USER GUIDE

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EXCAVATOR GUIDANCE SYSTEM USER GUIDE

Guangzhou Spherefix Navigation Technology Co., Ltd.

Disclaimer

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5. Document Revisions

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User Notice

Please review the following points before operating the SMC20 Excavator Guidance System:

1. Read First: Study every piece of documentation supplied with the system to become familiar with its operation and safety practices.
2. Live Power Hazard: Never connect or disconnect any cables while the unit is powered.
3. Cable Handling: Route and secure all cables exactly as described. Avoid pulling, twisting, or crushing them; improper handling can fracture pins or conductors, leading to poor contact and degraded performance.
4. Power Requirements: Supply 12–24 V DC with a continuous current rating of at least 5 A.
5. Damaged Cables: Stop using any cable that shows wear or damage and replace it immediately to prevent performance loss or further harm.
6. Force-Majeure Exclusions: Damage caused by lightning, high-voltage surges, impact, abrasion, or similar events is not covered under our complimentary repair policy.
7. Housing Integrity: Do not open or dismantle the enclosure; doing so voids the warranty.

Pre-Use Guidelines

1. Fundamental Practices

① Before first use, study the SMC20 thoroughly and comply with all local safety, health, traffic, and labor-protection regulations.

② Apply standard accident-prevention techniques and common-sense safety measures at all times.

③ Seek and follow expert advice whenever doubts arise—doing so minimizes downtime and safety risks.

④ Upon delivery, retain the packing list and this manual; install and operate the system only in accordance with Spherefix technical directions.

2. Operator Qualifications

① The system is intended for use while operating an excavator. The driver must hold valid certification, demonstrate full machine proficiency, and be capable of reacting to emergencies.

② Users must grasp every excavator function and adapt the SMC20's features to each jobsite scenario.

③ A working knowledge of the hardware and software is essential; operators should be able to diagnose and safely resolve routine issues.

④ Individuals under 18 years of age or anyone whose condition could compromise safe operation are strictly prohibited from using the machinery.

3. Pre-Installation Checks

① Clear the vicinity of the excavator for hazards and ensure unauthorized personnel are outside the work zone.

② Inspect the guidance system for loose, missing, or excessively worn parts, as well as for dirt or debris accumulation, following daily-maintenance protocols.

③ Confirm that operators can identify and understand every control and indicator on the SMC20.

4. Installation Care

① Route GNSS and IMU cables correctly; secure them with cable ties so they remain free from tension, pinching, or abrasion that could sever conductors and disrupt system performance.

Contents

1. Product Introduction

1.1. Manual Overview

This handbook walks you through every step required to install, configure, and run the SMC20 Excavator Guidance System. It begins with a complete bill of materials so you can verify that every required part is on-hand. Next, each component is explained in practical terms, clarifying why it matters and how it fits into the overall workflow. Finally, the guide offers a concise but thorough tour of the software, enabling you to get productive quickly. A technical specification sheet is also included, detailing performance limits, environmental tolerances, and compatibility notes to ensure dependable operation in a wide range of conditions.

1.2. Product Overview

The SMC20 is a high-accuracy, high-efficiency visual guidance package engineered by Spherefix Navigation Technology. At its core are a survey-grade GNSS antenna for centimetre-level positioning, a sunlight-readable 10.1-inch display, and rugged inertial measurement units that track machine attitude in real time.

1.3. Product Features

Designed for universal mounting on any excavator, the SMC20 delivers centimetre-level accuracy, removes line-of-sight barriers, and streamlines everyday tasks such as grading, trenching, slope finishing, pond cleaning, and canal repair.

1.3.1. Key Capabilities

(1) RTK precision: dynamic horizontal accuracy ≤ ±2.5 cm with multi-frequency GNSS heading.
(2) Always-connected: built-in GSM modem with automatic resume after power interruptions.
(3) Field tough: full IP67 aluminium housing shrugs off dust, rain, and vibration.
(4) Smart sensing: onboard IMU combines a high-speed microprocessor with advanced filtering for rock-solid attitude data.
(5) Real-time feedback: live bucket-offset readouts keep the operator on grade every swing.
(6) 360 ° perspective: switch instantly between front, side, and bird's-eye views to eliminate blind spots.
(7) Task ready: pre-configured modes for level, line, trench, ridge, slope, and canal work adapt to any job.
(8) Instant alerts: colour graphics plus voice prompts flag over-excavation or off-line errors the moment they occur.

1.3.2. System Advantages

(1) Faster, Flawless Work
Live centimetre-grade guidance lets the operator hit target grade on the first pass, eliminating guesswork, re-work, and costly over-digging typical of conventional methods.
(2) Lower Total Cost of Ownership
Shorter cycle times cut labour hours and fuel burn. Precise excavation also reduces excess spoil and imported fill, shrinking material budgets.

(3) Safer Jobsites

Virtual boundary alerts keep the machine clear of utilities, overhead lines, and other hazards. Real-time audio and visual warnings give operators instant feedback to correct unsafe movements.

(4) Confidence in Any Terrain

From narrow trenches to murky pond edges, the SMC20's bird's-eye and profile views overcome restricted sightlines, ensuring accuracy even when the bucket is out of sight.

(5) Built-in Insight

Every pass is logged—depth, position, and volume—creating a digital record for progress tracking, quality reports, and future project optimisation.

2. Equipment List

2.1. Vehicle Terminal List

No.	Name	Quantity	Picture
1	Tablet	1	
2	Radio Antenna(Optional)	1	
3	GNSS Antenna	2	
4	Satellite Antenna Cable	2	
5	Satellite Antenna Extension	1	

No.	Name	Quantity	Picture
6	Vehicle Controller	1	
7	Main Cable	1	
8	Gyroscope 1	1	
9	Gyroscope 2	1	
10	Gyroscope Extension Cable	1	
11	RAM Mount	1	
12	Installation Kit	1	

2.2. Base Station Terminal List (Optional)

No.	Name	Quantity	Picture
1	Receiver	1	
2	Radio Antenna	1	

No.	Name	Quantity	Picture
3	Power Cable	1	
4	Extension Pole	1	
5	Mounting Plate	1	

3. Introduction to Main Accessories

3.1. Tablet Kit

The rugged tablet is the brains of the SMC20. It ingests raw GNSS and IMU data, runs the guidance algorithms, presents the live interface, and transmits all operator commands to the machine.

The tablet kit contains the following:

No.	Name	Quantity	Picture
1	Tablet	1	
2	Tablet bracket	1	

3.2. Vehicle Controller Kit

The vehicle controller acts as the data hub: it streams angular-motion data from the gyroscopes to the tablet for real-time kinematic calculations, while simultaneously relaying base-station corrections to the GNSS board to maintain centimetre-level RTK accuracy and heading.

The vehicle controller kit contains the following:

No.	Name	Quantity	Picture
1	Vehicle Controller	1	
2	Radio Antenna(Optional)	1	

3.3. Satellite Antenna Kit

The antenna pair captures multi-constellation satellite signals and forwards the raw data to the GNSS board inside the tablet, where it is processed to determine precise position and heading.

The satellite antenna kit contains the following:

No.	Name	Quantity	Picture
1	GNSS Antenna	2	
2	Satellite Antenna Cable	2	
3	Satellite Antenna Extension	1	

3.4. IMU Kit

The IMU kit mainly collects attitude changes during excavator movement.

The IMU kit contains the following :

No.	Name	Quantity	Picture
1	Gyroscope 1	1	
2	Gyroscope 2	1	
3	Gyroscope Extension Cable	1	

4. Equipment Installation

4.1. Tablet Installation

The tablet can be fixed to the cab via the RAM bracket where it is convenient for the user to operate.

4.2. GNSS Antenna Installation

Weld a mounting plate to the left-hand side of both the boom (large arm) and the dipper (small arm), then secure each antenna to its plate with the supplied bolts.

(1) Route the dipper antenna cable to the tablet's ANT1 port.
(2) Route the boom antenna cable to the tablet's ANT2 port.

Notes:

(1) Keep both antennas on the left side of the machine so the operator can see them from the cab.

(2) Boom (large arm) antenna: mount it flat in the centre of the boom—positioning here will not interfere with normal digging motion.

(3) Dipper (small arm) antenna: leave generous cable slack to accommodate full rotation; place the antenna on the line that joins the two pivot points of the dipper to maintain geometric accuracy and prevent cable strain.

(4) Refer to the illustration that follows for the antenna mounting plate, retaining bolts, and all accompanying hardware.

4.3. IMU (Gyroscope) Installation

Weld a small mounting plate to the dipper arm (Gyro 1) and another to the bucket pivot pin (Gyro 2). Secure the corresponding gyroscope to each plate with the supplied screws.

（1）Gyro 1 – fixed to the dipper arm.

（2）Gyro 2 – fixed to the bucket hinge bracket.

Notes:

(1) Leave generous cable slack so the dipper and bucket can swing through their full range without straining or cutting the gyro leads.

(2) Point the connector on Gyro 2 toward the dipper arm to keep the cable run short and tidy.

(3) Mount Gyro 1 at the mid-span of the dipper arm, clear of any moving parts, to avoid operational interference.

(4) Refer to the supplied mounting plate and screws for secure attachment.

4.4. Others

(1) The controller can be placed to the right side of the cab seat where it does not interfere with the driver's work.

(2) The radio antenna can be mounted on the top of the cab.
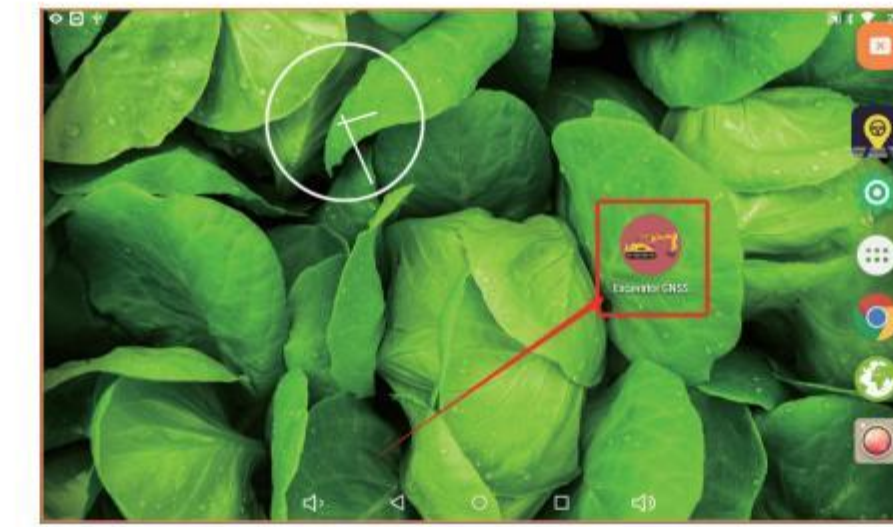
(3) Diagram of equipment connection.

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5. Software Introduction

5.1. Launching the Software

You can start the guidance application in one of two ways:

(1) From the Home Screen

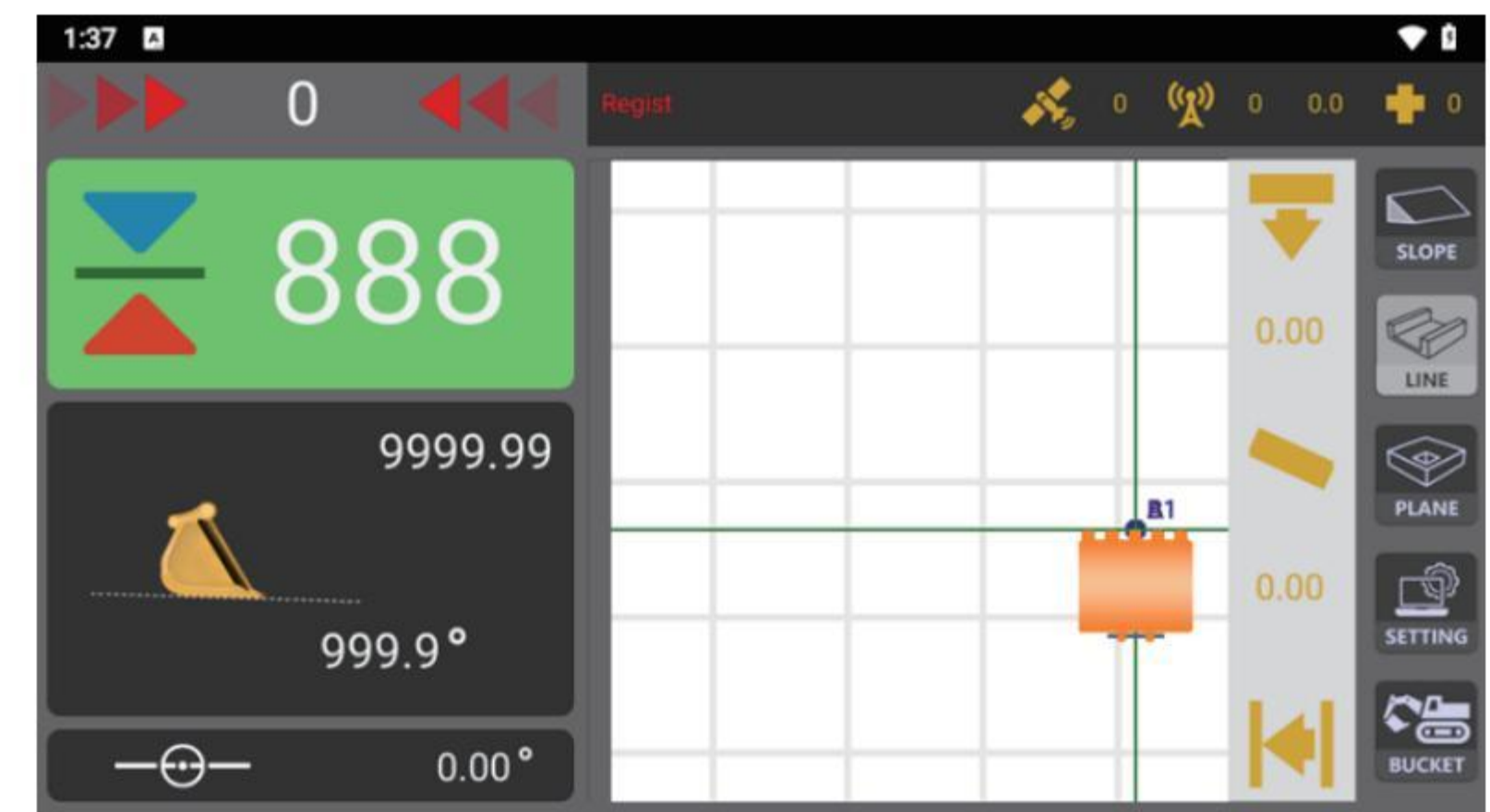Power on the tablet. If the Excavator GNSS icon appears on the desktop, tap it once to open the program.

(2) From the App Drawer

If the icon is not on the desktop, swipe up (or press the app-drawer button) to open the Android menu, then tap the Excavator GNSS icon to launch the software.

Once the application launches, the main operating screen appears (see the illustration below). Note that actual layouts may vary slightly depending on your configuration and current task.

5.2. Main Interface Icon Introduction

(1) Bucket left and right offset distance

(2) Bucket filling and excavation volume

(3) Real-time elevation of the bucket

(4) Benchmark elevation

(5) Bucket angle

(6) Navigation interface

(7) Registration prompt, permanent registration is not displayed

(8) Satellite Count (tap to access base station settings)

(9) RTK Status (Normal Status: 4; Age ≤ 3 seconds)

(10) Heading Status (Usually 4 or 5)

(11) Slope Cutting mode setting

(12) Ditch Digging mode setting

(13) Plane mode setting

(14) System Settings

(15) Equipment calibration setting

Note: There will be three more icons in the main interface of Slope Cutting Mode and Ditch Digging Mode.

Additional Icons for Special Modes:

(16) Designed fill and excavation volume

(17) Design Slope

(18) Left and right offsets taken inverse

6. Software Operation

6.1. Registration

(1) On the main screen, tap the Real-Time Parameters icon.

(2) In the menu that opens, press Register.

(3) Type in the activation code provided by Spherefix sales or support.

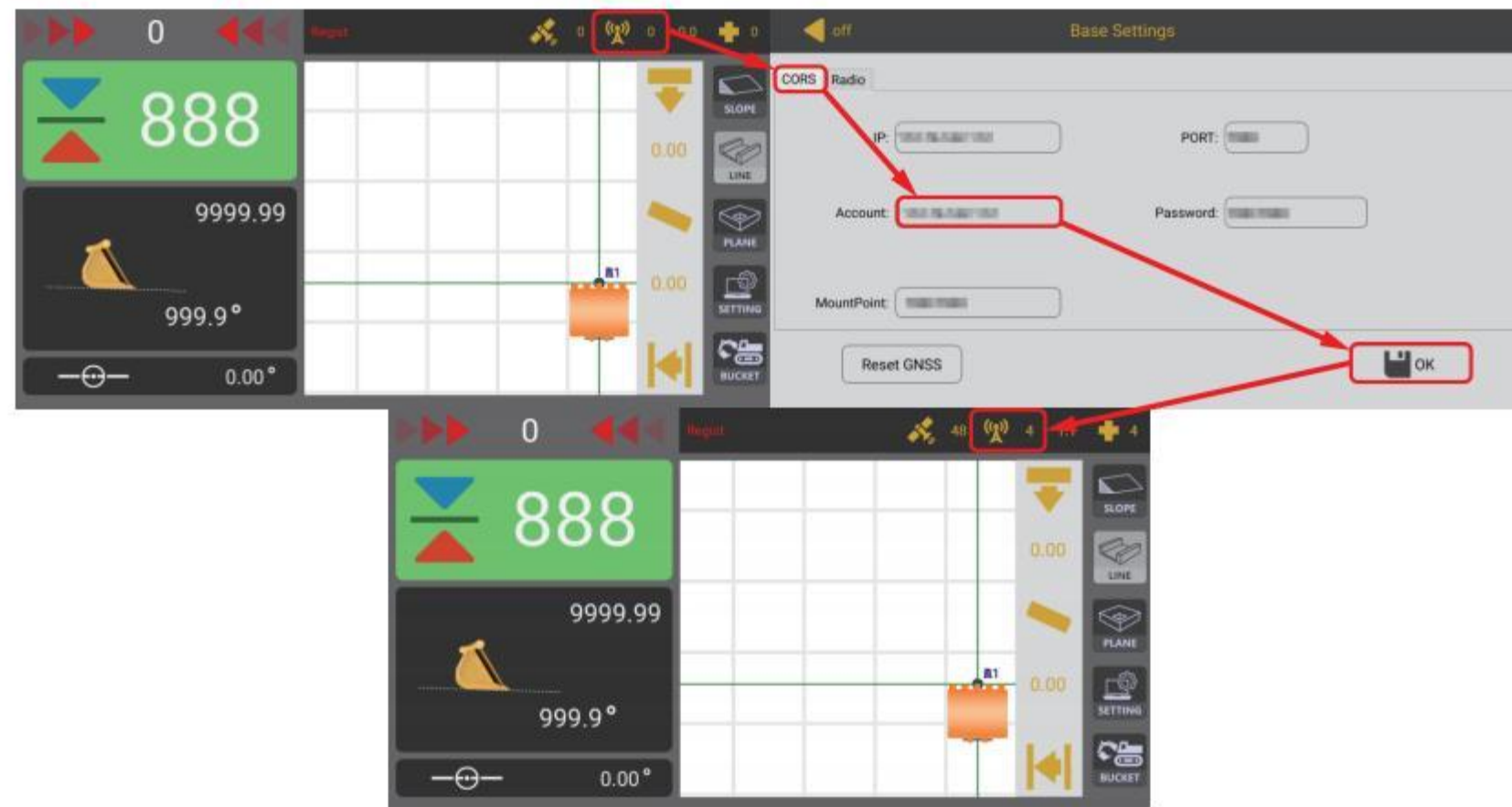(4) Tap Register again. A confirmation prompt appears once the licence is accepted.

6.2. Configuring the Base Station

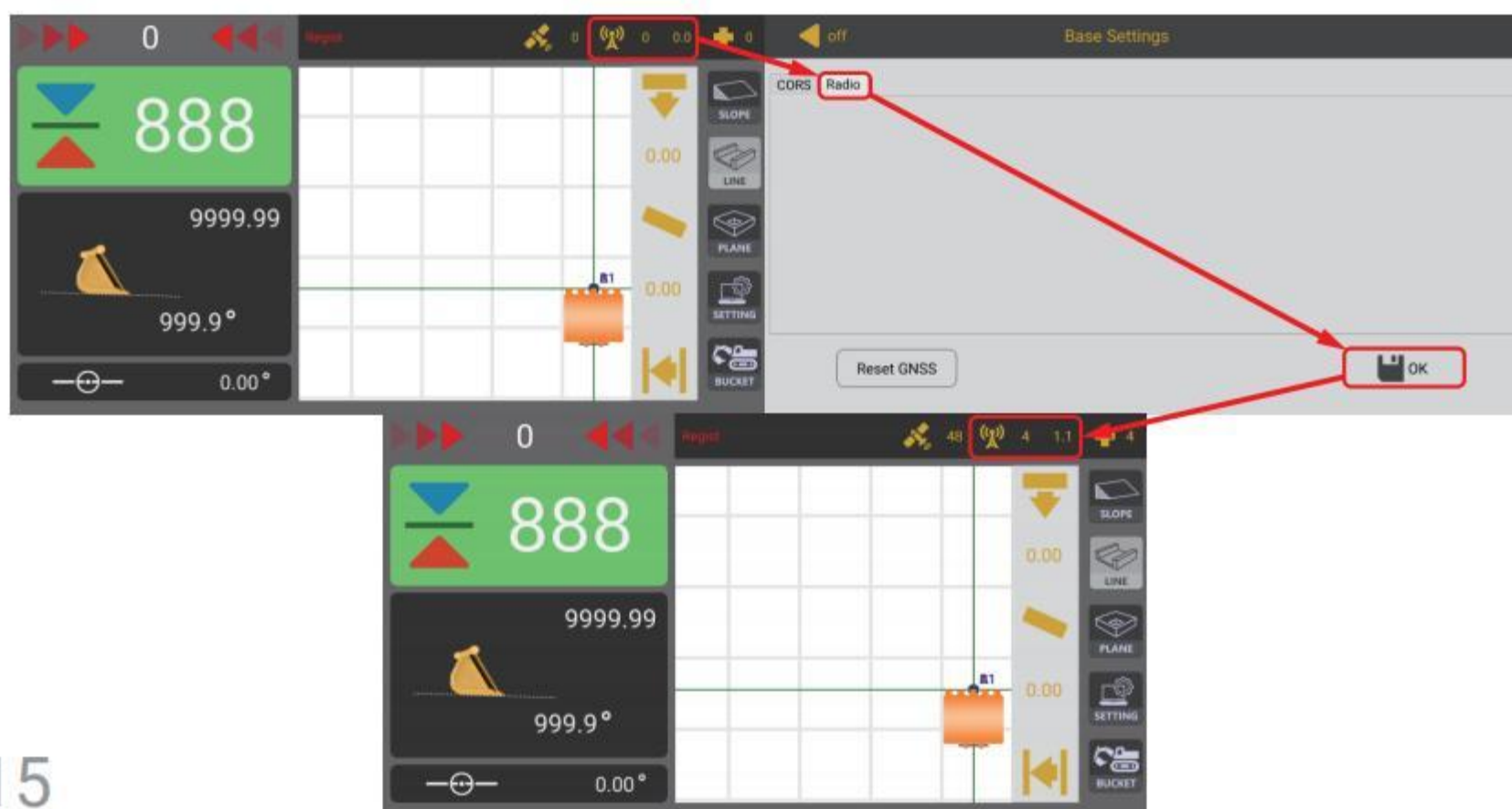The system supports two types of base station setups.

Option 1: CORS Mode

(1) Tap the RTK status icon → Select CORS.

(2) Enter IP, port, account, password, and mount point.

(3) Click OK. Status "4" indicates success.

Note: The number that appears after the differential status (e.g., 4.2) indicates how many seconds have elapsed since the last correction message was received from the base station.
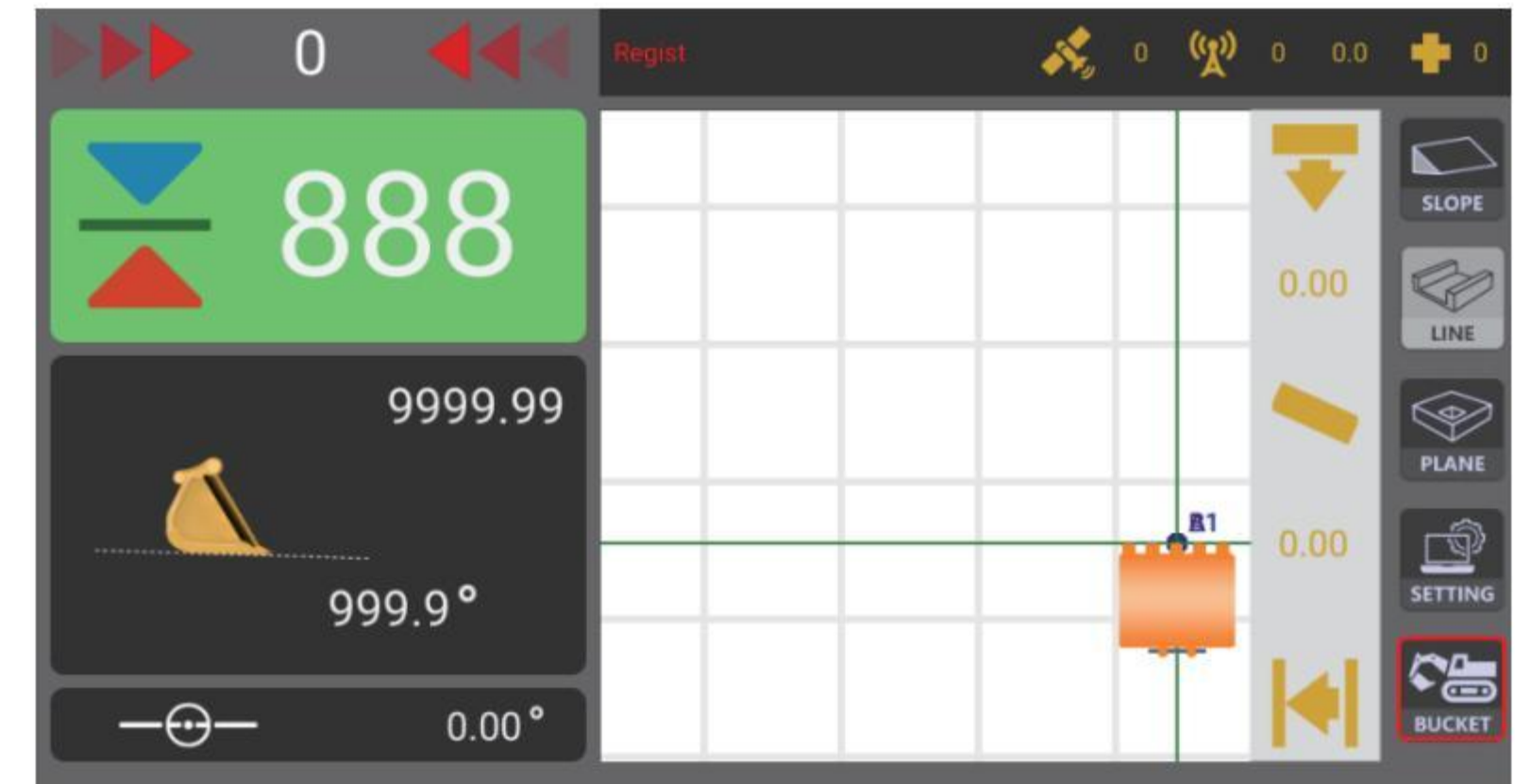
Option 2: Radio Mode

(1) Tap the RTK status icon → Select Radio.

(2) Click "OK". Status "4" indicates success.

6.3.Device Calibration

Start by positioning the excavator on level, stable ground. Next, press the Device Calibration Setting button on the main interface to open the calibration menu.
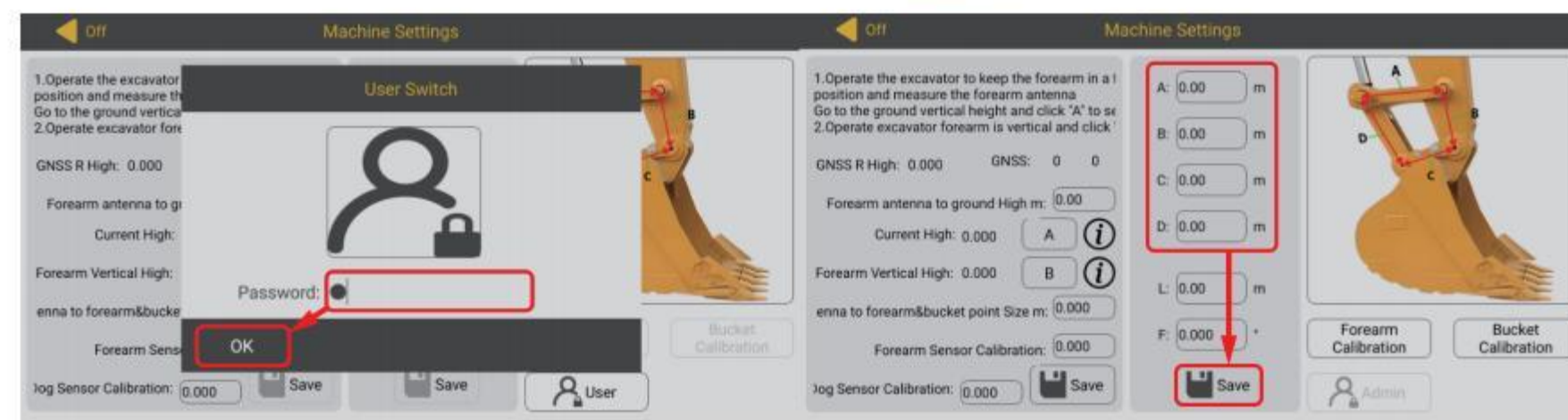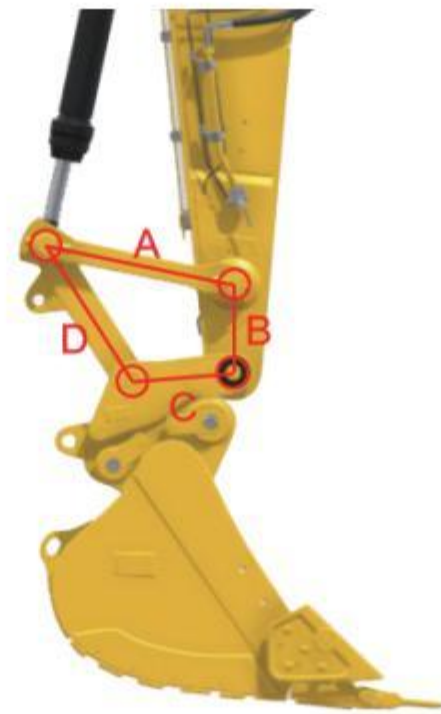

Tap User, type 1 in the Password field, then press OK to unlock the calibration functions.
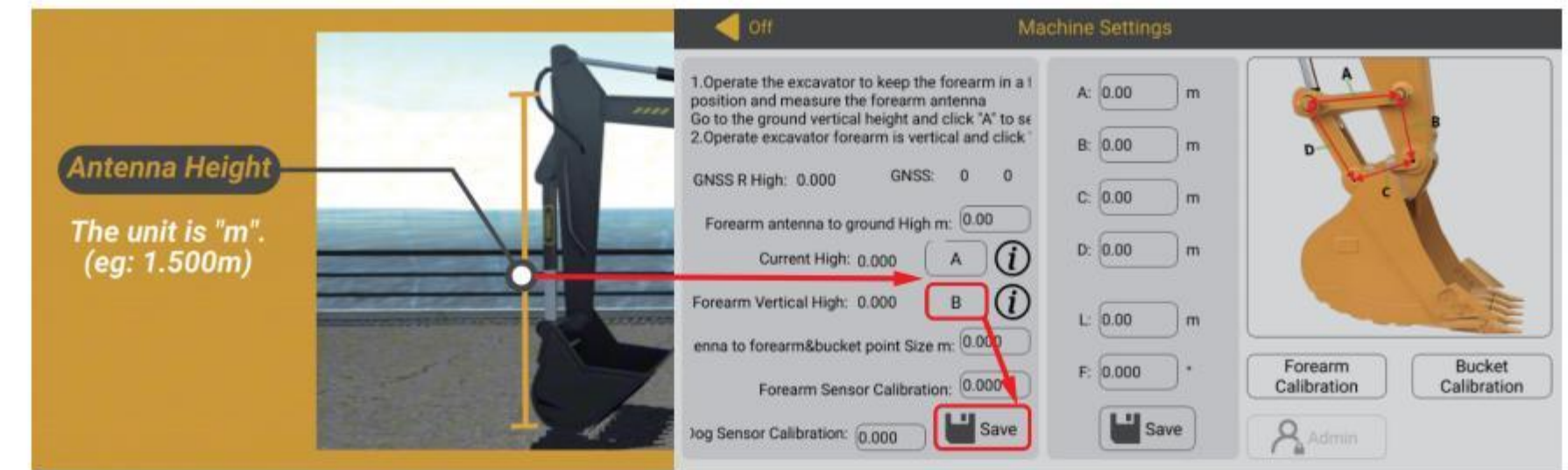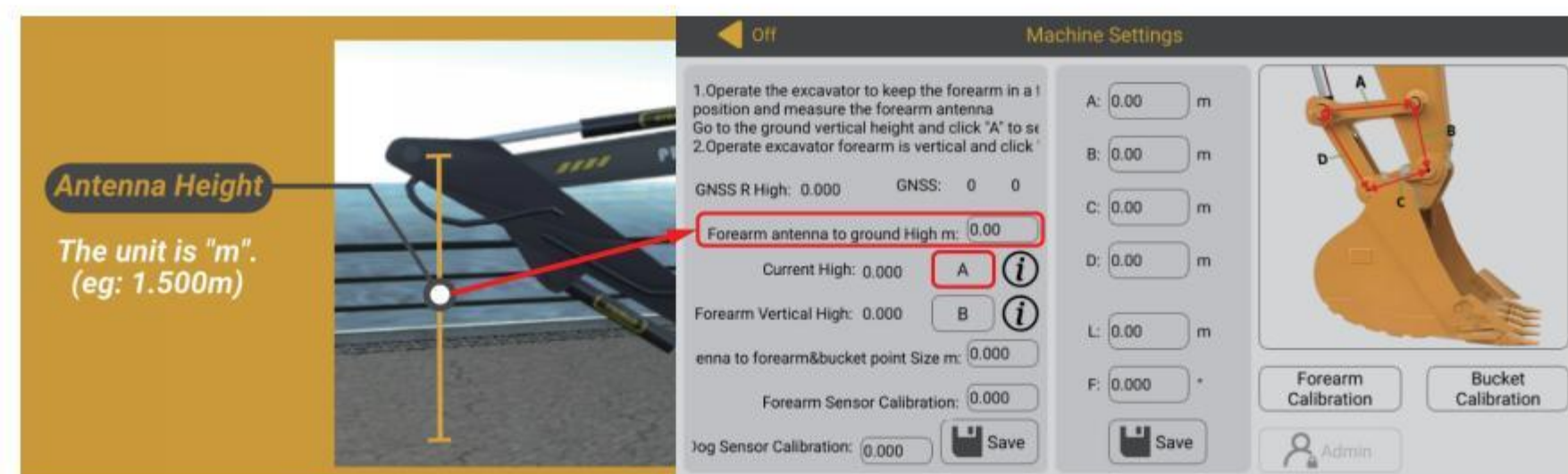

(1) Bucket dimension setting

① Measure the four labelled points A, B, C and D shown in the diagram.

② From the main calibration screen, key each dimension into its matching field.

③ Press Save to store the bucket profile

（2）Forearm dimension setting

① Lock the forearm in a fixed position.

② Measure the vertical distance from the dipper-mounted antenna to the ground and enter the value in the software.

③ Press A to capture the current antenna elevation.

④ Rotate the forearm until it is exactly perpendicular to the ground (90°).

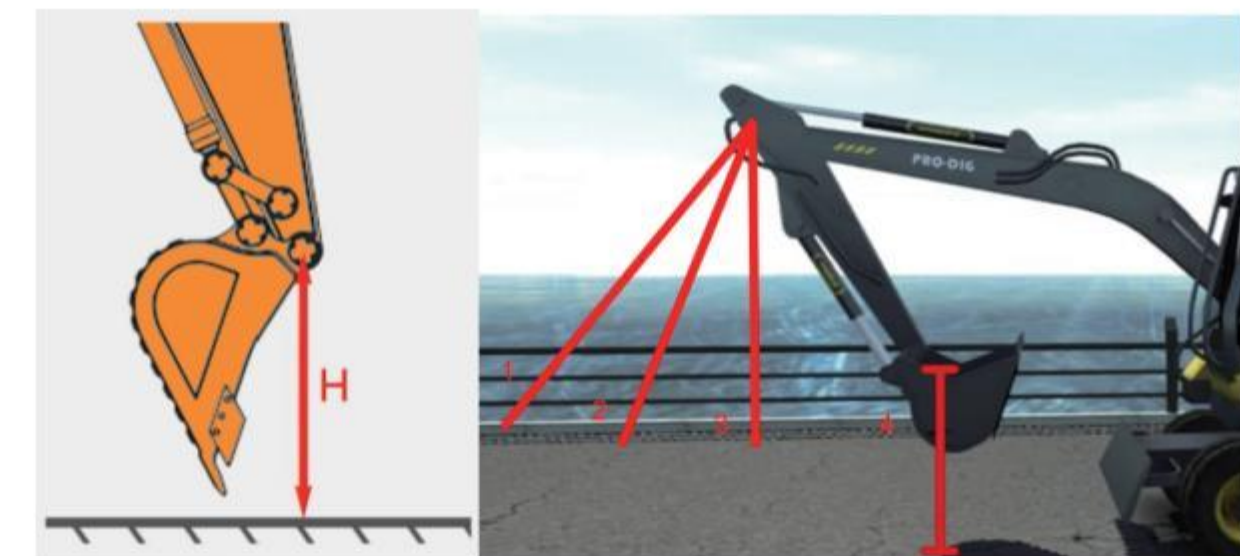⑤ Press B.

⑥ Select Save to store the forearm dimensions.

(3) Forearm Calibration

① Click the Forearm Calibration button to access the calibration interface.

② Measure the vertical distance from the forearm-to-bucket hinge point to the ground (see illustration).

③ Enter each reading into the software and advance to the next step.

④ Repeat the measurement at least four times to ensure accuracy.

⑤ When all values are recorded, press Save to complete forearm calibration.
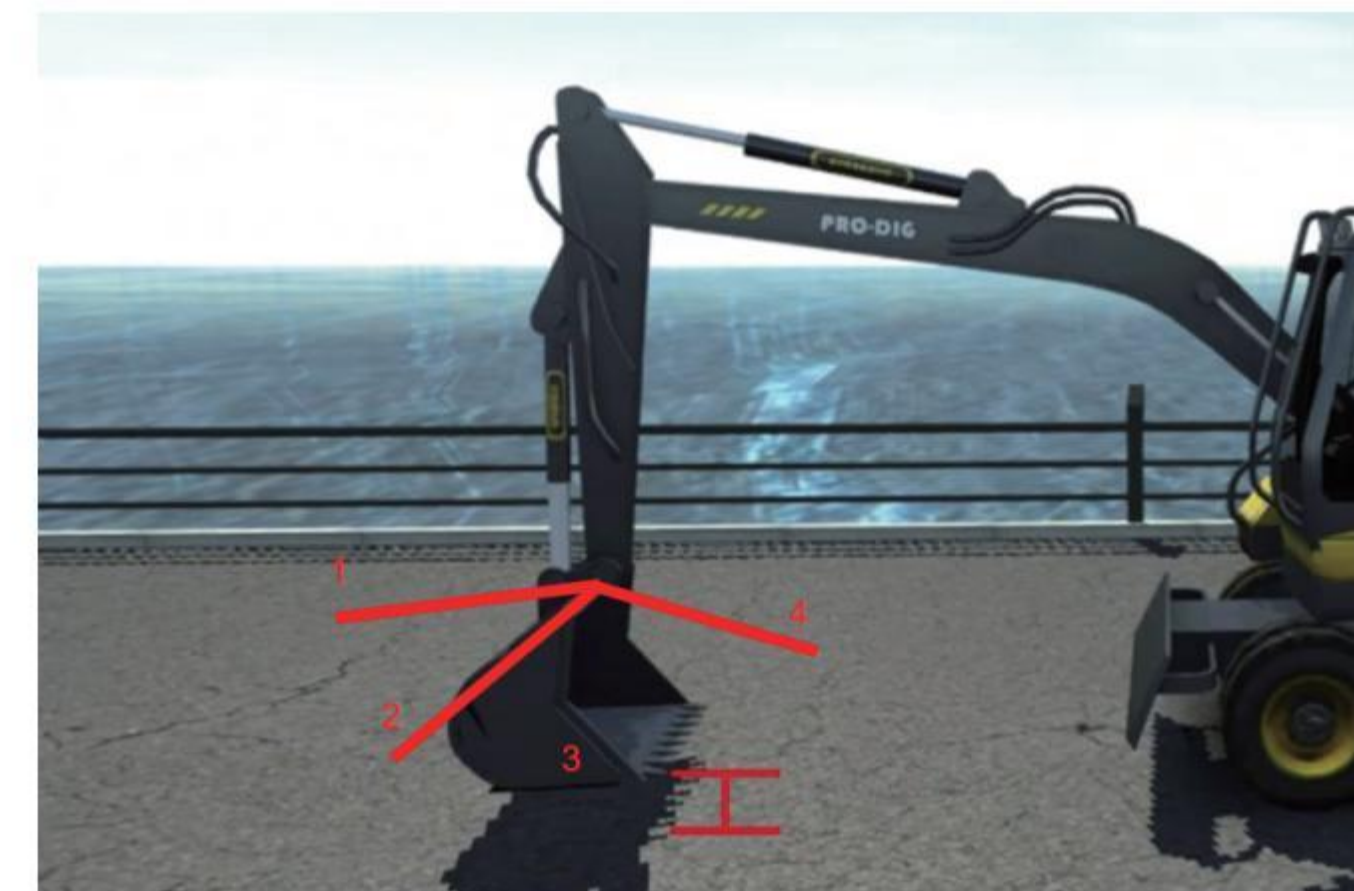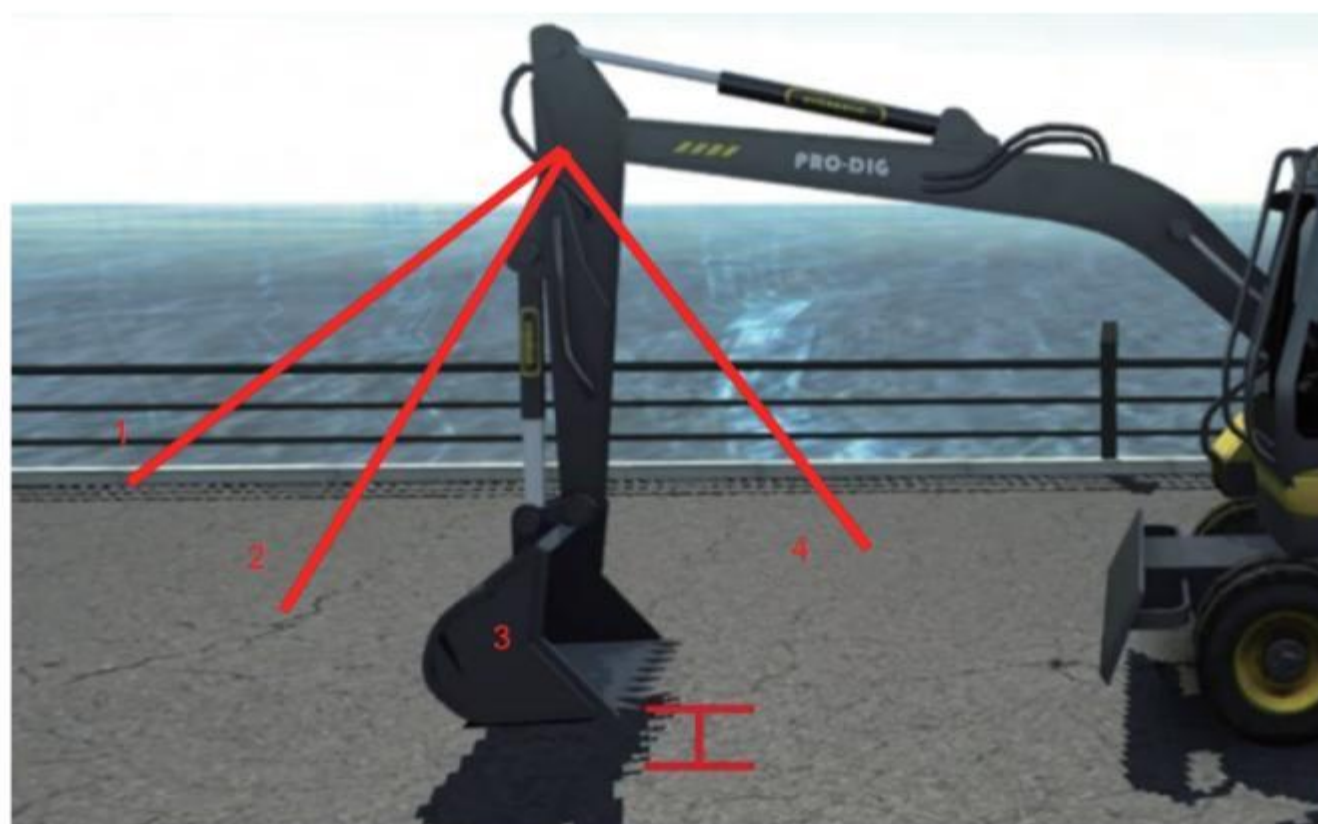
(4) Bucket Calibration

① Click the Bucket Calibration button to enter the calibration interface.
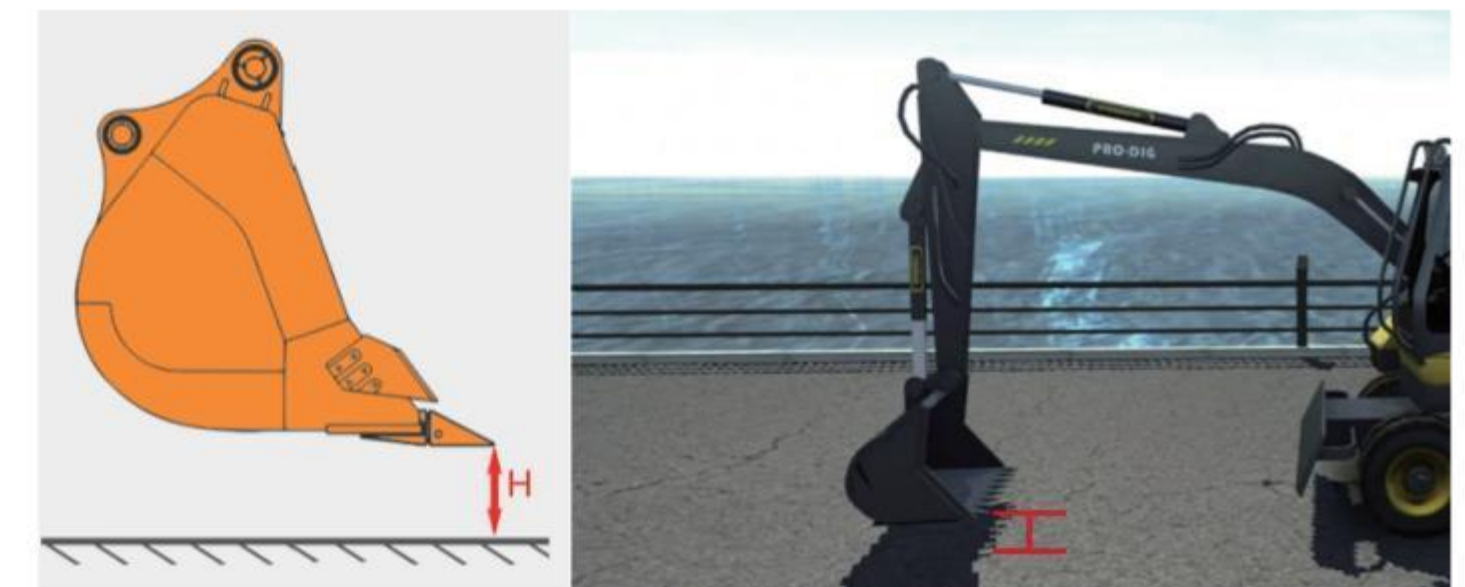

② Collect four data sets, one per forearm position.

③ Within each set, record the bucket-to-ground distance at four distinct bucket angles, giving 16 readings in total.

④ Enter each value as prompted; when all 16 measurements are stored, press Save to lock in the bucket calibration.
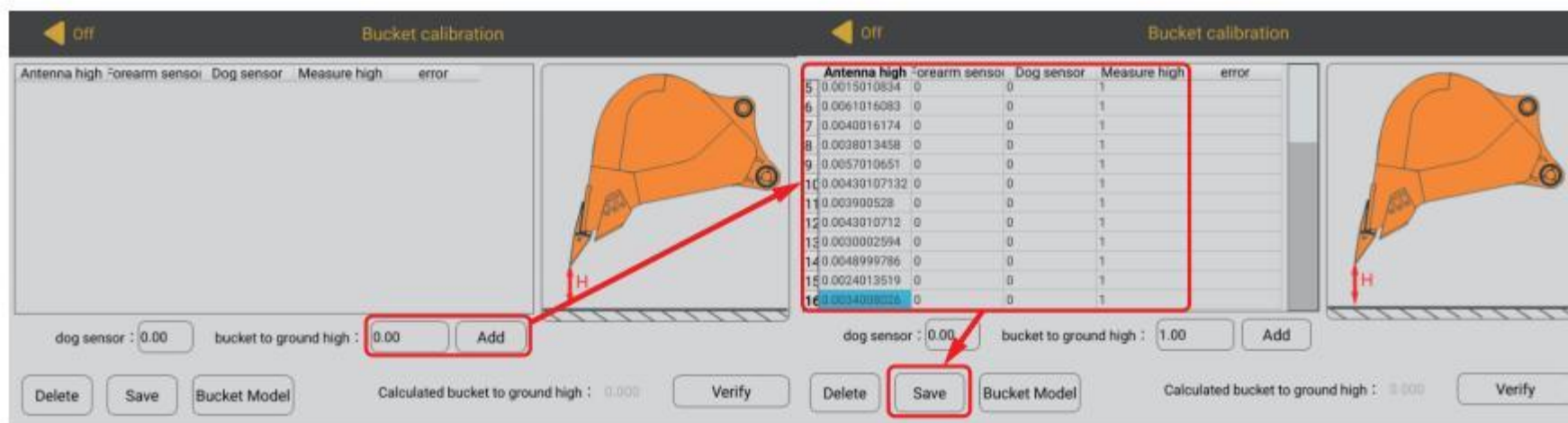

⑤ With the forearm parked at the first chosen position, measure the vertical distance from the bucket edge to the ground (see illustration).

⑥ Key the value into the software, then rotate the bucket to the next required angle and repeat.

⑦ Complete four measurements per forearm position, yielding 16 readings overall.
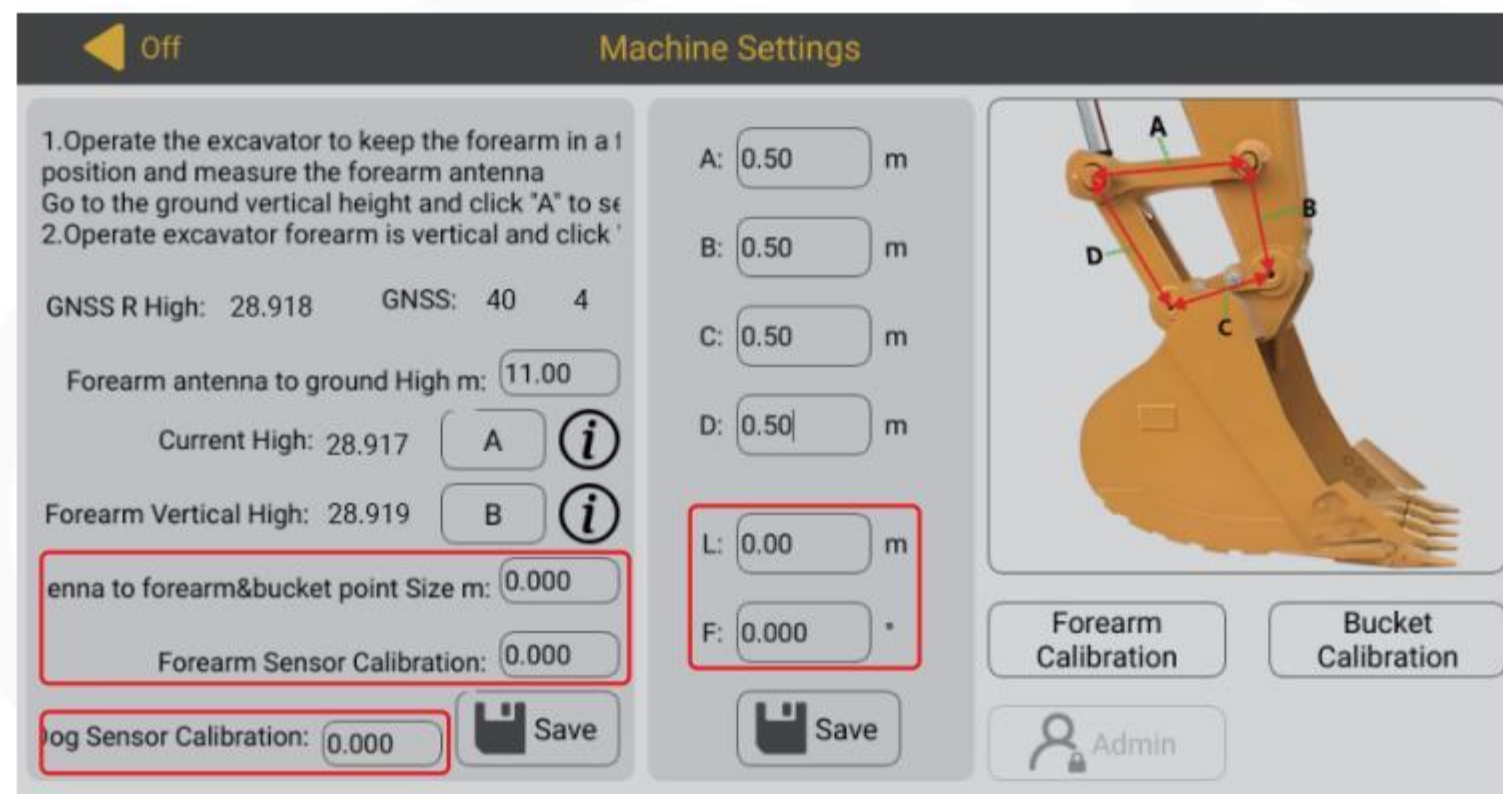
⑧ After the 16th value is entered, press Save to finalise the bucket calibration.

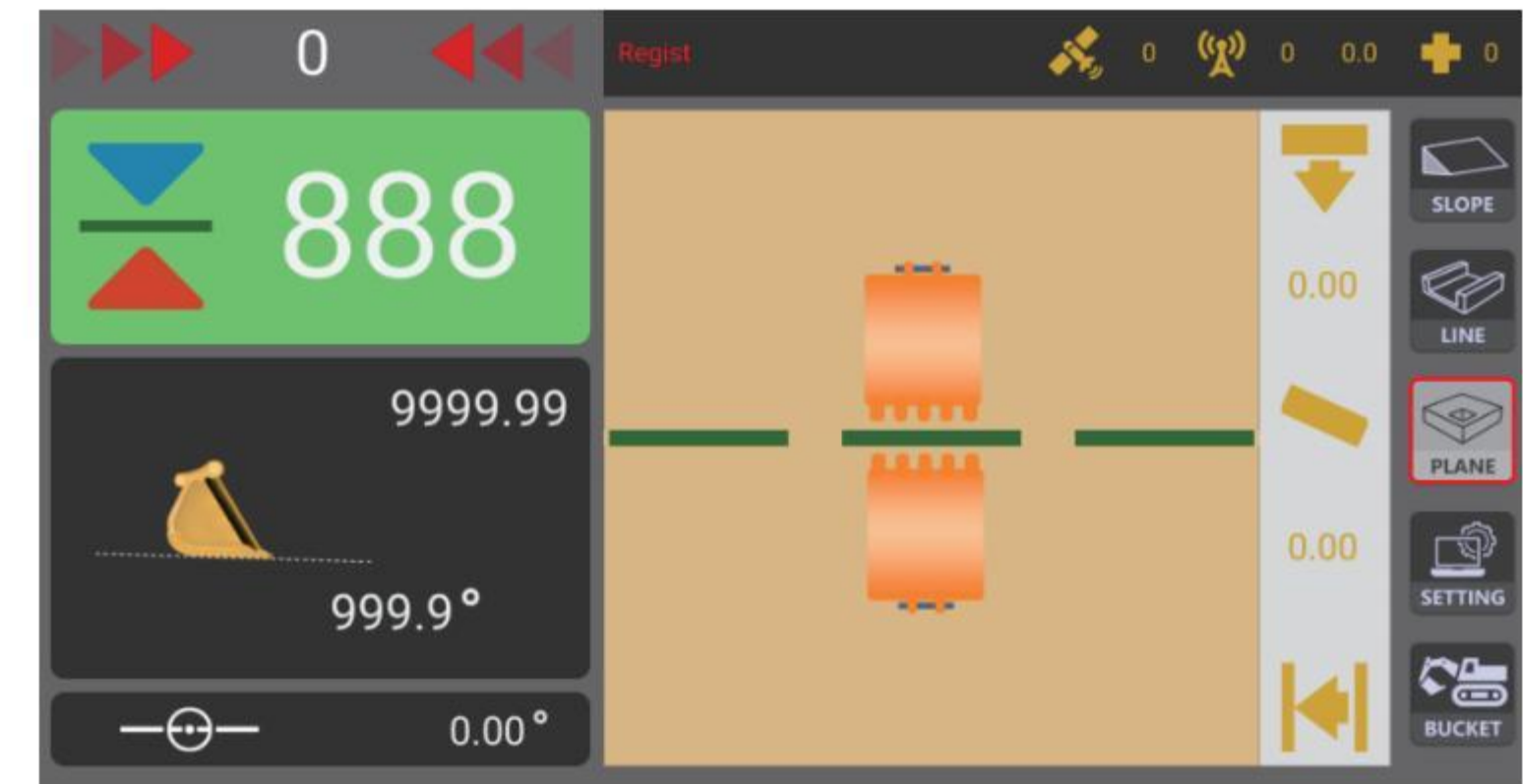Note: While repositioning the forearm, keep the bucket clear of the ground to avoid skewing the readings.

（5）Parameter calculation

Once all calibrations are saved, contact your Spherefix field technician to receive the five derived kinematic parameters unique to your machine.

6.4. Excavator Operation

Press the Real-Time Parameters icon on the main interface to open the mode-selection menu. Choose the task type that matches your current job, then hit Off to activate the guidance functions for that mode.

6.4.1. Plane &Fill and Dig mode

① Click on the Plane filling and excavation button in the main interface to enter the setting interface.
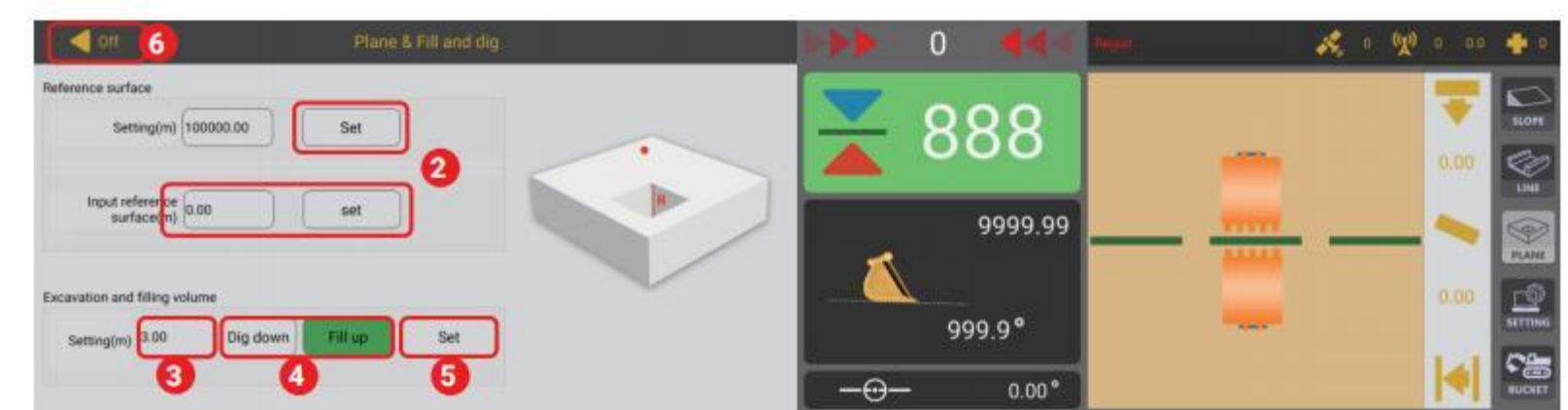

② Set Reference: lower the bucket to the desired starting elevation and press Set Reference Surface.

③ Enter Target: key in the required dig depth or fill height.

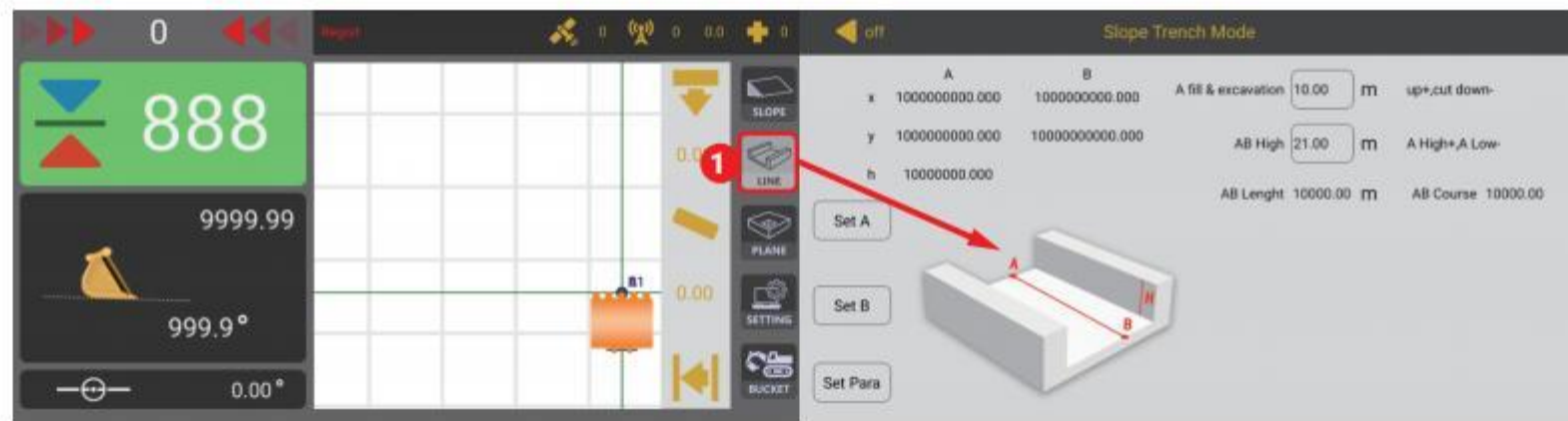④ Choose Direction: select Dig Down (remove material) or Fill Up (add material).

⑤ Tap Set to save the settings.

⑥ Start Work: press Off—the system now guides you to grade exactly to the programmed plane.
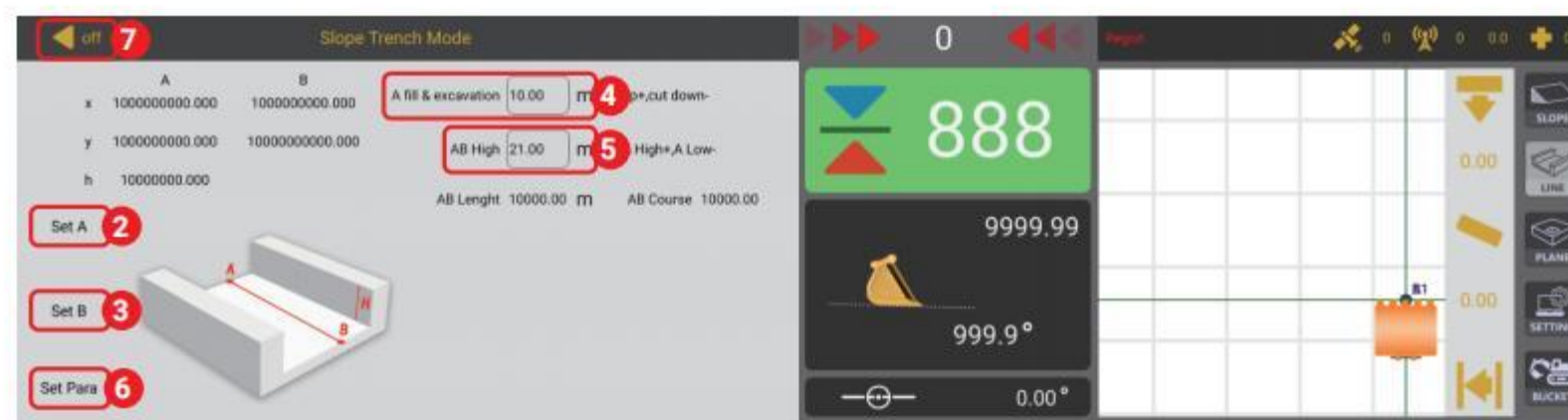
6.4.2. Slope Trench Mode

① Tap Slope Trench Mode on the main interface to enter the setting interface.

② Position the bucket at the desired starting point and press Set A.

③ Move the excavator to the end point, place the bucket at the target elevation, and press Set B.

④ Set the fill & excavation volume at point A;

⑤ Set the height difference between Points A and B;

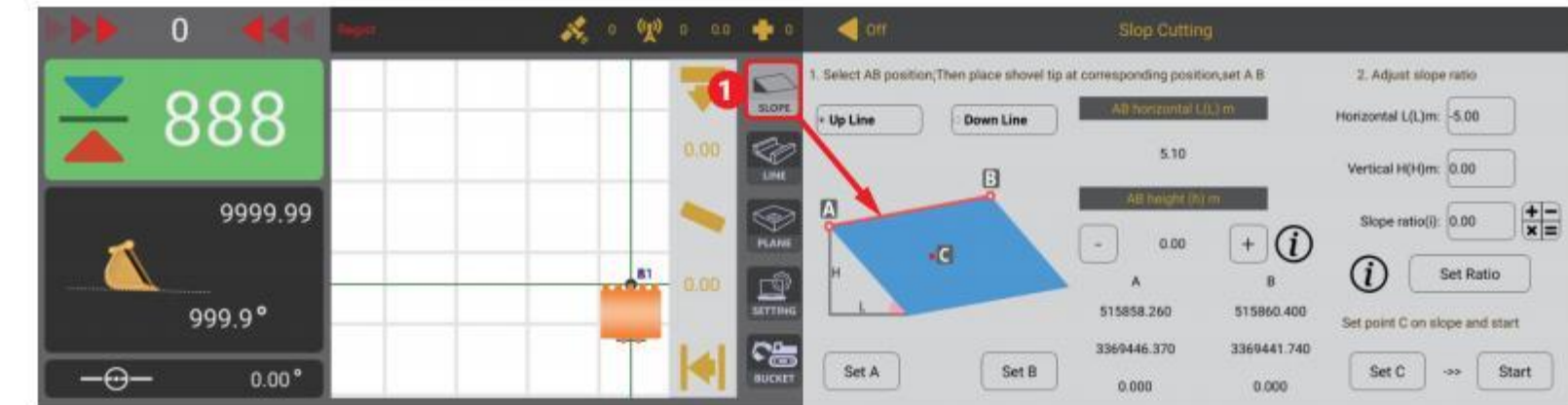⑥ Click the Set Para button;

⑦ Click Off to guide the operation.

Note:

① When setting the fill & excavation volume for point A, a positive value indicates digging down, while a negative value indicates filling up.

② When setting the height difference between points A and B, a positive value means point A is higher than point B, and a negative value means point A is lower than point B.

6.4.3. Slop Cutting Mode

① Tap Slope Cutting Mode on the main interface to enter the setting interface.

② Pick the starting edge where the slope will open.

③ Drive to Point A, set the bucket at the desired elevation, and press Set A.

④ Move to Point B, position the bucket at the target toe of the slope, and press Set B.

⑤ Enter the slope ratio, H, and L values.

⑥ Click the Set Ratio button;

⑦ Place the bucket on any intermediate point of the intended slope and press Set C to verify the grade.
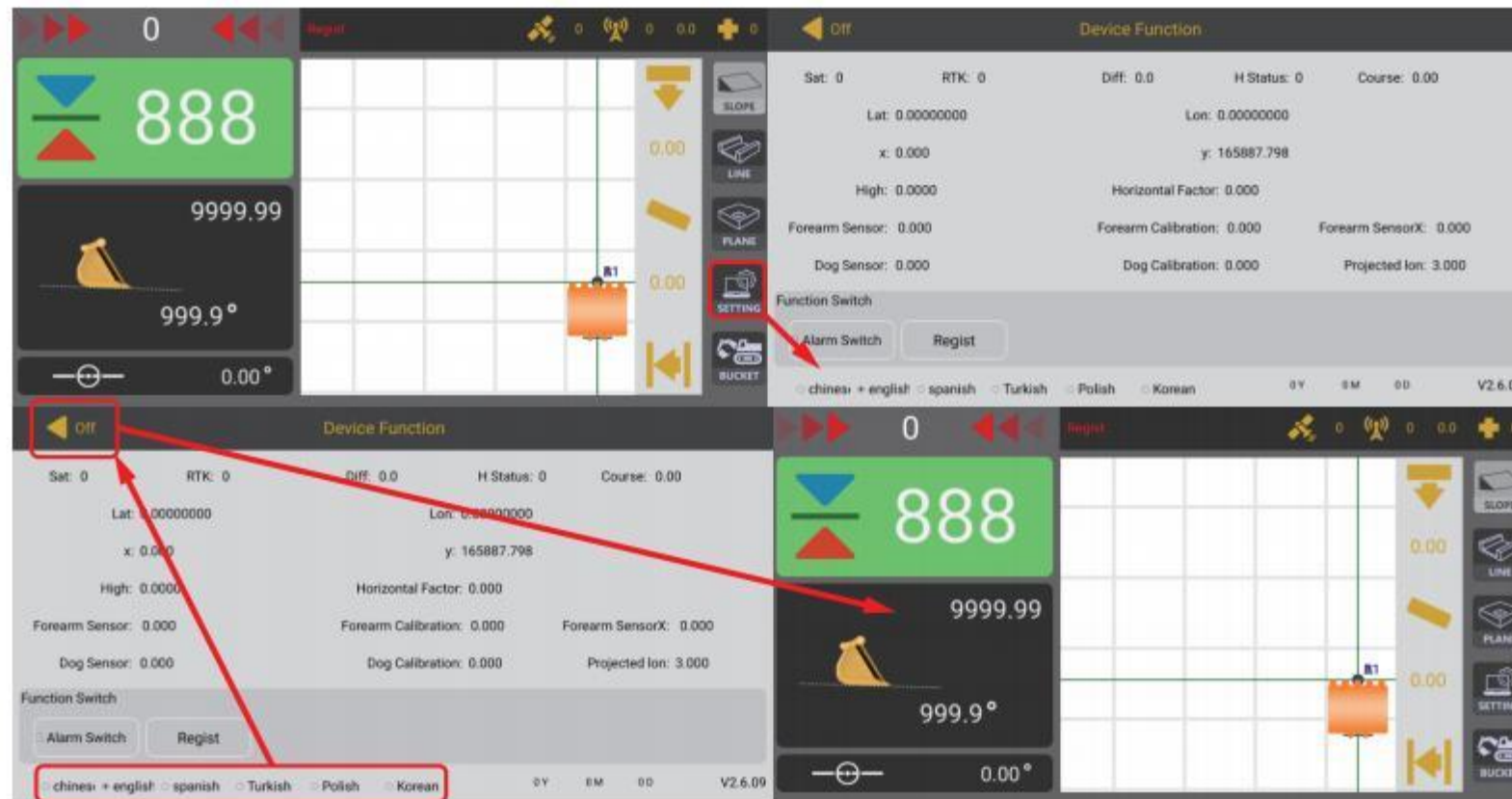
⑧ Click the Start button to guide the operation.

Note:

① Slope ratio = H/L, keep two decimal places.

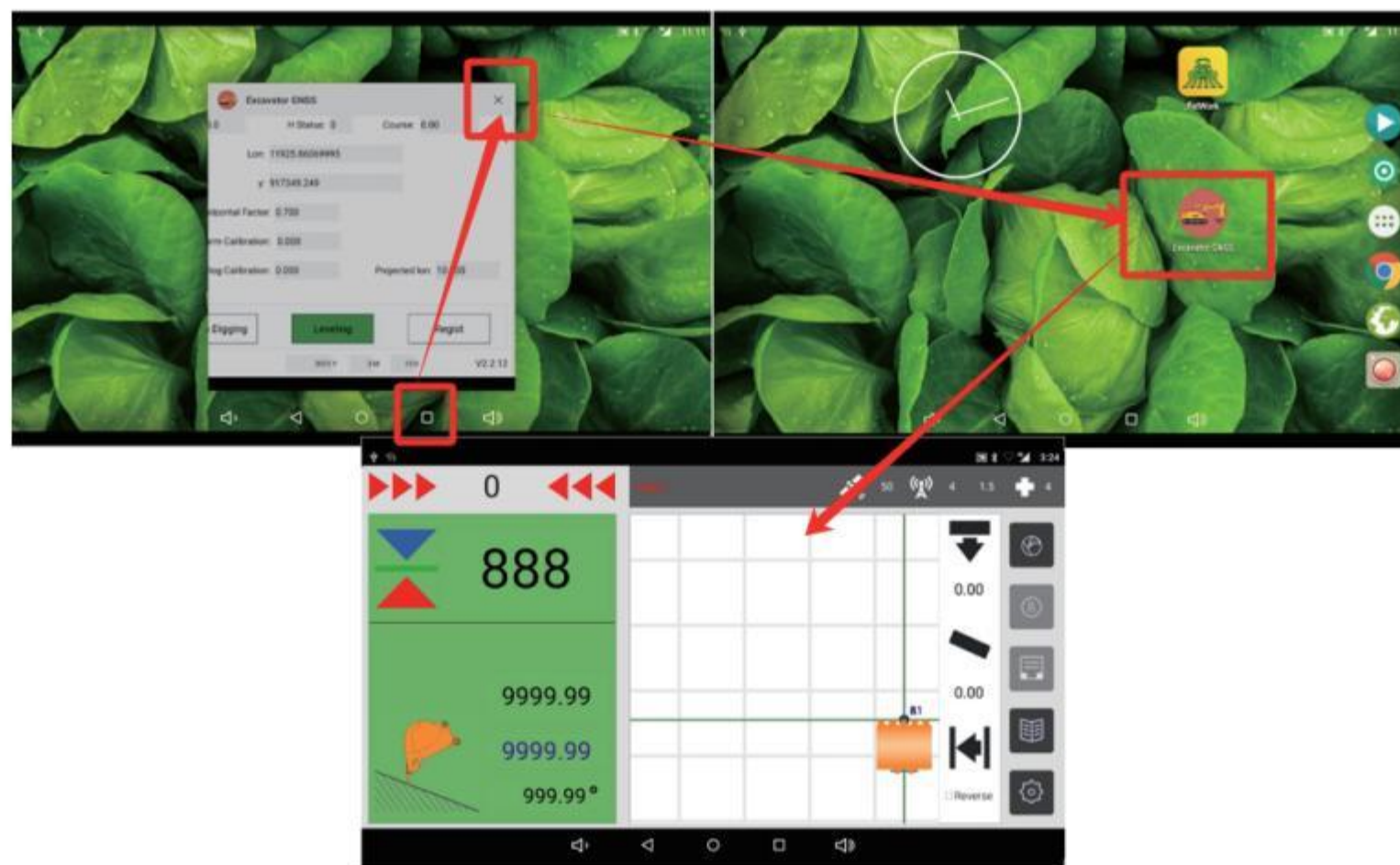② AB height is used to adjust the height difference between Points A and B.

7. Other Functions

7.1. Language Switching

① Click the Real-time Parameter button on the main interface to enter the Device Function interface, select the appropriate language and then click the Off button to return to the main interface.

① Tap Enter Device Background, then press Close Software.
② From the Android desktop, relaunch the Excavator GNSS icon.
③ The application now opens entirely in the language you selected.

7.2. Real-Time Parameters

① Raw Data
Displays live satellite counts, signal quality, and IMU readings. Intended for Spherefix engineers during troubleshooting or advanced support.
② Alarm Switch
Enables or disables audible warnings. The alarm tone is ON by default; use the switch to silence it if required.