Rock-Fall Hazards in Utah

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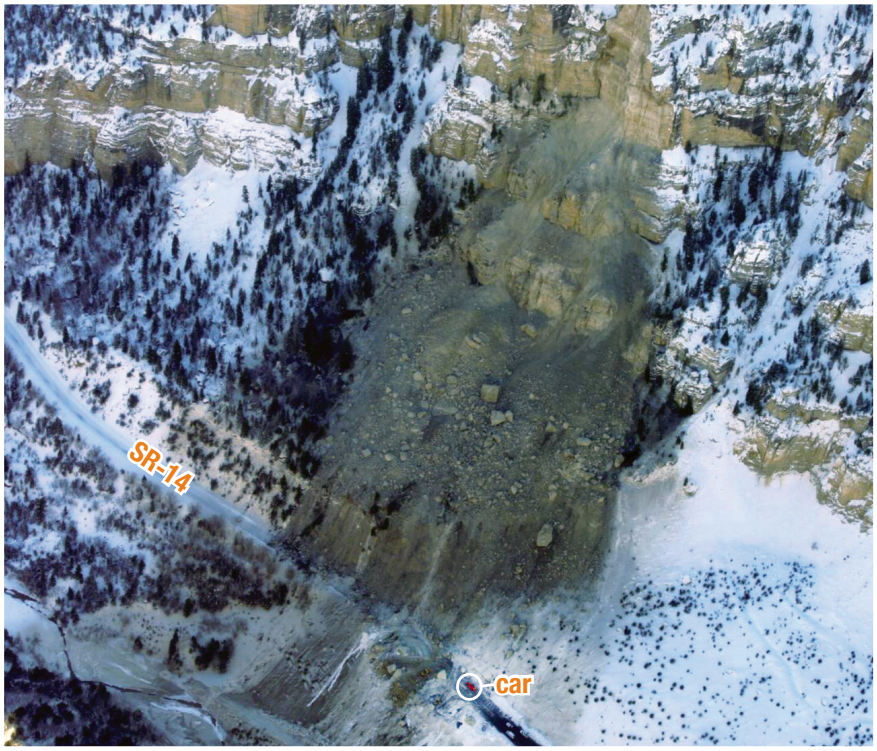
Rock falls pose a hazard in Utah because we live, work, and recreate in close proximity to mountains and mesas. Large rock fragments and boulders accelerate rapidly when dislodged from cliffs and hillsides and can cause significant damage to homes, property, roadways, and vehicles, as well as loss of life. Rock falls are initiated when rocks are dislodged by freeze/thaw action, rainfall, weathering and erosion of the rock and/or surrounding material, or root growth, and they can be triggered by ground shaking from earthquakes. Rock falls generally occur without warning, and have caused significant damage and fatalities in Utah.

Rock falls are a natural process in which dislodged rock moves downslope by gravity. Dislodged rocks can travel at high velocities and cover significant distances; rocks travel downslope by bouncing, rolling, sliding, or free-fall. Rock-fall hazards are dependent upon a number of factors including geology, topography, and climate. Rock falls in Utah typically occur more frequently during spring and summer months. This is likely due to spring temperature variations causing snow and ice to melt and re-freeze in rock fractures, snowmelt, and summer cloudburst storms.

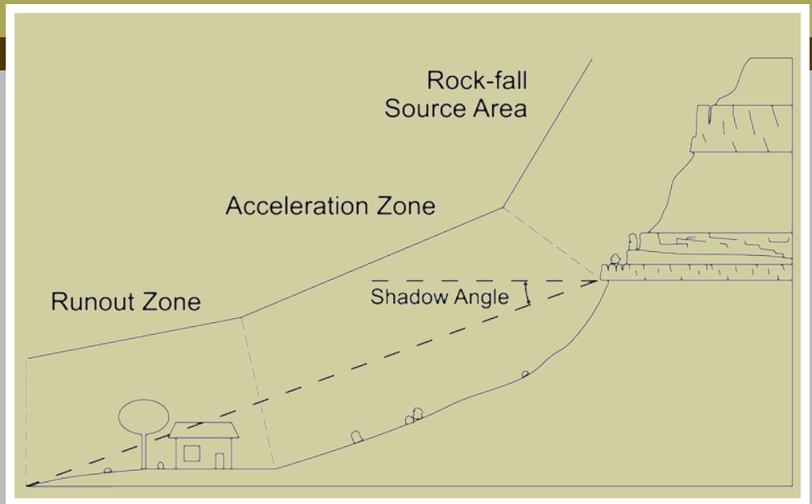
Rock falls occur where a rock source exists above slopes steep enough to allow rapid downslope movement of dislodged rocks. Most rock falls originate on slopes steeper than 35 degrees, although rock-fall hazards are found on lesser slopes. Rock-fall sources include bedrock outcrops or boulders on steep slopes such as mountainsides, cliffs, bluffs, and terraces. Rock-fall hazards may also exist along road cuts and other excavations.



Rock slide closed SR-14 in Cedar Canyon, Iron County, Utah, January 2009. Photo credit: Mel Aldrich.

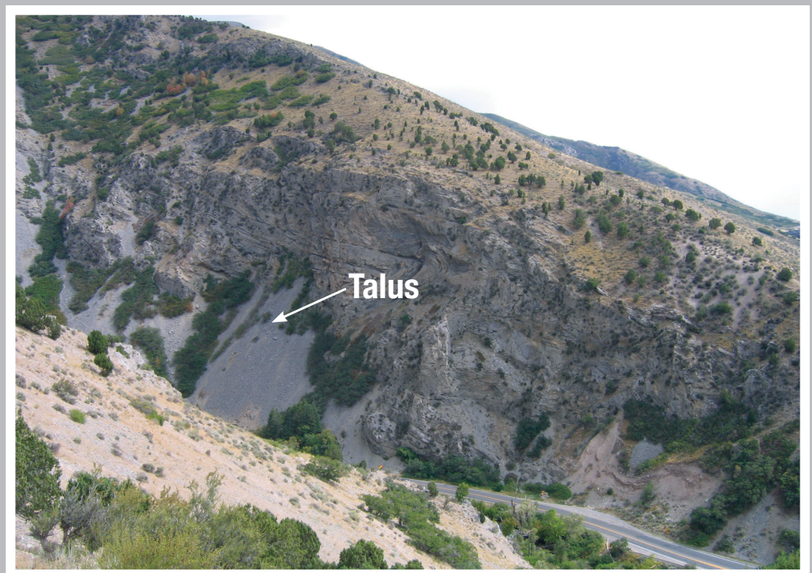
Rock debris that has detached from the source gains momentum as it travels downslope. The slope at the base of the source area where the incline is steep enough to accelerate the debris is called the acceleration zone. Rock debris comes to rest in the runout zone, which includes gentler slopes where boulders roll or bounce beyond the base of the acceleration zone. In many Utah locations, the runout zone can be up to a mile or more from the source location, depending upon the length and steepness of the acceleration zone. Talus cones (aprons of rock debris at the base of cliffs) and scree-covered slopes (steep slopes covered by rock fragments) are indicators of a high rock-fall hazard, although other areas are also vulnerable.

Early recognition and avoidance of areas subject to rock fall are the most effective means of reducing rock-fall risk. However, avoidance may not always be an option, especially for existing developments. Other techniques that may reduce potential rock fall damage include, but are not limited to, rock scaling, rock stabilization, and/or engineered catchment structures. Rock scaling is the removal of rocks that are likely to fall from a slope. Rock-stabilization methods are physical means of reducing the hazard at the source using rock bolts, steel mesh, and/or shotcrete on susceptible outcrops. Engineered catchment structures such as berms, trenches, or benches can be placed below source areas.



Components of a characteristic rock-fall path profile. The shadow angle is measured from the base of the source area and determines the distance of the runout zone from the source.

A large boulder destroyed a guest house (above-left) before the boulder stopped next to a large tree (above-right), Provo, Utah County, Utah, May 2005.



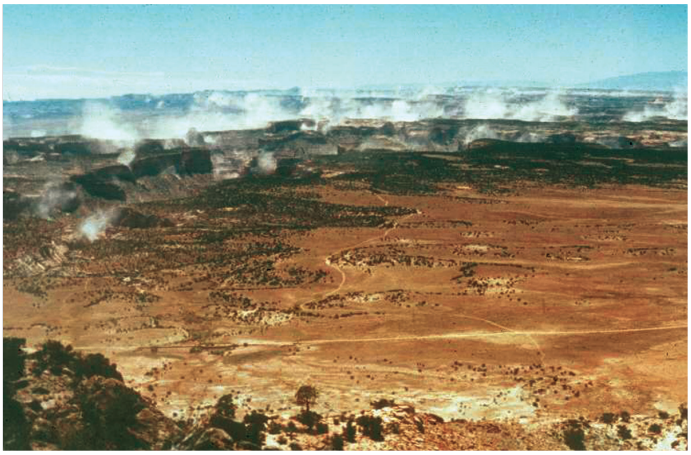
Rock fragments (talus) cover slope in American Fork Canyon, Utah County, Utah, September 2008.

Boulder that bounced downslope through the back of a house (above-left) came to rest in the garage (above-right) after falling through the floor. Provo, Utah County, Utah, April 2009. Photo Credit: Provo Fire Department.

The Utah Geological Survey recommends retaining a geotechnical firm familiar with rock-fall hazards early in the project design phase to conduct a site-specific investigation of the proposed site. If a rock-fall hazard is present, the geotechnical consultant should provide design, grading, and/or scaling recommendations as necessary to reduce the hazard.

Boulder detached from the north wall of Zion Canyon, estimated to weigh 300 tons, damaged this house in Rockville, Washington County, Utah, October 2001.

Boulder from a rock fall that weighs approximately 250 tons, measuring 20'x15'x13', near Croydon, Morgan County, Utah, March 2004. Orange arrow shows a person on the boulder for scale.



Dust produced by simultaneous rock falls triggered by a magnitude 5.3 earthquake in Emery County, Utah, August 1988. Photo credit: Terry A. Humphrey, Bureau of Land Management.

10-year history of selected damaging rock falls in Utah.

Date	Location	Description
October 1999	Big Cottonwood Canyon, Salt Lake County	Rock fall and slide injured 4 people
August 1999	Goosenecks portion of the San Juan River, San Juan County	A camper killed by rock fall from an overhanging cliff
October 2001	Rockville, Washington County,	House severely damaged by rock fall
March 2004	Devils Slide, Weber Canyon, Morgan County	Large boulders from rock slide near I-84 in Weber Canyon
May 2005	Provo, Utah County	Guest house destroyed by rock fall
January 2009	Cedar Canyon, Iron County	Large rock fall closes State Route 14
April 2009	Provo, Utah County	House adjacent to April 2005 event severely damaged by rock fall

For more information:
Geologic Hazards Program (GHP):
http://geology.utah.gov/ghp/index/htm

Notable Rockfalls of the 1990s and 1980s:
Utah Geological Survey Open File Report 373:
http://ugspub.nr.utah.gov/publications.open_file_reports/OFR-373.pdf

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