Acronyms

RIR Room Impulse Response 5

Contents

1.1 - Room Modelling

1.1.1) Room Measurements

Before taking room measurements, a quick top-down map of the room was made, highlighting objects, wall indents or protrusions and where doors and windows existed. The dimensions of

the room were then measured in meters and noted on the not to scale room map. The tool used for measurements was a DeWalt laser distance measurer [1]. This allowed for accurate measurements of distances that would otherwise not be accessible such as the distance between roof lighting and other fixtures. Once the basic layout had been mapped, maps of individual walls were made and features such as window and door dimensions, distanced between doors etc were noted. The example of an annotated blueprint can be seen in figure **??** in Appendix **??**.

Hendrix Hall measured at approximately 18.3m x 18.2m x 5.5m.

1.1.2) Designing the room

The blue prints were used to model the room in Google SketchUp starting with a hollow rectangle with the dimensions of Hendrix Hall. From this the wall indents and protrusions were modelled by using a push/pull tool. Figure 1 shows an early iteration of the SketchUp model where several wall protrusions have been modelled.

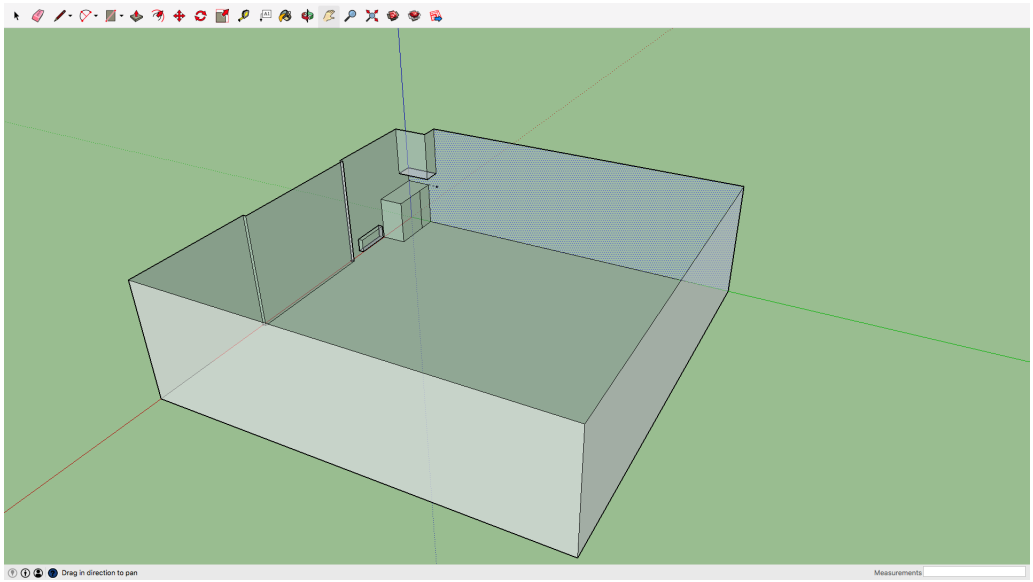


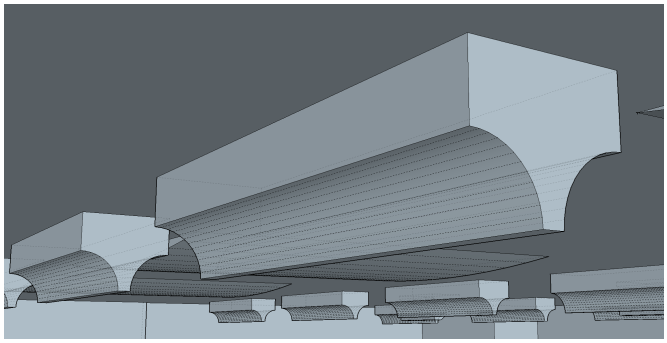
Figure 1: Early iteration of the Hendrix Hall SketchUp model with a few early wall protrusions being modelled such as the entrance door

The contents of Hendrix Hall are predominantly flat surfaces though some more complex surfaces include:

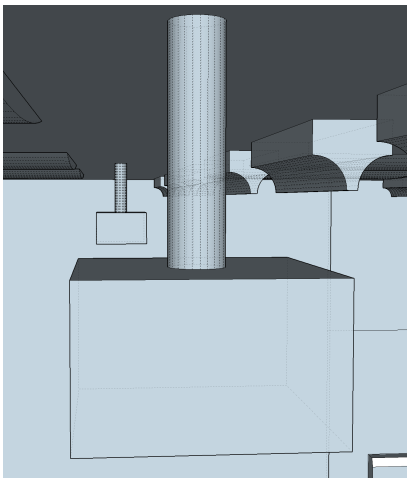
- Lights (concave curves)
- Canvas roof hangings (convex curves)
- Projector hangings (poles)
- Roof (tiled)
- Radiator and door grills

Objects with curved edges posed a problem when importing the model into Odeon. This is because SketchUp uses a large number of short surfaces to represent curves as can be seen in Figure 2 which shows the initial models of the lights, projectors and roof hangings. This then means that Odeon has to take each into account when calculating the rooms acoustics. According to the Odeon manual [2], when modelling a room for acoustic simulation purposes it is more accurate and less time consuming to keep the model simple and to add the appropriate scattering coefficients or materials in Odeon itself. This also applied to the grilled objects in the room as a grill surface material could be selected from Odeons material list, see section Material Selection

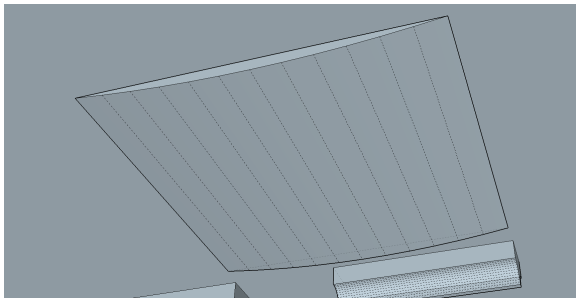
These objects were then redesigned more simply which can be seen in figure 3



(a) FIRST



(b) SECOND



(c) THIRD

Figure 2: Initial models of the lights and projector hangings made of a large number of surfaces

1.2 - ODEON

1.2.1) Water Tightness Test

Once the the SketchUp model had been exported as a .par file using the SU2Odeon plug-in [3] it could be opened in Odeon and checked to ensure that there were no gaps in the model for which rays to escape. If this was the case, the model would have to be fixed in SketchUp and reimported

into Odeon. Odeon makes checking the model easy by running a '**water tightness**' check where a large number of rays are reflected around the room seeing whether any of them manage to escape. Figure 4 shows the Hendrix Hall model undergoing such test. Once it was ensured that the model was fit for use, the surface materials could be assigned.

1.2.2) Material Selection

The surface materials within a room have a huge impact on how sound propagates around a room, heavily effecting reverberation time and frequency content of said reverb. It is therefore imperative to assign materials as accurately as possible to produce an accurate representation of a known acoustic environment. For this, Odeon provides a material list of common materials often found when constructing building.

1.2.2.1 Initial Materials

As the exact surface materials of Hendrix Hall are not known and Odeon's material list was limited to materials that seem to be tailored for construction sites only, assumptions had to be made for the original surface materials. In some cases, appropriate materials were not available therefore new materials had to be added to the material list. This can be done by finding a materials absorption coefficients, selecting '**Edit an existing material**' where new materials absorption coefficients can be entered and saved as a new material. Required materials that were absent from Odeons material list include:

Material	Surface applied to
Hard Plastic [1]	Roof lights and projector covers
Mineral fibre [2]	Ceiling Tiles
Slate [4]	Blackboard

This is shown in figure **??** An example of materials is as follows

A full material list is available in '`Material_List_V2.xlsx`'

1.2.2.2 Surface Types

For a number of surfaces it is appropriate to additionally edit properties other than just their absorption coefficients.

As explained in section Designing the room

[2] Avilable: http://www.acoustic.ua/st/web_absorption_data_eng.pdf
[2] Avilable: http://www.bembook.ibpsa.us/index.php?title=Absorption_Coefficient&action=edit

1.2.2.3 RIR Comparison

1.2.2.4 Final Material Choice

The incorrect Room Impulse Response (RIR)'s were used to calculate the room materials to begin with. Upon rendering new RIR's, three tests RIR's were rendered with the three main differences in materials selection in order to check that the spectrogram was close enough to the real RIR's

1.2.2.5 Original Material Selection

1.2.3) RIR Outputs

1.2.3.1 RIR Topology Problems

1.2.4) RIR Locations

REFERENCES

[1] *DeWalt Laser Distance Measurer Manual*, Manual, DeWalt, 2016. [Online]. Available: http://service.dewalt.co.uk/PDMSDocuments/EU/Docs//docpdf/dw03101-typ1_en.pdf

[2] C. L. Christensen and G. Koutsouris, *ODEON User's Manual*, Scion DTU Diplomvej Kgs. Lyngby Denmark, 2015.

[3] (2016) Su2odeon. Software. Odeon. [Online]. Available: http://www.odeon.dk/su2odeon-plugin-trimble-sketchup

[4] P. Kovalchik, R. Matetic, S. Peng, and G. Cole, "Measurement method for determining absorption coefficients for underground mines," pp. 1–4. [Online]. Available: http://www.cdc.gov/niosh/mining/userfiles/works/pdfs/ammfd.pdf

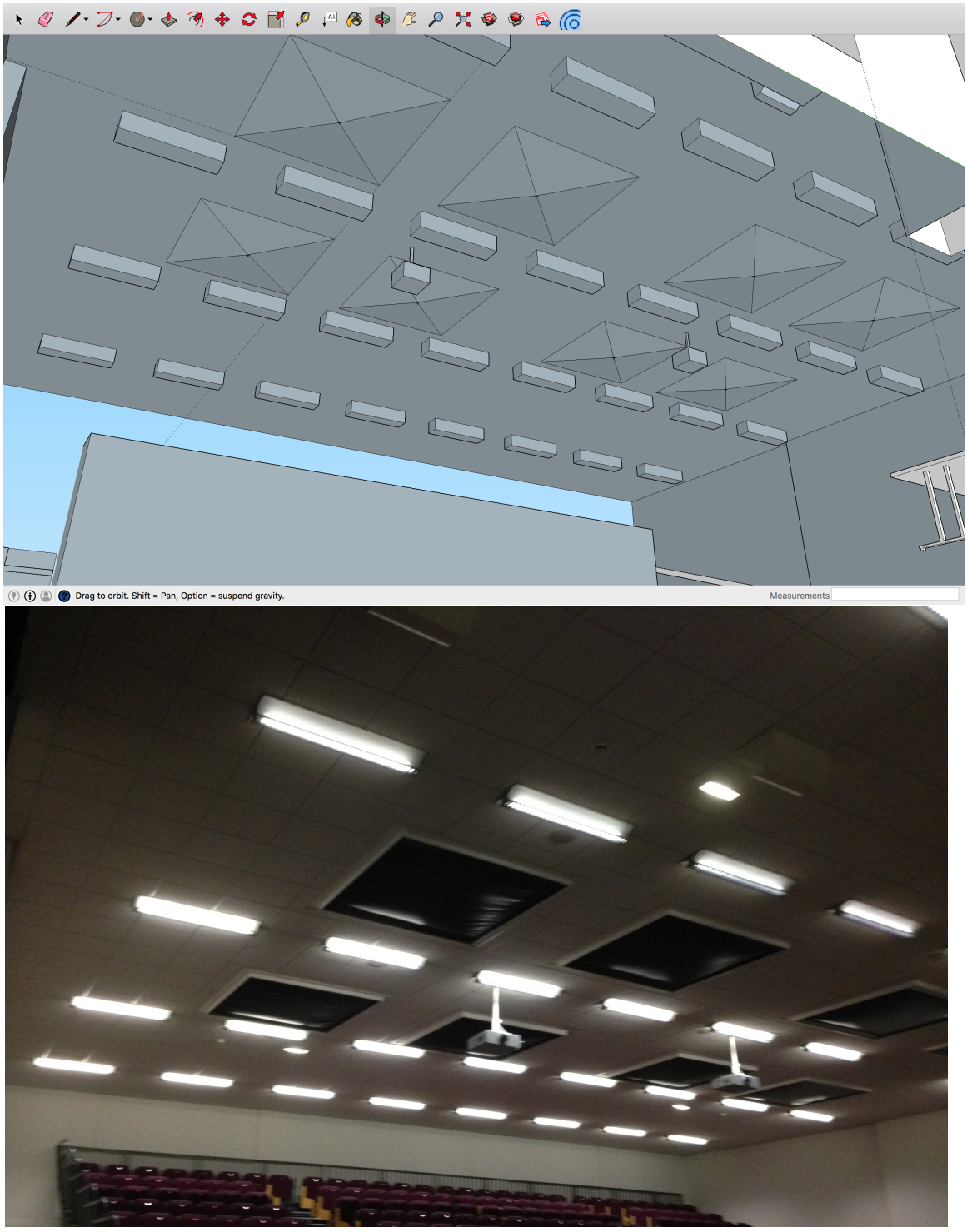


Figure 3: Comparison of the final simplified model and a picture of the real Hendrix Hall

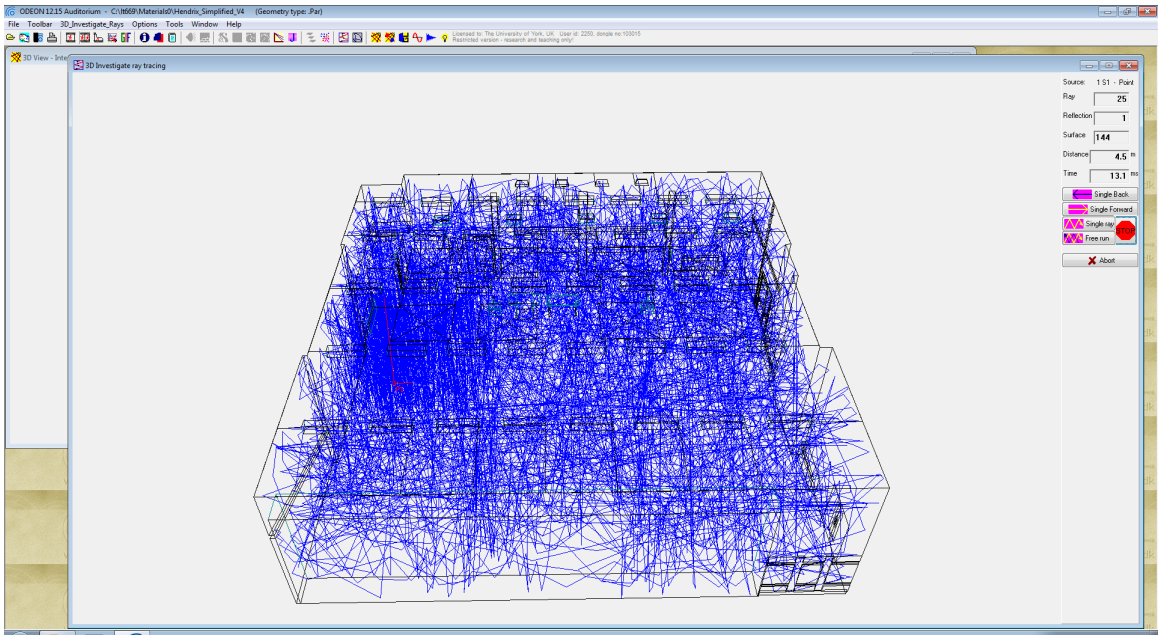


Figure 4: Hendrix Hall model undergoing a water tightness test in Odeon

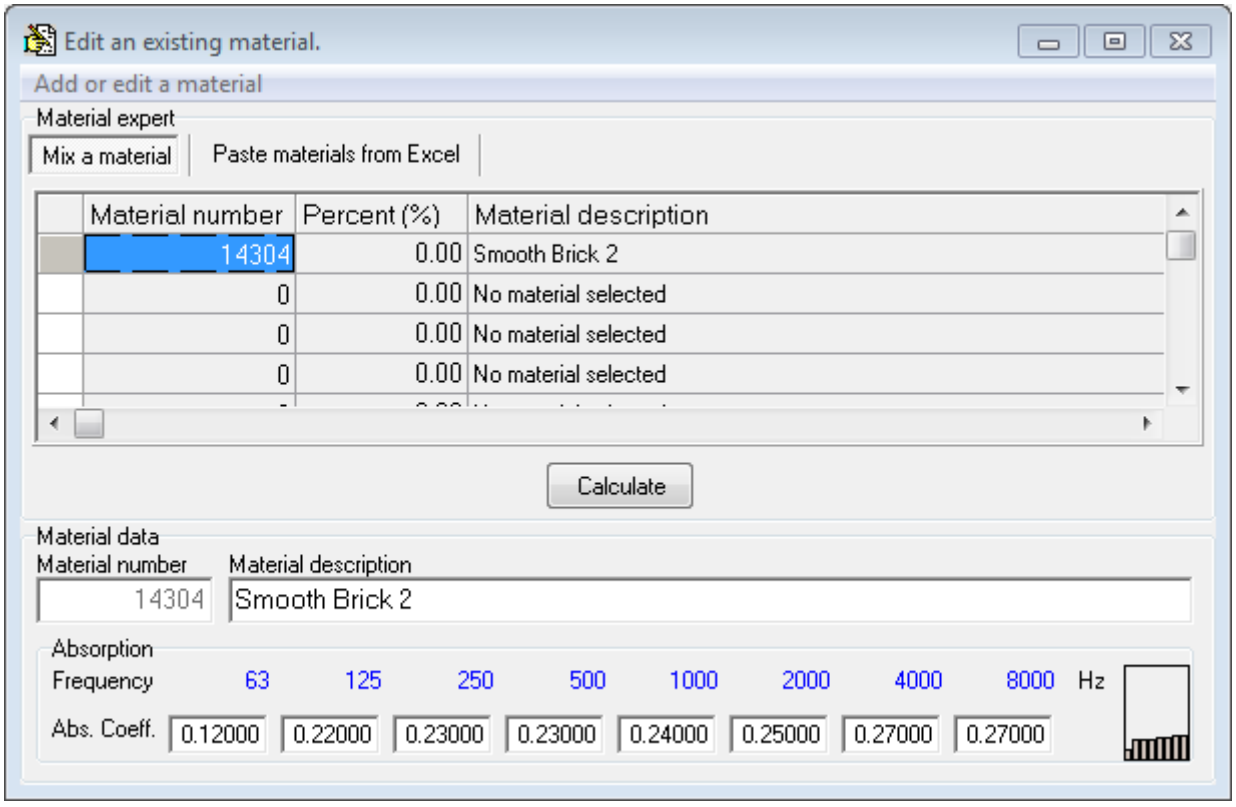


Figure 5: Absorption coefficient editing window in Odeon used to add unavailable materials