

The Importance of Types in Disaster Area Reconstruction

by Maria Cristina Villefort Teixeira, Stael of Alvarenga Pereira Costa,
Ana Beatriz Mascarenhas Pereira & Mirelli Borges Medeiros
Federal University of Minas Gerais

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Abstract: This work aims to analyze and evaluate the existing built types found in the Bento Rodrigues subdistrict of Mariana, located in the state of Minas Gerais, Brazil, in order to help direct housing construction/reconstruction for the local population after the rupture of a nearby tailings dam decimated the area. Bento Rodrigues was founded during the 18th century colonial period, with the discovery and exploitation of gold. After a period of decline, due to the depletion and exhaustion in the gold reserves, development was resumed with the implantation of iron ore mining companies from the 1970s on. In 2015, a rupture of one of the dams caused incalculable damage killing 19 people. The proposed construction of a new settlement, in an area close to the previous location, was therefore required to closely examine the original formation of the hamlet, taking into consideration the built types characterizing the place. As such, the periods of evolution were analyzed and the most recurrent types, in each of these historical phases, were identified. Familiarity with the types analyzed and their respective transformations over time would thus better contribute to mitigating the residents' losses and recapturing the historical and cultural aspects of the population in the new settlement.

1. Introduction

Bearing the name of its founder, Bento Rodrigues was founded in the late 17th century with the discovery of gold. By the beginning of the 18th century the hamlet was already in economic decline. The *Caminho dos Diamantes* (the Diamond route), which connects the cities of Ouro Preto and Diamantina, became the first axis of urban occupation in Bento Rodrigues, as well as offering accommodation for travelers. The village buildings exhibited typical rural characteristics, being generally located on large pieces of land in whose backyards orchards, vegetable gardens and animal rearing allowed the subsistence of the inhabitants.

The recovery of the local economy between the 1960s and 1970s was due to the exploitation of iron ore abundant in the region commonly referred to as the *Quadrilátero Ferrífero* and currently responsible for around 60% of national production. One of the mining companies, Samarco Mineração S.A., founded in 1977, commenced activities in the mines located about two kilometers from Bento Rodrigues.

This mining complex housed several excavations and tailings dams, among them the *Fundão* dam, which collapsed on November 5, 2015, causing a huge environmental disaster, killing nineteen people and impacting thousands directly and indirectly. The tailings traveled about 600km along the *Rio Doce* to the Atlantic Ocean. In the midst of national chaos, the town of Bento Rodrigues became emblematic because it was the first to be hit by the mud and to have almost all its territory destroyed. Due to the toxicity of the tailings and the risk of further dam ruptures in the same complex, the villagers had to be evacuated to the municipal centre of Mariana. Another nearby site was chosen for the resettlement and re-housing of the population.

Following this bleak scenario, a typological analysis was carried out to facilitate the inclusion of cultural, economic and social aspects in the construction of the new settlement. The methods of the Italian School of Urban Morphology, which evaluate the types and their transformations, have proven to be efficacious in relation to informing the proposal presented for Bento Rodrigues. A similar scenario occurred in the reconstruction of villages in Yamakoshi, Japan in the aftermath of the 2004 Chuetsu earthquake, in which Masuo (2015) addressed historical, cultural and climatic aspects for the development of archetypes based on the traditional residences of the region.

The study presented here was produced from orthophotos taken in 1966 and 1986, satellite imagery from 2005 and 2015 and Google Earth Street View technology, as well as pre-disaster photographs made available by residents.

This article is part of a broader survey of types, appropriations of place and relations of identity, related to the sub-district and its items of transformation and permanence. Developed by the Landscape Laboratory at the School of Architecture at the University of Minas Gerais (LAP), the study aimed to identify the types that existed in Bento Rodrigues before the destruction of the Dam, so that environmental, cultural and social aspects could be considered in the reconstruction of the new settlement.

2. Typological analysis

The study of type was developed by the Italian School of Urban Morphology and discussions on the theme resurfaced in the 1940s, in contrast to, the prevailing ideology of the Modernist Movement. The Italian School, whose principles derive from the studies of the architect and professor Saverio Muratori (1910-1973), deals with questions of the formal structure of the building and relates this to the history of the city. The study of buildings and their transformations over time consists of a typological analysis, in which, the methodology of the Italian School determines the type of building most commonly representative of a culture. This type derives from what has been referred to as “spontaneous consciousness”, that is, the reproductive capacity of an archetype that is inserted in the subconscious and thus reflects aspects inherent in the culture of its inhabitants (Pereira Costa; Gimmler Netto, 2015: 154).

Research conducted by Espirito Santo (2006: 29) corroborate this approach and view the building as a structure of anthropic space, characterized by its spatial scope. Thus, the components of a set are structured by human beings. The Typological Analysis described by the author also observes both the permanent aspects and the changes in the building. The diverse cultural elements are implicit in its formal composition, its implantation, facilities and uses on the plot of land.

The methodology of the Italian School, moreover, uses scale extension over four successive stages. They are as follows:

1. The isolated element (the building type).
2. The identification and degree of derivation.
3. Verification of the urban fabric.
4. The implantation and structuring of routes across the territory (Pereira Costa; Gimmler Netto, 2015: 155).

In the present work, only the first stage will be contemplated, since the project will evaluate the reading of the building or typology as a means of analysis or study of types.

For the application of this methodology it is essential to define morphological periods, in order to establish the typological process. In fact, the changes and / or permanent aspects in the built environment, focused on the type over time, will be presented, as they reflect social and economic actions. For the study of Bento Rodrigues, the periods were established through available cartographic material that, in a certain way, was related to the historical evolution of the settlement.

The first period commenced with the founding of the village and extends until 1977, with the establishment of the Samarco Mining Company in the area. It is interesting to note that this phase did not manifest major changes in the local road structure, due to the previous economic stagnation. The second covers the period between 1977 and the 1990s, in which there was an expansion in the southwest portion of the village, due to the employment opportunities generated by the mining activities in the region. The third period, between the end of the 1990s and 2008, was characterized by increased world demand for iron ore. This fact is reflected in the expansion of Bento Rodrigues towards the highest region of the village and the densification of the southwest part. The fourth period comprises the financial crisis from the end of 2008 until the dam rupture in 2015 – a period that manifested little development in the village.

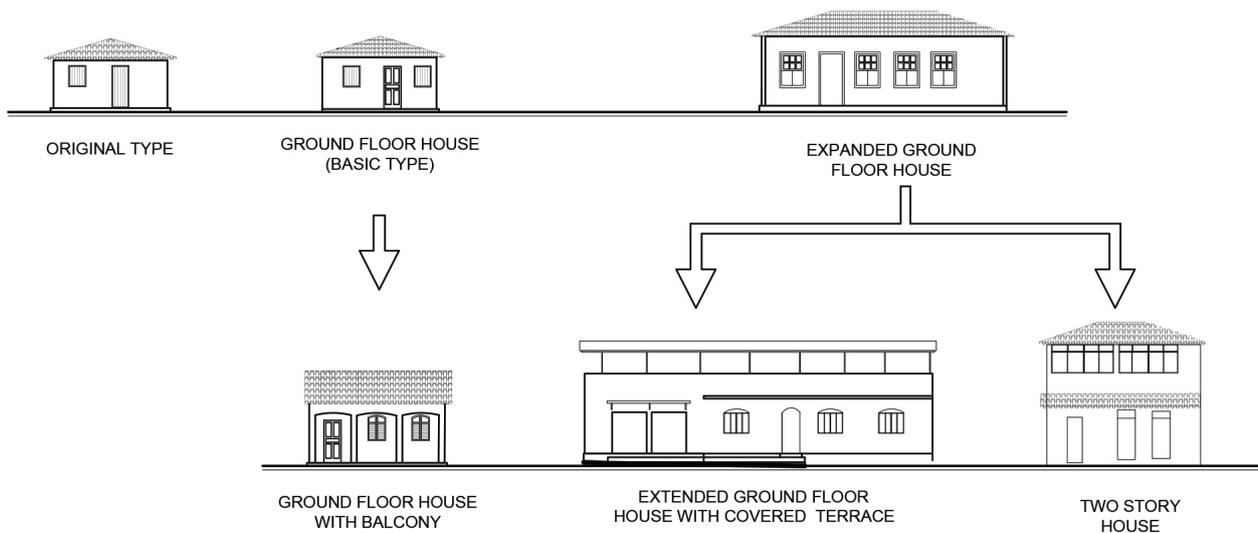
The constructions during the initial period followed a recurrent urban model and were typical of most buildings found in the first half of 18th century Minas Gerais. According to Vasconcellos (2004: 23), an analogy can be drawn with the indigenous constructions known as “*te-jupabas*” which can be considered the original type or starting point for civil state architecture. These one-room residences were composed of four *pau-a-pique* (wattle and daub) walls, two wings roof and a door. Vasconcellos points out that this type of building had nomadic origins and constituted a system of rapid construction that used materials easily found in the vicinity.

More elaborate and aesthetic constructions gradually appeared as the population established its permanence. With increased needs and the provision of financial resources, what had once been a single room was transformed to meet the demands of the residents. Thus began to appear side by side, the dormitory and the living room with openings from the front facade to the outside. Occasionally, there were doors leading to the yard or evidence of balconies to the rear of the houses (Figure 1).

The original and basic types and the enlarged single-storey house are examples of the first morphological period of Bento Rodrigues. Later modifications, as quoted by Vasconcellos (2004), would respond to the needs of the residents and manifest themselves as processes specific to typological analysis.

The only example of an original type was identified in Bento Rodrigues. The approximately 30m² building had a four wings roof with only one door and window on the front facade and two other windows on one of the side facades. There was also a small rear porch that opened on to the yard.

Derived from the original type, the basic type was defined as the most representative archetype within the urban network. In Bento Rodrigues, the one-story house was the example



TYOLOGICAL PROCESS IN BENTO RODRIGUES

Figure 1. *The Typological process in Bento Rodrigues. Source: Landscape Laboratory, 2019.*

with the highest number of occurrences and, therefore, could be determined as the basic type, according to the guidelines of the typological analysis. Its structure did not differ much from the original type, except for the inclusion of a window on the front façade, suggesting greater internal compartmentalization. In this case, the lower floor consisted of a rectangle of 8 x 6 meters, the front and rear façades being the largest. The internal division presented a living room directly connected to the outside, and next to it was a room whose window faced the street. The rest of the room was composed of one or two bedrooms, a combined living room and kitchen and a bathroom. The kitchen was a very significant element, mainly due to the presence of the wood stove, which in addition to its usual use was, in most cases, a meeting place for family and neighbors on cold nights. In addition, another unique feature in these homes was the absence of a hallway.

These characteristics were not completely dominant but, in general, they represented traces of the culture of Bento Rodrigues over more than three hundred years of existence. They were not limited to housing models but reflected habits of the population, whilst architectural projects, in the case of the majority of the residents, had almost finished. As such, research on the types of the former settlement did not directly contribute to the design of the new residences. However, the types not only transformed themselves, the residents also contributed with the consequent re-signifying of the cultural legacy (Figure 2).

Every period of time produces differentiated types that, according to the Italian School, are portrayed in the modifications of the basic type, which characterize their diversifications and variations. The former are classified as diachronic and diatopic. The diachronic occur as modifications in the basic type, located in the same cultural area, but in constructions from different periods. On the other hand, diatopic diversifications are modifications of the basic type that reflect different elements and vary “according to the cultural and architectural heritage of different areas in the same period of time” (Pereira Costa, Gimmler Netto, 2015: 159). Synchronous variations occur in the basic type as a function of their adaptation to the urban fabric and the

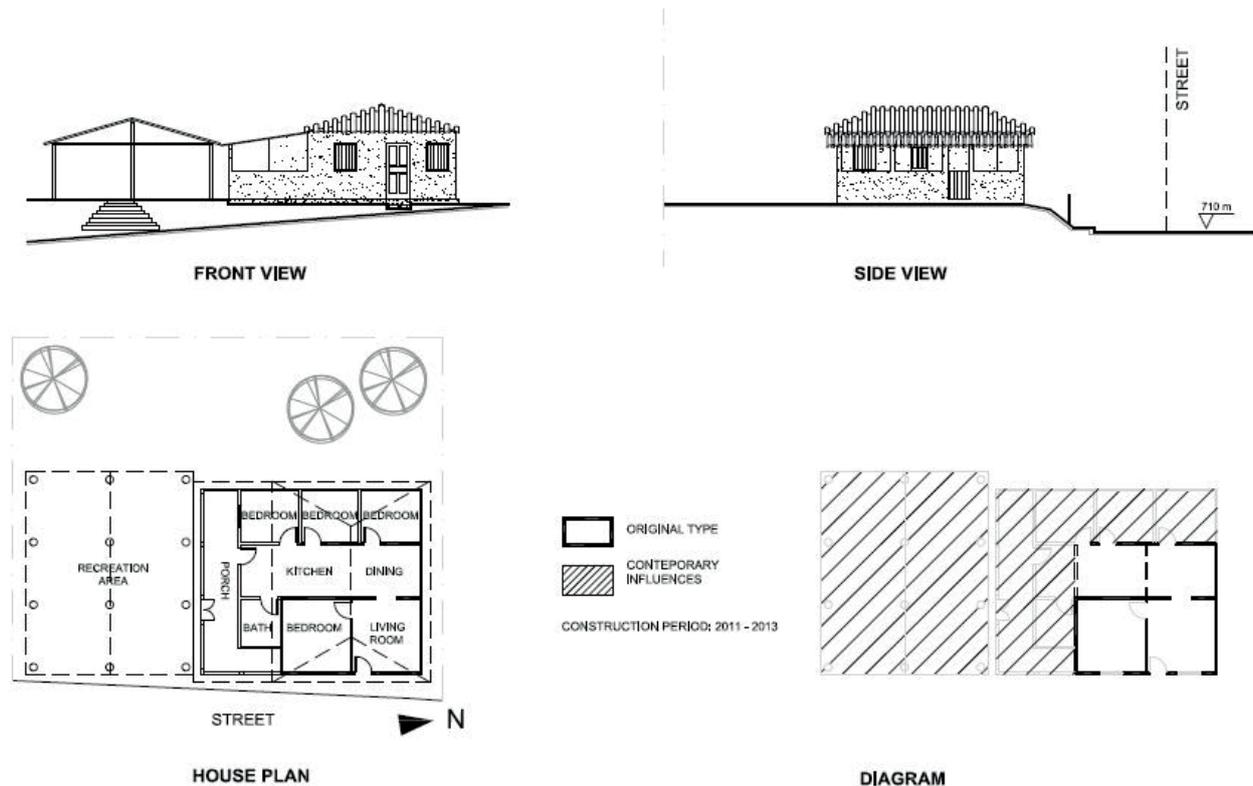


Figure 2. A single-storey house: the basic type in Bento Rodrigues. Source: Landscape Laboratory, 2019.

synoptic ones are transformations of the basic type occurring as a consequence of social and cultural needs.

Simultaneous synchronic and synoptic variation of the basic type, as exemplified in the enlarged one-story house, manifested itself significantly in Bento Rodrigues. Modifications were clearly evident with the addition of two windows on the front facade. These units also had the largest number of rooms and a dining room separated from the kitchen (Figure 3).

In the second and third periods, from 1977 to 2008, which paralleled the boom in iron ore mining and thus manifested a strong external influence, diachronic diversification emerged as the main characteristic of the changes that occurred, in which, the external elements stood out on the facade. The arched veranda became a striking element of the one-story house to which was added a tiled roof, whilst the front facade manifested a frame containing the windows and door.

The enlarged one-story house also featured the diachronic diversification characterized by a covered terrace without railings, or a second floor added as part of the house enlargement. It is important to emphasize that these residences maintained the characteristic core and incorporated aspects that conferred on them a certain “contemporaneity”: a front veranda with archway, a covered terrace or second floor, a kitchen integrated into the canopy (divided by a half wall), frontal clearance and hallway, among others. These elements reflected relatively recent and external influences on the village culture – in combination with the desire for the new and the attachment to tradition. Consequently, the facades were characterized by changes in frames and doors or the construction of front balconies (Figure 4).

The last period, which covers the interval between the years 2008 to 2015, did not manifest significant transformations with regard to types. However, it can be observed that some res-

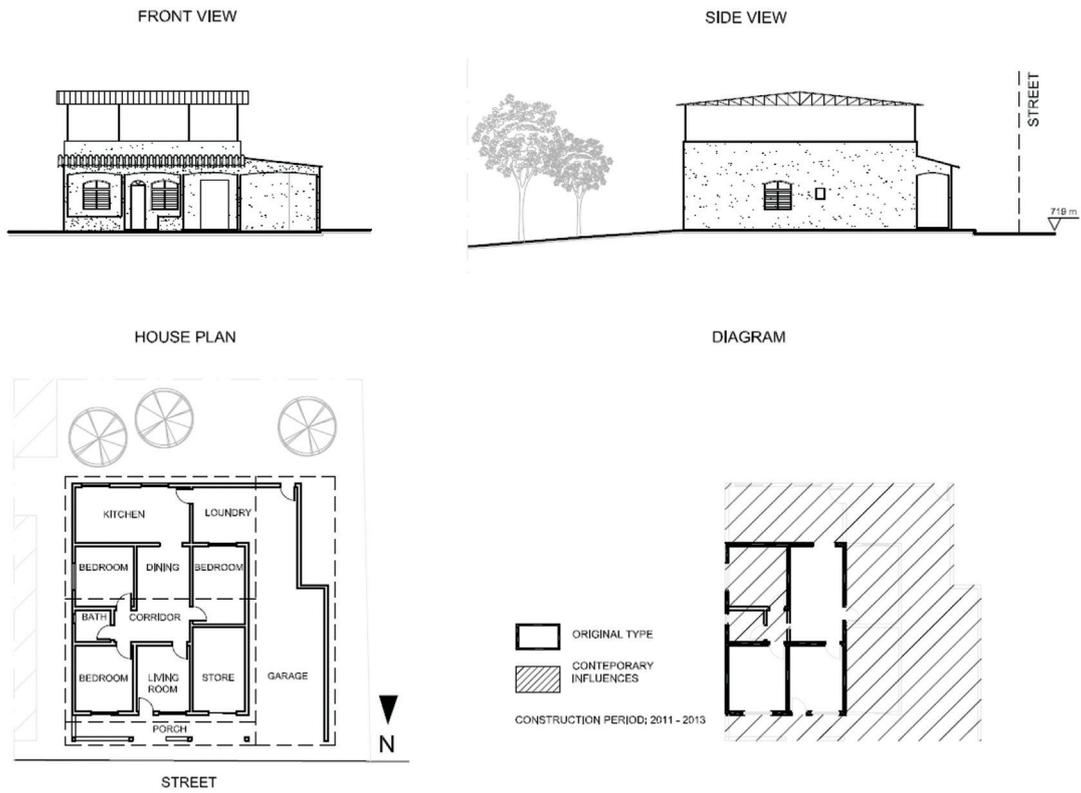


Figure 3. A house with enlarged floor space: synchronic and syntactic variation of the basic type. Source: Landscape Laboratory, 2019.

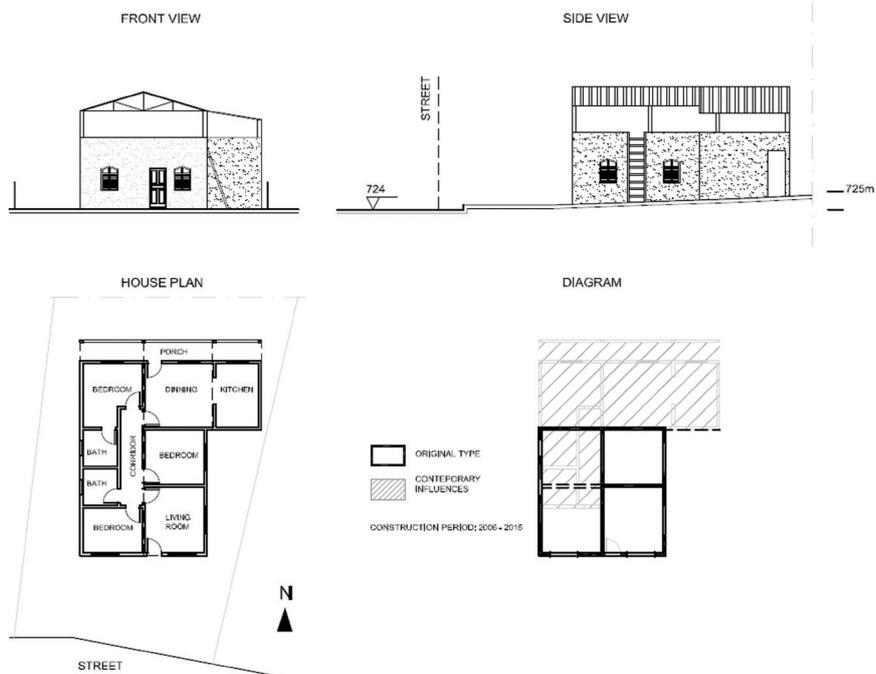


Figure 4. A larger single-storey house with balcony and covered terrace: diachronic diversification of the enlarged single-storey house. Source: Landscape Laboratory, 2019.

idences added a second floor, probably to house families formed by newly married offspring. This aspect was evident in the interviews granted by those affected by the mining disaster and verified *in loco*.

The study of the types also verified the issues related to the immediate building surroundings, or better, their implantation on the plot and the diverse activities realized there as appropriate for this integral part of the type. The interviews provided corroboration that the majority of the inhabitants had a garden, an orchard and raised small animals such as ducks, chickens and even bees. Some of the orchards had hundreds of trees with several species whose fruits were used to make jams, jellies, wines and spirits, all of which contributed to family subsistence.

Brosler and Bergamasco (2013: 23) highlight how rural ways of life represent an appreciation of popular knowledge which are imprinted on the constructive techniques and perpetuated up to the present day. It is from this perspective that the study of types constitutes a fundamental tool, not only for the reconstruction of materiality, but also for the reestablishment of cultural practices.

3. Perspectives for the new settlement

The urban project for resettlement was formulated on the results of a survey of expectations developed with the population. The selection of the area was also carried out in a participatory manner and decided by ballot. Currently, the process of village reconstruction is under development with completion forecast for 2020, according to the *Renova* Foundation¹ (Renova Foundation, 2019).

Although the new site has different topographic and environmental features which contrast with the old village, the cultural references should contribute to the process of resettlement being smoother and less traumatic. Thus, the study of types listed the main aspects of dwellings on the destroyed site, where the basic core of the original type, which reflected Muratori's "spontaneous consciousness", prevailed in the building plans. There was thus the presence of arched balconies and an emphasis on the absence of hallways and facades. Elements such as the backyard, the wood stove and the houses in line with the street *also* stood out, allowing easy social interaction between residents. It is important that such characteristics should remain in the residences of the new settlement so that cultural and social conviviality may guarantee the sense of belonging within the community.

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1. The Renova Foundation is a private nonprofit making organization. It was constituted on March 2, 2016, by a Transaction and Conduct Adjustment Agreement (TTAC), and began operations on August 2 of that year. It has as its remit the repair of the damage caused by the rupture of the *Fundão* dam, which took place in November 2015 at the Samarco mining facility located in Bento Rodrigues – a town of Mariana sub-district in the state of Minas Gerais, Brazil.

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