



March 4–8, 2013

# MAULE EARTHQUAKE WORKSHOP

# CONCEPCIÓN, CHILE

## **THE KINEMATIC OF THE MOTION PERCEIVED IN THE TALL BUILDINGS OF BUENOS AIRES CITY CAUSED BY THE GREAT 2010 CHILEAN SEISMIC EVENT**



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# BUENOS AIRES CITY AND THE EPICENTRAL AREA OF THE GREAT 2010 CHILEAN SEISMIC EVENT



**2010 GREAT CHILEAN EARTHQUAKE  
DISPLACEMENT OF EARTH CRUST BY GPS (BARRIENTOS S.,2010)**

# **THE MOTION PERCEIVED IN THE TALL BUILDINGS OF BUENOS AIRES CITY CAUSED BY THE GREAT 2010 CHILEAN SEISMIC EVENT**

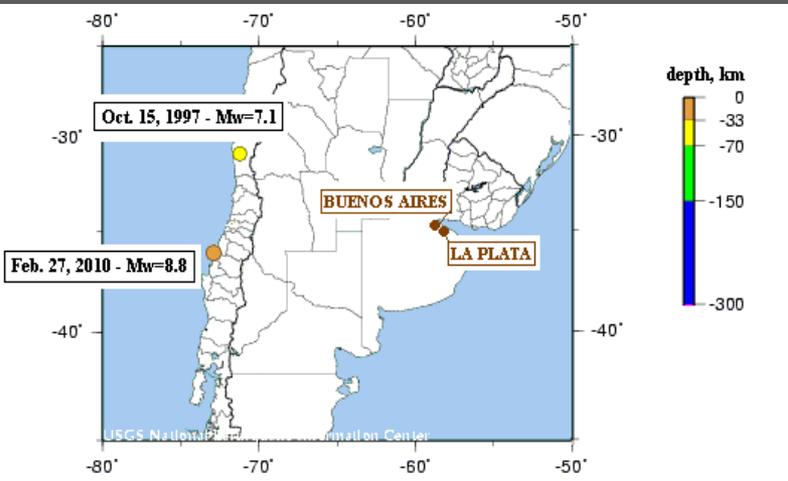
**ON FEBRUARY 27, 2010, AT APPROXIMATELY 3hs 35m LOCAL TIME,  
6hs 35m UTC, AND DURING SEVERAL TENS OF SECONDS, THE  
OCCUPANTS OF THE UPPER LEVELS OF THE TALLEST BUILDINGS  
OF BUENOS AIRES CITY, THE CAPITAL OF ARGENTINA, SUDDENLY  
PERCEIVED OSCILLATIONS WHOSE AMPLITUDES, FREQUENCIES  
AND DURATION GENERATED UNPLEASANT EMOTIONS AND  
SOMETIMES ALSO CONSIDERABLE ALARM BECAUSE THEY  
ASSUMED IT WAS AN UNKNOWN EMERGENCY WHICH COULD  
AFFECT THE STRUCTURAL STABILITY OF THE BUILDING.**

**AFTER THE MOTION CEASED, THE FIRST INSPECTION OF THE  
BUILDINGS DID NOT DETECT ANY DAMAGE, BUT MANY  
INHABITANTS EVACUATED THEM.**

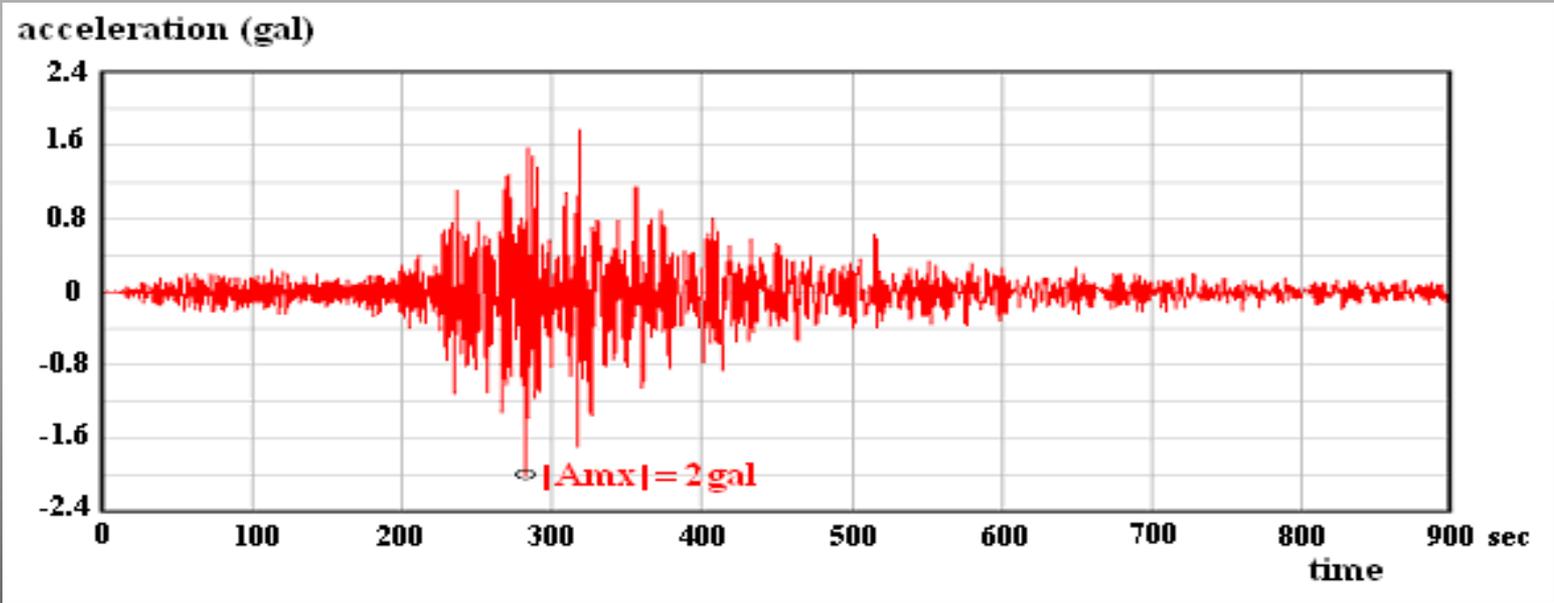
# **THE MOTION PERCEIVED IN THE TALL BUILDINGS OF BUENOS AIRES CITY CAUSED BY THE GREAT 2010 CHILEAN SEISMIC EVENT**

**AFTERWARDS, WHEN THE NEWS OF THE GREAT EARTHQUAKE THAT SHOOK THE CENTRAL SOUTHERN TERRITORY OF CHILE BROKE, THOSE FRIGHTENED OCCUPANTS OF THE TALL BUILDINGS OF BUENOS AIRES CITY LEARNT THAT THE CAUSE OF THE OSCILLATIONS IN THOSE BUILDINGS WERE THE SEISMIC WAVES GENERATED IN THE EPICENTRAL AREA 1300KM AWAY AND WHICH HAD PROPAGATED TO THE SITE.**

**HOWEVER, THESE SEISMIC WAVES WERE NOT FELT BY THE PEOPLE WHO WERE AT GROUND LEVEL IN THE SAME CITY.**

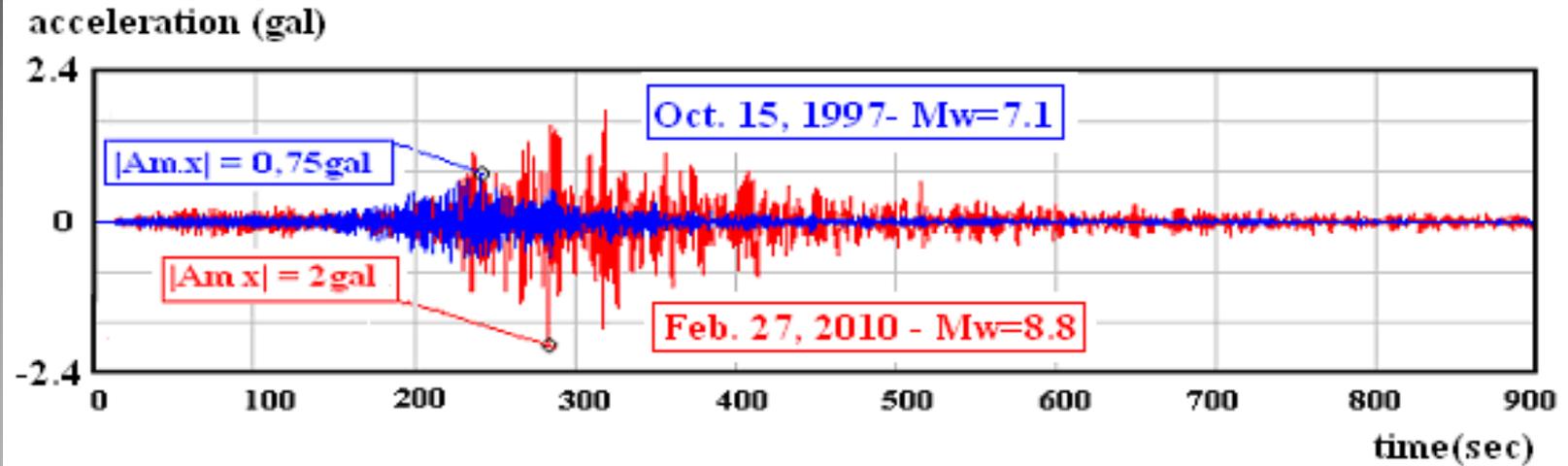


**LA PLATA SEISMOLOGICAL STATION IS LOCATED 50KM AWAY FROM BUENOS AIRES CITY AND HAS THE SAME TYPE OF SUBSOIL.**



**N-S COMPONENT OF LA PLATA ACELEROGRAM RECORDED DURING 2010 GREAT CHILEAN EARTHQUAKE**

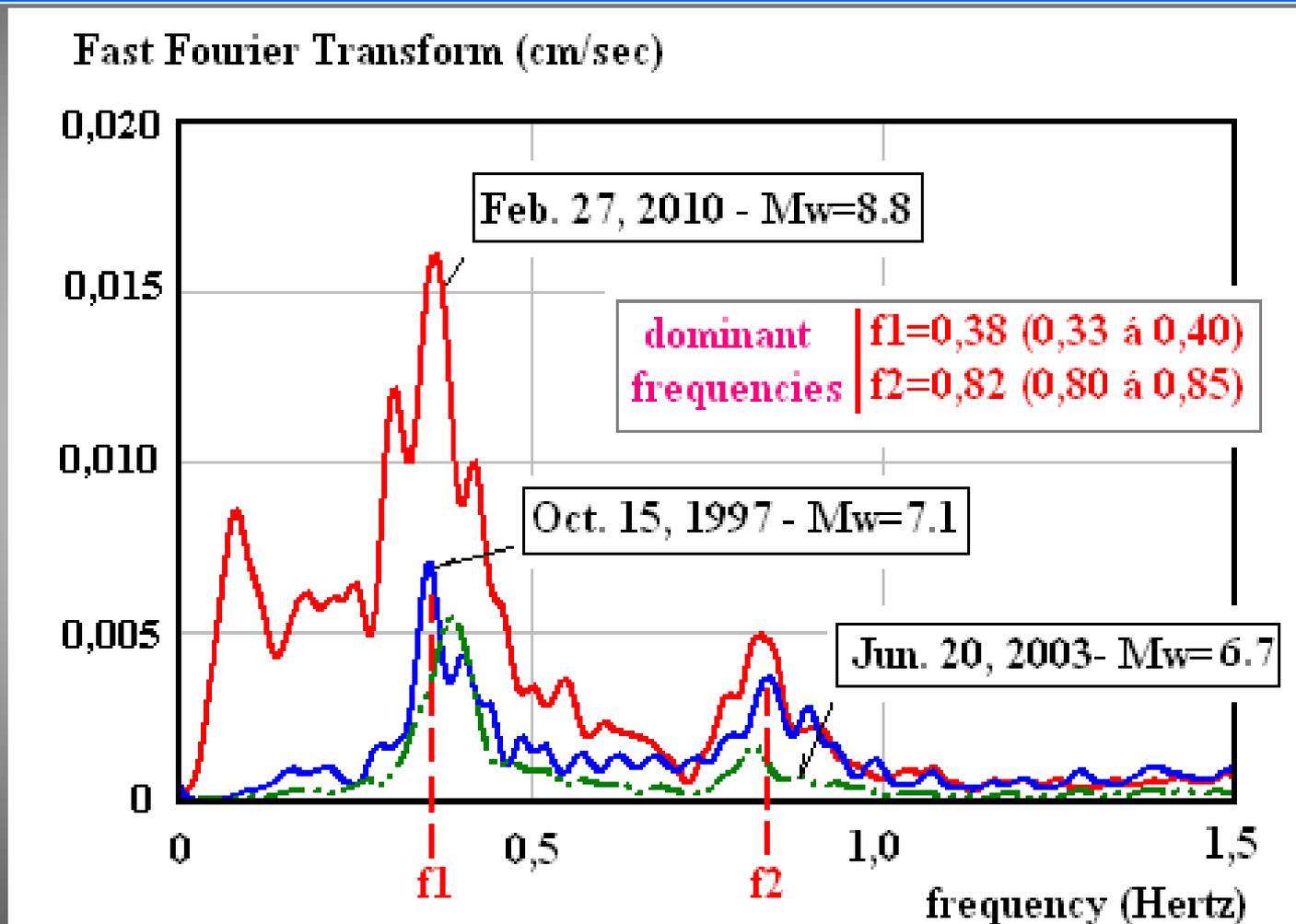
# N-S COMPONENTS OF LA PLATA ACCELEROGRAMS OF FEB.27, 2010 MW=8.8 AND OCT. 15, 1997 MW=7.1



DATE	Am <sub>x</sub> (NS) (gal)	Vm <sub>x</sub> (NS) (cm/seg)	$T_{AV} = 2\pi Vm_x/Am_x$ (seg)	DUR <sub>0,25Am</sub> (seg)	DUR <sub>0,5Am</sub> (seg)
Oct. 15, 1997	0,75	0,26	2,2	213	97
Jun. 20, 2003	0,60	0,25	2,6	135	30
Feb. 27, 2010	2,00	1,50	4,7	239	130

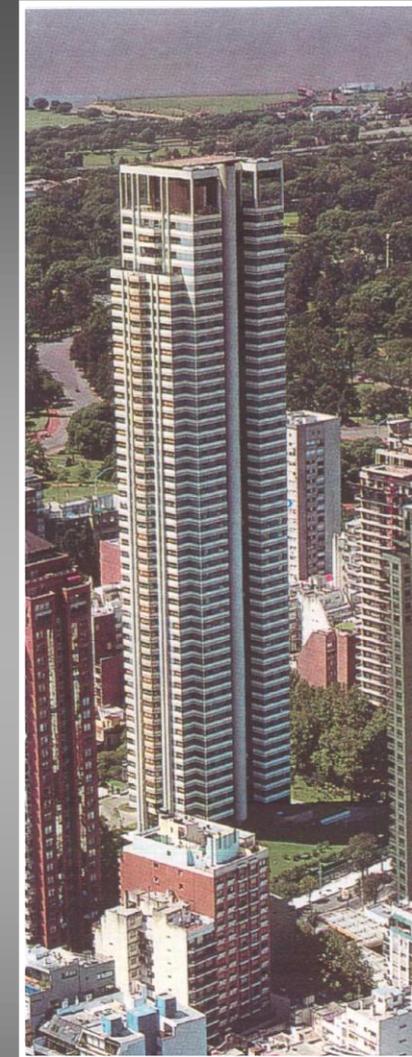
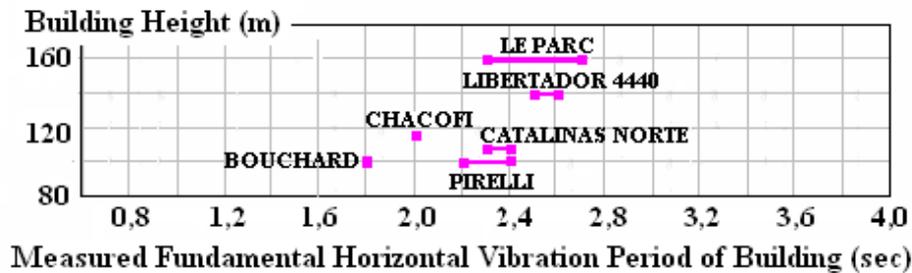
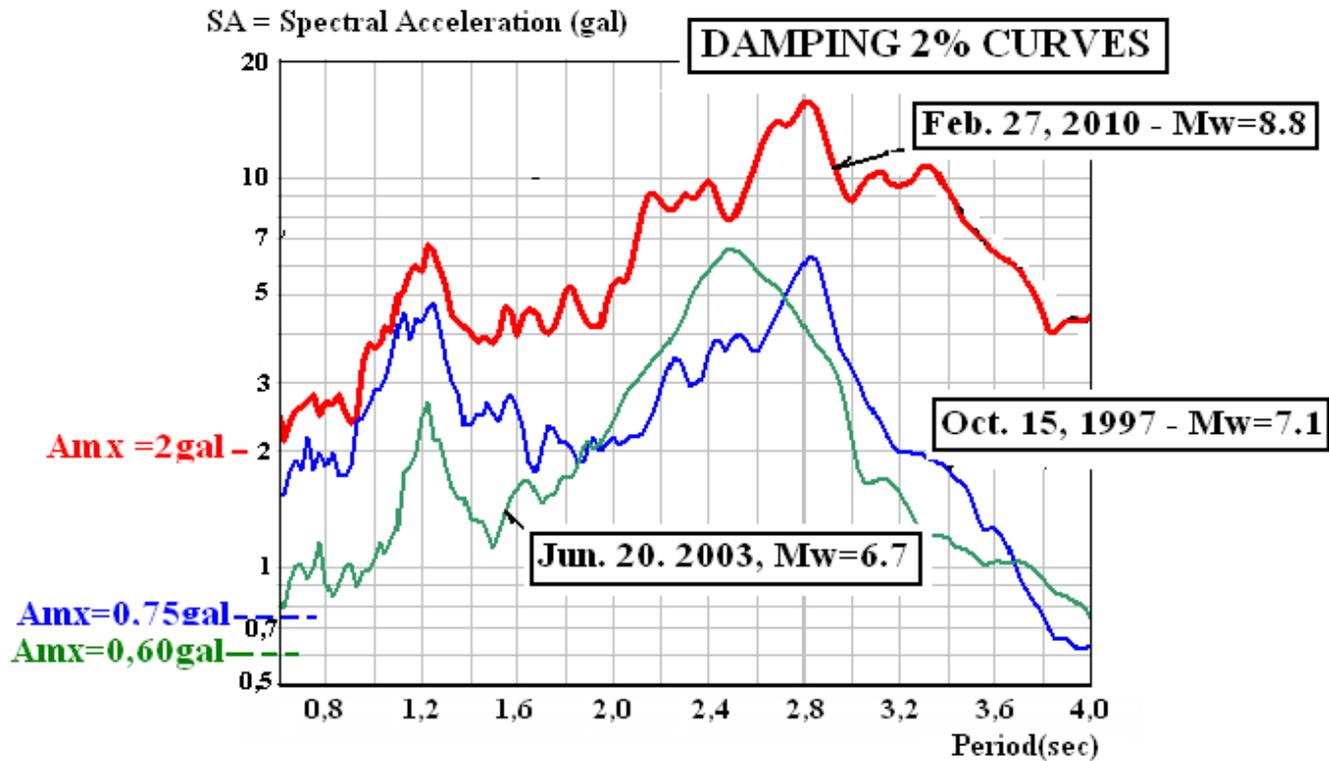
**KINEMATIC PARTICULARITIES OF THE LA PLATA  
ACCELERATION RECORDS CONSIDERED**

**THE TWO FREQUENCIES ARE ASSOCIATED WITH SUBSOIL NATURAL VIBRATION PROPERTIES OF LPA, CORRESPONDING TO THE QUATERNARY LOESS OF ARGENTINIAN “PAMPAS” WITH APPROXIMATELY 500m THICKNESS.**



**FAST FOURIER TRANSFORM OF THREE OF THE CHILEAN ACCELEROGRAMS RECORDED IN LA PLATA**

# HORIZONTAL SEISMIC ACCELERATION AT GROUND LEVEL IN BUENOS AIRES CITY



**LE PARC TOWER  
HEIGHT: 160 m**

**DAMPING 2% ACCELERATION RESPONSE CURVES AND  
BUILDING HORIZONTAL VIBRATION PERIOD**

## CONCLUSION A

**THE ACCELEROGRAM RECORDED IN LA PLATA, LPA, DURING THE 2010 GREAT CHILEAN SEISMIC EVENT SHOWS A MAXIMUM ACCELERATION OF  $A_{mx}=2\text{GAL}$  IN THE N-S COMPONENT AND ONE RELATIVELY LONG STAY IN TIME OF THE LARGER VALUES.**

**THE RESULTING MAXIMUM VELOCITY IS  $V_{mx}=8\text{cm/sec}$  WITH A LARGE CHARACTERISTIC PERIOD**

**$T_{AV}=2\pi \cdot V_{mx}/A_{mx}=4.7\text{sec}.$**

## CONCLUSION B

IN EVERY ACCELEROGRAM RECORDED IN LPA, THE FAST FOURIER TRANSFORM (FFT) SHOWS TWO OUTSTANDING FREQUENCIES OF APPROXIMATELY 0.35 C/S (PERIOD OF  $T=2.85$ SEC) AND 0.85 C/S (PERIOD OF  $T=1.18$ SEC). IT CAN BE ASSUMED THAT THESE TWO FREQUENCIES ARE ASSOCIATED WITH THE SUBSOIL NATURAL VIBRATION PROPERTIES OF LPA, WHICH IS QUATERNARY LOESS OF THE ARGENTINEAN PAMPAS OF NEARLY 500m IN THICKNESS.

## CONCLUSION C

**THE 2% DAMPING VALUE ACCELERATION RESPONSE CURVE SHOWS PEAKS AT APPROXIMATELY 1.2SEC AND 2.7SEC, LIKE THE DOMINANT PERIODS DETECTED IN ITS FFT. THESE ACCELERATION PEAKS ARE 7 AND 16 GALS RESPECTIVELY, WHICH ARE 3.5 AND 8AMX TIMES THE MAXIMUM GROUND ACCELERATION, WHILE THERE IS A MINIMUM OF 2AMX FOR PERIODS BETWEEN THEM.**

## CONCLUSION D

THE PERIOD VALUES OF THE TALL BUILDINGS OF BUENOS AIRES CITY ARE ON THE SAME INTERVALS AS THE LARGEST VALUES OF THE ACCELERATION RESPONSE CURVE. IF THE BUILDING MODAL SHAPE IS INCLUDED, ON THE UPPER LEVELS OF MORE THAN 25 FLOORS, THE MOTION AMPLITUDE WILL NOT BE LOWER THAN FOUR TIMES THE MAXIMUM GROUND ACCELERATION. THIS MEANS THAT THERE CAN BE AN ACCELERATION OF 8 GALS INCREASING TO 25GALS. THIS RESULT IS SIGNIFICANT BECAUSE IT EXPLAINS WHY PEOPLE WHO LIVE ON THE UPPER LEVELS OF TALL BUILDINGS CLEARLY PERCEIVE OSCILLATIONS WHEN LARGE MAGNITUDE SEISMIC EVENTS OCCUR IN THE CHILEAN TERRITORY, WHILE THE EARTHQUAKE WAVES ARE ALMOST IMPERCEPTIBLE AT GROUND LEVEL.



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**THANKS FOR YOUR ATTENTION !!!!!**