply and drainage are required. Grouping these spaces gives certain advantages.

b) The sleeping group

Bedrooms should be in the vicinity of the bathroom and a toilet.

c) The warm group

At last try to group the rooms that will be heated.

4) Reduce the lost space

Try to minimize lost space in corridors. However, do not exaggerate by looking for the solution in very narrow corridors.

Appendix

ROUND 1

1. Client

You want to build a house on an estate that you purchased.

You want to create a house that feels unique, and yet remains practical. You pay particular attention to the structure of spaces. Nobody wants to end up in the basement from the front door or have a kitchen where no light enters.

You definitely need the following spaces in your home:

- **Bedroom parents**
- **Child's bedroom**
- **Open kitchen (with living room)**
- **Toilet**
- **Bathroom**
- **Storage room**

2. Architect

You want to give your **own style** to the building that the client asks you to build. As an architect you have a style of your own and you want to express that explicitly. A beam-shaped or cube-shaped house is out of the question. The house that you are going to build must be asymmetrical anyway.

In addition to the aesthetic, it is also important that you take into account the robustness of the building at all times. The building should be able to withstand the elements of nature like rain and wind.

3. Government

You defend the long-term goals of the city. Keep an eye on how the **facade looks exactly from the city side** . Keep it looking attractive; no flashy colors and no other disturbing elements. Your role may be limited in the beginning, but no one says that you will not interfere any more in the future.

4. Bank Clerk

As a bank, you ensure that no unnecessary expenses take place. **Limit the use of materials**. You also keep an eye on the Property Tax, make sure you always know how much of the habitable space the house has.

ROUND 2

Update Client

You take another critical look at the current design. Does the house meet the ease of use as you had in mind.

Update Architect

You monitor your own style as an architect. Even with imposed adjustments you try to ensure that everyone sees at first sight that you were at the basis of the design.

You think about possible saving measures whereby you take more account of solar gains in the right rooms, shorter water pipes, etc.

Also make sure that the place where the pole enters the house or is attached to the house is clearly indicated (with a red marker). Once a working balance point is found, this is a permanent decision

Update Government

Building in a flood-zone is not ok, certainly not in times of climate change. However, the estate is in a flood area. You inform the client that he may only cultivate the estate if he will use a stilt house. The pole is provided by the government, but the dimensions and properties cannot be negotiated. The pole is also not just available for testing, this must be requested through a complex procedure.

Update Bank Clerk

Testing the balance of the house on the stilt house is a complex and especially expensive procedure. It is very important that you monitor that this testing can be limited to 1 single attempt.

ROUND 3

Update Client

You follow the new building conditions and, where possible, try to keep your initial requirements and conditions.

Update Architect

A new study of the construction area shows that there is a chance of strong gusts in this residential area. **Strong winds are** expected especially from the **southwestern direction.** Adjust your building so that it can easily handle such windbreaks.

Also pay attention in general to the structural strength of your house. Open spaces and windows weaken strength.

Update Government

A rear neighbor of the plot that is being built, has filed a complaint against the construction of the house. He denounces the right to his light. The house would take away its natural sunlight during the day. You investigate the case and give the architect the assignment to build **at least 50% light-transmitting** from the city side so that the sunlight is not blocked.

Update Bank Clerk

There is absolutely no budget left to change the place where the pole is attached to the house (normally indicated in red). This would entail a new structural study and those costs are not foreseen, other solutions must be found. This is not negotiable .

ROUND 4

Update Client

During a site visit you have seen damp spots on the walls. This is of course also unhealthy as it is a breeding ground for bacteria. As a customer, you demand that the home be as **watertight** as possible.

Update Architect

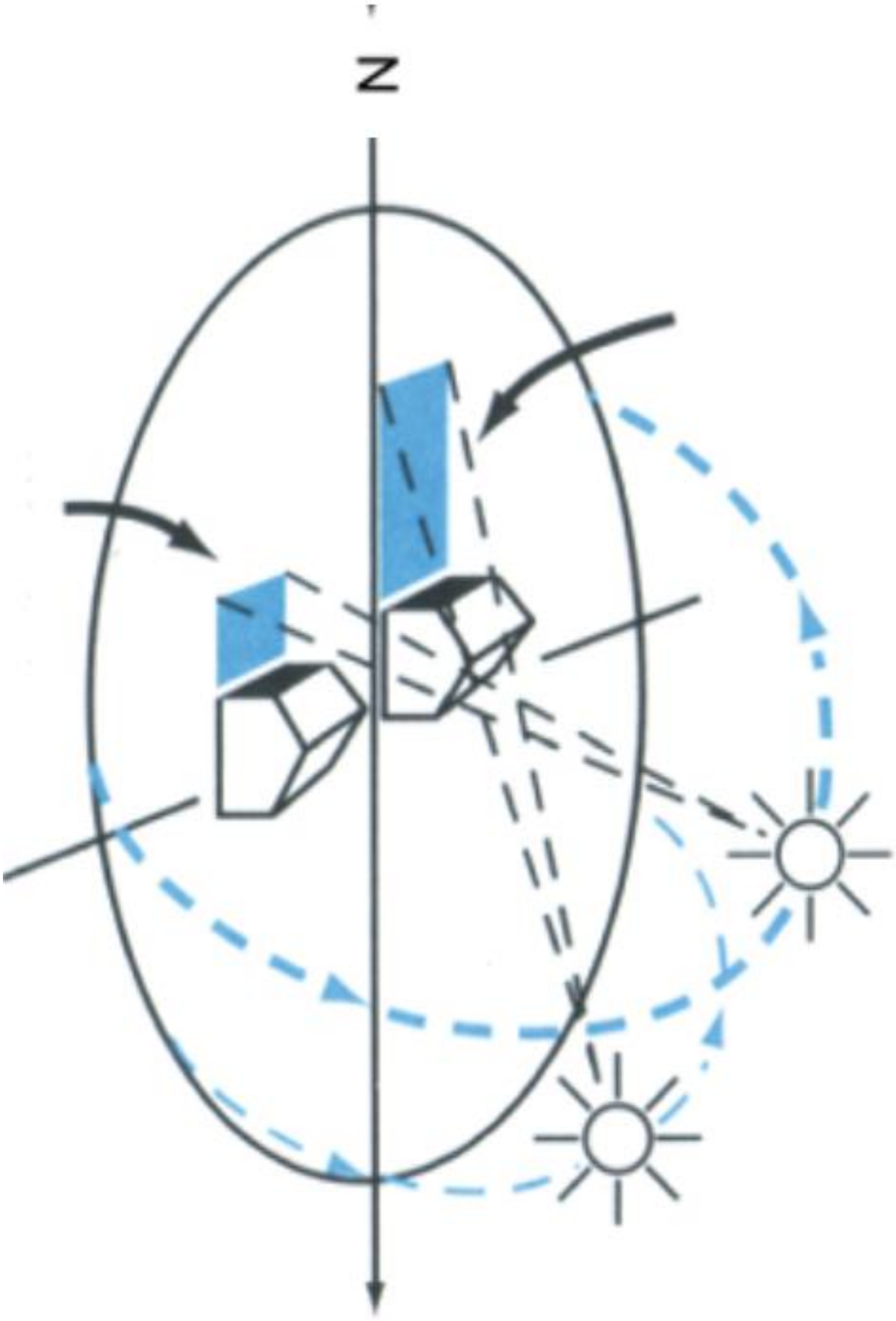
You try to meet your previous objective despite the bank's major challenge.

Update Government

You continue to defend the positions of the government and ensure that no construction violations will occur.

Update Bank Clerk

You notice that the budget of the house is completely consumed. Even worse: too much money has been spent. A drastic measure should be taken; the **floor space must be reduced by at least 20%**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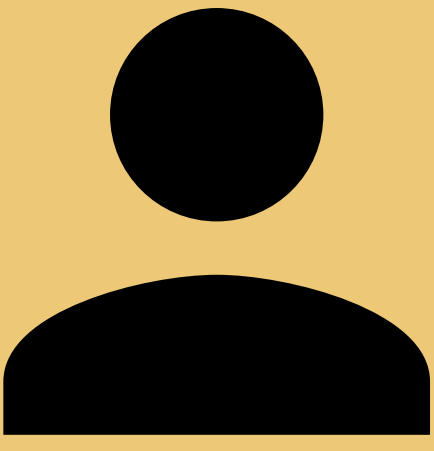
ROUND 1

CLIENT



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GOVERNMENT

You defend the long-term goals of the city. Keep an eye on how the facade looks exactly from the city side . Keep it looking attractive; no flashy colors and no other disturbing elements. Your role may be limited in the beginning, but no one says that you will not interfere any more in the future.

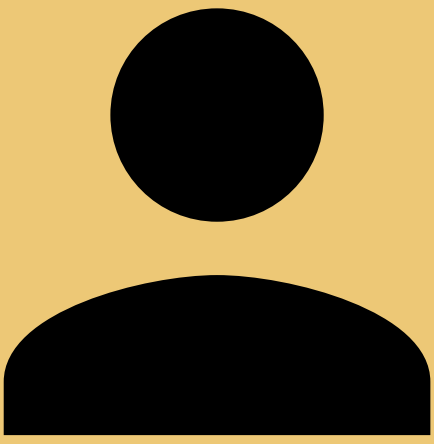
BANK CLERK

As a bank, you ensure that no unnecessary expenses take place. Limit the use of materials. You also keep an eye on the Property Tax, make sure you always know how much of the habitable space the house has.

CULTURE LOVER

As a culture and art lover you ensure that there is a culture in the house and various works of art surrounding that culture You have a work of art 2m by 3m, perfect for the living room, make sure there is room for this work. At first, your role may be limited, but no one says you won't interfere in the future.

ROUND 2



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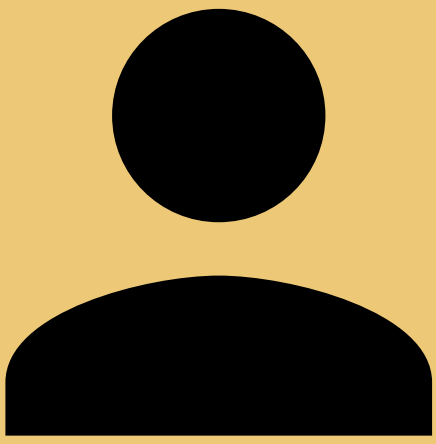
house is a complex and especially expensive procedure. It is very important that you monitor that this testing can be limited to 1 single
attempt.

CULTURE LOVER

You think the house gives too little culture. Go to the attendant and take a paper from jar one. Here you see a European country. This is the country where the house will be built. Make this visible. Research the culture on the Internet or in the library.

ROUND 3



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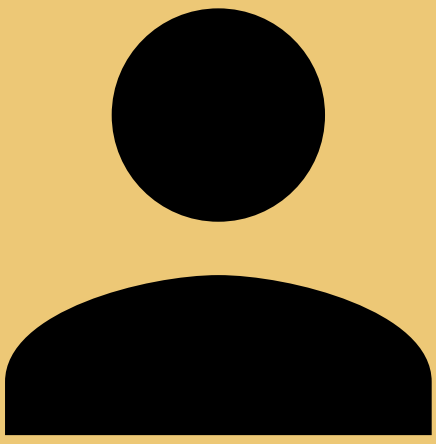

CLIENT

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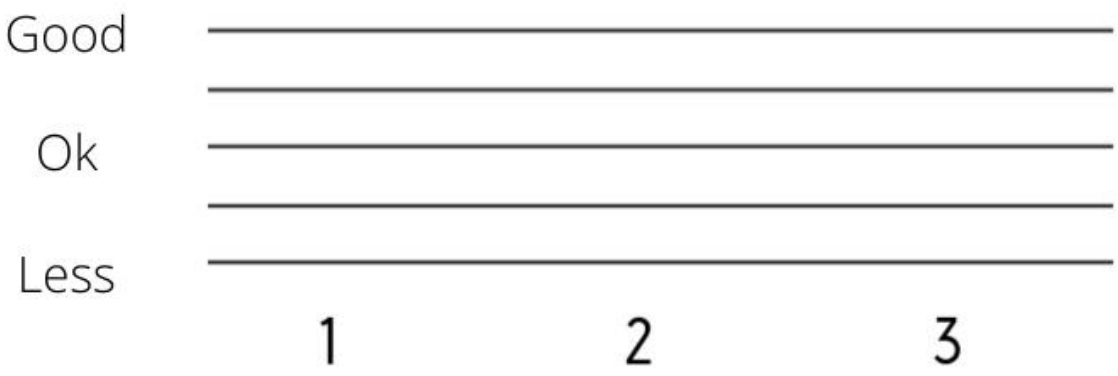
space must be reduced by at least 20%

CULTURE LOVER

During a site visit you have seen damp spots on the walls. This is unhealthy as it is
a breeding ground for bacteria. It is important for the costumer that the house is waterproof. However, you are greatly inspired by the damp spots and want to integrate them into a piece of art that comes to the house.

The highest stilt



Answer the questions below by drawing a stilt on the correct height.

1. Have you been able to put the characteristics of your received character into the product?
2. What does the end product look like?
3. How well did you put yourself in the group?