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Cálculos de superficies y ratios de casas mínimas: el caso de la barraca murciana.
Calculations of surface areas and ratios of minimum houses: the case of Barraca Murciana.

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Resumen-- **Casa mínima es aquella que teniendo en cuenta los estándares de habitabilidad, no sobrepasa la ratio máxima de 19,25 m2 útiles por persona que reside habitualmente en ella. Es decir, que, para un índice de ocupación de 3/4 habitantes, la superficie total para una casa con escalera interior deberá ser menor a 67,38 m2 útiles, y ello, sin computar en esta superficie útil, las dependencias auxiliares tales como, terrazas, porches, aparcamiento, trasteros, dependencias para residuos / reciclaje y cuartos de instalaciones. La barraca murciana es un ejemplo de arquitectura popular donde se ponen en práctica los parámetros para ser considerada una casa mínima.**

Palabras clave— Casa-mínima; barraca murciana; superficies mínimas; ratio mínima.

Abstract— **Falls from height during building construction are the leading cause of serious and fatal accidents in the construction sector and industry at large. During the usage and maintenance phases of buildings, this type of accident also results in a high incidence of injuries. The most used system to prevent such risks is the installation of safety guardrails.**

Focusing on the prevention of fall risks in buildings during their usage and maintenance stages, in order for guardrails to effectively serve their protective function, they must meet a set of geometric and mechanical requirements. These include ensuring that their dimensions prevent individuals from bypassing them and that the systems are sufficiently resistant to withstand the force exerted by leaning or impacting individuals or objects.

This study compares the regulatory standards used in the United States (IBC and OSHA) and in Spain (CTE) concerning guardrails intended to prevent falls in buildings during their usage and maintenance phases.

The results reveal significant differences in the requirements imposed by each country, showing that for guardrails with a post spacing of less than 2.44 meters, U.S. regulations are more stringent than those of Spain

Index Terms— Minimum house; murcian barrack; minimal-surface; minimum ratio.

I. Introduction

As an initial reference for the ratio per inhabitant of a minimum shelter, we start from the capsules of the "Nagokin Capsule Tower" building (Fig. 1-5), which measure 4.00 m x 2.50 m x 2.50 m, that is, they have a constructed area of 10 square meters, and a useful area of 8.74 m2 (3.80 m x 2.30 m).

The surface area of the prototype "minimum capsule" of 8.74 m^2 of the Nagokin Capsule Tower must be considered as very low for our Western civilization, and specifically for our country.

The referenced area does not comply with the legal minimum in force for a single-person room in Madrid, according to the ordinance that the City Council approved on July 17, 2023 (Carabante, 2023), through a modification of urban planning regulations, not allowing in general to build homes of less than 40 useful square meters, and in the case of collective housing type "cohousing", The minimum surface area of the dwellings

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will be 30 m^2, increased with common areas until reaching 40 m^2 per housing unit.

Specifically, for "coliving", the "private accommodation unit" for a person may not be less than 15 m], without including in this calculation the surfaces of the provision of common spaces.

The "Nagokin Capsule Tower" building, designed by architect Kishö Kurokawa, was completed in 1972, and its demolition began on April 12, 2022, 50 years after its inauguration, that is, with double its initially planned useful life, and this, in view of its exterior and interior deterioration, and the high costs of repairing the pathologies suffered by the capsules: more than 6 million yen for each of them, approximately 4,350 euros per square meter of rehabilitation.

As paradigmatic models of "contemporary minimal" houses, Narváez, in 2018, in relation to minimum housing, presents three paradigmatic cases and eight case studies of minimum houses located four in the Netherlands, and four in Japan. (Fig. 6).

The three paradigmatic cases are:

- Minimum kitchen Frankfurt: 3.40 m x 1.90 m. = 6.46 m^2. Architect Magarete Schutte-Lihotzky (1920)
- Dwellings in Hoek Van Holland – J.J.P. Oud (1924)
- Nagakin Capsule Tower in Tokyo, Japan: 4.00 m x 2.50 m = 10 m^2. Architect Kisco Kurokawa (1972)

The eight case studies are as follows:

- Keetwonen – Tempohousing Container Housing (Holland, 2002): 29 m^2 = 19.33 m^2 / inhabitant.
- Housing in Shinhuku – Junipei Nosaku (Japan, 2005): 45 m^2 = 22.50 m^2 / inhabitant.
- Lucky Drops – Atelier Tekuto (Japan, 2005): 48 m^2 = 19.50 m^2 / inhabitant.
- Housing in Nerima. Go Hasegawa (Japan, 2010): 23.50 m^2 = 23.50 m^2 / inhabitant.
- Casa Abiko – Siquero Fuse (Japan, 2011): 60 m^2 = 24.00 m^2 / inhabitant.
- Housing in Blaricum – Casanova + Hernandez (Netherlands, 2012): 44 m^2 = 22.00 m^2 / inhabitant.
- Villa Mokum – Kampman architecten (Holland, 2014): 28 m^2 = 18.67 m^2 / inhabitant.
- Loftwonen Housing – Architecten (Holland, 2017): 58 m^2 = 23.20 m^2 / inhabitant.

From the analysis of the built areas m^2, and the ratios of m^2 / inhabitant of the cases previously exposed, the following values are obtained:

- The interval between its maximum and minimum values, in m^2 built per inhabitant: 24.00 - 18.67 m^2 / inhabitant.

In m^2 per inhabitant, approximately: 20 - 16 m^2 /inhabitant

- The average value of the ratio, in m2 built per inhabitant: 21.59 m^2 built / inhabitant.

In useful m^2, approximately average value: 18 m^2.

- 3º.- The interval between its maximum and minimum values, in m^2 built per house: 60.00 - 23.50 m^2.

In m^2 per house, approximately: 50 - 20 m^2

- 4.- The average value of the built area per house: 41.94 m^2 built.

In useful m^2, per house approximately average value: 35 m^2.

Fig. 1. Nagokin Capsule Towers. Exterior view. (Source: Romero, 2016)

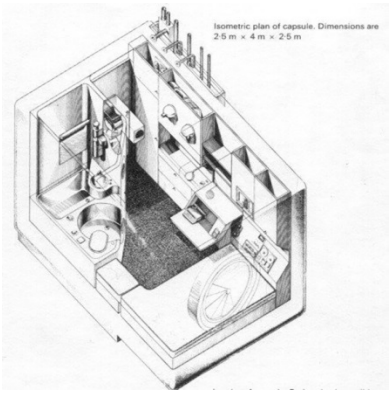

Fig.2 Nagokin Capsule Tower . Textured axonometry. (Source: Romero, 2016)

Fig. 3. Nagokin Capsule Towers. Interior view. (Source: Romero, 2016)

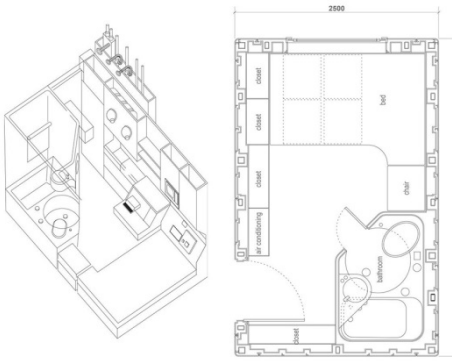

Fig. 4. Nagokin Capsule Towers. Line Drawings: axonometry and plant. (Source: Romero, 2016)

Fig. 5. Nagokin Capsule Towers. Pathologies of the capsules, drains and cables of installations on the outside. (Source: Romero, 2016)

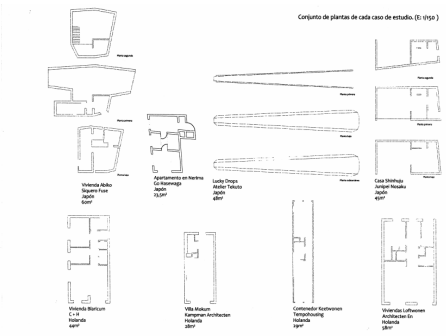

Fig. 6. Diagrams of floor plans, type of distribution of minimum houses. Source: Narváez, 2018

TABLE I
USABLE AREAS ACCORDING TO THE NUMBER OF INHABITANTS

Number of inhabitants	Usable area of the house (m^2)	Approximate useful area per inhabitant (m^2)
4/5	81,75	18
3/4	66,25	19
2/3	50,75	20
1/2	35,25	23

II. PRE-CALCULATION: PRE-DIMENSIONING OF MAXIMUM SURFACES

As a first approximation to the calculation of the surface area of a minimum house in relation to the number of people who inhabit it, an empirical formulation is proposed to estimate this useful area, in the manner and manner of the models and synthetic methods of pre-dimensioning of structures, and of pre-dimensioning of costs.

For the composition of a minimum house, the following estimates of surface areas by areas are used, where N is the average number of people living in the house:

- living/dining room and kitchen area 3m x 4m = 12 m^2 plus 3 m^2 for each inhabitant = (12+3n)
- 3m x 2m dormitory area = 6 m^2 per inhabitant = (6n)
- corridor and hallway area = 3 m^2 per inhabitant = (3n)
- toilet area = 2 m^2 per inhabitant = (2n)
- stairwell area = 1.5 m^2 per inhabitant = (1.5n)

The surface area per useful square metre will be:

Usable area m^2 = (12 + 3xN) + (6n) + (3n) + (2n) + (1.5n)

With the application of this empirical formula, the following estimated calculations are obtained of the pre-dimensioning of the maximum area of a minimum house (with a proportional part of the interior staircase), according to the average number of people who will inhabit the house:

- Subtle for 4/5 room = (12 +3x4.5) + (6x4.5) + (3x4.5) + (2x4.5) + (1.5x4.5) = **81.75 m^2**: 4.5 room = 18.17 m2 = +/-18 m^2 inhabitant.
- Subtle: for 3/4 room = (12 +3x3.5) + (6x3.5) + (3x3.5) + (2x3.5) + (1.5x3.5) = **66.25 m^2**: 3.5 room = 18.93m^2h = +/- 19 m^2 inhabitant.
- Subtle for 2/3 room = (12 +3x2.5) + (6x2.5) + (3x2.5) + (2x2.5) + (1.5x2.5) = **50.75 m^2**: 2.5 room = 20.30 m^2h = +/ - 20 m^2 inhabitant.
- Subtle for 1/2 room = (12 +3x1.5) + (6x1.5) + (3x1.5) + (2x1.5) + (1.5x1.5) = **35.25 m^2**: 1.5 room = 23.50 m^2h = +/ - 23 m^2 inhabitant.

In summary, the resulting estimate is summarized in Table I.

III. DETAILED CALCULATION OF MAXIMUM RATIOS

For a more detailed calculation of the ratios of m^2/inhabitant of minimum houses, the data contained in the Colony Resolution (U.I.O.F., 1957) are referenced below, which considers a house to be "minimal" when its surface area in relation to its occupancy index / number of inhabitants, is less than those outlined in Table II.

With the useful areas contained in the 1957 Resolution, the ratios per m^2 of average useful area per inhabitant have been calculated (Table III):

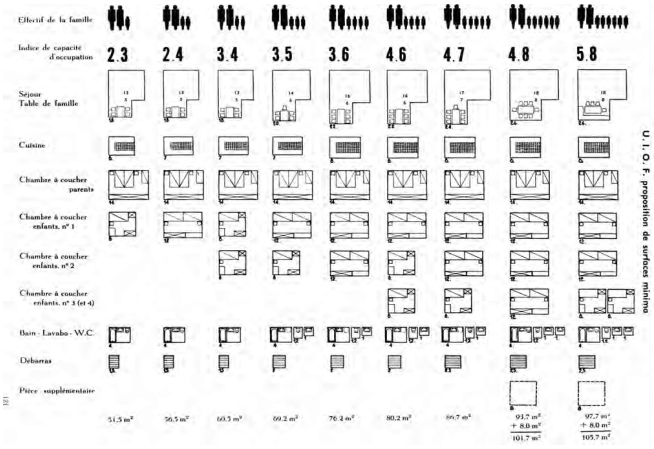

Fig. 7. Representación gráfica de la composición de casas mínimas.
Fuente: Unión International Organismos Familiares (U.I.O.F., 1959, p.121)

The surfaces and ratios referred to above are the same as those contained in the diagram of the U.I.O.F. (U.I.O.F., 1959, p.121) and reflected in Table IV.

Fig. 7 shows graphically the outbuildings that make up each minimum house, as well as the sum of the useful surfaces of each type of house, for different occupancy rates of each of them, without computing the proportional part of vertical communication (staircase):

The "ratios" obtained from the Cologne Resolution of 1957, (the same ones that are disseminated by the U.I.O.F, published

TABLE II
MAXIMUM SURFACE AREA OF A MINIMUM HOUSE DEPENDING ON ITS OCCUPANCY.

Occupancy rate	Maximum usable area (m^2)
3/4	60,50
2/4	56,60
2/3	51,50

TABLE III
RATIOS PER M^2 OF AVERAGE USEFUL AREA PER INHABITANT.

Average occupancy rate	Usable area per inhabitant (m^2)
3,5	17,28
3,0	18,83
2,5	20,60

TABLE IV
MAXIMUM USABLE AREA OF A MINIMUM HOUSE DEPENDING ON ITS OCCUPANCY

Occupancy rate	Maximum usable area of the house (m^2)	Usable area per inhabitant (m^2)
4/7	86,70	15,76
4/6	80,20	16,04
3/6	76,20	16,93
3/5	69,20	17,30
3/4	60,50	17,28
2/4	56,50	18,83
2/3	51,50	20,60

TABLE V
USABLE AREA PER INHABITANT TAKING INTO ACCOUNT THE VERTICAL CORE (1957)

Occupancy rate	Average number of inhabitants	Maximum usable area of the house (m^2)	Usable area per inhabitant (m^2)
3/6	4,5	76,20 + 4,95	18,03
3/4	3,5	60,50 + 4,95	18,69
2/3	2,5	51,50 + 4,95	22,58

Cuadro comparativo de las superficies útiles mínimas en diferentes países para las viviendas del sector público

Indice de ocupación	0/1	1/2	2/3	2/4	3/4
Resolución de Colonia	–	–	51,5	56,5	60,5
Revisión (R) 1971	35,5	51,0	64,5	69,5	74,5
Alemania (D)	–	–	56,5	61,3	64,3
Bélgica (B)	27,0	44,0	52,9	57,9	62,0
España (E) (•)	–	36	46	56	56
Francia (F) (••)	14 (16)	25 (28)	42 (46)	55 (60)	55 (60)
Inglaterra (GB) (•••)	32,5	47,5	60	70,5	70,5
Suecia (S)	–	–	54,3	58	62,0
Menor superficie citada	14 (F)	25 (F)	42 (F)	55 (F)	55 (F)
Mayor superficie citada	35,5 (R)	51,0 (R)	64,5 (R)	70,5 (GB)	74,5 (R)

(•) Actualmente sin vigencia desde Enero de 1979.
(••) entre paréntesis la propuesta de modificación en 1974 de los estándares superficiales mínimos y del modelo de composición distributiva de las "Habitations a Loyers Moderés".
(•••) Se ha tomado como referencia la superficie fijada para "Flats".

Fig. 8. Comparative table of usable areas of a minimum house in different countries.

in 1959), can be considered as a starting reference, given the tendency to reduce the surface area of the houses, for reasons of economy, functionality, reduction of the number of inhabitants of the house, Flexibility in the plant,... as well as by the demand in the real estate sector for "minimal houses" of small dimensions.

The proportional part of stairs must be increased to the ratios referenced in Tables II and IV, given that, as can be seen from the graphic representation by rooms contained in Figure 7, the sum of the surfaces does not include the stairs (1.10 m x 4.50 m = 4.95 m2) of the house (Table V):

After the first Resolution of Colonia in 1957, the ratios contained in the first Resolution were revised upwards in 1971 (Table VI), with a 23% increase, with the program going from 3/4 of the 60.50 m2 in 1957 to 74.50 m2 in the 1971 revision and increasing the values of its ratios for 3/4 inhabitants. from 17.28 m^2 inhabitant (1957), to 21.29 m^2 inhabitant (1971).

The proportional part of stairs must also be increased to the ratios in Fig. 8, corresponding to the 1971 Revision of Colonia, since they are not considered in the minimum useful areas of dwellings (Table VI).

Next, to calculate in detail by dependencies the useful area of a minimum house, the dimensions contained in the "Technical Design and Quality Standards" for Social Housing, published by the Spanish Ministry of Housing (Social Housing, 1976), are used. If the minimum useful areas of each room of the dwelling are computed, according to the Technical Design Standards of Royal Decree 2278/1976, the following useful areas are obtained (Table VII):

Resulting in this approximation of the ratio of useful m2 per person in Spain, for an occupancy rate of 2/3 inhabitants on two floors, 19.43 m^2 / inhabitant (average between 2 and 3 inhabitants = 19.93 m2 + 18.92m2 / 2 = 19.43 m2), for an occupancy rate of 3/4 inhabitants on two floors, 18.43 m^2 / inhabitant (average between 3 and 4 inhabitants = 18.92 m^2 + 17.94 m^2/ 2 = 18.43 m^2), and for an occupancy rate of 4/5 inhabitants on two floors, 17.43 m^2/inhabitant (increasing to the value 3/4 the m2 of difference between 3/4 and 2/3 = 18.43 m^2 + (18.43 m^2 - 19.43 m^2) = 17.43 m^2).

TABLE VI
USABLE AREA PER INHABITANT TAKING INTO ACCOUNT THE VERTICAL CORE

Índice de ocupación	Número de habitantes medio	Superficie útil máxima de la vivienda (m^2)	Superficie útil por habitante (m^2)
3/6	4,5	93,73 + 4,95	21,93
3/4	3,5	74,50 + 4,95	25,70
2/3	2,5	64,50 + 4,95	27,78

TABLE VII
MINIMUM USEFUL AREAS OF EACH HOUSE FOR FOUR, THREE AND TWO INHABITANTS.
SOURCE: "TECHNICAL STANDARDS OF DESIGN AND QUALITY", MINISTRY OF HOUSING, (1976), AND PREPARED BY THE AUTHORS.

Space	4occupants	3occupants	2occupants
Living room/lounge	9 m²	6 m²	4 m²
Dining room	8,10 m²	6 m²	4 m²
Kitchen	8 m²	6 m²	4 m²
Master double bedroom	10 m²	10 m²	no
Single bedrooms(6m² each)	12 m²	6 m²	12 m²
Bathroom/WC(2×4m² and 1×3m²)	8 m²	8 m²	3 m²
Entrance hall	1,40 m²	1,40 m²	1,40 m²
General storage(0,30×occupant)	1,20 m²	0,90 m²	0,60 m²
Wardrobes(1,60m²×occupant)	6,40 m²	4,80 m²	3,20 m²
Corridor(not counted in NTDyC nor in U.I.O.F)	2,70 m²	2,70 m²	2,70 m²
Total m^2 per floor	66.80 m^2	51.80 m^2	34.90 m^2
Staircase area increase(1,10m×4,50m)	4,95m²	4,95m²	4,95m²
TOTAL usable area (incl. proportional share of staircase)	71,75m²	56,75m²	39,85m²
Usable area per occupant ratio	17,94m²	18,92m²	19,93m²

In the VR manual: "Reduced housing", (Moya, 2007, pp.77-78), a proposal is made for surfaces for "Flexible / adaptable housing", in the case of isolated houses in rural areas, of 55 m^2 for an occupation of 2 / 3 people (Average over 2.50 people = 22.00 m^2 per inhabitant) and 66 m2 for an occupation of 3 / 4 people (Average over 3.50 people = 18.86 m^2 per inhabitant). Adding to these ratios the proportional part of stairs results (Table VIII):

Also considering values from other European countries as a reference, the average value of the European ratio for a family program of 3/4 inhabitants in a plant is as follows (Steegmann, 1986):

- Germany .....64.30 m^2
- Belgium.....62.00 m^2
- France..... 60.00 m2
- England..... 70.50 m2
- Sweden.....62.00 m^2

Average value: 63.76 m^2 (1 floor)

(European ratio: 63.76 m^2 / 3.5 = 18.22 m^2 for 3 / 4 inhabitants, without proportional part of stairs)

(European ratio 63.76 m^2 / 3.5 = 18.22 m^2 for 3 / 4 inhabitants, with proportional part of staircase (2 floors) : 1.10m x 4.50m = 4.95 m^2 : 3.5 hab = 1.41m^2 + 18.22 m^2 = 19.63 m^2 per inhabitant, and surface area : 63.76 plus 4.95 = 68.71m^2).

TABLE VIII
USABLE AREA PER INHABITANT CONSIDERING THE VERTICAL CORE/STAIRCASE (MANUAL VR)

Occupancy rate	Usable area per inhabitant without stairs (m^2)	Usable area per inhabitant with stairs (m^2)
3/4	18,86	20,27
2/3	22,00	23,98

IV. Results

As results of the calculations developed in the previous sections, these calculations are referenced in the following table (Table IX):

TABLE IX
MAXIMUM USABLE AREA OF A MINIMUM HOUSE DEPENDING ON ITS OCCUPANCY

Number of inhabitants of the house	2/3 inhabitants	3/4 inhabitants	4/5 inhabitants
Cologne Resolution 1957	22.58(*x1) m²/room 56.45 m²	18.69 m² /room 65.42 m²	18,03 m²/room 81.05 m²
Cologne Review 1971 (No ~~Minimal House~~)	~~27,68~~ m²/room ~~69.20~~ m²	~~25.70~~ m² /room ~~89.95~~ m²	~~21,93~~ m²/room ~~98.69~~ m²
Technical standards design and quality Spain 1967	19.43 (*x3) m²/room 48.58 m²	18,43 m²/room 64.51 m²	17,43 m²/room 78.44 m²
Reduced housing	23.98(*x1) m²/room 59.95m²	20,27 m²/room 70.95 m²	- m²/room -
Countries of Europe	- m²/room - m²	19,63 m²/room 68.71 m²	- m²/room - m²
Average "maximum" ratio m² per inhabitant	**20,97 (*) m²/room**	**19,25 m²/room**	**17,73 m²/room**
"Maximum" value m² of minimum house	52,43 m²	67,38 m²	79,79 m²

V. Discussion

The results are considered validated since all of them are coherent and consistent with those obtained by three different lines:

1. Paradigmatic models of minimal houses.
2. By means of pre-dimensioned calculation of surfaces.
3. Detailed calculation of surface areas and ratios.

And this, as detailed and justified below:

A. Results obtained in section 1.

Interval between its maximum and minimum values, in useful m² per inhabitant: [20 m²/inhabitant - 16 m²/inhabitant].

B. Results obtained in section 2.

- Useful area 4/5 inhabitants = 18 m² inhabitant
- Useful area 3/4 inhabitants =19 m² inhabitant
- Useful area 2/3 inhabitants = 20 m² inhabitant
- Useful area 1/2 inhabitants = 23 m² inhabitant

C. Results obtained in section 3.

Minimum house area ratio for occupancy rate 4/5 inhabitants: less than 79.79 m² and = < 17.73 m² per inhabitant. (These useful areas are NOT considered to include installation rooms, storage rooms, waste/recycling, car parks, porches, or terraces)

Minimum house area ratio for occupancy rate 3/4 inhabitants: less than 67.38 m² and = < 19.25m² per inhabitant.

(These useful areas are NOT considered to include installation rooms, storage rooms, waste/recycling, car parks, porches, or terraces)

Minimum house area ratio for occupancy rate 2/3 inhabitants: less than 52.43 m² and = < 20.97 m² per inhabitant.

(These useful areas are NOT considered to include installation rooms, storage rooms, waste/recycling, car parks, porches, or terraces)

Minimum house area ratio for occupancy rate 1/2 inhabitants: less than 34.04 m² and = < 22.69 m² per inhabitant.

(These useful areas are NOT considered to include installation rooms, storage rooms, waste/recycling, car parks, porches, or terraces)

As for its "useful" living area, the minimum house must also meet the maximum occupancy ratio, contained in the Table XI and located in the central row of the Table, maximum ratio measured in m² per inhabitant of the house.

As a practical application, a house with 3 / 4 inhabitants, its maximum reference area is 67.38 m², equivalent to a maximum occupancy ratio of 19.25 m² per person living in the house: 67.38 m² / 3.50 inhabitants = 19.25 m² per inhabitant.

As a final reflection, given the similarities of the ratios and the calculated surfaces, it can be deduced that the results obtained are adequate to the object pursued in this econometric study, given that their intermediate values and intervals are concordant:

1) Values referred to in paragraph 1.

The interval between its maximum and minimum values is:

[20 m² / inhabitant - 16 m²/ inhabitant].

2) Values resulting from paragraph 2.

[23 m²/ inhabitant - 18 m²/ inhabitant].

Both cases (1) and (2) are among the values resulting from Table X: [22.69 m² / inhabitant – 17.73 m²/ inhabitant], therefore, it is concluded that the values contained in Table X are adequate for the purpose pursued, "to calculate the maximum value of the ratios for minimum houses, in direct relation to the occupation of inhabitants of the house".

Regarding the useful areas of minimum houses, with respect to their number of inhabitants, it is also concluded that the values contained in Table XI are consistent with the results obtained by the two lines referred to above: [22.69 m² per inhabitant < 17.73 m² per inhabitant].

TABLE VIII
USABLE AREA PER INHABITANT CONSIDERING THE VERTICAL CORE/STAIRCASE (MANUAL VR)

Number of inhabitants	1/2 Inhab.	2/3 Inhab.	3/4 Inhab.	4/5 Inhab.
Average "maximum" ratio m² per inhabitant	**22,69 m²/inhab.** (x 1,50 hab)	**20,97 m²/inhab.** (x 2,50 hab)	**19,25 m²/inhab.** (x 3,50 hab)	**17,73 m²/inhab.** (x 4,50 hab)
"Maximum" value m² of minimum house	34,04 m²	52,43 m²	67,38 m²	79,79 m²

VI. Application to the case of Barraca Murciana

The Barraca Murciana was the traditional construction of the farmers who lived and worked in the orchard of Murcia, a simple and small house, self-built by its future inhabitants with natural materials, collected in the immediate environment in

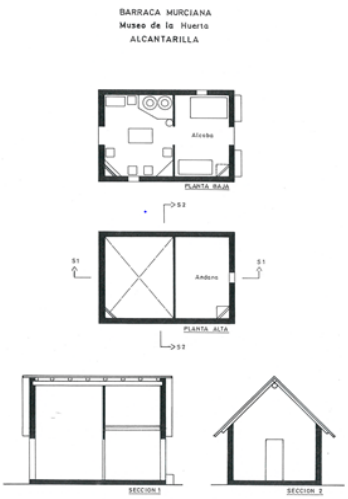

Fig. 8. Plans and sections of the Murcian hut. Source: authors' own elaboration.

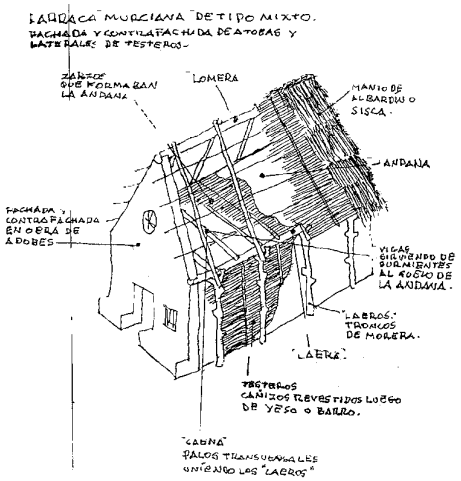

Fig. 9. Axonometric perspective of the Murcian hut. Source: Ethnographic Museum of Alcantarilla. (1970)

TABLE XII
COMPARATIVE TABLE OF SURFACES AND MAXIMUM RATIOS, WITH SURFACES AND RATIOS OF THE BARRACA MURCIANA PROTOTYPE

Number inhabitants of Barraca murciana	Number of Plants of the Barraca murciana (Bm)	**Usable area Barraca Murcia**	Surface "Maximum"m^2 useful	"Maximum" m^2/inhabitant ratio	**Ratio Barraca murciana m^2/inhabitant**
1/2 inhabitants	Ground floor + under deck	**30.43 m^2**	34.04 m^2	22.69m^2/room	**20.29m^2/room**
2/3 inhabitants	Ground floor + under deck	**43.50 m^2**	52.43 m^2	20.97m^2/room	**17.40 m^2/room**
3/4 inhabitants	II Floors + under deck	**54.25 m^2**	67.38 m^2	19.25m^2/room	**15.50 m^2/room**
4/5 inhabitants	II Floors + under deck	**65.00 m^2**	79.79 m^2	17.73m^2/room	**14.44 m^2/room**

TABLE XIII
COMPARATIVE TABLE OF SURFACES AND MAXIMUM RATIOS, WITH SURFACES AND RATIOS OF THE MURCIAN HUT PROTOTYPE

Number of inhabitants	**1/2 inhabitants**	**2/3 inhabitants**	**3/4 inhabitants**	**4/5 inhabitants**
Ratio "maximum" m^2	**22.69 m^2 /room** (x 1.50 hab)	**20,97 m^2/room** (x 2.50 hab)	**19,25 m^2/room** (x 3.50 hab)	**17,73 m^2/room** (x 4.50 hab)
"Maximum" value m^2	**34,04 m^2**	**52,43 m^2**	**67,38 m^2**	**79,79 m^2**

which it was implanted, and can be considered as a paradigm of a minimal, self-built house, and integrated into what was its natural environment: the Huerta de Murcia.

According to the reconstructed exhibition that exists in the Ethnographic Museum of Alcantarilla (Murcia), the Barraca Murciana was rectangular in plan and gabled roof, with dimensions of 6.60 meters in length and 4.60 in width, that is, an area on the ground floor of 30.36 m^2 and 15.18 m^2 on the mezzanine/andana floor under the roof. therefore, its surface area is 45.54 m^2.

VII. CONCLUSIONS

Therefore, and as a conclusion, a house is "minimal" when it has at most the areas referenced in Table XIII, in relation to the number of inhabitants of the house, and its ratios are lower than those contained in the Table, values that are detailed below.

These values and ratios are higher than those of the prototypes of the Barraca Murciana developed in the Thesis in the preparation phase: " Prototype of a self-sufficient minimum house: the case of the Barraca Murciana", being therefore the Barraca Murciana an example of popular architecture where the parameters to be considered a minimum house are implemented and put into practice.

The "ratios" obtained from the Cologne Resolution of 1957, (the same ones that are disseminated by the U.I.O.F, published in 1959), can be considered as a starting reference, given the tendency to reduce the surface area of the houses, for reasons of economy, functionality, reduction of the number of inhabitants of the house, Flexibility in the plant,... as well as by the demand in the real estate sector for "minimal houses" of small dimensions.

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