

ANNEX

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Annex

Case A, housing development site visit and interview. Mexico

Case A located in Nacajuca, Tabasco was analysed as a case study in Chapter 3 and 4. The project was built in 2016 as a response for the necessity of a social housing development designed to resist Nacajuca's annual floods. To analyse the quality of the housing development 31 surveys were done to people living there. Not all the inhabitants could be interviewed because some of them were not at home and others didn't want to answer any questionnaire for personal reasons. The results showed that the house design could be improved in the future taking into account aspects such as: improving the accessibility in the zone, improving the availability of water and electricity, and flexibility in the house layout to expand the house for future family members and bigger storage space.

Tabasco is located in south-eastern Mexico on the Isthmus of Tehuantepec. The state is bounded by the states Campeche in the east, Chiapas in the south, and Veracruz in the west, and by the 184 km-long coastline along the Gulf of Mexico in the north. Tabasco is already suffering impacts resulting from modifications in rainfall distribution due to changes in the variability of precipitation that would probably increase because of the effects of climate change. The last decades floods had increased in magnitude, extension and intensity. Yearly floods of about half a metre, nowadays could be as high as four metres. Nacajuca, is part of the Chontalapa region in the north centre of the state and is low-lying flat land making it very susceptible to flooding including being hard hit by the 2007 flooding and more recent flooding in 2011 and 2020.

To analyse the architectural quality of Case A, surveys were done as an alternative methodology. Surveys or interviews can be defined as a qualitative research technique which involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program or situation (Boyce & Neale, 2006). There are three different formats of interviews: structured, semi-structured and unstructured. In this research structured interviews were used with a series of predetermined questions that all interviewees answered in the same order. The data analysis usually tends to be more straightforward because the information can be compared and contrasted from all the different answers given to the same questions.

The interviews were conducted to 31 persons living in Case A. The questions were conducted in person using multiple choice and Likert scale in the format of the questions (Quality: Poor or null, Dissatisfied, Neutral, Satisfied, Very satisfied). The interviews were made in one day and the data were recorded by note-taking and audiovisual recordings. The names of the different persons interviewed in this study were not published as personal requirements from the interviewees. The 120 housing development design includes a 42 m² house distributed in two bedrooms, a bathroom, a kitchen and a dining room. The concrete elevated (palafito) structure allows the habitant to expand the house vertically one floor more with 42 m² behind the core house.

The surveys showed that in terms of urban design and resilience strategies, the performance of the project is poor in aspects such as distance to waste deposits, schools and hospitals, water and electricity availability and neutral quality in terms of flood resilience, gas availability and rain collectors systems considering that the houses are elevated 2.20 m from the ground floor.

In terms of indoor quality, the inhabitants need more natural light, natural ventilation, storage space and study space. 93% of the inhabitants mentioned that they don't have any study space and the other 7% mentioned that they have to study in the dining room. In terms of security, the surveys showed that the users don't feel secure at night because there is not enough outdoor lighting. The users added steel protections to the original design of the house in all the windows and the principal door as a strategy to avoid robberies. Potable water availability and electricity were very deficient in the flooding season and during other seasons of the year. It is also important to say that the location didn't have any access to the internet so this complication reduces the study and work performance. Therefore, the families had to travel

by motorcycle or bicycle to the city centre to have access to this service. The users were satisfied with the room's dimensions (10 m²/each), the kitchen is a very important space because it is the area where the users spend more of their time cooking and sharing with their families, in this case, the dimension was very small to develop familiar activities and cooking (5 m²), the users had a neutral opinion about the living room (7 m²) and dining room (8 m²) dimensions. The average of habitants per house was between 3-4 members and in this case, the houses were not overcrowded in accordance with the house dimensions. Results showed that 40% of building performance attributes are correlated with users' satisfaction.

Table 1 to Table 7 shows the different questions and the answers made to the 31 habitants in the social housing development in Nacajuca, Tabasco. The score of users satisfaction is based on the Likert scale (poor or null, dissatisfied, neutral, satisfied and very satisfied)

Table 1 General inhabitants data of Case A. 2020

N° (person)	Sex	Age	Job	Job sector	Educational level	Number of inhabitants	House quality (average)
1	woman	30-50	no		secondary school	5	2
2	woman	30-50	yes	public administration	technical	4	4
3	men	30-50	yes	commerce	secondary school	2	4
4	men	50-70	yes	public services	secondary school	3	3
5	men	30-50	yes	construction	secondary school	5	3
6	woman	20-30	no		secondary school	2	4
7	woman	30-50	yes	public services	high school	3	2
8	woman	30-50	I prefer not to say		secondary school	3	2
9	woman	50-70	no		secondary school	4	4
10	men	30-50	yes	construction	technical	4	4
11	woman	30-50	yes	public services	secondary school	4	4
12	men	50-70	yes	farming	primary school	3	3
13	woman	30-50	I prefer not to say		primary school	5	5
14	woman	20-30	yes	public services	secondary school	4	4
15	woman	30-50	yes	commerce	technical	2	2
16	woman	70-more	I prefer not to say		primary school	4	4
17	men	30-50	yes	energy	technical	2	2
18	woman	20-30	yes	public services	secondary school	4	4
19	woman	30-50	yes		secondary school	3	3
20	men	50-70	yes	public transport	technical	2	2
21	woman	20-30	no		primary school	3	3
22	woman	30-50	yes	public services	secondary school	4	4
23	woman	30-50	yes	public services	secondary school	2	2

24	woman	15-20	no		primary school	5	5
25	woman	70- more	yes	farming	primary school	2	2
26	woman	30-50	no		secondary school	4	4
27	woman	50-70	I prefer not to say		secondary school	3	3
28	men	30-50	yes	public services	secondary school	3	3
29	men	20-30	no		secondary school	4	4
30	woman	30-50	yes	commerce	high school	3	3
31	woman	70- more	yes	farming	primary school	5	5

Table 2 Component quality of Case A. 2020

N ^o	Component quality [Founda-tion]	Component quality [Columns]	Component quality [Beams]	Component quality [Floor]	Component quality [Walls]	Component quality [Interior walls]	Component quality [Floor]
1	satisfied	satisfied	satisfied	satisfied	neutral	neutral	satisfied
2	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
3	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
4	neutral	neutral	neutral	neutral	neutral	neutral	neutral
5	neutral	neutral	neutral	neutral	neutral	neutral	neutral
6	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
7	neutral	neutral	neutral	dissatisfied	dissatisfied	dissatisfied	dissatisfied
8	neutral	neutral	neutral	neutral	neutral	neutral	neutral
9	neutral	neutral	neutral	neutral	neutral	neutral	neutral
10	neutral	neutral	neutral	neutral	neutral	neutral	neutral
11	neutral	neutral	neutral	dissatisfied	dissatisfied	dissatisfied	dissatisfied
12	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
13	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
14	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
15	satisfied	satisfied	satisfied	satisfied	neutral	neutral	satisfied
16	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
17	satisfied	satisfied	satisfied	satisfied	neutral	neutral	satisfied
18	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
19	neutral	neutral	neutral	neutral	dissatisfied	dissatisfied	neutral
20	neutral	neutral	neutral	neutral	neutral	neutral	neutral
21	satisfied	satisfied	satisfied	satisfied	neutral	neutral	satisfied
22	neutral	neutral	neutral	neutral	dissatisfied	neutral	neutral
23	satisfied	satisfied	satisfied	satisfied	dissatisfied	dissatisfied	satisfied
24	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
25	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
26	neutral	neutral	neutral	dissatisfied	dissatisfied	dissatisfied	dissatisfied
27	neutral	neutral	neutral	neutral	dissatisfied	dissatisfied	neutral
28	satisfied	satisfied	satisfied	satisfied	neutral	neutral	satisfied
29	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
30	satisfied	satisfied	satisfied	satisfied	neutral	neutral	satisfied
31	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied

Table 3 Basic services availability of Case A. 2020

Nº	Potable water availability	Drainage availability	Electricity availability	Pluvial system	Disponibilitat y calidad de los servicios [Drainage system]	Disponibilitat y calidad de los servicios [Potable water system]	Gas system	Disponibilitat y calidad de los servicios [Electrical system]
1	dissatisfied	dissatisfied	dissatisfied	poor or null	dissatisfied	dissatisfied	neutral	dissatisfied
2	neutral	neutral	neutral	satisfied	satisfied	neutral	neutral	Neutral
3	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
4	dissatisfied	dissatisfied	neutral	neutral	dissatisfied	dissatisfied	neutral	dissatisfied
5	poor or null	dissatisfied	dissatisfied	neutral	dissatisfied	dissatisfied	neutral	dissatisfied
6	dissatisfied	dissatisfied	dissatisfied	neutral	dissatisfied	dissatisfied	neutral	dissatisfied
7	poor or null	poor or null	poor or null	dissatisfied	poor or null	poor or null	poor or null	poor or null
8	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
9	neutral	dissatisfied	dissatisfied	neutral	neutral	neutral	neutral	neutral
10	dissatisfied	dissatisfied	dissatisfied	neutral	dissatisfied	dissatisfied	dissatisfied	dissatisfied
11	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
12	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
13	dissatisfied	neutral	dissatisfied	neutral	neutral	dissatisfied	neutral	dissatisfied
14	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral
15	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
16	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
17	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
18	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral
19	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
20	neutral	neutral	neutral	neutral	neutral	neutral	satisfied	neutral
21	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
22	neutral	satisfied	neutral	neutral	neutral	neutral	neutral	neutral
23	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
24	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	neutral	dissatisfied
25	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
26	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
27	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	neutral	dissatisfied
28	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	neutral	dissatisfied
29	neutral	dissatisfied	dissatisfied	neutral	dissatisfied	dissatisfied	neutral	dissatisfied
30	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
31	dissatisfied	dissatisfied	dissatisfied	neutral	dissatisfied	dissatisfied	neutral	dissatisfied

Table 4 Urban services accessibility of Case A. 2020

4 N ^o	Security perception	Garbage collectors	Schools proximity	Hospitals proximity	Recreation centres proximity	Green areas quality	Construction quality [Accessibility]	Outdoor lighting	Noise comfort	Cooling system
1	dissatisfied	poor or null	poor or null	poor or null	poor or null	dissatisfied	poor or null	dissatisfied	neutral	dissatisfied
2	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	satisfied	satisfied	neutral
3	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	poor or null	poor or null	dissatisfied	dissatisfied
4	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	poor or null	poor or null	neutral	neutral	neutral
5	neutral	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	dissatisfied	poor or null
6	poor or null	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	neutral	neutral
7	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
8	neutral	dissatisfied	dissatisfied	dissatisfied	dissatisfied	poor or null	poor or null	dissatisfied	dissatisfied	dissatisfied
9	poor or null	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
10	poor or null	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	neutral	neutral
11	neutral	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
12	neutral	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
13	poor or null	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	neutral
14	poor or null	dissatisfied	dissatisfied	dissatisfied	dissatisfied	neutral	neutral	neutral	neutral	neutral
15	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
16	dissatisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
17	neutral	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
18	dissatisfied	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral
19	dissatisfied	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
20	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied
21	dissatisfied	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
22	dissatisfied	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral
23	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
24	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	neutral	dissatisfied
25	dissatisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied
26	dissatisfied	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null
27	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied
28	dissatisfied	neutral	neutral	neutral	neutral	neutral	neutral	neutral	satisfied	satisfied
29	dissatisfied	neutral	dissatisfied	neutral	neutral	dissatisfied	neutral	neutral	satisfied	satisfied
30	dissatisfied	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	poor or null	neutral	neutral
31	dissatisfied	neutral	neutral	neutral	neutral	satisfied	satisfied	satisfied	satisfied	satisfied

Table 5 Urban services accessibility of Case A. 2020

Nº	Constructio quality [Building safety]	Storage space availability	Constructio quality [Building resilience in floods]	Urban mobility accessibility	Spaces quality [Room one]	Spaces quality [Room 2]	Spaces quality [Kitchen]	Spaces quality [poly-valent area]	Spaces quality [Others]	Which is the most used house space?	Do you have a space for work or study?
1	poor or null	poor or null	poor or null	dissatisfied	dissatisfied	dissatisfied	neutral	poor	neutral	kitchen and dining room	No
2	satisfied	neutral	neutral	dissatisfied	satisfied	satisfied	satisfied	neutral	neutral	kitchen and dining room	No
3	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	satisfied	neutral	neutral	living room	No
4	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	neutral	neutral	neutral	living room	No
5	poor or null	poor or null	poor or null	poor or null	satisfied	satisfied	neutral	neutral	neutral	living room	No
6	dissatisfied	dissatisfied	neutral	dissatisfied	satisfied	satisfied	satisfied	neutral	neutral	living room	No
7	poor or null	poor or null	poor or null	poor or null	dissatisfied	dissatisfied	poor	poor	poor	living room	no
8	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	satisfied	neutral	neutral	living room	no
9	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	neutral	neutral	neutral	bedroom	no
10	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	satisfied	neutral	neutral	living room	no
11	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	kitchen and dining room	no
12	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	kitchen and dining room	no
13	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	neutral	neutral	neutral	living room	no
14	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral	kitchen and dining room	no
15	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	kitchen and dining room	no
16	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	kitchen and dining room	dining room
17	poor or null	poor or null	poor or null	poor or null	satisfied	satisfied	dissatisfied	dissatisfied	dissatisfied	living room	no
18	neutral	neutral	neutral	neutral	satisfied	satisfied	satisfied	satisfied	satisfied	living room	no
19	poor or null	poor or null	poor or null	poor or null	neutral	neutral	dissatisfied	dissatisfied	dissatisfied	living room	no
20	neutral	neutral	neutral	neutral	satisfied	satisfied	neutral	neutral	neutral	living room	no
21	poor or null	poor or null	poor or null	poor or null	satisfied	satisfied	dissatisfied	dissatisfied	dissatisfied	kitchen and dining room	no

22	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral	neutral	kitchen and dining room	
23	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	kitchen and dining room	no
24	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	kitchen and dining room	dining room
25	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	kitchen and dining room	no
26	poor or null	poor or null	poor or null	poor or null	neutral	neutral	dissatisfied	dissatisfied	dissatisfied	dissatisfied	kitchen and dining room	no
27	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied	satisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	kitchen and dining room	no
28	satisfied	satisfied	satisfied	neutral	satisfied	satisfied	satisfied	neutral	neutral	neutral	kitchen and dining room	no
29	satisfied	satisfied	neutral	neutral	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	bedroom	no
30	poor or null	poor or null	poor or null	poor or null	satisfied	satisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	kitchen and dining room	no
31	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	satisfied	neutral	neutral	neutral	kitchen and dining room	no

Table 6 House finishes and layout flexibility satisfaction of Case A. 2020

Nº	Floor finishes (level of satisfaction)	Wall finishes (level of satisfaction)	Interior walls finishes (level of satisfaction)	Finishes (level of satisfaction)	Finishes (quality) [Ventanas]	Doors	Windows	Layout flexibility [Incremental] (level of satisfaction)	Layout flexibility [Alternative use] (level of satisfaction)
1	satisfied	satisfied	neutral	dissatisfied	dissatisfied			dissatisfied	dissatisfied
2	satisfied	satisfied	satisfied	neutral	neutral			satisfied	neutral
3	satisfied	dissatisfied	satisfied	neutral	neutral			dissatisfied	dissatisfied
4	satisfied	satisfied	satisfied	neutral	neutral		No secure	poor	poor
5	satisfied	satisfied	satisfied	neutral	neutral		No secure	poor	poor
6	neutral	neutral	neutral	neutral	neutral			dissatisfied	dissatisfied
7	neutral	neutral	neutral	dissatisfied	dissatisfied	No secure	No secure	poor	poor
8	neutral	neutral	neutral	neutral	neutral			neutral	neutral
9	neutral	neutral	neutral	neutral	neutral			neutral	neutral
10	neutral	neutral	neutral	neutral	neutral			dissatisfied	dissatisfied
11	satisfied	satisfied	satisfied	neutral	neutral		No secure and without solar protection	dissatisfied	dissatisfied
12	satisfied	satisfied	satisfied	satisfied	satisfied			satisfied	satisfied
13	satisfied	satisfied	satisfied	satisfied	satisfied			dissatisfied	dissatisfied
14	neutral	neutral	neutral	neutral	neutral			neutral	neutral
15	neutral	neutral	neutral	dissatisfied	dissatisfied	No secure	No secure and without solar protection	dissatisfied	dissatisfied
16	satisfied	satisfied	satisfied	satisfied	satisfied			satisfied	satisfied
17	neutral	neutral	neutral	dissatisfied	dissatisfied	No secure	No secure and without solar protection	dissatisfied	dissatisfied
18	satisfied	satisfied	satisfied	satisfied	satisfied			neutral	satisfied
19	neutral	dissatisfied	dissatisfied	dissatisfied	dissatisfied	No secure	No secure and without solar protection	poor	poor
20	neutral	neutral	neutral	neutral	neutral			neutral	neutral
21	satisfied	dissatisfied	dissatisfied	dissatisfied		No secure	No secure and without solar protection	dissatisfied	dissatisfied
22	satisfied	dissatisfied	neutral	neutral	neutral			satisfied	satisfied
23	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied		No secure and without solar protection	dissatisfied	dissatisfied
24	satisfied	satisfied	satisfied	neutral	neutral			satisfied	satisfied
25	satisfied	satisfied	satisfied	satisfied	satisfied			satisfied	satisfied
26	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	No secure	No secure and without solar protection	dissatisfied	dissatisfied
27	dissatisfied	dissatisfied	dissatisfied	dissatisfied	dissatisfied	No secure	No secure and without solar protection	dissatisfied	dissatisfied
28	satisfied	satisfied	satisfied	neutral	neutral	No secure	No secure and without solar protection	neutral	dissatisfied
29	satisfied	satisfied	satisfied	satisfied	satisfied			neutral	neutral
30	satisfied	neutral	neutral	dissatisfied	dissatisfied	No secure	No secure and without solar protection	dissatisfied	dissatisfied
31	satisfied	dissatisfied	satisfied	satisfied	satisfied			satisfied	satisfied

Table 7 General comments of construction material availability for the expansion, disadvantages of the house design and perception of safety when flooding of Case A. 2020

Nº	Layout flexibility [Is it easy to buy the construction materials of your house for future maintenance?]	Disadvantages of the house design	Do you feel safe in your house when there is flooding in the area?
1	satisfied	humidity on the roof	no
2	neutral	there is no garbage management and the area under the house cannot be used due to flooding	no
3	neutral	inefficient drainage system	no
4	neutral	low adaptability of housing	no
5	satisfied	poor security	no
6	neutral	no space for study	maybe
7	neutral	insecure for women and children	no
8	neutral	no public transportation	no
9	neutral		maybe
10	neutral		maybe
11	satisfied	low adaptability of housing	no
12	satisfied		maybe
13	neutral	no exterior spaces for children to play	maybe
14	neutral		maybe
15	dissatisfied		no
16	satisfied		yes
17	neutral		no
18	satisfied		yes
19	neutral	no exterior spaces for children to play	no
20	neutral		maybe
21	dissatisfied	poor outdoor lighting and insecure for women and children	no
22	satisfied		maybe
23	neutral		no
24	satisfied	poor outdoor lighting and insecure for women and children	no
25	satisfied		yes
26	neutral	health problems when it is flood, no public transportation	no
27	neutral		no
		there is no work space, it floods under the house, there is no efficient drainage	
28	neutral		no
		there is no work space, it floods under the house, there is no efficient drainage	
29	neutral		maybe
30	neutral	development, no water filtration under the house, diseases due to malfunctioning of the biodigester	no
31	satisfied		no

Figure 1 to Figure 16 shows the summarised data obtained from the interview. Figure 1 shows the general housing quality is presented according to the 31 inhabitants, it is possible to see that the 32,3% of the housing users are mostly dissatisfied (1= poor or null, 2= dissatisfied, 3= neutral, 4= satisfied and 5= very satisfied)

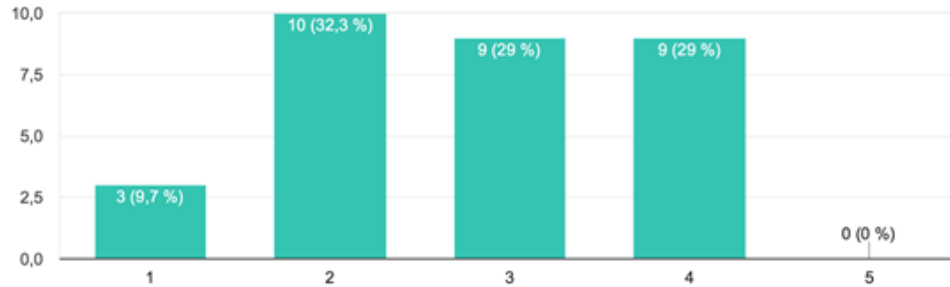


Figure 1: General housing quality. 2020

Figure 2 shows the users satisfaction in terms of the construction system. The roof's material has the lowest score of satisfaction.

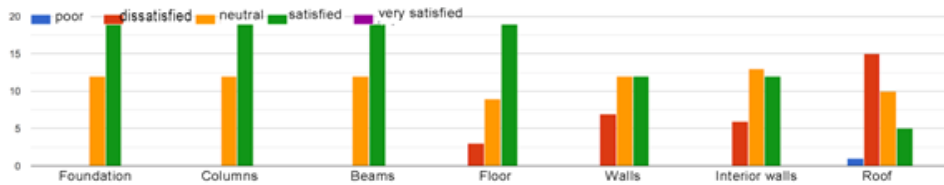


Figure 2: Construction system quality. 2020

Figure 3 shows the users satisfaction in terms of the housing finished quality. Doors and windows are the elements with the lowest score of satisfaction.

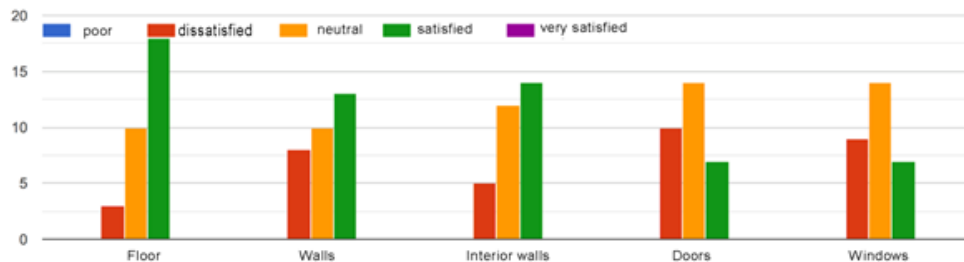


Figure 3: House finishes quality. 2020

Figure 4 shows the users satisfaction in terms of the space size including the rooms, kitchen, multi-purpose area, others. The size of the rooms have the highest score of the space size satisfaction.



Figure 4: Space size satisfaction. 2020

Figure 5 shows the users satisfaction in terms of layout flexibility (expansion, alternative indoor uses, and availability of construction materials for the expansion). It is possible to see that it is quite easy to find the construction materials for the expansion of the house near the area.

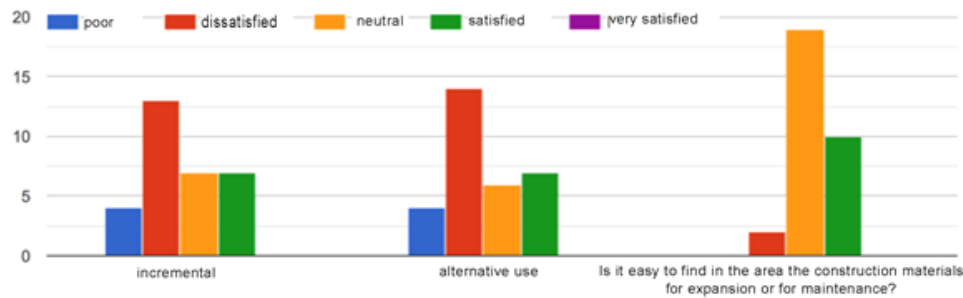


Figure 5: Layout flexibility satisfaction. 2020

Figure 6 shows the users satisfaction in terms of basic services quality (potable water, drainage, electricity, rain collector system and gas). Waste cans, drainage availability, electricity, and water availability are basic services that have the lowest score according to the users.

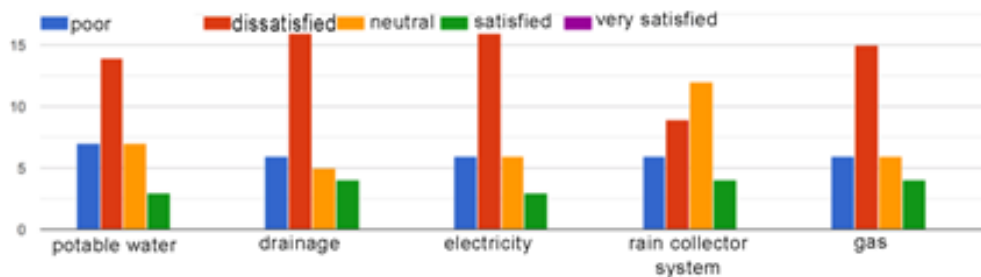


Figure 6: Basic services quality. 2020

Figure 7 shows the house space that is more used for the habitants. The kitchen and the dining room are the spaces more used in the house (54,8

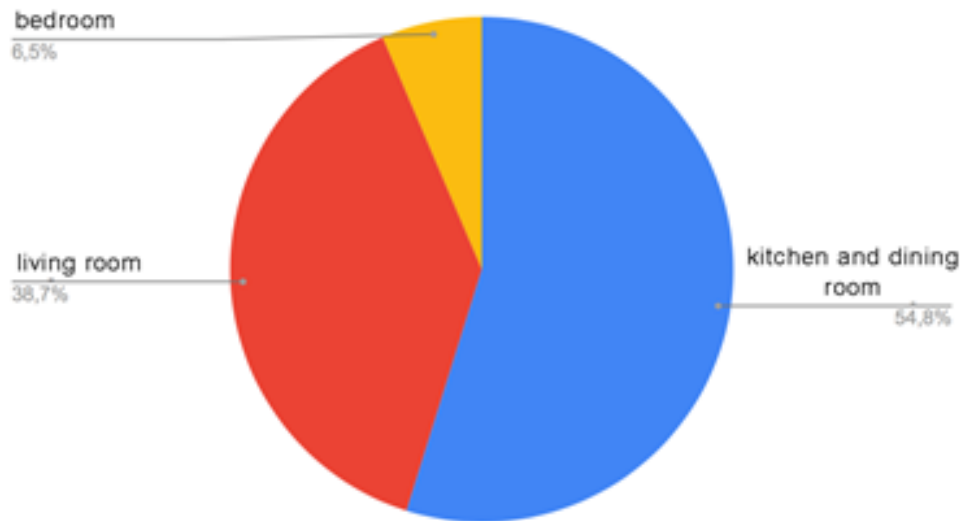


Figure 7: Which is the house space more used? . 2020

Figure 8 shows the house space for work or study. 93% of the inhabitants expressed that they do not have a proper space to study or work.

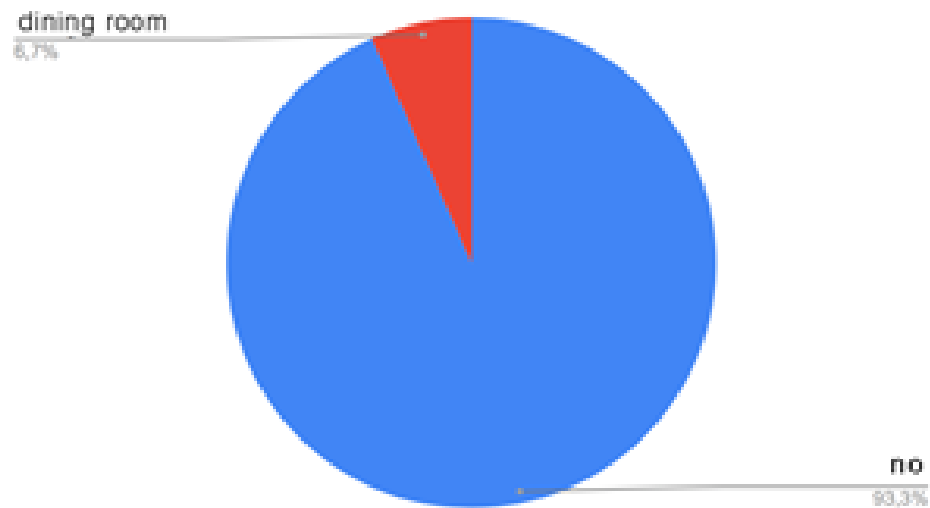


Figure 8: Do you have space for work or study in the house? . 2020

Figure 9 shows the users satisfaction in terms of layout flexibility. 41.9% of the inhabitants expressed that they are dissatisfied with the layout flexibility.

Figure 10 shows the users satisfaction in terms of urban mobility accessibility. The urban mobility



Figure 9: you have layout flexibility?. 2020

accessibility is according to the users 22,6% poor and 45,2% feel dissatisfied due to the lack of public transportation in the area.

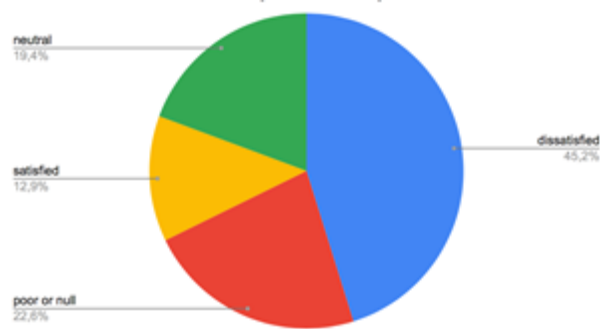


Figure 10: Urban mobility accessibility from Case A to urban infrastructure. 2020

Figure 11 shows the users satisfaction in terms of indoor thermal comfort. In general the users have a neutral and dissatisfied perception of the indoor thermal comfort as they have to turn on spring and summer all day the air conditioning.



Figure 11: Indoor thermal comfort. 2020

Figure 12 shows the users satisfaction in terms of indoor noise comfort. The users feel in general a neutral satisfaction about the indoor noise comfort.



Figure 12: Indoor noise comfort. 2020

Figure 13 shows the users satisfaction in terms of indoor natural light. The 38,7% of the habitants expressed that they are dissatisfied with indoor natural light, commenting that the windows should be bigger.

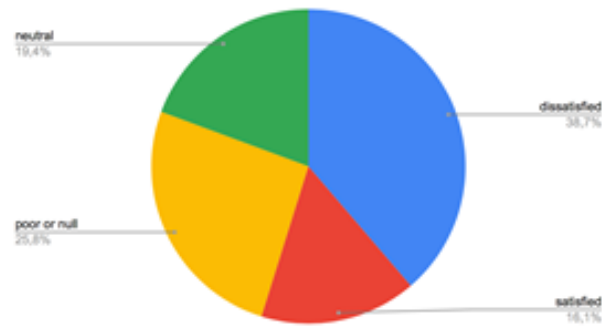


Figure 13: Indoor natural light according to the user’s satisfaction. 2020

Figure 14 shows the users satisfaction in terms of security perception. 64,5% of the users mentioned that they have a dissatisfied sensation of security inside the housing project, one cause is that the users mentioned that there is a lack of outdoor artificial light at night.



Figure 14: Security perception. 2020

Figure 15 shows the housing design disadvantage. Important disadvantages mentioned are the lack of exterior spaces for the kids to play, the necessity of a proper space to study and work inside the house, the poor adaptability of the house and the unsafe sensation inside the housing project during the night.

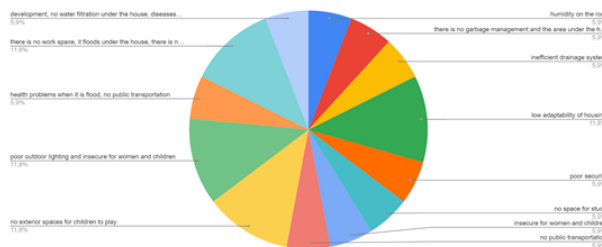


Figure 15: Housing design disadvantages. 2020

Figure 16 shows the flood risk perception in their houses according to the users. 61.3% of the habitants mentioned that the perception of flood risk is low.

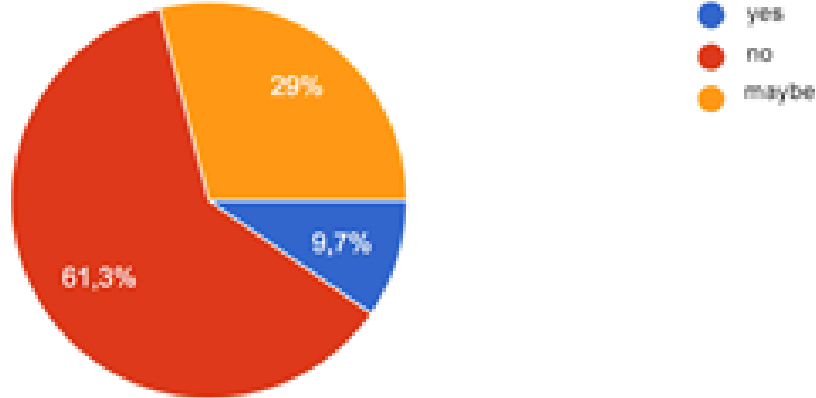


Figure 16: Flood risk perception. 2020

Annexes of Chapter 4 and 5

MIVES function values of the Case A, B, C and D

Table 8 shows the maximum and minimum values of the different indicators in Mexico City. References of each indicator are shown in the main thesis References section and shown in Chapter 4.

Table 8 Maximum and minimum values of the indicators for Mexico City. 2021

Mexico Social Housing (standard permanent housing)	Unit	min	max	Notes
I1 Construction cost	(euros/m ²)	195	572	BIMSA, CYPE, CMIC
I2 Maintenance cost	(euros/m ² /year)	0.93	7.92	CYPE
I3 Energy consumption	(kWh/m ² /year)	60	350	
I4 CO ₂	(kg/m ² /year)	3.5	43	Climate zone *emissions according to the zone* R dispersion (energy and emissions rating scale)
I5 Solid waste	(kg/m ²)	0.77	21	Examines the total amount of waste material generation remaining from the construction and assembly phase (construction system) assisted by CYPE and different papers regarding solid waste according to the different construction systems (insitu, prefabricated) and related to the construction material

I6 Construction time	(m ² /day)	0.8	2.4	m ² constructed per day according to a prefabricated construction system or an in situ construction system
Fire resistance	minutes (R)	60	120	According to the mexican construction regulations for an unfamiliar house with less than 15 m high it is correct to consider R30 but when the houses are contiguous/semidetached the min is R60 with a 15m high.
Seismic resistance	vulnerability (%)	0	0.9	The seismic resistance indicator measures the percentage of vulnerability to seismic damage of the construction system in an earthquake of 7.4 ^o in 1 minute according to the Normas Técnicas Complementarias para Diseño por Sismo 2020 de la Ciudad de México. This magnitude is the result of the average of the seismic activity in Mexico City from 1900- 2022 according to the Servicio Simologico Nacional. This vulnerability can be measured by ETABS in a range of between 0 to 1 (0-0.10 no damage, 0.10-0.25 light damage, 0.25-0.40 moderate, 0.40-1.0 severe y 1 collapse) this vulnerability, as well, takes into account the seismic zone in Mexico City.
Flood resistance	m (elevation)	0.05	0.5	The flood resistance indicator only measures the structural elevation in metres. It is considered the result of the historical average of the flood activity in CDMX with a 50mm level of water according to CENAPRED (distance from dangerous zone, building structure and material resilience are not considered in this study)
safety perception	points	0	3	This indicator measures the user's feeling about crime inside the house assisted with design strategies. Points scale: +1 window protection, +1 door protection, +1 outdoor lighting. Zero is considered when there is no design strategy for safety perception in the house.
I8 Incrementality	%	0	300	Percentage of sqm of construction for future expansion based on the original sqm.

I9 Thermal comfort (thermal conductivity)	W/m2(K)	0.2	2,46	This indicator assesses the U-value of the different construction materials, the component measures the amount of energy (heat) lost through a m2 (m2) of that material for every degree (K) difference in temperature between the inside and the outside.(W/m2(K)) watts/m2 per kelvin. Thermal comfort is one of the indoor environment factors that affect health and human performance. Additionally, this indicator considers the project location temperature, humidity, and air movement. As the ideal temperature for a house is 20-26°C the indicator calculates the energy required to keep the indoor environment in that temperature in winter and summer respectively, based on the Eficiencia energética en el confort térmico en viviendas de clima cálido en México, SENER, CONUEE, 2020.
I10 Acoustic comfort	(dB)	45	65	Material sound insulation properties
I11 Indoor natural light	Glazing ratio %	4	20	This indicator assesses the percentage of the total glazed area in the building divided between the total exterior wall area. These criteria include the orientation, number of windows, size of the windows and the existence of solar protections. This percentage of indoor natural light improves human health, well-being, and productivity. This indicator is a key variable in the layout design affecting energy performance in projects

Value function of the defined indicators

Regarding the shape of the value functions assigned to the indicators in Chapter 4 and 5, the Xmin, Xmax, Ci value, Ki value, and Pi value of each indicator are defined, as shown in Figure 17 to 30.

Fig. 17 Construction cost: Convex decrease, the lower the total construction cost, the greater the satisfaction.

Xmax	572,00
Xmin	195,00
Ci Value	596,00
Ki Value	0,400
Pi Value	1,50
Valor de Bi	5,486082917

	Construction cost		value
ALT. A	217	0,9215	0,92
ALT. B	301,12	0,6328	0,63
ALT. C	428,56	0,2531	0,25
ALT. D	546,45	0,0194	0,02

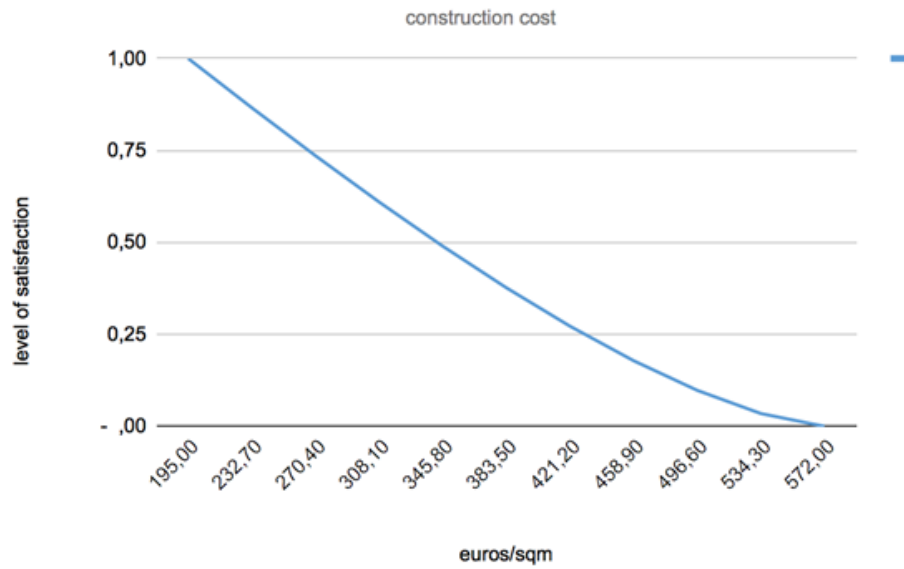


Figure 17: The value function of I1 Construction cost. 2021

Fig. 18 Maintenance cost: Convex decrease, the lower the total maintenance cost, the greater the satisfaction.

Xmax	7,92
Xmin	0,93
Ci Value	9,00
Ki Value	0,400
Pi Value	1,50
Valor de Bi	4,17215503

	Maintenance cost		value
ALT. A	1,04	0,9788	0,98
ALT. B	1,7	0,8566	0,86
ALT. C	2,38	0,7329	0,73
ALT. D	2,06	0,7908	0,79

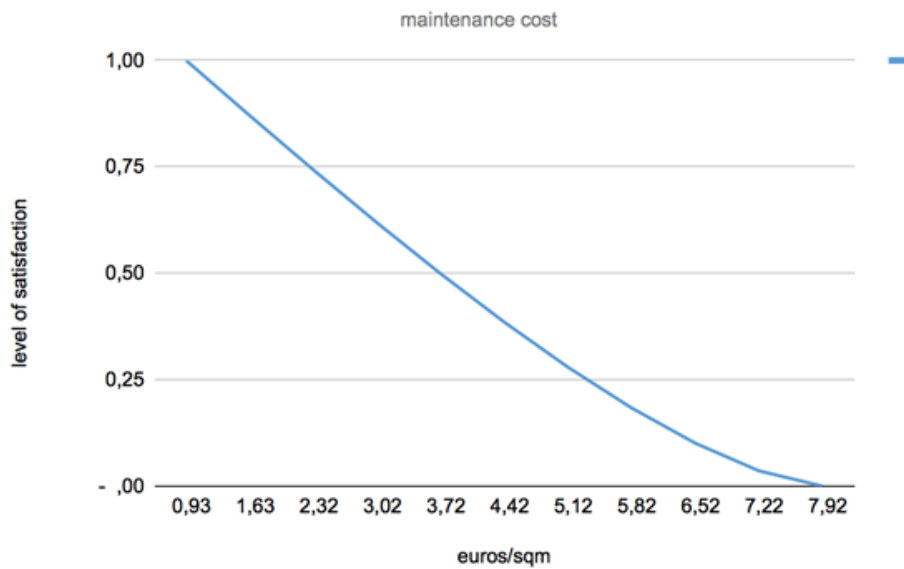


Figure 18: The value function of I2 Maintenance cost. 2021

Fig 19 Energy consumption: Convex decrease, the higher the energy consumption per sqm, the less the level of satisfaction.

Xmax	350,00
Xmin	60,00
Ci Value	430,00
Ki Value	0,400
Pi Value	1,50

Valor de Bi	5,032281832
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	Energy consumption		value
ALT. A	132	0,6766	0,68
ALT. B	105	0,7953	0,80
ALT. C	120,76	0,7256	0,73
ALT. D	82,93	0,8948	0,89

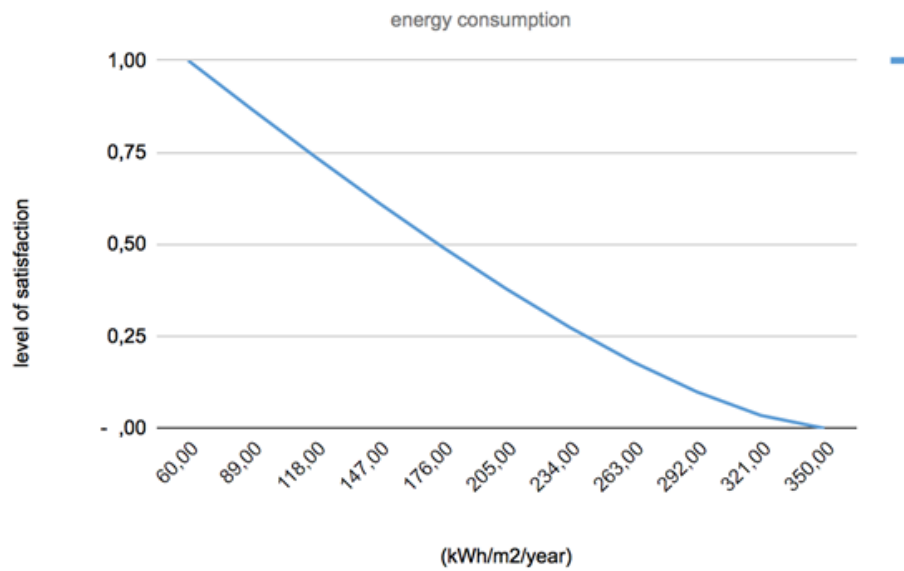


Figure 19: The value function of I3 Energy consumption. 2021

Fig 20 CO₂ emissions: Convex decrease, The increase in the co₂ emissions entails a drastic decrease in the quality of the environmental performance of the building.

Xmax	43,00
Xmin	3,50
Ci Value	40,00
Ki Value	0,400
Pi Value	2,00

Valor de Bi	3,096114793
--------------------	-------------

	Co ₂ emissions		value
ALT. A	23,88	0,2704	0,27
ALT. B	23,16	0,2902	0,29
ALT. C	21,96	0,3244	0,32
ALT. D	13,2	0,6164	0,62

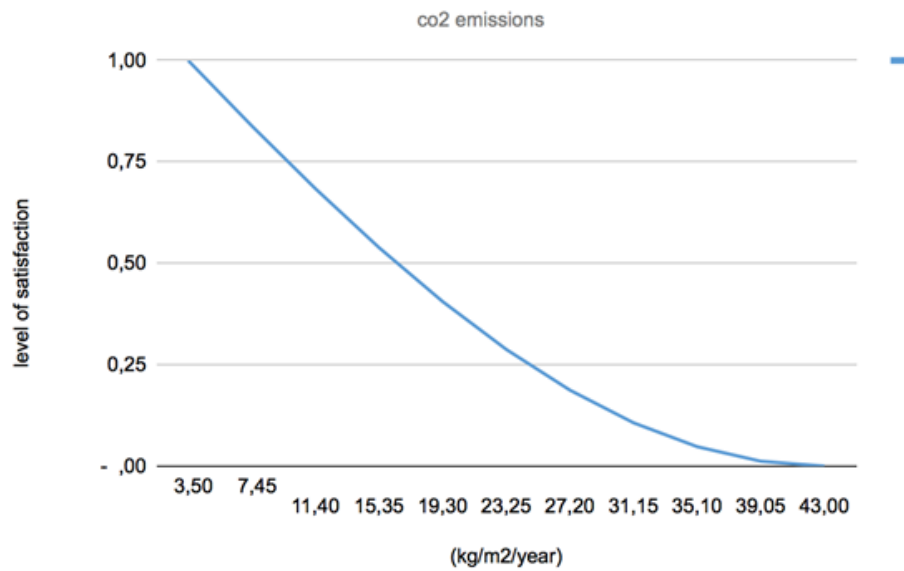


Figure 20: The value function of I4 CO2 emissions. 2021

Fig 21 Solid waste: S-shape decrease, the higher the solid waste emissions are, the lower the environmental performance quality is.

Xmax	21,00
Xmin	0,77
Ci Value	8,00
Ki Value	0,300
Pi Value	2,00

Valor de Bi	1,172120903
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	Solid waste		value
ALT. A	20,71	0,0005	0,0005
ALT. B	6,5	0,7346	0,73
ALT. C	18,15	0,0438	0,0438
ALT. D	6,6	0,7287	0,73

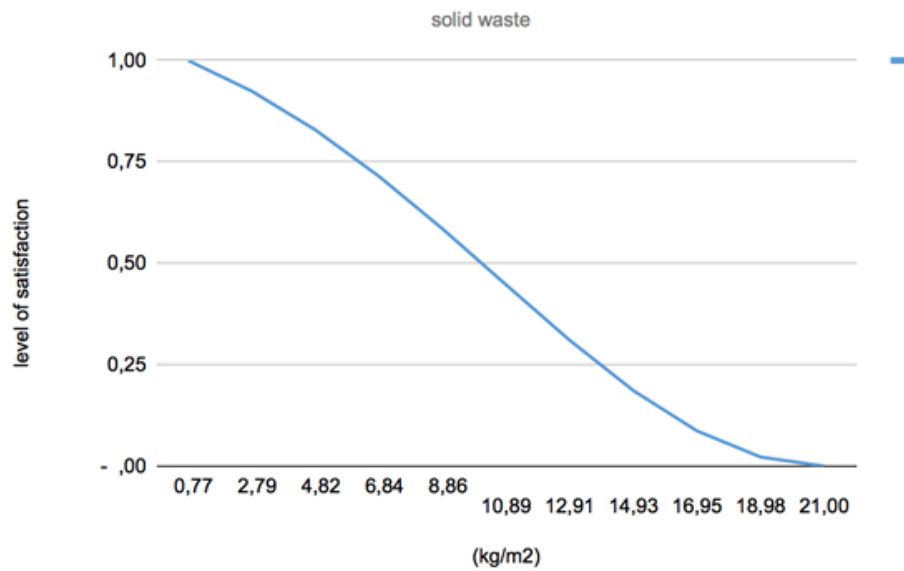


Figure 21: The value function of I5 Solid waste. 2021

Fig 22 Construction time: S-Shape increase, The faster the construction per sqm/ day, the higher the administration satisfaction.

Xmax	2,40
Xmin	0,80
Ci Value	1,22
Ki Value	0,400
Pi Value	2,00

Valor de Bi	2,010400639
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	Construction time		value
ALT. A	0,93	0,0009	0,01
ALT. B	1,8	0,474	0,47
ALT. C	1,2	0,085	0,08
ALT. D	1,8	0,474	0,47

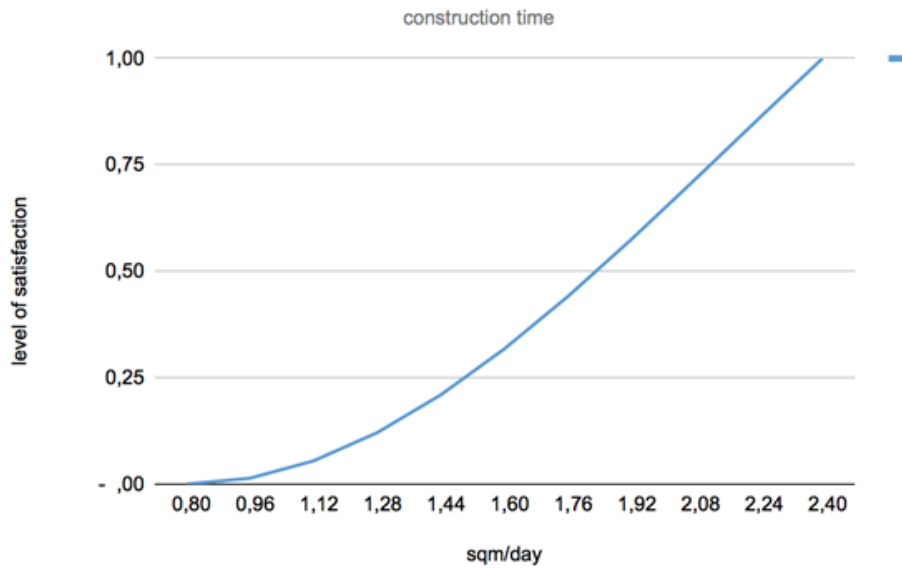


Figure 22: The value function of I6 Construction time. 2021

Fig 23 Fire resistance: Linear increase, The higher the fire resistance of the construction system, the higher the safety. The decrease for decreasing functions of the quantification of the indicator supposes an equal increase in satisfaction without influencing the position of the abscissa

Xmax	120,00
Xmin	60,00
Ci Value	60,00
Ki Value	0,00
Pi Value	1,00

Valor de Bi	1000,500083
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	Fire resistance		value
ALT. A	90	0,50	0,50
ALT. B	60	0,00	0,00
ALT. C	120	1,00	1,00
ALT. D	120	1,00	1

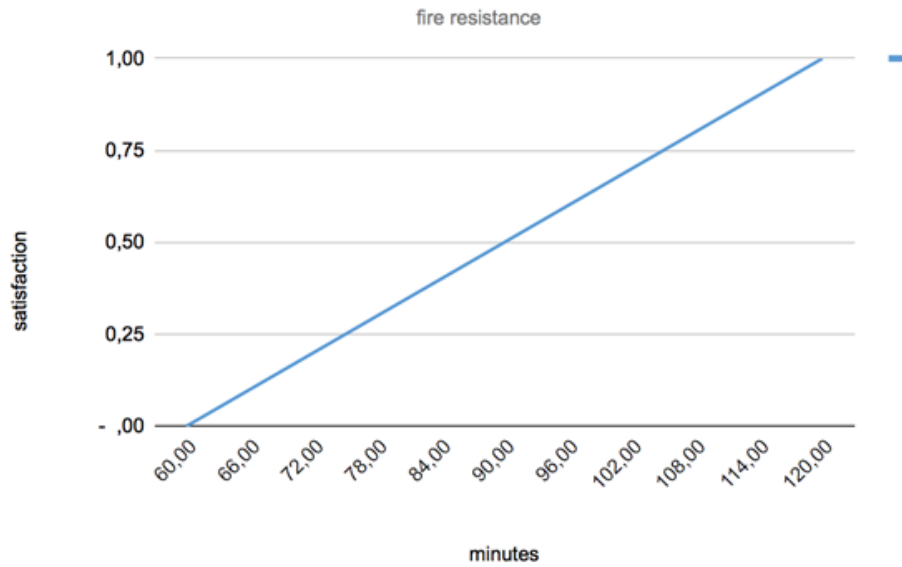


Figure 23: The value function of I7 sub-indicator 1 Fire resistance. 2021

Fig 24 Seismic resistance: Linear decrease, the higher the seismic vulnerability of the construction system, the less the safety satisfaction.

Xmax	0,90
Xmin	0,00
Ci Value	0,00
Ki Value	0,000
Pi Value	1,00

Valor de Bi	111,7354543
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	Seismic resistance		value
ALT. A	0,31 0	,6573	0,66
ALT. B	0,24	0,7350	0,74
ALT. C	0,28	0,6906	0,69
ALT D.	0,1	0,8903	0,89

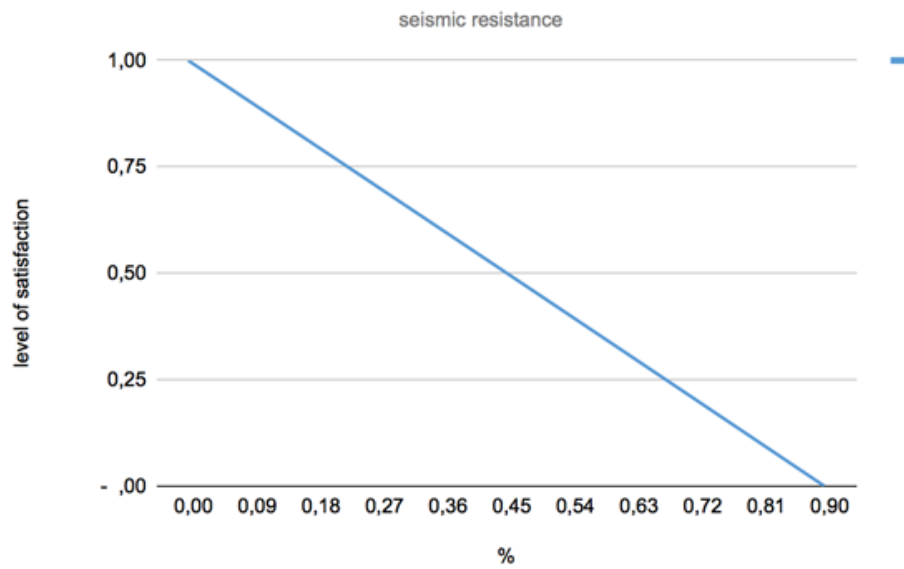


Figure 24: The value function of I7 sub-indicator 2 Seismic resistance. 2021

Fig 25 Flood resistance: S-shaped increase, the higher the structure is from the ground, the higher the safety flood resistance.

Xmax	0,50
Xmin	0,05
Ci Value	0,27
Ki Value	0,700
Pi Value	2,00

Valor de Bi	1,166951943
--------------------	-------------

	Flood resistance		value
ALT A	2,2	1,17	1
ALT B	0,60	1,10	1
ALT C	0,10	0,028	0,028
ALT D	0,54	1,051	1

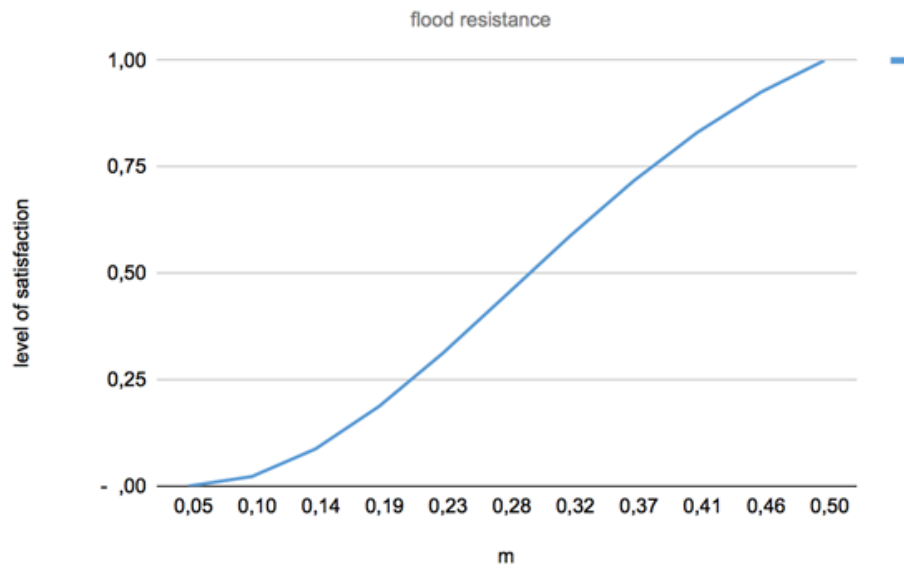


Figure 25: The value function of I7 sub-indicator 3 Flood resistance. 2021

Fig 26 Safety perception: Linear increase, the more points in the strategies to keep safety perception, the higher the social satisfaction.

Xmax	3,00
Xmin	-0,00
Ci Value	1,5
Ki Value	0,001
Pi Value	1,00

Valor de Bi	500,5001664
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	Incrementality		value
ALT A	0	0,00	0
ALT B	3	1,00	1
ALT C	1	0,33	0,33
ALT D	3	1,00	1

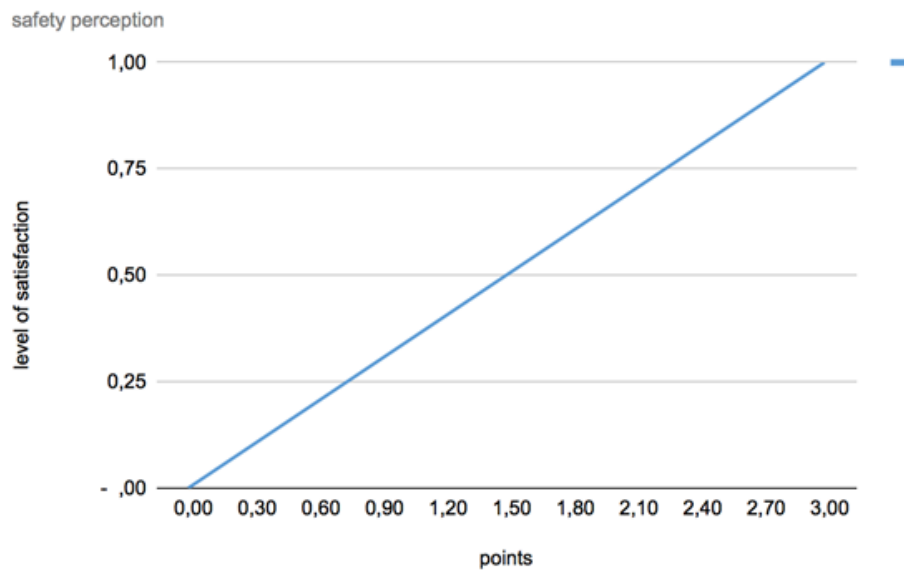


Figure 26: The value function of I7 sub-indicator 4 Safety perception. 2021

Fig 27 Incrementality: Linear increase, the higher the percentage in sqm to increment the house, the higher the social satisfaction.

Xmax	300,00
Xmin	-,00
Ci Value	100,00
Ki Value	0,001
Pi Value	1,00

Valor de Bi	33,83583328
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	Incrementality		value
ALT A	100	0,337	0,34
ALT B	200	0,670	0,67
ALT C	300	1,000	1
ALT D	200	0,670	0,67

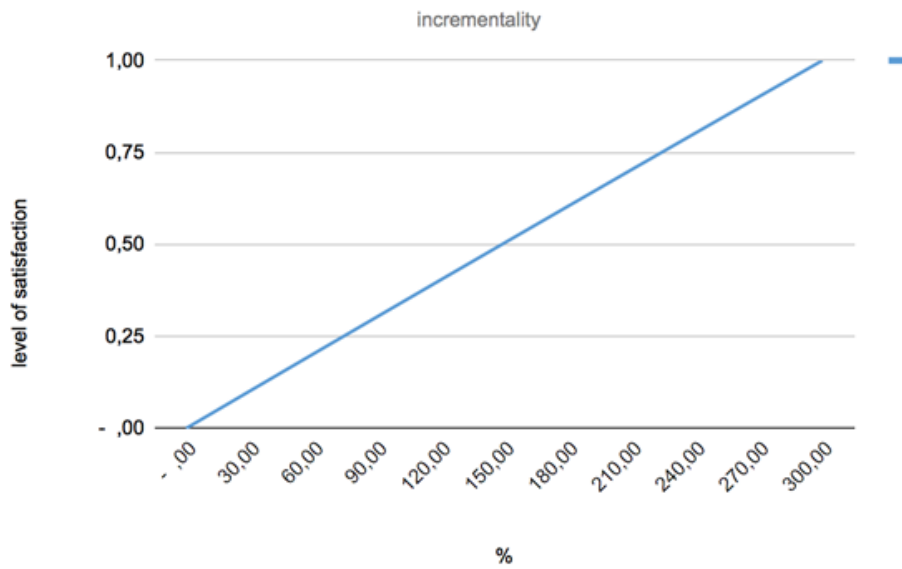


Figure 27: The value function of I8 Incrementality. 2021

Fig 28 Thermal comfort: Convex decrease, The lower the U-value, the better the thermal insulation and the lower the heat loss through the element and the higher the social satisfaction.

Xmax	2,46
Xmin	0,20
Ci Value	3,00
Ki Value	0,30
Pi Value	2,00

Valor de Bi	6,38778105
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	Thermal comfort		value
ALT. A	2,4	0,0008	0,00
ALT. B	2,17	0,0179	0,02
ALT. C	1,61	0,1520	0,15
ALT D	2,17	0,0179	0,02

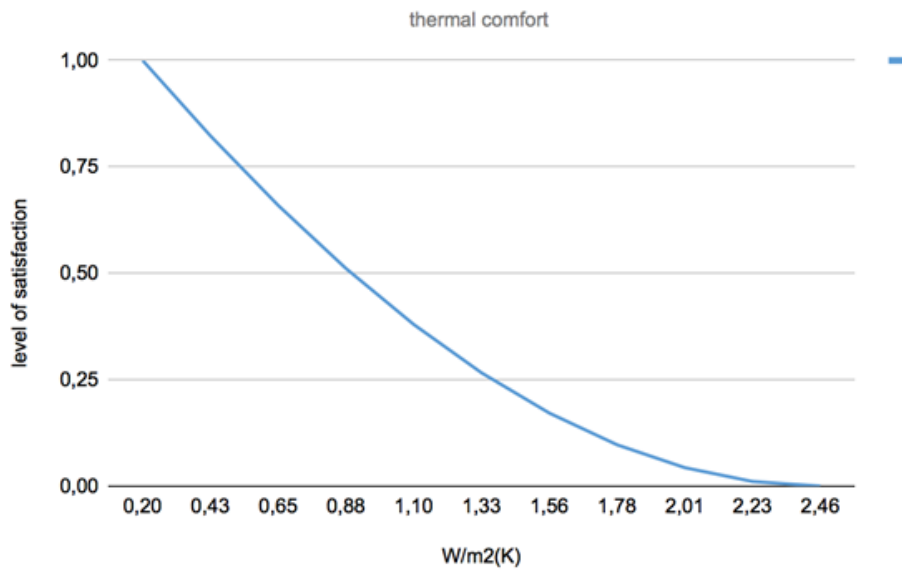


Figure 28: The value function of I9 Thermal comfort. 2021

Fig 29 Acoustic comfort: S-shape increase, the higher the acoustic isolation of the construction system, the higher the social satisfaction.

Xmax	65,00
Xmin	45,00
Ci Value	68,00
Ki Value	0,400
Pi Value	2,00

Valor de Bi	29,40288343
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	Acoustic comfort		value
ALT A	49	0,041	0,04
ALT B	60	0,567	0,57
ALT C	50	0,064	0,06
ALT D	60	0,567	0,57

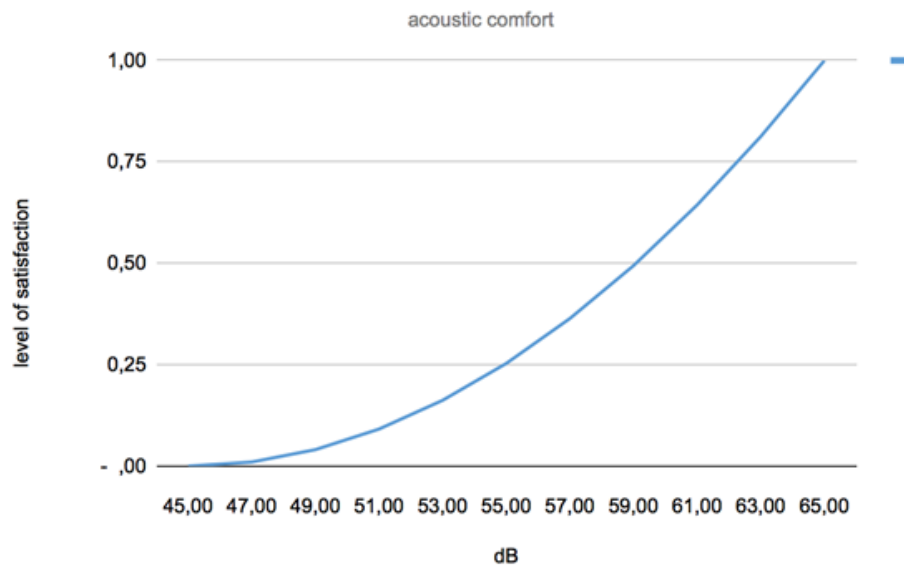


Figure 29: The value function of I10 Acoustic comfort. 2021

Fig 30 Indoor natural light: S-shape increase, the higher the indoor natural light quality inside the house, the higher the social satisfaction.

Xmax	20,00
Xmin	4,00
Ci Value	7,00
Ki Value	0,300
Pi Value	1,50

Valor de Bi	1,549479777
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	indoor natural light		value
ALT A	4	0,000	0
ALT B	7	0,125	0,13
ALT C	10	0,328	0,33
ALT D	7	0,125	0,13

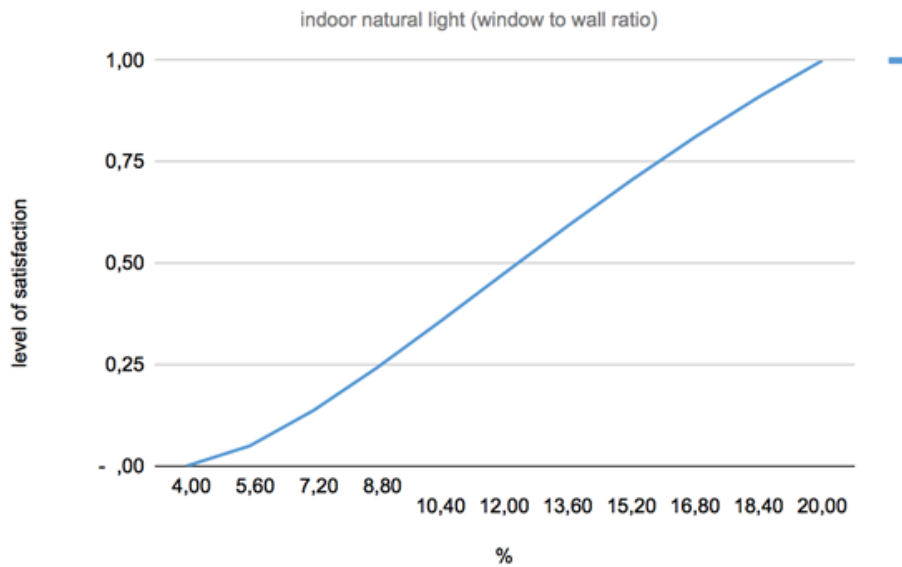


Figure 30: The value function of I11 Indoor natural light. 2021

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