7th World Congress on Joints, Bearings and Seismic Systems for Concrete Structures

October 2-6, 2011 ~ Las Vegas, Nevada USA

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American Concrete Institute

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Introduction

The first World Congress on Joints and Bearings was held in Niagara Falls, New York in 1981. Since that very successful meeting, congresses have been held every 5 years: San Antonio, Texas in 1986, Toronto, Ontario Canada in 1991, Sacramento, CA in 1996, Rome, Italy in 2001 and Halifax NS Canada in 2006.

The Congress will serve as a forum to bring together manufacturers, suppliers and installers of joint systems, bearing systems and seismic devices with engineers, specifiers, contractors and researchers to review the present state of knowledge and practice worldwide and to define future research needs.

The technical program during the congress will include keynote and invited speakers, presentation of offered papers and manufacturers exhibits featuring latest technology and reports of technical committees.

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DESIGN & DEVELOPMENT OF THE BASE ISOLATION SYSTEM FOR SEISMIC PROTECTION OF BUILDINGS

Govardhan and D.K.Paul,

S.N. Bagchi and Ratish Jain

Biography: ACI Student member **Govardhan** is a Doctoral Researcher at Earthquake Engineering Department, IIT ROORKEE, INDIA; He received his B.E and M.Tech from Visvesraiah Technological University, Belgaum, Karnataka, INDIA. Doing PhD at IIT ROORKEE and working on Seismic Base Isolation of Structures. His research interests include Seismic resistant design of reinforced concrete structures.

Prof. D. K. Paul is the Head of the Centre of Excellence in Disaster Management and Mitigation and Professor, Department of Earthquake Engineering at IIT ROORKEE. He received his Ph.D. degree in Civil Engineering from University of Wales, U.K., 1982. His research interests are Earthquake Resistant Design of Structures, Seismic Base Isolation of Buildings, Finite Element Analysis, Impact and Blast Response, Dynamic Soil Structure Interaction, Seismic Design of Hydraulic Structures.

S.N. Bagchi received M.Sc degree from BHU and M.Tech from IIT Delhi. In a career spanning 40 years he has been associated with various industry oriented research works and presently at Resistoflex Group of Industries. He heads the Technical Design group and works on design of Vibration and Shock Isolation systems for industrial applications.

Ratish Jain is the the Managing Director of the entire RESISTOFLEX GROUP having 5 manufacturing plants. He has done his B.Tech from IIT Delhi in 1977. He is working in the area of "Vibration Control Systems" for Defense, Space, Building & Industrial Applications, and "Air Suspension Systems" for Railways and Buses, Seismic Base Isolation of Structures and "Flexible Piping Systems" for Buildings & Industrial applications.

ABSTRACT

The paper first shares some of the experiences in the design and development of the seismic bearings. It then focuses on the status of seismic base isolation technology and discusses some of the important initiatives taken to make the technology affordable and easily implementable. Seismic base isolation is one of the most widely implemented and accepted seismic protection systems. This paper also describes the preliminary design and manufacture of a base isolator for a building for earthquake protection. For the proposed two storied base isolated building, the isolation system considered 21 numbers of Laminated Lead Rubber Bearing (LLRB). The different vertical loads from the columns for the design of LLRB system was optimized to three load cases such as 750kN, 1000kN, and 1500kN. The bearings are worked out based on the building configuration and its performance.

Keywords: Seismic Base Isolation, Earthquake protection, Laminated Lead Rubber Bearings, Hysteretic damping.

INTRODUCTION

Past earthquakes, especially in developing countries, have indicated that major loss of life often occurs due to the collapse of poorly constructed buildings. If the level of seismic demand on these buildings were reduced through a simple but reliable engineering solution, this would result in fewer building failures and less loss of life. Base isolation, which is aimed at reducing the seismic demand instead of increasing the earthquake-resistant capacity of the structure, is an attractive alternative to conventional earthquake-resistant design methods. Seismic base isolation is one of the most widely implemented and accepted seismic protection system. However, in India seismic base isolation has not picked up as an earthquake protection measure in the buildings and structures. Only a four storey hospital building at Bhuj has been constructed using this technology where the base isolators were brought from New Zealand. There is an effort now to use this technology and manufacture

these bearing in the country itself. This has become possible because of collaboration between the traditional bearing manufacturer and academicians from technical institution.

The isolation system mitigates the effects of an earthquake by essentially isolating the superstructure and its contents from potentially damaging ground motion. Accurate evaluation of the structural properties and precise modeling of isolation devices are of utmost importance in predicting the response of the structure during the earthquakes. The most common isolation system used is Laminated Lead Rubber Bearings (LLRB). They combine the function of isolation and energy dissipation in a single compact unit, giving structural support, horizontal flexibility, damping and a centering force in a single unit. The force deformation behavior of LLRB is modeled as bilinear system with viscous damping.

Seismic isolation is a relatively recent and evolving technology. It has been in increased use since the 1980s, and has been well evaluated and reviewed internationally. Base isolation has now been used in numerous buildings in countries like Italy, Japan, New Zealand, China and USA. Base isolation is also useful for retrofitting of important buildings (like *hospitals* and *historic buildings*). By now, over 1000 buildings across the world have been equipped with seismic base isolation.

INDIAN EXPERIENCE

In India, seismic base isolation was first used in masonry buildings. Arya *et al.* (1978), Arya (1984) carried out tests where the performance of brick masonry buildings were tested. It was observed that the buildings with a sliding base isolation system performed better than a conventional building. Deb (1993) designed and developed laminated rubber bearing (LRB) having cross section of 102mm x 102 mm and a total height of 152 mm suitable for medium rise RC model building and studied the performance both by analytically and experimentally. Extensive testing was carried out on the base isolators to evaluate the engineering properties. The important factors influencing the overall response of the base isolated building such as

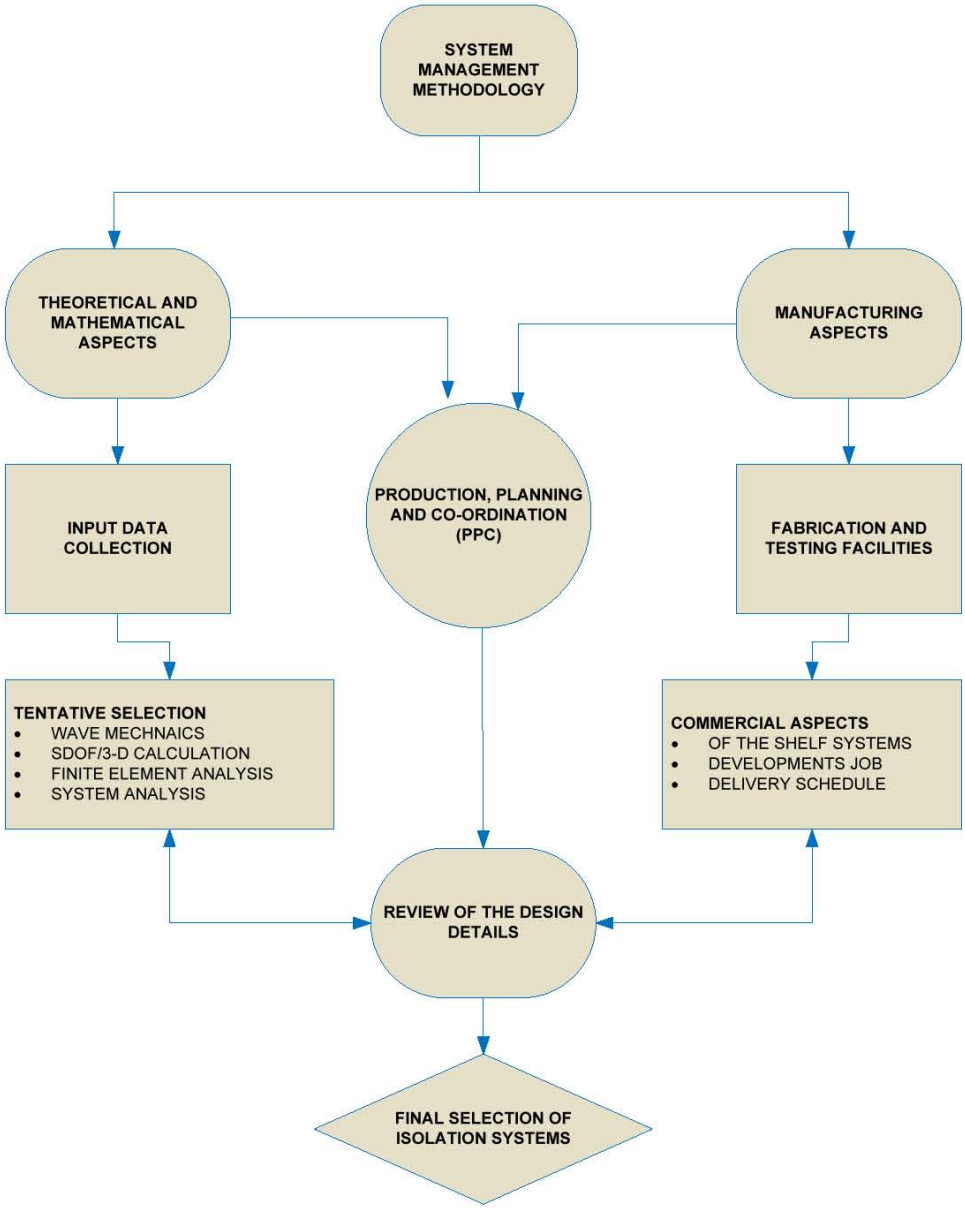

Fig. 4 - Flowchart for Industrial Design and Manufacturing