

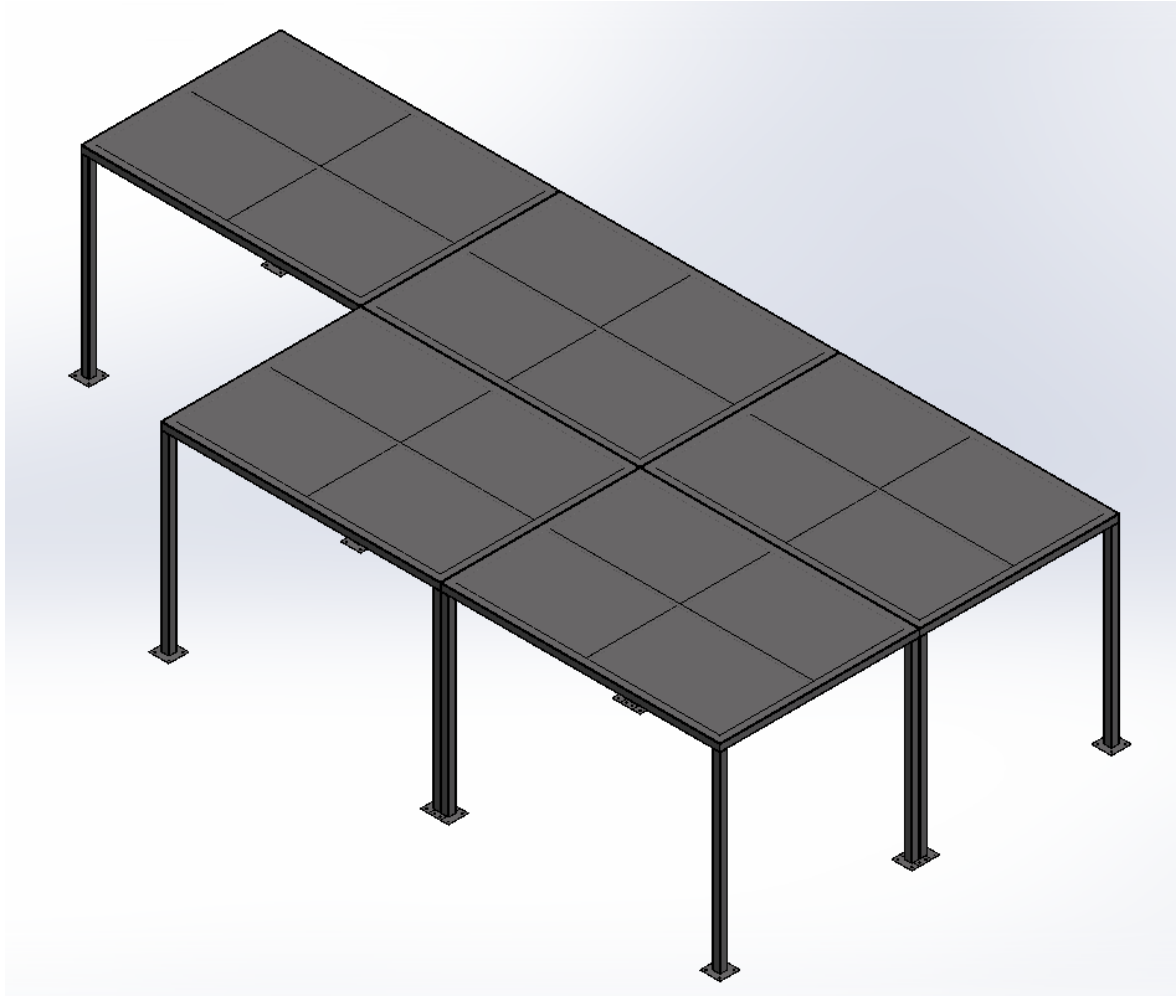
22 May 2023

Manchester Academy Air Source HeatPumps

Pump Stand Submission by B. Duncan B.Eng, M.Eng

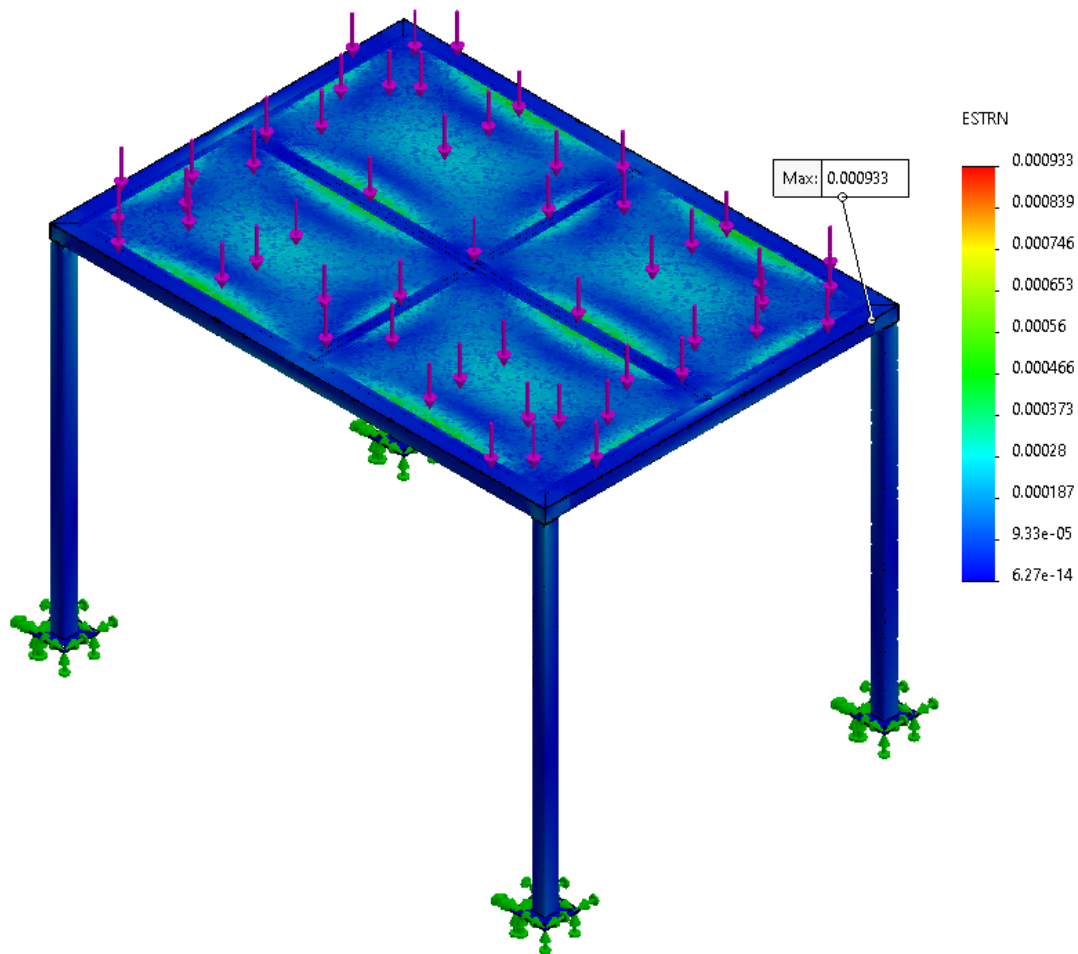
This is the design proposal and basic calculations/structural analysis for Manchester Academy's 5 heat pumps. The FEA analysis, SolidWorks modelling and hand calculations have been completed by an accredited mechanical engineer and time served 3D design engineer.

The pumps shall be supported on a box section frame with a supported non slip Durbar floor. The box section frame is to be made from 100x100x5mm S275 Box section steel, they will sit at a height of 2.5m off the ground, a louvred fence panel will surround the pumps and obscure them from view. The structure and louvred panels will be painted in RAL-7037 Dusty Grey. To fix the structure to the ground, high tensile M12 bolts will be driven into a concrete pad and secure them to ensure no lateral movement can occur. There will be four bolts per footing, each with a shear strength of 33.7kN giving a total of 134.8kN per footing. The welded pad secured to the 100mm box section with a 6mm fillet weld will provide a maximum potential shear and tensile strength of approximately 832kN.



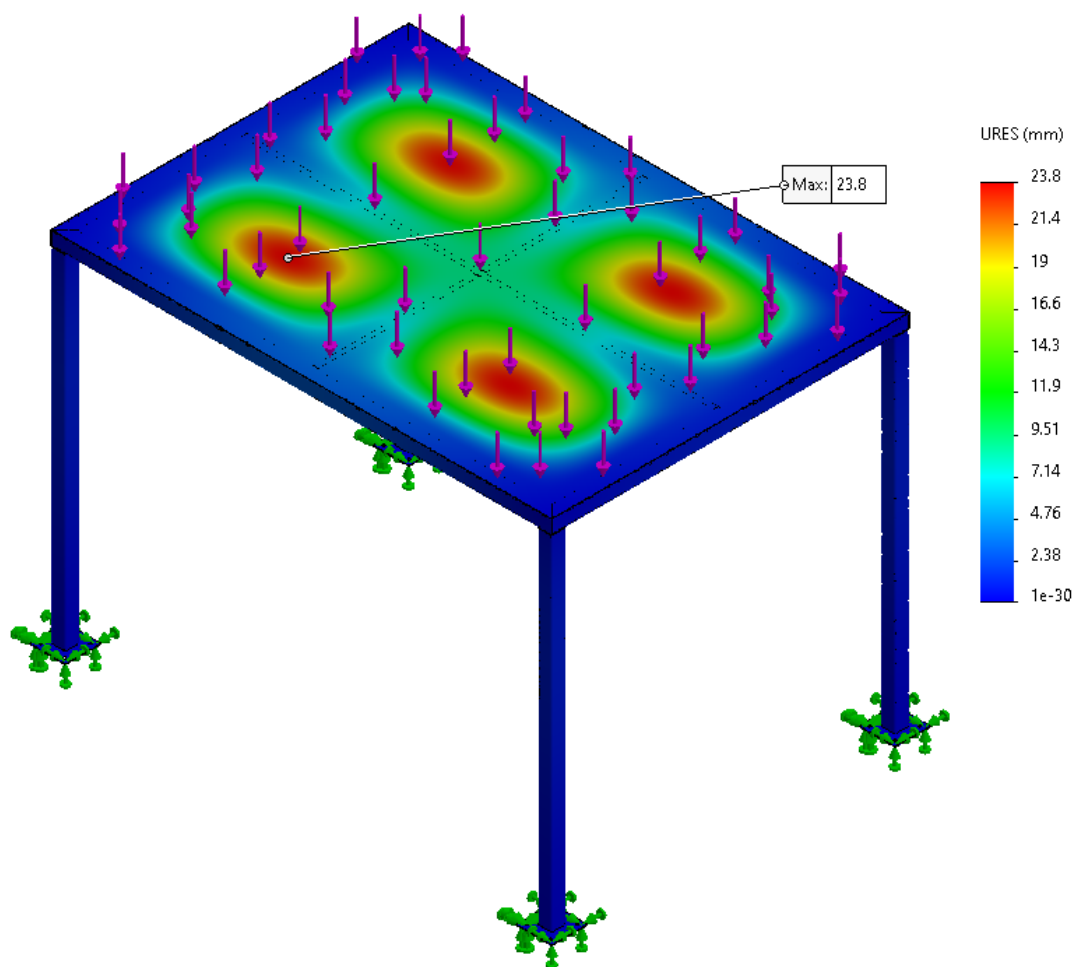
The model illustration above shows the assembled modular platforms in their proposed orientation, joining them together in this fashion will provide a stable and non slip access platform to the heat pumps for maintenance and installation works. Again M12 fasteners will be used to fix each section to the next, ensuring a strong and rigid foundation for the heat pumps.

FEA analysis shown below confirms the hand calculated values and loading strain on the platforms. With 3000kG applied as the loading (a safety calculation loading factor of 2.88) the maximum percentage failure of the legs is shown as 0.0009.



Subject to conditions and loading criteria, calculated at ambient temperature and at the average yield value of the chosen steel each leg has a potential maximum buckling load of around 50 tons in a purely vertical buckling condition.

The non slip steel plate floor upon which the heat pumps will sit is 3mm thick and supported by 50x50x3mm wall box section. With a load of 3000kG localised on the unsupported areas of plate, the maximum potential deflection is shown as 28mm which is well within the elastic limit for the steel. At 1039kG evenly spread loading, this will be negligible and unable to be seen by the naked eye.



Steel Platform Component Values	
M12 Fasteners 10.9	33.7kN Shear Strength, 87.7kN Ultimate Tensile Strength
100x100x5 RHS	50,000kN Load Limit in Fixed Buckling at 2.4m
50x50x3 RHS	Uniform Loading Deflection at 1m span 0.06mm
3mm Durbar Plate	Maximum Point Load Deflection at design intent 5.19mm (Reduced to sub 1mm with additional underfloor brace)
7018 Weld Material	52 kN Tensile Strength per inch of 6mm fillet weld