Architectural Design Strategies and Tactics as Driver of Critical Awareness: A Research by Design Application for Vulnerable Communities in Ciudad Juárez

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Abstract. This paper is the outcome of a joint-research-project initiative settled between the Tecnológico de Monterrey Campus Chihuahua (Mexico) and the University of Pavia (Italy) within the international research framework under the title Vulnerable Socio-Ecotones research project. The study focuses on the region along the US-Mexico central border, where socioenvironmental issues are extremely complicated and getting worse due to the current political, health, and environmental crises. The research has been implement using onsite participant observation, a detailed literature review on architecture and urban studies of Juárez's urban. The outcome of the study is a series of design reports realized through the architect's means of expression (plans, drawings, perspectives, collages, etc.) revealing possibilities of architecture against the actual conformity of design practices imposed by the actual patterns of urban space development. Our design proposals go beyond both theoretical research and pedagogical research creating a new understanding and hope that to change the vulnerable situation is possible through an active rejection of ongoing and imposed urban processes.

Keywords: Architectural Design · Urban Vulnerabilities · Vulnerable Communities · Counterdesign · Research by Design · Design for Vulnerables · Architecture and Urban Spatial Structure

1 Introduction

This paper is the outcome of a joint-research-project initiative settled between the Tecnológico de Monterrey Campus Chihuahua (Mexico) and the University of Pavia (Italy) within the international research framework under the title Vulnerable Socio-Ecotones research project [1].

The research project Vulnerable Socio-Ecotones seeks to explore territorial phenomena associated with the dimensions of social and environmental fragility, emphasizing the interrelationships between these two dimensions and their consequences for the practice of urban and architectural design. The study focuses on the region along the

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US-Mexico central border, where socioenvironmental issues are extremely complicated and getting worse due to the current political, health, and environmental crises. Given the obvious interdependence of social and environmental issues, it is critical to comprehend the urban dynamics in this complex context impacted by major crises. A context such as the Ciudad Juárez - El Paso metropolitan area is of great interest, which presents concerning social and environmental risks. An already challenging situation has been made considerably worse by the current problems, which have led to a sharp rise in the disparities between the two states, regions, cities, and social groups [1].

The research goal of the paper is to create an understanding and hope that to change the vulnerable situation is possible through an active rejection of ongoing and imposed urban processes by the means of architecture. To achieve this goal, we apply the research by design approach on specific urban areas of Ciudad Juarez, namely the Zone 2 in the eastern side of the city. In detail this study examines how architectural design may act at the urban level contributing to a change of perception of the urban space and effects on the construction of Ciudad Juárez's urban structure.

The article is structured in five sections. After this first section as introduction the second one is about the description of the research framework, methods and analysis needed to understand the spatial structure of the city and neighborhoods of Ciudad Juárez. The third section introduces in detail the research domain and context including the historical background and current status in terms of urban and architectural morphology. This section brings us to recognize five concepts useful to set a broad-spectrum of patterns that will be taken in our design actions as described at the section four. The fourth section is the most important one, and it includes both analysis and projects visualization on what principles of innovation can be promoted for reducing vulnerability in urban communities in Ciudad Juárez. Finally, the project outcomes are critically discussed in the fifth section which also includes recommendations for future research and comparisons with similar projects.

2 Research Framework: Method and Research by Design Approach

This paper is built on the groundwork laid in previous research by the authors [2–8] on the topic of vulnerable communities. Our method is distinguished by onsite surveys, desk research and experiment through research by design approach. The outcomes of which is both written texts and architectural design works and pilot project.

The research framework can be summarized in two main work packages and related tasks that involves strategies in a sequence of distinct phases.

First work package and related tasks:

- Knowledge preparation: definition of the application domain.
- Data collection and definition of the goals and strategies (taken from a wide range of scientific literature, documents and materials).
- Creation of a design strategies.

Second work package and related tasks:

- Application of the strategies in selected contexts of Ciudad Juárez specifying the main aims to achieve in those specific urban areas.
- Envisioning architectural development in three selected areas through meta-projects designed based on the tactics deduced from the strategies. The three meta-projects show the validity of the whole approach.
- Revision and adaptation of the results of the strategies.

The research has been implemented using onsite participant observation from a larger study that was conducted in Ciudad Juárez in 2021 and 2022. In addition, offline research and a review of previous morphological and empirical studies on the history of Juárez's urban evolution have been conducted along with literature review on the city's local planning and architecture history, and the changes involved in significant urban policies and plans; official documents and reports on significant urban plans and development projects have been used; including data analysis was made from government statistics and the Sistema de Información Geográfica Municipal (SIGMUN).

Moreover, the research by design approach was developed from previous experience developed by the authors [9–12].The research by design approach is a type of academic investigation through which design is explored as a method of inquiry, by the development of a project and also exploring the different materials by which a design is carried out. It has been widely described, defined and validated by many scholars worldwide such as for example Hauberg [13], Roggema [14], Frieling [15], De Jong [16], Nassauer and Opdam [17] and Creswell [18].

3 Research Domain, Context Description, Historical Background and Current Status

The geographic area of Ciudad Juárez - El Paso is the second largest transborder agglomeration along the Mexico - U.S. border. Ciudad Juarez is a municipality in the Mexican state of Chihuahua and El Paso is a city in and the county seat of El Paso County, Texas, United States. A bloody war between cartels in the years 2007–2011 is among the main causes of important socio-environmental conflicts in the city. Although violence has declined sharply in recent years, these socio-environmental conflicts, aggravated by the current social, political, environmental and health crisis, continue to afflict the population of Ciudad Juárez.

This urban agglomeration shows alarming levels of vulnerabilities which have been increasing more and more in the last decades and are projecting dark shadows on the sustainable future of the Mexican city [19]. Thus, the first challenge which we had to face was how to describe the complexity of the urban morphology background of Ciudad Juárez and the current status of its architecture. Our findings bring us to recognize five concepts useful to set a broad-spectrum of patterns that could be taken in account (or exclude eventually) in our design actions.

3.1 The Architecture and Urban Spatial Structure of a Borderland

Martén and Boano conceptualize the notion of "checkpoint urbanism" as the main strategy that has been used (consciously or unconsciously) to design the image of Ciudad

Juarez, and it has had a transformative spatial role when considered across the dimensions of infrastructure and stigma, triggering a material/symbolic tension. By this urbanism, "*the checkpoint surroundings acquire a magnetic significance, due to the resulting transit dynamics and the surveillance deterrents at the core of their function. Furthermore, their dual nature – official and criminal – has branded the region as a criminal outpost, stigmatizing the people inhabiting it, and perpetuating the idea that Juarez is defined by its violent infrastructures*" [20]. The case of Ciudad Juárez explains how economic and capital interests, spatial codifications of control, a weakened state apparatus endangered by violence, and a mix of these factors are consequence of the unique characteristics of the borderland and explain Juarez's urban evolution. Thus, by the urban evolution studied through the lens of the concept of checkpoint urbanism, what we can take for our design is that the historical characteristics of Ciudad Juárez - violence, production, and mobility - have had a dual territorial impact: the city's urban space has been shaped by cross-border dynamics, and the city's identity has been shaped by the formation of a character construct that stigmatizes the city as a symbol of extreme violence.

On the same line of study Gamlin in her article has theorized that "*urban gender violence – including gang violence and public violence against women – as a consequence not of poverty or urban marginality, but of its location and function within a globalized world, demonstrating how globalization, as a suspension of the nation state, repurposes historical and gender divisions to serve the global economy*" [21].

Moreover, Gamlin has argued that coloniality as expression of globalization as an axis of inequality structures and constricts Juarez City's development, including its urban morphology development. Being the urbanization of Juarez defined by its coloniality, Gamlin suggested that the urban distortions that result from a local economy focused on production for an international consumer global market create frictions that have pushed gender inequality out of the household and into the public realm, therefore changing urban spaces. According to this insight, what we can take for our project design, is that we cannot reconfigure how we theorize urban spaces, but we can use design as a critical means from which to rethink the awkward urban results of globalization and the coloniality development [21].

3.2 A New Urban Centrality

César M. Fuentes, in his seminal essay on Ciudad Juárez urban morphology, examines the changes in urban function and its effects on the construction of its urban structure. Fuentes point out that "*The changes in Ciudad Juárez's urban function have transformed its internal structure. Its shape has been influenced by the interaction between the local economy, social agents, and the territorial expression of transborder and transnational processes. These processes have made the construction of the border urban space quite unique. The most significant changes to affect Ciudad Juárez's urban function were its establishment as a border port and its incorporation into the global production market as multinational companies invested heavily in it. The city's new function as a port of entry generates two processes. The first involves the establishment of social and economic ties with communities in the southwestern United States, resulting in the city's new role as a regional service center. The second, stemming from its proximity to the border, involves high demographic growth rates that result from the northward pull*

by a large number of persons who seek better living conditions in the United States. The effects of these processes on urban structure can be seen in the presence of a tourism district within the central business district near the port of entry. High-income residential areas were concentrated in the central part of the settlement, while middle-income areas occupied an intermediate position between the central business district and the peripheral lower-income housing [22].

Within this context, the current urban structure is characterized by centrifugal forces (economical, political, social, environmental forces) that eject from the city life the most low-income and vulnerable populations. If this affirmation might sound trivial, we think that it is of vital importance instead to consider in our design the transition of the city's urban structure to a multicentric organization. In recognition of multicentricity city's organization architectural design can offer solutions to bring the marginalized urban space in a new perspective of centrality in both physical and urban space identity [22].

3.3 The Identity of Transitional Architecture

Sáinz and Banister in their study "*Transitional Architecture or Espacios de Paso y Simulacro*" [23] attempted to address the general questions on how architecture and urbanism have reciprocal cultural influence on the physical-spatial elements that figure prominently the borderlands imagery. Their answer was that this ephemeral and relative nature of Ciudad Juarez space is what shapes its peculiar architectural features. It is that to say, architecture becomes transitional by the fact of being located in borderlands between one cultural space and another, spaces that refer to a distinct national juridical sphere.

"*Transitional architecture*" is, actually, a contradiction in terms in which the natural feature of permanence of architecture blur into the domain of the ephemeral things. The transitional feature of architecture is characterized by provisional architectural elements, space and activities that, in order to be effective, disconnect relationship between people and place through a more generic use that removes cultural specificities and is devoid of the capacity to provide a sense of identity or affirmation as a place. Transitions tend to induce the non-place, the meaningless [23].

To use Sáinz and Banister's words, the Transitory architecture is: "*a) diverse, because regional ethnic group coexist in national spheres with their own forms of representation; b) deterritorialized (delocalized) because at one and the same time it expresses various times and cultures; c) a mosaic of superimpositions in three primary senses: of both nationalities, of multiple regionalities, and the ephemeral with involuntary permanence; d) a form of resistance, as identity is a tool of survival; e) ephemeral because it does not depend on permanence; and f) a gesture of belonging in the face of uncertain- ty. It offers a position to the resident in relation to everyone else. Architectural prototypes are fillers that condense either one's own or alien images*" [23].

3.4 The Values of Informal Urbanism and Architecture

The informal settlements are not subject to planned or regulated municipal systems and do not adhere to any disciplinary architecture or urban design frameworks. Nevertheless,

this does not negate the possibility to apply a series of design techniques that may create opportunity to reduce social and environmental vulnerability of these urban areas [24].

Regarding the informal urbanization many authors and scholars, such as for example Roy [25, 26] or Gamlin [21], refer to informality as a method of organizing life in marginalized suburbs that is not an unregulated process, 'but structured through various forms of extra-legal, social and discursive regulation… Producing an uneven geography of spatial value' [25].

The spontaneous urban growth of these cities demonstrates a remarkable degree of planning flexibility and pragmatism. The grid that was first put in place still meets the needs of this community quite well, indicating a cultural or intuitive awareness of the size, dimensions, and relationship between a street and a block. Residents have created discrete neighborhood districts inside this block arrangement, which frequently represent social clans from their original campo communities. A functional open space, schools, marketplaces, and churches have all been incorporated into the urban fabric of those informal districts. The people of Juarez have started to successfully negotiate the provision of infrastructure, urban services, and clear land titles through popular grassroots mobilization [24].

Jose Castillo, in his study of the evolution of *colonias* in Mexico City, calls this informal urbanism and architecture, a highly sophisticated developmental process which leads to a level of social interaction, plurality, and spatial complexity to which other planned communities can only aspire [27].

Using Neza in Mexico City as a case study, Castillo pointed out that *"After 1973 Neza began implementing formal planning procedures. The State's efforts focused on granting clear and legal land deeds and organizing urban services. A parallel history architecture and planning decisions continued to be made by individuals and organized groups, resulting in the progressive construction of the individual private dwelling, as well as the construction and appropriation of public space"* [27]. Yet, Castillo stated: *"The architecture and urban space in Neza have no fixed image: they are constantly evolving. In a few short months, a back-of-the-lot shack built with makeshift materials and rough exteriors may evolve into a 'smooth' bunker of concrete block. A prevailing issue is nevertheless the way in which decoration is applied freely to overcome the standard or generic quality of the structure"* [27]. This description could be similarly used for Ciudad Juarez *colonias* and districts.

On the other hand, the study by María Arquero de Alarcón and McLain Clutter of the Taubman College, University of Michigan, focusing on Chimalhuacán district in Mexico City, point out a similar result but highlighting a different issue occurring in many *colonias* in Mexico: "*this ostensibly informal development is in fact carefully planned and executed as a means of social, political, and spatial control of disenfranchised populations by politically motivated "social organizations." In the absence of effective governmental policies to provide housing for the expanding population of the urban poor, these organizations seize unoccupied land, often in disregard of existing ownership, environmental or regulatory structures"* [28].

3.5 The Re-Appropriation of the Public/collective Space

Ximena Arreola [19] along with a team of Tecnologico de Monterrey have had conducted and important study on the needs for urban-architectural interventions highlighted by civil association active in vulnerable communities of Ciudad Juárez. Two different conditions were studied and compared: (1) urban-architectural interventions that civil associations are actually promoting and (2) desires that civil associations would make to builders and designers in the hypothetical condition of be able to count with high economic resources. The results showed that the most requested interventions are those that allow individuals to appropriate public spaces to create a sense of belonging to the local community to which they belong. Further it emerges that the gap between implemented interventions and desired interventions remains wide, showing a structural powerlessness of the associations to be able to effectively affect reality as they could potentially do [19].

4 Design Phase and Project Visualization

The design phase forms the heart of the research by design process, and it has been framed according to previous experience developed by authors [9–12]. A transdisciplinary and international design team, composed by senior researchers, PhD students, practitioners and experts from both Tecnologico de Monterrey, Mexico and University of Pavia, Italy, engaged in an international collaboration between the two institutions. The design phase began with a series of field trip to Ciudad Juárez during the academic year 2021–2022 and was organized for team design members to observe the dramatic urban phenomenon underway at various scales in the environment in and around the city. During the field trip, the design team made analyses and collected data on the context and, most important, conducted unstructured and structured interviews with citizens and members of the civil associations. Design team members also attended seminars (online and offline) and exchanged ideas about vulnerable communities and sustainable development. All the information collected along with desk research and the literature review provided the basis for the site evaluation, analysis of existing conditions and, mainly, the mapping of the urban landscape patterns. Following the field trip, design team activities were structured around groups to systematize the fieldwork materials. Based on these findings, the researchers were able to make preliminary decisions about features, and then to define the on innovative “collaborative design” between members of both institutions in order to develop, collectively, intervention proposals (urban or architectural) for the most socio-environmentally vulnerable areas in Ciudad Juárez Zone 2.

The outcome of the design phase was a huge number of sketches, plans, drawings, perspectives, collages, videos etc. collected in twelves design reports of which three of them are shortly introduced in the next section.

4.1 Three Selected Projects for Three Design Strategies

It is impossible to fully include in this conference paper the huge amount of material produced. For this reason, this section introduces three selected projects which summarize the whole design package through a miscellany of the most significant images

which are relevant to represent the entire architectural narrative. As first, three types of information have distinguished our process with the aim to outline the full context of the selected site project: (1) a data collection tactics through observations, (2) documents review and (3) visual information has been implemented [18]. In addition, a distinction between interactive data or non-interactive data engagement has been specified.

The design team members constantly exchanged their understanding and new knowledge during the design process. New research inquires emerged during the team discussion on the design options, and the architectural design has been modified consequentially and then used to evaluate the research conclusions. In so doing, a circular iterative process has been applied. The following Figures (from Figs. 1 to 14), provide the visual representation of the architectural design products and offer a summary of the ultimate outcomes of this 'exchanging knowledge and understanding' iterative process.

In conclusion of this process, three design strategies have been defined as follows:

1. Break the wall, the enclosure/fence. Open the fence/wall. Visibility and openness of public facilities/collective buildings.
2. The non-wall. The wall as a space. The wall as a living place: the dichotomy of the wall, from the wall as a spatial dispositive of separation to the wall as a spatial filter, place of connections, place of communication.
3. The public for the collective. The occupancy of the public space. Urban occupancy through the public facilities.

Through the visual description of the design outcomes from Figs. 1 to 14, it is possible to confirm that the proposed architectural design strategies and tactics have the potential to become a catalyst for critical awareness among the citizens of Ciudad Juárez Zone 2. These projects may also be viewed as result of, and new possible starting point for policymakers, citizens, stakeholders, and designers, providing them with a list of priorities that could help to alleviate the actual vulnerable condition.

The architectural projects are presented in summary at three design scales as follow:

– Analysis at the scale of whole city with focus on the Zone 2;
– Conceptualization of the design at the urban design scale with the aim to propose how to make physical changes to reduce vulnerability;
– Sketches of the architectural design building solution to study a single plot building regeneration design. The scenarios have been visualized also through 3D models including physical models and 3D virtual models.

Project 1 - break the wall, the enclosure/fence. Open the fence/wall. Visibility and openness of public facilities/collective buildings.

Project 2 – the non-wall. The wall as a space. The wall as a living place: the dichotomy of the wall, from the wall as a spatial dispositive of separation to the wall as a spatial filter, place of connections, place of communication.

Project 3 - The public for the collective. The occupancy of the public space. Urban occupancy through the public facilities.

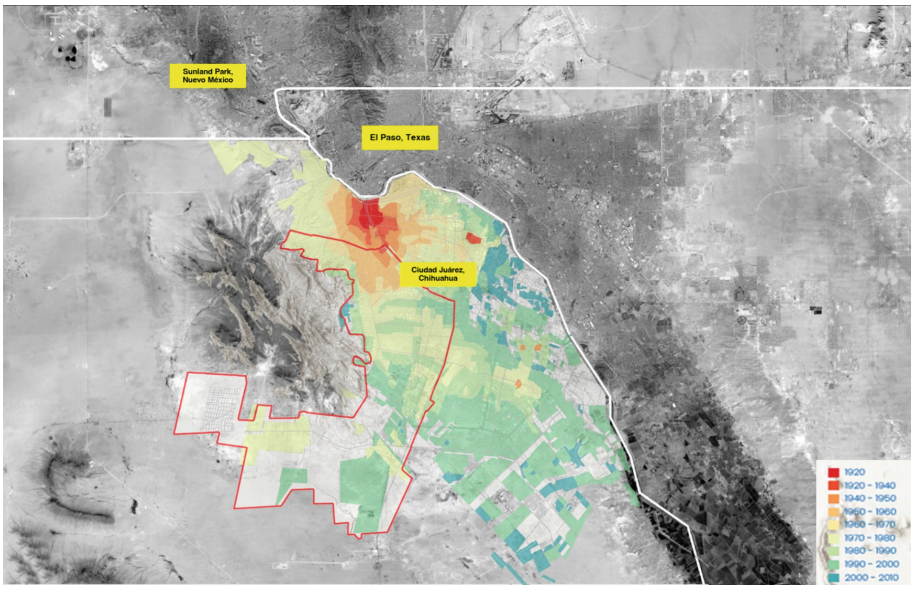


Fig. 1. Satellite image and historical phases of Ciudad Juárez. Highlighted with red line is the Zone 2. Source: Adapted from Mapa 4. Diagrama de crecimiento histórico de Ciudad Juárez, ONU-Habitat con información de IMIP 2022, e INEGI 2020.2040 and Diana Torres, TEC.

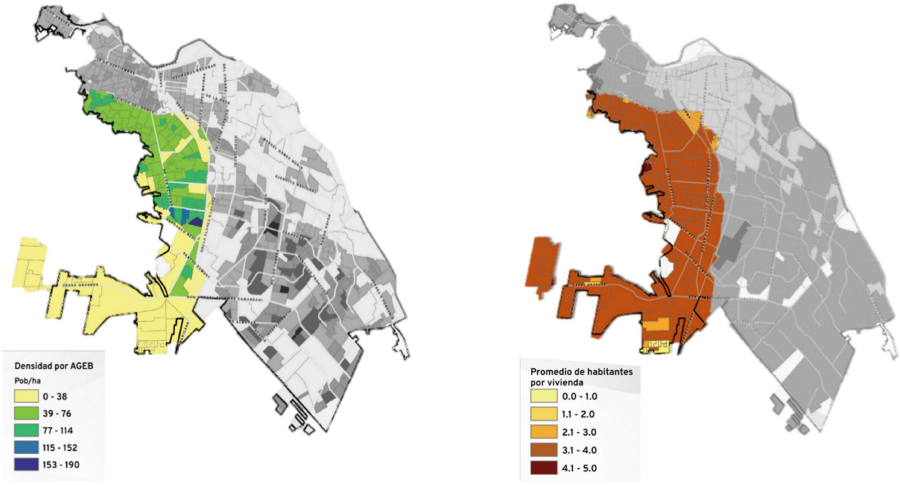


Fig. 2. Population Density per AGEB in Cd. Juárez Zone 2 2020 (left) and average number of inhabitants per home per AGEB, Cd. Juárez Zone 2, 2020 (right). Source: Adapted from https://www.imip.org [29–31] by Diana Torres, TEC.

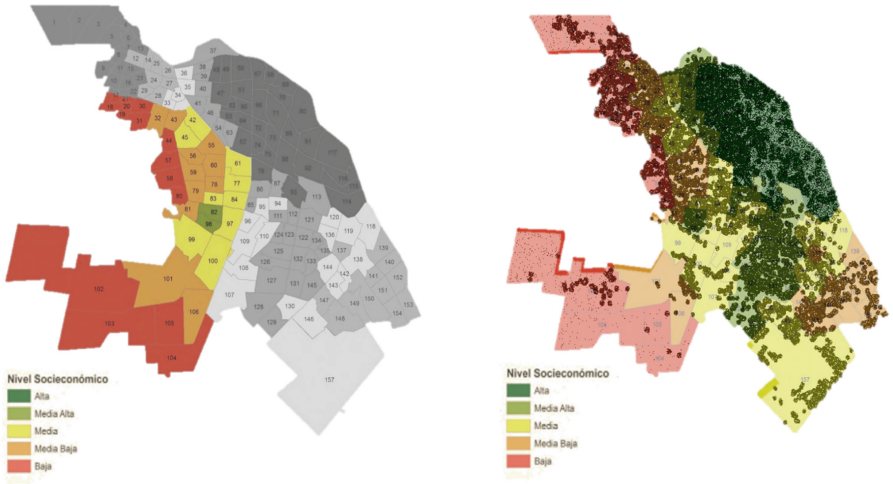


Fig. 3. Socioeconomic Levels per AGEB, Cd. Juárez, Zone 2 2020 (left) and area of Criminal Incidence, Cd Juárez Zone 2, 2020 (right). Source: Adapted from https://www.imip.org [29–31] and by Diana Torres, TEC.

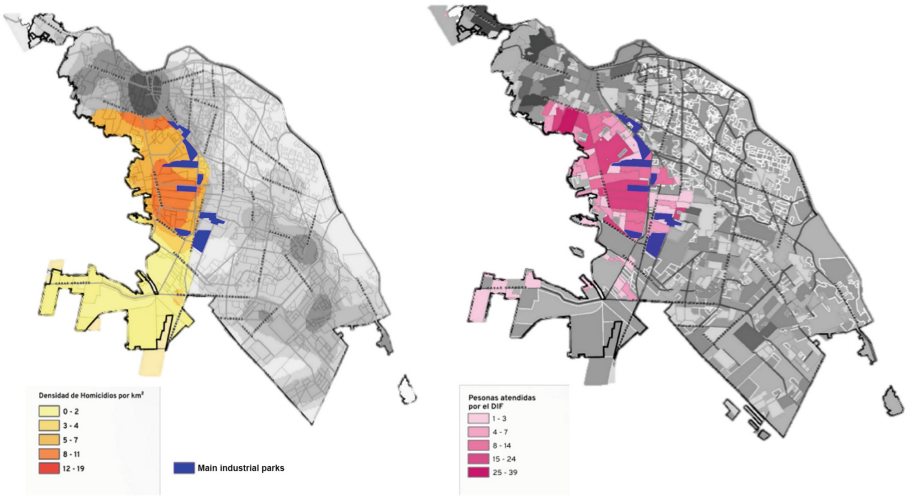


Fig. 4. Spatial behavior of homicides, density for sqkm, Cd. Juárez, 2020 (left) and People served by the *Sistema Nacional para el Desarrollo Integral de la Familia S*DIF per AGEB, Cd Juárez Zone 2, 2020 (right). Source: Adapted from https://www.imip.org [29–31] and by Diana Torres, TEC.

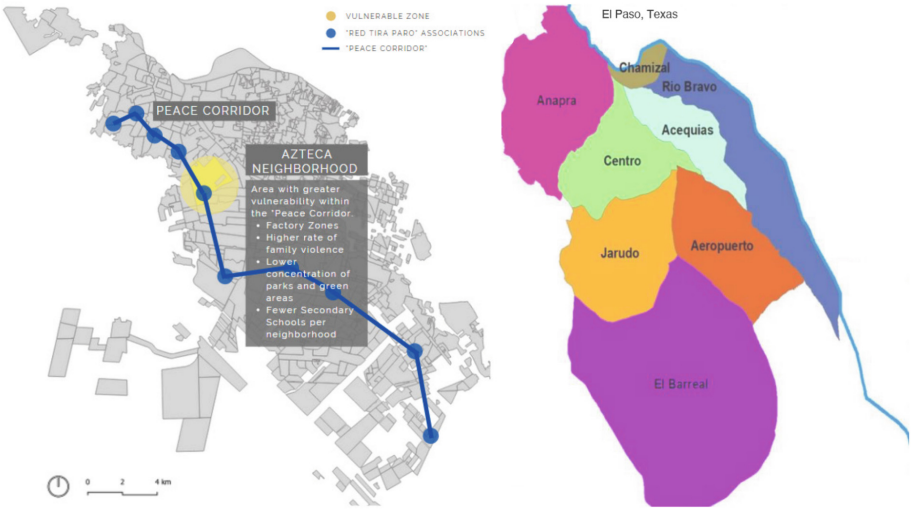


Fig. 5. Track of the project called "Corredor por la paz" ("Peace Corridor"), which is funded by Ficosec Júarez. This corridor forms an intervention belt with young people in vulnerable situations throughout Ciudad Juárez in 68 neighborhoods, in which more than 9 thousand young people benefit with different cultural, sports, training, educational and accompaniment activities (left). Ciudad Júarez districts denomination. The Zone 2 under investigation and the "Corredor por la paz" include all the most vulnerable areas of Ciudad Júarez (right). Source: Diana Torres and Karol Serrato, TEC.



Fig. 6. The three selected site project are located along the "Corredor por la paz" ("Peace Corridor" within the most vulnerable areas of Ciudad Juárez. Those urban areas are characterized by typical informal settlements. Source: Adapted by Authors from Diana Torres, Karol Serrato and Daniela Luján TEC.



Fig. 7. Aerial view and photos survey of the three selected site project. 1- leftover space; 2 – triangular space closed by walls; 3 - empty public space surrounded by roads Adapted by Authors from Greta Cozzi and Martina Rinaldi, Clizia Caroli and Enada Cela, Giulia Venanti and Ilario Piscioneri UNIPV.

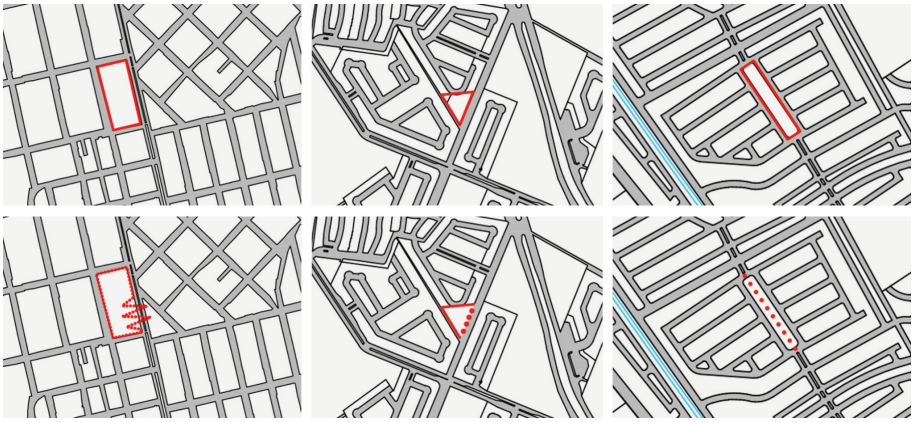


Fig. 8. Concept design. 1- breaking the wall; 2 – the wall as a living place; 3 - the occupancy of the public space. Source: Authors

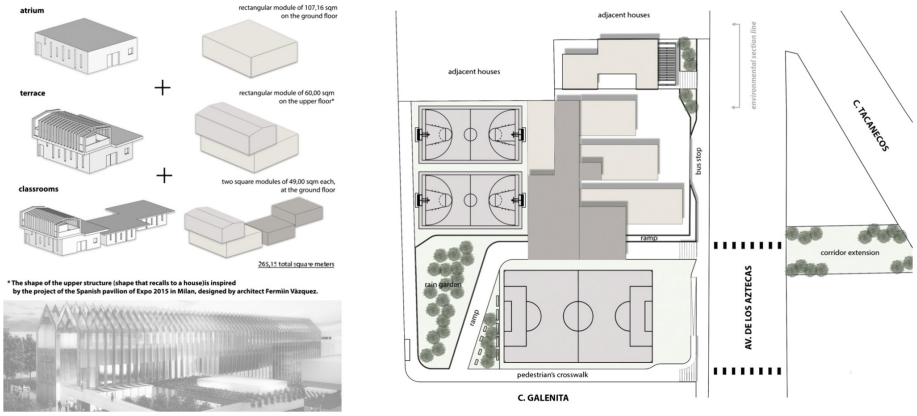


Fig. 9. Conceptual design Project 1- breaking the wall. Source: Adapted by Authors from drawings by Greta Cozzi and Martina Rinaldi, UNIPV.

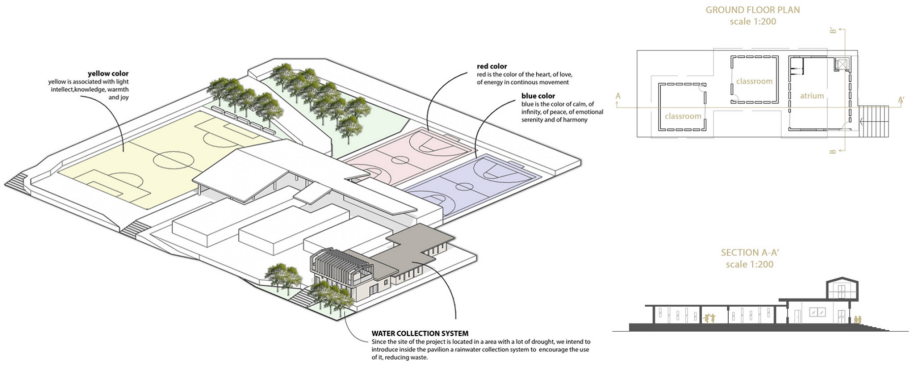


Fig. 10. Conceptual design Project 1- breaking the wall. Source: Adapted by Authors from drawings by Greta Cozzi and Martina Rinaldi, UNIPV

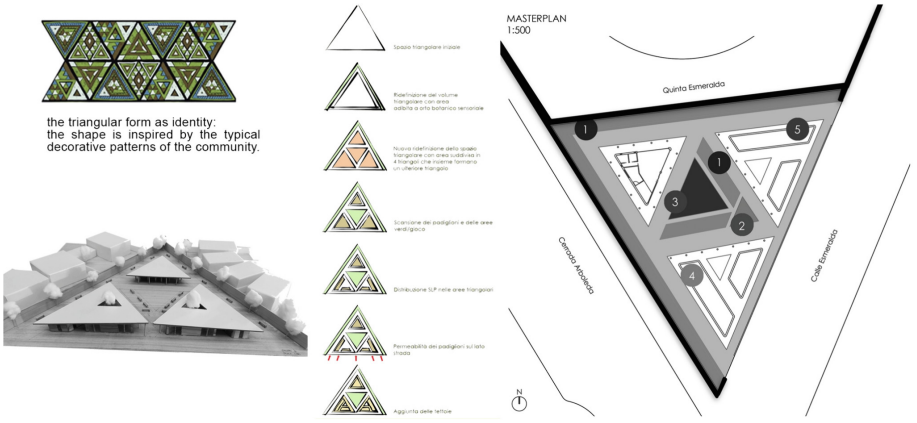


Fig. 11. Conceptual design Project 2 - The wall as a living place. Source: Adapted by Authors from drawings by Clizia Caroli and Enada Cela, UNIPV

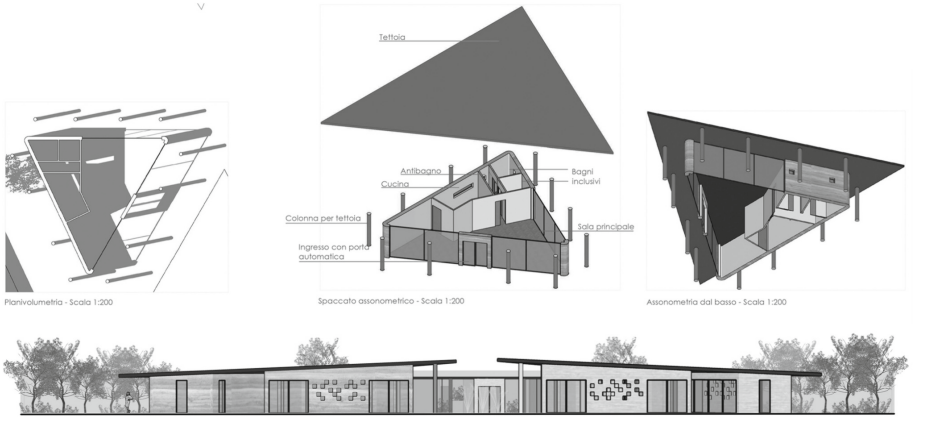


Fig. 12. Conceptual design Project 2 - The wall as a living place. Adapted by Authors from drawings by Clizia Caroli and Enada Cela, UNIPV.

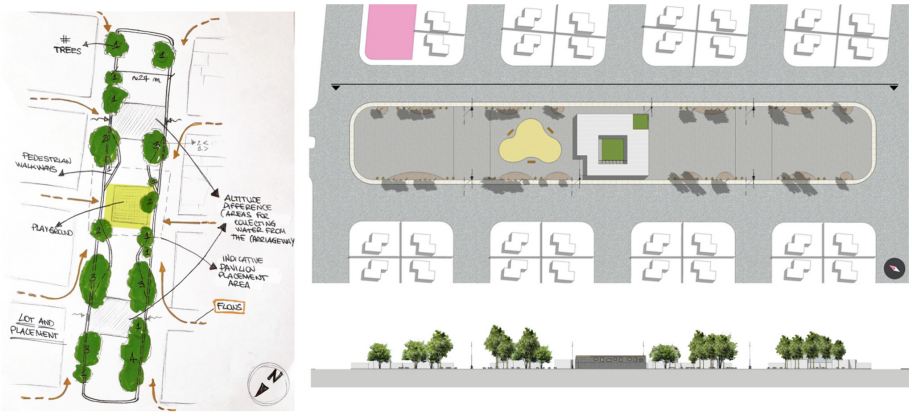


Fig. 13. Conceptual design Project 3 - The public for the collective and the occupancy of the public space. Adapted by Authors from drawings by Giulia Venanti and Ilario Piscioneri, UNIPV.

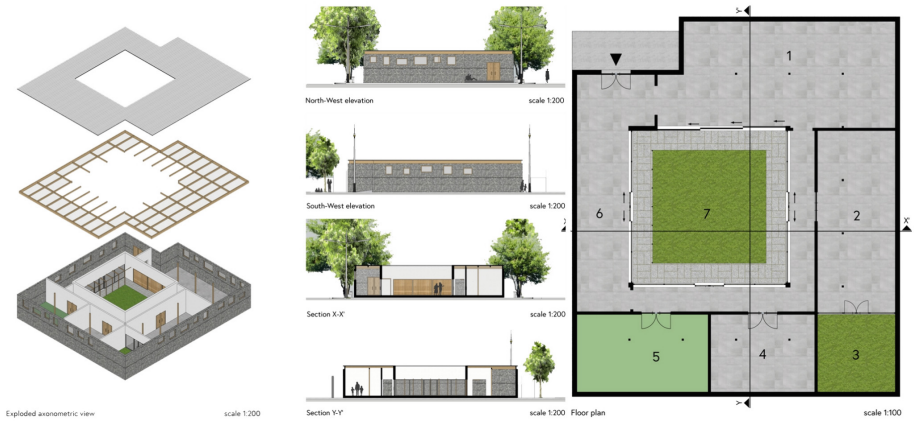


Fig. 14. Conceptual design Project 3 - The occupancy of the public space and urban occupancy through the public facilities. Adapted by Authors from drawings by Giulia Venanti and Ilario Piscioneri, UNIPV.

5 Conclusion

In this paper we introduce an overview of projects that reveals possible strategies and tactics and make visible the potentialities of architectural design as driver of critical awareness. The main contribution and novelty of this study are twofold: firstly, our research projects go beyond both theoretical research and pedagogical research. In fact, at the best of our knowledge and in view of the wide literature review performed on Ciudad Juárez, we can conclude that our study combines both theoretical approach and design project knowledge visualization. Previous valuable studies here analyzed are mainly theoretical studies or, mainly design studios related to pedagogy in architectural design such as for example the Transnational Ecologies Studio at the Taubman College [32], the Border Studio at The University of Arizona [33] and, the El Paso and Ciudad Juárez Studio Works at Rice University [34]. Secondly, our results in terms of strategies and visualization were in somehow predictive and anticipatory of what have been recently published by the ONU Habitat in collaboration with the Municipal Government of Ciudad Juárez, namely the report "Vision Ciudad Juárez 2040" [35]. Of course, the ONU Habitat is comprehensive of more urban scale, however our architectural visions are completely aligned to the results of their report and predictive respect their expected results. Moreover, using the Bernard Tcshumi's theory, our architectural design introduces the notion of use, of activities and program fostering the relationship between space and program, and in so doing trying to give a political dimension to the proposed project. Fully aware that, by its nature, no architectural project could ever influence the socioeconomic structure of a society, our projects design could be considered as Bernard Tcshumi defined Counterdesign: "*Its role is not to design a social alternative that would soon be mystified by the power groups that implement it, but simply to comprehend the official forces in an area, to predict their future and to translate them in graphical terms for explanation's sake*" [36]. By using the architect's means of expression (plans, drawings, perspectives, collages, 3D models, etc.) we intended to make clear alternative

possibilities of architecture against the conformity effects of design practices imposed by the actual patterns of urban space development. In conclusion our design proposals were aimed at creating an understanding and hope that to change the vulnerable condition of a community is possible through an active rejection of ongoing and imposed urban processes.

Finally, along with the intrinsic originality of the whole working packages of this research project, there are three crucial aspects of innovation that should be considered for future research: First, the engagement of authorities should be improved in cooperation with citizens to ensure coherence between plans and the real problems of the context. Second, implementing and deepening participation and social inclusion. To improve future projects social engagement should be expanded beyond academia to involve authorities and citizens. Third, generalization and transferability of the entire work package. Aware of the fact that vulnerability is contextual, the research framework and design phases should be improved in order to be applied and implemented in other contexts moving beyond the specific environmental scenario of this project.

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