

Term 1 Lesson Plans - Engineering

Week 1 – Unit Intro & WHS Foundations (Toolkit 1)

Lesson 1 – Intro to the Unit & Engineering Context (Classroom)

Learning intention

- Understand what we'll be doing this term (tower, beam, experiments, folio).
- Recognise different types of engineered structures and why they exist.

Success criteria

- I can explain, in my own words, what the water tower and concrete beam projects involve.
- I can give examples of engineered structures and the loads they carry.

Activities

- Quick roll & framing: what this unit is, major projects, folio, how it'll be assessed.
- PPT / website: show Term 1 Toolkits & key tasks from the site.
- Short video or image set of big structures (bridges, towers, dams).
- Class brainstorm: “What can go wrong if a structure is badly designed or built?”
- Start vocab dictionary (with pictures) in books / Google Doc (terms: structure, load, tension, compression).

Resources

- Toolkit 3 intro slides or website section.
- Unit outline / assessment brief.
- Images/video of major structures.

Evidence

- Vocab dictionary started.
- Informal questioning / contributions.

Lesson 2 – Basic Forces & Loads on Structures (Classroom)

Learning intention

- Understand basic forces and how they act on simple structures.

Success criteria

- I can label tension, compression, and bending on a simple beam or tower sketch.

- I know what “dead load” and “live load” mean.

Activities

- Direct instruction: forces (tension, compression, shear, bending), dead vs live loads, simple examples.
- Students annotate a basic beam and tower sketch with where tension/compression are likely.
- Quick pair task: “Draw a stick-figure bridge and label where you think it’s in tension / compression.”
- Mini exit ticket: 3 questions (define tension/compression; give one dead load and one live load).

Resources

- Toolkit 3 Key Notes (Loads & members).
- Whiteboard / visualiser.
- Printed/online worksheet.

Evidence

- Exit tickets collected.
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Lesson 3 – Workshop Expectations & Safety Signage (Workshop/Room)

Learning intention

- Understand workshop rules, PPE and safety signage.

Success criteria

- I can identify the five safety sign categories and give an example.
- I know the basic behaviour expectations in the workshop.

Activities

- Teacher-led discussion of expectations: PPE, behaviour, tools are not toys.
- Workshop walk-through:
 - Identify real hazards.
 - Find examples of each sign type (mandatory, prohibition, warning, emergency, fire).
- Back in room: quick table summarising sign types + examples.
- Start WHS induction checklist (if you use one).

Resources

- Toolkit 1 section: Safety Signs.

- Workshop itself.
- WHS induction checklist.

Evidence

- Completed sign table / notes.
 - Checklist started.
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Week 2 – WHS, OnGuard & SWMS (Toolkit 1)

Lesson 4 – Hierarchy of Control & Risk Management (Classroom/ICT)

Learning intention

- Understand the hierarchy of control and how to apply it.

Success criteria

- I can order the hierarchy of control from most to least effective.
- I can suggest at least one control for a tower-building hazard.

Activities

- Quick recap of Week 1.
- Teach the hierarchy of controls (eliminate, substitute, engineering, admin, PPE) with tower examples.
- Students complete a short worksheet: hazards in tower project + possible controls at different levels.
- Introduce SWMS idea and show template you'll use.

Resources

- Toolkit 1 Key Notes – Risk & Hierarchy.
- SWMS template / Risk Management Plan PDF.
- Worksheet.

Evidence

- Completed hierarchy/controls worksheet (keep for SWMS).
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Lesson 5 – OnGuard & Hand Tool Rules (Computer Room)

Learning intention

- Complete online safety training for general workshop and hand tools.

Success criteria

- I can pass the OnGuard Toolkits assigned.

- I can state core hand tool safety rules.

Activities

- Log students into OnGuard.
- Complete:
 - General Workshop Safety
 - Hand Tools Toolkits (as you've set).
- Early finishers: write 5 key rules for hand tool use that apply to our tower.

Resources

- OnGuard accounts.
- Headphones (if needed).

Evidence

- OnGuard completion reports/screenshots.
 - List of hand tool rules in books.
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Lesson 6 – DRABC & SWMS Drafting (Classroom/Workshop Demo)

Learning intention

- Understand DRABC and begin the SWMS for tower/beam tasks.

Success criteria

- I can describe what each letter in DRABC stands for.
- I can fill in the hazards/controls section of a SWMS for at least one task.

Activities

- Teach DRABC with simple scenario (no gore, just basic sequence).
- Short DRABC worksheet or matching activity.
- Introduce SWMS document for tower & beam:
 - As a class, complete one row together (e.g. cutting timber).
- Students in pairs complete 2–3 more rows (drilling, gluing, testing).

Resources

- Toolkit 1 DRABC section.
- SWMS template.
- DRABC worksheet.

Evidence

- Partially completed SWMS per student/pair.
 - DRABC worksheet.
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Week 3 – Materials & Corrosion Setup (Toolkit 2)

Lesson 7 – Material Groups & Key Properties (Classroom)

Learning intention

- Classify engineering materials and understand key properties.

Success criteria

- I can group samples as metals, polymers, ceramics, composites, concrete.
- I can match properties (tensile, compressive, hardness, etc.) to simple examples.

Activities

- Theory from Toolkit 2: Material groups & properties.
- Build a simple table in books (group, example, typical use, key property).
- Short class discussion: why we don't build bridges from glass or plasticine.
- Add terms to vocab dictionary.

Resources

- Toolkit 2: Material groups & properties.
- Sample images / real items if you want.

Evidence

- Completed material groups table.
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Lesson 8 – Materials Sorting & Corrosion Experiment Setup (Workshop/Lab)

Learning intention

- Practically identify material types and set up a corrosion experiment.

Success criteria

- I can correctly classify sample pieces into the right material groups.
- I can set up a fair corrosion test.

Activities

- In small groups: rotate through trays of sample coupons (mild steel, gal steel, aluminium, plastics, concrete, etc.) and classify.
- Record observations: colour, feel, magnet, density ("heavier/lighter than expected"), likely uses.

- Set up **saltwater corrosion experiment**:
 - Label each sample.
 - Place in saltwater containers.
 - Record starting condition with notes/photos.

Resources

- Coupons/samples.
- Saltwater containers, labels.
- Toolkit 2 “Corrosion essentials” notes.

Evidence

- Logbook entry: material classification + initial corrosion setup with sketches/photos.
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Lesson 9 – Damp-Proofing & Brick Stack Experiment (Classroom/Lab)

Learning intention

- Understand rising damp, DPC and how moisture affects durability.

Success criteria

- I can explain what a damp-proof course does.
- I can describe how the brick stack experiment will show this.

Activities

- Teach from Toolkit 2: Damp-proofing section.
- Students sketch and label a wall with DPC, ground level and rising damp.
- Set up **brick stack experiment** (with vs without membrane; both in saltwater trays).
 - Record initial mass and configuration.
- Remaining time: students do a quick tower concept sketch and list possible materials + why.

Resources

- Bricks, membrane, trays, scales.
- Toolkit 2 damp-proofing notes.

Evidence

- Brick experiment setup recorded in folio.
 - Wall+DPC sketch.
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Week 4 – Concrete & Beams (Toolkit 2 → 4)

Lesson 10 – Concrete Theory & Quiz (Classroom)

Learning intention

- Understand how concrete and reinforcement work together.

Success criteria

- I can state what concrete is strong in and what steel is strong in.
- I can explain why cover and curing matter.

Activities

- Teach from Toolkit 2: Concrete & reinforcement.
- Students complete **Concrete Information & Quiz**.
- Go through answers and discuss key points (compression vs tension, cover, curing, corrosion inside concrete).
- Add terms to vocab dictionary (cover, spalling, honeycombing).

Resources

- Concrete Information & Quiz PDF.
- Toolkit 2 notes.

Evidence

- Completed quiz.
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Lesson 11 – Beam Design & OnGuard Power Tools (Classroom/ICT)

Learning intention

- Plan a small reinforced concrete beam and complete any remaining power tool safety.

Success criteria

- I can sketch the beam and show where reinforcement should go.
- I've completed required OnGuard power tool Toolkits.

Activities

- Sketch a standard test beam: span, supports, loading point, steel placement with cover dimension.
- Discuss mix proportions and labelling (group ID, date).
- Computer time: OnGuard Power Tools / Machinery Toolkits (drill, grinder if relevant).
- Early finishers: draft beam section for folio (purpose, materials, expected failure).

Resources

- Toolkit 4 beam protocol.
- OnGuard accounts.

Evidence

- Beam sketch with reinforcement and cover.
 - OnGuard completions.
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Lesson 12 – Casting Concrete Beams (Workshop/Lab)

Learning intention

- Safely mix, place and label concrete beams.

Success criteria

- I can follow safe procedures for mixing and placing concrete.
- Our beam is correctly labelled and recorded in the folio.

Activities

- WHS reminder for concrete (gloves, eye protection, cement burns).
- In groups: measure and mix the concrete (teacher controls water/cement).
- Place concrete in moulds, set reinforcement in correct position, tap/rod to remove air.
- Label beams (group, date, mix).
- Log curing plan in folio.

Resources

- Concrete, aggregates, water, moulds, reinforcement.
- PPE.

Evidence

- Beams cast and recorded in log.
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Week 5 – Structural Concepts & Start Tower Build (Toolkit 3)

Lesson 13 – Loads & Structural Forms (Classroom)

Learning intention

- Understand different structural forms and how loads act on them.

Success criteria

- I can label dead/live loads on a simple bridge/tower.
- I can identify beam, truss, arch and cantilever in real examples.

Activities

- Teach from Toolkit 3: loads, reactions, structural forms.
- Students annotate diagrams of each form with where tension/compression likely are.
- Quick class “Which design would you choose?” discussion using 2–3 sample bridges/towers.

Resources

- Toolkit 3 Key Notes.
- Printed diagrams.

Evidence

- Annotated structural form sheets.
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Lesson 14 – PBS Bridge Basics & Challenge (Computer Room)

Learning intention

- Explore how bridge type and material choice affect performance.

Success criteria

- I can match real bridges to their structural type.
- I can explain at least one design decision from the PBS challenge.

Activities

- Students work through PBS “Building Big” **Bridge Basics** then **Bridge Challenge**.
- They keep notes: chosen design, why, results.
- Short debrief at end: “What surprised you about the bridge types?”

Resources

- PBS Building Big links (from program/Toolkit 3).
- Computers and headphones.

Evidence

- Completed PBS worksheet/notes.
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Lesson 15 – Start Water Tower Build: Base & Legs (Workshop)

Learning intention

- Begin constructing the tower with accurate measurement and safe tool use.

Success criteria

- I can measure, mark and cut tower members accurately.

- Our base and legs are assembled square and to plan.

Activities

- Quick WHS reminder, SWMS open and visible.
- Students prepare and cut base frame and legs.
- Use squares/jigs to assemble base and legs; clamp while gluing/nailing.
- Teacher circulates focusing on safe tool use and accurate dimensions.

Resources

- Toolkit 4 tower build protocol.
- Materials for tower (timber, glue, fasteners).
- PPE and tools.

Evidence

- Base and legs completed or well underway.
 - Teacher observation notes.
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Week 6 – Strength-to-Weight, Buckling & Costing (Toolkit 3)

Lesson 16 – Buckling & Strength-to-Weight (Classroom)

Learning intention

- Understand why slender compression members buckle and why strength-to-weight matters.

Success criteria

- I can explain why a long thin strut fails differently to a short thick one.
- I can describe in simple terms what strength-to-weight means.

Activities

- Demonstration with rulers or strips (short vs long, bracing effect).
- Teach from Toolkit 3: tension vs compression, buckling, strength vs stiffness.
- Quick written task: identify likely struts and ties in their own tower design.

Resources

- Toolkit 3 Key Notes – buckling & S/W sections.
- Simple demo props (rulers, strips).

Evidence

- Short written explanation in books.
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Lesson 17 – Harbour Bridge & Costing Task (Classroom/ICT)

Learning intention

- Apply structural and costing ideas to a real example.

Success criteria

- I can describe how loads travel through the Harbour Bridge.
- I can use basic data to estimate mass and cost for a scaled tower.

Activities

- Harbour Bridge case study (load path, truss form, maintenance).
- Introduce **Liberty SHS mass tables** & costing spreadsheet (already set up).
- Students complete a simple scaled tower costing task: choose SHS size/wall, calculate length, mass and cost.

Resources

- Liberty SHS PDF/link.
- Spreadsheet template (Google Sheets/Excel).
- Toolkit 3 costing section.

Evidence

- Completed or near-complete costing sheet.

Lesson 18 – Tower Build: Bracing & Deck (Workshop)

Learning intention

- Add triangulation and deck to improve tower performance.

Success criteria

- Our tower has consistent bracing triangles and a deck that loads the structure evenly.
- I can explain which members are in compression and which are in tension.

Activities

- Very quick recap: “Why triangles?” (M3 triangulation).
- Workshop: add diagonal bracing; construct and attach deck.
- Encourage students to label members as C (strut) / T (tie) in their folio sketch.

Resources

- Tower materials and tools.
- PPE.

Evidence

- Tower mostly structurally complete.
 - Updated tower sketch with C/T labels.
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Week 7 – Build Quality & Test Planning (Toolkit 4)

Lesson 19 – “What Makes a Good Test?” (Classroom)

Learning intention

- Plan a safe, repeatable test for the tower.

Success criteria

- I can describe how we will load the tower and measure deflection.
- Our group has a simple written test plan.

Activities

- Teach from Toolkit 4: testing, data & evaluation.
- Class discussion: good vs bad test methods (where people stand, where load is applied).
- Groups draft a **Tower Test Plan**:
 - Load steps (e.g. 1 kg increments).
 - Deflection measurement method.
 - Role assignments (loader, recorder, camera).

Resources

- Toolkit 4: Testing & Data section.
- Test plan template.

Evidence

- Completed test plan per group.
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Lesson 20 – Finish Tower Build & Pre-Test Inspection (Workshop)

Learning intention

- Finalise tower build and identify weaknesses before testing.

Success criteria

- Our tower is ready for testing (all joints secure, deck safe).
- We have recorded any build flaws in our folio.

Activities

- Workshop time: finish any remaining bracing/deck work.

- Pre-test inspection checklist: students identify misalignment, loose joints, damage.
- Students note these in folio as “known weaknesses”.

Resources

- Checklist.
- Tools/materials as needed.

Evidence

- Completed tower.
 - Pre-test notes in folio.
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Lesson 21 – Folio: Brief, SWMS Summary & Drawings (Classroom)

Learning intention

- Develop the front half of the project folio.

Success criteria

- My folio has a clear brief, safety summary, and finished tower drawing.
- I can explain the main requirements of the project.

Activities

- Model an exemplar folio structure (Toolkit 4: Folio structure & example).
- Students:
 - Write project brief (purpose, requirements).
 - Insert/complete SWMS summary section.
 - Finalise neat orthogonal or isometric drawing of tower (hand or Onshape print).

Resources

- Example folio PDF (Toolkit 4 embed).
- Drawing tools / access to printouts.

Evidence

- Folio front sections substantially completed.
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Week 8 – Tower Testing & Evaluation (Toolkit 4)

Lesson 22 – Tower Testing Session 1 (Workshop)

Learning intention

- Conduct safe, controlled testing of student towers.

Success criteria

- I follow the test plan and record data accurately.
- I maintain safe behaviour during testing.

Activities

- Set up test area: PPE, exclusion zone, scales/weights ready.
- Test ~ half the class towers.
- Each group:
 - Runs test.
 - Records load at each step plus deflection and observations.
 - Video test where possible.

Resources

- Test rig, weights, scales.
- Ruler/deflection measuring method.
- Phones/cameras (if allowed).

Evidence

- Data table & notes for each tested tower.
-

Lesson 23 – Tower Testing Session 2 (Workshop/Classroom)

Learning intention

- Complete tower testing and begin initial analysis.

Success criteria

- All towers have test data.
- I can identify the failure mode of our tower.

Activities

- Test remaining towers.
- Short group debrief:
 - Identify first signs of failure.
 - Classify failure mode (buckling, joint failure, etc.).
- Quick compare: towers ranked by max load and by load per kg.

Resources

- As previous lesson.

Evidence

- Completed datasets for all towers.
 - Simple “leaderboard” (max load & load/kg).
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Lesson 24 – Writing Evaluation Paragraphs (Classroom)

Learning intention

- Turn test data into a clear evaluation.

Success criteria

- I can write at least one evaluation paragraph using data and structural language.
- I can suggest specific design improvements.

Activities

- Use Toolkit 4 Q&A + Evaluation scaffold.
- Teacher models a short evaluation paragraph on one sample tower.
- Students write:
 - Paragraph 1: performance summary (strength/stiffness, data).
 - Paragraph 2: failure analysis (where, why, link to theory).
 - Paragraph 3: specific improvements (bracing, member size, joints).

Resources

- Toolkit 4 Q&A.
- Tower evaluation scaffold PDF.

Evidence

- Draft evaluation in folio.
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Week 9 – Concrete Beams (Toolkits 2, 3, 4)

Lesson 25 – Beam Recap & De-mould (Classroom/Workshop)

Learning intention

- Recall beam theory and prepare beams for testing.

Success criteria

- I can describe where tension and compression act in our beam.
- Our beam is safely removed and inspected.

Activities

- Quick recap of Toolkit 2: concrete & reinforcement; beam bending.
- Workshop: strip formwork, inspect beams for defects (honeycombing, cracks).
- Sketch beam and note any visible issues in folio.

Resources

- Beams, tools for de-moulding.
- Toolkit 2 notes.

Evidence

- Inspection sketch and notes.
-

Lesson 26 – Beam Testing (Workshop/Lab)

Learning intention

- Test beams and record structural behaviour.

Success criteria

- I can record loads at first crack and failure.
- I can sketch crack patterns and identify the likely failure type.

Activities

- Set up beam test rig (supports, loading point).
- Test beams one by one:
 - Record first visible crack load, max load, deflection.
 - Photograph crack patterns.
- Students assist and rotate roles (loader, recorder, photographer).

Resources

- Test rig, loads, ruler/deflection gauge.
- Worksheet for beam data.

Evidence

- Completed beam data sheet.
-

Lesson 27 – Beam vs Tower Analysis (Classroom)

Learning intention

- Compare tower and beam performance and update folio.

Success criteria

- I can compare beam and tower behaviour using structural language.
- My folio includes a clear beam section.

Activities

- In class:
 - Add beam results (table, sketches, photos) to folio.
 - Brief written compare/contrast: tower vs beam (redundancy, stiffness, failure).
- Optional: small group share-out of interesting failures.

Resources

- Student data & photos.
- Folio scaffold.

Evidence

- Completed beam section in folio (data + reflection).
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Week 10 – Wrap, Reflection & Submission

Lesson 28 – Safety, Environment & Industry Links (Classroom)

Learning intention

- Understand how safety and environment apply to real engineering work.

Success criteria

- I can explain at least one environmental issue related to materials and structures.
- I can name at least two engineering-related career paths.

Activities

- Short input: societal/environmental impact (materials, corrosion, maintenance, waste).
- Industry links: civil/structural engineer, trades, fabrication, maintenance roles.
- Students write a short reflection: “Why safe and durable structures matter to the community.”

Resources

- Toolkit 2 & 4 “Societal and environmental impact” notes.
- Any career videos/resources you like.

Evidence

- Reflection paragraph.
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Lesson 29 – Folio Completion Workshop (Classroom/ICT)

Learning intention

- Finalise folio ready for submission.

Success criteria

- My folio has all required sections completed.
- My evaluation is clear, readable, and based on evidence.

Activities

- Students work through a folio checklist (cover, brief, safety, design, build log, tower data/eval, beam data/eval, costing & environment).
- Teacher roves, conferencing with students who are behind.
- Light-touch peer check: swap folios and check for missing sections.

Resources

- Folio checklist.
- Access to printed photos/Sheets etc.

Evidence

- Nearly complete folios.
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Lesson 30 – Submission, Quiz & Personal Reflection (Classroom)

Learning intention

- Consolidate learning and reflect on progress.

Success criteria

- I submit my completed folio.
- I can answer key questions about WHS, materials and structure behaviour.

Activities

- Collect folios (or finalise and submit digitally).
- Short quiz or Kahoot revising core concepts (WHS, materials, buckling, loads).
- Personal reflection:
 - What did I learn?
 - What would I do differently next time?
 - Did my attitude/skills change?

Resources

- Quiz (paper or online).

- Reflection prompt slide.

Evidence

- Folio submission.
- Quiz results (optional grading).
- Reflection.