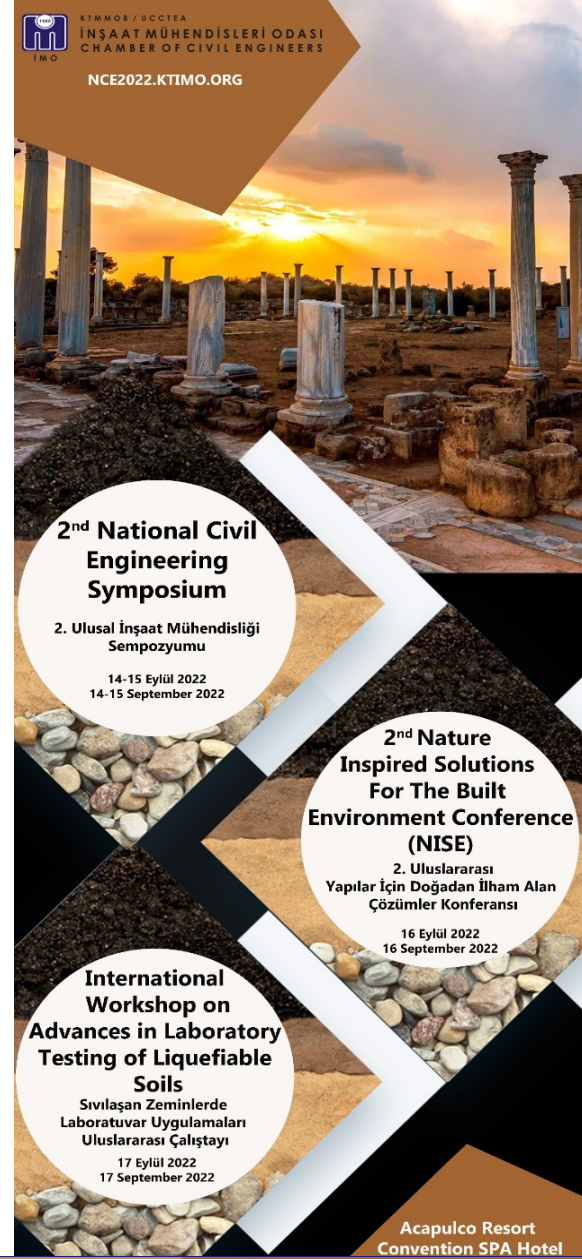


SITE RESPONSE STUDY OF TUZLA REGION TITLE

Asst. Prof., ISMAIL SAFKAN

European University of Lefke



2nd National Civil Engineering Symposium
2. Ulusal İnşaat Mühendisliği Sempozyumu
14-15 Eylül 2022
14-15 September 2022

2nd Nature Inspired Solutions For The Built Environment Conference (NISE)
2. Uluslararası Yapılar İçin Doğadan İlham Alan Çözümler Konferansı
16 Eylül 2022
16 September 2022

International Workshop on Advances in Laboratory Testing of Liquefiable Soils
Sıvılaştan Zeminlerde Laboratuvar Uygulamaları Uluslararası Çalıştayı
17 Eylül 2022
17 September 2022

Acapulco Resort Convention SPA Hotel

Content

- Tuzla Region Development
- Previous studies based on the region
- Site investigation data
- Analysis
- Results
- GiS Data

History of Tuzla/Enkomi

Enkomi was settled in the [Middle Bronze Age](#), near an inlet from the sea (now silted up). From about the 16th century BC to the 12th, it was an important trading center for [copper](#)

During the 13th century BC, Enkomi was inhabited by Greeks. From the 13th century, other towns along the southern coast of Cyprus competed with Enkomi.

After an earthquake ca. 1050 BC, the site was abandoned, leaving an opening for the rise of [Salamis](#).



Development of the Region 1985



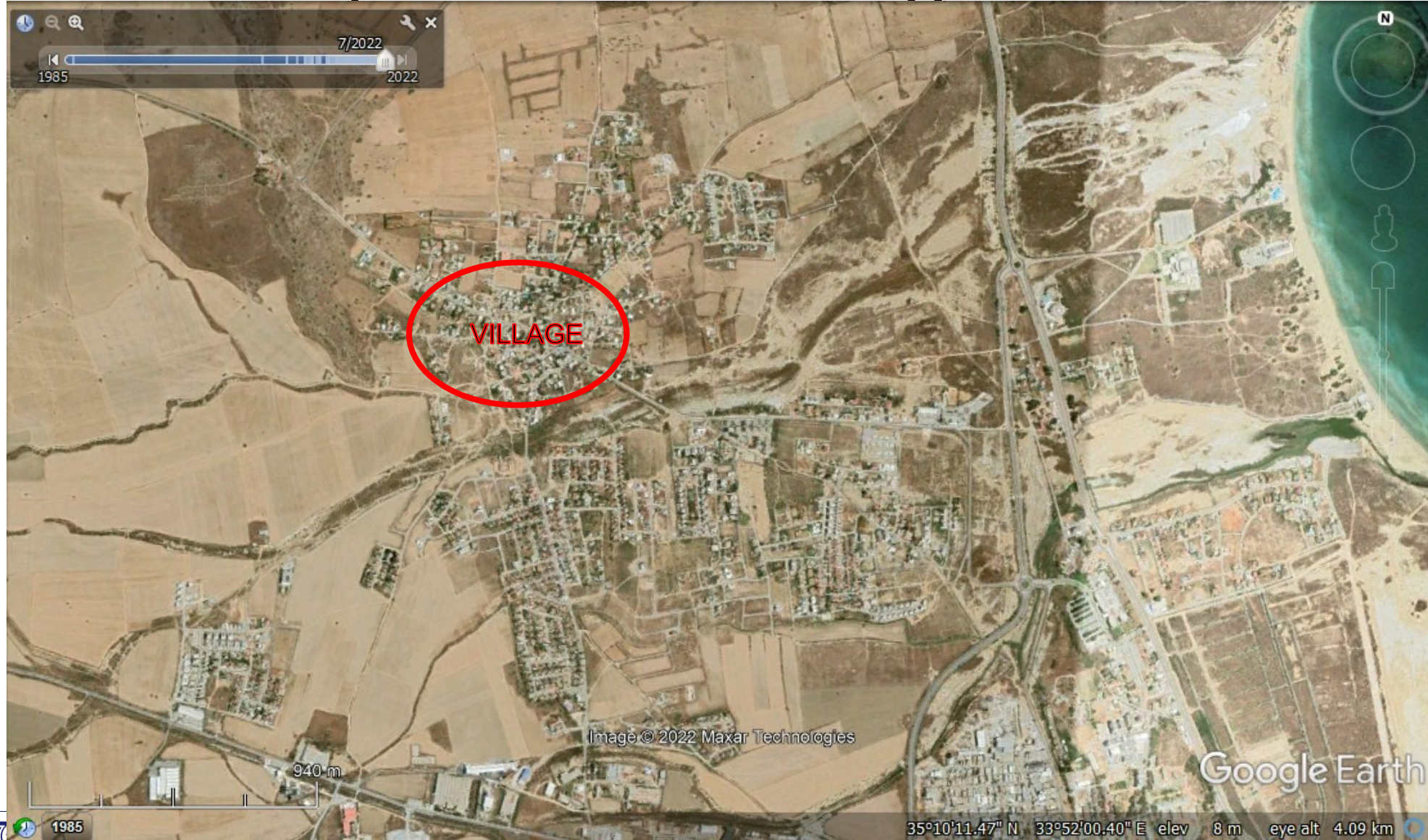
Development of the Region 2008



North Cyprus

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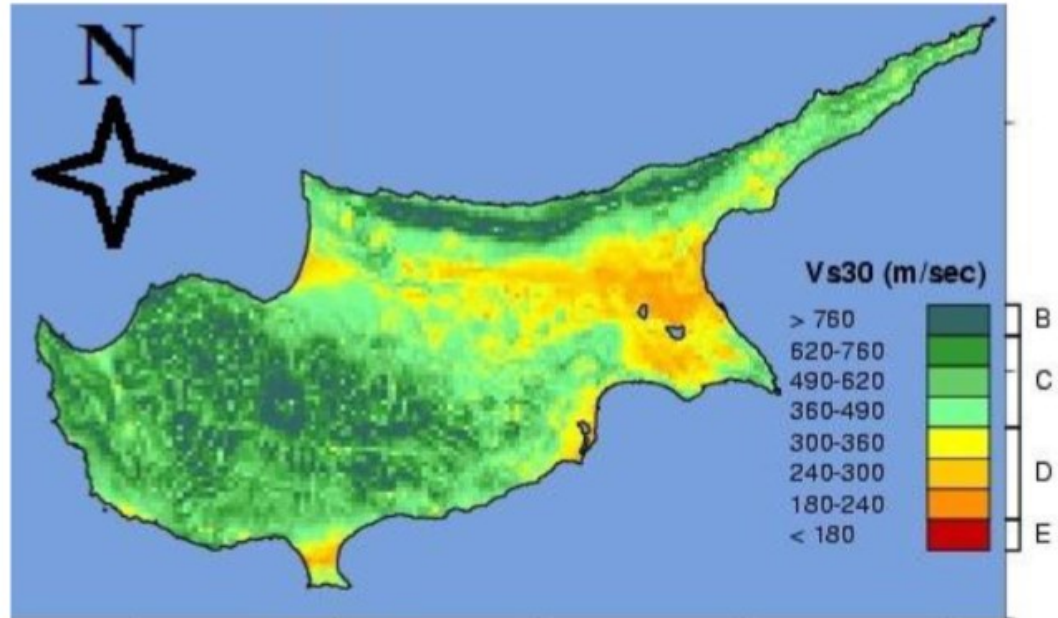
Development of the Region 2022



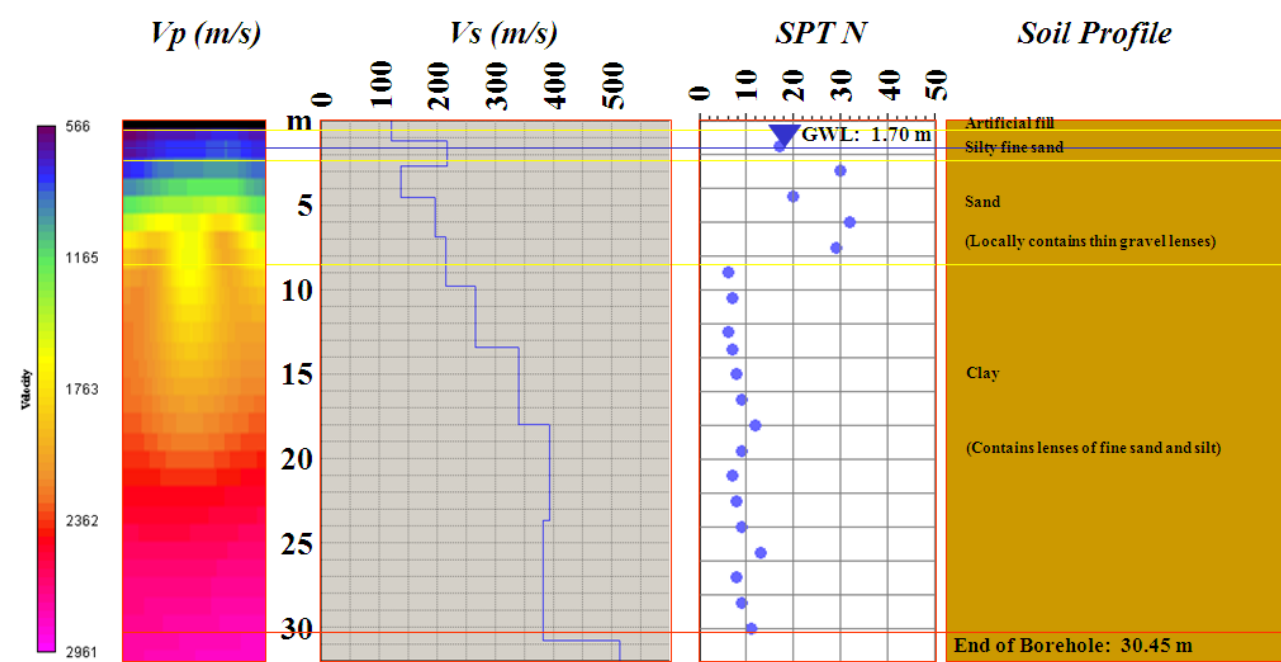
North Cyprus

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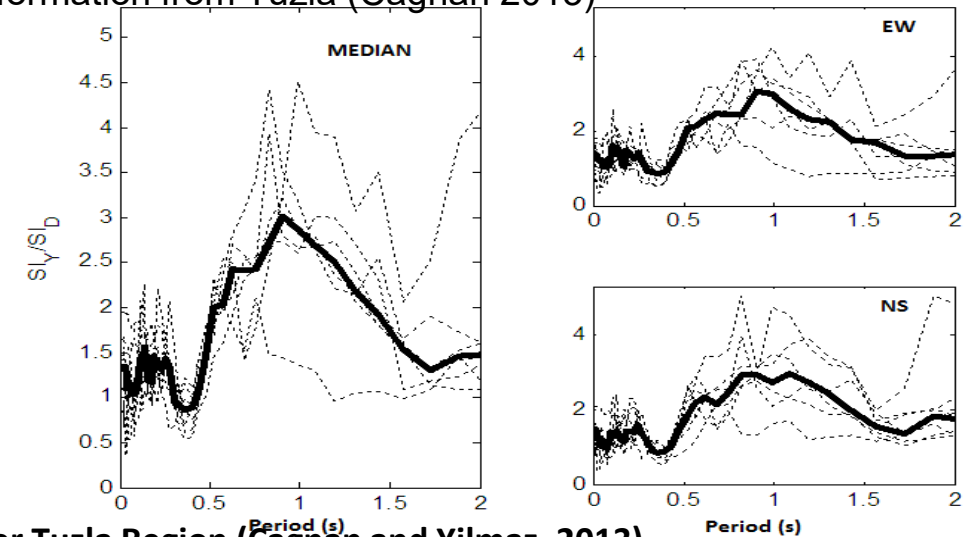
Soil Investigation History of the region



Vs 30 Map USGS (2012)



Borehole information from Tuzla (Cagnan 2013)



H/V Method for Tuzla Region (Cagnan and Yilmaz, 2013)

Soil Investigation History of the region

Bedrock depth varies among the region

Classification was done based on the bedrock depth



Figure 2. Tuzla City Satellite View (Google 2013)

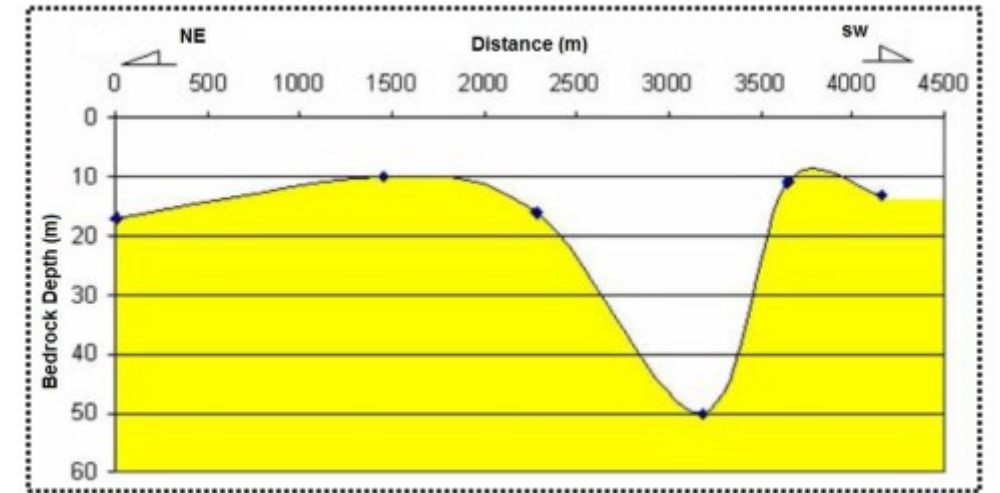


Figure 3. Tuzla City Bedrock Cross Section

Arsin M., 2010

Current Seismic Hazard in Practice

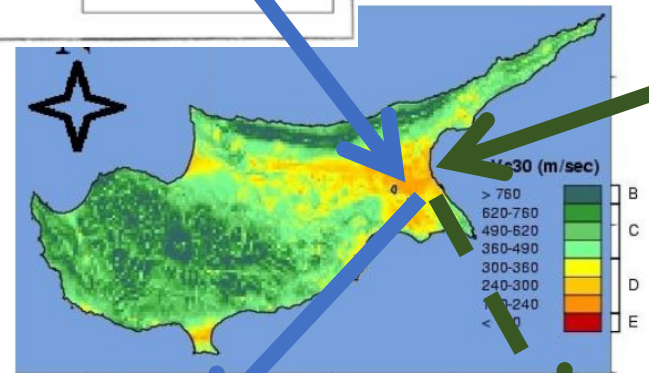
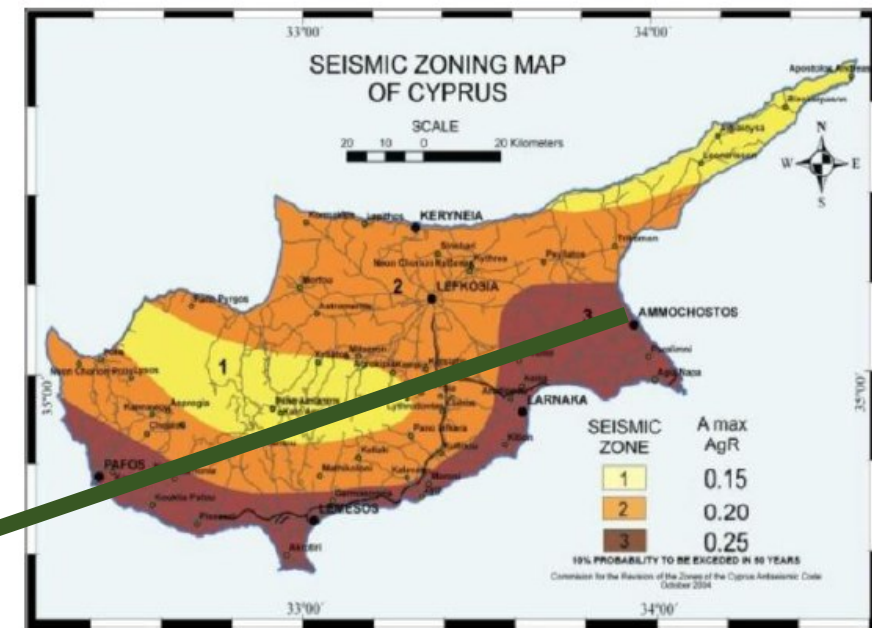
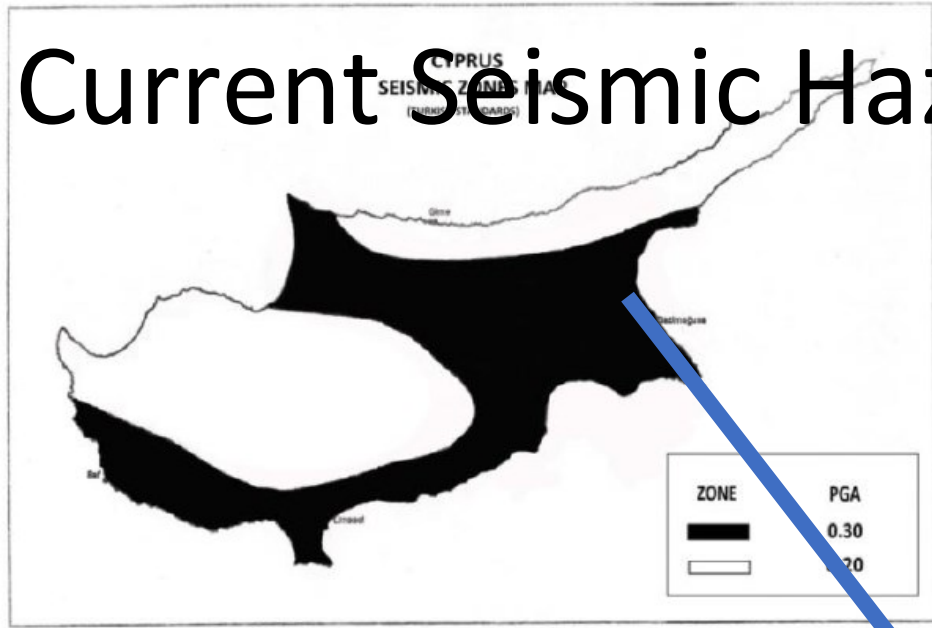
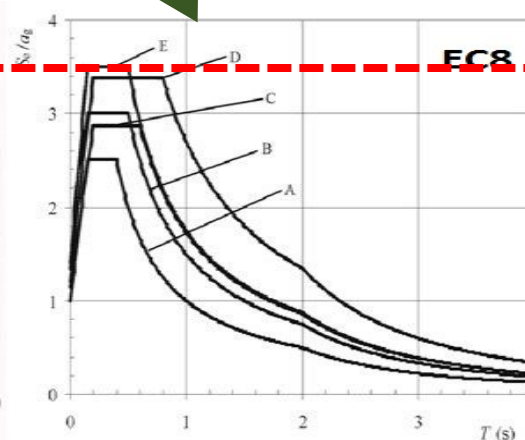
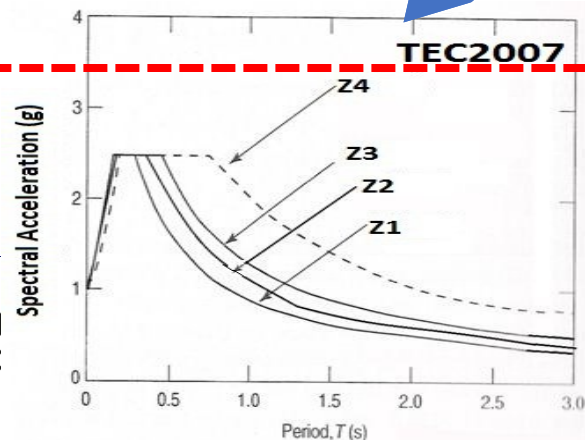


Figure 2.3 Shear Wave Velocity Map of Cyprus (USGS 2012)

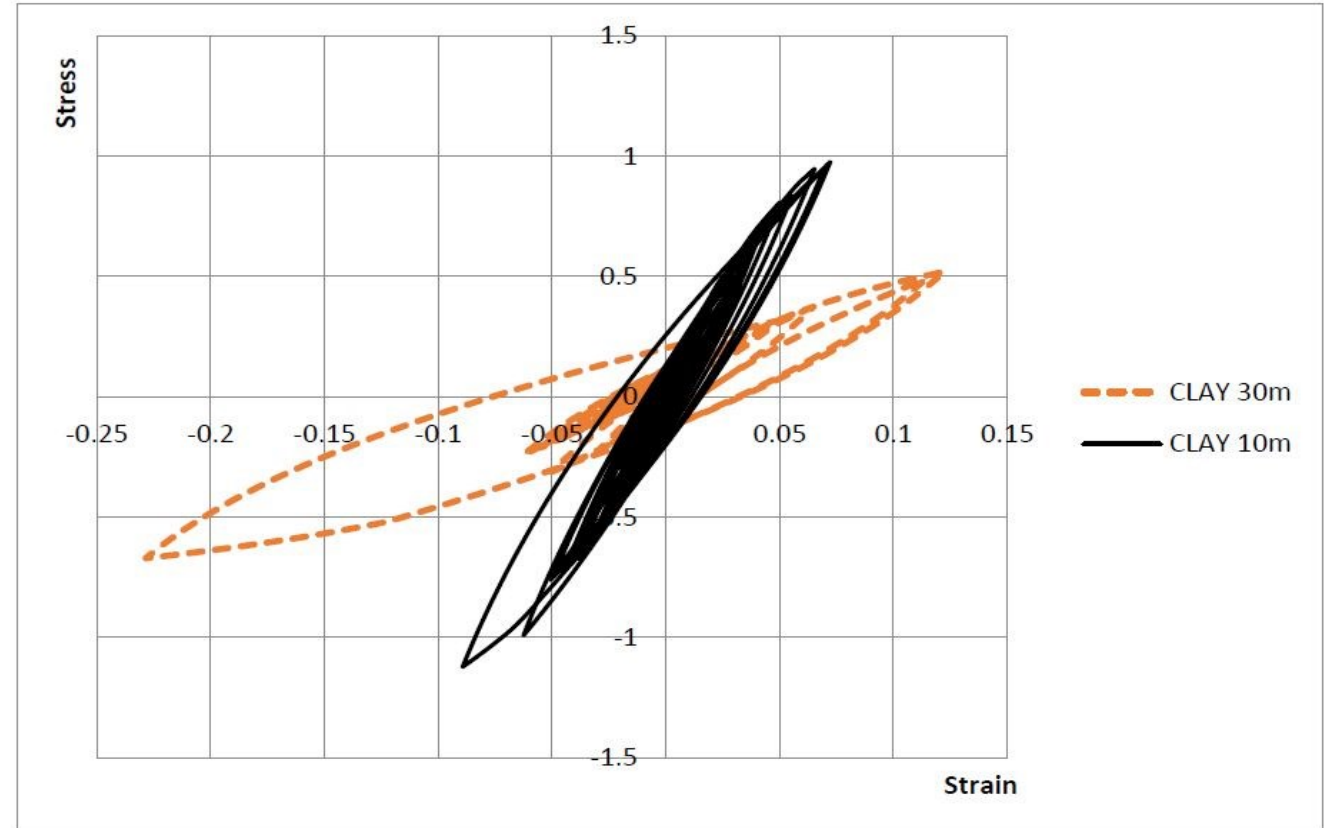


Seismic Design Code Differences

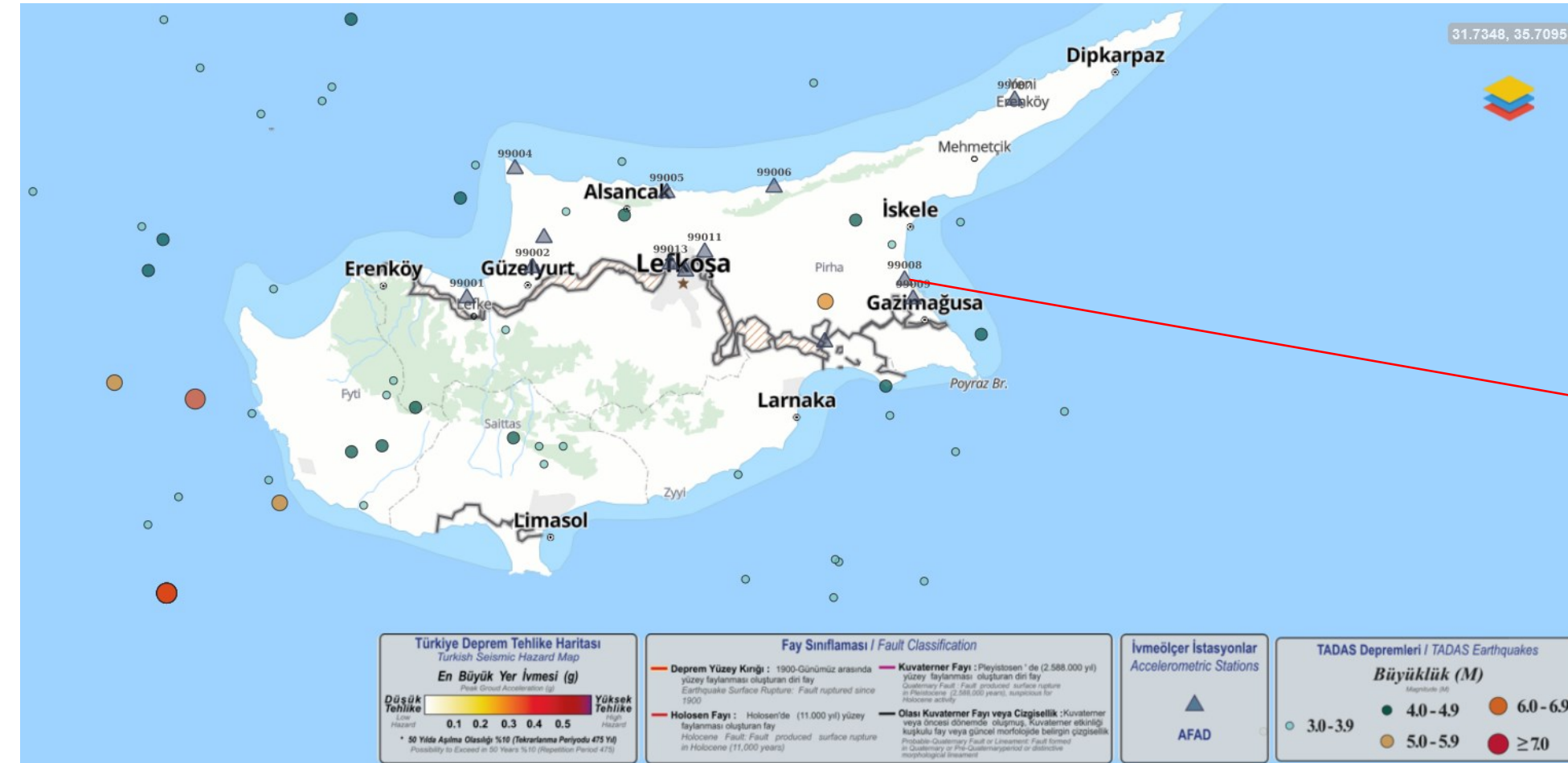
Analysis

Used Ground Motions for the Site Response Analysis (PEER 2014)

GM No	Event	Year	Mw	Focal Mechanism
1	Tabas	1978	7.35	Reverse
2	Taiwan	1999	7.62	Reverse Oblique
3	L. Prieta	1989	6.93	Reverse Oblique
4	Northridge	1999	6.20	Reverse
5	Taiwan	1999	6.69	Reverse
6	Cape Mendocino	1992	7.01	Reverse
7	Big Bear	1992	6.46	Strike Slip
8	Nahanni, Canada	1985	6.76	Reverse
9	Alaska	2002	7.90	Strike Slip
10	Duzce	1999	7.14	Strike Slip
11	Hector Mine	1999	7.13	Strike Slip
12	Norcia, Italy	1979	5.90	Normal
13	Gazli, USSR	1976	6.80	Normal
14	San Fernando	1971	6.61	Reverse
15	Parkfield	1966	6.19	Strike Slip



Recent Seismic Events: Spectrum Comparison



AFAD Strong Motion Network

-Recently established

-Limited data

TUZLA Station

Recent Seismic Events: Spectrum Comparison

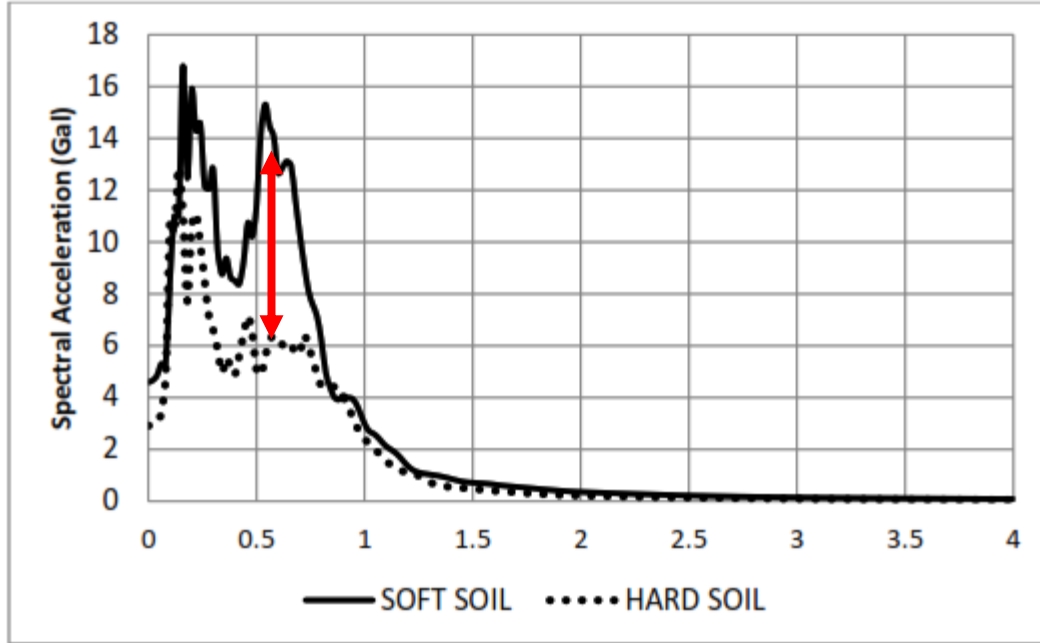


Figure 6. 28th December 2013 Mw5.9 West Cyprus Event

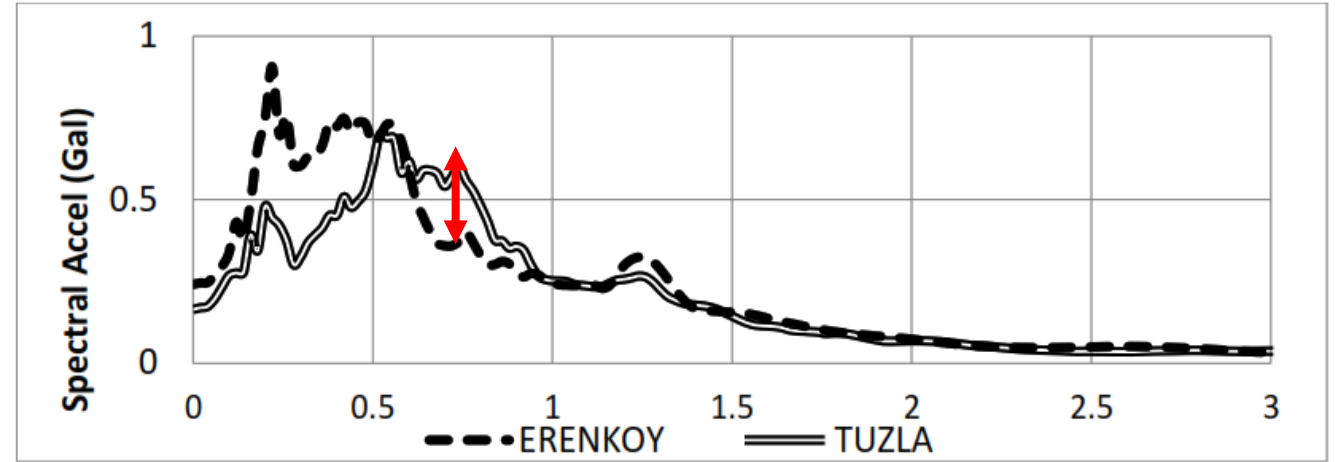


Figure 9. Comparison of 23rd October 2013 Event Spectra Comparison

Short return period events that do not have long period amplitudes

No large strain impact!

Results

15 Ground motion site response analysis results were used

Different variation in short and long period range was observed

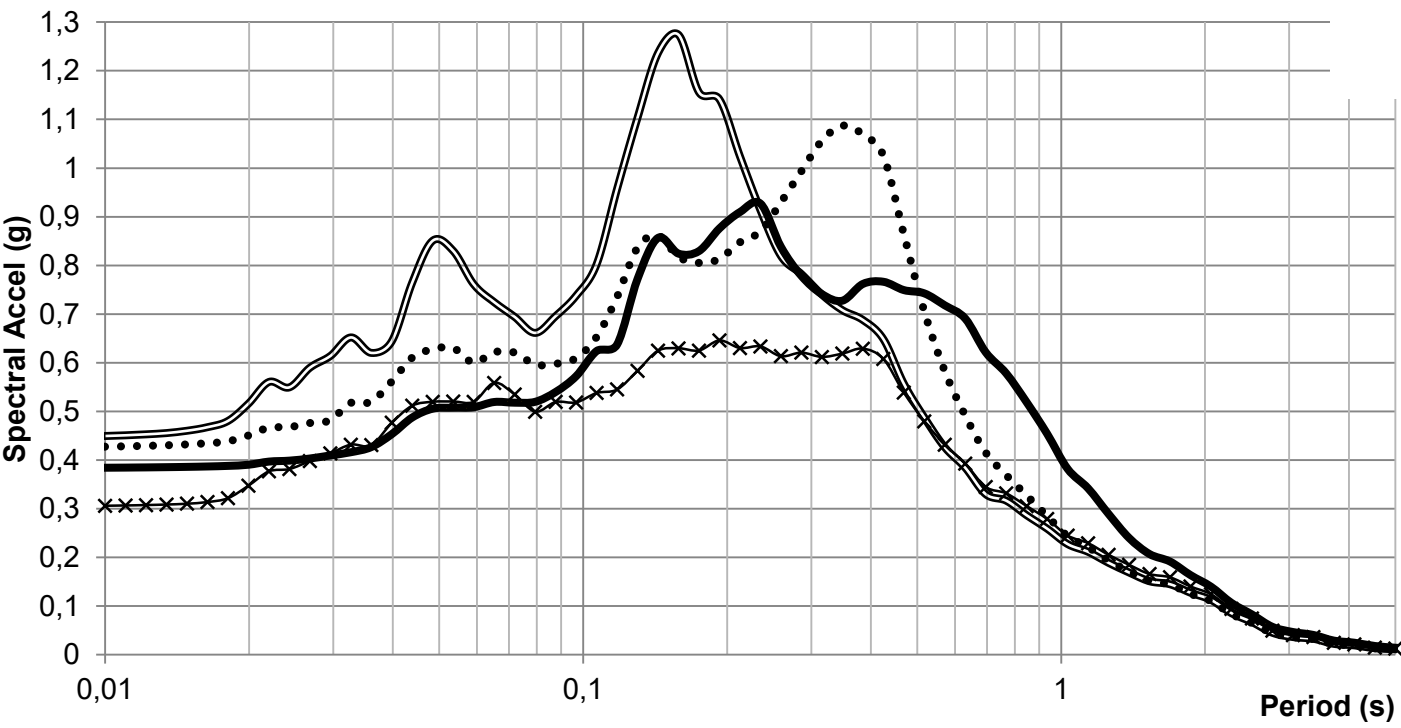


Table. Calculated Soil Factors and Peak Ground Acceleration Values

	Bedrock Depth	EC 8 Soil Factor	Median Soil Factor	475 Years	
				PGA	SA (T: 1s)
Rock	0m	1	1	0.3g	0.20
Zone 1	5-15 m	1.40	1.48	0.46g	0.22
Zone 2	15-30m	1.40	1.42	0.44g	0.25
Zone 3	30-60m	1.35	1.30	0.39	0.38

Good correlation with EC8!

Results: PGA amplification

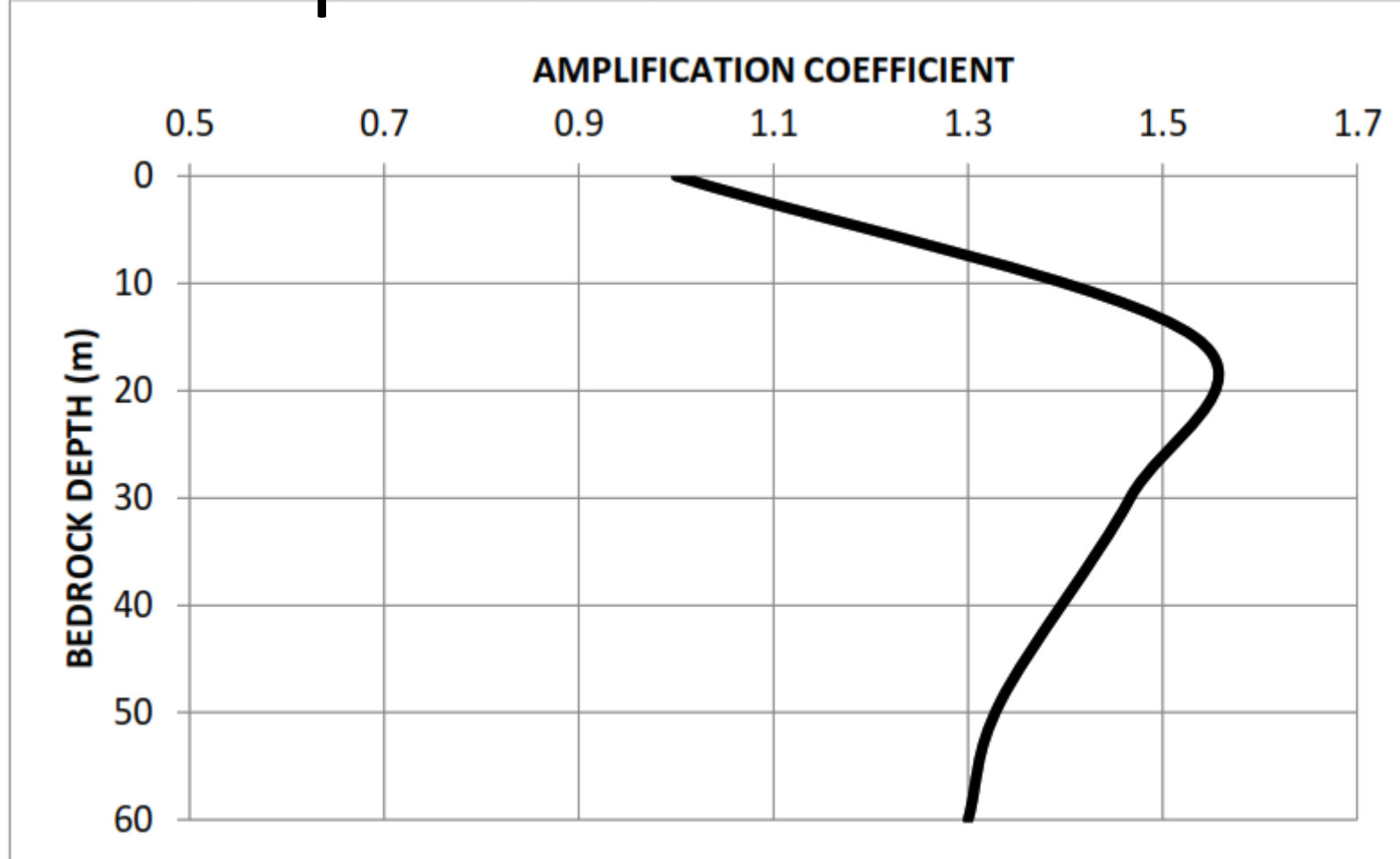
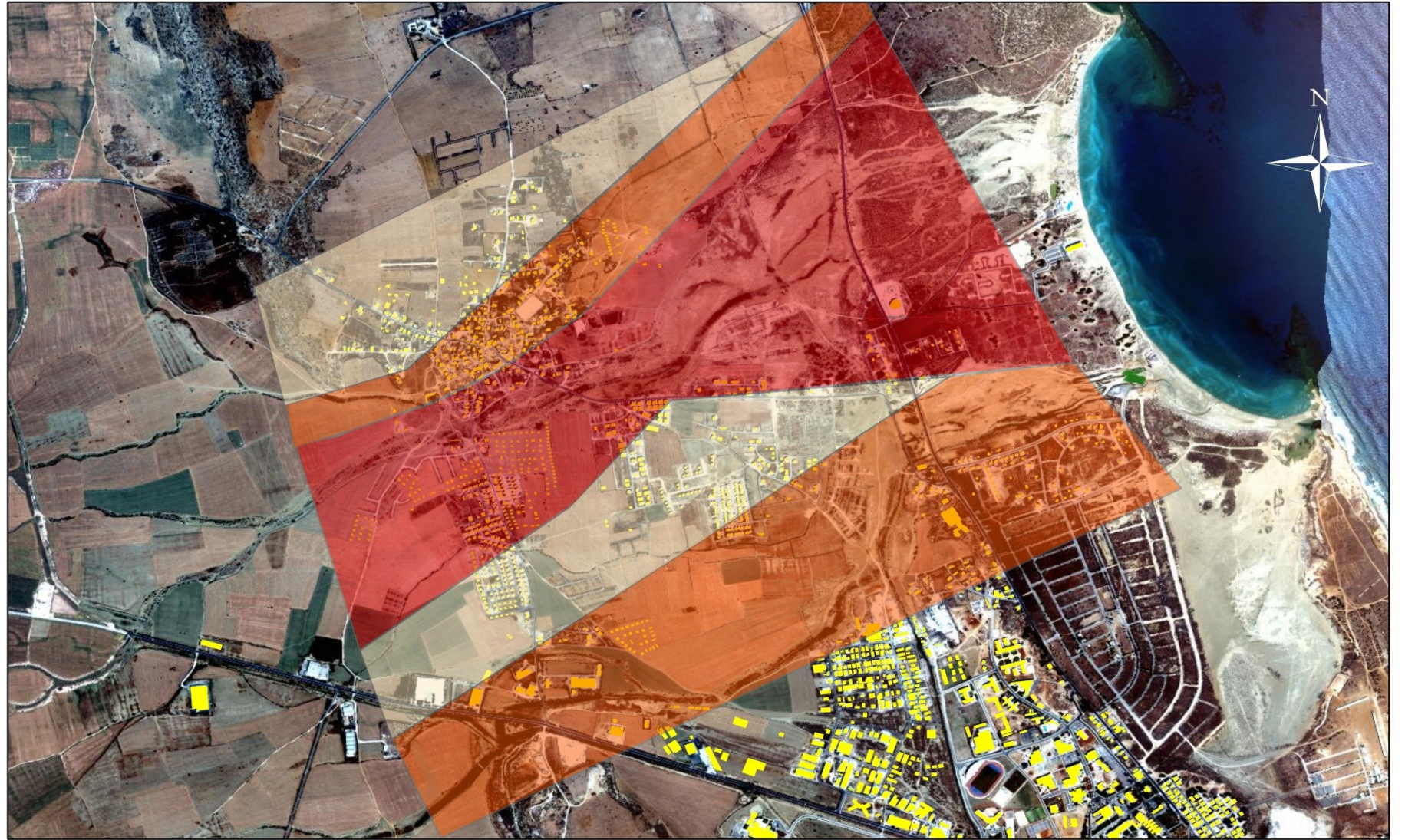


Figure 10. Variation of Amplification respect to Bedrock Depth Case

PGA MAP

Zoning based on bedrock depth

GiS data from Municipality



0 0.4 0.8 1.6 Kilometers

PEAK GROUND ACCELERATION (475 YEARS)

0.39g 0.44g 0.46g

North Cyprus



K.T.M.M.O.B.

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CHAMBER OF CIVIL ENGINEERS



Bahçeşehir
Cyprus University

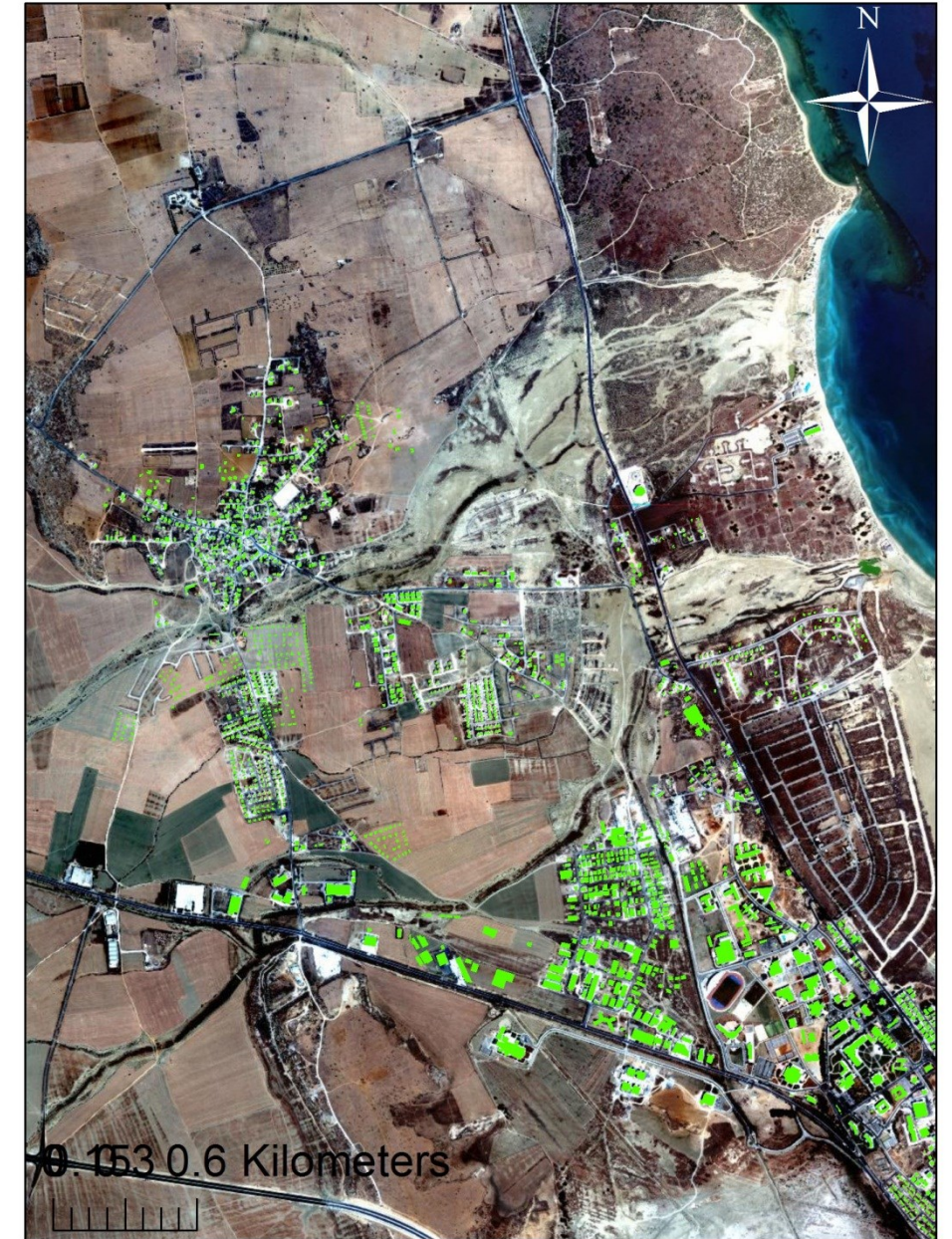


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Future Studies

Seismic Loss Assessment by using the site specific acceleration spectra
GIS Format Building Inventory can be used.

GiS data covers the building area, height and age characteristics of each building.



Thank you



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North Cyprus

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