Airflow Velocity Testing

Complete App Capabilities

A Demonstration Guide

Professional UK-Compliant Smoke Control Testing

Web & Mobile Application (iOS/Android)

- Smoke Control Damper Velocity Testing
- Stairwell Differential Pressure Testing
- Professional PDF Report Generation
- UK Building Standards Compliance
- Business Management CRM
- Offline-First Mobile App
- Trend Analysis & Anomaly Detection

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A demonstration guide showing exactly what this application can do

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Overview

This is a professional, UK regulation-compliant application for smoke control system testing, commissioning, and business management. It's designed for fire safety engineers and technicians working on-site, available as both a web application and native mobile app (iOS/Android).

Who is this for? Fire safety contractors, commissioning engineers, building services consultants, and smoke ventilation specialists who need to test smoke control dampers and stairwell pressurisation systems to UK standards.

Core Testing Features

Smoke Control Damper Velocity Testing

What it does: Measures and documents airflow velocity readings across smoke control dampers to verify they meet design specifications.

How to use it:

1. Create a new test - Navigate to the Testing section and tap "New Damper Test"

2. Enter damper dimensions - Input the width and height in millimetres (e.g., 600mm x 400mm)

3. Watch the grid auto-calculate - The system automatically determines whether you need a 5x5, 6x6, or 7x7 measurement grid based on BSRIA BG 49/2024 standards:

   - Dampers under 0.5m²: 5x5 grid (25 readings)
   - Dampers 0.5m² to 1.0m²: 6x6 grid (36 readings)
   - Dampers over 1.0m²: 7x7 grid (49 readings)

4. Enter your readings - Tap each cell in the grid and enter your anemometer reading. Use keyboard navigation (Tab or arrow keys) to move quickly between cells.

5. See instant calculations - As you enter readings, the average velocity updates in real-time. You'll see:

   - Overall average velocity (m/s)
   - Minimum and maximum readings
   - Calculated airflow volume (m³/s)

What you'll see on screen:

• A visual grid matching the damper face

• Each cell showing its reading value

• Colour coding: green for readings within tolerance, amber for borderline, red for out of spec

• The calculated average prominently displayed

• Pass/fail status against the design velocity

Real-world example: You're commissioning a smoke shaft serving floors 1-10 of a new residential tower. Each floor has a 750mm x 500mm motorised damper. You set up the test, enter the dimensions, and the app creates a 6x6 grid. You take your 36 readings across the damper face using your anemometer, entering each

value. The app shows an average of 8.2 m/s against a design requirement of 8.0 m/s - a clear pass.

System types supported:
• Push systems - Supply air into protected areas
• Pull systems - Extract smoke from affected areas
• Push-pull systems - Combined supply and extract

Visit types you can record:
• Initial commissioning (new installation)
• Annual inspection (maintenance contract)
• Remedial works (after repairs)
• Final verification (sign-off testing)

Stairwell Differential Pressure Testing

What it does: Measures and documents pressure differentials in pressurised stairwells to verify they meet building standards for escape route protection.

How to use it:

1. Select your building standard - Choose from:
   - BS EN 12101-6:2022 (current standard)
   - BS EN 12101-6:2005 (legacy installations)
   - BS 5588-4:1998 (older buildings)

2. Choose the pressure class - Options range from Class A to Class F, each with different pressure requirements:
   - Class A: 50 Pa (±10%)
   - Class B: 45 Pa (±10%)
   - And so on...

3. Add floors to test - List each floor in the stairwell (Ground, 1, 2, 3... up to the roof level)

4. Record measurements for each scenario:

   Doors Closed Test:
   - Enter the pressure differential (Pa) across the stairwell door at each level
   - The app shows whether each reading is within the acceptable range

   Single Door Open Test:
   - Open one door at a time and measure the minimum pressure at other levels
   - Records which door was opened and resulting pressures

   Door Force Test:
   - Measure the force (Newtons) required to open each door
   - App checks against 100N limit (or 140N for fire doors)
   - Flags any doors exceeding the maximum opening force

What you'll see on screen:
• A floor-by-floor table of all readings
• Green/red indicators for pass/fail at each level
• Automatic calculation of average pressures
• Door force compliance status

• Overall system pass/fail summary

Real-world example: You're conducting an annual inspection of a 15-storey pressurised stairwell. You select BS EN 12101-6:2022, Class B. Starting at ground level, you work your way up, recording the pressure at each floor with all doors closed (target: 45 Pa ±10%). You then repeat with the ground floor door open, then first floor door open, and so on. Finally, you measure door opening forces. The app compiles all results and shows 2 floors failing the single-door-open test - you know exactly where remedial work is needed.

Test Scenarios Supported

The app handles various testing configurations:

• All doors closed - Standard operating condition testing
• Single door open - Tests pressure maintenance when occupants use the stairwell
• Multiple doors open - Simulates evacuation conditions
• Fire service override - Tests firefighter switch operation and bypass modes

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Compliance & Reporting

UK Building Standards Reference

The app includes built-in reference to key standards:

Standard | Description | When to use

BS EN 12101-8:2020 | Smoke control dampers | All damper testing
BS EN 12101-6:2022 | Stairwell pressurisation | Current installations
BS 5588-4:1998 | Smoke control in escape routes | Older buildings
BSRIA BG 49/2024 | Commissioning air systems | All commissioning work

What you'll see: When you select a standard, the app automatically applies the correct:
• Measurement grid requirements
• Pressure tolerances
• Door force limits
• Commissioning checklist items

Professional PDF Reports

What it does: Generates polished, client-ready reports that you can email or print directly from the app.

How to use it:

1. Complete your testing - All readings must be entered
2. Add project details - Client name, site address, your engineer details

3. Capture signatures - Both tester and witness signatures using touch screen

4. Tap "Generate Report" - The PDF is created in seconds

What you'll see in the report:
• Your company logo and branding (upload once, used on all reports)

• Executive summary with pass/fail status

• Complete test data with the measurement grid

• Visual representation of readings

• Compliance checklist with tick marks

• Digital signatures

• Report reference number and date

• Standard references

Report types available:
• Commissioning certificate (new installations)

• Annual inspection report (maintenance visits)

• Remedial works report (after repairs)

• Summary report (quick overview)

Real-world example: After completing damper testing across a 6-floor office building (12 dampers total), you tap "Generate Report". In 10 seconds, you have a 25-page PDF with all test data, a summary showing 11 pass and 1 fail, photographs of the failed damper, and both signatures. You email it to the client before leaving site.

Compliance Checklists

What it does: Provides structured checklists aligned to UK standards to ensure nothing is missed during testing.

How to use it:

1. Select the checklist type - Choose from pre-test, functional, performance, or documentation checklists

2. Work through each item - Tick off items as you verify them

3. Add notes - Record observations against specific items

4. Mark completion - The checklist becomes part of your test record

Checklist categories:

Pre-Test Verification:
• [ ] Damper accessible for testing

• [ ] Control panel in manual mode

• [ ] Building HVAC system status confirmed

• [ ] Test equipment calibrated (date checked)

• [ ] Site access arrangements in place

Functional Testing:
• [ ] Damper opens on command

• [ ] Damper closes on command

• [ ] End switches operate correctly

• [ ] Manual release functions
• [ ] Position indicators accurate

Performance Testing:
• [ ] Design airflow rate documented
• [ ] Measurement grid completed
• [ ] Average velocity calculated
• [ ] Leakage rate within tolerance
• [ ] System response time acceptable

Documentation:
• [ ] As-built drawings available
• [ ] O&M manual present
• [ ] Previous test results reviewed
• [ ] Calibration certificates checked

Golden Thread Document Management

What it does: Supports Building Safety Act compliance by maintaining a structured audit trail of all testing documentation.

How to use it:

1. Upload existing documents - Add as-built drawings, O&M manuals, previous reports
2. Link to tests - Connect documents to specific dampers or projects
3. Track versions - When documents are updated, the history is preserved
4. View audit trail - See who uploaded/modified what and when

What you'll see:
• Document library organised by building and system
• Version numbers on each document
• Upload dates and user names
• Links to related test records
• Export capability for handover packs

Why this matters: The Building Safety Act requires a "golden thread" of building safety information. This feature ensures your testing records are part of that thread, properly linked to the building's safety case documentation.

Business Management Platform (CRM)

Client Management

What it does: Maintains a complete database of all your clients with their contact details, sites, and preferences.

How to use it:

1. Add a new client - Tap "New Client" and enter:
   - Company name (e.g., "Jones Property Management Ltd")
   - Primary contact person and their role
   - Phone numbers (office and mobile)
   - Email addresses
   - Company address

2. Add multiple contacts - Each client can have several contacts:
   - Building manager: Sarah Thompson, sarah@jonesproperty.com
   - Accounts: accounts@jonesproperty.com
   - Emergency out-of-hours: 07xxx xxxxxx

3. Add multiple addresses - Useful for clients with several sites:
   - Head Office: 45 High Street, Manchester M1 1AA
   - London Office: 22 Fleet Street, London EC4Y 1AA
   - Birmingham Site: Unit 4, Industrial Estate, B1 2CD

4. Set client priority - Helps you prioritise:
   - Standard: Normal service levels
   - Preferred: Priority scheduling
   - VIP: Immediate response

5. Record financial details:
   - VAT number
   - Account reference
   - Payment terms (30 days, 60 days, etc.)

What you'll see on the client screen:
• Client summary card with key details
• List of all contacts with click-to-call/email
• All associated addresses on a map
• Contract summary (active contracts, value)
• Job history
• Outstanding invoices
• Notes and activity log

Real-world example: You receive a call from "Green Facilities Ltd". You search for them, see they're a VIP client with 3 active contracts worth £45,000/year. You can see their 5 sites on a map, their preferred engineer is Dave (who knows their systems), and they have one overdue invoice. You have everything you need to handle the call professionally.

Contract Management

What it does: Tracks all your service agreements, their value, renewal dates, and SLA requirements.

How to use it:

1. Create a new contract - Enter:
   - Contract name (e.g., "Annual Smoke Vent Maintenance - Tower Court")
   - Client (select from your list)

- Start date and end date
- Contract value (e.g., £3,500 per year)
- Billing frequency (monthly, quarterly, annually)
- Auto-renewal: Yes/No

2. Set SLA levels:
- Basic: 5-day response, 10-day resolution
- Standard: 2-day response, 5-day resolution
- Premium: Same-day response, 2-day resolution

3. Add covered sites - List which addresses are included

4. Define scope - What's included:
- Number of dampers covered
- Annual tests included
- Emergency callouts (included/chargeable)
- Parts (included/chargeable)

What you'll see:
• Contract dashboard showing all active contracts
• Upcoming renewals (next 30, 60, 90 days)
• Contract value totals
• SLA performance metrics
• Linked jobs and invoices

Real-world example: It's October and you want to see which contracts renew in January. You filter by renewal date and see 8 contracts worth £28,000 are due for renewal. You can generate renewal letters directly, see the service history for each, and plan your retention calls.

Job Scheduling

What it does: Creates and tracks work orders from initial request through to completion and invoicing.

How to use it:

1. Create a new job:
- Job type: Testing / Installation / Repair / Maintenance
- Client: Select from list
- Site address: Select from client's addresses
- Description: "Annual smoke damper testing - 12 dampers across 6 floors"
- Priority: Low / Normal / High / Urgent

2. Schedule the job:
- Planned date: Pick from calendar
- Estimated duration: 4 hours
- Assigned engineer: Select from staff list

3. Add site access notes:
- "Report to main reception, ask for security"
- "Parking in loading bay, need permit from security"
- "Out of hours access: call 07xxx before arrival"

4. Track progress - Job statuses:

- Pending: Created but not scheduled
- Scheduled: Date and engineer assigned
- In Progress: Engineer has started work
- Completed: Work finished
- Invoiced: Invoice sent to client
- Cancelled: Job cancelled (with reason)

What you'll see:
• Job board showing all jobs by status
• Calendar view of scheduled work
• Engineer diary view
• Job details with all notes and history
• Linked test records
• Time and materials logged

Real-world example: A client calls with an urgent fault - one damper failed to open during a fire alarm test. You create an Urgent job, see that Dave is free tomorrow morning, assign it to him. Dave gets a notification on his phone with all the site details. He arrives, fixes the issue, marks the job complete, and logs 2 hours labour plus a new actuator. You invoice the same day.

Quotes & Invoices

What it does: Creates professional quotes and invoices linked to your jobs and contracts.

How to create a quote:

1. Start a new quote:
   - Select client
   - Enter quote description
   - Add line items:
     - "Annual smoke damper testing (12 dampers)" - £1,800.00
     - "Fire stopping inspection" - £350.00
     - "Report production and handover" - £150.00
   - Subtotal, VAT, and total calculate automatically

2. Send to client - Generate PDF and email directly

3. Convert to invoice - When accepted, one tap converts the quote to an invoice

4. Track payment:
   - Mark as sent
   - Record payment received
   - Chase overdue invoices

What you'll see:
• Quote/invoice list with status (Draft, Sent, Accepted, Paid, Overdue)
• Outstanding amounts
• Payment history
• Aged debtor reports

Financial Tracking

What it does: Records all costs associated with jobs so you can see true profitability.

How to record expenses:

1. Add an expense:
   - Date
   - Category: Materials / Travel / Subcontractor / Equipment / Other
   - Description: "Replacement actuator for Tower Court"
   - Amount: £245.00
   - Receipt: Capture photo of receipt

2. Record mileage:
   - Start location
   - End location
   - Miles travelled
   - Rate (e.g., 45p/mile)
   - Auto-calculates value

3. Log time:
   - Job reference
   - Hours worked
   - Engineer
   - Activity type (travel, testing, paperwork)

What you'll see:
• Expense reports by category
• Mileage summaries
• Job costing: revenue vs expenses = profit
• Margin calculations per job
• Monthly financial summaries

Real-world example: You complete a job invoiced at £2,400. Looking at the job costing:
• Labour (8 hours × £45): £360
• Materials: £245
• Travel (85 miles): £38
• Total costs: £643
• Profit: £1,757 (73% margin)

Staff & Resource Management

Staff Directory

What it does: Maintains complete records for all your employees and contractors.

Information stored for each person:
• Full name and job title

• Contact details (phone, email, address)
• Employment type: Full-time / Part-time / Contractor / Apprentice
• Start date
• Line manager
• Emergency contact
• National Insurance number
• Driving licence details (including expiry date)

What you'll see:
• Staff list with quick search
• Individual profile cards
• Organisation chart
• Upcoming driving licence renewals
• Employment anniversary dates

Skills & Qualifications

What it does: Tracks all certifications, training, and competencies for each team member.

How to use it:

1. Add qualifications:
   - Type: CSCS Card / NVQ / Manufacturer Training / In-house
   - Name: "Fire Door Inspection - FDIS Level 1"
   - Issue date
   - Expiry date
   - Certification number
   - Upload certificate image

2. Record skills:
   - Skill name: "Smoke Damper Testing"
   - Competency level: Trainee / Competent / Specialist / Trainer
   - Date assessed

3. Set up alerts - Get notified before certifications expire

What you'll see:
• Skills matrix across the team
• Who is qualified for what
• Upcoming certificate renewals
• Training needs identification
• Competency gaps

Real-world example: A client specifically requests a BSRIA-trained engineer. You search by qualification and see Dave and Maria both hold BSRIA CP/47 certification. Maria's is due to expire next month - you make a note to book her refresher course.

Sample engineers in the demo data:

Name | Level | Key Skills

David Thompson | Senior | Smoke dampers, Stairwell pressurisation, BSRIA CP/47
Sarah Mitchell | Competent | Damper testing, AOV servicing
James Wilson | Trainee | Under supervision, learning damper testing
Michael Brown | Specialist | Complex commissioning, training delivery
Emma Davis | Competent | Testing, inspection
Robert Taylor | Senior | Pressure systems, commissioning
Lisa Anderson | Trainee | Basic testing under supervision
Chris Martin | Specialist | System design, witness testing

Staff Scheduling

What it does: Manages availability, time-off, and shift patterns.

Features:
• Availability patterns (Mon-Fri 8am-5pm, etc.)
• Time-off requests and approvals
• Shift handover notes
• Daily briefing distribution

Equipment & Vehicles

What it does: Tracks all your test equipment and company vehicles.

For equipment:
• Asset register with descriptions
• Serial numbers
• Calibration status and due dates
• Current location/custodian
• Service history
• Reservation for specific jobs

For vehicles:
• Fleet list
• MOT and service due dates
• Mileage tracking
• Driver assignments
• Booking calendar

Real-world example: You need to send an engineer to a job requiring a calibrated anemometer. You check equipment availability - see that anemometer #3 is calibrated until March and currently with Dave (who has a job nearby). You can reassign it to Maria's job next week.

Intelligent Features

Trend Analysis

What it does: Charts historical velocity data so you can spot declining performance over time.

How to use it:

1. Select a damper - Choose from your damper registry
2. View history - See all tests performed on that damper
3. See the trend chart - X-axis shows dates, Y-axis shows average velocities

What you'll see:
• Line chart showing velocity over time
• Design velocity baseline for comparison
• Trend line (is it declining?)
• Anomaly markers (unusual readings highlighted)
• Comparison with similar dampers

Why this matters: If a damper tested at 8.5 m/s last year now tests at 7.2 m/s, that's a 15% decline. The trend chart makes this immediately visible. You can recommend preventive maintenance before it fails completely.

Anomaly Detection

What it does: Automatically flags readings that are statistically unusual.

How it works:
• Uses MAD (Median Absolute Deviation) algorithm
• Compares each reading against historical patterns
• Flags readings more than 2 standard deviations from normal

What you'll see:
• Unusual readings highlighted in orange/red
• Explanation of why it's flagged
• Comparison to historical average
• Suggested action (investigate, retest, service required)

Real-world example: You enter readings for a damper. Most cells show 7-8 m/s, but one shows 3.2 m/s. The app immediately highlights this reading with an alert: "This reading is 58% below the damper average. Check for obstruction or damage in this quadrant."

Predictive Maintenance

What it does: Uses historical data to predict when maintenance will be needed.

Features:
• Velocity decline rate calculation

• Time to reach minimum acceptable velocity
• Maintenance scheduling recommendations
• Pre-loaded predictive readings based on history

What you'll see:
• Predicted test results before you start (based on trend)
• Expected maintenance date
• Recommended service items
• Comparison of actual vs predicted

Real-world example: The app shows a damper has declined 5% per year over the last 3 tests. At this rate, it will drop below the minimum 6.5 m/s requirement in approximately 18 months. You can schedule preventive maintenance now rather than waiting for failure.

Project & Site Management

Projects

What it does: Groups related buildings and dampers together for efficient management.

How to use it:

1. Create a project:
   - Project name: "Tower Court Residential Development"
   - Client: Select from list
   - Site address
   - Main contractor (if applicable)
   - Project status: Planning / Active / Complete / On Hold

2. Add buildings:
   - Building A: 15-storey residential
   - Building B: 12-storey residential
   - Podium: 2-storey retail

3. Add dampers to each building - See Damper Registry below

What you'll see:
• Project overview dashboard
• Building list with damper counts
• Testing progress (12 of 45 dampers tested)
• Linked contracts and jobs
• Document library

Damper Registry

What it does: Maintains a complete database of every damper you manage.

Information stored for each damper:
• Unique damper ID (e.g., "TC-A-L05-SD01")
• Building and location (Tower Court, Building A, Level 05)
• Shaft identifier (Smoke Shaft 1)
• Dimensions (600mm × 400mm)
• System type (Push/Pull/Push-Pull)
• Manufacturer and model
• Installation date
• All historical test records

What you'll see:
• Searchable damper list
• Filter by building, floor, system type
• Test status (never tested, passed, failed, due soon)
• Quick access to test history
• Photo gallery

Damper ID naming convention:
The app suggests a standardised format:
`[Building]-[Floor]-[Type]-[Number]`
Example: TC-A-L05-SD01 = Tower Court, Building A, Level 05, Smoke Damper 01

Damper Templates

What it does: Saves commonly-used damper configurations for quick reuse.

How to use it:

1. Create a template:
   - Template name: "Standard AOV 600x400 Push"
   - Default dimensions
   - Default system type
   - Standard manufacturer

2. Apply to new dampers - Select template, adjust only what's different

Real-world example: A development has 45 identical dampers. You create a template with the standard settings, then apply it to each damper, only changing the floor and location identifier. Saves significant time versus entering all details manually 45 times.

Floor Sequencing Mode

What it does: Provides structured floor-by-floor testing to ensure nothing is missed.

How to use it:

1. Start floor sequence - Select the building
2. Work through floors - App presents dampers floor by floor

3. Mark completion - Each floor shows complete/incomplete status

4. Track progress - Visual indicator of progress through building

What you'll see:
• Floor-by-floor list
• Number of dampers per floor
• Completion status
• Time spent per floor
• Estimated time remaining

Data Management

Export Options

PDF Reports:
• Professional client-ready documents
• Company branding
• Digital signatures
• Pass/fail summaries

CSV Export:
• Raw data for spreadsheet analysis
• All readings in tabular format
• Suitable for client data systems

JSON Backup:
• Complete data export
• Suitable for backup and restore
• Can transfer to another device

ZIP Archives:
• Bundle multiple reports
• Include photos and documents
• Complete project handover package

Offline Capability

What it does: Works fully without internet connection - essential for basement and core testing where signal is poor.

How it works:
• All data stored locally on device
• Create and complete tests offline
• Offline indicator shows when disconnected

• Changes queued for sync when back online
• Automatic sync when connection restored

What you'll see:
• Connectivity indicator in header
• Pending sync count (e.g., "3 changes waiting to sync")
• Sync status animation when connecting
• Confirmation when sync complete

Real-world example: You're testing dampers in a basement car park with no signal. You complete 6 damper tests over 2 hours. When you return to the surface and get signal, the app automatically syncs all 6 tests to the server within seconds.

Auto-Save

What it does: Continuously saves your work so you never lose data.

What you'll see:
• Save indicator: "Saved" with timestamp
• Auto-saves every few seconds during data entry
• Confirmation when manually saving
• Recovery of unsaved work if app closes unexpectedly

User Experience

Touch-Optimised Interface

Designed for field use:
• Large tap targets (no tiny buttons)
• Works with gloves
• Works in bright sunlight
• Minimal scrolling required
• Key actions always visible

Navigation

Keyboard shortcuts for efficiency:
• Tab: Move to next cell
• Shift+Tab: Move to previous cell
• Arrow keys: Move within grid
• Enter: Confirm and move down

• Escape: Cancel edit

Quick navigation:
• Recent items list
• Search across all data
• Breadcrumb trails showing where you are
• Back button always available

Visual Feedback

Clear status indicators:
• Saving: Subtle animation
• Saved: Green checkmark with timestamp
• Offline: Orange indicator
• Error: Red alert with explanation
• Success: Green toast notification

Image Documentation

What it does: Captures photos of dampers and attaches them to test records.

How to use it:

1. Tap camera icon on damper or test
2. Capture photo - Shows preview
3. Annotate - Draw on image to highlight issues
4. Save - Attached to record

Photo types:
• Damper in open position
• Damper in closed position
• Defects or damage
• Location/identification plate
• General installation views

Mobile App Features (Capacitor)

Native Functionality

The mobile app provides:
• iOS and Android versions - Install from app stores

• Camera integration - Native camera for quality photos
• Splash screen - Professional branding on launch
• Status bar - Customised to match app design

Offline-First Design

• Full functionality without internet
• Local data persistence
• Background sync when online
• Battery optimised

Security & Authentication

User Management

Login options:
• Replit Auth (quick social login)
• Username/password (traditional)
• Session management (stay logged in)

Data Isolation

• Each user sees only their own data
• Shared demo data for training new users
• Role-based access ready for team implementation

Sample Data (Pre-loaded)

The app comes pre-loaded with realistic UK demo data to explore:

8 Staff Members:
• Mix of experience levels (Trainee to Specialist)
• Various qualifications (CSCS, NVQ, BSRIA)
• Complete profile information

6 Client Companies:
• Spread across UK regions
• Different sectors (commercial, residential, public)
• Multiple contacts and addresses

9 Service Contracts:
• Various values and terms

• Different SLA levels
• Renewal dates spread throughout year

6 Building Projects:
• Different sizes and types
• Multiple dampers per building
• Complete test histories

18 Jobs:
• Various statuses (pending to completed)
• Different types (testing, maintenance, repair)
• Assigned to different engineers

Dampers and Test Records:
• Multiple damper configurations
• Historical velocity readings
• Trend data for analysis demos

Getting Started

1. Log in using your preferred method
2. Explore the demo data - All features have sample data to try
3. Create your first client - Start building your own database
4. Add a project and dampers - Set up your first site
5. Run a test - Experience the touch-optimised testing workflow
6. Generate a report - See the professional PDF output

Technical Stack

For developers and technical teams:

• Frontend: React 18+, TypeScript, Vite, shadcn/ui, Tailwind CSS
• Backend: Express.js, TypeScript, RESTful API
• Database: PostgreSQL with Drizzle ORM
• Mobile: Capacitor for iOS/Android
• Charts: Recharts
• PDF: jsPDF, html-to-image
• Forms: React Hook Form, Zod validation