QGIS Slope Stability Analysis Plugin Manual
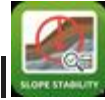
Based on the source code provided in the previous turns (specifically slope_stability_dialog.py and slope_stability_plugin.py) and the logic defined in slope_stability_logic.py, I have drafted a detailed **"Step-by-Step Operation"** section.

Here is the updated content for your Slope_Stability_Plugin_Manual_EN.docx. I have appended the new section (**5. Step-by-Step Operation**) to the end of the existing text.

Updated Manual Content

QGIS Slope Stability Analysis Plugin Documentation

1. Algorithm & Library Introduction

This plugin is developed based on Python Shapely and NumPy libraries, designed for 2D slope stability analysis within QGIS.

The core algorithm utilizes the widely used Bishop's Simplified Method.

Limit Equilibrium Method (LEM): Analyzes circular slip surfaces using the method of slices.

Bishop's Iteration: Calculates Factor of Safety (FS) through iteration, offering higher accuracy than the Ordinary Method.

Numerical Stability: Built-in m_alpha protection and effective stress checks to prevent divergence.

General Scan Mode: Automated matrix calculation for various seismic coefficients and water depths.

Event-Based Mode: High-density verification for specific seismic coefficients and imported water table layers.

2. Parameters & Units

The following parameters are required:

Parameter Table:

Parameter	Unit	Description
Seismic Coeff. (Kh)	None (g)	Horizontal seismic coefficient, typically 0.0 ~ 0.3.
Geology Layer	Polygon or MultiPolygon	Select from interface
Water Level Layer	LineString	Select from interface
Output Path	File Path	Destination for the result GeoJSON file.

3. Input Data Formats

A. Geology Layer (test data : testdata_geomodel.geojson)

Geometry Type: Polygon or MultiPolygon.

CRS: Must be a Projected CRS (e.g., EPSG:3826), units in Meters.

Attributes: Must contain the following fields (Case-sensitive).

Attribute Table:

Field Name	Unit	Description
cohesion	kPa	Soil Cohesion
phi	Degree (°)	Friction Angle
unit_weight	kN/m^3	Unit Weight

B. Water Level Layer (Optional, test data : testdata_water_level_event.geojson)

Geometry Type: LineString.

Function: Represents the phreatic surface for pore pressure calculation.

If omitted, fixed depth mode can be used.

4. Limitations

Circular Failure Only: Not applicable for planar or wedge failures.

2D Analysis: Assumes Plane Strain conditions.

Geometry: Polygon layers must be topologically tight (no gaps).

Physical Assumption: Soil tension strength is assumed to be zero.

Performance: High grid density (>50x50x50) may increase computation time.

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5. Step-by-Step Operation

Step 1: Data Preparation

1. Launch QGIS.
2. Load your **Geology Model Layer** (Polygon). Ensure the Attribute Table contains the required columns: cohesion, phi, and unit_weight.
3. (Optional) Load your **Water Table Layer** (LineString) if you intend to run an Event-Based analysis with specific water levels.
4. **Important:** Ensure all layers are in a Projected Coordinate System (meters), such as EPSG:3826 or EPSG:3857.

Step 2: Launch the Plugin

1. Navigate to the QGIS Menu Bar.
2. Click **Plugins** > **Slope Stability** > **Slope Stability Analysis (Bishop)**.
3. Alternatively, click the plugin icon on the Toolbar if available.

Step 3: Configure Analysis Settings

Once the dialog window appears, configure the following tabs:

- **Geology Model Layer:** Select your polygon layer from the dropdown menu.
- **Water Table Layer:** * Select your line layer for precise pore pressure calculation.
  - Select *"None (Use Depth Parameter)"* if you do not have a water layer.
- **Seismic Coefficient (Kh):** Enter the horizontal seismic coefficient (default is 0.15).
- **Analysis Mode:**
  - *General Scan Only:* Runs a broad search with default Kh (0.0~0.2) and Depth variations.
  - *Event Specific Only:* Runs a high-density search using the user-specified Kh and Water Layer.
  - *Run Both Modes:* Executes both algorithms sequentially (Recommended).
- **Output Path:** Click "Browse..." to define where to save the result .geojson file.

Step 4: Execution

1. Click the **Run Analysis** button.
2. A progress bar at the bottom will indicate the status of the calculation.

- ○ *Note:* The interface may briefly pause during complex matrix calculations.
3. Upon completion, a message box will appear: *"Analysis completed! File saved to..."*

Step 5: Result Interpretation

1. The plugin will automatically load the result layer (Lines) into the QGIS Layer Panel.
2. Open the Attribute Table of the result layer to view:
   - ○ **FS:** Factor of Safety (The critical value).
   - ○ **Radius:** Radius of the slip circle.
   - ○ **Center:** Coordinates of the circle center.
   - ○ **Scenario:** Indicates if the result is from "General" or "Event" mode.
3. **Visualization Tip:** Right-click the result layer > **Properties** > **Symbology**. Choose **Graduated**, set the Column to **FS**, and use a color ramp (e.g., Red for low FS, Green for high FS) to visualize the critical slip surfaces.