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New City Court

Southwark, London, UK

SOUTHWARK CATHEDRAL ASSESSMENT

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Project Information

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AUTHORS:	Thomas Avery-Hickmott (TAH)
	Rob Rowsell (RR)
	Patricia Pino (PP)
	Dr Giulio Vita (GV)
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Contents

1. Executive Summary

This note has been prepared in response to the objection to the proposed New City Court development by the Cathedral Fabric Commission for England. The objection raises concerns regarding the impact of the proposed New City Court on the structure of the Cathedral.

As part of the wider wind microclimate assessment, changes to the pressure conditions on the surface of Southwark Cathedral resulting from the addition of the proposed develpoment were analysed for both the 2018 and 2021 schemes.

The pressure coefficients as reported during consultation for the 2018 and 2021 schemes are included in this note in addition to a retest of the 2018 scheme. This scheme has been retested in response to the objection with the high-definition model of Southwark Cathedral as used within the 2021 study, and the existing surrounds as tested for the 2021 scheme.

The pressure coefficient describes the relative pressures on the façade of the Cathedral and provide an indication of how these pressures change as a result of the buildings around the Cathedral.

Positive pressure coefficients indicate a wind force pushing into the face of the structure, and negative pressure coefficients indicate a wind induced suction pulling away from the structure. A higher number (either positive or negative) indicates the relative strength of these actions.

Results across three key wind angles were tested. These angles, 180°, 210° and 240° are wind directions corresponding to angles in the dominant wind sector for Southwark and angles at which the wind microclimate that is changed by the addition of the proposed development could interact with Southwark Cathedral. These angles are the same as the wind angles tested previously.

Where identified, any changes to peak pressure coefficient values between the existing and proposed case have been highlighted in Section 4. Many changes highlighted here indicate a movement to more neutral pressure conditions across the Cathedral, which may reduce potential for wind induced structural damage, whilst any increases in peak Pressure Coefficient values are limited to the façade of the tower.The pinnacles remain unaffected. Most of the changes are small in magnitude.

It can therefore be reasonably concluded from this study that for both the 2018 and 2021 schemes the proposed New City Court schemes do not materially alter conditions observed on Southwark Cathedral and key fabric features such as the pinnacles. No increase in the potential for wind related structural damage to Southwark Cathedral has been identified within this study.

2. Introduction

This note has been prepared in response to the objection to the proposed New City Court development by the Cathedral Fabric Commission. The objection raises concerns regarding the impact of the proposed New City Court on the structure of the Cathedral.

This note addresses directly the concerns raised within this objection.

It should be noted that the Planning Statement of Common Ground prepared for this inquiry between the parties states "*It is agreed that the wind impacts resulting from the Appeal Schemes are generally acceptable and any minor issues could be overcome by way of tree planting in the ground level public realm, screening to the terraces and balconies, and further testing of these to demonstrate suitability and safety shall be subject to planning conditions and a planning obligation.*"

Throughout the development process a wind mitigation strategy to ensure suitable conditions was developed, including the use of landscaping. Planning conditions concerning wind mitigation measures and landscaping for both the building and public realm have been agreed with Southwark Council Planning Department. The Section 106 agreement also includes an obligation for wind assessment post completion of construction and further mitigation to be implemented to achieve satisfactory conditions, if required.

This study explores the surface pressures on Southwark Cathedral. Firstly we set again the results that were accompanying the 18/AP/4039 and 21/AP/1361 submissions, we then provide an update to the 18/AP/4039 findings with a higher definition model of Southwark Cathedral and an update to the existing surrounding.

3. Methodology

3.1 Assessment Methodology

The assessment was undertaken using Wirth Research's high-resolution Computational Fluid Dynamics (CFD) modelling.

CFD is a computer based modelling technique, which simulates the effect of wind on the built environment. Wirth Research use a high-performance supercomputer, 500 times faster than a standard desktop, to achieve market leading accuracy. The CFD modelling delivers a detailed assessment of wind conditions in and around a site for all wind directions in terms of pedestrian comfort and strong winds. In addition to the assessment of pedestrian comfort, the CFD data also obtains the data to compare pressure on surfaces, with the observed pressures on Southwark Cathedral compared within the study. Southwark Cathedral is located just over 100m to the north/north-west of New City Court.

A full description of the test methodology is included in Environmental Statement Part 4: Appendix 12.1 – Wind Technical Report as detailed in the 21/AP/1361 submission (CDB.15).

3.1.1 Surface Pressure Comparison

All plots provide a snapshot of the Pressure Coefficient observed on the surface. Pressure coefficient is a dimensionless number directly related to pressure throughout the flow field. This value is a measure of the local fluid pressure and is independent of wind speed, so should be the same value regardless of climatic wind speed. This value can therefore be used to determine the pressure observed at a variety of wind speeds.

The equation for Pressure coefficient is:

$$C_p = \frac{p - p_\infty}{\frac{1}{2}\rho_\infty V_\infty^2} = \frac{p - p_\infty}{p_0 - p_\infty}$$

Where:

p is the static pressure at the point at which the pressure coefficient is being evaluated, in this case the surface of Southwark Cathedral.

p_∞ is the static pressure in the freestream.

P_0 is the stagnation pressure in the freestream.

ρ_0 is the fluid density in the freestream.

V_∞ is the fluid velocity in the freestream.

A positive C_p value indicates a pressure force on the surface relative to the freestream, with C_p value of 1 is equivalent to full stagnation of the flow. A negative C_p value indicates a suction force relative to freestream conditions, as explained in the equation above.

3.2 Testing Scenarios.

Three test scenarios are detailed in this note, these are:

- 2018 Scheme – Existing Surrounds: This comprises of the current New City Court as it currently stands, surrounded by those buildings which either already exist or are under construction. This is compared to the completed and operational 2018 development, surrounded by those buildings which either already exist or are under construction. These results were detailed in the 2018 planning submission (18/AP/4039 – Environmental Statement – Volume IV – Appendix 12.1 (CDA.13)). The results of this are featured in Section 4.1 of this note.
- 2021 Scheme – Existing Surrounds: This comprises of the current New City Court as it currently stands, surrounded by those buildings which either already exist or are under construction. This comprises of the completed and operational 2021 development, surrounded by those buildings which either already exist or are under construction. These results were shared with Southwark Cathedral as part of the Southwark Cathedral FAC Meeting on 23/03/2021 during the consultation of 21/AP/1361. The results of this study are discussed in Section 4.2 of this note.
- 2018 Scheme – Existing Surrounds – Updated: This comprises of the current New City Court as currently stands, surrounded by those buildings which either already exist or are under construction. This comprises of the same proposed scheme as the first scenario. Updates have been made to the Southwark Cathedral model to address concerns raised within the objection. The existing surrounds was also updated so both with and without the 2018 scheme now include the Guy's Cancer Centre and Shard Place, consistent with the existing surrounds of the 2021 scheme test. These results are shown in Section 4.3.

The creation of appropriate CAD models, as well as the determination of the surrounding follows a consistent approach to those already reported within the previous submissions.

4. Results

4.1 2018 Scheme – Existing Surrounds

The following results detail the Pressure Coefficient plots for the 2018 Scheme conducted as part of the 2018 submission. This compares the effect of the proposed development on Southwark Cathedral, with the only change between the two models run is the addition of the proposed New City Court 2018 scheme. The below results consider the impact of conditions at 180°, 210° and 240°, covering the most dominant wind angles by frequency, as well as the angles most likely to interact with Southwark Cathedral.

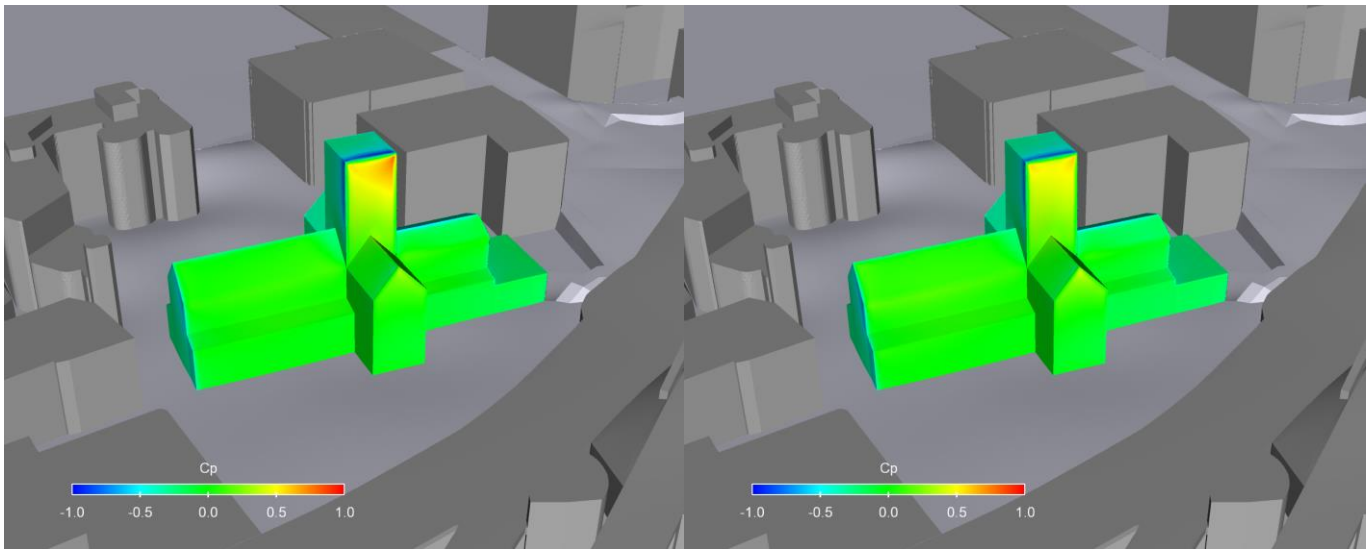

Figure 1: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2018 scheme at 180°.

As shown above in Figure 1, at 180°, the main tower central section shows a reduction in the darkest red colour, this indicates a reduction in relative pressure towards more neutral pressures (green colours). This would indicate an improvement in conditions at these locations with the presence of the 2018 scheme. These changes are however small. At the regions closest to the edges, which are most likely to be susceptible, there are no apparent changes between the two cases.

For the 210° case, the results in Figure 2, on the main tower central section there is an increase in darker red regions in the central areas, indicating an increase in relative pressure. This would indicate an increase in pressure felt for the same freestream wind speeds with the development in place. However, as with the pressure changes at 180°, the changes in pressure coefficient are small. As with the results at 180°, when comparing the edges of the building, there are no apparent changes between the two cases.

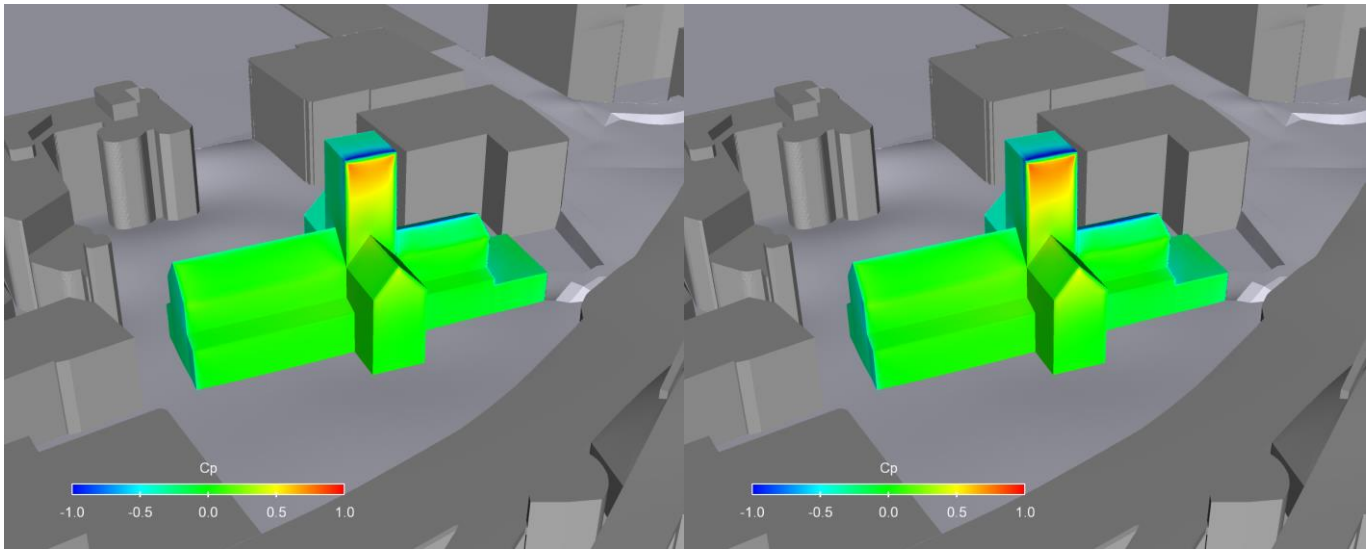

Figure 2: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2018 scheme at 210°.

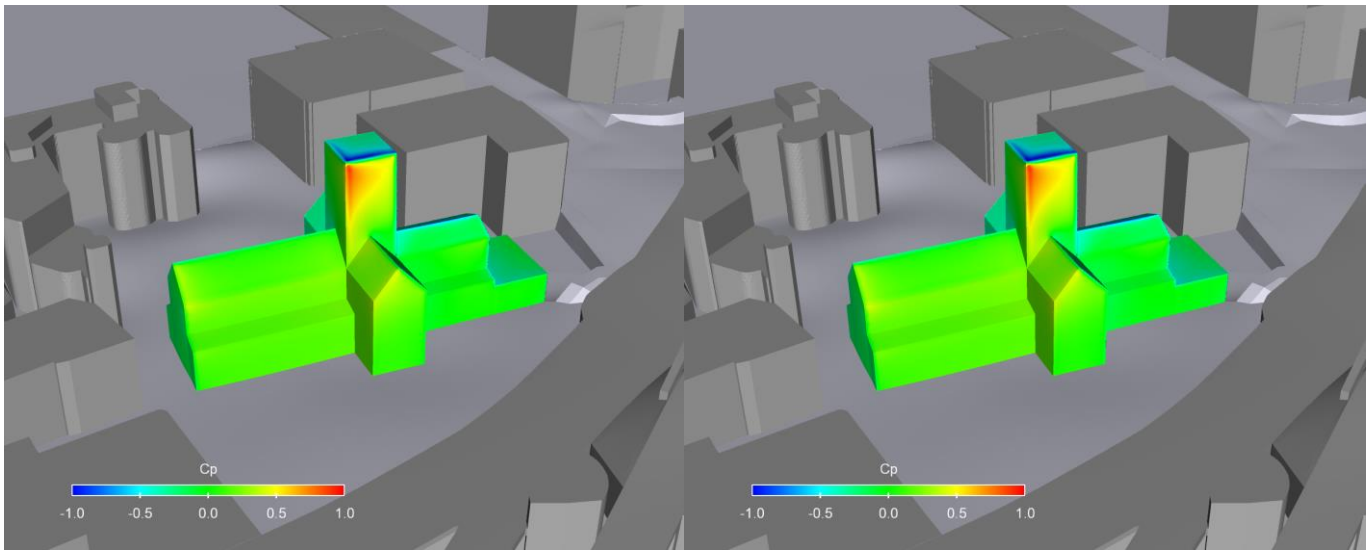

Figure 3: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2018 scheme at 240°.

Figure 3 shows the results at 240°. For both cases explored at this angle, there is no apparent change on either the main tower in the central section or at the edges.

From the tests carried out and evaluated above, there are no clear effects to be seen within the data set.

4.2 2021 Scheme – Existing Surrounds

This set of results is the corresponding plots of Pressure Coefficient for the proposed 2021 scheme. Again, this compares the difference between the existing surrounds in which Southwark Cathedral is located to these same surrounds, with the proposed 2021 New City Court replacing the existing buildings on this site at 180°, 210° and 240°. Within 400m radius from New City Court site, the changes to the surrounds (as compared to the 2018 assessments above) are the addition of the new Guy's Cancer Centre, located 200m to the south-east of New City Court and the addition of Shard Place, 50m north-east of New City Court. More significantly to the concerns raised by the objecting party, a high-definition 3D CAD model of Southwark Cathedral became part of the model, replacing the model shown in Section 4.1.

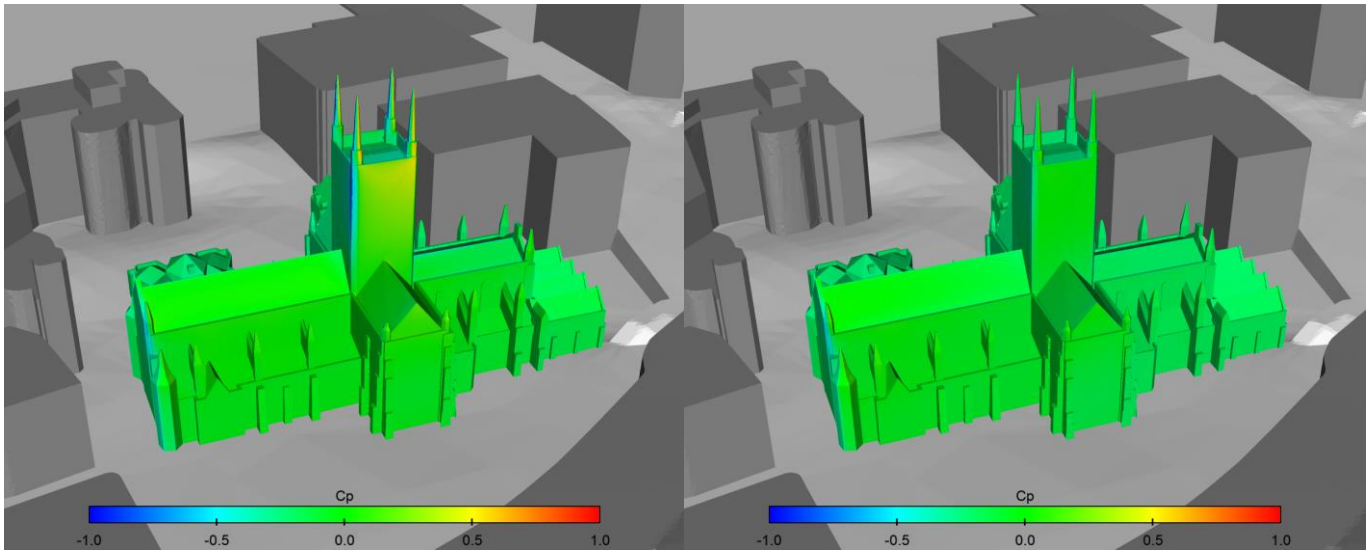

Figure 4: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2021 scheme at 180°

Figure 4 shows the comparison when accounting for the addition of the planned 2021 scheme at 180°. With the addition of the scheme, there is an increase in the green colouring indicating neutral pressures. This is visible for the pinnacles at the top of the main tower, where the magnitude of C_p decreases with the addition of the 2021 scheme, both from relative suction and pressure forces for negative and positive C_p values accordingly. There is a small change observed on the pinnacles to the east side of the Cathedral, with negative C_p values moving towards a neutral C_p. Whilst moving in a direction indicating improvement of conditions, the change is not a significant change, but a minor beneficial change.

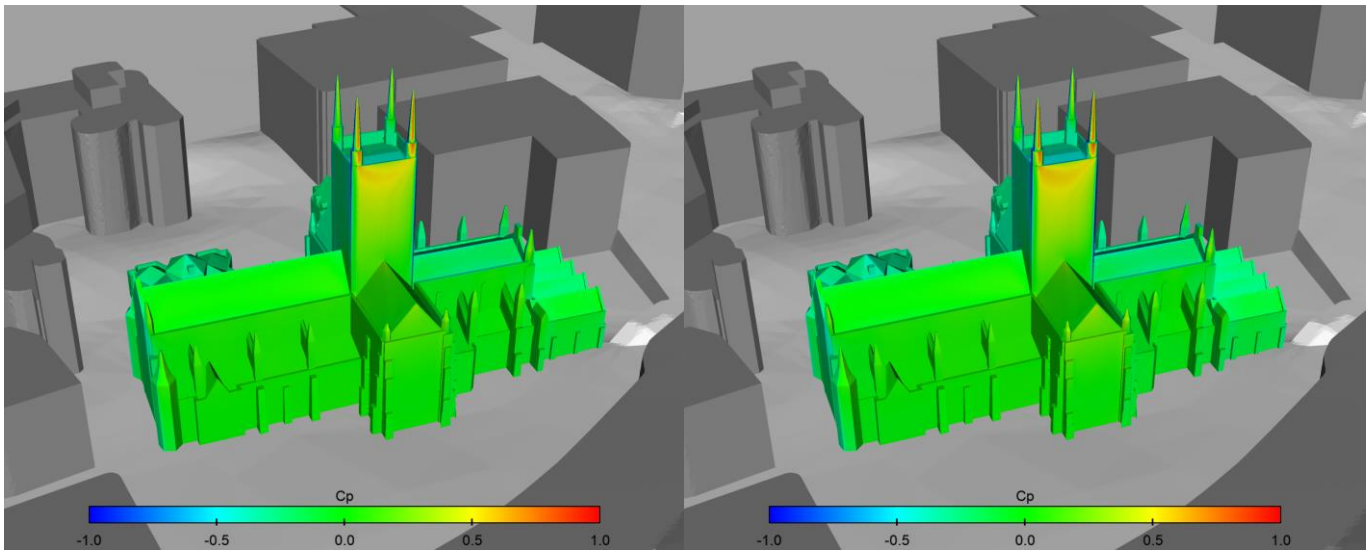

Figure 5: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2021 scheme at 210°

Comparing the effect of the 2021 scheme at 210°, as shown in Figure 5, shows no discernible differences between the two cases across the pinnacles. As discussed in the corresponding section in 4.1, there is a slight change visible across the front face of the tower, but the changes are negligible (C_p change of less than 0.05). From this angle it would be reasonable to conclude there are no apparent changes in the pressure conditions observed at the pinnacles.

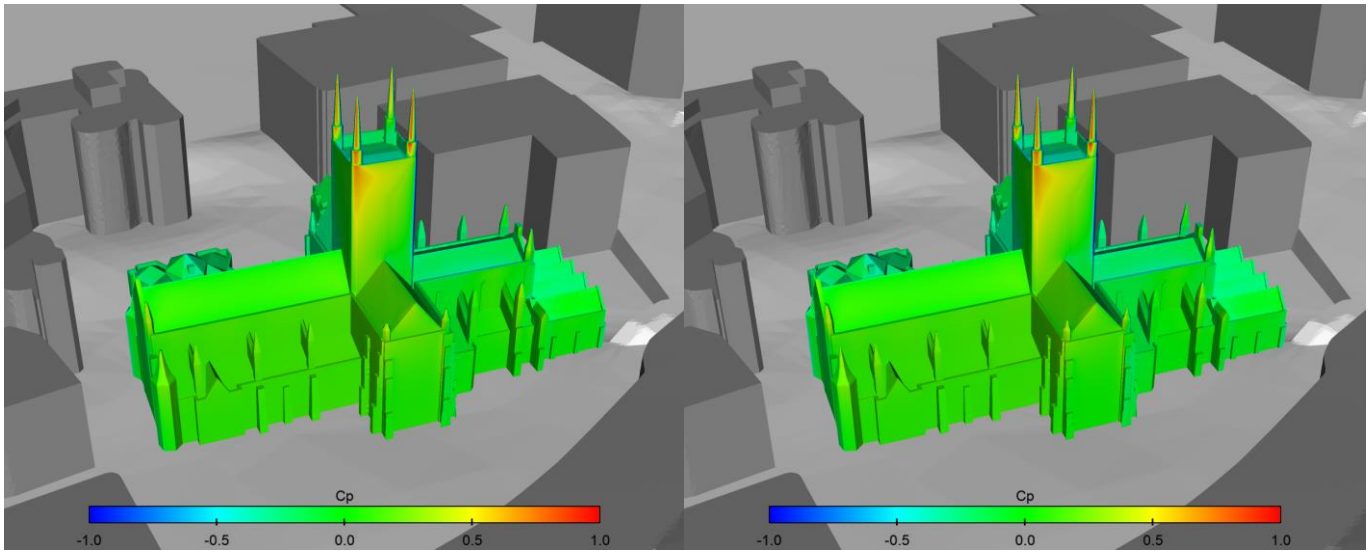

Figure 6: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2021 scheme at 240°.

The comparison of pressure profiles as shown in Figure 6, shows no apparent changes between the two snapshots, both across the pinnacles as well as façade elements. This indicates the 2021 scheme has no observable impact on conditions across the Southwark Cathedral pinnacles at 240°.

4.3 2018 Scheme – Existing Surrounds – Updated Version

The following results detail the Pressure Coefficient plots for the 2018 Scheme, updated with the high-definition model of Southwark Cathedral, in particular with the inclusion of the pinnacles and the inclusion of the Guy's Cancer Centre and Shard Place as buildings under construction. This compares the effect of the proposed development on Southwark Cathedral, with the only change between the two models run is the addition of the proposed New City Court 2018 scheme. The below results consider the same wind angles as in Section 4.1.

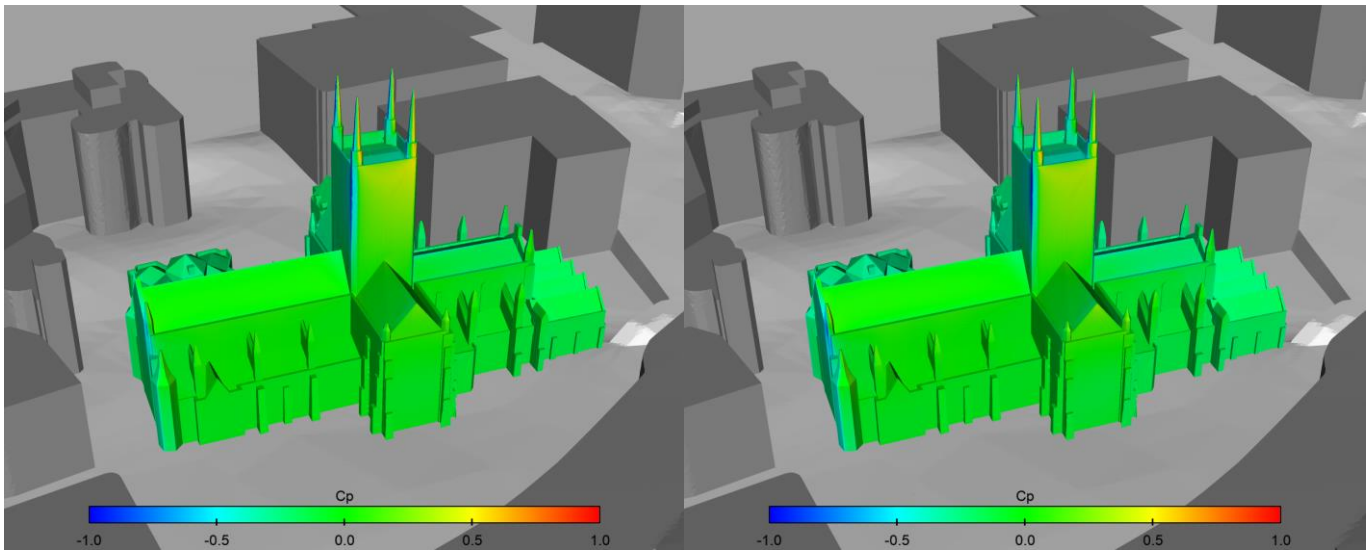

Figure 7: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2018 scheme and high-definition Southwark Cathedral at 180°.

At 180° (Figure 7) there are no apparent changes on the tower at this wind angle. On the pinnacles there is a small indication of neutralisation of pressure on the tower pinnacles, with a reduction in magnitude of both positive and negative. These changes in C_p are of the order of 0.05-0.1. Another change is in the profile over the

pinnacle to the western end of the nave. There is a slight increase in peak negative C_p observed to the west side of the pinnacle, but a neutralisation of pressure over the pinnacle windward side. This is not likely to result in a significant change in the total forces observed over the pinnacle when the changes are considered in their totality. Of the wind angles tested, this wind angle has the largest area of neutral pressures across the pinnacles.

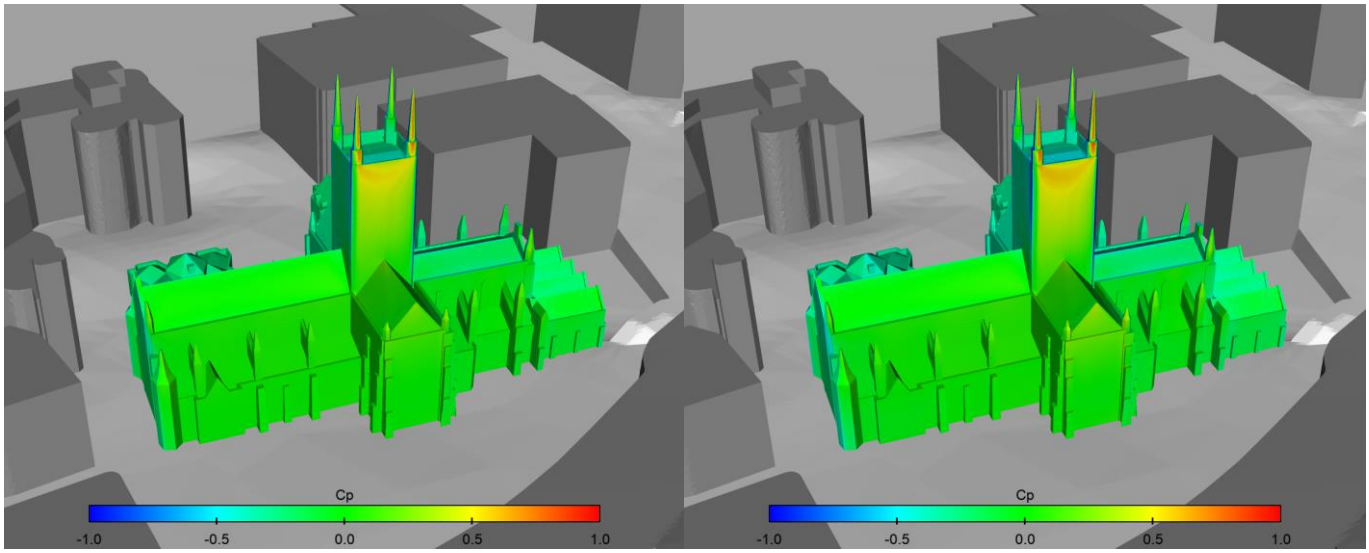

Figure 8: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2018 scheme and high-definition Southwark Cathedral at 210°.

As already illustrated in Figure 2, there are some changes in the pressure profile observed across the face of the tower. However, when comparing the pinnacles atop the tower, there are no apparent changes in either extents of the pressure patterns or magnitude changes, particularly in areas of red or blue coloured pressure, the areas of more extreme pressure forces. The C_p changes across the tower are approximately 0.05.

A similar phenomenon can be seen on the western pinnacles on the nave. There is a slight increase in peak negative C_p observed to the west side of the pinnacle, but this falls on an area of more neutral pressures, so will be unlikely to have any significant impacts.

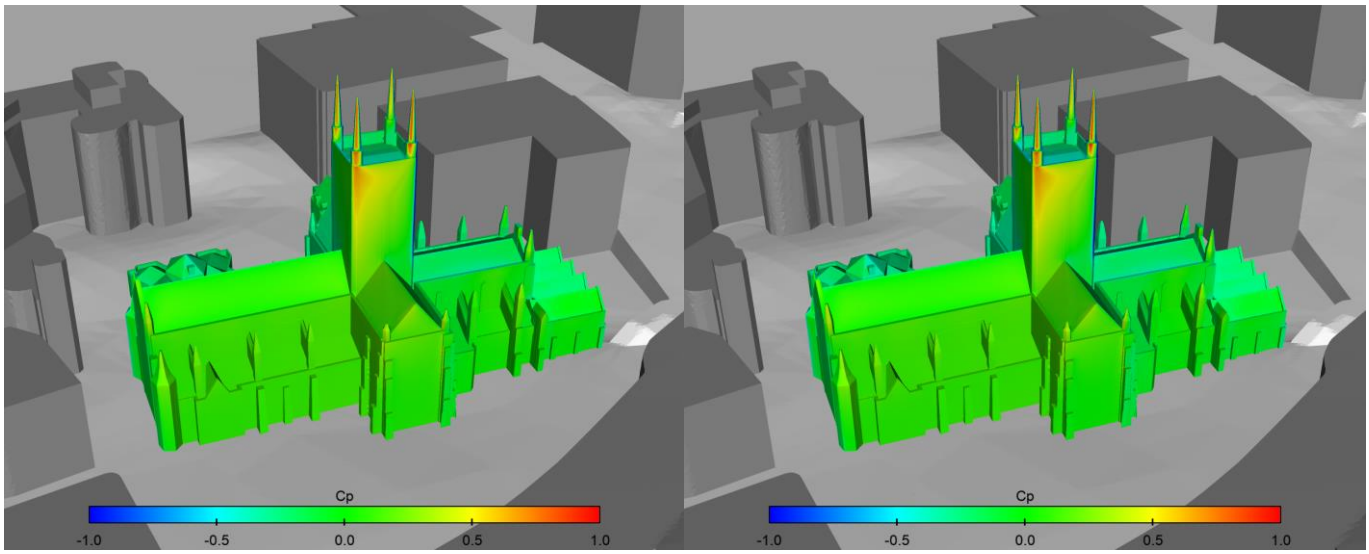

Figure 9: Comparison of Pressure Coefficient on the surface of Southwark Cathedral for (left) the existing case and (right) with the proposed 2018 scheme and high-definition Southwark Cathedral at 240°

As discussed within the previous two examples analysed at 240°, Figure 9 illustrates there are no observable changes in conditions at 240° resulting from the introduction of the 2018 scheme. This is across the pinnacles

and the main facades. This indicates that this angle is insensitive to any changes occurring by the introduction of either the 2018 or 2021 scheme.

5. Conclusions

This note summarises the tests carried out on the wind microclimate around the proposed New City Court and any observed impacts on Southwark Cathedral. This study is in response to the objection tabled by the Cathedrals Fabric Commission for England.

Comparisons of conditions between the existing New City Court building currently standing and the proposed scheme were conducted. With the only change between the comparative cases being the addition of the proposed scheme, any effects observed can be deemed attributable to the impact of the building on the local wind microclimate.

The 2018 scheme tested as part of the 18/AP/4039 submission (with a lower definition model of Southwark Cathedral) show some small changes in conditions, with some areas of lower relative pressure and some areas of higher main pressure between the wind angles. These changes are mostly limited to the central area of facades and are small in the change in magnitude observed. Areas near edges show no apparent changes in magnitude in any cases.

Testing of the 2021 model, consulted as part of the 21/AP/1361 submission, included a higher definition model of Southwark Cathedral, with additional detail of the pinnacles and roof pitches. With the 2021 scheme, conditions across the pinnacles show no significant changes with the addition of the 2021 scheme relative to the existing case. There is a small positive change observed at 180°, but the overall comparison of the three angles shows there is no indication of any worsening of conditions arising from the inclusion of the proposed development.

For the second round of testing of the 2018 scheme, the Southwark Cathedral model was updated and the Guys Cancer Centre and Shard Place were added to the existing surroundings to reflect existing conditions. The findings with the inclusion of the pinnacles into the model shows similar changes across the main façade as analysed within the earlier tests. Across the pinnacles, at 180°, a small change towards more neutral pressures were observed. At other angles no significant changes were observed. As with conditions for the 2021 scheme, the analysis indicates no significant worsening of conditions as a result of the proposed development.

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Contact Information:

ROB ROWSELL

ENGINEERING DIRECTOR

rob.rowsell@wirthresearch.com

THOMAS AVERY-HICKMOTT

SENIOR WIND ENGINEER

thomas.avery-hickmott@wirthresearch.com

PATRICIA PINO

BUILDING PHYSICS CONSULTANT

patricia.pino@wirthresearch.com

DR GIULIO VITA

PRINCIPAL WIND ENGINEER

giulio.vita@wirthresearch.com

WIRTHRESEARCH.COM