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CURLEW ALTERNATIVES EIGHTH PROPERTY LP

FORMER GAMECOCK PUBLIC HOUSE, BOOTH STREET WEST, MANCHESTER

WIND MICROCLIMATE ASSESSMENT

AUGUST 2022

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1 INTRODUCTION

- 1.1.1 Wardell Armstrong (WA) has been appointed by Curlew Alternatives Eighth Property LP to undertake a wind microclimate assessment for the Proposed Development at Booth Street West, Manchester, grid reference: SJ841966. The development comprises *“Demolition of existing building and structure and redevelopment of site for Purpose Built Student Accommodation (PBSA) uses (Sui Generis use class) with ancillary amenity space, a ground floor ‘community hub’ (proposed for Use Classes F2(b), E(b), E(3), E(f)) associated landscape works and infrastructure.”*
- 1.1.2 This report has been produced with reference to current guidelines for pedestrian wind impact assessments, in particular that of Manchester City Council and the City of London planning advice note ‘Wind microclimate guidelines for developments in the city of London’ dated August 2019. Reference is made to the City of London guidance as it provides some of the most up to date guidance on urban wind modelling in the UK. These guidelines have been used as many councils do not have specific guidance for wind microclimate assessments. Leeds City Council have also produced a ‘Draft Wind Micro-climate Toolkit for Leeds’ dated July 2021. This is largely based upon the London guidance and is yet to be finalised and so the London guidance is still deemed appropriate for use in this case.
- 1.1.3 The purpose of the Wind Microclimate Assessment is to satisfy the requirements of local planning policy as given in *‘High Places – a planning policy framework for tall buildings’*. The National Planning Policy Framework (NPPF) also sets out the Government’s Planning Policies for England and how they are to be applied. The NPPF establishes a presumption in favour of sustainable development and seeks to establish streetscapes and buildings that are attractive and comfortable places to live, work and visit.
- 1.1.4 This assessment utilises Computational Fluid Dynamics (CFD) to model wind flows around the site and the buildings within approximately 350m of the site centre.
- 1.1.5 A previous application was put forward on this site for a slightly taller building. This report revises the previous findings and updates them based on the new designs.

1.2 Site Context

- 1.2.1 The site lies on the junction of Booth Street West and Boundary Lane. The site is currently occupied by a former public house.

1.3 Scope of Study

- 1.3.1 Simulations of the wind microclimate around the area of the proposed buildings were conducted to quantitatively assess the effect on pedestrian comfort and safety levels in and around the Site.
- 1.3.2 The study aims to produce a model of the macro level wind regime around the Site. The assessment was undertaken using CFD techniques to model a 'virtual wind tunnel' and simulate conditions that may be experienced. This report contains the methodology involved and results from these simulations.
- 1.3.3 Predicted wind speeds will be assessed against the Lawson Comfort Criteria and the proposed types of use planned for the various external areas of the site within the redline boundary.
- 1.3.4 Predicted wind speeds will also be assessed against the Lawson Safety Criteria for pedestrians in areas in and around the proposed development.
- 1.3.5 The purpose of this report is to demonstrate acceptable wind conditions as a result of the Proposed Development. As such mitigation will be proposed if it is deemed to be required.

2 POLICY CONTEXT

2.1.1 This section outlines relevant legislation and policy related to pedestrian wind comfort.

2.2 National Planning Policy

2.2.1 The National Planning Policy Framework (2018) does not make reference to legislation or policy dealing with microclimate and in general there is little guidance at a national level on wind effects. Historic England produced a 'Tall Building Guidance' report in 2015 to aid developers, designers and local authorities in the sustainable planning and design of tall buildings. Relevant sections refer to the expectation to address the street level wind environment and take consideration of the impact of the development on the microclimate.

2.3 Local Planning Policy

2.3.1 Local guidance comes in the form of the Manchester Core Strategy 2012 to 2027. Policy EN 2 relates to tall buildings and states that *"By their very size tall buildings can have a significant impact on the local environment and its micro-climate. It is therefore expected that this impact be modelled and that submissions for tall buildings also include appropriate measures to create an attractive, pedestrian friendly local environment."* Paragraph 12.14 of the strategy goes on to say that *"Tall buildings by their very nature can dominate the street scene and be highly visible over long distances. They can also have an impact on the local micro-climatic conditions, for example, by creating wind tunnels. It is for these reasons that it is considered particularly important that they are designed to the highest quality, both in terms of appearance and their impact on the functioning of surrounding space."*

3 ASSESSMENT METHODOLOGY

3.1.1 To identify the likely effect of the Proposed Development on the wind environment, a 3D CFD model of the development and surrounding site was created. This section describes the methodology for the creation of this model and the inputs used.

3.1.2 Wind directions always indicate the direction that the wind blows from. For instance, a wind direction of 90 degrees denotes a wind blowing from the east.

3.2 Computational Fluid Dynamics

3.2.1 Simulations of the microclimate were conducted using OpenFOAM CFD software. CFD simulation of likely wind patterns requires the generation of a three-dimensional computer model of the site and surrounding buildings.

3.2.2 A model of the Proposed Development was provided by Rhomco on the 4th of August 2022.

3.2.3 OpenFOAM CFD software was used to obtain a solution to the fundamental equations of fluid motion as applied to each cell in the model through intensely computational numerical processing. A computational 'mesh' was created to represent the geometry by dividing the domain into a large number of cell volumes. During the simulation, the values of each variable are determined in each cell of the mesh and so a comprehensive assessment of velocity and scalar variation within the calculation domain is obtained.

3.2.4 The dependant variables are as follows:

- Velocities in the three co-ordinate directions (X, Y, Z)
- Pressure (P)
- Turbulence Kinetic Energy (k)
- Turbulence Dissipation Rate (ϵ)
- Turbulence Specific Dissipation (ω)

3.2.5 To improve the resolution of the results, the mesh was concentrated in the areas of most interest (at pedestrian level around the proposed development) and around any significant small-scale flow features. This ensures greater accuracy of the variables under investigation.

3.3 Boundary Conditions

3.3.1 The modelling domain is rectangular with inlet and outlet boundary conditions specified for the relevant portions of the domain for the wind direction being modelled.

3.3.2 The inlet boundary condition is adjusted for each wind direction to account for the threshold wind speed for each wind direction at 20m above ground level.

3.3.3 The atmospheric boundary layer (ABL) is also approximated for each wind direction. The ABL is defined as the part of the atmosphere that is directly influenced by the Earth's surface. Surface heating, surface roughness, and especially surface friction are the main actors on the ABL mechanism. The main consequence of this is that the Earth continuously extracts momentum from the wind and the resulting flow is turbulent.

3.3.4 The effect of the ABL is approximated within OpenFOAM using the following equation:

$$U = \left[\frac{U^*}{K} \right] * \ln \left[\frac{z - z_{Ground} + z_0}{z_0} \right]$$

3.3.5 Where:

- U^* is the frictional velocity;
- K is Karman's Constant;
- z_0 is the surface roughness length;
- z is the vertical coordinate; and,
- z_{Ground} is the minimum coordinate value in z-direction.

3.4 Building and Terrain Surfaces

3.4.1 No-slip wall functions for wind speed were applied to both the terrain and building surfaces as part of the modelling process. For the purposes of modelling porous structures and vegetation have been excluded but will be discussed as part of any mitigation strategy should one be required.

3.5 Assessment Criteria

3.5.1 The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (as amended) require the applicant to provide a 'description by the applicant or appellant of the forecasting methods used to assess the effects on the environment.'

The methods used to interpret the results of the modelling, detailed above, and to forecast potential effects on the environment are detailed below.

- 3.5.2 This report is intended to assess the effects of changes in wind microclimate on pedestrian activities within and around the proposed development. The wind model covers an area that extends to 500m radius from the proposed development in order to capture all upstream and downstream effects. The model from which the rectangular computational domains are created is shown in Figure 3.1, below.



Figure 3.1: Computational domain used within this assessment.

(The proposed development is highlighted in blue)

- 3.5.3 The receptors considered within this chapter are pedestrians carrying out their usual activities within the area of wind influence of the proposed development. These activities are broken down into categories as per the Lawson Criteria.
- 3.5.4 The Lawson Criteria provide threshold wind speeds which should not be exceeded 95% of the time for given pedestrian activities to be carried out comfortably. This report uses the London Docklands Development Corporation (LDDC) version of the criteria as outlined in the City of London planning advice note which has been reproduced in Table 3.1, below.

Table 3.1: Lawsons LDDC Criteria – Comfort		
Comfort Category	Threshold (m/s)	Description
Frequent Sitting	2.5	Acceptable for frequent outdoor sitting use, e.g. restaurant, cafe
Occasional Sitting	4	Acceptable for occasional outdoor seating, e.g. general public outdoor spaces, balconies and terraces intended for occasional use, etc.
Standing	6	Acceptable for entrances, bus stops, covered walkways or passageways beneath buildings
Walking	8	Acceptable for external pavements, walkways
Uncomfortable	>8	Not comfortable for regular pedestrian access

3.5.5 In addition, a safety threshold is set for the wind speed exceeded twice per year or 0.022% of the time from any wind direction.

Table 3.2: Lawsons LDDC Criteria – Safety		
Comfort Category	Threshold (m/s)	Description
Unsafe	>15	Winds above this threshold will pose safety risks, particularly for more vulnerable pedestrians (elderly, cyclists, etc.)

Significance Criteria

3.5.6 The significance criteria to measure the impact on pedestrians from wind microclimate are presented below in Table 3.3.

3.5.7 Effects that are classified as moderate or above are considered to be significant. Effects classified as below moderate are considered to be not significant.

Table 3.3: Significance Criteria		
Effect	Trigger	Mitigation Required
Very Large	Conditions are 'unsafe' or 'uncomfortable'	Yes
Large	Conditions are 3 categories windier than desired	Yes
Moderate	Conditions are 2 categories windier than desired	Yes
Slight	Conditions are 1 category windier than desired	If Possible
Neutral	Conditions are calmer than required for the intended pedestrian use (by at least one comfort category).	No

Limitations

3.5.8 In common with other forms of modelling, such as the use of wind tunnels, there are various limitations that can affect the accuracy of modelling carried out in support of this assessment.

- CFD modelling is a mathematical approximation of real-world conditions and is not to be considered an exact representation of conditions on site at any specific point in time. Instead, it uses time-averaged data that gives a good understanding of flow across the calculation domain under commonly occurring conditions. It is an excellent tool for assessing likely issues in relation to pedestrian comfort and safety as it balances accuracy with visualisation tools;
- The CFD simulation is steady state and does not explicitly quantify short-term gusts;
- Certain landscaping features, including porous structures under 8m in height, have not been included within the 3D model;
- The consented buildings in the area have been included in the 3D model, however, if their designs were to change this could impact upon the wind speeds at the application site;
- The 3D model does not include those buildings currently in planning that have not yet been consented; and

- Analysis is based on virtual met mast wind data, provided by the Met Office and covers a 30-year period. It is assumed to be representative of the wind conditions present at the application site. Future increases in wind speed, and gusting and increased volatility in weather patterns as a result of climate change or other unforeseen factors are not accounted for in the modelling.

4 BASELINE CONDITIONS

- 4.1.1 The baseline wind conditions have been modelled for both safety and comfort. This will allow an understanding of the current conditions at the location of the Site and the surroundings in the absence of the proposed building. The results can then be used to assess whether any significant wind speeds are as a result of the development.
- 4.1.2 In the baseline scenario there were no significant adverse effects present in either the comfort or safety assessments. The highest modelled wind speeds that occurred around the site location were at 20 degrees and 280 degrees where the threshold for 'occasional sitting' but not 'standing' was exceeded in some pedestrian areas.
- 4.1.3 Figures 4.1 and 4.2, below, illustrate these scenarios and have been colour-coded according to wind speed in line with Table 3.1.

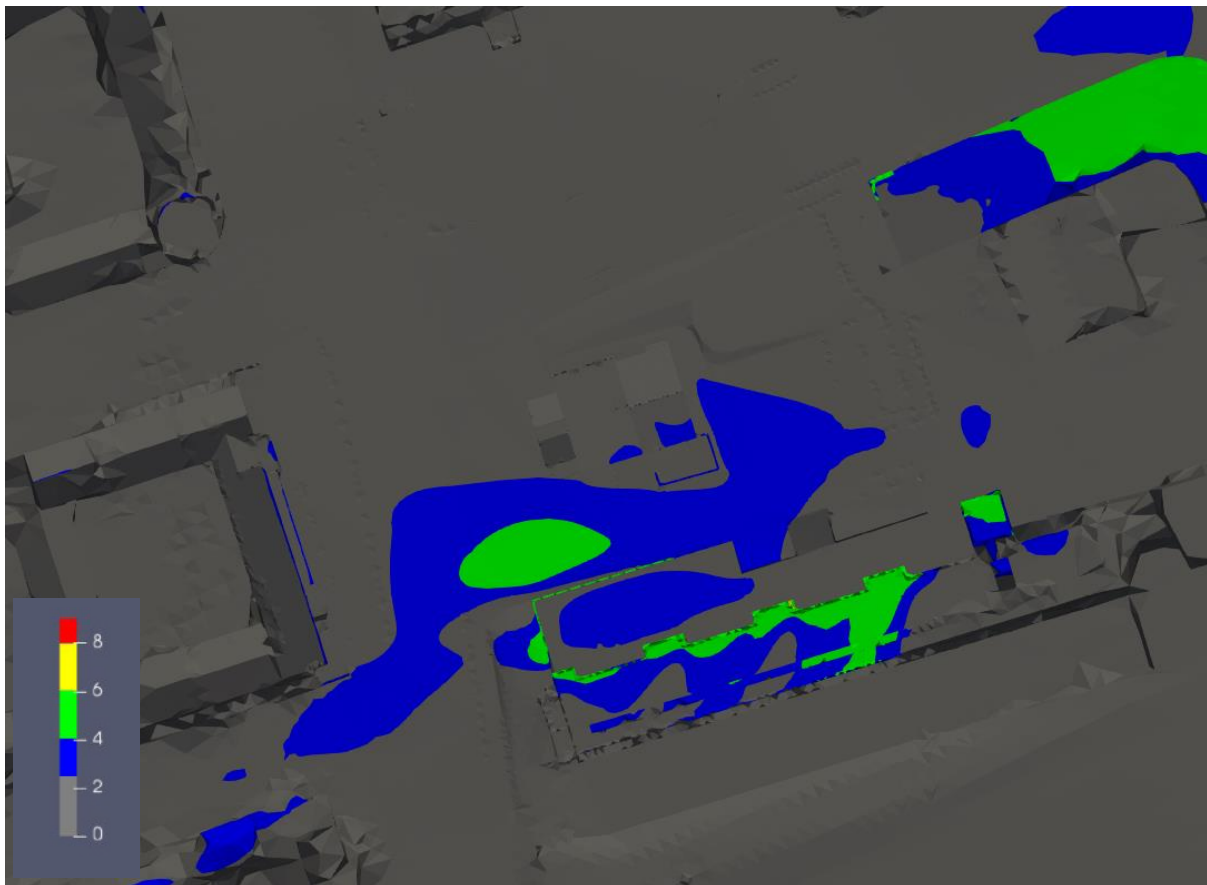


Figure 4.1: Baseline Scenario with Comfort Criteria Wind Speeds and 20° Wind Direction

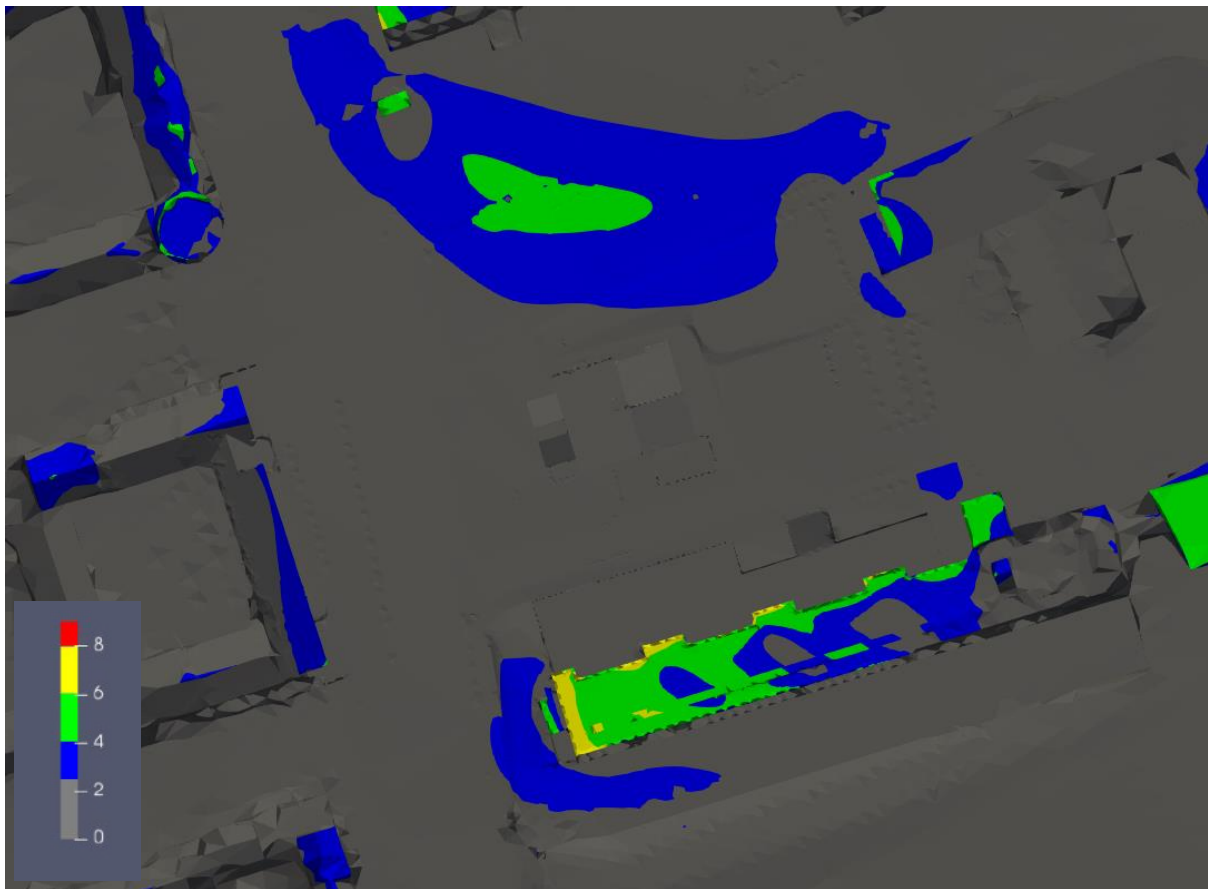


Figure 4.2: Baseline Scenario with Comfort Criteria Wind Speeds and 280° Wind Direction

4.2 Sensitive Receptors

- 4.2.1 The receptors within a wind microclimate assessment are the pedestrians using the public realm and outdoor facilities within and surrounding the Proposed Development.

5 ASSESSMENT OF EFFECTS

5.1 Design Solutions and Assumptions

5.1.1 Within and immediately surrounding the Proposed Development area there are multiple locations where there are high wind speeds present. In some cases, embedded mitigation, in the form of trees, will reduce the wind speeds experienced. Landscaping has not been included in the CFD model as it is difficult to accurately quantify the effect of landscaping features, such as trees. However, it is acknowledged that trees will have an overall effect in lowering wind speeds within the pedestrian environment. As landscaping features have not been included with the CFD model, expert judgement has been used to establish how landscaping will affect wind speeds.

5.2 Assessment of Effects

5.2.1 This section highlights any exceedances identified at the Proposed Development and establishes their significance criteria.

Safety

5.2.2 There are no wind speeds in excess of 15 m/s identified within the safety assessment. As such the effects are considered neutral and not significant with regards to safety.

Comfort

5.2.3 In line with guidance for this comfort assessment areas surrounding the proposed development have had different comfort criteria applied to them depending on the proposed end use. There are areas of seating to the north and south of the Proposed Development. These seating areas have been classified as 'occasional sitting', while the entrances to the north are classified as 'standing'. As there is no public access to the roofs within this Proposed Development therefore these areas have not been considered within the comfort assessment.

Seating Areas

5.2.4 As seating areas are classified as 'occasional sitting', significant effects in these locations will be any speeds that are classified as 'walking'. Many directions lead to suitable wind speeds being experienced at the Site. No directions leading to speeds classified as 'walking' at the pedestrian level are experienced. The maximum wind speeds in seating areas reach a classification of 'standing'. These cover large areas which are intended for seating, however these speeds in these areas will only result in a slight negative impact, and the effects are not considered significant.

Entrances

- 5.2.5 The comfort criteria at entrances is 'standing'. The results of the comfort assessment show that there are no significant effects resulting from high wind speeds at the entrances to the Proposed Development. The entrances benefit from the recessed design of the buildings, which reduce the risk of downdrafts being experienced.

5.3 Comparison with Baseline Wind Conditions

- 5.3.1 As has already been identified, there are no safety exceedances expected in either the baseline or the post-construction scenarios.
- 5.3.2 At most incoming wind directions, the wind speeds surrounding the site will be slightly accelerated with the building present compared to the situation without it. This is to be expected for tall buildings as wind will be redirected around the building and there will be some downdrafts present, adding to wind speeds at ground level. The building will also create sheltered areas of slower wind speeds at different locations depending on the wind's given direction of approach. However, it should be noted that comfort assessments are based on the specific uses of areas within the site i.e. whether a particular location is intended for pedestrian walking or sitting etc. It is therefore of limited benefit to directly compare the comfort baseline to the situation after the building has been constructed, as the intended uses within the site will have changed as a result of the buildings introduction.
- 5.3.3 Appendix 1 shows a comparison of the baseline scenario against the 'with development' scenario with wind approaching from selected directions.

5.4 Mitigation

- 5.4.1 As seating areas are classified as 'occasional sitting', significant effects in these locations will be any speeds that are classified as 'walking'. All speeds encountered at the site are at lower comfort speed levels than 'walking' and therefore no mitigation measures are required for either seating or entrances areas.
- 5.4.2 The landscaping scheme will introduce elements that are likely to reduce these windspeeds further than the worst case conditions currently modelled.

5.5 Residual Effects

- 5.5.1 No residual effects have been identified.

5.6 Assessment of Cumulative Effects

- 5.6.1 No cumulative developments have been identified or modelled within this assessment and therefore there are no cumulative effects identified.

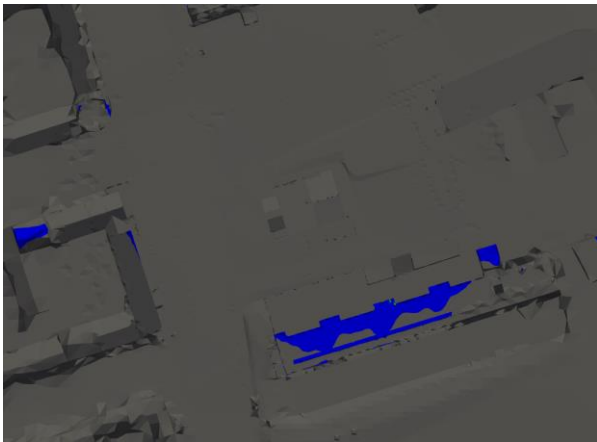
6 SUMMARY

- 6.1.1 This report presents the results of the Wind Microclimate Assessment which looked at pedestrian safety and comfort in and around the site. The impacts on the microclimate surrounding the site have been assessed against the Lawson Criteria. The method uses computational fluid dynamics to model the wind flow and predict the speeds that could be experienced at the site.
- 6.1.2 The safety results show that there are no significant effects within or immediately surrounding the site.
- 6.1.3 The comfort results also show that there are no significant effects within or immediately surrounding the site for the intended pedestrian uses.
- 6.1.4 Overall, and as expected, the results show slightly lower wind speeds than in the previous assessment for a taller building on this site.

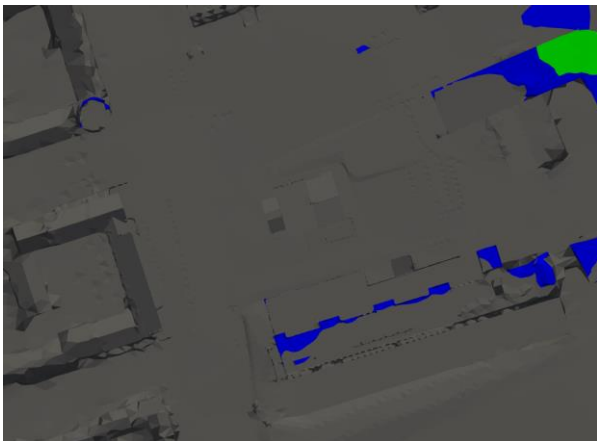
APPENDIX 1

BASELINE AND AFTER DEVELOPMENT COMFORT IMAGES COMPARISON FOR SELECTED POTENTIAL PROBLEMATIC WIND DIRECTIONS

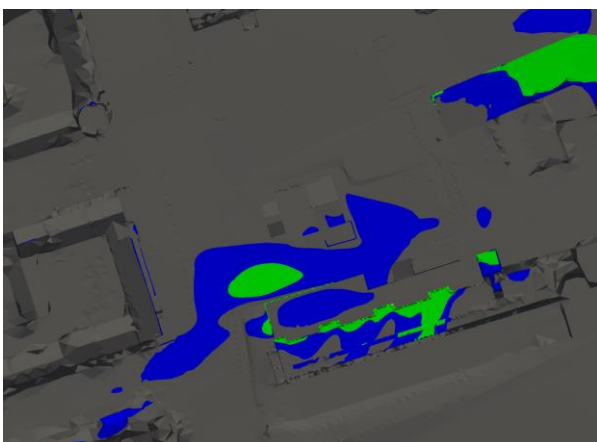
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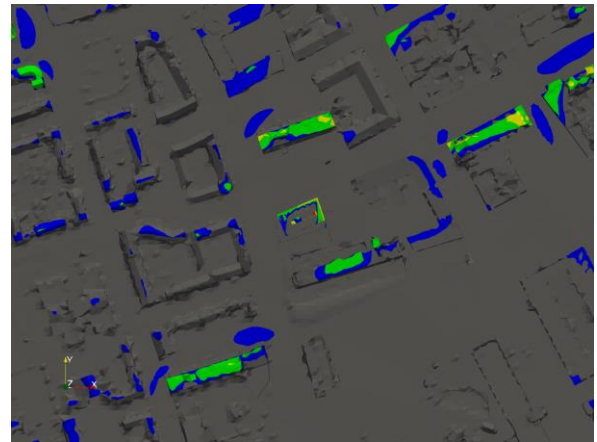


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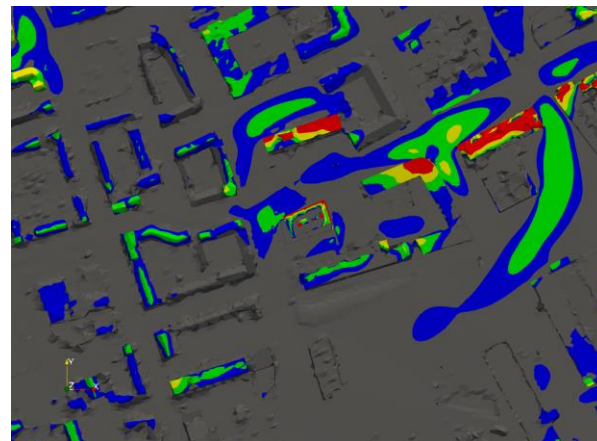


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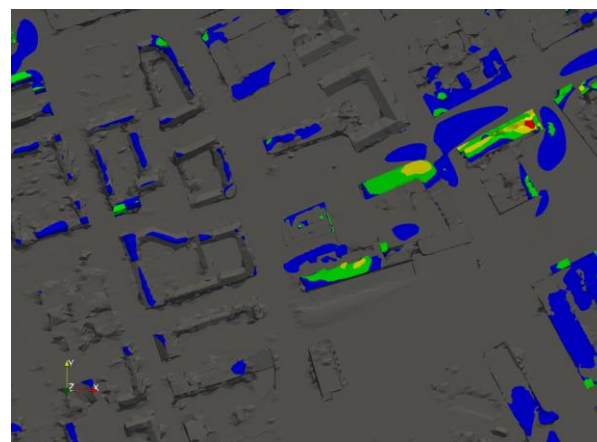
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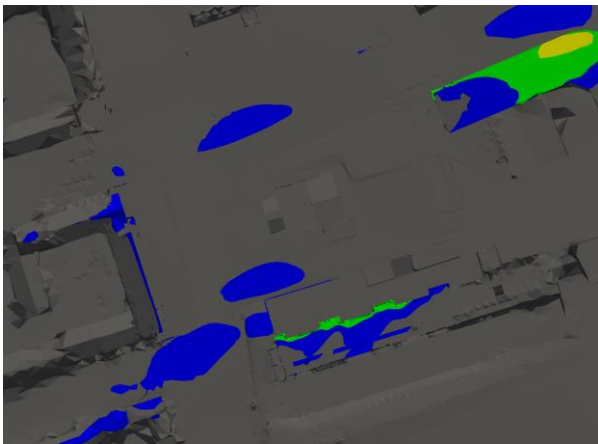
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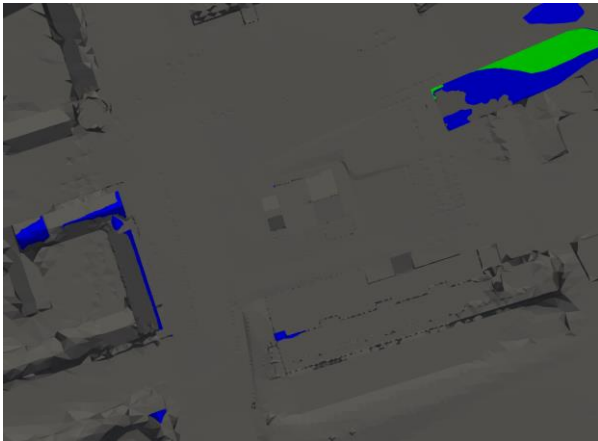
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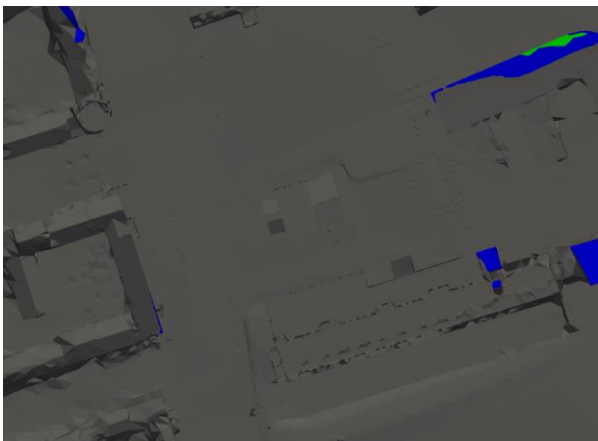
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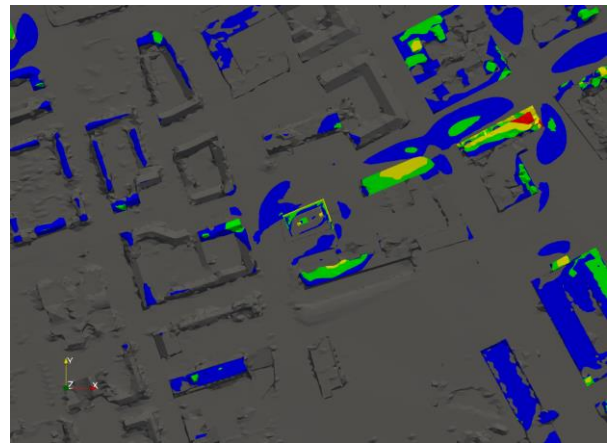
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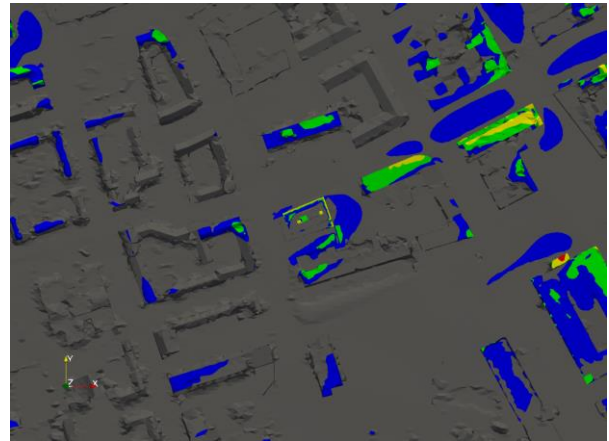
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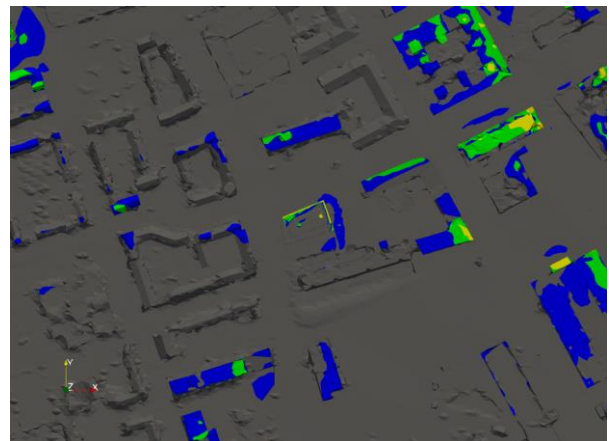
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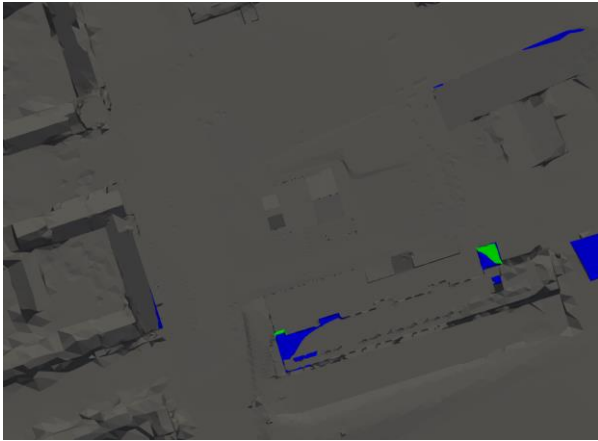
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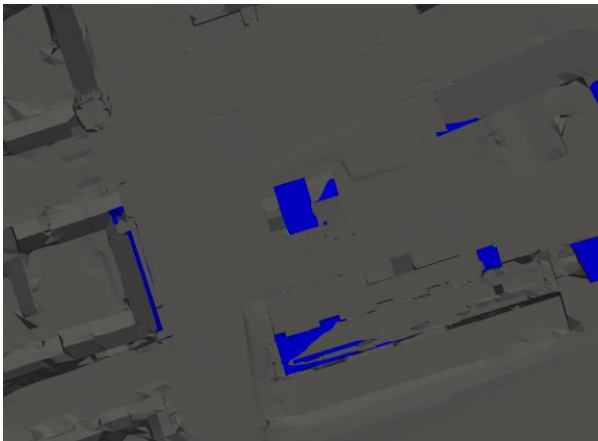
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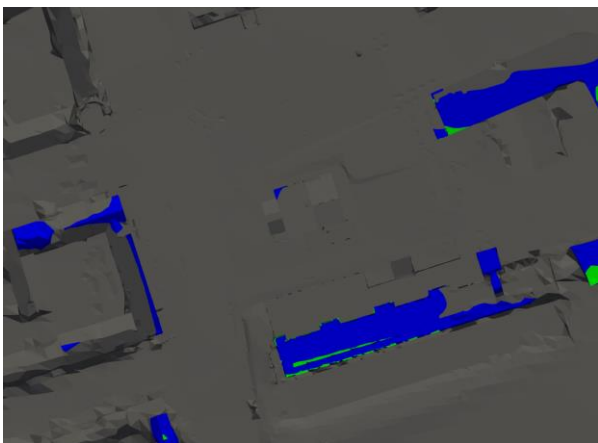
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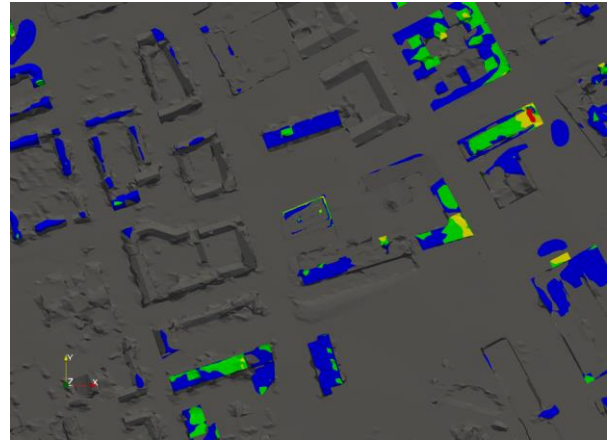
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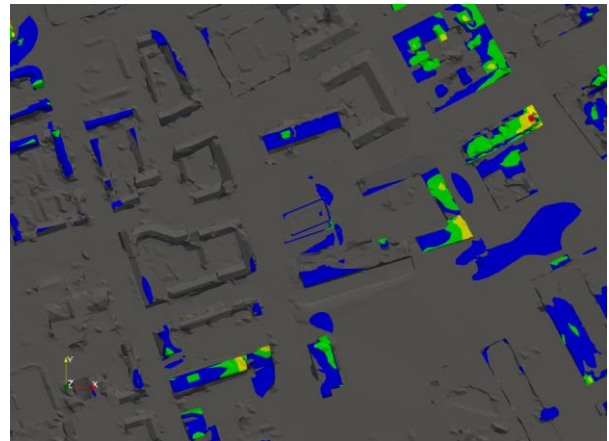
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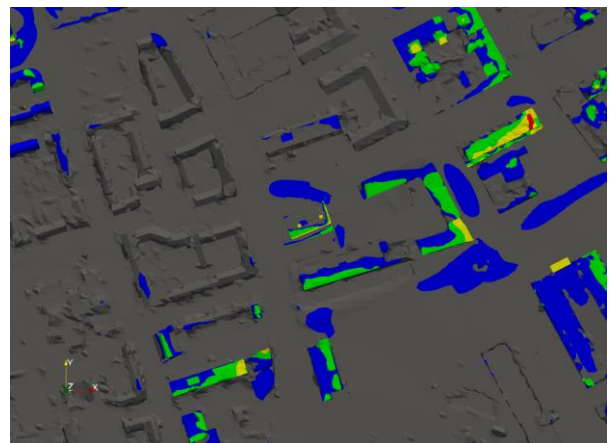
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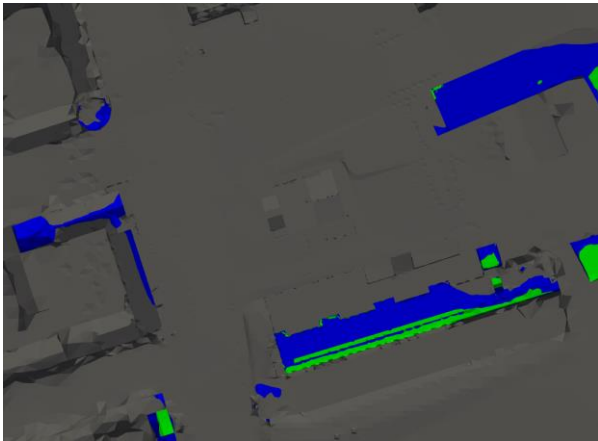
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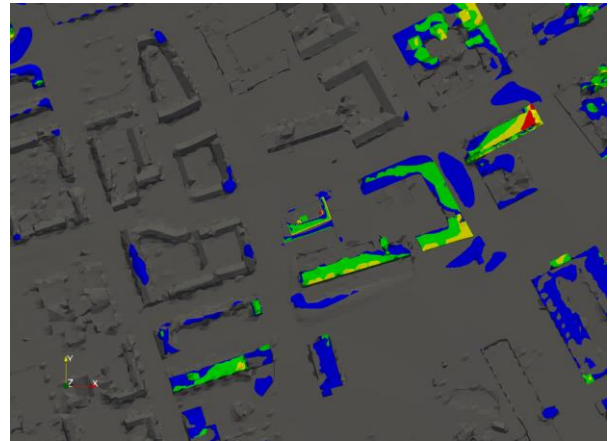
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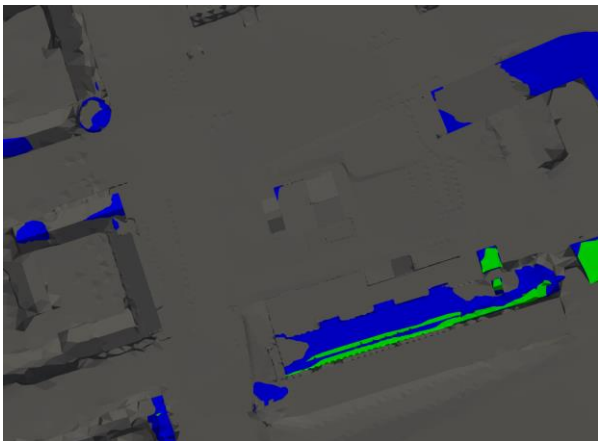
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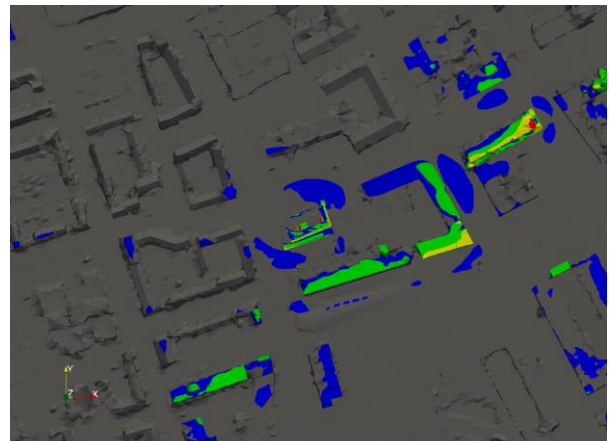
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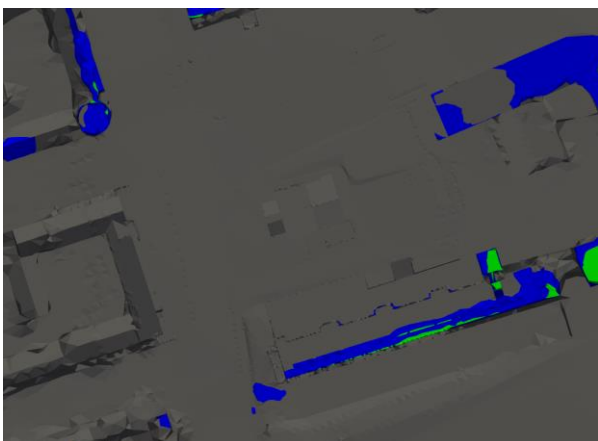
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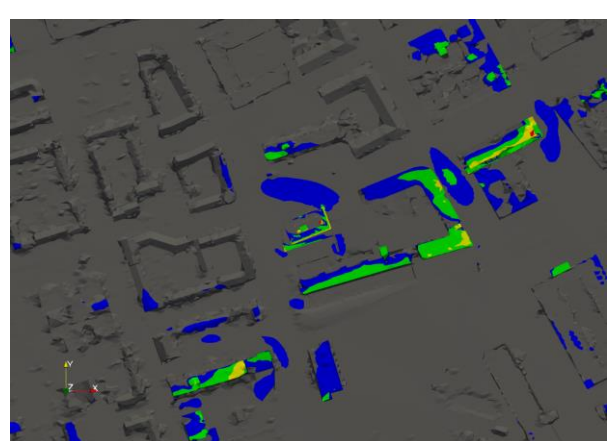
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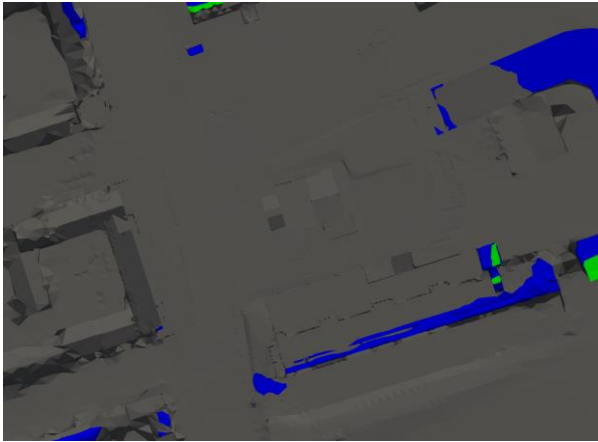
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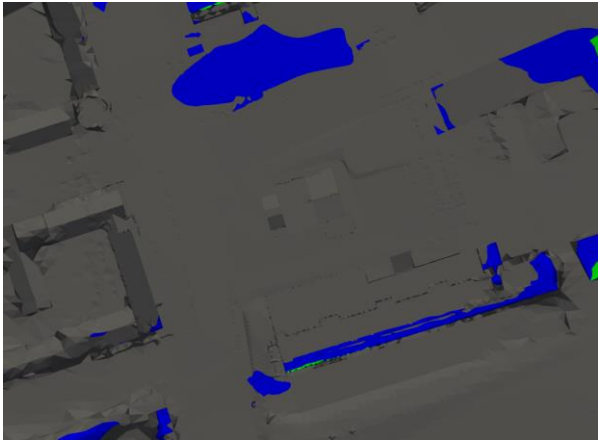
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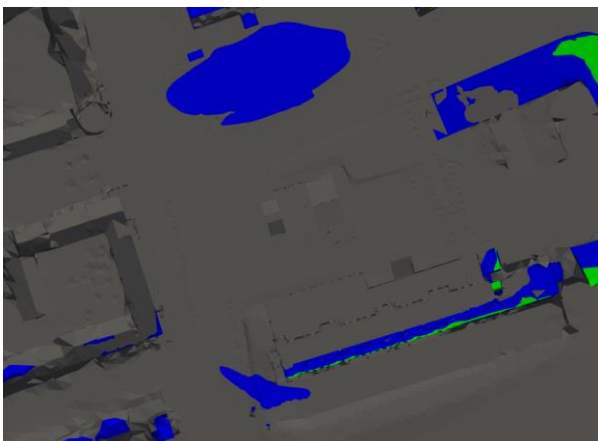
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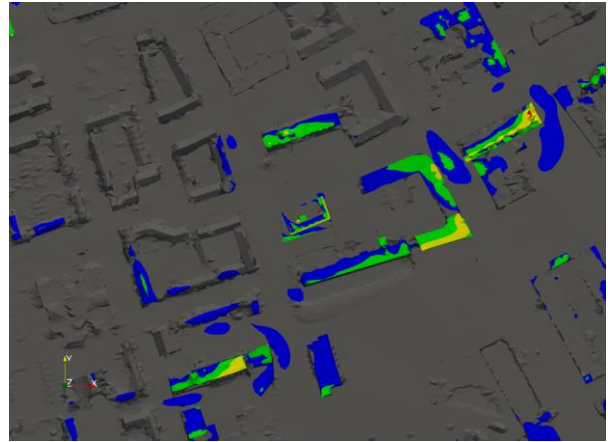
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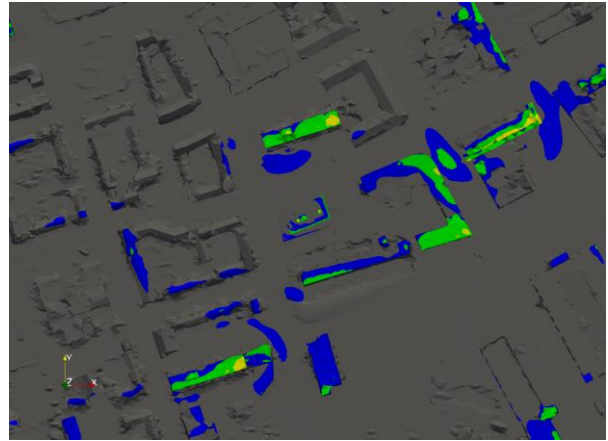
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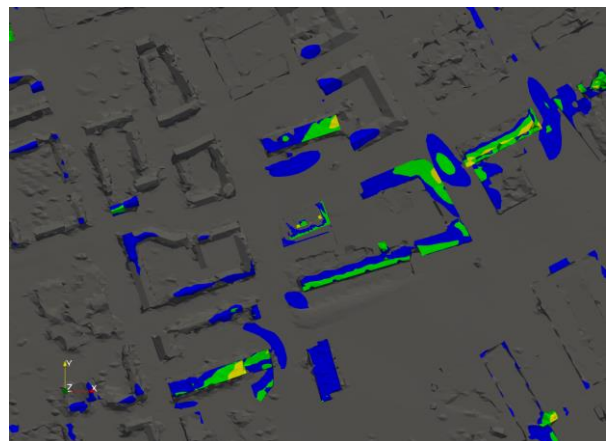
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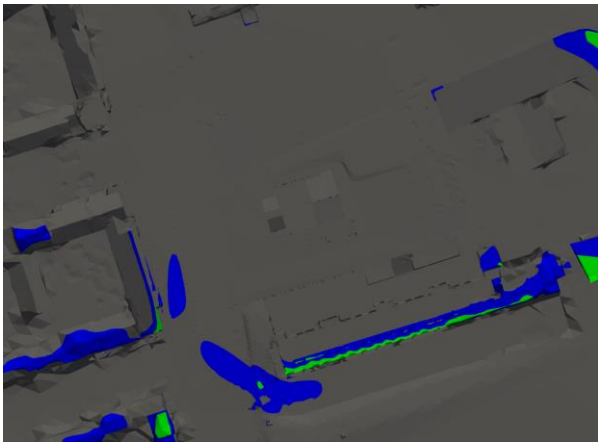
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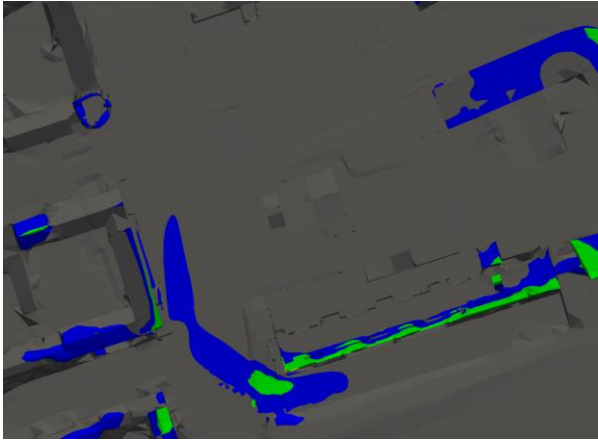
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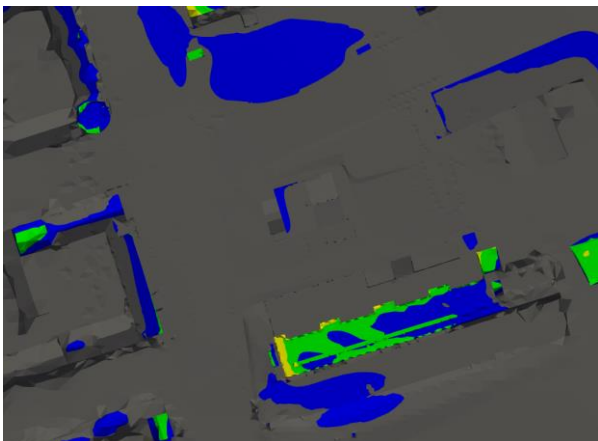
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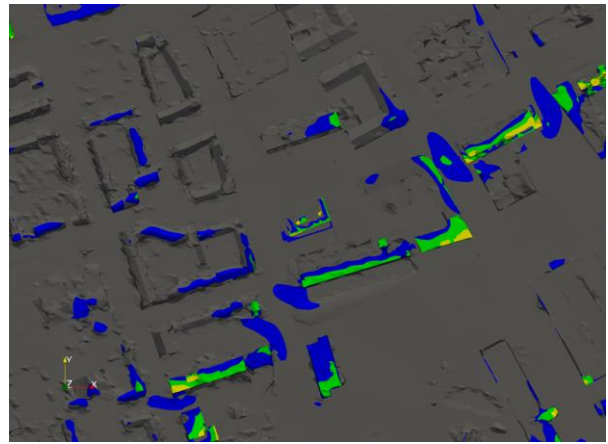
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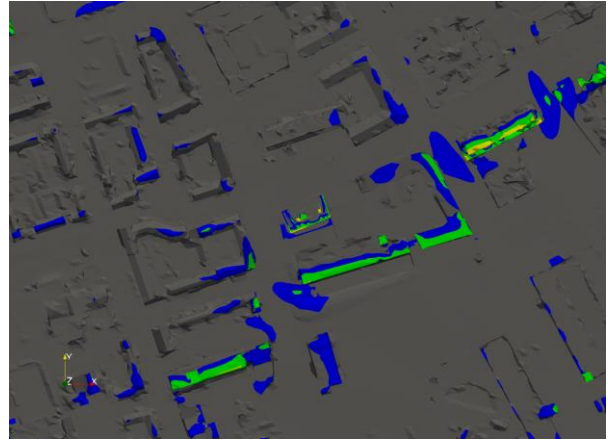
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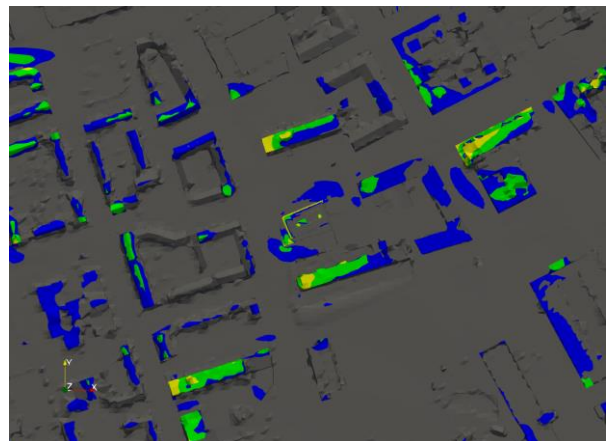
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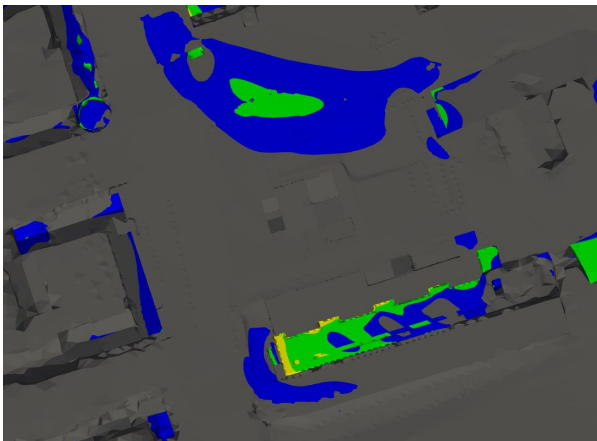
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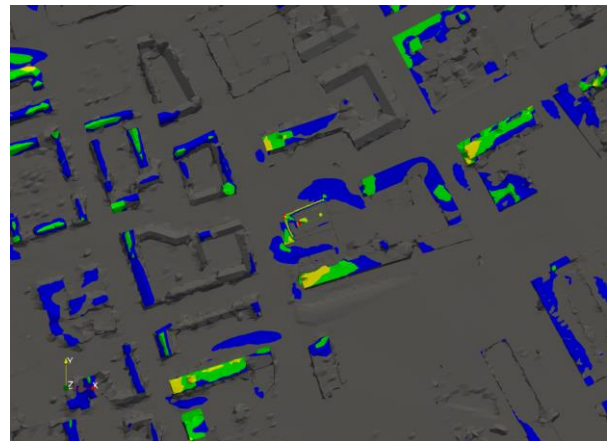
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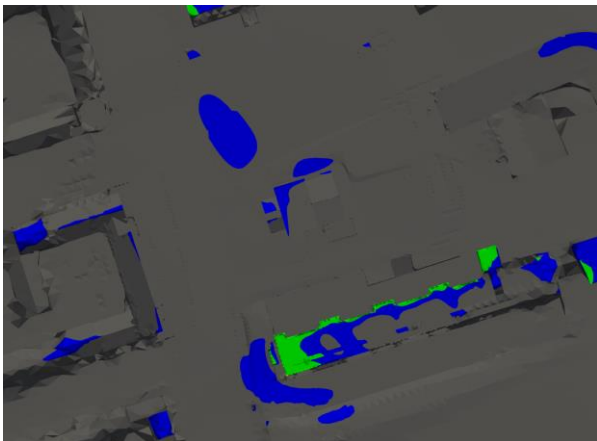
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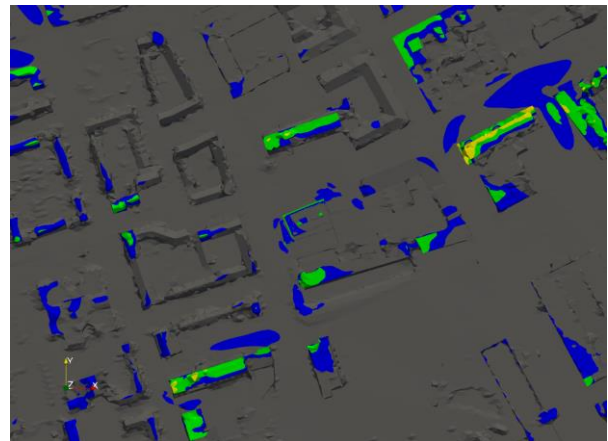
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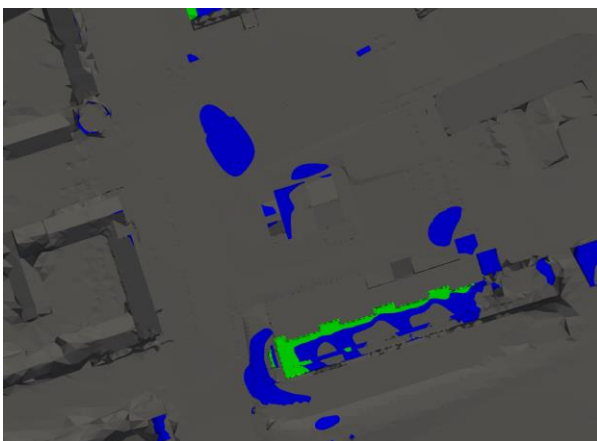
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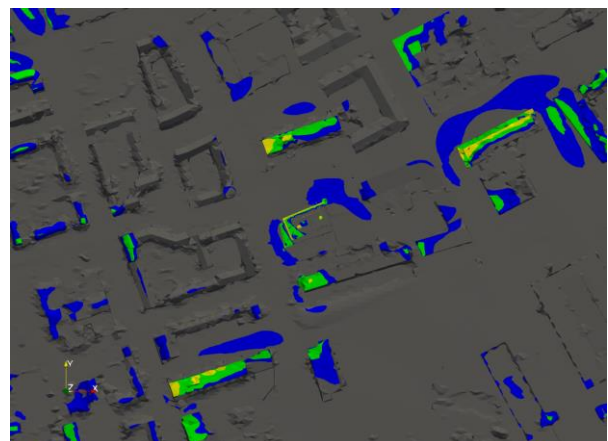
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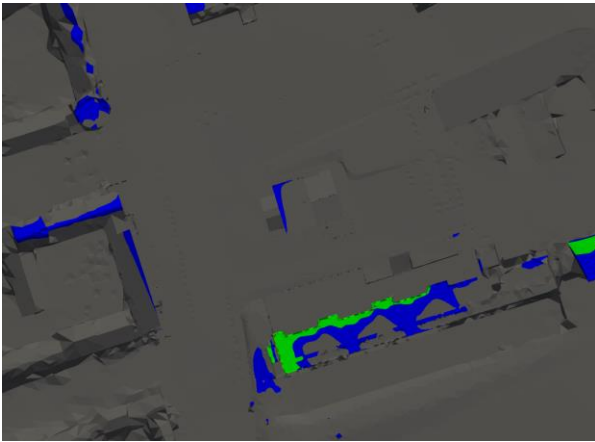
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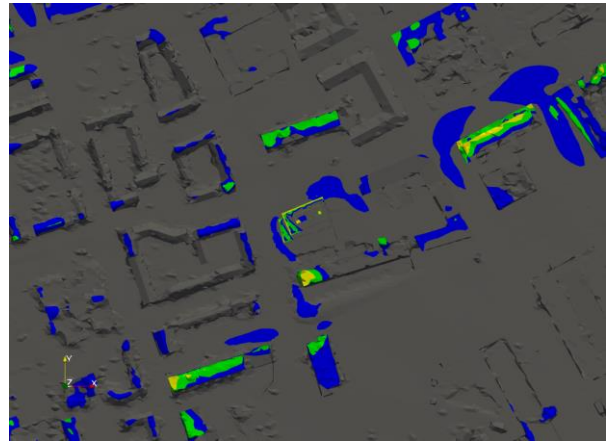
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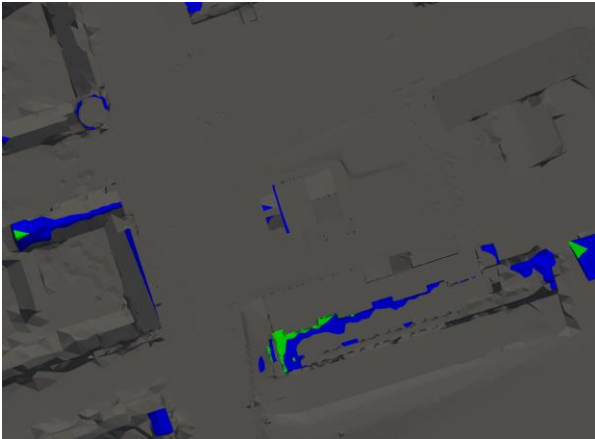
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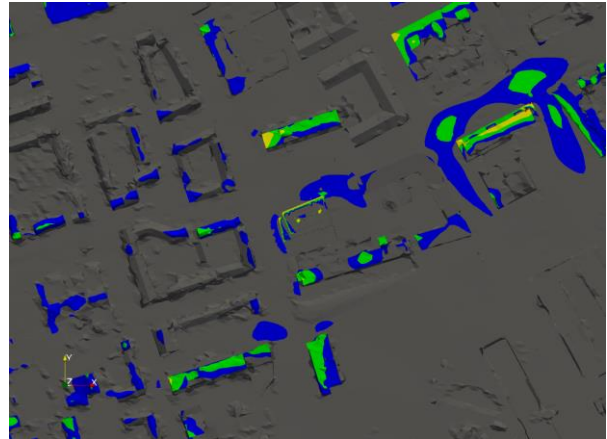
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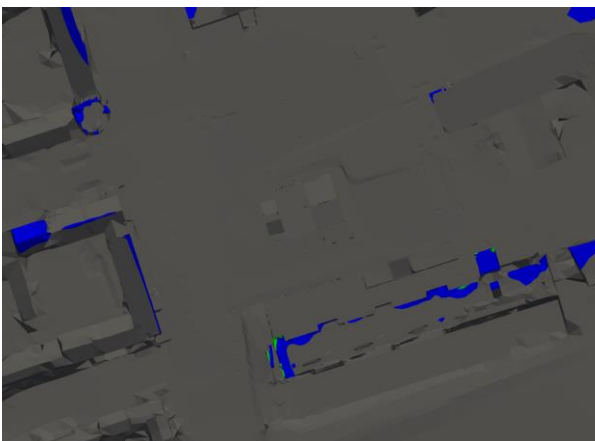
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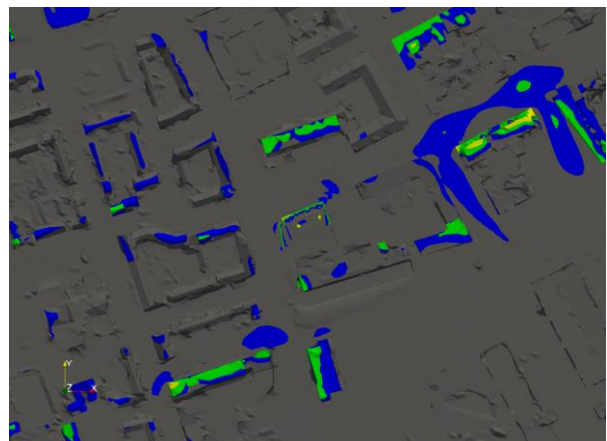
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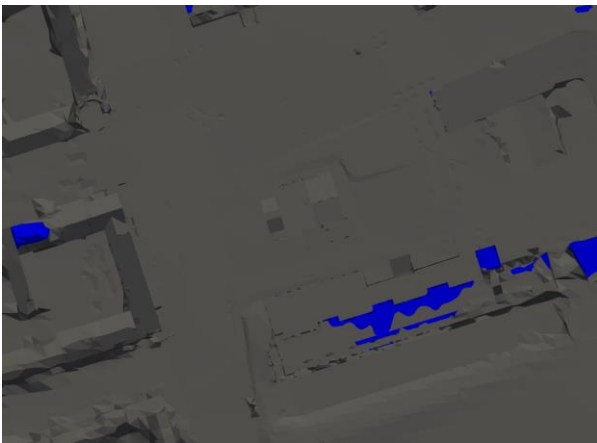
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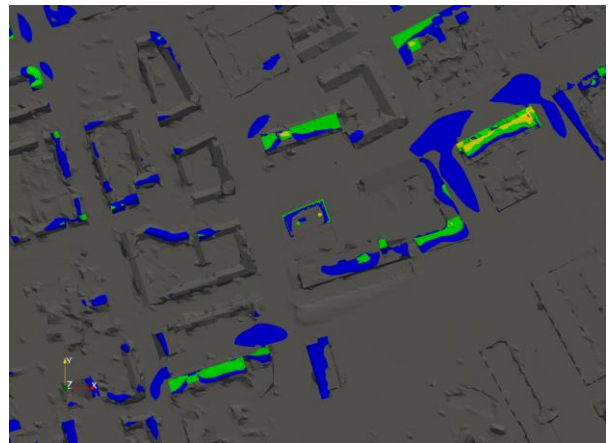
340°



340°



350°



350°

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