MCIBSE CEng Experience Based Learning Record

The purpose of this form is to demonstrate how the applicant has gained learning within a professional environment. They must show that their knowledge and skills are equivalent to those gained in an academic setting at Masters level. The learning outcomes on this form are from the Engineering Council Accreditation of Higher Education programmes (AHEP 4) model which details the standards that academic courses must cover to be accredited.

To determine if an engineer has gained sufficient experiential learning to be equivalent to Masters Level learning they must describe a variety of problem-solving activities and projects which they have either led or were substantially involved in. These can be the same projects that are referenced in your Engineering Practice Report. When describing these activities or projects you should identify how you are demonstrating your ability to carry out the activities described in the following learning outcomes. Your description should be clear and concise and include how you gained the knowledge and skills required. Use 'I' statements rather than 'we'.

Name: **Membership no:**

AHEP Reference	Learning Outcome	Company and job title	Date	Examples of **technical experience** gained in the workplace Please add a **brief** summary of examples of technical experience gained in the workplace.	**For Office use only – Assessor Comments**

M1	Is able to draw upon a comprehensive knowledge of natural science and engineering principles in the solution of complex problems which will often be at the forefront of current knowledge.	[redacted]	April 2021 to May 2025	<u>Example 1:</u> [redacted] <u>– Critical Chilled Water System Design</u> I designed the critical cooling system for the [redacted] first to the coordinated design stage, and then to the detailed design stage. Following the completion of the phased IT installation the facility would total a cooling load of 7.5MW, and so I had to ensure the efficiency and energy usage of the system was fully optimised. I designed a system comprising of Water Cooled Chillers, as opposed to Air Cooled Chillers, as they utilise the ambient wet-bulb temperature for heat rejection, rather than the ambient dry-bulb. As T_{wb} is lower than T_{db}, the condensing temperature and pressure of the refrigerant within the chiller is reduced, and therefore the compressor needs to do less work and hence consume less energy. This had significant benefits to	

				optimising the Power Usage Efficiency (PUE) of the facility; maximising the IT output of the facility compared to the energy consumed by the facility and its systems. Furthermore, the longer lifespan of Water Cooled Chillers, combined with the improved efficiency, offset the initial capital cost uplift required over traditional Air Cooled Chiller solutions. In order to further optimise the efficiency of the primary cooling system, I designed a resilient heat rejection circuit comprising of adiabatic coolers served from a ring-main configuration to allow for continuous heat rejection regardless of maintenance or plant failure. Utilising adiabatic heat rejection rather than evaporative further optimised the efficiency of the system, both in terms of reduced fan speed and usage, and also reduced water consumption. I also configured the system to operate at 20^{o}C flow and 28^{o}C return, to introduce the opportunity for free cooling and further reduce the energy consumption. This resulted in an SEER of 7.38.	
			June to December 2024	Example 2: [redacted] – LZC Primary System Design I led the mechanical design for the [redacted] up to RIBA Stage 2, and wanted to push the LZC design as far as possible whilst remaining within the clinical requirements of the HTMs and NHS Net-Zero Carbon framework. I designed the heating and cooling plant using R290 heat pumps in an N+1 configuration, at roof level to minimise the risks of propane inside the building. I used integrated primary shunt pumps on the flow, to serve dedicated LTHW and CHW low-loss headers. Completing the primary side of the system, I sized a 2-pipe buffer vessel on the primary return of each circuit to minimise the potential cycling of the heat pumps and improve efficiency. I wanted to drive passive design throughout the building; however, future climate trends were a concern with regards to overheating where solely relying on natural ventilation. As a heating system would already be required, I designed an underfloor heating system that utilised a motorised changeover valve on the inlet to the manifold connected to the CHW system. This would then allow peak-lopping underfloor cooling to be used during particularly	

				warm weather, to enhance the benefits of natural ventilation and adaptive thermal comfort. My design here had significant impacts on the building envelope and structural design, particularly with material selections and their subsequent thermal mass, and so I demonstrated to the Client and the Architect that, by using CIBSE TM52 thermal modelling analysis through IES Virtual Environment with future climate data, this hybrid design solution would be successful in achieving comfortable conditions to the occupants within the space throughout the lifespan of the building whilst significantly reducing the energy consumption of the main servicing plant.	
			November 2024	Example 3: [redacted] – Air Handling Unit De-steaming To calculate the benefits of de-steaming the frost and heating coils to 43No. existing Air Handling Units at the [redacted] I calculated and designed a new LTHW system to interface with a low-carbon district heating system. I facilitated the survey of the existing units to ascertain the current capacity and outputs of the steam system. This also had added benefit in understanding the current compliance with HTM guidelines, and identify whether further works were necessary to meet the clinical classifications. I built an Excel spreadsheet to size the coils and associated energy consumptions, based on the surveyed fan motor size, air flow rate and specific fan power. Firstly, using CIBSE external design temperatures, I calculated the peak heating load using $Q = m \cdot C_p \cdot \rho \cdot \Delta T$. One such use of this calculation resulted in an estimated frost coil size of 137kW and reheat coil size of 200kW; using an airflow rate of 12.5m^3/s from the survey information, an air density and specific heat capacity of 1.225kg/m^3 and 1.005kJ/kg.K respectively, and a winter external design temperature of -3.9^{o}C. The frost coil was sized to an off-coil temperature of 5^{o}C, with the reheat coil then uplifting the supply temperature to an average banding of 18^{o}C internal setpoint derived from HTM 03-01 Appendix 2 across clinical spaces. In order to then design the distribution network to these coils, I used the flow and return	

				temperatures of the district heating system (83/72°C F&R) and the calculated coil outputs to size the pipework using a rearrangement of the above formula. In this instance, I used a water density and specific heat capacity of 1kg/m^3 and 4.186kJ/kg.K, and a temperature differential of 11°C. Rearranging $Q = m \cdot C_p \cdot \rho \cdot \Delta T$ to find the mass flow rate, where Q is the total coil load of 337kW, then enabled the sizing of the pipework.	
M2	Is able to identify, process, interpret and apply natural science and engineering principles in the solution of complex problems. Using engineering judgment to work with information that may be uncertain or incomplete to make a well reasoned conclusion.	[redacted]	November 2024	<u>Example 1: [redacted] – Air Handling Unit De-steaming, continued</u> Further to the peak frost and reheat coil sizing I conducted on the [redacted] de-steaming works, I subsequently calculated the estimated annual energy consumption and proposed carbon emission savings associated with replacing the energy generation from steam to the integration on the electrically generated sitewide district heating system. To achieve this, I ran the same coil output equation, $Q = m \cdot C_p \cdot \rho \cdot \Delta T$, for every hour of an annual weather file. I imported the [redacted] data into my spreadsheet, and calculated the frost and reheat coil outputs per hour for each of the 43No. AHUs. Each individual calculation used the same methodology and inputs as the initial peak coil sizing, but used the weather file ambient T_{db} as the initial on-coil temperature rather than the CIBSE winter design condition. For instances where the ambient temperature exceeded the frost coil off-coil temperature of 5°C, I bypassed the frost coil and instead uplifted the ambient external temperature to the 18°C setpoint solely using the reheat coil. Using this methodology I did have to assume a constant airflow rate in each AHU; however, to comply with HTM design guidance of fixed Air Change Rates in the clinical spaces, this assumption was justified. Using the 8760 calculated outputs per coil for each AHU, I then summated the values to achieve an estimated MWh annual consumption for each of the frost and reheat coils. Then, using a derived efficiency of 77.4% for the gas-fired boilers serving the steam system, and a simplified assumption of 3.63 COP for the district heating system, I then converted the MWh into annual energy consumption. Using	

				Government-reported data for Gas and Electricity prices and $kgCO_2e/kWh$ equivalent carbon emissions, I then demonstrated the operational costs and proposed carbon emission savings associated with the works.	
			November 2024	Example 2: [redacted] – Air Handling Unit Heat Recovery Implementation Following the conclusion of the de-steaming analysis on the existing [redacted] at the [redacted], I identified a number of mitigations that could be implemented in order to further reduce the energy consumption of some of the units. I proposed that introducing heat recovery to units currently with no interfacing between supply and return airstreams would result in significant energy savings. Additionally, I empirically demonstrated that omitting the aforementioned frost coil would result in additional energy savings, through maximising the differential temperature across the heat recovery system and thus improving the efficiency of the heat transfer. Using a development of my yearly annual energy consumption spreadsheet, I first calculated the reheat on-coil temperature based on an estimated runaround coil efficiency of 40%; a worst-case assumption derived from discussions with an AHU manufacturer with experience in similar retrofit projects. My initial calculations using this on-coil temperature resulted in an approximate 10.4% annual reduction in energy consumption and equivalent carbon emissions. The second stage of the calculations was to omit the frost coil, using the climate data as the pre-heat recovery condition. Taking the peak as an example – an external T_{db} of -3.7^{o}C – the benefits of this omission are most prevalent. In the base-case scenario, a frost coil ΔT of 8.7^{o}C and reheat coil ΔT of 13^{o}C at the 12.5m^3/s flowrate resulted in a total heating load of 334kW. Introducing the runaround coil increased the reheat on-coil temperature from 5^{o}C to 11.8^{o}C, and therefore reduced the reheat coil load from 200kW to 95.4kW, for a total heating load of 229kW. I then removed the frost coil and the reheat on-coil decreased to 6.2^{o}C, but the total heat load also dropped to 176kW. Overall, I	

			January 2024 to May 2025	calculated an average annual energy consumption saving of 11.9% per unit. <u>Example 3: [redacted] – Existing System Appraisal and Overheating Analysis</u> The buildings within the [redacted] utilise fan-assisted natural ventilation as the only source of fresh air. I led the retrofit design to RIBA Stage 3 on these buildings, and as part of the design process I conducted CIBSE TM52 overheating analysis using IES Virtual Environment. For the natural ventilation to sufficiently operate within the building, the initial design philosophy utilised a fully open-plan internal layout to promote the movement of air to glazed stair cores, which subsequently promoted the stack effect. The proposed architectural design deviated from this strategy, and so I pushed the Architect to adapt their internal layouts to ensure sufficient air paths from the air inlets at the perimeter to the stair turrets were retained. Furthermore, it was clear from the overheating assessment that any cellular spaces on South-facing facades would experience overheating in future climate scenarios. I ran the simulations using the Nottingham 2050High50 weather file to analyse the building's thermal performance, and this data provided the platform for me to further optimise the architectural design to remove this overheating risk. I then directly liaised with the Client and end users to understand the legacy issues of overheating within the existing system. I created and presented an operational guide on the mechanical building services to the end-user, where my principal recommendation was to remove the opportunity for the short-circuiting of hot air from the stacks in the stair turret back into the top floor. There was insufficient height from the top floor stair core entrance to the top of the stack, with the resulting neutral pressure line driving warm air into the top floor. I presented this risk to the FM team, to ensure the requirement for isolating the top floor from the rest of the building was implemented in the building's standard operation.	

M3	Is able to engage appropriate computational and analytical techniques to better understand complex problems	[redacted]	February 2022 to July 2023	<u>Example 1: [redacted] – D55 Ward BMS Analysis</u> I was engaged by the Trust to investigate the root causes of overheating within their acute respiratory isolation rooms during a significant spell of warm weather. Working with the BMS commissioning engineers, I received weekly data dumps of the system operation, consisting of Outside Air Temperature, Internal Space Temperature, Off-Coil Air Temperatures, Calculated Supply Air Set Points, Supply Static Pressures, Lobby Air Pressures, and Supply and Extract Fan Speeds. I created graphical representations of the system performance over time, and plotted the trend data against the commissioning test results. I could then determine the relationship between the internal and external conditions to identify the cause of the issues. I identified that the isolation suite lobbies were operating at a significantly reduced air pressure; HBN design stipulates an 8-12Pa pressurisation of the lobbies, and my data analysis indicated an actual value of between 2-6Pa. I undertook a site visit to visually inspect the operation of the systems. The pressure stabilisers were not opening correctly and there was a significant temperature differential between the lobby and the isolation suite, which supported my findings that the supply air wasn't impacting the isolation suite despite correct conditioning. I held multiple review workshops with the Trust and the BMS commissioning engineers to advise them how to rectify this issue. This consisted of on-site adapting of set-points, followed by a subsequent data download which I analysed against the trends of the system prior to any modifications. Ultimately, this process was effective in alleviating the issues with the system. The supply and extract fan speeds were reverted back to their as-commissioned values to ensure 10ACH, and then the supply fan speed was incrementally increased until the lobby air pressure reached the desired range.	

			August to September 2022	Example 2: [redacted] – Energy Conservation Measures I undertook a costing exercise to calculate required cost uplifts across 8No. template hotels/climates for the implementation of carbon saving upgrades to the mechanical and electrical services, versus the like-for-like replacements. As part of this process, I calculated an estimated payback period based on the operational energy savings, accounting for local cost indices, local energy tariffs and local carbon emissions associated with the primary energy generation. I developed a spreadsheet model to first calculate the capital costs of a direct like-for-like replacement based on manufacturer quotes to create a baseline cost, and then compared this value to the cost of upgrading the efficiency of that system. This included for all ancillary works associated with the measure, such as the decommissioning of defunct services, additional builderswork openings, and associated electrical installations where additional power was required. An example measure was the installation of Variable Speed Drives and Variable Air Volume to all AHUs. I calculated the costs associated with the isolation of connected services, the supply and installation of the VSDs, VAVs and CO_2 sensors including cabling and terminations, the re-balancing of the systems upon completion, and the testing and commissioning of the installations including BMS integration. To calculate the payback period, I first calculated the energy savings as a result of implementing the demand-based ventilation. This required a basic assumption that implementing VSDs would remove a typical design margin from the volume flowrate of the AHUs. Then, using power affinity laws, I derived that a fan operating at 110% output would require 133% more power: $q_1/q_2 = (n_1/n_2)$, $dp_1/dp_2 = (n_1/n_2)^2$, $P_1/P_2 = (n_1/n_2)^3$ where *q* is the volume capacity, *dp* is pressure, and *P* is power. This provided the baseline auxiliary energy consumption, which I could then use to subsequently calculate the CAPEX costs and OPEX savings for each template climate.	

			November 2024	<u>Example 3: [redacted] – Air Handling Unit upgrades, continued</u> Further to my investigations and calculations on the steam coil replacements and implementation of heat recovery at the [redacted], I expanded the scope of my calculations to include further potential AHU upgrades. These include performance uplifts due to replacing and upgrading of filters, replacement of belt-driven fans to EC fan walls, integrating BMS controls, and a deep-clean of the units. Each upgrade utilised an assumed percentage uplift in the performance of the fan motor based on manufacturer guidance, which in combination with the previously calculated energy consumptions associated with the heating coils provided an overall annual energy and carbon emission saving for each AHU. Combining these energy saving measures into one spreadsheet model then allowed me to demonstrate the savings associated with different combinations of measures. Furthermore, I ensured that all design inputs used for the annual heat load calculations can be easily modified, to facilitate future flexibility or for fine-tuning after further site investigations. This is particularly useful with the integration into the sitewide district heating system. I initially calculated these energy savings using an assumption for the COP of the cascade 2-stage heat pump configuration of 3.63. As the heat pump design and installation is through a different workstream, I took the lowest efficiency value offered in the construction issue technical submittal issued by the Contractor. If more accurate efficiency values are known at a later date, or if elements such as the equivalent carbon emission factors and energy prices were to change, then these can be very quickly implemented with the output energy saving calculations then automated.	
M4	Is able to select and critically evaluate technical literature and other sources of information to solve complex problems	[redacted]	June 2024 to Present	<u>Example 1: [redacted] BSRIA BG/50 and BG/29 review of existing Heating and Cooling systems</u> As part of my role as Technical Advisor to the [redacted] for their ongoing sitewide decarbonisation, I identified the requirement to investigate the water quality of their	

				existing heating and cooling systems due for retention. The main decarbonisation works are the eventual replacement of the primary heating and cooling generation systems; currently gas-fired boilers and steam-powered absorption chillers. The installation of their replacements, a 2-stage cascade heat pump system, will be owned and operated by others to create a hydraulically separate sitewide primary distribution network. This will connect into the existing secondary systems across the [redacted] via plate heat exchangers. I identified that by connecting an aged existing system into a new interface point, there is a risk of poor water quality and system blockages negatively impacting the heat transfer from the primary system. Therefore, following water quality testing, I evaluated the results against the requirements outlined in BSRIA BG/50 and BG/29. This included factors such as the physical condition, the quantities of nitrates, phosphates and sulfates, alkalinity, water hardness, corrosion, and microbiology such as pseudomonas count. It was clear from my analysis that, if the systems were connected without further intervention, not only would the Trust be in breach of contract with regards to providing adequate water quality, but that the primary system may not be able to achieve HTM-compliant conditions with regards to Domestic Hot Water provision as a result of the blockages and restricted/throttled flow throughout the existing pipework and equipment. I therefore provided design guidance to the Trust to implement water conditioning units across their existing systems, strategically placed based on the Contractor's construction issue design information, to ensure that existing system performance is improved and contractual obligations are met at the point of interface.	
			November 2022 to Present	Example 2: [redacted] – HBN 04-01 Isolation Suite Design Further to my work on the [redacted] acute respiratory isolation suites, I developed a clinical classification strategy for the [redacted] against the HTM guidance, and presented this to the Trust's technical advisors for their approval. I had to ensure that the included isolation rooms were HBN 04-01 and HTM 03-01 Part A	

				compliant. To achieve this, I had to size and select supply-only AHUs which delivered air to the isolation room lobby. The isolation room itself has a stringent requirement for 10ACH in addition to accounting for air escaping through door leakage, which must be supplied to a positively pressurised lobby to prevent the spread of infectious disease. In the design phase, I originally assumed a value of 0.080m^3/s using Appendix 4 of HTM 03-01 for a double door. However, I understood from my legacy knowledge from the D55 BMS analysis and a further review of the 9-part commissioning pressure testing in BSRIA BTS 3/2018, that this value would likely be much lower in reality. When writing the specification clauses for this system, I ensured that the Contractors understood that the supply fan should initially be setup to achieve the 10ACH in the isolation room, and then the fan speed is incrementally increased until the required differential pressure is achieved in the lobby. I sized and coordinated pressure stabilisers to operate between the lobby and the isolation room, to allow the full 10ACH to impact the room whilst ensuring the lobby remained positively pressurised to between 8-12Pa. I then designed a dedicated extract system from the adjacent WC ensuite, using bifurcated extract fans to allow the safe maintenance of the units, and HEPA filtration to prevent cross-contamination of airstreams after exhaust.	
			December 2024 to July 2025	<u>Example 3:</u>[redacted] <u>Process Machine Equipment Technical Requirements</u> The key driver in the design of manufacturing or industrial projects is the servicing requirements to the process machinery/equipment. In this case, these requirements were substantial and constantly evolving. The specific processes and workflows within the facility were under development alongside the RIBA Stage 3 design, and so I had to remain flexible in my servicing strategy and design. Particular processes in this facility included the requirement for local exhaust ventilation, process gases such as nitrogen, argon and compressed air, and deionised water. The Client would issue their individual machine's servicing requirements, which I would then	

				review to confirm the sizing and integration to the wider building systems. Once confirmed, I then embedded these into the design. For example, one particular manufacturing process had an LEV requirement of 4.0m^3/s, a diversified compressed air load of 2,800Nm^3/hr, and would emit heat up to temperatures of 250^{o}C. I firstly designed a makeup supply ventilation system with VAV control, to modulate the airflow based on the operation of the extract system. The main challenge with this was to ensure the minimum turndown of the VAV provided sufficient background ventilation to the space during process downtime. I then investigated the opportunity to recover heat from the extract system, as 250^{o}C air at 4.0m^3/s would be wasteful to exhaust. Air-to-air heat recovery would be the most effective method of heat transfer at these temperatures; however, the process heat gain wouldn't be consistent or dependable, or conversely the incoming supply airstream could potentially be too warm after the heat transfer. Therefore, I designed a fresh air inlet system to dilute the extract airstream prior to the transfer, using a combination of a non-return backdraft dampers and motorised control dampers to modulate the total air volume and match the incoming airflow requirements back to the makeup supply.	
M5	Is able to resolve complex problems using original thought meeting a combination of societal, user, business and customer needs as appropriate. This will involve consideration of applicable health and safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards.	[redacted]	June to December 2024	<u>Example 1: [redacted] HBN 11-01 Design and the NHS Net-Zero Building Standard</u> The design brief for the [redacted] was to provide a Primary and Community Care facility, with additional Dentistry treatment, Vulnerable/Young Persons mental health facilities, and a community library and pharmacy. Given the multitude of functions, users and conflicting clinical requirements, I first had to understand the hierarchy of legislation that would apply to each area. The overall facility had to comply with HBN 11-01, the Dentistry areas fall under HTM 01-05, and any treatment spaces required compliance against the standard HTMs such as 03-01 for ventilation and 04-01 for water management. However I, alongside the Architect and the Client, identified the opportunity to increase the passive and LZC design principles across the wider facility. The NHS Net-Zero	

				Building Standard can conflict against the technical requirements of the HTMs, and so I developed a clinical classification strategy to derogate away from the HTMs and loosen the servicing requirements of particular zones and space categories. I then steered the Architect to place these derogated spaces along the perimeter, to facilitate the inclusion of natural ventilation. Based on site constraints, the majority of these spaces would be located on the South façade. Therefore, I produced a solar shading strategy to include brise-soleil, and defined clear performance requirements for the g-values, reflectivity and u-values of the glazing to minimise the impact of direct solar radiation within the spaces. In some spaces however, such as the Mental Health facilities, the implementation of natural ventilation would not be suitable due to the requirement for larger openings in the façade. With those spaces on the ground floor, this could present an issue of safeguarding for the occupants, alongside an increased sensitivity to privacy. Therefore, despite the sustainability benefits, these spaces were instead included on the central mechanical ventilation system.	
			June 2024 to Present	Example 2: [redacted] – Sitewide Decarbonisation Technical Advisory Role Under my appointment as Technical Advisor to [redacted] at the [redacted], I have to balance good practice design principles with a consideration of Contractor's priorities, Client requirements for clinical classifications, potential future expansions and the phased nature of sitewide decarbonisation. These sitewide works are governed through the Public Sector Decarbonisation Scheme, where funding is granted based on calculated equivalent carbon emissions savings from the proposed works. Therefore, any review I undertake of the technical proposals developed by the Contractor should prioritise the energy savings of the solution. However, the constraints of integrating the sitewide decarbonisation with the existing LTHW, HWS and CHW networks across the 3 primary blocks/cores presents challenges in maintaining this priority in lieu of functionality, practicality and cost. For example, the most straightforward integration of the new primary CHW network to the West Block	

				system would be connecting a new hydraulically separated "thermal substation" into the top of the riser from the roof, and backfilling the system with the new lead coolth provision. However, anecdotal evidence suggested the inverter frequency of the secondary distribution pumps, located in the basement, are manually balanced and adapting these setpoints would starve certain circuits in peak conditions. Furthermore, the access and maintenance zones to these pumps have been diminished over time, and so the replacement with modern equivalents to allow automated balancing would have significant impacts on surrounding unrelated services, project costs, and Contractor scope. As Technical Advisor, my guidance to the Trust in this instance must prioritise the correct functionality of the proposals. As such, I advised that the Contractor's design to backfill the CHW system from the roof should be rejected, with a defined requirement for the updated proposal to connect into the original primary circuit at the basement to maintain the secondary circuit's pressure regime.	
			February 2022 to July 2023	<u>Example 3: [redacted] D55 Ward BMS Analysis, continued</u> As part of my investigative works into the issues of overheating within the [redacted] ward isolation suites, I conducted site visits to supplement the desktop study of BMS data with actual observations. Despite nearing the end of the COVID pandemic, the nature of the isolation suites providing acute respiratory care required substantial health and safety considerations. I conducted a risk assessment to balance the merits of a site visit with the risks posed to the patients, myself and my colleagues. I deemed the visits necessary, as the initial BMS data was unclear in immediately identifying the root cause of the overheating issues experienced. Pressure loss through the system was evident, but physical observations were necessary to determine the functionality of the pressure stabilisers, a comparison of the pressure data to the magnehelic gauges, and any potential external factors introducing further heat gain to the suites. During the site visits, I had to gain permission from the Ward Nurse to enter the ward. This included	

				strict compliance with PPE and H&S protocols; demonstrating negative COVID tests, the wearing of facemasks and gloves, and ensuring no construction debris or contaminants were introduced to the ward. I then would speak to the patients themselves for permission to enter the isolation suite and inspect the systems. In some instances, this was denied and so had to be respected. It was evident from the site visits that the ventilation and pressure strategy was not being adhered to, with occupants and nurses forcing open windows and internal doors. This had an adverse effect on both the infection control strategy and the space temperature, with the cool air escaping before it could condition the space. Part of the remediation strategy included the locking of windows to prevent this, which ultimately aided the successful recommissioning works.	
M6	Is able to approach, plan and resolve complex problems using a systems approach and taking account of multiple stakeholders and/or factors.	[redacted]	January to March 2025	Example 1: [redacted] – Low Loss Header Bypass Arrangement Following a value engineering process on all packages in the [redacted], the design responsibility for the CHW system shifted to the Contractor. They produced design proposals that significantly differed from my developed design which the Client had reviewed, accepted, and cemented as their contractual works information. As such, my role of MEP lead then developed into an extensive review of the new proposals to ensure they complied with the Client's requirements. One such amendment proposed by the Contractor was to the resilience strategy of the primary CHW system, changing the configuration of the load-sharing duty/duty low loss headers to duty/standby. From a technical perspective this change was insubstantial, but the proposal introduced a risk of water stagnation in the standby header. Following my raising of this issue back to the Contractor, they proposed a weekly manual changeover routine that did not fit with the Client's expected operational model for the facility. To rectify this issue, the Contractor then proposed a minimum flow bypass arrangement to prevent stagnation in the standby header, and thus extend the changeover requirement to fit with the valve	

				exercising routine for the rest of the facility. However, I was concerned that the flowrates and velocities in the standby header were still insufficient. They had been sized to provide one system volume turnover every 24 hours, which resulted in a velocity of approximately 0.5mm/s. A CFD review of the system required a laminar solver, which I argued was unreliable in confirming sufficient water turnover throughout the header. My technical advice to the Client, which was then successfully implemented by the Contractor, was to increase the flow rate through the bypass until a turbulent CFD solver – such as the *k-ε* solver – indicated sufficient dynamic movement in all areas of the header.	
			April 2024	<u>Example 2: [redacted] – On-Rack Cooling Loop Commissioning</u> As part of the commissioning process for the CHW system of the [redacted], I led the workshop and client-side design review of the specification and integration of a bespoke temporary heat generation system, to simulate load on the CHW system. The Contractor's proposal utilised electric boilers, to uplift the CHW circuit to the 28^{o}C secondary return design temperature. However, following my review it was clear that the control strategy for the introduction of this heat to the CHW system would not be sufficient in commissioning the PDU control valves, or demonstrating the system response to realistic load profiles. Their configuration consisted of a tertiary shunt pump from the temporary boiler to a plate heat exchanger acting as the interface point, with 3-port control valves only providing a constant volume of 28^{o}C water to the PDU branches. I identified that this would therefore only test the system capacity and not the dynamic response to a variable load. The drivers for the Contractor's design philosophy centred around the costs for the temporary load generation, and an inherent difference between their understanding of a data centre versus a [redacted] the former having a relatively stable baseline load requirement, and the latter having a much more dynamic and variable load profile. It was a fundamental Client requirement that they have confidence in their system being able to	

				adapt to such a profile, and so I developed and presented a control strategy for the temporary circuits using PICVs with manual actuation to provide the required load profile. Alongside the Contractor and the Commissioning specialist, I then supported the development of an integrated systems test to ensure the Client's requirements were met for the commissioning of the primary system and the PDU control valves, and for their confidence in the response of the system.	
			November to December 2023	Example 3: [redacted] ASHP Acoustic Concerns and Boundary Planning Conditions One of the challenges encountered when specifying the ASHPs for the [redacted] was with regards to the noise emissions under stringent planning conditions. A nearby housing estate drove the planning requirement for plant noise to not exceed 5dB below the typical night-time background noise level of 25dB(A), resulting in a maximum allowable noise emission of 20dB(A) at the nearest sensitive residential receptor (NSR). I organised and managed the integration of a specialist Acoustics team within [redacted] to further investigate potential mitigations, liaised with the Planning consultants to further understand the conditions specified by the Local Authority, and personally undertook technical discussions with the ASHP manufacturer to experiment with alternative compressor sizes and acoustic measures that could satisfy the conditions. My design development with the manufacturer resulted in several potential mitigations, ranging from inexpensive but low impact to satisfactory yet far too expensive to justify the implementation. Furthermore, many acoustic mitigations increased the height of the units, which would then result in their protruding over plant screens and subsequently failing compliance with other planning regulations. Therefore, I used CIBSE TM54 Energy Modelling methodology with IES Virtual Environment to provide estimates on the 'actual' performance of the heat pumps during nighttime conditions. My findings suggested that during Summer the units operated at just 13% capacity, and at 56% capacity in the Winter. I presented these findings to the Acoustics team, the	

				Planning consultants and the Local Authority. The resulting acoustic savings, as a result of the compressor operation in these turndown scenarios, did not exceed the boundary conditions nor the ISO 289-7:2019 threshold of hearing at the site boundary. Ultimately, the plant selection was accepted to be compliant within the planning condition.	
M7	Is able to evaluate the environmental and societal impact of solutions to complex problems	[redacted]	January 2024 to May 2025	[redacted] <u>– Existing System Appraisal and Overheating Analysis, continued</u> Following the CIBSE TM52 analysis I undertook on the [redacted] I then had to evaluate the opportunities and risks associated with a change to the intended function of one particular building. The Client intended to overhaul the building from open-plan office spaces to cellular University teaching spaces, including lecture theatres and seminar rooms with high occupant densities. These clearly would not function as intended with the retention of the original natural ventilation philosophy, but the building's Grade II listing placed specific emphasis on the original sustainability and passive design principles. I therefore had to minimise any mechanical interventions in order to limit additional energy consumption, to adhere to these heritage and conversation constraints. My solution was to push the Architect to retain open plan spaces wherever possible, in order to facilitate dedicated plant requirements solely for the high-density spaces. There, I implemented demand-based VAV displacement ventilation controlled by CO_2 sensors to minimise the airflow requirements and the subsequent ductwork distribution. I purposefully omitted cooling coils from the plant to promote the occupants to open windows, increasing the fresh air intake during summer months and implementing an adaptive thermal comfort occupation model.	
M8	Is able to analyse a proposed course of action on the basis of ethical choices and relevant professional codes of conduct.	[redacted]	July 2024	<u>Sustainability Inception Reviews and General Ethical Practices</u> I am a firm believer in the delivery of sustainable and ethical design, aligning with the UN's Sustainable Development Goals. An example of my commitment to these philosophies is shown	

				through my leading of the mechanical team throughout the design phase of the Bosting Integrated Healthcare Centre. Here, one of my responsibilities in this role was to undertake a sustainability inception review alongside my multidisciplinary counterparts. I evaluated both the strengths and opportunities of the project against each of the 17 goals that form the UN SDGs. My particular focus areas were Goals 3, 10 and 11 – good health and wellbeing, reduced inequalities, and sustainable cities and communities. As part of my continued professional development, I ensure that I am suitably trained in ethical practices through both generic and project-specific training modules. Furthermore, I am aware of and adherent to the 4 fundamental principles outlined in the Engineering Council's Statement of Ethical Principles.	
M9	Is able to employ risk management techniques in the management of activities and projects	[redacted]	March 2024	<u>CDM Risk Registers, Access and Maintenance Drawings, and Plant Replacement Strategies</u> Across multiple instances of leading either the mechanical design team or the wider MEP team, I have created and developed various registers, drawings and strategies in order to clearly and sufficiently communicate the risks associated with the construction and maintenance of my work. I have communicated CDM risks through the creation of CDM risk registers, dedicated access and maintenance drawings, and plant replacement strategies. One such example of the risks I have raised within a risk register is for the [redacted]. A selection of the risks that I raised were those associated with ongoing adjacent construction works, risks of scalding or shocks when working alongside live services, the risk from exposure to refrigerant or the release of refrigerant during plant replacement, and the risk of falling when working at height. Despite highlighting these and similar risks across multiple projects, I understand that the safest principle is to avoid or minimise risk through safe design practices. To that end, I am trained in these practices under the CDM Regulations 2015, and am also a qualified CSCS card holder under the manager and professional category.	

M10	Is able to identify security risks in any proposed activity and mitigate them as appropriate	[redacted]	December 2024 to July 2025	[redacted] The [redacted] project has significant security risks associated with the manufacturing processes in the facility. As such, there were stringent requirements regarding the flow of information, layouts and images related to those processes. This presented challenges when I required specialist design input from both manufacturers and also internal colleagues who did not hold sufficient clearance. An example of such a challenge was in the designing of the desiccant dehumidification process for ISO 7 clean rooms. I could not discuss or share certain information with the manufacturers, and instead could only discuss the ventilation rate, the humidity control criteria, and the ISO cleanliness classification. Consequently, I had to appraise the solutions presented and suggest amendments to guide the equipment selections until the outcome was suitable for the system. External to the [redacted] project, I am also sufficiently trained in Data Privacy and Information Security through internal learning modules, which I routinely complete to ensure my continued awareness and adherence.	
M11	Is able to use the principles of equality, diversity and inclusion for the benefit of all stakeholders	[redacted]	November 2022 to January 2024	[redacted] – Neurodivergent Space Design A particular department at the [redacted] was required to be inclusive and suitable for neurodivergent occupants. As part of my role as the mechanical lead during the coordinated specific design, I had to ensure that any previously designed services were suitable for such an application. I had concerns that the provision of wall-mounted radiators – despite being specified as low-surface temperature – and the diffusers in the ceiling presented potential ligature risks. I therefore conducted a workshop with the Client and the Architect to present these risks, and understand the specific requirements of the occupants. It was determined that, due to the ceiling buildup, anti-ligature grilles would not significantly reduce any ligature risk. However, I was correct to identify that the LST radiators were unsuitable. Therefore, I implemented duct-mounted heater batteries as part of the ventilation system,	

				balancing the size of the coil with the airflow provision to the space. I then updated the controls specification to ensure that the PICVs controlling the LTHW flow to the coils would modulate based upon the inputs received from a temperature sensor within the space.	
M12	Is able to assess the practical factors underpinning any technical solution	[redacted]	June 2024 to Present	[redacted] – Sitewide Decarbonisation Technical Advisory Role, continued One of my key considerations when providing technical advice to NUHT with their sitewide decarbonisation is the access and maintenance implications of the Contactor's proposals. Many of the design deliverables issued for my review focus on the small, granular works that form part of the wider integration of existing systems to the district heating and cooling systems. These submissions often overlay proposed pipework routing and plate heat exchanger placement onto existing plantrooms. These plantrooms are tightly compact, with little tolerance for additional services. As part of my review process, I liaise with the Estates team members responsible for the ongoing maintenance of the existing services, to understand their access requirements to plant and valves. This, combined with a more standard technical review, then forms the basis of my responses. In many instances, proposals have been rejected purely based on the impact of new routing and equipment placement on the existing maintenance constraints. The challenging aspect of this role is then to provide sound technical and logistical alternatives to the Contractor's proposals, to ensure that both sides' requirements are met.	
M13	Is able to select appropriate materials, equipment and technologies for a given project or activity.	[redacted]	November 2022 to January 2024	[redacted] – Equipment Data Sheets for Procurement To deliver a coordinated specific design on the [redacted] I worked alongside the subcontracting team and their chosen manufacturers to create the equipment data sheets for their procurement. I had to ensure that all the technical requirements, materials and project constraints were accurately captured. I incorporated these units into our coordinated 3D model, to ensure that all connecting	

				services and access and maintenance requirements were feasible for installation. One particular example was the equipment selection process for the secondary LTHW and CHW pumps. Following the integration of all heating and cooling equipment such as radiant panels and AHU coils, I updated the sizing of pipework to a sufficient water velocity and static pressure drop per unit length. I then calculated the system static pressure loss on the index circuit, and used this value in my discussions with the pump manufacturer. However, I was aware of impending Stage 5 alterations to the pipework systems that would impact this system static pressure loss, notably the change in pipework material from stainless steel to copper. I therefore had to ensure that the subsequent amendments to the internal pipe diameter and roughness coefficients would not detrimentally impact the sizing and operation of the pumps.	
M14	Is able to employ quality assurance principles in delivering stakeholder satisfaction	[redacted]	January 2024 to May 2025	[redacted] – Client-Side Design Team Review Process I have led both the Mechanical team and wider MEP team under the appointment of client-side design review, with one such example being during the design development and construction phases of [redacted] buildings D and F. Here, I attended site to observe the installation practices of the Contractor and Mechanical Subcontractor; ensuring they are conforming to CDM and HSE regulations, following the design intent of the contractual works, and providing solutions to previously unknown constraints discovered during the works. This was accompanied by desktop reviews of design information produced by the Subcontractor as part of their design and build appointment. My conclusions and design guidance were communicated through site observation reports and technical submittal responses, which then formed the basis of workshops between myself, the Client and the Contractor to provide collaborative solutions. A particular concern during this process were the repeated attempts by the Contracting team to raise change requests and contract variations caused by their findings during the works. Whilst having to remain pragmatic in solving issues, it was important that each query was assessed on	

				its merits and against the tender documentation to ensure that the Client weren't being charged for unnecessary or out-of-scope works.	
M15	Is able to manage a project efficiently against key deliverables	[redacted]	June to December 2024	[redacted] – OBC and Planning Submissions Whilst defined as works up to RIBA Stage 2 per BSRIA BG/6 guidance, our appointment to provide SMEP deliverables on the BIHCC was primarily to provide a sufficient level of detail to support the project's Outline Business Case and then the subsequent planning permission submission to the local council. I led the mechanical team in this process, where I had to provide a level of detail which exceeded that of a typical concept design. I was responsible for the management of a team of mechanical engineers and technicians, ensuring that they produced work to a high quality whilst remaining within the project's financial budgets and programme. I then presented the mechanical deliverables of this project to the Client team to incorporate their comments, before then supporting the Architect with their further delivery towards the planning submission. Of particular importance here was the incorporation and sizing of the natural ventilation openings and louvres, as cementing this strategy was crucial is ensuring my sustainable design principles were captured in the submission and hence the contractual project requirements.	
M16	Is able to function effectively as an individual, and as a member or leader of a team. Evaluate the effectiveness of own and team performance	[redacted]	December 2024 to July 2025	[redacted] My role on the [redacted] project was supporting the lead mechanical engineer, where I took ownership of many facets of the design process. I lead the design of the ventilation, heating and cooling systems across both the manufacturing and ancillary areas of the building. Part of my responsibilities included the delegating of tasks and workstreams within these systems to a team of junior colleagues, managing their daily tasks and providing technical support. I was ultimately responsible for the quality and delivery of their work, and so would undertake rigorous checking exercises in	

				which I encouraged them to present and discuss the technical aspects of their calculations and modelling. I was also responsible for liaising with other multidisciplinary members of the design team, including electrical and structural engineers to collaborate on tasks such as the electrical maximum demand calculations, or the point loading of mechanical plant. These tasks were required alongside my own designing of the more complex aspects of the HVAC strategy, particularly the interaction between the makeup supply and local exhaust forming the majority of the process ventilation design.	
M17	Is able to communicate effectively on complex engineering matters with technical and non-technical audiences, evaluating the effectiveness of the methods used.	[redacted]	May 2025	[redacted] – Mechanical Design Principles Client Presentation Following the completion and handover of the retrofit to two of the buildings at the [redacted] the Client asked if I could present the mechanical engineering principles to the end-users to assist in their daily usage and occupation of the buildings. As the scope of the mechanical retrofit works aimed to retain the initial design philosophy of passive design, a change in ownership of the campus meant that legacy knowledge of the systems had been lost. I presented to the end-users an overview of both the initial system design coupled with the retrofit works and their intended impact on this design philosophy. This predominantly focused on the encouragement of natural ventilation paths, proposals for overcoming any short-term overheating concerns through passive means, and an overview of an adaptive thermal comfort occupation model. As areas of the buildings were to be leased to other tenants, it was crucial that the information and guidance I provided was easy to understand and could be used by the Client as part of their tenancy agreement for future occupants.	
M18	Plans and records self-learning and development as the foundation for lifelong learning/CPD.	[redacted]	August 2018 to Present	I strive to continue both my own professional development and that of my colleagues, through formal and informal training and research. During the infancy of my career, I organised regular CPD sessions with manufacturers based on areas I believed I required further learning, which additionally helped ensure the team were	

				current with their technical guidance. As I have progressed, I have mentored junior colleagues to organise their own CPD sessions, and I have been a regular attender of those both mechanical and electrical. I maintain records of my attendance in these sessions, which includes the learning material and certification totalling 114 hours of accredited learning across 31 different manufacturers and companies. I routinely complete internal training modules on widespread topics, both prevalent to mechanical engineering and in the wider construction sphere. These include such topics as asbestos awareness, general and specific site safety awareness, and more focussed learning on energy reporting, embodied carbon and sustainable design practices.	