Analysis of Ground Motions in Anchorage Bowl from 30th November, 2018 Earthquake (Mw=7.1)

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Ground Failure map of Anchorage during 1964 EQ

The map has been prepared based on the ground failure evidences collected from 1964 Alaska Earthquake.
Geological Map of Anchorage

Four main geological Units of Anchorage:

1. The metamorphic terrain
2. Glacial till
3. Glacio-Fluvial Deposits
4. Bootlegger Cove Formation
Geological Cross-Section AA'
The survey was conducted at 36 sites in the Anchorage bowl with the co-operation from VIC of Japan and Ensol corporation of Raleigh, NC.

7 sites were Calibrated sites

29 sites were Experimental sites
Seismic Site Class: Average S-wave Velocity Structure in 0-30m Depth Interval

- The phase velocity values were inverted in terms of S-wave velocity structure by using an inversion scheme.
- From the layered velocity model 30m Average Shear-wave velocity values are computed.
- Site classes are estimated as per NEHRP – provision.
- Site Class E < 180 m/s  
  D = 180-320 m/s  
  C/D= 320-410 m/s  
  C = 410-760 m/s
RESULTS: SHALLOW 3-D VELOCITY STRUCTURE OF ANCHORAGE
Anchorage Strong Motion Network

Distribution of seismic sensors in the Anchorage area and its vicinity (Chugiak and Palmer). Blue and red marks are for stations established by USGS and UA, respectively. Green marks are for the structural arrays.
Spatial Variation of Site Response in Anchorage Basin

Site Response Map (5Hz)

Site Response Map (1Hz)
The PGA value in Anchorage for the Denali earthquake shows a high value around the region adjacent to the Knik Arm, Turnagain Arm, and also the eastern part of Anchorage International Airport.
Structural and non-Structural Damage Map

Locations of self-reported structural and non-structural damage (red dots). Damage distribution information provided by Casey Cook, Mat-Su Borough emergency manager and Ross Noffsinger, acting building official, Municipality of Anchorage (Pic Courtesy: GEER, USA)
Western Side of EIB

Seismic Instrumentation of UAA College of Engineering Building (Engineering Industrial Building, EIB)

Eastern Side of EIB
EIB SEISMIC SENSOR REPORT: M7.0 EARTHQUAKE 2018-11-30

Interstory Drift Ratio

Alarm Level Description:
- 3: IDR Limit 3 Exceeded
- 2: IDR Limit 2 Exceeded
- 1: IDR Limit 1 Exceeded
- 0: No IDR Limit Exceeded
- n/a: No Information Available
EIB SEISMIC SENSOR REPORT: M7.0 EARTHQUAKE 2018-11-30

Acceleration

EW West-Side - Absolute Acceleration (g)

<table>
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<th>Floor</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
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NS West-Side - Absolute Acceleration (g)

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EIB SEISMIC SENSOR REPORT: M7.0 EARTHQUAKE 2018-11-30

Displacement

EW West-Side - Absolute Displacement (cm)

NS West-Side - Absolute Displacement (cm)
Response and Design Spectra

Response Spectra (Damp = 0.05)
Recorded Ground Motions at Chugach Electric, Anchorage

Station: CHUG, East-West Component

Station: CHUG, North-South Component

Station: CHUG, Vertical Component
Figure. (a) North Fork Campbell Creek (Elmore) Bridge (viewing towards south) and (b) Location of North Fork Campbell Creek Bridge with respect to Site (8030) at Anchorage Police Department (APD) Headquarter (Picture Courtesy: Joey Yang, UAA)
Seismic Instrumentation Plan of the North Fork Campbell Creek Bridge, Anchorage
September 2, 2008

358’

58’-8”

58’-8”

60’-0”

60’-0”

58’-8”

58’-8”

117’-4”

120’-0”

117’-4”

ELEVATION

Uniaxial accelerometer

PLAN

2” dia. borehole underneath the bridge
for ground temperature monitoring

Notes:
1. One of the two 2” conduits owned by Muni Traffic Dept. on the 1st bay from the western side will be used to run signal cables, as shown in Fig. 1.
2. The sensors will be installed in the first bay from the western side. Specifically, eleven (11) seismic sensors will be bolted on the diaphragms or backwalls.
3. Drilling of small shallow holes in the diaphragms is required for mounting sensors and junction boxes. No drilling on the girder or cap beam is required. Drilling will be done according to AK DOT & PF’s standard utility memo. The contractor will locate, map, and avoid cutting of reinforcing steel in concrete backwalls and diaphragms. No cutting of reinforcing steel will be permitted without the Department’s approval.
4. One 12-chan. data recorder will be installed on the North Abutment and properly secured.
5. A 2” borehole beneath the bridge toward the north abutment is planned to monitor seasonal frost depth.
6. Sensor orientation: Chans 1, 2, 4, 5, 8, 9 & 11 – E-W; Chans 3, 7 & 10 – Up; Chan 6 – N-S.

(Picture Courtesy: Joey Yang, UAA)
Spatial Variation of Peak Ground Accelerations in Anchorage Basin
Spatial Variation of Peak Ground Velocity in Anchorage Basin
Spatial Variation of Spectral Acceleration (0.2 sec) in Anchorage Basin
Spatial Variation of Spectral Acceleration (1.0 sec) in Anchorage Basin
Spatial Variation of Site Response in Anchorage Basin

Site Response Map (5Hz)

- Legend:
  - Stations
  - SR (5 Hz)
  - SR (5 Hz) Interval
    - 0.3 - 0.6
    - 0.6 - 0.9
    - 0.9 - 1.2
    - 1.2 - 1.5
    - 1.5 - 1.8
    - 1.8 - 2.1
    - 2.1 - 2.4

- Map areas marked with numbers:
  - 1
  - 2
  - 3

- Site Amplification Factor

- Scale:
  - 0 - 4 Miles
  - 150.00 - 149.00
Spatial Variation of Site Response in Anchorage Basin
Comparison of Computed Site Response
Relation of Site Response (1 Hz) and Vs(30) in Anchorage Basin

SR = 2.1 - 0.0024$\beta_{30}$