Music and Architecture: from Digital Composition to Physical Artifact

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Abstract. *This paper addresses how relationships between music and architecture can be explored within the design studio through a series of digital games and projects and culminating in the actual construction of small-scale architecture. Through the examination of music and architecture, students are provided with valuable opportunities for authentic learning opportunities relating to digital mastery, teamwork, tectonics, the role of digital technologies in the design and construction process and the translation of an architectural concept relating to composition to a physical artifact.*

Keywords. *Music, architecture, real-scale modeling, the design studio.*

Re-introducing Music into the Architecture Curriculum

'Let him be educated, skilful with the pencil, instructed in geometry, know much history, have followed the philosophers with attention, understand music, have some knowledge of medicine, know the opinions of the jurists and be acquainted with astronomy and the theory of the heavens.' (Marco Pollio Vitruvius)

Architecture has, since the times of Vitruvius, been one of the most inclusive of disciplines (Morgan 1960). Defined as a mathematical science within the quadrivium of astronomy, music, mathematics and geometry, architecture was regarded as a mechanical art, until its 15th Century transformation into a liberal art through the firm theoretical foundation of mathematics (Wittkower, 1971). The twentieth century saw an expansion of the exploration of relationships through music, art and architecture, brought about by the use of multimedia, including photography, recorded music and, more recently, computers (see McGilvray 1992).

Projects such as the Corbusier, Varese and Xenakis collaboration for the 1958 Phillips Pavilion at the Brussells World Fair and, more recently, the Aegis Hyposurface project, demonstrate the potential of integrating music and architecture. Elizabeth Martin (2000) established a model for the examination of music and architecture on three levels: 'Based on acoustics' (eg Bernard Leitner's Le Cylindre Sonore), 'Instrument as Architecture' (eg Ellen Fullman's Long Stringed Instrument) and 'Layered Relationships' (eg Steven Holl's Stretto House). Martin describes the 'y-condition' as 'the middle position of music + architecture when translating one to the other and finds an organic union' between the two.

Due to recent pressures on the architecture curriculum, exacerbated by the relatively recent introduction of computing, the study of non-architectural disciplines has been significantly reduced.

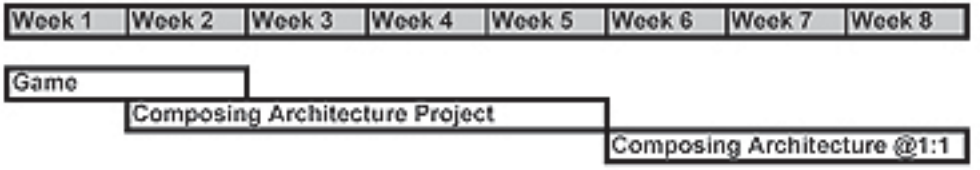

Figure 1: Architecture 2b Programme Timeline

This paper explores the y condition through a second year design studio (Architecture 2b) held at Deakin University since 2001 that addresses this shortcoming. This design studio uses a series of two games, a conceptual digital design project and a 1:1 construction project to undertake the transition from digital composition to physical artifact (see Figure 1). The project is enhanced by digital technology: 'Digital Projects' and 'games' are delivered online, supported by paperless submission and assessment.

'Games' were introduced as a part of the Deakin University and University of Adelaide CUTSD-funded 'Reflective Making' project, as low-risk learning activities that incorporated play and fun within a digital environment (Woodbury, Wyeld et al. 2001). Evaluation of these games found that, particularly in the construction curriculum at Deakin, some of them were not much fun and that the low-risk environment did not fully optimise higher-order learning opportunities. In response to this, games were introduced to the Architecture 2b unit as digital esquisse-type activities in support of design projects.

The Composition and Instrumentation Game

Design

The 'Composition and Instrumentation' game was designed to test two contentions: that practitioners of music and architecture share similarities in compositional and design processes and that musical instrumentation and architectonics are both products of making, reliant on intuitive and sensory interplay in order to produce a finely 'tuned' artifact unit website. The game provided opportunities for students to 'cross the floor' and explore areas outside of architecture within the design studio.

Playing with themes of composition and instrumentation, students were asked to undertake one of three tasks within a period of one week: to compose a musical piece using music shareware, to research the works of a musical composer and prepare a digital presentation or to design a prototype musical instrument. Each of these tasks embodied different levels of play and provided students with different ways to engage with the topic.

Outcome

Approximately 270 students have completed this game since its inception in 2001. Generally, about 1/2 of the class research the compositional processes of a composer, whereas 1/4 of the class undertake a digital composition and 1/4 design a prototype music instrument. Self-selection of tasks for the game provides insights into the variety of individual interests and motivations. Students generally chose researching a composer as the easiest option. Designing a prototype musical instrument or composing music were generally perceived to be harder tasks for the game. Student comments illuminate this point. One student selected researching a composer because (he) couldn't do the other two,' whereas a second student designed

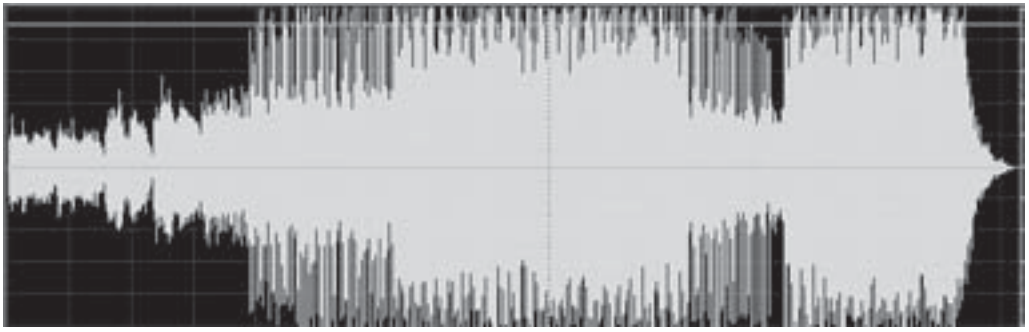

Figure 2: Screen shot from student composition

a musical instrument, because it is a 'much more dynamic adventure when taken out of your comfort zone.' This paper will focus on the composition aspect of the game, as this offers the most potential for a discussion of music and architecture facilitated by digital technologies.

Students were introduced to the works of Cage, Varese and Zappa and ideas of re-defining 'music' through compositional processes, including 'musique concrete' as a form of gathering sounds from the environment. Students utilised musical software available freely on the Web, or used Minidisks, mobile phones or tape recorders to compose their pieces. Cutting and splicing audio tape (the analogue form of musique concrete) was translated into the digital realm using software such as Cool Edit Pro, Fruity Loops or Garage Band. As a result of this technology, the most common musical response was the creation of sample-based music gathered from websites. Contrary to initial perceptions, students with prior musical skills appeared to hold little advantage in composing the music. For amateur composers, these compositions were of a reasonably high quality, full of ideas and inspiration from diverse sources such as the sea, the heartbeat and the sound of the city.

Parallels were formed between the compositional and design process through the use of layers, samples and overlays to express an idea (see figure 2). One student summarised an interesting compositional process brought out by this Game:

'The starting point was visualising sound, this then followed into the human response and movement… When it came to producing the music/sound I experimented literally with the human heartbeat in 'Fruity Loops' It was interesting to apply ideas based on architecture into a different realm. I think that the outcome was successful and it provided a good start to the 'composing architecture' design'

Although one student felt that the Game imposed a 'huge workload' and 'was only relevant if you have a strong interest in music,' the cohort generally responded to the game well. The strongest feedback for the game, however, was the benefit of operating outside of architecture in order to inform architectural design. This is supported by feedback comments such as 'the game made one think of architecture in a new way' and 'reinforced my commitment to investigate the other arts' and the game '…opened up a whole new realm of design for me personally, and has encouraged me to look further into the relationship between mathematics and architecture'.

Although the Composition and Instrumentation game required several hours of work, student outcomes reflect a game-like quality, playing with the area of music that is of almost uniform interest to the cohort. This served the purpose of informing a design response well.

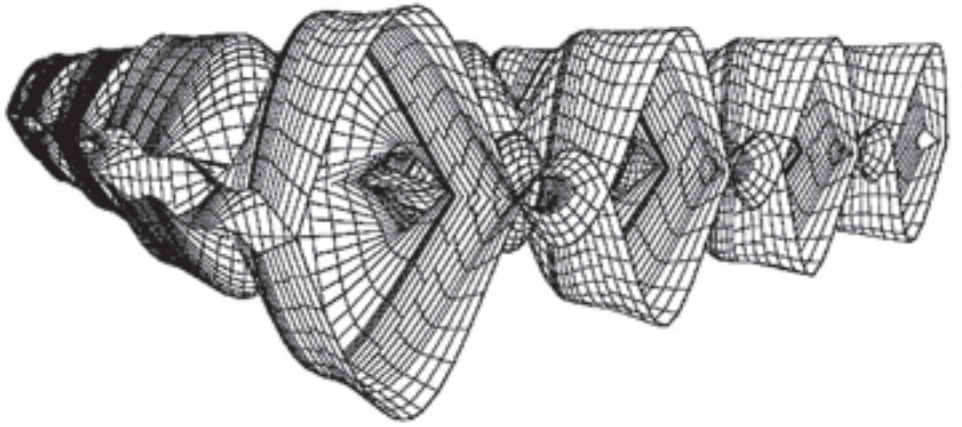

Figure 3: CAD model translation of The Avalanches 'Flight Tonight'

The 'Musitecture' Game

Design

Operating over a four hour period in groups of five students, this game contrasted to the 'Composition and Instrumentation game in focus, intensity and work requirements. This game explored relationships between music and architecture through translations of music into digital representations of architectural form. In playing the game, students downloaded music files and a 3D CAD model of the City of Geelong from the game website as resources. Groups developed a representation of architectural form directly from a selected piece of music, selected for its compositional, mathematical or 'architectural' qualities. Music deliberately crossed genres, and included jazz musicians such as John McLaughlin, cut and paste artist such as The Avalanches, mathematical bands, Metallica, Tool and King Crimson and composer of extreme complexity, Frank Zappa.

Following examination of Solomon (1999), students examined musical parameters, including dynamics, tempo, meter, rhythm, texture, media, timbre, thematic and motivic structure and development, harmony, harmonic motion and form. These parameters were then used as the basis for a representation of architectural form in a digital streetscape. Images of human-level interaction with this form were then included in a website or Powerpoint presentation.

Outcome

Given the wicked nature and intensity of the task, this game reinforces the need for teamwork, creative ideation and quick representation of developed ideas using digital media. An example of this is where one group constructed their representation the Avalanches tune, 'Flight Tonight' by initially mapping the form of the composition from sound waves, then adding depth to this linear translation (see figure 3). Once this was accomplished, the surface model was further translated into a 3D solid.

Student feedback indicated that teamwork, peer learning and rapid advancement of 3D CAD modeling skills were important learning outcomes for the game. One student reflected:

'Through this design game, I learnt basic use of Rhino and most importantly what can be

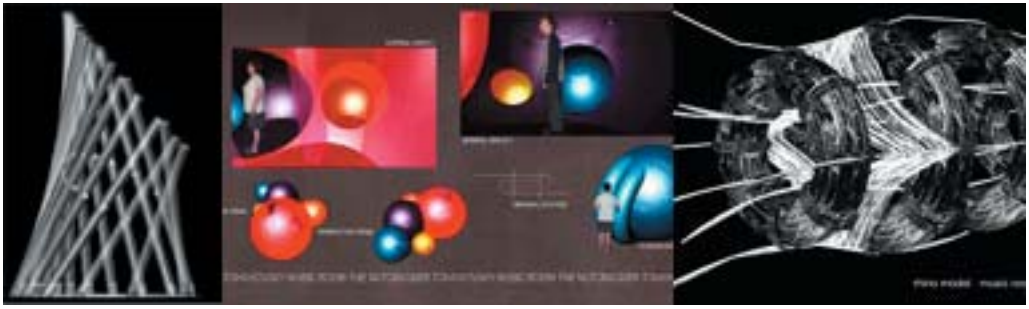

Figure 4: Music Room designs using 3D CAD models as design and presentation tools.

achieved in a very limited amount of time. This was an extremely beneficial exercise, not in the actual design objectives but more through the team building aspects'.

Some students felt frustrated at the short time allocation, and reflected that more time was required to produce better results. As one student stated, 'We only had 4 hours to try accomplish what others spend a life time to understand'. Overall, the intentions of games as fun accompaniments to design projects appeared to have been realized. As one student stated, the Game was 'very conceptual and fun'.

Framing these tasks as games brings forward the self-directed exploration of music and architecture within a low-risk environment that utilises computers in new ways for these students. In a game, students can explore freely, knowing that 'its only a game'. The absence of a marking regime associated with these two tasks reinforced this freedom of exploration. It was observed that this association between music and architecture is strongest on the level of a game.

The Composing Architecture Project

Design

Since 2001, approximately 300 students have completed this project. The project operates over a period of four weeks, and is supported by weekly studio sessions and guest lectures from composers and artists. This project involved the design of a 'Music Room', a space specifically designed for the contemplation and/or composition of music (unit website). This design project raised the stakes beyond the 'low-risk' environment of the previous games, bringing forward considerations of tectonics, materiality and demountability. Operating over a five-week period, the project allowed students time to develop an architectural concept relating to a game. In a sense, the game operated as a 'lure' to draw students into a design project with a high tectonic emphasis. Here, we see a raising of the stakes, and risk inherent in the project, beyond that of the games.

Outcome

Students develop design work by employing hybrid combinations of drawings, physical models and 3D CAD models. These representations are then incorporated into a digital presentation in PowerPoint, Dreamweaver, Director or Flash format for online submission. The use of hybrid media for these projects is encouraged by design staff, following by the recognition of the benefit of hybrid media processes by Bermudez and King (2000) and the author's own investigations into representational media in the design studio (Ham 2003).

The project allows students to adopt either deep or shallow approaches to the interconnection between music and architecture. 'Deep learning' approaches are characterized by conceptualisa-

tion, connections between concepts and data, and reflective activity, whereas shallow learners generally focus on discrete elements without integration and are unreflective about purpose or strategies (Saljo, 1979). For this project, deep learning students spend more time and effort exploring connections between music and architecture, whilst shallow learners may defer these considerations in order to concentrate on the tectonic attributes of the design.

One student who successfully realized connections between music and architecture was 'Samantha,' who received a mark of 83% for her very innovative interpretation of the Music Room. Samantha integrated her Game into her design, underpinned by interactions between musical composition software, 3D CAD and Flash. 'The computer enabled quick visuals of simply constructed but complex shapes. The process of applying a material to a complex shape whilst maintaining a mystical aural experience was investigated'. (see figure 4 left)

The principal limitation of this project is its operation for students in the second year of their studies. Limited design and representation skills filter most students' abilities to grasp concepts of music and architecture on a deep level. This is particularly evident when students are required to translate potential connections with music into representations of architecture. Within the filter of a second year studio, a number of students do successfully develop their Music Rooms both conceptually and tectonically. From these, six to eight projects are selected for actual construction at 1:1 scale each year.

The Composing Architecture @1:1 Project

Design

This project elevates the consideration of music and architecture considerably beyond the previous games and digital project. Groups of 12 students are formed to facilitate the construction of Music Rooms, with no budget (sponsorship required) and within a time period of three weeks. The project website states that 'This project requires you to test your understandings of the relationship between music and architectural design processes covered throughout the year in the construction of a small but exquisitely detailed piece of architecture, a Music Room.

Selection of projects is undertaken by students and is based on the conceptual development in relation to music, tectonic viability, cost, and perceived effort. Staff intervention forces students not to adopt a shallow approach to project selection. This project is based on concepts of risk and reward, where students are encouraged to take risks by selecting challenging design projects that extend their learning. With a higher risk, the potential for reward, in terms of learning, is provided.

Outcome

We have observed that, at each step between the game, the design project and the final real-scale modelling project, there is a tendency for the relationship between music and architecture to be relegated backwards in deference to more architectural considerations. This has important parallels to the construction industry. Considerable effort is required by unit staff to continually reinforce the relationship between music and architecture in the 1:1 construction stage. The digital game and project environment encourages free design thinking where exotic ideas can be explored where the only risk relates to the students grades (and not even that for the games). This all changes once students are required to physically manifest a relationship between music and architecture in the real world, with its constituent real restraints. Once this is reinforced, a remarkable number of real-scale models achieve a high level of resolution, particularly in consideration of the year level and time allowed for the project. In reward for this student grades are generally 10-15% higher than for other projects.

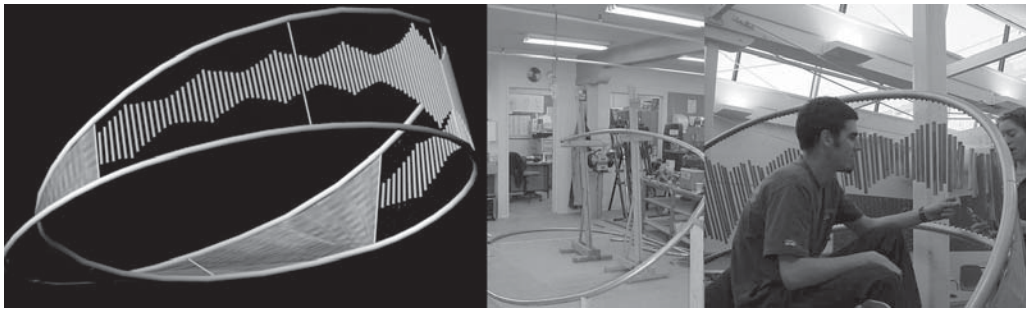

Figure 5: Process of construction of the mobius sculpture; Rhino model and construction process.

In constructing their Music Rooms, teams address issues of actual construction, scale, tectonic physicality, aesthetics and the poetics of construction, teamwork and collaboration, risk and reward and cost and safety that cannot be realized in digital design projects. They also realize that the translation of an architectural concept to the built form requires innovation, motivation and a serious amount of work. This is an important lesson for second year students, the majority of whom have had little or no experience with the construction process. In actually constructing a small building, students realize the limitations of 3D CAD, drawings and physical models. Reflection on the experience of actual construction acts as a benchmark through which other media are compared to, even after several years.

Although the limitations of representational media are recognized, the role of digital technologies in the procurement process is addressed. The complex nature of many Music Rooms requires students to draw upon the resources available within the local construction industry. Students engage in higher end activities such as 3D scanning, fabrication through CNC routers and digital shop drawings by necessity in order to realize their construction within the limited time period.

An example of this is where one team elected to construct a musical mobius strip, based on only a loose sketch and a wobbly model made of wire and stocking material. This project would have been impossible to construct without the intervention of digital technologies and the assistance of colleagues. Following Andrew Maher's presentation on building blobs at eCAADe 2003, students worked with SIAL to translate a Rhino 3D centerline model of the mobius, into a spreadsheet specifying tubular steel components using a script developed for a sculpture project. These components comprised a series of parameters including arc, length and angular offset. From this, components were fabricated and returned to students:

'Then there was the challenge of getting the correct shape of the mobius strip. This consisted of laying out a grid on the workshop floor which corresponds to that of the CAD model and using props to keep the connections at certain heights above ground level. These heights yet again corresponded to figures from the CAD model.'

CUTSD learning evaluator Dr. Di Challis tested the programme against Martin-Kneip's attributes of authenticity (real purpose and audience, integration of content and skills, disciplined enquiry and academic rigour, explicit standards and scoring criteria, elaborate communication, levels of thinking, reflection and feedback). Challis's conclusion was that 'from the outset, students were challenged and what they produced throughout these intensive five weeks offers abundant evidence that all…were engaged in a rich learning experience… This complex series of tasks demonstrably meets accepted characterizations of an authentic learn-

ing experience (Challis 2001, p36).'

Conclusions

This paper has demonstrated the exploration of the y-condition through a series of games and projects that operate from digital composition to physical artifact. The use of digital technologies in a fun, low-risk environment assist this free exploration of music and architecture. The freedom of association between music and architecture has been observed to decrease as the risk and requirements for tectonic resolution increase. This is particularly evident during the construction phase of the curriculum and has real parallels with the diverging interests of architects and builders in the construction industry. Here, the educator (and architect) has an important role in reinforcing the conceptual basis of the constructed projects, whilst ensuring projects are completed on time.

Games have been found to be an excellent means of starting ideation for design projects, with positive outcomes in terms of teamwork, increasing digital mastery, ideation and conceptualisation. In addition to providing students with opportunities to physically construct buildings, thus understand the limitations of representational media, actual construction allows opportunities for the use of digital technologies to facilitate complex construction. Thus, the games, digital project and 1:1 construction projects work together to reinforce the integration of music and architecture within an authentic learning environment.

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