Geophysical Research Abstracts
Vol. 13, EGU2011-5534, 2011
EGU General Assembly 2011


# Seismic refraction survey to identify faults along a planned viaduct site in Constantine, Algeria: Application and comparison of tomography and generalized reciprocal method interpretations.

Kerim Martínez and José Alfredo Mendoza
COWI, Geology and Geophysics, Kongens Lyngby, Denmark (kemr@cowi.dk)

The design and construction of large infrastructure projects require detailed information on subsurface geology and identification of potential risks. Geophysical investigations can provide important information for design and risk assessment provided that the optimal method and interpretation approach is adopted.
This work presents results from seismic refraction surveys carried out along a planned viaduct across a river valley at Constantine, Algeria. Northern Algeria is a seismically active region and therefore large infrastructure projects require detailed information on structural conditions. In Constantine there are recent occurrences of large scale earthquakes with active and passive faults prevalent throughout the area. The aim of the surveys was to map the strata and localise faulting systems and their extension along the planned bridge alignment.
The geophysical surveys comprised of seismic and geoelectrical surveys spanning the viaduct alignment. The seismic refraction surveys were comprised of three parallel lines each of 700 m length with a line separation of approximately 30 m. Each line was comprised of three overlapping segments using 10 Hz geophones with a spacing of 5 m. The source used inline was 8 kg hammer strokes spaced 15 m complemented with a drop weight of a 2400 Kg (1 m3) concrete cube released from a vertical distance of 3 m. These drop weight shots had an average spacing of 50 m including inline and offline locations.
The seismic results were interpreted using both tomography and the Generalized Reciprocal Method (GRM). The seismic tomography results showed a clear anomaly indicated by an abrupt change in lithology at the location of one of the planned viaduct pylons. To obtain more detailed information on this anomaly, and identify if any other locations along the viaduct have similar conditions, the GRM method was carried out.
Interpretation of a structural feature from GRM results in the present work necessitates the following factors to be satisfied: 1) Appreciable or abrupt discontinuity along a horizontal refractor 2) Discontinuity of horizontal refractor velocity and 3) Consistent discontinuity results across parallel survey lines of similar
data quality.
The analysis of the GRM time-difference curves allowed the identification of three velocity layers. There are large similarities between resulting sections for all lines, with some punctual differences.
The first (upper) layer is the low velocity layer with velocities generally ranging from 500 m/s to 600 m/s. This thin layer (up to 4 m thick) can be interpreted as either the top fill or organic layer and/or the unsaturated zone.
The second layer corresponds to the first refractor presenting velocities ranging from 1000 to 2000 m/s. This layer is interpreted as marl based on comparison with existing lithological logging. The second layer varies in thickness in the south from 10 to 20 m with average velocities of 1250 m/s. In the middle of the valley the layer is largely non-existent, suggesting that there is no appreciable marl unit present below the river channel. On the east bank of the river there is a large variability in thickness and velocities between lines. Comparison shows the tomography interpretation better able to image this area. Along the northern slope there are generally lower velocities (1000-1500 m/s) down slope compared to upslope where velocities are $\sim$2500 m/s. This correlates with geotechnical parameters derived from SPT measurements where down slope marls are of lower shear strength properties.
The third layer represents marlstones with velocities of 2750-3000 m/s to the south and limestone with velocities of 4000-5000 m/s to the north. The change in velocity of the third refractor occurs abruptly on the east bank of the river on all three profiles and show both a horisontal velocity discontinuity and a discontinuity along the horisontal refractor. These observations indicate the presence of a fault at this location that was validated by susbsequent drillings.
Based on the seismic refraction interpretations the location of planned viaduct pylon was moved away from the mapped fault while the location of another pylon did not show any indication of a fault.