

Large-Scale Mobile Shakers and Associated Instrumentation for Dynamic Field Studies of Geotechnical and Structural Systems

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Current State-of-the Art:

- **small-scale laboratory testing**
- **limited, small-strain field tests**

Proposed Large-Scale Field Equipment:

- **evaluate nonlinear soil behavior**
- **evaluate liquefaction resistance**
- **3-D imaging (depth > 300m, length > 1 km)**
- **full-scale foundations/structures behavior**

Mobile Field Equipment

- 1. large triaxial mobile shaker**
- 2. two, 3-D cubical shakers**
- 3. two-ton instrumentation van**
- 4. field instrumentation**
 - wired and wireless sensors**
 - multi-channel recording**
 - waveform processors**
- 5. teleparticipation equipment**

INDUSTRIAL VEHICLES INTERNATIONAL, INC

TRI-AX

A Dynamically Transforming 3-Axis Vibrator

birdwagen

A Hydraulic Drive Articulated 4X4 Vehicle

Large Triaxial Mobile Shaker

The **TRI-AX** vibrator system is an evolutionary step forward in seismic sources. It is a dynamically transforming 3 axis vibrator. It is capable of transforming from P-wave output to either in-line or cross-line shearwave output. It's low profile design in conjunction with a circular dome baseplate generates a uniquely stable and clean multi-axis output. The **TRI-AX** shearwave coupling plate leaves a minimal footprint compared with previous shearwave vibrators. The **TRI-AX** is mounted on the latest model 'birdwagen' MARK IV off-road carrier. The 'birdwagen' is a time proven carrier designed to produce the high production rates required on today's 3-D seismic crews. The combination of these 2 systems offers a practical solution for multicomponent field data gathering.



Transformation of the **TRI-AX** from P-wave output to shearwave output

P-wave mode



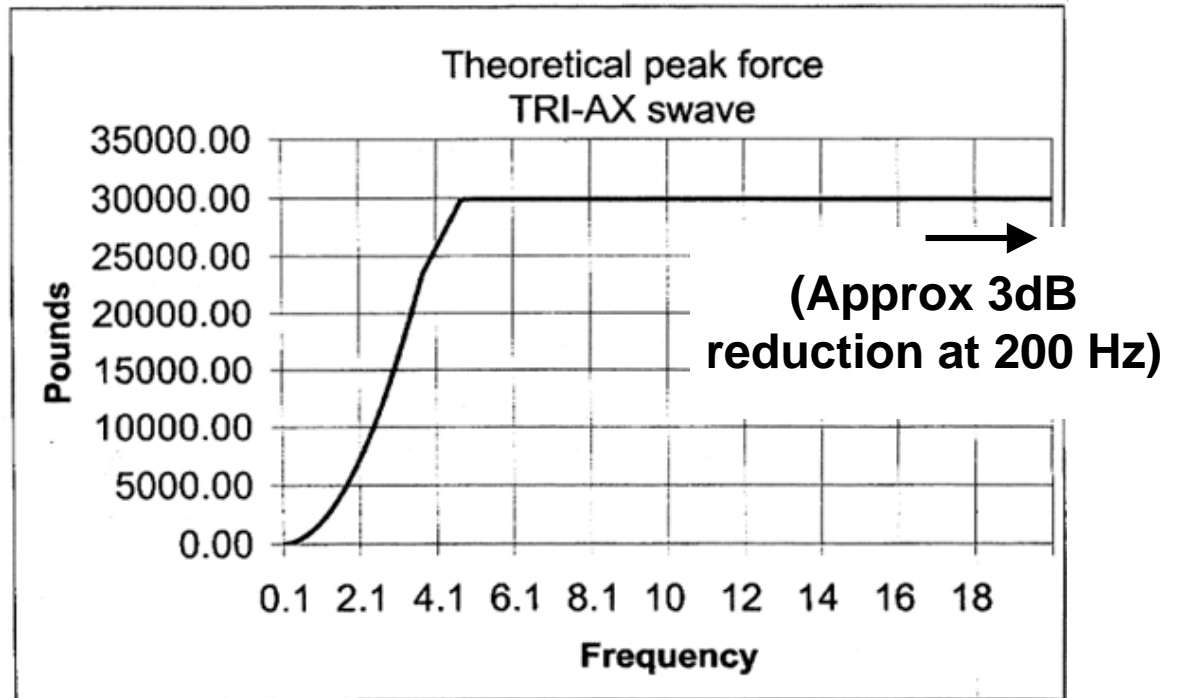
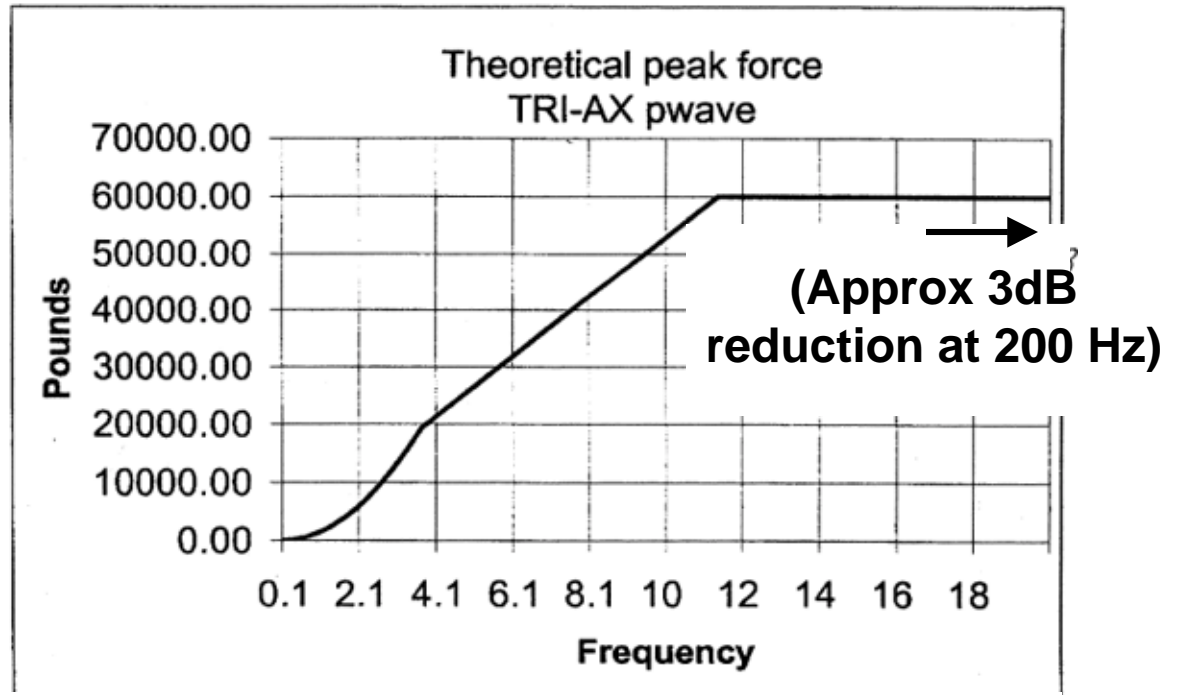
In P-wave mode the combined **TRI-AX** mass operates in a vertical motion just like a conventional vibrator.

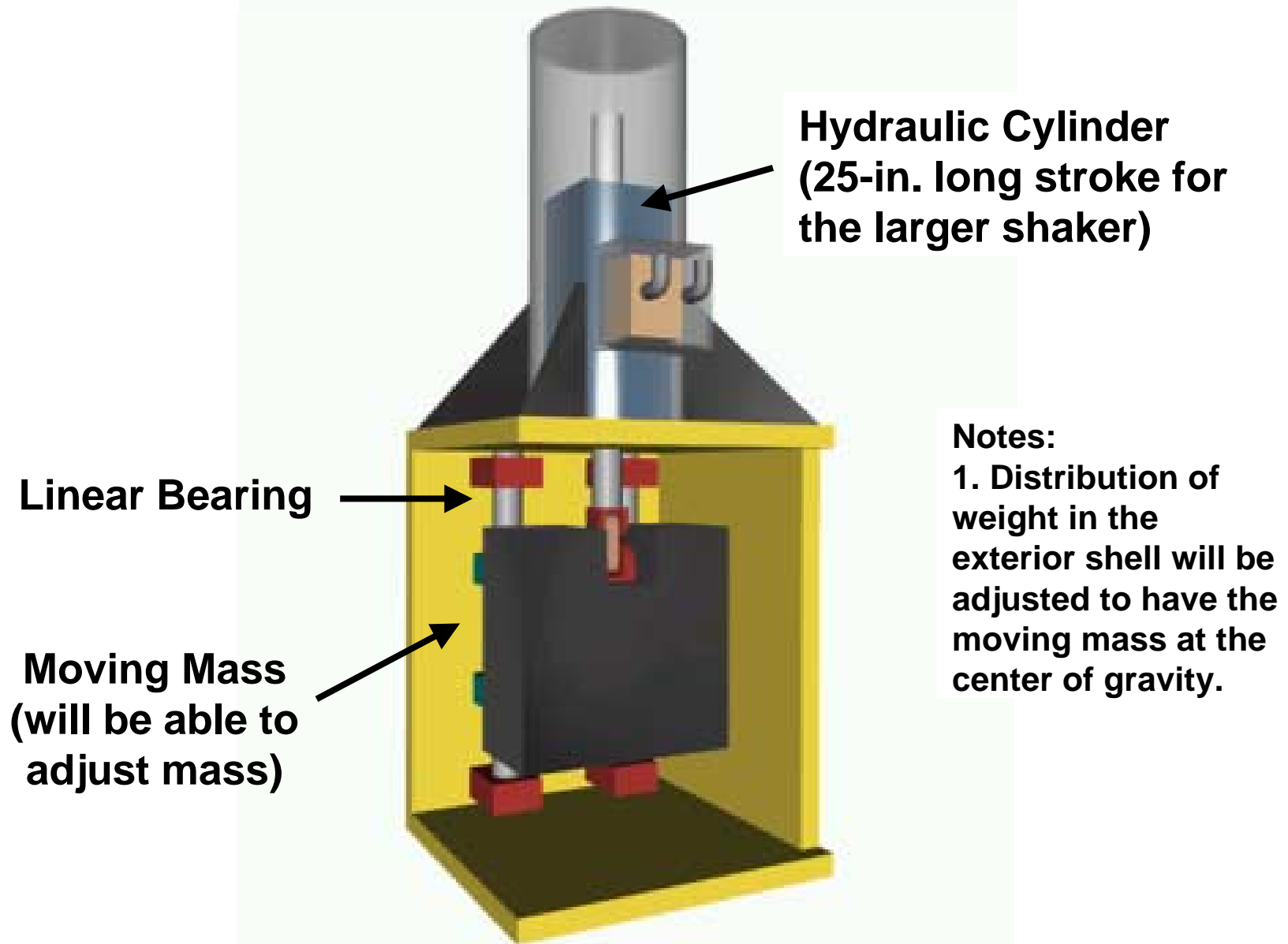
Shearwave mode



In shearwave mode the **TRI-AX** mass locks into the baseplate and the shearwave mass moves horizontally either cross-line or in-line.

Shaking Capabilities



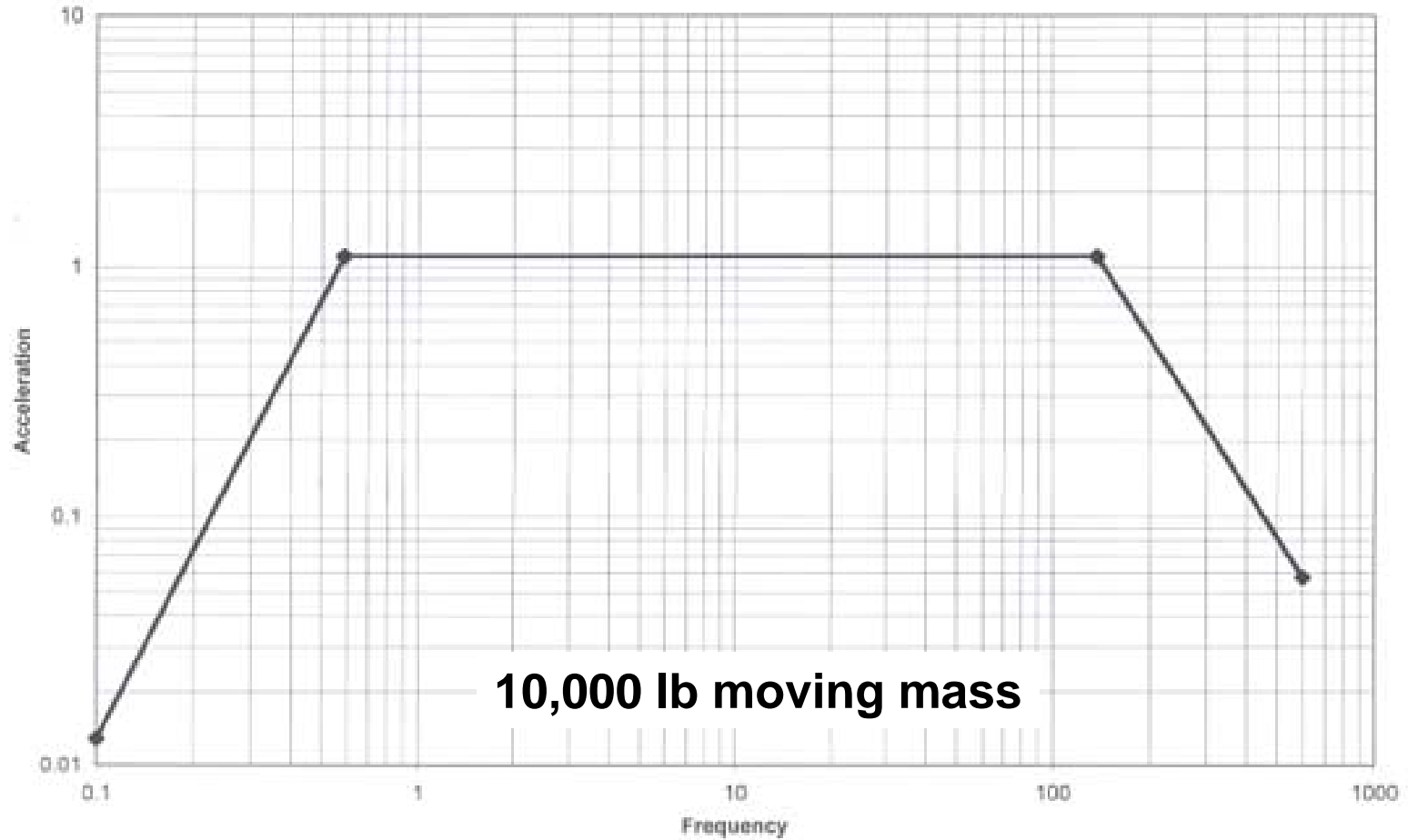


**Cut-Away Schematic of One “Cubical” Shaker
Oriented in the Vertical Direction**

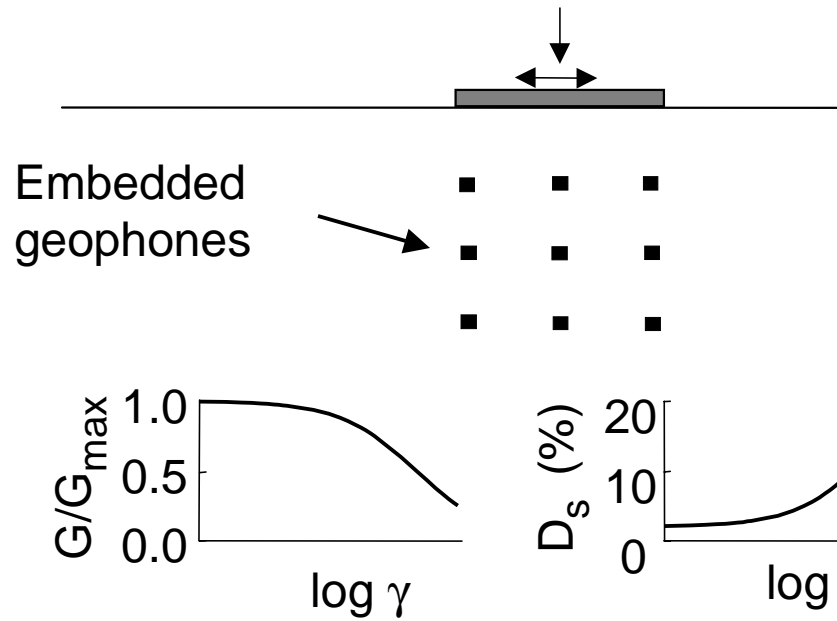
10,000 lb Moving Mass
25" Displacement
78.5 in/sec Velocity

Requires 130 gpm, 3,000 psi
Hydraulic Flow Rate

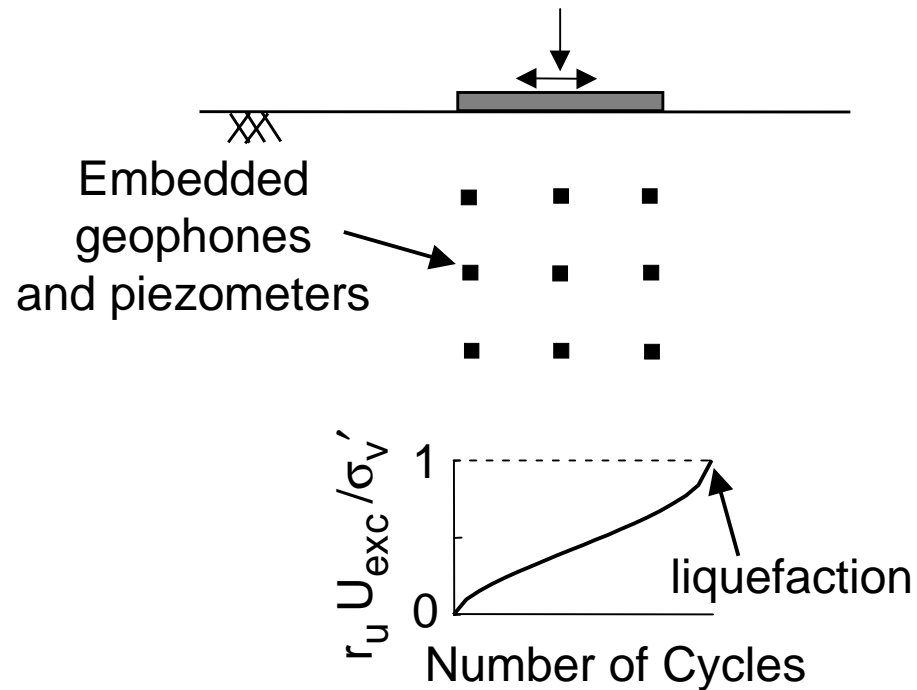
Estimated Performance



In Situ Evaluation of Nonlinear Soil Properties in Shear



In Situ Evaluation of Liquefaction Resistance



Common Issues/Problems

- **substantial developmental work is necessary**
- **high-tech equipment will become outdated**
- **budgets needed for shakedown/demonstration projects**
- **setting up a cost schedule and accounting for major breakdowns**
- **common standard for teleparticipation equipment**
- **creating some commonality for cost effectiveness**
- **joint usage of equipment**

Unique Issues to Field Testing

- **protection/vandalism of field equipment**
- **breakdowns in the field and backup support**
- **training and retaining highly skilled field personnel**
- **training new PI's on new equipment**
- **difficulties with teleparticipation when no hard-wired ports**
- **small pieces of equipment placed over large areas**