

Year 9 Industrial Tech – Engineering

Unit: Water Tower / Concrete Beam / Materials Experiments (T1)

Modules:

- Toolkit 1 – WHS & Risk Control
- Toolkit 2 – Materials & Corrosion
- Toolkit 3 – Structural Concepts
- Toolkit 4 – Build, Test & Evaluate

10-Week Scope & Sequence (T1)

Week	Focus & Module Link	Key Theory / Learning	Practical / Activities	Assessment & Evidence
1	Unit intro & WHS foundations (Toolkit 1 + program intro)	<ul style="list-style-type: none">- Overview of unit: water tower, concrete beam, materials experiments, folio/report expectations.- Intro to engineering fields and reasons for engineered structures (access, resources, shelter).- Basic forces: tension, compression, shear, bending, loads on simple structures.- Workshop expectations, PPE rules, safety culture.	<ul style="list-style-type: none">- Classroom: Intro PPT on engineering fields and real projects (bridges, towers, dams).- Discussion: where students see structures in everyday life; brainstorm “what can go wrong?”.- Workshop walk-through: identify hazards and WHS signage types (mandatory, prohibition, warning, emergency, fire).- Weigh selected timber/sections so students connect mass (kg) to the idea of load.	<ul style="list-style-type: none">- Formative: Participation in discussion; completion of WHS induction checklist.- Start vocab dictionary (with pics) for key terms (PPE, hazard, tension, compression).- Outcomes focus: IND5-1, IND5-3, IND5-5, IND5-6.

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2	WHS, OnGuard & SWMS (Toolkit 1)	<ul style="list-style-type: none"> - Detailed WHS: hierarchy of control, risk management steps. - Core rules for hand tools and power tools (OnGuard theory). - DRABC and basic first response in the workshop. - Link safety directly to tower/beam tasks (cutting, drilling, gluing, testing). 	<ul style="list-style-type: none"> - ICT: Students complete OnGuard modules (general workshop safety + hand tools). - Theory: PPT/notes on types of forces + video of past tower tests (discuss successes & failures, link to buckling, joint failure). - Worksheet: hierarchy of control; identify hazards and propose controls for tower build. - DRABC worksheet + simple bandaging/slings practice (where appropriate). 	<ul style="list-style-type: none"> - Evidence: OnGuard completion records (general + hand tools). - Draft SWMS sections started for tower/beam work (hazards, controls, PPE). - Outcomes focus: IND5-1, IND5-3, IND5-6, IND5-7.
3	Materials & corrosion – experiments set-up (Toolkit 2)	<ul style="list-style-type: none"> - Classify materials: metals (ferrous/non-ferrous), polymers (thermoplastic/thermoset), ceramics, composites, concrete. - Key properties: tensile, compressive, hardness, toughness, ductility, density, corrosion resistance. - Intro to corrosion: rust as an electrochemical process; bare vs galvanised steel; role of saltwater. - Damp-proofing concept: rising damp, DPC and building durability. 	<ul style="list-style-type: none"> - Lab/bench: Sort material samples into groups and record properties (appearance, mass/feel, magnetism, likely uses). - Set up saltwater corrosion experiment: mild steel, galvanised steel, plastic and concrete offcuts; record initial condition with photos. - Set up DPC brick stack experiment: one stack with membrane, one without; record initial mass and arrangement. - Begin tower concept sketch + list of 	<ul style="list-style-type: none"> - Formative: Materials classification sheet; initial observations for corrosion and DPC experiments recorded in folio/log. - Outcomes focus: IND5-2, IND5-4, IND5-7, IND5-10.

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			possible materials and why (early “materials brief”).	
4	Concrete & reinforcement + beam casting (Toolkit 2 → Toolkit 4)	<ul style="list-style-type: none"> - Concrete as a composite: role of cement, sand, aggregate, water. - Compression vs tension in reinforced concrete; why beams crack on the tension side. - Cover, curing, carbonation, chlorides; common deterioration modes (spalling, rust staining). - WHS for concrete mixing: PPE, cement burns, washing out equipment safely. 	<ul style="list-style-type: none"> - Theory/quiz: Complete Concrete Information & Quiz; discuss answers and link to beam design. - Workshop/lab: Prepare moulds and reinforcement; place steel at correct depth (cover) for a small beam. - Cast concrete beams in groups; tap/rod to remove air; label beams clearly; record mix ratios and curing plan in folio. - ICT: Students complete OnGuard power tools/machinery (where required). 	<ul style="list-style-type: none"> - Evidence: Concrete quiz; beam casting record (mix details, reinforcement placement, curing notes). - OnGuard power tools/machinery completion. - Outcomes focus: IND5-1, IND5-3, IND5-4, IND5-8.
5	Structural concepts – loads, trusses & bridges (Toolkit 3)	<ul style="list-style-type: none"> - Loads: dead, live, environmental (wind); point vs distributed loads. - Support reactions on simply supported beams; correct use of SI units (N, kN). - Structural forms: beam, truss, arch, cantilever; role of struts and ties. - Triangulation and why triangles make frames stable. 	<ul style="list-style-type: none"> - ICT: Work through PBS “Building Big” Bridge Basics and Bridge Challenge; note how form and material choice affect load paths. - Activity: “Bridges Around the World” research task – identify structural type, main materials, main loads. - Practical: Start water tower build – base and legs, using accurate measurement and clamping; apply Module 1 WHS in practice. 	<ul style="list-style-type: none"> - Evidence: Completed PBS/bridge worksheets; research notes (Bridges Around the World). - Teacher observation of tower build: safe use of tools, accurate set-out. - Outcomes focus: IND5-2, IND5-3, IND5-7, IND5-9.

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6	Strength-to-weight, buckling & costing (Toolkit 3)	<ul style="list-style-type: none"> - Tension vs compression behaviour; buckling in slender compression members (effect of length, bracing, section depth). - Strength vs stiffness; reading simple load–deflection behaviour. - Strength-to-weight concept; why hollow sections and deeper beams are efficient. - SI units and basic costing using steel SHS tables and spreadsheets. 	<ul style="list-style-type: none"> - Theory: Harbour Bridge case study – how loads travel, why trusses, why maintenance and materials matter. - Worksheet: forces, mass, acceleration and basic reactions for a simply supported beam. - ICT: Use Liberty GFG SHS tables + spreadsheet to cost a 30 m tower based on the 300 mm model (mass, cost, wall thickness comparison). - Practical: Continue tower build (bracing + deck); check for straightness/square and link build choices to expected buckling behaviour. 	<ul style="list-style-type: none"> - Evidence: SI units worksheet; costing spreadsheet for scaled tower (materials, mass, cost). - Ongoing folio entries (design notes, build log with photos). - Outcomes focus: IND5-2, IND5-4, IND5-5, IND5-8.
7	Build quality & test planning (Toolkit 4 – Water Tower)	<ul style="list-style-type: none"> - What makes a “good” test: repeatable loading point, clear data, safe procedure. - Build quality: tolerances, joint consistency, effects of misalignment on structural behaviour. - Folio/report structure: cover, brief, planning, safety, design/drawings, build log, testing/data, evaluation, costing & sustainability. 	<ul style="list-style-type: none"> - Workshop: Complete tower construction; carry out pre-test inspection (loose joints, twisted frames, missing bracing). - Plan testing: decide load steps (e.g. kg increments), deflection measurement method, video setup. - Start folio sections: project brief, SWMS summary, final drawings (sketch/Onshape printout), build log entries with photos. 	<ul style="list-style-type: none"> - Evidence: Tower structurally complete and ready for test. - Folio draft: planning & safety sections; finalised tower drawings. - Outcomes focus: IND5-2, IND5-3, IND5-5, IND5-6, IND5-7.

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8	Tower testing & evaluation (Toolkit 4 – Water Tower)	<ul style="list-style-type: none"> - Distinguish between strength (max load) and stiffness (deflection under service load). - Failure modes: buckling, tension fracture, joint failure, shear, crushing. - How to write strong evaluation paragraphs that use data and structural language. 	<ul style="list-style-type: none"> - Conduct water tower tests to near failure: <ul style="list-style-type: none"> • record load step, deflection and observations each increment. • video tests; mark first visible buckling/cracking. - Debrief: compare tower performance between groups (max load, load per kg, failure mode). - In class: use Module 4 Q&A and evaluation scaffold to draft evaluation paragraphs. 	<ul style="list-style-type: none"> - Evidence: Tower test data table (load vs deflection, failure notes). - Draft evaluation section in folio (what worked, what failed first, why, improvements). - Outcomes focus: IND5-7, IND5-8, IND5-10.
9	Concrete beam testing & comparison (Toolkit 2 + Toolkit 3 + Toolkit 4)	<ul style="list-style-type: none"> - Beam bending: compression at top, tension at bottom; role of reinforcement. - Reading crack patterns (flexural vs shear, cover issues). - Factors of safety: working load vs failure load. - Link between tower test results and beam behaviour (structural redundancy, stiffness, serviceability). 	<ul style="list-style-type: none"> - Workshop: Remove beams from curing; inspect for defects (honeycombing, surface cracks). - Test beams over defined span: record first crack load, peak load, deflection at mid-span. - Compare beams (if different mixes or reinforcement patterns used). - Add beam data, crack sketches and photos to folio; compare to tower performance and discuss strengths/weaknesses of each structure type. 	<ul style="list-style-type: none"> - Evidence: Beam test record (load, deflection, failure mode, sketches). - Folio updated: separate section for concrete beam with data and reflection. - Outcomes focus: IND5-4, IND5-7, IND5-8, IND5-9.
10	Folio completion, reflection &	<ul style="list-style-type: none"> - Societal and environmental impact of structures: materials use, maintenance, 	<ul style="list-style-type: none"> - Class: Complete folio sections (costing & sustainability, final 	<ul style="list-style-type: none"> - Summative: Final Water Tower & Beam Folio submitted (including

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	industry link (wrap-up)	recycling, embodied energy. - Industry links: civil/structural engineers, construction trades, fabrication, inspection/maintenance roles. - Revision of key concepts from the unit: WHS, materials & corrosion, structural behaviour, testing & evaluation.	evaluation, personal reflection). - Short reflection: "What I learned about structures and why it matters in the real world." - If time: Quick preview/demo of the next topic (e.g. hydraulic digger/mechanisms) to show continuity from structures to mechanisms.	safety, materials, design, build log, test data, evaluation, costing & environmental considerations). - Optional short quiz/exit ticket on core theory. - Outcomes focus: IND5-1 to IND5-10 sampled across folio and reflection.