Recommended Standards of Practice for Fault Studies in the Houston Area, Texas

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Introduction

It has been said that Houston has the dubious distinction of having the greatest concentration of active faults of any city in the world.� To avoid unacceptable damage by a fault, it is necessary to assess whether a fault is present on the project site.� If one is present, it should be located and its presence should be considered in design and sitting of project facilities.���

In 1985, the author helped develop a set of standards[1] to establish a reasonable level of effort for fault studies for residential subdivisions.� Those standards have stood the test of the past 17 years for a wide variety of projects.� This listing reiterates and confirms the basic principles described in the 1985 version, updates a few details, and adds some details that experience has shown to be important.� Because of space limitations, some details are omitted.��

Three types of studies are normally employed, as described below.�

Reconnaissance Fault Detection Study (Phase I)

An initial fault detection study should include the following items, except in cases where there are sound technical reasons for deviation.�

- ���������� Review information on surface faulting in the area.� This should include professional papers, maps by the U. S. Geological Survey, thesis and dissertations, reports of other fault studies, and such other information as may be available.�
- ���������� Interpret topographic maps for geomorphic features associated with surface fault activity.�
- ���������� Review maps of subsurface geologic structure for the presence of faults at depth that might project to the surface at the site.� While these may include published maps of oil fields, the most useful are those prepared by log libraries (such as Geomap Company and Cambe Geological Services).�
- ���������� Review aerial photographs to check for photo linears that may be related to surface faults.� A normal minimum is five flights over a wide range of years at a scale of no worse than about 1: 60,000, with a preference toward 1:20,000 to 1:40,000, including as many as practicable before the area is developed or covered by forest.���

���������� Conduct a site and general area reconnaissance to look for physical evidence of distress resulting from surface fault activity.

A reconnaissance study cannot prove the absence of faulting at a site, but it usually provides enough confidence that no further detection work is needed.���

Detailed Fault Detection Study (Phase II)

In some cases, a detailed study is needed to provide adequate confidence in the presence or absence of faulting at a site.� This nearly always requires electric logs of existing wells or new borings.�

For some projects, it is possible to use existing logs of explorations for oil and gas.� This is usually reserved for large sites and locations where wells are less than about 1 to 2 miles apart (closer if interpretations must rely on markers above the marine deposits).� It is rare to find logs of water wells spaced close enough to permit their valid use.�

Most detailed studies will require drilling and electric logging borings.� Depending on the project, the line(s) of borings may be oriented more-or-less perpendicular to the expected trace of the fault or may encircle the perimeter of the site.� While boring spacing as great as 1,000 ft may be appropriate in some areas close to the coast, spacings no more than about 500 to 700 ft are required in most of the Houston area.� A minimum of three borings is usually needed to provide confidence in the markers and to prove the presence or absence of a fault.� Borings are typically about 300 ft deep.� It is very rare for greater boring depths to be preferred over closer boring spacings.� At a minimum, the log suite should include: single point resistance (or a focused log that gives equivalent stratigraphic definition), natural gamma, and spontaneous potential.� A 16 inch short normal log is desired.�

The logs should be interpreted for stratigraphic markers that are expected to have been laid down nearly horizontally.� A minimum of five to seven markers should be expected from appropriately spaced borings; if fewer markers are interpreted, more borings may be needed.� The markers should be plotted to scale with at least 2 to 5 times vertical exaggeration to look for smaller faults.�

Detailed Fault Delineation Study (Phase III)

If a fault is present on a site, it may need to be delineated across the site.�

If the fault has a relatively undisturbed scarp that can be confidently recognized, it may be delineated by means of elevation sections surveyed across the fault to determine both the location of the fault and the width of the portion of the ground surface that it deforms.� While simple staking of the scarp may suffice in some cases, care must be taken to assure that the width of the zone of surface deformation is chosen appropriately.� In this manner, the fault location is usually defined at points no more than about 100 ft apart .�

If the fault cannot be mapped from the surface, it must be mapped from the subsurface.� This is usually accomplished by means of electrically logged borings drilled in lines across the fault.� In each line, the fault should be penetrated at least twice, so the locations of the fault penetrations (cuts) can be used to project the fault to the surface.� It is rarely appropriate to use the dip of a fault from nearby lines to project more than a short distance to the surface.� Lines of borings should be spaced no more than about 250 to 300 ft apart, to reduce the risk of the fault deviating excessively from the interpreted trace between the lines of borings.�

A recommended fault hazard band should be developed considering the width of the band of surface deformation caused by the fault, the uncertainties in locating the fault (particularly between the points where it is located), and appropriate clearances to provide a margin of safety.� Criteria should be developed for siting and design of structures and infrastructure with respect to the fault�

Conclusions

This summary is intended to list a minimum set of standards for due diligence.� It does not attempt to provide details for untrained practitioners.� Detection and delineation of faults in the Houston area requires substantial specialized training and experience that are not provided in formal education programs.� Even then, careful attention to detail is needed to avoid errors that can be very costly to both the professional and the owner.�

If you have any questions, please contact **Dr. C.Vipulanandan**