

# **INFLUENCE OF THE 1964 GREAT ALASKA EARTHQUAKE ON CIVIL ENGINEERING AND BUILDING CODES IN ALASKA (AND THE USA)**

**Robert (Buzz) Scher, P.E.**

**Alaska Seismic Hazards Safety Commission  
Anchorage Geotechnical Advisory Commission**



# ALASKA SEISMICITY

- Most seismically active State
- Since early 1900s:
  - 11% of instrumented earthquakes in world; 3 of 12 largest in world; and 9 of 10 largest in N.A.
  - 50 to 100 earthquakes daily;  $\approx$  24,000 annually, including at least one M6-7; M8+ every 13 years
- One of the most prominent sources of tsunamis in the world

Pre-1964 Earthquakes  
Post-1964 Earthquakes  
Earthquake Magnitude

# Earthquakes in Alaska

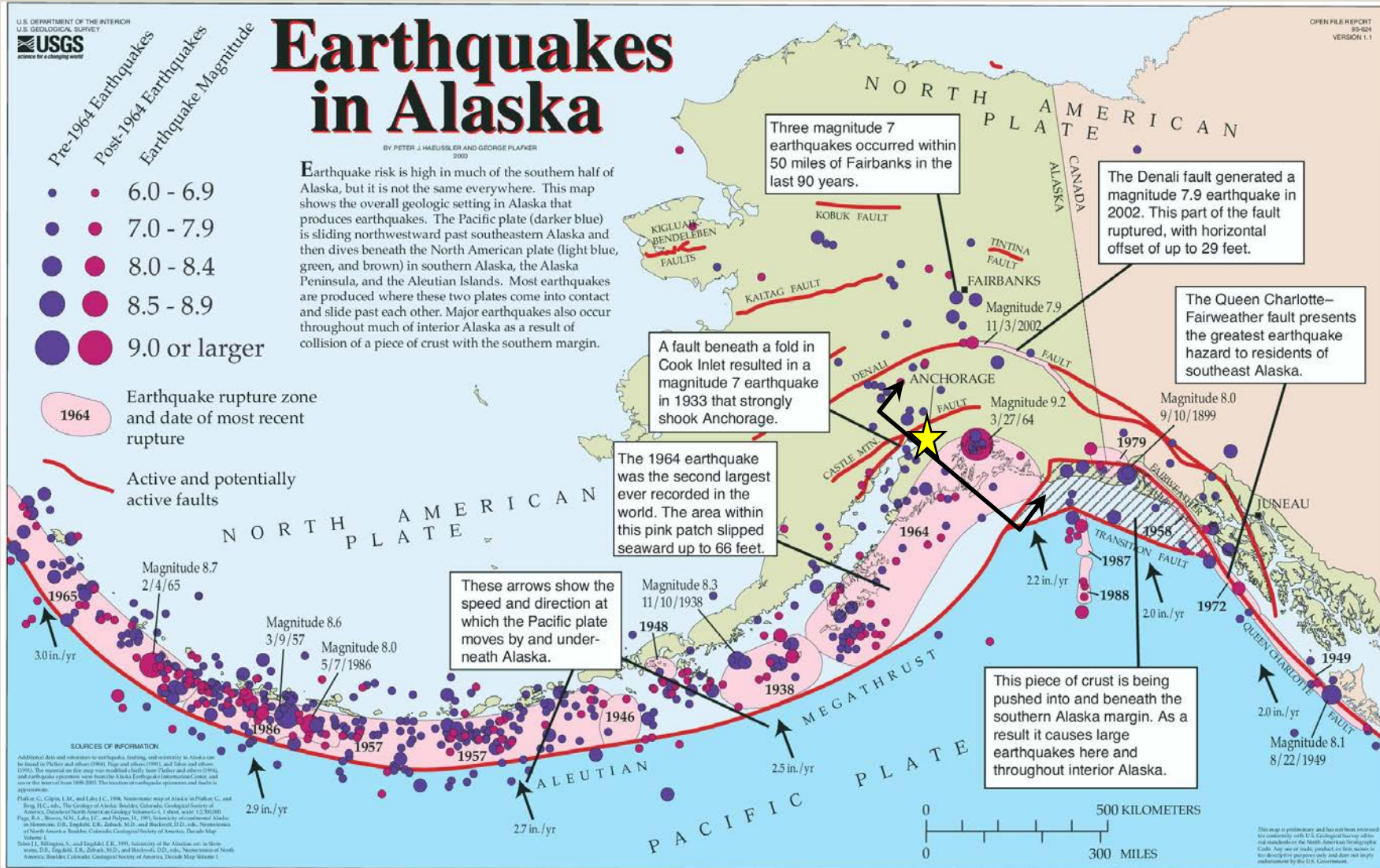
BY PETER J. HAEUSSLER AND GEORGE FLAPKER  
2002

Earthquake risk is high in much of the southern half of Alaska, but it is not the same everywhere. This map shows the overall geologic setting in Alaska that produces earthquakes. The Pacific plate (darker blue) is sliding northwestward past southeastern Alaska and then dives beneath the North American plate (light blue, green, and brown) in southern Alaska, the Alaska Peninsula, and the Aleutian Islands. Most earthquakes are produced where these two plates come into contact and slide past each other. Major earthquakes also occur throughout much of interior Alaska as a result of collision of a piece of crust with the southern margin.

- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.4
- 8.5 - 8.9
- 9.0 or larger

1964 Earthquake rupture zone and date of most recent rupture

Active and potentially active faults

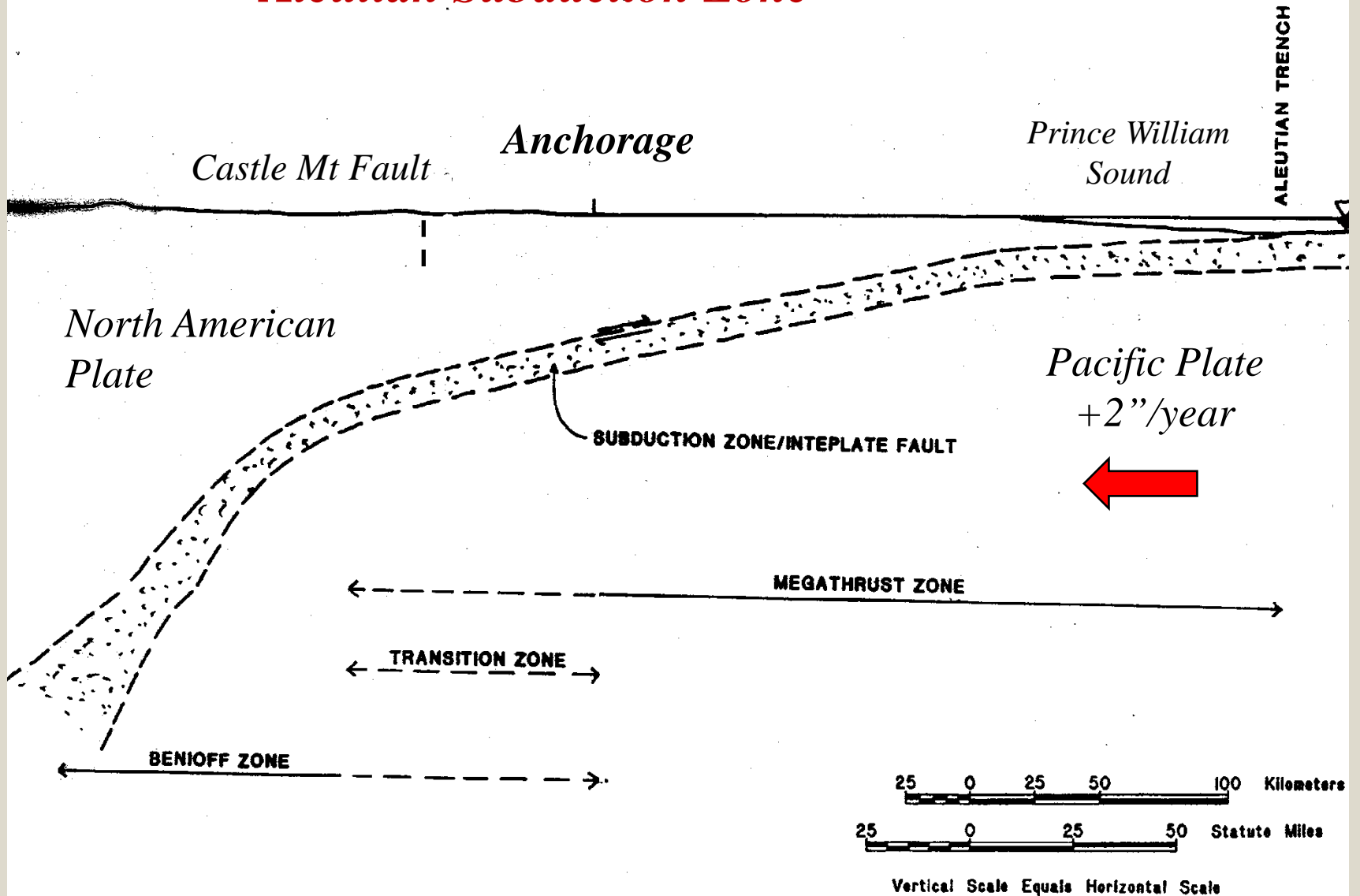


**SOURCES OF INFORMATION**  
Additional data and references to earthquake location, and intensity in Alaska can be found in Parker and others (1964), Page and others (1991), and Tabor and others (1993). The material on this map was modified locally from Parker and others (1964), and earthquake epicenters were from the Alaska Earthquake Information Center, and cover the interval from 1669-2001. The location of earthquake epicenters and fault is approximate.  
Parker, C., Gilpin, L.M., and Lahr, C., 1964, Neotectonic map of Alaska in Parker, C., and Berg, H.C., eds., *The Geology of Alaska*. Boulder, Colorado: Geological Society of America, Circular North American Geology, Volume 1, 1, 166p., section 12-30(10).  
Page, R.A., Brown, N.S., Lahr, J.C., and Phipps, H., 1991, *Seismicity of continental Alaska in 1986*. D.F., Fairbanks, L.A., Anchorage, M.I., and Boulder, CO, eds., *Neotectonics of North America*. Boulder, Colorado: Geological Society of America, Pacific Map Volume 1.  
Tabor, J., Billingson, S., and Swadlow, E.R., 1993, *Seismicity of the Alaskan arc in 1986*. Swadlow, E.R., Englekamp, E.R., Zbinden, M.D., and Blackford, D.D., eds., *Neotectonics of North America*. Boulder, Colorado: Geological Society of America, Pacific Map Volume 1.

This map is preliminary and has not been reviewed for consistency with U.S. Geological Survey official standards or the National Geographic Society's *World Atlas*. Any use of trade names or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.



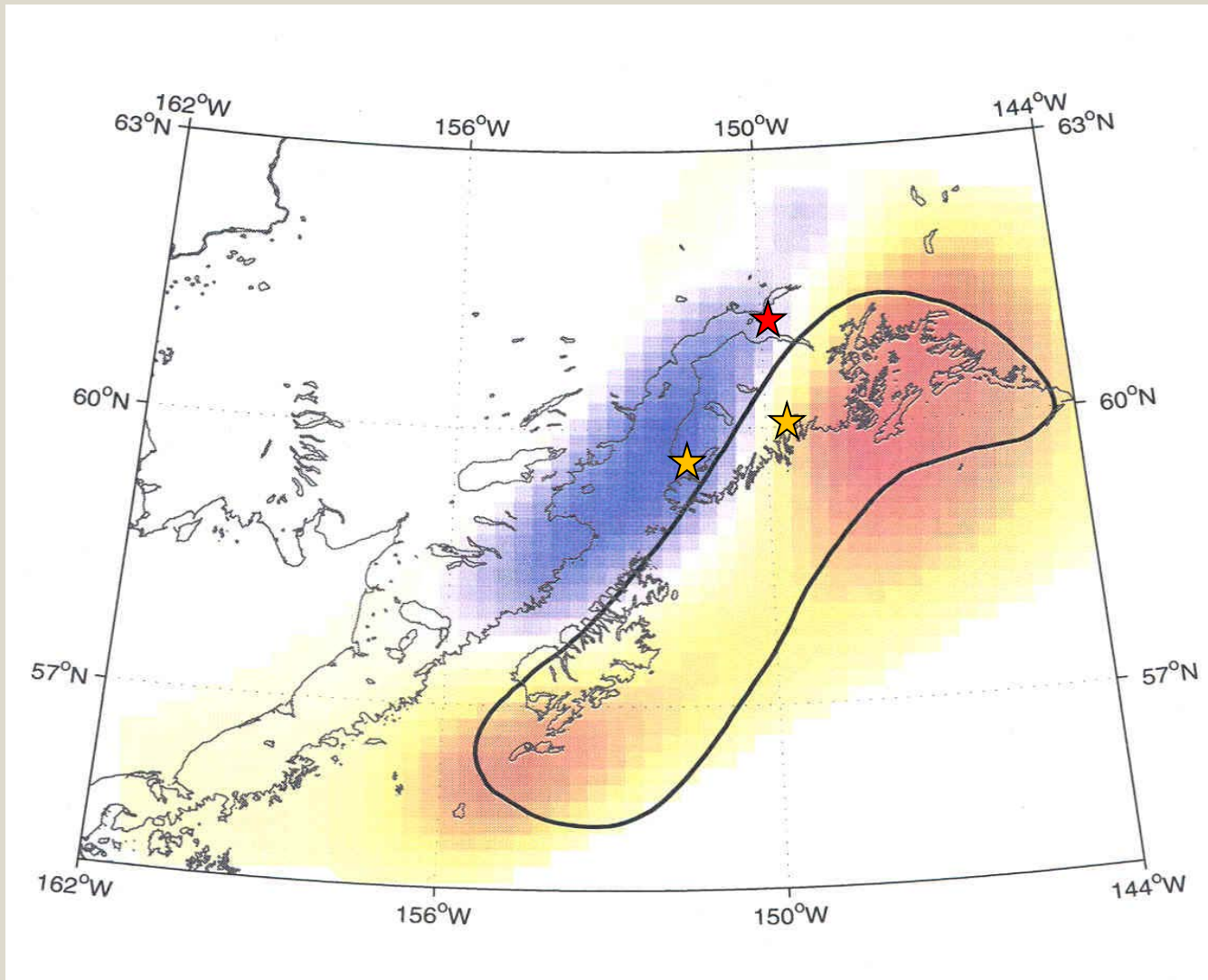
# Aleutian Subduction Zone



# 27 MARCH 1964 GREAT ALASKA (GOOD FRIDAY) EARTHQUAKE

- M9.2 (*largest recorded earthquake US History*)
- Strong Shaking (*almost 5 minutes in Anchorage*)
- \$311 million damage (*\$2.3 billion in 2013 dollars*);  
131 deaths (*122 in tsunamis*)
- Extensive Ground Failure (*accounted for most of damage in Anchorage, versus ground shaking*)

# Post 1964 Earthquake Plate Movements (1992-2001)



(Zweck & Freymueller 2002)

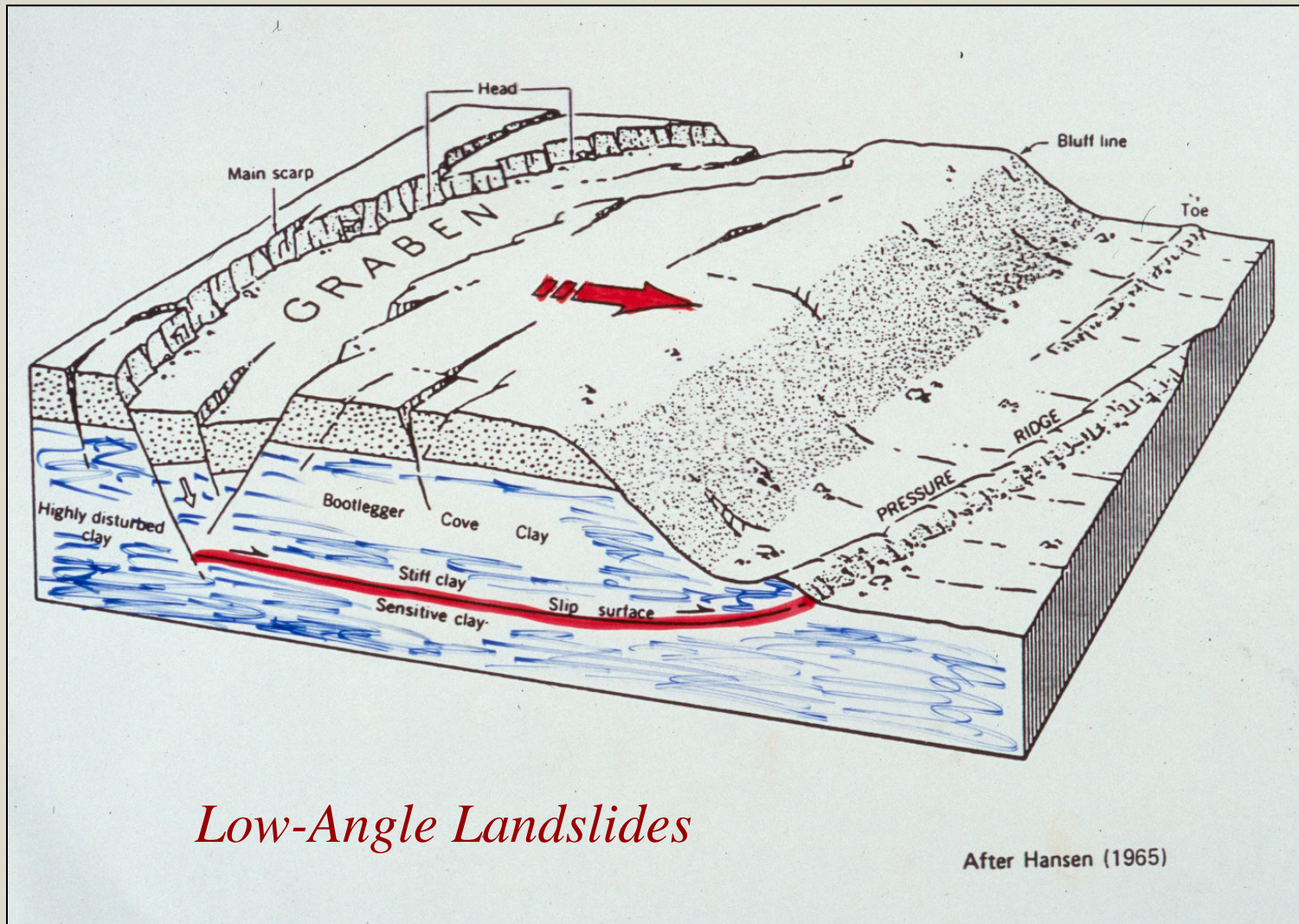
## *Damage at Anchorage due to Ground Shaking*



*JC Penny Building*



# *Damage at Anchorage due to Ground Failure*





*4<sup>th</sup> Avenue Slide*



*Government Hill Slide*





*L Street Slide Pressure Ridge*

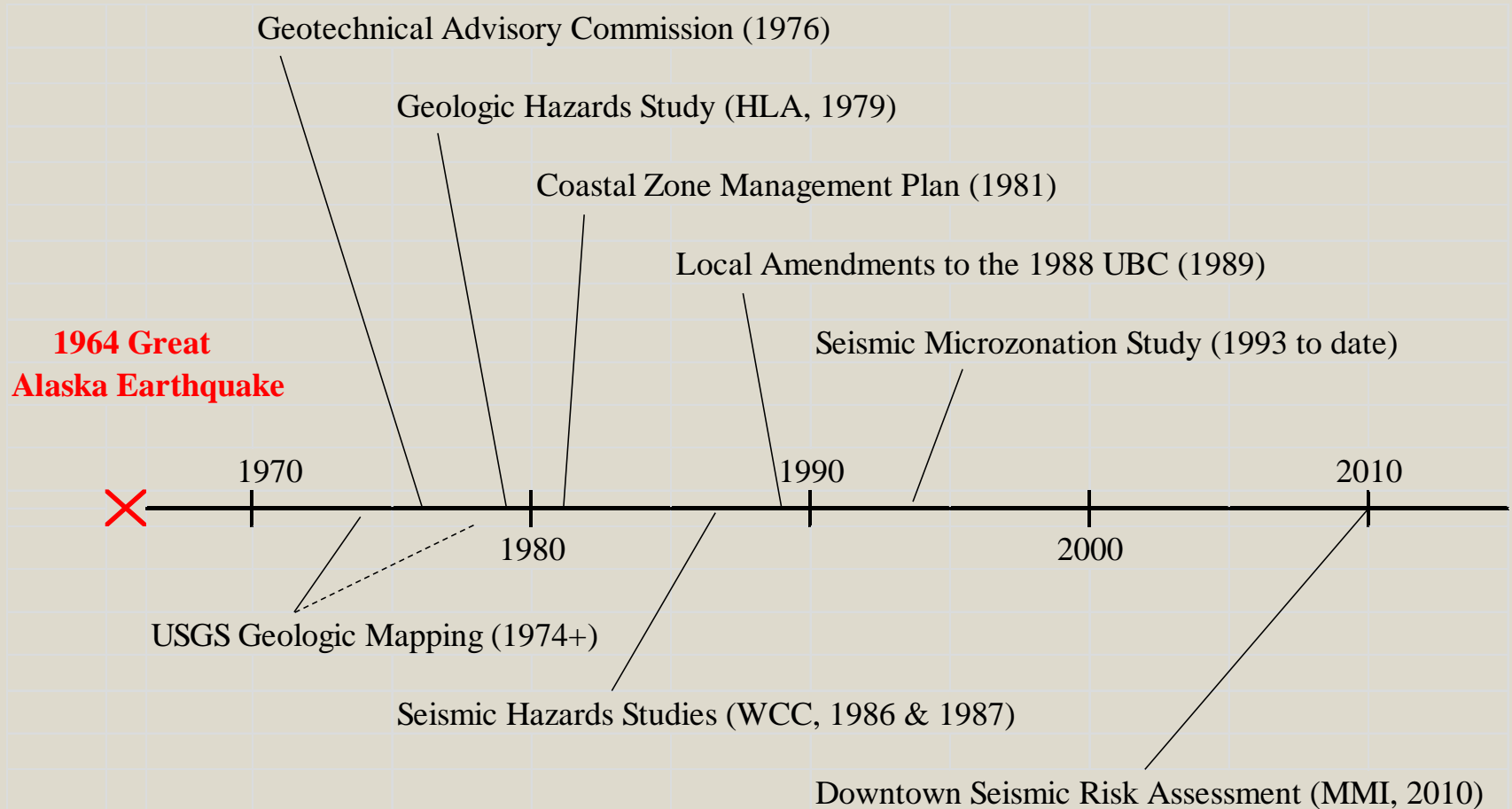




# *Turnagain Heights Slide*



# Post 1964 Earthquake Engineering Milestones in Anchorage



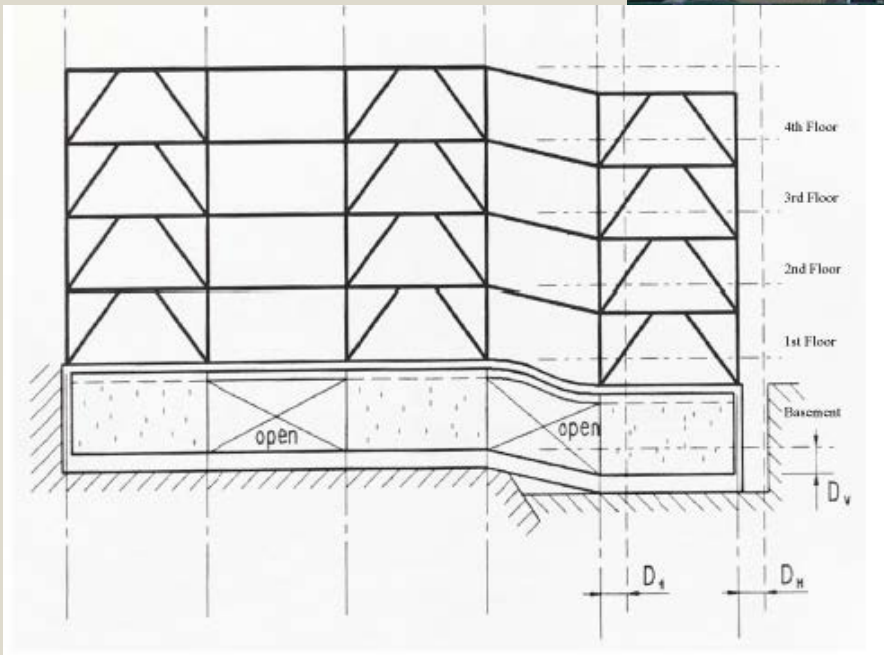
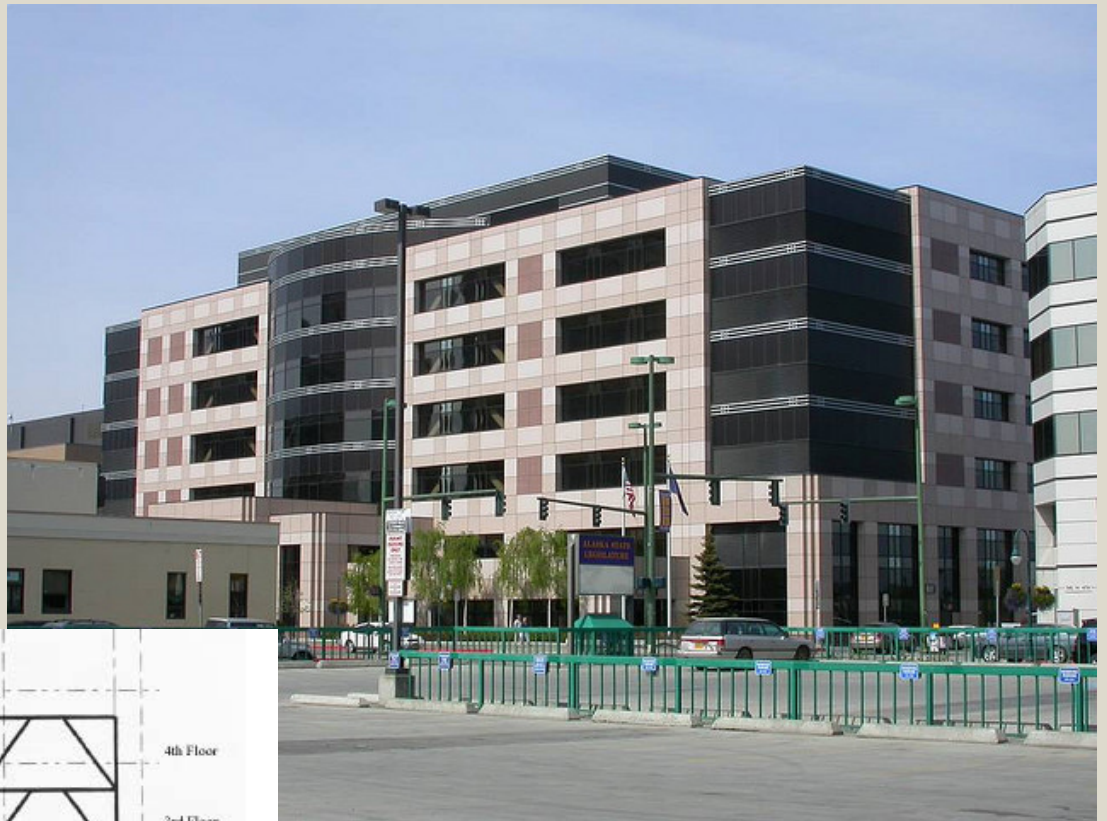


# ANCHORAGE GEOTECHNICAL ADVISORY COMMISSION

- Established in 1976; 9 members (*civil engineers & geologists*)
- Technical advisory resource to the Mayor, Assembly & City Departments
- Key Accomplishments:
  - Inventory of geologic hazards (HLA, 1979)
  - Local amendments to the building code
  - Review major projects in high earthquake hazard zones
  - Downtown Seismic Risk Assessment (MMI, 2010)



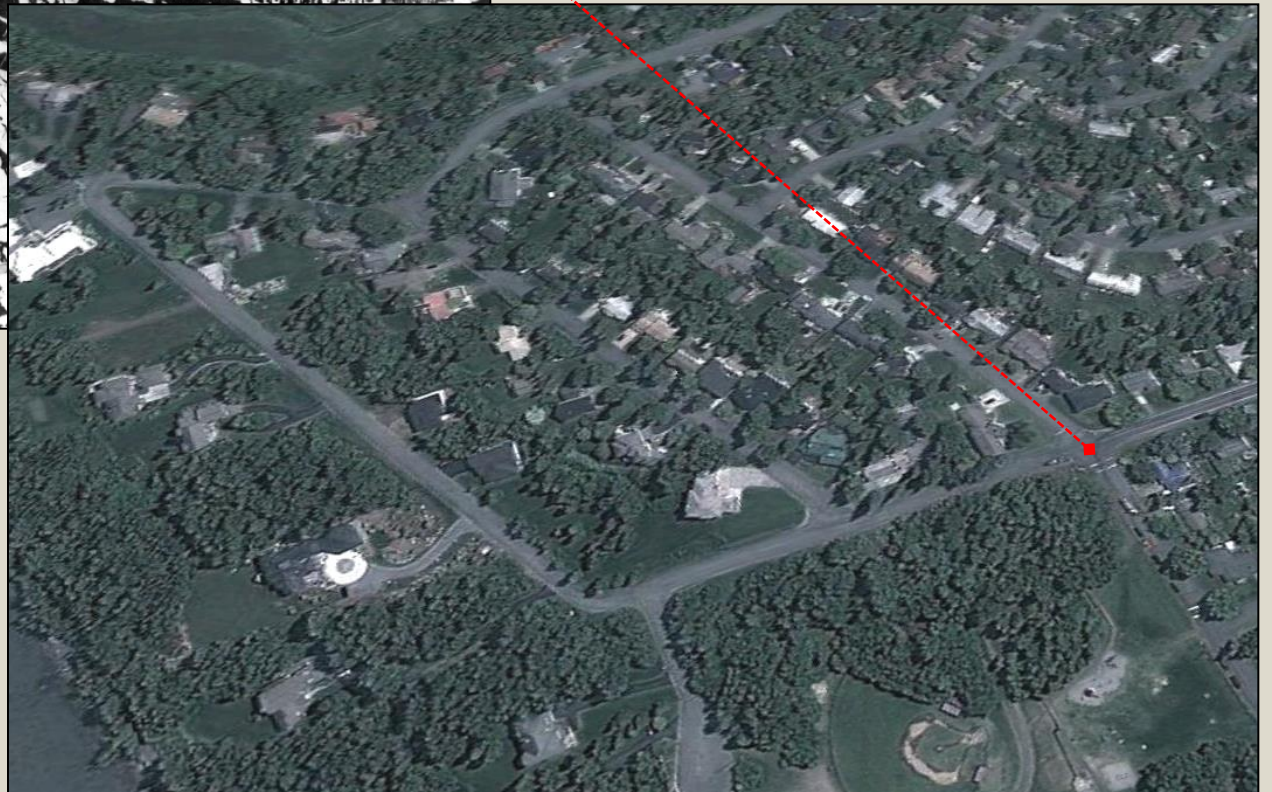
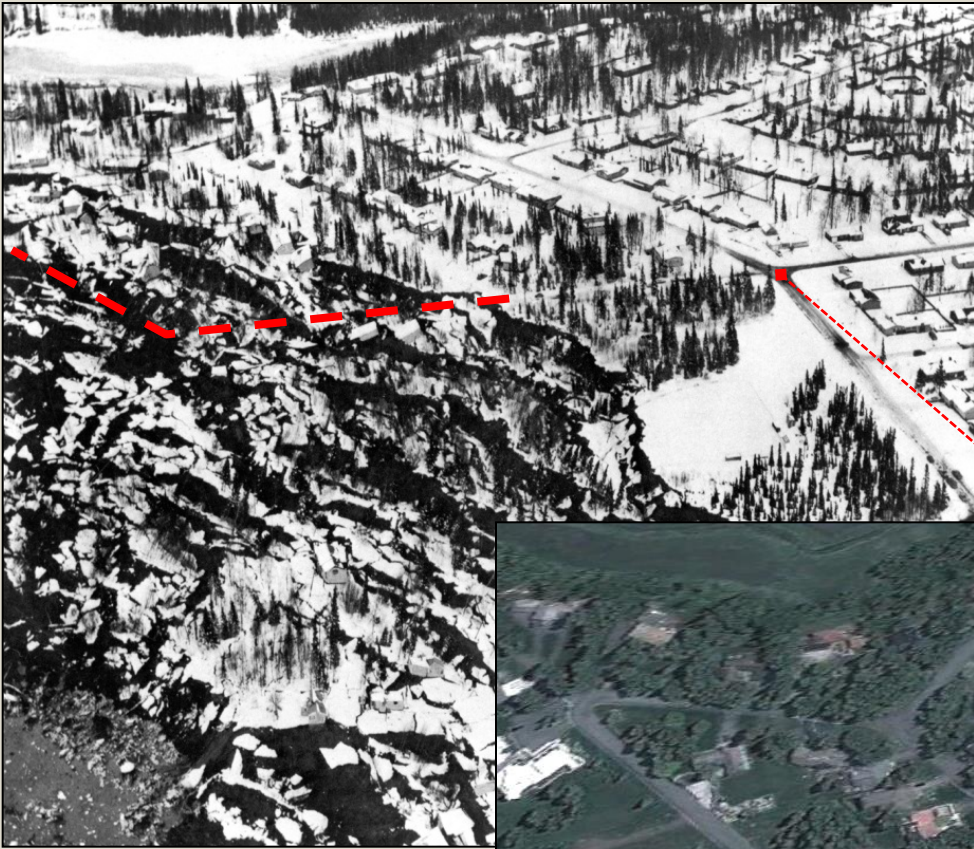




*Alaska State (Nesbitt)  
Court House*

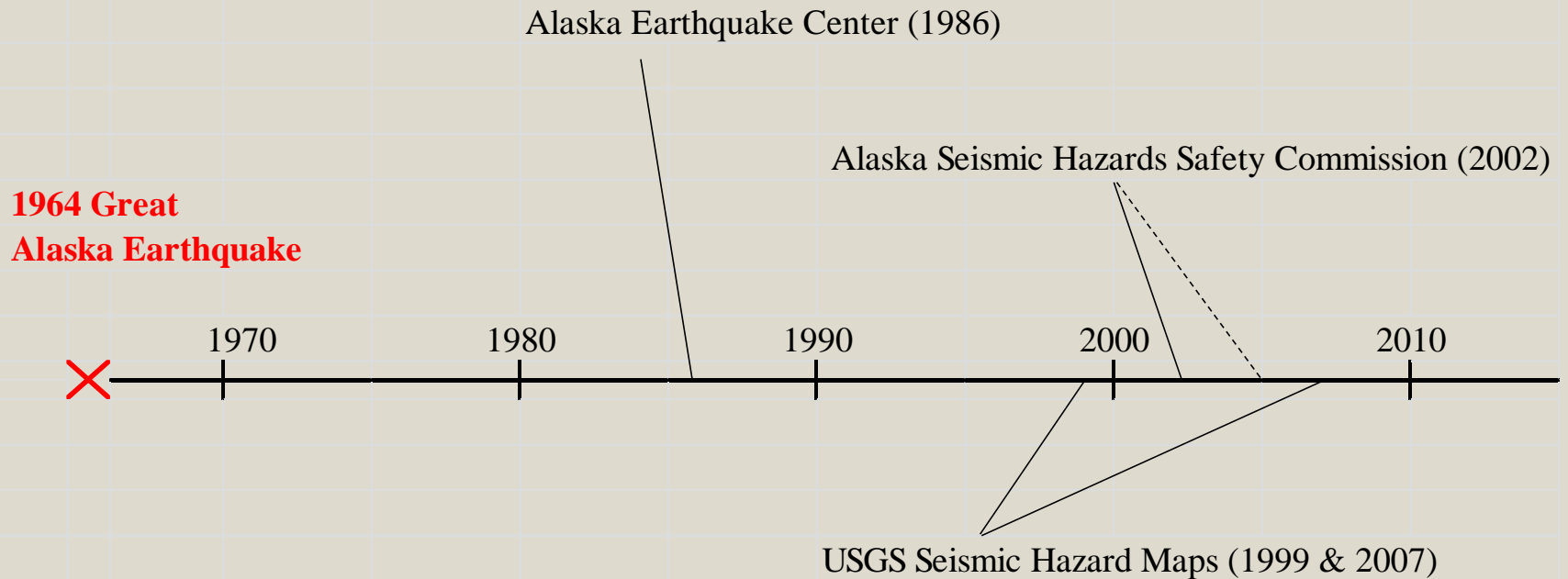


*Turnagian Heights  
then and now*





# Post 1964 Earthquake Engineering Milestones in Alaska



# ALASKA SEISMIC HAZARDS SAFETY COMMISSION

- Established in 2002, first members appointed in 2005; 11 members (*civil engineering, geology, seismology, emergency management, local government, insurance*)
- Advisory body empowered to recommend to the governor, legislature, state departments and local governments goals, priorities, programs, research, recovery practices, etc. to mitigate seismic hazards in Alaska.
- Key Objectives & Projects:
  - Identify and prioritize schools at risk from earthquakes
  - Independent review of designs and construction of public facilities
  - Kodiak scenario earthquake study
  - Advocate for Alaska earthquake research
  - Regulations for seismic knowledge of civil engineers licensed in Alaska

On a national scale, the 1964 Great Alaska Earthquake strongly affected:

- Geology - *Theory of plate tectonics*
- Seismology – *Subduction zone earthquakes*
- Seismic Engineering – *Geotechnical hazards*

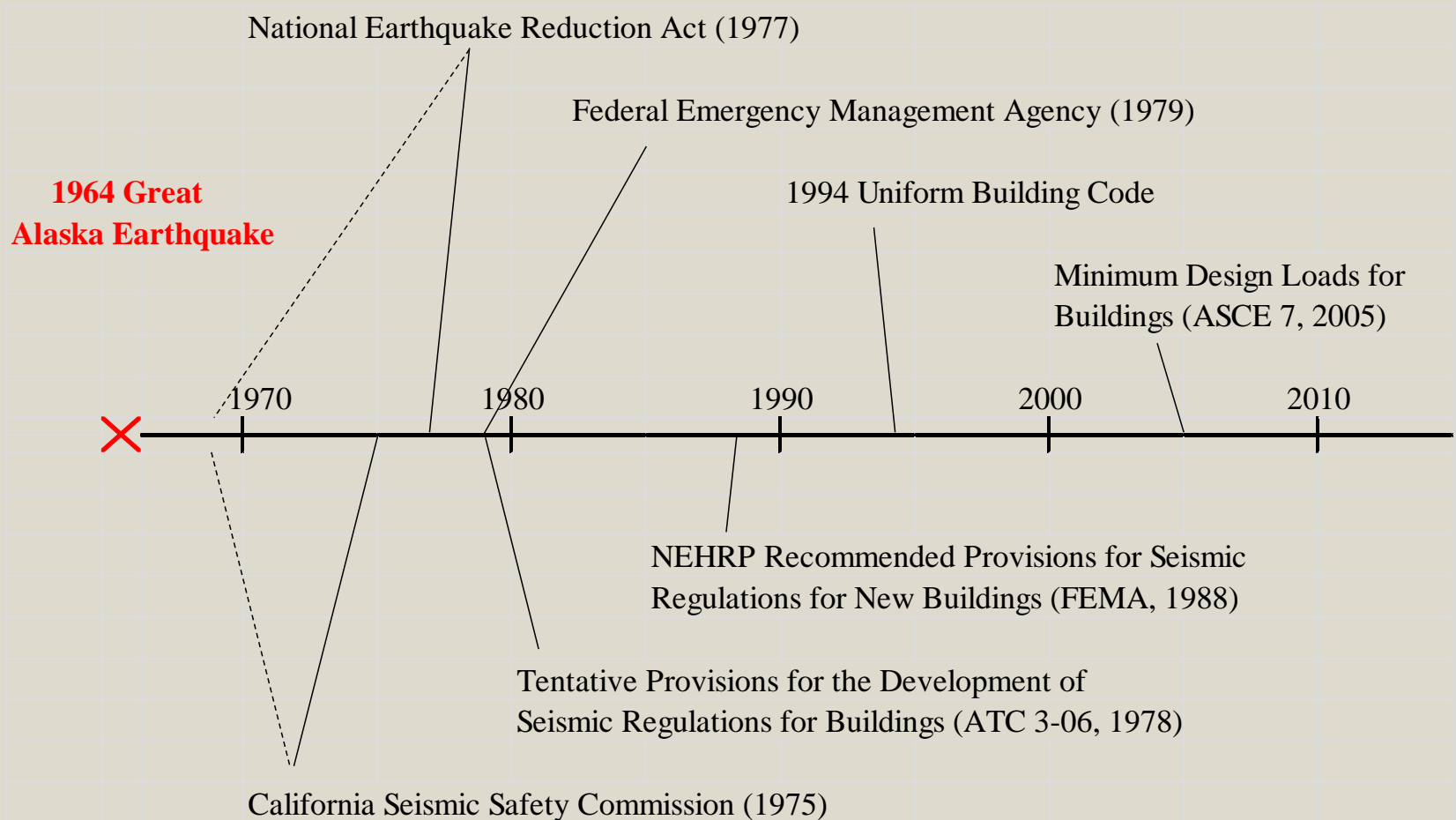


R.E. WALLACE, PhD, USGS GEOLOGIST:

“The great Alaskan earthquake on Good Friday 1964 was a major turning point and a trigger for new [*national*] programs. To my thinking, and most people’s thinking, I believe, the Alaskan earthquake was the beginning of, and stimulus for, our whole modern earthquake program. That earthquake showed what great seismic events could do very close to home.”

*(in USGS 1996; OFR 96-260)*

# Post 1964 Earthquake Engineering Milestones in the USA



# NATIONAL BUILDING CODES

- The design codes are intended to protect the safety of a building's occupants during and immediately after an earthquake – not to eliminate structural damage or loss of property.
- Design codes are based on a premise that the ground is and remains stable.
- Provisions to design for earthquake loads have been included in national building codes since the late 1920s; however, specific requirements to consider the potential for earthquake-induced ground failure were not included until the 1994 UBC (*despite recommendations in ATC 3-06 {1978} and NEHRP {1988}, etc.*)



## 1964 Great Alaska Earthquake—A Photographic Tour of Anchorage, Alaska



Open-File Report 2014–1086

U.S. Department of the Interior  
U.S. Geological Survey

<http://pubs.usgs.gov/of/2014/1086/>

<http://alaska.usgs.gov/announcements/news/1964Earthquake/>