



DAYLIGHT & SUNLIGHT

SOLAR GLARE ASSESSMENT

The Hotspur Press, Manchester

17 March 2025

GIA No: **20256**

PROJECT DATA:

Client **DLM Manchester Limited**
Architect **Hodder & Partners**
Project Title **The Hotspur Press, Manchester**
Project Number **20256**

REPORT DATA:

Report Title **Solar Glare Assessment**
GIA Department **Daylight & Sunlight**
Dated **17 March 2025**

Prepared by **VT**
Checked by **KST**
Type **Standalone Report**

Revisions	No:	Date:	Notes:	Signed:
Rev A	1	05/03/2025	Adjustment in overall height	VT

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SOURCES OF INFORMATION:

Information Received **IR-13/16-20256**
Release Number **Rel_05_20256_DSD**
Issue Number **01**
Site Photos **GIA**
3D models **VU.CITY**
OS Data **FIND Maps**



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OS 100047514

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1 EXECUTIVE SUMMARY

This report is prepared to support the submission to Manchester City Council of a series of design amendments to the proposed redevelopment of the subject site which is subject to planning application reference 138805/FO/2023. A previous assessment was prepared by GIA in April 2024 relating to the scheme which was considered by the City Council's Planning Committee at its meeting of 30th May 2024. This report presents a new assessment of the scheme as now proposed. A description of the development, including of the changes to the design as proposed, are presented in an updated Design and Access Statement.

The author of this report is Viktorija Truksina, who is a Senior Design Analyst at GIA. She holds a BSc Hons in Architecture and Environmental Design and has three years experience in undertaking solar glare assessments and preparation of technical reports. This report has been reviewed by Krystle Stewart who is a Director at GIA and holds a Masters in Building Science (MBS). Krystle has over nine years UK experience in the field of solar glare.

The purpose of this report is to study the likely occurrence of sunlight being reflected towards train drivers on the adjacent railway tracks. Glare sequences were produced for three railway track:

- Track 2 Down (Westbound from Manchester Piccadilly via Platform 2 at Manchester Oxford Road Station and towards Deansgate Station)
- Track 3 Down (Westbound from Manchester Piccadilly via Platform 3 at Manchester Oxford Road Station and towards Deansgate Station)
- Track 3 Up (Eastbound from Castlefield Junction through Deansgate Station towards Manchester Oxford Road Station)

It is our opinion that whilst some reflections may occur toward train drivers, no major issues with glare from reflected sunlight are to be expected with the proposed Hotspur Press development and no further assessment is considered necessary.

This opinion is based on the following:

- The design of the building comprises strips of glazing rather than full, curtain wall glazing as such, reflections are broken up by non-reflective facade elements and are somewhat shaded by the facade articulation.
- Given the distance from the proposed development and broken up nature of the reflections, it is unlikely the full solar disc could be reflected and any reflections that would occur would be unlikely to be considered an instance of glare.
- Where reflections are visible within the same stretch of track that signals are visible, drivers would be slowing towards the end of the platform having been alerted to the need to slow down by earlier signals where reflections from the proposed development would not be visible.
- If and when the reflection of the sun is visible, the actual sun will also be within the field of view of the driver, who will be prepared for this situation and be likely to have the visor deployed, or be wearing sun glasses.
- The reflections either occur in the very early morning in summer or during winter when the solar intensity is at its lowest and there is a much greater probability of overcast skies.

The overall conclusions are unchanged from the April 2024 assessment.

Further details can be found in Section 5.

2 INTRODUCTION

GIA have assessed the proposed scheme in order to ascertain whether solar reflections given off the proposed building's facade will be visible from sensitive viewpoints which may affect road users and train drivers.

1.1 GLARE

Glare is a phenomenon occurring in the eye that is caused by the presence of bright light sources within the visual field. It can lead to visual discomfort and, if the glare source is very bright compared to its surrounding, even be disabling in the sense that objects become hard or impossible to see (Fig. 01 and Fig. 02). This is because they are cloaked by the high intensity glare source, whose light gets scattered within the eye.

The CIE 146:2002 Collection on Glare expresses the latter type of glare more formally as:

"Disability glare is glare that impairs vision (CIE, 1987). It is caused by scattering of light inside the eye [...]. The veiling luminance of scattered light will have a significant effect on visibility when intense light sources are present in the peripheral visual field and the contrast of objects to be seen is low."

"Disability glare is most often of importance at night when contrast sensitivity is low and there may well be one or more bright light sources near to the line of sight, such as car headlights, streetlights or floodlights. But even in daylight conditions disability glare may be of practical significance: think of traffic lights when the sun is close to them, or the difficulty viewing paintings hanging next to windows."

Glare is of particular concern if it affects drivers of motor vehicles or trains, since it might impair the visibility of signals and traffic signs, potentially putting the driver, passengers or other parties at risk.

1.2 GLARE FROM REFLECTED SUNLIGHT

Whether or not a sun reflection will cause an instance of glare depends upon a number of factors, these are summarised below:

- The location of the observer and his view direction;
- The sun's position in the sky, which changes not only with the hour of the day, but with the seasons too;
- The location and orientation of the reflective surface, e.g. a glazed facade, in relation to the observer's view direction;
- The specific quality of the reflective surface, e.g. sheen, specularity, etc.;
- The observer's physiology, e.g. age and eye pigmentation; and
- The background brightness defining the state of adaptation in the observer's eye;

This final point is an important one as the same brightness which could cause glare against a dark background may be perfectly acceptable when looked against a light one. A typical example of adaptation is illustrated in Fig. 01 and Fig. 02 where the same headlights cause glare at night whereas they do not during daytime hours.

Understanding whether solar glare is likely to occur is based on the observer's position and view direction. Given the transitory nature of the phenomenon, due to the sun's constant movement, any glare assessment should be carried out for a number of representative locations and view directions.

Such studies are often carried out with the help of sun path protractors or with the aid of a full three-dimensional computer simulation.

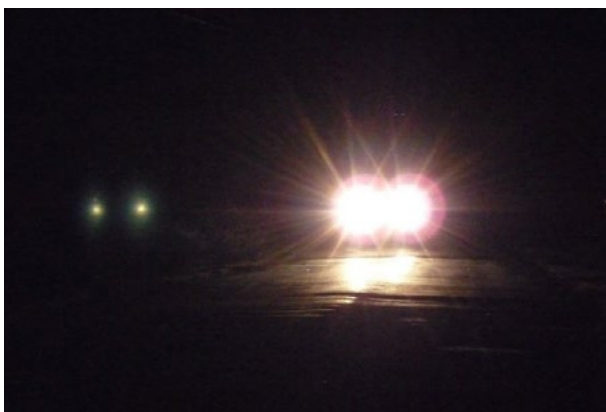


Fig. 01: Headlights at night



Fig. 02: Headlights during day

3 GUIDANCE

In the UK, guidance that is relevant to glare assessments is limited to a short section in the BRE's guidance "Site Layout Planning for Daylight and Sunlight: a guide to good practice" (BR209 - 2022 edition). It suggests that:

"If it is likely that a building may cause solar dazzle the exact scale of the problem should be evaluated. This is done by identifying key locations such as road junctions and windows of nearby buildings, and working out the number of hours of the year that sunlight can be reflected to these points. BRE Information Paper IP 3/87 gives details."

BR IP3/87 provides more detailed instructions on why and how solar dazzle can be calculated:

"Glare or dazzle can occur when sunlight is reflected from a glazed facade. For vertical façades this problem usually occurs only when the sun is low in the sky; but some types of modern design incorporate sloping glazed façades which can, under certain circumstances, reflect unwanted high altitude sunlight into the eyes of motorists, pedestrians and people in nearby buildings."

Both BR 209 and BR IP3/87 only deal with geometrical considerations of glare by identifying when and where reflections occur.

The City of London (CoL) published their own guidance in the form of a Planning Advice Note in July 2017. The aim was to establish "Guidelines and best practice for assessing solar glare in the City of London".

The CoL Guidelines distinguish between discomfort glare and disability glare.

"There are two types of reflected glare problem that can occur. Discomfort glare causes visual discomfort without necessarily affecting the ability to see. Disability glare happens when a bright source of light (such as the reflected sun) impairs the vision of other objects."

"Outdoors, disability glare is easily the more serious problem, as it can affect motorists' ability to drive safely. It is especially important at locations where a driver has to make a key decision, for example approaching a road junction, traffic signal or pedestrian crossing. It can also affect train drivers, particularly if they are looking at illuminated signals."

"Discomfort glare is a less dangerous problem because it does not impair the ability to see. It can be important where work involves continuous viewing of the outdoor space from a fixed vantage point, for example in security surveillance."

Because discomfort glare a) does not impair the ability to see; and b) it only needs to be looked at where work involves continuous viewing of the outdoor space from a fixed vantage point – which is clearly the case for a train driver – GIA's solar glare assessments do not assess disability glare.

The CoL Guidelines also explains with regard to disability glare that:

"If the reflected sun would be visible close to the driver's line of sight, then either a more detailed calculation of solar glare is required, or measures should be taken to reduce the glare."

4 GIA'S APPROACH AND METHODOLOGY

Following the guidance documents referenced above, GIA have developed specialised computer software to undertake reflected glare assessments.

The preparation of reflected solar glare assessments is based upon the steps described below:

- The construction of a 3d-computer model that includes the proposed building and its relevant setting (Paragraph 3.1);
- The description of the reflective surface properties (Paragraph 3.2);
- Rendering of stills of the solar reflections (Paragraph 3.3);
- Masking the images to represent the Human Field of View (Paragraph 3.4); and
- Image analysis of the Static Assessment (Paragraph 3.5)
- The limitations of this approach and methodology are set out in Paragraph 3.6.

4.1 3D-COMPUTER MODEL

The detailed geometry of the proposed building, and specifically of its facade and glazing configuration, is provided by the project architects either in 2d format (i.e. plans, sections and elevation drawings) or 3d format as a computer model. The received information is processed by GIA and prepared for assessment with our proprietary software. GIA also prepares the context 3d-model from photogrammetry and high resolution stereoscopic aerial photographs, including details relevant for assessment such as rail tracks, sleepers, gantries and signals as well as road junctions and traffic lights. An example of the details included in the solar glare context 3d-model is provided in Fig. 03, Fig. 04 and Fig. 05.



Fig. 03: Computer model of train tracks & signals from photogrammetry

4.2 REFLECTIVE SURFACE PROPERTIES

The static assessment assumes all potential reflective portions of the Proposed Development as "mirrors", therefore portraying an absolute worst-case scenario which is however aimed at identifying whether a reflection can occur or not.

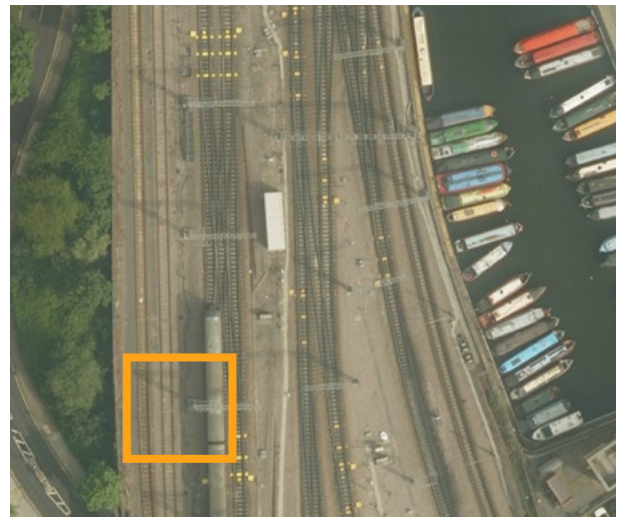


Fig. 04: High-resolution aerial photograph



Fig. 05: High-resolution aerial photograph (close-up)

4.3 RENDERING OF STILLS

As mentioned above, glare is a phenomenon that depends on the observer's location, but also on his view direction.

For train drivers, the view direction is defined by the rail tracks. UK recommendations set the eye level of the driver at 2.75 m above the rails. The view point is centred between the tracks for ease of reference. Although train drivers sit slightly to the left within the cabin, this bears no material effect on the analysis of the images as the signals are visible at a distance of hundreds of metres at which point the slight shift in the cabin equates to a very small angular change. Fig. 06 shows the typical set up of our viewpoints. Actual trains and driver's cabin are not included in our 3d computer model.

Individual virtual cameras located accordingly in our 3d computer model are spaced between 1 and 3m apart in the direction of travel. Before the stills are compiled, a human field of view mask is overlayed onto them in order to define the angular distance between the instance of reflection and the observer's line of sight.

This procedure allows for the assessment of entire stretches of railway tracks providing a complete overview of potential risks as well as information about signal sighting.

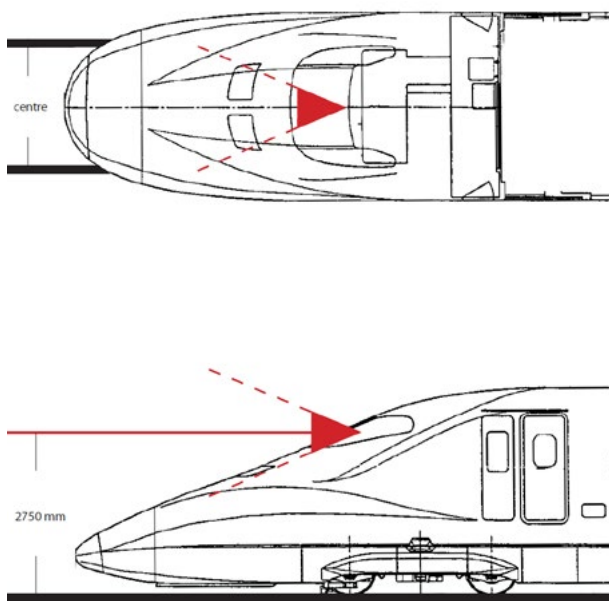


Fig. 06: Driver Viewpoint

4.4 HUMAN FIELD OF VIEW

The field of view is the angular extent within which objects can be observed by one or both eyes. Owing to the arrangement of the human eyes, the stereoscopic visual field extends to approximately 60° either side on the vertical and 90° either side on the horizontal.

In the United Kingdom, the minimum field requirement for driving is 60° either side of the vertical meridian, and 20° above and below horizontal.

The fovea centralis is the central area of the retina. It extends about 3° in all directions. The fovea is responsible for sharp vision that is used for reading, driving, and any other activity where visual detail is important. Fig. 07 shows our typical field of view overlay.

The CIE 146:2002 suggests that occurrences at angles beyond 30° would be of little significance in most situations, but may be relevant in exceptional circumstances. Any reflection within 30° is looked at in greater detail in terms of its duration, size of the reflective surface and where appropriate, predicted intensity.

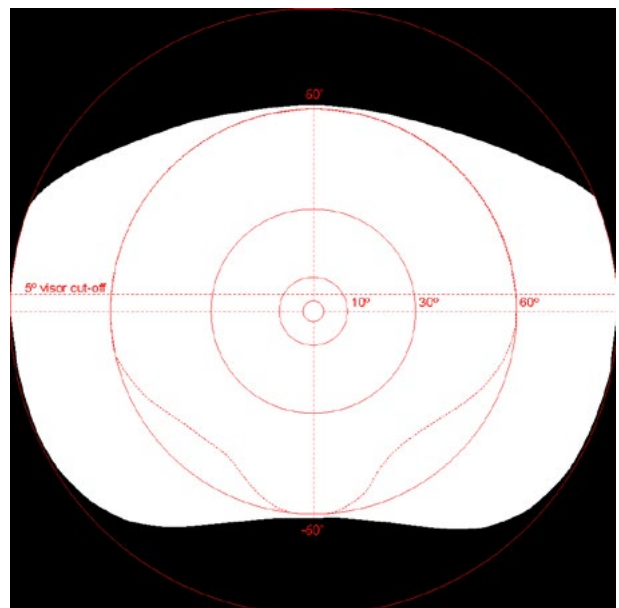


Fig. 07: Typical human field of view

4.5 **STATIC ASSESSMENT**

The methodology described below is aimed at addressing the occurrence and duration throughout the year and the location of this occurrence in respect of a driver's line of sight. This will inform the necessity of implementing mitigations at either early or detailed design stage.

For this purpose the glazed facade of the Proposed Development is assumed to have the same properties of a mirror, i.e. it is fully reflective and all of its reflected component is specular. This therefore portrays a worst-case scenario.

The potential for reflected solar glare or dazzle from the glazed or reflective façades of the development are assessed using specialist lighting software.

In the Static Assessment, stills or a computer animation are generated with which the potential for the occurrence of reflected sunlight is evaluated with regards to the times of the year and hours of the day when this may happen, as well as its relative location to the observer's line of sight.

In order to achieve this, the yearly sun path is mapped onto the sky and colour-coded so that the hours of the day and the period of the year can be distinguished. This sun path is picked up by the reflective elements of the proposed buildings in our rendered stills.

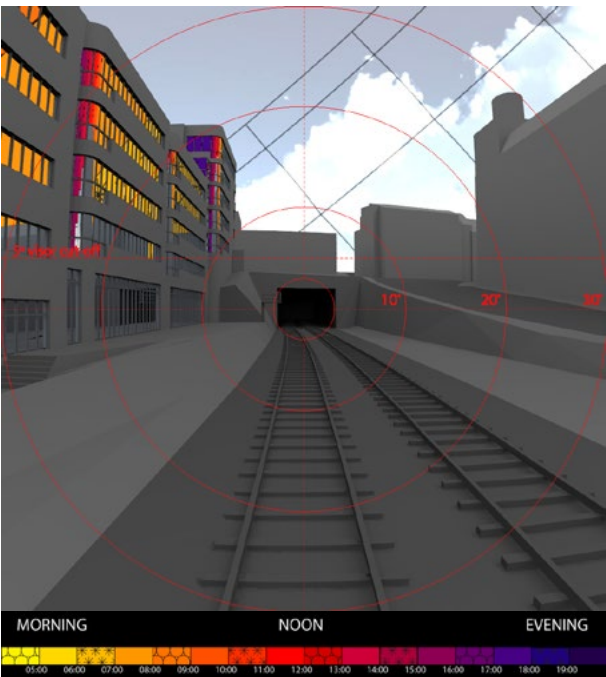


Fig. 09: Stage 1 Example - Hours

Fig. 08 shows the colour coded sunpaths projected onto the sky dome to visualise the time of day and season during which solar reflections occur.

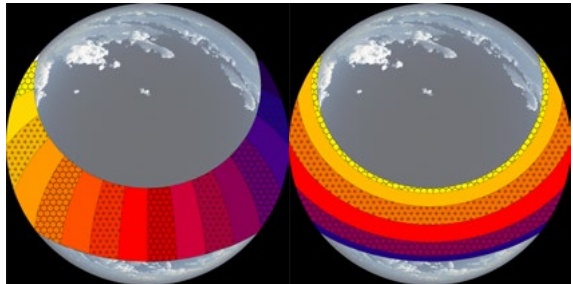


Fig. 08: Stage 1 - Colour coded sunpath for time of day and seasons

Two identical viewpoints are rendered as shown in Fig. 09 and Fig. 10: one focusing on the times of the day when the reflection would be visible, and the second looking at the months throughout the year.

The following guidance is used to determine whether an intensity study is necessary:

- Solar reflections are visible within 30° to 10° of the driver's line of sight for a long period of time (large reflective surface) or between 10° to 5° for a short period of time;
- Solar reflections are visible within 10° and 5° of the driver's line of sight occurring for a long period of time;
- Solar reflections are visible within 5° of a driver's line of sight;

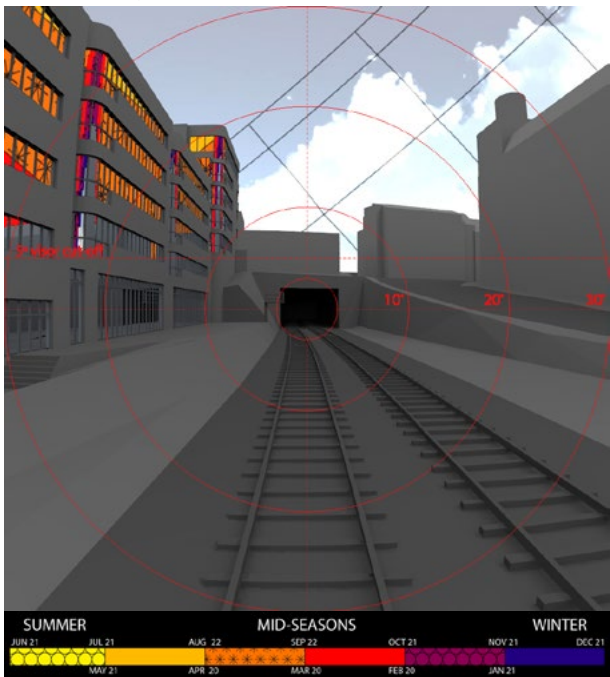


Fig. 10: Stage 1 Example - Months

4.6 LIMITATIONS

Great care is taken in identifying typical viewpoints around a new development. However, this does not guarantee that all sensitive locations where reflected solar glare could present a particular risk are covered, especially where these are farther away from the site.

IMPORTANT: The hours shown in the diagrams and described in the text reflect solar time and therefore do not take British Summer Time into account.

5 SCENARIO OVERVIEW:



Fig. 11: Top View

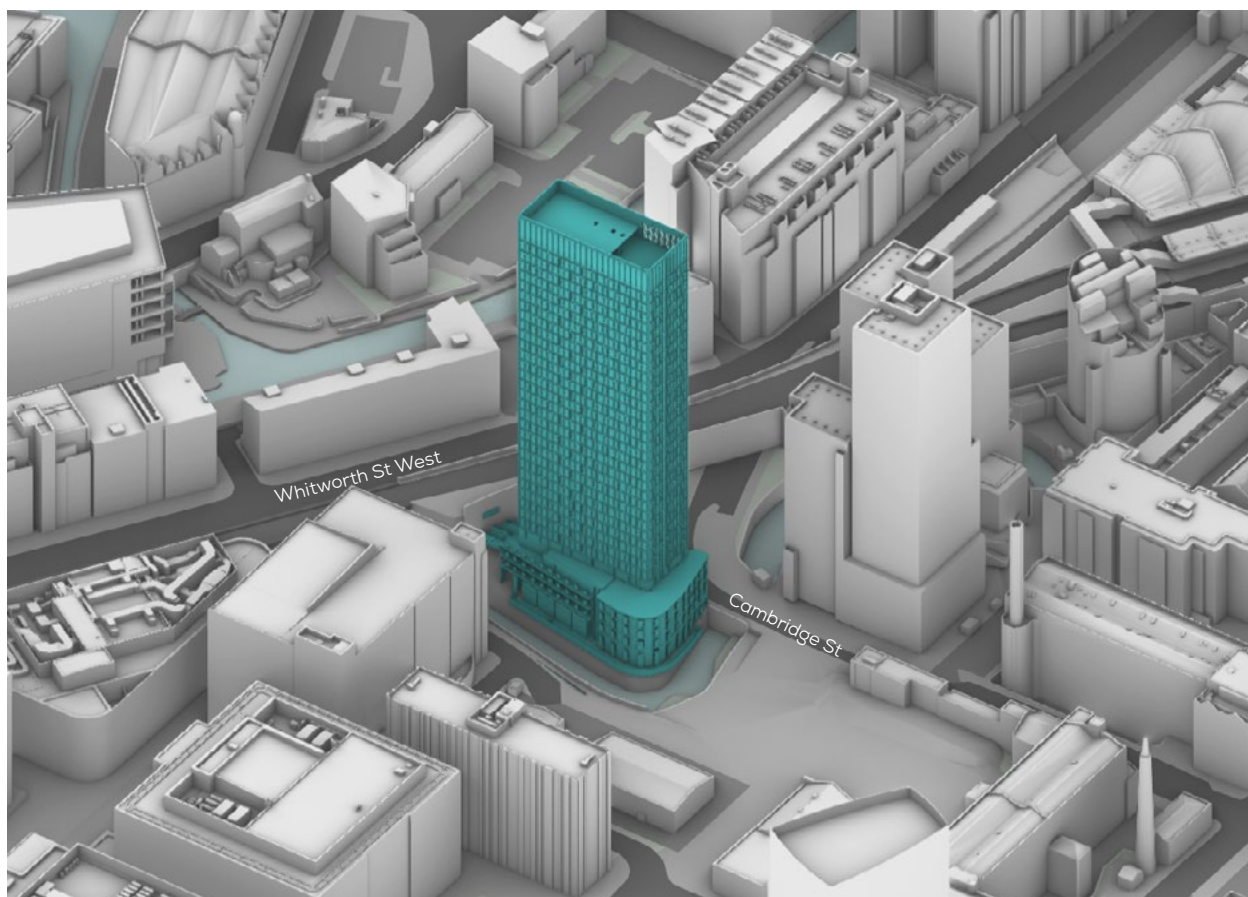


Fig. 12: Perspective View

6 DISCUSSION AND CONCLUSIONS

A glare assessment was carried out for the rail tracks passing to the north of the amended proposed development of The Hotspur Press, Manchester.

The amended proposed Hotspur Press development sits along the railway lines between Deansgate and Manchester Oxford Road Station. To study the likely occurrence of sunlight being reflected towards train drivers, glare sequences were produced for three railway tracks running to the north of the site, one eastbound track and two westbound tracks passing either side of the Manchester Oxford Road Station platform. The tracks are shown in Figure 14 on page 13 and comprise:

- Track 2 Down (Westbound from Manchester Piccadilly via Platform 2 at Manchester Oxford Road Station and towards Deansgate Station)
- Track 3 Down (Westbound from Manchester Piccadilly via Platform 3 at Manchester Oxford Road Station and towards Deansgate Station)
- Track 3 Up (Eastbound from Castlefield Junction through Deansgate Station towards Manchester Oxford Road Station)

All tracks have the ability to be bi-directional through Manchester Oxford Road Station. The views assessed are considered to comprehensively assess the potential for solar reflections to impact train drivers travelling in either direction.

There are known to be four sets of signals relevant within the stretch of track assessed.

For Track 2 Down:

- Signal MP447 is located at the end of Platform 2 at Manchester Oxford Road Station, to the east of the site at approximately frame 440, approximately 100m from the site.

For Track 3 Down:

- Signal MP445 is located at the end of Platform 3 at Manchester Oxford Road Station, to the east of the site at approximately frame 440, approximately 100m from the site.

For Track 3 Up:

- Banner Repeater MC458BR is located to the west of the site at approximately frame 40, approximately 490m from the proposal; and
- Signal MC458 is located at the end of the platform at Deansgate Station, to the west of the site at approximately frame 180, approximately 350m from the site.

The proposal is a 35-storey residential building with all facades facing the rail tracks being a unitised facade system comprising anodised (matte finish) aluminium panels and glazing. As such, potential reflections from the glazing elements would be broken up by the non-reflective elements of the façade.

The 3D representation of the proposal has been provided by Hodder & Partners Architects and placed in the context as shown in the overview images presented in Figures 11 and 12. Subsequent to the technical analysis being undertaken, there was an adjustment in overall height to the proposed development which is immaterial in nature for solar glare and does not alter any of the conclusions contained within the following pages.

Train signals have been modelled and placed in the context following the information provided by Network Rail (an extract is given in Figure 13 on page 12).

Representative views from each of the sequences are shown on Pages 14 to 51.

Track 2 Down

The proposed development is visible within 30° of a driver's line of sight within this stretch of track. The sun path is also visible within the field of view.

The assessment commences at approximately 500m from the proposed development, and approximately 280m from Manchester Oxford Road Station. At this point, no reflections are visible from the proposed development.

Around frame 245, trains enter Manchester Oxford Road Station and Signal MP447 would become visible in the distance, there remains no reflections visible within a driver's line of sight at this point and until approximately frame 440, once drivers have passed through Manchester Oxford Road Station.

From frame 440 to 507, when trains are nearby to the proposed development, reflections would occur from the lowest couple of floors of the tower. The reflections occur outside 25° of a driver's direct line of sight and so are not considered to be a risk of glare.

As the reflections occur far from the direct line of sight and do not occur within the stretch of track where signals are visible, there is not considered to

be concern from a solar glare perspective for train drivers travelling westbound on Track 2 Down and no further assessment is considered necessary. The conclusions are unchanged from the April 2024 assessment.

Track 3 Down

The proposed development is visible within 30° of a driver's line of sight within this stretch of track. The sun path is also visible within the field of view.

The assessment commences at approximately 500m from the proposed development, and approximately 280m from Manchester Oxford Road Station. At this point, no reflections are visible from the proposed development.

Around frame 260, trains enter Manchester Oxford Road Station and Signal MP445 would become visible in the distance, there remains no reflections visible within a driver's line of sight at this point and until approximately frame 410, as drivers arrive at the end of the platform at Manchester Oxford Road Station. By frame 435, Signal MP445 sits outside 20° of the driver's line of sight and drivers would no longer require sighting of this signal.

From frame 410 to 478, reflections would occur from the lowest couple of floors of the tower. The reflections occur from small areas of facade between 18°-27° of a driver's direct line of sight. From frame 447, the reflections occur outside 20° of a driver's direct line of sight and so are not considered to be a risk of glare. The reflections occur in the very early mornings (sunrise-05:00 GMT) during the summer months (early-May to late-July) when the intensity of the sun is much lower and there is a low probability of the sun shining, less than 30%.

Whilst Signal MP445 is visible within approximately 25m of the stretch of track where reflections occur within 20° of a driver's line of sight, they are from an elevation where reflections are broken up by solid elements of the facade. The reflections would occur when the signal has been visible for much of the station transit, at the point when reflections become visible, trains would be travelling at low speeds and stopping as they approach the end of the platform, and then awaiting the signal to recommence their journey.

All reflections occur from windows where reflections are broken up by non-reflective facade elements, therefore any reflections occurring would be for a very short period of time and the potential for the full solar disc to be reflected is very limited. The reflections occur in the very early mornings when the solar intensity is low and the likelihood of the sun shining is less than 30%. Therefore, there is not considered to be concern from a solar glare perspective for train drivers travelling westbound on Track 3 Down and no further assessment is considered necessary. The conclusions are unchanged from the April 2024 assessment.

Track 3 Up

The proposed development is visible within 30° of a driver's line of sight within this stretch of track. The sun path is also visible within the field of view.

The assessment commences at approximately 500m from the proposed development, and approximately 100m from Deansgate Station.

At commencement, trains are about to pass under banner repeater MC458BR having had sight of the banner repeater signals for a significant distance without reflections from the proposed development being visible. Between commencement and frame 34 no reflections are visible from the proposed development. From frame 35, reflections are just visible from the top floor of the proposed development in the distance. The area of reflection increases as trains enter Deansgate Station and travel towards Signal MC458. By frame 175, Signal MP458 sits outside 20° of the driver's line of sight and drivers would no longer require sighting of this signal but reflections remain visible until frame 413.

When train drivers approach Deansgate Station and Signal MP458, the reflections occurring are predominantly outside 10° of a driver's direct line of sight with just a small area falling between 9°-10° between frames 125 and 175 (circa 50m) as drivers approach the middle of the platform until they are stationary at the end of the platform. Within this section of track, the reflections occur in the early afternoon (13:00-14:00 GMT) during the winter months (early-November to late-January) where the likelihood of the sun shining is less than 30%. Given the distance from the proposed development and non-reflective facade elements, these solar reflections are extremely small and broken up so are

unlikely to result in an instance of glare. Furthermore, trains would be travelling at low speeds and stopping as they approach the end of the platform, and then awaiting the signal to recommence their journey.

As trains exit Deansgate Station and travel towards Manchester Oxford Road Station, reflections briefly remain within 9°–10° of a driver's direct line of sight until frame 185 where they are outside 10° and the proposed development is mostly obscured from view by an existing building. As trains continue eastbound, the reflections move further from the direct line of sight until frame 299 where the lower section of the proposed development would become visible and would generate reflections outside 13° of the driver's line of sight. By frame 404 reflections would sit outside 20° so would no longer be of significance. Reflections occurring within 20° for this section of track could occur in the early afternoon (12:00–14:00 GMT) during the mid-seasons and winter months (mid-October to mid-February) where the likelihood of the sun shining is less than 40%. There are no signals visible within this stretch of track.

For the full stretch of track assessed, all reflections occur well above the driver's visor cut-off line which could be deployed to mitigate any reflections that do occur. All reflections occur from glazed areas that will be relatively small within the field of view and broken up by the non-reflective elements of the façade. As such, any reflections that do occur are unlikely to result in an instance of glare and are unlikely to affect the visibility of drivers. Overall, there is not considered to be concern from a glare perspective for train drivers travelling eastbound on Track 3 Up and no further assessment is considered necessary. The conclusions have shown a slight improvement compared from the April 2024 assessment due to the reduction in height of the proposed development.

CONCLUSIONS

It is our opinion that no major issues with glare from reflected sunlight are to be expected with the proposed Hotspur Press development and no further assessment is considered necessary.

This opinion is based on the following:

- The design of the building comprises strips of glazing rather than full, curtain wall glazing as such, reflections are broken up by non-reflective facade elements and are somewhat shaded by the facade articulation.
- Given the distance from the proposed development and broken up nature of the reflections, it is unlikely the full solar disc could be reflected and any reflections that would occur would be unlikely to be considered an instance of glare.
- Where reflections are visible within the same stretch of track that signals are visible, drivers would be slowing towards the end of the platform having been alerted to the need to slow down by earlier signals where reflections from the proposed development would not be visible.
- If and when the reflection of the sun is visible, the actual sun will also be within the field of view of the driver, who will be prepared for this situation and be likely to have the visor deployed, or be wearing sun glasses.
- The reflections either occur in the very early morning in summer or during winter when the solar intensity is at its lowest and there is a much greater probability of overcast skies.

The overall conclusions are unchanged from the April 2024 assessment.

7 SIGNALLING DIAGRAMS

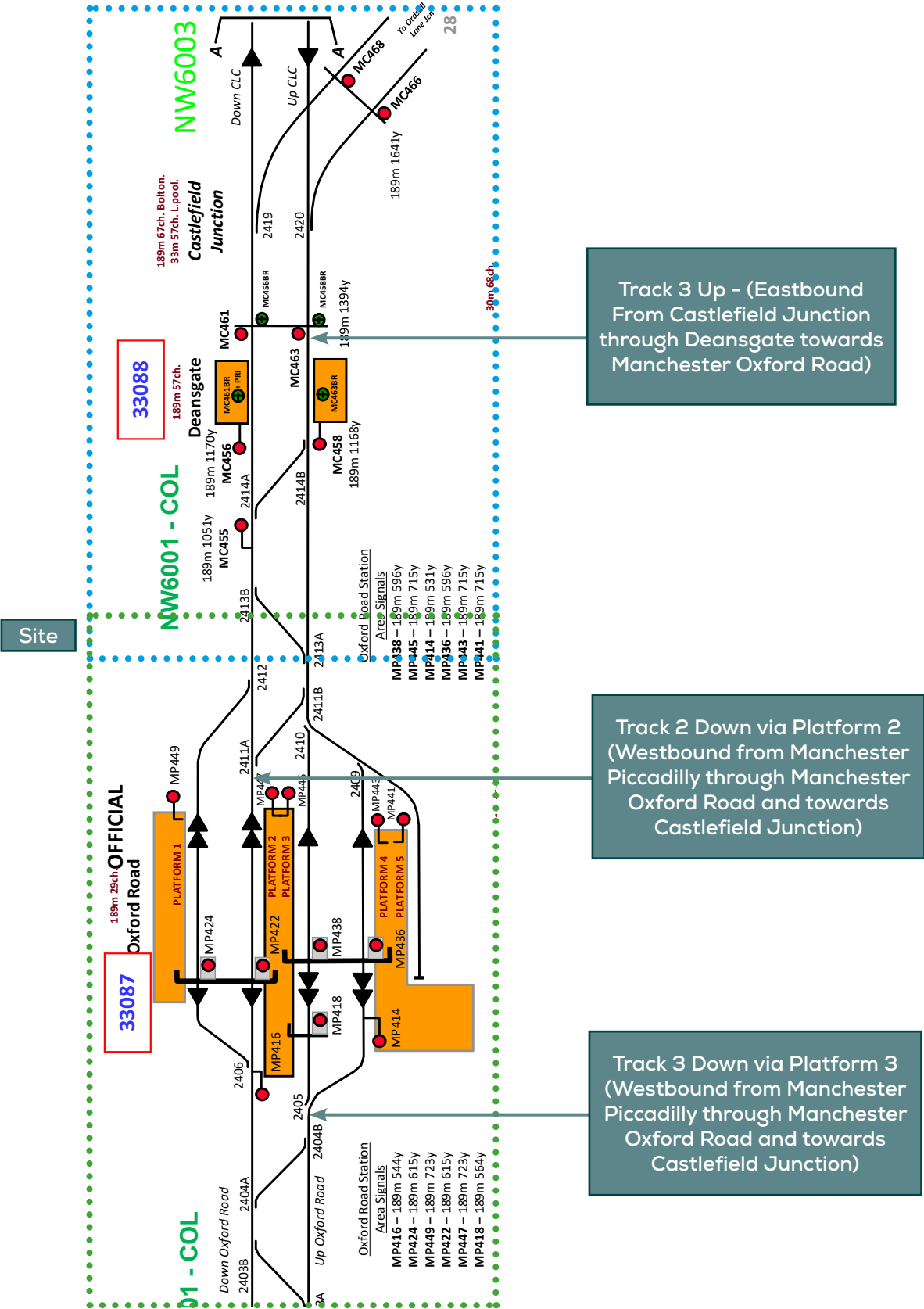


Fig. 13: Signalling diagram

8 OVERVIEW: TRACKS, VIEWPOINTS AND SIGNALS

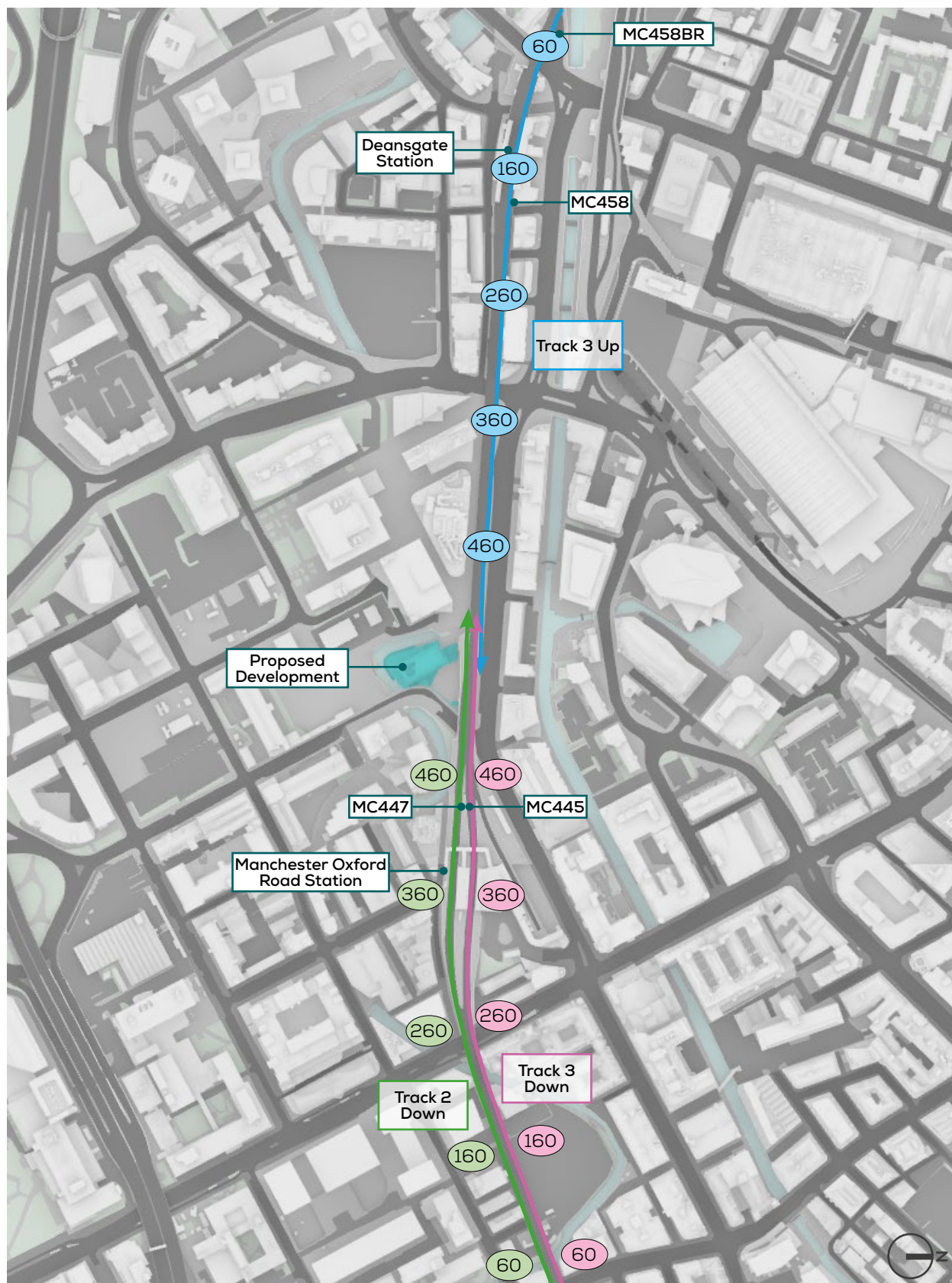


Fig. 14: Site Plan - Tracks and Viewpoints

9 STAGE 1: STATIC ASSESSMENT

The following pages present our Stage 1 Assessment results

60° FIELD OF VIEW: TIME OF DAY
TRACK 2 DOWN - FRAME 1

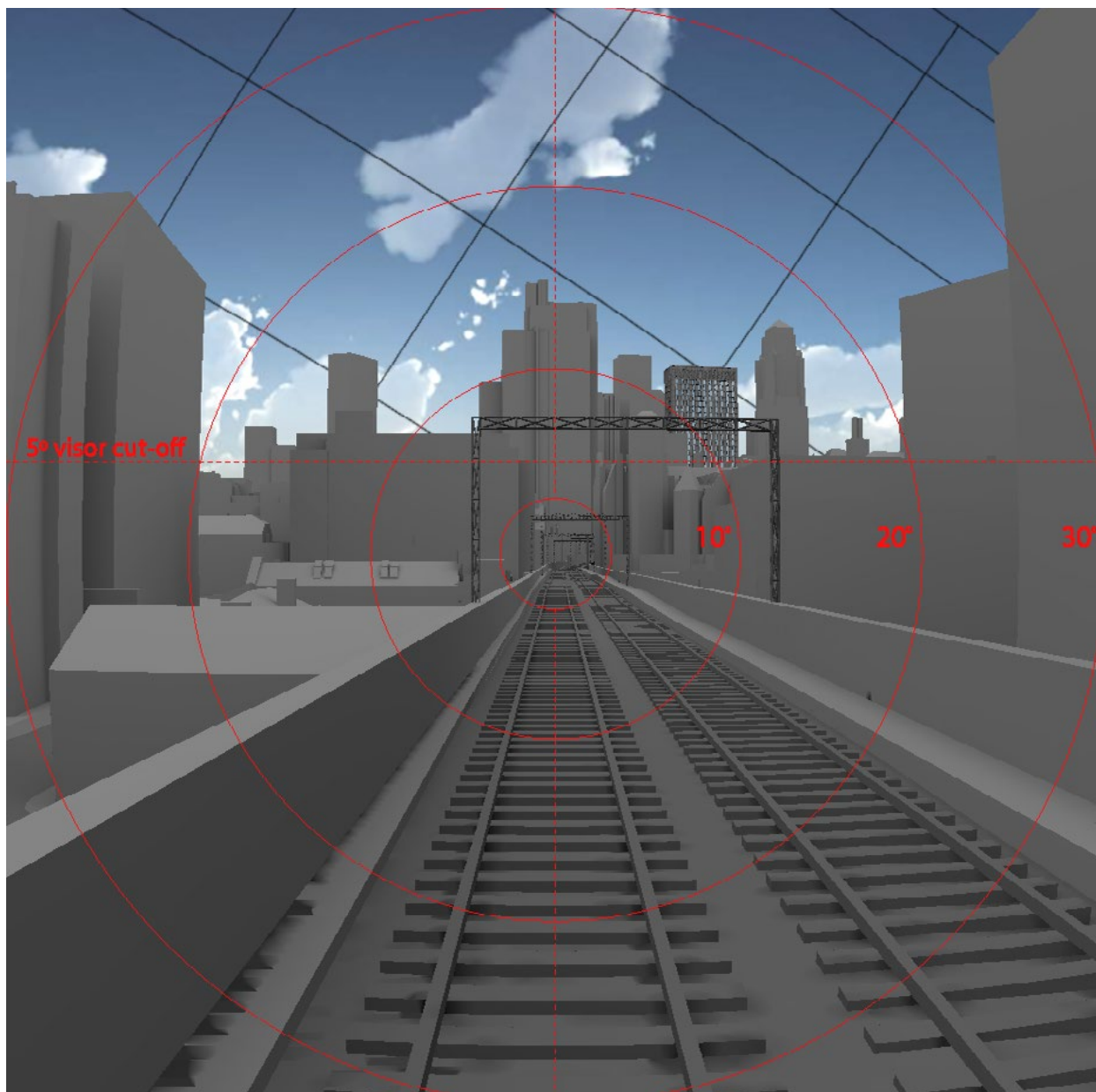
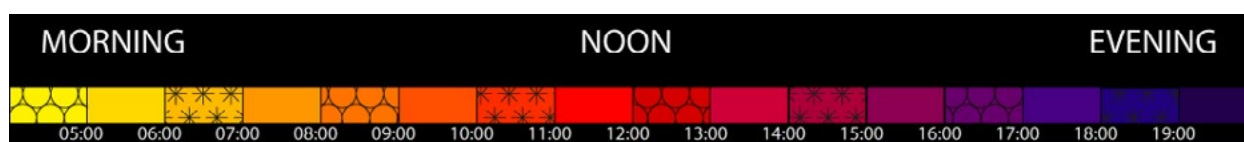


Fig. 15: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 2 DOWN - FRAME 1

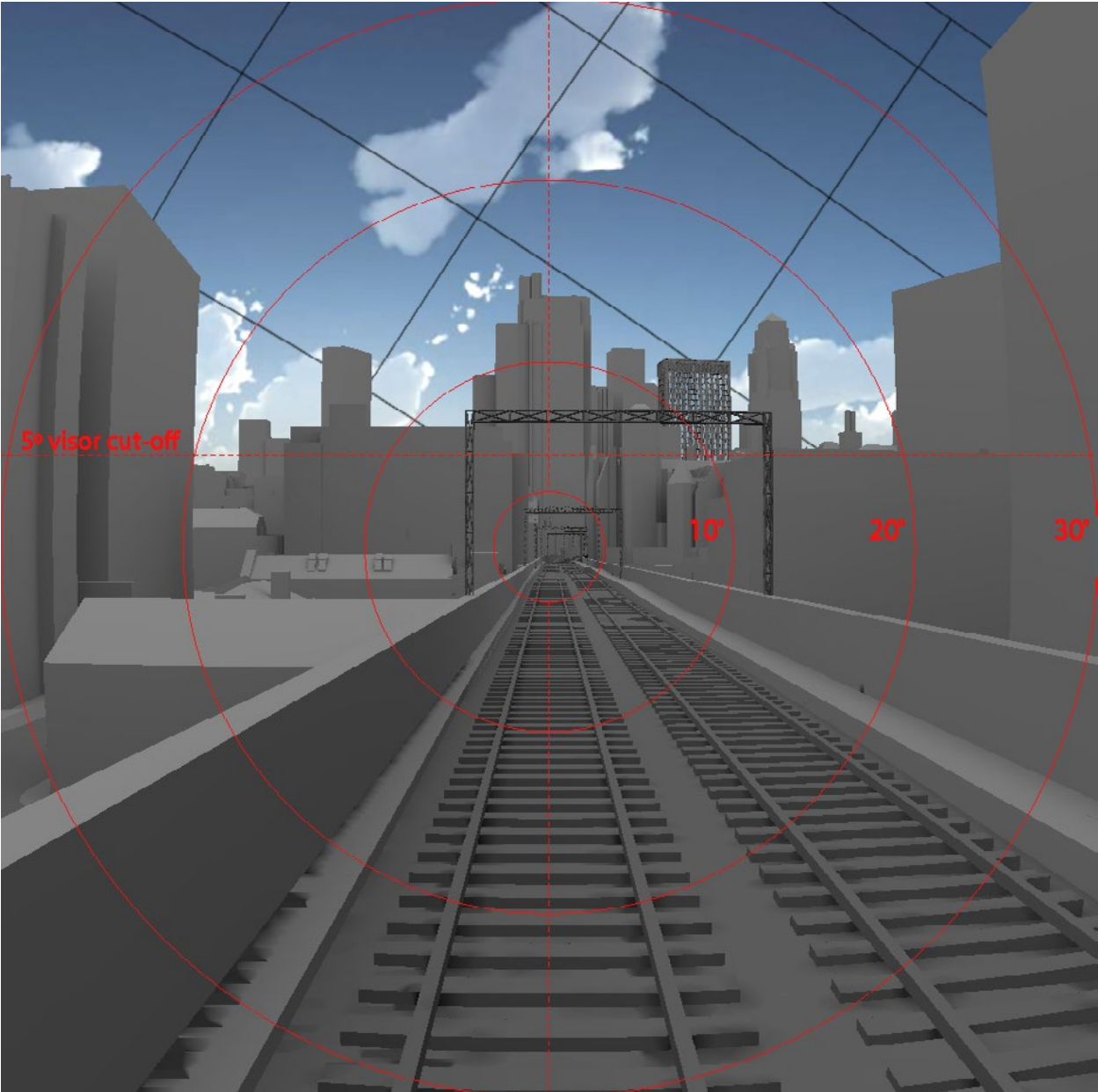


Fig. 16: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 2 DOWN - FRAME 245

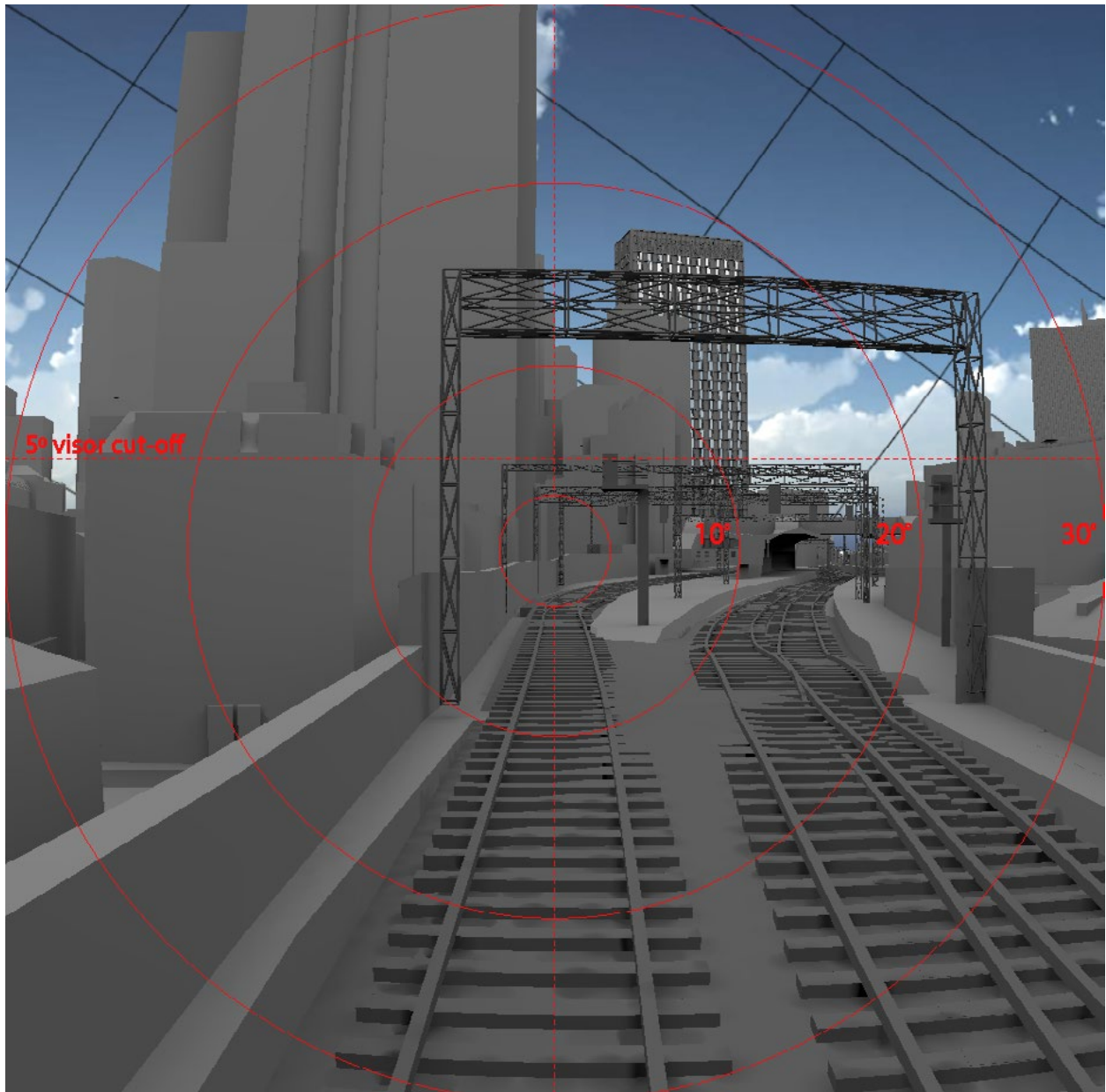
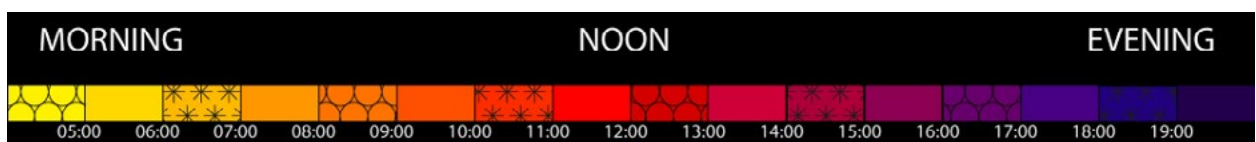


Fig. 17: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 2 DOWN - FRAME 245

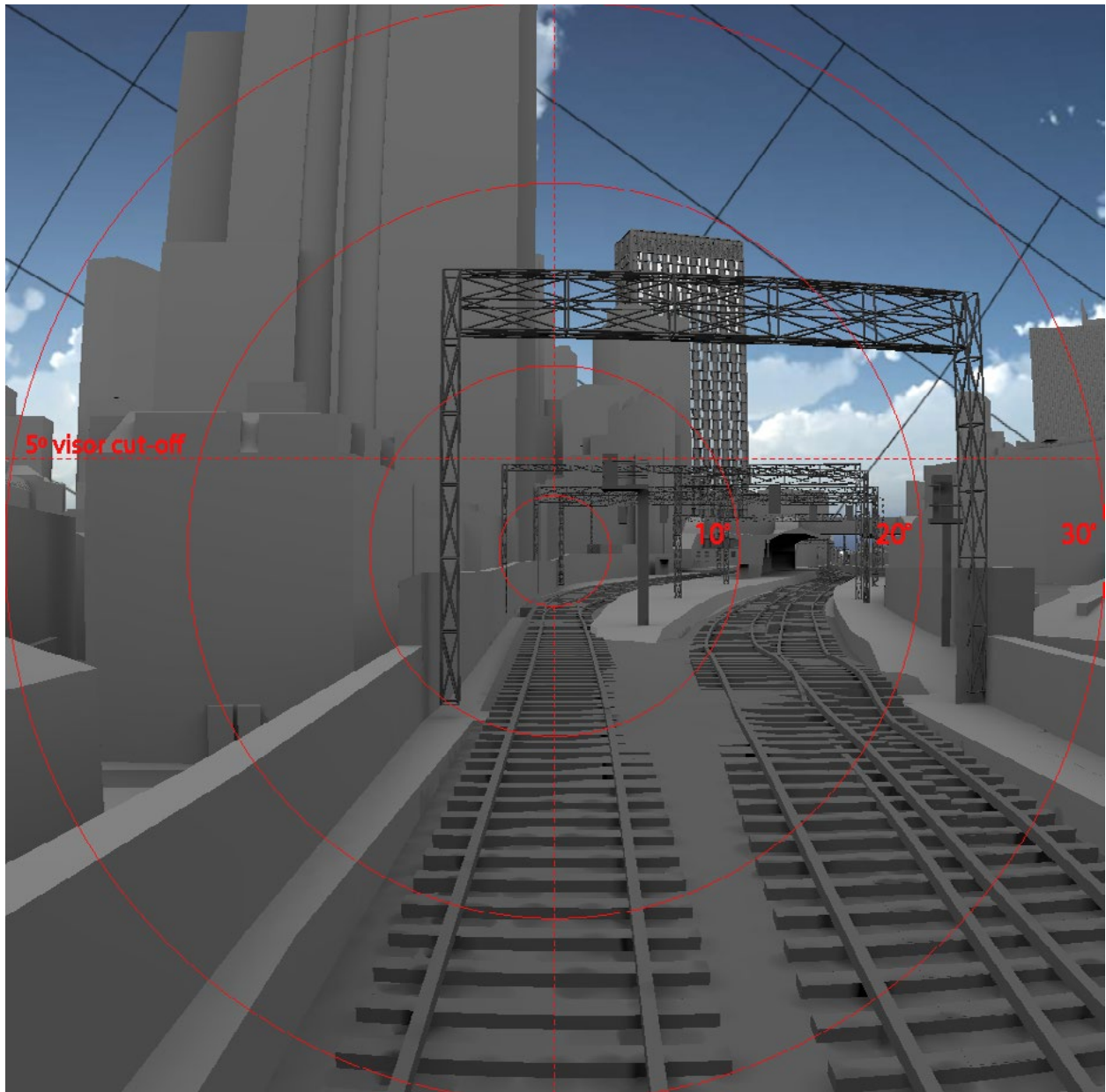


Fig. 18: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 2 DOWN - FRAME 350

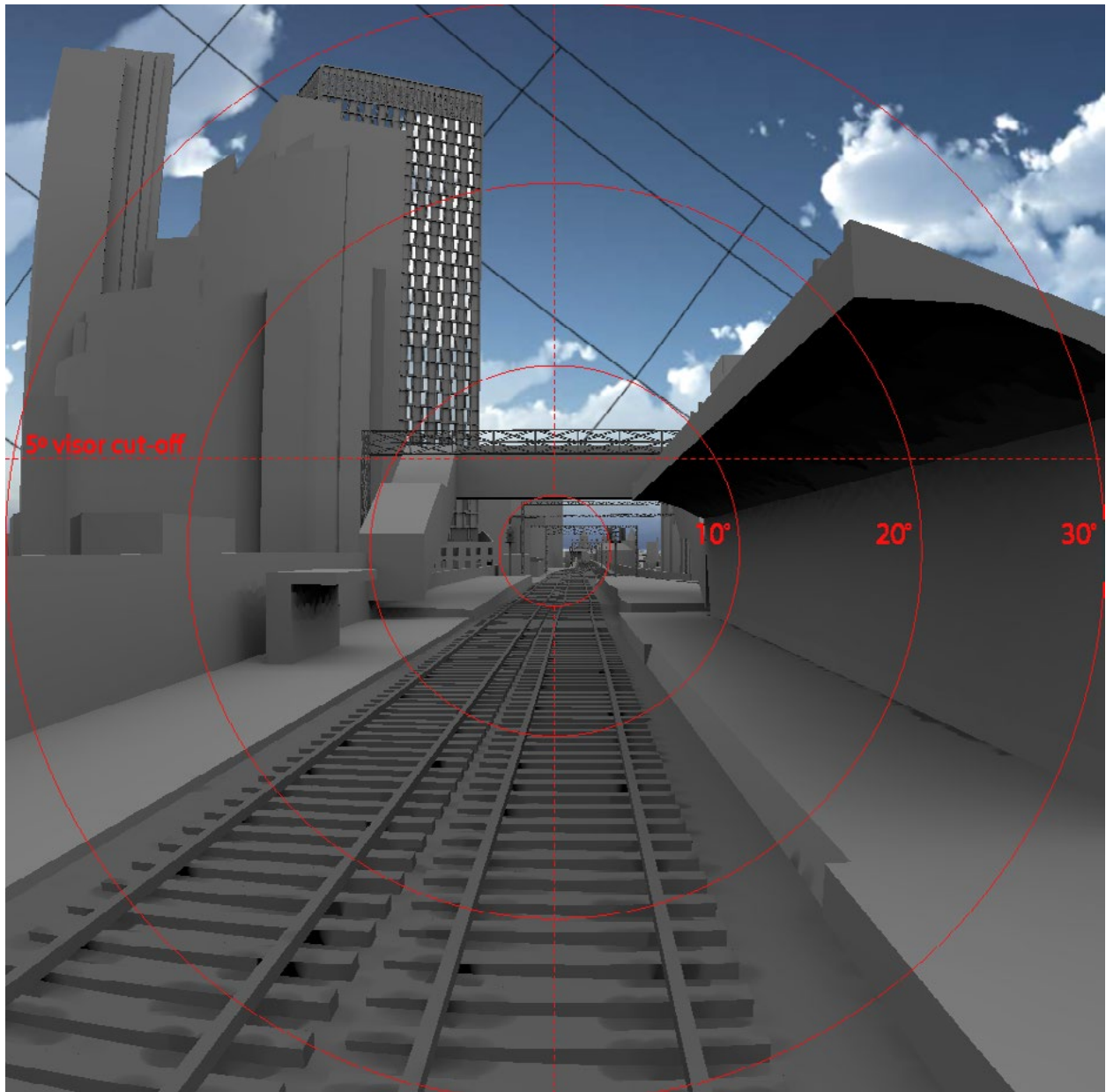
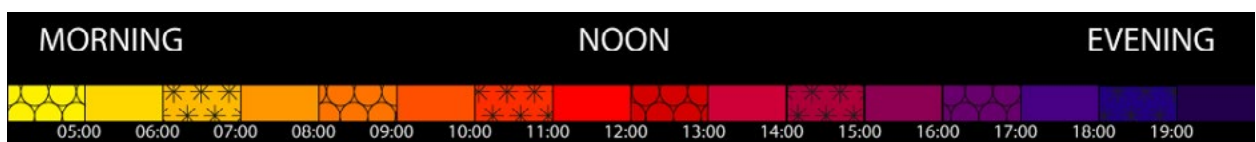


Fig. 19: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 2 DOWN - FRAME 350

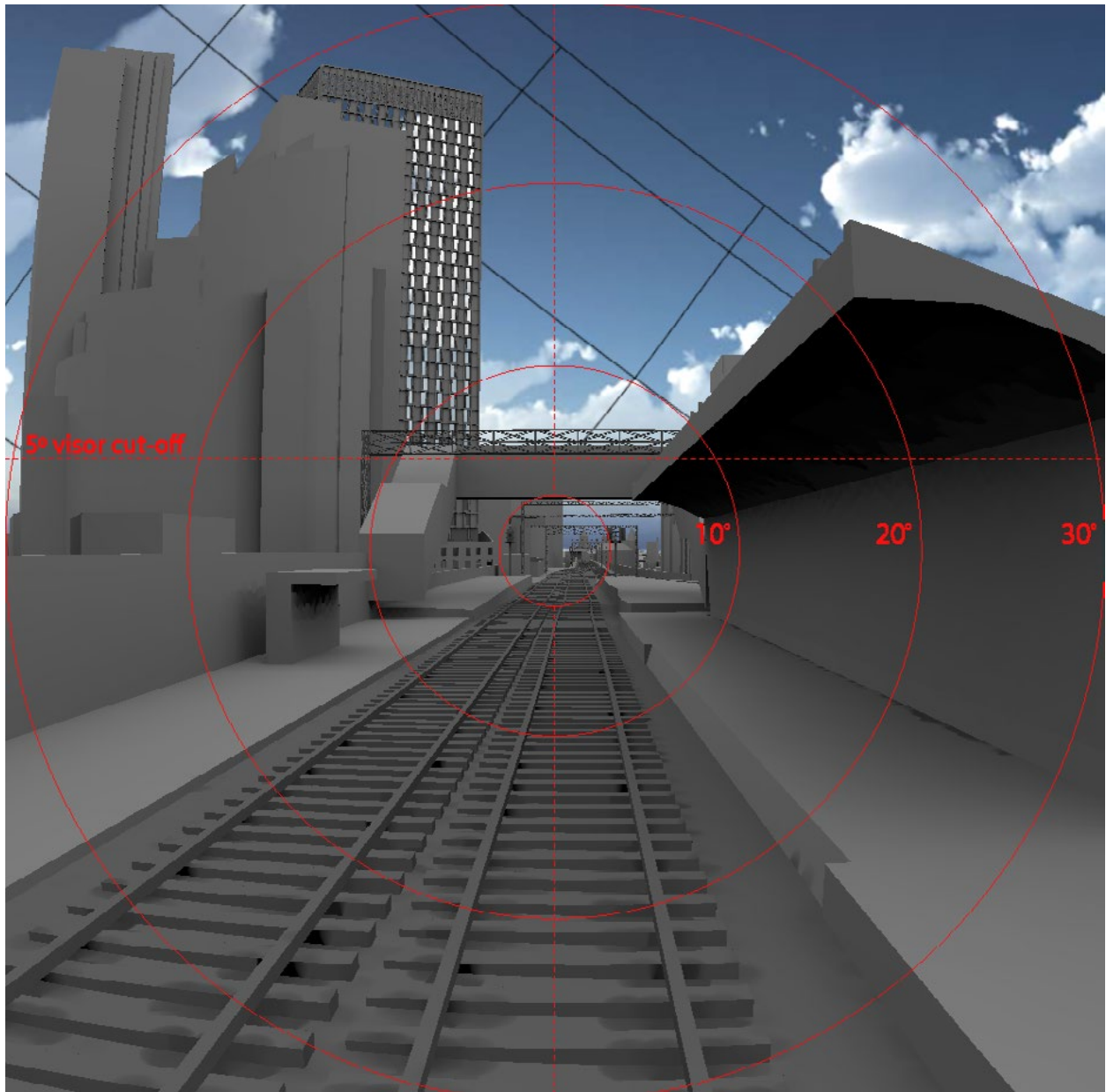


Fig. 20: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 2 DOWN - FRAME 440

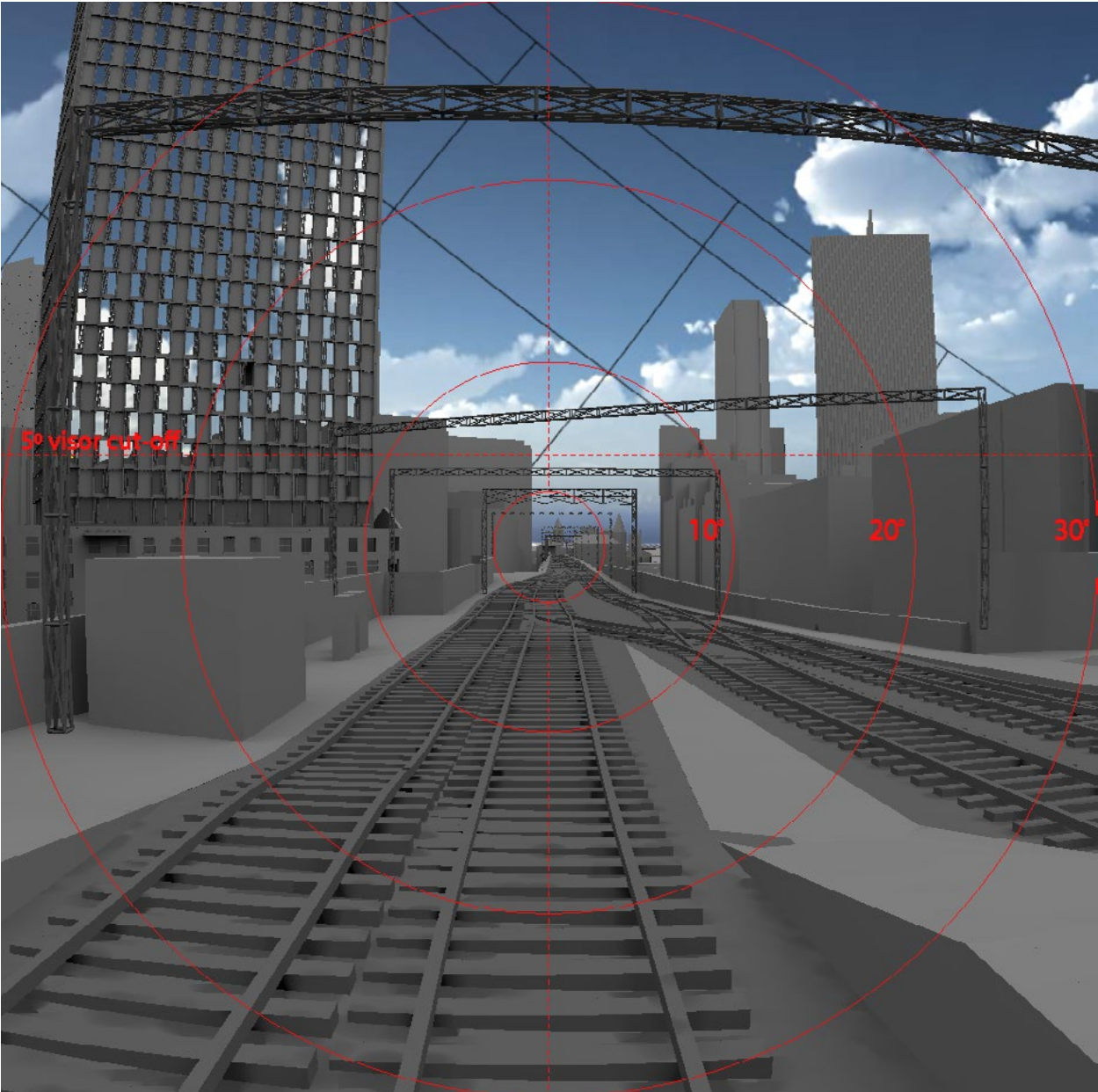
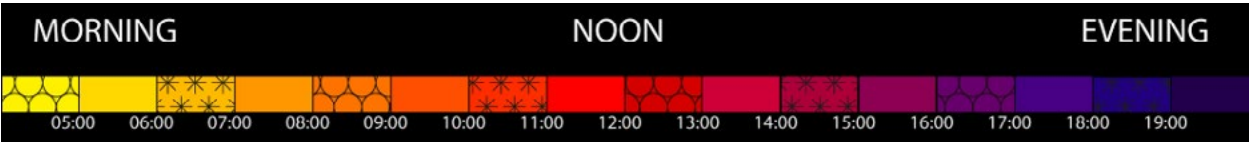


Fig. 21: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 2 DOWN - FRAME 440

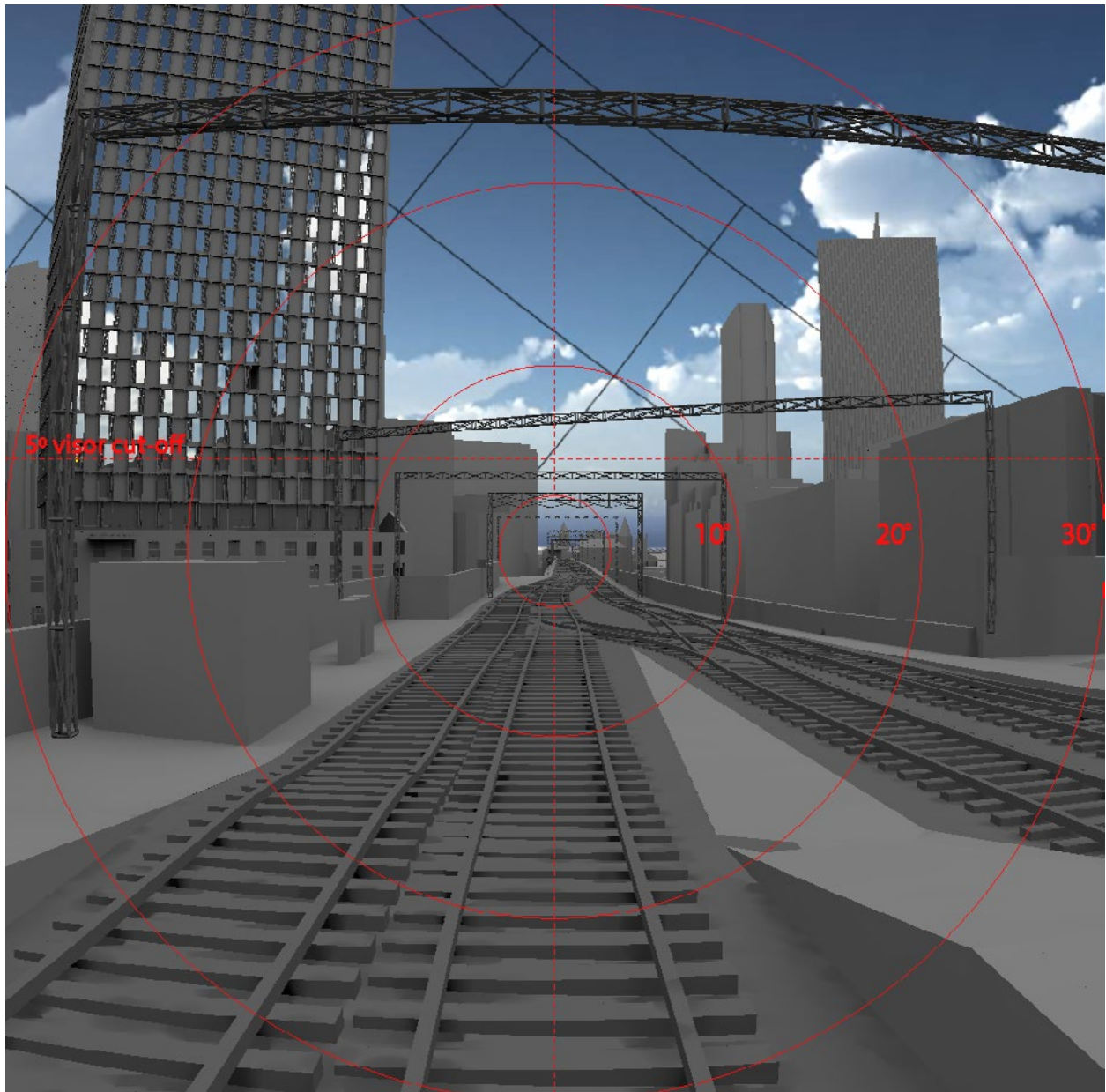


Fig. 22: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 2 DOWN - FRAME 460

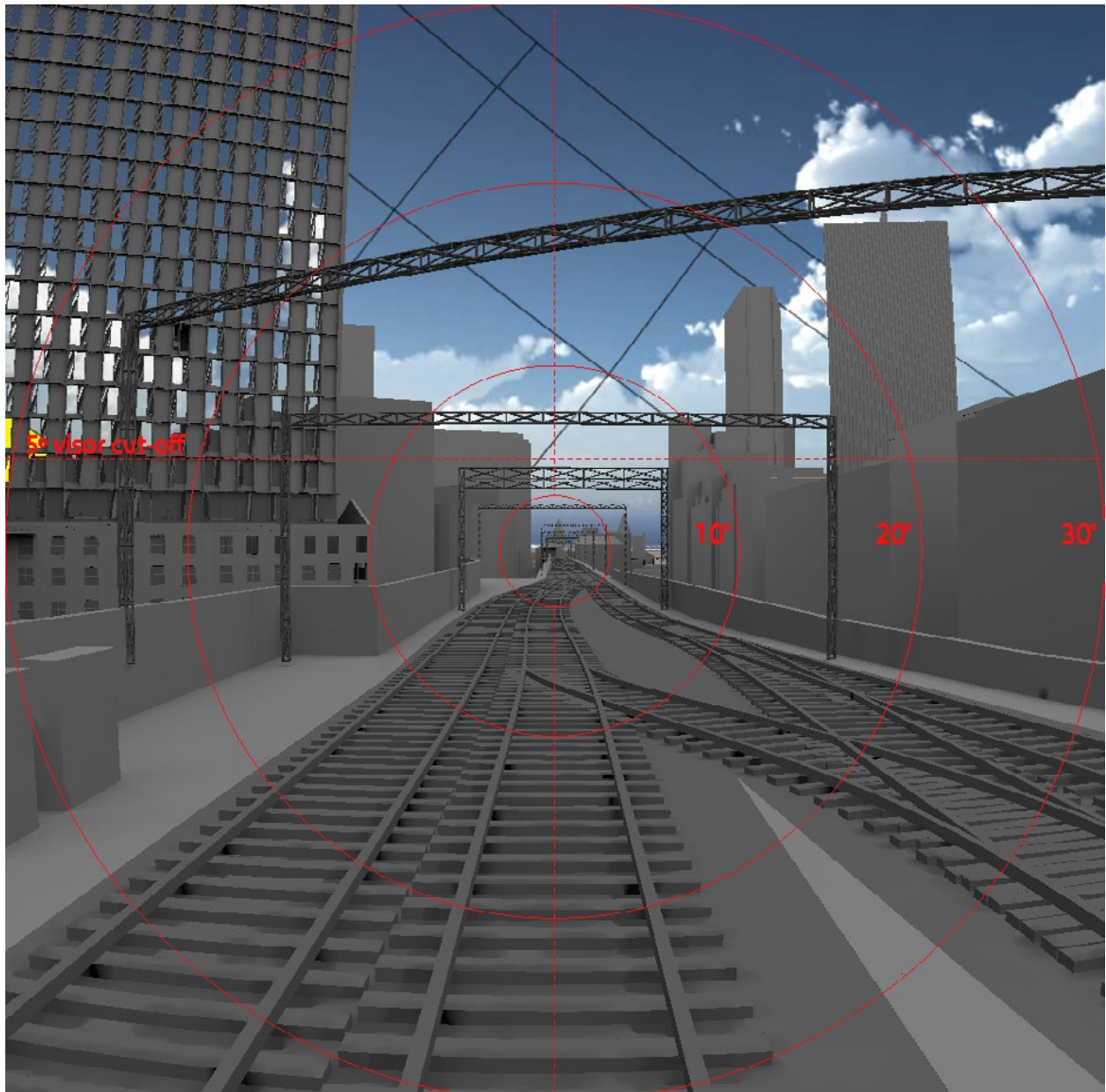
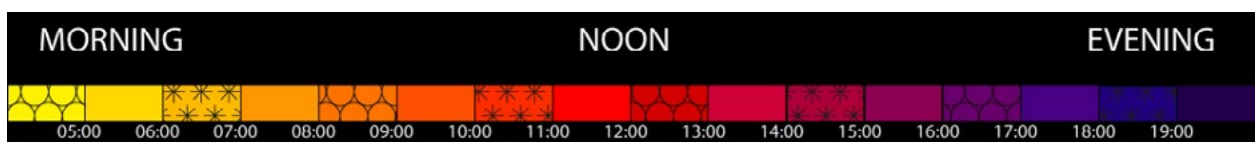


Fig. 23: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 2 DOWN - FRAME 460

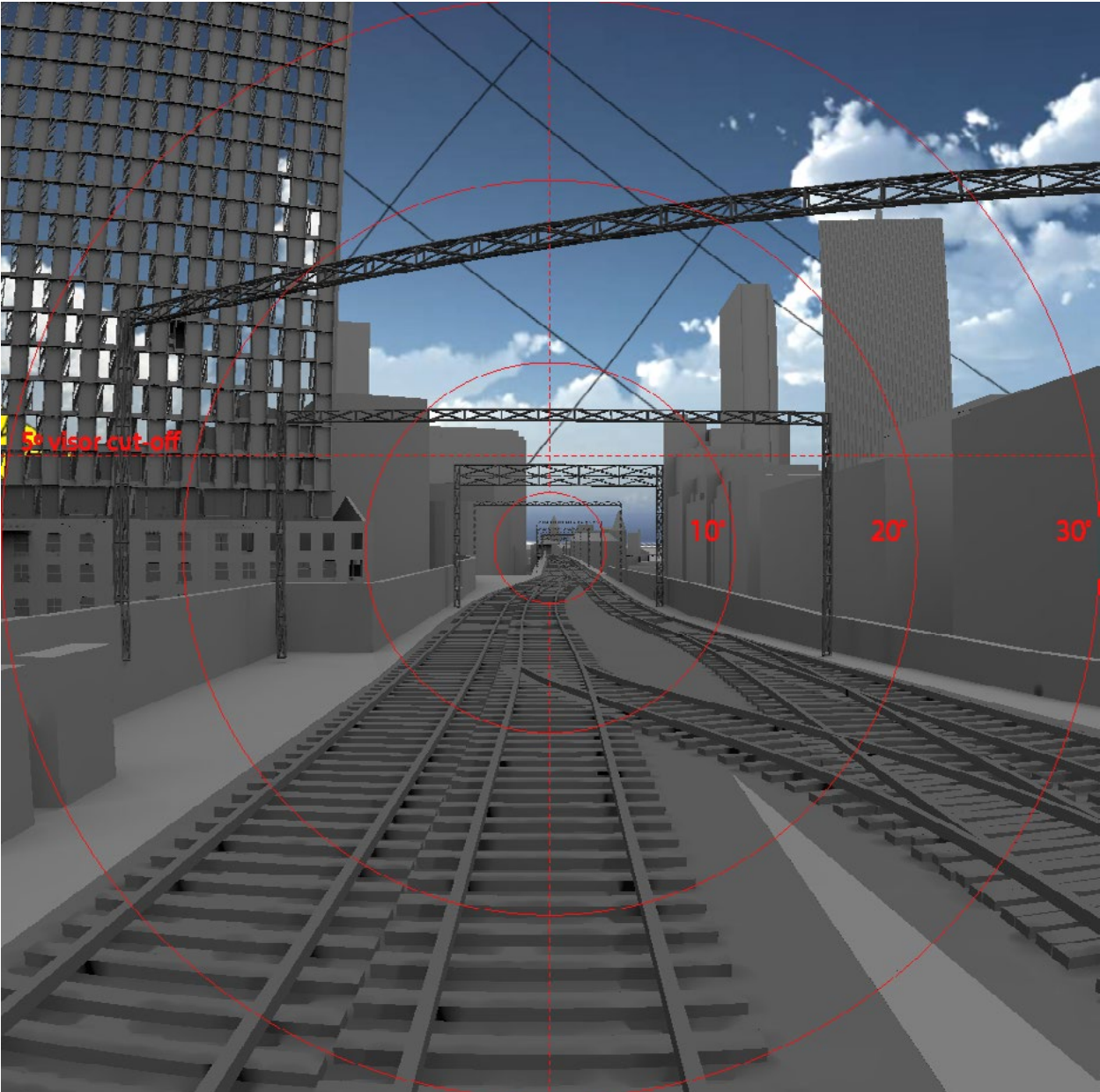


Fig. 24: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 DOWN - FRAME 1

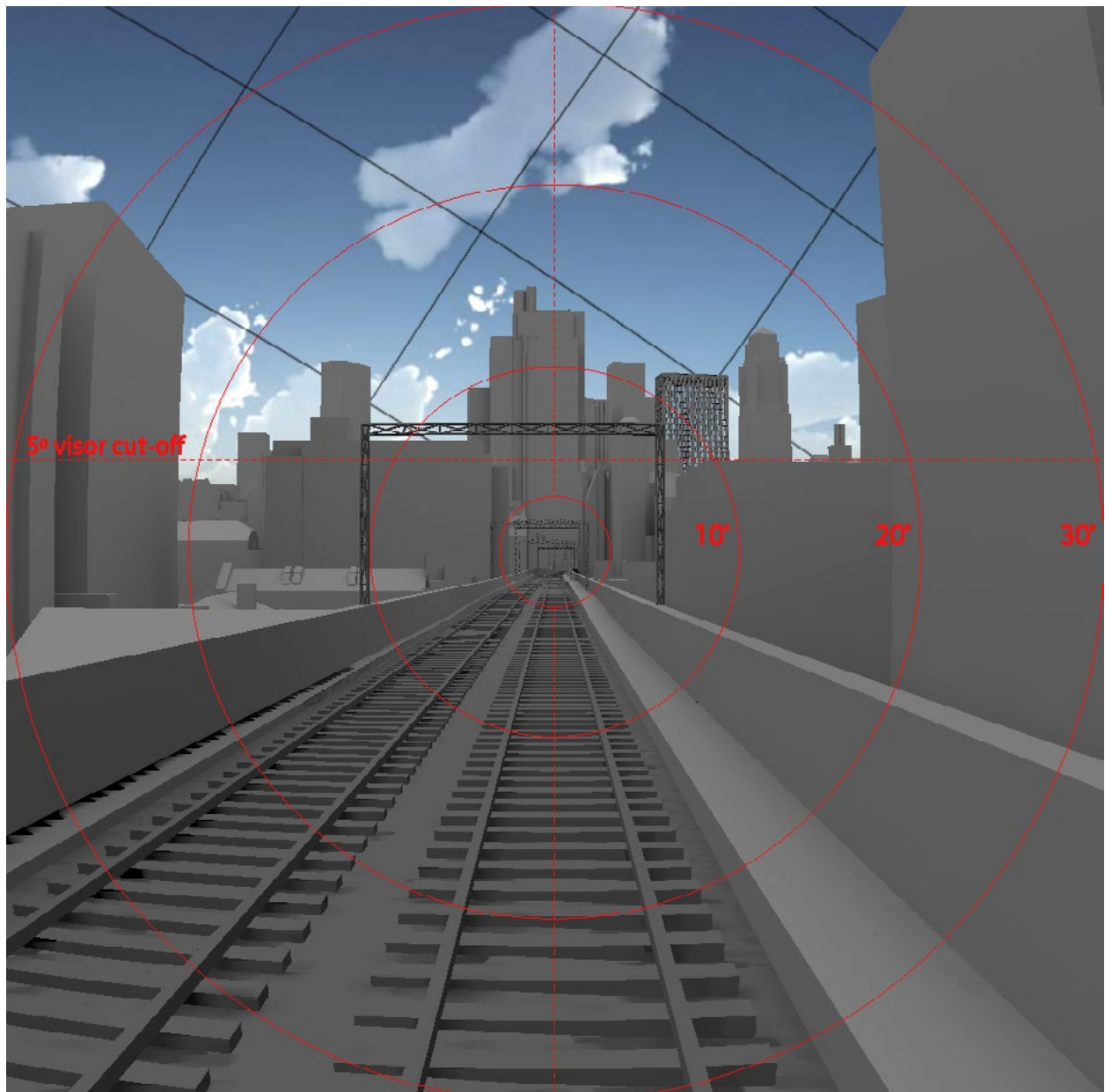
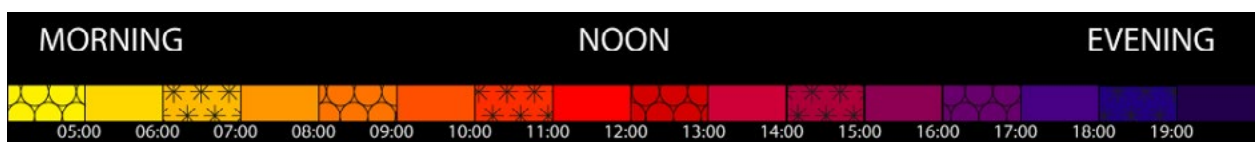


Fig. 25: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 DOWN - FRAME 1

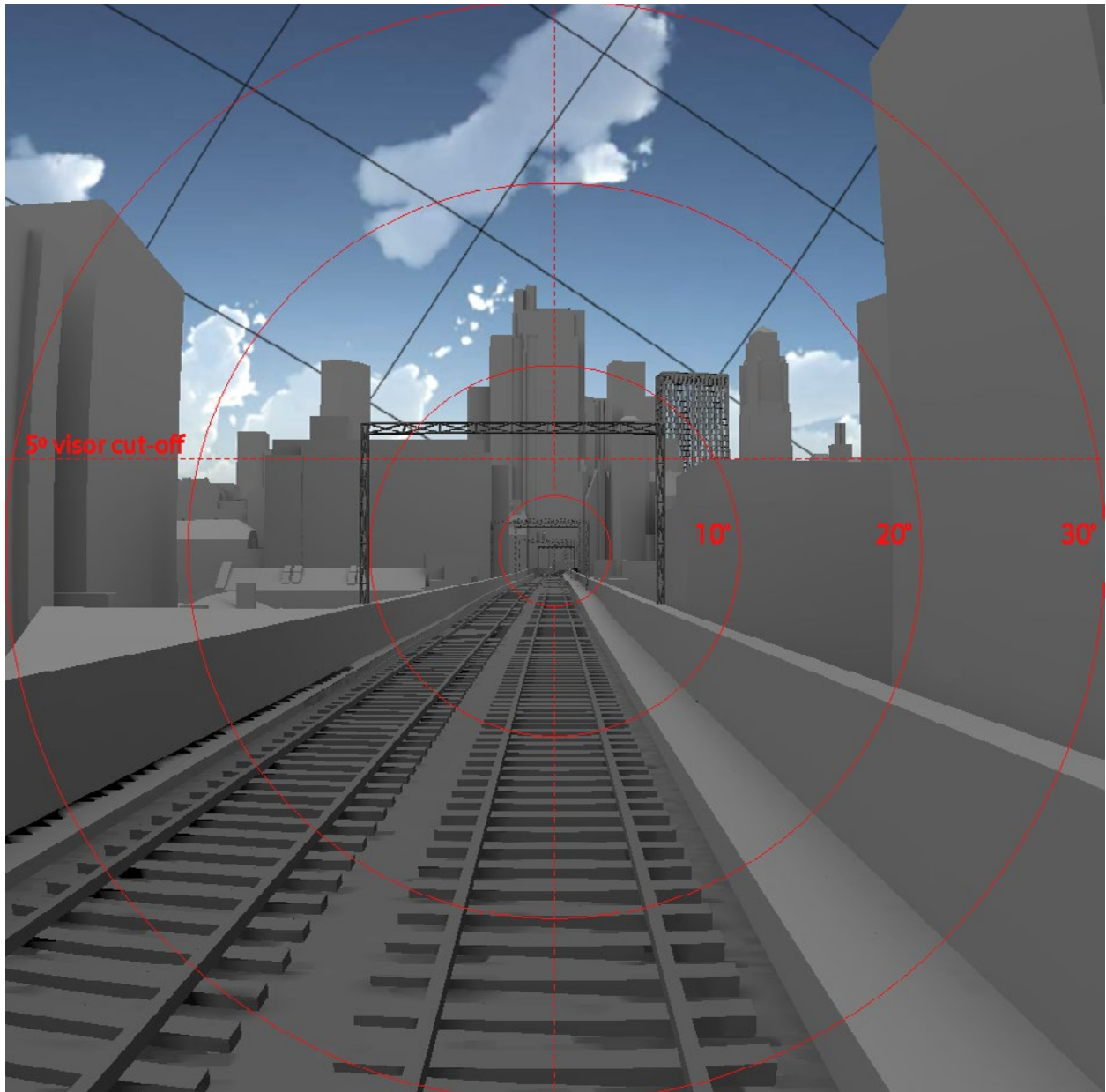


Fig. 26: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 DOWN - FRAME 260

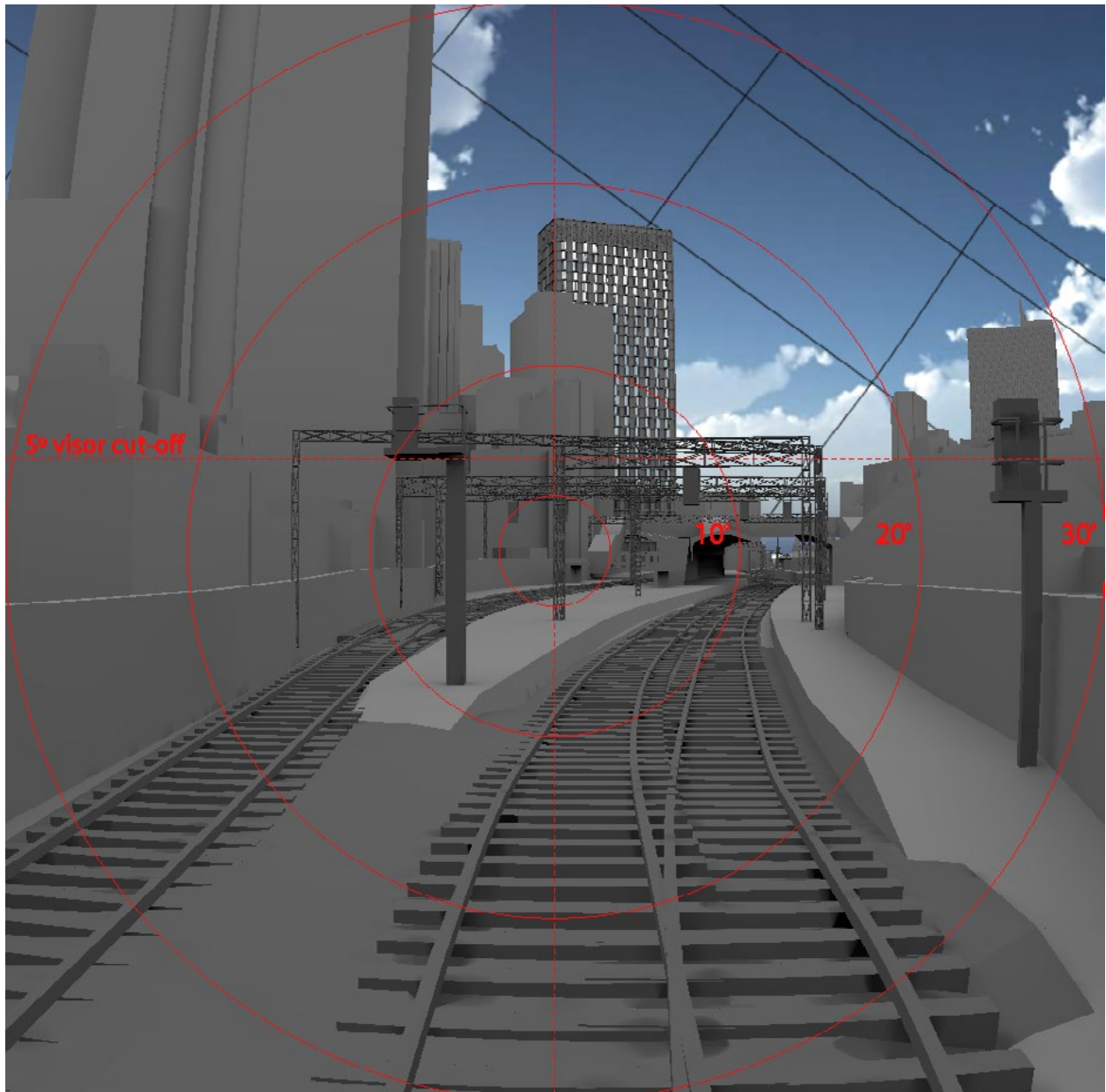
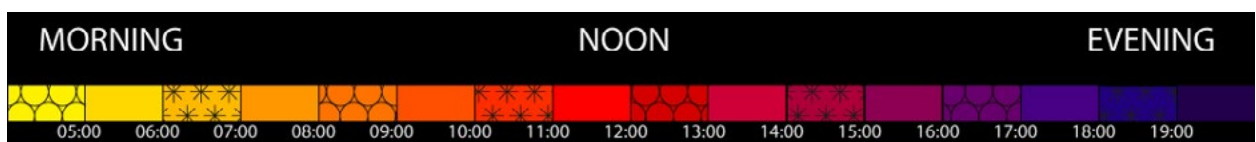


Fig. 27: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 DOWN - FRAME 260

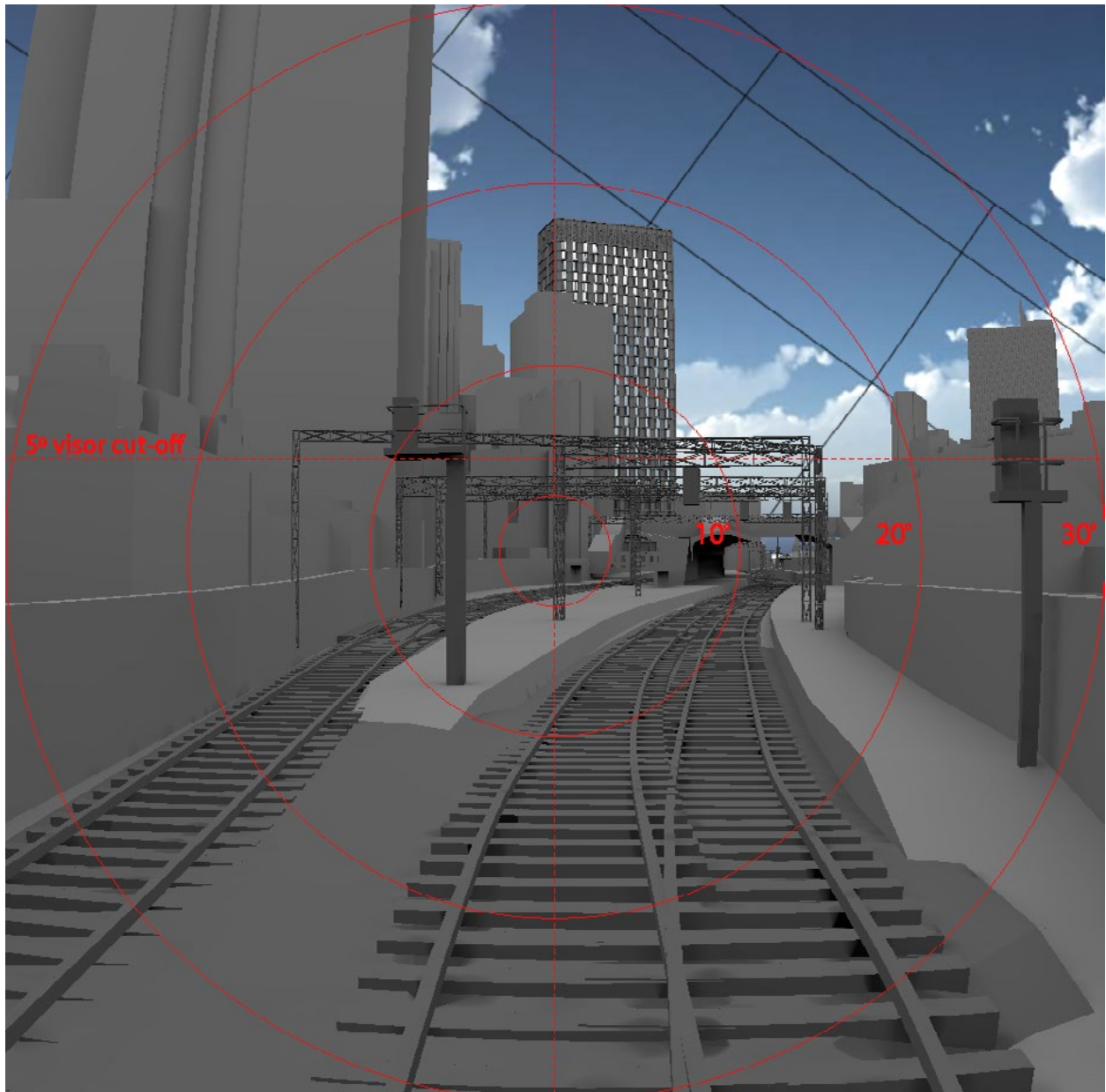


Fig. 28: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 DOWN - FRAME 360

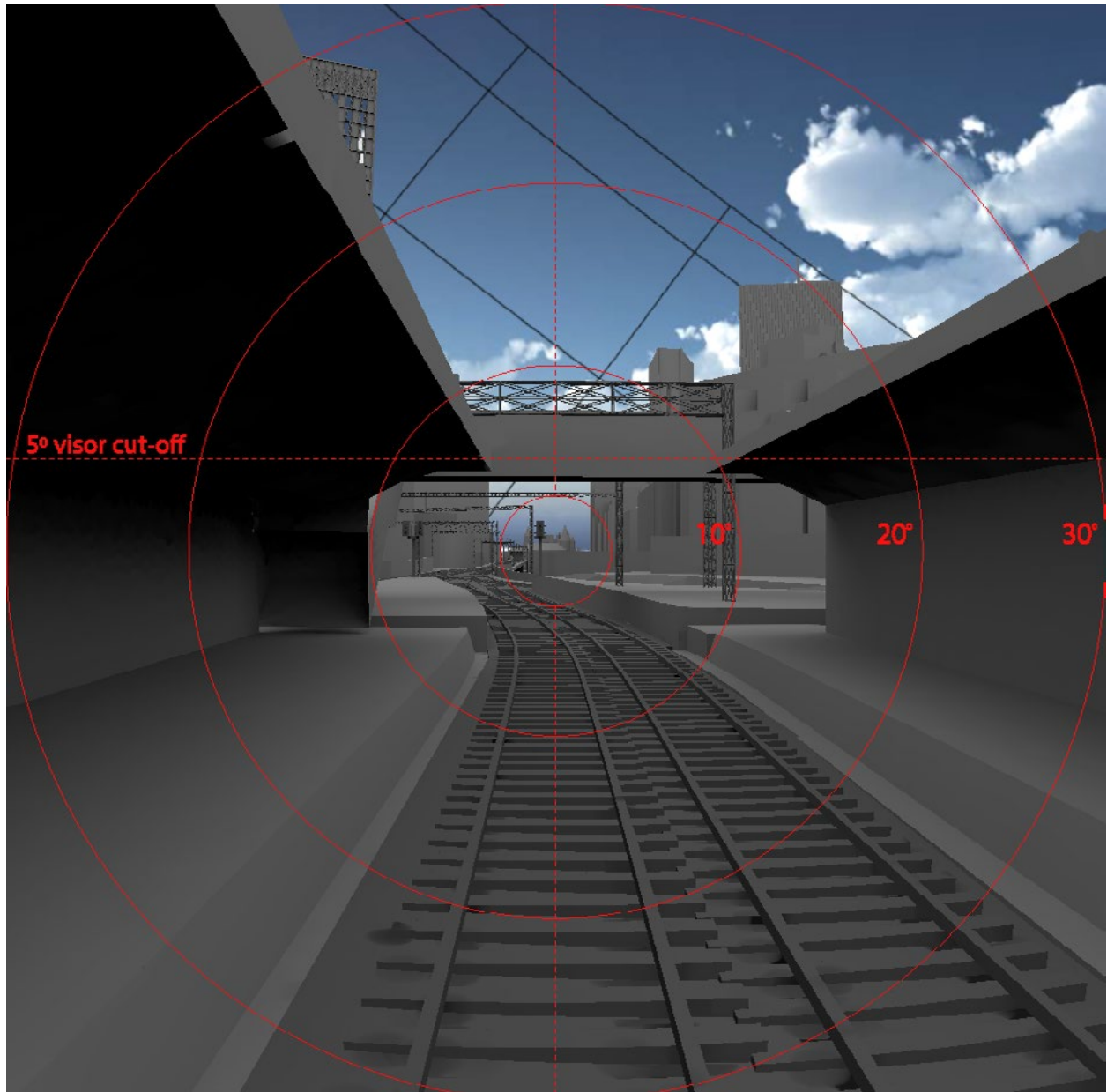
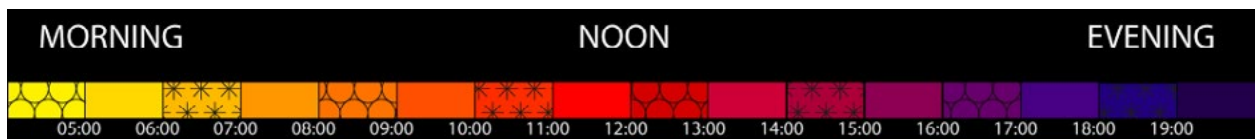


Fig. 29: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 DOWN - FRAME 360

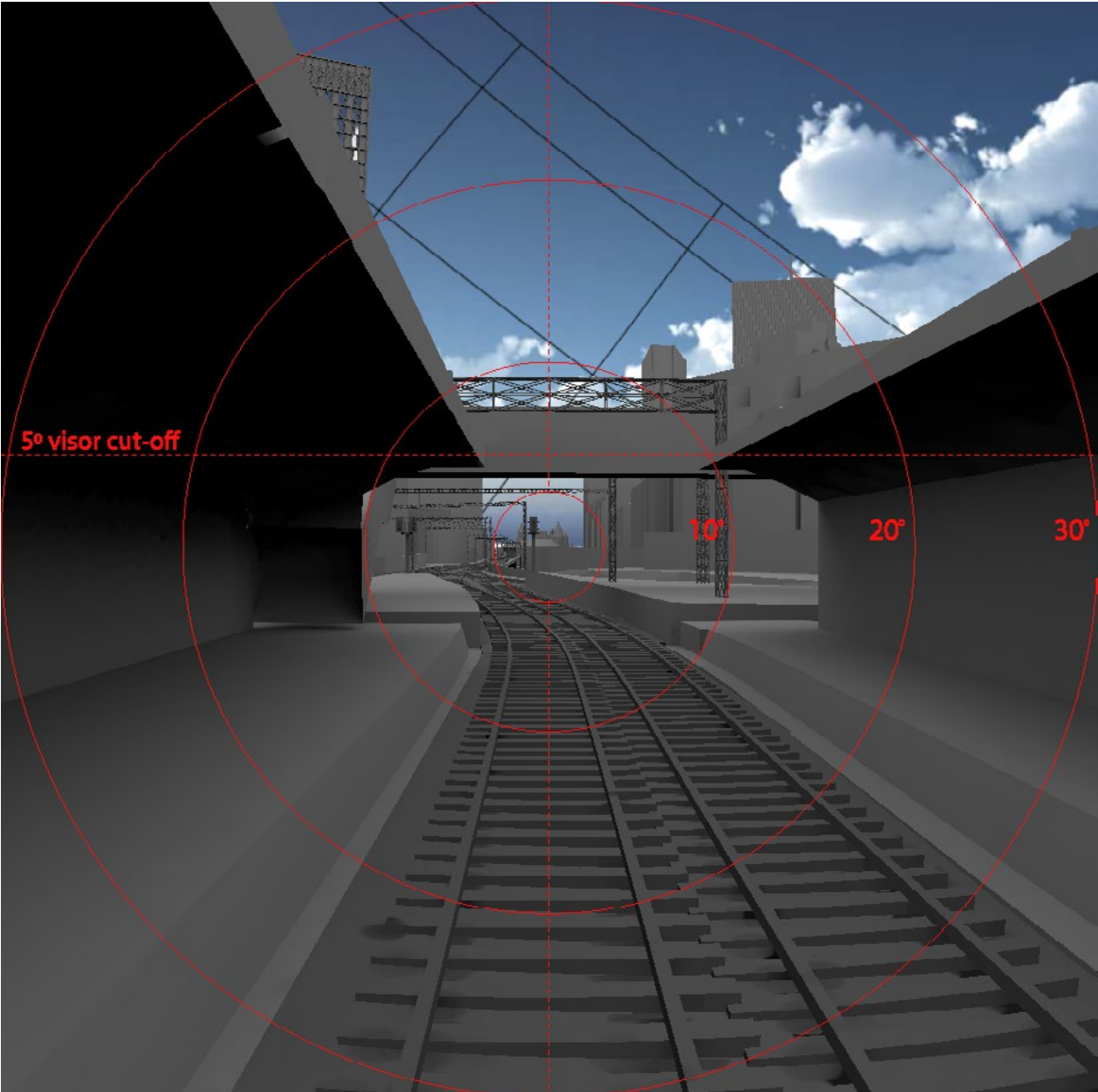


Fig. 30: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 DOWN - FRAME 410

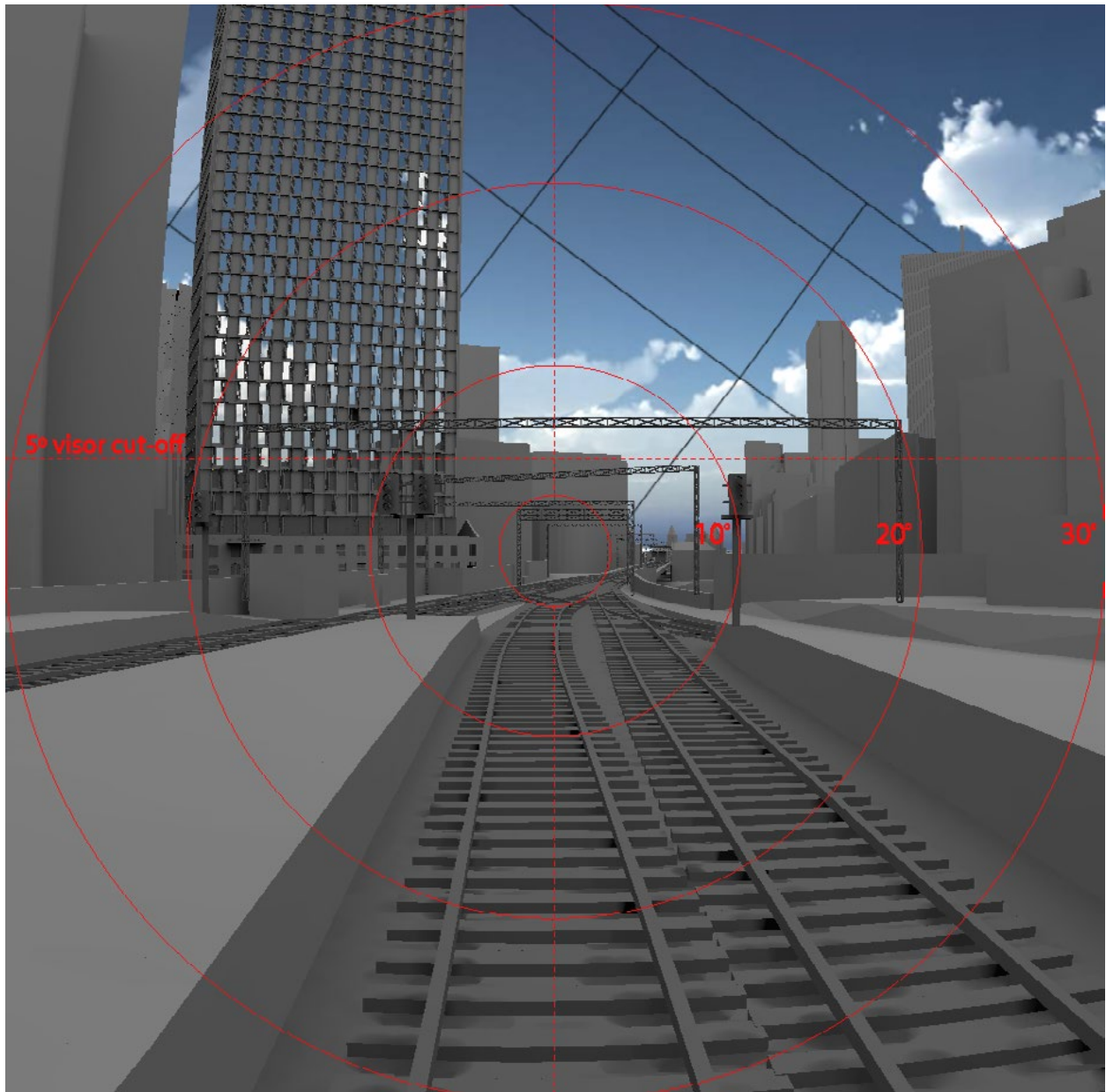
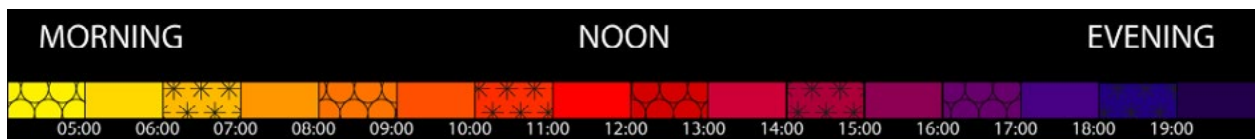


Fig. 31: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 DOWN - FRAME 410

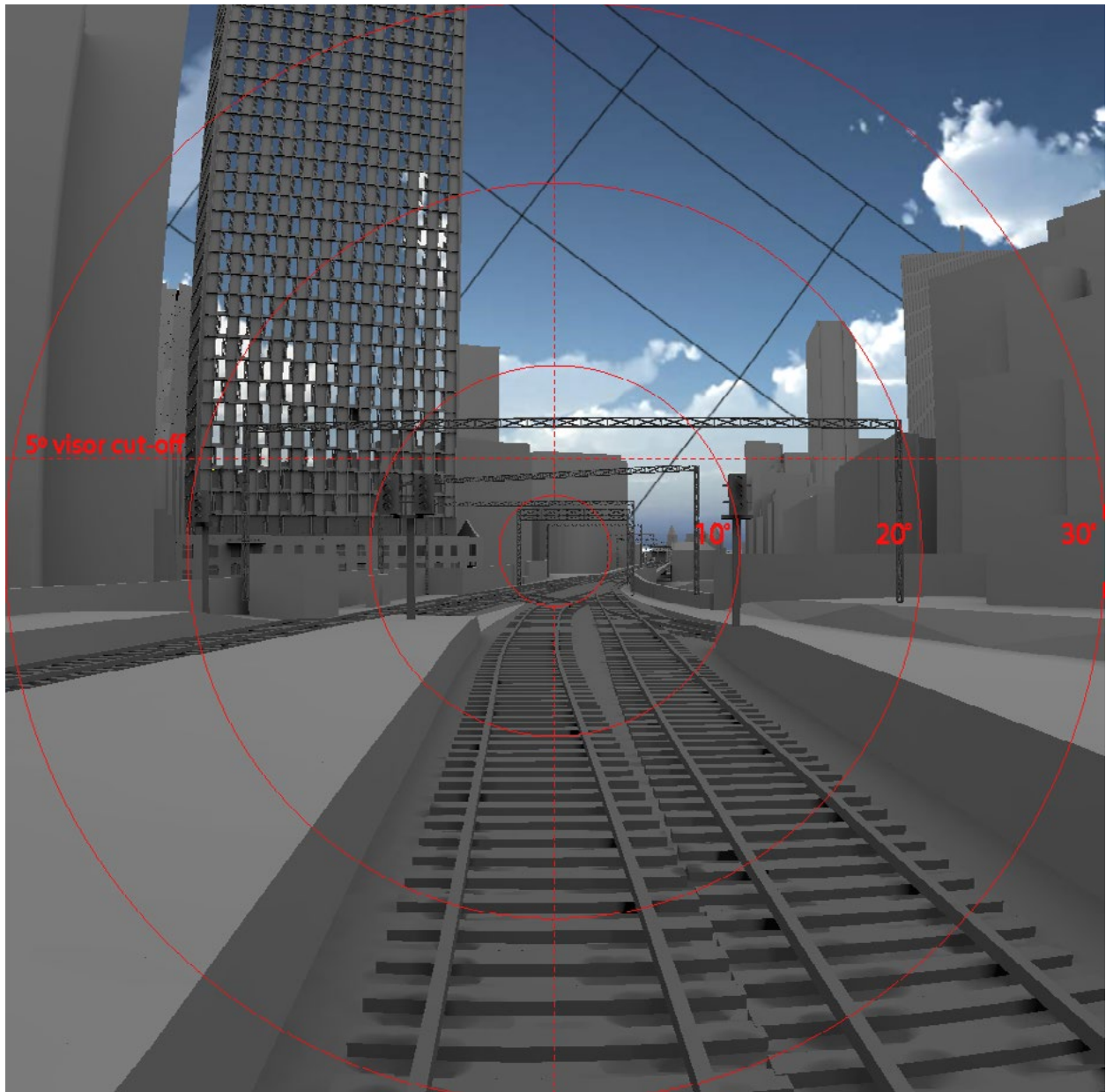


Fig. 32: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 DOWN - FRAME 420

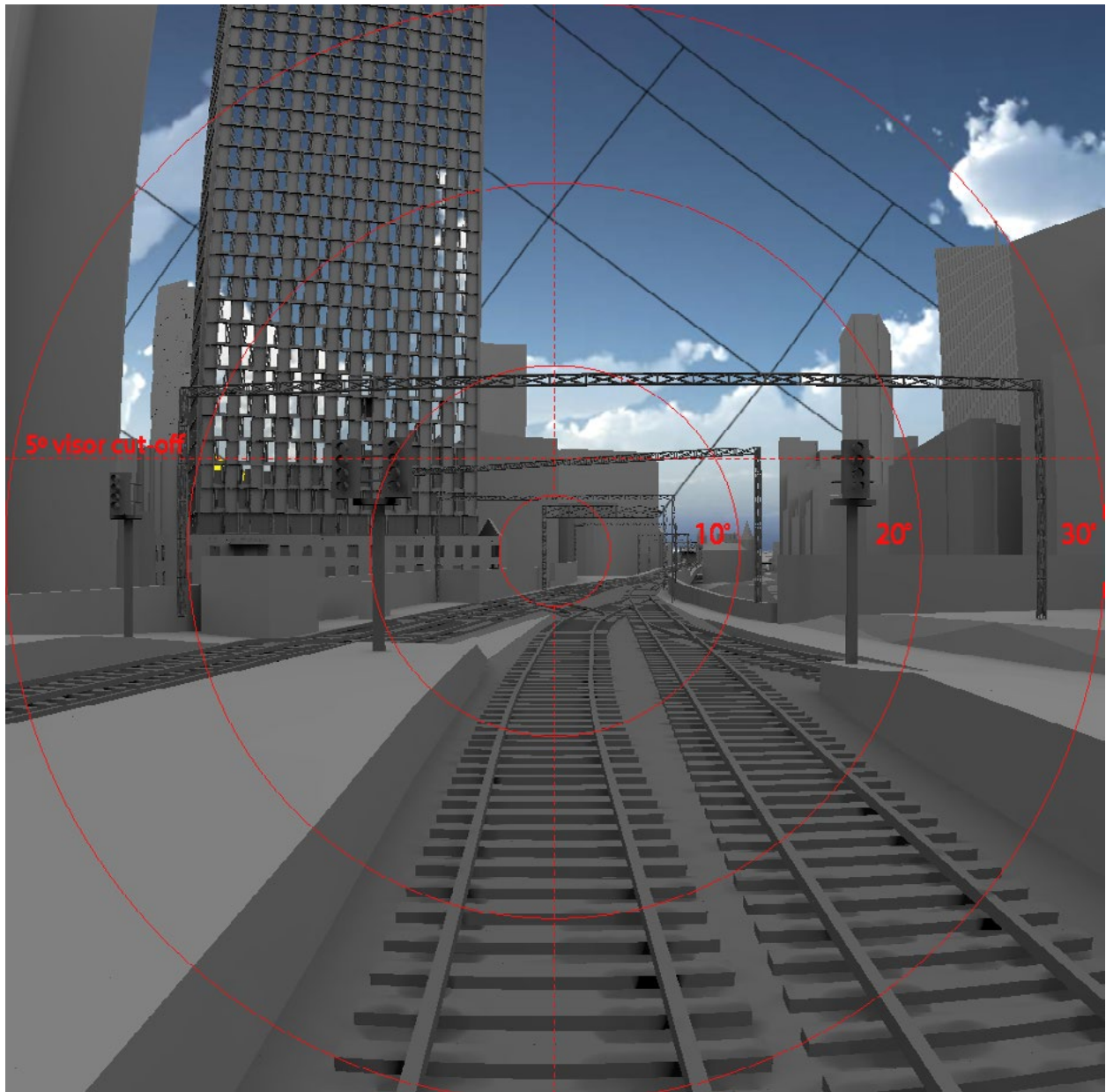
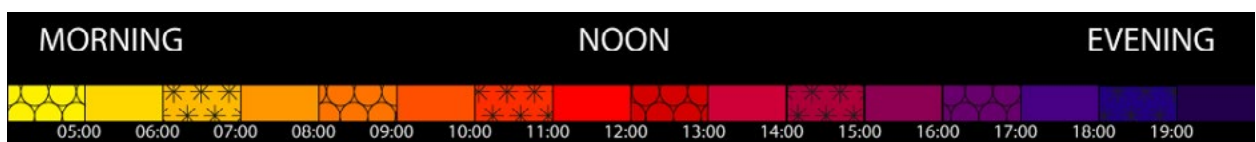


Fig. 33: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 DOWN - FRAME 420

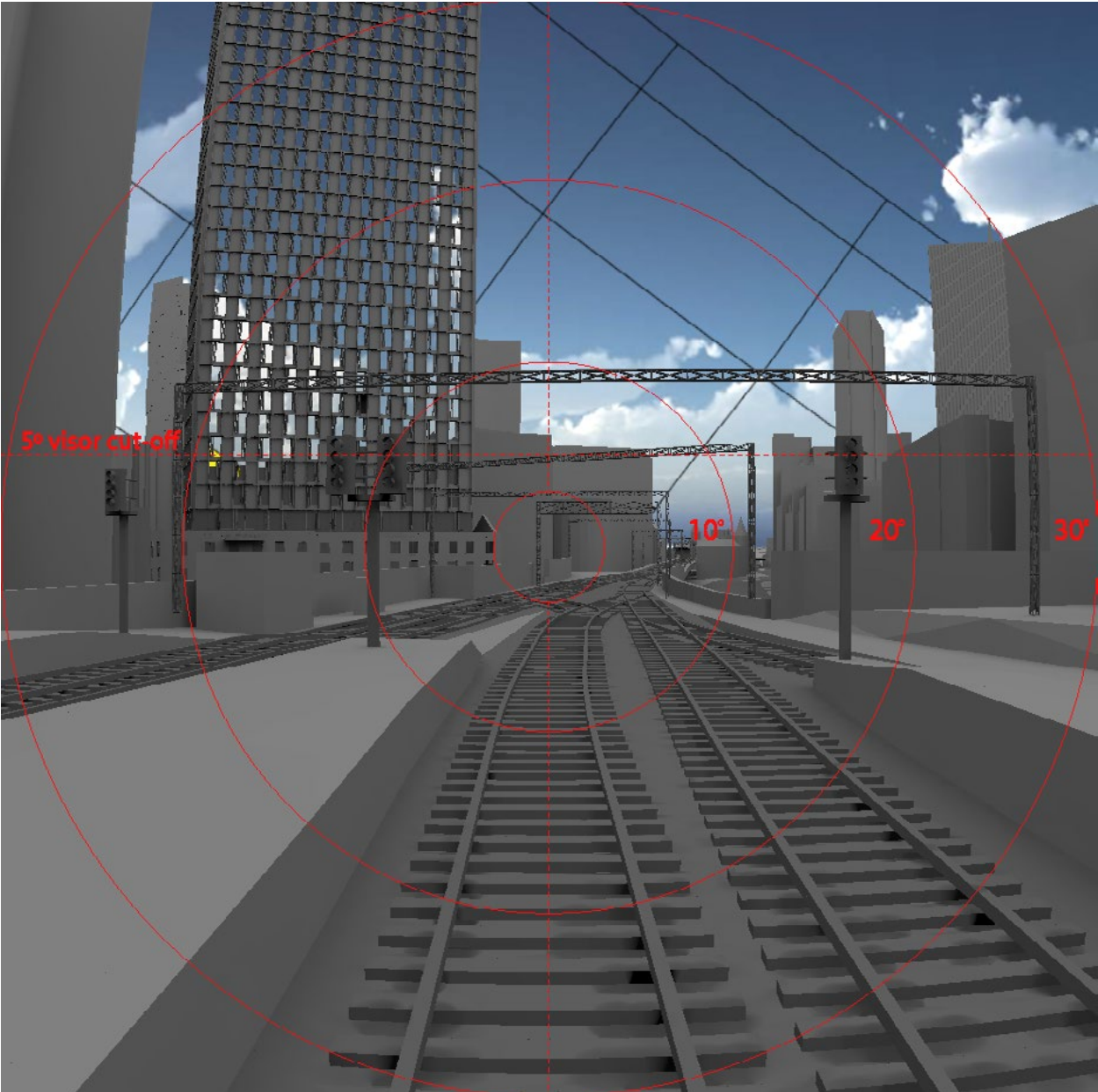


Fig. 34: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 DOWN - FRAME 435

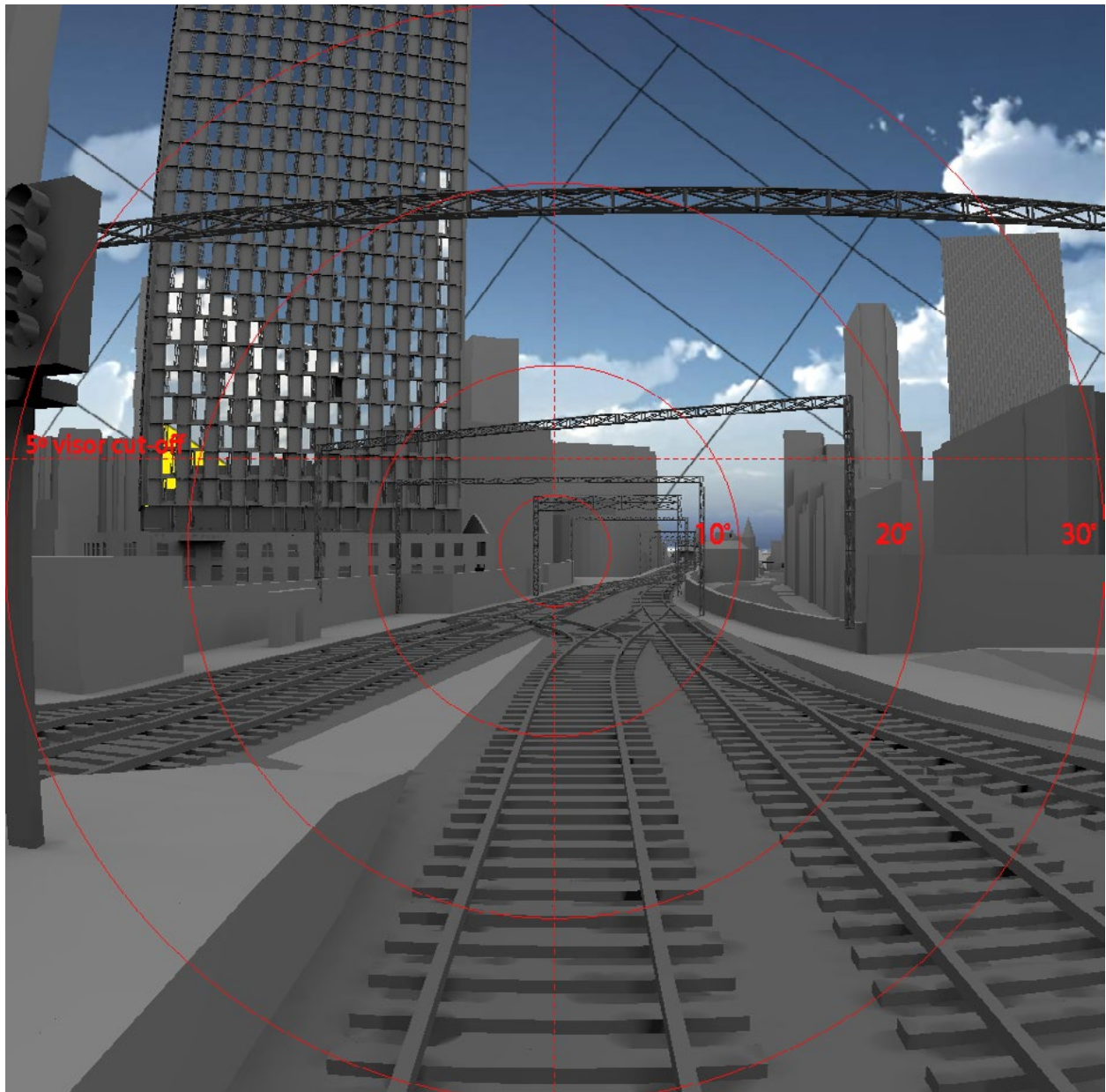
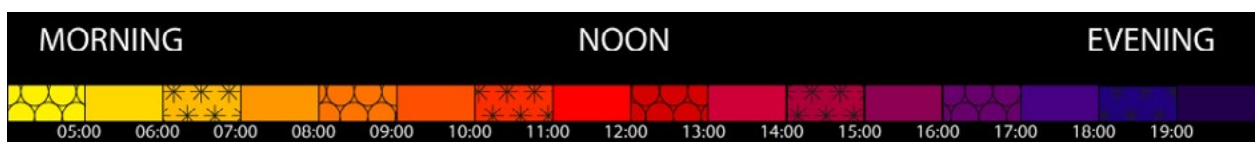


Fig. 35: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 DOWN - FRAME 435

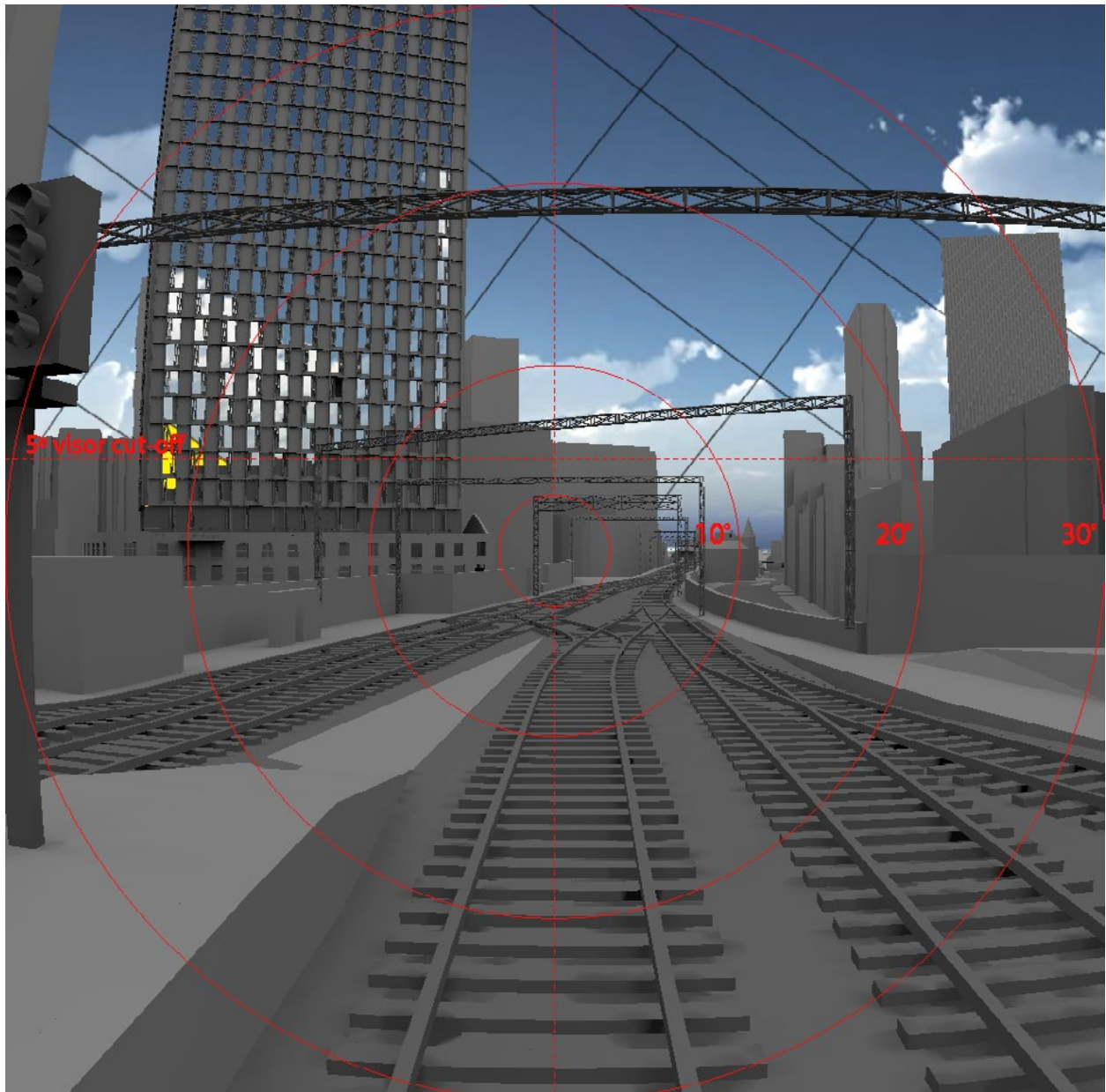


Fig. 36: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 DOWN - FRAME 447

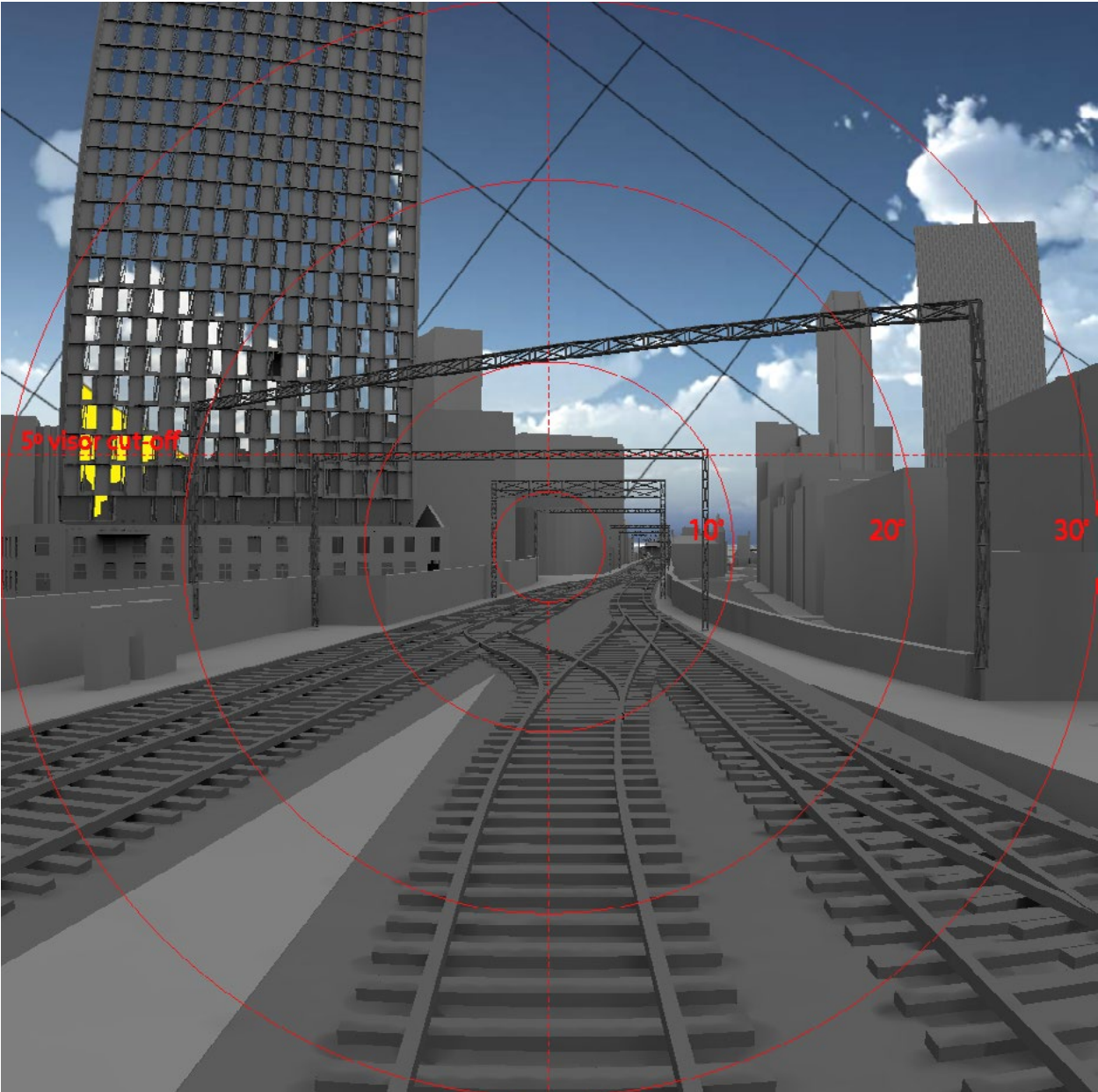
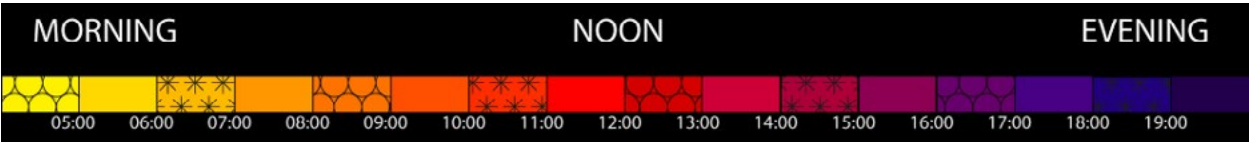


Fig. 37: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 DOWN - FRAME 447

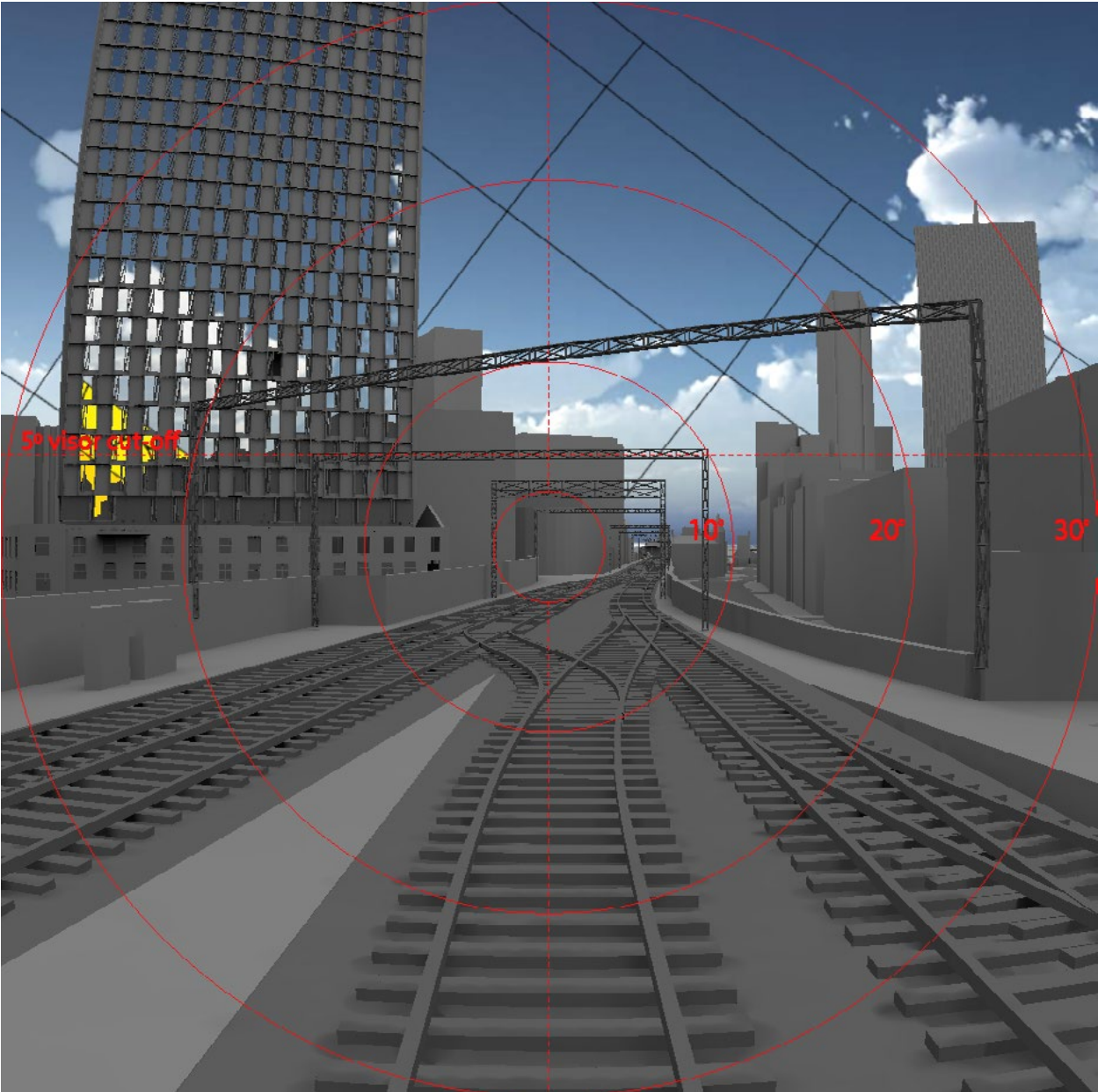


Fig. 38: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 UP - FRAME 1

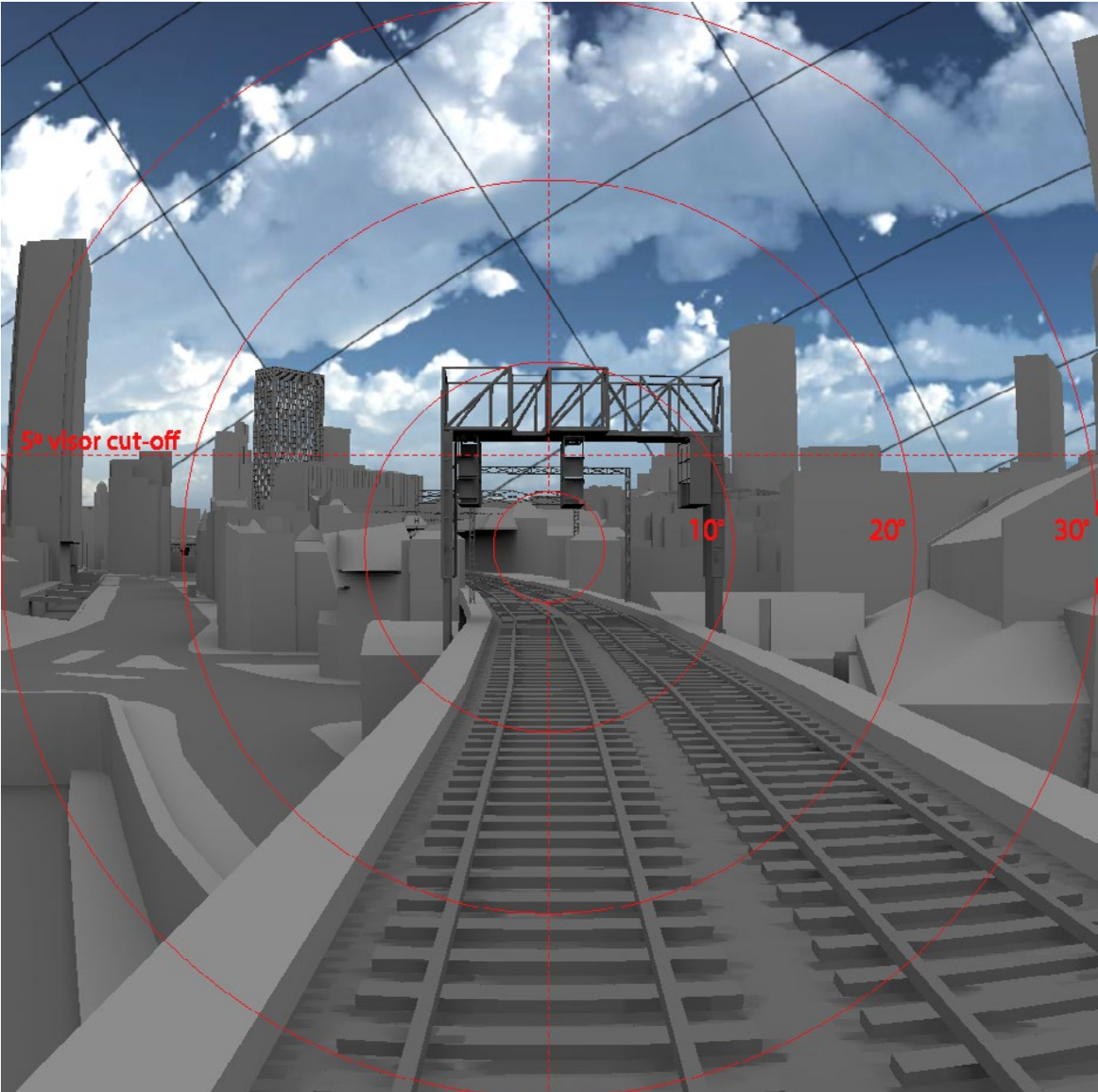
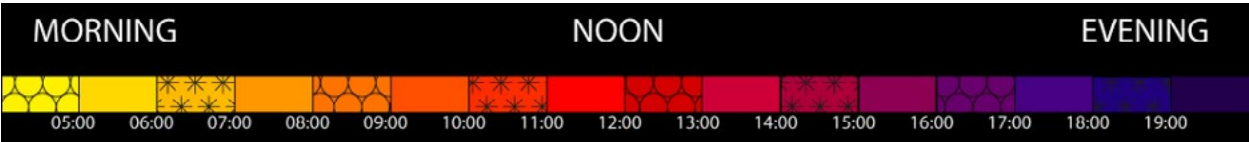


Fig. 39: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 UP - FRAME 1

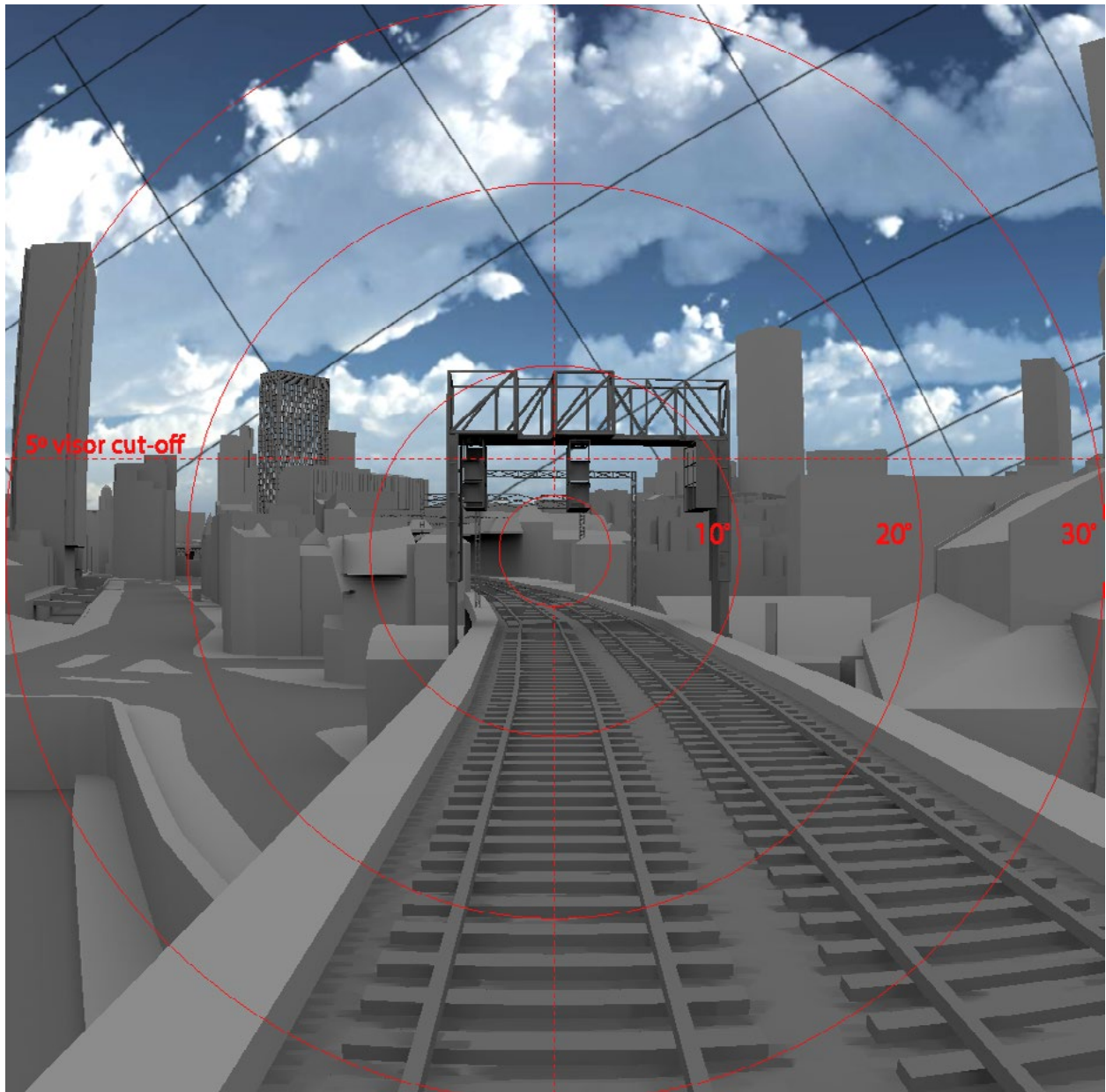


Fig. 40: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 UP - FRAME 35

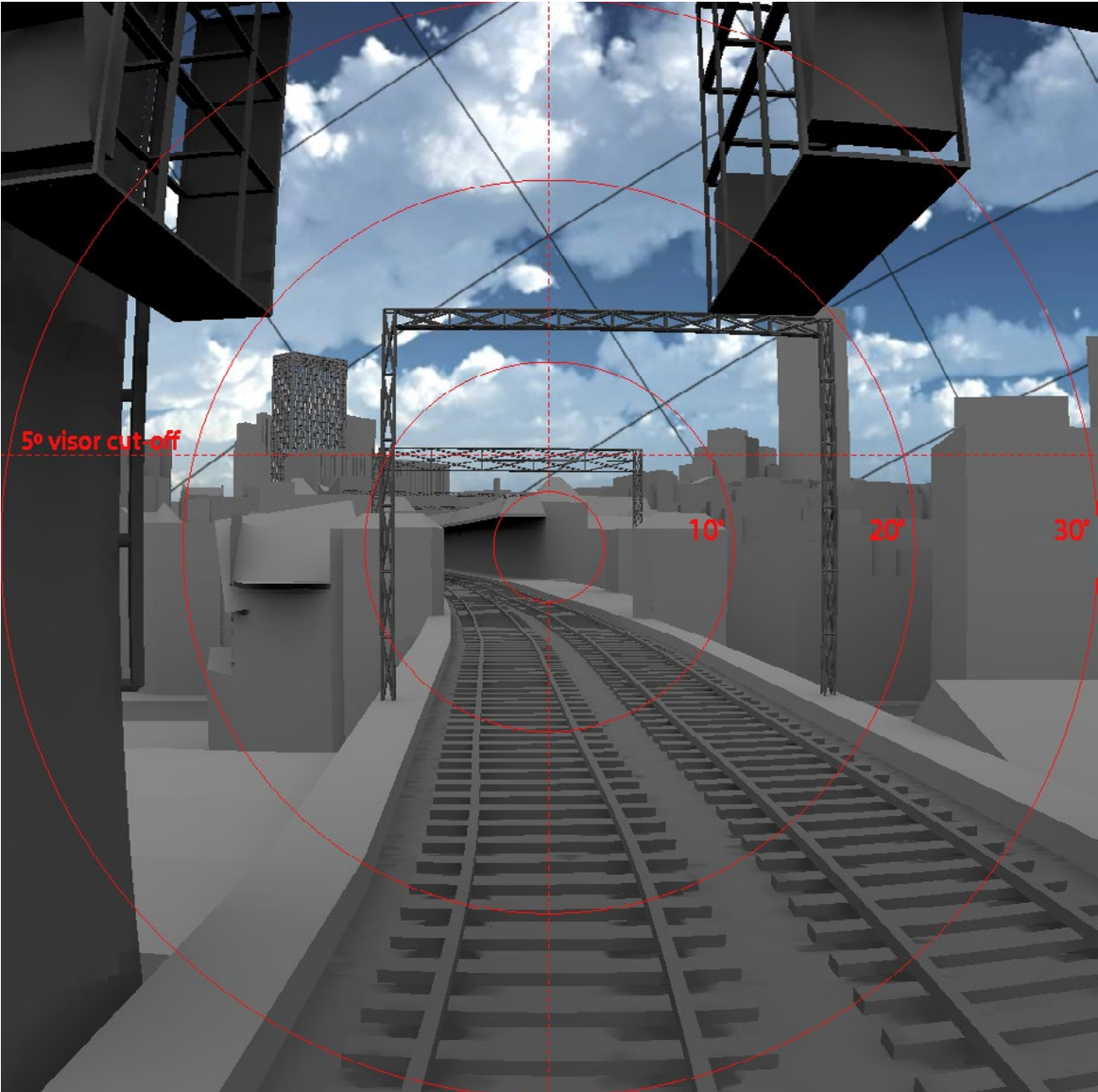
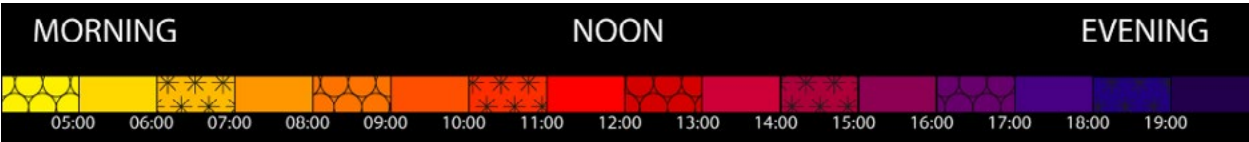


Fig. 41: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 UP - FRAME 35

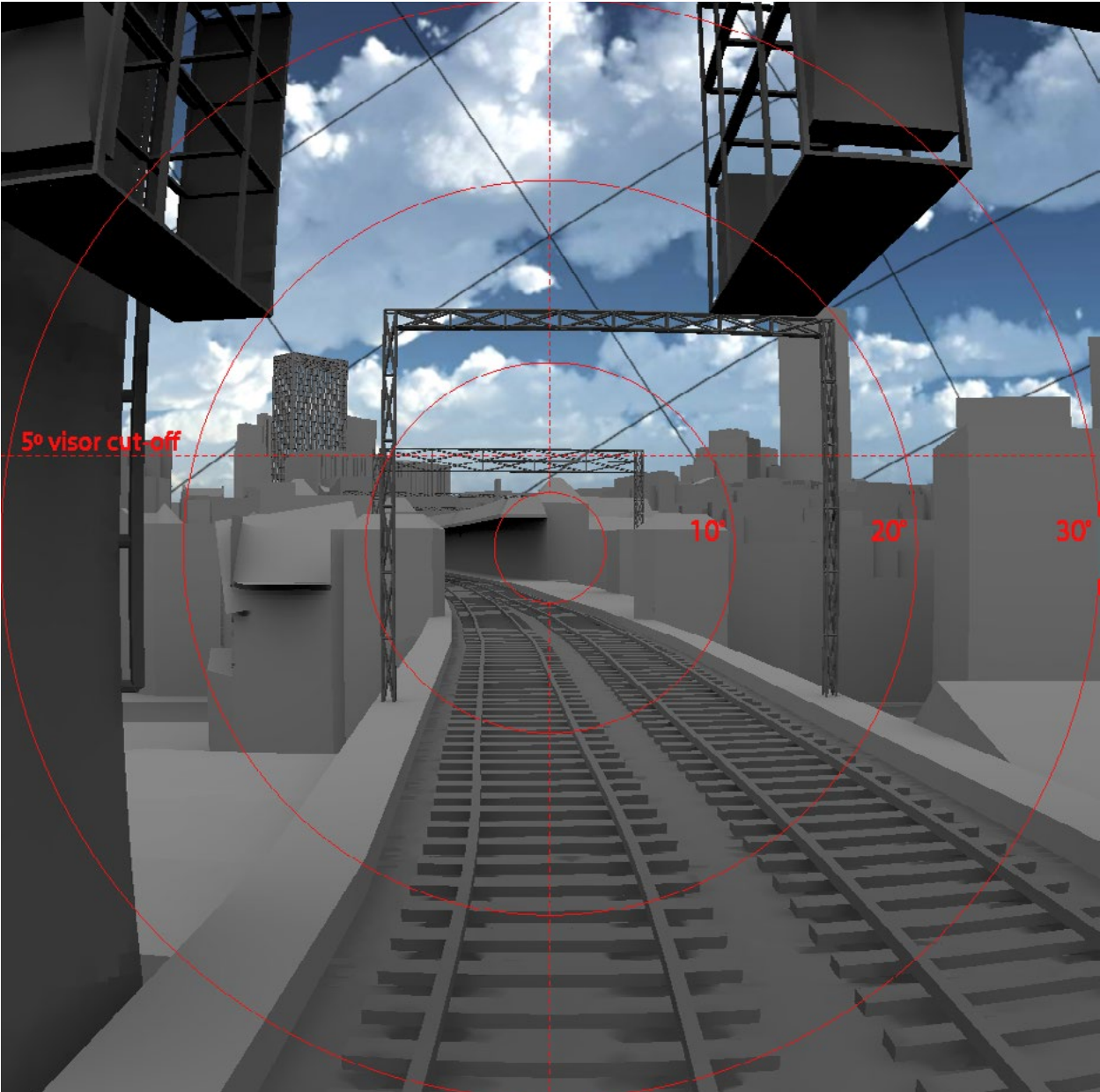


Fig. 42: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 UP - FRAME 130

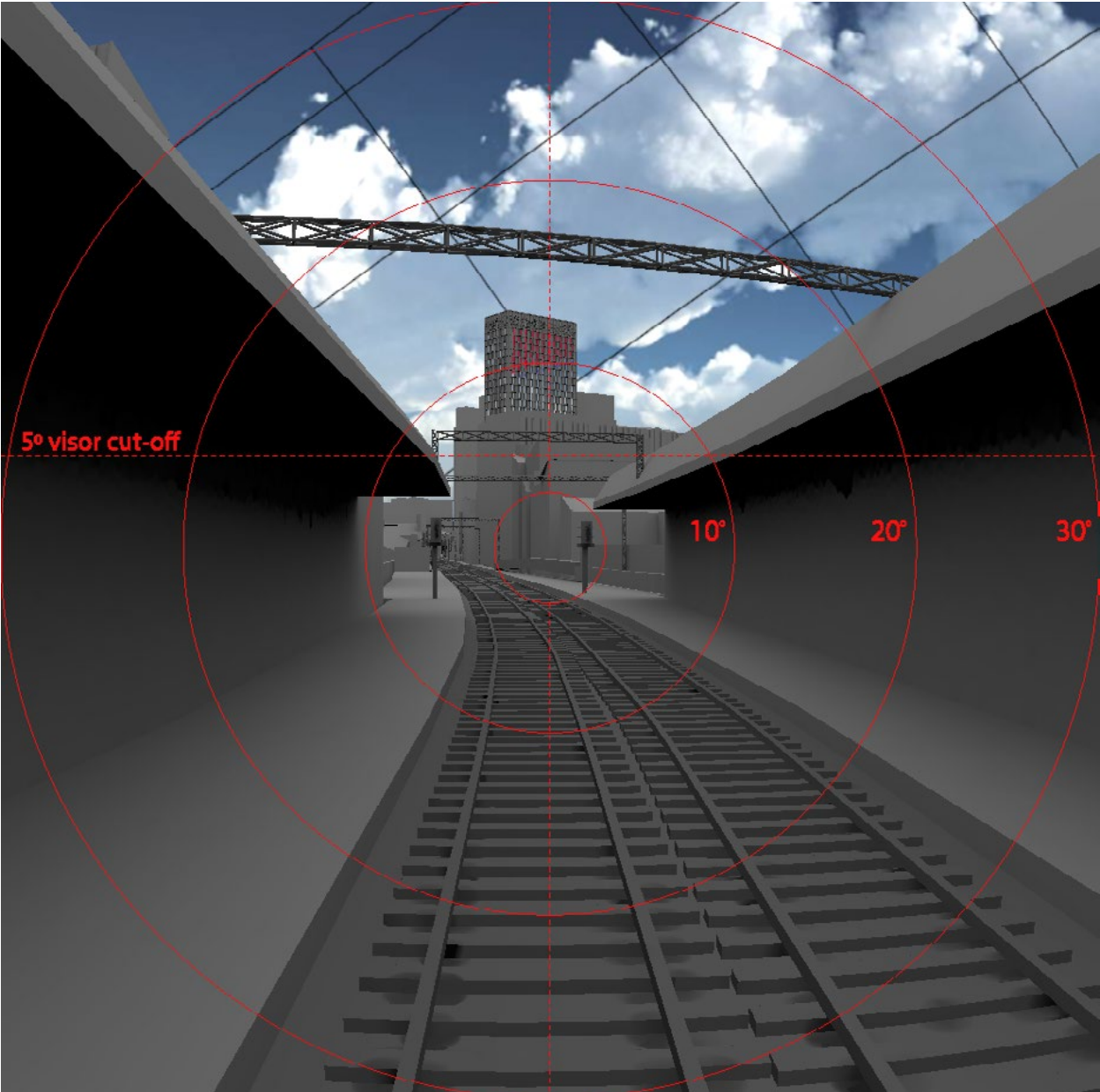
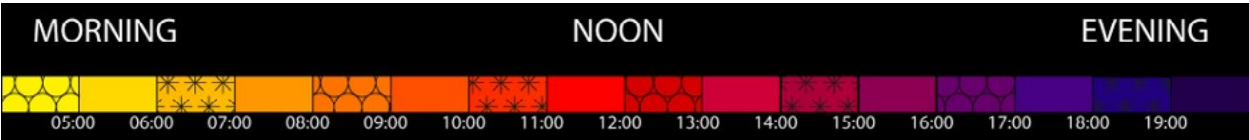


Fig. 43: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 UP - FRAME 130

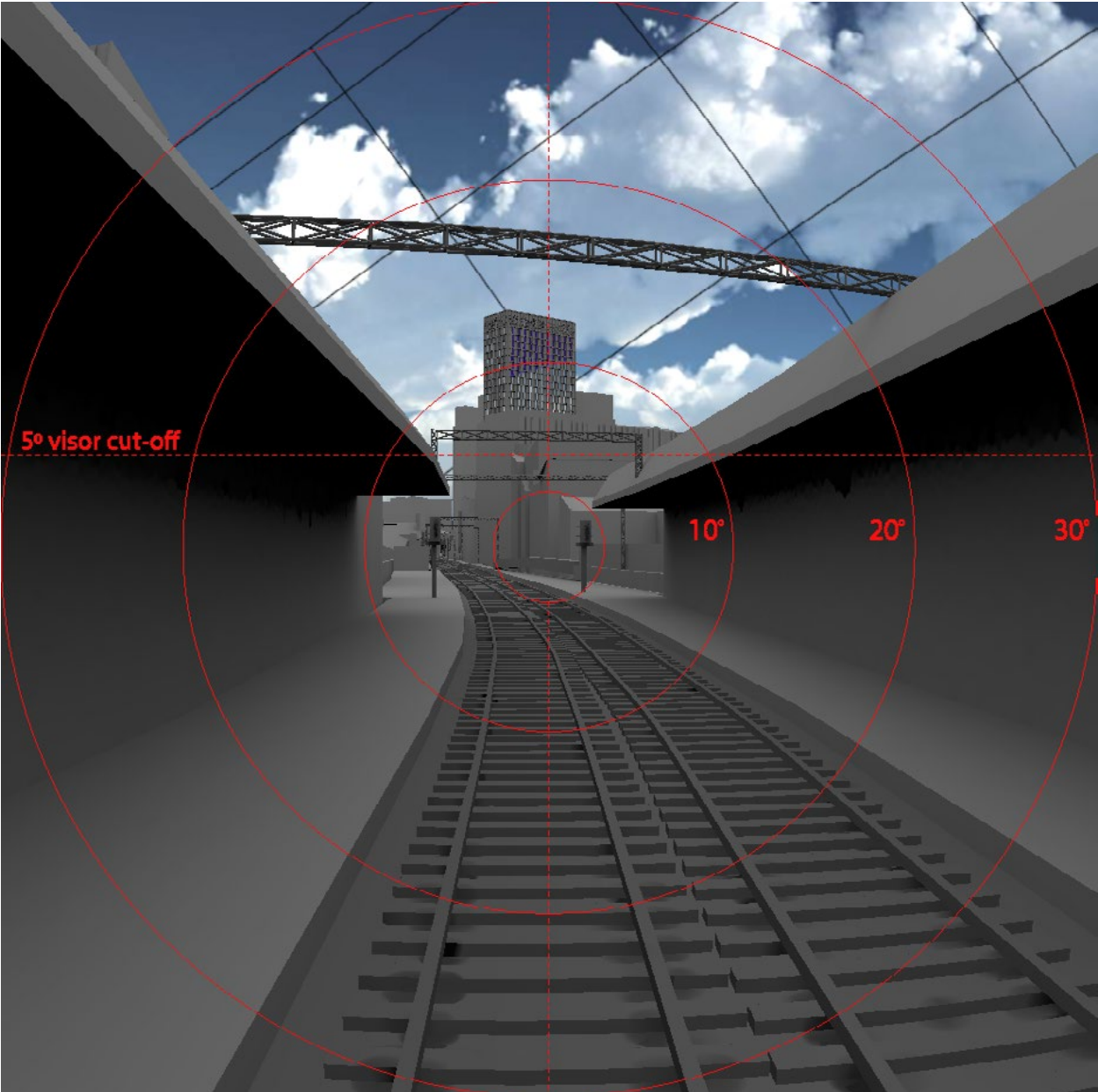


Fig. 44: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 UP - FRAME 175

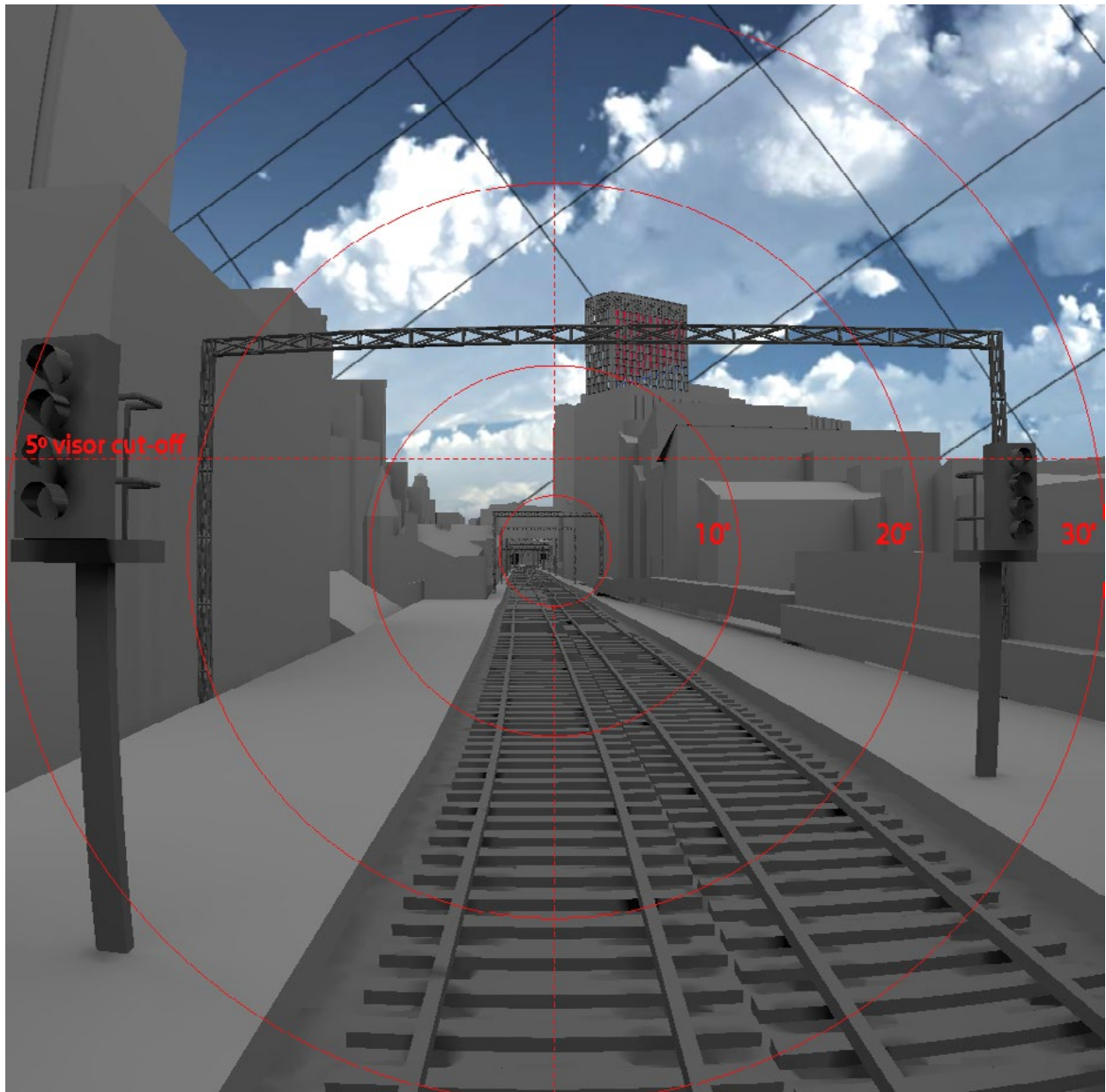
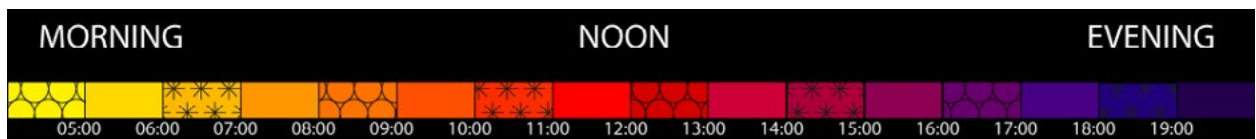


Fig. 45: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 UP - FRAME 175

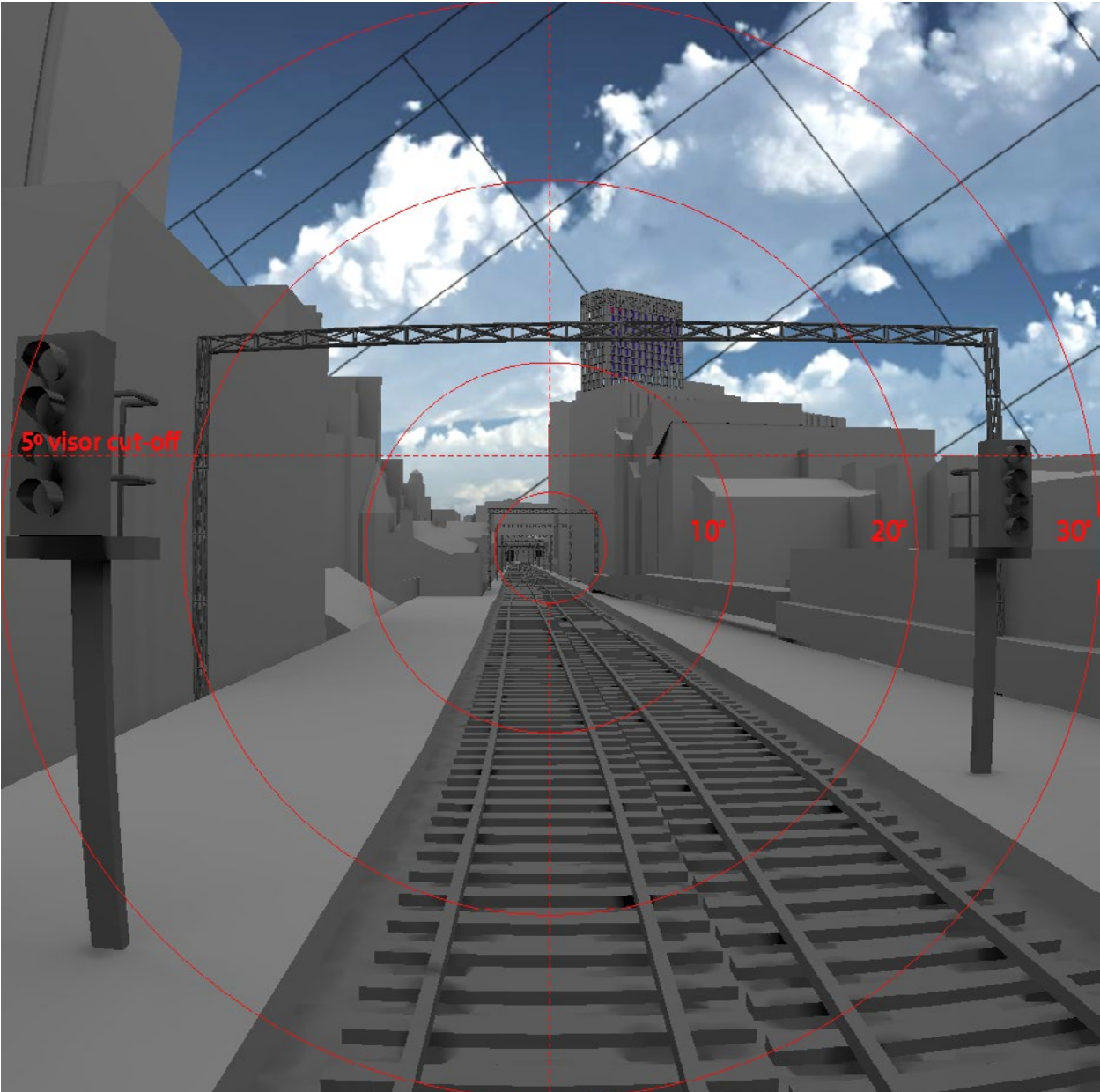


Fig. 46: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 UP - FRAME 295

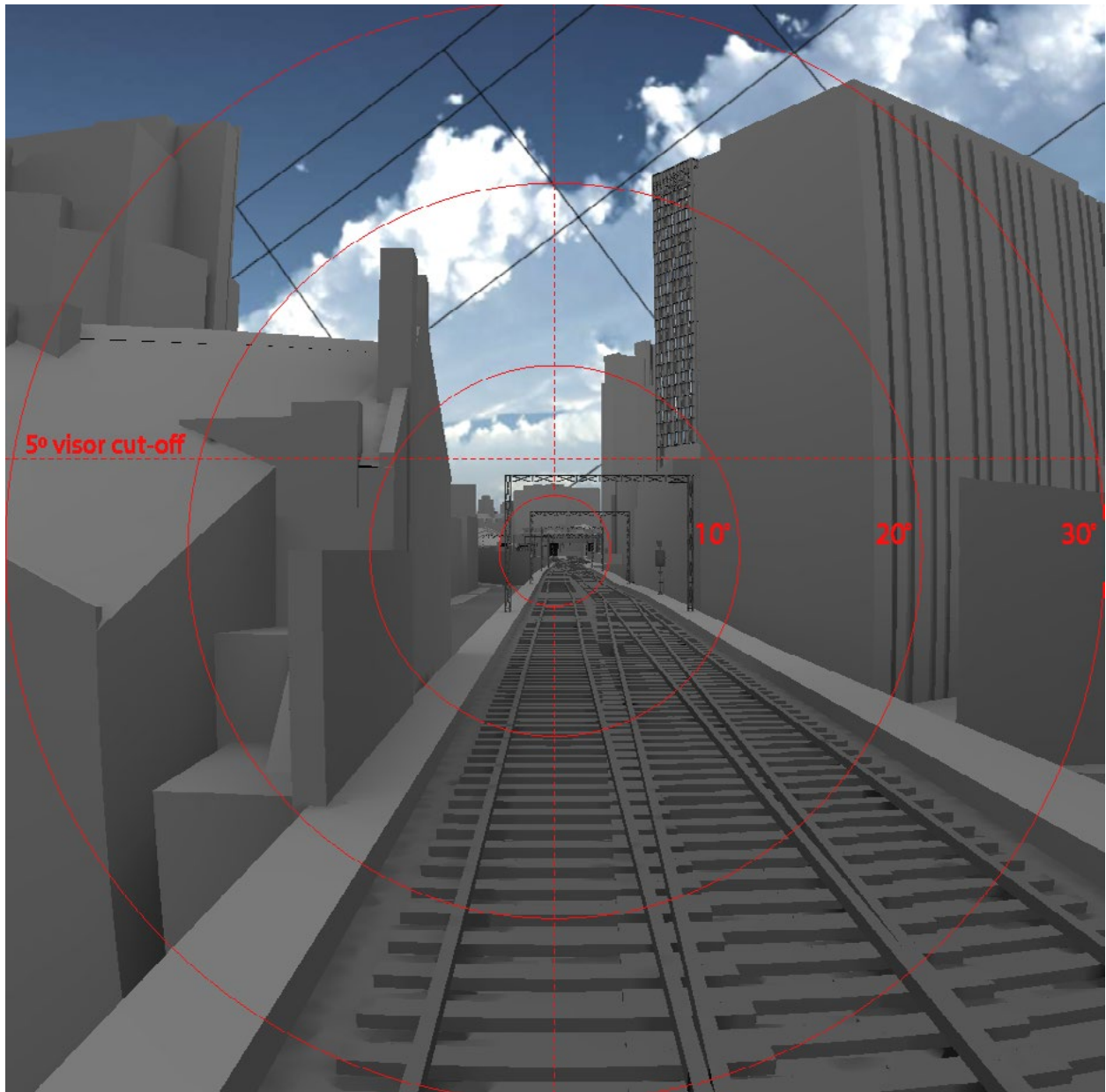
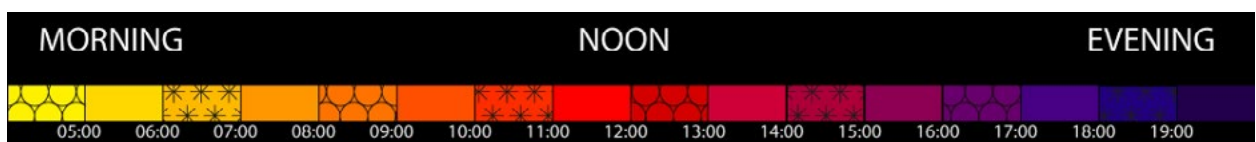


Fig. 47: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 UP - FRAME 295

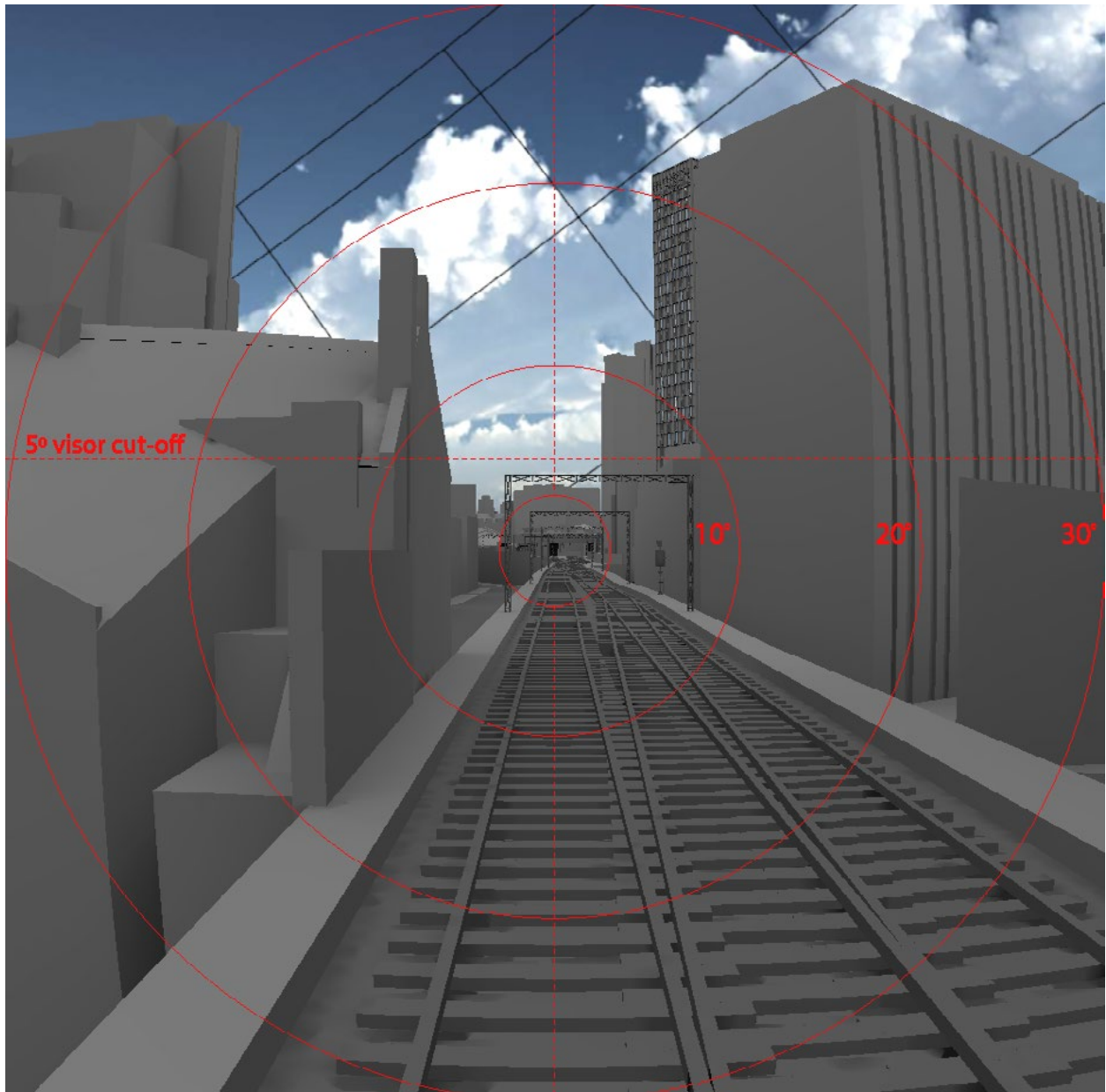


Fig. 48: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 UP - FRAME 335

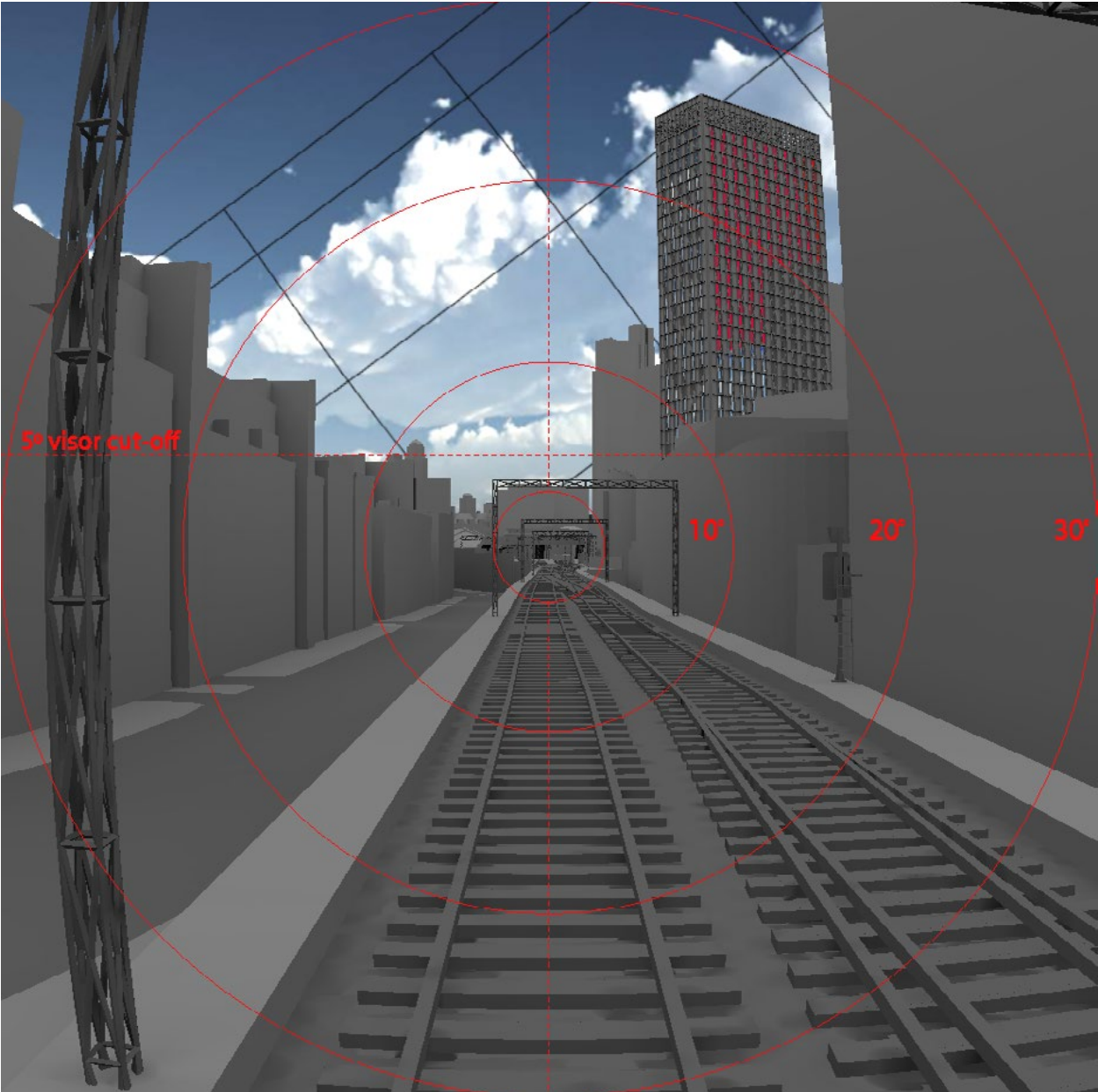
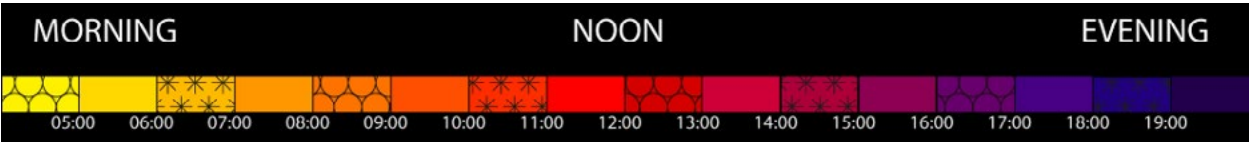


Fig. 49: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 UP - FRAME 335

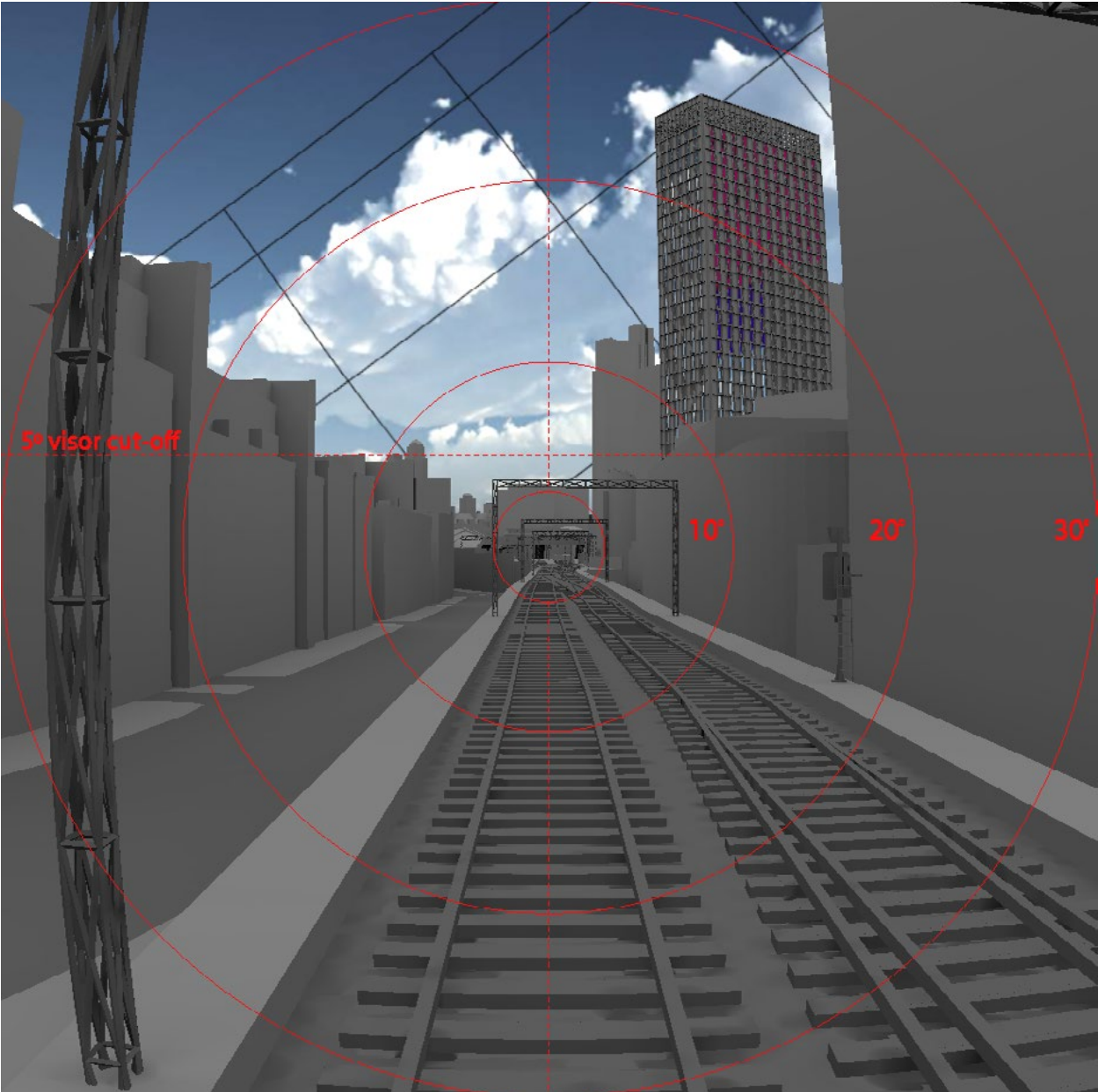


Fig. 50: Solar reflections



60° FIELD OF VIEW: TIME OF DAY
TRACK 3 UP - FRAME 413

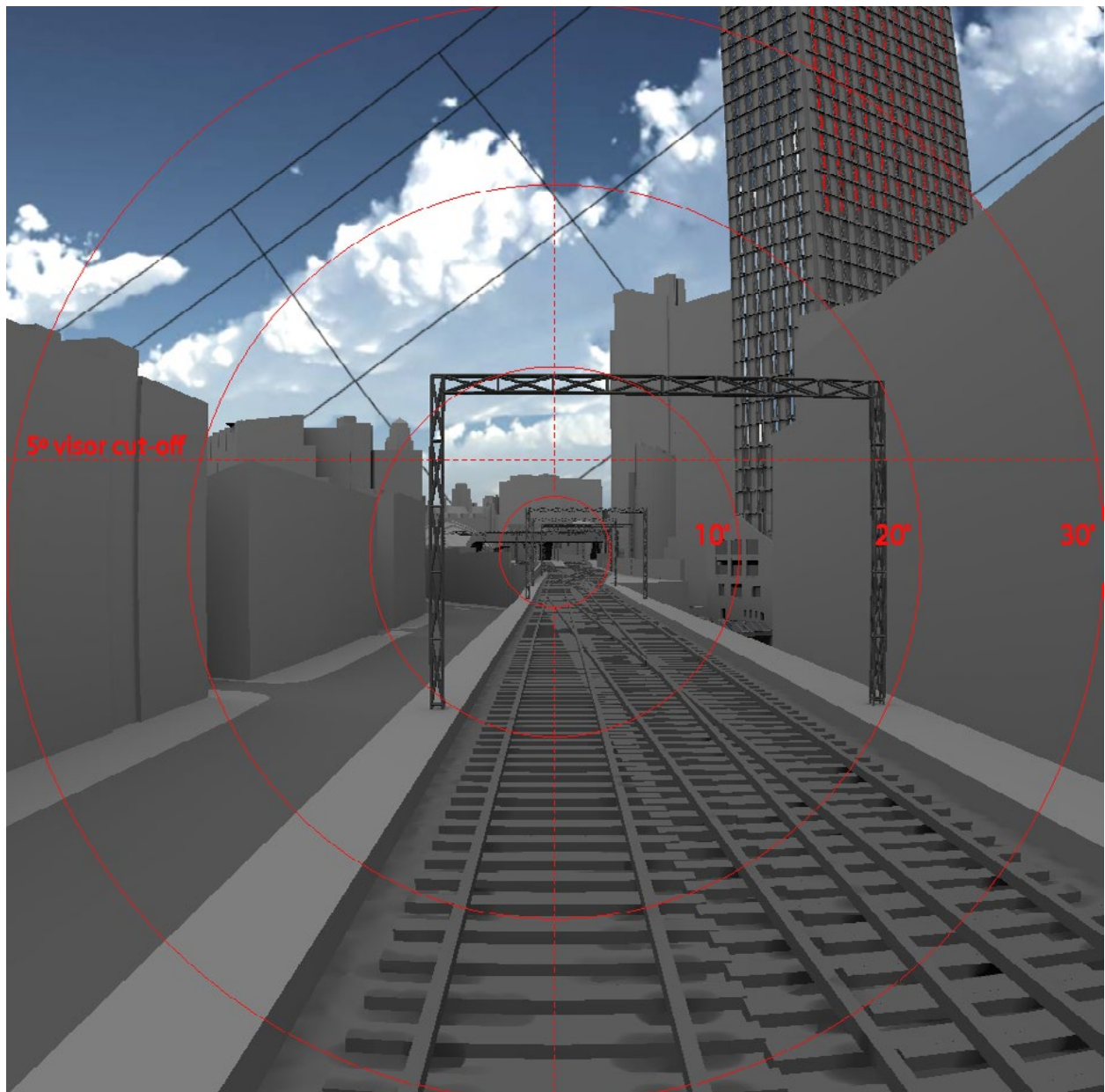
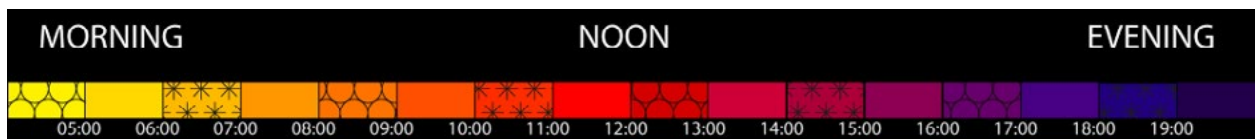


Fig. 51: Solar reflections



60° FIELD OF VIEW: SEASON
TRACK 3 UP - FRAME 413

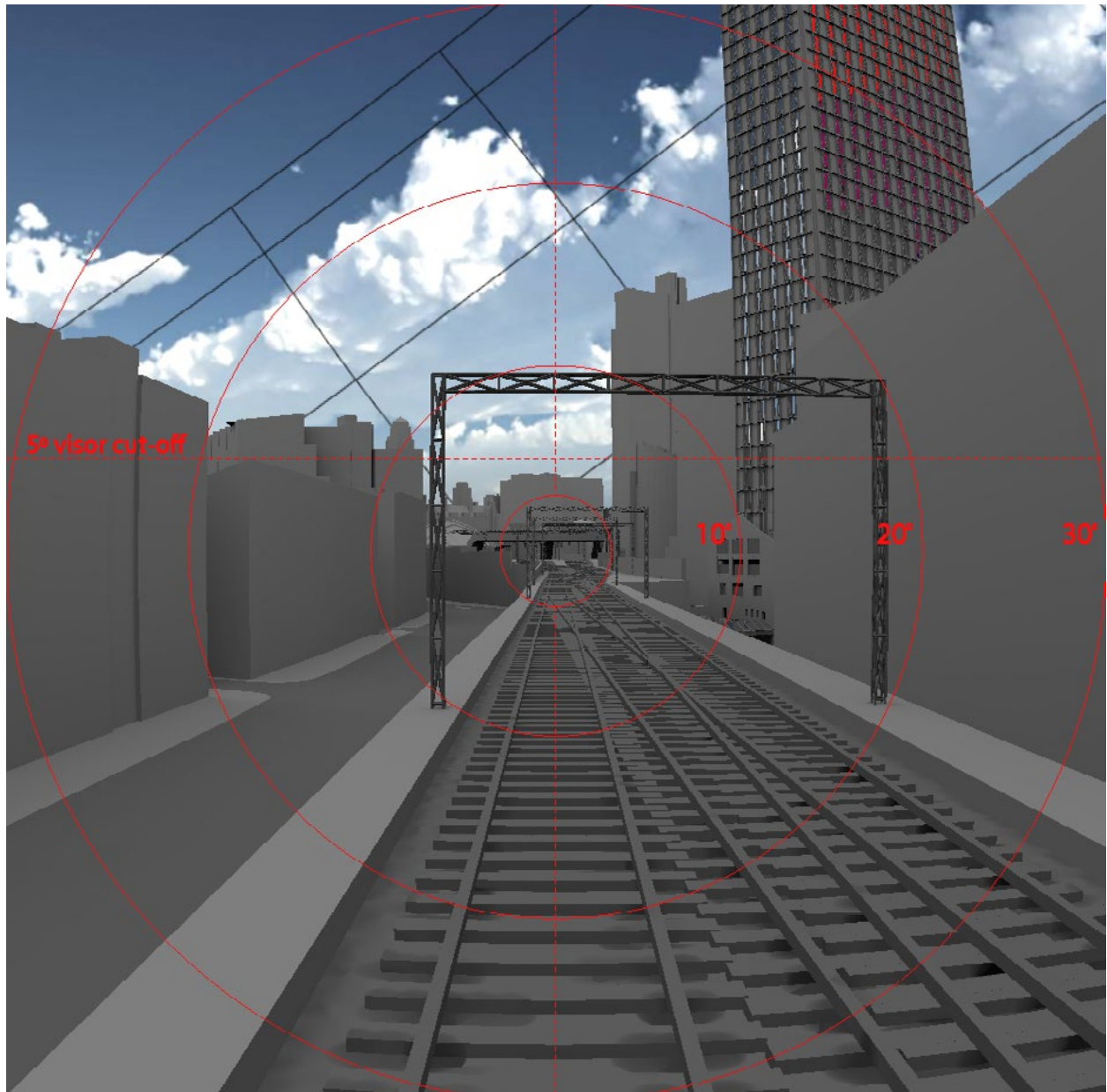


Fig. 52: Solar reflections





What we do:

Building Surveying
Daylight & Sunlight
Light Obstruction Notices
Measured Surveys
Party Wall & Neighbourly Matters
Rights of Light
Solar PV
Wind Analysis

Where we are:

Belfast
Birmingham
Bristol
Dublin
London
Manchester