

JUNE 2015 MEETING

Wednesday, June 10, 2015 (1.0 PDH)

TECHNICAL PROGRAM

Seismic Design of Flexible Buried Structures – Applied to Tanks, Pipe Lines, and Rigid Rectangular Culverts

Speaker: John M. Clark, P.E., with Clark Engineers, Houston TX, Tel. 936.273.6200.

Mr. Clark, Past FPA President, and licensed professional engineer and holds a master's degree in civil engineering. He has worked in the area of buried flexible structures and pipes since 1976. Mr. Clark worked twelve years in research and development in Owens Corning Fiberglass' Non Corrosive Products Division.

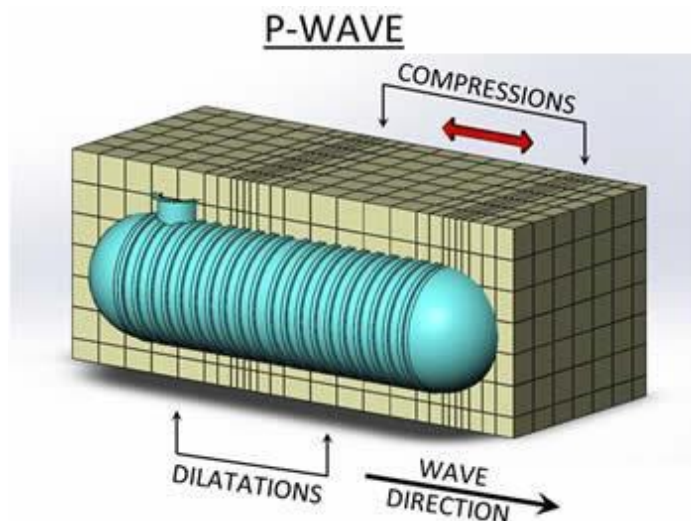
In 1989 he formed John Milton Clark Engineers, Inc. 'Clark Engineers'. The company' regularly consults with manufacturers of FRP tanks and equipment and other types of industrial equipment, including thermal ovens, water treatment equipment, structural dynamics, advanced stress analysis, soil structure interaction, finite element analysis, and other general structural and foundation design projects and investigations.

PRESENTATION SUMMARY

To an audience of about 65, Mr. John Clark, provided discussion and documentation on various methods used for seismic design of buried flexible structures subjected to seismic loading. John provided sources for much of the information and data required for the design procedures.

The main points of the design procedure were reviewed including a historical background of seismic design of buried flexible structures such as FRP (Fiber Reinforced Plastic) UST's (Underground Storage Tanks). John also reviewed the recent history on methodology dating back to the 1960's and then presented updates to the most recent methods published in 2008 along with some design recommendations.

The properties of soils related to seismic design (axial and hoop) were reviewed including the shear modulus and a discussion of seismic spectra. Calculations of axial stresses due to P waves and S waves were presented. John also discussed various methods for calculating transverse loads on circular conduits and box culverts including the Wang/NCHRP methods. John also discussed the Xerxes patented method (reduced shear modulus) with transverse loads on FRP UST's. The effects of "sloshing" on buried enclosed structures were discussed at length and methods of calculation were illustrated. Buckling of soil surrounded tubes was presented with examples and photos. The effects of liquefaction of soils on buried structures were discussed.



To download a copy of John Clark's presentation slides, [click here](#)

PAST FPA PRESENTATIONS

To read summaries of previous FPA presentations by Mr. Clark, please click:

[August 13, 2014](#) - The PTI Ver. 3 Design Method for MATHCAD 15

[May 08, 2013](#) - How to use Mathcad to do contour and surface plots for foundations

[November 09, 2005](#) Homebuyers Guide for Foundation Evaluation

[February 20, 2002](#) - Design of Buried Structures and Some Similarities to Residential Foundation Design