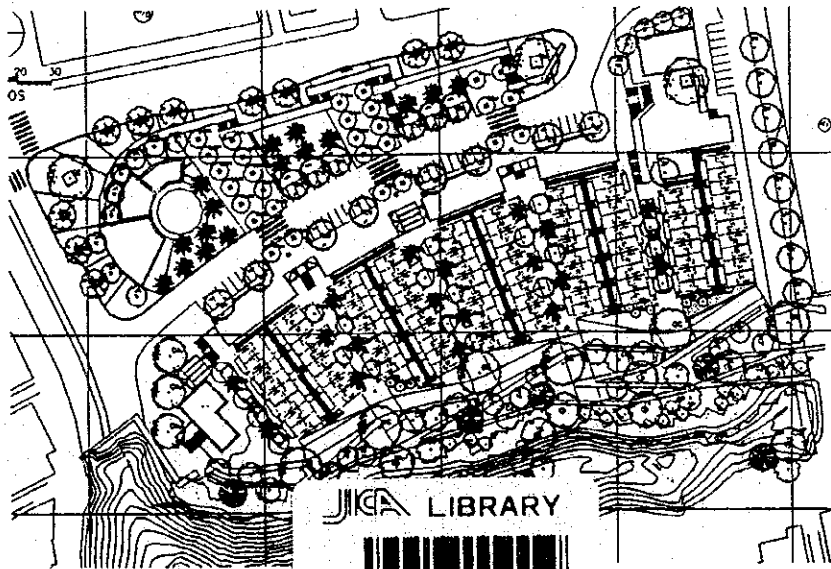


Japan International Cooperation Agency (JICA)  
Santa Fe de Bogota,  
Republic of Colombia.

No. **022**

**“Anti Seismic Development Master Plan for the  
Community of Life and Work Village,  
for Low Income Habitants in the City of Armenia in the  
Republic of Colombia.”  
Final Report**



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November 2000

Mario Noriega & Asociados Ltda.  
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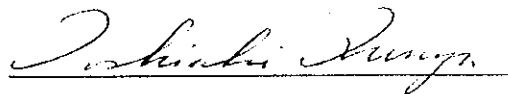
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## PREFASE

In response to a request from the Government of the Republic of Colombia, the Government of Japan decided to conduct a local development study on antiseismic development plan for the community of life and work village for low-income habitants in the city of Armenia and entrusted the study to the Japan International Cooperation Agency (JICA)

JICA Colombia Office held discussions with the officials concerned of the Government of Colombia and conducted field survey at the study area. And based on them, this office prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries. Finally, I wish to express my sincere appreciation to the officials concerned of Colombia for their close cooperation extended to JICA.



**TOSHIAKI FURUYA**

Residente Representative JICA Colombia





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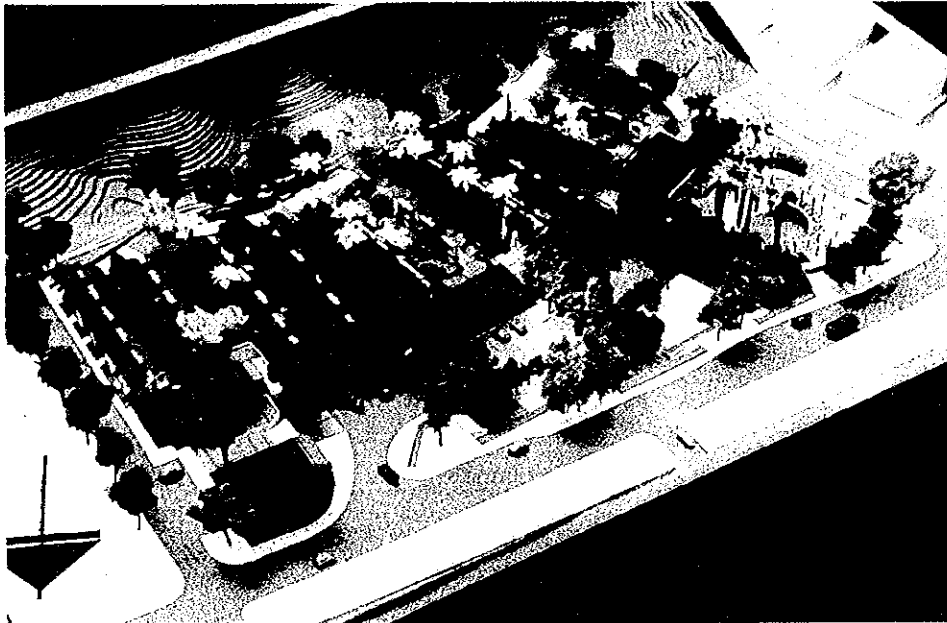
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Maqueta general del proyecto



# **Anti Seismic Development Master Plan for the Community of Life and Work Village, for Low Income Habitants in the City of Armenia in the Republic of Colombia**

## **Final Report**

### **1. INTRODUCTION.**

#### **1.1. Background.**

On 25 January 1999, a massive earthquake broke out in the western part of the Republic of Colombia, registering 6,2 degrees in the Richter scale. 1,230 people died, nearly 8,000 were injured, 400,000 people were affected, and more than 90,000 constructions were damaged, as well as the infrastructure of utility services and the environmental system of the zone.

The urban area of Armenia suffered the greatest damage from the earthquake. In order to overcome the emergency, the national government created the Fund for the Reconstruction and Social Development of the Coffee-Growing Belt, known as *FOREC*. This entity, joined with Armenia's Municipal Administration, has been in charge of the planning, reconstruction, and consolidation of the most affected areas.

As part of its reconstruction program, the Government of the Republic of Colombia has requested assistance to the Government of Japan to develop a housing project with workshops for low-income artisans. This Project, named "**Village of Life and Work**", had been initially proposed as part of the Land-Use Regulation Plan, known as *PORTE*. Such Plan was approved by the Municipality before the earthquake, but this Project had not been carried out. In view of the disaster and state of emergency, the execution of this Project gained particular importance, especially because of its social and economic aspects, since it created new jobs for its recipients. But it was also important due to the earthquake-resistant characteristics of its design, and because it made it possible to create a model of a trained community that was to become a support for Armenia's System of Emergency Assistance.

As a result of the petition of the Colombian government, JICA (Japan International Cooperation Agency) started to develop the Project by signing an agreement with Armenia's Municipal Administration by the end of 1999. In such contract, JICA agreed to contract a local consulting firm under the supervision of two Japanese firms. JICA also agreed to start the urban, architectural, social and economic study of the Project, cooperating closely with the authorities responsible for it in the government of Colombia. In turn, Armenia's Municipal Administration promised to provide a site for the Project. The funds for the construction of housing and workshops come mainly from the Fund for the Reconstruction and Social Development of the Coffee-Growing Belt, *FOREC*; and the National Institute of Low Income Housing and Urban Reform, *INURBE*

#### **1.2. Objectives of the Study.**

According to the agreement, the objectives of the study are:

- To compile basic data in order to identify and define the type of community in the low-income groups of the city, which will be the basis of the Project<sup>1</sup>.
- The infrastructure for the “**Village of Life and Work**”, which for the purpose of this study will be named the Project, will be designed based on the results of this compilation.
- To prepare the work schedule to be followed by the responsible institutions.

### 1.3. The Study Area.

The design is located in the site Lindaraja II, bought by the Municipality of Armenia. The context analysis is to include general urban, social, and economic aspects of the Municipality of Armenia, Department of Quindío, in the Republic of Colombia.

### 1.4. Scope of the Study.

Under the agreement between Armenia’s Municipal Administration and JICA, the study should cover the following areas:

- *A review of policies based on the Land-Use Regulation Plan (PORTE).*
- *A survey of the current situation of the infrastructure and urban environment in the zone.*
- *A social and economic evaluation of the low-income population and craft workers.*
- *A physical study of the site.*
- *The funds required for housing.*
- *The infrastructure projects for the city.*
- *Strategies for community development with special regard of factors such as disaster prevention.*
- *The formulation of seismic-resistant plans, and provision of low-income housing.*
- *Cost estimates.*
- *Development of plans for implementation of the Project.*

The specific purpose of the study is to define the urban, social, economic, and architectural bases for the creation of a community of approximately 100 families composed by craft-workers in the city of Armenia. It will be a community development based on the reduction of its vulnerability and on knowledge and training on prevention of disasters. The utmost priority is the protection of human life.

### 1.5. Organization of the Study.

#### 1.5.1. Components.

The success of the Project depends upon the integration of three components:

**a). Executive Unit and Available Resources.** This refers to the economic, administrative and managerial resources that should be allocated for the organization of the Project’s design, the selection of beneficiaries, construction, and the subsequent operation of the residential area and workshops.

**b). Beneficiaries.** In order to incorporate the recipients into the Project and provide guidelines to organize the community, both their social and productive profile must be clearly identified (i.e., how each family is composed, which utilities and services are needed, etc.). Thus, it will be

<sup>1</sup> The Executive Unit is responsible for selecting the beneficiaries of the Project. This unit is coordinated by the Office of Competitiveness and Economic Development of Armenia.

possible to define ways of organization during the various stages that comprise the production and commercialization of goods and services.

c). **Physical Configuration.** This refers to the handling of the site in which the Project is located, its urban configuration, and the development of architectural components.

#### 1.5.2. **Methodology.** Figure 1.5.2.

At first, the methodology proposed was based taking for granted the availability of a site. Unfortunately, the site was finally owned three months after the Project was started. The ultimate selection of recipients has not been done according to the initial program. As a result, the methodology was modified as the Project went on in order to become flexible to eventualities. Thus, while the Municipal Government of Armenia was setting the conditions for the acquisition of the site, the Project made progress analyzing and gathering proposals in regard to the three basic components (resources, beneficiaries- out of the preliminary selection - and site planning and architectural configuration).

The methodology was based in the development of six steps that were gradually incorporated into the analyses of results, a thorough study of the characteristics of the site, and the recipient selection process.

#### 1.5.3 **Participants.**

The organization of the study is based on the role of three participant groups.

a). **Executive Unit.** It is the group of entities responsible for the implementation of the Project. This comprises the acquisition of the site, the coordination of the technical studies made by JICA, the selection of recipients, the construction of housing and workshops, the support to the execution of productive activities once the Project has been built and given to the community. The Executive Unit is also responsible for the acquisition and management of the resources needed for the construction of the Project.

In order to organize the Executive Unit and assign tasks to each participant entity, the Mayor of Armenia issued the Decree 016 of 18 February 2000, defining the composition of the Steering Committee for the Project, with representatives of the following entities:

1. The Secretary of Basic Infrastructure and Land Appraisal.
2. The Secretary for Urban Regulation and Development.
3. The Director of the Administrative Department of Evaluation and Planning.
4. The Director of the Municipal Housing Fund.
5. The Regional Director of COMFAMA.
6. The Secretary of the Office of Competitiveness and Economic Development.
7. A representative of the "City Workshop."

Of these 7 entities, 6 belong to the Municipal Administration of Armenia. COMFAMA is a Non-Governmental Organization, NGO, responsible for managing the reconstruction of one of the zones into which the City of Armenia was subdivided. The site originally intended for the Project was located within the zone managed by COMFAMA. This entity presented the Project "**Village of Life and Work**" to FOREC, and as part of the approved Plan of Reconstruction, a budget of Col.\$820,000,000.00 was allocated for infrastructure and workshops.

This Committee is coordinated by the Secretary for Competitiveness and Economic Development, who also acts as chairperson. This is a consultative committee offering support, whose principal function is to make sure that the Project is properly implemented, and the Municipal Administration carries out its responsibilities. The Steering Committee should meet at

least once a month, and decisions should be made by vote.

The Municipal Fund for Housing is responsible for the technical development of the Project. In September 2000, the Mayor's Office of Armenia appointed a Manager for the Project in order to a) coordinate all paperwork and licenses, b) handle technical documents and bids, and c) check the construction process.

**b). The Local Team and the Japanese Team.** Following the agreement signed between the government of Colombia and JICA, this group of professionals is responsible for developing all technical studies required for the construction of the Project with all the technical studies it requires. At the same time, it provides support to the Executive Unit in organizing the community in its productive activities and community development.

This team is composed by a Japanese Consulting Group, consisting of the firms YAMASHITA SEKKEI INC., and REGIONAL PLANNING INTERNATIONAL Co. LTD. The local group belongs to the Temporary Partnership of Mario Noriega & Asociados Ltda., and Goebertus Estrada y Cia. S. en C., the successful bidders for the invitation opened by JICA.

**c). Other Participants.** In addition to the members of the Steering Committee, the following entities are already involved in the Project, or their involvement will be defined as the Project progresses:

- Fund for the Reconstruction and Social Development of the Coffee-Growing Belt, *FOREC*
- National Institute of Low Income Housing and Urban Reform, *INURBE*.
- The National University of Colombia. It is the NGO responsible for the reconstruction of the zone where the Project is located.
- Armenia's Chamber of Commerce.
- Handicrafts of Colombia, Inc. (*Artesanías de Colombia, S.A.*).
- Local Committee of Emergencies.
- The Office of the Governor of Quindío (Bamboo – Guadua Agreement).
- Colombian Institute of Architects SCA.
- National Agency for Learning SENA.

## 1.6. Study Schedule. Figure 1.6.

The first timetable was presented to FOREC on 22 September 1999, and covers the entire Project, including studies and designs, contracting processes, and construction. In the timetable presented to FOREC, the key date planned for activities to start was 3 January 2000, and the completion date was estimated as 30 December 2000.

The second timetable is dated 24 November 1999, and corresponds to the agreement signed between JICA and the Municipality of Armenia. This schedule refers only to studies and designs, and a tentative duration of eight months was estimated.

On 18 February 2000, the mayor of Armenia issued the Decree 016 to form the Steering Committee for the Project, and on 13 March 2000 a contract was signed between JICA and the local advisory team in Colombia, setting 6 September 2000 as the deadline for completion of studies. The intention, therefore, was to begin construction activities by October at the latest.

Dates and deadlines on timetable were not met for the following reasons: 1) only until 1 June 2000 it was decided which site would be allocated for the Project; 2) The process to select beneficiaries also affected the work schedule. 3) The list of beneficiaries whose subsidies will be processed before INURBE and FOREC was defined on mid-September. 4) Lastly, the schedule

was modified in order to help the Executive Unit obtain Urban and Construction Licenses, which are a prerequisite to be able to process the necessary subsidies for housing construction. All this brought obstacles by the end of October 2000 since the Urban Curator's Office demanded that the area of the lot be changed, and naturally, this modification affected many elements in the design<sup>2</sup>.

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<sup>2</sup>A 31-meter section was determined for the prospective West Avenue. This was approved by the Directive Committee and the Administrative Department of Planning, DAP (i.e., *Departamento Administrativo de Planeación*). This fact was registered in the section 7.1.1.h. on page 7-6 of the Appendix to the Interim Report. The report was entitled Analysis of the Site of the Project, and it was submitted in July. However, upon the request of the Curator's Office in October, that section had to be extended 17 more meters (up to 48m) because the modification that the DAP had proposed still was being processed in the Municipal Council. This modification shortened in 13 meters one side of the site. Therefore, the day care center, the complex with community workshops and business stores, and the way of access had to be designed again altogether.





# METODOLOGIA

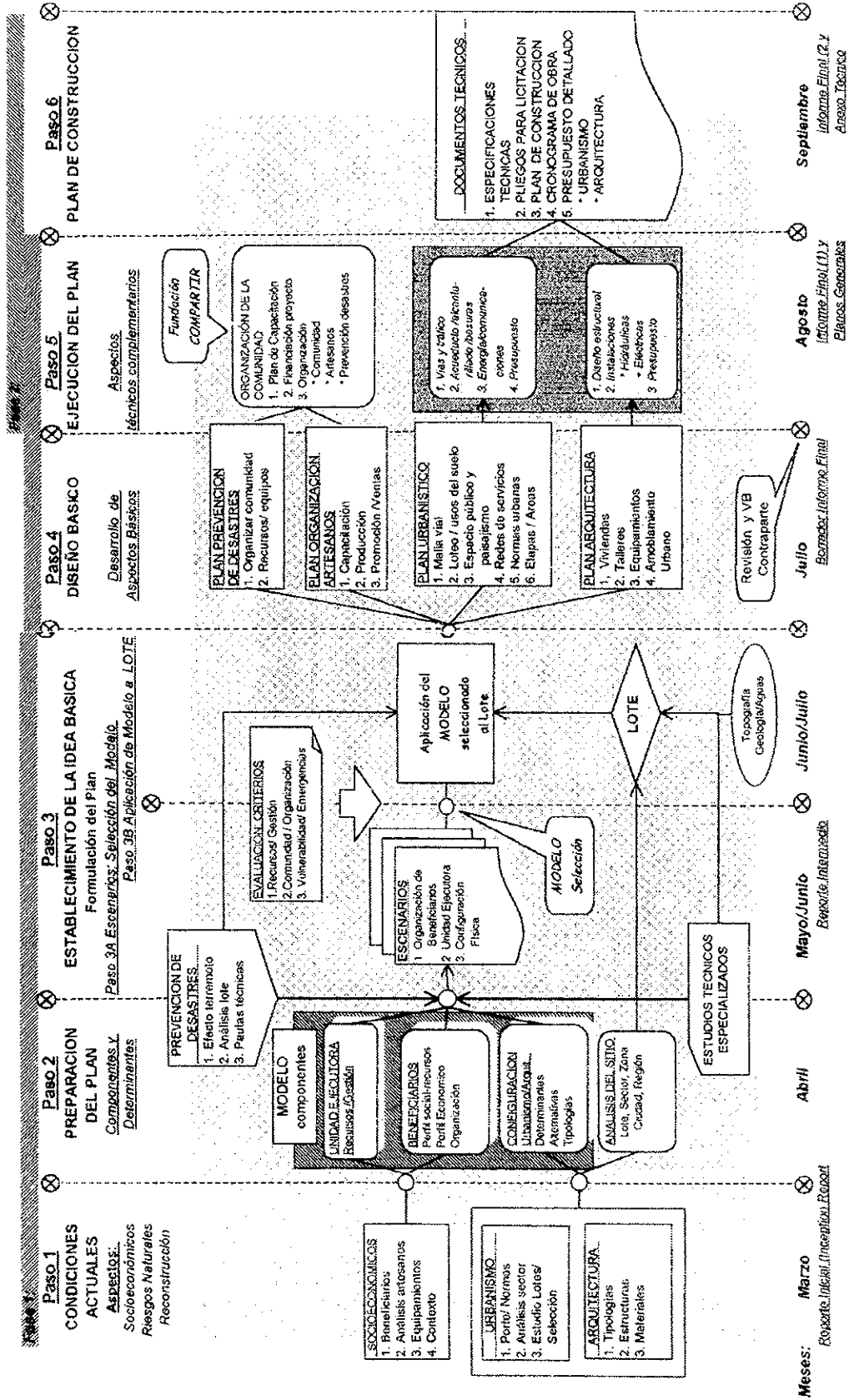
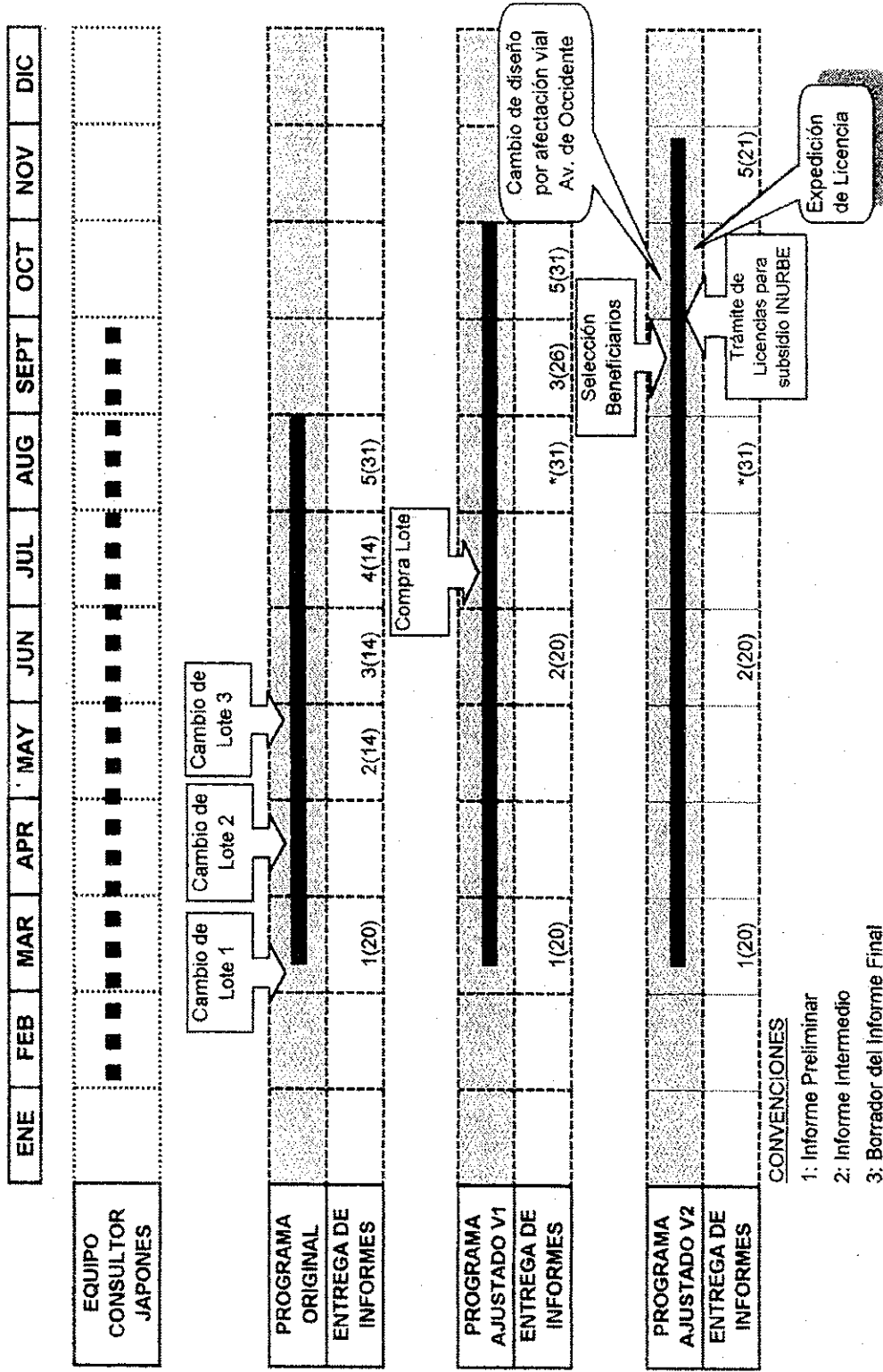


Figura 1.5.2. Estructura del trabajo metodológica.  
Figure 1.5.2. Methodology.

FIGURA 1.6. Cronograma



- CONVENCIONES
- 1: Informe Preliminar
  - 2: Informe Intermedio
  - 3: Borrador del Informe Final
  - 4: Informe Final 1
  - 5: Informe Final 2
  - \*: Informe Ejecutivo

El número entre paréntesis indica la fecha de entrega.

## 2. ANALYSIS OF GENERAL DETERMINING FACTORS FOR PLANNING AND DESIGN.

### 2.1. Social and Economic Conditions.

#### 2.1.1. Outline of the City of Armenia. Figures 2.1.1.(1) and 2.1.1.(2).

In 1966, the Department of Quindío was founded, with Armenia as its capital city. The Department of Quindío, as well as the Departments of Caldas and Risaralda are the greatest producers of coffee in the country. For this reason, the area conformed by these departments is known as the Coffee Growing Belt. It is located in the Colombian Andes Mountains, specifically on the western watershed of its central range at a height of 4000 ft above the sea level, with temperatures between 18 and 25°C.

Armenia Municipality has a total area of 121.33 square kilometers, of which 81.4% is rural. The city is the center of all activities in the Department, and it is connected to all other municipalities by paved roads over distances that range between 6 and 52 kilometers. The city grew in four directions. At the end of the 1990s, it had more than 220 urban districts developed, 52 of which were officially considered unfinished or inadequate before the earthquake.

The population of Armenia has doubled itself in 30 years, from 137,000 in 1965 to 270,000 in 1995, and an estimated 300,000 in 1999. According to projections based on the 1993 census, in 1998 the Municipality of Armenia was to have 274,401 inhabitants in the urban area, and 8,748 in the rural area, of which 48% were to be men and 52% were to be women. Estimates for the year 2006 predict nearly 320,000 inhabitants.

Armenia's economy started with a mercantile structure based on cattle-breeding, sugarcane and plantain. Yet Armenia became a regional economic emporium due to the national and international importance of coffee and tobacco.

Colombia's road-network and the creation of the Pacific Railroad in 1927 allowed to concentrate the supply of services in the area. This fact turned the region into a focus of attraction to migrants and helped to increase the production of services.

#### 2.1.2. Economic conditions of the Coffee Growing Belt.

Since the beginning of the 20th century until the decade of the 1980s, the Coffee Growing Belt has had a vital economic role in the land division of labor since coffee exports have brought foreign currency and resources for industrial activities in all urban sectors of the country.

Colombia still has not estimated the most recent production of its main cities. Yet, in order to illustrate the economic importance of the Coffee Growing Belt, the Table below shows the figures of the three departments that compose such Belt, their respective Gross Domestic Product (GDP), and their share in the national GDP. There are significant differences among the GDPs per capita of each of these departments. Risaralda's GDP is particularly high, taking into account that the GDP of the nation is \$21.884.

Table 2.1.2.(1). Departmental GDP (1993).

Department	GDP 1993*	GDP/Dept - GDP 3 Depts.	GDP 3 Depts - GDP National	GDP per person 1993 **
Risaralda	\$20,531	38.6%	2.50%	\$32,937
Caldas	\$20,437	38.5%	2.49%	\$19,841
Quindío	\$12,174	22.9%	1.48%	\$24,583
Aggregate	\$53,142	100.0%	6.47%	

Source: DNP-DANE.

(\$) Data in million pesos

Constant 1975 prices

The table below shows that agriculture is the most important sector, followed closely by manufacturing. Caldas shows the most marked differences, and Quindío the smallest. Trade, services, government services, the financial sector and other sectors have a significantly lower participation than the former in the GDP of the three Departments.

**Table 2.1.2.(2).** Sector participation in Departmental GDP.

Department	Caldas	Quindío	Risaralda	Aggregate
Agriculture	38,8%	29,5%	24,4%	31,1%
Manufacturing	17,2%	27,3%	31,8%	25,2%
Commerce	8,4%	9,3%	9,4%	9,0%
Transport	5,7%	6,0%	4,3%	5,2%
Banking and services	6,4%	6,6%	7,3%	6,8%
Government services	8,7%	7,9%	6,3%	7,6%
Housing rental	4,9%	4,6%	4,6%	4,7%
Other	9,9%	8,8%	11,9%	10,4%
Total	100%	100%	100%	100%

Source: DPN - DANE.

The table below, according to Helmsing and Villa<sup>1</sup> (1998), shows the production of the four more important sectors of the Coffee Growing Belt as a whole in relation to the total production of the nation in 1993.

**Table 2.1.2.(3).** Participation by sectors, and position in national production.

	Clothing		Food		Publishing		Furniture	
	%	Position	%	Position	%	Position	%	Position
Regional	59.1%		62%		35%		34.6%	
Caldas	0.9%	8	2%	7	0.9%	10	10.1%	4
Risaralda	5.6%	4	1.1%	8	0.5%	16	0.3%	10
Quindío					0.1%	18		

Source: Acosta, 1997, 81- 83

### 2.1.3. Micro-Businesses and Crafts.

In 1994, Micro-businesses<sup>2</sup> made a substantial contribution to the Colombian economy. They employed 26% of salaried workers, 93% of independent workers, and 33% of employers. In other words, they employed 46% of national employment, and the informal sector<sup>3</sup> generates some 18% of urban GDP. This leads to the conclusion that social and business development policy in Colombia should be channeled through the development of micro-businesses.

Of the establishments which provided information in the 1989-1990 economic census, 50% are one-person businesses; 45% have between two and nine employees, 3% from 10 to 19 employees, and 1.5% between 20 and 49 employees. That is to say, 95% of businesses have less than 10 employees.

The growth of micro-businesses is of particular importance in Armenia. At the end of 1998, there were 11,000 of them in Quindío as a whole, representing 81% of all businesses registered at the Armenia Chamber of Commerce. 70% correspond to businesses located in Armenia itself. Small and medium industry is composed by the furniture manufacturing industry, four companies which mill and roast coffee, "parchment" coffee threshing machines, and a garment design center with

<sup>1</sup> Helmsig, AHJ. (Bert) & Villa. 1998. Reestructuración Económica y Respuestas Institucionales Locales, el caso de Armenia, Manizales y Pereira. Bogotá- La Haya: Mimeo.

<sup>2</sup> A business which has up to 10 full-time employees and fixed assets of less than Col\$120 million. In commerce and services, businesses with 5 or less full-time employees. Conpes Doc. 2966 1997-2001

<sup>3</sup> Sometimes considered to be similar to the activity of a microbusiness working at subsistence level (sales are below expenses). They are not formal or established in legal form. This includes domestic employees, relations engaged in the business, the self-employed and non-professional, non-technical salaried employees.

<sup>4</sup> i.e., "pergamino," a type of coffee bean.

nearly 20 companies.

As a result of the coffee crisis, and in the search for viable alternatives, tourism grew rapidly in the regional and then the national market. Products included the coffee farms, the National Coffee Park, the Cocora Canon, and the Maraveles Valley, which became a source of new employment and income. So much so, that in 1998, despite the coffee crisis, Armenia calculated its unemployment as 12%, compared to a national average of 16%.

According to the Armenia Chamber of Commerce, there are almost 15,000 business units in the entrepreneurial sector, with 1,300 companies in manufacturing, 8,400 in commerce, and 5,300 in services. It is estimated that 55.6% of manufacturing companies are micro businesses, and the same applies to 71.2% of commerce, and 47.6% of services.

In 1999, the economic sectors which showed greatest dynamism were commerce and services (restaurants, hotels), given the movement generated by the reconstruction process. 74 companies were created and investment totalled Col\$3,491,462,440, followed by construction in which 70 new companies were started with a capital of Col\$2,547,910,900. In terms of investment, financial services and property services made a similar investment of Col\$1,810,860,000 in a total of 76 companies<sup>4</sup>.

Micro-businesses provide around 57.2% of employment in Armenia and in the Department. The composition of businesses in the Department and in the city of Armenia is mostly made up of micro-businesses (92% of all businesses), 5% are small and medium enterprises (between 10 and 199 employees) which provide 22.8% of employment.

Available information in the crafts sector is scattered, and in general not up-to-date. It was seen that this is a sector which has not been much studied, and in which more attention is paid to market promotion from a study of the products and their standards. It has not been possible to find reliable sources on sociological matters related to craft-workers in general, or those of this region.

According to *Artesanías de Colombia*, the official and a nation-wide entity responsible for the sector, "*The situation of Colombian crafts is quite critical, due to problems of credit, high cost of raw materials, lower levels of production, etc. Craft markets create the largest volume of sales, but a craft worker finds that the relationship is very expensive, in terms of profits. The scarcity of funds to buy raw materials and tools and machinery have prevented production from expanding to satisfy demand, and increase the income of the craft-workers, and this principally affects the rural sector. There is the problem of lack of capital, and the inability to solve it, and the State comes forward to provide that solution, through institutions for development lending, to irrigate financial resources towards the crafts. The craft-worker almost always requires loans for food, raw-materials, health, etc., which has led him to depend on intermediaries, private lenders, and suppliers of raw-materials. Thus, at the same time as the products are of low-quality, and put the reputation of market at risk, the situation means that buyers can bargain prices down, and there is also a consequence of major losses by craft-workers hold move from one side to another in trying to obtain a market for their products.*" (III seminar of craft workers, Artesanías de Colombia, 1976).

The greatest concentration of craft-workers is to be found in Departments of Nariño, Sucre, Córdoba, Boyacá, Cesar, Atlántico and Tolima. In indigenous reservations, craft production is a very important activity, and perhaps the only one which produces a value for exchange. Conditions of economic and social marginalization are reflected in lower levels of education.

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<sup>4</sup> Armenia Chamber of Commerce, *Panorama de la Economía del Quindío en 1999*.

Illiteracy is prevalent in 12% of the population, which is higher than the national average of under 5%. Only 2.6% have taken university courses, and 17% have attended technical training courses; of those who have gone to school, at 34.2% did not complete primary education, and 9.6% had secondary studies. Crafts are transmitted from generation to generation, and only a minority receives an academic formation. 48% learn at home, 15.29% in private workshops as apprentices, and in training for trade. Their main products and abilities are concentrated in the production of textiles, coal carvings, hemp and wood, baskets and pottery (National Economic Census of the Crafts Sector, Ministry of Development, Artesanias de Colombia, S.A).

From a sociological point of view, craft workers are occupied in a transformation industry. They do not work in a factory, but have the following characteristics: they a) are independent workers; i.e., they use their own means of production; b) work in an organized workshop or in their own home; c) have the cooperation of a family group or of a small number of employees; d) work with their hands, perhaps with the help of rudimentary machinery; e) do not work a normal working day, but dedicate extra time to their craft, and, f) whenever possible, seek to sell directly to the consumer."<sup>5</sup>

According to the same author, based on Maget, there is an equivalence between a domestic group and a production group in a craft enterprise:

- It does not include all the descendants of the same couple or family, but it may include people extraneous to this biological or parental nucleus.
- There is communal residence.
- There is communal use of domestic equipment, but there may be priorities for the use of certain objects.
- The head of household is usually the owner of the residence, the equipment, or both.
- The budget is common to all members of the group, each contributing according to his or her age.
- Domestic functions are shared between groups of age and sex.

#### **2.1.4. Housing Conditions in Colombia.**

Housing needs are one of the main problems associated with poverty, especially in urban areas. The lack of agile and effective instruments to take care of the problem effectively means that persons other than the State begin to offer solutions. In many cases, these offers are made under conditions of doubtful legality, and at the expense of maintaining in conditions of exploitation and misery those who require housing. The misery belts of the cities of Colombia are constant reminders of this point.

From the beginning of the 1980s the State changed its form of intervention in the housing sector, and began building and granting loans for demand subsidies through its agency INURBE, with the participation of family co-operatives.

The allocation of subsidies has been effected applying the following criteria:

- Legality.
- Availability of public services.
- Quality of design.

The chart below shows the types of housing solutions for low-cost schemes (VIS) established by INURBE, the government housing agency, in accordance with multiples of the national minimum monthly salary, by the value of housing, and the subsidy approved by municipality, with values of houses.

<sup>5</sup> Barajas, Cristina. 1984. La producción artesanal de lazos en Tibaná, Boyacá. Universidad Nacional de Colombia, Mimeo, Bogotá.

**Table 2.1.4.** Types of solution VIS (values in multiples of national minimum monthly salaries).

Size of Municipalities	Value of housing in *NMMS	Value in Pesos
Less than 100,000 inhabitants	100	\$26,010,000
From 100,000 to 500,000 inhabitants	120	\$31,212,000
More than 500,000 inhabitants	135	\$35,113,500

\*NMMS = National Minimum Monthly Salary.

Source: National Plan of Development 1998-2002.

The value of subsidy is 20 N.M.M.S., which is equivalent to \$5,202,000.00. The program gives special attention to individuals that earn less than 3 N.M.M.S. per month.

### 2.1.5. The current situation of low-income victims of the earthquake.

According to a report issued by the Central Bank (*Banco de la República*) in June 2000, as a result of the earthquake in Quindío the unemployment rate rose 39.2 per cent. 33.4 per cent of people who were working before the earthquake lost their jobs. The unemployed population in Armenia grew up to 56,918 people, and in Quindío up to 80,440.

As a result of the earthquake, 158,918 people (approximately, 15,000 families, 7,700 of which belong to Armenia) had to be sheltered in temporary dwellings.

In July 2000, the National University of Colombia - NGO in charge of the reconstruction of Zone 13, where the Project is located - finished a research about the present conditions of the 1,707 families that were sheltered in temporary settlements in this zone. The study of this group allows to identify the profile of low-income victims. It could be expected that these people have similar characteristics to those of the prospective recipients of the Project.

The following statistics were drawn from the research 18 months after the earthquake:

- Educational level: Primary school is 61.39%. High school is 24.72%. Technical training is 0.28%. University level is 0%. Eighty seven per cent of the population ranging from 5 to 17 years old is currently studying. 80.10% attend public schools, and 8.21% is in child care centers. 8.71% attend "cradle-rooms" and shelters of the Colombian Institute of Family Welfare (ICBF). 1.99% go to private businesses (schools as well as child care centers).
- Work situation: 27.8% of the total population holds jobs, either formal or informal. 52.71% are women. 47.3% are men. The unemployment rate (UR) is seventeen per cent. 45.1% of people is an employee or worker in the private sector. 31.1% work freelance. Housework (cleaning and so forth) represents 11.7%. 4.9% of the population is employer and 4.3% works for the government. 1.1% works at home unpaid. 1.7% does not know or gives no answer.
- Economic activity: The most important one is construction (28.3%), followed by commerce (22.6%), utilities and services (16.3%), other (16.9%), transport (7.7%), cattle and agriculture (4.3%), industry (3.1%), financial organizations (banks, saving corporations, etc.) (0.3%), and 0.6% does not know or give no answer.
- Family income. The average monthly income is Col\$296,000.00. Seventy one per cent of people depend economically on the head of household. In average, families distribute their expenses monthly as follows: food (71.74%). Transport (11.22%). Clothing—buying it once in December (5.43%). Education (5.33%). Health (1.88%). Currently, rent and services do not reach even 1% since families are living in temporary shelters. Credits granted by banks, corporations, cooperatives, funds, etc., or debts to lenders only amount to 1.60% of the total.
- Rent and utility services. Before the earthquake, the monthly average for utility services was Col.\$15,587.93, and \$78,549.83 for rent, which adds up to Col.\$94,137.76. This amount would allow people to acquire debts in order to solve their housing situation definitively. According to estimates made by Family Subsidy Funds, a monthly payment of Col.\$80,000.00 would make it feasible to grant Col.\$5,650,000.00 credits for housing.

## **2.2. Current Conditions of Natural Risk and Disaster Prevention.**

### **2.2.1. Vulnerability of Armenia.** Figures 2.2.1.(1) and 2.2.1.(2).

Armenia is located in a zone of volcanic origin, and has constructed dense settlements over man-made landfills. These characteristics, in addition to the geological and geo-technical conditions of the city, brought as a result the damage of one-to-six-floor-high buildings, and the almost instantaneous collapse of vast sectors even in the outskirts of the city on 25 January 1999. Those buildings were shaken with particular violence during the secondary tremors after the main earthquake took place. This proves that the construction systems employed in the zone affected by the earthquake show ignorance of or failure to apply seismic-resistant criteria, in addition to the improper use of areas of evident risk for urbanization.

Armenia is also threatened by the decomposition of volcanic ashes, the overabundance of human-made landfills and the consequent instability of the soil, its possible liquation, and potential landslides due to the saturation of the soil and the hilly topography of the city. Meteorological phenomena such as high winds and thunderstorms also can affect it. Finally, forest fires are yet another threat in times of extreme heat during summers, as well as sudden overflows of brooks and streams, and clogs in the city's sewage system.

In Armenia, as in other Colombian cities, problems of land ownership have meant that a large number of people are located in zones not suitable for urban construction, and the authorities are powerless to control the situation, so that the number of housing units in risk prone areas is increasing. Armenia, like other cities, has made significant efforts to relocate marginal human settlements without success in numerical terms, since the problem continuously increases and moves faster than the solution. The extreme poverty of a large section of the Colombian people is one of the major factors of vulnerability. Among this group, there is an important percentage of women, children, and the elderly.

### **2.2.2. Effects of the earthquake.** Figures 2.2.2.(1) and 2.2.2.(7).

The earthquake caused 1,230 deaths, and 5,300 injured were treated in hospitals. 200,000 people lost their homes and places of employment. The earthquake damaged some 50,000 buildings in the Coffee Belt, and the direct economic loss can be estimated, without including losses to commerce and industry, at around US\$1,800 million.

Of the 49,163 houses registered in Armenia, 19,734 suffered partial damage, 11,163 were total losses, and 10,380 were left uninhabitable. The earthquake of 25 January 1999 had direct effects on 1% of the population, and indirect effects on 4%. Of all the fatal victims, 929 deaths occurred in Armenia.

Most damages were concentrated in older buildings, in constructions of bricks and mortar which were not reinforced or held in by elements of reinforced concrete, and in buildings designed and built prior to the issue of the first national earthquake-resistant construction code. This code was issued in 1984, as a national law, as a positive legacy of the earthquake which struck Popayan in 1983. Most of the modern buildings built with earthquake-resistant standards were damaged only in non-structural elements such as walls, partitions, ceilings, architectural finish, etc. Nonetheless, this type of damage was expected in the event of a strong earthquake, and in 1997 the Colombian Association of Seismic Engineers AIS succeeded in having Congress pass a new law to update the 1984 regulations.

The new standard for design and construction of earthquake-resistant buildings, NSR-98, took account of the need for further restrictions on horizontal displacement or drifting of structures to protect finish materials, the design of non-structural elements, and the mandatory nature of an



appraisal of seismic vulnerability, and rehabilitation and earthquake-resistant reinforcements for community or governmental buildings. Therefore, the current standards have not had to be updated in regard to regulations, although there have been complementary provisions with regard to the rehabilitation and reinforcement of structures affected by the earthquake.

### **2.2.3. Land Use Regulation/Seismic Micro-Zoning in Armenia.** Figure 2.2.3.

The Armenia Land Use Plan PORTE was one of the few programs that succeeded in being approved within the initial deadline set by the government, in Law 388/97, for territorial development. The Municipal Council had adopted the plan just the day before the earthquake took place. Yet, the plan had come out as a result of a long process of discussion and agreement among participants of several social sectors. The plan overcame the opposition of those who considered its restrictions an exaggerated obstacle to the normal growth of the city. But the restrictions mostly applied to particularly vulnerable areas due to geological threats, soil conditions, and the imperative need to protect watersheds at the headwaters of several streams around which the city had been growing. The effects of the earthquake and several of the provisions of the Land-Use Plan, PORTE, justified the arguments of those who insisted that the hazard and risks should be a decisive factor for setting restrictions on urban development. The imperative principle that the recovery of the disaster zone should take into account environmental considerations was restated. Without such consideration, the sustainability of the city would not be conceivable as an objective.

At present, the intention is to adapt the Land-Use Plan PORTE in order to incorporate in its reviewing process the results of the seismic micro-zoning study of 1999. The study is a specific measure for risk reduction management, which contributes to define what can and cannot be done in each sector of the city, that is, what uses can be given to the site, and what technical characteristics must be employed in the different types of intervention. This study had been proposed in the original plan, and then, due to the occurrence of the earthquake, it was implemented in a very short time, in order to serve as a guide to reconstruction.

### **2.2.4. The Reconstruction Process.** Figure 2.2.4.

To face the earthquake that took place on 25 January 1999, the Government of Colombia declared such state as a national disaster and created a Fund for the Reconstruction and Social Development of the Coffee-Growing Belt—called *FOREC*— as a special entity ascribed to the Presidency of the Republic.

*FOREC* exerts special faculties to perform a quick managerial outline of the “Coffee-Growing Belt Reconstruction Program.” It is financed with funds provided by the “International Bank of Reconstruction and Foment” *BIRF*, and the Inter-American Bank of Development, *BID*, through loan-contracts signed with the Republic of Colombia. The Program is also financed, among other sources, with local funds that partially pay off such loans.

The outline of the Program is built up on the basis of land decentralization, establishing the differences among the functions of the institutions involved, according to their level of competence and their responsibilities. The program is carried out in the regions that local governments assign. Each zone has a Local Management Office run by a Non Governmental Organization. Thirty one zones have been established, fifteen of which belong to the Municipality of Armenia. The zone where the execution of the Project was originally planned is run by COMFAMA. The zone where the Municipality of Armenia finally obtained the lot *Lindaraja II* is run by the National University of Colombia.

*FOREC* adopted as a guide the 1999-2006 Municipality of Armenia’s Land-Use Plan, known as PORTE, which Armenia’s Municipal Council had approved on 24 January 1999, based on the Accord 001 of 1999. This Accord provided guidelines to go through the consolidation, planning and reconstruction processes in Armenia itself.

The following is one of the policies that the Municipality has determined in regard to the management and development of middle-income housing: To facilitate the foundation of the first "**VILLAGE OF WORK AND LIFE**", giving advise on how people could direct their personal and working skills. This has been defined as a 'spatial strategy,' for it conceives of housing as a productive factor, and of production and trade as complementary and independent activities.

#### **2.2.5. The Local Committee for Disaster Prevention and Attention.**

In Armenia, The Local Committee for Disaster Prevention and Attention leads a program created in 1992. This Inter-institutional body, called the "Local Emergency Committee," has a co-ordination Office (the Disaster Prevention and Attention Division) that belongs to the Municipal Office of Government and Co-existence and Civic Security, and maintains a constant relationship with the Regional Disaster Prevention and Attention Committee, called *CREPAD*, and the prime environment authority in the Department, known as *CRQ*).

The Committee is conceived of as an inter-institutional body conformed by entities of the public and private sector that belong to the so-called "National System." The committee is divided into 3 commissions, which are responsible for defining and promoting activities related to technical and operational aspects, and educational action on prevention and attention.

At present, the Disaster Prevention and Attention Division is promoting a program which contains the following projects:

- 1) Implementation of social networks for Disaster Prevention and Attention.
- 2) Institutional strengthening of the Local Committee for Disaster Prevention and Attention (in terms of training of members, strengthening of the regional seismic network and facilities, and improving capacity of responding in the event of emergency).
- 3) Development of a disaster prevention and attention plan in schools.
- 4) Strengthening of the Local Committee's documentation and dissemination center.
- 5) Strengthening of the Technical, Operational, and Educational Commissions of the Local Committee.

### **2.3. Research on Architecture and Earthquake-Resistant Structures.**

#### **2.3.1. Effect of the earthquake on the buildings by type of construction.**

Many buildings in the center of Armenia suffered severe structural damage due to the deficient quality of materials, deficient design and defects of construction. This was typical prior to the introduction of earthquake-resistant standards. The insufficient dimensions of structural elements, and the lack of transverse steel stirrups in columns and beams facilitated the occurrence of failure due to a shearing effect, and in some cases it was the cause of total or partial collapse of a building. Traditionally, buildings in Armenia were built using an empirical technology similar to daub and wattle (in this case bamboo). The first settlers in the area called it "earthquake style," because it stood up well. However, some of these buildings, which were considered to be part of the local seismic culture, collapsed or lost their roofs due to deficient maintenance, or because over the years non-reinforced brick walls had been built inside, or on facades.

It is estimated that some 80% of school buildings in the area suffered moderate to severe damage. Several health facilities in small villages were seriously damaged, and the main hospital in Armenia had to be partially closed due to non-structural damage. It should be noted that this hospital was in the process of earthquake-resistant reinforcement, but the work had not been finished. The main building of the police station and the fire department collapsed, causing the death of several police officers and firemen who would have been essential in the response

to the emergency. Most of the churches in the City, and in the villages around the epicenter, were seriously damaged, and some roofs collapsed entirely.

**Table 2.3.1.(1). Effects of the earthquake on the city of Armenia.**

HOUSING RECORDED BY TYPE OF DAMAGE IN THE DEPARTMENT AND THE MUNICIPALITY						
PLACE	TOTAL	No. OF DAMAGES	PARTIAL LOSS	TOTAL LOSS	UNINHABITABLE	N/K
QUINDIO	74,068	9,671	31,735	16,458	15,774	430
ARMENIA	49,163	7,642	19,734	11,163	10,380	244
TOTAL AFFECTED AREA	90,474	10,466	43,476	17,552	18,420	560

HOUSING RECORDED BY TYPE OF TENURE BY MUNICIPALITY						
PLACE	TOTAL	OWN	OWN WITH LOAN	RENTED	OTHER	N/K
QUINDIO	74,068	33,951	9,294	27,555	2,597	671
ARMENIA	49,163	21,077	7,937	18,500	1,261	388
TOTAL AFFECTED AREA	90,474	44,870	10,440	30,609	3,599	956

OWN HOUSES BY TYPE OF DAMAGE IN THE DEPARTMENT AND THE MUNICIPALITY						
PLACE	TOTAL OWNED	NO DAMAGE	PARTIAL LOSS	TOTAL LOSS	UNINHABITABLE	N/K
QUINDIO	43,245	5,988	21,455	7,770	7,825	207
ARMENIA	29,014	4,845	13,547	5,264	5,234	124
TOTAL AFFECTED AREA	55,310	6,442	30,476	8,442	9,675	275

RENTED HOUSES BY TYPE OF DAMAGE IN THE DEPARTMENT AND THE MUNICIPALITY						
PLACES	TOTAL RENTED	NO DAMAGE	PARTIAL LOSS	TOTAL LOSS	UNINHABITABLE	N/K
QUINDIO	27,555	3,331	8,916	7,956	724	112
ARMENIA	168	2,566	5,562	5,486	4,807	59
TOTAL AFFECTED AREA	30,609	3,607	10,735	828	7,847	140

OWN HOMES BY TYPE OF DAMAGE IN THE DEPARTMENT AND THE MUNICIPALITY				
PLACE	TOTAL HOMES	NO DAMAGE	PARTIAL LOSS	TOTAL LOSS OR UNINHABITABLE
QUINDIO	19,860	4,441	7,053	16
ARMENIA	14,057	3,112	4,724	16
TOTAL AFFECTED AREA	22,949	5,021	8,550	9,378

NUMBER OF INDIVIDUALS RECORDED AS RESIDENT IN LOST OR UNINHABITABLE HOUSING IN THE DEPARTMENT AND THE MUNICIPALITY	
PLACE	TOTAL
QUINDIO	142,401
ARMENIA	94,386

Source: DANE, First Semester 1999.

The comparison and analysis of damages in the buildings that were stricken by the earthquake depending upon their type of structure, is shown on Table 2.3.1.(2).

**Table 2.3.1.(2). Number of buildings and degree of damage according to type of construction.**

Damage Type	None	Slight	Moderate	Severe	Collapse	Total
Concrete frames	2,956	4,231	7,553	2,730	157	17,627
Concrete Walls	15	146	34	29	0	224
Prefabricated Structures	3	10	33	16	3	65
Mixed Structure	125	317	333	372	6	1,153
Confined masonry	584	1,279	1,970	1,896	77	5,806
Reinforced masonry	155	364	558	511	4	1,592
Not-reinforced masonry	1,192	2,448	3,785	6,699	617	14,741
Bahareque Walls	405	315	704	2,409	296	4,129
Bahareque and bricks	298	403	985	2,379	365	4,430
Metallic Structure	2	2	2	2	0	8
Composite structure	2	10	14	47	5	78
Wood frames	52	34	51	117	13	267
Wood Structure	11	5	10	14	0	40
Other Structures	109	62	140	278	19	606
<b>TOTAL</b>	<b>5,909</b>	<b>9,626</b>	<b>16,172</b>	<b>17,499</b>	<b>1,562</b>	<b>50,768</b>

Source: Omar Dario Cardona. Team of Disaster Attention and Prevention.

### 2.3.2. Application of the Earthquake-Resistant Code in the City of Armenia.

**Regulation NSR-98.** Law 400 of 19 August 1997 repealed Decree 1400 of 1984—i.e., Colombia's earthquake-resistant construction code—and created the COLOMBIAN EARTHQUAKE-RESISTANT DESIGN AND CONSTRUCTION STANDARD NSR-98, whose methods of design are based on the following steps:

- **Step 1.** Level of seismic hazard, and definition of the Aa value (acceleration coefficient).
- **Step 2.** Definition of seismic momentum in design, expressed as:
  - a) A design spectrum.
  - b) A cluster of accelerograms.
  - c) Results of microzoning studies.
- **Step 3.** Definition of characteristics of structures and structural materials used.
  1. Structural systems for earthquake-resistant construction:
    - a) Load-bearing walls.
    - b) Combined.
    - c) Portic.
    - d) Dual.
  2. Structural materials:
    - a) Structural concrete.
    - b) Structural brickwork.
    - c) Metal structures.
    - d) Wood.
  3. Definition of the capacity for energy dissipation in the inelastic range:
    - a) DES Special Capacity for Energy Dissipation.
    - b) DMO Moderate Capacity for Energy Dissipation.
    - c) DMI Minimum Capacity for Energy Dissipation.
  4. Restrictions on the use of structural systems and materials:
    - a) With DMI, materials which can only be used in low-seismic-hazard zones.
    - b) With DMO, materials which can be used in low and intermediate seismic hazard zones.
    - c) With DES, materials can be used in all seismic hazard zones.
- **Step 4.** Degree of irregularity of structures, and procedure for analysis.
  - a) Degree of regularity of the ground: Op.
  - b) Degree of regularity of vertical construction: Oa.
  - c) Type of soil profile: S.

- d) Use group I, 2, 3 or 4.
- e) Level of seismic hazard: high, intermediate or low.

Definition of procedure for analysis:

- a) Method of equivalent force.
- b) Method of dynamic elastic analysis.
- c) Method of inelastic dynamic analysis

- **Step 5.** Bases for the design of seismic forces.
  - a) Evaluation of the building mass:  $M$ .
  - b) Evaluation of vibration period:  $T$ .
  - c) Evaluation of spectral acceleration:  $S A$ .
  - d) Evaluation of seismic shearing at base.
- **Step 6.** Analysis of structure.

Analysis of structure for seismic forces in design, employing the procedure of analysis in Step 3.
- **Step 7.** Horizontal displacement.
  - a) Axial forces.
  - b) Bending moments.
  - c) Shearing forces.
  - d) Torsion moments.
- **Step 8.** Verification of drifts.

The drift will include the torsion-effect of the entire structure, and the P-Delta effect.  
Maximum admissible drift is one percent of floor height.  
For structural brickwork, the maximum admissible drift is 0.5 percent of floor height.
- **Step 9.** Design of structural elements.
- **Step 10.** Foundations.
- **Step 11.** Design of non-structural elements.

Definition of minimum performance.

  - a) Use 4 group: superior.
  - b) Use 3 group: good.
  - c) Use 2 group: good.
  - d) Use 1 group: low
- **Step 12.** Construction and technical supervision.



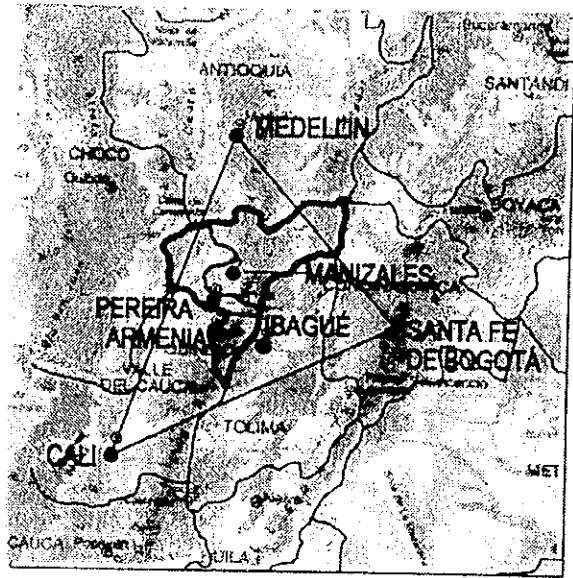
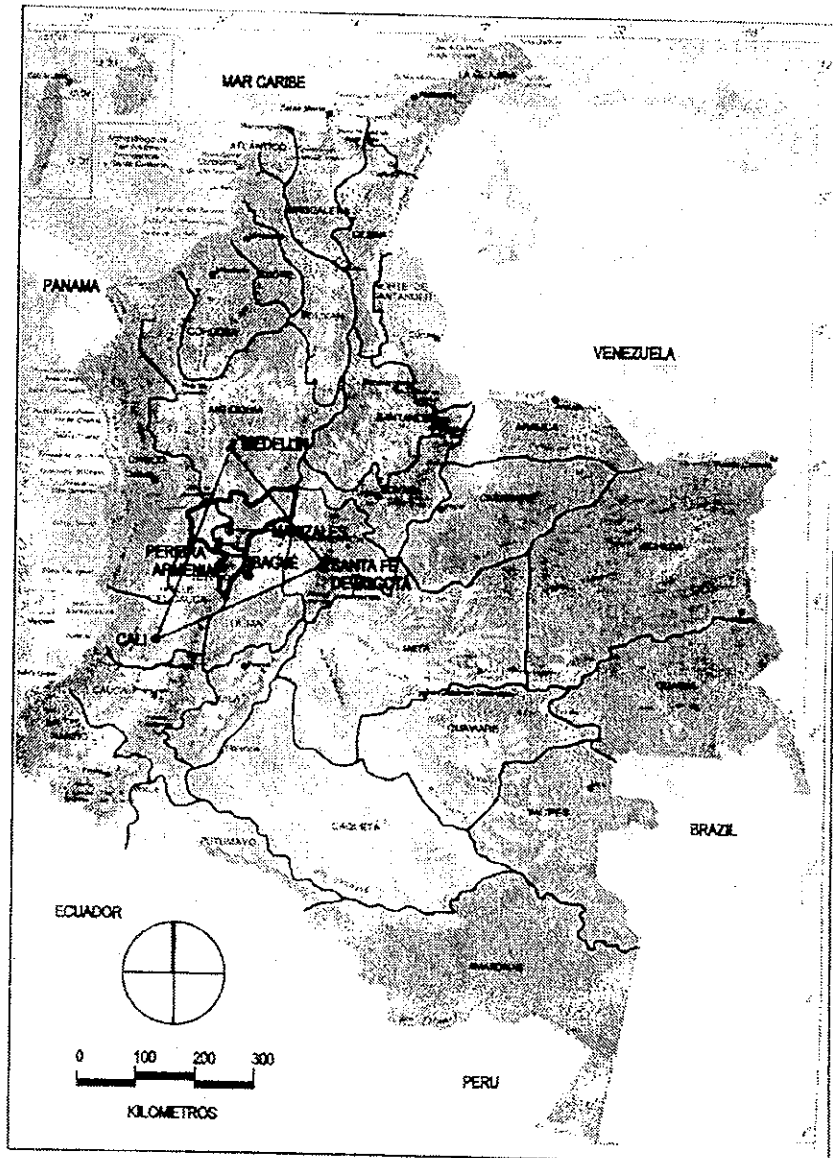


Figura 2.1.1. (1) La región se ubica en la mitad del eje industrial colombiano, denominado como el "Triángulo de Oro", conformado por las principales ciudades del país, Cali, Medellín y Bogotá.

La ciudad de Armenia se encuentra a 310Kms. al occidente de Santa Fe de Bogotá en el centro del país dentro del llamado "Eje Cafetero", región compuesta principalmente por los departamentos de Caldas, Risaralda y Quindío, siendo la capital de este último.

Figure 2.1.1.(1) The region is located in the middle of the Coffee Belt, the center of the industrial production in Colombia, known as the Golden Triangle, formed by three of the major cities: Cali, Medellín and Bogotá.

Armenia is 310Kms. west of Bogotá, in the center of the Coffee Belt, which is formed by the departments of Caldas, Risaralda and Quindío. Armenia is the capital of Quindío.



Fuente: Atlas Universal y de Colombia.

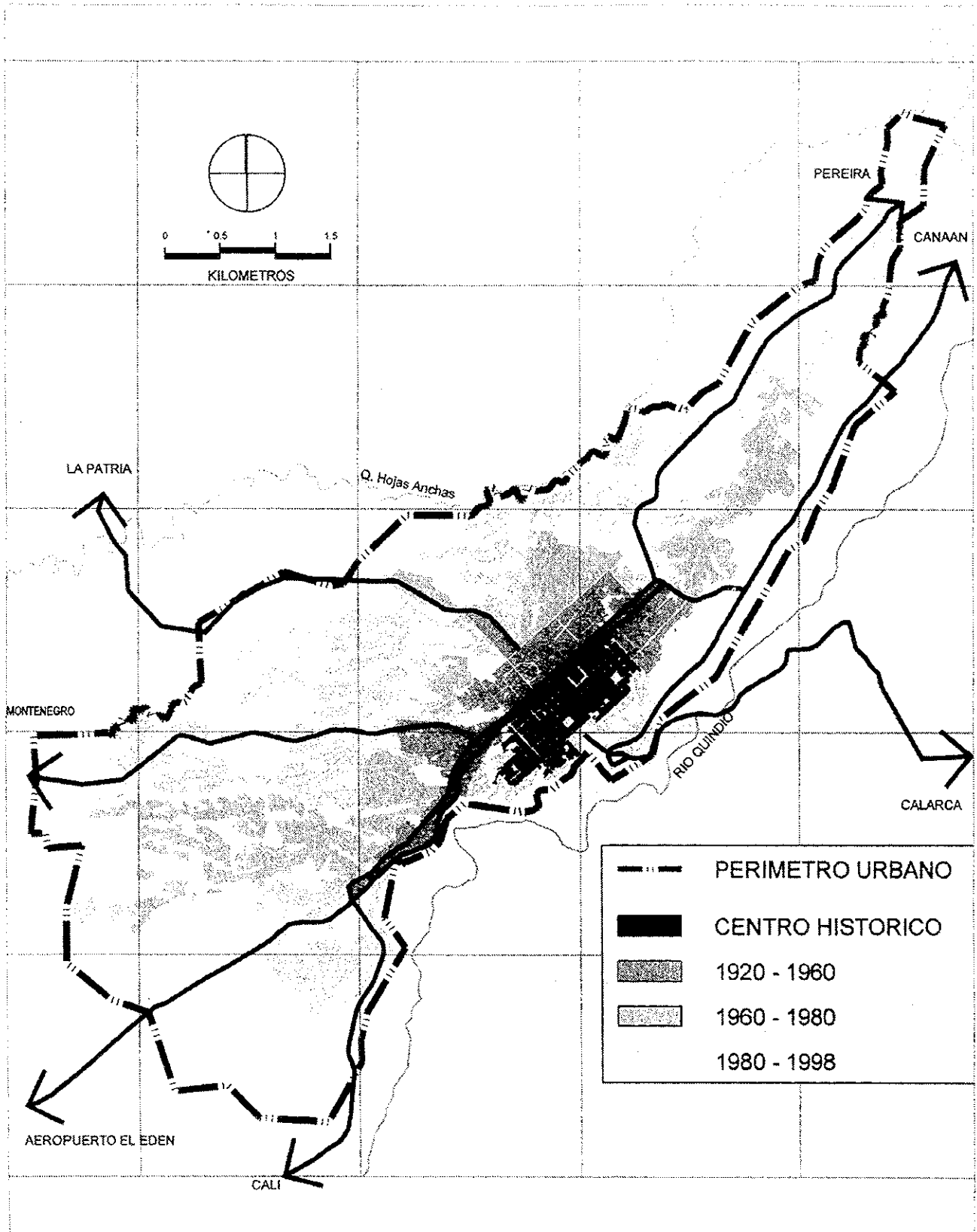


Figura 2.1.1.(2). Armenia. Proceso de crecimiento histórico.

Figure 2.1.1.(2). Armenia. Process of urban growth.

Fuente: Departamento Administrativo de Planeación Municipal de Armenia.



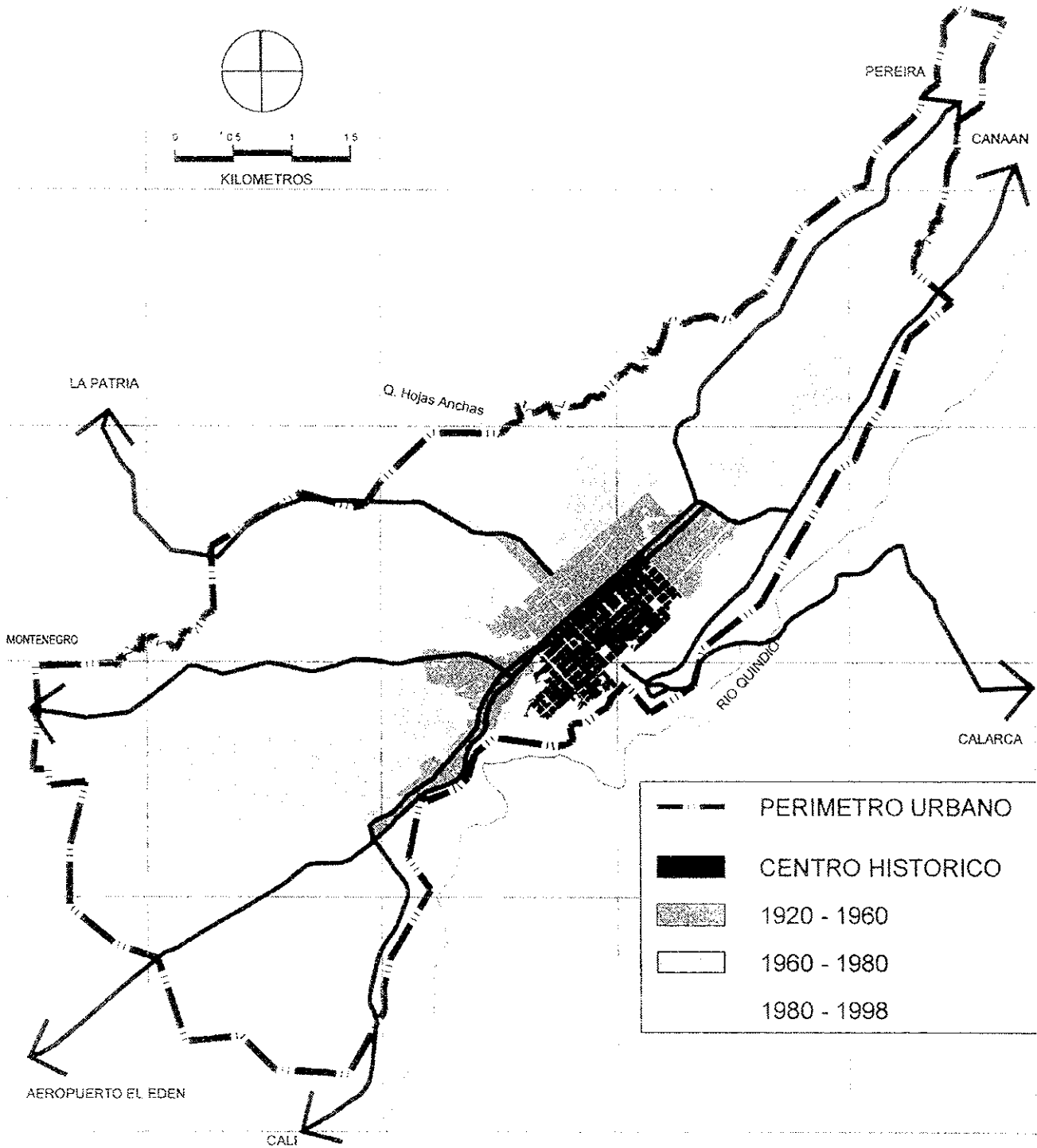


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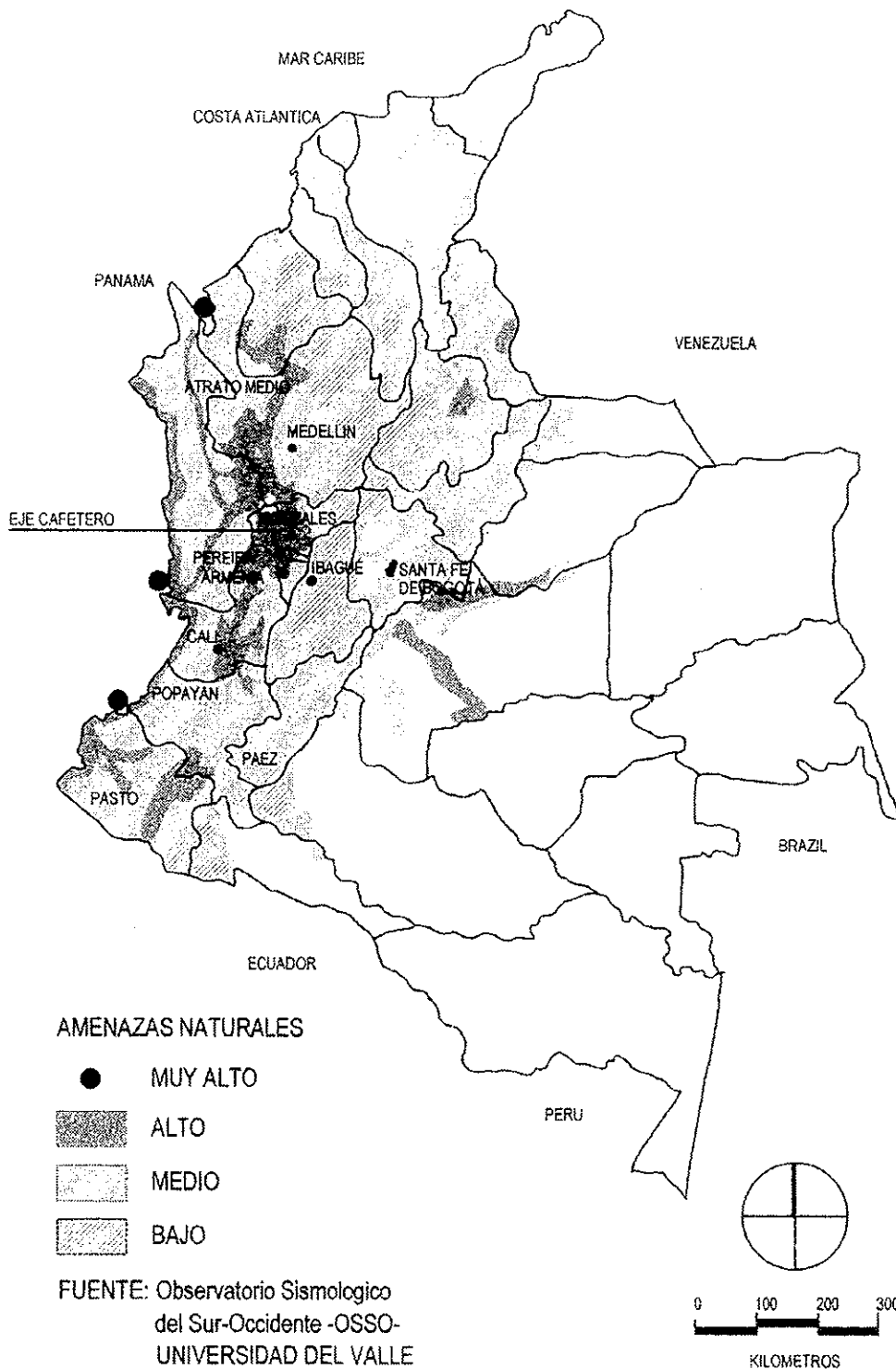


Figura 2.2.1.(1). Amenazas Naturales en Colombia.

Figure 2.2.1.(1). Natural Hazards in Colombia.

Fuente: Asociación Colombiana de Ing. Sísmica. Estudio de Misonificación Sísmica.

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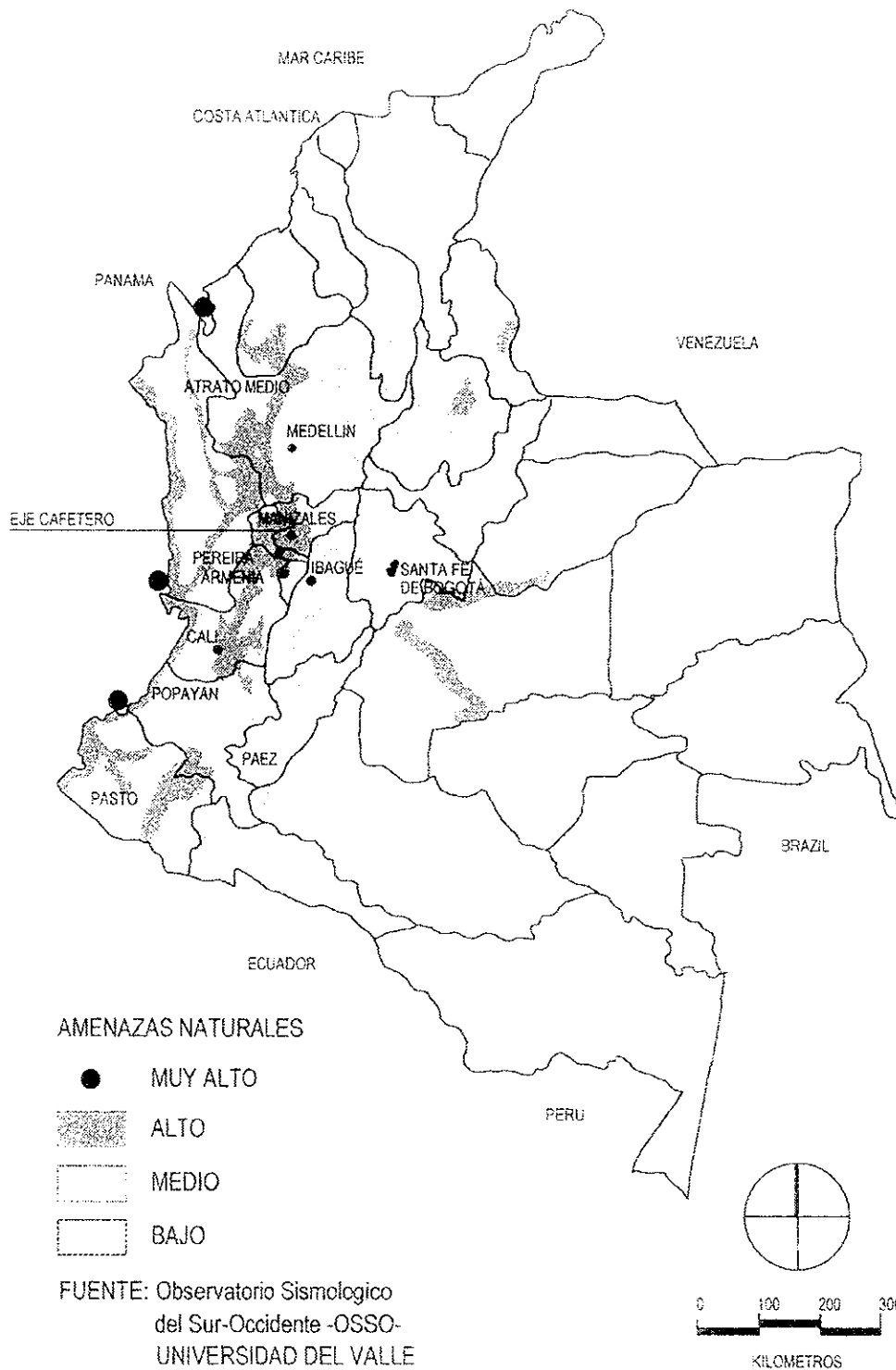
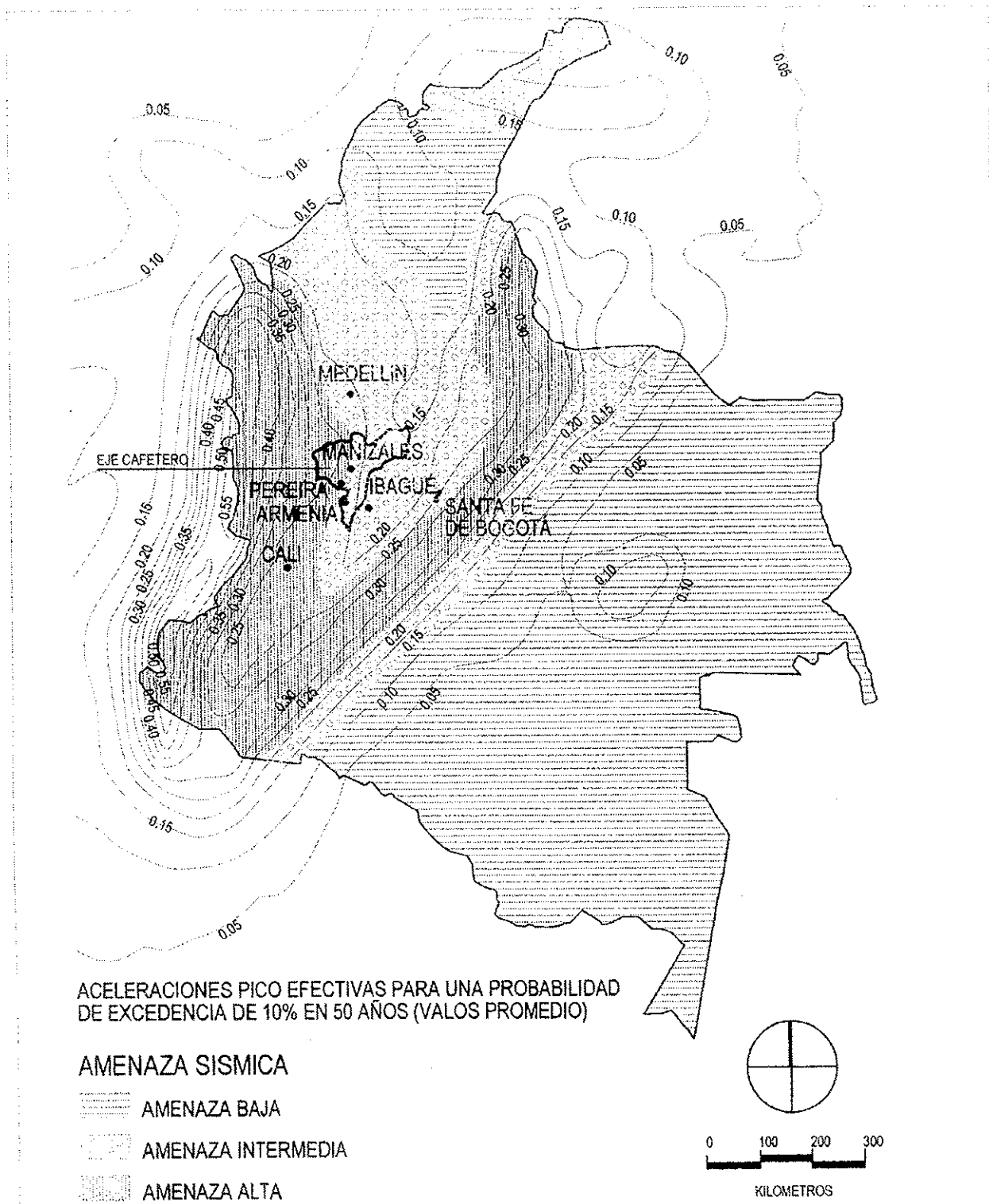


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Fuente. Asociación Colombiana de Ing. Sísmica. Estudio de Misonificación Sísmica



**Figura 2.2.1.(2).** Zonas de amenaza sísmica y aceleraciones en Colombia.  
**Figure 2.2.1.(2).** Seismic and acceleration risk zones in Colombia.

Fuente: Asociación Colombiana de Ing. Sísmica. Estudio de Mzonificación Sísmica.

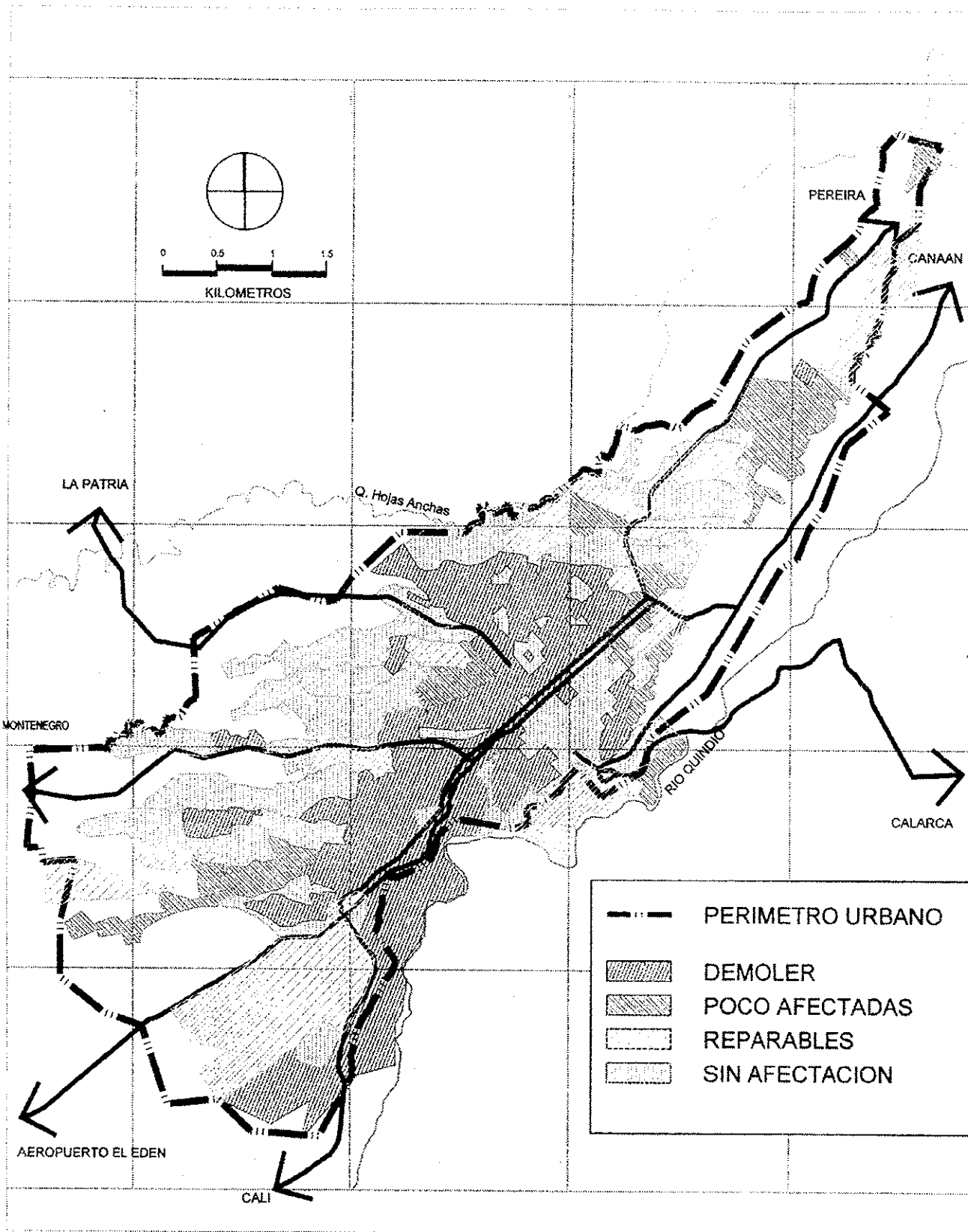


Figura 2.2.2. (1). Areas urbanas de Armenia afectadas por el terremoto.  
 Figura 2.2.2. (1). Earthquake effects in the urban area of Armenia.

Fuente: DANE. Censo Eje Cafetero.

**Figura 2.2.2.(2).**  
Destrucción del Barrio  
Brasilia localizado  
sobre una colina  
(Ingeominas).



**Figure 2.2.2.(2).**  
Destruction of Barrio  
Brasilia district, on a hill  
(Ingeominas).

**Figura 2.2.2.(3).**  
Colapso de edificio  
moderno en la zona norte  
de Armenia  
(Ingeominas).



**Figure 2.2.2.(3).**  
Collapse of a modern  
building in North Armenia  
(Ingeominas).

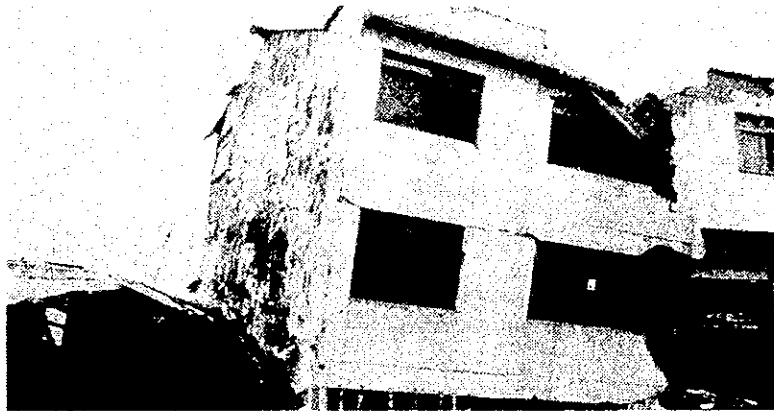
**Figura 2.2.2.(4).**  
Edificación de  
mampostería no  
reforzada gravemente  
afectada.  
(O.D. Cardona.).



**Figure 2.2.2.(4).**  
A brick building not  
reinforced, seriously  
damaged.  
(O.D. Cardona.).

**Figura 2.2.2.(5).**  
Colapso de edificación  
de mampostería no  
reforzada ni confinada  
(O.D. Cardona.)

**Figure 2.2.2.(5).**  
*Collapse of a brick  
building, not reinforced  
or confined.*  
(O.D. Cardona.)



**Figura 2.2.2.(6).**  
Colapso de edificación  
antigua construida sin  
requisitos  
sismorresistentes.  
(O.D. Cardona)

**Figure 2.2.2.(6).**  
*Collapse of an old  
building, built without  
earthquake-resistant  
requirements.*  
(O.D. Cardona.)



**Figura 2.2.2.(7).**  
Colapso parcial de  
edificio con tanque  
superior de grandes  
dimensiones. (O.D.  
Cardona).

**Figure 2.2.2.(7).**

*Partial collapse of a  
building with a large roof  
tank.*  
(O.D. Cardona.)



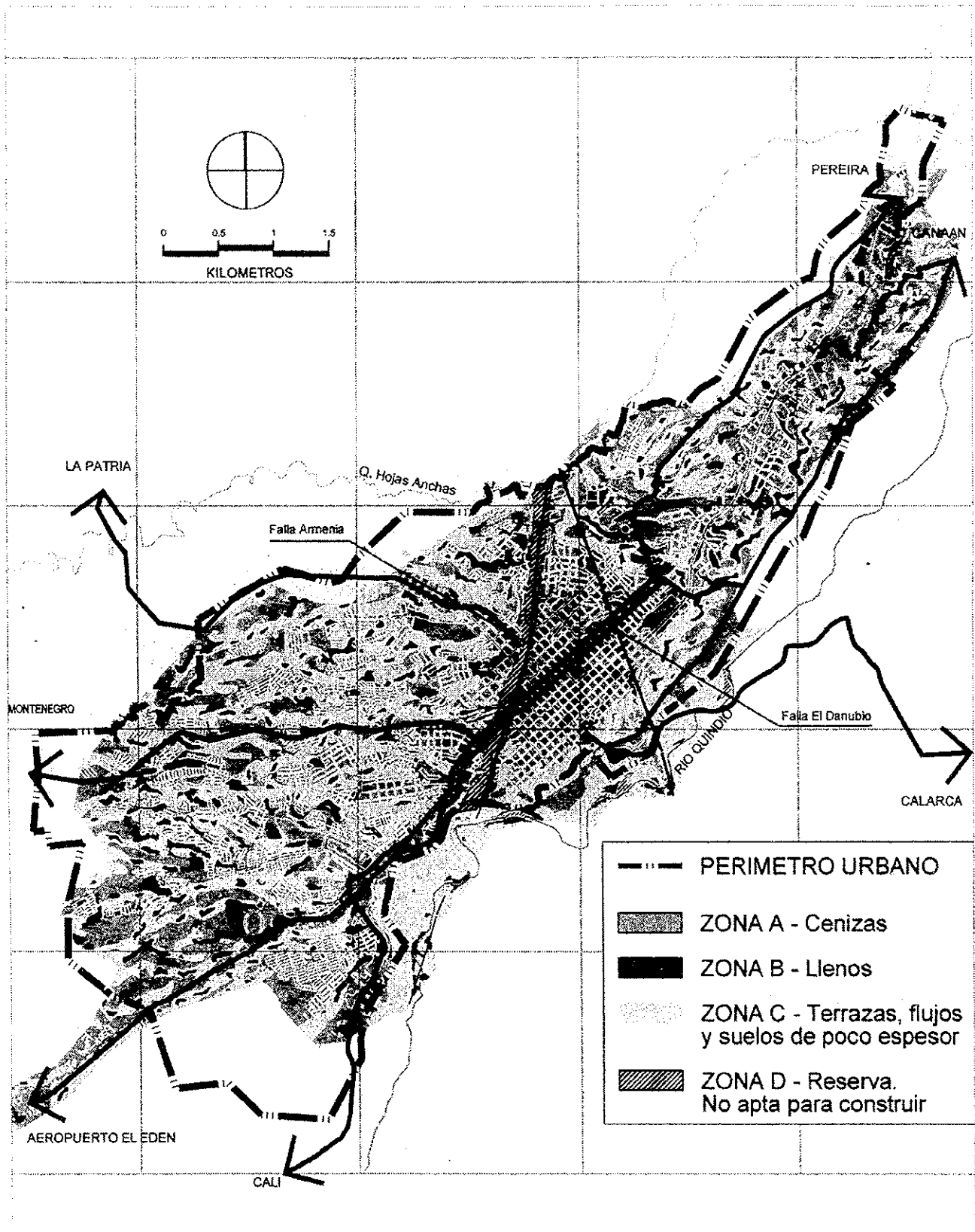


Figura 2.2.3. Microzonificación sísmica.

Figure 2.2.3. Seismic Micro zoning.

Fuente: Asociación Colombiana de Ingeniería Sísmica. Estudio de Microzonificación Sísmica.



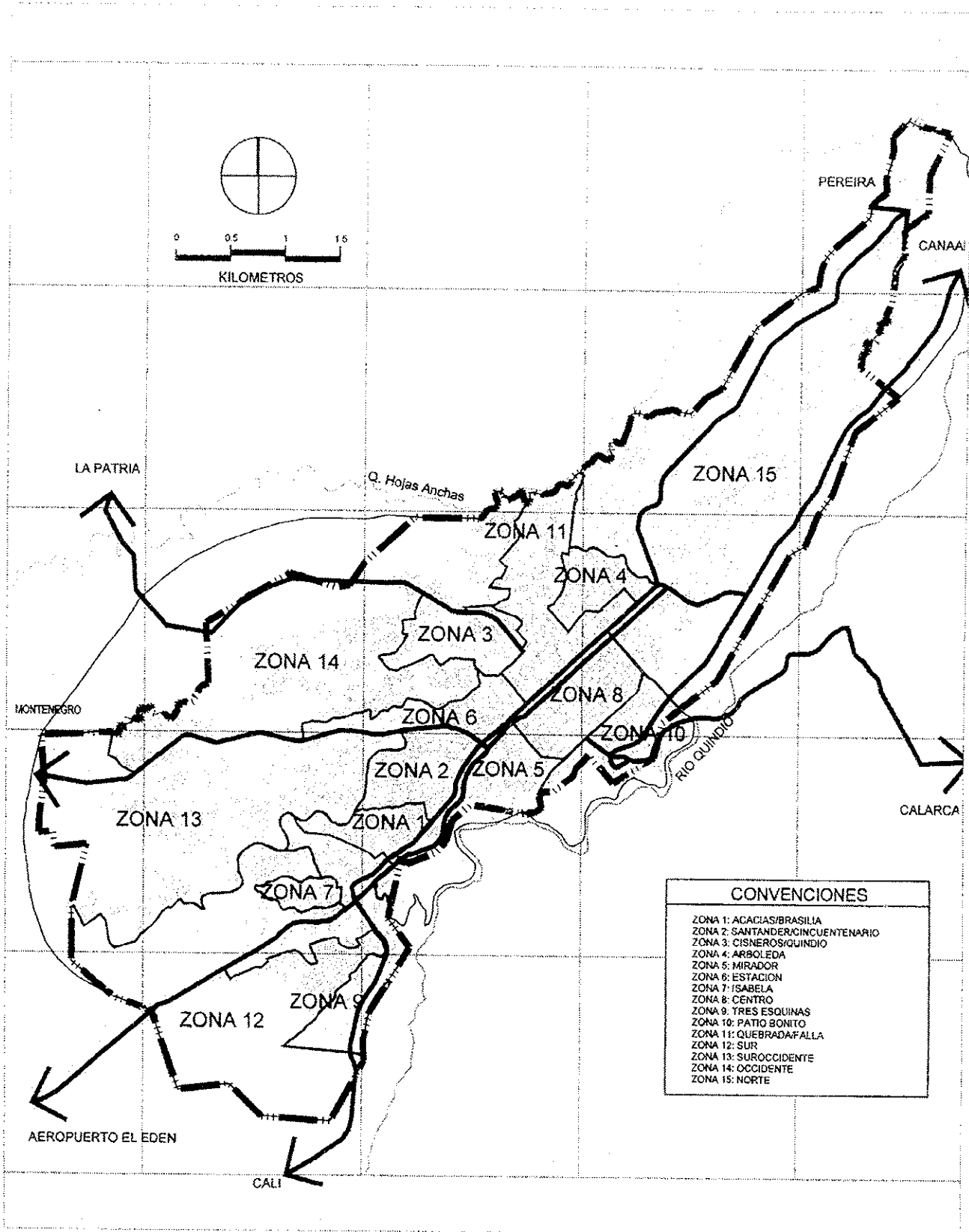


Figura 2.2.4. Programa de reconstrucción. Gerencias zonales.

Figure 2.2.4. Reconstruction program. Zone managements.

Fuente: Fondo de Reconstrucción del Eje Cafetero, FOREC

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