

*JICA International Video Conference on  
Feasible and Affordable Seismic Construction  
February 08, 2007*

# Proposal of Seismic Base Isolation using Scrap Tire Pads\*

\* for Serial Number 5, Component number 2-3

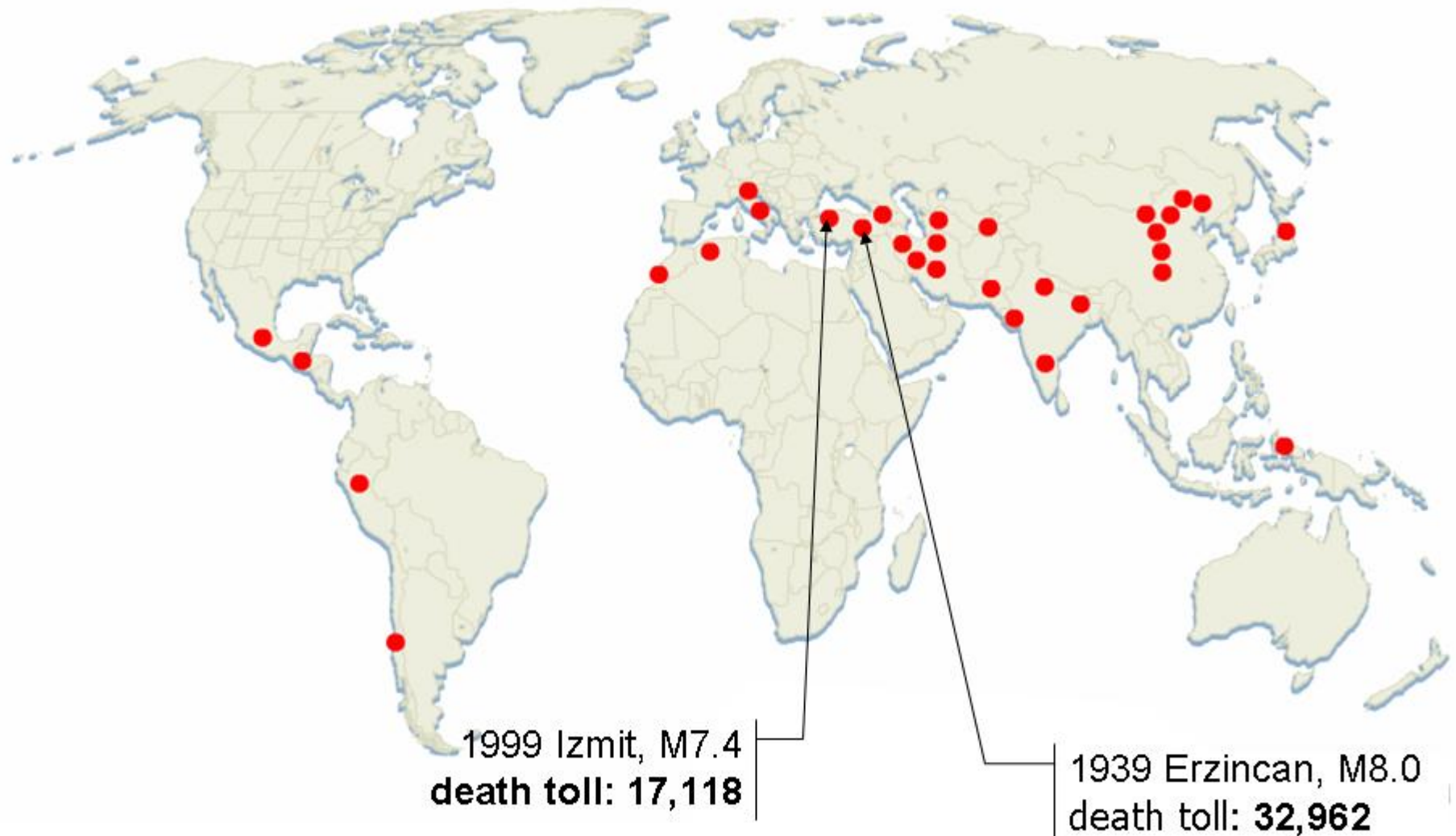
**Middle East Technical University  
Civil Engineering Dept.  
Structural Mechanics Lab.  
Ankara, TURKEY**

**Asst. Prof. Dr. Ahmet Turer**

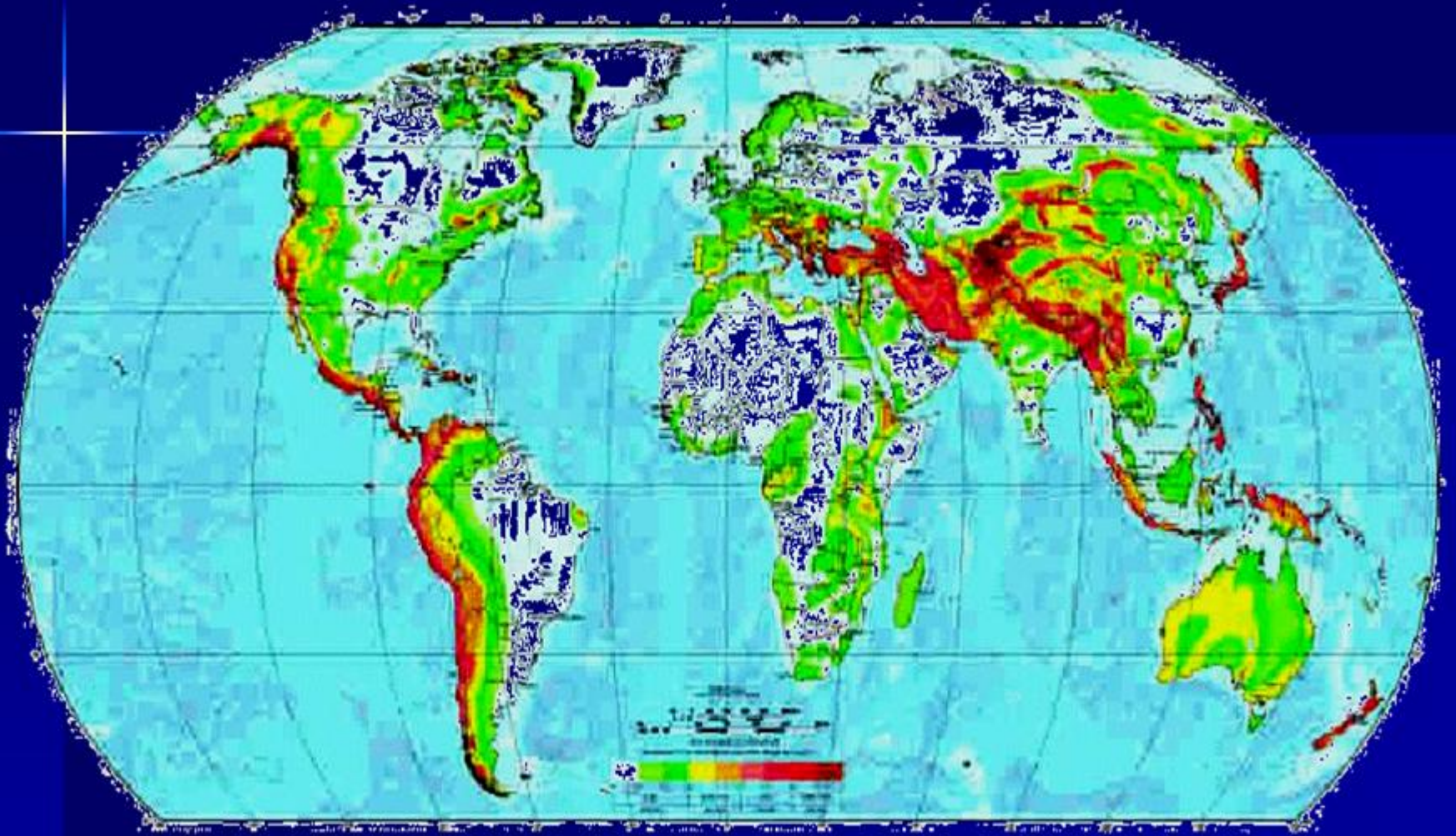
# Outline

- Introduction
- Developing Countries and Seismicity
- Affordable, efficient, and environment friendly seismic base isolation proposal
- Laboratory tests
- Conclusions

# World wide earthquakes causing more than 10,000 life losses.

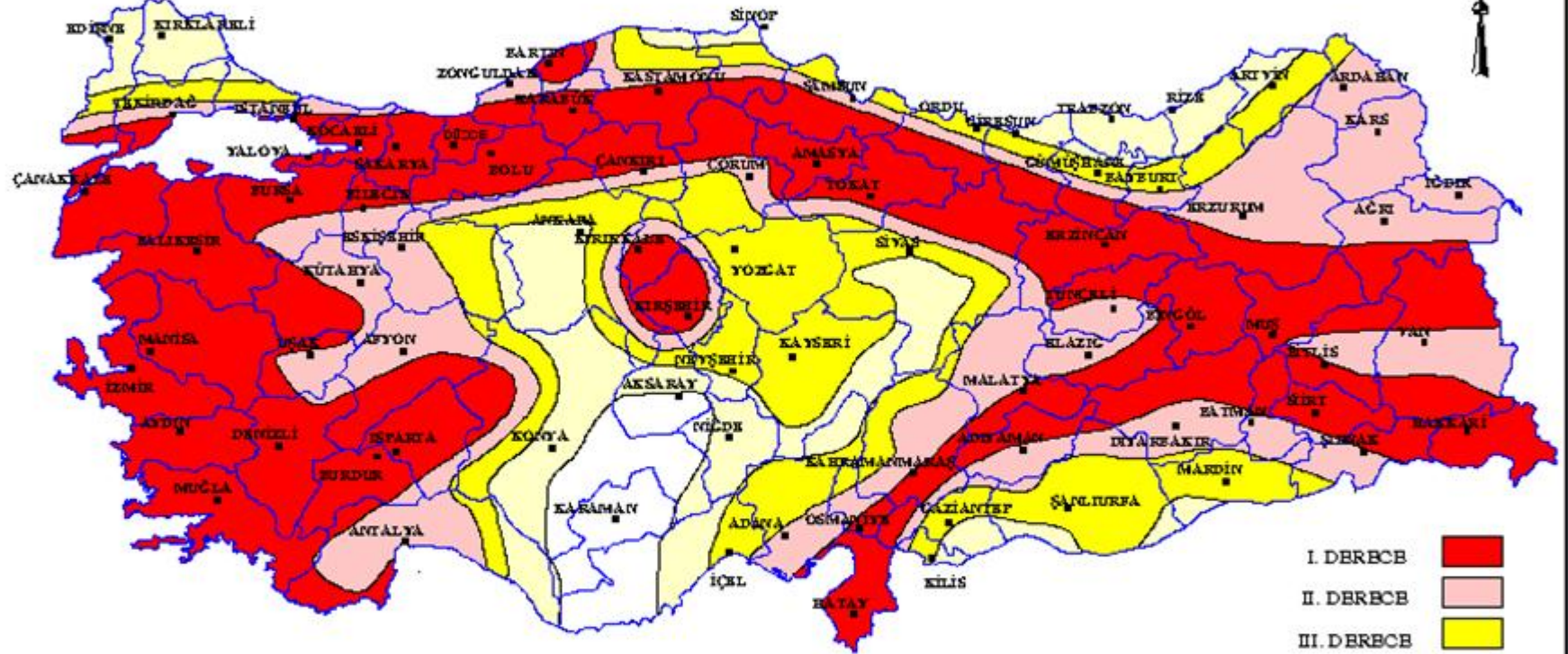








# EARTHQUAKE ZONING MAP OF TURKEY\*



\* T. C. Bayındırlık ve İskan Bakanlığı, 1996

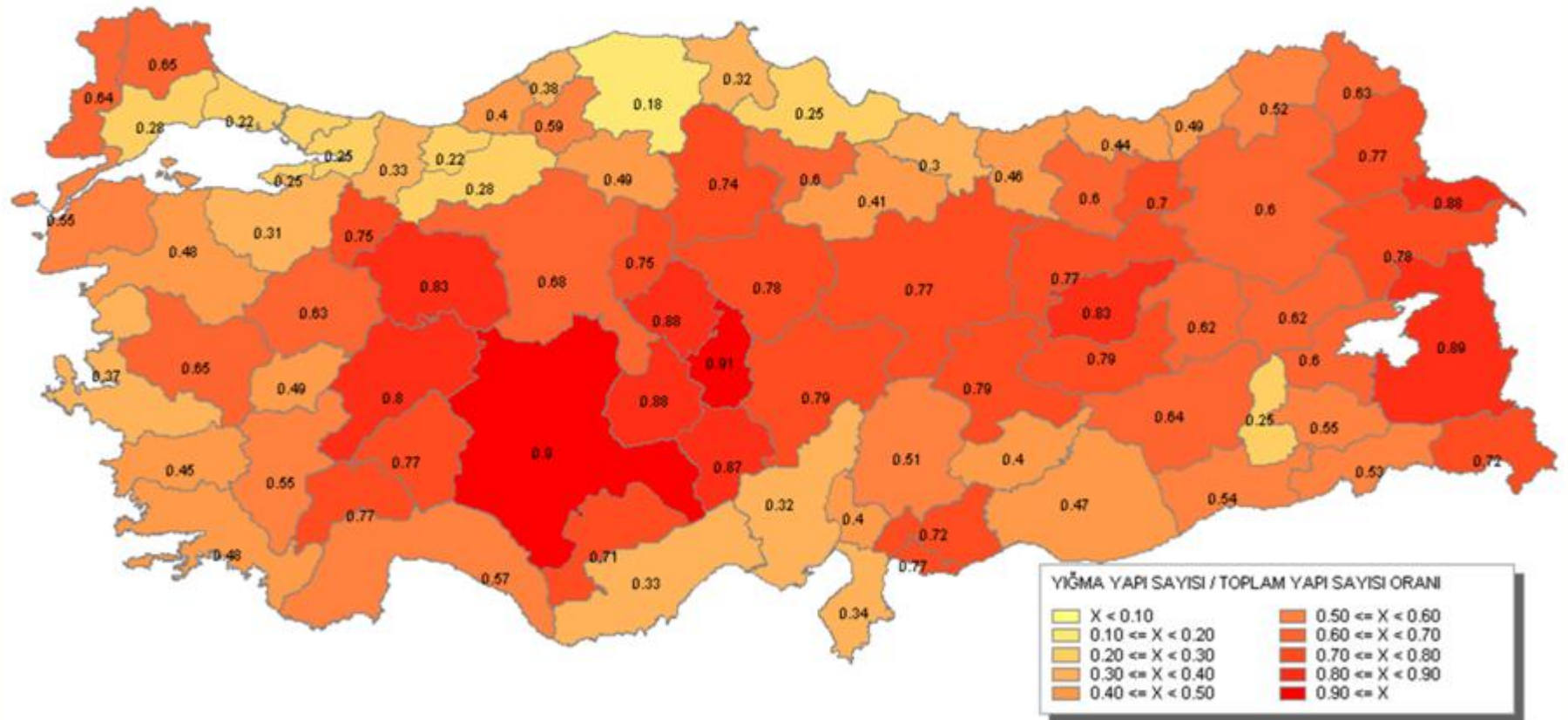
B. Özmen, M. Nurks ve H. Güler'in 1997 yılında hazırladıkları,

"Coğrafi Bilgi Sistemi ile Deprem Bölgelerinin İncelenmesi" kitabından alınmıştır.

AFET İŞLERİ GENEL MÜDÜRLÜĞÜ  
DEPREM ARAŞTIRMA DAİRESİ  
ANKARA-TÜRKİYE

- |             |  |
|-------------|--|
| I. DERECE   |  |
| II. DERECE  |  |
| III. DERECE |  |
| IV. DERECE  |  |
| V. DERECE   |  |
| İ merkezi   |  |
| İ sınırı    |  |

# Masonry house ratio\*



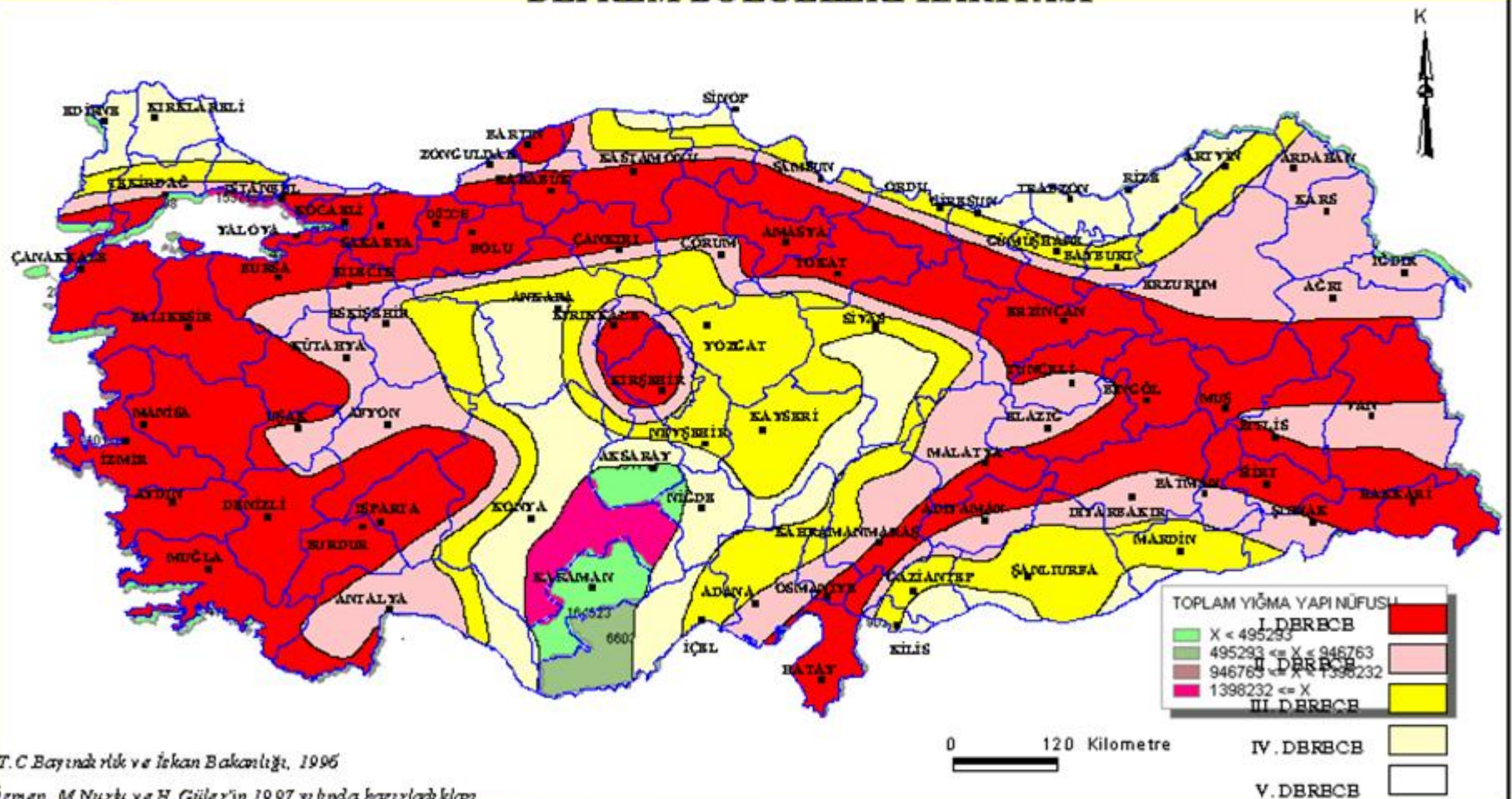
\* State Institute of Statistics (DIE) data, 2000

Dr. Ahmet TURER, Middle East Technical University, Civil Engr. Dept., Ankara TURKEY



# Population living in Masonry

## DEPREM BÖLGELERİ HARİTASI





# AFYON:

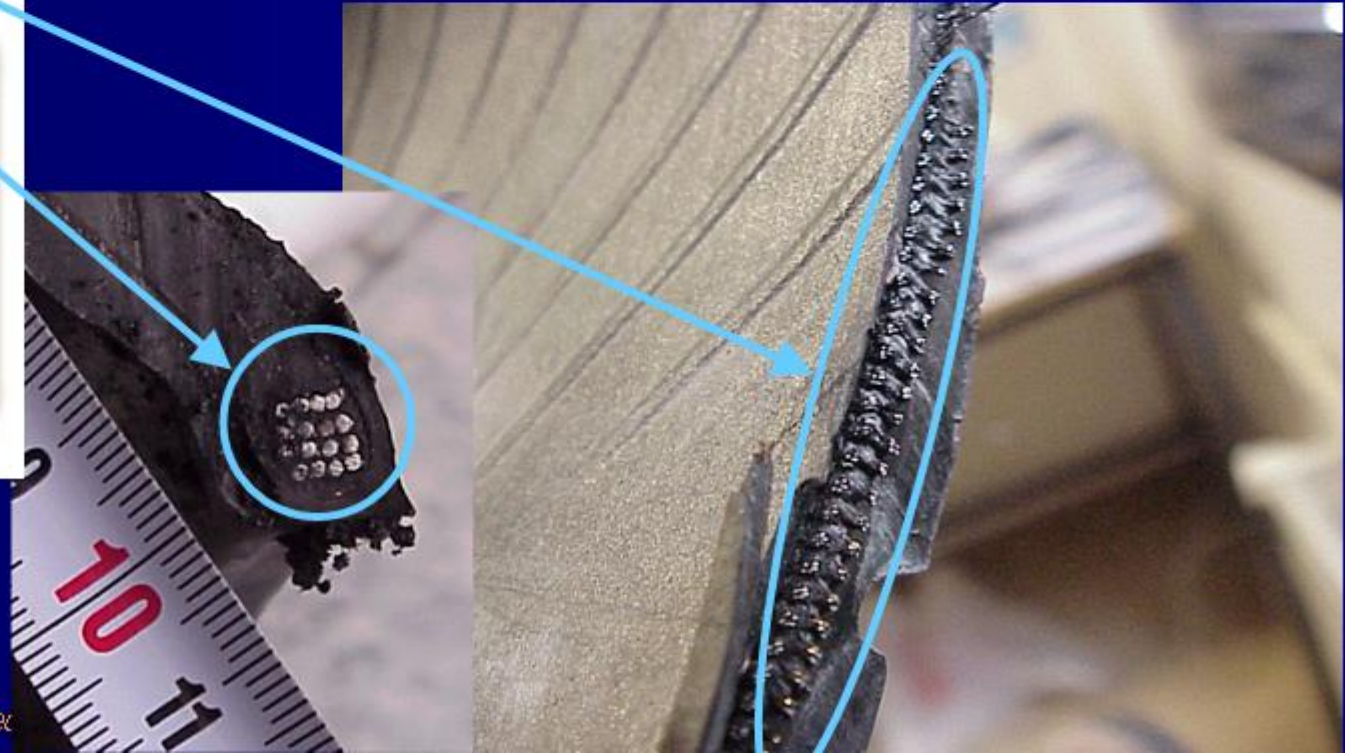
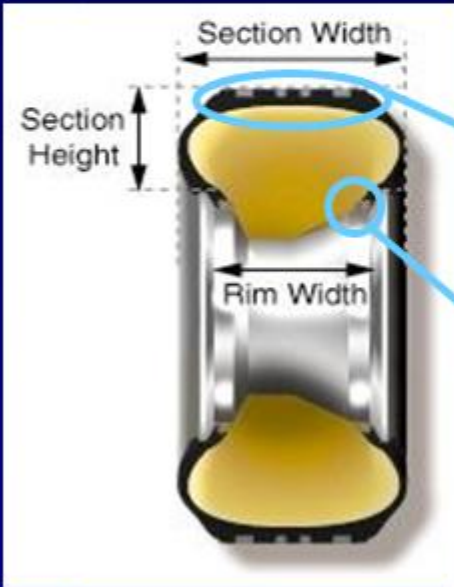




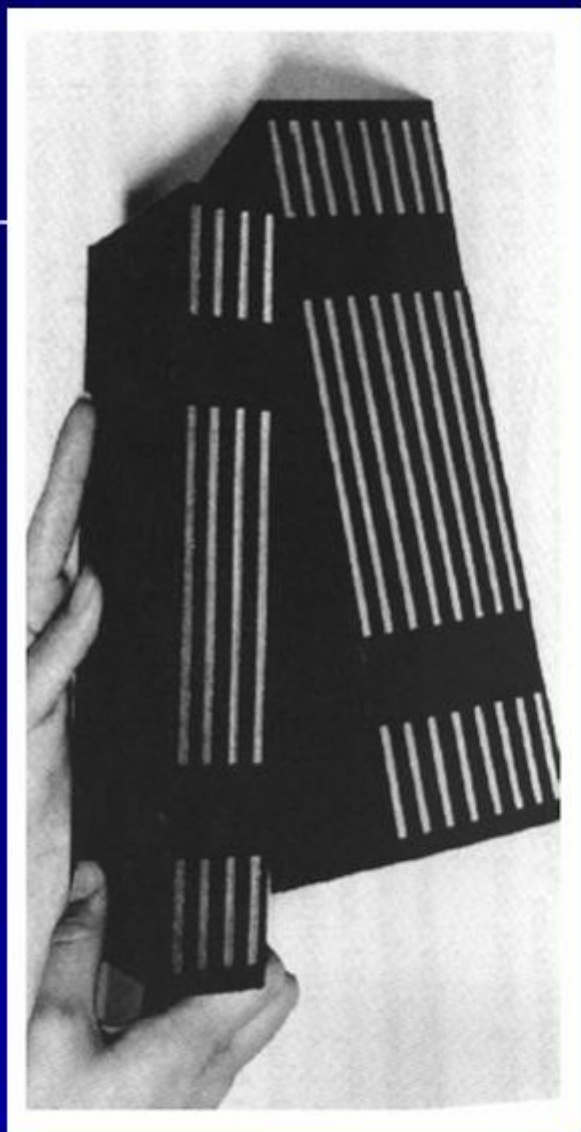
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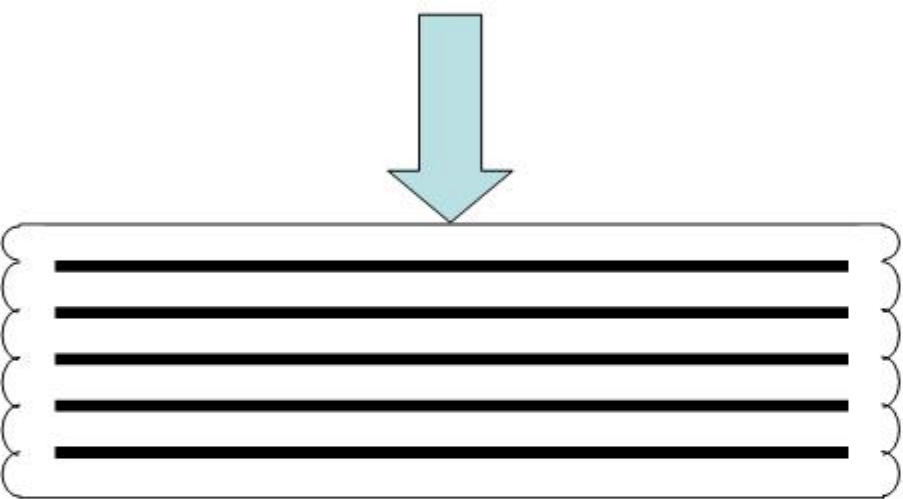




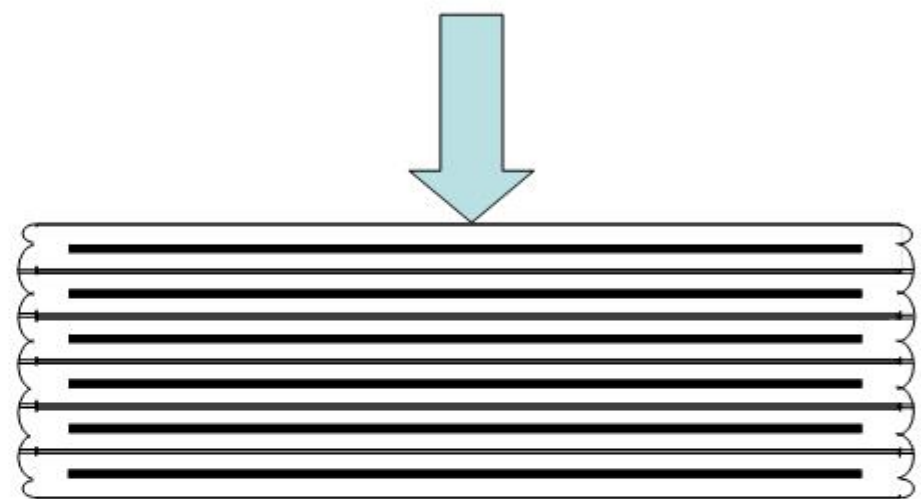






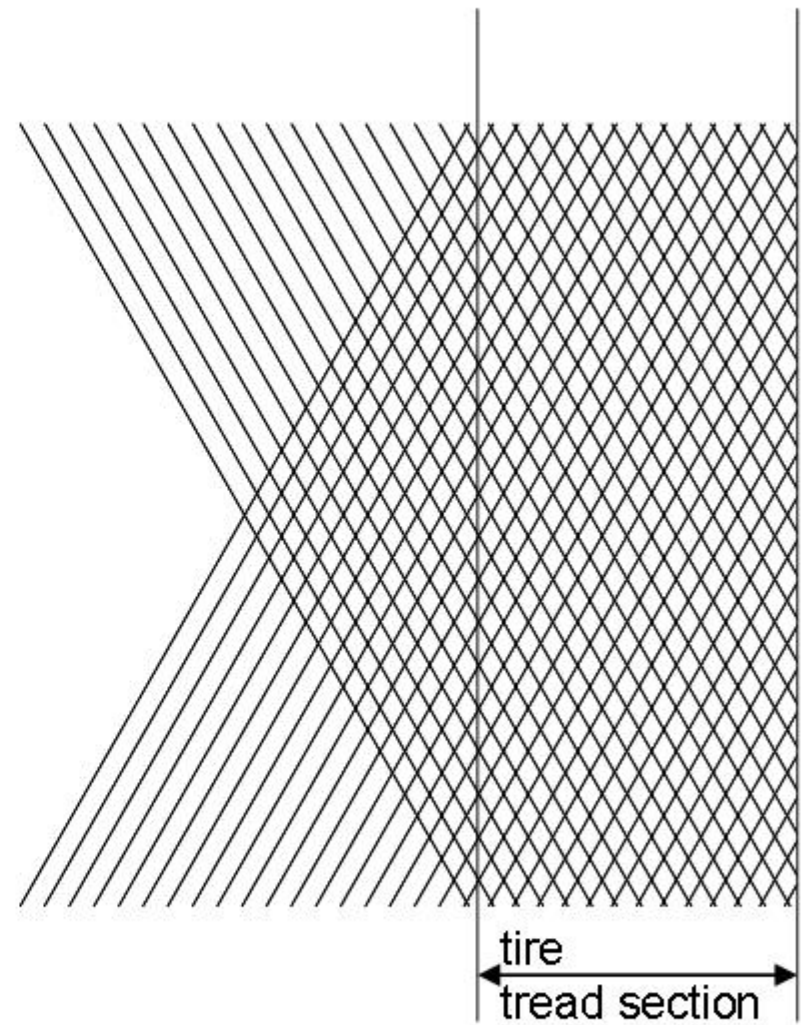
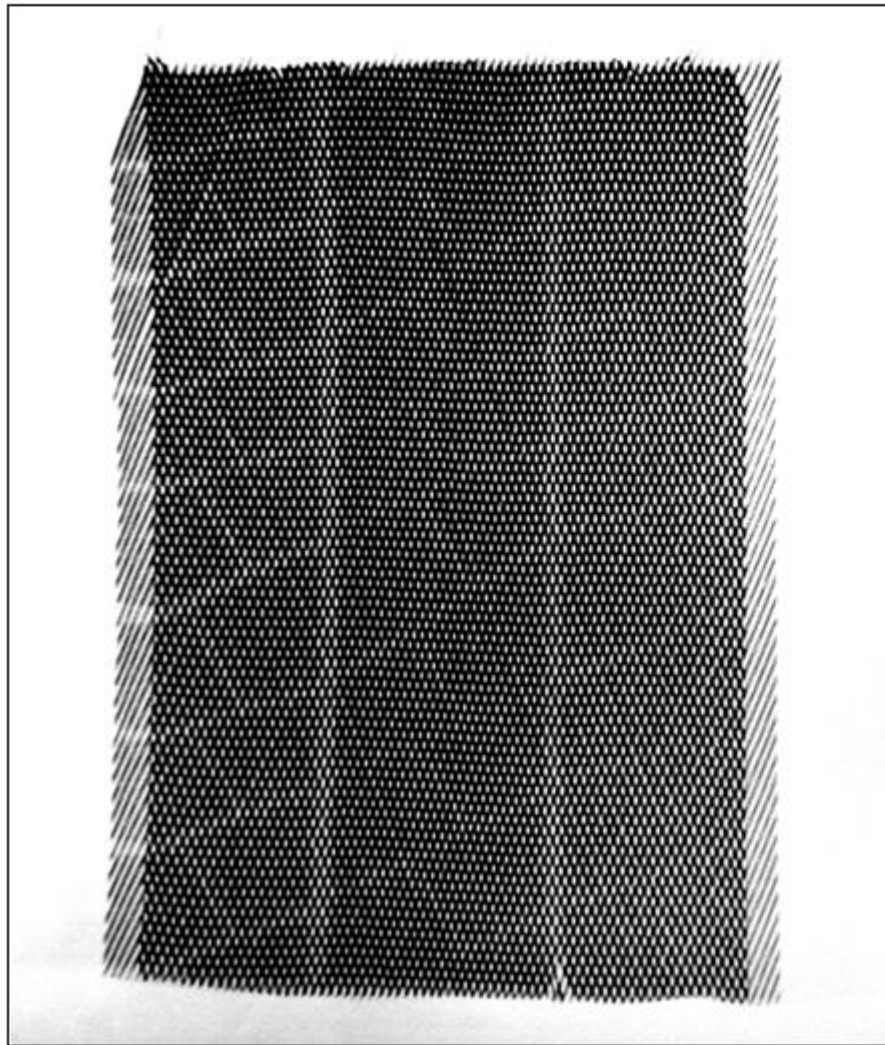


(a) RB



(b) STP







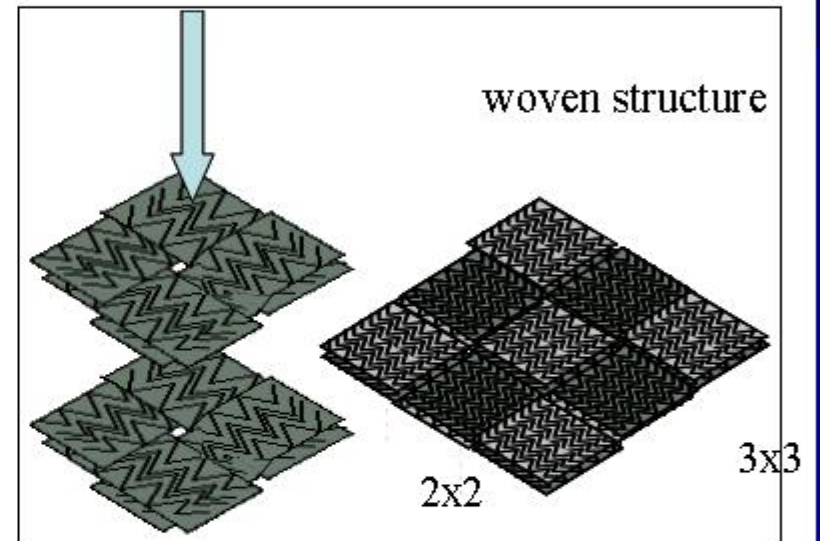
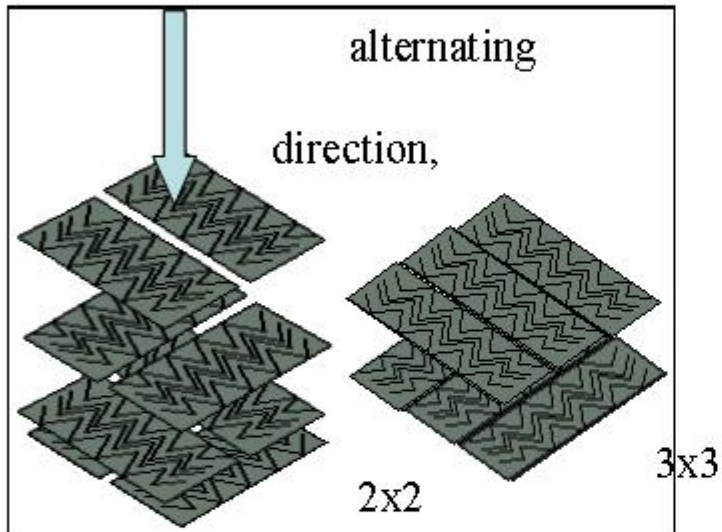


2004.03.23

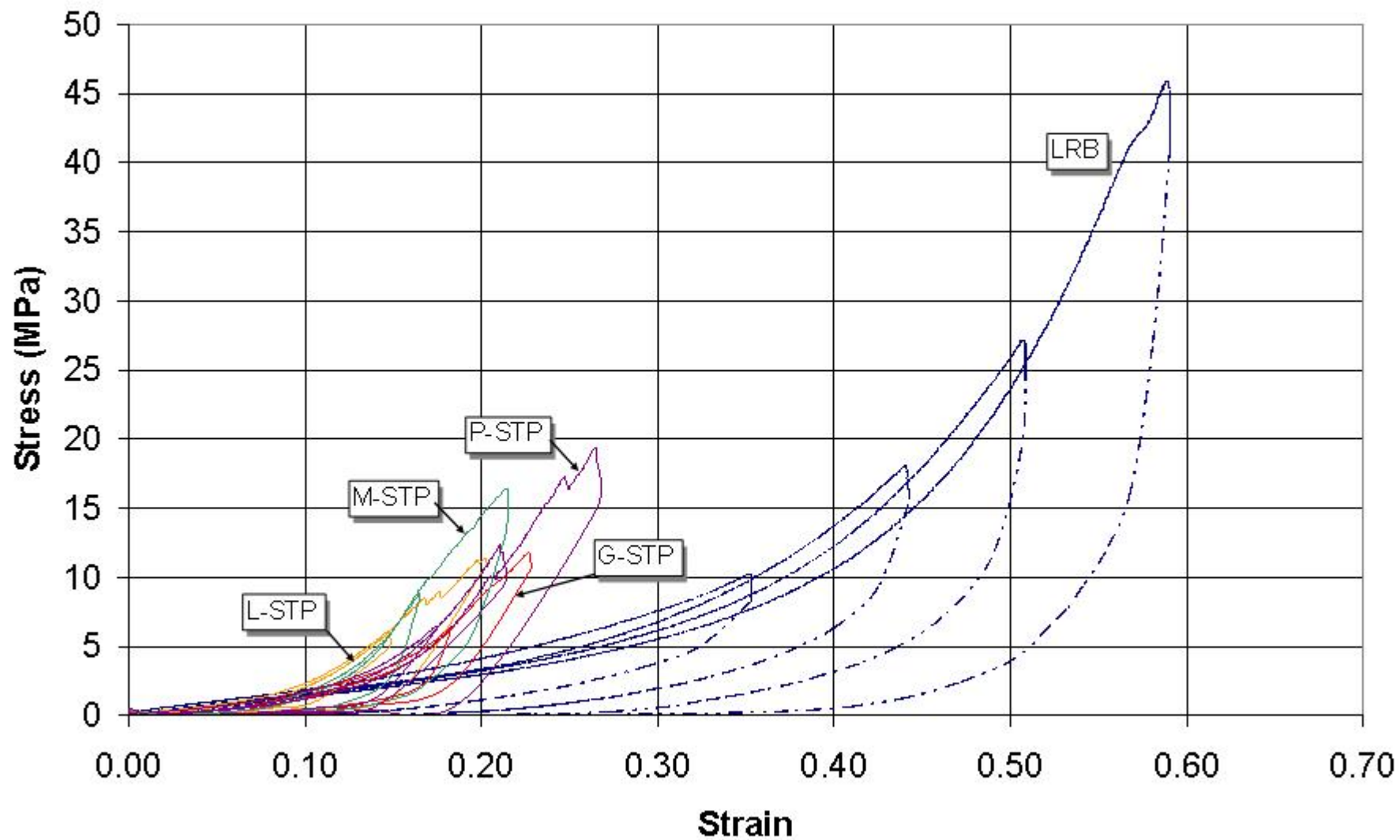


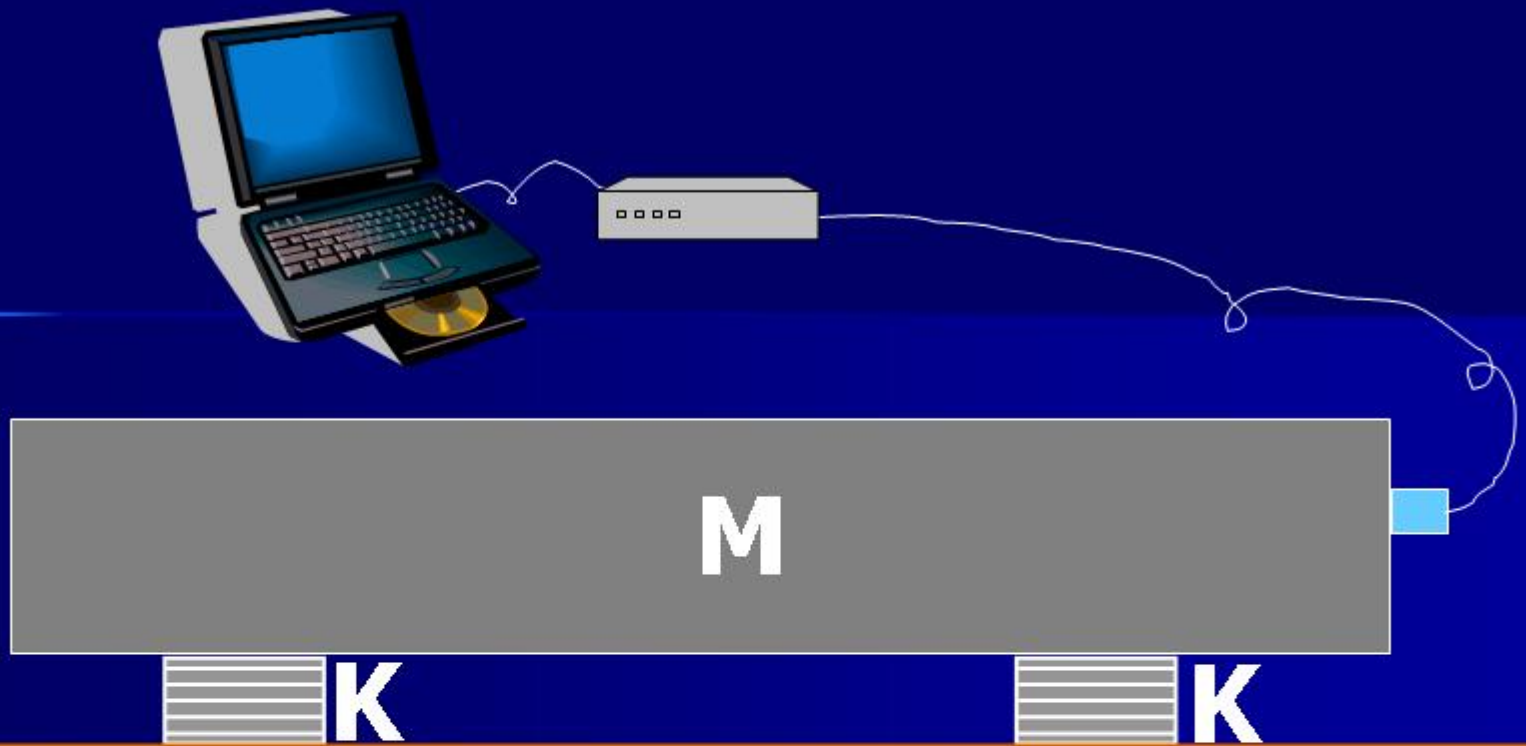


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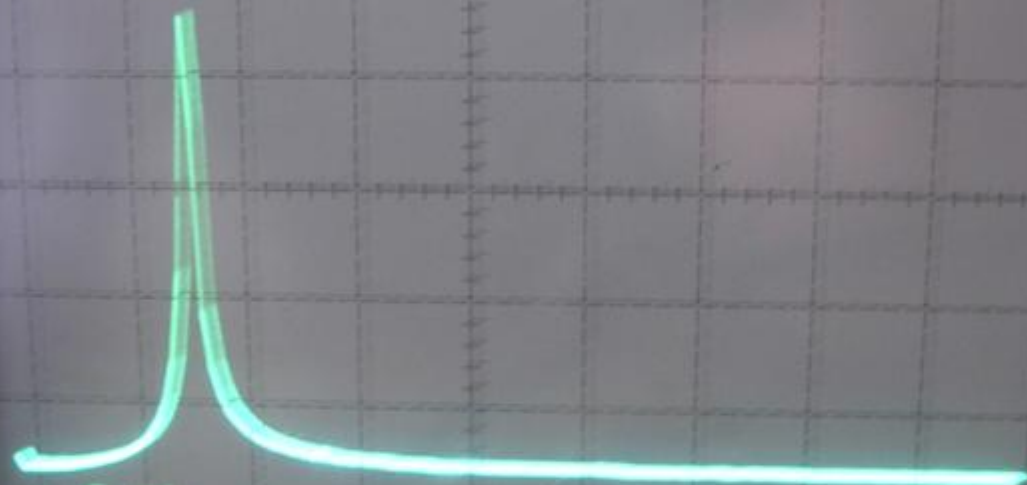


$$f(\text{Hz}) = \frac{1}{2\pi} \cdot \sqrt{\frac{2K}{M}}$$



CH1 ST 10.0 MV FS  
MKPc 714 uV

2.00 uV/DTF



0 Hz  
MKPc

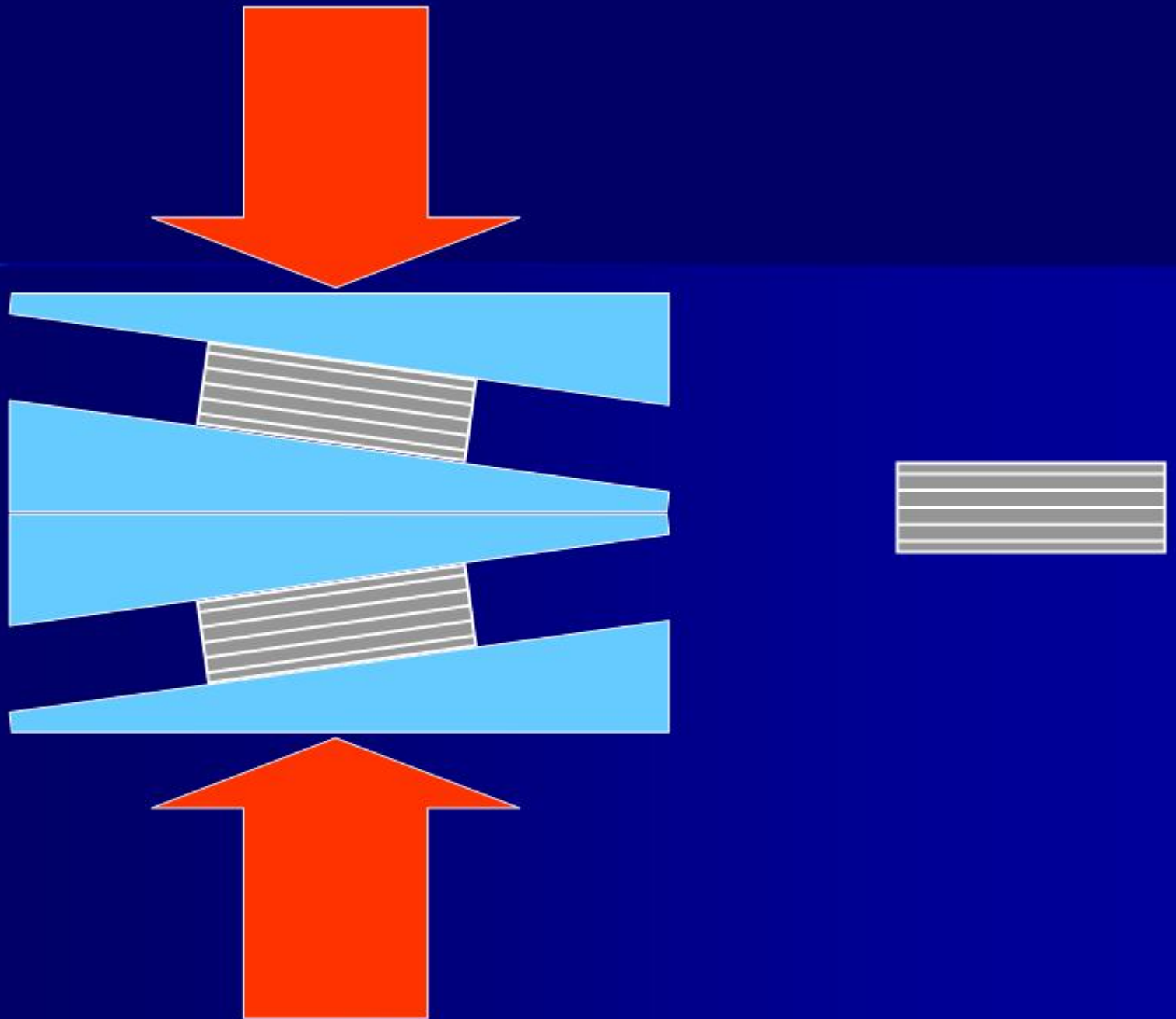
7.3 Hz

25 Hz  
..OVERLOAD..

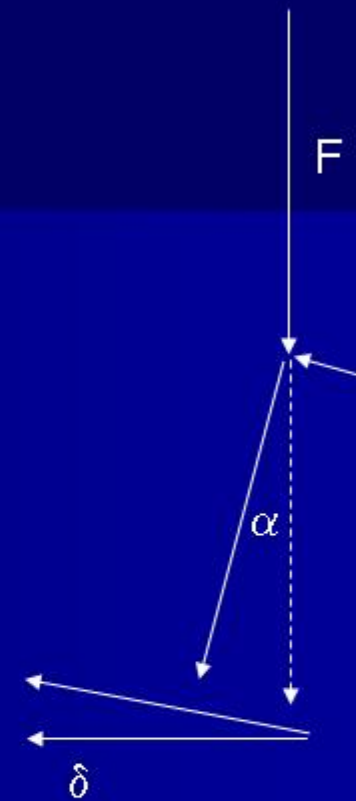
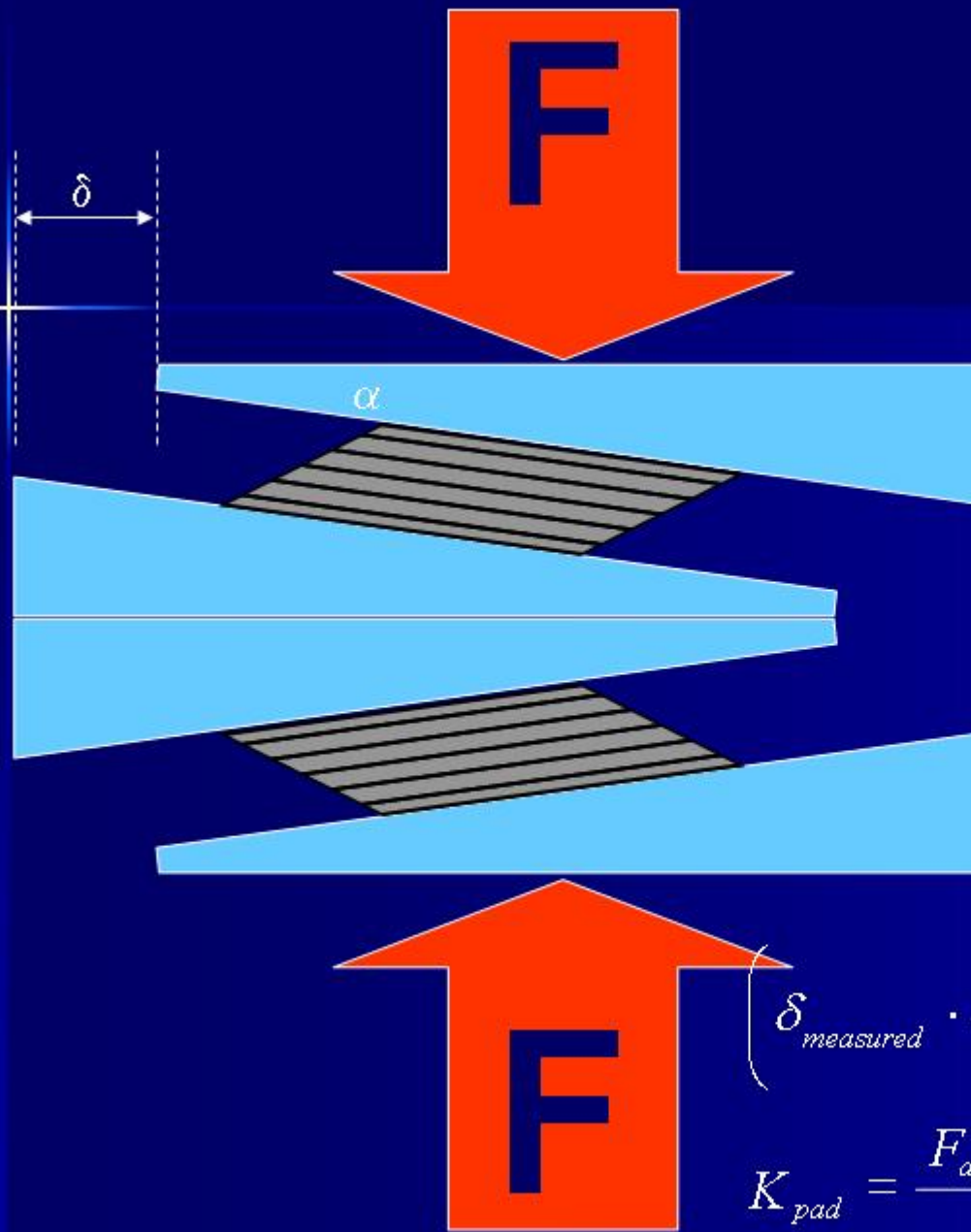
2004.03.23

hp 35680 SPECTRUM ANALYZER  
NEW YORK

RESET







$$\left( \delta_{measured} \cdot \frac{1}{\cos(\alpha)} \right) \cdot K_{pad} = F_{applied} \cdot \sin(\alpha)$$

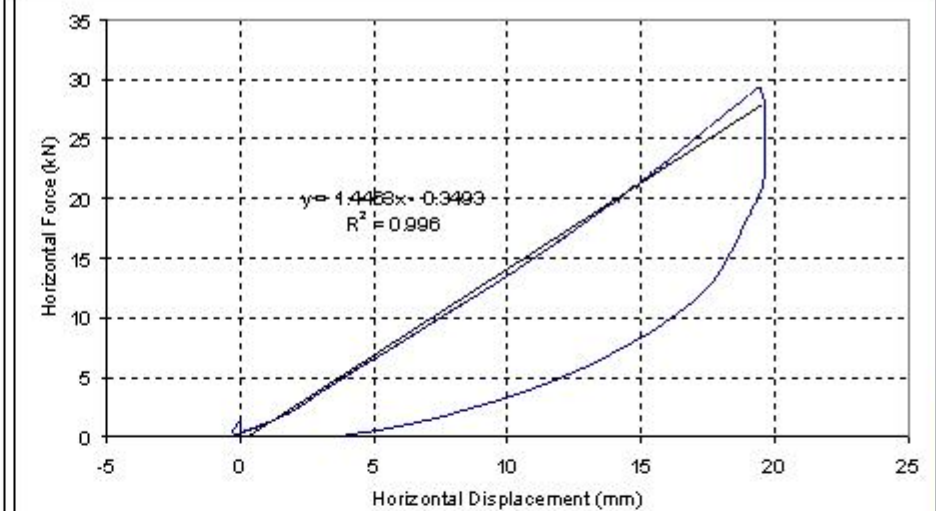
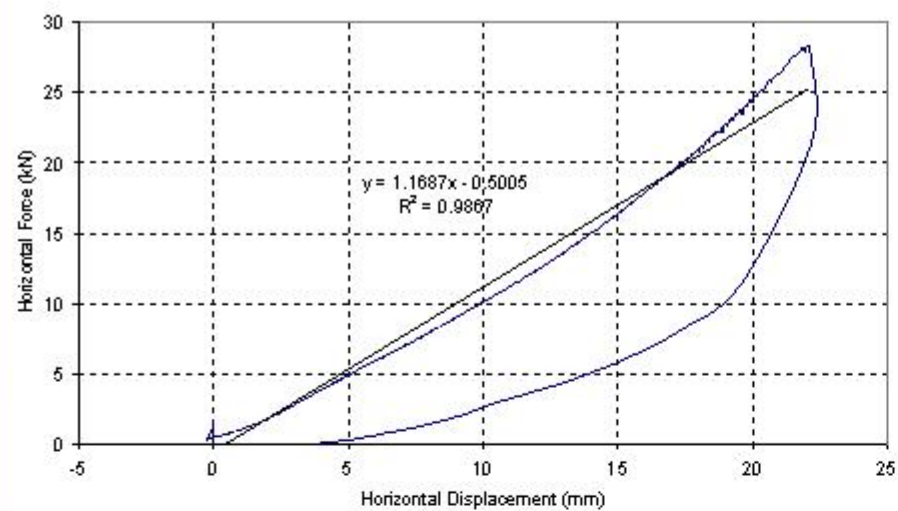
$$K_{pad} = \frac{F_{applied} \cdot \sin(\alpha) \cdot \cos(\alpha)}{\delta_{measured}}$$





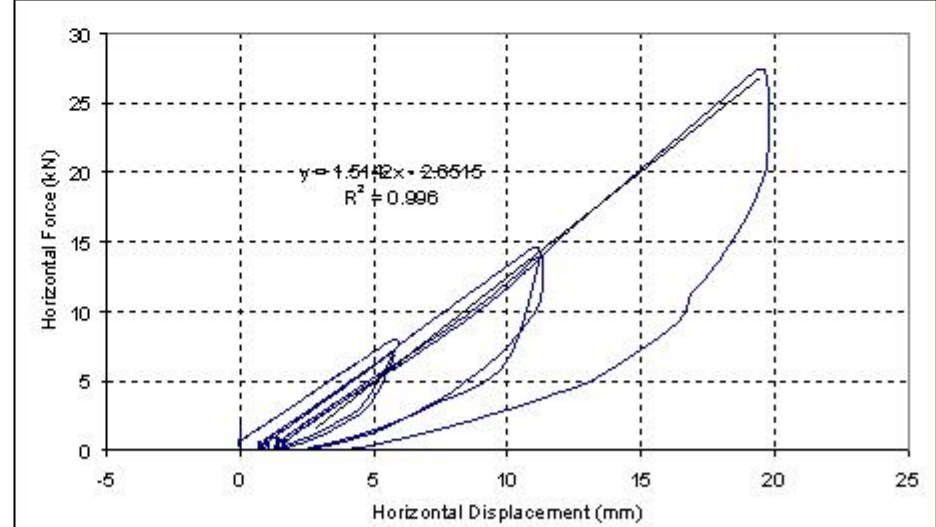
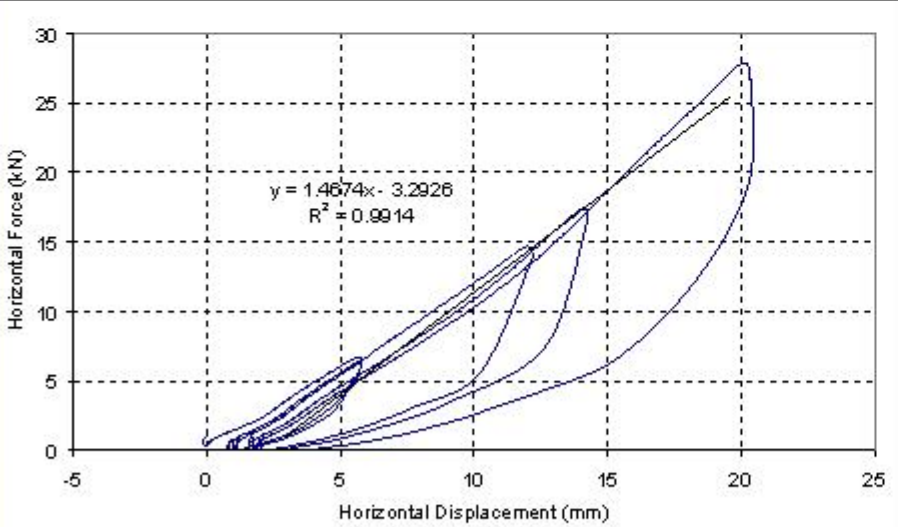


2004.04.13



(a) G-STP Transverse

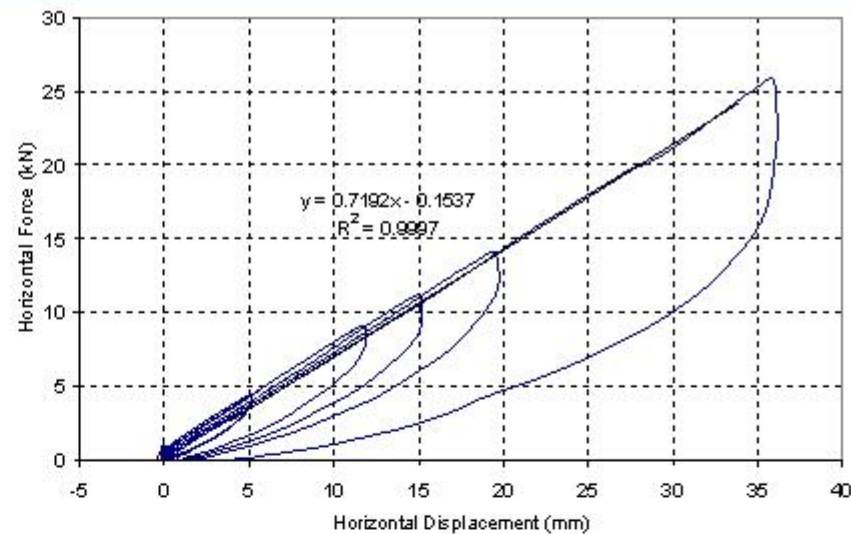
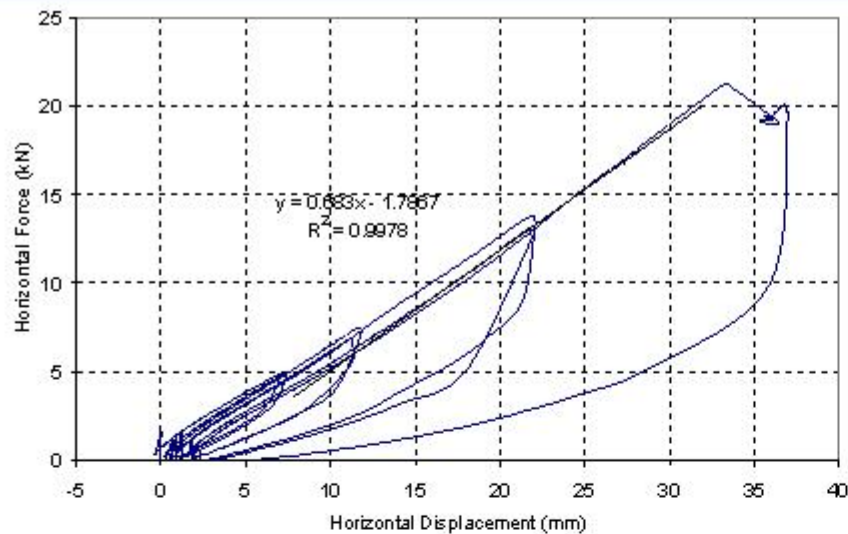
(b) G-STP Longitudinal



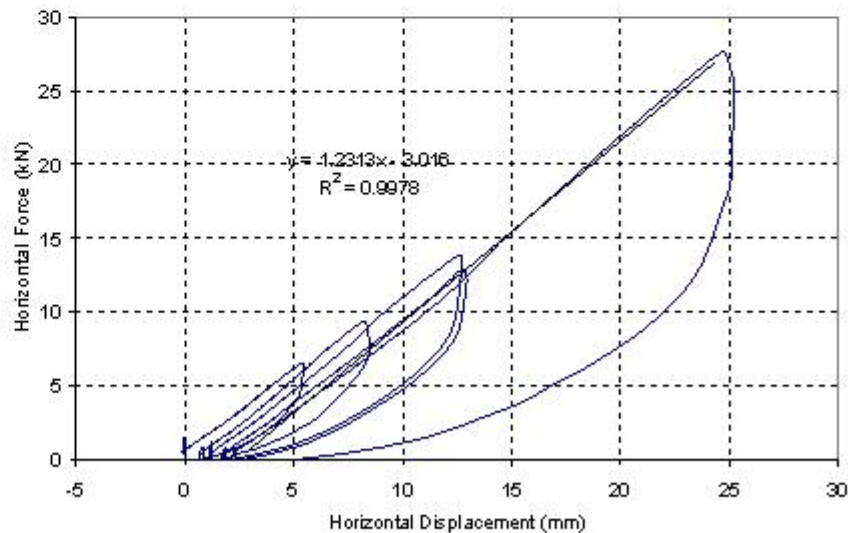
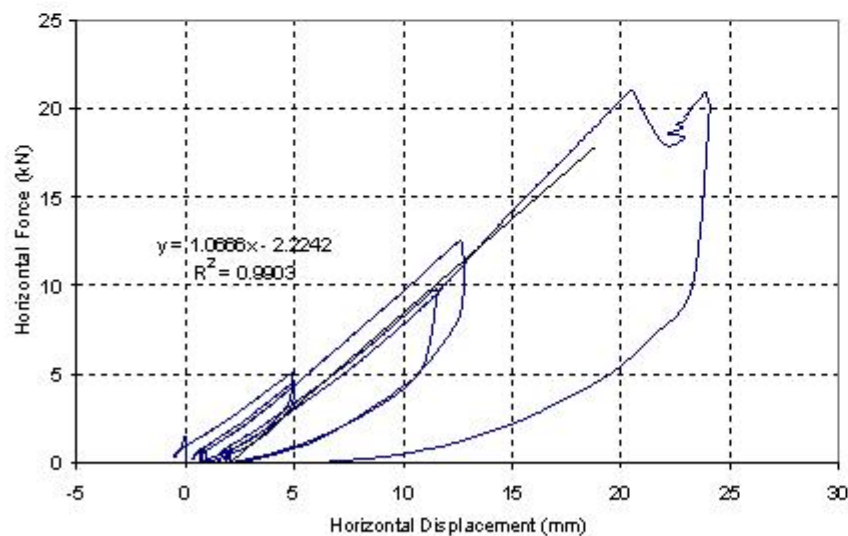
(c) M-STP Transverse

(d) M-STP Longitudinal





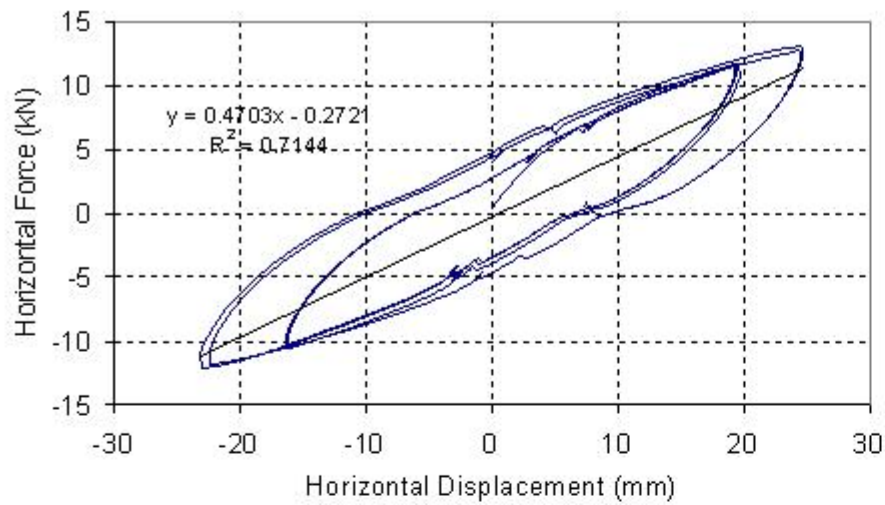
(e) L-STP Transverse (f) L-STP Longitudinal



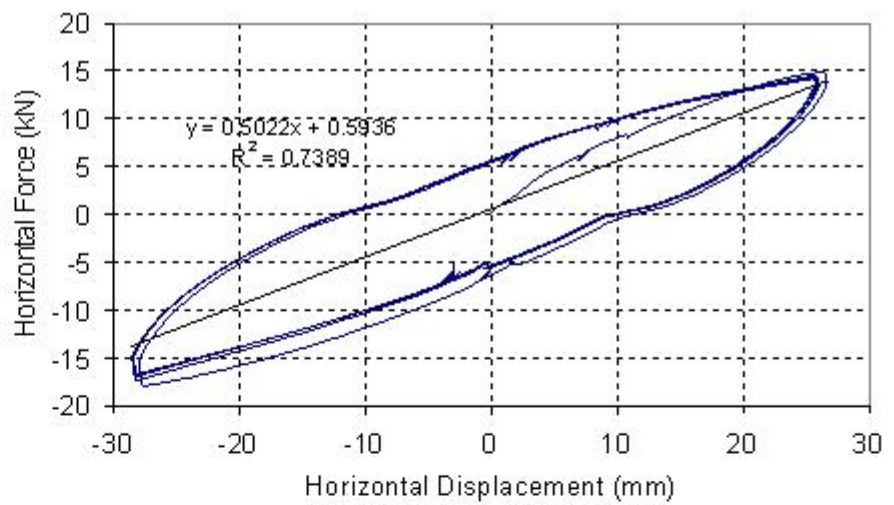
(g) P-STP Transverse (h) P-STP Longitudinal



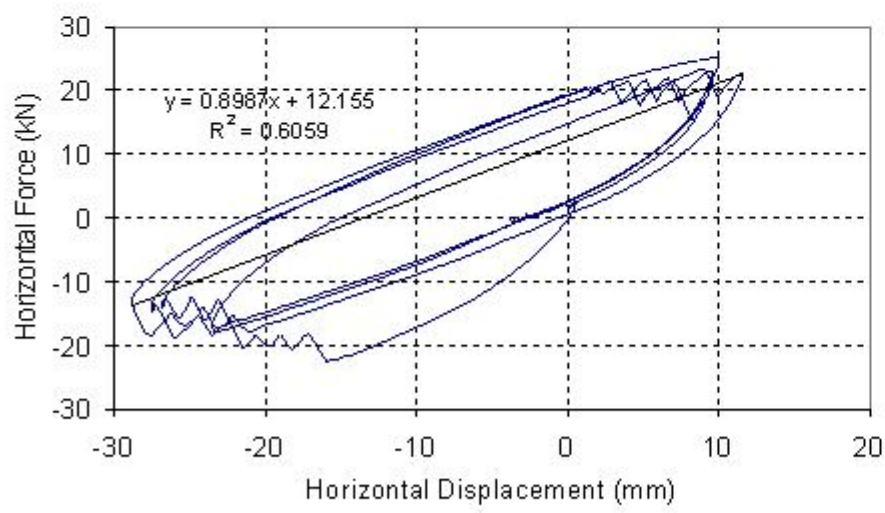




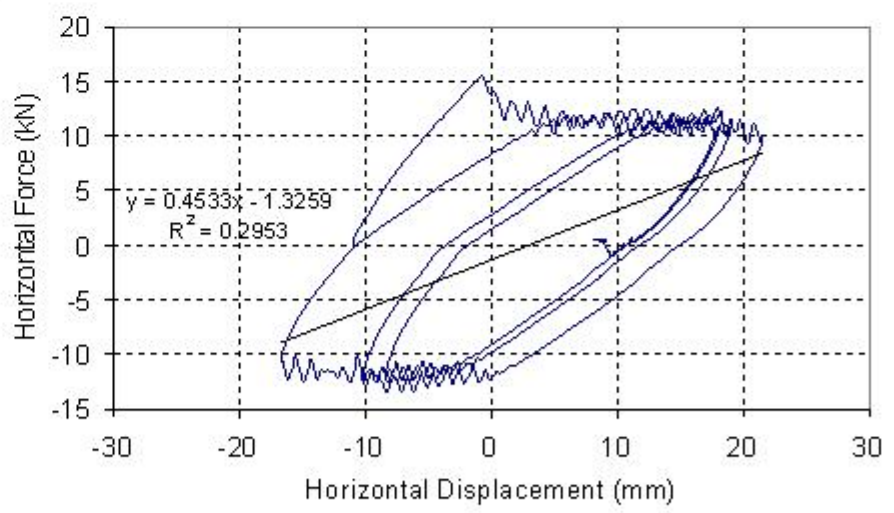
(a) G-STP Longitudinal



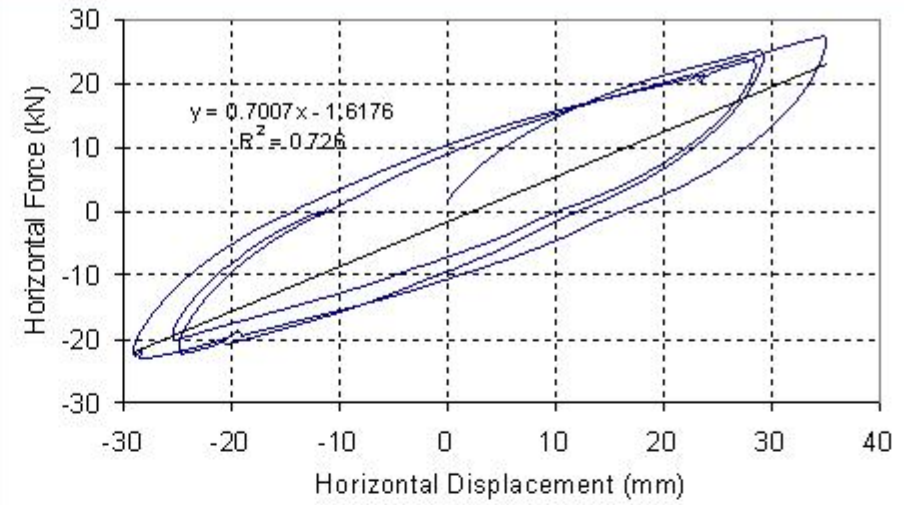
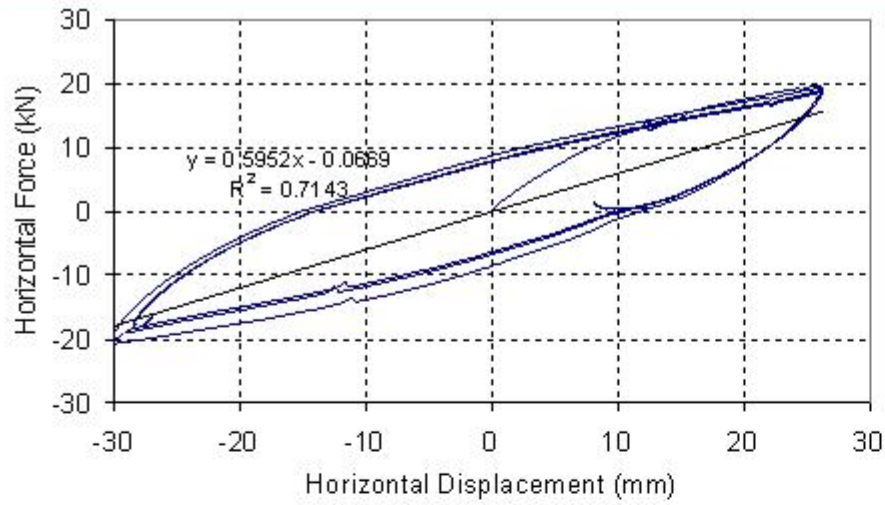
(b) G-STP Transverse



(c) M-STP Longitudinal

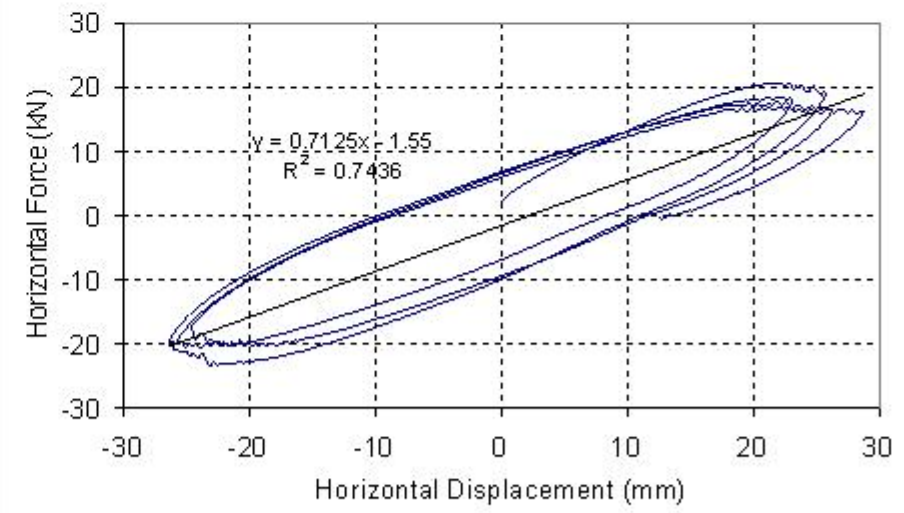
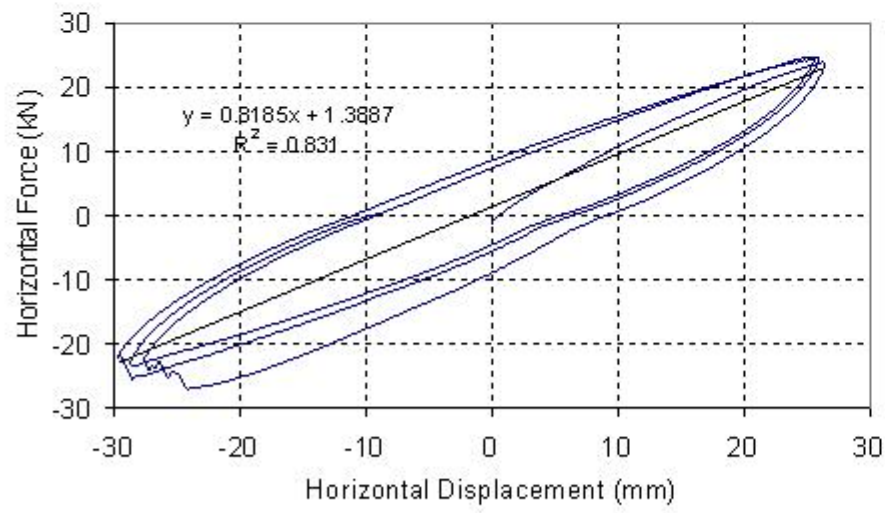


(d) M-STP Transverse



(e) L-STP Longitudinal

(f) L-STP Transverse

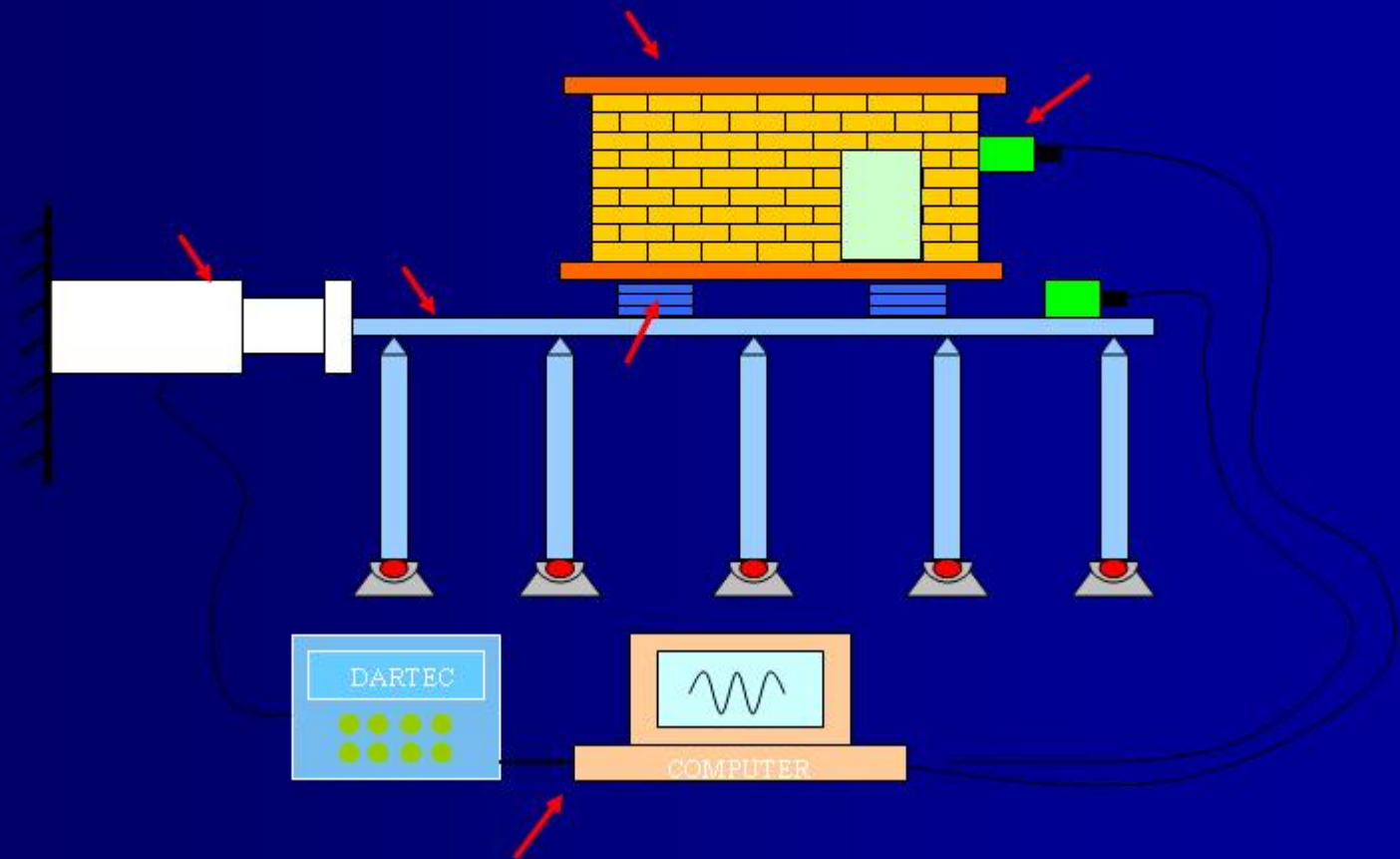


(g) P-STP Longitudinal

(h) P-STP Transverse



# Shaking table tests









PENCERE 1

915

611

612

613

513

413

313

412

212

213

214

215

112

113

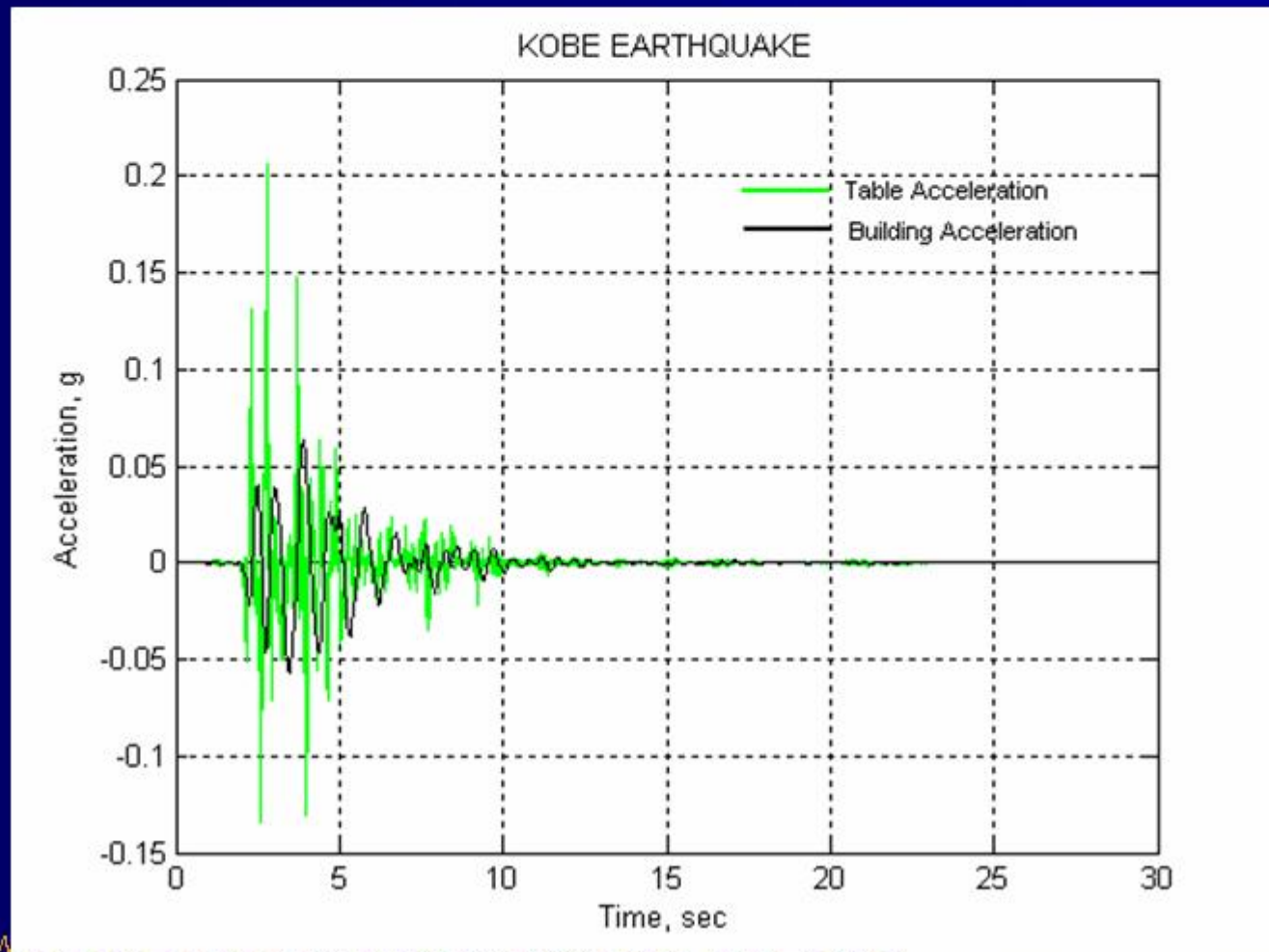
114

116

118

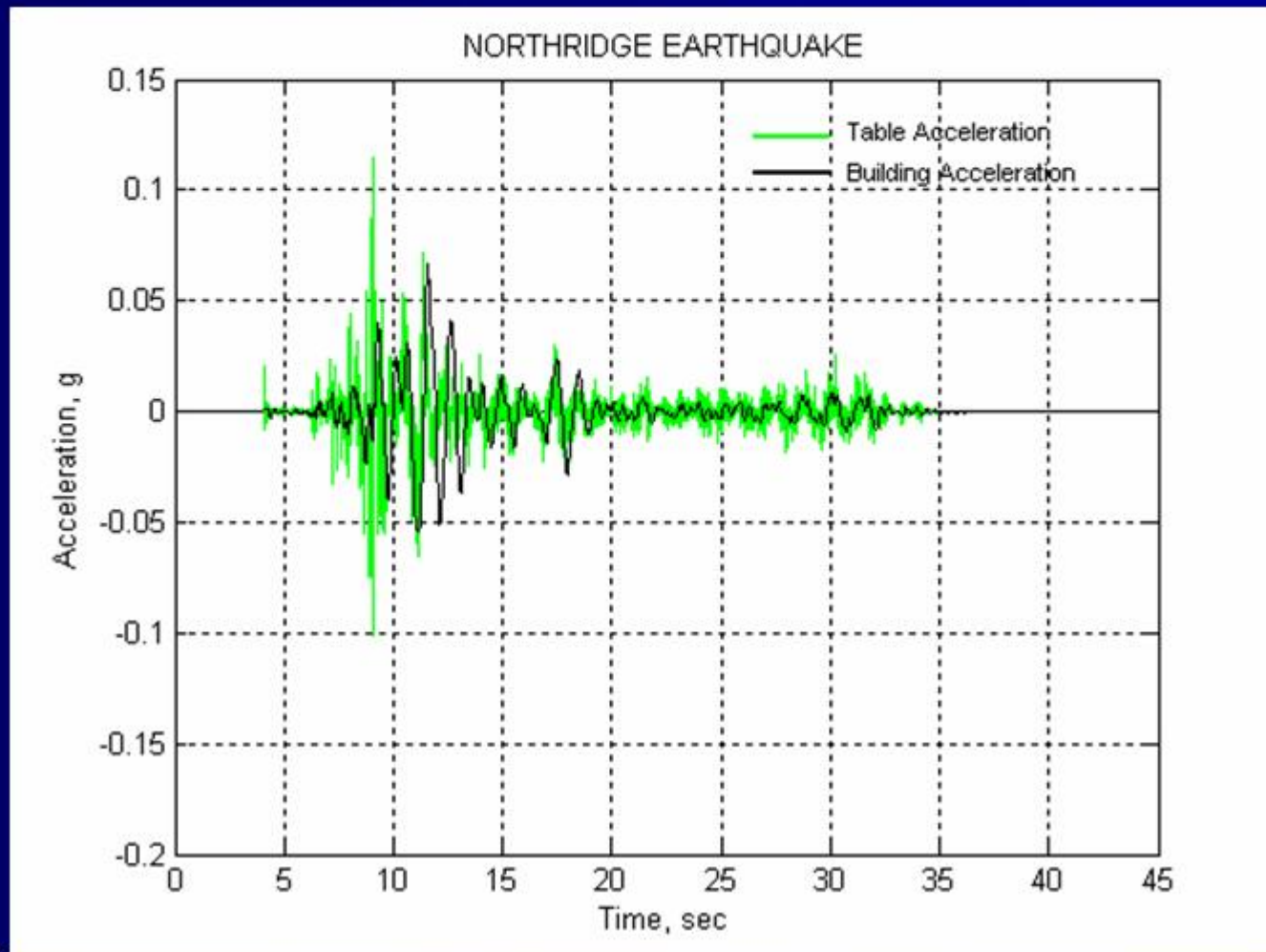
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# Kobe Earthquake

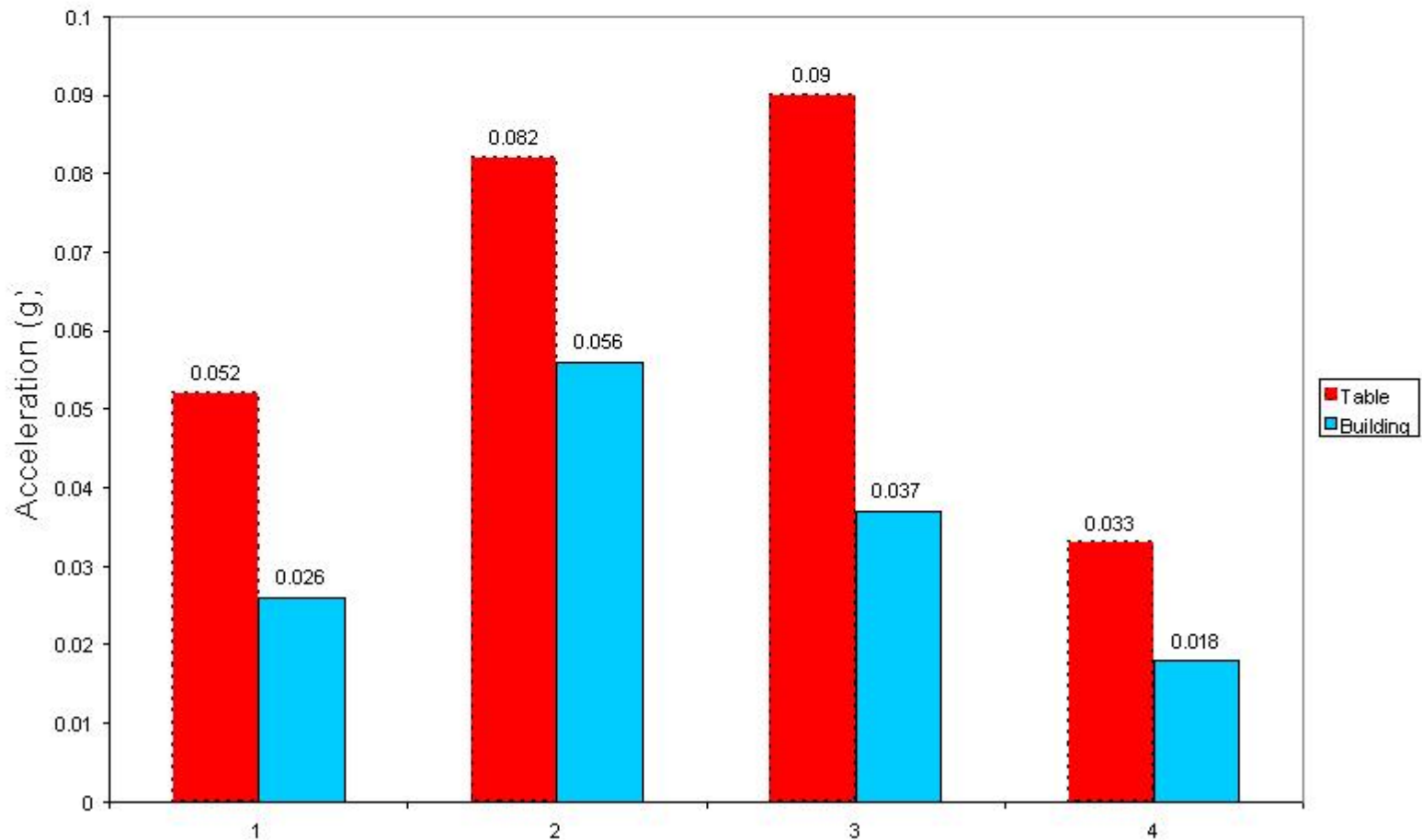




# Northridge Earthquake

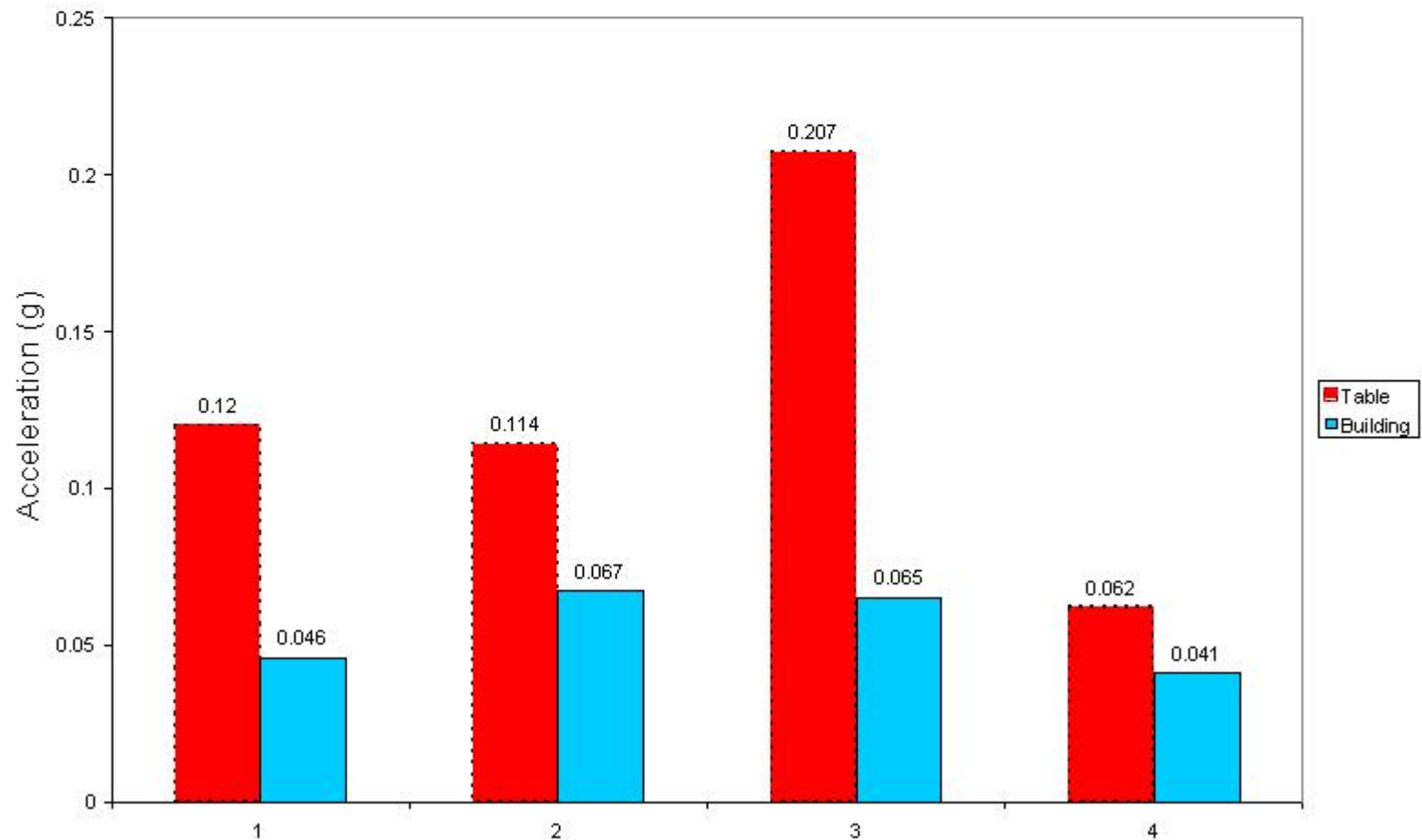


# 10% EQ loading results:





# 20% EQ loading results:



# Conclusions

- STP formed by placing tread sections of scrap tires show similar properties and behavior as metal sheet rubber pads.
- Friction between rubber to rubber contact is generally high enough to prevent slippage (e.g., coefficient of friction = 0.3 means surfaces would not slide until  $(0.3g) \cdot \text{Mass}$ )
- STP would still function by rolling or sliding, if they would disintegrate.



# Conclusions

- Additional tests on full scale masonry houses would be necessary to investigate the actual performance of STP.
- Foundation-basement requirements might only permit new masonry house constructions applicable to STP
- Hypothetical design examples for STP are also available but time limit forces them to be left outside the scope of this presentation.

# Conclusions

- It is noted that “**Economical and affordable seismic strengthening of existing buildings**” is also an important topic and recommended to be included in List of Proposed Components (Jan.22,2007)
  - as an additional item, or
  - as a part of serial # 1, component number 2-1: “Feasible and Affordable Seismic Constructions”





**Thank you for your  
kind attention !**

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