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Building Services Engineer (mechanical) – model career pathway – Version 1.0

AIRAH Strategic aim #2 - *Closing the skills gap*



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Feedback and comments

AIRAH welcomes all comments on the model career pathways defined in this report.

Feedback should be send to carolyn@airah.org.au

About AIRAH

AIRAH is the recognised voice of the Australian air conditioning, refrigeration and heating industry. We aim to minimise the environmental footprint of our vital sector through communication, education and encouraging best practice.

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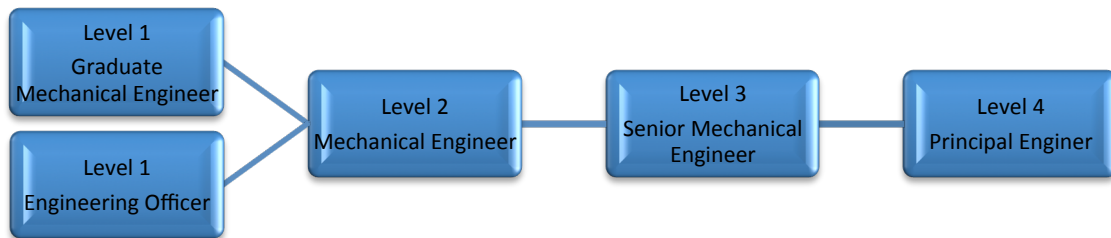
Model career pathways

Following interviews, industry survey and analysis, the following model career pathways are provided to the HVAC&R industry for use as guidance.

It is recognised that engineers will have varying exposure to the aspects of the skills, tasks and knowledge depending on a range of factors including size and structure of their organisation.

In order to improve the proposed pathway, all feedback is welcome – e-mail carolyn@airah.org.au

For full details of the development process refer to *Building Services Engineer (mechanical) – model career pathway – Version 1.0 Job analysis and report, April 2013*



Career pathway for Mechanical Engineers working in Building Services

Summary of Career levels and role descriptions

Lvl	Title	Role
1	Engineering Officer (for those with a trade background, or currently studying toward an engineering degree) Graduate Engineer (the most junior position for graduates)	Undertake concept design, schematic design, design development, tender documentation, construction supervision, and practical completion duties under the direct supervision of a more senior engineer.
2	Mechanical Engineer	Undertake concept design, schematic design, design development, tender documentation, construction supervision, and practical completion duties under the limited supervision of a more senior engineer, or independently.
3	Senior Mechanical Engineer	Undertake feasibility assessment, master planning, design development, tender, and construction supervision duties with broad conceptual guidance from a more senior engineer.
4	Principal Engineer	Translate clients brief into a system that achieves the engineering functions required of a building. Direct resources, personnel and new business towards fulfilment of overall organisational objectives. Lead business development, service provision and technical quality and innovation.

Level 1 (entry level) | Engineering Officer or Graduate Engineer

Model Career Pathway Building Services Engineer (mechanical) Version 1.0	
Level 1 (entry level) Engineering Officer or Graduate Engineer	
Title	<p>Engineering Officer (for those with a trade background, diploma or advanced diploma, or currently studying toward an engineering degree)</p> <p>Graduate Engineer (the most junior position for engineering graduates)</p>
Role	Undertake concept design, schematic design, design development, tender documentation, construction supervision and practical completion duties, under the direct supervision of a more senior engineer.
Tasks	<p>Concept design</p> <ul style="list-style-type: none"> • Receive plans/brief from architect • System to be used determined by Senior/Principal Engineer • Determine room and ceiling spaces required for mechanical services • Confirm understanding of the brief • Evaluate environmental performance <p>Schematic design</p> <ul style="list-style-type: none"> • Preliminary thermal calculations • Client/architect liaison • Depict generally how the system will function • Environmental performance assessment and measurement <p>Design development</p> <ul style="list-style-type: none"> • Perform software modelling and calculations • Determine heat loads and prepare calculations • Detailed design determining size of plant and equipment • Analyse and apply performance requirements of Australian Standards, the National Construction Code, State Planning Legislation and Regulations • Coordinate with other services (electrical, hydraulic, fire, lifts) • Prepare reports (specifications, equipment schedule) including quality requirements • Submit all documents to Senior Engineer for review • Support to achieve good design outcome <p>Tender documentation</p> <ul style="list-style-type: none"> • Assist with fee and cost calculations, and budget preparation • Engage with contract issues • Package documentation for approval from client, architect and other building services • Review tenders for discrepancies in scope (materials and costs) • Review against brief • Coordination <p>Construction supervision</p> <ul style="list-style-type: none"> • Conduct site visits to confirm installation by contractor is according to the design • Respond to requests for information (RFIs) • Ensure regular client contact and engage with clients as directed • Prepare site inspection reports • Review of variations, defects and liabilities period and practical completion • Assist with ensuring that specified design flow rates are achieved (contractor) • Assist with labour allocation (contractor) <p>Practical completion</p>

	<ul style="list-style-type: none"> • Inspect for defects • Assist with addressing defects • Hand over operations and maintenance manual to the building owner • Inspect installation in one year's time <p>Other duties as required</p> <ul style="list-style-type: none"> • Assist with witnessing commissioning • Other duties as directed by senior engineer and/or manager
Technical / analytical /process skills	<ul style="list-style-type: none"> • Appreciation of the built environment • Brief interpretation • Computational analysis • Document control • Drafting and 3D modelling • Information gathering (access the "right information") • Perform calculations • Problem solving • Spatial reasoning • Basic job costing and financial skills • Basic engineering measurement techniques (for air and water flows, noise) • Undertaking continuing professional development • Basic review and analysis
Soft skills	<ul style="list-style-type: none"> • Active listening • Clear communication and non-technical writing (co-workers, clients, architects, on-site contractors) • Negotiation skills (with other services and architect on design) • Presenting to clients • Basic project management (including on multiple projects) • Report writing • Teamwork • Time management
Knowledge	<ul style="list-style-type: none"> • Acoustics • Air conditioning system types • Basic psychrometrics • Building materials characteristics • Building structures • Climate • Computer software • Conservation (energy/water) • Construction stages • Costs (of construction, labour and other consultants) • Cultural differences • Daylight • Design responsibilities for occupational health and safety • Different design techniques • Drawing practices and standards • Duct design • Electrical engineering controls • Energy performance • Engineering and refrigeration principles, techniques, procedures and equipment • Environmental rating tools • Financial implications of different design concepts • Fluid mechanics • Human factors in engineering design

	<ul style="list-style-type: none"> • Internal comfort requirements • Legislative compliance requirements (building hierarchy, Australian Standards, National Construction Code, relevant state and territory acts and regulations) • Low energy technologies • Mathematics • Network piping analysis • On-site hazards • Protective equipment • Refrigeration and water systems • Right sizing • Safe work method statement • Statics and strength of materials • Sustainability and environmental issues • Thermodynamics • Working at heights
Skills and knowledge for the future	<p>Skills</p> <ul style="list-style-type: none"> • Building information modelling (BIM) • Energy modelling • Revit – MEP • Calculation for mixed mode ventilation • Passive system design • Low energy system design skills • Energy management (including relevant software) <p>Knowledge</p> <ul style="list-style-type: none"> • Basic understanding of building management systems • Soft Landing framework • Environmentally responsive building design and design requirements of other disciplines • NABERS, Green Star requirements • Sustainable development and green building • Mixed mode ventilation • Emerging energy efficient products and technologies

Level 2 | Mechanical Engineer

Model Career Pathway Building Services Engineer (mechanical) Version 1.0	
Level 2 Mechanical Engineer	
Title	Mechanical Engineer
Role	Undertake concept design, schematic design, design development, tender documentation, construction supervision and practical completion duties, under the limited supervision of a more senior engineer, or independently .
Tasks	<p>Concept design</p> <ul style="list-style-type: none"> • Receive plans/brief from architect • System to be used determined by Senior/Principal Engineer • Determine room and ceiling spaces required for mechanical services • Confirm understanding of the brief • Evaluate environmental performance <p>Schematic design</p> <ul style="list-style-type: none"> • Preliminary thermal calculations • Client/architect liaison • Depict generally how the system will function • Environmental performance assessment and measurement <p>Design development</p> <ul style="list-style-type: none"> • Perform software modelling and calculations • Determine heat loads and prepare calculations • Detailed design determining size of plant and equipment • Analyse and apply performance requirements of Australian Standards, the National Construction Code, State Planning Legislation and Regulations • Coordinate with other services (electrical, hydraulic, fire, lifts) • Prepare reports (specifications, equipment schedule) including quality requirements • Submit all documents to Senior Engineer for review • Support to achieve good design outcome <p>Tender documentation</p> <ul style="list-style-type: none"> • Assist with fee and cost calculations, and budget preparation • Engage with contract issues • Package documentation for approval from client, architect and other building services • Review tenders for discrepancies in scope (materials and costs) • Review against brief • Coordination <p>Construction supervision</p> <ul style="list-style-type: none"> • Conduct site visits to confirm installation by contractor is according to the design • Respond to requests for information (RFIs) • Ensure regular client contact and engage with clients as directed • Prepare site inspection reports • Review of variations, defects and liabilities period and practical completion • Assist with ensuring that specified design flow rates are achieved (contractor) • Assist with labour allocation (contractor) <p>Practical completion</p> <ul style="list-style-type: none"> • Inspect for defects • Assist with addressing defects • Hand over operations and maintenance manual to the building owner • Inspect installation in one year's time

	<p>Other duties as required</p> <ul style="list-style-type: none"> • Assist with witnessing commissioning • Other duties as directed by senior engineer and/or manager
Technical/ analytical /process Skills	<ul style="list-style-type: none"> • Appreciation of the built environment • Brief interpretation • Computational analysis • Document control • Drafting and 3D modelling • Information gathering (access the “right information”) • Perform calculations • Problem solving • Spatial reasoning • Basic job costing and financial skills • Basic engineering measurement techniques (for air and water flows, noise) • Undertaking continuing professional development • Basic review and analysis
Soft skills	<ul style="list-style-type: none"> • Active listening • Clear communication and non-technical writing (co-workers, clients, architects, on-site contractors) • Negotiation skills (with other services and architect on design) • Presenting to clients • Basic project management (including on multiple projects) • Report writing • Teamwork • Time management
Knowledge	<ul style="list-style-type: none"> • Acoustics • Air conditioning system types • Basic psychrometrics • Building materials characteristics • Building structures • Climate • Computer software • Conservation (energy/water) • Construction stages • Costs (of construction, labour and other consultants) • Cultural differences • Daylight • Design responsibilities for occupational health and safety • Different design techniques • Drawing practices and standards • Duct design • Electrical engineering controls • Energy performance • Engineering and refrigeration principles, techniques, procedures and equipment • Environmental rating tools • Financial implications of different design concepts • Fluid mechanics • Human factors in engineering design • Internal comfort requirements • Legislative compliance requirements (building hierarchy, Australian Standards, National Construction Code, relevant state and territory acts and regulations) • Low energy technologies

	<ul style="list-style-type: none"> • Mathematics • Network piping analysis • On-site hazards • Protective equipment • Refrigeration and water systems • Right sizing • Safe work method statement • Statics and strength of materials • Sustainability and environmental issues • Thermodynamics • Working at heights
<p>Skills and knowledge for the future</p>	<p>Skills</p> <ul style="list-style-type: none"> • Building information modelling (BIM) • Energy modelling • Revit – MEP • Calculation for mixed mode ventilation • Passive system design • Low-energy system design skills • Energy management (including relevant software) <p>Knowledge</p> <ul style="list-style-type: none"> • Basic understanding of building management systems • Soft Landing framework • Environmentally responsive building design and design requirements of other disciplines • NABERS, Green Star requirements • Sustainable development and green building • Mixed mode ventilation • Emerging energy efficient products and technologies

Level 3 | Senior Mechanical Engineer

Model Career Pathway Building Services Engineer (mechanical) Version 1.0	
Level 3 Senior Mechanical Engineer	
Title	Senior Mechanical Engineer
Role	Undertake feasibility assessment; master planning, design development, tender, and construction supervision duties with broad conceptual guidance from a more senior engineer.
Tasks	<p>Feasibility assessment</p> <ul style="list-style-type: none"> • Translate client’s brief into a system that achieves the engineering functions required of a building • Assist in setting vision and performance outcomes • Identify the viability of the project • Formulate a brief for the client • Form a “works package”/(tender) • Determine and submit an engineering design services fee • Estimate other costs and program times • Plan work <p>Master planning</p> <ul style="list-style-type: none"> • Determine system selection options • Identify industry trends • Ensure concept design is on track and meeting timelines with internal staff • Test solutions <p>Design development</p> <ul style="list-style-type: none"> • Review detailed documents (incl. sizing and system selection) prepared by Mechanical Engineer • Monitor progress of design • Ensure design meets the performance requirements of Australian Standards, the National Construction Code, State Planning Legislation and Regulations • Communicate with internal project team members and external clients • Negotiate with other building disciplines and coordinate feedback • Facade design <p>Tender</p> <ul style="list-style-type: none"> • Manage queries from tenderers • Review contractors pricing (matches design criteria) • Check exclusions • Recommend selected tender to client • Review against statutory and brief requirements <p>Construction supervision</p> <ul style="list-style-type: none"> • Review contractors installation proposal • Ensure integrity of design • Conduct site inspections, if required • Check contractors quality assurance procedures • Witness systems in operation • Review energy consumption, if required • Certification • Assess variations • Review alternative proposals • Assist in rectifying defects <p>Other</p>

	<ul style="list-style-type: none"> • Supervise the preparation and submission of bids • Supervise relationships with clients • Direct resources, personnel and new business towards fulfilment of overall organisational objectives • Provide technical assistance/training to less experienced engineers • Supervise/lead/manage professional and non-professional staff, individually or in teams • Provide technical review of engineering services to ensure the functional, operational and performance requirements are met • Conduct life-cycle costing and energy audits • Ensure that the operating and maintenance manuals (including commissioning data) are provided to the client • Financially manage projects as assigned • Develop and oversee schedules • Be responsible for the commissioning of systems
Technical/ analytical /process Skills	<p>Skills for Graduate Mechanical Engineer plus:</p> <ul style="list-style-type: none"> • Allocate labour (contractor) • Analyse quality control • Benchmarking • Coordinate with external design team members • Design requirements of other disciplines (electrical, fire, hydraulics etc.) • Develop assumptions • Job costing and financial skills • Planning and monitoring • Pre-commissioning of installed systems (contractor) • Manage own continuing professional development
Soft skills	<ul style="list-style-type: none"> • Collaboration • Communication • Critical thinking • Leadership • Manage client expectations • Manage contracts • Manage multiple projects • Manage multiple view points • Manage project finances • Manage staff • Mentorship and staff professional development • Negotiation • Non-technical writing • Presentation (to client) • Prioritise • Problem solving (inventive) • Resolve conflicts between builders / property owners and contractors • Selling design solutions
Technical knowledge	<p>Knowledge for Graduate Mechanical Engineer plus:</p> <ul style="list-style-type: none"> • New technologies • Local, state and federal government regulations and acts • Provide a rationale for system selection and design • Building disciplines • Scheduling • NABERS, Green Star • Re-lifing buildings

	<ul style="list-style-type: none"> • Climatically responsive building design • Advanced psychrometrics • Advanced refrigeration principles • Basic knowledge of the fundamentals of design of other disciplines (electrical, fire safety, hydraulics, waste management etc.) • Life-cycle costing analysis
Non-technical knowledge	<ul style="list-style-type: none"> • Meeting procedures/etiquette • Motivations • Contract law • Emotional intelligence • Occupational change • Business management • Quality assurance and auditing • Vision setting • Occupational change • Mentorship
Skills and knowledge for the future	<p>Skills</p> <ul style="list-style-type: none"> • Building information modelling coordination • National Construction Code alternative solutions and advanced alternative modelling • Integrating green designs, zero carbon considerations • Forward projection / life-cycle planning <p>Knowledge</p> <ul style="list-style-type: none"> • Stewardship

Level 4 | Principal Engineer

Model Career Pathway Building Services Engineer (mechanical) Version 1.0	
Level 4 Principal Engineer	
Title	Principal Engineer
Role	<p>Translate client's brief into a system that achieves the engineering functions required of a building.</p> <p>Direct resources, personnel and new business towards fulfilment of overall organisational objectives.</p> <p>Lead business development, service provision and technical quality and innovation.</p>
Tasks	<p>Business development</p> <ul style="list-style-type: none"> • Present and explain proposals, reports and findings to clients • Consult or negotiate with client to prepare project brief • Understand client requirements • Analyse technology, resource needs and market demand to plan and assess the feasibility of projects • Networking • Preparation of proposals to management • Technical mentorship • Manage team professional development • Manage client expectations <p>Management</p> <ul style="list-style-type: none"> • Ensure functional, capital and operational requirements are met • Develop and implement policies, standards and procedures • Recruit employees, assign, direct and evaluate performance • Be responsible for staff training • Provide mentorship and stewardship to support team in delivering on the functional, operational and performance requirements of the brief • Set financial targets • Determine concepts in line with the organisation's policy direction • Be responsible for office profitability • Be responsible for marketing and bringing work into the office • Be responsible for contract reviews and dispute resolution • Lead continued professional development <p>Technical</p> <ul style="list-style-type: none"> • Set concepts and review design development • Resolve design and test problems • Ensure design intent is met • Certification • Manage design errors • Respond and manage potential professional indemnity claims • Assure the quality of work by less senior engineers
Technical/ analytical /process skills	<p>Skills for Senior Engineer plus:</p> <ul style="list-style-type: none"> • Complex problem solving • Technical skills and knowledge management • Cost analysis • Quality assurance/auditing
Soft skills	<ul style="list-style-type: none"> • Client research • Active learning • Judgement and decision making

	<ul style="list-style-type: none"> • Risk management • Marketing • Human resource management • Leadership
Technical knowledge	<p>Knowledge for Senior Mechanical Engineer plus:</p> <ul style="list-style-type: none"> • Expert witness • Industry trends • Personal development and structures
Non-technical knowledge	<ul style="list-style-type: none"> • Business development • Financial principles, documentation • Human resources • Knowing the audience • Leadership techniques • Marketing • Office culture • Strategic planning
Skills and knowledge for the future	<p>Skills</p> <ul style="list-style-type: none"> • Advising staff and clients about energy modelling for energy-efficient equipment • Advanced comfort management • Collaboration, mentorship and professional development of staff • Applying a more holistic approach to BIM • Outsourcing and working with staff in other countries <p>Knowledge</p> <ul style="list-style-type: none"> • The latest technologies and engineering design trends from overseas

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