Functions of SLOPE-ffdm 2.0

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2.1 CONTENTS OF SLOPE-ffdm 2.0

Computer program **SLOPE-ffdm 2.0** consists of six major routines:

1. Main analytical routines (Section 2.2)
2. Text file output routines (Section 2.3)
3. User-friendly guided input with graphics (Section 2.4)
4. Output text file inspection window (Section 2.5)
5. Critical surface-related graphics inspection (Section 2.6)
6. Batch job execution and reports (Section 2.7)

2.2 MAIN ANALYTICAL ROUTINE

A total of nine analytical types is incorporated, each utilizing distinct failure surface geometries, search algorithms, and computational methods:

(1) Type-1 Analysis – Circular Failure Surface (Trial-and-Error)

This analysis employs a trial-and-error approach using circular failure surfaces. Three slice methods—Fellenius (Swedish), simplified Bishop, and Spencer—are simultaneously applied to assess slope safety and displacement behavior. In addition to the standard Spencer method, an enhanced version with a modified solution procedure (Spencer-1) is also included.

(2) Type-2 Analysis – Circular Failure Surface through a Designated Point

Similar to Type-1, this analysis applies all methods to circular surfaces constrained to pass through a designated point. It is applicable in scenarios where a known failure point exists, such as tension cracks, inclinometer shear displacements, or settlement beneath isolated footings on slopes.

(3) Type-3 Analysis – Specific Circular Failure Surface

This type focuses on a single, known circular failure surface, applying the four methods used in Type-1. It is suitable for detailed evaluations of previously identified surfaces or post-failure site investigations. It also serves as a tool for stress- or displacement-based back analysis.

📘 Note on Type-1, 2 and 3 Analyses

In **Type-1, Type-2, and Type-3** analyses, the ***interslice function***—which defines an arbitrary function *f(x)* to vary the dip angle of interslice thrusts—is **automatically set to** *f(x)*= 1.0. This default setting implies that **interslice thrusts are assumed to be parallel** across slices, simplifying the force distribution model.

For more advanced control, **user-defined** *f(x)* values can be applied to both **circular and non-circular failure surfaces** when using **Spencer's method** in **Type-7 and Type-8** analyses. 👉 See section **Versatility of Type- 7 and 8 analyses** below for details on the versatility of these types.

(4) Type-4 Analysis – Multi-Wedge Failure Surface (Trial-and-Error)

Designed for steep slopes with facings and reinforcements, this analysis uses trial-and-error with multi-wedge and simplified Janbu methods. It excels in modeling the dominant multi-wedge failure mechanism in reinforced slopes and enables examination of facing-reinforcement interactions, including connection failure behavior.

(5) Type-5 Analysis – Noncircular Failure Surface (Trial-and-Error)

This approach applies simplified Janbu, rigorous Janbu, Spencer, and Spencer-1 methods to trial-and-error noncircular failure surfaces. Logarithmic spiral surfaces are automatically generated within specified upper and lower bounds of the failure zone for both safety and displacement analyses.

(6) Type-6A Analysis – Specific Logarithmic Spiral Failure Surface

Focused on a single logarithmic spiral failure surface, this analysis uses simplified Janbu, rigorous Janbu, Spencer, and Spencer-1 methods to calculate slope safety factors and displacements.

(7) Type-6B Analysis – Specific Polyline Failure Surface

Similar to Type-6A, this analysis evaluates a designated polyline failure surface using the same four computational methods.

(8) Type-7 Analysis – Compound Failure Surface (Trial-and-Error)

This method evaluates compound failure surfaces composed of a linear (or polyline) segment and an arc. Not all generated arcs are intersected by the linear portion, resulting in coexistence of compound and circular surfaces. All surfaces are analyzed using simplified Janbu, rigorous Janbu, Spencer, and Spencer-1 methods to determine critical safety and displacement outcomes.

(9) Type-8 Analysis – Specific Compound Failure Surface

Identical in methodology to Type-7 but applied to a designated compound surface. It is suited for in-depth inspection of known compound failure mechanisms and for conducting stress- or displacement-based back analysis.

🔍 Versatility of Type- 7 and 8 analyses

Although **Type-7 and Type-8** analyses are primarily designed for **compound failure surfaces**, they can be adapted to simulate **pure circular failure conditions** by **artificially deepening the weak layer**. This adjustment prevents the circular failure surface from intersecting the weak layer, effectively eliminating compound failure behavior.

In such cases, the circular failure surfaces are analyzed using:

- **Janbu's method**, which requires a user-defined ***thrust height function***
- **Spencer's method**, which requires a user-defined ***interslice function***

These functions are **mandatory input parameters** and allow users to:

- Explore the influence of **interslice thrust height** (Janbu)
- Investigate the impact of **thrust direction variation** (Spencer)

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2.3 TEXT FILE OUTPUT ROUTINE

The output text file includes the following analytical results:

(a) Minimum safety factors among all trial-and-error surfaces.

(b) Maximum vertical displacements at the slope crest (d_0) among all trial-and-error surfaces (applicable only for displacement analysis).

(c) Geometry of the critical failure surface.

(d) Displacements at the base of slices (applicable only for displacement analysis).

(e) Effective normal stresses at the base of the critical slip surface.

(f) Porewater pressures at the base of the critical slip surface.

(g) Mobilized forces and failure modes of reinforcement (or pre-stressed anchor forces).

(h) Mobilized forces and failure modes of reinforcement at the facing-backfill interface (applicable only in Type-4 analysis).

2.4 USER-FRIENDLY GUIDED INPUT ROUTINE

The guided input program offers two modes: **Mode 1**: Create a new input data file, and **Mode 2**: Append data to an existing input data file.

2.4.1 MODE 1: PREPARING AN INPUT DATA SHEET

This input mode has the following features:

(a) Real-time graphics of input slope conditions.

(b) Graphics of slope profiles, water table, reinforcement, and facing.

(c) Comparison the input Mohr-Coulomb envelope with imported experimental data.

(d) Comparison the input soil model with imported experimental data.

(e) Comparison the input reinforcement pullout curve with imported experimental data.

2.4.2 MODE 2: EDITING AN EXISTING INPUT DATA SHEET

This input mode has the following features:

(a) Event-by-event graphical presentations of slope conditions.

(b) Real-time visualization and editing of data files.

2.5 OUTPUT TEXT FILE INSPECTION WINDOW

A 'Read-only' mode is available for inspecting the output text file upon project completion. (The text file contains analytical results for all events in the project.)

2.6 CRITICAL SURFACE-RELATED GRAPHICS INSPECTION

If a 'pause' command is prescribed at the end of a data input event, program execution is temporarily halted following that event's analysis. A graphical inspection mode is then activated, allowing visual assessment of effective normal stress distributions, displacements, and local safety factors along the critical slip surface.

2.7 BATCH JOB EXECUTION AND REPORTS

An efficient tool for engineers and researchers to optimize analysis workflow. A batch job may encompass multiple projects (or jobs), each consisting of several analysis events. A user-friendly dialog interface assists in preparing batch job input files. Upon completion of batch execution, a summary report of the batch job status is generated.