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AI-generated content may be incorrect.

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*Logbook*

## Foreword

Previously, I attempted to achieve this project in Semester 1, 2025 for PAST onboarding. However, I did not achieve sufficient milestones for my work to be accepted. I am re-applying, however, as I consider this project challenging and fulfilling and failed to achieve most of the significant design, I am redoing this project. Milestones 1 & 2 have been kept as they are primarily research documents, however milestone 3 has been entirely abandoned with a new concept design.

## Work Completed

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| --- | --- | --- | --- |
| **Date** | **Week** | **Time** | **Work Accomplished** |
| **13/8/25** | **0** | **2 hrs** | * **Installed Inventor NASTRAN** * **Joined PAST discord server** * **Watched youtube videos about inventor NASTRAN and the analysis process. Learned how to work with parts and assemblies and interpret simulation data** * **Reread my previous notes on JAXA requirements and concept designs** |
| **20/8/25** | **1** | **2 hrs** | * **Made logbook document and wrote a foreword** * **Revisited previous draft design concepts and cleared out old concept designs to make way for new ones** * **Attended session and took quiz** * **Researched manufacturers for potential designs and found JLCCNC and Xometry** * **Researched precision metal bending** |
| **22/8/25** | **1** | **3 hrs** | * **Came up with new concept design (#3) using CNC machined parts.**   While previous designs used bent metal parts, after researching the cost and quality of CNC machined parts, I determined that using some CNC parts would overall reduce manufacturing complexity as hand-bending metal precisely is far too complex for students to perform |
| **27/8/25** | **2** | **2 hrs** | **Attended session**   * **Researched bolts for the design. After asking Raph & Inde, I found that McMaster is preferred, and most designs used M2 or M3 bolts.** * **Learned about PAST PCB sizing and adjusted my concept design to meet PAST PCB sizing** * **Referenced JAXA clearances to update my design. I calculated the surface area percentage of my rails with recesses and adjusted the recess sizes to accommodate the required 75% by JAXA specification** * **Changed to 3 mounting points and larger brackets to allow for mounting ease and meet JAXA requirements** |
| **28/8/25** | **2** | **1 hrs** | * **Researched manufacturing methods for flat plate aluminum & the available aluminum 6061 sheets in Australia. Noted the allowable thicknesses for future concept design work.** * **While laser cutting allows fine precision, it isn’t suitable for thicker materials. Waterjets have rougher surface finishes, so they may need sanding** * **Researched satellite surface finishes and found that most materials need to be sanded or ground down.** |
| **29/8/25** | **2** | **2 hrs** | **Updated my rail designs. Reduced mass by adding cutouts while maintaining a safety margin over JAXA minimum spec, thickened the bracket to increase stiffness and allow for extra recess after researching bolt head heights on McMaster, and added chamfers to both surfaces to meet the JAXA spec.** |
| **30/8/25** | **3** | **1 hrs** | * **Consulted with my AERO3001 professor (Robert) about CAD options for cubesats. Learned about the dimensional accuracy and tolerances of JLCCNC and competitors, as well as their quality. Learned that BINAR uses their work for non-critical test hardware and about the drawbacks and advantages of these shops** * **Investigated the dimensional accuracy of JLCCNC and the range of surface finish / threading options they provide to drive design** * **Researched existing cubesat designs from both COTS providers (both websites and youtube) as well as student designs to gain an understanding of general concepts in cubesat design in terms of rough dimensions of components and general design trends** |
| **1/9/25** | **3** | **3 hrs** | * **Created and described 3 concept designs using what I learned about exsiting designs to base existing designs** * **Created a ranking system for my concept design** * **Listed pros and cons of each cubesat design** * **Selected my final design using my ranking system** * **Began modelling of concept design 3** |
| **2/9/25** | **3** | **2 hrs** | * **Refined model of concept design 3** * **Began selecting bolted components** * **Modelled total mass to be ~140g using inventor’s BOM system and iProperties** * **Refined design to use real 6061 sheet sizes** * **Used small representative areas of my design to investigate clearances and manufacturability of the design** |
| **6/9/25** | **3** | **2 hrs** | **Revised concept design assembly to include multiple layers by creating a tileable layer design through inspection of the constraint sets**  **Updated material sizing to improve level to level clearances and noted bolt sizings**  **Researched how to parametise designs in inventor to allow for quicker modification and began the process of reworking my dimension and constraint sets to allow for quicker edits** |
| **10/9/23** | **4** | **2 hrs** | **Attended the week 4 session**  **Had my design reviewed by PAST members Aiden and Jack to spot any glaring issues physically. Jack noted potential vibration concerns, leading to a design revision to enhance stiffness horizontally.**  **Discussed with PAST members about PCB thickness and ended up settling on a representative 92x92x1.6 pcb with rounded corners and a FR-4 material**  **After modelling a PCB, I split the frame into three modular sections that could be tiled in the assembly, allowing for ease of design modifications**    **A revised structural frame bottom with a PCB for the top mount.**  **Re-investigated specifications for required tolerances and adjusted assembly layout to make full use of allotted space.**    **New stackup.** |
| **12/9/15** | **4** | **1 hr** | **Modified the design of the horizontal reinforcement bars to add more mass (with the goal of reducing vibration and increasing supported load) and add central mounting holes (3, 20mm apart, centered) so that solar panels or externally facing assemblies could be mounted on** |
| **17/925** | **5** | **2 hrs** | **Was unable to attend session due to illness. Instead worked from home**  **Began process of prepping for FEA. Added simple mass simulators to each frame element to add ~170g to each frame, including hanging significant mass (~70g) off each PCB.**    **Static steel blocks designed to emulate significant mass for structural loading tests**    **Fake solar panels as mass simulators**  **Generated a FEA model for a subframe to do analysis on and constrained it using bolts and seperation contacts** |

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| **20/9/25** | **5** | **2 hr** | **Performed preliminary frame analysis and noted stress concentration at the brackets. Added additional mass, performed a new analysis, and noticed no stress concentration** |
| **23/9/25** | **6** | **2 hrs** | **Performed preliminary frequency analysis on a sub assembly and verified it meets the JAXA requirements.** |
| **24/9/25** | **6** | **2 hrs** | **Attended PAST workshop. Began the process of making a full assembly for NASTRAN simulation and adding the loads as per JAXA specifications.** |
| **26/9/25** | **6** | **1 hrs** | **Sought the advice of PAST members about manufacturability and consulted the JLCCNC threading page to guide a design revision to turn bolted connections into cap screws. After learning about the manufacturing cost differences between CNC and flat plate machining at these scales, I elected to modify the design in the name of manufacturability due to the sheer number of threaded components. Remodelled the design.** |
| **28/9/25** | **6** | **2 hrs** | **Updated the NASTRAN simulation file to account for the new bolts and learned how to apply mesh controls to parts to drastically reduce the number of objects simulated while keeping rapid simulation** |
|  |  |  | Ran sim for statics  Read papers to gain understanding: <https://www.sciencedirect.com/science/article/pii/S1110982324000528?via%3Dihub> [approach]\  <https://upcommons.upc.edu/server/api/core/bitstreams/2711ce66-b17e-4b21-ac4b-b54726200c21/content> [damping]  <https://ieeexplore.ieee.org/document/10281761> [meshing]  <https://sites.google.com/site/manitobasat1/systems-engineering/verification-reports/payload-verification/payload-analysis/finite-element-analysis-fea> [mesh sizing]  Finite Element Analysis of a Cubesat Kudzanai Sekerere [meshing]  Updated mesh sizes and damped |
|  |  |  | Ran final FEA. Finished FEA |
|  |  |  | Attended 3D printing workshop to learn how to print parts  Began printing parts [picture]  Printed parts [picture] |
|  |  |  |  |
|  |  |  | Updated to use fillet instead of chamfer for manufacturability reasons |
|  |  |  | Assembled 3D print  Attended PAST W7 ws |
|  |  |  | More drawings |
|  |  |  | Finalised logbook |
|  |  |  | Updated and packed deliverables |

## Final Design overview & reflections

### Strengths - Weaknesses

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### Images:

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|  |  |  |
| Full view of a final proposed assembly with mass simulators and solar panels | Close up of the top showing rail features and clearances | Detail view of a single connection showing clearances and key features |
|  | Image |  |
| View of the structure with all PCB’s and horizontal frames removed, showing the general concept layout | 3D printed components for physical verification | 3D printed partial assembly to verify component fit and rigidity in various axes, supporting a real PAST PCB. |

### Design reflections and potential modifications:

- Rail design is good, but could be made smaller by decreasing the size   
- Brackets could use small ridges. These would decrease rotation of the components under load  
- Horizontal bars are incredibly fiddly to add and remove. If they’re CNC’d, small guide keys on the bracket and rail would make assembly much easier  
- Brackets themselves have more than enough space vertically for screws – initial design had enough space for bolts. Shortening the brackets adds more clearance for assemblies  
- The horizontal bars are quite thin – since they are now CNC machined, adding thickness in certain areas for bending resistance would be easy, and would be useful for alignment if added on the front face  
- PCB’s provide significant structural support by themselves – by standardizing a PCB size, they can become the sole horizontal support.

## Final Design BoM

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| --- | --- | --- | --- | --- |
| Part | Supplier | Cost per | Amount | Link |
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## Deliverables completed

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| --- | --- | --- |
| Deliverable | Status | Link |
| Deliverable 1: Design requirements | Finished in Sem 1 | https://github.com/sudo-ellipsis/PAST-onboarding/blob/main/Deliverables/1.%20JAXA%20Requirements.md |
| Deliverable 2: Cubesat structure review | Finished in Sem 1 | https://github.com/sudo-ellipsis/PAST-onboarding/blob/main/Deliverables/2.%20Cubesat%20Structures.md |
| Deliverable 3: Concept designs | Started Sem 2 Week 2  Finished, Sem 2 Week 3 |  |
| Deliverable 4: Concept design CAD | Started Sem 2 Week 3  Finished, Sem 2 | None |
| Deliverable 5: FEA | Started Week 4, Finished Week 7 |  |
| Deliverable 6: Technical drawings | Started Week 7, Finished Week 8 |  |
| Deliverable 7: 3D print | Started Week 7, Partially completed Week 8 |  |

## Reflection on process & Lessons learned

Surprised at how much I used my own documentation

Not starting parametric was a pain

Bolted connections suck.

“How should I manufacture this” is a good thing to do. Einstein thought experiment like – walk through steps in your head helped

Don’t love the design – too many connections. In the future, here’s what I would change – I think this is a valuable lesson learned

Modularity is hard and not always needed – being able to consult w/ others about what is needed is good

Jaxa specs less restrictive than originally thought