ILC Detector Strategy Questions

- Some of us have been wondering about the fundamental assumptions that seem to have been accepted – and are shaping the thinking about the interaction region for ILC.
- This is an early and perhaps biased set of questions…

Beneficial Occupancy

- We have been assuming that useful occupancy of the underground volume does not occur until shortly before beam. Why???
- What are the overall economics of having the collision hall available for detector assembly and beamline assembly 2 to 3 years before beam?
  - We have been assuming that magnetic measurements (which may be somewhat distinct from coil testing) occurs on the surface, and then the detector gets moved – in some set of pieces – to the hall. Maybe this is not a great idea?
  - Would underground assembly have real advantages if the facility was available early enough?

Large Shaft

- We have been assuming that huge shafts are needed to lower big detector systems. Consider MINOs:
  - MINOS is a neutrino detector constructed deep underground at the Soudan mine.
  - Minos has ~5.4 KT of iron.
  - The Soudan shaft is inclined at 7^0.
  - The Soudan cage has a base of ~1.2 m by 1.9 m, and a capacity of ~6T.
- The largest SiD unit appears to be the solenoid. It would fit down a shaft 6 x 7 m, and weighs ~160 Tonnes.
- The barrel iron segments would fit this shaft, and weigh ~375 Tonnes.
- An early, preliminary possibility is that a small shaft and 400 Tonne cranes above and below might be adequate.

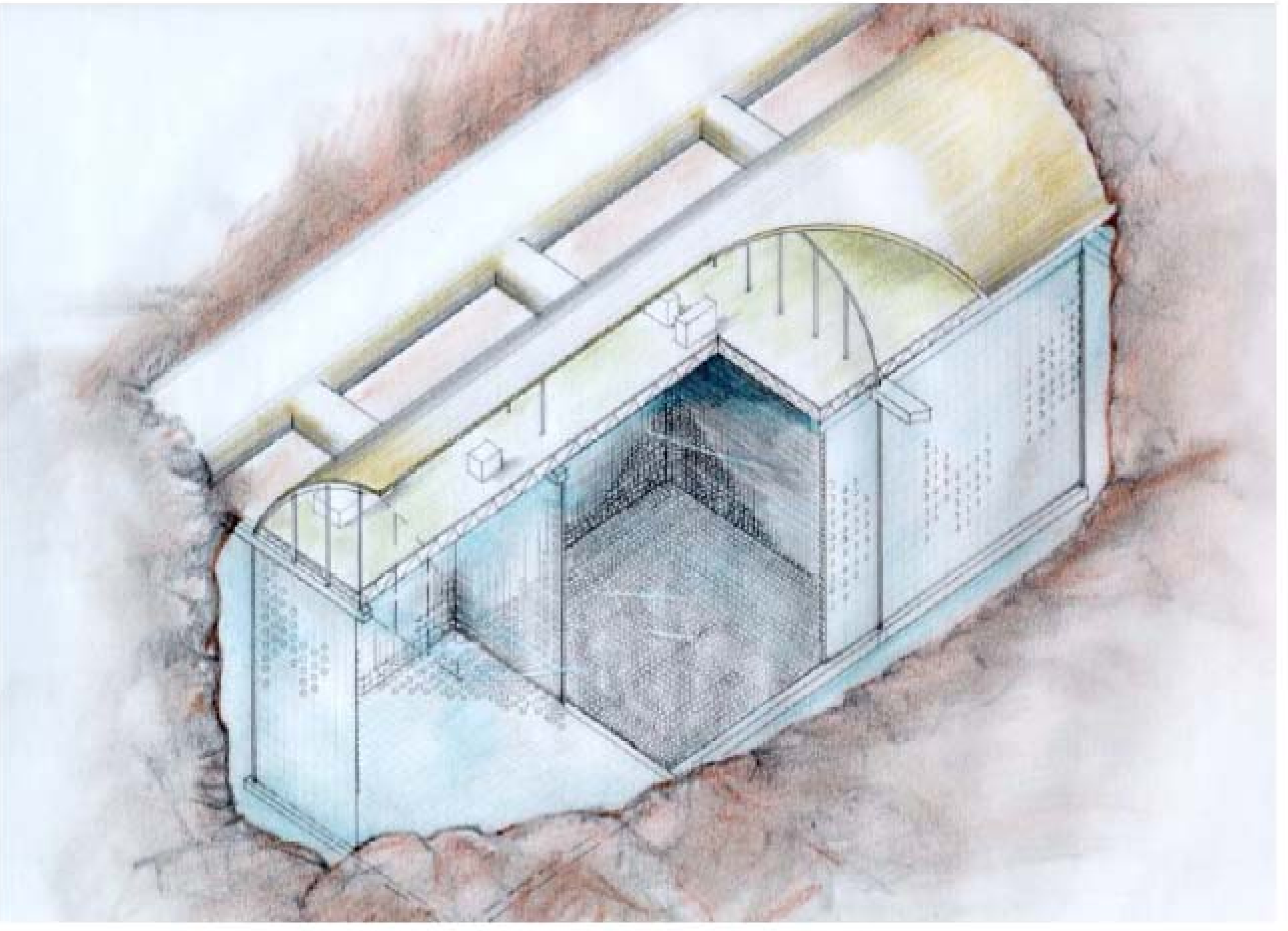
Cavern Shape and Configuration

- How much of thinking of the underground shape of the cavern is based on CERN geology?
- Would larger cranes cost less in other rock?
- Are two shafts required for safety? Could the secondary escapeway be into a beamline?
- Could the shafts (if there are two) be over the garage position? Is the major reason for offsetting the shaft safety?

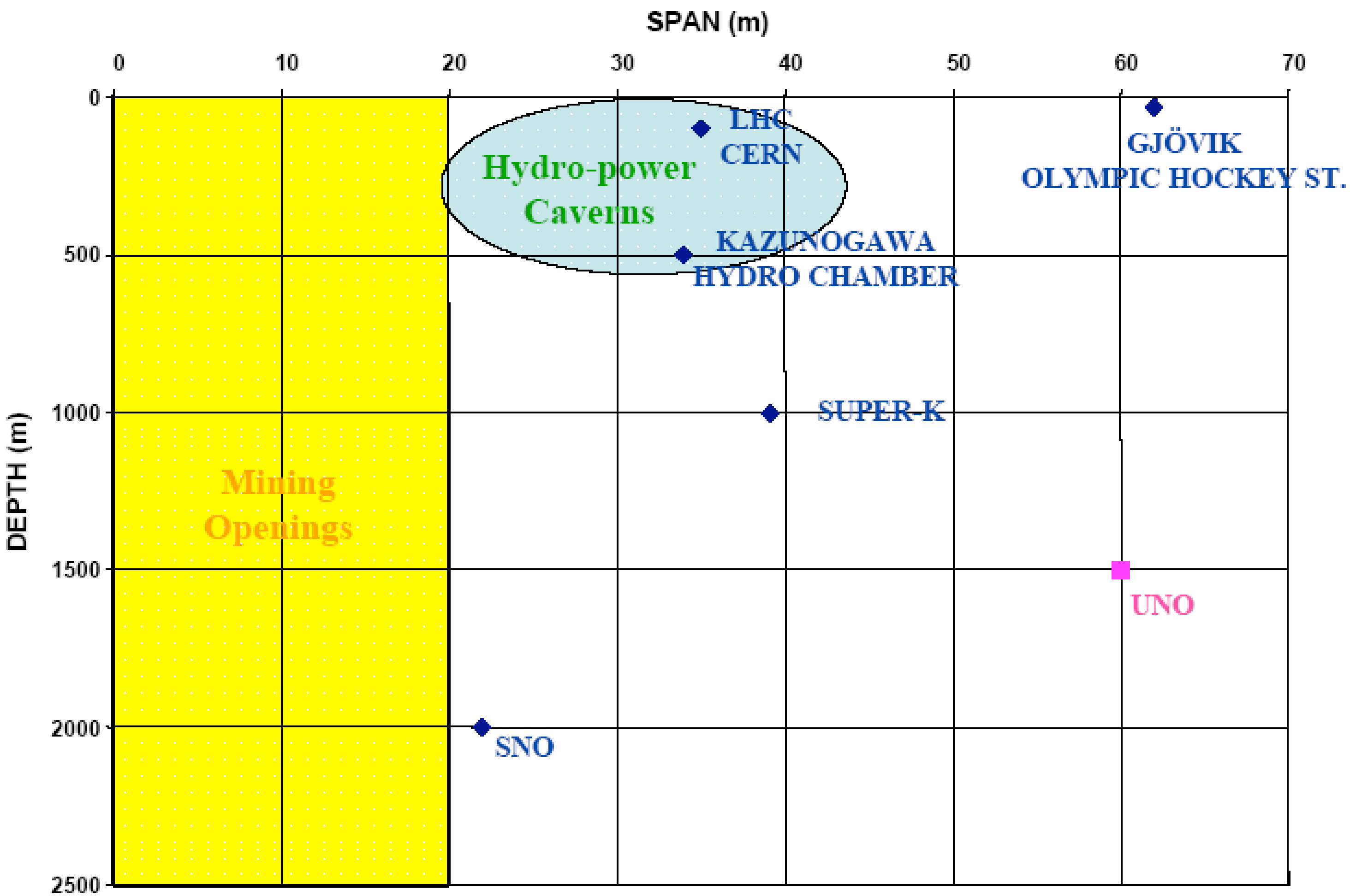
- UNO is among the largest proposed underground excavations. A few excerpts for it and other large projects follow:

Proposed UNO Cavern

- Dimensions: 60 x 60 x 180 (m^3)
- Depth: >4000 mwe (>1500 m)



BENCH MARKING

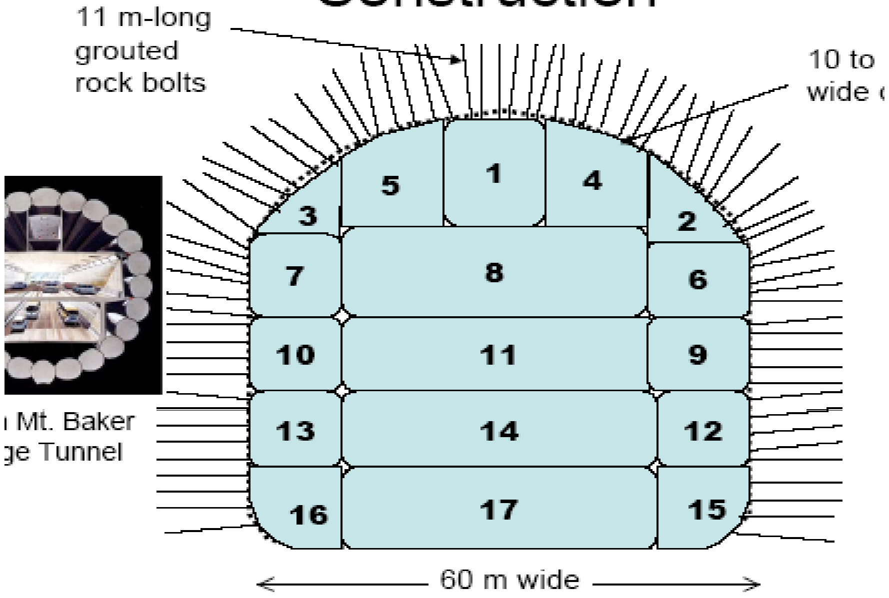


Cascades Site

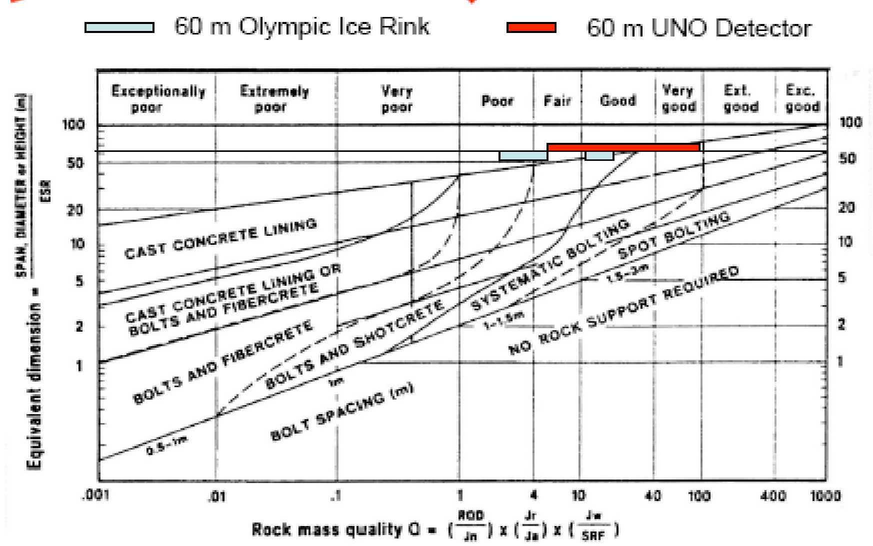
Sets the stage for international cooperation on superbeams, Neutrino Factories (independent of location!), detector construction: important to HE physics

The site has the baselines, the transportation systems, and the rock

UNO Cavern Sequence of Construction



Ask Red about these



Excavation Support Requirements Based on the Q-system and 1,250 case histories with 70 caverns (Barton & Grimstad, 1994)

UNO Collaboration Meeting
Aussois, France

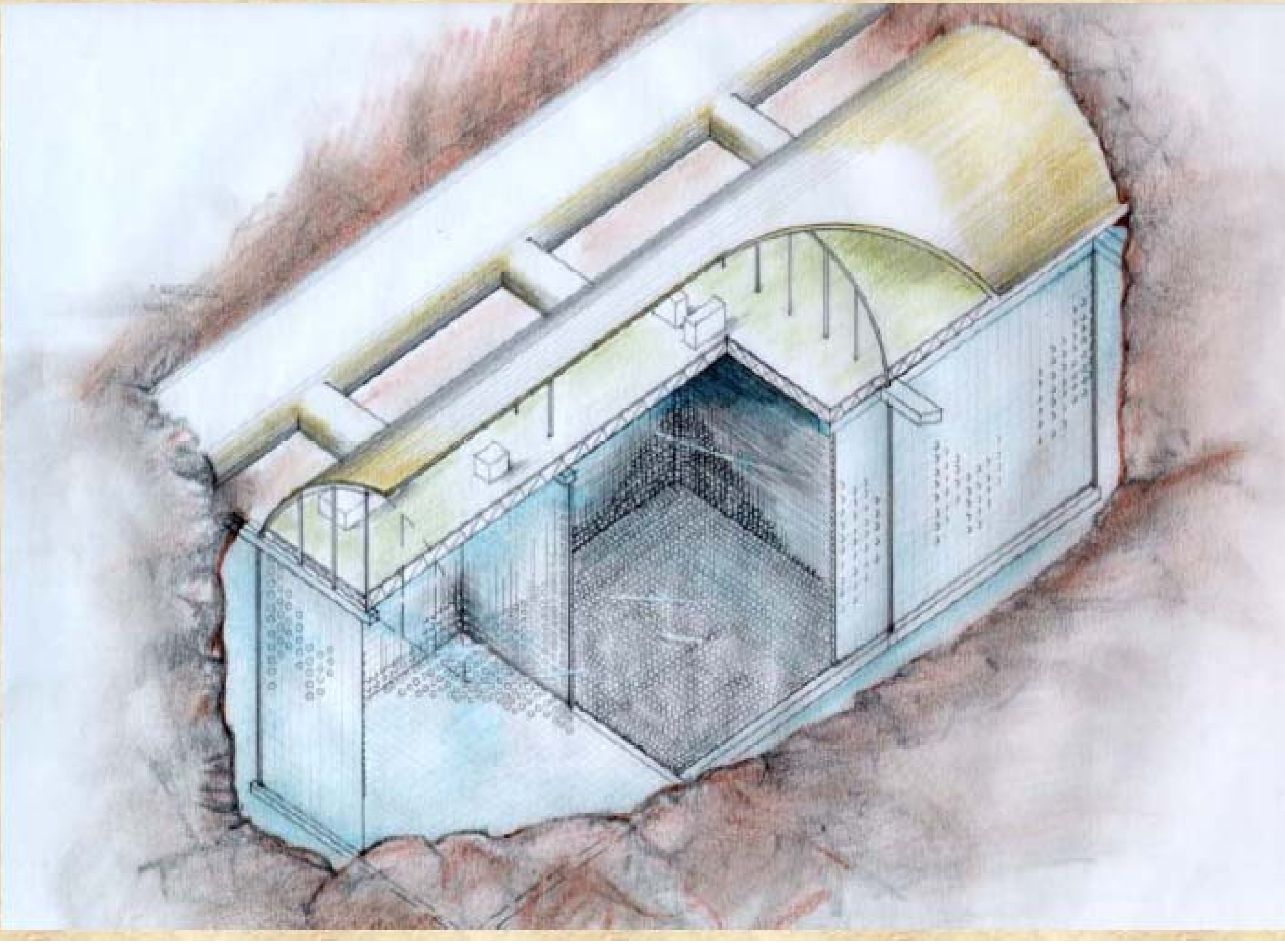
VERY LARGE CAVITY EXCAVATION

Pedro Varona
ITASCA

ITASCA
Consulting Group, Inc.

PROPOSED UNO CAVERN

- Dimensions: 60 x 60 x 180 (m^3)
- Depth: >4000 mwe (>1500 m)



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BENCH MARKING

	WIDTH	HEIGTH	LENGTH	DEPTH
LHC CERN	35	42	82	100
GJÖVIK	62	25	91	30
KAZUNOGAWA	34	54	210	500
SNO	22	30	22	2000
SUPER-K	39	41	39	1000
UNO	60	60	180	1500

The combination of span and depth makes the UNO excavation unique

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CONTROLLING FACTORS

- ROCK MASS STRENGTH
- "IN SITU" STRESSES
- STRUCTURAL FEATURES: JOINTS,FAULTS, ETC.

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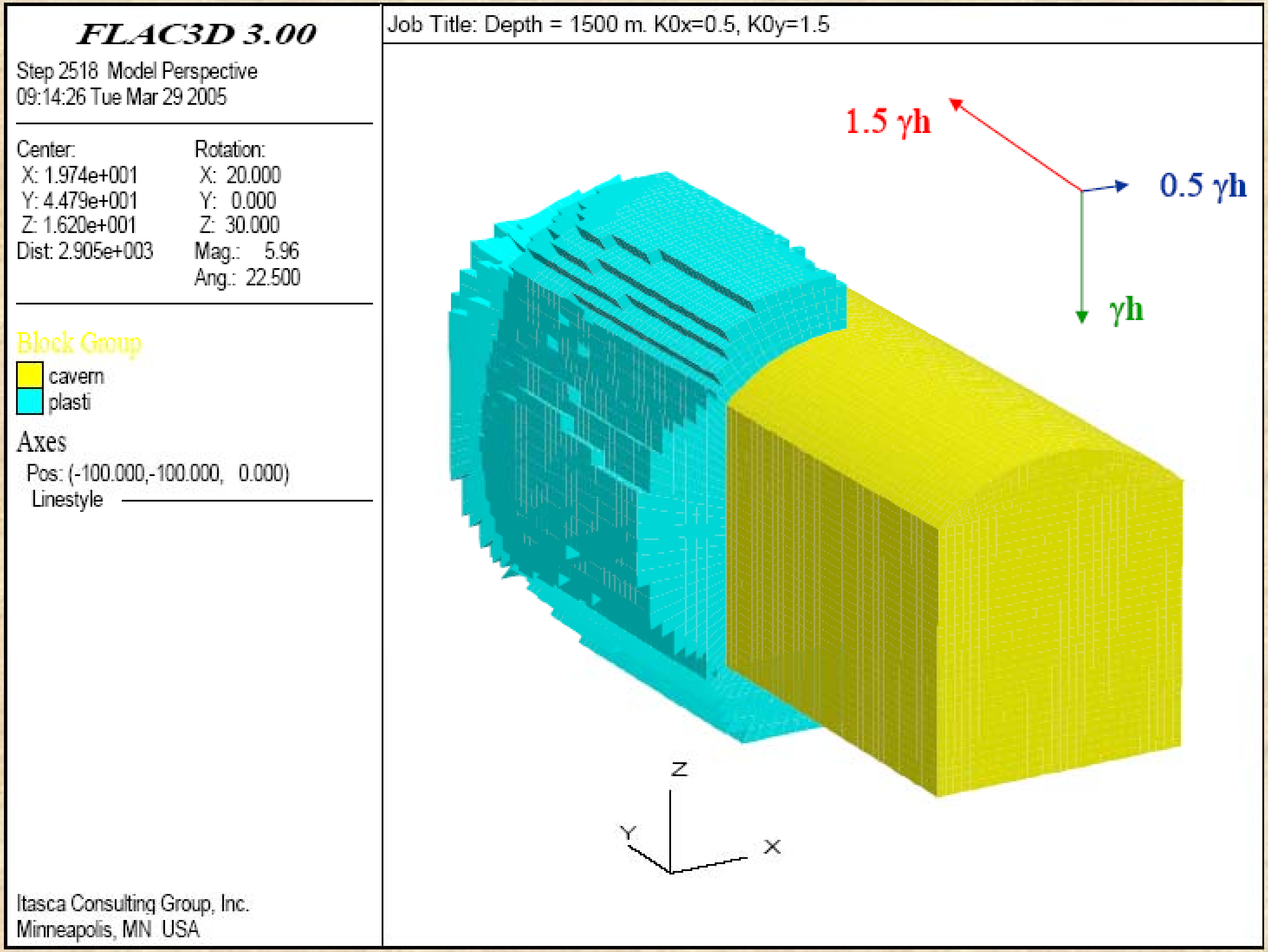
NUMERICAL MODELING



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UNO Collaboration Mtg

Rock Engineering, Risks & Outfitting

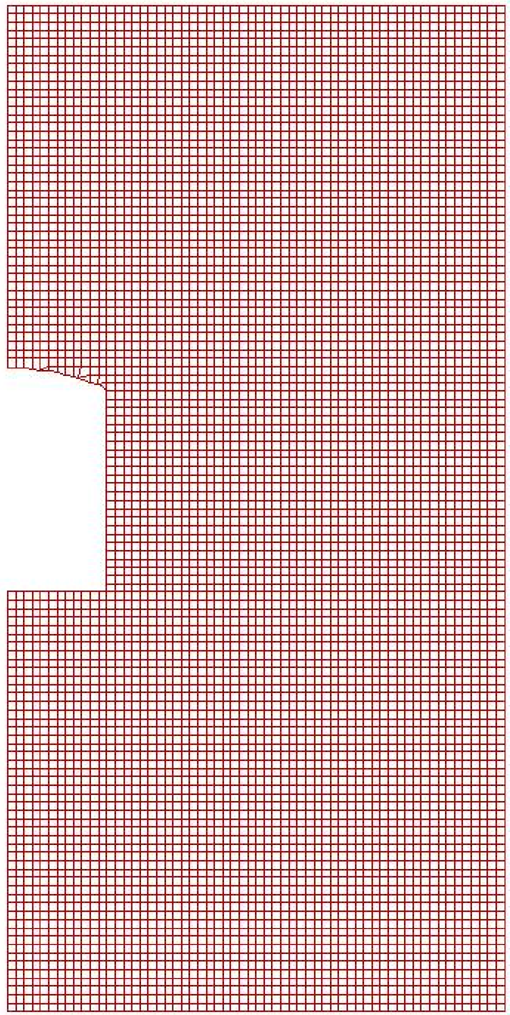
Lee Petersen
CNA Consulting Engineers

Rock Engineering 101

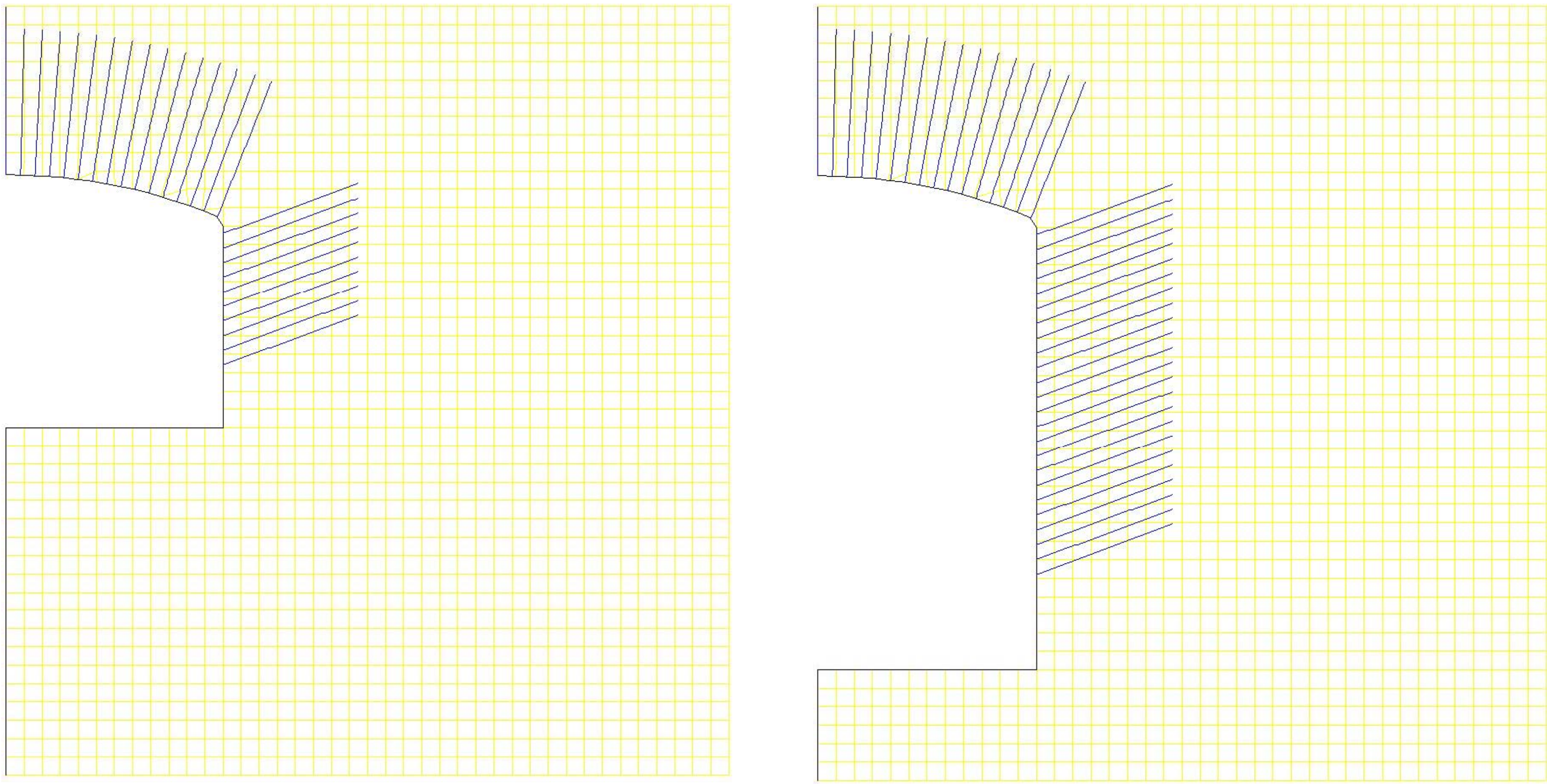
- What are the implications for large cavern construction?
  - Find a site with excellent rock
  - Characterizing the rock mass is JOB ONE
  - Avoid tectonic zones & characterize in situ stresses
  - Select size, shape & orientation to minimize rock support, stress concentrations, etc.
    - Soudan 2 & MINOS caverns

Simple example

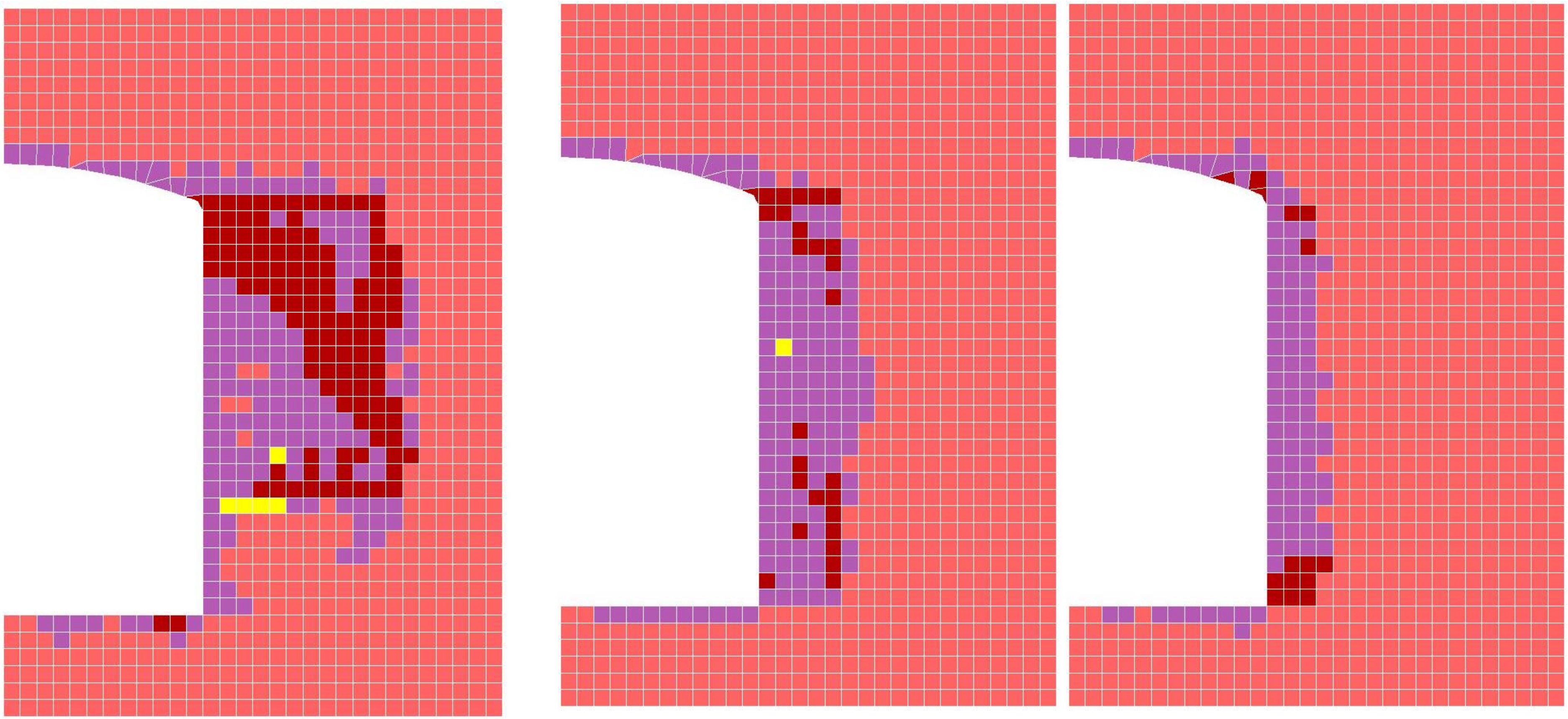
- Continuum model FLAC 2D
- 60 x 60 x 180 meters (length not modeled)
- Curved roof & straight walls
- Depth 1300 meters
- Stresses ≈ depth
- Example rock properties
- Sequential excavation
- Rock reinforcement
- Rock failure



Sequential excavation



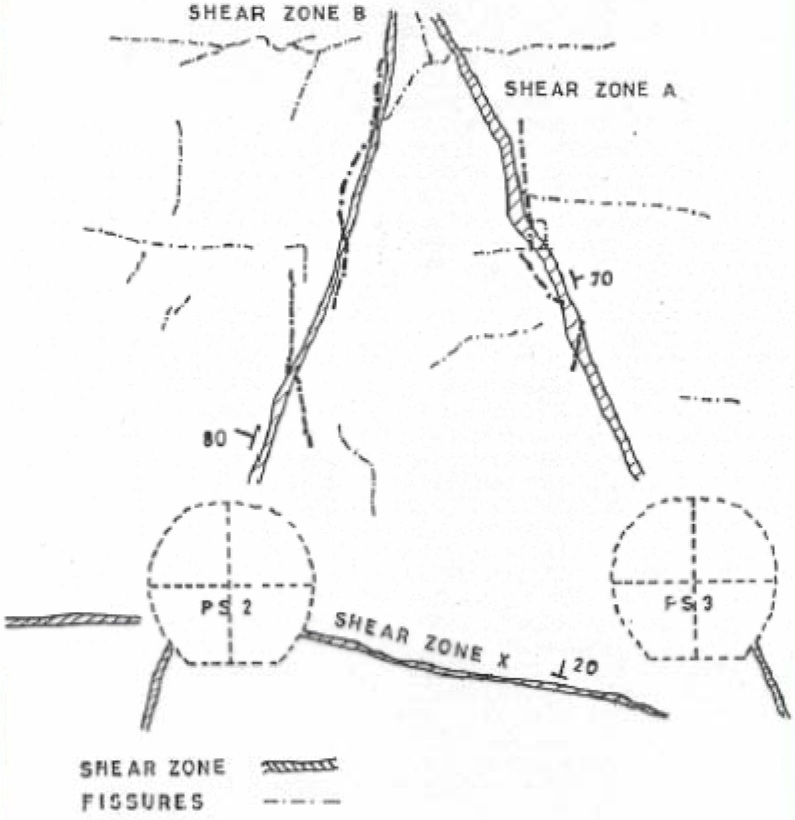
Effect of Rock Strength



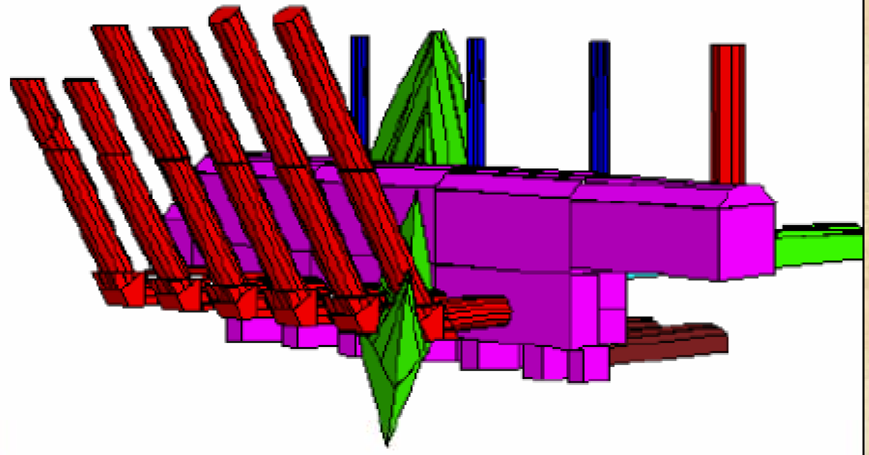
NUMERICAL MODELING

SARDAR SAROVAR PROJECT (SSP)
GUJARAT, WESTERN INDIA

Cracks on Upstream Wall

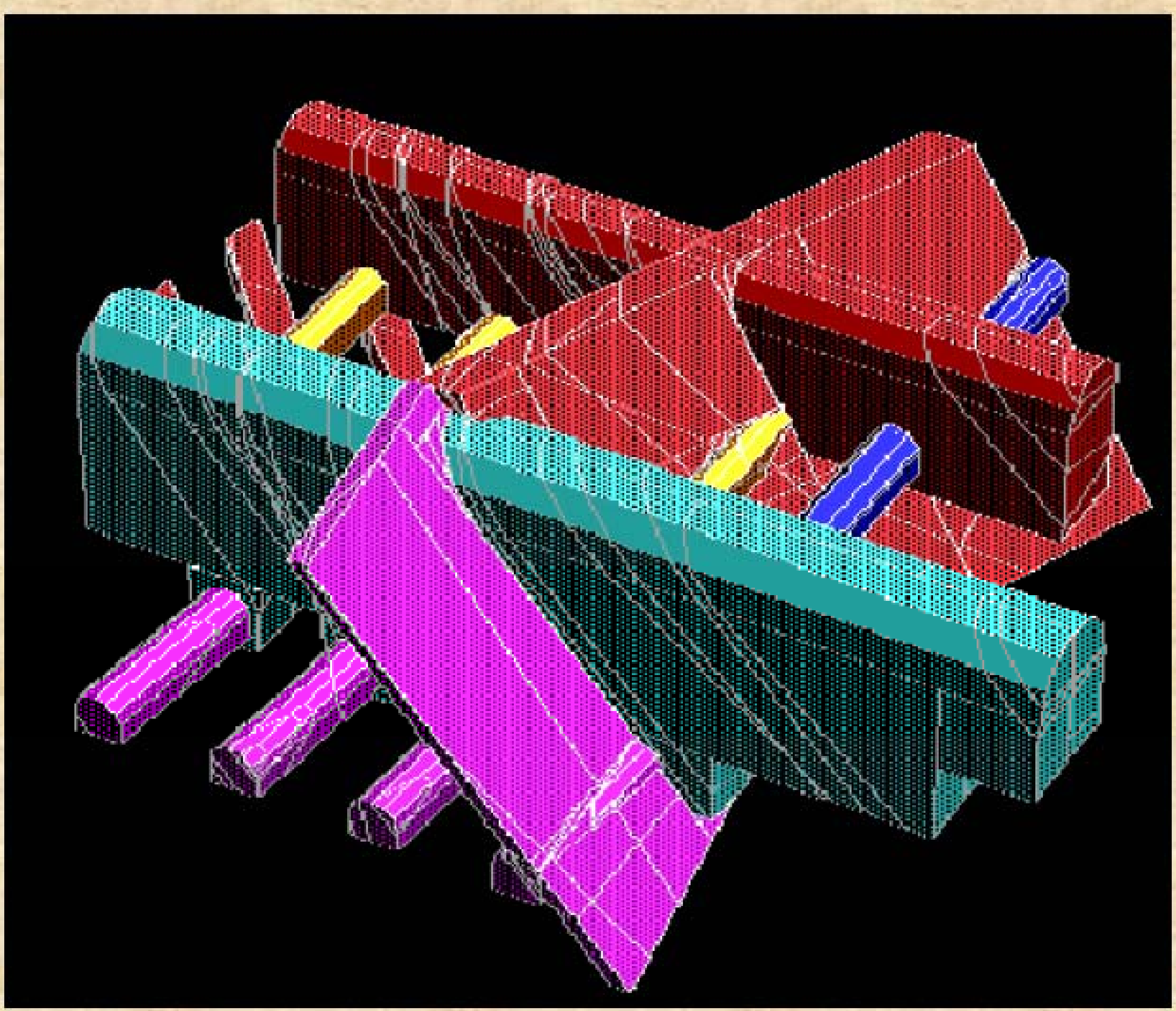


Wedge on Upstream Wall



NUMERICAL MODELING

TEHRI HYDRO POWER PROJECT
U.P., NORTHERN INDIA



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Kazunogawa Cavern

216 m long, 33 m wide, 52 m high, ~500 m deep.

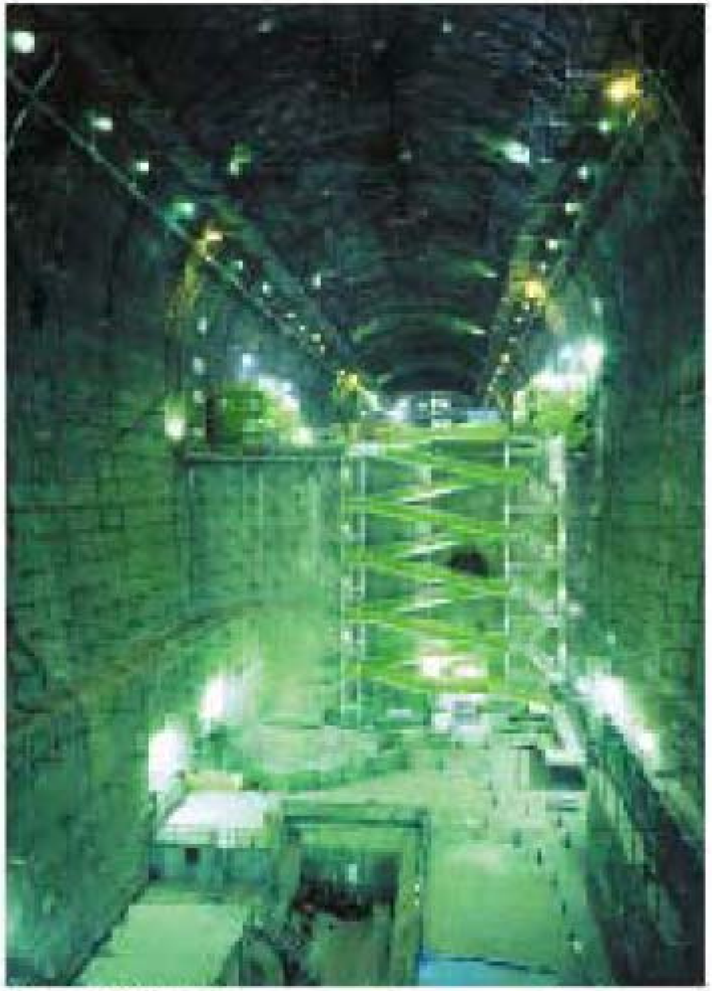

Photo 3: Underground power plant after excavation

Deep Caverns

- This is politically incorrect – so please do not pay any attention to this slide.
  - Is it only politics that we are limited to deep sites?
  - A first look at radiation indicates that a slightly buried linac – ie the top of the housing at grade, with the housing then buried under the excavated soil, is adequate for normal beam loss and accident scenarios.
    - This would require a very flat site.
    - This might save money.
    - Such a site is not on the approved list.
    - This might permit a shallow hall.

LHC Influence

- The LHC has enormous issues of radiation and rates, and makes the LHC detectors very challenging.
- ILC should have rate and radiation issues only very far forward where e^+e^- pairs are an issue, and should have a low rate, low radiation environment elsewhere.
- Are there any issues with self-shielding?
  - A concern is that the detector endcaps nominally are planes normal to the beam. The detector volumes ~look at the beamline. Is this an issue if the beam were to target a beamline component?
  - Are there other issues?
- Large cable plants coming off the detector are natural at the LHC. Are such plants needed for detectors at the ILC?
- Separate shielded areas for support facilities (e.g. power supplies) are needed at LHC. Can they be more closely associated with the detector structures at ILC?
- It would appear that all data from a detector could be transmitted on modest numbers of fibers? Should detector control rooms be located on the surface? Elsewhere?

Platforms and Push-Pull

- Platforms seem to make the interface issues easier, but they increase the depth of the hall below beamline. Are there technical risks that are increased by the platform approach – assuming that cable plants and other services are small.
- As the time required to effect a detector interchange increases, the frequency of interchange will decrease to maximize luminosity. When do the sociological issues become problematic? Does a slow interchange push towards an eventual one detector outcome?
- What are the fundamental limits for interchange time?
  - Is it obvious that a detector solenoid must be run down?

ILC Beams

- The ILC beams are quite small transversely. Is adequate attention being paid to vibration?
- The ILC beam is quite short longitudinally. Is adequate attention being paid to EMI?

Seismicity

- We do not have a site yet. What if ILC winds up in Japan? Or California?

Detector Maintenance

- What scale of maintenance should be possible on beamline?
  - Access to the exterior of the detector during operation has been assumed by SiD.
  - Door opening of ~2 m is assumed. Is this adequate, particularly if there is a shift to “plug” style door? Might this affect hall width?
- What scale of maintenance should be possible off beamline?
  - If a detector requires major maintenance, can it interfere with the other detector?
  - It seems that the ability to access the VXD is required, and this probably means removing the tracker. Is this the limit of major maintenance, or should there be the possibility of even removing the solenoid?
  - Will crane motion interfere with machine operation?

Summary

- These are a few questions that have been worrying us.
- There will be more.
- These seem to affect fundamental strategy for the IR. At this time, should we be making decisions or developing options?