



# Bridging the knowledge gap from Technologist to Professional Engineer

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# Abstract

A comparison of course structures is undertaken between the 3-year Management Group's Bachelor of Engineering Technology (Civil) and the Washington Accord accredited 4-year Bachelor of Engineering (Hons)(Civil) at the Universities of Auckland, Canterbury and Southern Queensland. Analysis is also included for the Engineers Australia endorsed Master of Engineering Practice at the University of Southern Queensland that is designed to bridge the knowledge gap between Technologist and Professional Engineer. On the basis of the analysis the difference in full time study between Sydney and Washington Accord degrees should be no more than 1 - 2 years assuming similar course breadth and depth across qualifications at the same NZQA levels.

# Knowledge Profiles

19 signatories and 5 provisionals make up the Washington Accord.

10 signatories and 3 provisionals make up the Sydney Accord.

A Washington Accord programme provides:	A Sydney Accord programme provides:
WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline	SK1: A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline
WK2: Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline	SK2: Conceptually-based mathematics, numerical analysis, statistics and aspects of computer and information science to support analysis and use of models applicable to the sub-discipline
WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline	SK3: A systematic , theory-based formulation of engineering fundamentals required in an accepted sub-discipline
WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.	SK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline
WK5: Knowledge that supports engineering design in a practice area	SK5: Knowledge that supports engineering design using the technologies of a practice area
WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline	SK6: Knowledge of engineering technologies applicable in the sub-discipline
WK7: Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability	SK7: Comprehension of the role of technology in society and identified issues in applying engineering technology: ethics and impacts: economic, social, environmental and sustainability
WK8: Engagement with selected knowledge in the research literature of the discipline	SK8: Engagement with the technological literature of the discipline

# Washington Accord Comparison

Subject	NZQA Level	U of Auckland (2017)	NZQA Level	U of Canterbury (2017)	NZQA Level	USQ (2017)	Norm Min Level
Mathematics	6	ENGSCI 211 Mathematical Modelling 2 ENGSCI 311 Mathematical Modelling 3	6	EMTH 118 Engineering Mathematics 1A EMTH 119 Engineering Mathematics 1B EMTH 210 Engineering Mathematics 2 ENCN 304 Deterministic Mathematical Methods	6	ENM1600 Engineering Mathematics ENM2600 Advanced Engineering Mathematics	6
Electrical/Electronic	5	ELECTENG 101 Electrical and Digital Systems	3	High School Physics	4	ENG1002 Introduction to Engineering and Spatial Science Applications	4
Mechanics	5	ENGGEN 121 Engineering Mechanics	5	ENGR 102 Engineering Mechanics	5	CIV1501 Engineering Statics	5
Materials	6	CIVIL 250 Civil Engineering Materials and Design CHEMMAT 121 Materials Science	6	ENCN 221 Engineering Materials	6	MEC1201 Engineering Materials	6
Thermodynamics & Chemistry	4	ENGGEN 140 Engineering Biology and Chemistry	5	CHEM 111 Chemical Principles and Processes PHYS 101 Engineering Physics A: Mechanics, Waves and Thermal Physics	4	ENG1002 Introduction to Engineering and Spatial Science Applications	4
Fluids	7	CIVIL 230 Fluid Mechanics 1 CIVIL 331 Hydraulic Engineering ENVENG 333 Engineering Hydrology	7	ENCN 242 Fluid Mechanics and Hydrology ENCN 342 Fluid Mechanics and Hydraulics	7	ENV2103 Hydraulics I ENV3104 Hydraulics II ENV3105 Hydrology ENV4203 Public Health Engineering	7
Structures	6	CIVIL 210 Introduction to Structures CIVIL 211 Structures and Design 1	7	ENCN 231 Solid Mechanics ENCI 335 Structural Analysis ENCI 336 Structural Design	7.5	MEC2402 Stress Analysis CIV2503 Structural Design I CIV3505 Structural Analysis CIV3506 Concrete Structures CIV2605 Construction Engineering CIV4508 Structural Design II	7
Soil Mechanics & Geotechnics	7	CIVIL 220 Introductory Engineering Geology CIVIL 221 Geomechanics 1 CIVIL 322 Geomechanics 2	7	ENCN 253 Soil Mechanics ENCN 353 Geotechnical Engineering	7	CIV2403 Geology and Geomechanics CIV3403 Geotechnical Engineering	7
Surveying	5	CIVIL 201 Land Information Systems	4	ENCN 261 Transport and Surveying	5	SVY1500 Spatial Science for Engineers	4.5
Design	5	ENGGEN 115 Principles of Engineering Design	6	ENCN 213 Design Studio 1 ENCI 313 Civil Engineering Design Studio 2	6	ENG1100 Introduction to Engineering Design CIV3907 Civil Systems Practice	5
Software Engineering	6	ENGGEN 131 Introduction to Engineering Computation and Software Development	6	EMTH 171 Mathematical Modelling & Computation ENCN 305 Computer Programming and Stochastic Modelling	6	ENG3104 Engineering Simulations and Computations	6

# Washington Accord Comparison cont.

Subject	NZQA Level	U of Auckland (2017)	NZQA Level	U of Canterbury (2017)	NZQA Level	USQ (2017)	Norm Min Level
Transportation	7	CIVIL 360 Transportation Engineering CIVIL 361 Transportation Engineering 2	5	ENCN 261 Transport and Surveying	6	CIV3703 Transport Engineering	6
Environmental	6	ENVENG 244 Environmental Engineering 1	6	ENCN 281 Environmental Engineering	6	ENV4203 Public Health Engineering	6
Business	6	ENGGEN 204 Managing Design and Communication ENGGEN 303 Managing Projects and Innovation CIVIL 790 Civil Engineering Administration ENGGEN 403 Managing a Business General Education (exclude from count) ENGGEN 499 Practical Work	6	ENGR 100 Academic Writing Assessment ENGR 101 Foundations of Engineering ENCI 199 Health & Safety on the Worksite ENCN 201 Communication Skills Portfolio 1 ENCN 301 Communication Skills Portfolio 2 ENCN 470 Professional Engineering Development ENCN 371 Project and Infrastructure Management Practical Work	6	ENG2002 Technology, Sustainability and Society ENG1004 Engineering and Spatial Science Problem Solving Principles ENG4110 Engineering Research Methodology ENG3003 Engineering Management ENG3902 Professional Practice 1 ENG1901 Engineering Practice 1 ENG4903 Professional Practice 2 ENG4909 Work Experience – Professional	6

# Washington Accord Comparison - Electives

Subject	U of Auckland (2017)	U of Canterbury (2017)	USQ (2017)
Electives	CIVIL 312 Structures and Design 2 CIVIL 313 Structures and Design 3 ENVENG 341 Environmental Engineering 2 ENVENG 342 Environmental Engineering Design CIVIL 314 Structural Dynamics CIVIL 324 Geomechanics 3 CIVIL 332 Fluid Mechanics 2 CIVIL 713 Structures and Design 4 CIVIL 731 Water Resources Modelling CIVIL 758 Traffic Systems Planning and Design CIVIL 791 Construction Management CIVIL 714 Multistorey Building Design CIVIL 741 Ground Improvements and Geosynthetics Engineering CIVIL 750 Timber Engineering CIVIL 759 Highway and Transportation Design ENVENG 701 Urban Stormwater Management ENVENG 740 Water and Wastewater Engineering CIVIL 718 Light Gauge Steel CIVIL 719 Matrix Structural Analysis CIVIL 721 Foundation Engineering CIVIL 725 Geotechnical Earthquake Engineering CIVIL 733 Coastal Engineering 1 CIVIL 715 Advanced Structural Concrete CIVIL 726 Engineering Geology CIVIL 734 River Engineering CIVIL 782 Water Resources Engineering ENVENG 746 Surface Water Quality Modelling ENVENG 747 Soil-Contaminant Fate Processes and Modelling ENVENG 750 Advanced Sustainability Engineering CIVIL 701 Studies in Civil Engineering 1 CIVIL 710 Advanced Structural Dynamics CIVIL 743 Special Topic: Building Information Modelling ENGGEN 701 Professional Project	ENCI 423 Advanced Structural Analysis and Dynamics ENCI 425 Structural Steel ENCI 426 Structural Concrete ENCI 427 Timber Structures ENCI 429 Structural Systems ENCN 401 Engineering in Developing Communities ENCN 412 Traffic Engineering ENCN 415 Pavement Engineering ENCN 444 Water Infrastructure and Design ENCN 445 Environmental Fluid Mechanics ENCN 452 Advanced Geotechnical Engineering ENCN 454 Geotechnical Earthquake Engineering ENCN 481 Environmental Engineering Design ENGR 403 Fire Engineering ENGE 411 Engineering Construction Practice ENGE 412 Rock Mechanics and Rock Engineering ENGE 415 Engineering Geomorphology and Geohazards GEOL 475 Engineering and Environmental Geophysics	AGR3304 Soil Science CIV3603 Construction Methods CIV5704 Road and Street Engineering CIV5705 Pavement Design and Analysis ENG4004 Engineering Project and Operations Management ENV2201 Land Studies ENV4107 Water Resources Engineering ENV4204 Environmental Technology GIS1402 Geographic Information Systems MEC2401 Dynamics I SVY1104 Survey Computations A URP3201 Sustainable Urban Design and Development URP1001 Introduction to Urban and Regional Planning

# Washington Accord Comparison - Summary

		U of Auckland (2017)	U of Canterbury (2017)	USQ (2017)
<b>Summary</b>		CIVIL 705 A & B Research Project  3 x Level 7 electives 4 x Level 8 electives Total courses = 34 Business = 6 Tech = 28	ENCN 493 Project  6 x Level 8 electives Total courses = 37 Business = 8 Tech = 29	ENG4111/2 Research Project  6 x electives Total courses = 38 Business = 8 Tech = 30

# USQ MEP(Civil) c.f. BEngTech upskill for BE(Hons)

Subject	NZQA Level	USQ Master of Engineering Practice (Civil) (BEngTech to BE(Hons) Pathway with 5 years experience)	NZQA Level	BEngTech(Structural)	Norm WA Min Level	BEngTech (Structural) Upgrade Courses
Mathematics	5	ENM1600 Engineering Mathematics	6	MG5004 Engineering Mathematics 1 MG6190 Mathematics 2 CC	6	ENM2600 Advanced Engineering Mathematics Open Poly
Electrical/Electronic					4	Online Basics of Electrical Technology <a href="https://alison.com/courses/Basics-of-Electrical-Technology">https://alison.com/courses/Basics-of-Electrical-Technology</a>
Mechanics			5	MG5002 Engineering Mechanics	5	
Materials			5	MG5107 Civil Materials	6	
Thermodynamics and Chemistry					4	Online Introduction to Thermodynamics <a href="https://www.coursera.org/course/introthermodynamics">https://www.coursera.org/course/introthermodynamics</a> or 214.111 Chemistry in the Environment Massey U Or Chem 191 Introductory Chemistry - Victoria <a href="https://www.victoria.ac.nz/courses/chem/191/2018/offering?crn=7193">https://www.victoria.ac.nz/courses/chem/191/2018/offering?crn=7193</a>
Fluids	7	ENV3104 Hydraulics II	5	MG5008 Fluid Mechanics	7	ENV3104 Hydraulics II USQ
Structures	8	CIV3505 Structural Analysis CIV3506 Concrete Structures CIV4508 Structural Design II	5	MG5032 Basic Structures MG6046 Structural Principles* MG6007 Structural Steel and Timber* MG6008 Structural Concrete* MG7004 Design of Structures* * Electives	7	CIV4508 Structural Design II USQ* *Elective
Soil Mechanics & Geotechnics	7	CIV3403 Geotechnical Engineering	5	MG5009 Engineering Site Investigation	7	CIV3403 Geotechnical Engineering USQ
Surveying			5	MG5006 Land Surveying	4	



# USQ MEP(Civil) c.f. BEngTech upskill for BE(Hons) cont.

Subject	NZQA Level	USQ Master of Engineering Practice (Civil) (BEngTech to BE(Hons) Pathway with 5 years experience)	NZQA Level	BEngTech(Structural)	Norm WA Min Level	BEngTech (Structural) Upgrade Courses
Design	7	CIV4908 Civil Design Practice	6	MG5005 Engineering Design and Drawing MG6005 Civil Engineering Detailing and Modelling	5	
Software Engineering			5	MG5001 Engineering Computing	6	
Transportation	6	CIV3703 Transport Engineering	5	MG5012 Highway Engineering	6	GEH7.361 Pavement Design NZIHT or CIV5704 Road and Street Engineering USQ or CIV3703 Transport Engineering
Environmental					6	ENV4204 Environmental Technology Open Poly or 214.111 Chemistry in the Environment Massey
Business	7	ENG8300 Self-Assessment Portfolio ENG8311 Workplace Portfolio	7	MG7025 Project Management CC MG7026 Risk Management CC MG6106 Civil Engineering Construction Practices MG5003 Engineering Communication MG6103 Engineering Management Principles MG7121 Professional Engineering Practice	6	

# USQ MEP(Civil) c.f. BEngTech upskill for BE(Hons) - Electives

Subject	NZQA Level	USQ Master of Engineering Practice (Civil) (BEngTech to BE(Hons) Pathway with 5 years experience)	NZQA Level	BEngTech(Structural)	Norm WA Min Level	BEngTech (Structural) Upgrade Courses
Electives		1 from: ENG8104 Asset Management ENG8208 Advanced Engineering Project Management  1 from: ENV4203 Public Health Engineering CIV5705 Pavement Design and Analysis		MG6046 Structural Principles MG6007 Structural Steel and Timber MG6008 Structural Concrete MG7004 Design of Structures  MG6109 Water and Waste Engineering MG6110 Water and Waste Treatment MG6011 Hydrology and Erosion Management MG7005 Urban Drainage Systems  MG6012 Geotechnical Engineering A MG6045 Geotechnical Engineering B MG6013 Engineering Geology MG7045 Geotechnical Engineering C  MG6012 Geotechnical Engineering A MG6014 Highway Design and Maintenance MG6015 Traffic Engineering MG7007 Urban Transport Planning  MG5113 Fundamentals of Environmental Engineering MG6116 Sensitive Environment MG7008 Sustainable Resource Utilisation MG7109 Resource and Environmental Management		

# USQ MEP(Civil) c.f. BEngTech upskill for BE(Hons) - Summary

		<b>USQ Master of Eng Practice (Civil)</b> (BEngTech to BE(Hons) incl. 5 years experience	<b>BEngTech(Structural)</b>	<b>BEngTech (Structural) Upgrade Courses</b>
<b>Summary</b>		ENG8308 Industry Project  Electives 2 Total courses = 13 Business = 2 Tech = 11	MG7101 Eng Development Project  3 x Level 6 electives 1 x Level 7 elective Total courses = 23 Business = 6 Tech = 17	Electives 1 Total courses =8 Business = 0 Tech = 8

# Overall Summary

		U of Auckland (2017)	U of Canterbury (2017)	USQ (2017)
<b>Summary</b>		CIVIL 705 A & B Research Project  3 x Level 7 electives 4 x Level 8 electives Total courses = 34 Business = 6 Tech = 28	ENCN 493 Project  6 x Level 8 electives Total courses = 37 Business = 8 Tech = 29	ENG4111/2 Research Project  6 x electives Total courses = 38 Business = 8 Tech = 30

		USQ Master of Eng Practice (Civil) (BEngTech to BE(Hons) incl. 5 years experience)	BEngTech(Structural)	BEngTech (Structural) Upgrade Courses
<b>Summary</b>		ENG8308 Industry Project  Electives 2 Total courses = 13 Business = 2 Tech = 11	MG7101 Eng Development Project  3 x Level 6 electives 1 x Level 7 elective Total courses = 23 Business = 6 Tech = 17	Electives 1 Total courses = 8 Business = 0 Tech = 8

# Conclusion

- Analysis of 3 Washington Accord accredited BE(Hons)(Civil) degrees shows that they average 29 technical courses and 8 business courses.
- Analysis of the BEngTech(Civil) shows that it contains 17 technical courses and 6 business courses.
- At USQ, transitioning from the BEngTech(Civil) to the BE(Hons)(Civil) via the Master of Engineering Practice (Civil) requires 5 years experience and additional knowledge of 11 technical courses and 2 business courses. The USQ Master of Engineering Practice is designed to “...enable experienced Engineering Technologists to demonstrate and/or acquire the academic, personal, professional, and technical knowledge, skills and understanding required to commence practice as a graduate Professional Engineer in Australia or overseas...”  
(<https://www.usq.edu.au/handbook/current/engineering-built-environment/MEPR.html>)
- Transitioning from the NZ Management Group BEngTech(Civil) to the BE(Hons)(Civil) will require knowledge of minimum of 8 additional technical courses (many providing additional breadth of knowledge) although an additional 12 technical courses and 2 business courses are required to meet the Washington Accord degree average course count.
- The analysis assumes similar course breadth and depth across qualifications at the same NZQA levels.

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