2.1 Backfill - General

Excavations are made for the purpose of constructing bridge substructure elements, and consequently requiring competent backfill material. The backfill material must be adequately compacted into place to minimize future settlement of the material. Backfill may also be required to build up areas where the existing ground level is lower than that required in the final project or for the construction of guide banks for river training works.

2.2 Environmental Constraints

Alberta Environment's Code of Practice is to be followed for all projects involving a stream or river crossing. The Bridge Inspector must aware of the environmental constraints relating to backfilling in and adjacent to the stream channel. The following criteria must be met:

- Normally, there are only certain time periods that construction activities are allowed within a channel under the Code of Practice.

- Backfill material deposited into fish bearing streams must be clean and contained few fines. Fines shall be confined with filter fabric, silt trap/fence/barrier, or settling pond, etc., to prevent entering into the stream.

- Approval must be obtained from the Bridge Project Engineer before the Contractor is allowed to remove any material within the channel to be utilized as backfill material.

2.3 Safety

Refer to the Alberta's Occupational Health and Safety Regulation, General Safety Requirements (to replace the existing General Safety Regulation) for specific approved safety requirements:

- Part 15 Personal Protective Equipment

- Part 16 Powered Mobile Equipment

- Part 27 Excavation, Tunnelling and Trenching

2.4 Bridge Inspector's Record

It is important that the Bridge Inspector keep an accurate record of the following items:

- In situations where the approach fill is deficient and extra fill material is anticipated in order to achieve the final grade line, it is essential to obtain and record before and

after cross-sections so that an accurate quantity of the extra fill material can be calculated for payment purposes. For certain projects this is done as "Roadway Work" and is bid as a lump sum price.

- The results of density tests need to be accurately recorded in order that rejection or acceptance of a backfill material can be validated.

- All rejected work should be recorded.

- Include the date, any related discussions held with the Contractor, and stated reasons for rejection of any work.

2.5 Materials

Backfill is generally classified into two types: Compacted non-granular and compacted granular. The location where each type of material is required should be clearly noted on the plans and specifications.

2.5.1 Compacted Non-Granular Backfill

Non-granular backfill material may be excavated if it is suitable. If excavated material is used as backfill material, in freezing weather, material should be piled such that the frozen outer shell can be removed and discarded leaving access to the unfrozen inner material.

- Material similar to that being used for the roadway embankment is generally acceptable to be used as non-granular backfill material.

- Non-granular backfill must be acceptable to the Bridge Project Engineer.

- Material must be free from all topsoil, roots, large lumps and any frozen material.

2.5.2 Compacted Granular Backfill

Compacted granular material is a mixture of free draining sand and gravel complying with the gradation noted in the specification. It must also be free from any frozen lumps.

2.5.2.1 Granular Pit-Run

- The material is to be visually inspected for acceptance.

- The maximum aggregate size should not exceed 100 mm.

- The material should be relatively clean to ensure drainage, but a sufficient amount of fine material must be present to achieve compaction.

- Sieve analysis for pit-run granular is not always necessary. This is to be confirmed with the Bridge Project Engineer.

2.5.2.2 Crushed Granular

Crushed granular material is generally specified in areas where a higher standard of backfilling is required, such as around culverts and culvert beds. In such a case the specified gradation and density must be achieved.

- Requires sieve analysis.

- Material must meet specified gradation.

- Density tests need to be taken to ensure that specified compaction is achieved.

2.6 Placing

The sequence of placing and compacting backfill can be important depending on the structural element being backfilled. For example, backfilling only one side of a wingwall cast recently can cause significant lateral forces, which could displace or completely fail such a wall.

- No backfill should be placed against abutment wingwalls or backwalls or culverts until permission is granted from the Bridge Project Engineer.

- Ensure that all patching is properly carried out and cured before backfilling against any concrete element.

- The backfilling should progress at the same rate, in lifts of approximately 150 mm, on all sides of a concrete element, especially for thin sections.

- Steps or terraces may be required to be excavated when backfilling on a slope so that the newly placed backfill material can be “keyed” into the slope.

2.7 Compaction

For backfill material, compaction is required to be 95% Standard Proctor Density with optimum moisture content. Proctor Density is obtained by taking an actual sample of the backfill material and doing **standard** compactions on it at varying moisture contents.

- Field tests may be taken to determine the density of the material as compacted and to compare it to the optimum density as achieved in the Proctor test.

- Testing of the density of the compacted material shall be in accordance with the appropriate specification.

- Compaction equipment can be small hand operated mechanical rollers or tampers, or larger vibratory roller type equipment.

- **ALWAYS** review the requirements for testing backfill at **each** location at the site with the Bridge Project Engineer.

2.7.1 Non-Granular Material

- In confined areas adjacent to substructure element, a motorized "jumping jack" tamper or a pneumatically operated tamper may be used to achieve the required density.

- In larger areas, a "sheep foot" type of roller may be more economical and more appropriate.

2.7.2 Granular Material

- Granular materials are usually compacted effectively with a smooth vibratory drum type roller.

- In confined areas, a "jumping jack" tamper or a pneumatically operated tamper may be more effective.

2.8 Checklist

2.8.1 Bridge Inspector's Responsibilities

- Review specifications and study drawings.

- Report on Contractor's compliance with the project environmental requirements.

- Ensure Bridge Project Engineer approves the backfill material.

- Check backfill material frequently to see that it is free from topsoil and roots, large lumps and frozen material.

- Be aware as to where granular and non-granular types are required.
- When backfilling thin elements, check that backfill material is being placed to the same elevation on both sides.
- Check that backfill material is being placed and compacted in maximum 150mm lifts, with appropriate equipment.
- Obtain density tests as required.

2.8.2 Bridge Project Engineer's Responsibilities

- Review environmental constraints with the Bridge Inspector and Contractor.
- Discuss anticipated problem areas, solutions and construction methods with the Bridge Inspector and Contractor.
- Discuss and approve backfill material, density tests and sieve analysis if required.
- Discuss with the Bridge Inspector possible "extra cost" claim items.
- Promptly refer or report contractual issues or matters to Project Sponsor.

SECTION 2

BACKFILL

2-1 Compacted granular backfill under abutment seat

2-2 Soft yielding material replaced with competent granular backfill

2-3 Compact granular backfill behind abutment backwall with hand operated mechanical tamper

2-4 Granular backfill material delivered to site should contain no frozen lumps during winter months

2-5 Placing unfrozen backfill into pier excavation with a bobcat

2-6 Backfill material placed in 150mm lifts and compact to 95% Standard Proctor Density at optimum moisture content with hand operated mechanical tamper

SECTION 2

BACKFILL

2-7 Backfill for culvert installation compact to 95% Standard Proctor Density at optimum moisture content with hand operated mechanical roller

2-8 Backfill compact to 95% Standard Proctor Density at optimum moisture content with hand operated mechanical roller

2-9 Bringing backfill up evenly on both sides of the culvert in 150mm lifts

2-10 Culvert foundation (700 mm thick) Des. 6 Class 80 granular backfill compact to 95% Standard Proctor Density at optimum moisture content

2-11 Pre-shaped invert bedding (150mm thick) Des. 2 Class 40 uncompacted crushed granular backfill

2-12 Bringing backfill up evenly on both sides of the culvert in 150mm lifts