# *THE COSTA RICAN HOSPITAL RETROFITTING PROGRAM: DECISION-MAKING, IMPLEMENTATION PROCEDURES, AND THE CONSTRUCTION PROCESS*

*ENGLISH PROJECT SUMMARY*
*(FINAL VERSION)*

*PREPARED BY: ALLAN LAVELL Ph.D.*

*Contracted by: Office for Foreign Disaster Assistance (OFDA) of the U.S. Agency for International Development (AID) and Basic Health Management Inc. (BHM)*

*In cooperation with the Pan American Health Organization (PAHO)*

*SAN JOSE, SEPTEMBER 31st, 1992*

## *FOREWORD*

This monograph is designed to make a contribution to the International Decade for Natural Disaster Reduction. Natural disasters often cripple lifeline facilities which are critical to providing urgent assistance to disaster victims. Health care facilities are among the most important and have been severely damaged or destroyed in various disasters throughout the world.

The type of damage that health care facilities suffer is often preventable. Hospitals, clinics, and other health care delivery facilities in developing countries are frequently built without taking into account their vulnerability to earthquakes, hurricanes and other hazards. It is clearly less expensive and easier to design the facility to withstand the disaster threat than to retrofit. However, there are cases where retrofitting makes sense and is justifiable in economic terms.

This case study describes how one Central American country, Costa Rica, carried out major retrofitting of health infrastructure. The objectives of the study were: a) to analyze the decision-making processes that led the Costa Rican Social Security authorities to promote a seismic retrofitting program; b) to analyze the contracting procedures for the vulnerability studies, retrofitting plans, and technical specifications, and the construction works themselves; c) to analyze the implementation of the retrofitting program in the construction stage; and d) to analyze the changes made in the Costa Rican Social Security System's seismic risk insurance policy between 1982 and 1992.

Costa Rica's efforts in this area took place over a long period. The author traces some of the concerns regarding seismic risk back to the 1972 Managua earthquake. The credit for the success of the retrofitting effort clearly belongs to the Costa Ricans. The United States Agency for International Development's Office of Foreign Disaster Assistance initiated and funded this monograph, and together with the Pan American Health Organization's Emergency Preparedness Program is pleased to document this important case history. We hope that its publication will prove useful to other countries facing similar threats and will facilitate taking the difficult decisions necessary to better promote the mitigation of health care infrastructure.

## PRESENTATION

The summary presented in this document is the result of a research endeavor undertaken between 1 June and 31 September 1992.

The objectives of the project were: i) to analyze the decision making process which led the Costa Rican Social Security authorities (Caja Costarricense de Seguro Social-CCSS) to promote a seismic retrofitting program, from 1986 onwards, which included various of its major facilities (the National Children's, Monseñor Sanabria, Mexico and Ciudad Neily Hospitals; and the Social Security Head Offices); ii) to analyze the contracting procedures for the vulnerability studies, retrofitting plans and technical specifications, and the construction works as such; iii) to analyze the implementation of the retrofitting program in the construction stage; iv) to analyze the changes made in the Social Security System's seismic risk insurance policy between 1982 and 1992.

The presentation of specific conclusions and recommendations relevant to the promotion of retrofitting schemes in other Latin American countries comprised an overall global objective of the project.

The research was undertaken using both secondary information sources and the results of 34 interviews undertaken with Social Security officials at the CCSS headquarters in San Jose, and at its Regional Offices and hospitals; technical experts from the structural engineering field; and various politicians and disaster prevention specialists.

The information acquired during the research process was facilitated by the open collaboration of numerous Social Security officials, and the institution's Board of Directors.

## *I Seismic Risk and Social Response in Costa Rica: Some Historical Antecedents:*

Detailed and reasonably reliable information on the levels and spatial incidence of seismic risk in Costa Rica has improved notably during the last 10 years. The Osa-Golfito and San Isidro de El General quakes in 1983; the Cóbano, Puriscal, and Alajuela quakes in 1990; and the very unexpected Limon earthquake in 1991 generated a good deal of new seismologic information which has allowed local and international scientists to improve their knowledge of seismic patterns (temporal and spatial) and probable intensity and impact levels. The growth and development of a national seismological research capacity, improved instrumentation, and a growing public and governmental interest in the disaster problematic have helped push this knowledge base forward.

Prior to 1983, the knowledge base and interest levels were severely deficient. Part of this situation may be attributed to the relatively low level of high intensity seismic activity suffered in the country in the preceding decades.

Various high intensity quakes had affected the country between 1910 (the date of the highly destructive Cartago earthquake) and 1983, but their occurrence in relatively isolated areas with low population density signified a very limited impact on the population and economy. As regards hospital infrastructure, no recorded structural damage had been suffered since the Cartago earthquake in 1910, which destroyed the existing hospital, built during the last century. In general, a low level of seismic consciousness existed in the country prior to the 1980s, and disaster prevention and preparedness activities related to seismic risk were extremely limited.

However, some symptoms of concern did exist, spurred, particularly, by the 1972 Managua and 1976 Guatemalan earthquakes. Thus, in 1974, the country's first seismic code was published, product of the work of a number of concerned structural engineers, members of the country's Federated College of Engineers and Architects. Later, in 1977, the National Insurance Institute contracted a study of seismic risk in Costa Rica with the University of Stanford, as a basis for its policy-making on earthquake insurance. This study, prepared by Franz Sauter, a distinguished Costa Rican structural engineer, and Haresh Shah, from the University of Stanford, was completed in September, 1978.

The zoning utilized in the seismic risk study drew on the results of a 1977 study by Mortgat et. al., the first to be undertaken for Costa Rica. Based on isoacceleration lines derived from the analysis of historically recorded seismic events, this study proposed three major zones for the country, of ascending risk: Zone I, covering the country's Atlantic Coast Region (low risk); Zone II, including the country's Central, Northwestern and Southeastern regions (medium risk); and Zone III covering the

country's Southwest regions (high risk). This zoning, and its data base, would later be incorporated in the country's most recent, 1986, Seismic Code.

Imprecisions in the seismic data base employed, an overreliance on the analysis of subduction generated epicentres, many of irrelevance to Costa Rica due to their locus off the Nicaraguan coast, and the lack of sufficient consideration given to fault generated quakes have been posited to be major weaknesses of the zoning proposed by Mortgat (See Pujol, 1981; Vargas and Santana, 1991).

Prior to 1983, the knowledge on active faults in Costa Rica was, in fact, extremely limited. Fault generated earthquakes have, however, been the cause of the majority of the more destructive events suffered in Costa Rica and Central America during the present century.

## *II The Osa-Golfito and San Isidro Earthquakes: A Slow Awakening of Consciousness.*

A relatively long period of low seismic impact in the country was interrupted, in 1983, by two high intensity quakes during a period of three months--the Osa-Golfito subduction quake (7.2 R.), on 2 April; and the San Isidro de El General fault quake (6.2 R.), on 3 July.

This latter quake caused severe damage to the Escalante Pradilla Hospital in San Isidro, and led to the evacuation of the installations.

Structural damage to some 40 of the hospital's 250 ground floor columns and non-structural damage led to economic losses of around 6 million colones (approximately 142 thousand U.S. dollars).[1] The hospital was retrofitted as a result of the earthquake, at a cost of some 15 million colones (approximately 355 thousand U.S. dollars). These expenditures were made during a period of severe financial restrictions on the Social Security System, due to the impact of the economic crisis faced by the country at that time.

Despite the fact that the San Isidro quake was the first to cause major damage to a hospital in Costa Rica in over 70 years, the impact of this event was insignificant in terms of stimulating actions to protect health infrastructure. A limited awakening of consciousness did take place, however, amongst Social Security headquarter officials, and certain hospital directors and

---

[1]. *Throughout the text conversions into dollars have been made at the average exchange rate for the year.*

administrators. The probable structural vulnerability of many hospital facilities was discussed by the engineering staff at the institution's headquarters, and the weaknesses of the "imported" Mexican construction model were recognized, but no concrete action was taken. This can be explained by the presence of a number of more prevailing objective economic, and subjective valorative contexts.

The severe economic restrictions faced by the institution at this time, a low level of consciousness as regards the country's real levels of seismic vulnerability, and the tendency to consider San Isidro to be an isolated and atypical occurrence, were to have a major influence in displacing the problem. Only a latent consciousness existed as regards the vulnerability of the hospital system. The problem was noted, but postponed for future consideration.

Despite the fact that little real attention was paid to the lessons derived from the San Isidro experience at the engineering, architectural, or political level at the Social Security headquarters, the event did have a definitive impact as regards the development of the institution's policy on insurance coverage and protection. The San Isidro quake, and a large-scale fire in the institution's warehouses at the beginning of 1984, were important stimuli for the creation of a specialized Insurance Office at the Social Security Headquarters, and in the search for a more comprehensive and updated insurance coverage.

Despite pressures exerted since 1980 by the institution's Financial Director to improve the insurance coverage, little real advance had been achieved prior to San Isidro. The CCSS basically maintained a philosophy of "self-insurance", and the formal coverage given to its installations was minimal being based on a gross underestimation of real property values. This became clear following the quake when the institution only recovered some 900 thousand colones (21 thousand dollars) from the state insurance company, as compared to the 6 million colones (142 thousand dollars) in damages suffered. The insured value of the Escalante Pradilla Hospital was only 32 million colones (762 thousand dollars), as opposed to its real value of 140 millions (3.3 millions dollars).

Outside of the CCSS, the 1983 quake's impact on the hospital was an important consideration in stimulating two students from the University of Costa Rica's (U.C.R.) Engineering Faculty to undertake their degree project on hospital vulnerability. Under the supervision of two young civil engineers, Miguel Cruz and Roy Acuña, one of the students, Ileana Hidalgo, completed her thesis on the seismic vulnerability of systems in the Calderón Guardia Hospital in San Jose.

This study, completed in mid-984, was the first of its kind in

the country (Hidalgo, 1984). Despite the fact that a structural analysis of the hospital was not completed, the experience gained from the study motivated Cruz and Acuña to continue promoting hospital vulnerability studies.

Toward the end of 1984, they approached the CCSN in order to seek support for further analyses of the hospital system. Although the authorities showed an obvious interest in the proposal, both financial considerations and certain doubts as to the ability of the U.C.R. engineers to adequately undertake such specialized studies, put a brake on the plan. Faced with the lack of real support from the CCSS, Cruz and Acuña sought support from the country's National Science and Technology Council, during 1985. Towards the end of the year they were awarded a grant to study the seismic vulnerability of the country's principle medical installation, the Hospital Mexico. This study would be undertaken during 1986 by two engineering students at the U.C.R., Carlos Herrera and Victor Quirós.

The projects stimulated by Cruz and Acuña on hospital vulnerability represent the only concrete and manifest interest in this topic in Costa Rica prior to the October 1985 Mexico City earthquake. The authorities at the CCSS had as yet to be stimulated to take a definitive move in this direction.

## *III The Mexico (1985) and San Salvador (1986) Quakes: From Consciousness to Action.*

### *1. The Mexico Earthquake*

The earthquake on 19 October 1985 destroyed nearly 60% of Mexico City's installed hospital capacity. The city's principle hospital installations were severely damaged, if not tumbled by the intensity of the quake.

The impact of the quake on hospital infrastructure increased the levels of consciousness of many Costa Rican doctors, given the close links that existed between the Costa Rican Social Security System and its Mexican counterpart. The plans for the Hospital Mexico in San Jose had been a gift from the Mexican Social Security Institute in the early 1960s and the hospital had been built with the help of Mexican experts. Many Costa Rican doctors had been trained in the Mexican hospitals that fell during the quake. And, Costa Rican hospitals employed important components of the Mexican architectural and engineering models in their construction.

Despite these factors, the quake did not, as such, lead to any widescale promotion of vulnerability analyses or retrofitting activities by the CCSS central authorities. Two factors possibly combined to help explain this situation. First, there existed a persistent and still unsatisfactory financial situation in the

institution. This factor, combined with the building plans and programs already committed for 1986, would have made it very difficult for the CCSS to promote any new construction projects (the Mexico quake occurred toward the end of the fiscal year when budgetary allocations for the following year were already under negotiation). Secondly, despite the impact of the Mexico quake, it could also be rationalized to have been a "special" case. The particular subsoil conditions of central Mexico City, and serious problems with the original construction techniques and materials had accentuated the overall impact.

The stimulus for hospital vulnerability studies in Costa Rica during the year between the Mexico and the San Salvador quakes was to come from the authorities of the National Children's Hospital, and through the Mexico Hospital study, promoted by the Engineering Faculty at the U.C.R.

Dr. Edgar Mohs, Director of the Children's Hospital, had studied for many years in Mexico in the hospitals of the Mexican Social Security System. Following the Mexico quake he and other hospital authorities were particularly concerned for the structural conditions of the hospital. This concern was already latent due to their fears, during the previous two years, that the Osa-Golfito quake had caused problems in a structural column and cross beam in the installations.

Following the October quake in Mexico, the hospital authorities asked Franz Sauter, Costa Rica's most reknowned structural engineer, to take a quick look at the hospital and provide criteria as to its structural security. Sauter visited the hospital in December. After a quick revision of the installations and a look at the construction plans, he concluded, in a letter sent to Mohs on 16 December, that the hospital did present difficulties which made it vulnerable to earthquakes.

With these criteria in hand, Mohs requested that the Caja contract a thorough vulnerability study of the hospital. Following a series of discussions as to who should undertake the study, Sauter was finally contracted in April 1986, and presented his diagnosis in mid-June. The study concluded that the hospital needed a thorough retrofitting program. The CCSS agreed to contract this. Dr. Mohs had by this time been installed as Costa Rica's new Minister of Health.

The discussions that took place amongst the CCSS technical staff during the first semester of 1986, were typified by a concern for the need for other vulnerability studies, but also for the problem of available financial resources. The financial aspect seems to have been an overriding consideration in any decision to undertake a more ambitious program. By year's end, the Children's Hospital study and the ongoing Engineering Faculty study of the Mexico Hospital, were the only projects underway.

## 2. *The San Salvador Earthquake*

The 10 October 1986, the San Salvador earthquake also had its major sectoral impact on the hospital system, reducing the city's installed capacity by 60%. Severe structural and nonstructural damage was experienced in six major hospitals, including the General Hospital of the Salvadorean Social Security System.

The impact of this Central American event; the increased consciousness raising efforts of certain Costa Rican structural engineers; the definitive conclusions of the Children's Hospital study and the preliminary conclusions of the Mexico Hospital analysis; the memories of the Mexico and San Isidro quakes; and an improving financial situation at the CCSS, came together to definitively change the policy context of the institution and stimulate the move towards a hospital retrofitting program. The San Salvador quake established a hiatus, and the motivation for stimulating vulnerability analyses and retrofitting activities was "internalized" for the first time among the authorities at the CCSS headquarters.

The developing program would be pushed forward with urgency from this moment onwards. This was principally attributable to the institution's Director of Engineering and Architecture, Jeni Villalobos, and to Alberto Linner, the head of the Architecture Department at CCSS. Dr. Guido Miranda, the institution's Executive Officer, was to give his undivided and unrelenting support to the promotion of the retrofitting activities from this moment onwards.

Following the San Salvador quake, the CCSS Board of Directors expressed its first recorded concerns for the structural security of the institutions' installations, and on 23 October requested information on the state of the studies being promoted in this area. Internal reports were then circulated on the matter, certain planning and policy guidelines were put together, and implementation problems were discussed (including budgetary and human resource considerations).

On the 4 December, the Board of Directors discussed the overall context and, on 11 December, finally authorized the contracting of vulnerability studies and retrofitting plans for structurally insecure buildings. This discussion and decision had been given an added impetus by a lucid presentation on the hospital vulnerability problematic given to the Board of Directors by Franz Sauter on 4 December.

The Board's authorization constituted the first formal acceptance of the institution's retrofitting program. The program thus became official CCSS policy.

The urgency to implement the program and the commitment shown from now on was both its principle ally and, at the same time, would become its principle enemy. As we will analyze further on, the enthusiasm and urgency to get things done was not accompanied by well thought out administrative, planning and coordinating procedures. This context would lead to numerous problems over the following five years.

## *IV The Selection of First Phase Units and the Contracting of Structural Plans*

### *1. The Selected First Phase Units*

The selection of the installations to be included in the first phase of the retrofitting program followed a basically ad hoc process. No overall, in-depth evaluation of hospital and clinic vulnerability took place. Rather, the process took up the inertia already set in motion by the ongoing evaluations of the Children's and Mexico hospitals, and summed a number of other installations according to their suspected vulnerability levels and importance in the structure of the Social Security System.

The ongoing evaluations of the Children's and Mexico Hospitals made it almost inevitable that they would be incorporated in the program from the very beginning. The Monseñor Sanabria Hospital in Puntarenas and the Central Office building in San Jose were immediately incorporated in the evaluation proposals in November 1986. The implicit criteria that they were large, multistory buildings offering the greatest risk to human life and economic investments seems to have been behind this decision. The Monseñor Sanabria Hospital is also the largest provincial hospital in the country and serves a population of some 350,000 persons. The Ciudad Neily Hospital appeared in the formula in 1987. The criteria used to select this relatively modern installation are unclear, although its location in Costa Rica's projected highest risk zone seems to have been one of the factors taken into account.

The exclusion of the remaining 26 hospitals in the country from the first stage program can be explained in terms of a number of different criteria, which were never clearly spelled out, however, in documentary terms.

Four different criteria can be identified:

a. Hospitals in projected low seismic risk zones, including the Tony Facio hospital in Limon, the Guápiles Hospital, and the Los Chiles and Upala hospitals on the northern border with Nicaragua. The Tony Facio hospital was in fact severely damaged by the 1991, 7.2 R, Limón quake and has been subjected to retrofitting procedures as a consequence. Seismic zoning parameters are clearly not down to a fine art as yet.

b. Hospitals where plans already existed for their replacement or substantial remodelling. This included the cases of the hospitals in Alajuela, Liberia, Cartago, Quepos and the San Juan de Dios Hospital in San Jose.

c. Single story or low-rise hospitals, including Nicoya, Golfito, San Ramon, San Vito and the psychiatric hospitals of Chapui and Chacón Paut in San Jose. With the exception of the Tony Facio hospital in Limon, all of the "low" seismic risk zone hospitals are also low-rise buildings.

d. More recent structures, certified to be sound by their designers, including the San Carlos hospital, and the annexes of the Central Offices and Calderon Guardia hospital.

The Blanco Cervantes geriatric hospital and the Polyclinic unit of the Calderon Guardia hospital in San Jose were not considered given that the U.C.R. proposed to include them in a second round of studies, once the Hospital Mexico analysis was completed. The larger clinics were reserved for a second phase of studies, supposedly to start in 1989.

## 2. *The Contracting of Retrofitting Plans and Technical Specifications.*

The dates of the contracting and completion of retrofitting plans are summarized in Table 1.

TABLE 1

DATES OF RETROFITTING PLANS, CONTRACTED COMPANIES AND COSTS

| | Date of Contract | Date of Completion | Company | Cost (Millions of Colones) |
|---|---|---|---|---|
| National Childrens | 23-12-86 | 23-04-87 | Sauter and Company | 1.95 |
| Monseñor Sanabria | 20-02-87 | October 87 | Bel Engineering | 1.39 |
| Mexico | 29-10-87 | July 88 | Bel Engineering | 2.50 |
| Ciudad Neily | 04-12-87 | 02-11-88 | HERIEL S.A. | 1.70 |
| Central Offices (1st Phase) | 20-02-87 | not completed | INGES S.A. | 1.57 |
| Central Offices (2nd Phase) | 11-12-87 | late 1988 | Bel Engineering | 6.00 |

The contracts for the National Childrens Hospital, the Central Offices and the Monseñor Sanabria Hospital were offered directly to the consulting companies, and not opened to public bidding. This was undertaken with the authorization of the Comptroller Office (received on 17 December 1986) and the support of the country's Federated College of Engineers and Architects.

The arguments used by the Caja to justify this procedure were: i) the urgent need to complete the plans, and ii) the fact that the companies were the original designers of the buildings, with the ethical and professional connotations this involved. In fact, Sauter and Associates had not originally designed the Children's Hospital.

The Ciudad Neily contract was also offered to its original designers, INGES S.A. This procedure was to cause severe problems later on, given that the Comptroller's, December 1986, authorization had not covered this company.

The Hospital Mexico contract was opened to public bidding, and awarded to HERIEL S.A., a company formed by Miguel Cruz and Roy Acuña, the engineers that had previously inspired and completed the hospital's vulnerability analysis.

The first contract for the Central Offices of the Caja was left uncompleted. The study of retrofitting options offered two possibilities. Firstly, a cheaper internal solution which would require the builders to occupy 40% of the office space, thus severely interrupting the routine functioning of the staff. And, secondly, a more expensive external, anchored solution which would allow an increase of 6000 sq. meters in the office's working area, i.e., doubling the space. This solution would also permit the continued functioning of the offices during the construction process.

The Caja's Board of Directors finally opted for the anchoring system (at an estimated cost of 200 million colons; 3 million dollars approx). This decision was taken in September 1987, and a new contract was given to Bel Engineering for the construction plans and technical specifications. The architectural plans were drawn up by Alberto Linner at the CCSS head offices. Both sets of plans were completed by late 1988.