2D DYNAMIC MODELLING OF DIP-SLIP FAULTS USING APPLIED ELEMENT METHOD

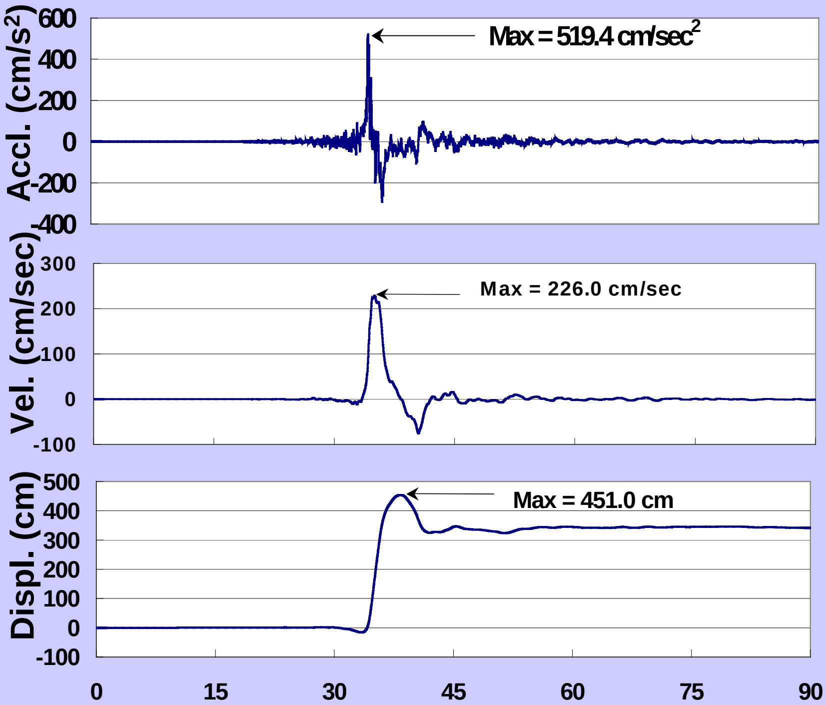
応用要素法(AEM)を用いた逆断層2次元動的モデリング

This study contributes to the understanding of the response of soil deposits to the underlying bedrock fault displacement. In the conventional attenuation relationship, peak ground acceleration shows maximum value at the closest distance from the fault. However, in the real observations, sometimes it is found that the damage near to the surface fault is not maximum, instead it is high little away from the surface rupture zone. To study this phenomenon, a new application to Applied Element Method (AEM) is formulated and the behavior of the fault rupture zone is studied. From the numerical results, it can be clearly said that the high non-linearity of the soil around the surface rupture zone compared to the adjacent areas is responsible for this phenomenon. In this study, we also investigated the influence of various parameters like material strength & stiffness, thickness, etc. on the surface rupture.

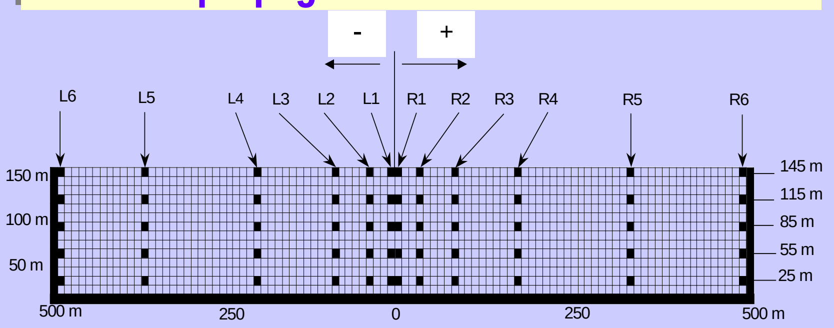
1999年のトルコ・コジャエリ地震や台湾・集集地震では，起震断層の破壊挙動結果として地表に現れた大きな地盤変状(地表断層変位)が，地表断層直上にあった構造物に多大な影響を与えることが問題となった．しかしその一方で，地表断層の近傍でも，直接変位の影響を受けなかった構造物の被害は軽微であった事例が多く観察された．これらの事実は，地表断層が確認された過去の他の地震でも観測されているが，地震動の強度や被害が断層からの距離とともに減衰すると考えられてきた従来の理論とは矛盾する．

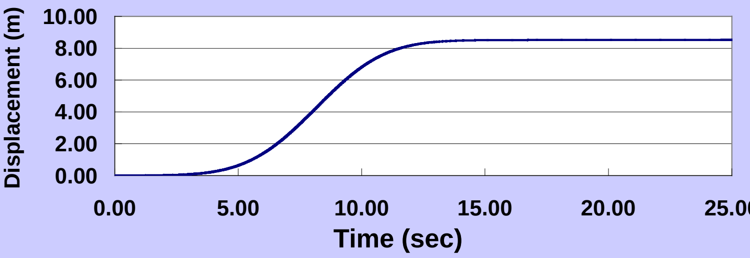
そこで本研究では，最近開発された高精度破壊解析法(応用要素法：AEM)を用いて，上記の問題の解明を試みた．AEMは従来の数値解析モデルでは困難であった複合材料や構造体の破壊に至るまでの非線形破壊挙動を高精度に追跡できる数値解析モデルである．AEMを用いた断層の動的破壊解析を行った結果，断層が地表に達した付近の地震動は低減され，断層から少し離れた位置で最大となる場合があることが確認された．これらの解析結果は先の観測事実を説明するものになっている．

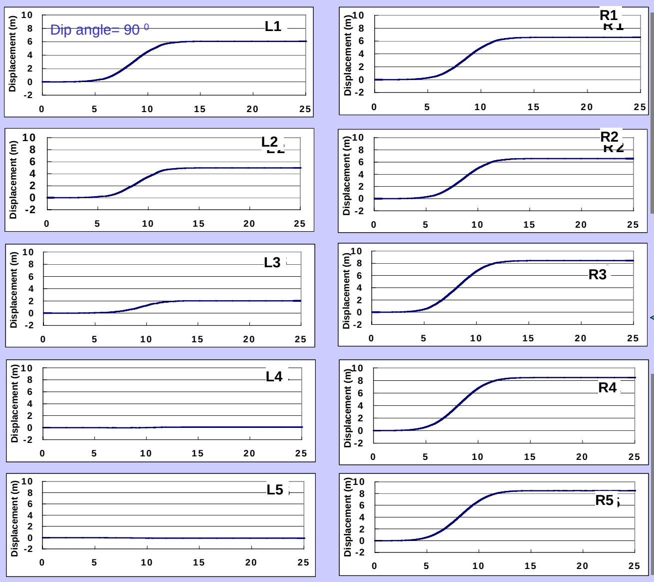
Acceleration, Velocity and displacement time history of the records obtained at Shihkan (TCU068) during the 1999 Chi-Chi, Taiwan Earthquake



Model used for comparing the dynamic rupture propagation with real case

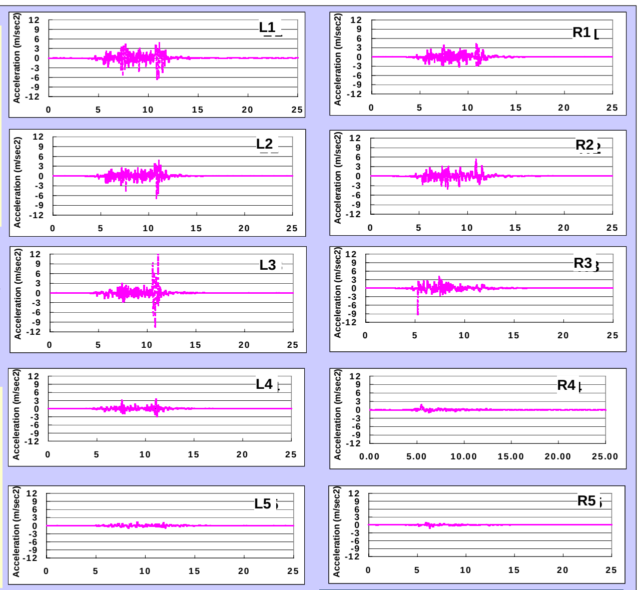






Vertical displacement time histories (at L1 ~ L6 and R1~ R6)

Horizontal acceleration time histories (at L1 ~ L6 and R1~ R6)



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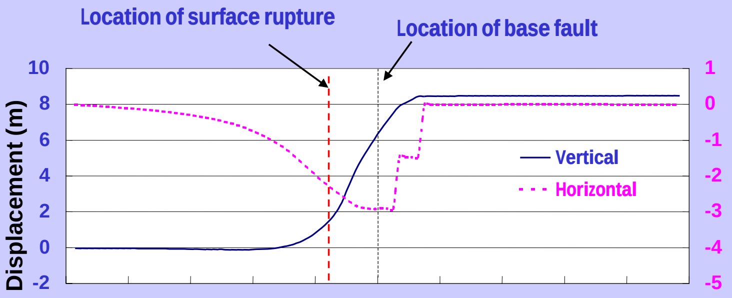
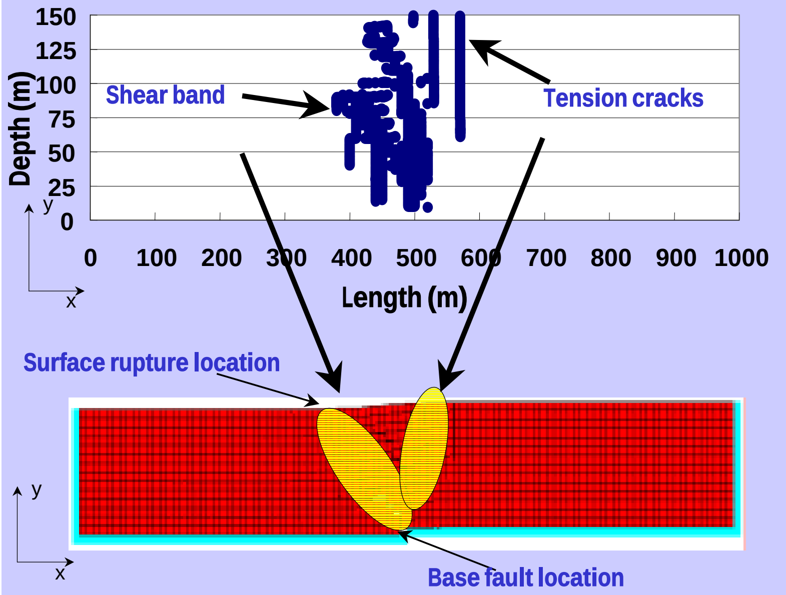
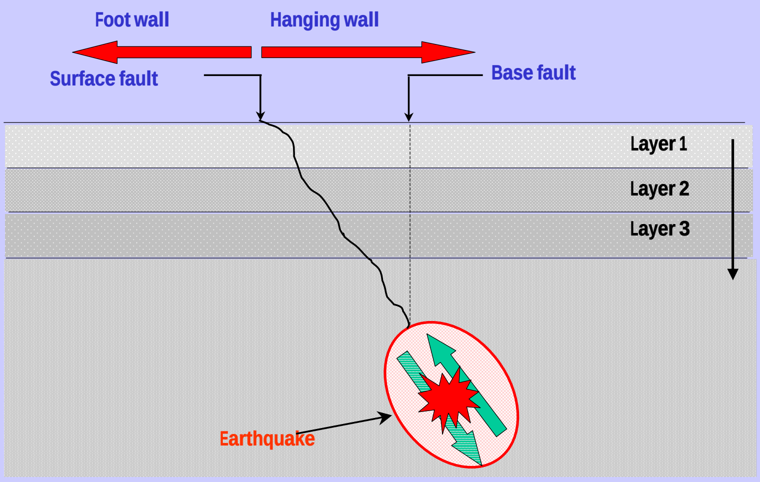


Final surface displacement



Element location and developed rupture zone

HYPOTHETICAL MODEL



- Relation between P-wave and S-wave and rupture velocoties

  $V_p/V_s = \mathrm{sqrt}[(2-2\mu)/(1-2\mu)]$

  $V_{rup} \approx 0.7\,Vs$

- Time for the S-wave and rupture to reach the ground surface

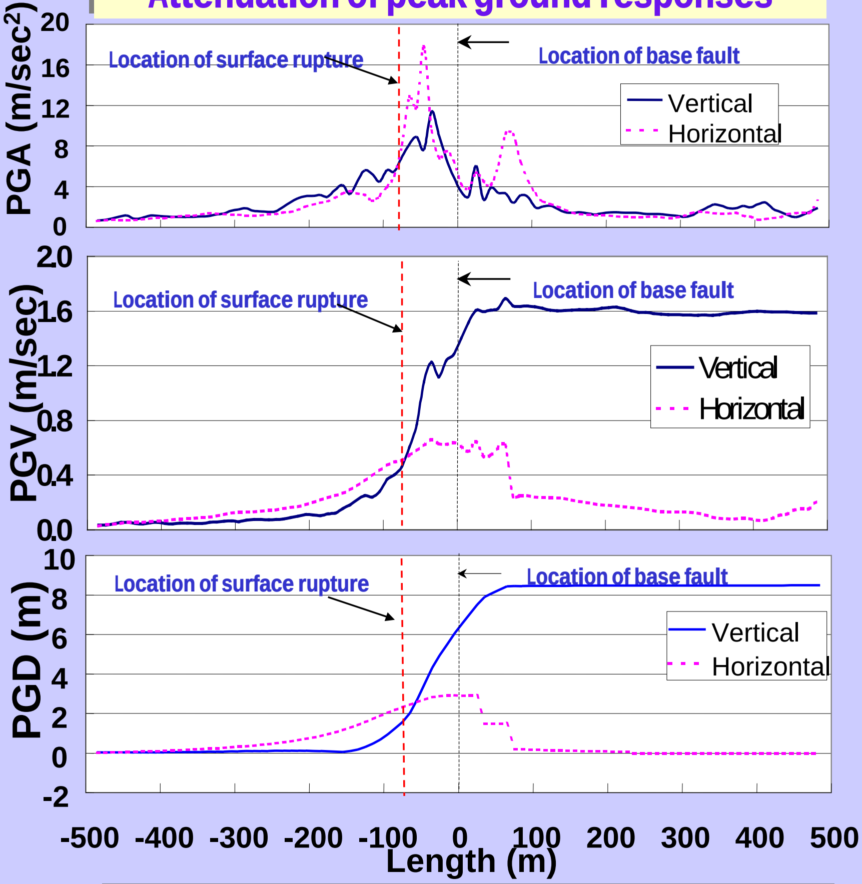
  $t_s = D/V_s$

  $t_{rup} = D/V_{rup\,f}$

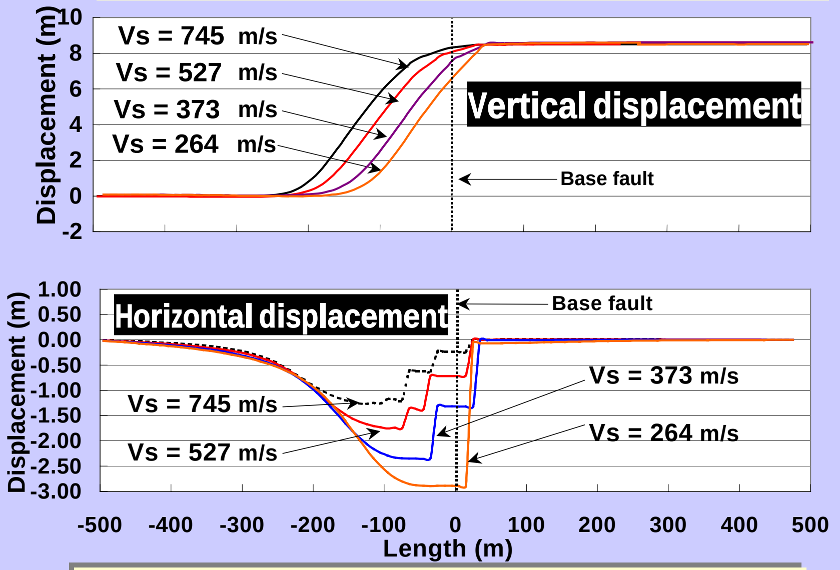
  For Vs = 2.0 km/sec
  D = 10 km
  $\Delta t = 2.15$ sec

  $t_{rup} - t_s = \Delta t \approx 0.43\,D/V_s$ --- time difference

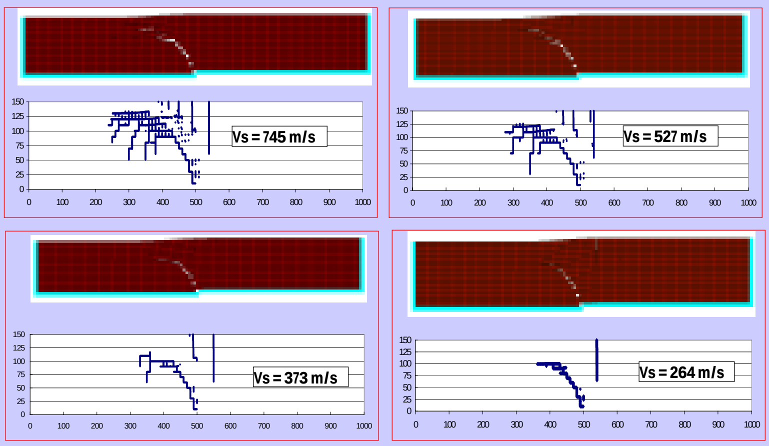
Attenuation of peak ground responses



PARAMETRIC STUDY



Comparison of final surface displacement



Developed rupture zone

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