

# Uncut Gems

En teater för oslipade ädelstenar

Kandidatarbete i Arkitektur och Teknik

Våren 2025

Av: Axel Lindeberg

Tillsammans med: Erik Sundberg och Abdirahman Duaale



## Ett kandidatarbete, utifrån ett tävlingsprogram

Många av byggnaderna runt om oss börjar som tävlingar. Flera förslag skickas in och ett väljs slutligen ut och får byggas. Genom att basera upplägget för vårt kandidatarbete efter en årligen återkommande tävling, som handlar om att förena arkitektur med akustik, fick vi en väldigt verklighetstrogen kontext för projekten. Samtidigt var detta på många sätt den mest konstnärliga större projektkursen hittills.

Mycket emfas lades på starka koncept och att experimentera fram nya saker genom iterationer. En viktig lärdom jag tar med mig är att även om programmet som följs kan tyckas formellt och som verklighetskäppar i fantasihjulet, kan allt överkommas med rätt attityd och rätt metoder. När det verkliga förenas med det fantasifulla skapas det en extra gnista, som ett häftigt men ej verklighetsförankrat projekt inte riktigt når.

# Presentation

Det här är de planscher vi gjorde utifrån det tävlingsprogram som kandidatarbetet utgick från. På nästa sida står den text som finns på planscherna



## UNCUT GEMS

### Concept

The concept of the theater is vibrant gemstones that emerge from a rough stone. The colors and shapes of the rooms in the theater are inspired by gemstones. The transparent facade represents the openness of the building, inviting visitors into the lobby. The theater is located at the university in Boulder, Colorado. The aim of the theater is to create a playful space for student actors and dancers to develop from uncut gems to polished diamonds.

### Lobby

The lobby is designed to support smaller gatherings and more intimate conversations. A glass facade allows natural light to shine into the lobby. The gems divide the space, creating a cozy and inviting atmosphere. This makes the lobby ideal for events such as mingles and reception before entering the theatre hall. The staircase at the center of the lobby, leading into the theater hall, invites to pause and sit down, whether to study, enjoy a performance, listen to a speech or lecture in the welcoming lobby. The lobby also holds a café that offers the choice between more secluded tables inside the gemstone, or more public tables in the open lobby.

### Theater Hall

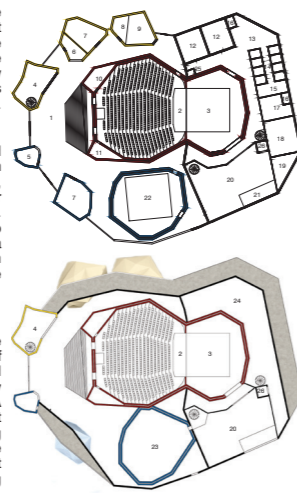
At the heart of the building lies the theater, a striking red gemstone that is visible from every corner of the building, including the exterior. Inside the theater hall, the seamless flow between the walls and ceiling creates the feeling of being inside a cave, inviting visitors into the lobby.

### Rehearsal Room

A large, blue gemstone-shaped structure housing the rehearsal room is situated at the end of the lobby, ensuring easy access for smaller drama performances or conferences. The wall and ceiling design, similar to that of the main theater hall but on a smaller scale, is employed to maintain similar acoustic qualities despite the reduced volume.

### Back of house

Dressing rooms, costume and stage shops are located at the back of the building. This area is separated from the public areas in the lobby as it is not accessible for visitors. A dedicated staff entrance is provided at the back of the building. The loading dock is positioned adjacent to the scene shop, offering convenient street access while minimizing any disruption to the theater hall.



Abdirahman Duale  
Axel Lindeberg  
Erik Sundberg

Room name/ Function	Noise criteria
1. Lobby	NC 35
2. Theatre	NC 15
3. Stage	NC 15
4. Café	NC 40
5. Reception	NC 40
6. Wardrobe	
7. Toilets	
8. Residential Office	NC 25
9. Technical Office	NC 25
10. Lights control room	NC 20
11. Followspot booth	NC 20
12. Chorus dressing rooms	NC 35
13. Staff entrance	
14. Solo dressing rooms	NC 35
15. Wig and makeup	NC 30
16. Back of house toilets	
17. Green Room	NC 30
18. Costume Shop	
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21. Loading Dock	
22. Rehearsal Hall	NC 15
23. MEPFIT and MER	
24. Storage and Archive	
25. Orchestra Pit Elevator	
26. Elevator	

### Acoustics in the Lobby

To create a quiet and comfortable lobby with an NC 35 sound level, a special triple-glazed glass system is used. The nooks formed between the gemstone-shaped structures offer quieter, more secluded areas ideal for studying or reading. A three layered glass wall with gas between the glass panes. These gaps help block noise from outside. The glass is held in a wooden frame with insulation around the edges. This setup reduces sound by 23 to 44 dB in the most important frequency range (125 Hz to 8 kHz). Overall, it reaches an estimated sound reduction (Rw) of 45 dB, making the lobby peaceful and pleasant to be in. Additionally the floor of the lobby is decoupled where the lobby meets the street.

### Noise control for the Theater Hall

To make sure the theatre hall meets the NC-values, a box-in-a-box design is used with a double wall and floor structure. These walls are built with gypsum boards mounted on separated studs, creating a double-wall system with a resonance frequency around 50 Hz, ensuring sufficient airborne sound insulation between rooms. The fundamental frequency of the vibration insulation is below 10 Hz. The inner most floor of the theater hall rests on springs to prevent vibrations from reaching the theatre.

### Stage House

The interior walls in the stage house are made of a fiber glass to reduce sound reflections from reaching the theater hall. The outer walls are made out of CLT to avoid noise from the outside reaching the theater.

### MEPFIT

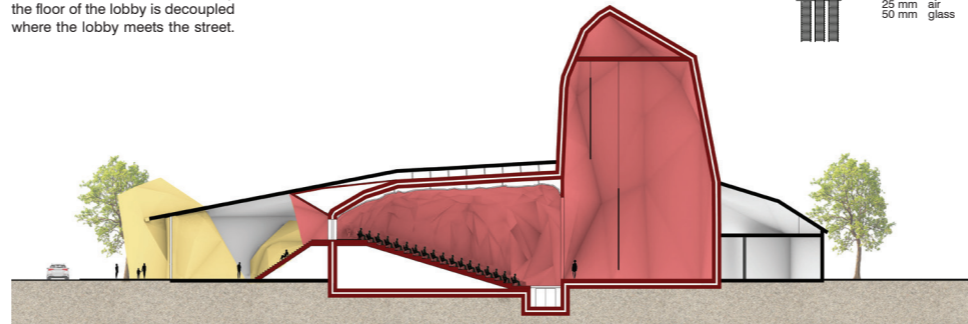
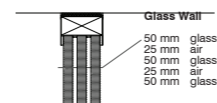
A floating floor and vibration-damping materials between the ventilation units and the building structure reduces vibrations from spreading from the MEPFIT room and keeps the theatre hall and rehearsal room calm and undisturbed.

### Rehearsal Room

The walls and ceiling in the rehearsal room follow the same design strategy and material usage as the theater hall to achieve similar acoustics.

### Orchestra Pit

Absorbers are installed along the walls of the orchestra pit to provide optimal acoustic conditions for the musicians. When not in use by the orchestra, the pit can be elevated to stage level, allowing the space to be used for additional audience seating in the theatre hall.



### Acoustics in the Theater Hall

The theatre hall is designed to serve as both an auditorium for speech and a venue for musical performances. At the same time, the hall remains adaptable for other types of performances that may require different acoustic conditions. The geometry of the hall provides an intimate sound environment regardless of where one is sitting, ensuring voices and music sounding rich and clear all the way to the back rows. Each section is surrounded by acoustic panels with their reflective surfaces and absorptive surface behind.

### Triangular Panels

A pattern of irregular triangular acoustic panels on the walls and ceiling are used to effectively scatter sound throughout the theatre hall. These panels are designed to integrate both architectural and acoustical functions, maintaining the hall's geometric aesthetics while enhancing its acoustic performance. To ensure effective diffusion across a wide frequency range, the panels are constructed in varying sizes and arranged irregularly although following an optimal shape on a macro scale throughout the auditorium. This creates a balanced and consistent sound environment throughout the hall.

### Variable Acoustics

The triangular panels serve a triple purpose. When the plywood panel is mounted, they reflect sound in multiple directions. When the plywood panel is removed, an absorptive surface is revealed and they act as absorbers. This allows the reverberation time to be dynamically adjusted depending on the type of event, whether it's a musical performance or a speech. Thirdly, instead of the absorbers, Helmholtz resonators are installed behind some of the panels to reduce reverberation time for lower frequencies.

### Sound System

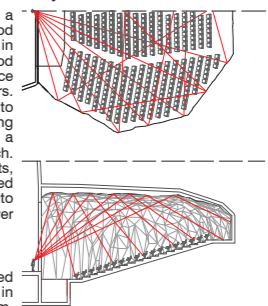
The speaker system is also integrated in the triangular panels. Located in the ceiling close to the proscenium, integrating the speaker system in the triangular panels makes them less visible for the audience, which provides a natural sounding electro-acoustic environment.

### Wall Section

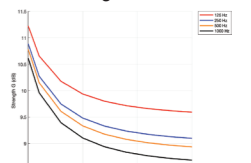
Theater Hall Wall Section  
30 mm plywood  
100 mm fiberglass board  
200 mm air  
12.5 mm gypsum board  
375 mm mineral wool  
12.5 mm gypsum board  
200 mm air  
12.5 mm gypsum board  
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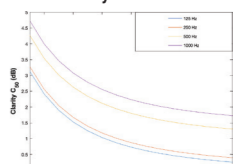
### Early Reflections



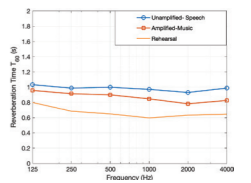
### Sound Strength Distribution



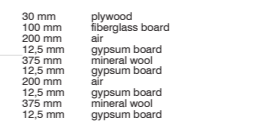
### Sound Clarity Distribution



### Reverberation Time



### Helmholtz resonator, 125, 250 Hz



# TXT

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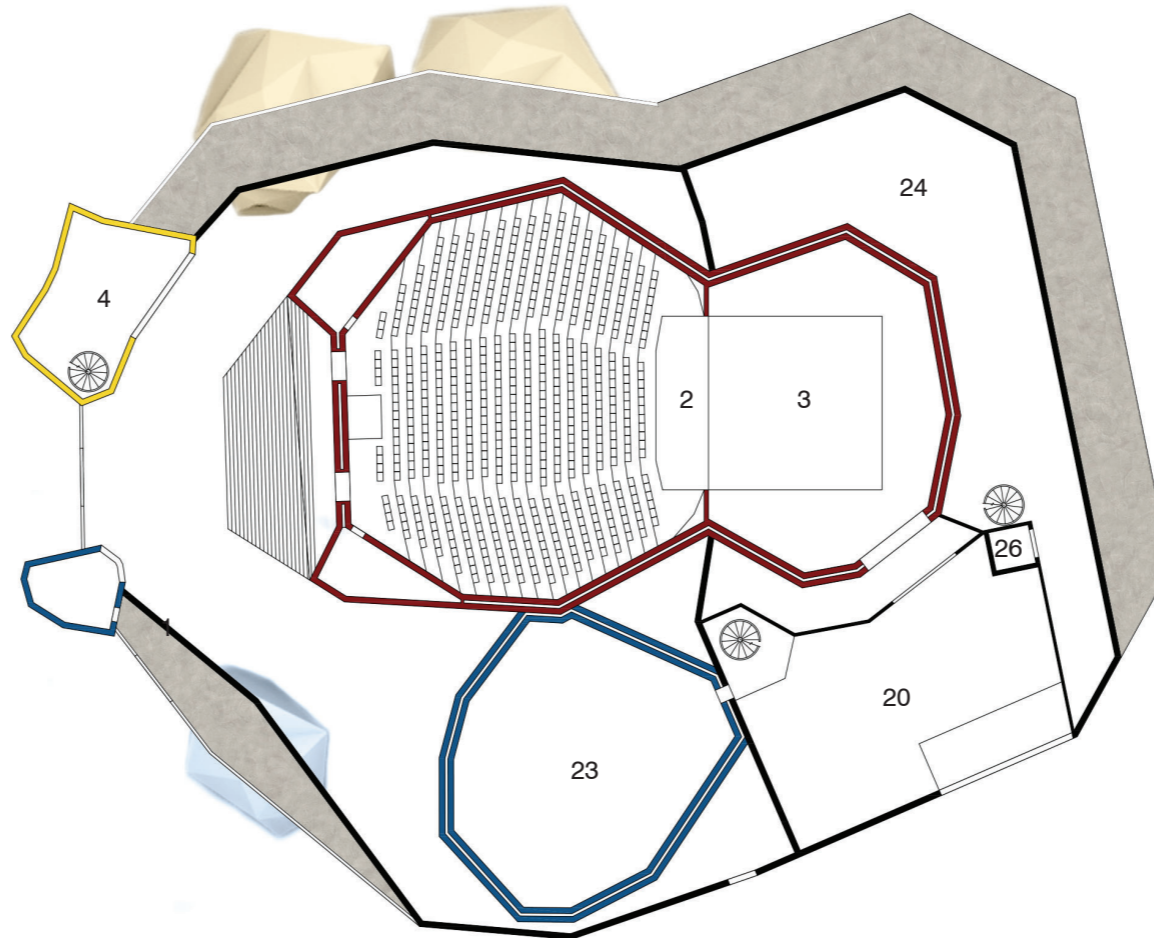
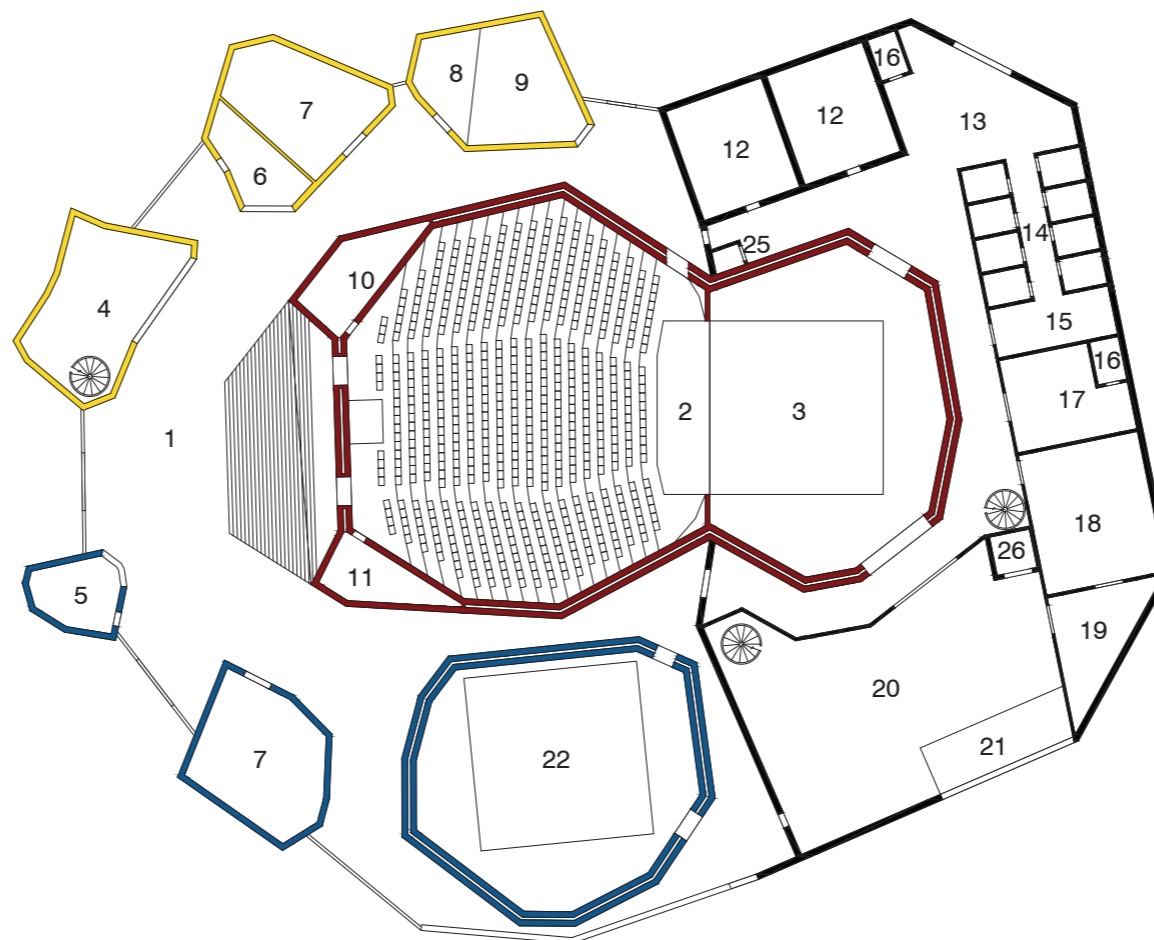
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# Plan

Byggnadens olika rum och funktioner består av separata volymer i starka färger, "ädelstenar" som hålls samman av ett omslutande skal, "berget". I mitten av byggnaden finner man den röda rubinen, teatersalen, för att ge så mycket skydd som möjligt från ljuden från staden. Lobbyn består till stor del av tomrummet som uppstår mellan ädelstenarna. Där finns också bland annat ett cafe i en stor gul volym, mindre intima fickor mellan ädelstenarna för studieplatser och en stor central trappa som leder upp till teatersalen. Den är tänkt som en informell samlingsplats, och som en mer spontan läktare för vissa framträdanden.

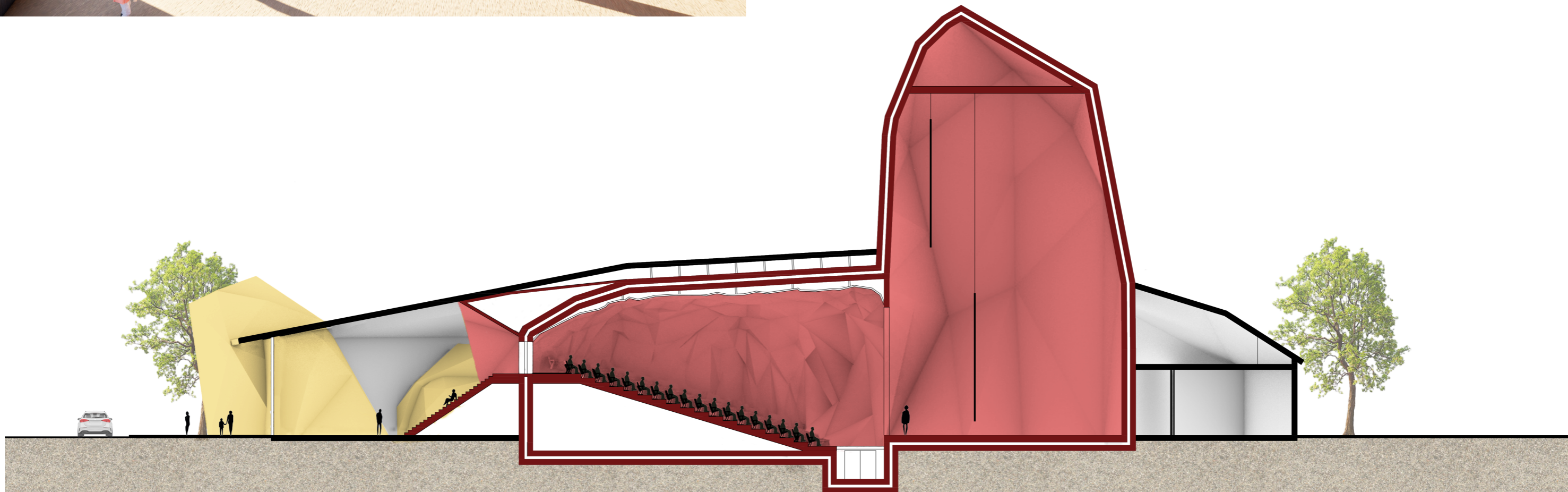


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# En mötesplats



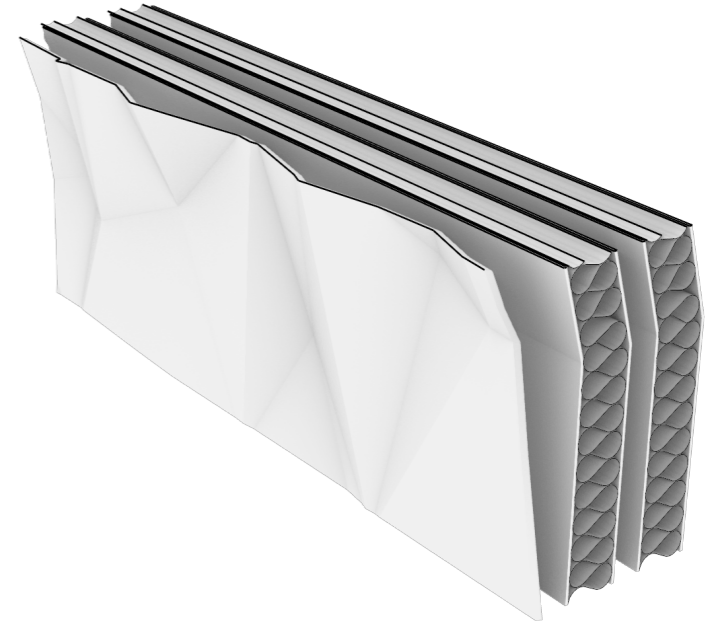
Teatern ligger vid universitetet i Boulder, Colorado, USA. Det var viktigt för oss att skapa en byggnad som fungerar som mötesplats för hela universitetet. Ett öppet fönster mot teater, dans och musik. Teaterns lobby är ur denna aspekt byggnadens viktigaste del. Den centrala trappan och caféet är två viktiga grundpelare för att få en gemytlig känsla i lobbyn.



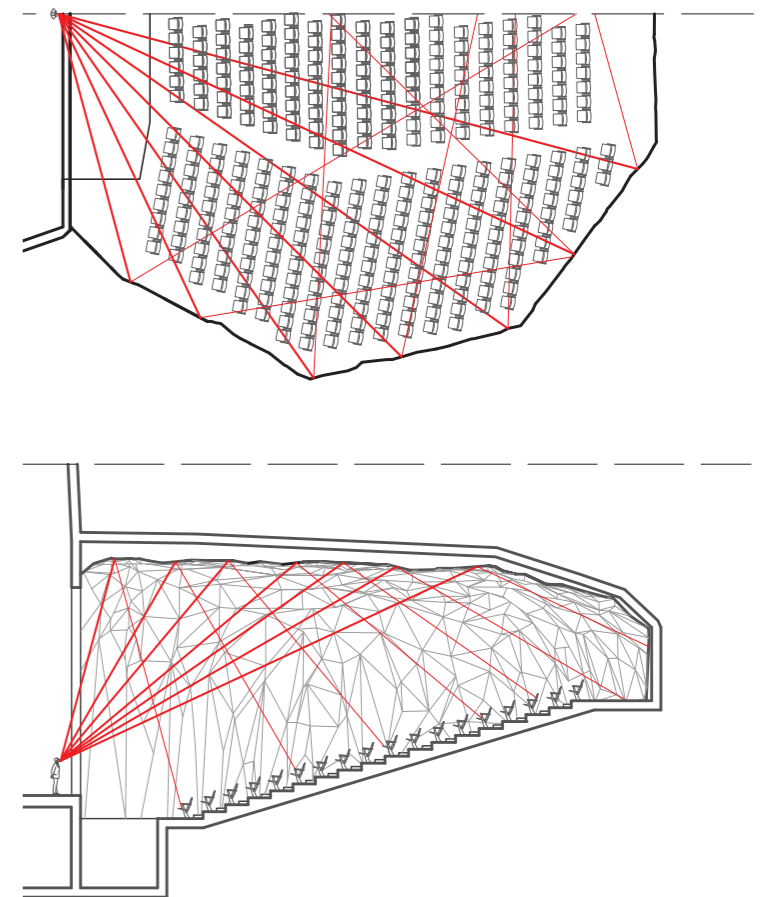
# Teatersalen

Målet med teatersalen var att skapa känslan av att gå in i en grotta, belägen i en gigantisk röd kristall. Samtidigt var det väldigt viktigt att detta gjordes på ett sätt som skapade en bra akustisk miljö. Vi använde oss av oregelbundna triangulära paneler, som reflekterade och spred ljudet från scenen genom salen. Bakom dessa reflekterande paneler, som går att plocka av finns ett absorberande skikt. På så sätt kan man reglera akustiken i salen utefter önskad efterklangstid.

Väggutsnitt



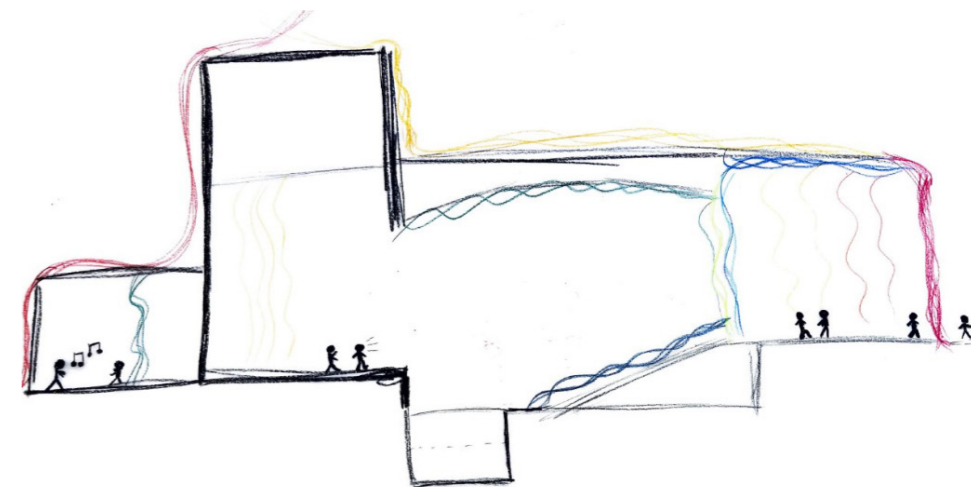
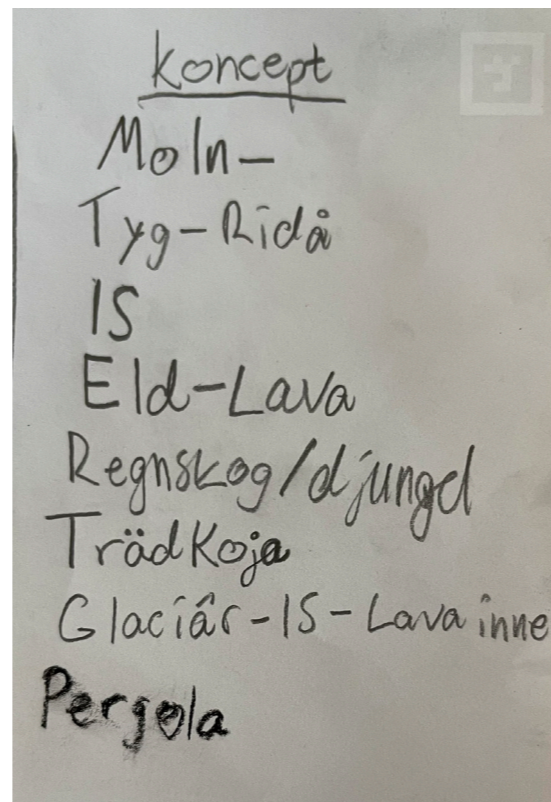
Early Reflections



# Process

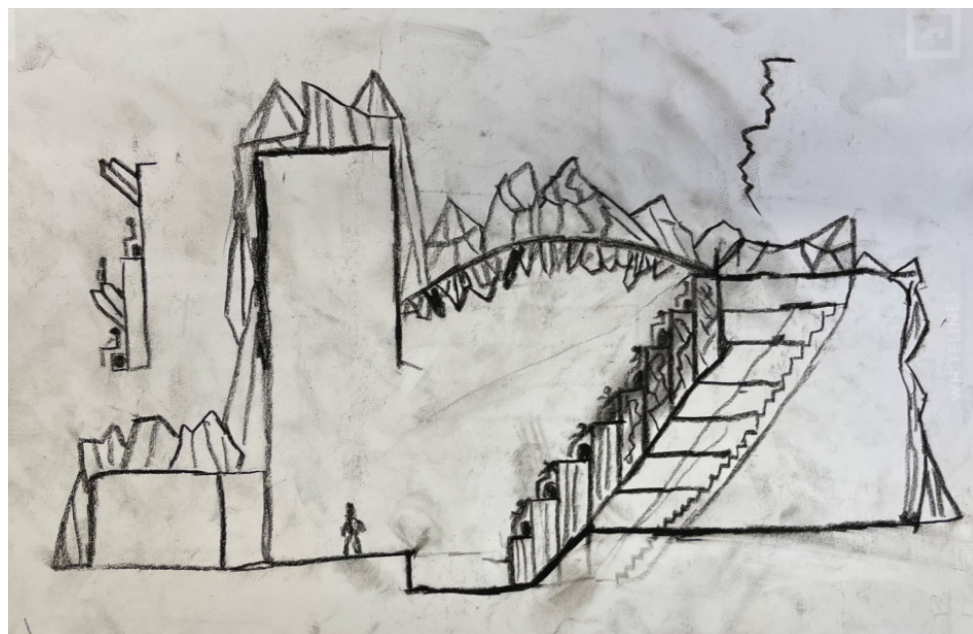
## Tre koncept

Den första uppgiften var att ta fram tre koncept, för att presentera för akustikerna. Sedan skulle ett av dessa koncept väljas. De två andra kunde sedan förenas inom det valda, ifall en möjlighet för det hittades. De koncept vi tog fram fokuserade på olika aspekter.



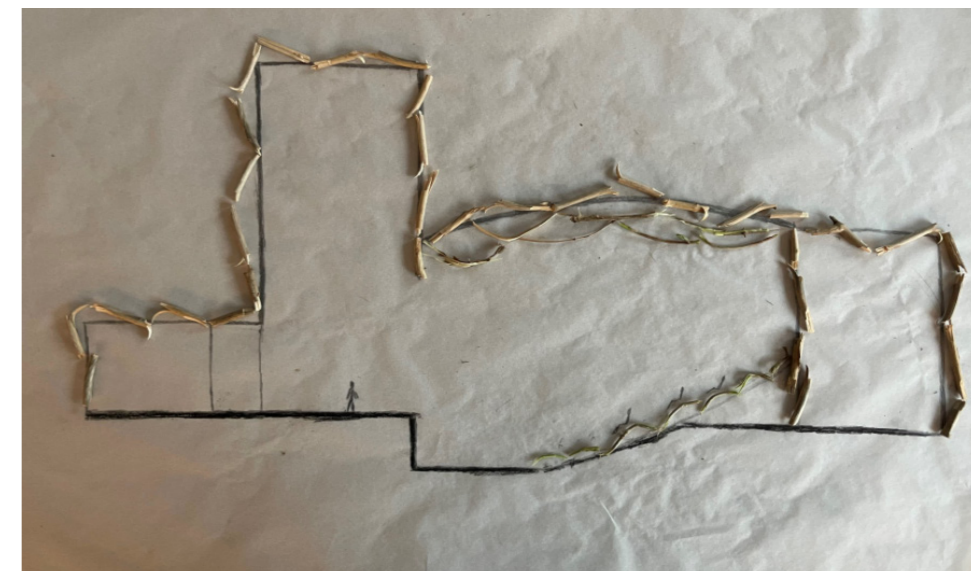
## Ridå

Det här konceptet började med en ide om att byggnadens yttervägg skulle likna en scenridå som lyftes upp lite och hintade om vad som fanns där inne. Sedan lyftes iden om att en ridå leder till en annan, och så vidare, en spännande färd in till byggnadens innersta rum; teatersalen. Det finns definitivt spår av denna ide om en resa inåt inkorporerade i vårt slutgiltiga koncept, men de är ganska vaga.



## Kristall

Det här är konceptet som vi valde att jobba vidare med. Redan från början tänkte vi att byggnaden skulle vara gjord av trä, men med former och färger som liknade kristaller av olika slag. Viktigt redan från början var färger för oss. Vi såg framför oss olika delar av byggnaden i olika färger, med öppna ytor mellan där färgerna kolliderade.



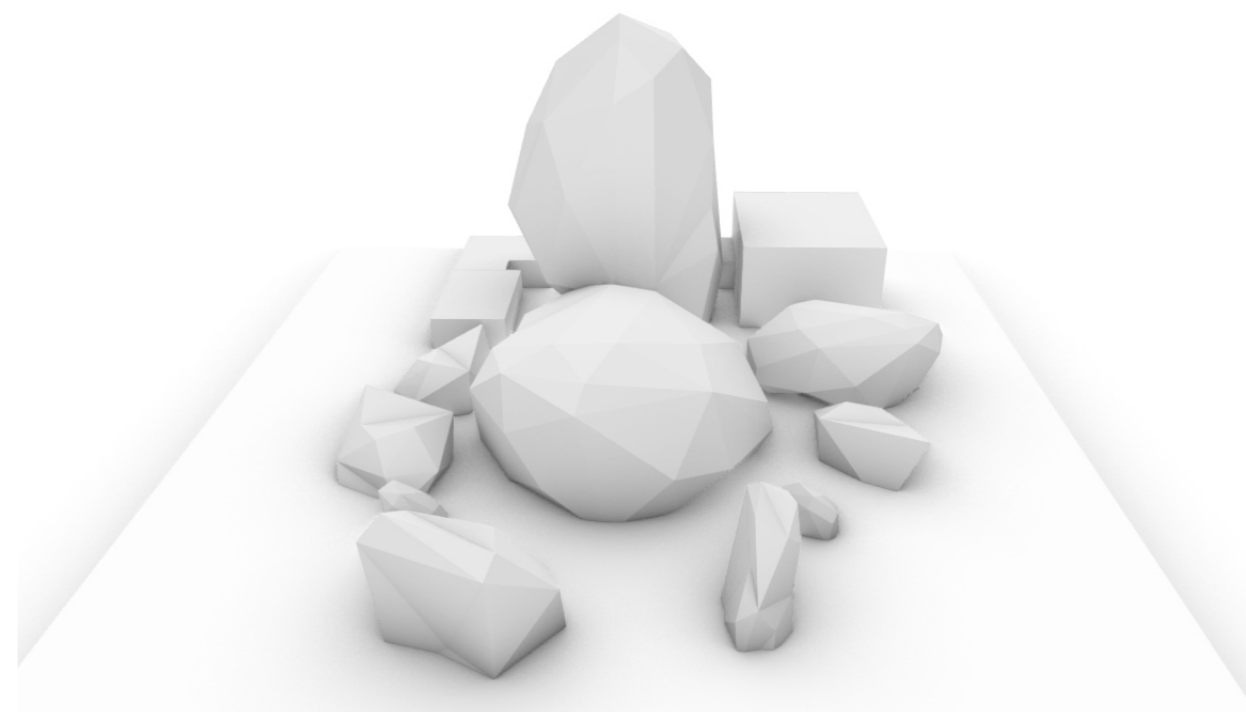
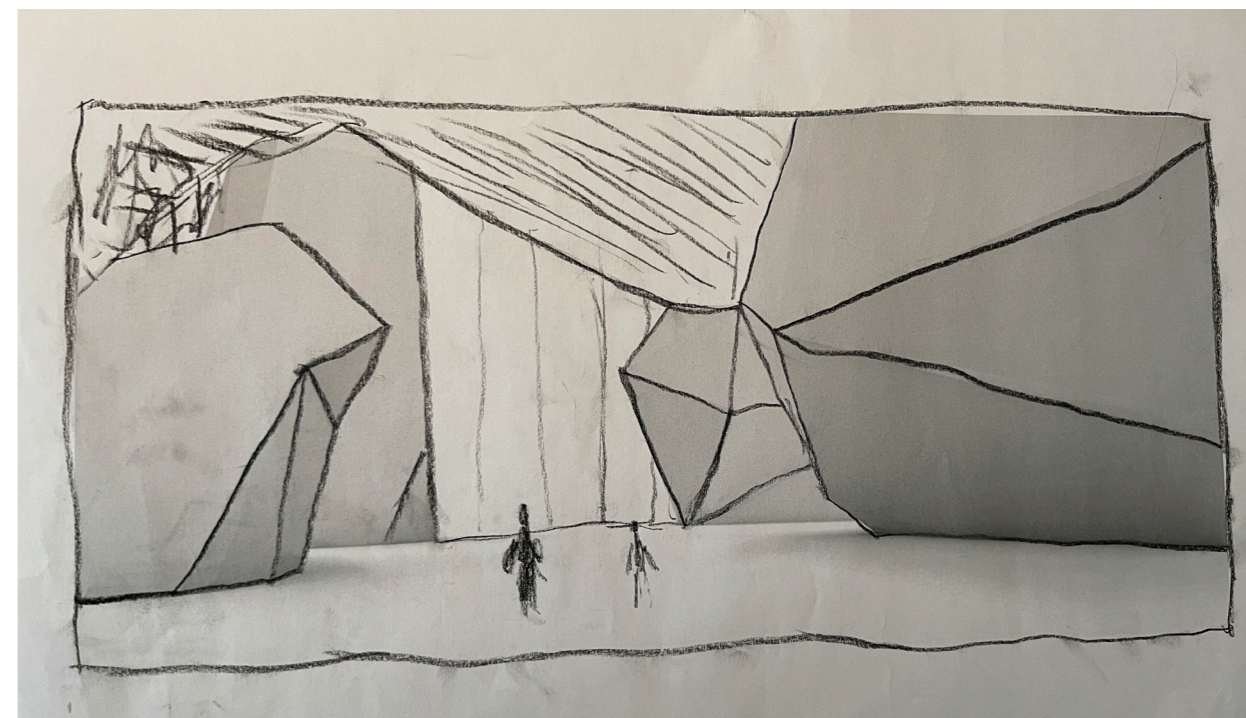
## Spillvirke

Det här var vårt hållbarhetsfokuserade koncept. Grundidén var att skapa en teaterbyggnad som till stor del bestod av spillvirke som annars skulle slängas. Vi kom inte superlångt med själva formgivningen här, men en tidig tanke var att skapa något som liknade Lars Vilks Nimis, fast i större skala.

# Process

Vi prövade lite olika sätt för att få fram den känsla vi ville ha, men det kändes alltid som att det föll lite platt. De oregelbundna dramatiska formerna vi ville åstadkomma blev förutsägbara och vårt grundkoncept fanns inte riktigt kvar. Genombrottet kom när vi byggde en konceptmodell av faktiska stenar, med ett skyddande skal av skisspapper. Det var långt ifrån en praktisk och exakt modell av en byggnad men den framkallade lite av den känsla och de former som vi var ute efter.

Vi valde sedan att skanna in olika stenar. Sedan importerade vi dem till rhino och förenklade geometrin. Efter det skalade vi upp och ner och lekte med formerna tills de fungerade med planen. Det slutgiltiga resultatet är en produkt av ett pusslande där både funktionen av rummen, som var utgångspunkten, och stenarnas oregelbundenhet var formgivande.



# Reflektion

**Att förena Akustik med Arkitektur** genom ett grupparbete där folk med olika kunskaper, intressen och färdigheter var svårt, men också helt avgörande för att kunna producera vårt slutresultat. Det var definitivt en utmaning i början, det blev snabbt tydligt att vi hade helt olika referensramar och det tog ett tag innan vi förstod varandra fullt ut. Men redan från början fanns ett behagligt socialt klimat i vår grupp. Det tror jag var avgörande för att det till slut skulle bli ett bra samarbete.

**Iteration, Improvisation och Översättning.** Tre ord som vi blev ombudade att reflektera över när arbetet med teatern var så gott som klart. Tre ord som beskriver sättet vi arbetat på under denna vår. Iteration var nog tydligt för de flesta av oss. Hela upplägget för kursen baserades på etapper, där nytt material producerades och där många idéer tilläts flyga i olika riktningar, en arbetsmiljö skapad för att kunna improvisera fram material. Varje etapp hade sina distinkta delmål och successivt närmade sig arbetet sin slutdestination. De sista veckorna handlade det i mångt och mycket om att översätta alla idéer, alla skisser, allt det vi sysslat med, till tre

koncisa och tydliga planscher. Men också om att översätta konceptet kristaller i ett stenblock till en byggnad.

Arbetet med kandidatarbetet sammanfattar programmet **Arkitektur och Teknik** på ett bra sätt. En unik och sprudlande blandning av matematik, fysik, arkitektur och konst. Eufori och frustration. Förvirring och klarhet. Samarbete och ego. Ja de kontraster och de separata världar, som är så viktiga att ställa mot varandra om man ska ha en möjlighet att förstå vår värld.

