

2.2.1. Number of masonry buildings

Data from the 2002 Census provides information on dwellings, not on structures. Therefore, for a given census block and for a given exterior wall material, the total number dwellings located inside of buildings is known. However, the total number of buildings containing these dwellings, and the number of stories of each building is unknown. The average number of dwellings or apartments per story and the distribution of masonry buildings with different number of stories, are estimated from the UESF database for each commune.

The average number of apartments (or dwellings) per story in masonry buildings was obtained from the UESF data at each commune. For communes without masonry buildings, the average apartments per story were obtained at the regional level. Figure 2.1 shows the average apartments per story in masonry buildings for each region and the national average which is 6.4. Note that XI Region shows 0 apartments per building in Figure 2.1 as there are no masonry buildings permits in this region. Therefore, the national average was used to estimate the number of apartments per story in masonry buildings in XI region.

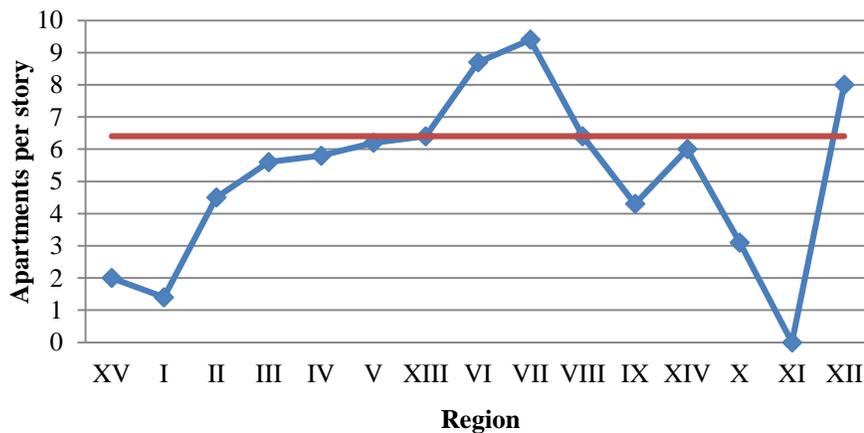


Figure 2.1: Average apartments per story in each region for masonry buildings (INE, 2014b)

Four different construction techniques are considered for masonry structures in the National Exposure Model (Table 1.2): unreinforced clay brick, reinforced clay brick, confined clay brick, and reinforced or confined concrete block structures. From the 2002 Census data, only two different masonry categories can be identified from the information of the external walls material: brick and block. However, this census classification can not be correlated with the four masonry construction techniques in the National Exposure Model. On the other hand, UESF data identifies only materiality of the structure (handmade clay brick, hollow clay

brick, and concrete block) and not its construction technique (unreinforced masonry, reinforced masonry, or confined masonry) which are used to define building typologies.

Table 2.1 shows the assumptions considered to relate a masonry building permit in the UESF to the four construction techniques of the National Exposure Model. These assumptions use the percentage of the main walls material.

Table 2.1: Percentage wall material available in the UESF and its related assigned masonry construction technique

Characteristics from UESF	Assigned masonry construction technique
100% of the main wall material corresponds to handmade clay bricks	Unreinforced masonry with clay bricks
100% of the main wall material corresponds to hollow clay bricks	Reinforced masonry with clay bricks
- Less than 100% of the main wall material corresponds to handmade clay bricks - Less than 100% of the main wall material corresponds to hollow clay bricks	Confined masonry with clay bricks
100% of the main wall material corresponds to concrete blocks	Reinforced or confined masonry with

For masonry buildings of three to five stories, the use of unreinforced handmade clay brick was not identified in the field (Table 2.1). Therefore, this construction technology is not assigned for masonry buildings in the National Exposure Model, and handmade clay bricks are automatically assigned as confined masonry with clay bricks.

The methodology used to obtain the total number of masonry buildings of each building typology in each census block is the following:

- i) Distribution of apartments in urban and rural areas: The 2002 Census apartments (or dwellings) in masonry buildings are separated by location in urban and rural (data by census blocks). Similarly, the communal UESF apartments and buildings were separated into urban and rural zones.
- ii) Distribution of apartments by number of stories of the building: With de UESF data the apartments per commune contained in 3-story, 4-story and 5-story buildings were separated, and this communal distribution (percentages) of height distribution are applied to 2002 Census information to separate apartments prior to 2002 in that distribution at census block level.
- iii) Estimation of number of buildings by building height and material unit: The apartments prior 2002 per height distribution were converted into number of buildings of each story height and typology, using data from UESF regarding the number of dwellings per story for each commune.

From steps i) and ii), for urban and rural the information of the UESF buildings were classified by heights (3-story, 4 story and 5-story buildings), and finally the communal buildings were split in material unit (handmade clay brick, hollow clay brick and concrete block). Therefore, each of the location (urban or rural) group was separated in 9 categories (see Table 2.2).

Then, the distribution (percentages) by stories and material unit obtained were applied in the prior 2002 estimated buildings per stories at block level. Finally, in order to obtain the total number of buildings (prior 2002 and 2002-2014) the UESF buildings were added in each census block by assuming a uniformly distribution.

- iv) Estimation of number of buildings by typologies: From step iii) the obtained buildings at census block level only consider material unit and not construction technique. Then, the UESF information is used to separate the 3-story, 4-story and 5-story buildings of hollow clay brick into confined or reinforced masonry according to the assumptions previously mentioned (see Table 2.1). Also, the handmade clay brick buildings were separated into confined and unreinforced masonry. Finally, these numbers of masonry buildings are separated into the defined building typologies (see Table 1.2).

Table 2.2: Categories of separation for masonry buildings

Category	Stories	Material unit
1	3	Handmade clay
2	3	Hollow clay brick
3	3	Concrete block
4	4	Handmade clay
5	4	Hollow clay brick
6	4	Concrete block
7	5	Handmade clay
8	5	Hollow clay brick
9	5	Concrete block

A detailed example of the application of this methodology is presented in Appendix A for masonry buildings.