Common Problems When Working with Soil and Concrete

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My Background

• Plants Engineer- Aggregate, Asphalt, and Concrete production facilities
• Construction Materials Engineering Department Manager- Construction material testing for a variety of projects.
• Geotechnical Engineer- Field investigations and construction oversight.
• DNRC Civil Engineering Specialist- Dam Safety, State Projects, Floodplains, and Water Rights.
Outline
Question

Why should we worry about the dirt?

In almost every project you will either be building on the soil or using it as a construction material.

The majority of the time you are trying to recompact soil or other aggregate materials.
Soil Types

Gravel
Sand
Silt
Clay
Any combination of each
Compaction Equipment

- Vibratory or static, smooth drum rollers
- Vibratory or static, pad or sheep’s foot rollers
- Hand operated equipment
- Various equipment attached to excavators or backhoes.
- Others
Preparing the site
Ready to Place and Compact the Soil
Common Problems

Too Dry

Too Wet
Common Problems

Too Hot

Too Cold
Common Problems

Too Thick
Common Problems

Sample #1

Placed in a 20” loose lift
Common Problems

Sample #2

Placed in 3, 8” thick loose lifts.
Common Problems

Sample #1-
Overall loose lift thickness- 20”

Final Lift Thickness- 16”

Sample #2-
Overall loose lift thickness- 24”

Final Lift Thickness- 12.5”
Common Problems

Dry Density of each sample when compared with a D698 Proctor

100% compaction according to proctor

Sample #2 - 93% Compaction

Sample #1 - 80% Compaction
Effective compaction of soils is dependent on:

- Soil Type
- Moisture Content
- Compaction Equipment
- Weather Conditions
- Lift Thickness
Benefits

Effective Compaction helps:

• Mitigate excessive settlement
• Mitigate differential settlement
• Provide a working surface for the construction of other structural elements.
• Helps prevent future maintenance.
Concrete

Why should we worry about the mud?

Problems with the concrete, the placement methods, or the curing can affect the integrity of the structure and cause excessive future maintenance.
Poorly prepared subgrade can lead to settlement and cracking of the concrete.
Formwork

Problems with formwork can cause future maintenance issues.
Problems with reinforcing steel placement can cause structural problems and future maintenance issues.
Joint Location

• The location of joints in the structure can affect future maintenance.

• Additional measures may have to be implemented to protect joints.
Concrete Problems

Too Wet:

- Reduced Strength
- Segregation of the Gravel in the Concrete
- Problems During Placement
- Shrinkage Cracking
Concrete Problems

Too Dry:

- Consolidation
- Workability
- Finishing
Concrete Problems

Air Content:

• If the air content is too low the concrete loses its resistance to the effects of freeze/thaw cycles.

• If the air content is too high the strength of the concrete can be reduced. High air content combined with a high slump can cause significant strength loss and/or severe segregation of the aggregate materials.
Concrete Problems

Consolidation:

• Problems with consolidation can cause voids in the structure.

• Voids or other anomalies are likely going to be the first area to fail.
Concrete Problems

Sample #1: Hot and Dry

• The sample was delivered to the site and in accordance with all specifications.

• The concrete was placed in a large 4” thick slab.
Concrete Problems

Sample #2: Cold

• The sample was delivered to the site and in accordance with all specifications.

• The concrete was placed in a large 4” thick slab.
Concrete Problems

Sample #3: Water Added

• The sample was delivered to the site and had a slump greater than what was in the specifications.
Concrete Problems

Sample #4: Just Right

• The sample was delivered to the site and in accordance with all specifications.

• The concrete was placed in a large 4” thick slab.

• After placement the slab was covered with a moist covering and allowed to cure.
Summary

The durability of the concrete in a structure is dependent on:

• Having a stable subgrade

• Proper placement of forms, joints, and reinforcing steel

• Having an appropriate mix design and getting the concrete delivered to the site in accordance with the specifications.

• Effective consolidation.

• Appropriate curing and/or other protection measures.
Benefits

The benefits of good concrete and appropriate placement are:

• More resistant to the elements

• Reduction in future maintenance

• Stability
Conclusions

• Increasing the money spent upfront to control and monitor the quality of the initial construction will reduce the cost of maintenance in the future.

• Owners- You are the ones left with the final product. It is unlikely that the contractor, engineer or anyone else is going to come back in the future to help you out with your maintenance.
Questions