

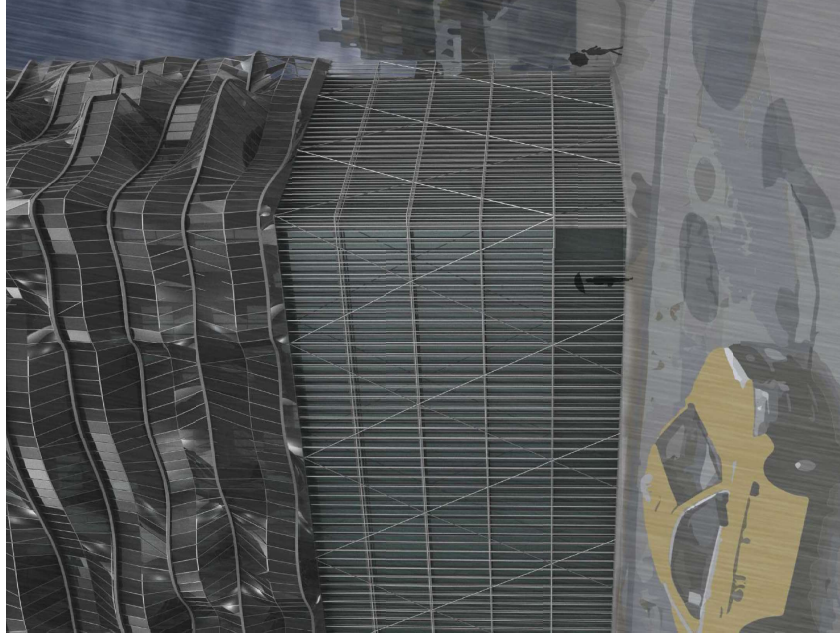
# BOX OP. OFFICE

**KURS:** Kandidatarbete i Arkitektur & teknik  
**STORLEK:** 15 Hp  
**PERIOD:** Vt 2019  
**TYP:** Elin Olsson och Rebecca Engvall  
**EXAMINATOR:** Morten Lund  
**VERKTYG:** Rhino, Grasshopper, CATT acoustics, Adobe Photoshop, AutoCAD

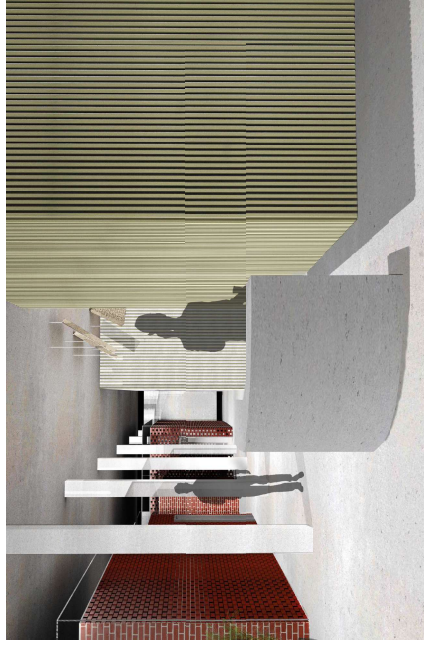
Kandidatarbetet utgjordes av ett arkitekturprojekt med stort fokus på akustik, som följer programmet till tävlingen *2019 Acoustical Society of America Student Design Competition*. Årets uppgift var att utforma ett kontorsplan åt ett växande media- och teknikföretag, på den sjätte våningen i en 15 våningar hög byggnad i centrala Louisville, USA.

Vårt förslag karaktäriseras av två tydliga koncept — ett interiört boxkoncept, och en extern konstruktion som kapslar in kontorsplanen och skärmar bort urbant buller. Varje rum blev sin egen box, och kunde därför hanteras efter funktion som enskilda akustiska enheter. Den utanpåliggande, strukturellt skilda konstruktionen dockar an mot kontorsbyggnaden och tillför organiskt formade balkonger och ger skydd mot direkt solljus.

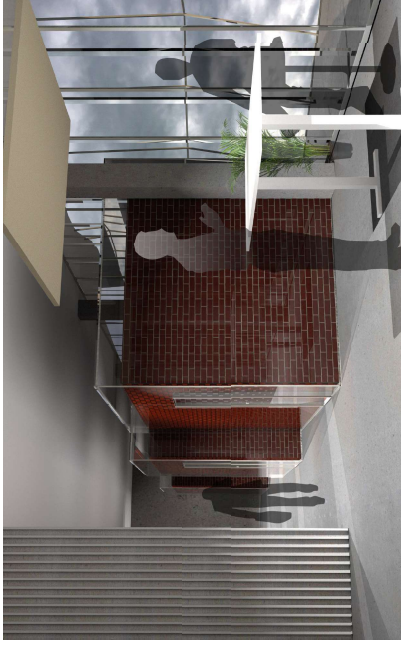
Under projektets gång har vi fått hjälp och råd kring akustiken utav Xuanzhu Chen, student vid masterprogrammet för akustik på Chalmers.



External construction defining entrance.



Conferring box covers entering the lobby.



Co-working place gradually opens towards entered area.



Employee benefits distinguished by narrow corridor.



Blank opening enabling visual transparency for conference rooms.



People enjoying their break, breaking barriers between inside and outside.

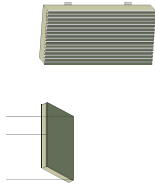




Section through the big conference room and the gym.

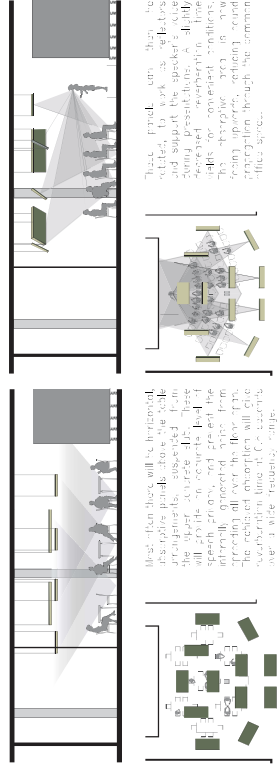
### A flexible place for several functions

Multi-use spaces are needed to fulfil the overall use of the music club. In order to start an rehearsal to have the right to start such activity, available, study the club is essential to be able to offer an indoor hall to the music clubs, the above the same purpose. One side is self-reflective, while the other is relatively

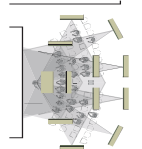


### Assembly space

Located in the center of attendees, the assembly space will figure as both a meeting place and a gathering point. This enables the placing of group meetings, having a small important meeting, having a small group of people, or even a large group of people. The space requires different acoustic properties.

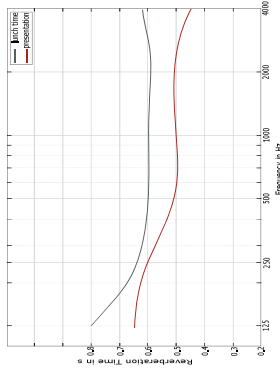


More than there will be, the room will be able to handle also in the hall. The arrangements suggest that the room will be able to handle a lot of people for speech events, and great for the overall general use of the room. The room of events will also be able to handle a lot of people for a wide variety of events.



These people can then be used to work as speakers and support the speakers' role. The room will be able to handle a lot of people for speech events, and great for the overall general use of the room. The room of events will also be able to handle a lot of people for a wide variety of events.

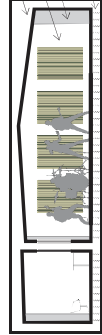
Supported from the ceiling, which attach to these systems parts on each floor. This enables the placing of group meetings, having a small important meeting, having a small group of people, or even a large group of people. The space requires different acoustic properties.



Big absorbent furniture keeps the reverberation time from depending on the amount of people in the room.

### Music recording and reproduction suit

A room equipped for both music recording and reproduction will be able to handle a lot of people for speech events, and great for the overall general use of the room. The room of events will also be able to handle a lot of people for a wide variety of events.



Reverberation will not be a problem to prevent further effects. The room will be able to handle a lot of people for speech events, and great for the overall general use of the room. The room of events will also be able to handle a lot of people for a wide variety of events.



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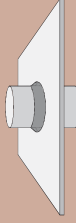
Efter ett stort och omfattande projekt har det nu blivit dags att reflektera över så väl arbetsprocess som färdigt resultat. Ett projekt som tydligt präglas av två tidigt uppkomna koncept - ett inre boxtema, och en utnppåliggande konstruktion som omfattar den befintliga byggnaden. Ett tvåmannas samarbete, som vi i slutändan blivit nöjda med både Rebecca och jag.

Akustiken har stått i fokus genom hela projektet. Så väl materialval som planorganisation har valts och utformats utefter dess akustiska konsekvenser.

Med boxkonceptet som grund har vi fått fram flera goda arkitektoniska egenskaper. Varje enskilt rum blir sin egna box. De kan därför hanteras som enskilda akustiska enheter som anpassas utefter funktion. Rum som alstrar kritiska ljudfrekvenser, styrkor eller vibrationer kunde hängas eller ställas på fjädrar. Vi kunde också använda en box-i-box-princip. På en vandring genom kontorsplanet möts man av hårda hörnor och kanter, boxar av varierande storlek, förskjutna i förhållande till varann som skapar intressanta korridorer, och boxar som hänger från taket eller står på fjädrar. Många olika boxoperationer, som tillsammans skapar en spännande atmosfär på kontoret, men som också möjliggör en funktionell arbetsplats. Multifunktionella rum som ger hög yteffektivitet.

Jag hade önskat att vi haft mer tid att experimentera med och utveckla den yttre konstruktionen mer. Det känns tyvärr som att vi fastnade i den som en idé, som vi sen inte spenderade tillräckligt tid på att utveckla till sin fulla potential.

Ett uppenbart problem som vi stött på är hur de fristående boxarna ska möta pelarsystemet. Det känns som att vi nöjde oss med en för enkel lösning, som nog egentligen inte blev tillräckligt bra.



En lärdom jag tar med mig är hur samarbeten med experter på bästa vis genomförs. Tydliga och specifika krav, gränser och tidsramar bör sättas tidigt för att arbetet ska flyta på smidigt.



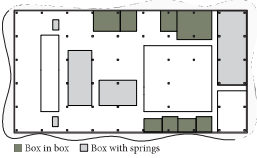
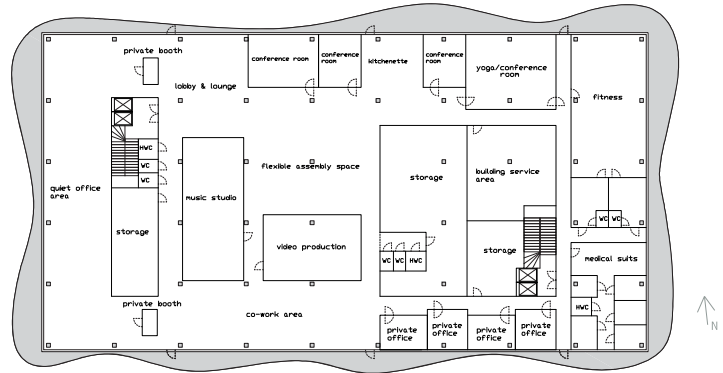
Section through the big conference room and the gym.

## Varying density among boxes

Organizing space in order to optimize its function, experience and acoustic performance. The enclosed boxes, such as the medical suits and the fitness area, are placed along the eastern facade, far away from the company front door, narrow corridors, high density structure of boxes and the most distant location from the entrance makes the area secluded, for employees only.

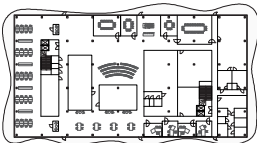
The dense block structure is gradually changing towards the middle. Corridors, reception, and more natural light are left into the assembly spaces, that is perceived as the company living room. The centrally located kitchenette, the assembly space, and the lobby compose central circulation space. Movement and conversations are wanted, and the acoustic properties have been designed accordingly.

Finally reaching the western part of the building, the architectural expression changes again. Vertical pathways with suspended dividers are dominating, but using a lightweight expression. The area is clearly discernible from the central business influencing a quiet and calm behavior of entrants.



## Acoustical ideas

Every enclosed area is considered an individual acoustical unit. They are all treated according to one of three acoustic concepts, depending on their function. Rooms dealing with critical frequencies or sound pressure levels are managed using springs and double walls. Other rooms, where common speech privacy is to be achieved, a box-in-a-box is implemented. The thin and final concept considers the open-plan areas where distinct zone divisions are the key to achieve the acoustic environment and eases of the area.



## Zoning the office area

Through distinct zone separation, employees will feel more comfortable whilst using and working in each area. Quiet work stations for individual tasks without distractions, an area specifically suited for cooperation, small booths for private conversations, and separate conference rooms in various sizes to be used for more exclusive meetings.

## Acoustical values

- Conference rooms: NC25, RT 0.3
- Assembly space: NC25, RT 0.6/0.5
- Lobby: NC33, RT 0.8
- Reception: NC20, R 0.8
- Music studio: NC10, RT 0.4 / NC30, 0.5
- Control room: NC15, R 0.3
- Open-plan office: NC25, RT 0.5
- Private offices: NC25, RT 0.7
- Open office: NC33, RT 0.5
- Co-working area: NC25, RT 0.7
- Medical suits: NC25, RT 0.6-0.65



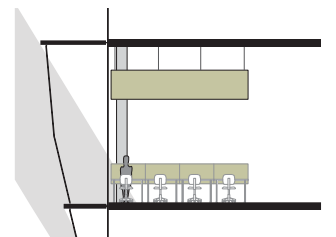
The quiet zone of the open office.

## Quiet area grants for effective conditions

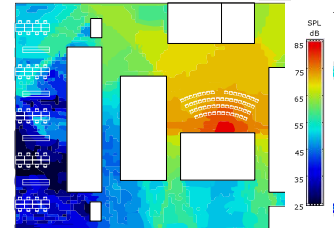
Flanking the western facade, the open office area provides an excellent environment for working. The area is clearly separated from other office functions away to avoid unnecessary and disturbing transit.

Visually distinguishing the open office area from the overall floor clearly influences the unconscious behavior of entrants. Entering through narrow passageways meeting other seating and furniture arrangement, one will sense that this is a quiet area. Furthermore, a thick, solid heavy carpet, lengthwise redwood vertical baffles and porous absorptive walls, contributing to the reverberation time of 0.5 seconds, suitable for working environments, minimizing overhearing.

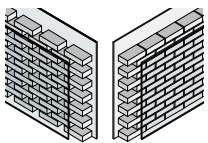
The double glass facades will nearly eliminate the outdoor noise, and there will be no direct sunlight disturbing work thanks to the shading balconies.



Sunlight through the outer facade in the quiet office part.



Noise generated during presentation is clearly decreased reaching quiet office area. If the northern part of the office receives too much noise, perforated absorbing glass could be used for the internal facade.



## Elements of acoustic control

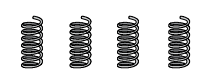
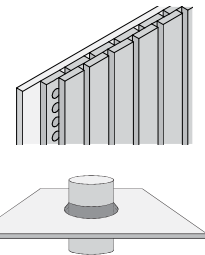
The private offices and conference rooms are arranged similarly, placed inside a brick inner box surrounded by another box entirely of glass. Furniture is made through double glass doors with wall insulated frames.

Absorptive materials are placed in the ceiling and a carpet contributes to a good acoustic environment. The big conference room is also seen as a yoga studio during lunch, one before and after working hours. Some visual contact with the gym area is therefore achieved by their separated walls facing the intermediate corridor. Thick, heavy curtains give more privacy during meetings, and will also work as effective mid-frequency absorbers.

Steel springs with neoprene pads separates crucial functional volumes from the overall construction, including the fitness studio, the video production studio, the music recording and production suite and the small rooms for private conversation. This will prevent low-frequency sound from travelling through the structure into nor out of those volumes. In more critical volumes, yet another set of springs disconnects an inner room to provide further privacy and negligible background noise. The mass-spring resonance will be tuned to a frequency below 20 Hz. In this range, low-frequency within hearable spectra will be amplified.

Absorptive internal walls, combining the scattering effect with absorption, will enable continuous concrete slabs in open plan areas, vertical wooden laths covering Helmholtz absorbers and foam materials underneath to control higher frequency.

The consistent pillar system occasionally interferes with the box units. The required excisions are hence sealed with suitable insulation, allowing horizontal movements and minor vibrations horizontally.



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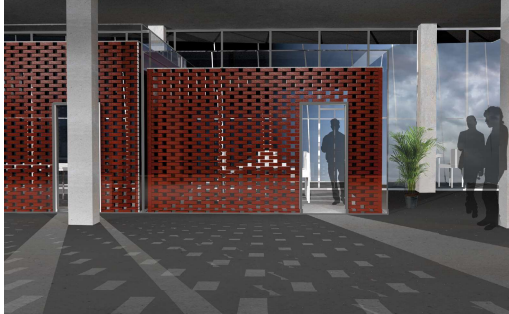
External construction defining entrance.



Confronting box corners entering the lobby.



Co-working place gradually stiffen towards restricted area.



Brick openings enabling visual transparency for conference rooms.



Employee benefits distinguished by narrow corridor.



People enjoying their break, breaking borders between inside and outside.

## Revitalizing floor 6

In a re-emerging downtown district in central Louisville, a 15 floor office building is situated. A media company wishes to lease out the 6th floor. The task is to propose a new tenant retrofit design to meet the company needs.

This proposal features the concept of an office organization in form of boxes. The concept allows for providing appropriate acoustic properties to areas

of different activities. An outer shell, an external self-supporting structure as an addition to the existing building, offers protection against sun and exterior noise as well as give space to the employees for enjoyment.

### External construction

An external construction, supported on its own, docking onto the existing building will add an additional quality. It will provide reduction of noise caused by urban traffic, an effective sun shading, enable natural ventilation and also provide balconies for employees to enjoy.

Vegetation, tables and chairs will stage a pleasant area for break times or informal meetings. A large area outside the gym enables outdoor fitness sessions for the employees all with breath taking views.

Based on the amount of traffic measured on the streets surrounding property line, a low frequency noise level of 60-68 dB on the external facade is to be expected. The first glass surface will reduce

this value with at least 20-30 dB. With further absorption using plants, furniture and absorbers underneath balcony structure, the area will meet the requirements for NC-35 even outside the original glass curtain wall. Once inside each glass facade, the outdoor noise will be reduced substantially.

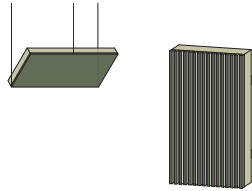
By enclosing all office floors, including the five first garage levels, the noise generated below will not disturb.



Section through the big conference room and the gym.

## A flexible place for several functions

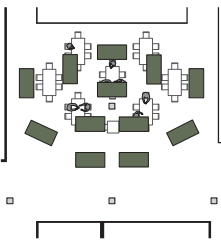
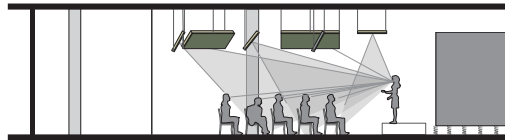
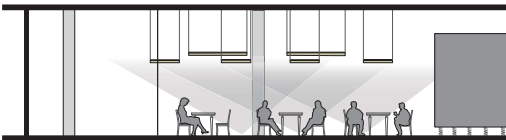
Adaptable occasions are needed in both the assembly space and the music studio. In order to change reverberation time and absorption to suit each activity, reversible panels are used. Suspended from the upper concrete slab in assembly space or attached to interior walls in the music studio, they serve the same purpose. One side is reflective or scattering, whilst the other is effectively absorbing.



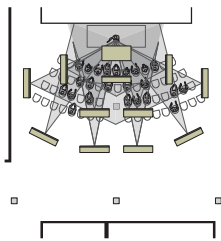
## Assembly space

Located in the center of attention, the assembly space will figure as both a primary living room and a gathering place for grand meetings. Having a small conversation over lunch or presenting important company news in front of employees requires different acoustic properties.

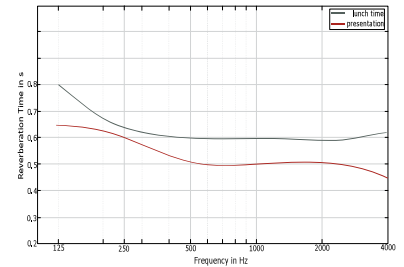
Suspended from the ceiling slab, wires allow for three anchor points on each panel. This enables a tilt during the just procedure, to aim the reflection of spoken word towards the audience. The wire attached to the single anchor are fastened in a ceiling rail to be moved remotely.



Most often there will be horizontal, absorptive panels above the table arrangements, suspended from the upper concrete slab. These will provide an accurate level of speech privacy, and prevent the normally generated noise from speaking all over the floor space. The achieved absorption will give reverberation time at 0.6 seconds over a wide frequency range.



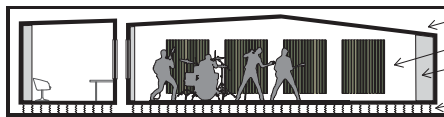
These panels can then be rotated, to work as reflectors and support the speaker's voice during presentations. A slightly absorptive reverberation time yields far convenient conditions. The absorptive area is now facing upwards, reducing sound propagation through the common office space.



Big absorptive furniture keeps the reverberation time from depending on the amount of people in the room.

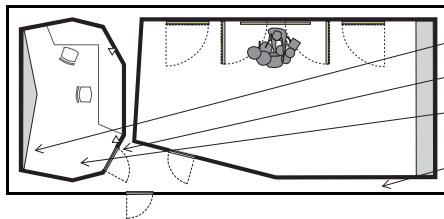
## Music recording and reproduction suit

A room designed for both music recording and reproduction in music activities for employees demands adaptable acoustics. By reversible panels one can achieve different reverberation times, depending on desired acoustic experience.

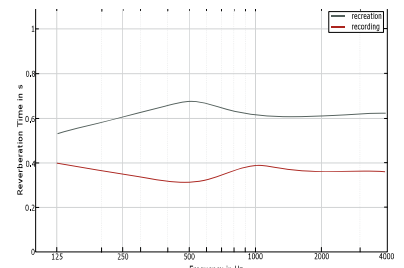


- Non-parallel walls and a tilted ceiling to prevent flutter echo.
- Reversible panels to vary reverberation times.
- Broadband absorptive rear wall, featuring an open-closed pipe concept.
- The studio and control room are kept separate within the suspended box structure, standing on springs with insulation and air in between the volumes.
- An anteroom with insulated doors and frames prevent noise transmission between rooms.

The panels mounted on the wall can be turned around by hand, offering more absorptive area during official recording and a scattering effect whilst instrumental practice. The panels can also divide the area, enclosing absorbing booths for loud instruments during band recordings. A curtain covers the back and top of the booth.



- Diffuser and absorptive material on rear wall, redirecting reflections to keep them out of listener's zone.
- Loudspeakers mounted in a 60-degree angle, aiming towards a point around 80 centimeters behind the listener to keep the receiver in the sweet spot.
- Axial symmetry through mixer position, enabling classic stereo imaging.
- Using the airspace between the outer box and the inner rooms as a buffer zone, where the volume is vast enough to store consumed air for at least one hour of intense work for three people. Once the recording is finished, one can mechanically ventilate the volumes. The increased background noise will work sound masking while employees are jamming.



The reverberation time is appropriately increased during recreational use of the studio.

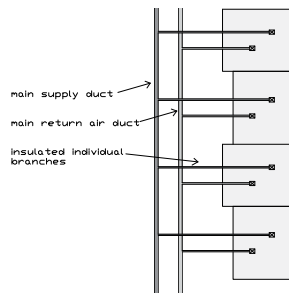
## Video production studio

Accoustically designed with a room-in-a-room concept – the outer box structurally disconnected using springs, enclosing another box elevated on a set of springs. This will completely produce low frequency sound traveling through the structure.

The walls are highly absorptive of lightweight construction with a resonance frequency below 20 Hz.

A thin layer of foil on interior walls and ceiling will reduce absorption of high frequency sounds, which otherwise tends to be too effective, generating peculiar results.

Effectively absorptive walls and ceiling enclose hard flooring, which will ease handling of rolling camera equipment.



## HVAC and technical equipment

Natural ventilation will provide comfortable conditions in open plan areas through stack effect, without generating noise.

The enclosed volumes will be individually provided for via wall and duct systems. Ductwork often transmit noise between rooms. These should therefore be lined with suitable insulation and silencers. Each unit is supplied with air through individual branches, connecting to main ducts located outside the room on the upper slab.

The core building services are all strategically located among storage areas.