ROCK SLOPES STABLIZATION
A – MANAGEMENT OF ROCK SLOPE PROGRAMS

Lesson 8 – Topic A

LESSON 8A - ROCK SLOPE STABILIZATION MEASURES

Learning Outcomes -

- *Identify Causes of Rock Falls;*
- *Describe Rock Slope Inventory Systems;*
- *Select Rock Slope Stabilization Measures.*

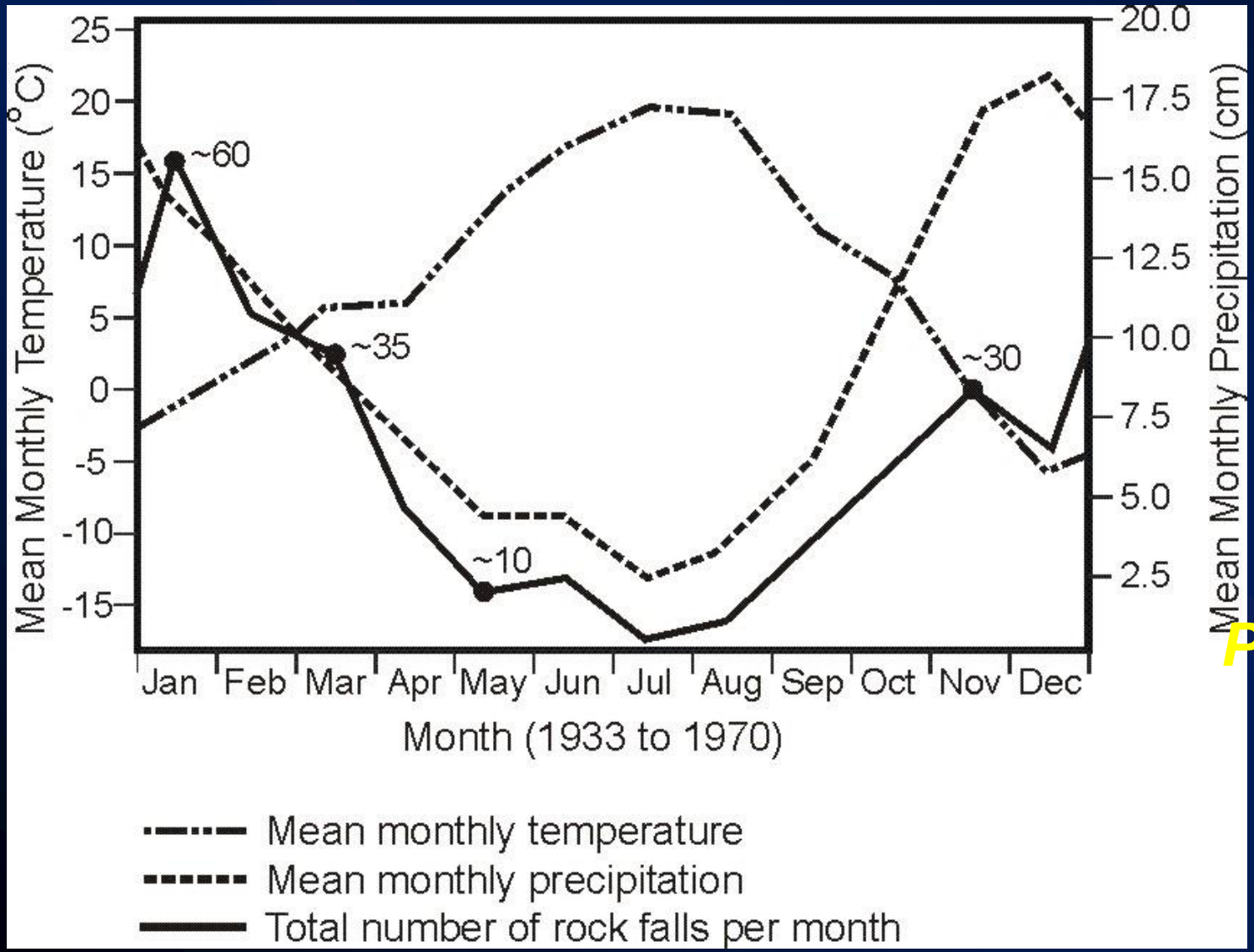
Rock fall in strong blocky granite; rigid concrete wall was ineffective barrier

Source of rock fall about 500 ft. above highway

Trains can survive larger impacts than cars, but cannot swerve or brake to avoid hazard.

Rock fall could be predicted from observations of previous falls in housing development

Rock fall frequency related to rainfall and freezing



Weather conditions in Pacific North-west

Causes of Rock Falls

- *Water is Major Cause of Rock Falls - i.e. Rain, Freeze-Thaw, Snowmelt, Erosion, Seepage and Root Growth*
- *Most Rock Falls Occur During High Rainfall Periods, and Spring and Fall When the Slopes Thaw*
- *Table 10.1 - ~2/3 of falls are related to ground water*
- *Earthquakes are an additional source of rock falls*

Rock Slope Inventory System

- Point Scores (3, 9, 27, 81) Assigned to Nine Slope Parameters:
- Table 10.2
- Risk

1. Slope Height	Hazard:
2. Ditch Width	6. Geology
3. Vehicle Risk	7. Block Size
4. Decision Site Distance	8. Climate/Water
5. Roadway Width	9. Rock Fall History

- Hazard rating is sum of score for each of the nine parameters
- Multiply risk and hazard ratings to obtain risk rating.

Rock Slope Inventory System

Table 10-2

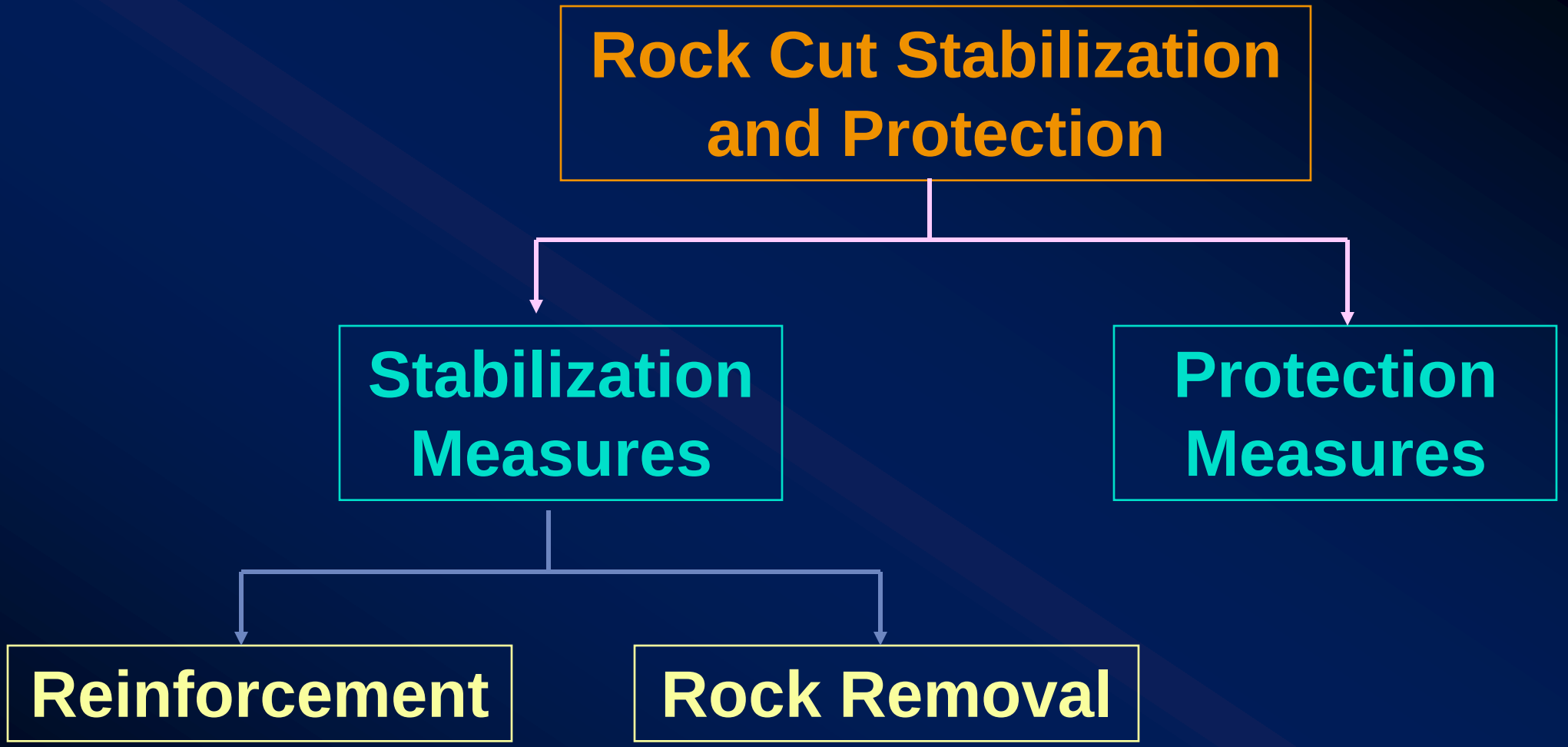
Category			Rating Criteria and Score			
			Points 3	Points 9	Points 27	Points 81
a) Slope Height (m)			7.5 m	15 m	23 m	30 m
b) Ditch Effectiveness			Good Catchment	Moderate Catchment	Limited catchment	No catchment
c) Average Vehicle Risk (% of time)			25% of the time	50% of the time	75% of the time	100% of the time
d) Percentage of Decision Sight Distance (% of design value)			Adequate sight distance, 100% of design value	Moderate sight distance, 80% of design value	Limited sight distance, 60% of design value	Very limited sight distance 40% of design value
e) Roadway width including paved shoulders (m)			13.5m	11 m	8.5 m	6 m
f) GEOLOGIC CHARACTER	CASE 1	Structural Condition	Discontinuous joints, favorable orientation	Discontinuous joints, random orientation	Continuous joints, adverse orientation	Continuous joints, adverse orientation
		Rock Friction	Rough, irregular	Undulating	Planar	Clay infilling, or slickensided
	CASE 2	Structural Condition	Few differential erosion features	Occasional erosion features	Many erosion features	Major erosion features
		Difference in erosion rates	Small difference	Moderate difference	Large difference	Extreme difference
g) Block Size ___ Quantity of rock fall event			0.3 m ___ 3 cu.m.	0.6 m ___ 6 cu.m.	1.0 m ___ 9 cu.m.	1.2 m ___ 12 cu.m.
h) Climate and Presence of Water on Slope			Low to moderate precipitation; no freezing periods, no water on slope	Moderate precipitation, or short freezing periods, or intermittent water on slope	High precipitation or long freezing periods, or continual water on slope	High precipitation and long freezing periods, or continual water on slope and long freezing periods
i) Rock fall History			Few falls	Occasional falls	Many falls	Constant falls

Selection of Stabilization Measures

- *Blasting - Careful Blasting to Minimize Rock Damage, or Mechanical Excavation*
- *Topography – if Slope Above Crest of Cut, Resloping will Increase Cut Height*
- *Access - Design Compatible with Equipment, e.g. small dia. anchors for hand access drilling*
- *Waste Disposal - Disposal Areas and Haul Costs*

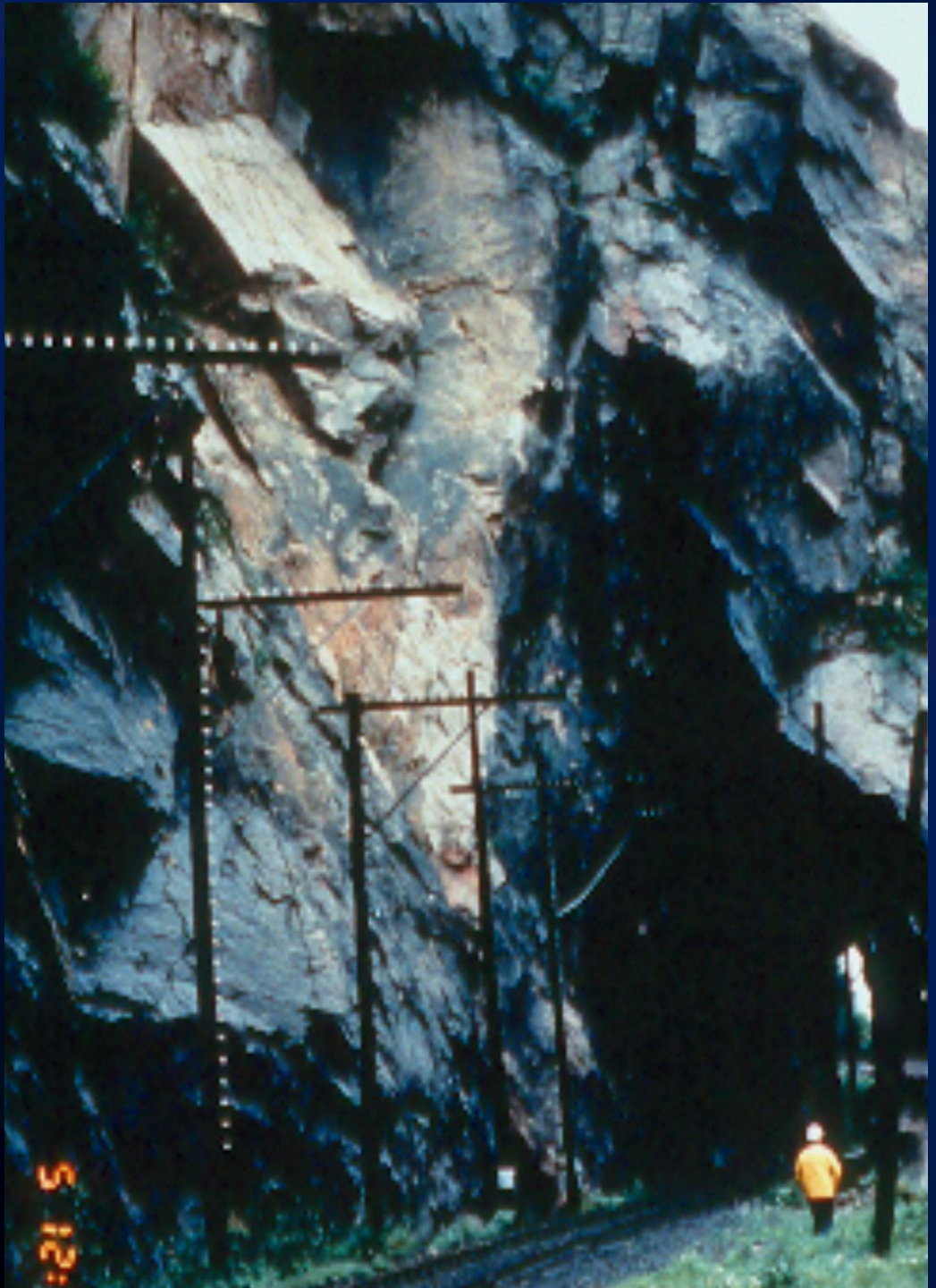
Selection of Stabilization Measures (cont'd)

- Costs - Indirect Costs (Mob/Demob, Flagging, waste disposal) may exceed stabilization costs.
- Aesthetics - Limit Cut Area, Sculpted Colored Shotcrete, Planting Niches
- Environmental Issues – Dust, Noise, Wildlife and Vegetation Impacts
- Efficient Designs Consider Geotechnical and External Issues


Rock Cut Stabilization and Protection
Stabilization Measures
Protection Measures
Reinforcement
Rock Removal

Reinforce, Remove, Protect?

Protect - Contain Falls



Reinforce,
Remove,
Protect?

Reinforce – Bolt
Potentially
Unstable Blocks

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