



UNIVERSIDAD NACIONAL DE INGENIERIA  
FACULTAD DE INGENIERIA CIVIL



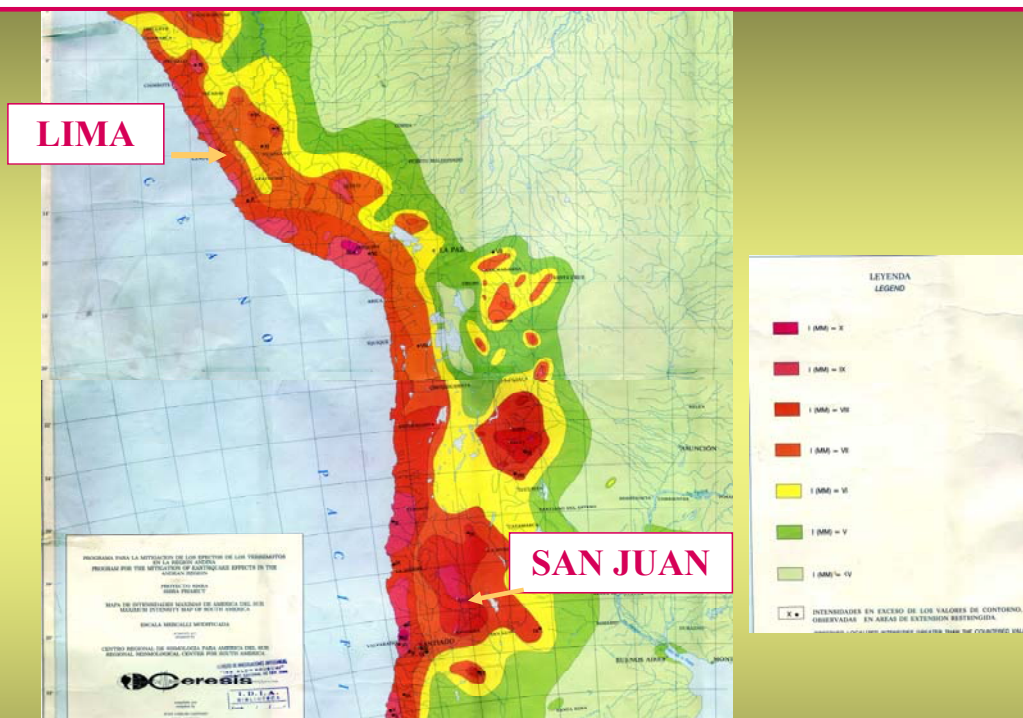
Centro Peruano Japonés de Investigaciones  
Sísmicas y Mitigación de Desastres

THE 1st JAPAN WORKSHOP ON ENHANCEMENT OF  
EARTHQUAKE AND TSUNAMI DISASTER MITIGATION TECHNOLOGY  
LIMA, MARCH 15-16, 2010

THE OBLIGATORY OFFICIAL TECHNICAL AUDITS  
APPLIED DURING MORE THAN FIFTY YEARS FOR  
THE EARTHQUAKE SAFETY ON THE CONSTRUCTION  
OF SAN JUAN, ARGENTINA

Juan S. Carmona  
Universidad Nacional de San Juan – Argentina  
Profesor Honorario de la U.N.I. – Lima - Perú

MAXIMUM SEISMIC INTENSITIES  
CERESIS - 1985



“WHERE IT FELT EARTHQUAKE, IT WILL BE FELT AGAIN THERE”  
PLINIO THE OLD (roman naturalist, first century)



THE 1st JAPAN-PERU WORKSHOP ON ENHANCEMENT OF  
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# EARTHQUAKE January 15, 1944- M=7,2

**GREAT DAMAGE ON THE CITY OF SAN JUAN, ARGENTINA,  
8 a 10000 DEATHS , 15% OF ITS POPULATION      epicentral  
distance  $\approx$  30 km**



**MERCALLI INTENSITY: IX**



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# EARTHQUAKE January 15, 1944- M=7,2

**THE CATHEDRAL OF THE CITY OF SAN JUAN  
epicentral distance  $\approx$  30 km**



**BEFORE THE EARTHQUAKE**



**THE INTERIOR AFTER  
THE EARTHQUAKE**



**PARTIAL COLAPSE ON  
EXTERNAL WALL**



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**AFTER THIS 1944 DISASTER, THE NATIONAL GOVERNMENT OF ARGENTINE CREATED THE COUNCIL FOR THE SAN JUAN RECONSTRUCTION**

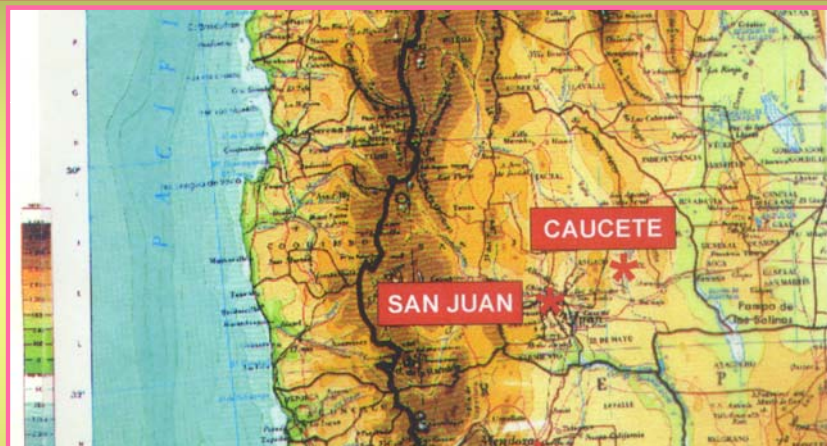
**BETWEEN ITS ACTIVITIES, WERE INCLUDED TO DICTATE A SEISMIC BUILDING CODE AND TO SUPERVISE ITS EFFECTIVE USE IN THE DESIGN AND BUILD STEPS OF ALL TYPES OF PRIVATE AND OFFICIAL CONSTRUCTIONS.**

**TO THIS PURPOSE, ONE SELECTED GROUP OF OFFICIAL PROFESSIONALS SUPERVISED THAT THE ASSUMPTIONS APPLIED ON THE DESIGN PLANS AND THE TECHNICS USED TO BUILD THE CONSTRUCTION, WERE IN CORRESPONDENCE WITH THE SEISMIC CODE.       THUS, THE OBLIGATORY OFFICIAL TECHNICAL AUDITS WERE IMPLEMENTED.**



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**DURING NOVEMBER 1977, THE FULL-TEST OF THE EARTHQUAKE DISASTER MITIGATION TECHNOLOGY APPLIED IN SAN JUAN AFTER THE JANUARY 15, 1944 EARTHQUAKE, OCCURRED.**



**EARTHQUAKE November 23, 1977- M=7,4**

**SAN JUAN CITY, epicentral distance  $\approx$  60 km , IMM = VIII**

**CAUCETE CITY, epicentral distance  $\approx$  30km , IMM = IX**



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# EARTHQUAKE November 23, 1977- M=7,4



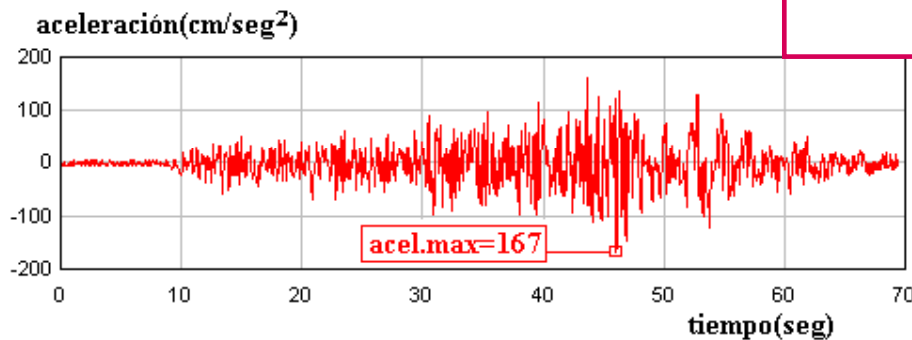
**CITY OF SAN JUAN (epicentral distance  $\approx$  60 km , IMM=VIII)  
NEITHER BUILDING COLLAPSED NOR DEATHS OCCURRED**



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LIMA, MARCH 15-16, 2010

# EARTHQUAKE November 23, 1977- M=7,4

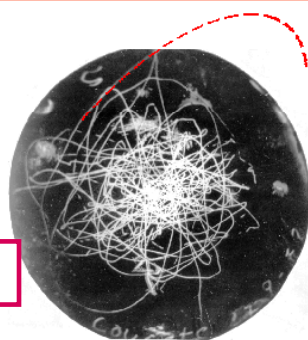
**SISMO CAUCETE 23-XI-1977  
ACELEROGRAMA IDIA77-EO**



**SEISMOSCOPE IN I.D.I.A.  
SA= 0,26g**

**CITY OF SAN JUAN**

**CAUCETE**

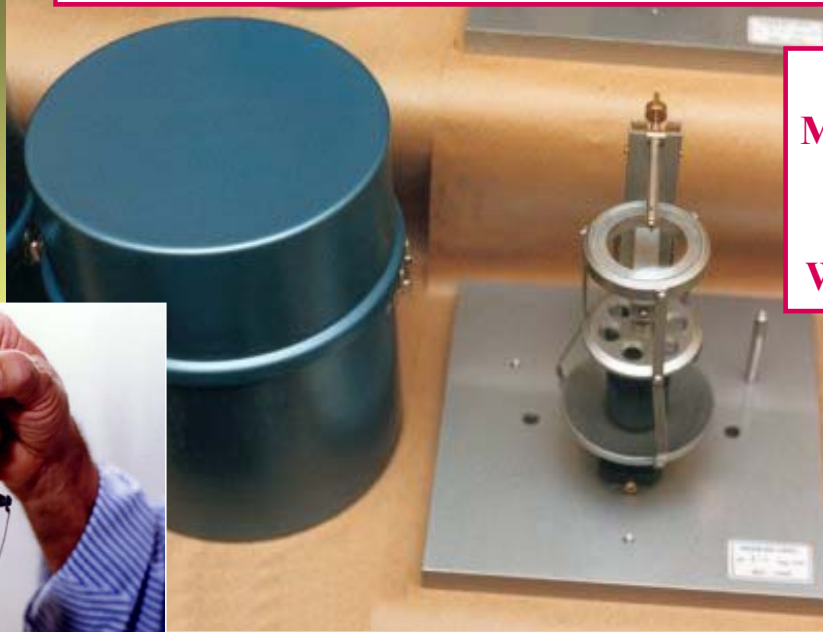


**SISMO CAUCETE 23-NOV-1977  
ESCUELA VIEYTES - CAUCETE  
SISMOSCOPIO TIPO WILMOT  
PERIODO 0,7seg , AM=10%  
SA = 0,75 a 0,80 g**



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## WILMOT TYPE SEISMOSCOPE



**EQUIVALENCE OF  
MERCALLI INTENSITY  
WITH AMPLITUDE OF  
THE RECORD ON  
WILMOT SEISMOSCOPE**

<u>IMM</u>	<u>SA(SisW)</u>
VI	0,08g
VII	0,15g
VIII	0,30g
IX	0,60g
X	1,20g



**MECHANICAL VIBRATORY LINEAL SYSTEM  
PERIOD: 0,7 seg. ; 10% DAMPING**

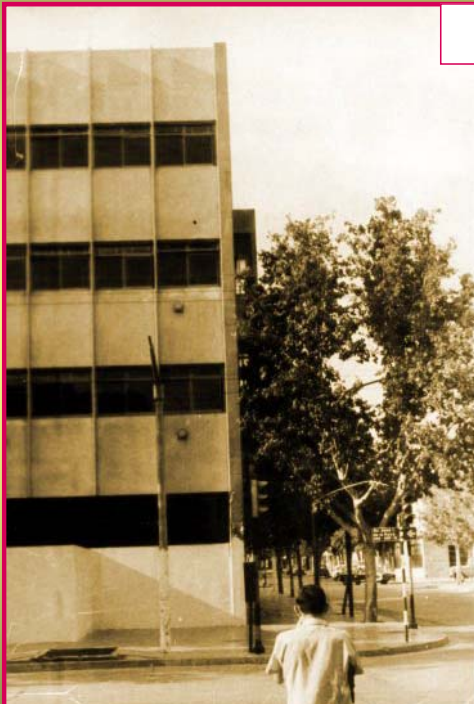


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## **EARTHQUAKE November 23, 1977- M=7,4**

**CITY OF SAN JUAN - ENET N°4 BUILDING SCHOOL  
FIRST FLOOR WITHOUT WALLS - IMPORTANT DAMAGE ON COLUMNS**

**epicentral distance  $\approx$  60 km , IMM = VIII**

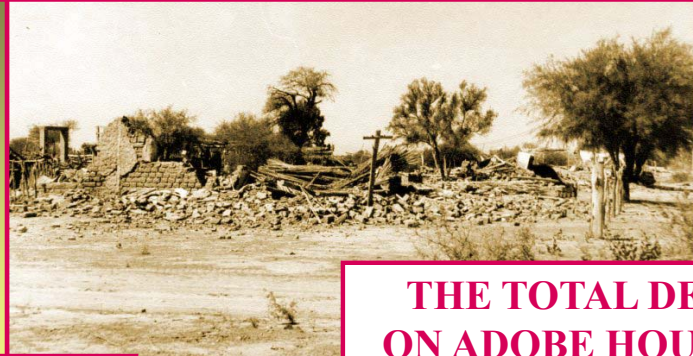


**LESSON LEARNED AND THEN INCLUDED ITS CONSIDERATION IN THE CODE**



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# EARTHQUAKE November 23, 1977- M=7,4



**THE TOTAL DESTRUCTION  
ON ADOBE HOUSES SEVERAL  
DEATHS CAUSED**

**BERMEJO TOWN  
EPICENTRAL AREA**

**IMM  $\approx$  IX - X**



**WITHOUT DAMAGE,  
SUCCESSFUL TEST**



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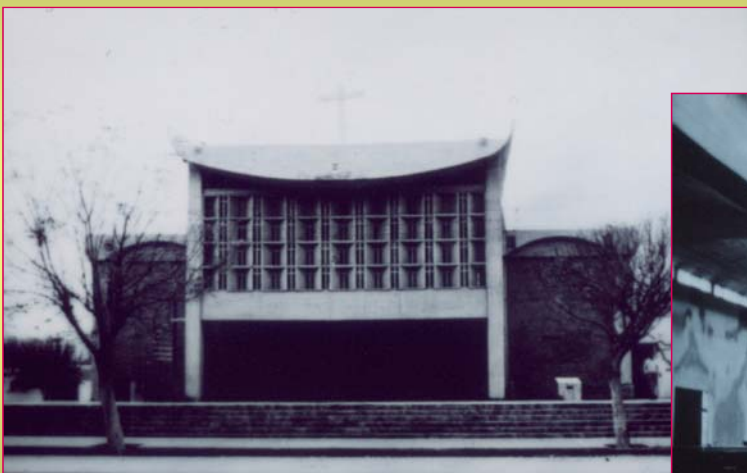
# EARTHQUAKE November 23, 1977- M=7,4

**CRISTO REY CHURCH**

**ONLY MINOR DAMAGE**

**CAUCETE CITY  
epicentral distance  $\approx$ 30km  
IMM = IX**

**WILMOT SEISMOSCOPE  
SA= 0, 55g**



**DESIGNED WITH HORIZONTAL FORCES FROM  $C_s= 0,15$**



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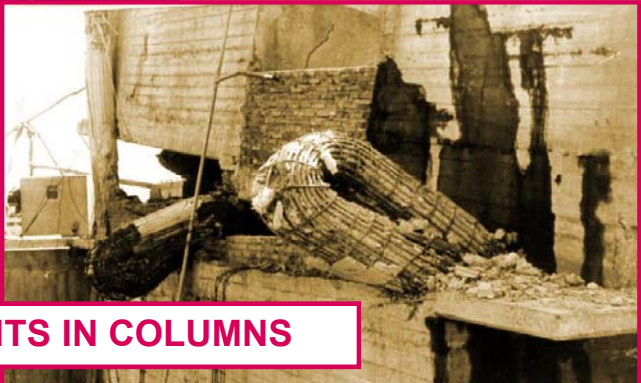
# EARTHQUAKE November 23, 1977- M=7,4



**SEGURA WINERY  
COLAPSED**

**CAUCETE CITY**  
epicentral distance  $\approx 30\text{km}$   
IMM = IX

**WILMOT SEISMOSCOPE**  
SA= 0, 55g



**HIGH DENSITY OF STEEL REINFORCEMENTS IN COLUMNS**

**LESSON LEARNED AND THEN INCLUDED ITS CONSIDERATION IN THE CODE**



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# EARTHQUAKE November 23, 1977- M=7,4

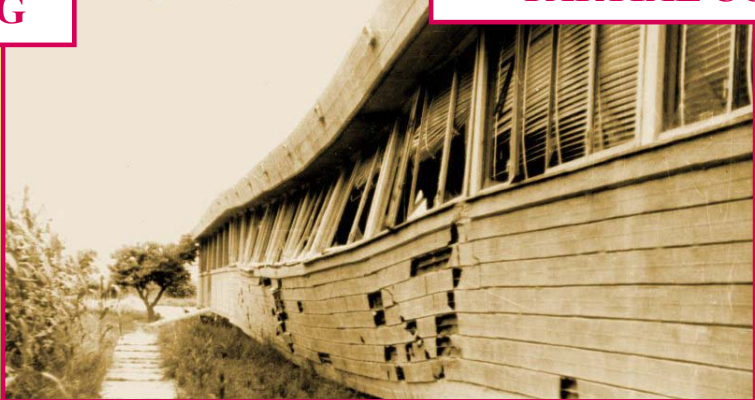
**CAUCETE CITY**  
epicentral distance  $\approx 30\text{km}$   
IMM= IX

**WILMOT  
SEISMOSCOPE**  
SA= 0, 55g

**“ESCUELA NORMAL”  
SCHOOL BUILDING**



**GREAT DAMAGE WITH  
PARTIAL COLAPSES**



**BUILDING WITHOUT THE OBLIGATORY OFFICIAL TECHNICAL AUDITS**

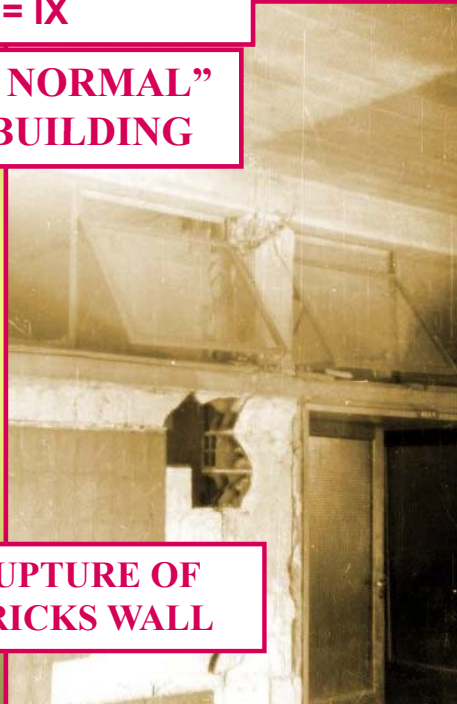


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# EARTHQUAKE November 23, 1977- M=7,4

**CAUCETE CITY**  
epicentral distance  $\approx 30\text{km}$   
IMM= IX

**“ESCUELA NORMAL”  
SCHOOL BUILDING**



**BRITTLE RUPTURE OF  
HOLLOW BRICKS WALL**

**WILMOT SEISMOSCOPE**  
SA= 0, 55g



**SHORT COLUMN EFFECT**

**LESSON LEARNED AND THEN INCLUDED ITS CONSIDERATION IN THE CODE**



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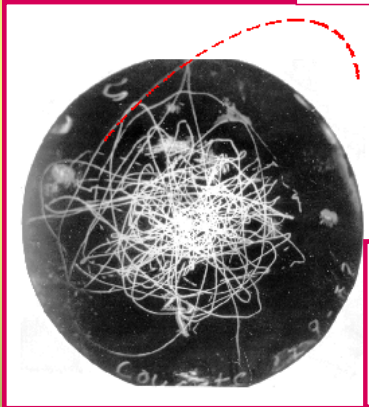
# EARTHQUAKE November 23, 1977- M=7,4

**CAUCETE CITY**  
epicentral distance  $\approx 30\text{km}$   
IMM= IX- X

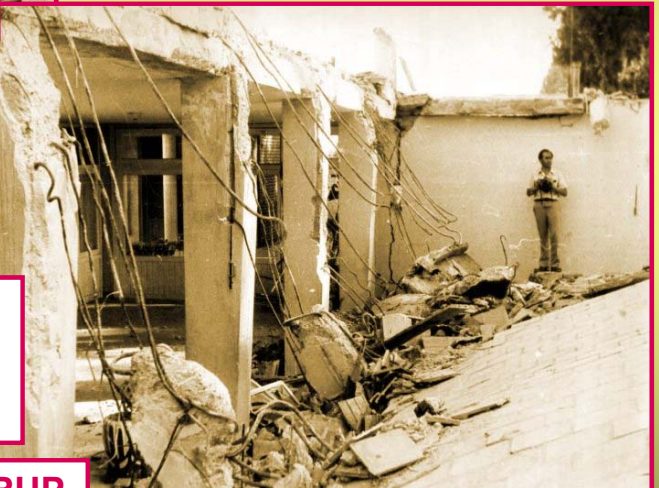
**“ESCUELA VIEYTES”  
SCHOOL BUILDING**



**PARTIAL COLAPSED**



**WILMOT  
SEISMOSCOPE**  
SA= 0,75-0,80g



**SHORT COLUMN EFFECT – SCARCE STIRRUP**

**LESSON LEARNED AND THEN INCLUDED ITS CONSIDERATION IN THE CODE**



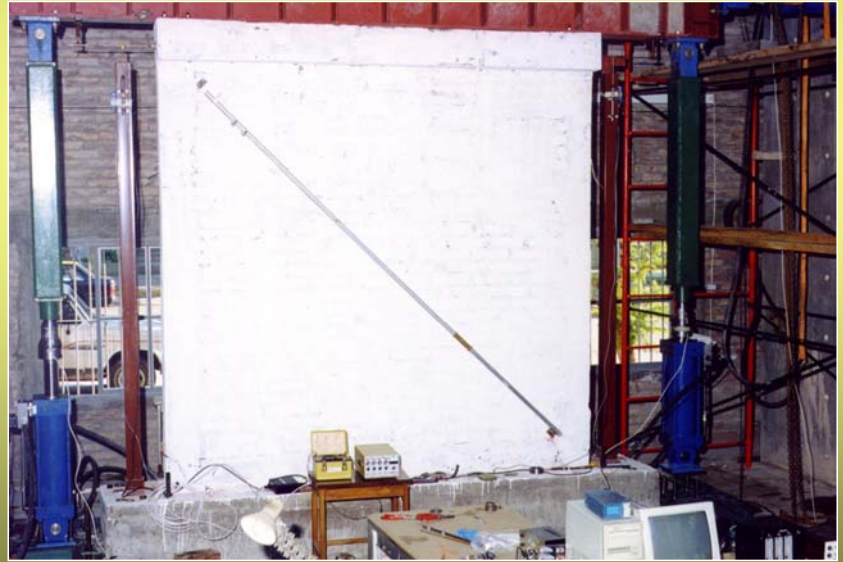
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**ENSAYOS EN MURO REACTIVO  
PANELES DE MAMPOSTERIA EN ESCALA NATURAL  
APLICACIÓN DE FUERZAS HORIZONTALES ALTERNATIVAS**



**INSTITUTO DE INVESTIGACIONES ANTISISMICAS  
UNIVERSIDAD NACIONAL DE SAN JUAN**

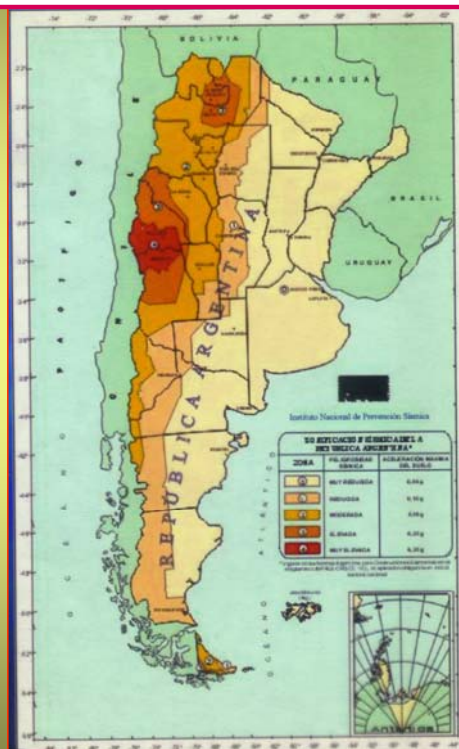


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**WITH THE LESSONS LEARNED AND OTHER STUDIES**

**EARTHQUAKE BUILDING CODE OF ARGENTINA  
INPRES-CIRSOC 103**

**SEISMIC ZONES**



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**UP TO THE DATE, THE EARTHQUAKES ARE NOT PREDICTABLES AND THEY OCCUR SUDDENLY.**

**IF AN EARTHQUAKE OCCURS, IT IS IMPOSSIBLE TO AVOID IMMEDIATELY THEIR DESTRUCTIVE EFFECTS.**

**ONE OF THE BEST TOOLS TO MITIGATE THE EARTHQUAKE EFFECTS, IS TO APPLIED THE OBLIGATORY OFFICIAL TECHNICAL AUDITS TO THE DESIGN AND CONSTRUCTION OF THE BUILDINGS ON SEISMIC AREAS.**



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**A LAS DISTINGUIDAS AUTORIDADES de la  
UNIVERSIDAD NACIONAL DE INGENIERIA, de su  
FACULTAD DE INGENIERIA CIVIL y del CISMID**

**MUY HONRADO POR VUESTRA INVITACION Y  
NUESTROS MEJORES AUGURIOS PARA ESTA  
NUEVA ETAPA DE ACTIVIDADES DEL CISMID !!!**

**marzo del 2010**



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LIMA – PERU – junio de 1960



**II SIMPOSIO PANAMERICANO DE ESTRUCTURAS  
UNIVERSIDAD NACIONAL DE INGENIERIA  
LIMA-PERU-enero de 1964**



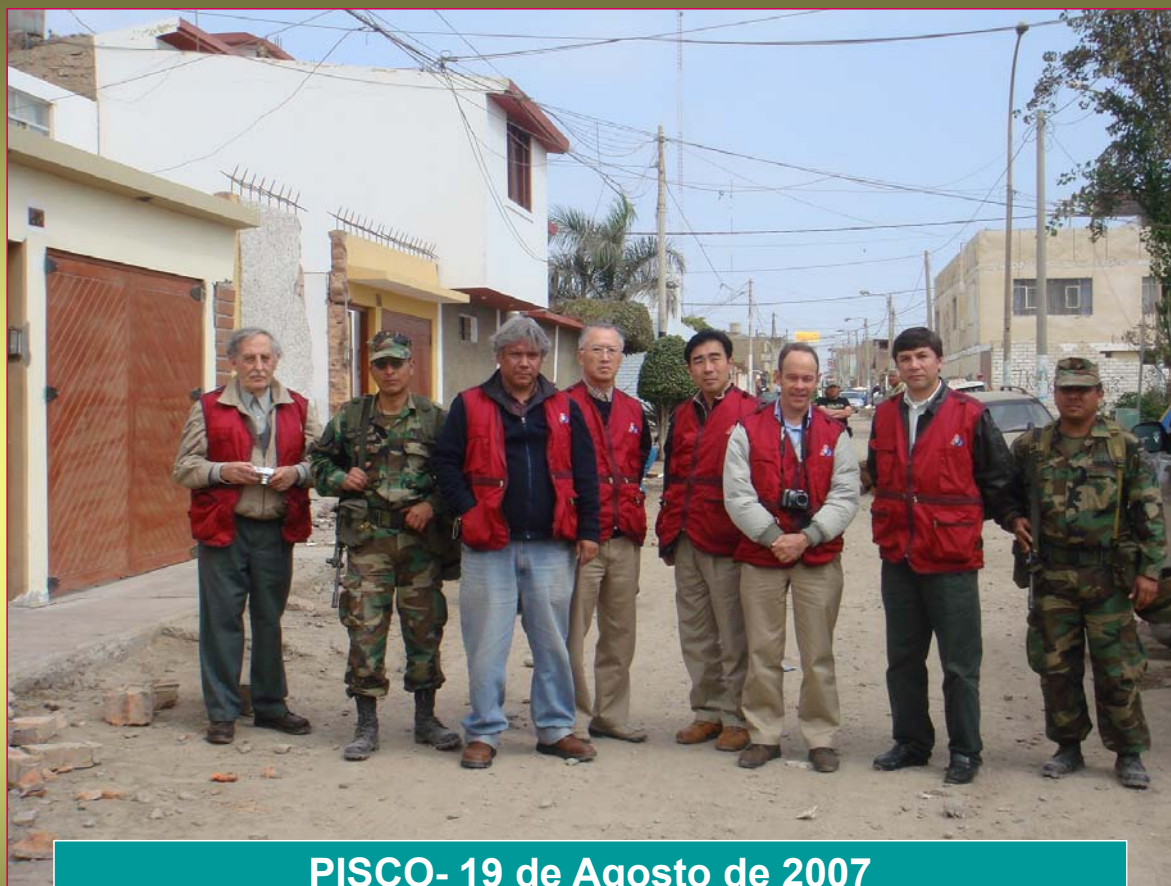
**PALACIO DE PIZARRO  
Presidente Arq. BELAUNDE TERRY**

LIMA – PERU – junio de 2007



RECTOR U.N.I. – Ing. MORALES

PROFESOR HONORARIO U.N.I. – Ing. JUAN S. CARMONA



PISCO- 19 de Agosto de 2007



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**ESTIMADOS COLEGAS  
MUCHAS GRACIAS POR SU  
PACIENCIA !!!**



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