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TECHNICAL DESIGN ISSUES FOR POST CLOSURE DEVELOPMENT OF LANDFILLS

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Vice President
BKF Engineers

Landfill Post Closure Land Use Symposiums
Ontario, Ca. February 15 & Stockton Ca. February 28

KEY DESIGN GOALS

California Code of Regulations, Title 27 §21090 to §21200

1. Protect the Public from Environmental Issues
2. Achieve Acceptable Performance As the Site Settles
3. Avoid Penetrations of the Final Landfill Cover
4. Minimize Future Maintenance Costs

Not this…

Or this…

Or this…

Home Depot

Colma Ca.

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Autobahn Motors

Belmont, Ca.

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Island Park

Belmont, Ca.

TECHNICAL DESIGN ISSUES

1. Analyze Historical Documents and Geotechnical Investigation
2. Final Cover Designs
3. Define Site Characteristics (Boundary Conditions)
4. Design for Differential Settlement
5. Penetrations of the Final Cover
6. Define future inspection and maintenance requirements

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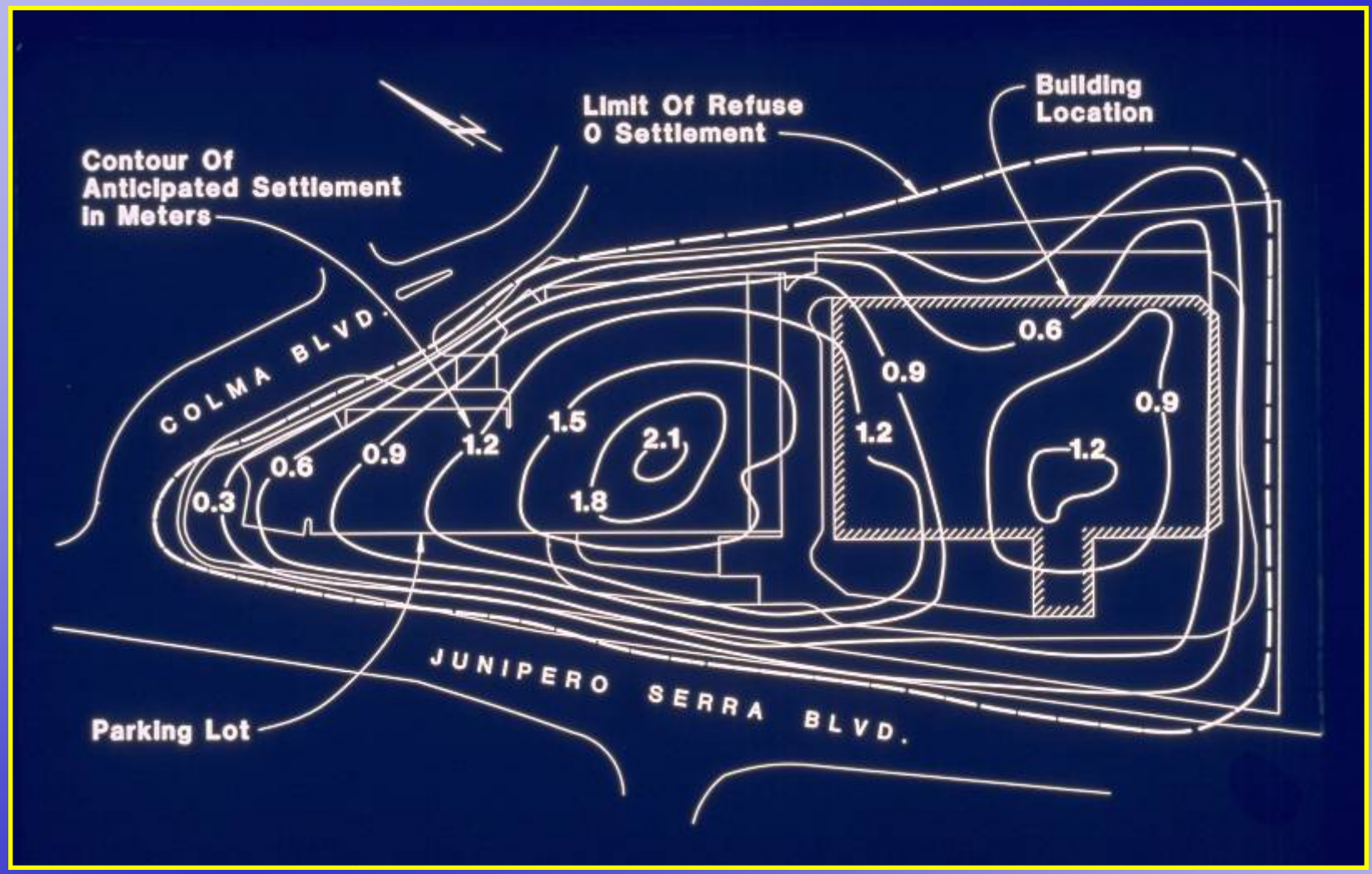
TECHNICAL DESIGN ISSUES

1. Analyze Historical Documents and Geotechnical Investigation
    a. Site Characterization
        - Limits of Landfill
        - Depth of Landfill
        - Predicted Settlement



Limit of Landfill and Predicted Settlement

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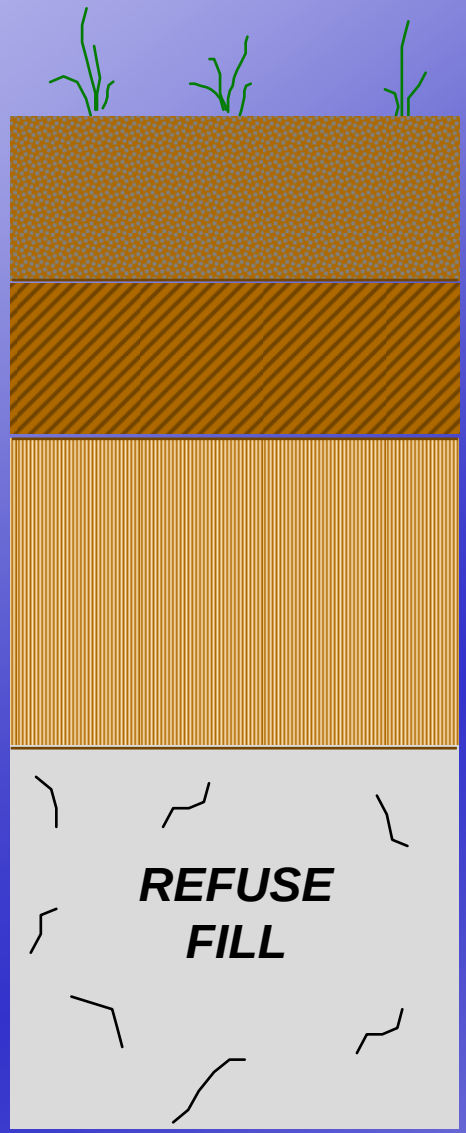
TECHNICAL DESIGN ISSUES

1. Analyze Historical Documents and Geotechnical Investigation

2. Final Cover Design
    a. California Code of Regulations, Title 27 §21090 (a) Final Cover Requirements
        - "Prescriptive Cover"
        - Alternative Final Cover



12” Erosion-Resistant Layer (vegetative layer)

12” Low-Hydraulic-Conductivity Layer (1 x 10^{-6} or less)

24” Foundation Layer (appropriate landfill material or dirt)

Prescriptive Cover

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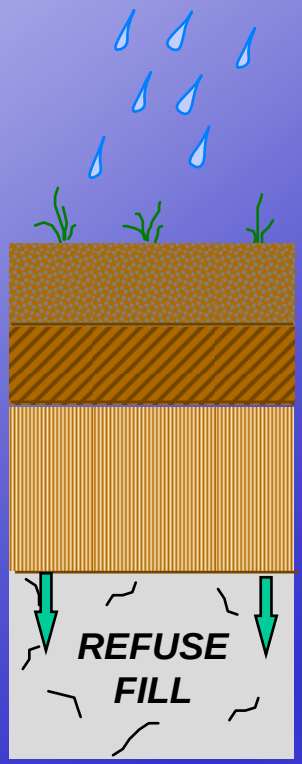
"The RWQCB can allow an alternative cover design that it finds will continue to isolate the waste in the Unit from precipitation and irrigation waters at least as well as would be a final cover built in accordance with applicable prescriptive standards…." (CCR Title 27 §21090a)

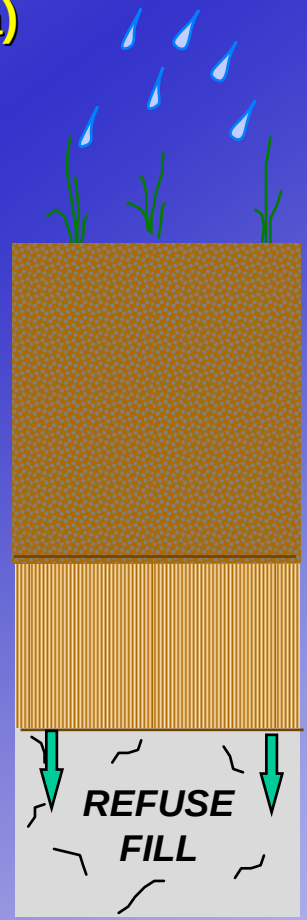
Hydrologic Evaluation of Landfill Performance Model (HELP)



INFILTRATION
3.5"

Prescriptive Cover

INFILTRATION
1.5"



Alternative Cover

Alternative Cover

TECHNICAL DESIGN ISSUES

1. Analyze Historical Documents and Geotechnical Investigation
2. Final Cover Design
3. Define Site Characteristics (Boundary Conditions)
    a. “Soft Edge” Boundary Conditions (Natural Boundaries)
    b. “Hard Edge” Boundary Conditions (Artificial Boundaries)

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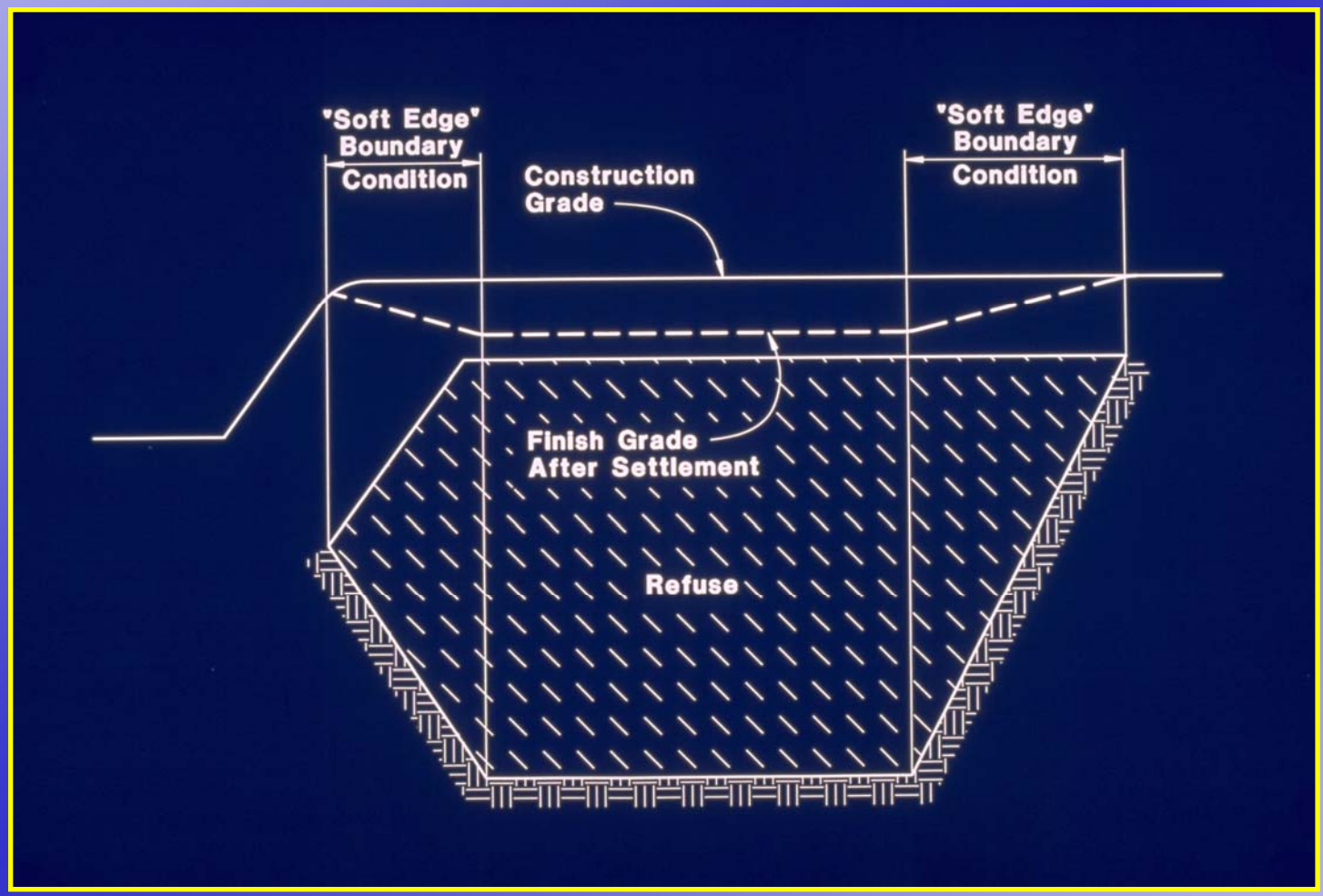
“SOFT EDGE” BOUNDARY CONDITIONS (NATURAL BOUNDARIES)

1. Depth of refuse / topography of landfill bottom
2. Composition of landfill refuse
3. Age of landfill refuse
4. Thickness of landfill cover
5. Previous uses

"SOFT EDGE" BOUNDARY CONDITIONS (NATURAL BOUNDARIES)



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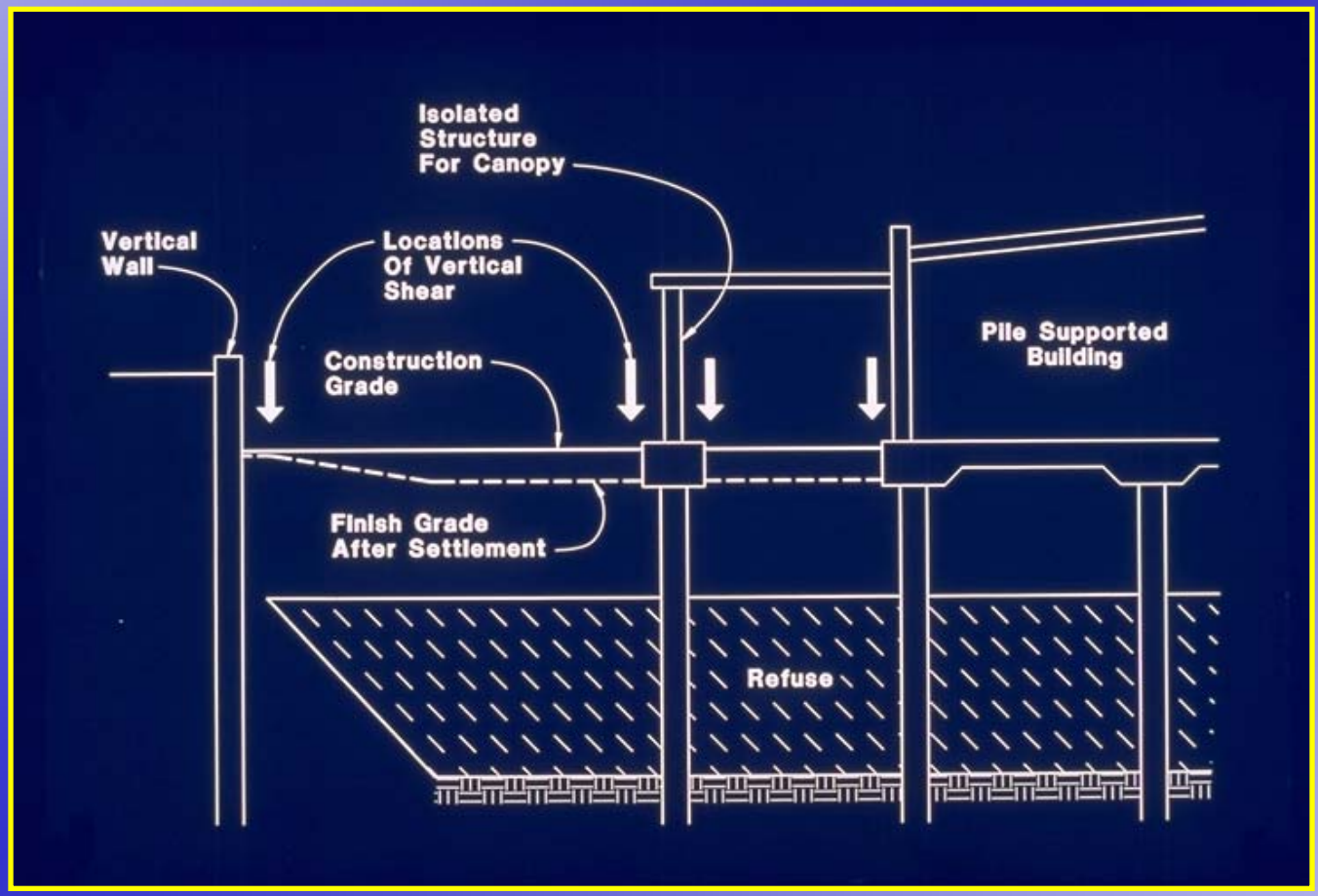
“HARD EDGE” BOUNDARY CONDITIONS (ARTIFICIAL BOUNDARIES)

1. Edges of supported structures
2. Isolated pile caps and grade beams
3. Vertical elements

"HARD EDGE" BOUNDARY CONDITIONS (ARTIFICIAL BOUNDARIES)



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TECHNICAL DESIGN ISSUES

1. Analyze Historical Documents and Geotechnical Investigation
2. Final Cover Design
3. Define Site Characteristics (Boundary Conditions)
4. Design for Differential Settlement
    a. Finished Slope and Grading Design (“Soft Edge”)
    b. Site Utility Design
    c. Building Connections (“Hard Edge”)

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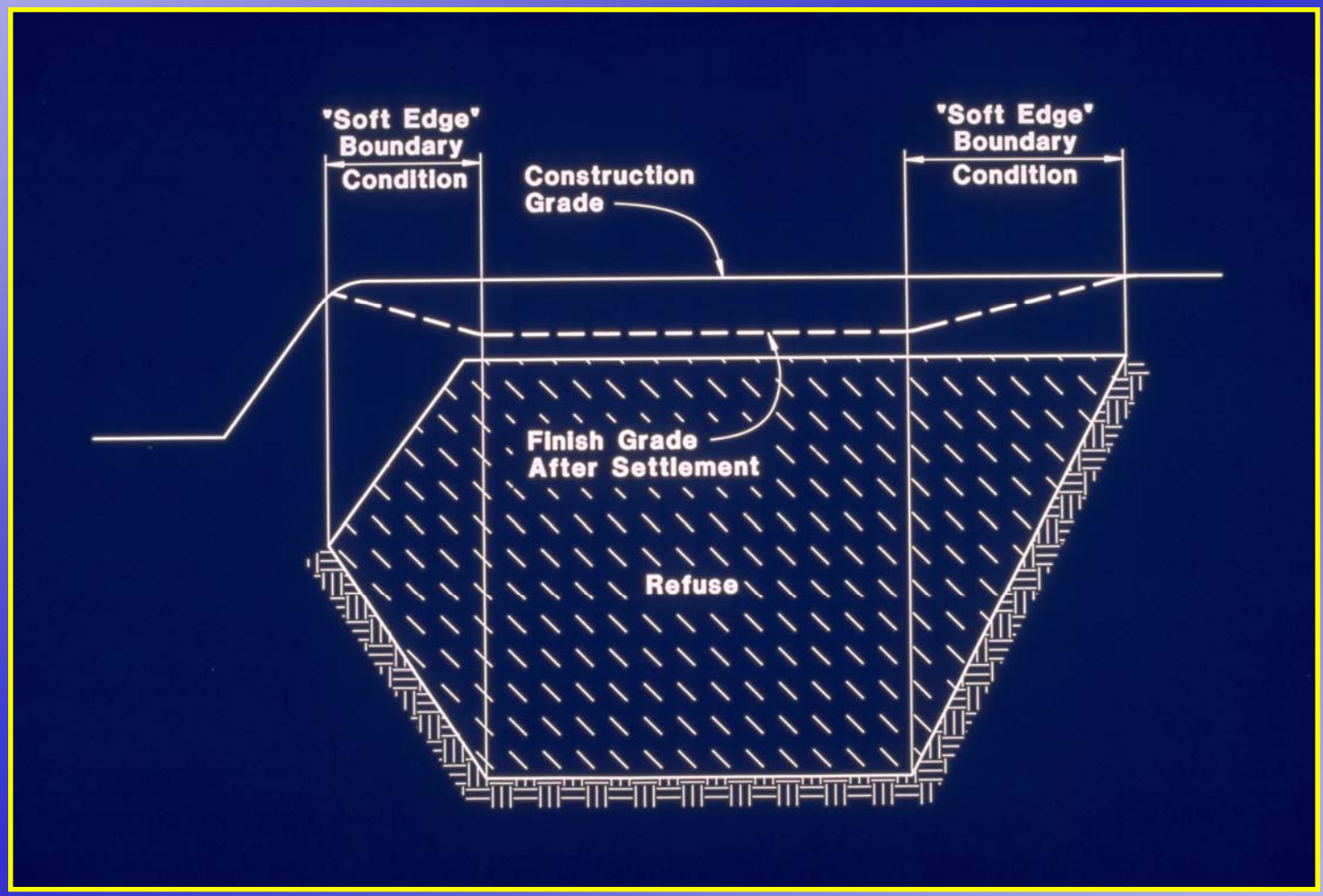
FINISHED SLOPE AND GRADING DESIGN "SOFT EDGE"

1. Design for Ultimate Slope Desired After Differential Settlement

2. Minimize Additional Fill

3. Avoid or Mitigate "Difficult" Boundary Areas

FINISHED SLOPE AND GRADING DESIGN
"SOFT EDGE"



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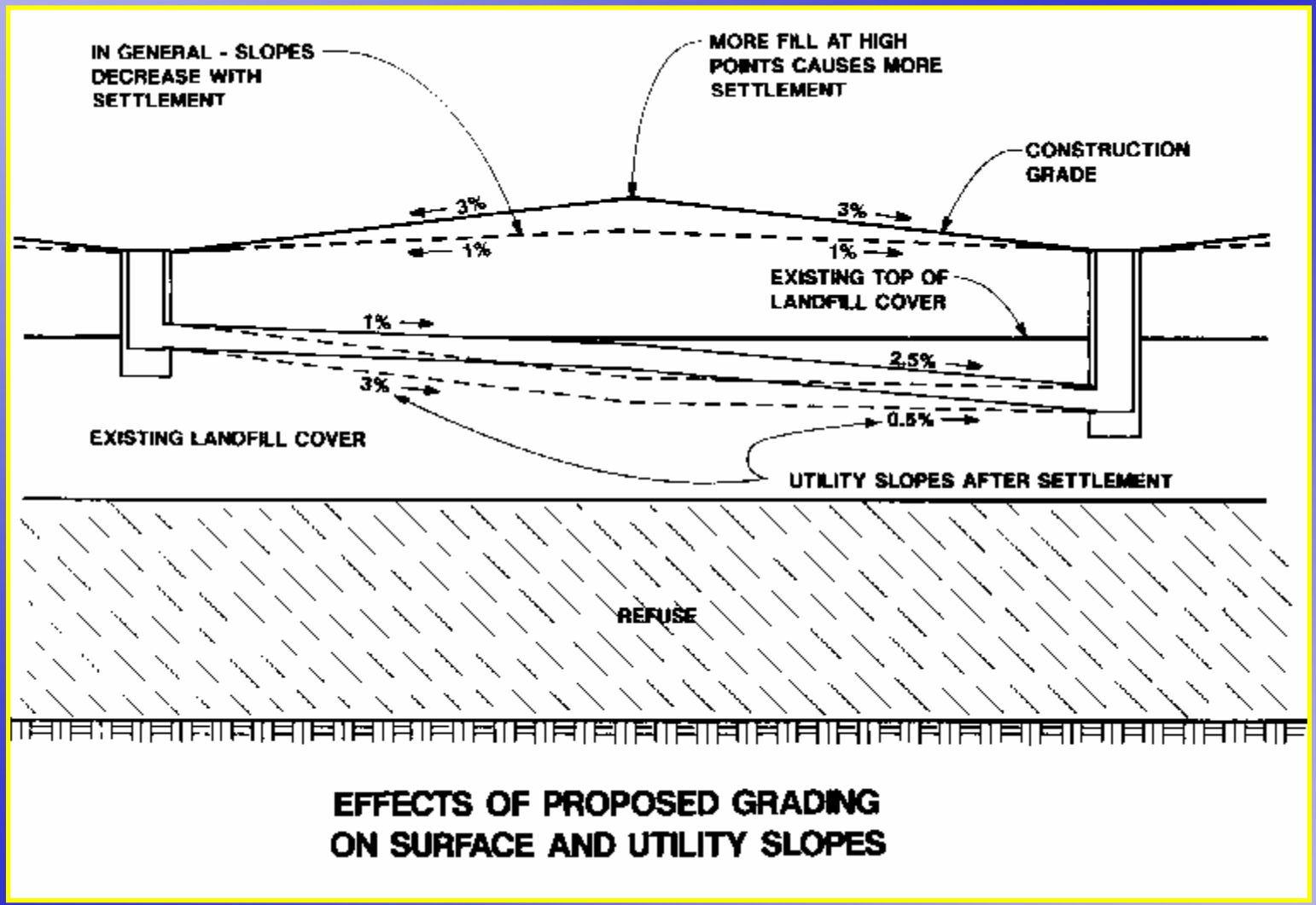
SITE UTILITY DESIGN

1. Minimize the Utilities
   Within the Landfill Area

2. Design for Anticipated Settlement
   - "Soft Edge"
   - "Hard Edge"

SITE UTILITY DESIGN



EFFECTS OF PROPOSED GRADING
ON SURFACE AND UTILITY SLOPES

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SITE UTILITY DESIGN

BUILDING CONNECTIONS ("HARD EDGE")

Design for Vertical Dislocation Caused by Vertical Shear

- Hinged Access Slabs to Accommodate Vertical Dislocations
- Vertical Dislocations at Footings, Grade Beams and Vaults
- Vertical Dislocations at Utility Connections
- Design Considerations Below the Structural Slab

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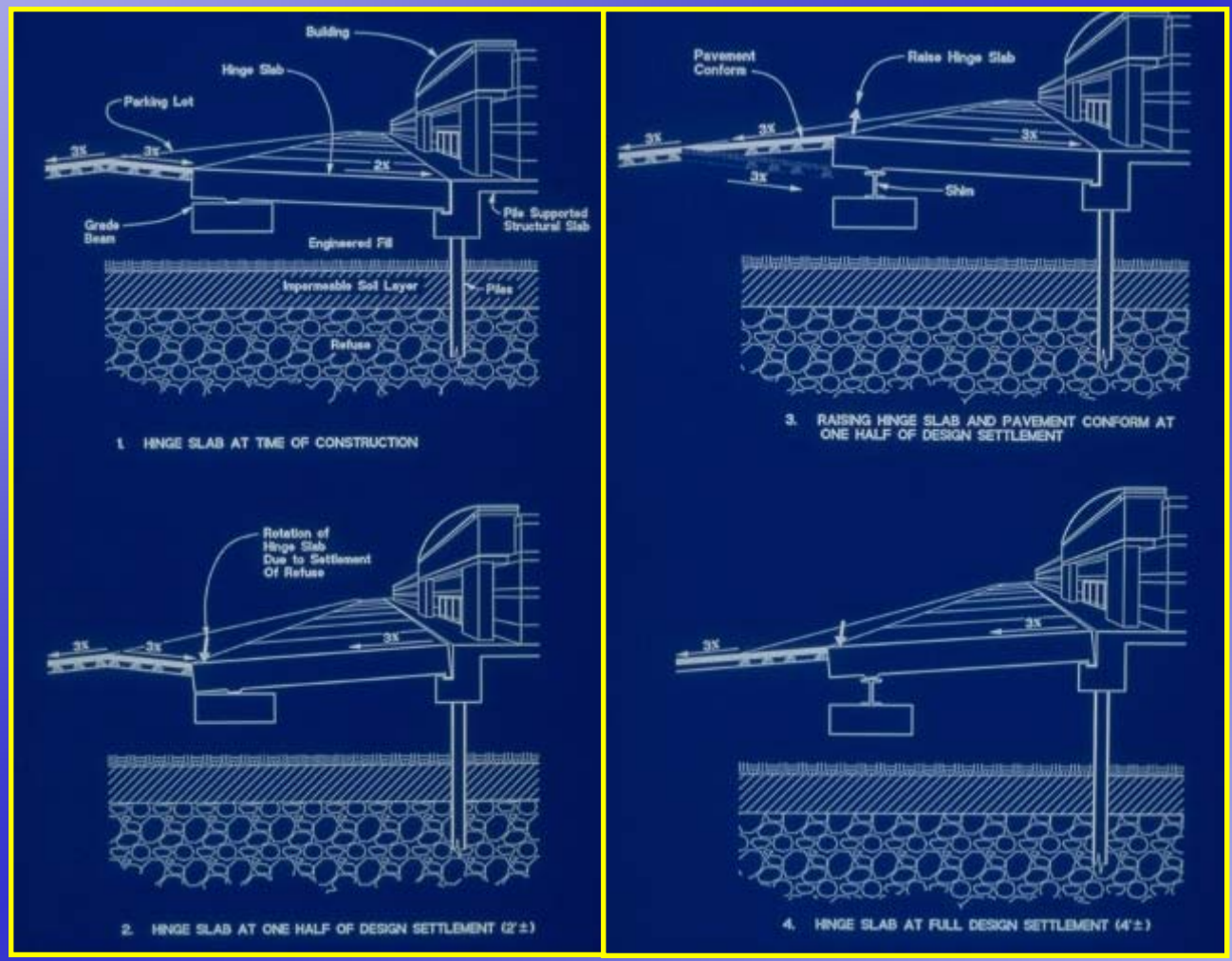
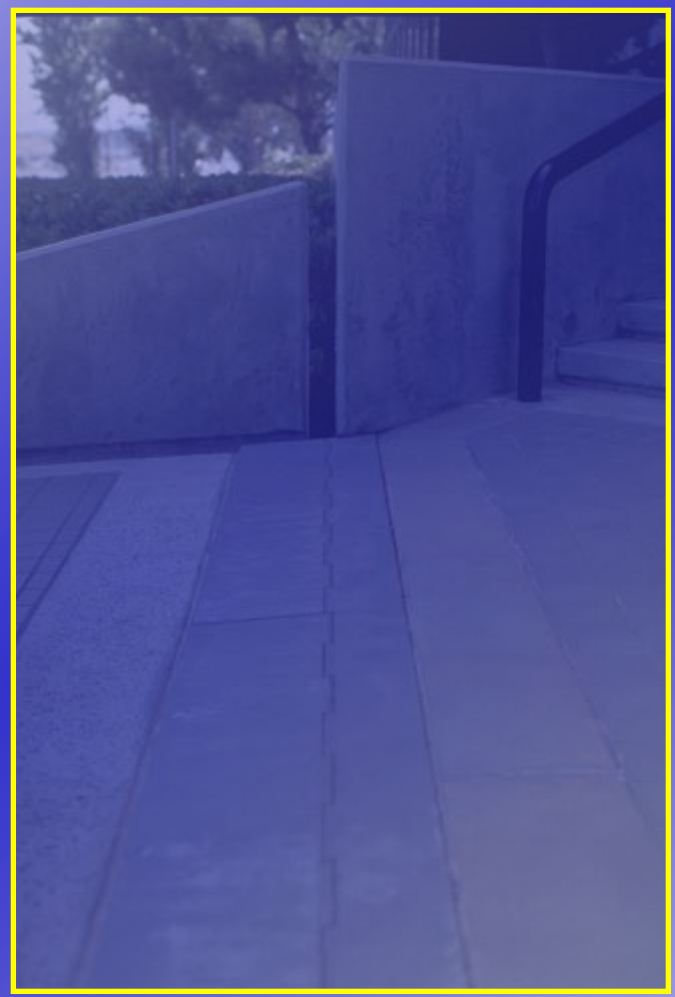
BUILDING CONNECTIONS ("HARD EDGE")



Hinged Access Slabs

BUILDING CONNECTIONS ("HARD EDGE")



Hinged Access Slabs

BUILDING CONNECTIONS ("HARD EDGE")

Footing and Grade Beams

BUILDING CONNECTIONS ("HARD EDGE")

Utility Connection Points

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BUILDING CONNECTIONS ("HARD EDGE")

Utility Connection Points

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BUILDING CONNECTIONS ("HARD EDGE")

Utility Connection Points

BUILDING CONNECTIONS ("HARD EDGE")

Utility Connection Points

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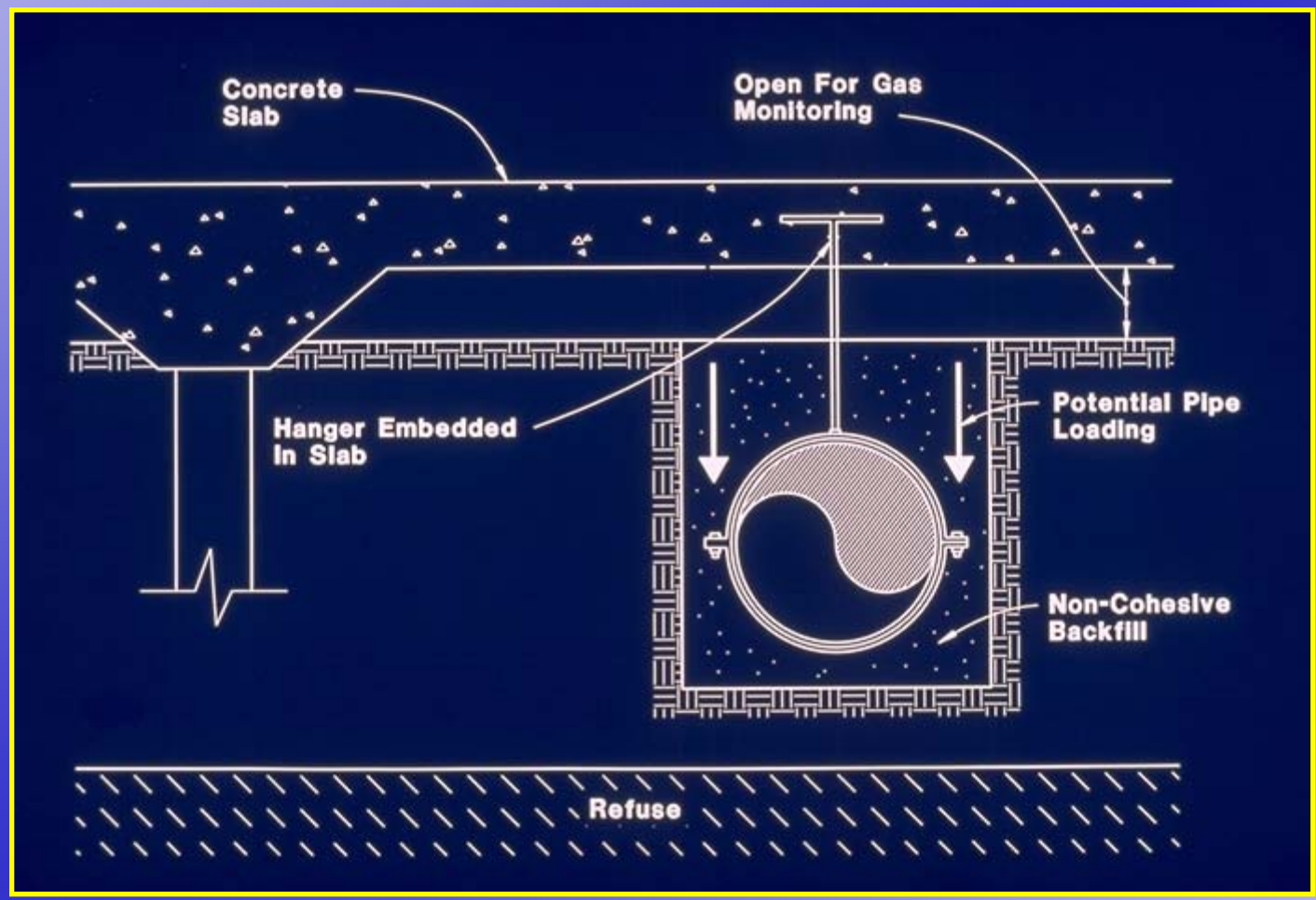
BUILDING CONNECTIONS ("HARD EDGE")



Utility Connection Below Structural Slab

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TECHNICAL DESIGN ISSUES

1. Analyze Historical Documents and Geotechnical Investigation
2. Final Cover Design
3. Define Site Characteristics (Boundary Conditions)
4. Design for Differential Settlement
5. Penetrations of the Final Cover
   a. AVOID IF POSSIBLE!
   b. Develop Special Details

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AVOID IF POSSIBLE !

- Add Fill to Site for Utilities and Foundations
- Route Utilities Around the Landfill Area
- Modify Typical Site Details
- Re-grade Refuse During Final Cover Construction to Create Utility “Corridors” and Building Pads.

AVOID IF POSSIBLE !

Modify Typical Site Details

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AVOID IF POSSIBLE !

Modify Typical Site Details

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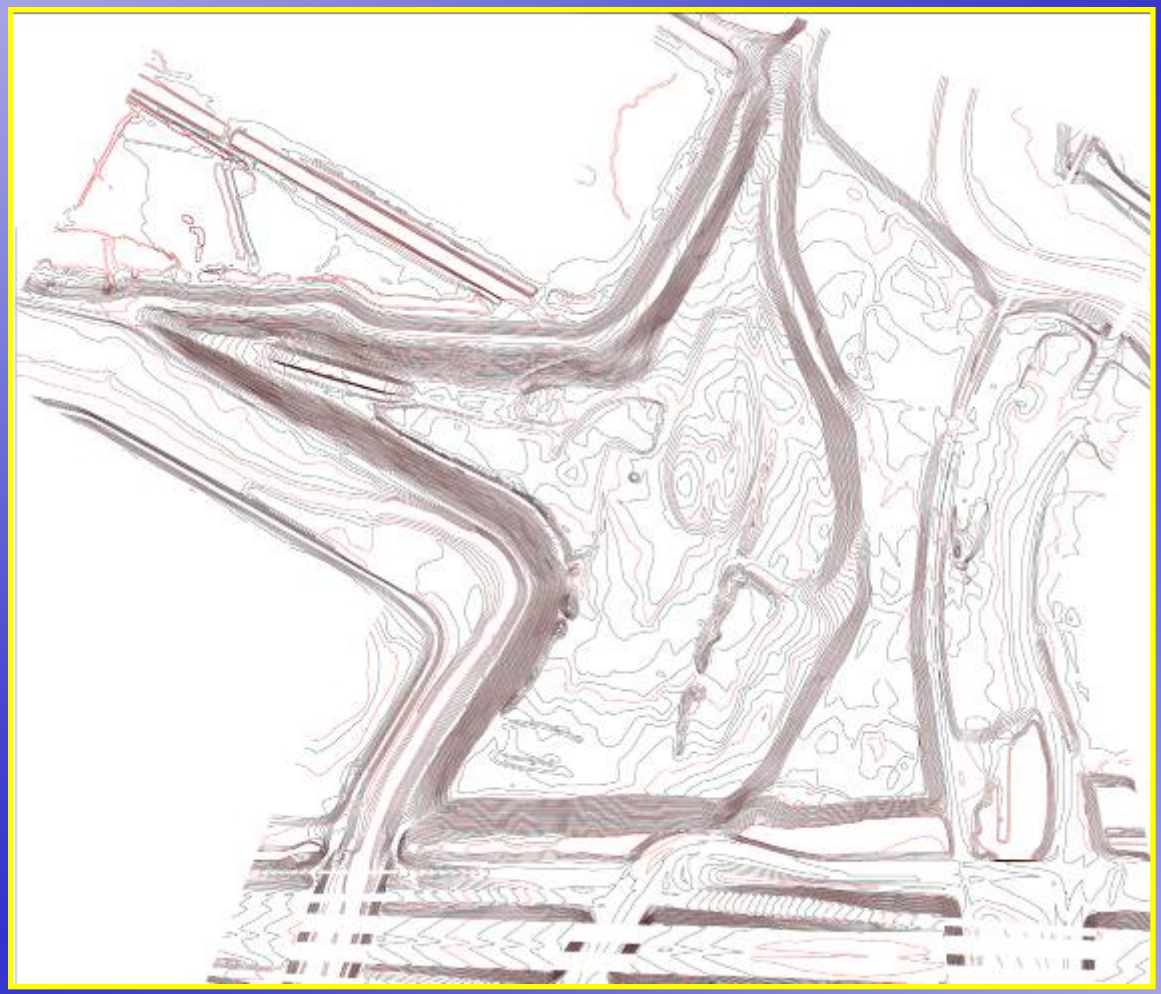
AVOID IF POSSIBLE !

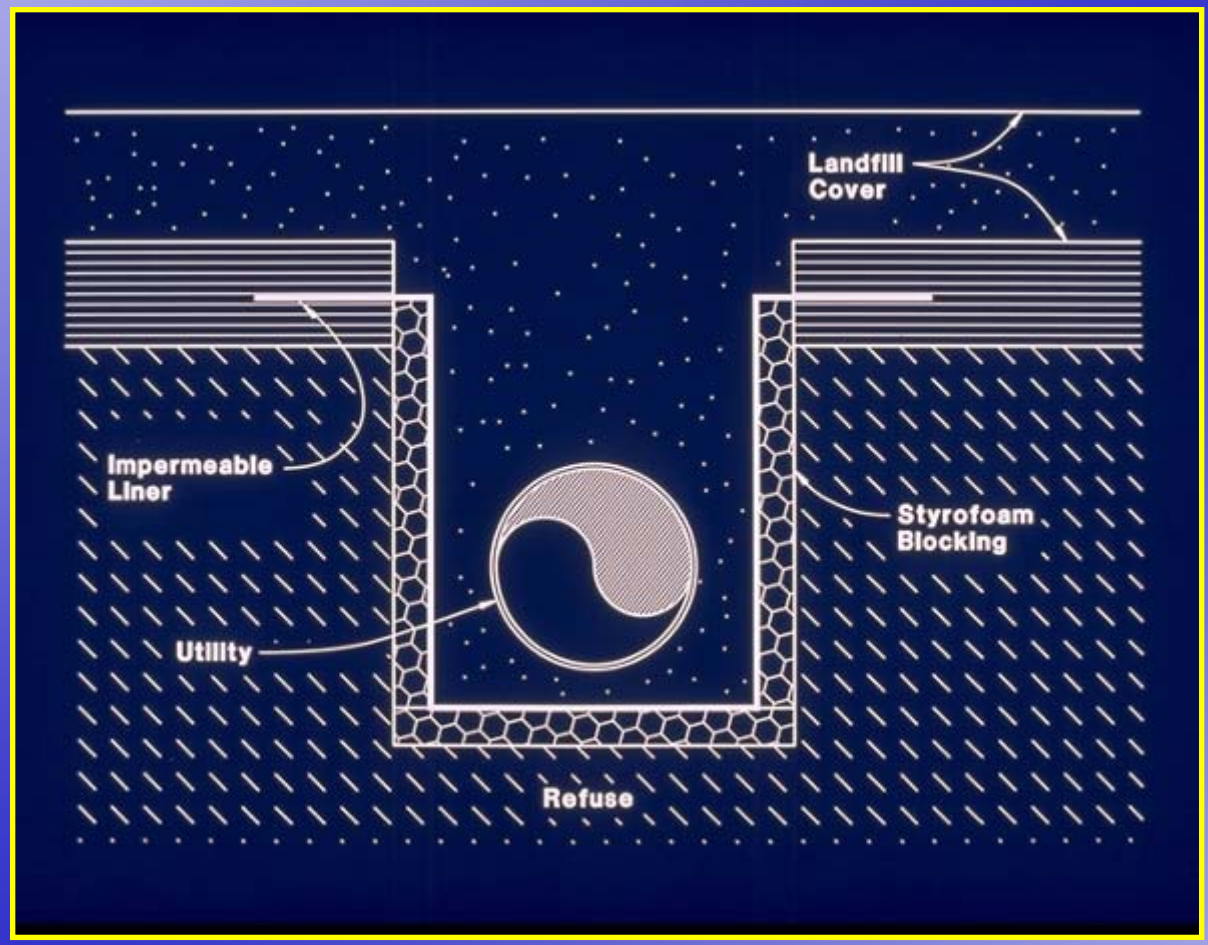


Utility “Corridors” and Building Pads Before

AVOID IF POSSIBLE !

Utility “Corridors” and Building Pads After

If you can't Avoid…..

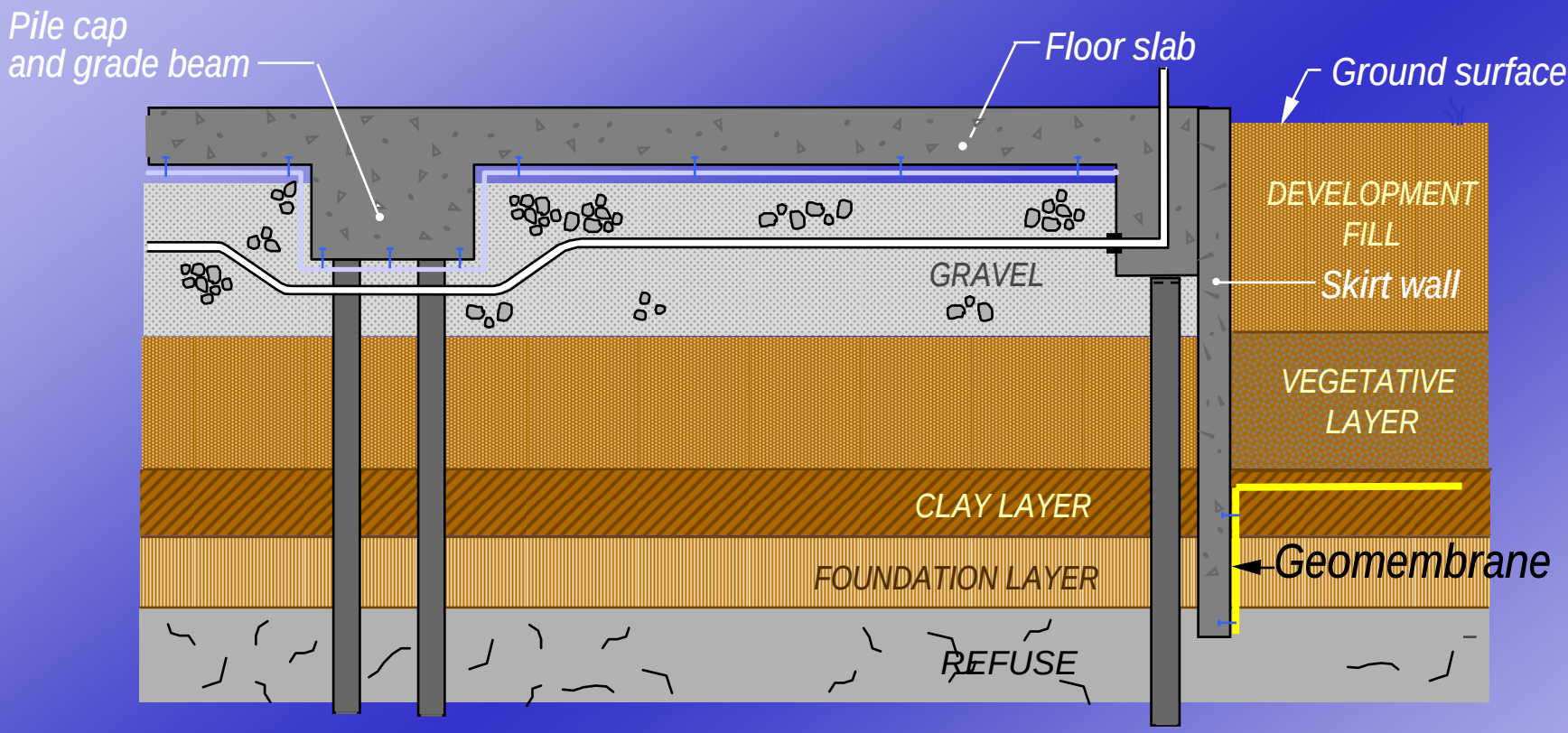


Create Special Detailing for Penetrations

If you can't Avoid…..

Create Special Detailing for Penetrations

If you can't Avoid…..



Create Special Detailing for Penetrations

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TECHNICAL DESIGN ISSUES

1. Analyze Historical Documents and Geotechnical Investigation
2. Final Cover Designs
3. Define Site Characteristics (Boundary Conditions)
4. Design for Differential Settlement
5. Penetrations of the Final Cover
6. Define Future Inspection and Maintenance Requirements

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Define Inspection and Maintenance Requirements

- Site Settlement Monitoring
- Pavement Condition Inspection
- Hinged Slab Monitoring
- Utility Connection Monitoring
- Reporting to Local Enforcement Agency (LEA)

TECHNICAL DESIGN ISSUES

SUMMARY

1. Analyze Historical Documents and Geotechnical Investigation
2. Final Cover Designs
3. Define Site Characteristics (Boundary Conditions)
4. Design for Differential Settlement
5. Penetrations of the Final Cover
6. Define Future Inspection and Maintenance Requirements

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PAY ATTENTION TO DETAIL !!

&

PROVIDE ADEQUATE DESIGN ENERGY !!

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PERSONNEL
ONLY


NO DUMPING
ALLOWED
VIOLATORS WILL
BE PROSECUTED
SECT. 374B P.C.
DUMP IS
CLOSED
PERMANENTLY
POSTED
NO TRESPASSING
KEEP OUT

BkF

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