

**The HEIMDAL Instrument at ESS
Diffraction STAP Meeting 24/4/2020
Update Summary**

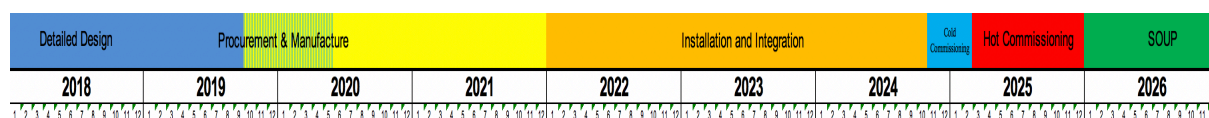
(1) In-kind Agreements and Technical Annex

Partner	MOU	TA
Aarhus University (Denmark) 30%	Signed	In Review
PSI (Switzerland) 35%	Signed	In Review
IFE (Norway) 35%	Signed	In Review

Current Status: Heimdal has all TA's now signed and approved by ESS as of February 2020.

(2) Current Instrument Timeline:

A schematic of the new Heimdal project management timeline, following the ESS rebaseline is shown in the figure below.



Summary of Main Milestones:

Phase II Instrument (9-16) User operation scheduled for July 2026

Tollgate-2 Review: June 2017

April 2019 - Order of monolith optics.

Current Status: Design expected May 2020 from Swiss Neutronics. Manufacturing could be effected by Coronavirus.

March/May 2019: TG3 CTVs finalised for large items, Guides, Detector, Choppers.

Current Status:

Chopper Procurement: Full costing agreed with ESS common chopper project.

Detector Procurement: Expected to start July 2020 after Dream Detector.

Guide Procurement: On hold by ESS until July 2020 for first 8 instrument priority.

December 2020 CTV presented for Cave Design

Current Status: Tender delayed due to lack of neutronics simulation time due to priority allowed for BiFrost (first 8 instrument). Expected October 2020.

November 2020 Monolith installation. Risk of delay to manufacturing due to coronavirus.

May 2020 Sub-TG3 scheduled for slits, sample table, bunker wall insert.

May 2020 Tollgate-3 - **Current Status** - Final TG3 moved to March for 2D detector.

March 2021 Start of delivery and integration of sample stage & detector to AU.

September 2022 Tollgate-4

January 2023 – Start of Cave Installation

November 2023 - Start of Long Straight Guide + Shielding Installation.

August 2024 - Start of Bunker Installation

2025 – Tollgate-5 start of hot commissioning

June 2026 Start of User Operations.

(3) Change of scope request:

Following the last STAP diffraction meeting, where change request to include more cold guide (figure 1) into scope of Heimdal due to savings on the shielding was discussed. We have decided to move forward with obtaining real contractual costings for all items including Cave, Choppers,

Detector and Guides before resubmitting the idea of changing the scope of Heimdal. This was also the advice from the ICEB meeting.

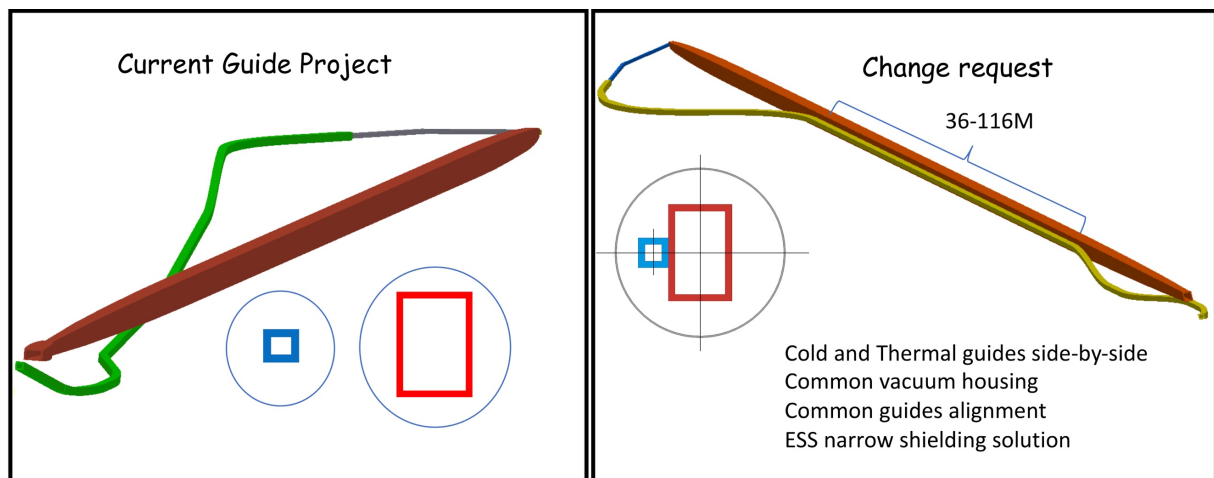


Figure 1. Left: The current Heimdal guide project, which keeps the thermal and cold guide separated in the long straight section and wide shielding (more shielding cost), to allow for a later up-grade of cold guide later. Right: Guide change request - keeping guides together in straight section in common vacuum chamber and common ESS narrow shielding (less shielding cost). Doing this later involves more cost, working with an activated thermal guide and longer shutdown of the Heimdal to upgrade.

(4) TG3 Schedule.

The current TG3 schedule for Heimdal is given below. We have been through the Call For Tender Verifications (CTVs) with ESS for all the large long lead time items - Guides, Choppers and Detectors and Cave Structure.

May'20	October '20	Mar'21
<p>Sub-TG3 [Handled remotely. Deliverables 28April20. Reviewers 28May20]</p> <p>Bunker Wall Insert</p> <ul style="list-style-type: none"> - XYZ table (SSDD: Mogens) - Slits1 - Divergence Slits (SSDD: Mogens) - Slits2 - Collimating Slits (SSDD: Mogens) <p>CTV [Handled remotely]</p> <ul style="list-style-type: none"> - Radial collimator 	<p>Sub-TG3 [In-Person meeting]</p> <p>(1) Optics</p> <ul style="list-style-type: none"> - Guides and Support Structure (SSDD: Dan) <p>(2) Shielding and shutters</p> <ul style="list-style-type: none"> - Light Shutter <p>Chopper Systems</p> <ul style="list-style-type: none"> T0 Chopper <p>Cave & BeamStop</p> <ul style="list-style-type: none"> Hutch Cabin Detector Collimators 	<p>Sub-TG3.4 [In-person mtg]</p> <ul style="list-style-type: none"> - Monitors: (ESS Common?) (SSDD: Uwe) - Detector (SSDD: Uwe) <p>Detector support</p> <p>Detector Collimator</p> <ul style="list-style-type: none"> - Heavy Shutter (SSDD: Kåre/Dan) - Instrument Control and Automation [ESS MCA] (SSDD Kåre/Engineer) - PSS [ESS PSS] (SSDD: Dan) - DMSC [ESS DMSC] (SSDD: Mogens/Dan) - Vacuum system [ESS Vacuum Team] (SSDD: Kåre/Engineer) - Drawing package of complete system (Kåre/Engineer) <p>Final TG3</p>

The Current TG3 schedule is as above. The final TG3 is moved to March 2021 to allow time for the detailed design of the 2D detector, which is the third in line in the consortium of B-10 detectors at ESS with Dream, Magic and Heimdal. The procurement plan will proceed in this order to reflect the first 3 and 8 instrument developments by ESS.

(5) ICEB meetings: Last Heimdal ICEB meeting took place on the 7th November 2019 and the next meeting is scheduled on 2nd June, which is planned by video-conference due to coronavirus. The main recommendation from the last ICEB meeting was to move forward in obtaining real costing for items before re-submitting our change request. The main risk identified was for the end of contract of our neutrons person in July 2020 and the need to finalize the neutronics calculations for Heimdal, (Cave, Guide, Bunker Wall Insert, Heavy Shutter).

(6) Instrumentation

6.1 NBOA

The NBOA was scheduled for subTG3 process in February 2019, but this was postponed due to delay in the work schedule of Swiss-Neutronics. Work on this project of NBOAs with Swiss neutronics has now restarted again in 2019 and we are still on schedule for delivery before Beam on Target. The NBOA design has had support from ESS engineering which is in close contact with Swiss-Neutronics. Detailed design is expected at the end of 2019 and NBOAs should be delivered by May 2020 to ESS. We organised an inperson meeting at Swissneutronics in January 2020 to resolve issues. Swiss Neutronics have informed us (April 2020) of possible manufacture delays due to coronavirus).

6.2. Choppers

The call for tender verification meeting is scheduled for our chopper systems at the end of May. We now have a full costing of our chopper systems and will move ahead with procurement.

The T0 chopper: The T0 chopper prototype is currently being manufactured by Mirtron for Dream. Our T0 chopper will require some slight modifications compared to the prototype. The CVT TG3 process for the T0 is scheduled for December 2019. With the Detailed design expected with Mirtron in early 2020. Chopper group have asked for new manufacture costing for a common Heimdal/Odin To chopper system.

6.3 Guides

We have been re-working the design of the cold guide, following the opportunity of cost saving we realised with the ESS common guide shielding project. We now have a new cold guide design with a long straight section ready for approval by the ESS. We have performed McStas neutronics of the cold guide as shown in figure 2 below.

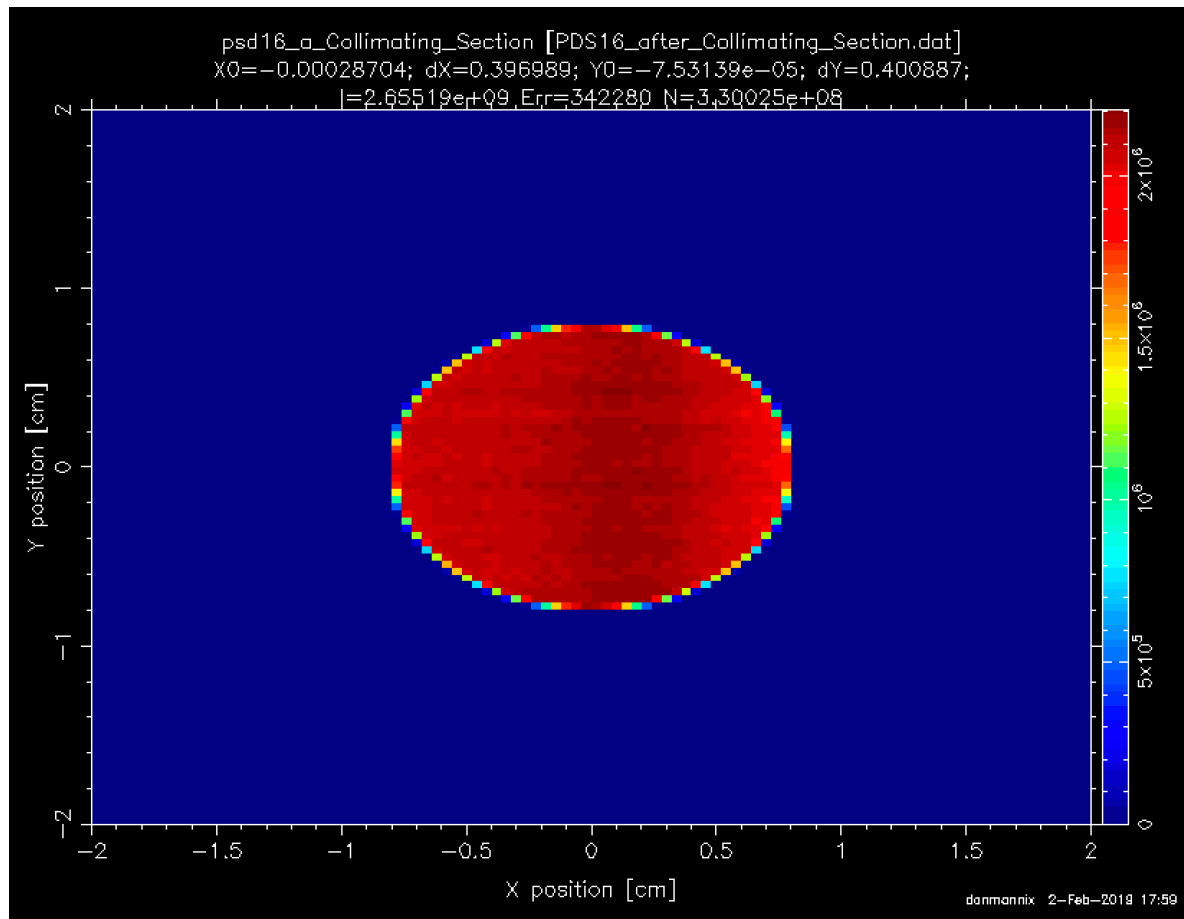


Figure 2 McStas simulations of the beam intensity profile in the collimating section of the new straighter cold guide system. The simulations indicate a slightly higher flux than for the current cold guide.

We have undergone a call for tender verification for our guide systems. The guide procurement is currently on hold by ESS until July 2020 to allow priority for first 8 instruments. We plan to have full costing for all large items (Cave, Choppers, Detector) before moving forward with the guide procurement. A decision on change request for more cold guide will be made at that time.

6.4 Detector:

We had had a call or tender verification meeting with ESS at the end of May. There is essentially only one supplier of this detector system so that it is unlikely to be an open call for tender. The meeting will therefore be a more technical review. The process for the detector system follows a detailed design schedule after Dream and Magic. We are currently waiting for the finalisation of the Dream detector procurement before moving ahead with the Heimdal procurement, in July 2020. We expect to have the final TG3 for the detector in 2021.

6.5 Shielding

As stated previously, there is a possibility for Heimdal to make large savings from ESS common shielding project. He have been working on getting a detailed costing for our shielding to include in the change of scope setting. This has been a slow process due to the stretched resources at ESS for shielding neutronics calculations. We now have a good calculation for the

Heimdal source and these can be fed into calculations to optimise the guide shielding. This work is still in progress. Below are some preliminary calculations of shielding designs, but this still needs to be optimised as it gives a background of around $3\mu\text{Sv/hr}$ at the surface. Once these calculations are finished and the shielding costed, we plan to submit the change of scope request.

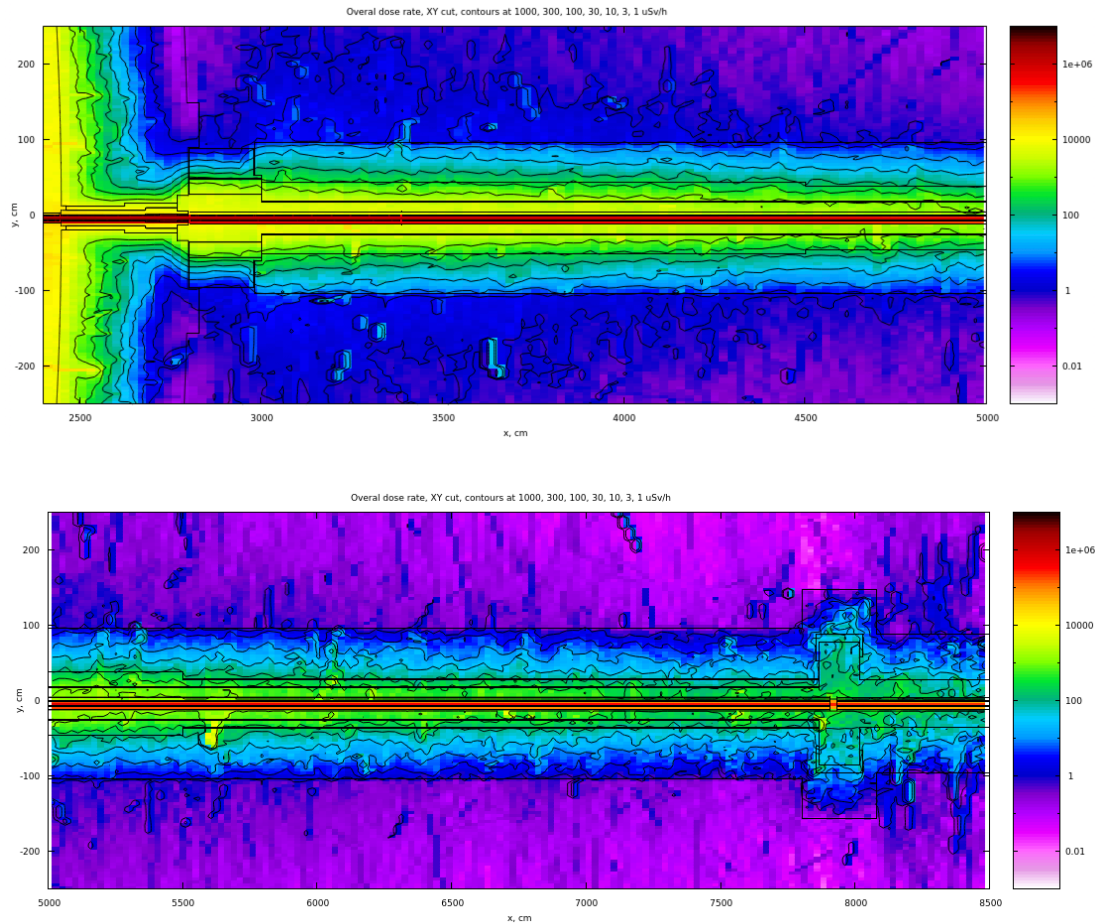


Figure 3. Preliminary shielding calculations for Heimdal guides. Top is for the section after the bunker wall from 25M to 50M. Bottom is from 50m to 85M, just after the frame-overlap chopper. The current design is still giving too high back ground and is being refined. This can be seen by the dark blue area just after the bunker.

The neutronics are performed for the below shielding.

Interface (28-30m, first 2 meters from bunker wall) 20 cm steel 40 cm heavy concrete (3.8 g/cm^3)

30-45 m: 25 cm steel 50 cm regular concrete (2.3 g/cm^3)

45-55 m: 20 cm steel 55 cm regular concrete

55-chopper pit: 10 cm steel 65 cm regular concrete

Chopper pit shielding according to common shielding project (will need extra steel when contribution from thermal neutron beam will be considered)

Beyond chopper pit: 60 cm regular concrete.

Inner steel shielding is lined with 5 mm B4C both inside and outside B4C/epoxy tiles.

6.6 Cave Shielding Neutronics:

We have had the CTV meeting for the cave shielding in December 2019. We have also had approved our H1/H2 scenarios document (February 2020). We still required some of the neutronics to be finalised before opening the tender for the cave structure. This has been delayed because we have allowed BiFrost priority access to the neutronics calculations as it is a first 8 instrument. We expect to

finalise our design before July 2020. We have made some allocation to extend the contract of our neutronics person (Rodion Kolotov at IFE) by 4 months to finalise the neutronics calculations. This will be jointly funded by contingency in the cave budget by Heimdal and BiFrost. Cave shielding neutronics calculations are shown in figure 4 and the cave design shown in figure 5.

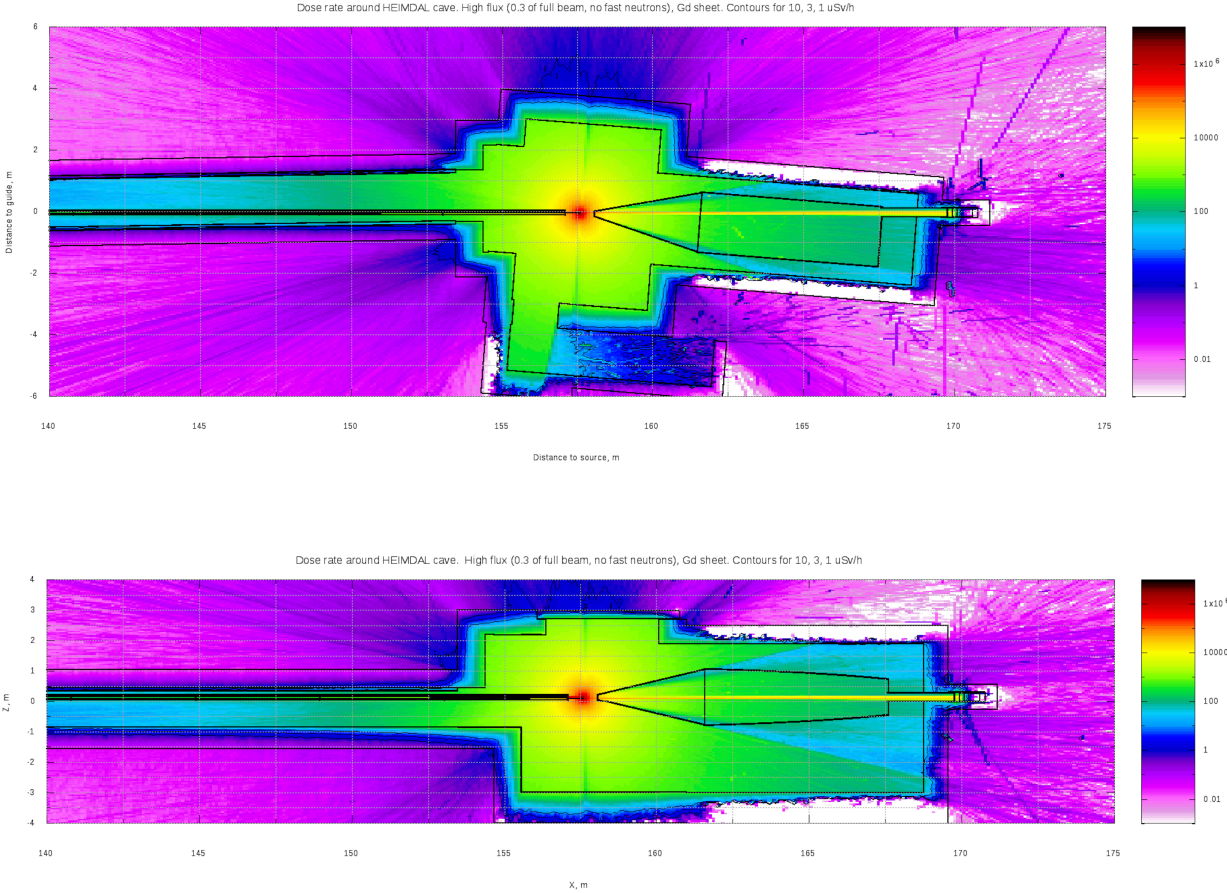


Figure 4. Cave shielding calculations with walls of 90cm thick concrete.

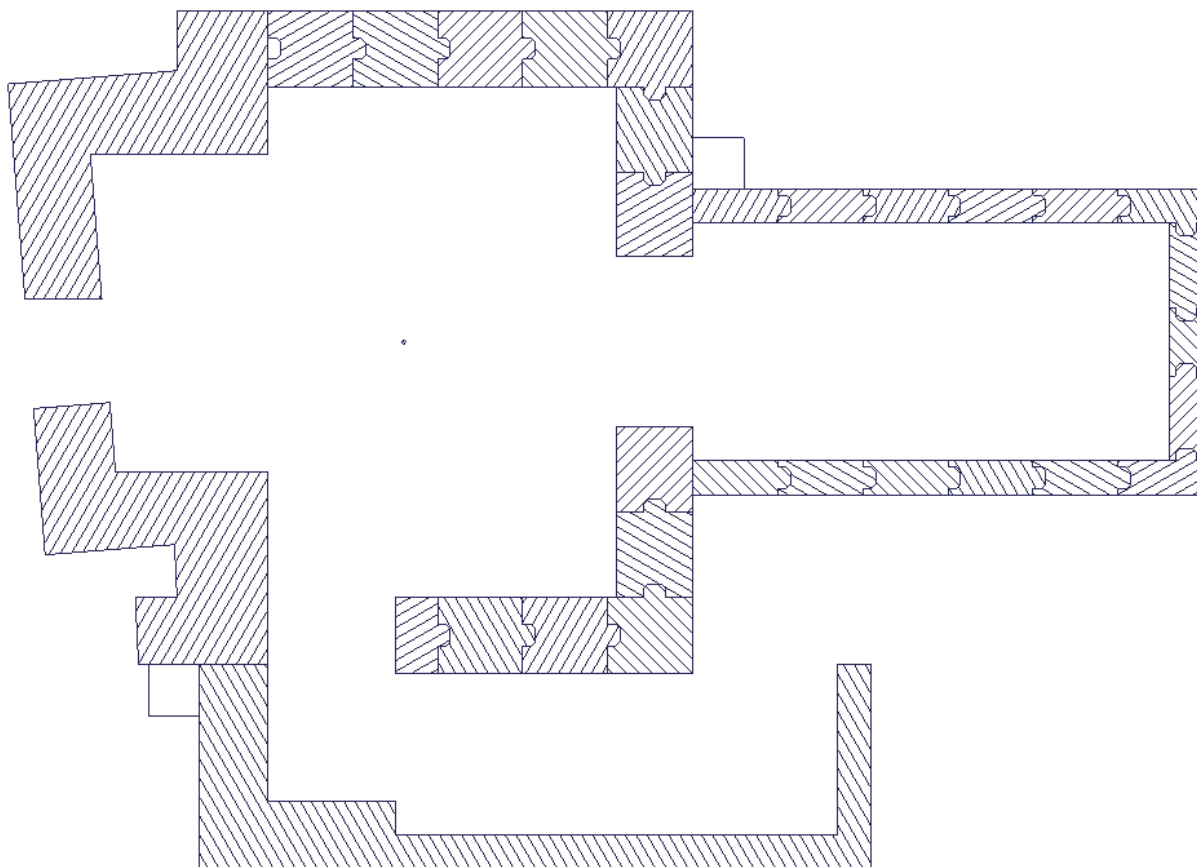
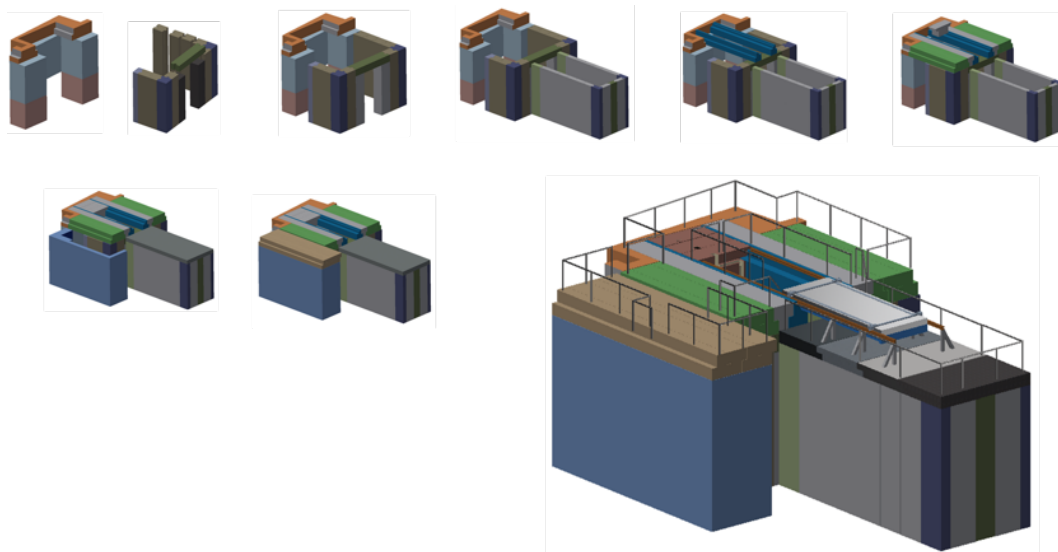


Figure 5: Design of the Heimdal Cave.