gia CHARTERED SURVEYORS

DAYLIGHT & SUNLIGHT

SOLAR GLARE ASSESSMENT

Pope's Road, Brixton

31 March 2020

GIA No: **13866**

PROJECT DATA:

Client	**AG Hondo Pope's Road BV**
Architect	**Adjaye Architects**
Project Title	**Pope's Road, Brixton**
Project Number	**13866**

REPORT DATA:

Report Title	**Solar Glare Assessment**
GIA Department	**Daylight & Sunlight**
Dated	**31 March 2020**

Prepared by	**ERLA**
Checked by	**KST**
Type	**Planning**

Revisions	No:	Date:	Notes:	Signed:

SOURCES OF INFORMATION:

Information Received	**IR-29-13866**
Release Number	**Rel_10_13866_DSD**
Issue Number	**04**
Site Photos	**GIA**
3D models	**VERTEX**
OS Data	**FIND Maps**

Map data

CONTENTS

1 EXECUTIVE SUMMARY

GIA have assessed the Proposed Scheme for the Pope's Road, Brixton site to understand the potential impact of solar glare on adjacent train lines .

GIA have been instructed by AG Hondo Pope's Road BV to provide solar glare advice in relation to the Pope's Road, Brixton development in Brixton, London. The Site currently comprises of low-rise industrial units and a car park, bound by railway viaducts to north and south.

GIA have undertaken a technical solar glare assessment of the Proposed Scheme at Pope's Road, Brixton "the Site" to understand the potential solar glare effect of the development on the adjacent Network Rail and Transport for London train lines.

Policy 7.7 of the London Plan (2016) states that states tall buildings "*should not affect their surroundings adversely in terms of microclimate, wind turbulence, overshadowing, noise, reflected glare, aviation, navigation and telecommunication interference*".

Policy Q26 - Tall and Large Buildings of the Adopted Lambeth Local Plan (2015) states that "*Proposals for tall buildings will be supported where: it does not have an unacceptably harmful impact on its surroundings including microclimate, wind turbulence, noise, reflected glare, aviation, navigation and telecommunication or broadcast interference*."

The methodology used in the assessment of solar glare has been outlined further within this report and all train lines with the potential to experience solar glare effects have been included within this assessment. The solar glare assessments demonstrate a worst-case scenario, assuming the sun is shining at all times during daylight hours when in reality, the likelihood of the reflections occurring is significantly less due to cloud cover and overcast days typical of London.

To study the likely occurrence of sunlight being reflected towards train drivers, glare visualisations were produced at 1m intervals for railway tracks running in close proximity to the Site, commencing approximately 500m from the Site. The following tracks have been assessed:

- SWR1 - Westbound Southwest Rail/Thameslink line travelling from Elephant & Castle Station to Brixton Station. This line passes to the north of the Site.
- SWR2 - Eastbound Southwest Rail/Thameslink line approaching Brixton Station. This line passes to the north of the Site.
- SWR3 - Northbound Southwest Rail/Thameslink line travelling from Herne Hill to Brixton Station. This line travels towards the Site from the south and then passes to the west of the Site.
- SWR4 - Southbound Southwest Rail/Thameslink line travelling to Hearne Hill from Brixton Station. This line passes to the west of the Site.
- SWR5 - Westbound Southwest Rail/Thameslink line travelling from Denmark Hill Station to Brixton Station. This line passes to the north of the Site.
- Overground Eastbound - Eastbound TfL Overground line travelling from Clapham High Street to Denmark Hill. This line passes to the south of the Site.
- Overground Westbound - Westbound TfL Overground line travelling from Denmark Hill to Clapham High Street. This line passes to the south of the Site.

The assessments have demonstrated that the Proposed Scheme would not give rise to major issue in terms of glare from reflected sunlight impacting train driver on the adjacent lines.

Whilst there will be instances of reflections that exceed the threshold along tracks SWR1, SWR2, SWR4, SWR5, Overground Eastbound and Overground Westbound, these are largely above the driver's visor cut-off and fall outside 5° of the drivers direct line of sight so are outside the critical vision zone.

There are no signals that would be impacted by the instances of reflections. Furthermore, the instances of reflections with intensities greater than the threshold would occur for a very short period of time due to the reflections being broken-up by solid elements of the facade, within an isolated section of track and would not cover an area large enough to reflect the full sun disc. As a result, the true intensity of the reflections would be lower than reported.

Overall, in our professional opinion, the Proposed Scheme is in line with regional and local planning policy as it does not have an unacceptably harmful impact on its surroundings in terms of reflected glare.

Network Rail's Asset Protection team will be consulted prior to commencement on-site. The reflectance properties of the glazing used represents a worst-case scenario. Once a final glazing has been specified, and if requested by Network Rail, the assessments may be updated.

2 PLANNING POLICY

Below we have detailed sections from the following relevant planning policy in relation to solar glare:

- The London Plan – The Spatial Development Strategy for London Consolidated with Alterations Since 2011 (March 2016) (Greater London Authority);
- The London Plan – Intend to Publish (December 2019);
- Adopted Lambeth Local Plan (2015);
- Draft Revised Lambeth Local Plan (January 2020).

2.1 CONSOLIDATED LONDON PLAN (MARCH 2016)

The London Plan was adopted in March 2016 and sets out the strategic plan for London providing a socio-economic, environmental and transport framework for a 20-25-year period.

Policy 7.7 of the London Plan states that tall buildings *"should not affect their surroundings adversely in terms of microclimate, wind turbulence, overshadowing, noise, reflected glare, aviation, navigation and telecommunication interference"*.

2.2 THE LONDON PLAN- INTENT TO PUBLISH (DECEMBER 2019)

The Intent to Publish London Plan 2019 considers the spatial development strategy for Greater London.

Policy D9 1g Tall Buildings notes *"Development proposals should address the following impacts: Visual Impacts: g) buildings should not cause adverse reflected glare"*.

2.3 ADOPTED LAMBETH LOCAL PLAN (2015)

The Lambeth Local Plan sets out planning policies for Lambeth to guide growth in housing and jobs, infrastructure delivery, place-shaping and the quality of the built environment over the next 15 years to 2030. It replaces the Lambeth Core Strategy 2011 and remaining saved policies in the Unitary Development Plan 2007. Along with the London Plan, it forms the new statutory development plan for the borough.

Policy Q26 - Tall and Large Buildings states that *"Proposals for tall buildings will be supported where:*

it does not have an unacceptably harmful impact on its surroundings including microclimate, wind turbulence, noise, reflected glare, aviation, navigation and telecommunication or broadcast interference."

2.4 DRAFT REVISED LAMBETH LOCAL PLAN PROPOSED SUBMISSION VERSION (JANUARY 2020)

The Draft Revised Lambeth Local Plan Proposed Submission version was issued for consultation in January 2020.

The proposed Policy Q26 (Tall Buildings) states that *"having particular regard to the international obligation to preserve the OUV of the Westminster World Heritage Site and taking into account the desirability of preserving the settings of heritage assets, proposals for tall buildings will be supported where they are in locations identified as appropriate for tall buildings in Annex 11 and where:*

v) the proposal adequately addresses the criteria in London Plan policy D9C in terms of acceptable visual, environmental and functional impacts including microclimate, wind turbulence, noise, daylight and sunlight, reflective glare, aviation (including the safeguarded zones around Heathrow Airport, London City Airport, Battersea Heliport and the helipad at Kings' College Hospital), navigation and electronic communication or broadcast interference."

3 GUIDANCE & METHODOLOGY

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 train drivers.

3.1 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. 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.

3.2 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, as depicted in Fig. 03 opposite, or with the aid of a full 3 dimensional computer simulation.

When a large number of locations need to be looked at, studies involving solar protractors become rather impractical. Computer software allows multiple view points to be assessed with greater ease so that it has even become feasible to render video sequences showing when and where reflections may become an issue.

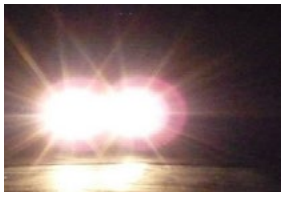


Fig. 01: Headlights at night

Fig. 02: Headlights during day

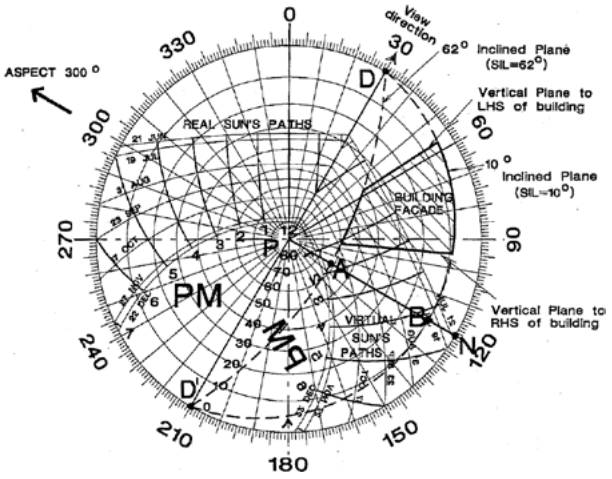


Fig. 03: Hassall's Protractor

3.3 EXISTING GUIDANCE

In the UK, guidance that is relevant to glare assessments is limited to a short section in Littlefair's Site Layout Planning for Daylight and Sunlight published by the BRE in 2011. This document is commonly referred to as BR 209. 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 facades this problem usually occurs only when the sun is low in the sky; but some types of modern design incorporate sloping glazed facades 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. However, neither pieces of guidance suggest any threshold values above which reflected sunlight may give rise to an instance of glare. That such a threshold exists in theory becomes clear from the guidance in BR 209:

"... Substituting clear or absorbing glass for reflective glass can also help although sometimes even clear glass may cause reflected glare if, eg, a motorist has the reflected sun close to the centre of their line of sight."

Recommendations on acceptable limits for solar glare is equally sparse in other countries. The only document dealing with the subject is Hassall's Dealing with Rogue Solar Reflections from 1996. Although published in Australia, the theory, methodology and recommendations it introduced are equally applicable in other countries such as the UK.

The severity of glare can be calculated as the equivalent veiling luminance which is caused by the excess light being scattered in the eye thereby creating a 'veil' through which objects are seen. If the brightness of the veil is sufficiently high compared to that of the actual object, the latter becomes less visible. In very severe cases of disability glare, the object cannot be seen at all.

The veiling luminance can be calculated with a simple empirical formula first proposed by Holladay:

$$L_{seq}\ [cd/m^2] = K*E_{gl}\ /Q^n < threshold$$

The Holladay glare formula depends on four variables, namely:

- **K**, which is a factor accounting for the observer's sensitivity to glare (eg. age);
- **Egl**, which is the illuminance from the glare source, measured at the eye of the observer;
- **Q**, the angle between the line of sight and the glare source;
- **n**, indicating the power with which Q affects the outcome;

An individual's sensitivity to glare is affected primarily by age. We used a K factor of 17.5 in our calculations, which represents a 65-year old driver.

According to CIE 146:2002, the n power in Holladay's equation has three angular domains:

- Q3 for angles between 0.1° and 1°;
- Q2 for angles between 1° and 30°; and
- Q for angles beyond 30°;

This angular dependency means that a glare source close to the object being looked at has a much more severe impact upon the visibility of that object than a glare source at the periphery of the observer's visual field.

As stated in CIE 146:2002, occurrences at angles beyond 30° would be of little significance in most situations, but may be relevant in exceptional circumstances. When seated in a driving seat of a typical car, for example, the limits of the windscreen would generally obstruct the driver's view at angles beyond 30° from the line of sight. We have therefore adopted the 1° to 30° domain as a reference for our calculations.

Hassall in his paper proposes a threshold value of 500 cd/m^2, which we have adopted as a threshold in our assessments.

3.4 GIA'S APPROACH

The preparation of reflected solar glare assessments is based upon the approach described below, which entails:

- The construction of a three-dimensional computer model that includes the proposed building and its relevant setting;
- The physically accurate description of the reflective surface properties;
- Rendering of stills of the solar reflections;
- Masking the images to represent the human field of view; and
- Image analysis.

The individual steps of our work flow are further explained below.

3d Computer Modelling

Detailed geometry of the proposed building, 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.

A computer model of the proposed building's context is built from high resolution stereoscopic aerial photographs, examples of which are shown in Fig. 04 and Fig. 05.

This includes rail tracks, sleepers, gantries and signals as well as relevant neighbouring buildings. An example is provided in Fig. 06.

Fig. 04: High-resolution aerial photograph

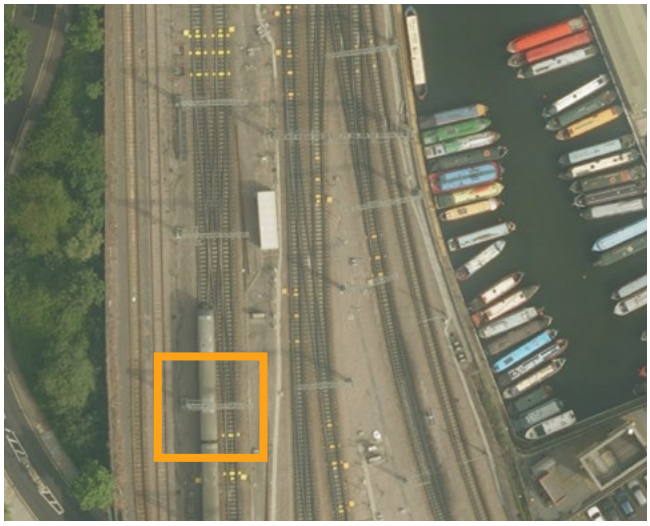


Fig. 05: High-resolution aerial photograph (close-up)

Fig. 06: High-resolution aerial photograph (close-up)

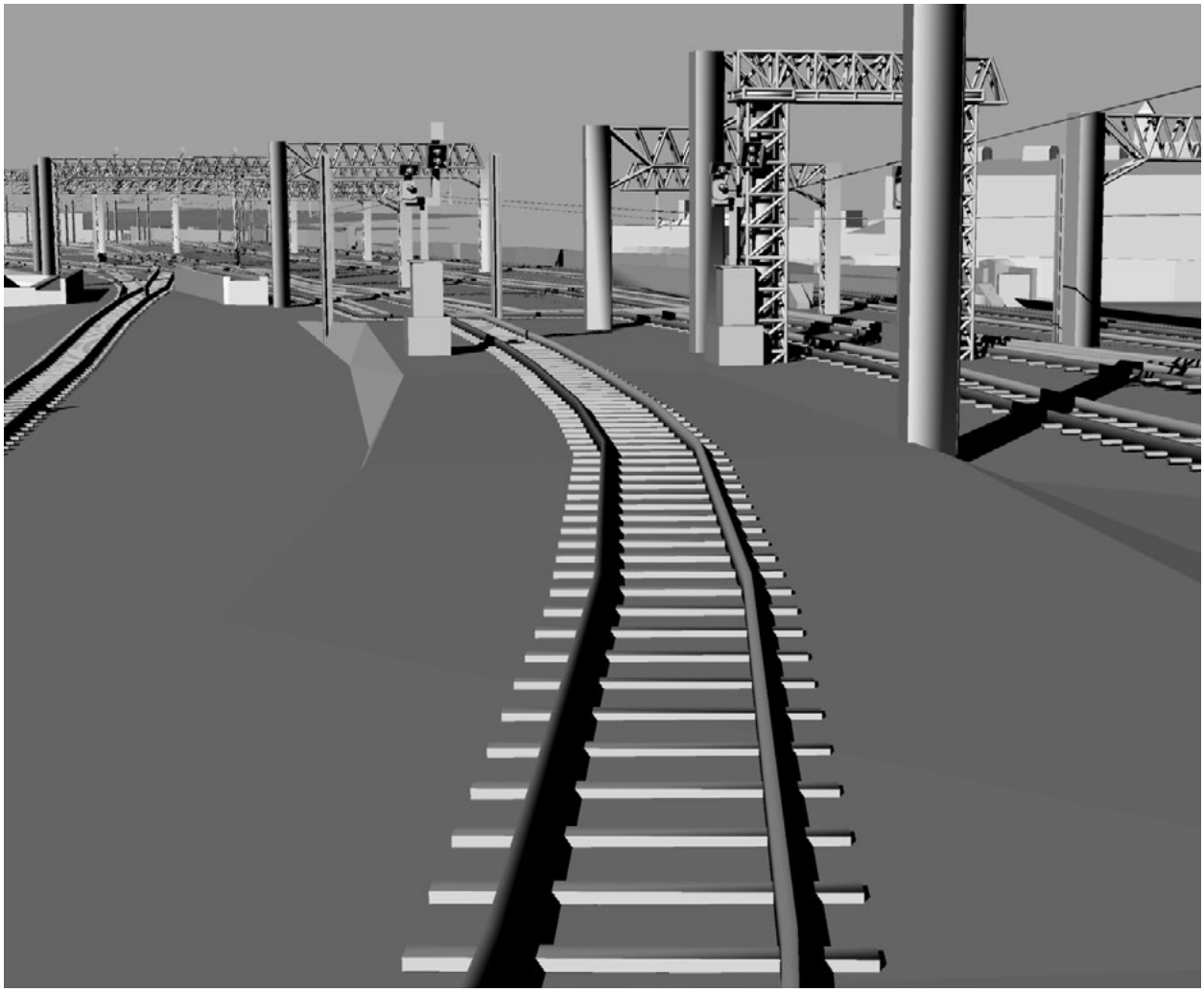


Fig. 07: Computer model of train tracks & signals from photogrammetry

Reflective Surface Properties

In order to undertake the glare studies it is necessary to acquire physically accurate computer representations of all materials that have the potential of specularly reflecting sunlight, thereby becoming sources of glare. Such materials would include all vertical or sloped glazing, but also certain facade materials such as metal cladding or glazed building tiles.

Diffuse surface reflectance values and object colours can be measured relatively easily however, the same cannot be said of their specular characteristics. These parameters are very hard to estimate yet critical for the study of glare. It is therefore best practice to have samples of the glazing or cladding materials studied in specialised optical laboratories. An example of such a data set is given in Fig. 07. It shows the angular dependency of the reflective properties of a glazed cladding tile.

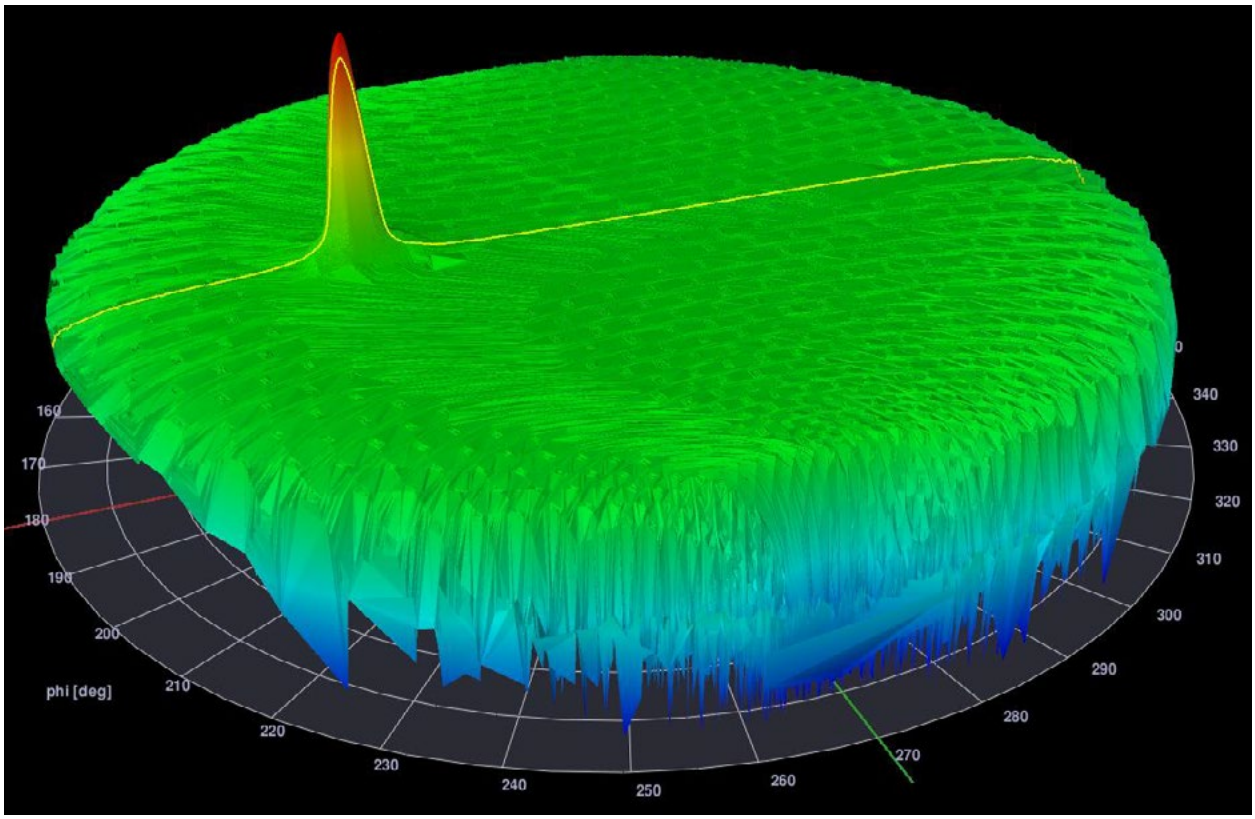


Fig. 08: Reflective properties measurement of a glazed tile

Rendering of Stills

As mentioned above, glare is a phenomenon that depends on the observer's location, but also on his view direction. In the case of a train driver the view direction is defined by the rail tracks. UK recommendations set the eye level of the driver at 2.75m 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. 09 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 typically spaced 1.0m apart. 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.

Field of View Overlay

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. 10 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.

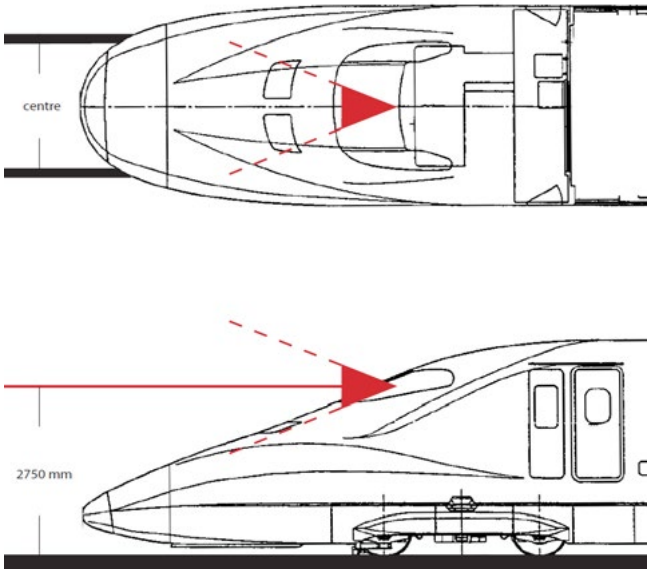


Fig. 09: Driver Viewpoint

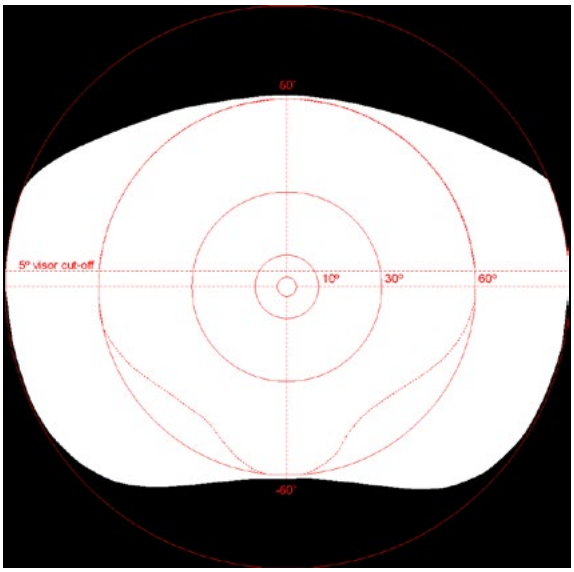


Fig. 10: Typical human field of view

Image Analysis

Glare assessments of railroad tracks are carried out following a three-stage approach. In **Stage 1**, 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. 11 shows the colour coded sunpaths projected onto the sky dome to visualise the time of day and season during which solar reflections occur.

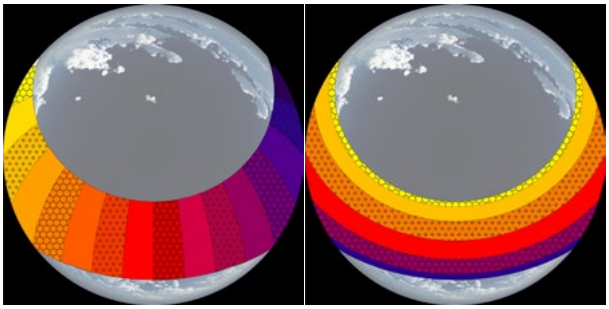


Fig. 11: Stage 2 - Colour coded sunpath for time of day and seasons

Two identical viewpoints are rendered, shown in Figs. 12 and 13, one focussing 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;

Stage 2 predicts the intensity of the reflected sunlight, using the Holladay formula presented in Section 1.3 of this report. An example is provided in Fig. 15. Only one view is necessary to portray the equivalent veiling luminance and a summary of all peak values recorded by the animations is also provided for reference, an example of which is illustrated in Fig. 14.

Any value exceeding 500 cd/m^2 is further looked into and discussed within the conclusions of our report.

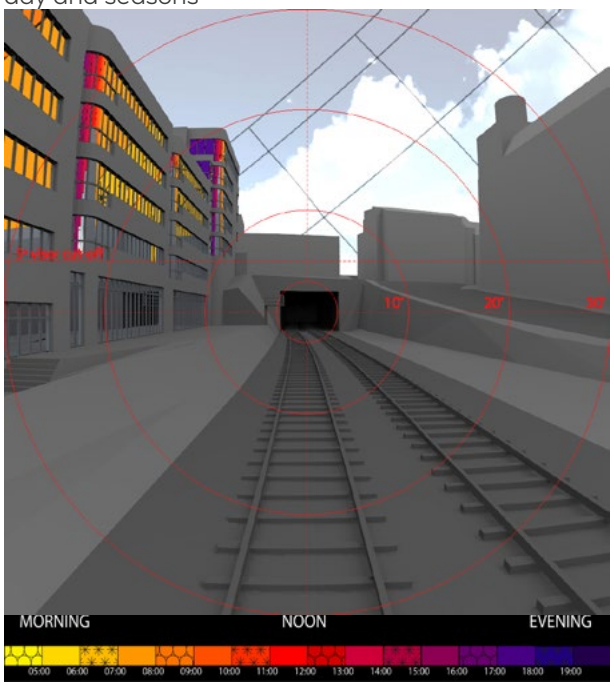


Fig. 12: Stage 1 Example - Hours

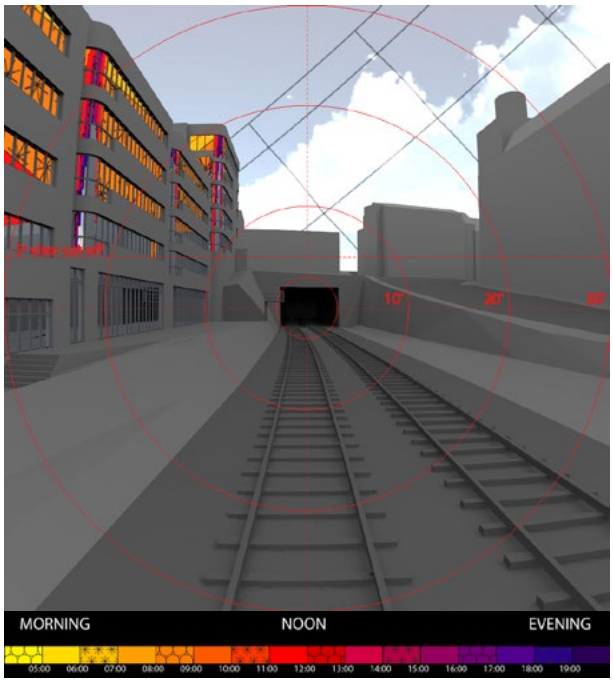


Fig. 13: Stage 1 Example - Months

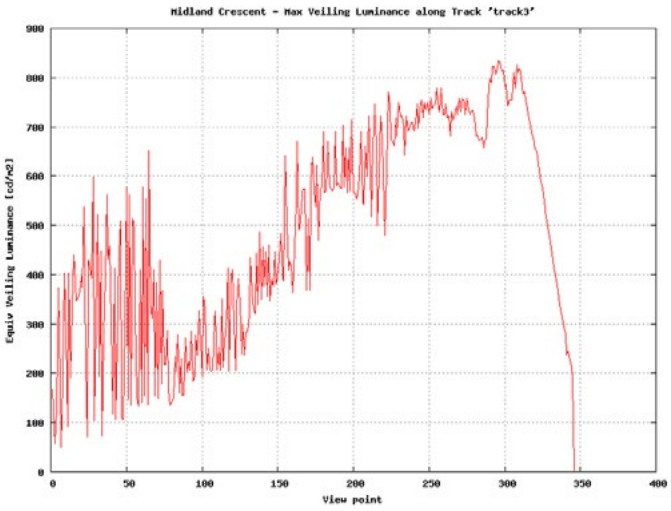


Fig. 14: Stage 2 Example - Summary of Peak Values

A limitation of this Stage 2 methodology is that it can flag false positives when the reflector, i.e. a window, is too small to actually reflect the full extent of the solar disc. As a result of this, even a single bright pixel in the computer image is capable of producing a peak veiling luminance equivalent to that of the full solar disc.

In our 60° animations, which are rendered out at a resolution of 1,000 x 1,000 pixels, the sun's disc has a diameter of 8 pixels.

Fig. 15: Stage 2 Example - Veiling Glare Luminance

Limitations & Assumptions

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.

A Visible Light Reflectance (VLR) of 15% has been used within the analysis. The final installed glazing of the scheme should therefore ensure the VLR is 15% or less.

4 SITE OVERVIEW

The Proposed Scheme is shown below in orange, with the adjacent train lines (Network Rail Southwest Rail tracks and TfL Overground) identified along with the direction of travel.

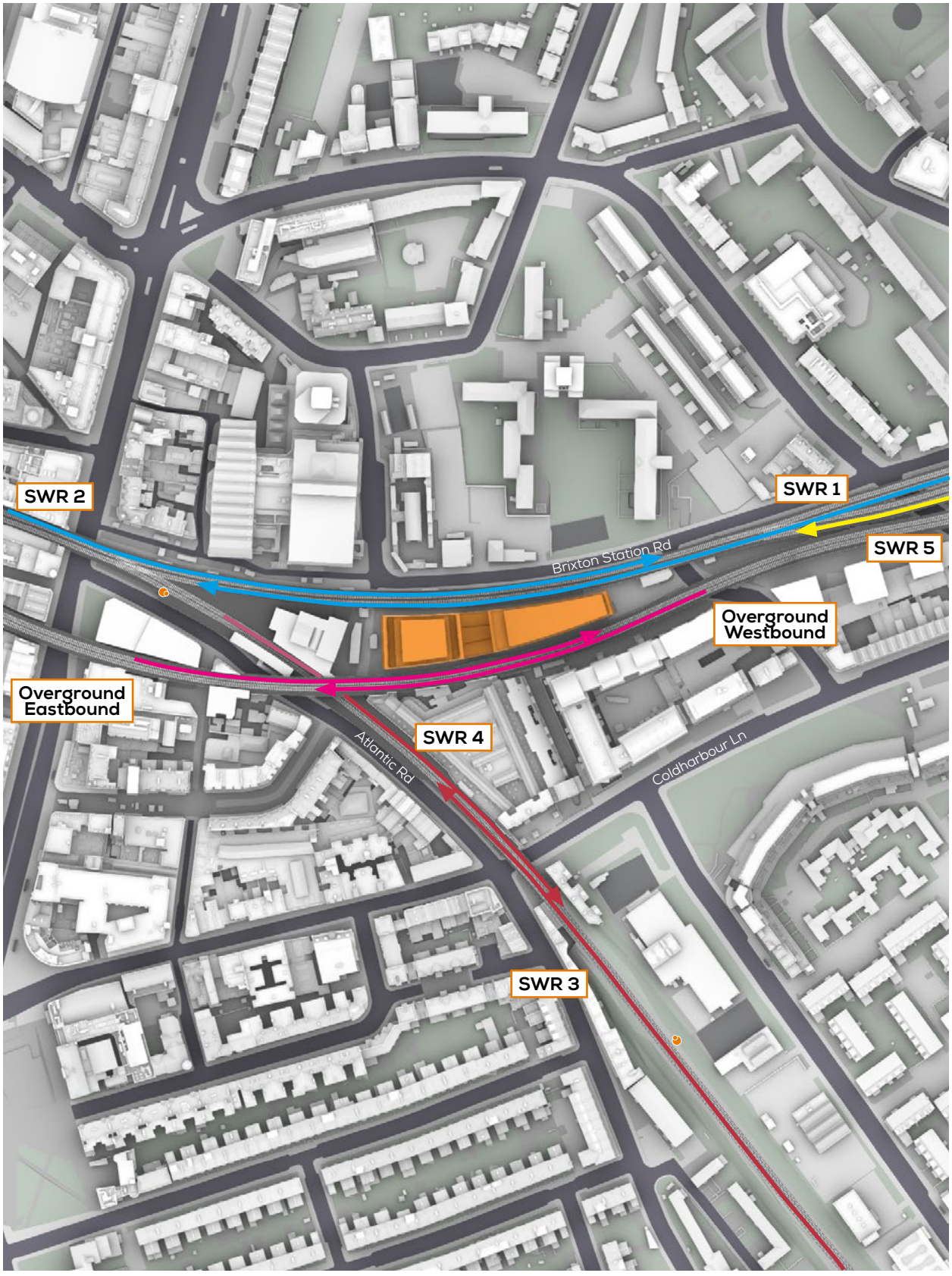


Fig. 16: Top View

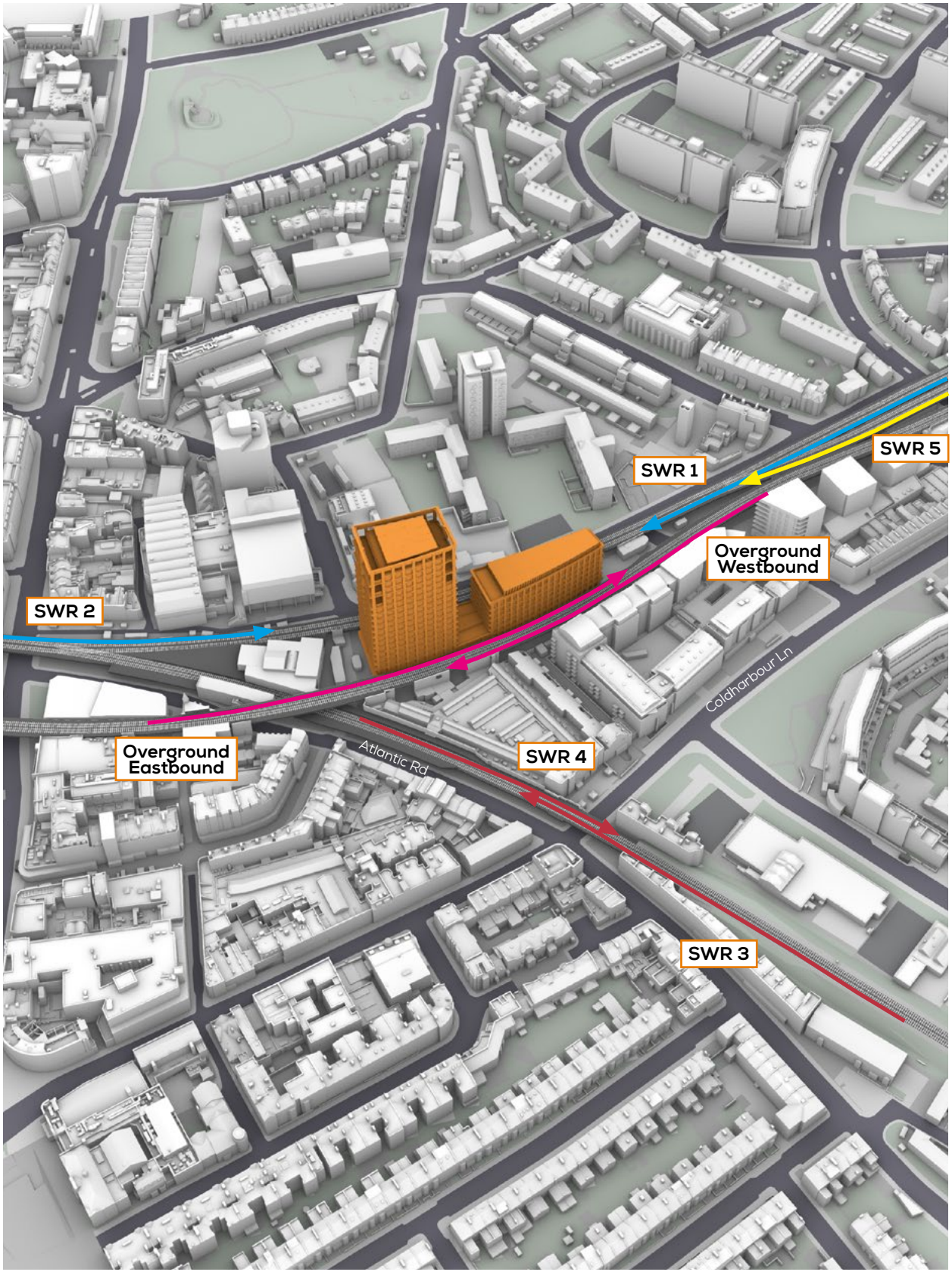


Fig. 17: Perspective View

5 DISCUSSION AND CONCLUSIONS

A glare assessment was carried out for seven of the rail tracks passing near the Proposed Scheme approaching or departing Brixton Station. All tracks pass the Proposed Scheme in close proximity to its façades and are considered to be those most likely to give rise to potential solar glare impacts.

To study the likely occurrence of sunlight being reflected towards train drivers, glare sequences were produced every 1m for railway tracks running in close proximity to the Site. The following tracks have been assessed and are shown diagrammatically in Figures 16 and 17:

- SWR1 - Westbound Southwest Rail/Thameslink line.
- SWR2 - Eastbound Southwest Rail/Thameslink line.
- SWR3 - Northbound Southwest Rail/Thameslink line.
- SWR4 - Southbound Southwest Rail/Thameslink line.
- SWR5 - Westbound Southwest Rail/Thameslink line.
- Overground Eastbound - Eastbound TfL Overground line.
- Overground Westbound - Westbound TfL Overground line.

Our glare studies are carried out using stages, as explained in Section 3 of this document.

A Stage 1 glare sequence was rendered every metre for each of the seven chosen tracks and a representative selection of renders are presented in pages ## to ##. The Stage 1 assessment identifies the times of day and year when potential reflections could occur within 30° of the drivers line of sight on sunny days. Where the Stage 1 assessment shows potentially significant instances of solar reflection, a further Stage 2 assessment has been undertaken to establish the potential intensity of reflections and whether they have the potential to lead to instance of solar glare that could affect a train drivers vision.

5.1 SWR1 - WESTBOUND SOUTHWEST RAIL/THAMESLINK LINE

This trainline serves westbound Southwest Rail and Thameslink trains travelling from Elephant & Castle Station to Brixton Station. This line passes to the north of the Site.

Stage 1 Assessment

The Proposed Scheme is visible within 30° of the driver's line of sight from the first frame, approximately 560m from the Site. As trains approach the Proposed Scheme, the potential reflections shift slightly closer to the drivers line of sight. At approximately 360m from the Site (frame 200) the potential reflections from the eastern facade of the East Block would fall within 10° of the drivers line of sight and at approximately 344m from the Site (frame 216) potential reflections from the eastern facade of the West Block would fall within 10° of the drivers line of sight. At approximately 340m from the Site (frame 220), the northern façades would start to fall within the drivers line of sight.

At approximately 310m from the Site (frame 250), the eastern facade of the East Block falls within 5° of the drivers line of sight. From approximately 288m from the Site (frame 272), the northern façades would fall within 5° of the drivers line of sight. Between frame 272 and frame 629, an element of the Proposed Scheme would be visible within 5° of the drivers line of sight (the most critical zone for vision).

By frame 531 the eastern façades both fall outside 10° of the drivers line of sight. From frame 646, all of the Proposed Scheme falls outside 10° of the drivers line of sight and at frame 664, trains will have passed the Proposed Scheme.

The duration of reflections would be:

- Northern façades: Potential reflections would occur in the evenings (18:00 GMT until sunset) during the mid-seasons and summer months (mid-March to mid-September).
- Eastern facade of the West Block: Potential reflections would occur in the mornings (06:00 until 08:00 GMT) during the mid-seasons (mid-February to late-April and early-August to mid-October).
- Eastern facade of the East Block: Potential reflections would occur in the mornings (sunrise until 07:00 GMT) during the mid-seasons and

summer months (mid-March to mid-September).

Potential reflections from the northern façades would be broken-up by the punched nature of the windows and at glancing angles, thus potential reflections would only occur for a very short time (seconds at a time) and would be low intensity. As such, the potential reflections would not lead to a significant instance of solar glare and do not require further assessment.

The eastern façades have flat areas of glazing falling within 5° of the drivers line of sight between frames 250 and 477 (approximately 230m of track), with the potential to lead to significant instances of glare. As such, a Stage 2 assessment has been undertaken for this stretch of track and concluded below.

Stage 2 Assessment

The Stage 2 assessment has been undertaken from frame 200 to 531 (when the eastern facades fall within 10° of the drivers line of sight), as the section of track which presents the greatest potential for significant instances of solar glare.

The assessment shows the threshold of 500 cd/m^2 will be exceeded for reflections from the eastern façades of both blocks. The reflections from the eastern facade of the West Block would be located above the drivers visor cut-off and are outside 5° of the drivers line of sight. Those of the East Block occur within a short stretch of track (frames 279 - 294 and again at frame 428 - 473), the second instance sits above the drivers visor cut-off.

Whilst there are instances of reflections with an intensity greater than the 500cd/m^2 threshold, the area of reflection would be less than 8 pixels in diameter and therefore cannot reflect the full sun disc, and the solid elements of the facade would help break-up any reflections so they would only occur for a short period of time. As such, the true intensity of these reflections would be lower than indicated and they are unlikely to cause a significant instance of glare.

It is worth noting that there are no known signals in this section of track therefore there is a limited risk of impaired vision affecting signal visibility. Furthermore, the probability of the sun shining during these times would be less than 50%.

Overall, the reflections from the Proposed Scheme are not expected to generate significant glare concerns to train drivers on the Westbound Southwest Rail/Thameslink line (SWR1).

5.2 SWR2 - EASTBOUND SOUTHWEST RAIL/THAMESLINK LINE

This train line serves eastbound Southwest Rail and Thameslink trains approaching Brixton Station. This line passes to the north of the Site.

Stage 1 Assessment

The Proposed Scheme is visible within 30° of the drivers field line of sight from the first frame, approximately 510m from the Site. As trains approach the Proposed Scheme, the potential reflections shift slightly closer to the drivers line of sight. At approximately 447m from the Site (frame 63) the potential reflections from the northern façades would fall within 10° of the drivers line of sight, and at approximately 397m from the Site (frame 113) potential reflections from the eastern facade of the West Block would fall within 10° of the drivers line of sight.

At approximately 199m from the Site (frame 221), the western facade of the West Block falls within 5° of the drivers line of sight. From approximately 133m from the Site (frame 377), the northern façades would fall within 5° of the drivers line of sight. Between frame 221 and frame 561, the Proposed Scheme would be visible within 5° of the drivers line of sight.

Between frames 394 and 537 the western facade of the East Block would be visible outside 8° of the drivers line of sight and above the visor cut-off line.

By frame 469 the western façade falls outside 10° of the drivers line of sight. By frame 578, the Proposed Scheme falls outside 10° of the drivers line of sight and at frame 595, trains will have passed the Proposed Scheme.

The duration of reflections would be:

- Northern façades: Potential reflections would occur in the early mornings (sunrise until 06:00 GMT) during the mid-seasons and summer months (mid-March to mid-September).
- Western facade of the West Block: Potential reflections would occur in the late afternoon/early

evenings (15:00 until 18:00 GMT) during the mid-seasons and winter months (early-September to late-March).

- Western facade of the East Block: Potential reflections would occur in the mornings (07:00 until 08:00 GMT) during the mid-seasons (mid-February to mid-April and mid-August to mid-October) These reflections would results from inter-reflection from the eastern facade of the West Block and would therefore be lower intensity.

Potential reflections from the northern façades would be broken-up by the punched nature of the windows and glancing angles, thus potential reflections would only occur for a very short time (seconds at a time) and would be low intensity. As such, the potential reflections would not lead to a significant instance of solar glare and do not require further assessment.

The western facade has flat areas of glazing falling within 5° of the drivers line of sight between frames 221 and 440 (approximately 220m of track), with the potential to lead to significant instances of glare. As such, a Stage 2 assessment has been undertaken for this stretch of track and concluded below.

Stage 2 Assessment

The Stage 2 assessment has been undertaken from frame 113 to 469, as the section of track which present the greatest potential for significant instances of solar glare.

The assessment shows the threshold of 500 cd/m^2 will be exceeded for reflections from the western facade of West Block. The reflections would be located above the drivers visor cut-off and are outside 5° of the drivers line of sight. Those of the East Block occur within a short stretch of track (frames 345 - 352 and again at frame 377 - 416). All reflections from the East Block would be marginally above the 500cd/m^2 threshold. The solid elements of the facade would also help break-up any reflection so they would only occur for a short period of time.

It is worth noting that there are no known signals in this section of track therefore there is a limited risk of impaired vision affecting signal visibility. Furthermore, the probability of the sun shining during these times would be less than 40%.

Overall, the reflections from the Proposed Scheme are not expected to generate significant glare concerns to train drivers on the Eastbound Southwest Rail/Thameslink line (SWR2).

5.3 SWR3 - NORTHBOUND SOUTHWEST RAIL/THAMESLINK LINE

This train line serves northbound Southwest Rail and Thameslink trains travelling from Herne Hill to Brixton Station. This line travels towards the Site from the south and then passes to the west of the Site.

Stage 1 Assessment

The Proposed Scheme is visible within the 15° of the drivers line of sight from the first frame, approximately 500m from the Site, however the façades do not generate potential reflections falling within the drivers line of sight. These conditions remain until approximately 360m from the Site (frame 140), when potential reflections would appear from the top western corner of the southern facade. These potential reflections would occur outside 10° of the drivers line of sight.

The potential reflections would remain outside 10° of the drivers line of sight and above the visor cut-off until trains have passed the Proposed Scheme at approximately frame 420.

The duration of reflections would be:

- Southern façades: Potential reflections would occur in the middle of the day (11:00 until 14:00 GMT) during the winter months (early-October to late-February).

Potential reflections from the southern facade of the West Block would be broken-up by the punched nature of the windows and thus potential reflections would only occur for a very short time (seconds at a time) and would be low intensity. The potential reflections are also all located well above the drivers visor cut-off and at a time of the year when the probably of the sun shining is low (circa 30%). As such, the potential reflections would not lead to a significant instance of solar glare and do not require further assessment.

5.4 SWR4 - SOUTHBOUND SOUTHWEST RAIL/THAMESLINK LINE

This train line serves southbound Southwest Rail and Thameslink trains travelling to Hearne Hill from Brixton Station. This line passes to the west of the Site.

Stage 1 Assessment

The Proposed Scheme is visible within the 30° of the drivers line of sight from the first frame, approximately 500m from the Site. As trains approach the Proposed Scheme, the potential reflections shift slightly closer to the drivers line of sight. At approximately 434m from the Site (frame 66) the potential reflections from the northern facade of the East Block would fall within 10° of the drivers line of sight and at approximately 400m from the Site (frame 100) potential reflections from the northern facade of the West Block would fall within 10° of the drivers line of sight. At approximately 388m from the Site (frame 112), the western façade would start to fall within 10° of the drivers line of sight.

At approximately 280m from the Site (frame 220), the western facade of the Western Block falls within 5° of the drivers line of sight. The northern façades would remain outside 5° of the drivers line of sight. Between frame 220 and frame 370 the Proposed Scheme would be visible within 5° of the drivers line of sight.

By frame 413, the Proposed Scheme falls outside 10° of the drivers line of sight and at frame 460, trains will have passed the Proposed Scheme.

The duration of reflections would be:

- Northern façades: Potential reflections would occur in the early mornings (sunrise until 06:00 GMT) during the mid-seasons (mid-March to mid-May and mid-July to mid-September).
- Western facade of the West Block: Potential reflections would occur in the late afternoon/ early evenings (13:30 until 18:00 GMT) during the mid-seasons (mid-January to mid-April and mid-August to mid-November).

Potential reflections from the northern façades would be broken-up by the punched nature of the windows and at glancing angles, thus potential reflections would only occur for a very short time (seconds at a time) and would be low intensity. As such, the potential reflections would not lead to a significant instance of solar glare and do not require further assessment.

The western facade has flat areas of glazing falling within 5° of the drivers line of sight between frames 220 and 370 (approximately 150m of track), with the potential to lead to significant instances of glare. As such, a Stage 2 assessment has been undertaken for this stretch of track and concluded below.

Stage 2 Assessment

The Stage 2 assessment has been undertaken from frame 112 to 413, as the section of track which present the greatest potential for significant instances of solar glare.

The assessment shows the threshold of 500 cd/m^2 will be exceeded for reflections from the western facade of West Block. The reflections would be located above the drivers visor cut-off and are outside 5° of the drivers line of sight. Those of the East Block occur within a short stretch of track (frames 263 - 286 and again at frame 341 - 356). All reflections would be marginally above the 500cd/m^2 threshold. The solid elements of the facade would help break-up any reflection so they would only occur for a short period of time.

It is worth noting that there are no known signals in this section of track therefore there is a limited risk of impaired vision affecting signal visibility. Furthermore, the probability of the sun shining during these times would be less than 50%.

Overall, the reflections from the Proposed Scheme are not expected to generate significant glare concerns to train drivers on Southbound Southwest Rail/Thameslink line (SWR4).

5.5 SWR5 - WESTBOUND SOUTHWEST RAIL/THAMESLINK LINE

This train line serves westbound Southwest Rail and Thameslink trains travelling from Denmark Hill Station to Brixton Station. This line passes to the north of the Site.

Stage 1 Assessment

The Proposed Scheme is visible directly within the drivers line of sight from the first frame, approximately 540m from the Site. Potential reflections would be visible from the eastern façades of both the East and West Blocks, as well as the northern façades.

As trains approach the Proposed Scheme, the potential reflections shift slightly further from the drivers line of sight. At approximately 490m from the Site (frame 50) the potential reflections from the all façades would fall between 5° and 10° of the drivers line of sight.

At approximately 420m from the Site (frame 120) potential reflections from the Proposed Scheme would fall outside 10° of the drivers line of sight and would remain outside 10° until 393m from the Site (frame 147).

At approximately 315m from the Site (frame 225), the Proposed Scheme would re-enter 5° of the drivers line of sight. Between frame 272 and frame 629, the Proposed Scheme would be visible within 5° of the drivers line of sight. At frame 408 the eastern façades falls outside 5° of the driver line of sight and from frame 509 they would fall outside 10°. The northern facade would remain within 5° of the drivers line of sight up to frame 609.

By frame 629, the Proposed Scheme falls outside 10° of the drivers line of sight and at frame 645, trains will have passed the Proposed Scheme.

The duration of reflections would be:

- Northern façades: Potential reflections would occur in the evenings (17:00 until 19:00 GMT) during the mid-seasons and summer months (mid-March to mid-September).
- Eastern facade of the East Block: Potential reflections would occur in the early mornings (sunrise until 06:30 GMT) during the mid-seasons and summer months (mid-March to mid-September).
- Eastern facade of the West Block: Potential reflections would occur in the mornings (06:00 until 08:00 GMT) during the mid-seasons (mid-February to mid-May and mid-July to mid-October).

Potential reflections from the northern façades would be broken-up by the punched nature of the windows and at glancing angles, thus potential reflections would only occur for a very short time (seconds at a time) and would be low intensity. As such, the potential reflections would not lead to a significant instance of solar glare and do not require further assessment.

The eastern façades have flat areas of glazing falling within 5° of the drivers line of sight between frames 1 - 50 and 225 - 408 (approximately 233m of track), with the potential to lead to significant instances of glare. As such, a Stage 2 assessment has been undertaken for this stretch of track and concluded below.

Stage 2 Assessment

The Stage 2 assessment has been undertaken from frame 1 to 509, as the section of track which present the greatest potential for instances of solar glare.

Potential reflections from the eastern facade of the East Block would not exceed the 500cd/m^2 threshold and therefore would not lead to instances of glare.

The assessment shows the threshold of 500 cd/m^2 will be exceeded for reflections from the eastern façades of West Block. The reflections would be located above the drivers visor cut-off and are outside 5° of the drivers line of sight.

Whilst there are instances of reflections with an intensity greater than the 500cd/m^2 threshold, the area of reflection would be less than 8 pixels in diameter and therefore cannot reflect the full sun disc, and the solid elements of the facade would help break-up any reflection so they would only occur for a short period of time. As such, the true intensity of these reflections would be lower than indicated and they are unlikely to cause a significant instance of glare.

It is worth noting that there are no known signals in this section of track therefore there is a limited risk of

impaired vision affecting signal visibility. Furthermore, the probability of the sun shining during these times would be less than 40%.

Overall, the reflections from the Proposed Scheme are not expected to generate significant glare concerns to train drivers on Westbound Southwest Rail/Thameslink line (SWR5).

5.6 OVERGROUND EASTBOUND

This train line serves eastbound TfL Overground trains travelling from Clapham High Street to Denmark Hill. This line passes to the south of the Site.

Stage 1 Assessment

The Proposed Scheme is visible within the 30° of the drivers line of sight from the first frame, approximately 500m from the Site. As trains approach the Proposed Scheme, the potential reflections shift slightly closer to the drivers line of sight. At approximately 450m from the Site (frame 45) the potential reflections from the northern facade of the East Block would fall within 10° of the drivers line of sight and at approximately 438m from the Site (frame 62) potential reflections from the northern facade of the West Block would fall within 10° of the drivers line of sight. At approximately 433m from the Site (frame 67), the western facade of the West Block would fall within the drivers line of sight.

At approximately 420m from the Site (frame 80), the northern face of the East Block falls within 5° of the drivers line of sight. From approximately 395m from the Site (frame 105), the northern and western façades of the West Block would fall within 5° of the drivers line of sight. Between 395m and 300m (frame 200) from the Site, the Proposed Scheme would be visible within 5° of the drivers line of sight.

By 270m from the Site (frame 230), the Proposed Scheme falls outside 10° of the drivers line of sight and no further potential reflections would occur within 10° of the drivers line of sight up to the point where train drivers have passed the Proposed Scheme (frame 631).

At 150m from the Site (frame 350), the northern facade would no longer be visible and thus potential reflection could only occur from the western facade until at frame 509, when the western facade of the West Block falls out of view. At frame 509, trains would travel parallel to the Site and potential reflections could occur from the southern façades and at frame 521 the western facade of the East Block would become visible at approximately 20° of the drivers line of sight.

The duration of reflections would be:

- Northern façades: Potential reflections would occur in the early mornings (sunrise until 06:00 GMT) during April, May, July and August.
- Western facade of the West Block: Potential reflections would occur in the late afternoon/early evenings (16:00 until 19:00 GMT) during the mid-seasons through summer months (mid-February to mid-October).
- Southern façades: Potential reflections would occur in the mornings (07:00 until 08:00 GMT) during the mid-seasons (mid-February to late-April and early-August to mid-October).
- Western facade of the East Block: Potential reflections would occur in the mornings (05:00 until 07:00 GMT) during the summer months (mid-April to mid-August). These would likely occur from inter-reflections from the eastern facade of the West Block and are therefore low intensity.

Potential reflections from the northern façades, southern façades and western facade of the East Block would be broken-up by the punched nature of the windows and thus potential reflections would only occur for a very short time (seconds at a time) and would be low intensity. In additiona, the reflections fro the northern and southern facades would be at glancing angles. As such, the potential reflections would not lead to a significant instance of solar glare and do not require further assessment.

The western facade of the West Block has flat areas of glazing falling within 5° of the drivers line of sight between frames 105 and 200 (approximately 95m of track), with the potential to lead to significant instances of glare. As such, a Stage 2 assessment has been undertaken for this stretch of track and concluded below.

Stage 2 Assessment

The Stage 2 assessment has been undertaken from frame 62 to 230, as the section of track which present the greatest potential for significant instances of solar glare.

The assessment shows the threshold of 500 cd/m^2 will be exceeded for reflections from the western facade of the West Block, These occur within a short stretch of track (frames 112 - 177).

Whilst there are instances of reflections with an intensity greater than the 500cd/m^2 threshold, the area of reflection would be less than 8 pixels in diameter and therefore cannot reflect the full sun disc. Reflections would also be broken-up by the solid elements of the facade, thus lasting for a short period of time. As such, true intensity of these reflections would be lower than indicated and they are unlikely to cause a significant instance of glare.

It is worth noting that there are no known signals in this section of track therefore there is a limited risk of impaired vision affecting signal visibility. Furthermore, the probability of the sun shining during these times would be less than 40%.

Overall, the reflections from the Proposed Scheme are not expected to generate significant glare concerns to train drivers on Overground Eastbound.

5.7 OVERGROUND WESTBOUND

This train serves westbound TfL Overground trains travelling from Denmark Hill to Clapham High Street. This line passes to the south of the Site.

Stage 1 Assessment

The Proposed Scheme is visible directly within the drivers line of sight from the first frame, approximately 540m from the Site. Potential reflections would be visible from the eastern façades of both the East and West Blocks, as well as the northern façades.

As trains approach the Proposed Scheme, the potential reflections shift slightly further from the drivers line of sight. At approximately 505m from the Site (frame 35) the potential reflections from the all façades would fall between 5° and 10° of the drivers line of sight.

At approximately 461m from the Site (frame 79) potential reflections from the Proposed Scheme of would fall outside 10° of the drivers line of sight and would remain outside 10° until 347m from the Site (frame 193).

At approximately 286m from the Site (frame 254), the Proposed Scheme would re-enter 5° of the drivers line of sight. Between frame 254 and frame 466 elements of the Proposed Scheme would be visible within 5° of the drivers line of sight. From frame 484 the eastern façades would fall outside 10° and the northern façades would not be visible.

At frame 580, the southern facade has the potential to reflect sunlight outside 20° of the drivers line of sight and at frame 642, trains will have passed the Proposed Scheme.

The duration of reflections would be:

- Northern façades: Potential reflections would occur in the evenings (17:00 until 19:00 GMT) during the mid-seasons (mid-March to mid-May and mid-July to mid-September).
- East facade of the East Block: Potential reflections would occur in the mornings (sunrise until 06:00 GMT) during the mid-seasons and summer months (mid-March to mid-September).
- Eastern facade of the West Block: Potential reflections would occur in the mornings (06:00 until 08:00 GMT) during the mid-seasons and summer months (mid-February to mid-October).
- Southern façades: Potential reflections would occur in the afternoons (15:00 until 17:00 GMT) during the mid-seasons (mid-January to mid-April and mid-August to mid-November).

Potential reflections from the northern façades and southern façades would be broken-up by the punched nature of the windows and at glancing angles, thus potential reflections would only occur for a very short time (seconds at a time) and would be low intensity. As such, the potential reflections would not lead to a significant instance of solar glare and do not require further assessment.

The eastern facade has flat areas of glazing falling within 5° of the drivers line of sight between frames 1-35 and 254-466 (approximately 247m of track), with the potential to lead to significant instances of glare. As such, a Stage 2 assessment has been undertaken for this stretch of track and concluded below.

Stage 2 Assessment

The Stage 2 assessment has been undertaken from frame 1 to 484, as the section of track which present the greatest potential for instances of solar glare.

The assessment shows the threshold of 500 cd/m^2 will be exceeded for reflections from the eastern façades of both blocks. The reflections from the eastern facade of the West Block would be located above the drivers visor cut-off and are outside 5° of the drivers line of sight. Those of the East Block occur within a short stretch of track (frames 383- 439), the majority of reflections sit above the drivers visor cut-off.

Whilst there are instances of reflections with an intensity greater than the 500cd/m^2 threshold, the area of reflection would be less than 8 pixels and therefore cannot reflect the full sun disc, and the solid elements of the facade would help break-up any reflection so they would only occur for a short period of time. As such, true intensity of these reflections would be lower than indicated and they are unlikely to cause a significant instance of glare.

It is worth noting that there are no known signals in this section of track therefore there is a limited risk of impaired vision affecting signal visibility. Furthermore, the probability of the sun shining during these times would be less than 30%.

Overall, the reflections from the Proposed Scheme are not expected to generate significant glare concerns to train drivers on Overground Westbound.

5.8 CONCLUSIONS

It is our opinion that the Proposed Scheme would not give rise to major issue in terms of glare from reflected sunlight impacting train driver on the adjacent train lines.

Whilst there will be instances of reflections that exceed the 500cd/m^2 threshold, these are largely above the drivers visor cut-off and fall outside 5° of the drivers direct line of sight so are outside the critical vision zone.

There are no known signals that would be impacted by the instances of reflections. Furthermore, the instances of reflections with intensities greater than the threshold would occur for a very short period of time due to the reflections being broken-up by solid elements of the facade and occur within an isolated section of track. In addition, the reflections are less facade area is less than 8 pixels in diameter and would therefore not cover an area large enough to reflect the full sun disc.

Overall, therefore, the Proposed Scheme is in line with regional and local planning policy as it does not have an unacceptably harmful impact on its surroundings in terms of reflected glare.

APPENDIX 01

SWR1 - WESTBOUND SOUTHWEST RAIL/THAMESLINK LINE

VIEWPOINTS & FRAME NUMBERS
SWR 1

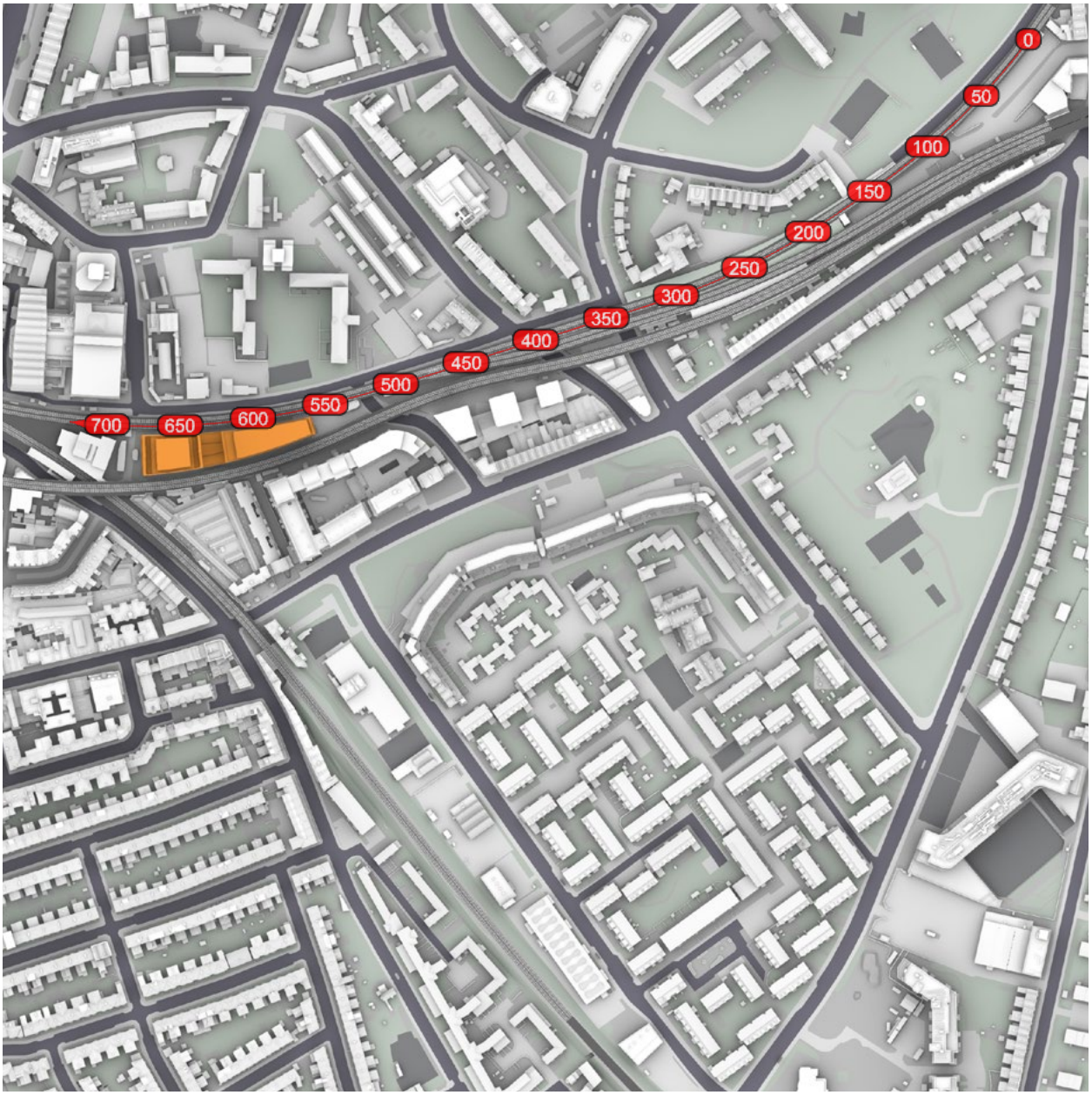


Fig. 18: Viewpoints and frame numbers

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 1

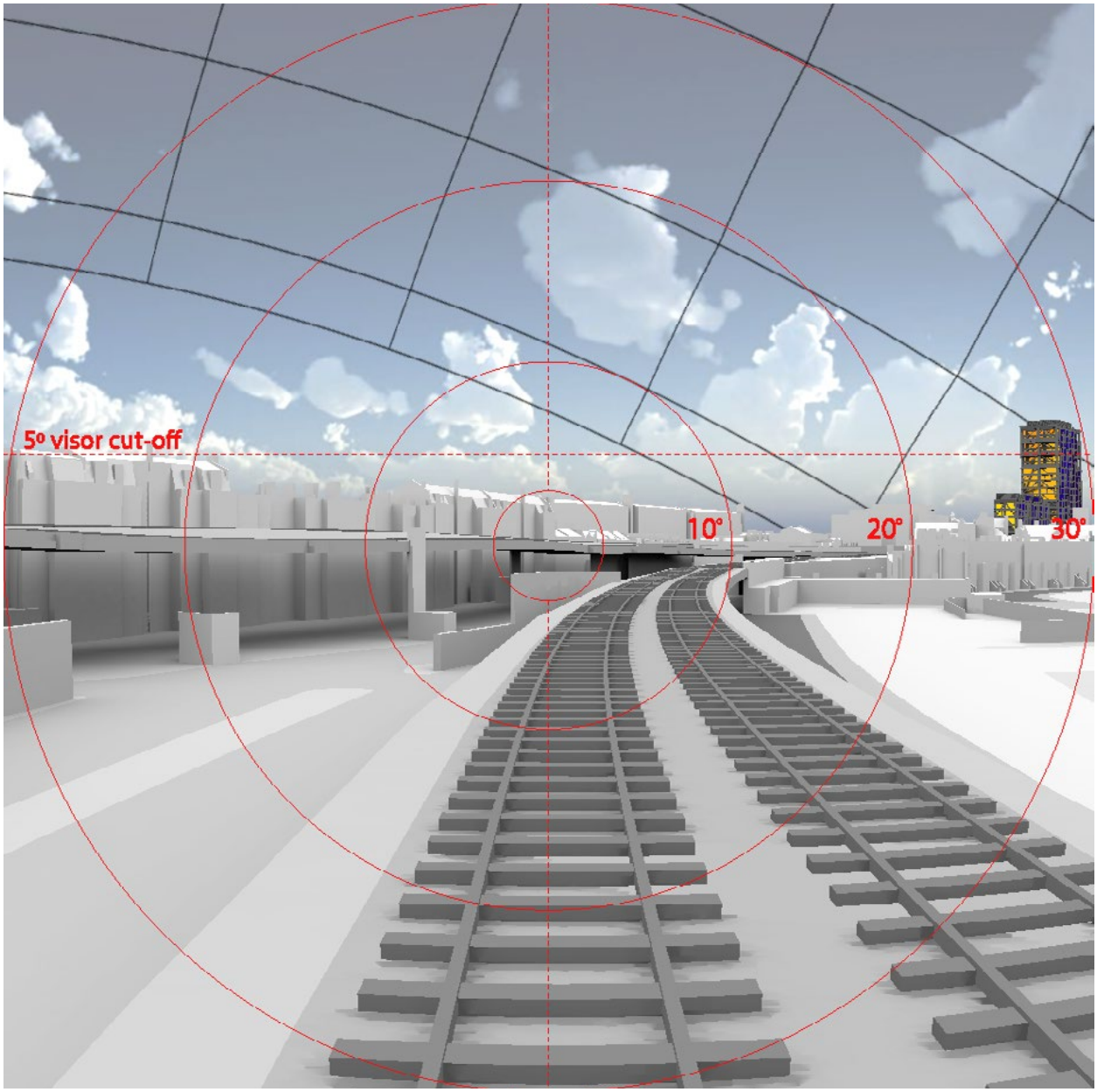
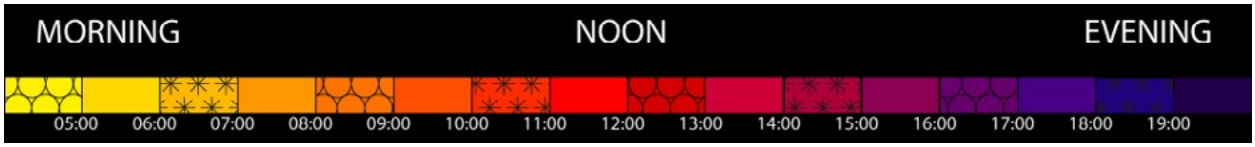


Fig. 19: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 1

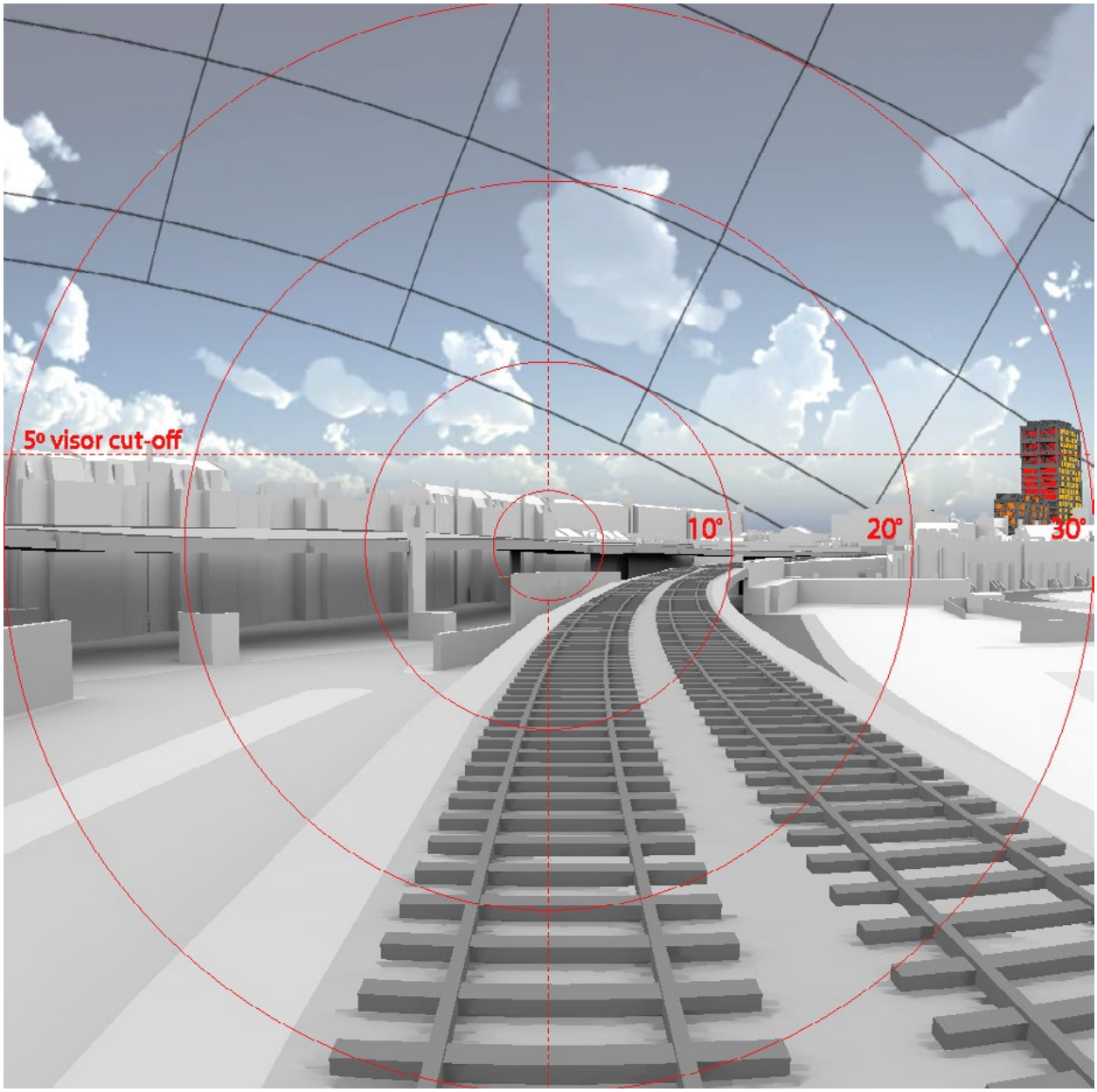


Fig. 20: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 200

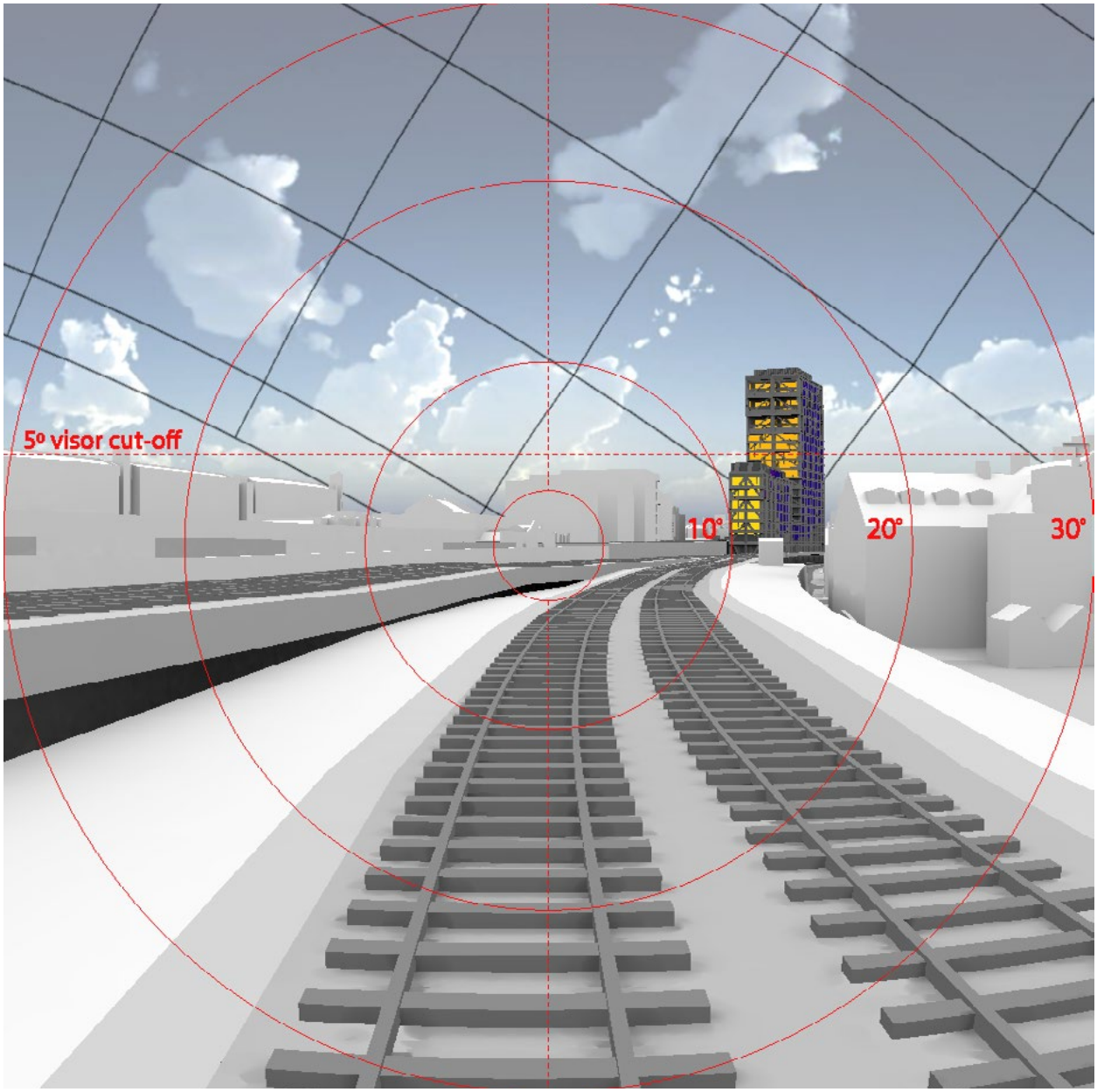
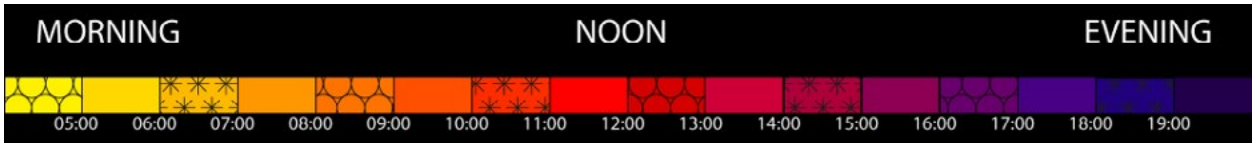


Fig. 21: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 200

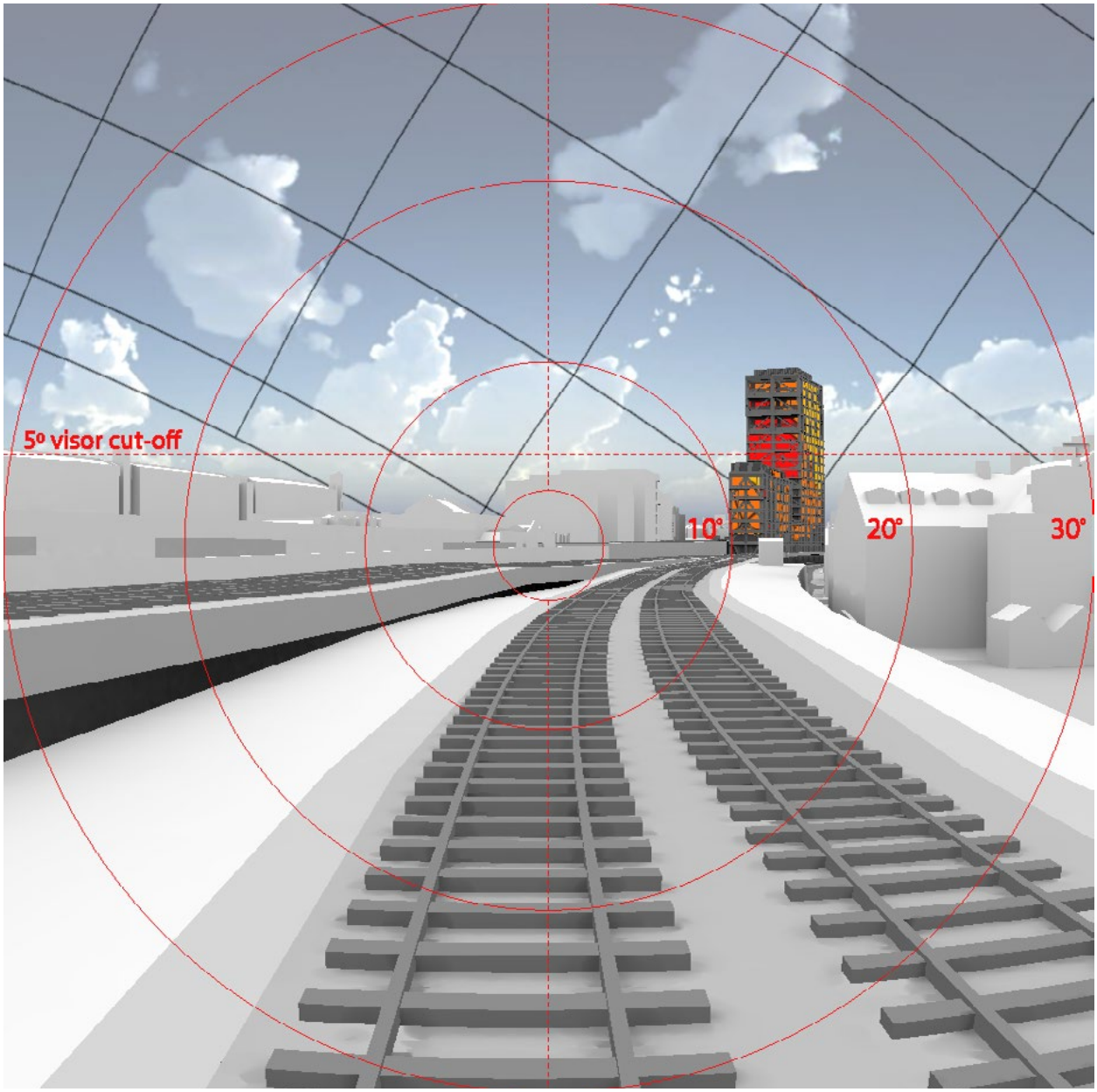


Fig. 22: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 216

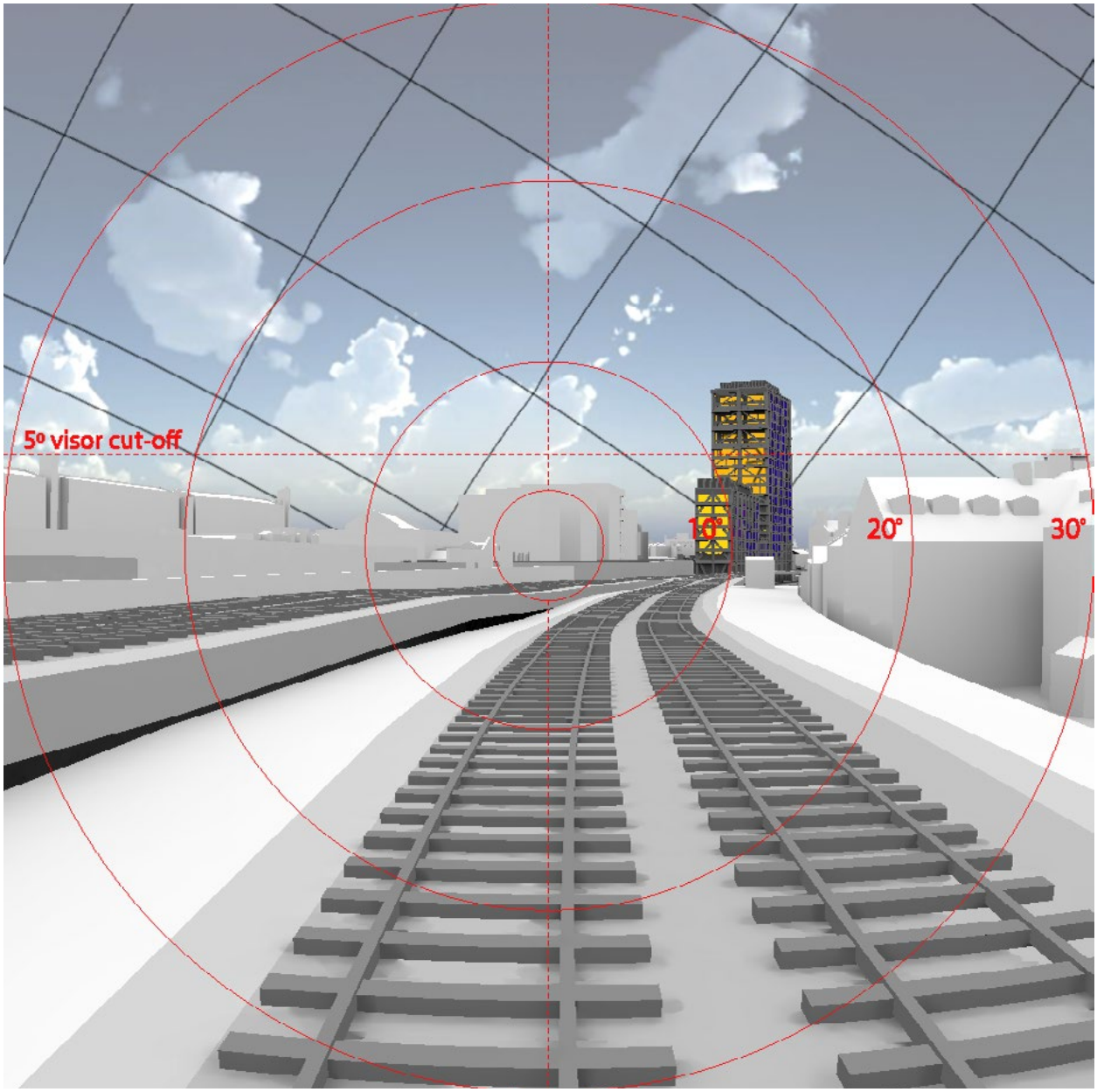
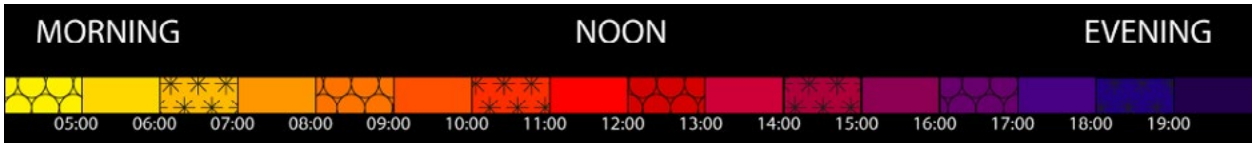


Fig. 23: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 216

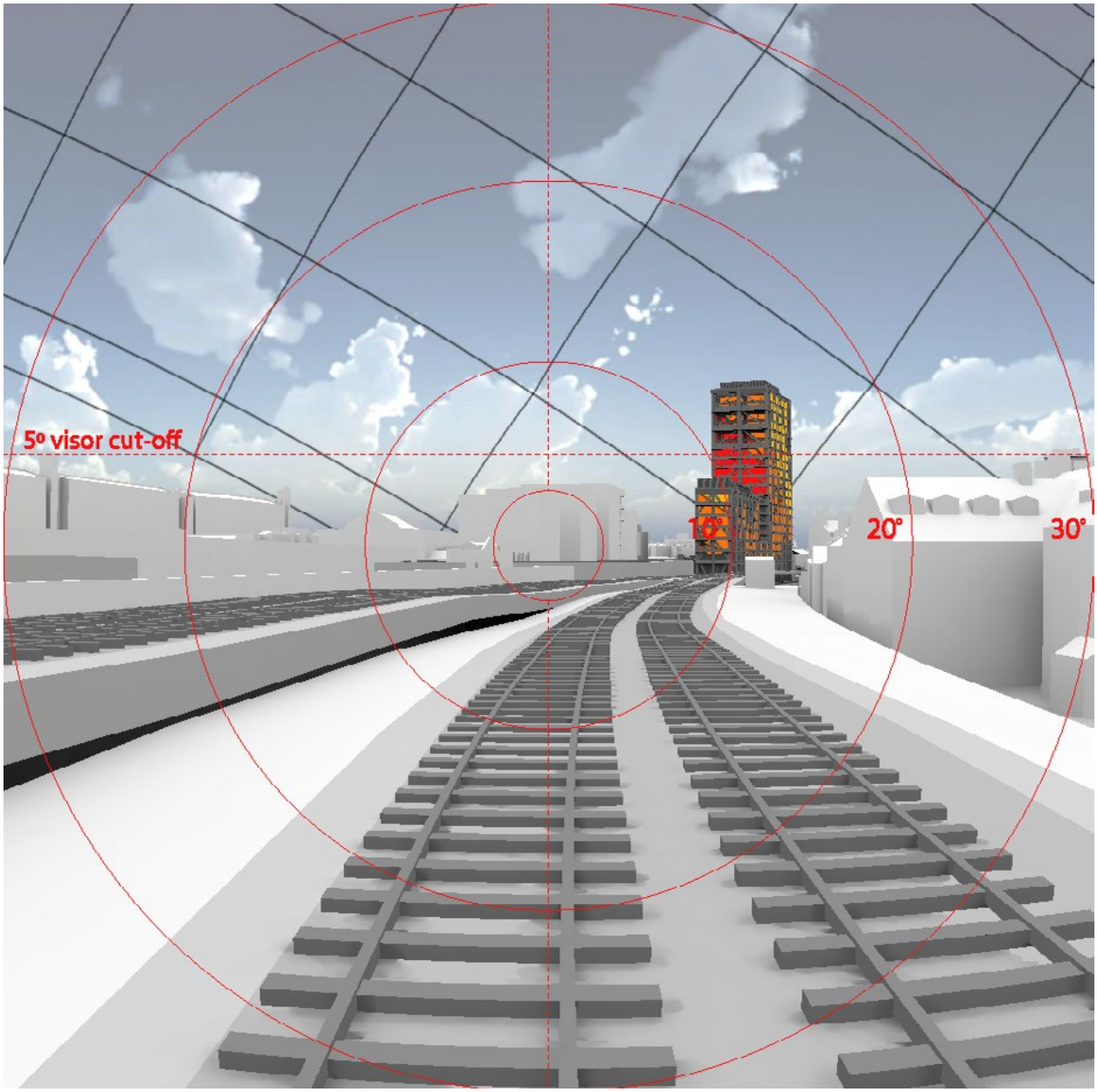


Fig. 24: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 220

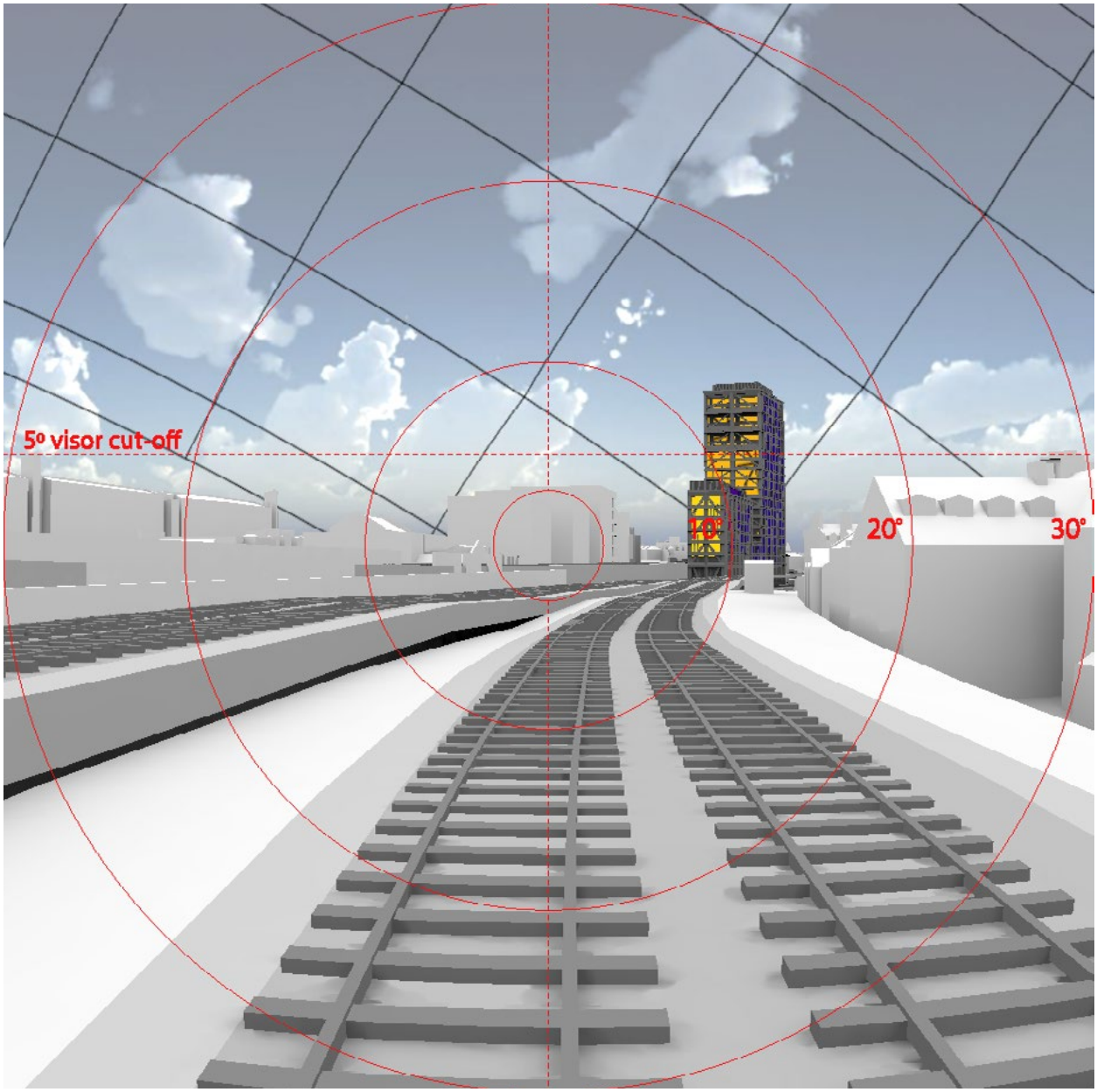
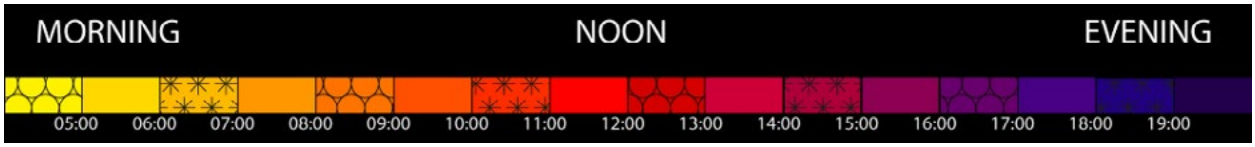


Fig. 25: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 220

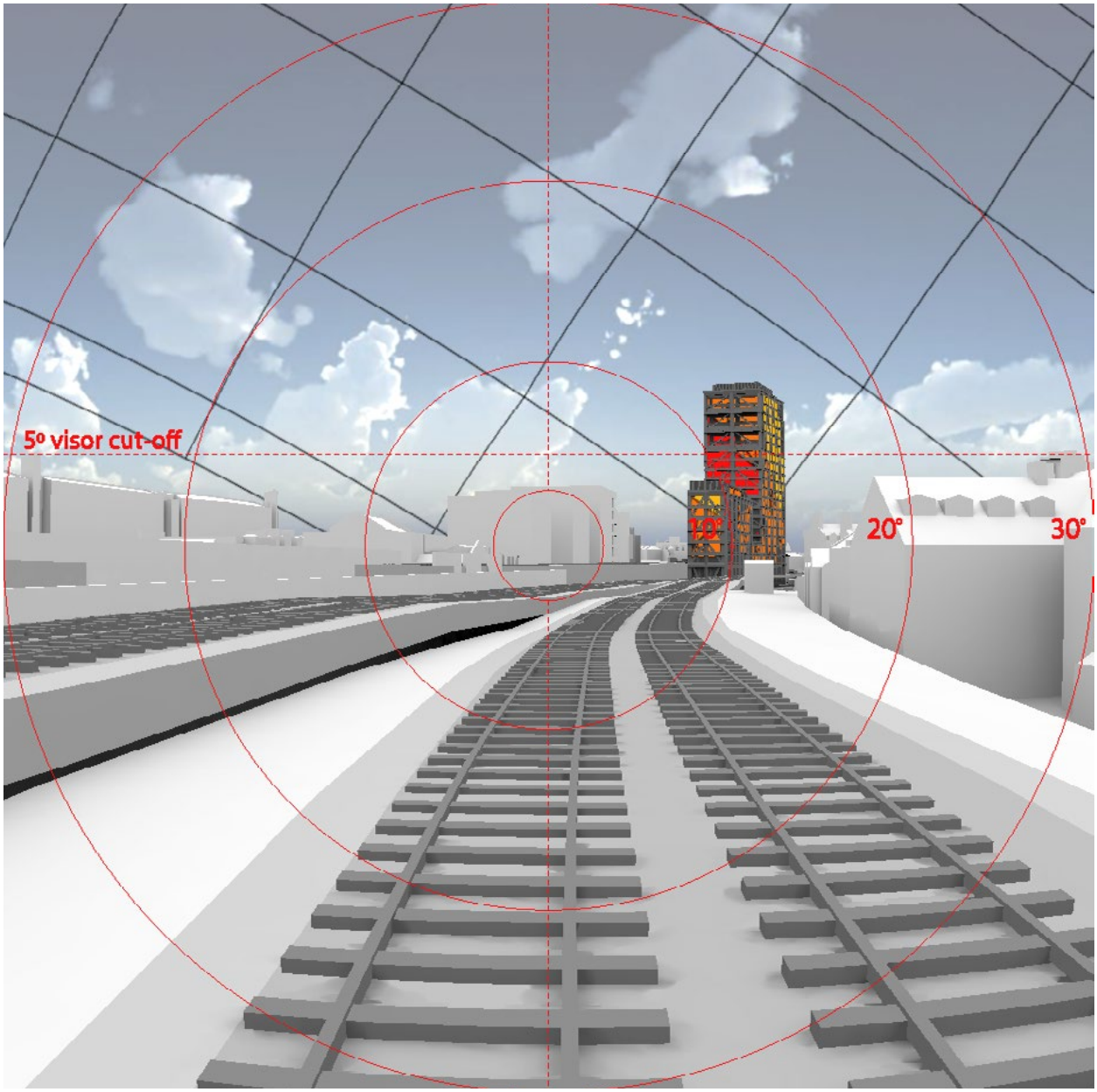


Fig. 26: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 250

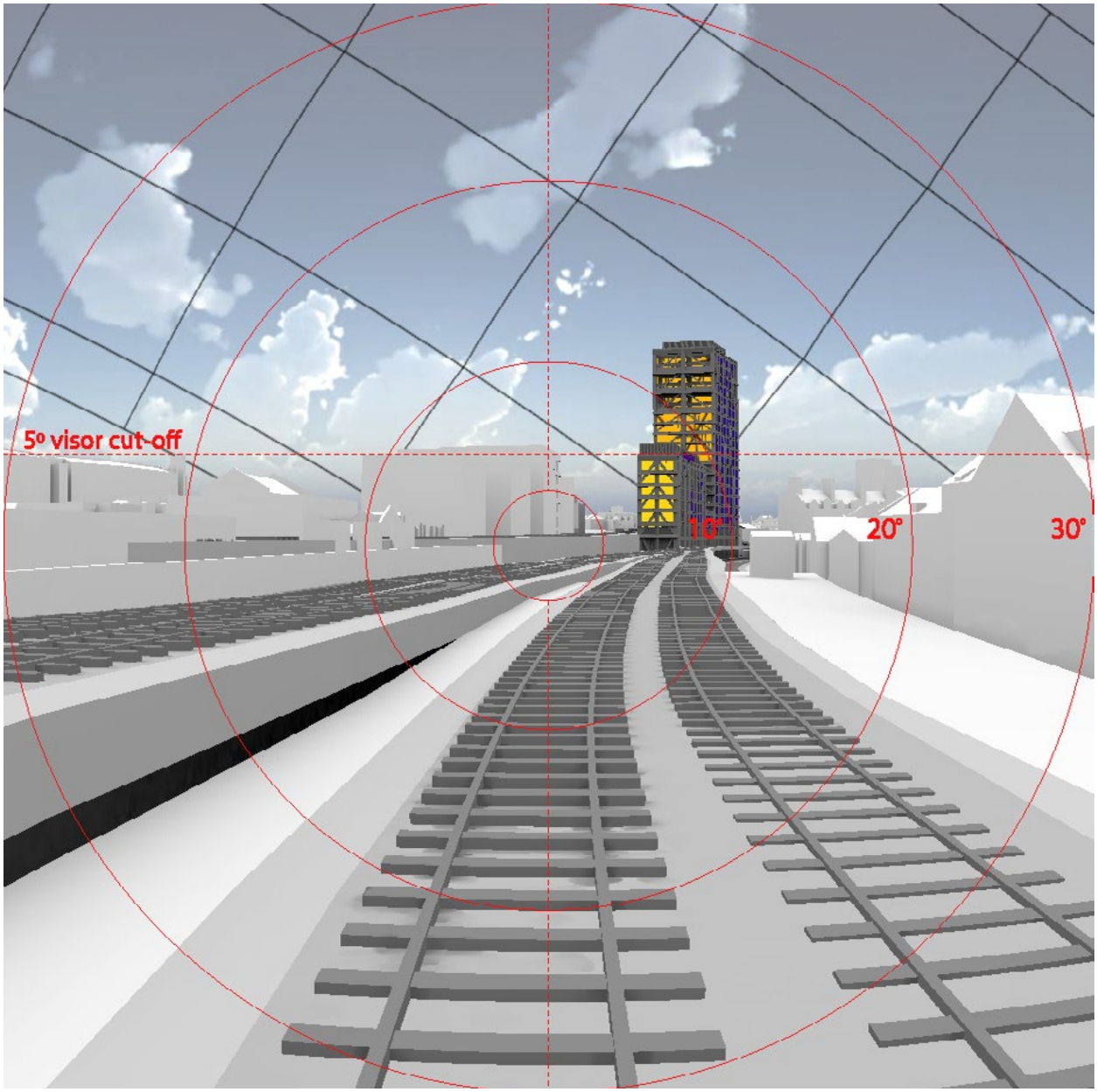
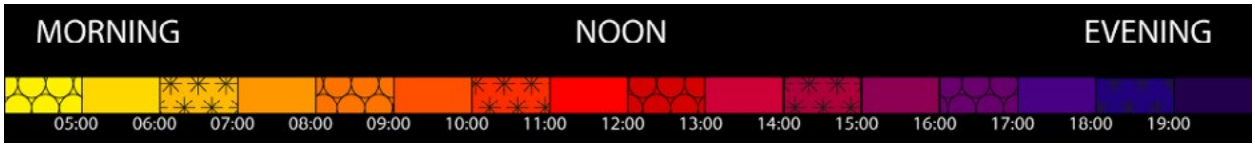


Fig. 27: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 250

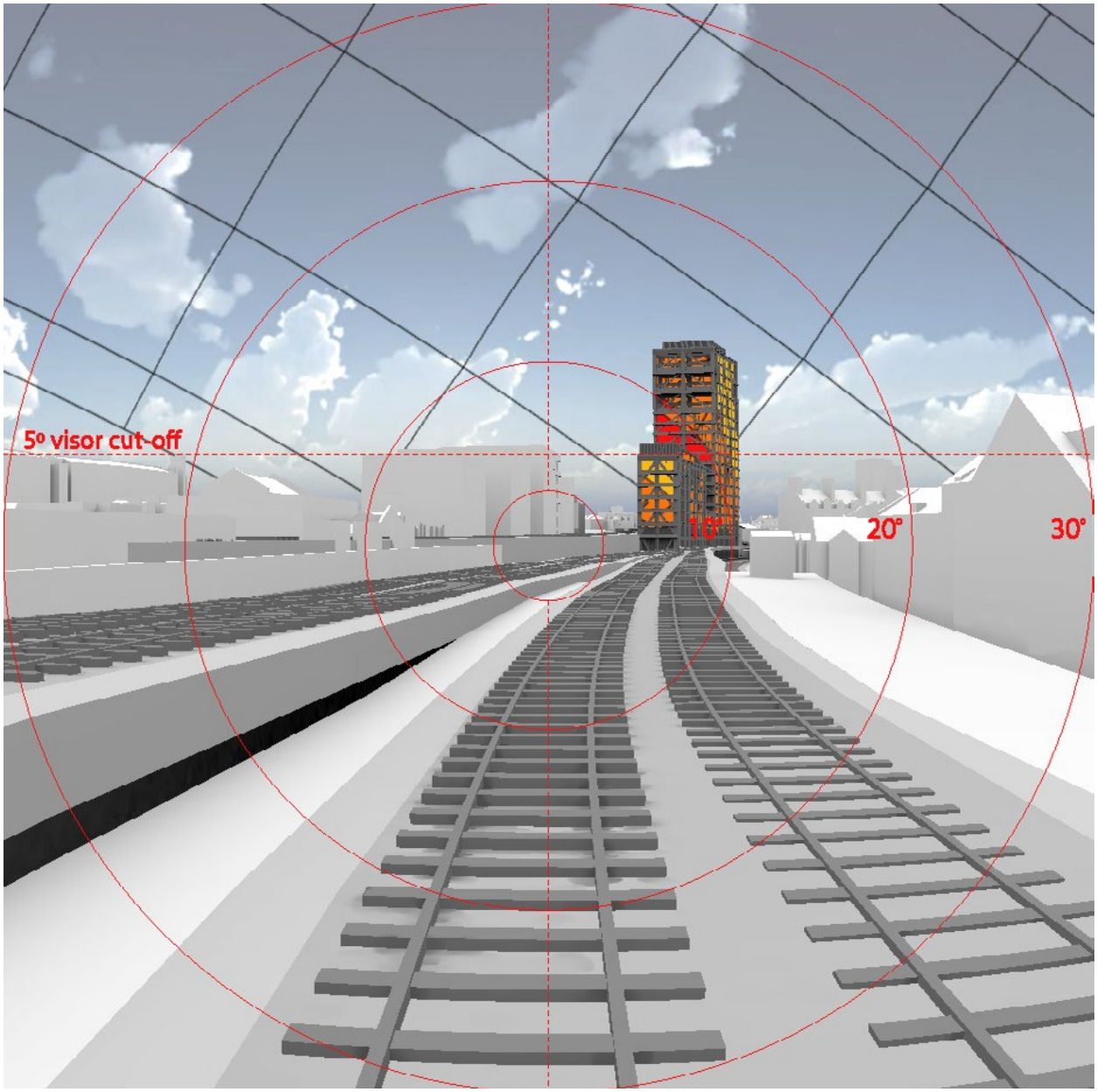


Fig. 28: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 272

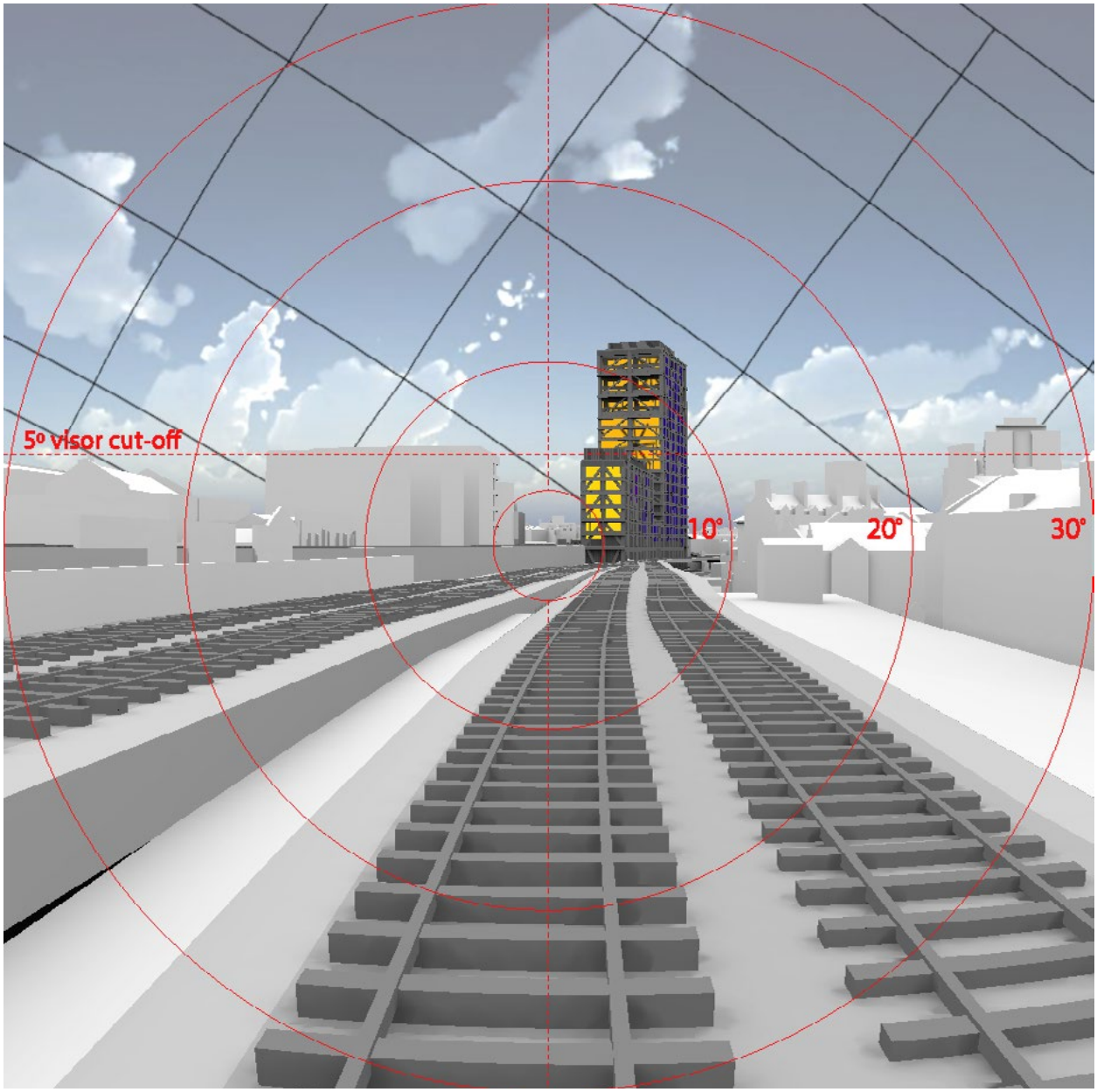
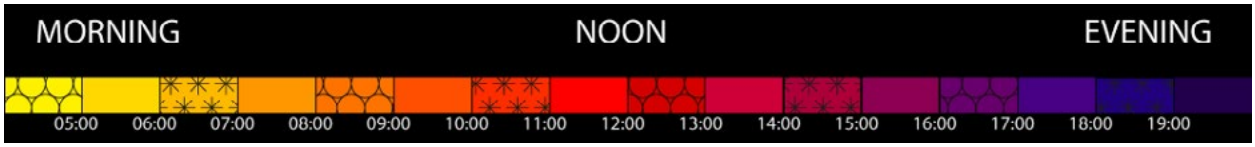


Fig. 29: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 272

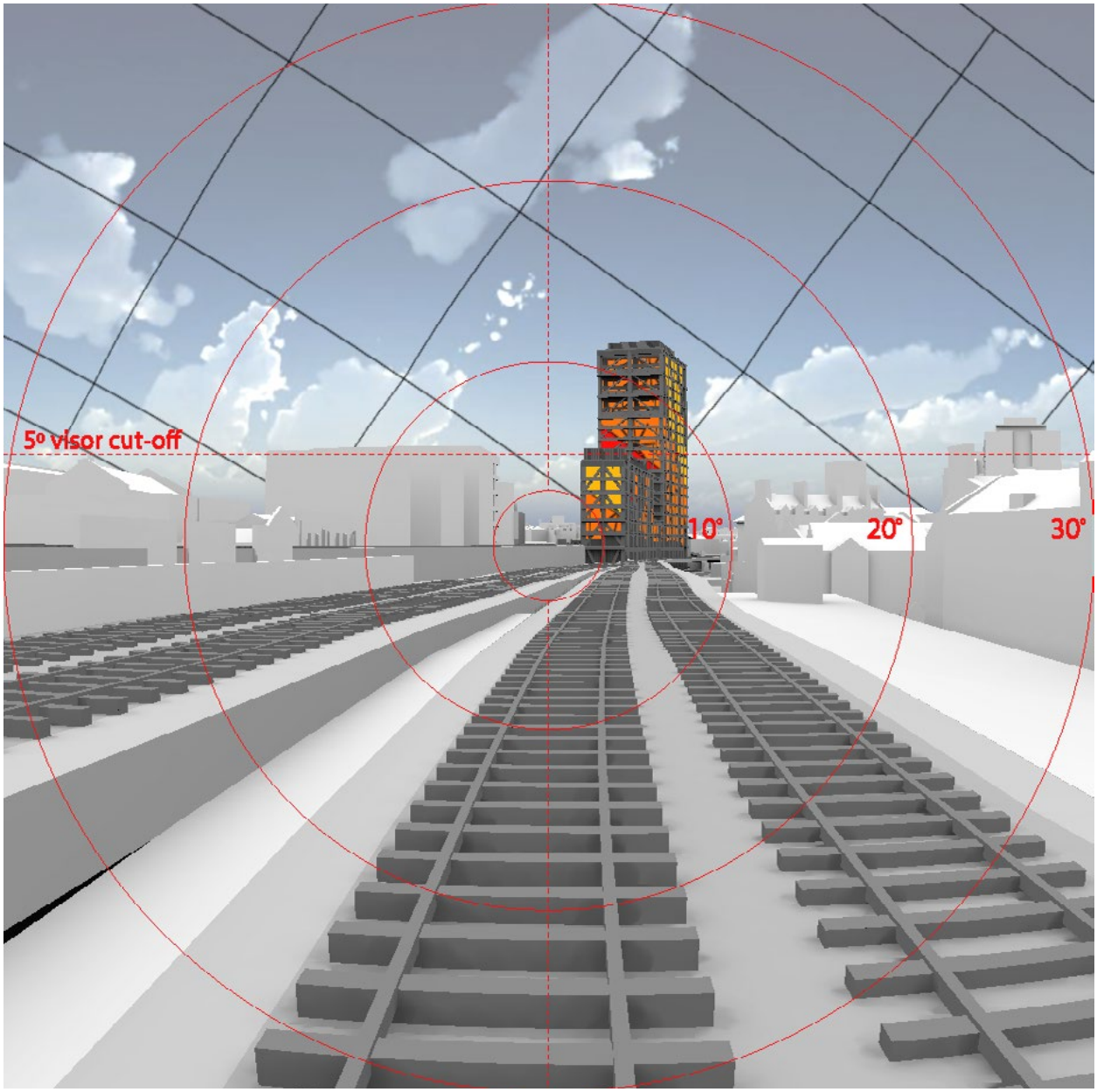


Fig. 30: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 303

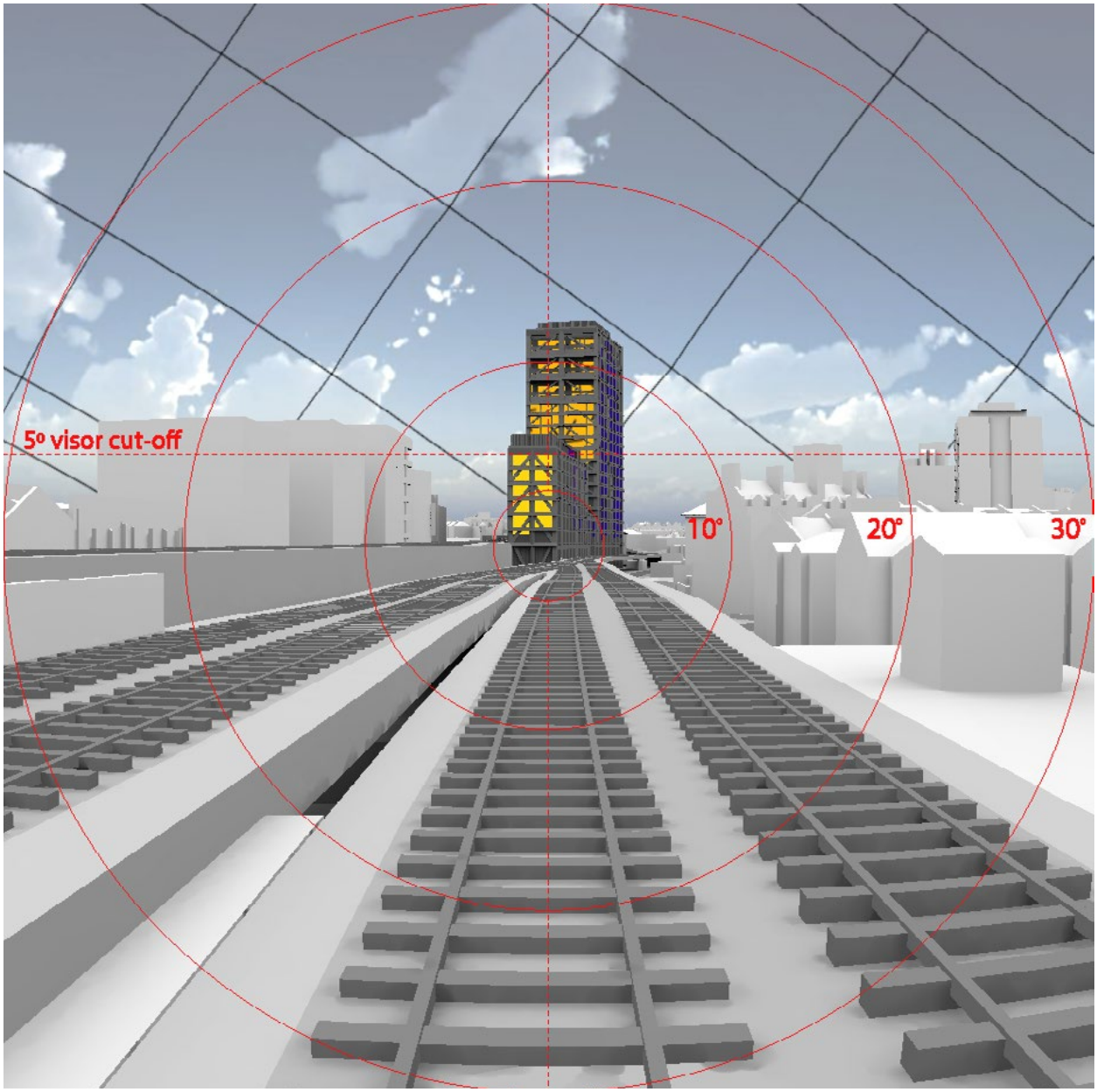
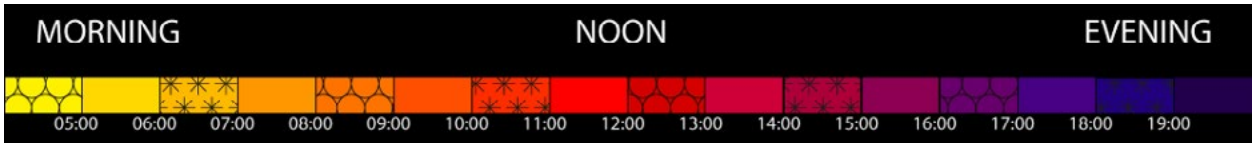


Fig. 31: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 303

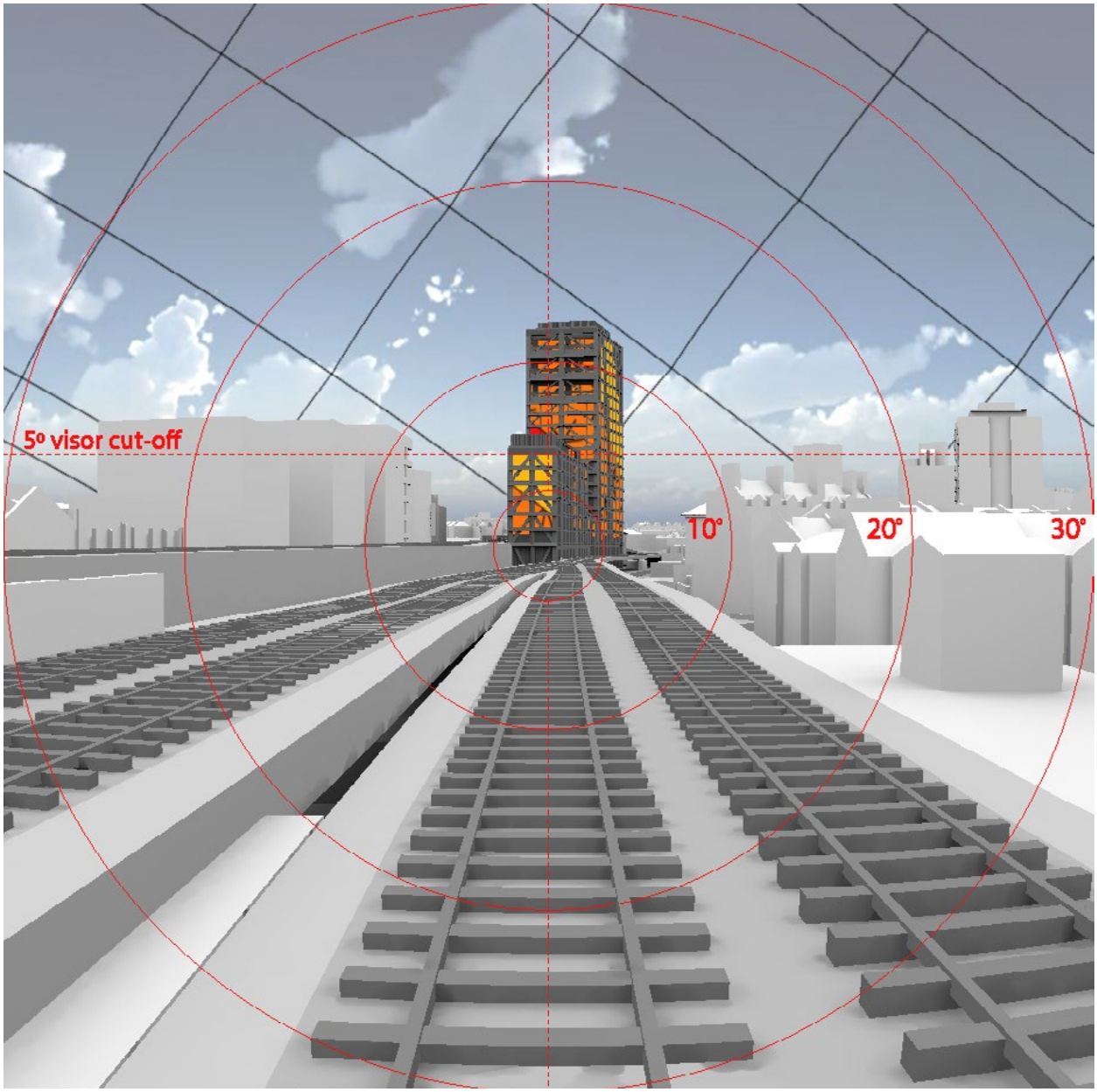


Fig. 32: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 416

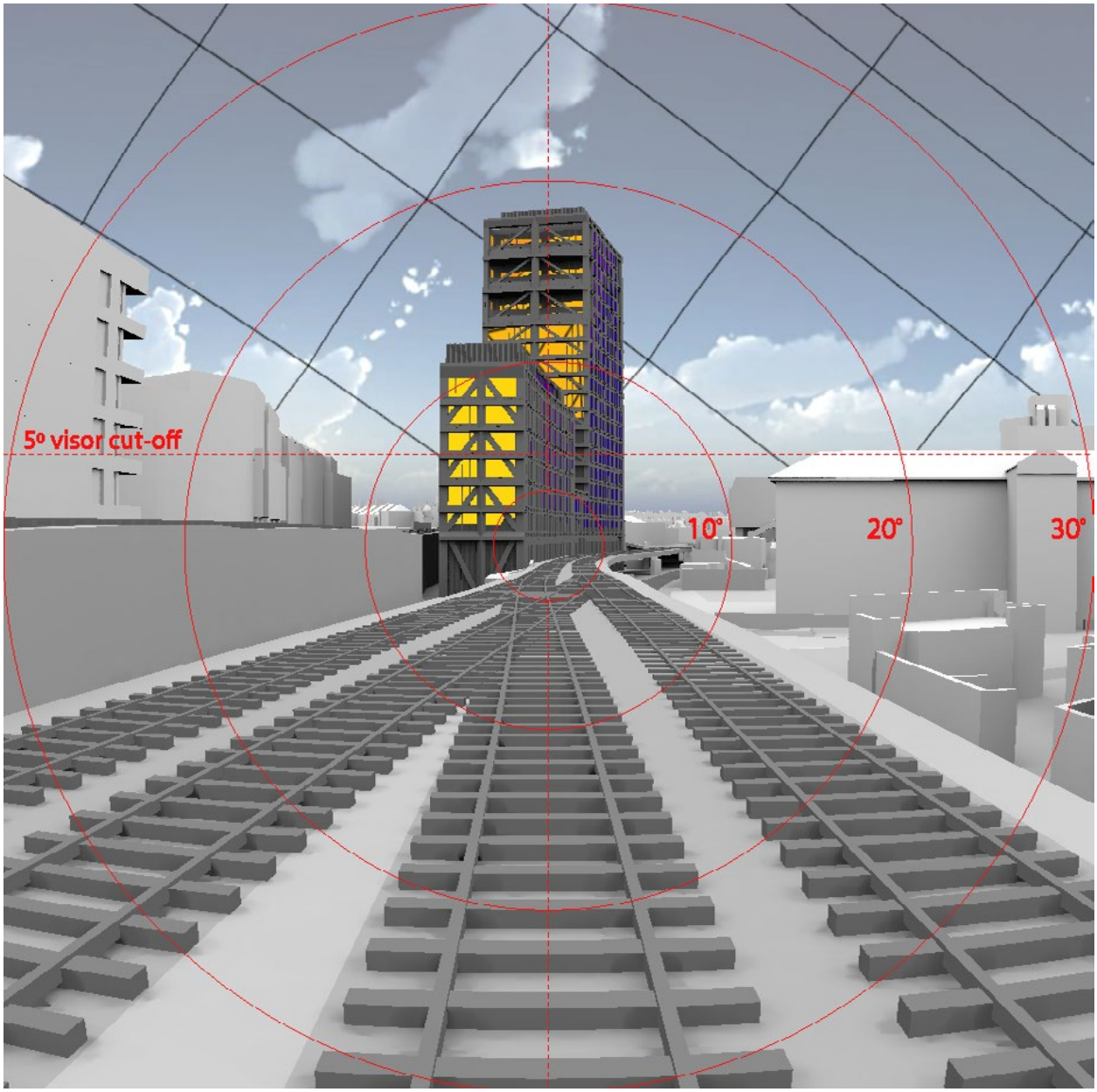
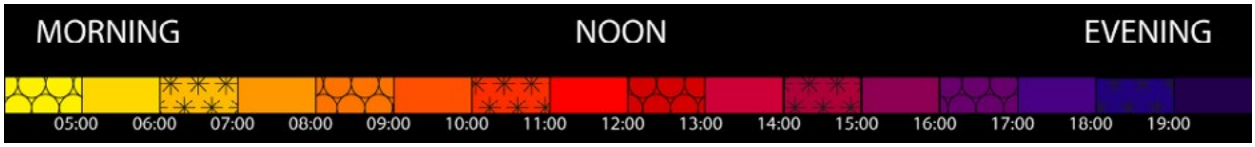


Fig. 33: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 416

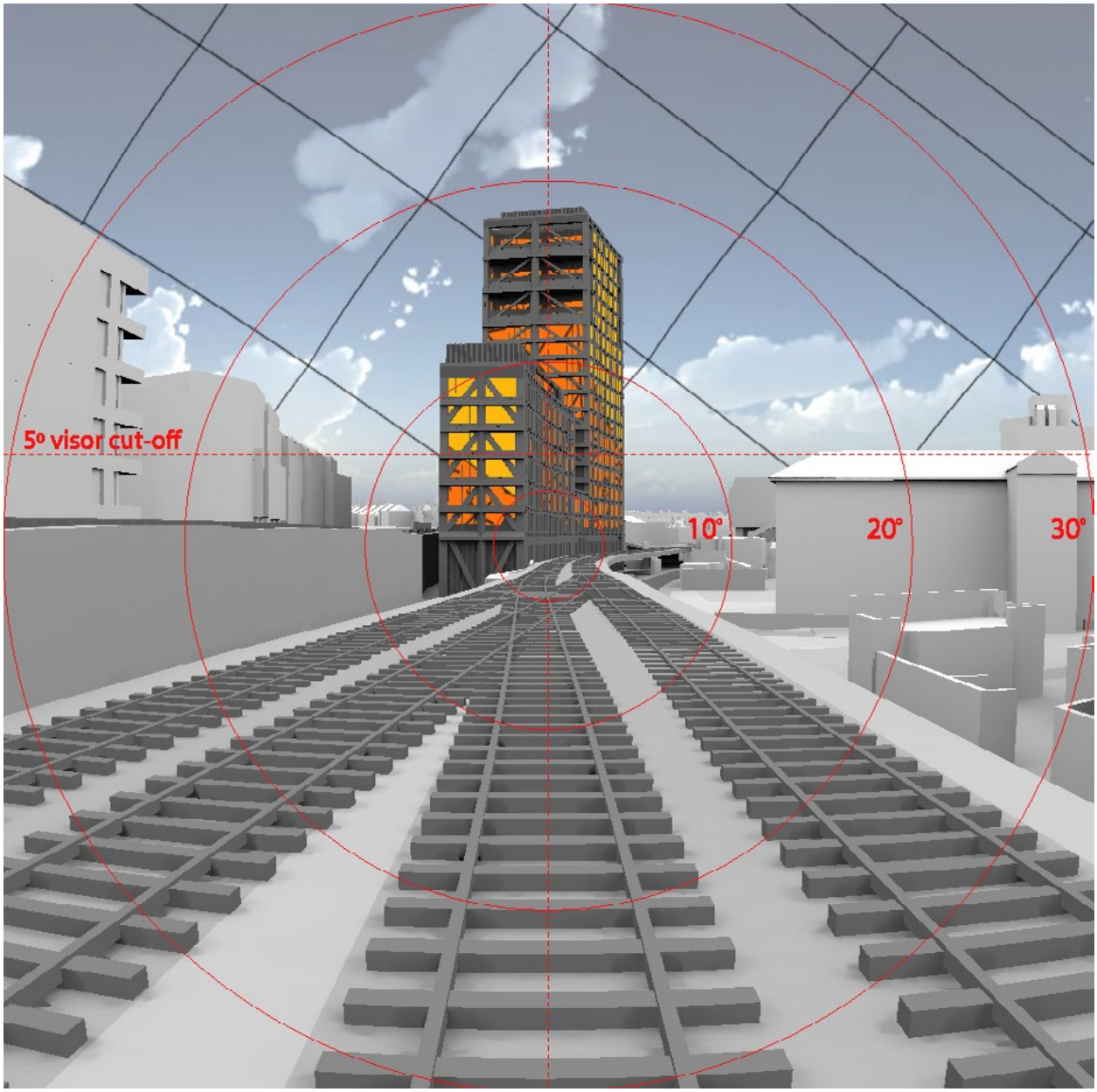


Fig. 34: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 531

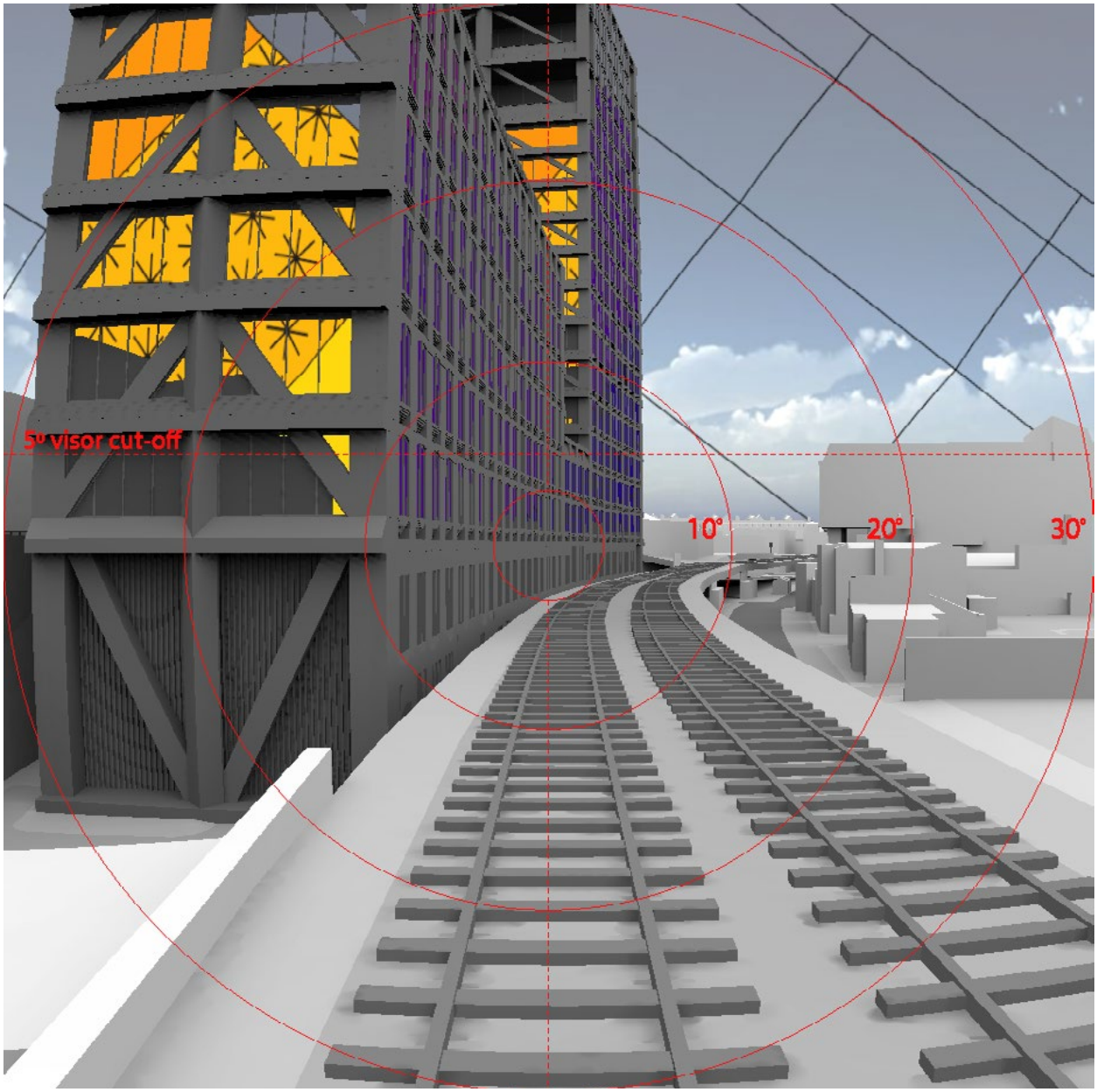
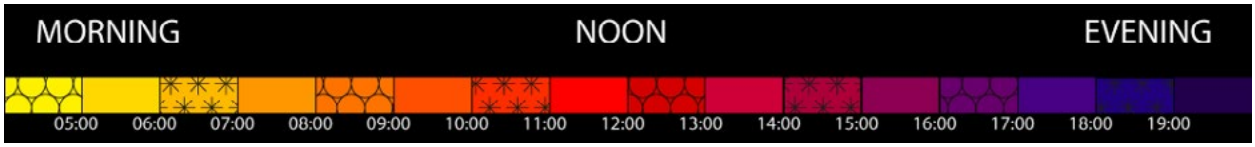


Fig. 35: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 531

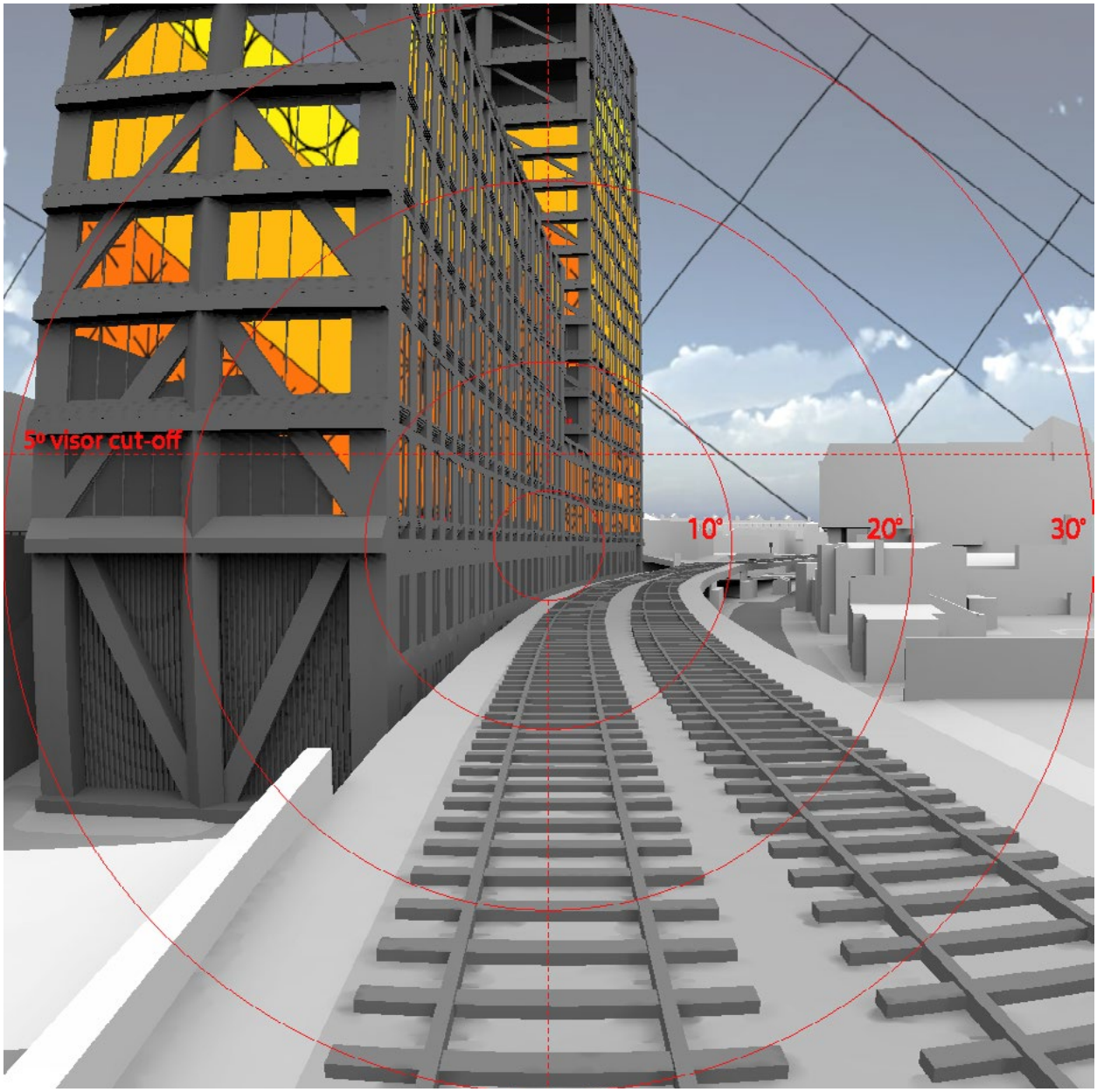


Fig. 36: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 646

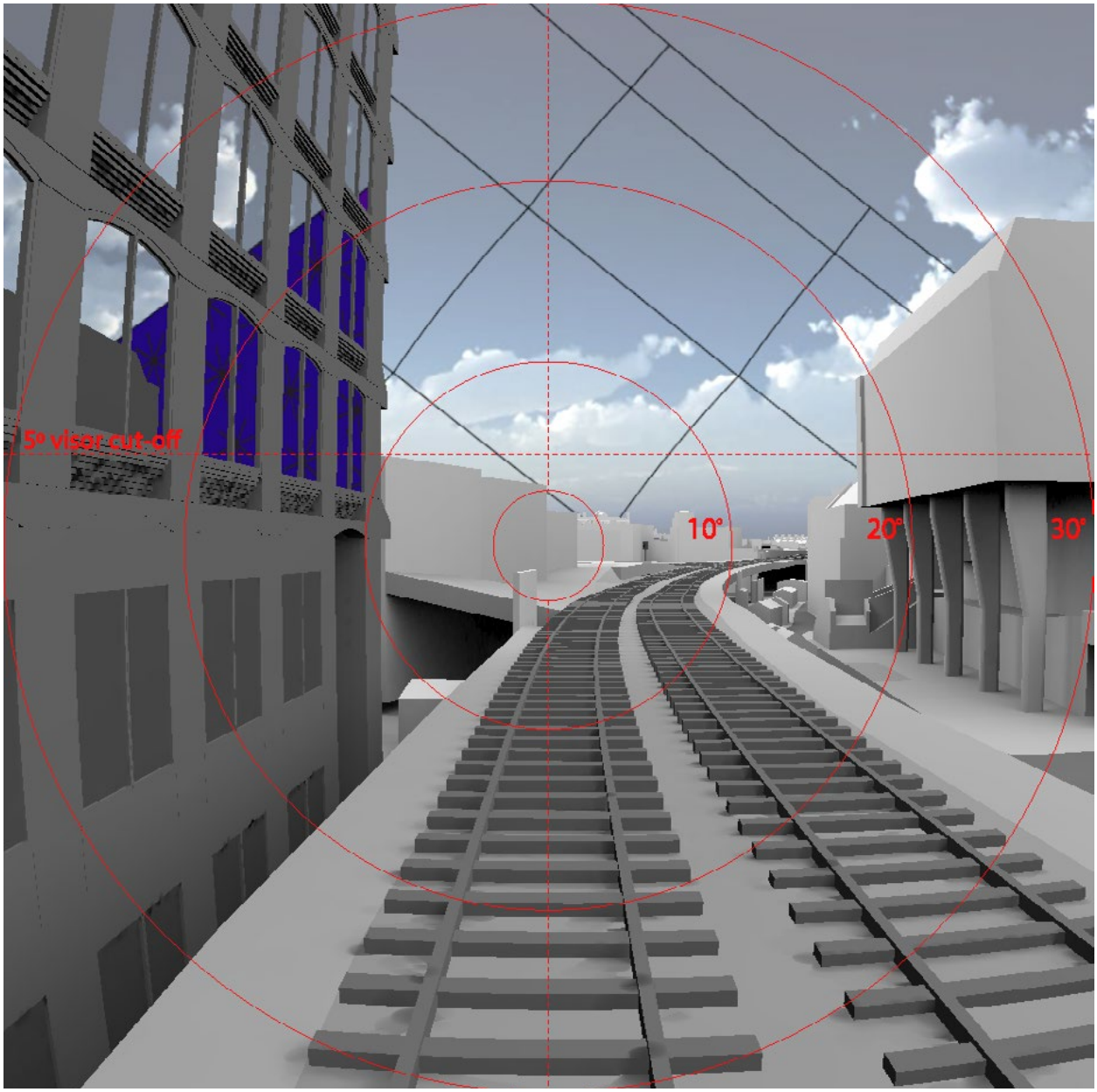
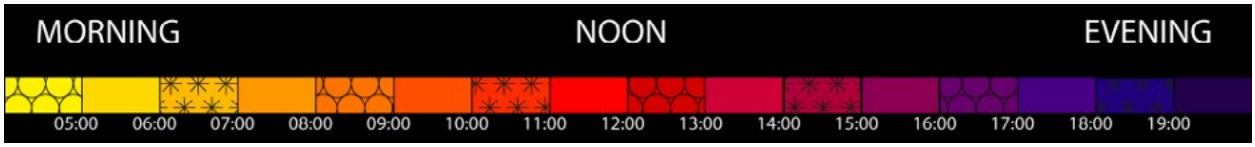


Fig. 37: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 646

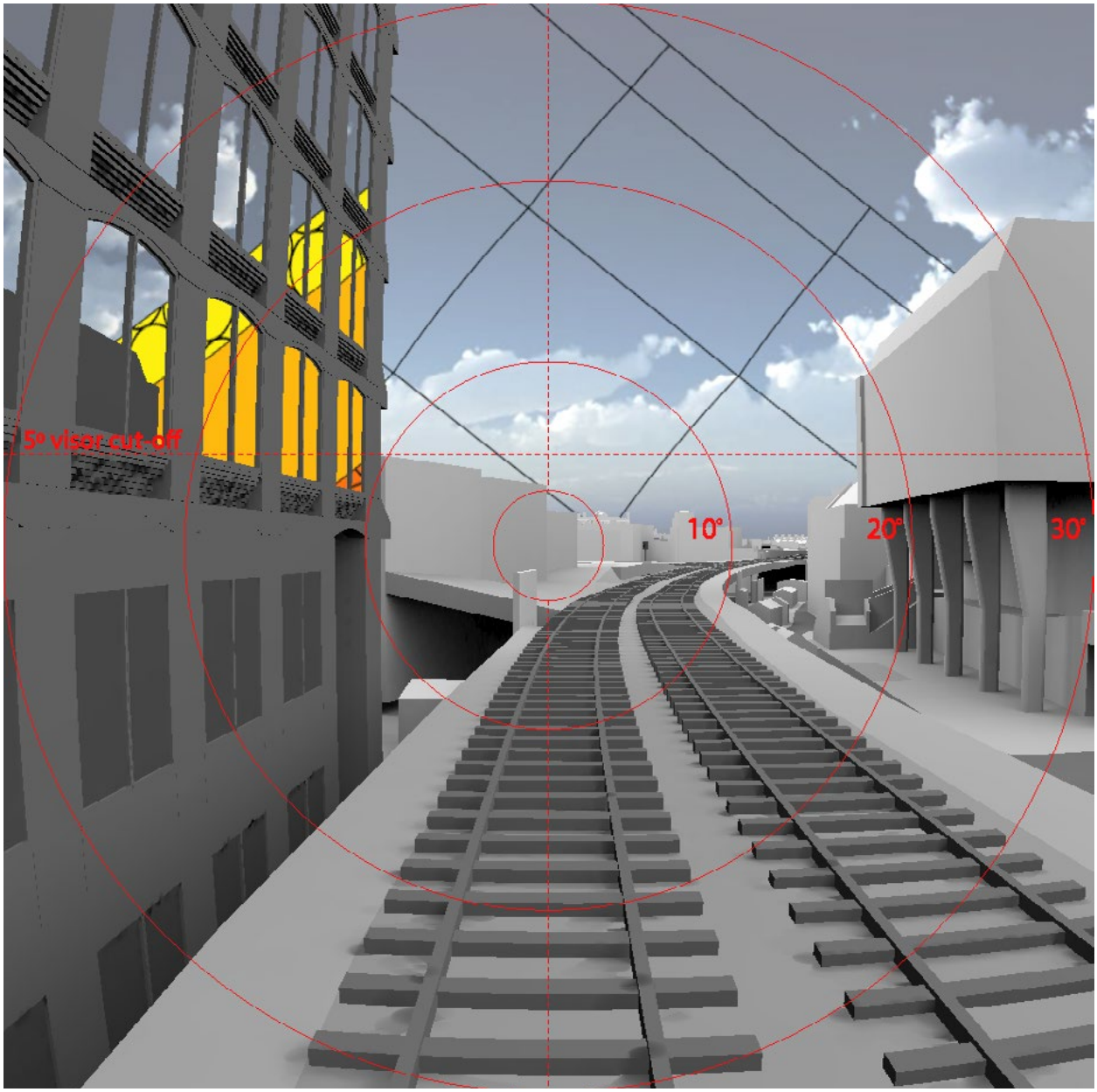


Fig. 38: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR1 - FRAME 664

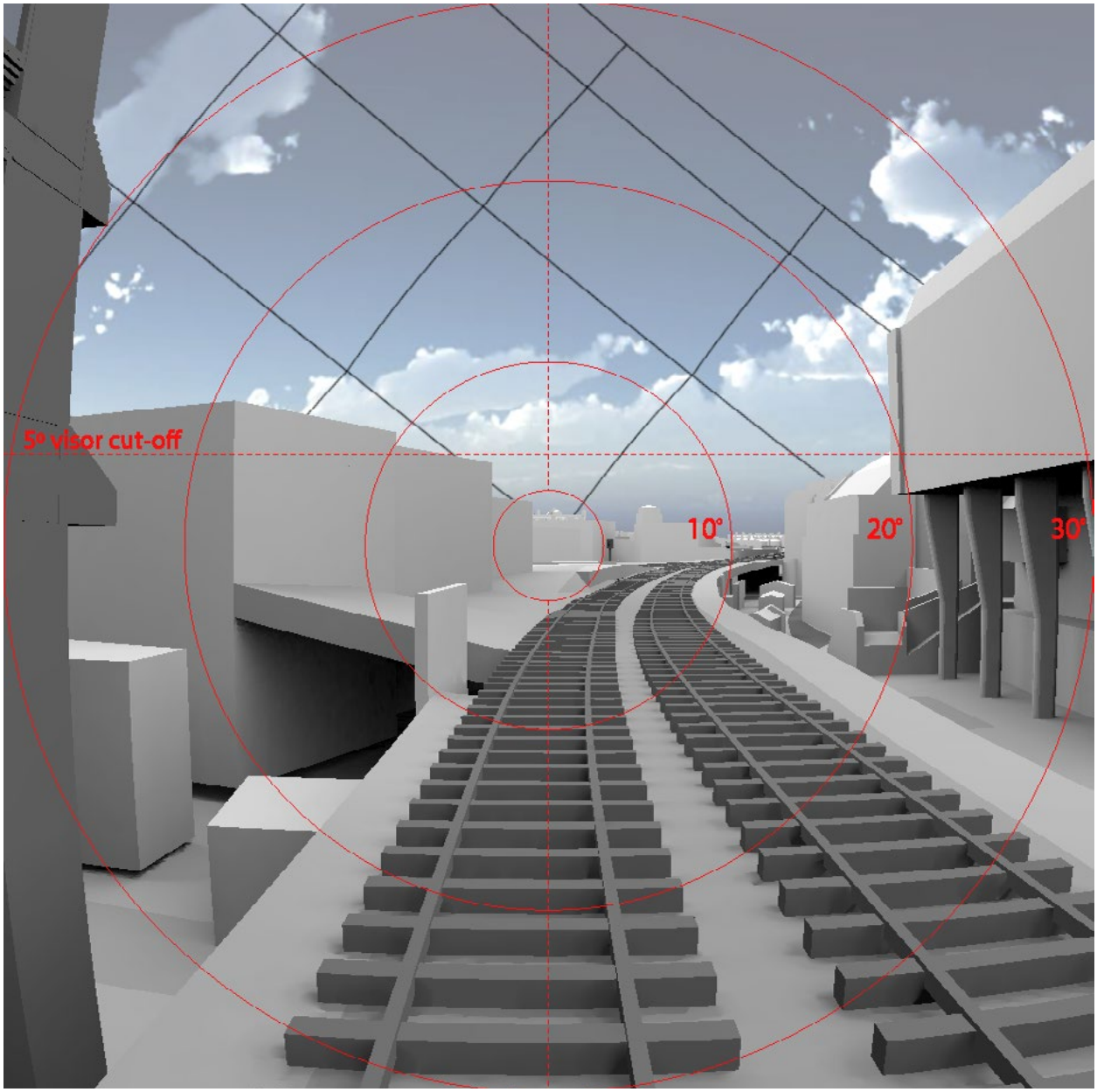
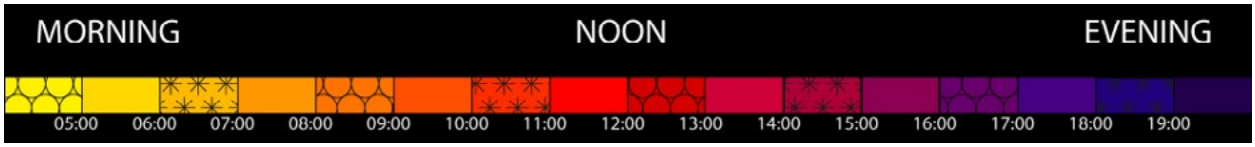


Fig. 39: Solar reflections



60° FIELD OF VIEW: SEASON
SWR1 - FRAME 664

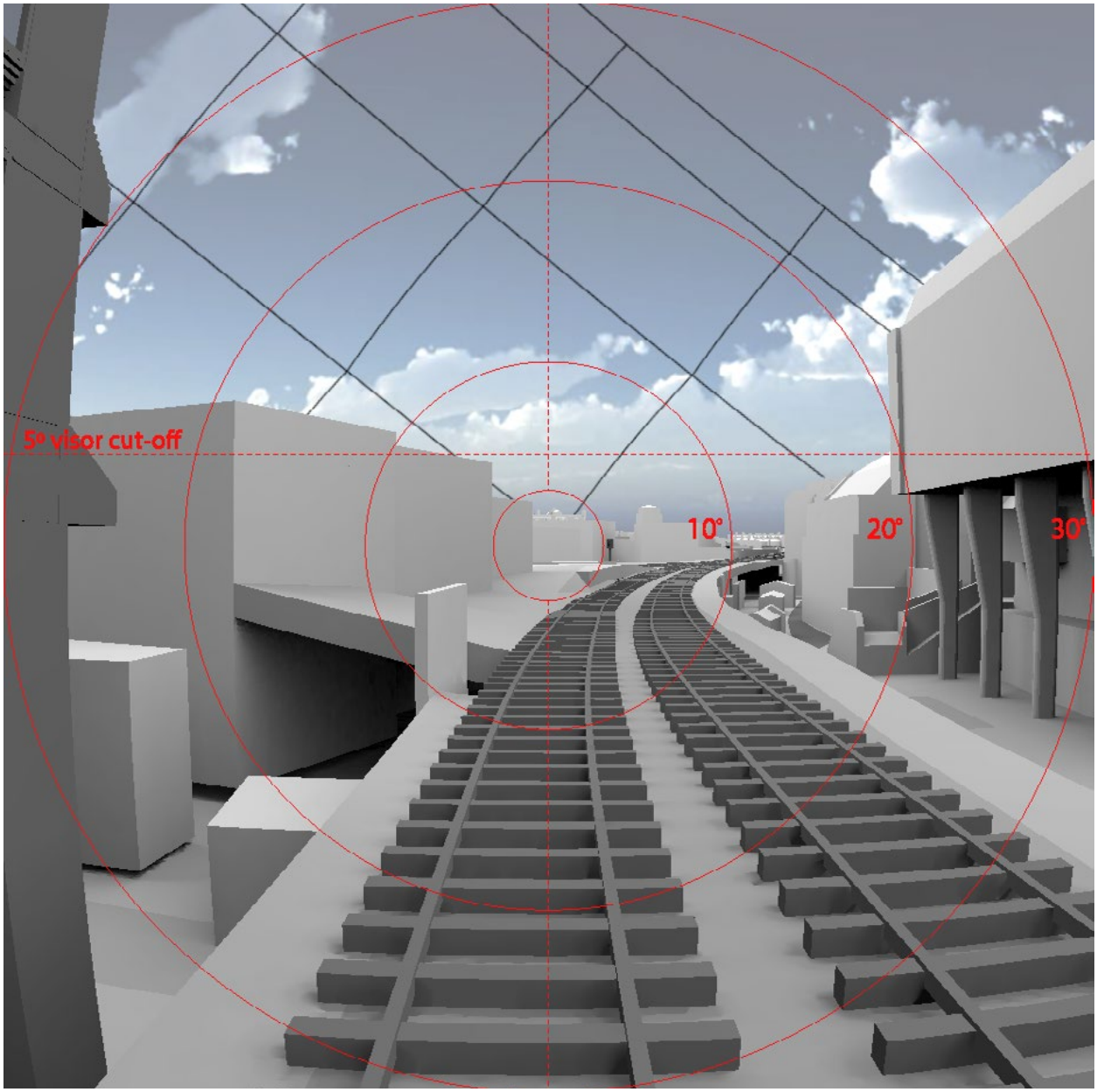


Fig. 40: Solar reflections

60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 200

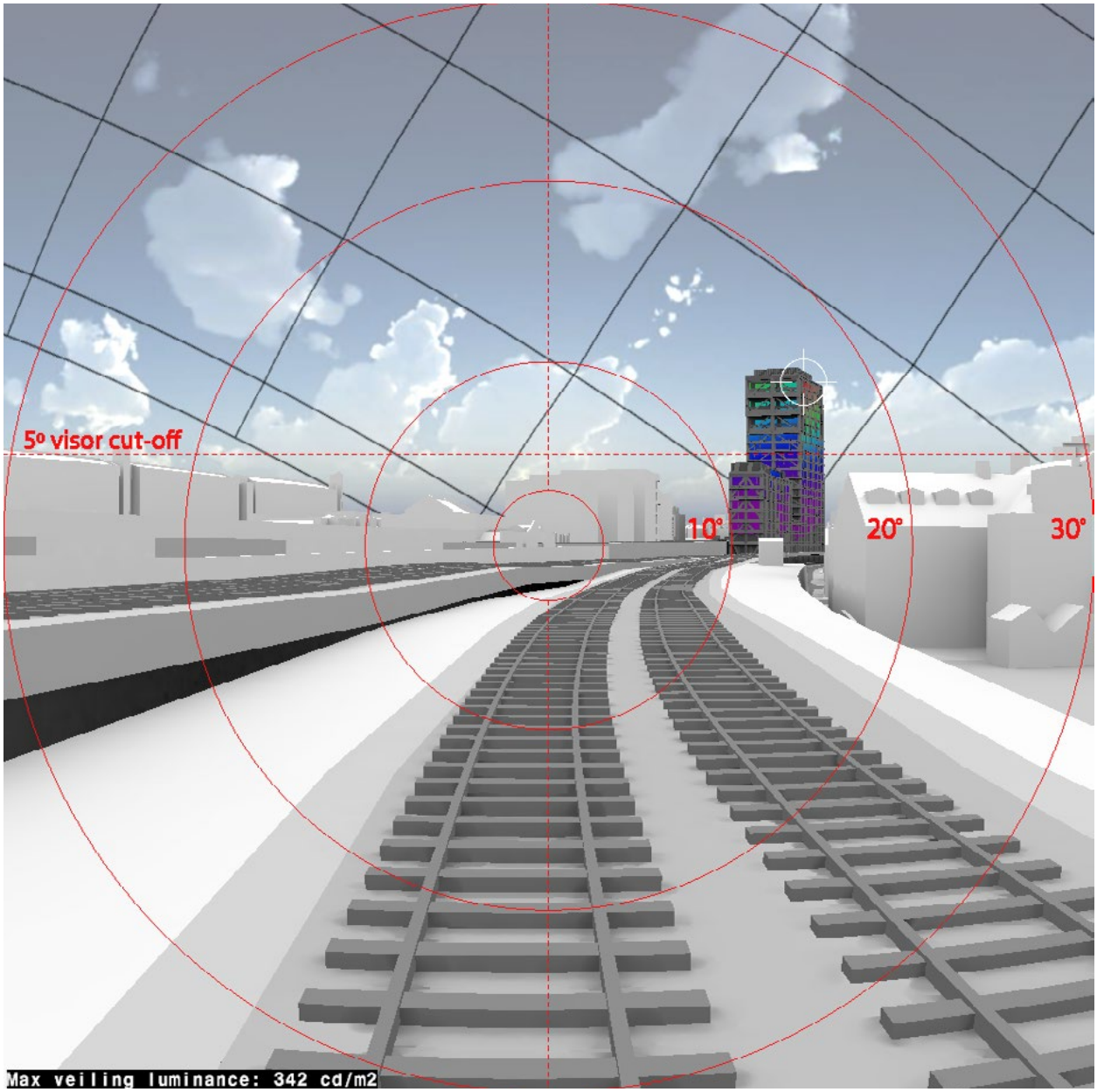
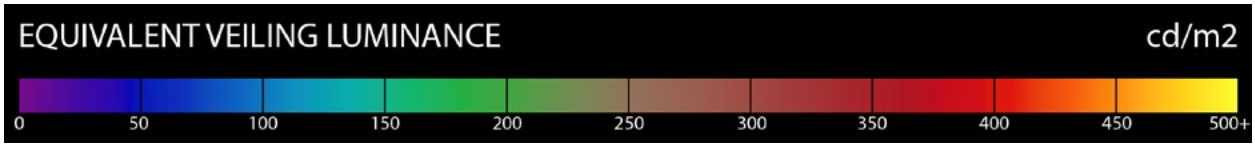


Fig. 41: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 279

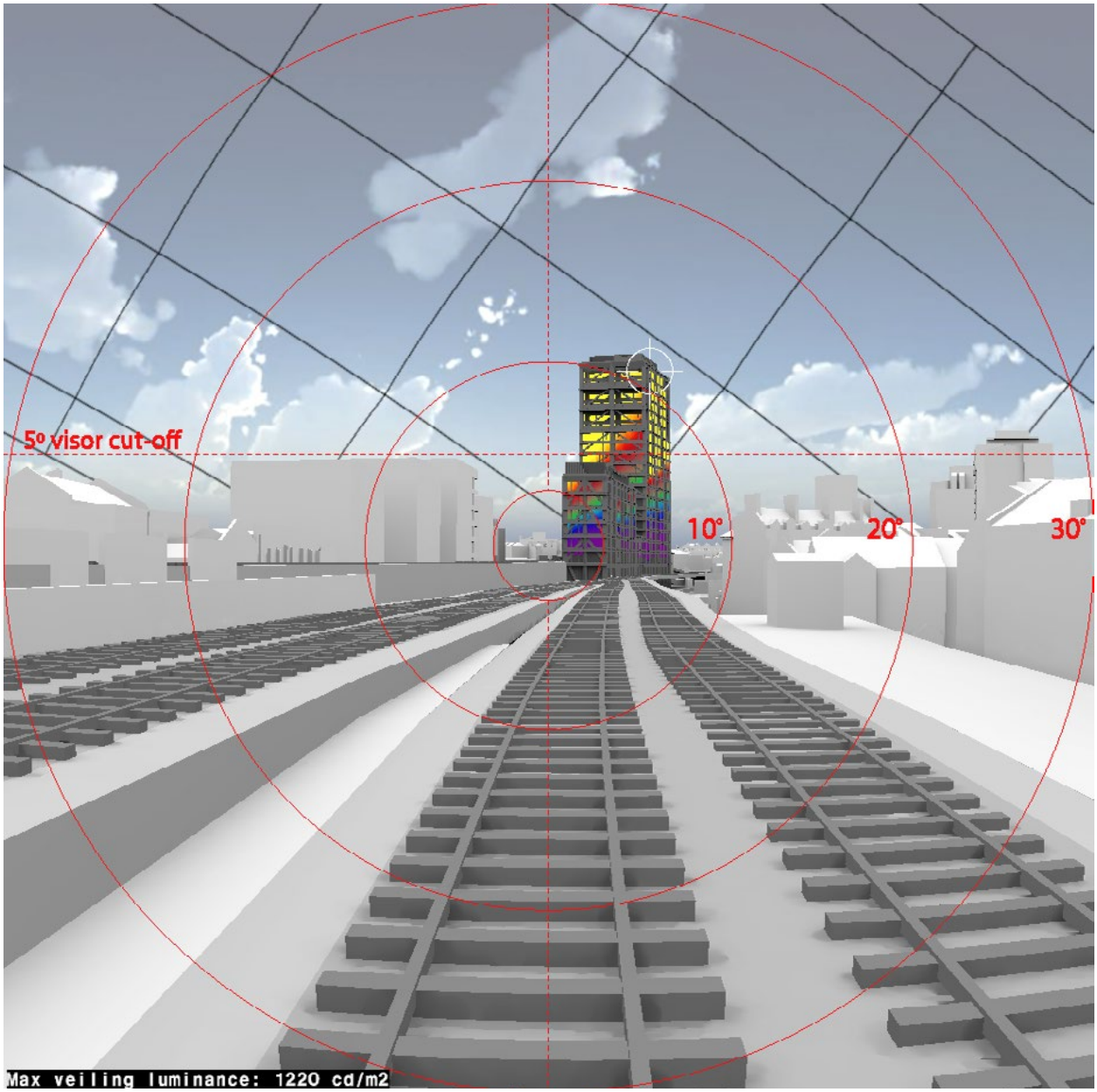
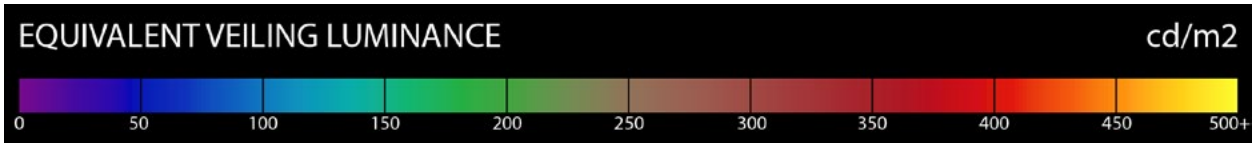


Fig. 42: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 286

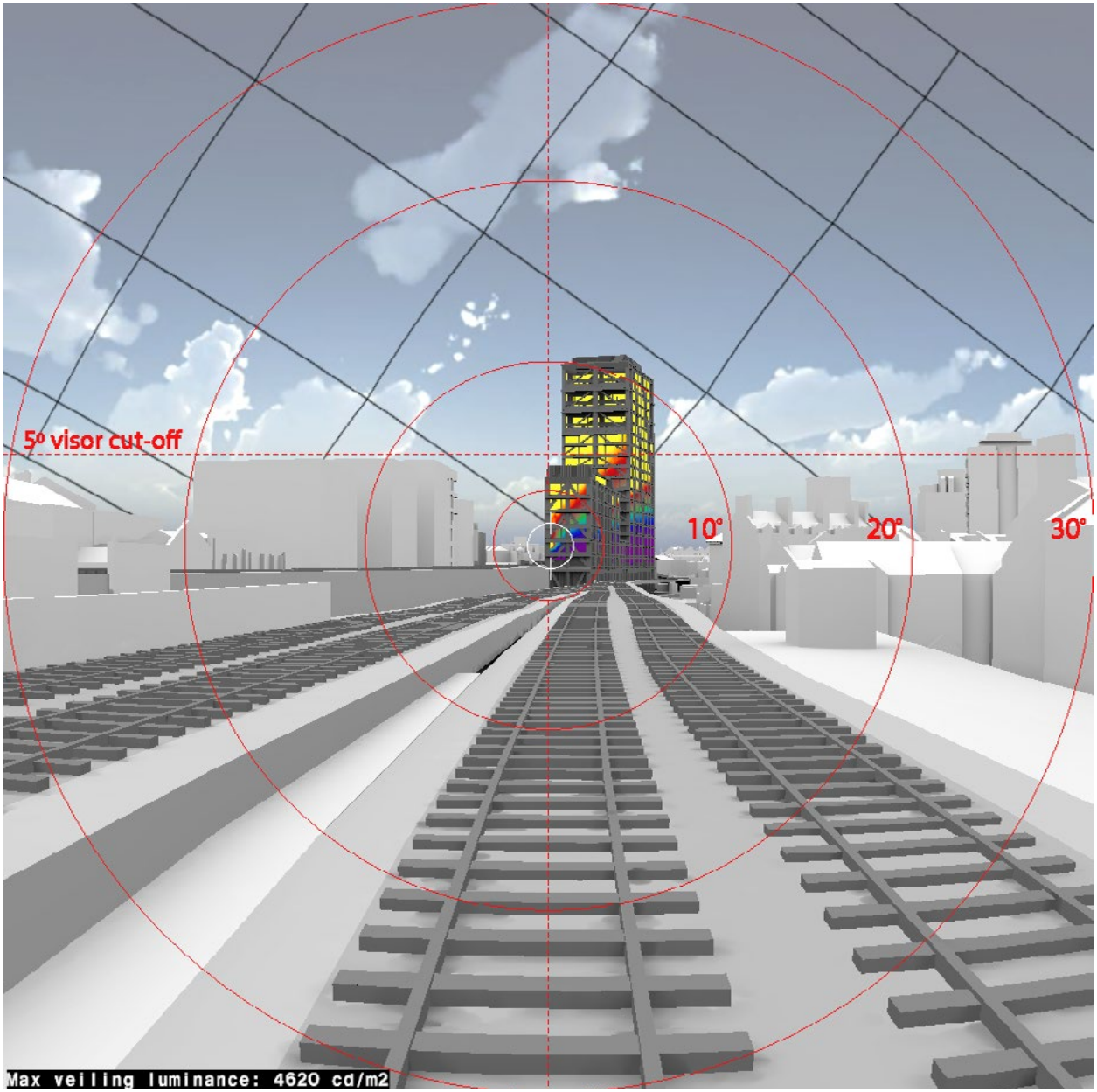
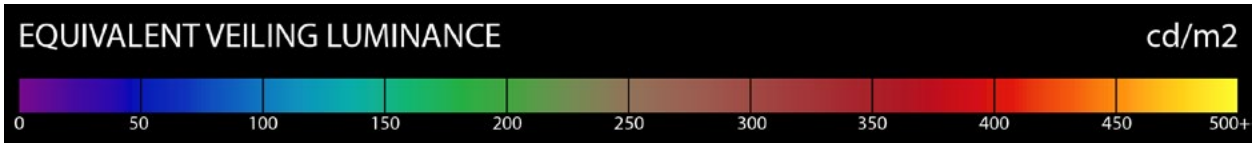


Fig. 43: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 294

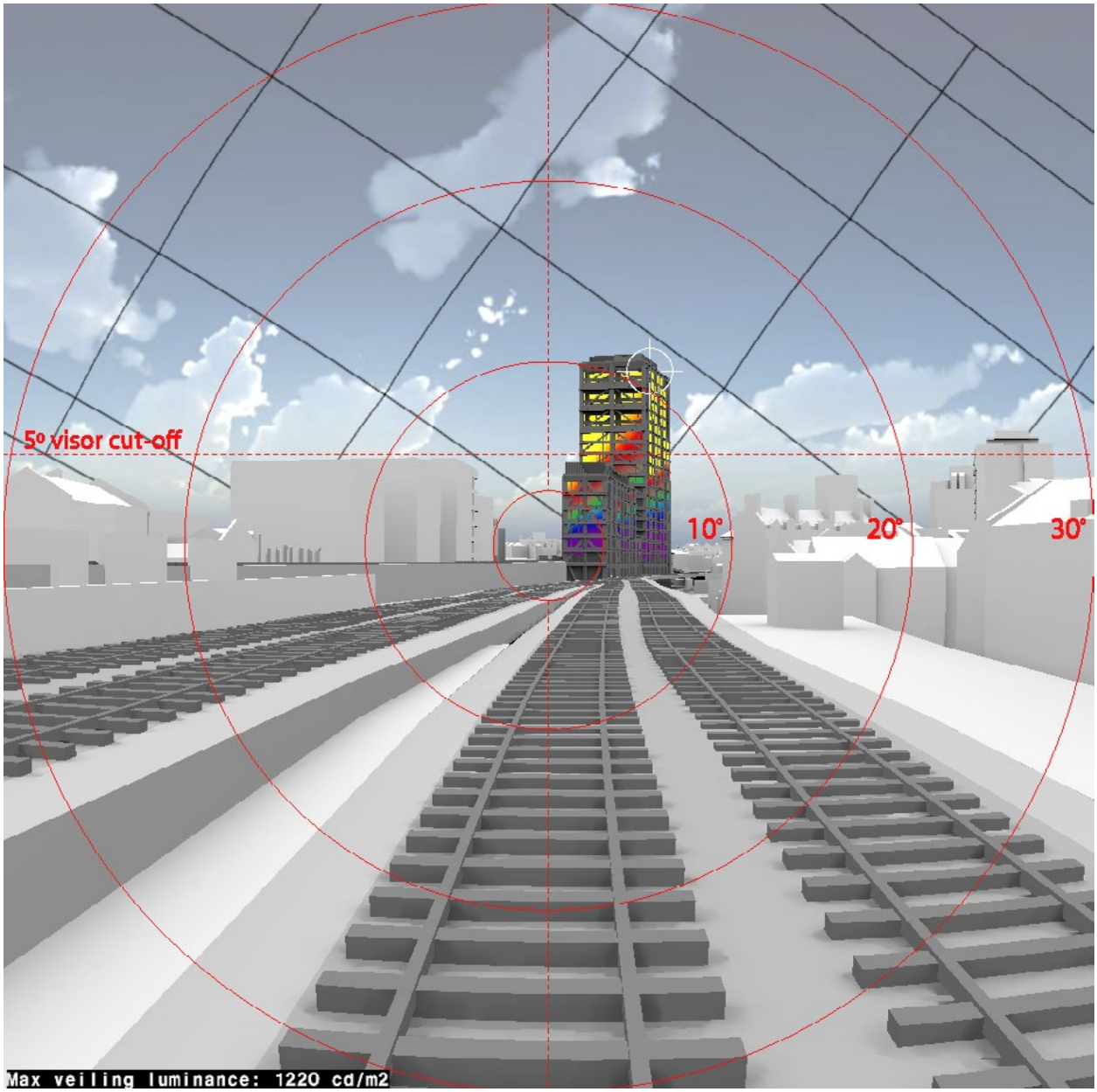
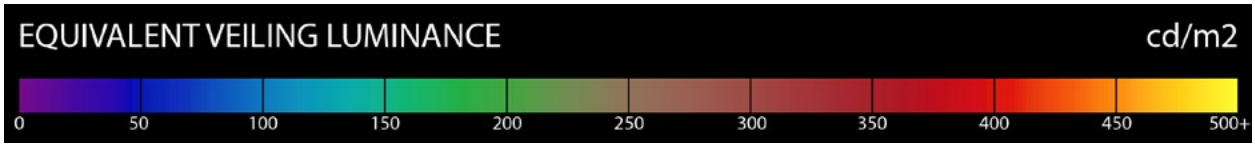


Fig. 44: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 350

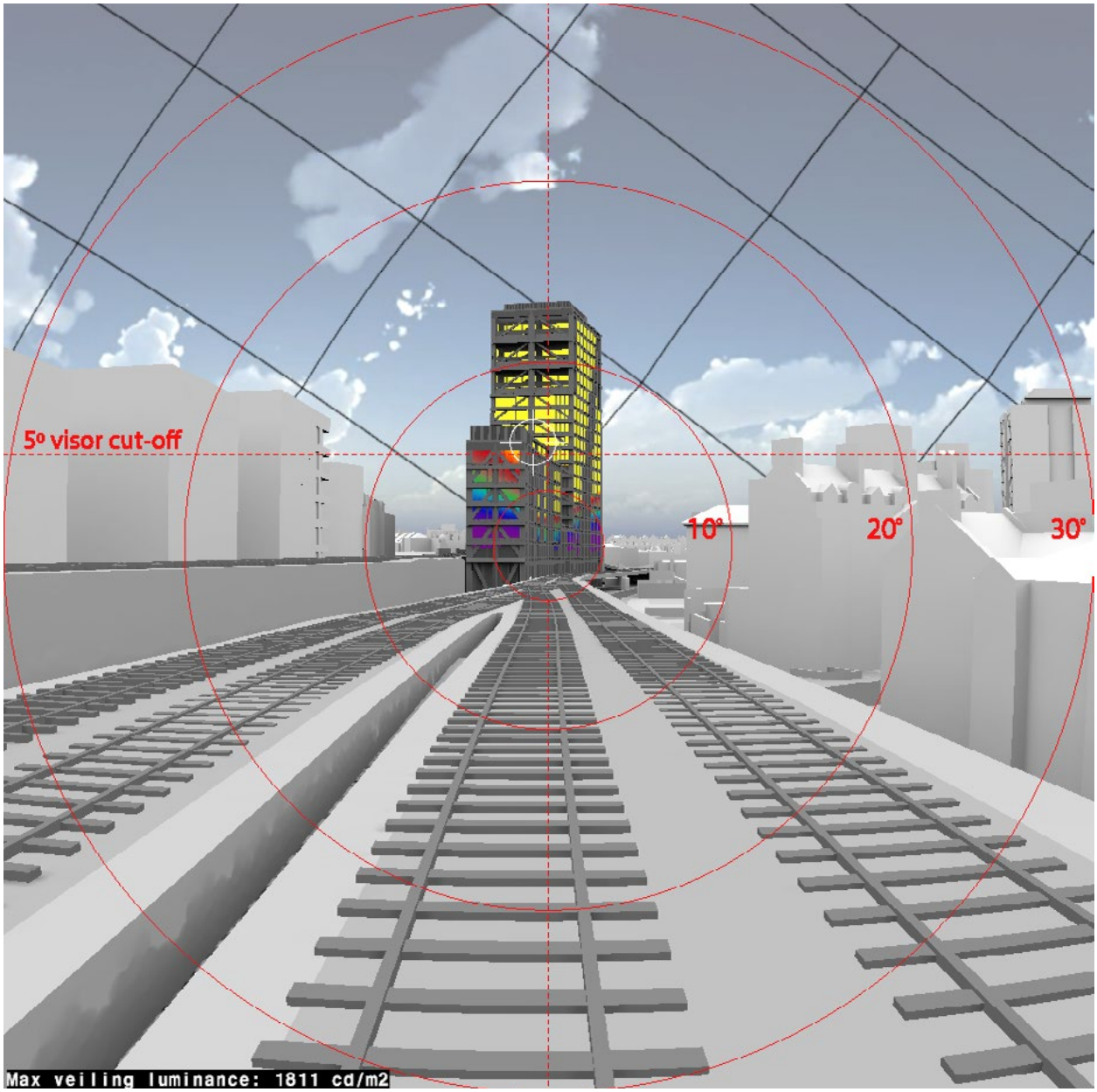
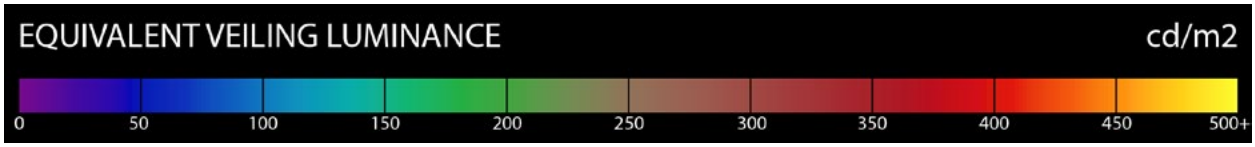


Fig. 45: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 428

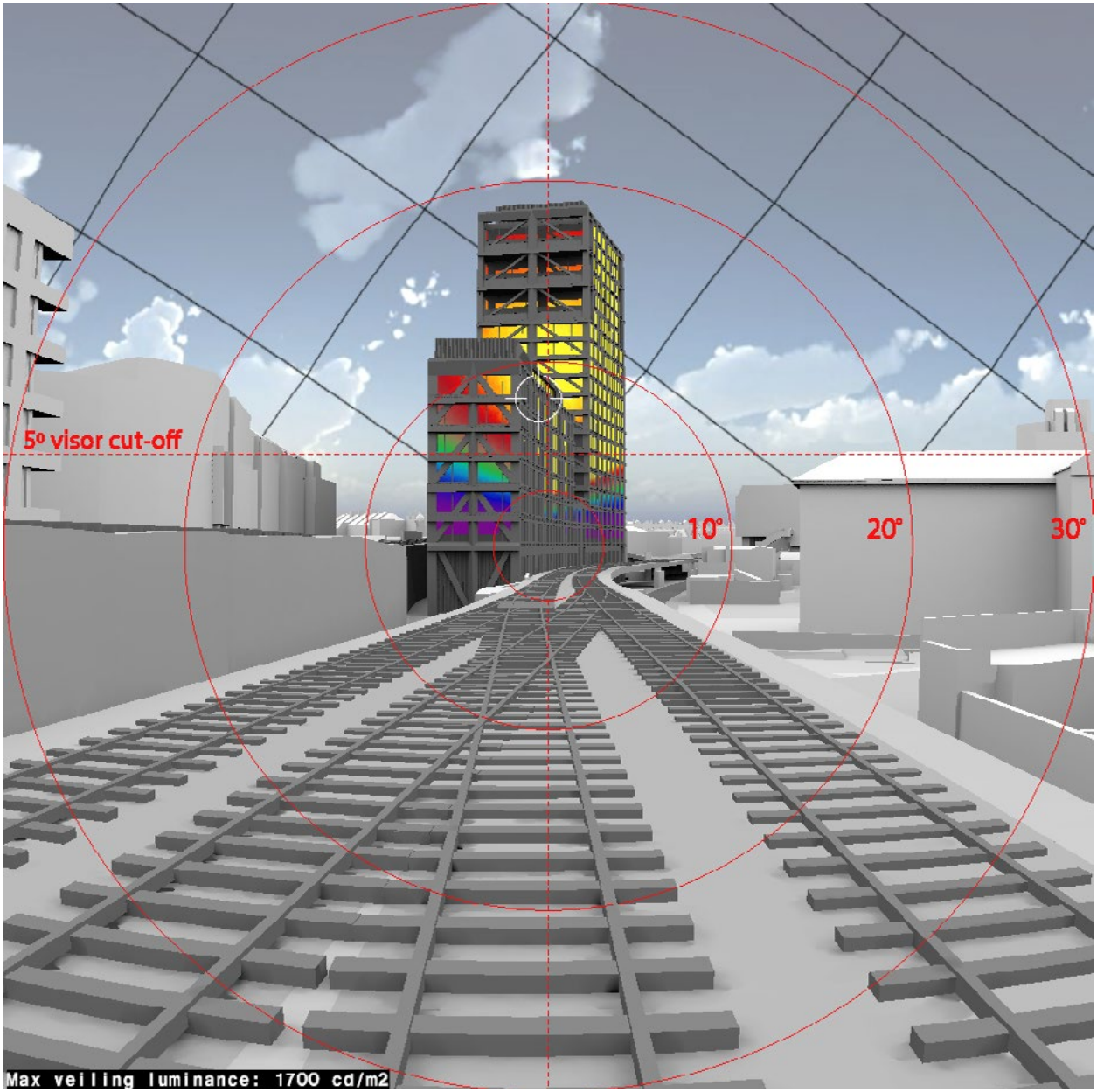
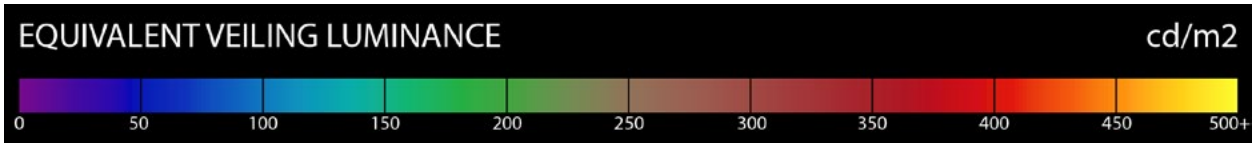


Fig. 46: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 453

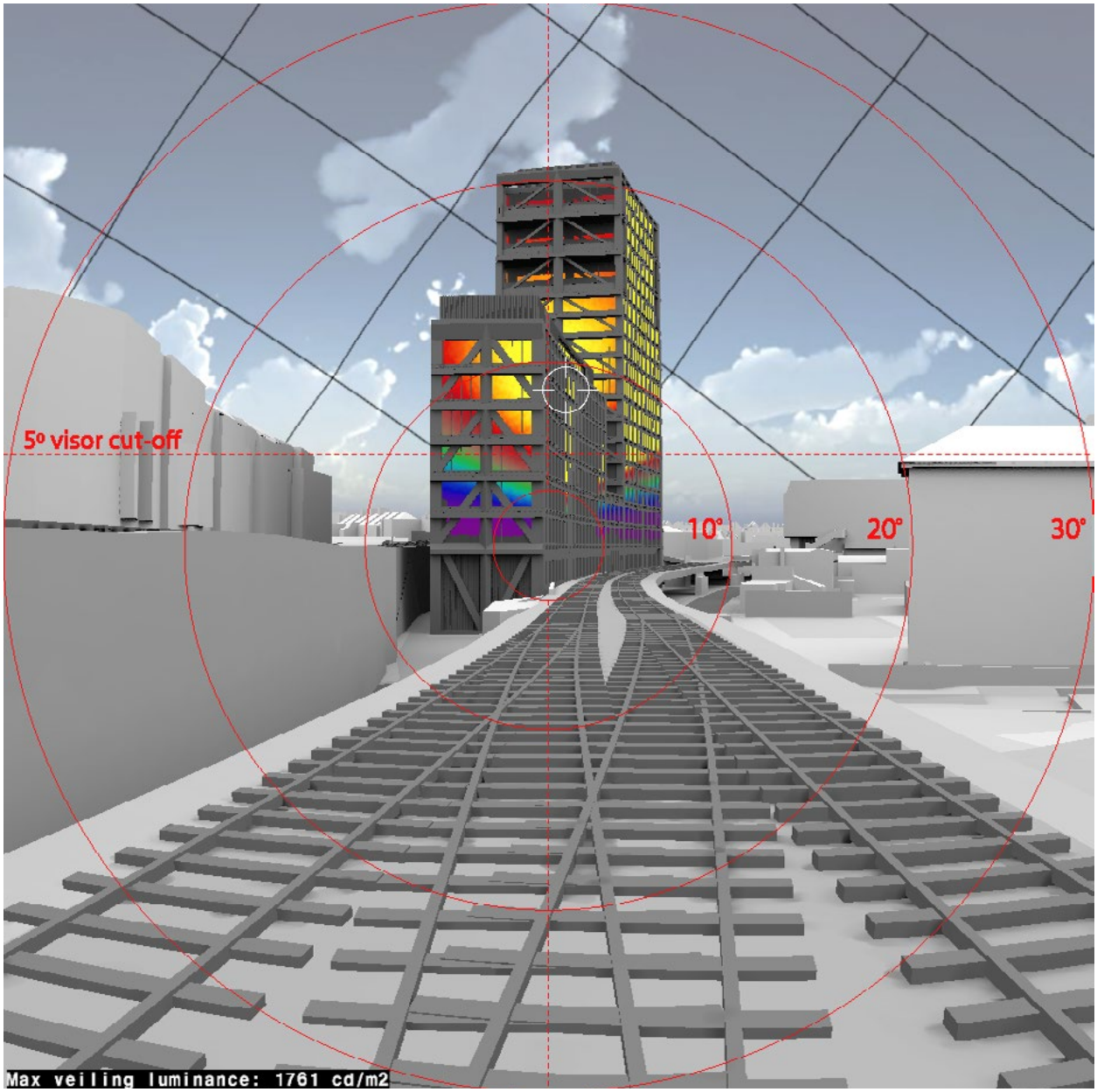
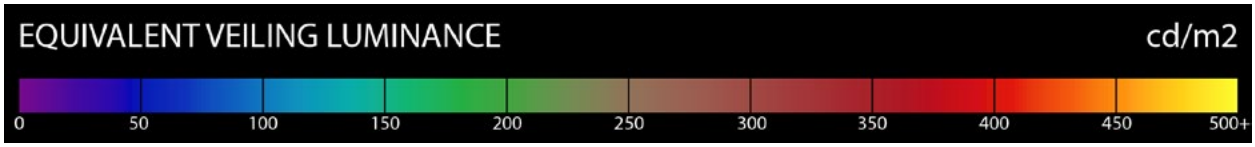


Fig. 47: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 279

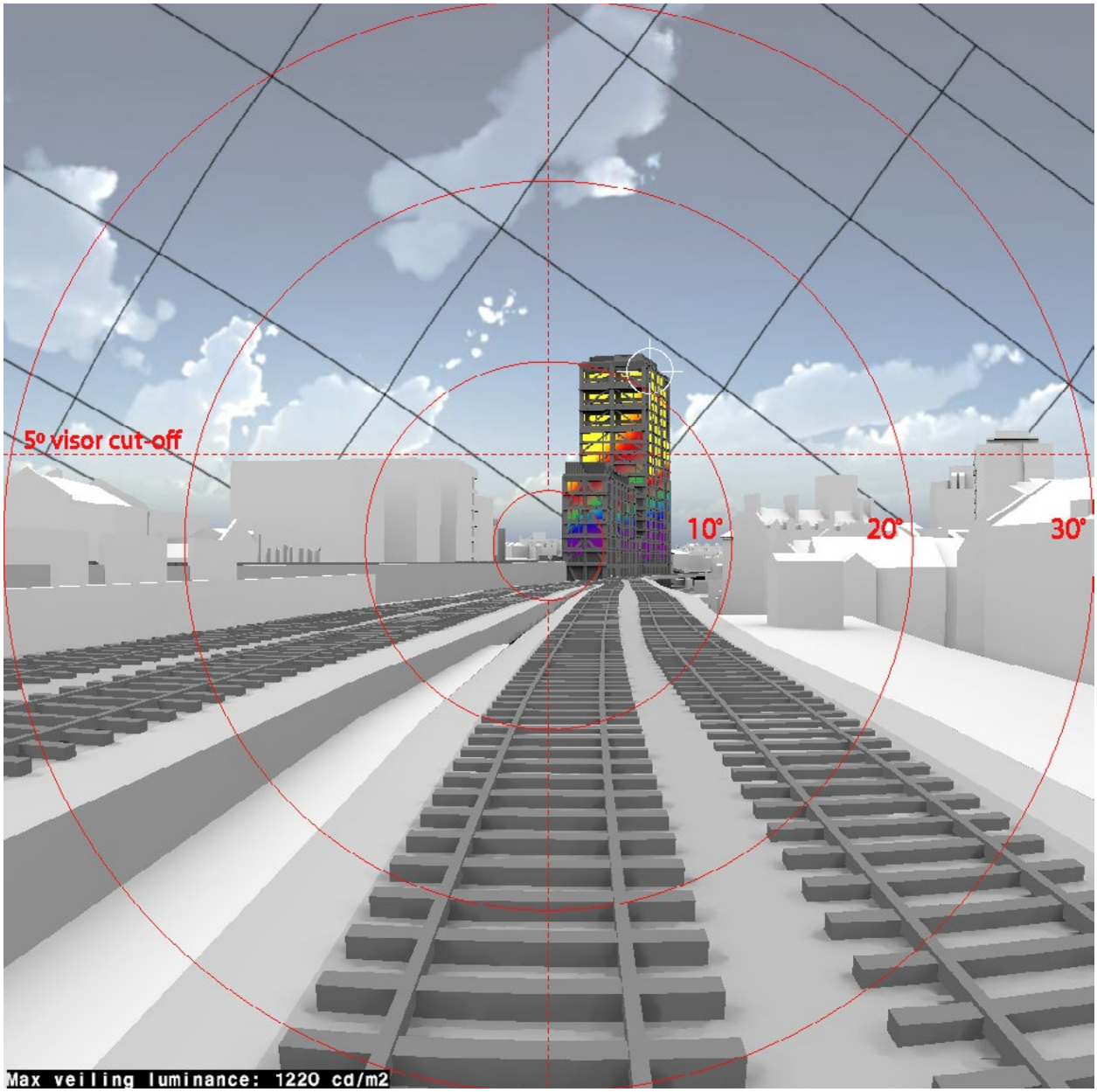
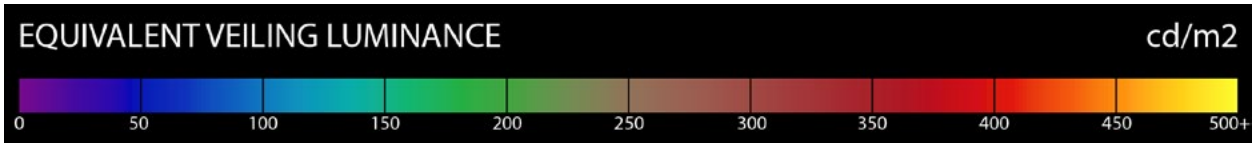


Fig. 48: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR1 - FRAME 531

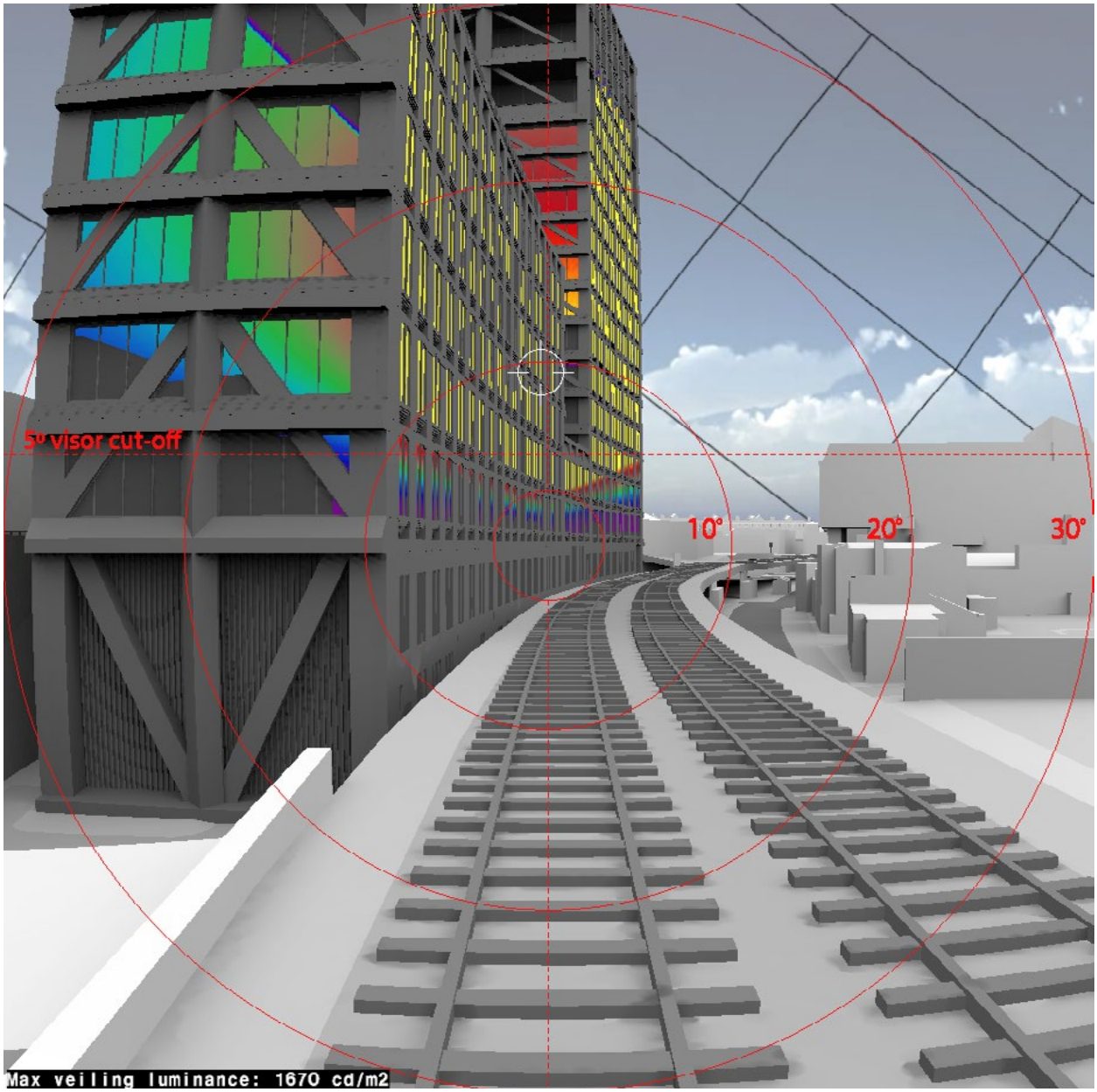
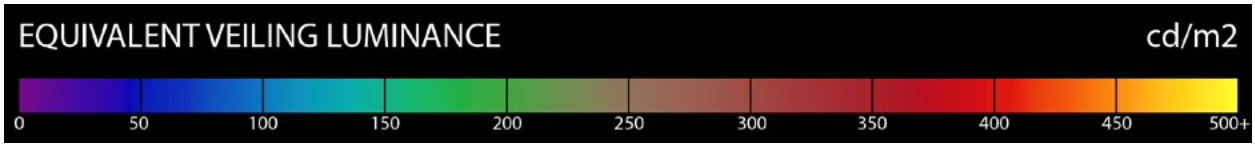


Fig. 49: Solar reflections



APPENDIX 02

SWR2 - EASTBOUND SOUTHWEST RAIL/THAMESLINK LINE

VIEWPOINTS & FRAME NUMBERS
SWR 2

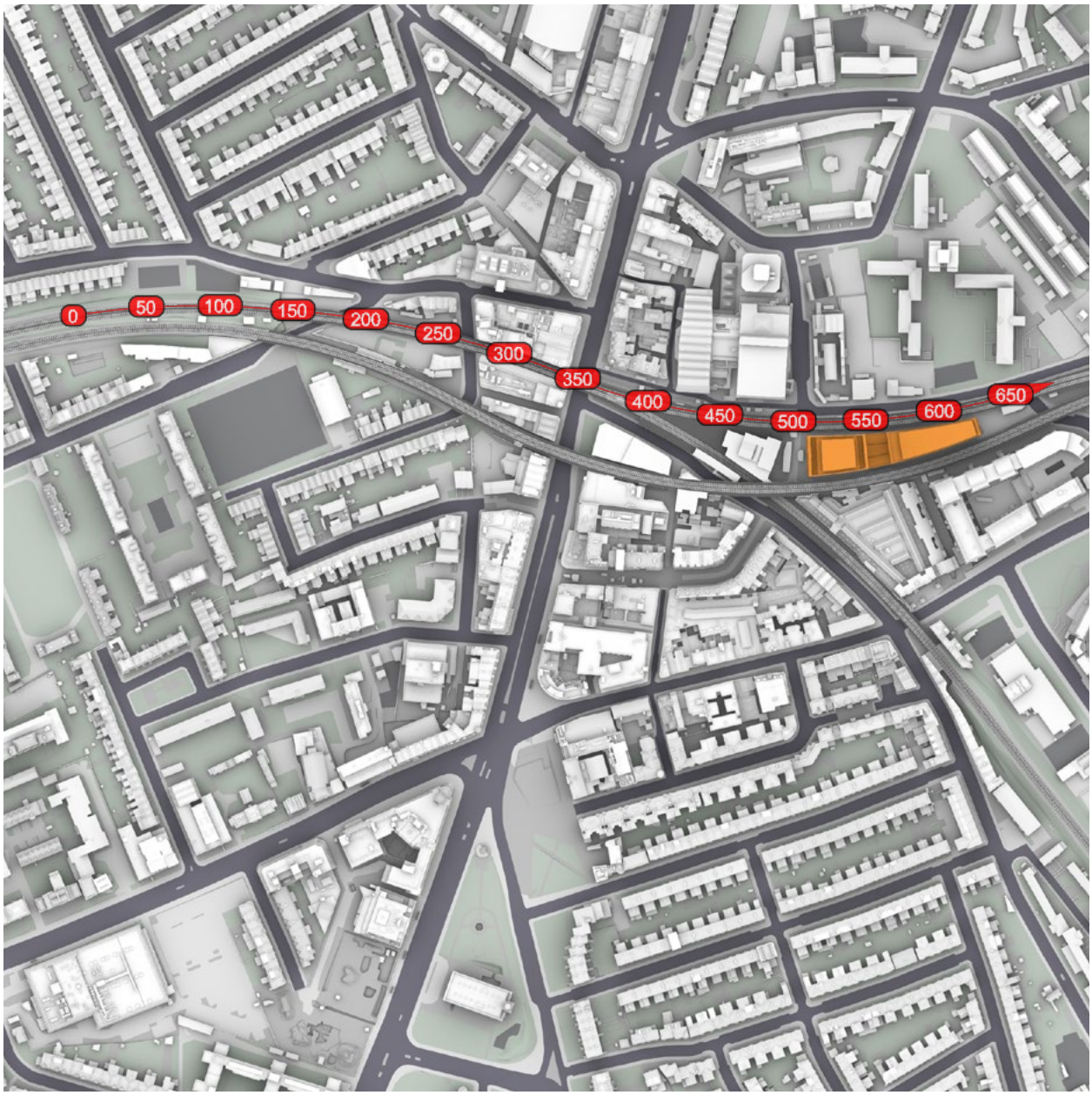


Fig. 50: Viewpoints and frame numbers

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 1

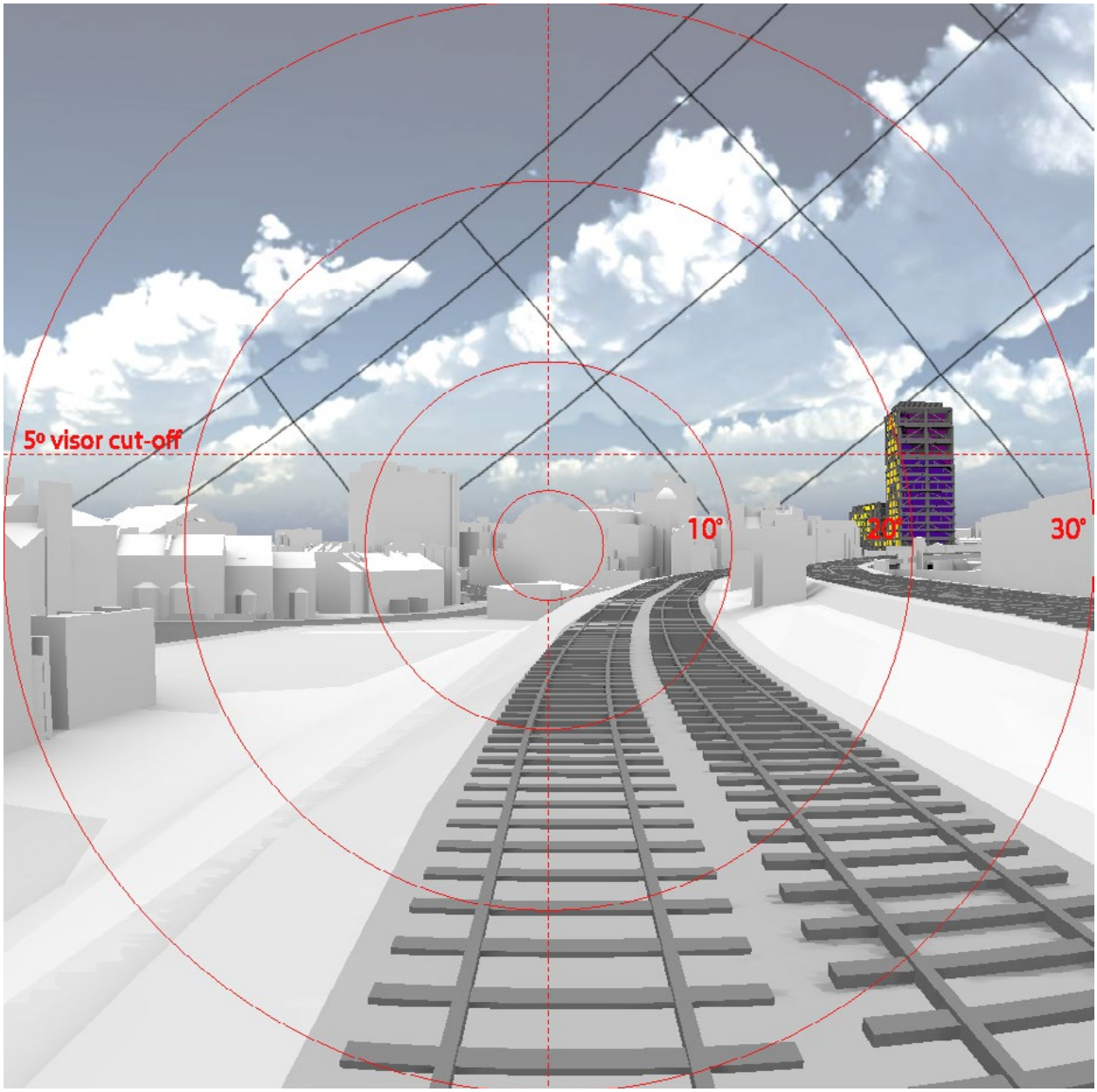
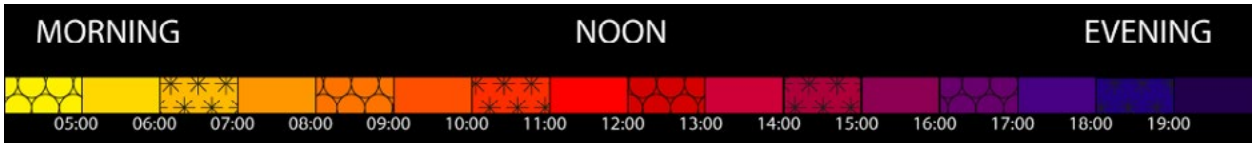


Fig. 51: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 1

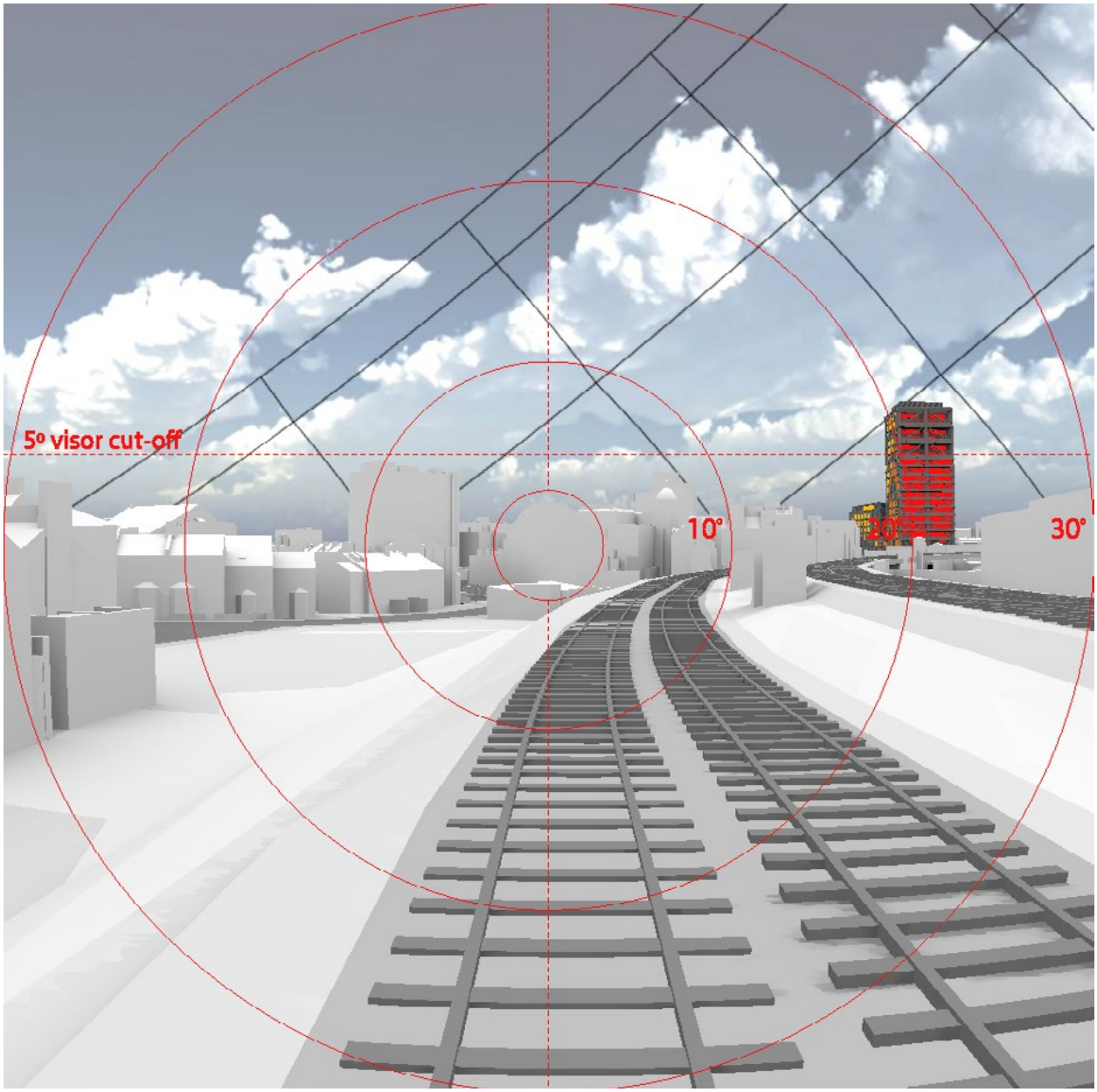


Fig. 52: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 63

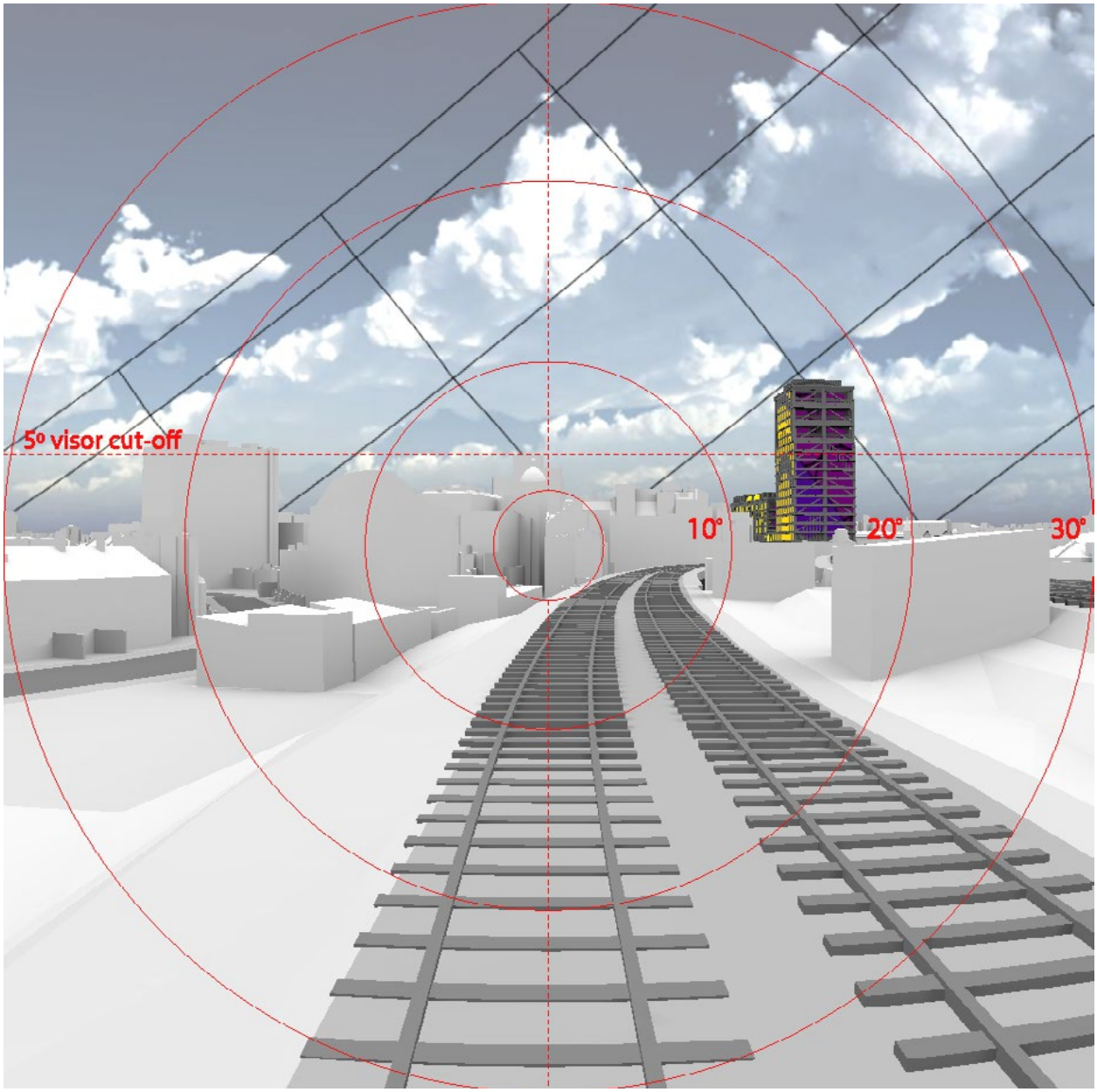
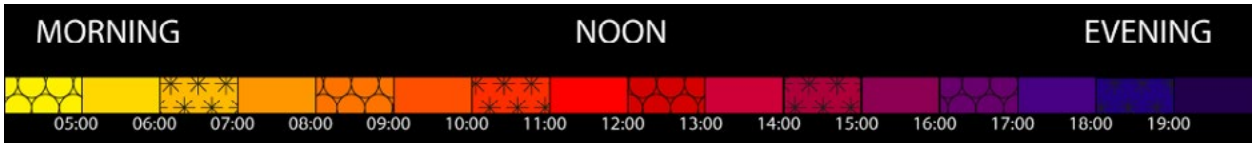


Fig. 53: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 63

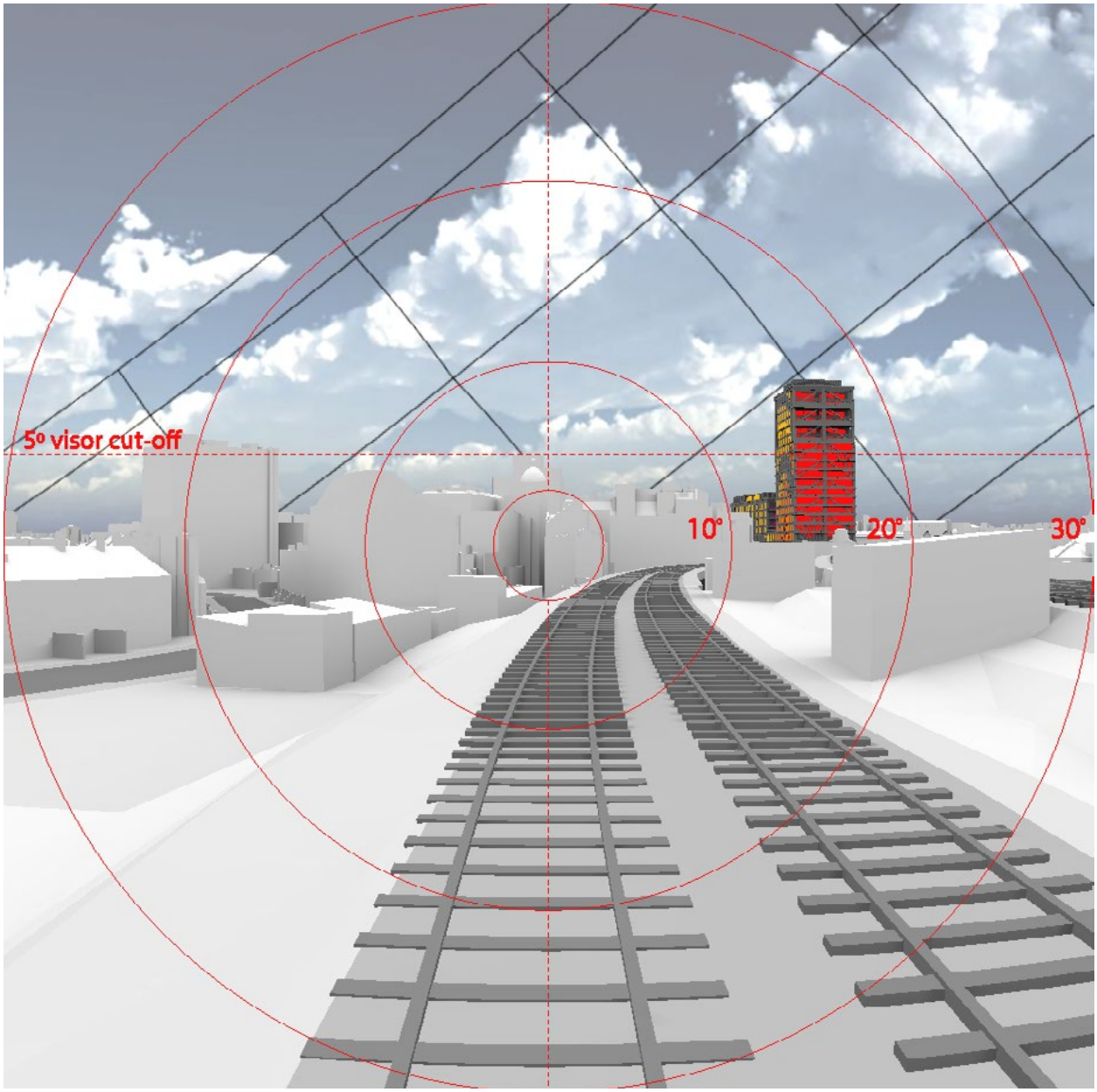


Fig. 54: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 113

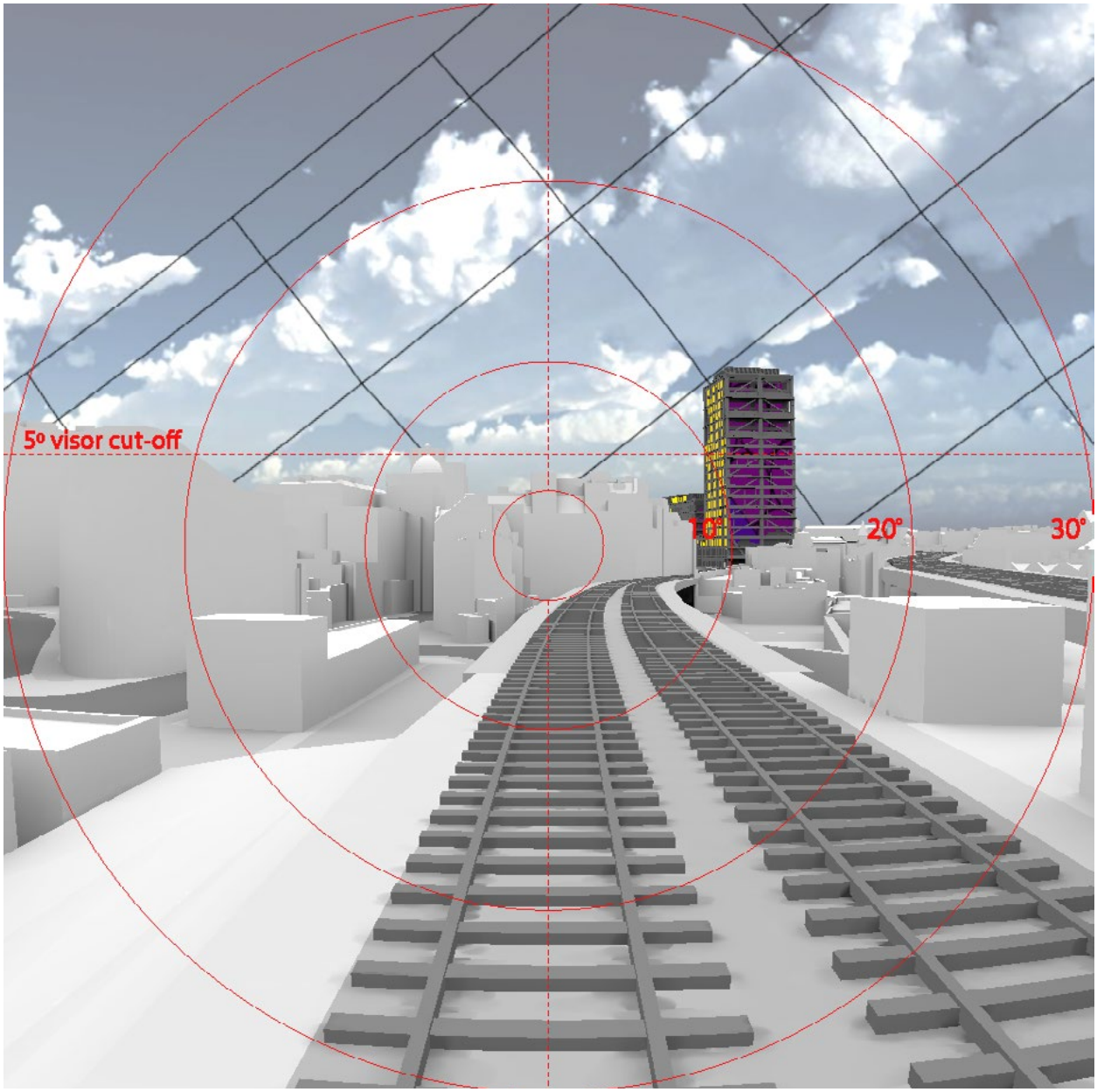
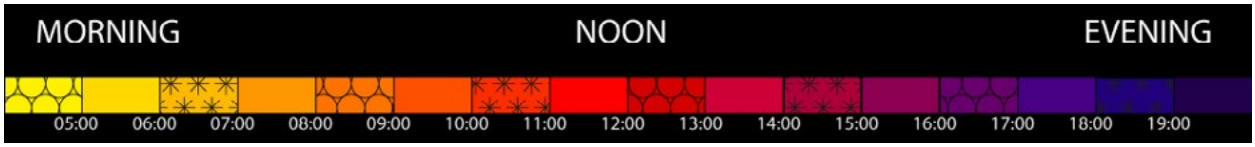


Fig. 55: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 113

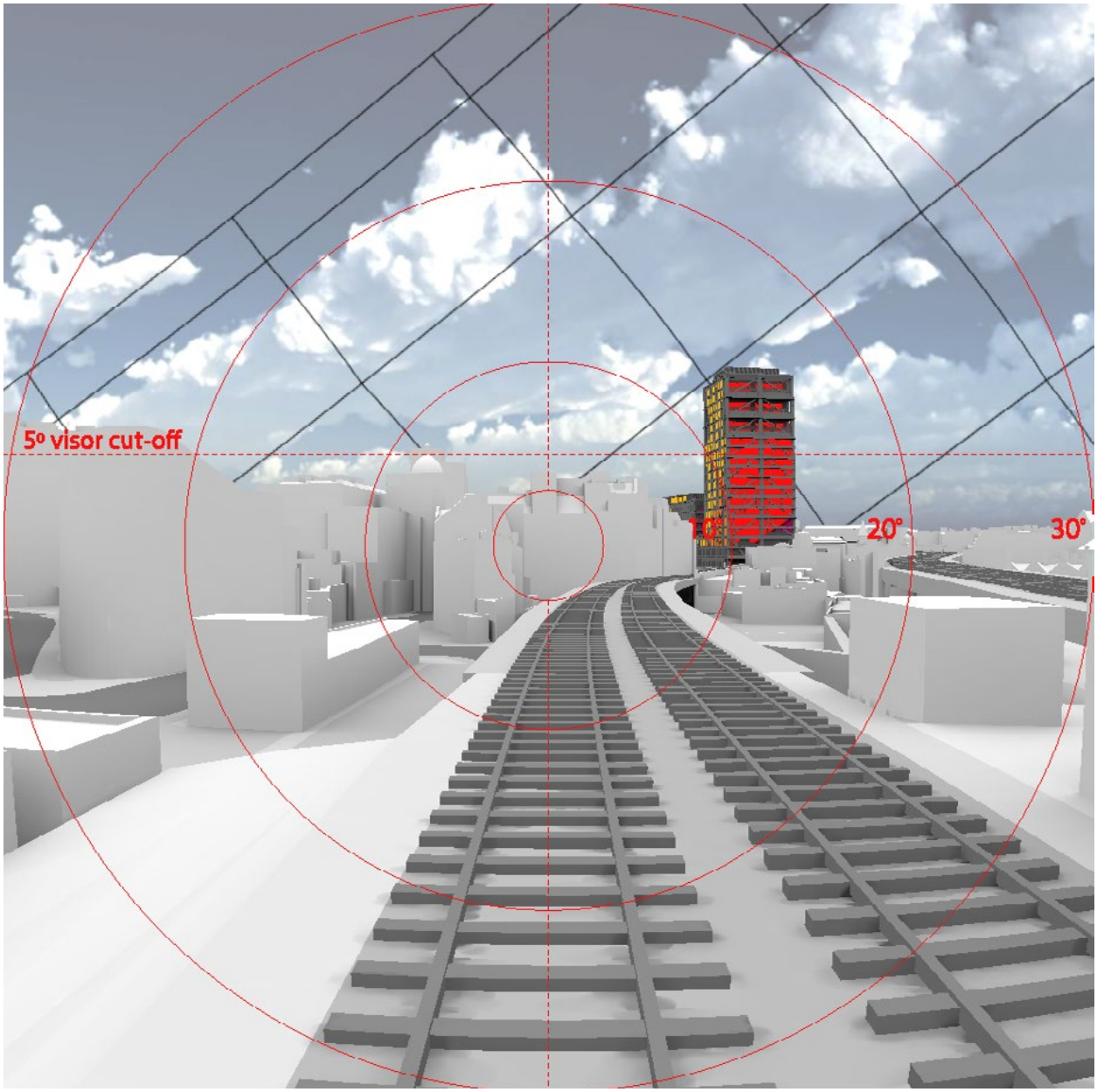


Fig. 56: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 221

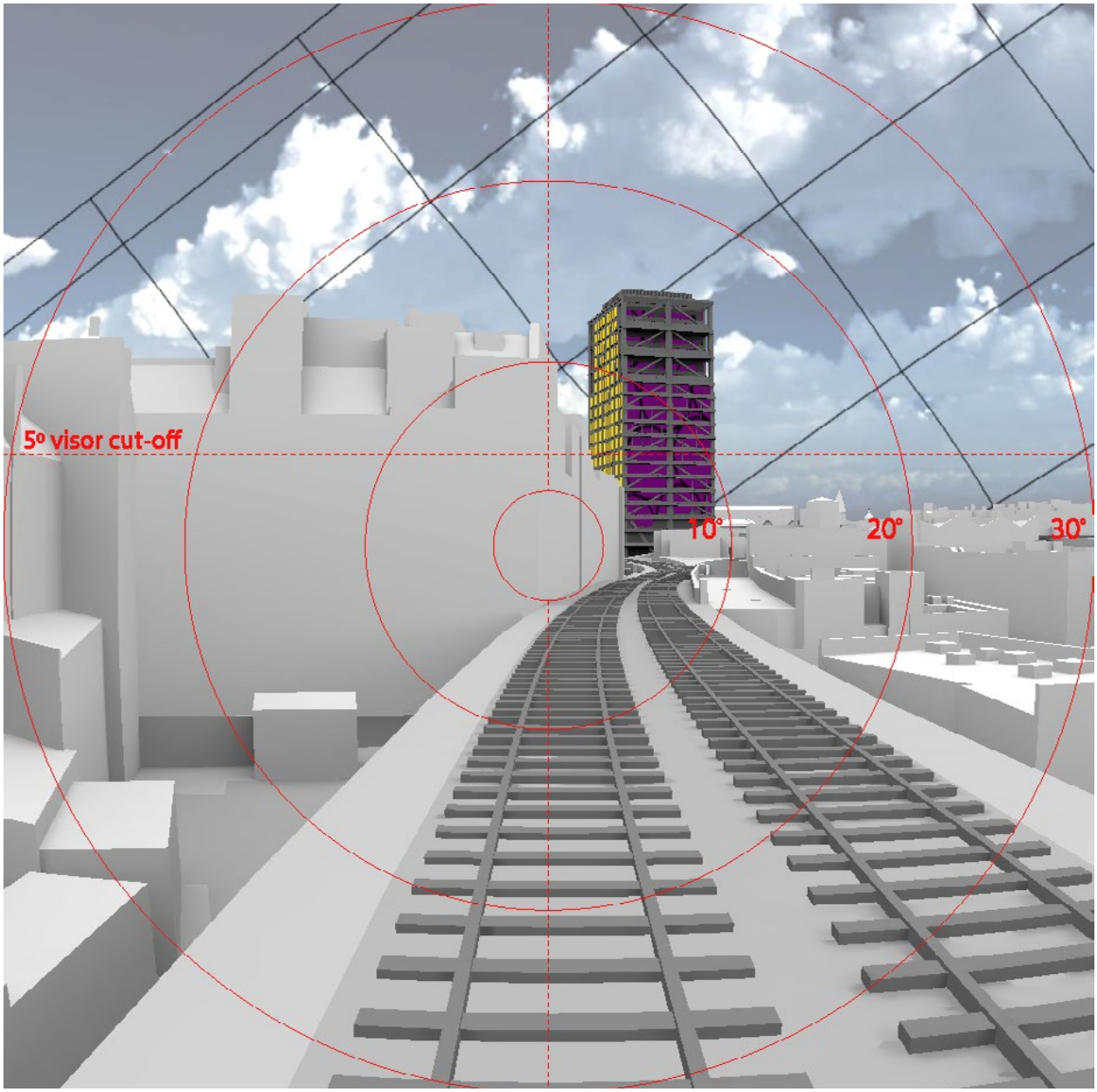
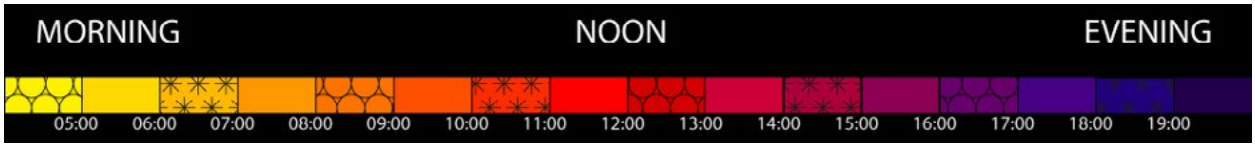


Fig. 57: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 221

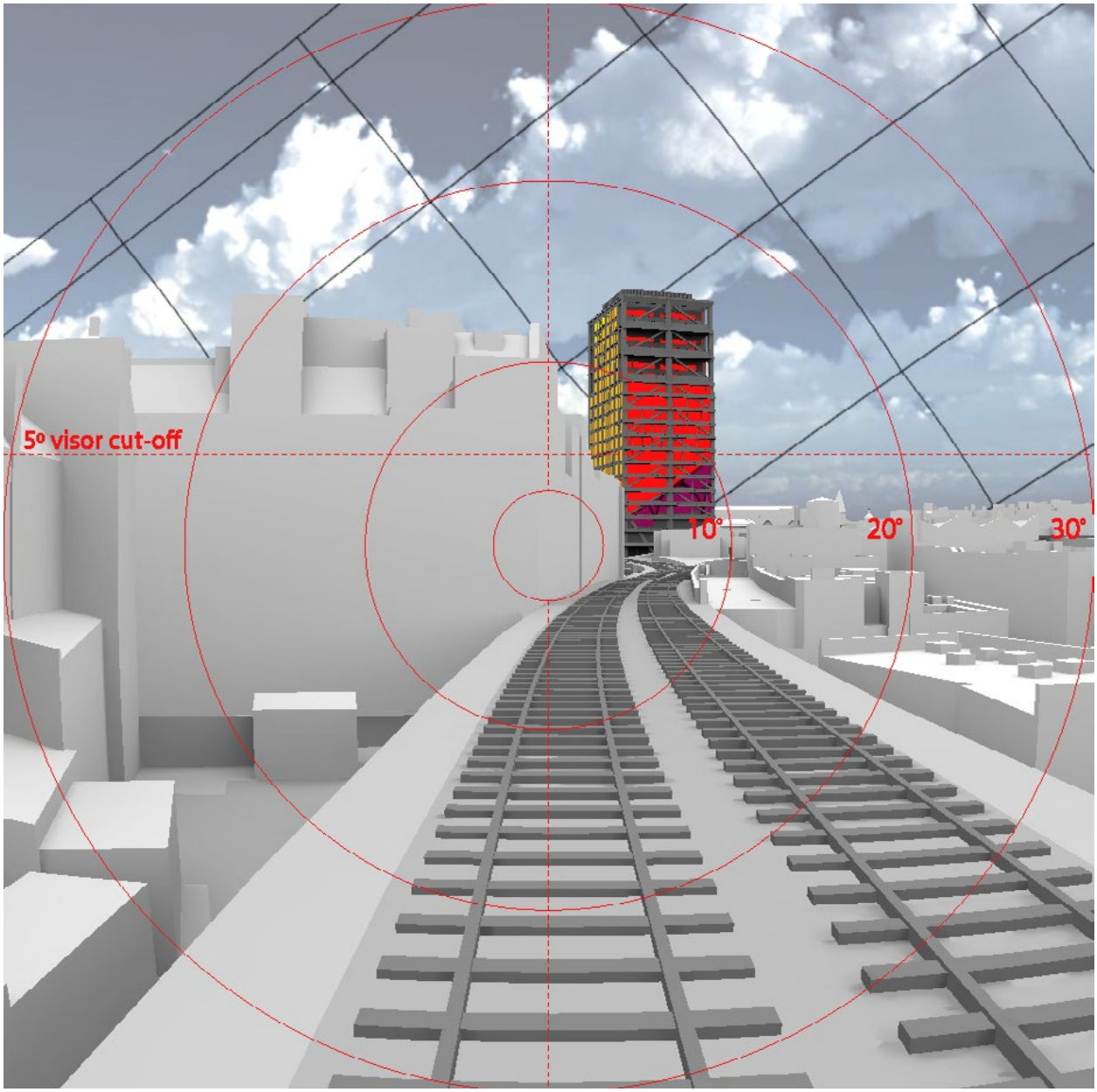


Fig. 58: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 377

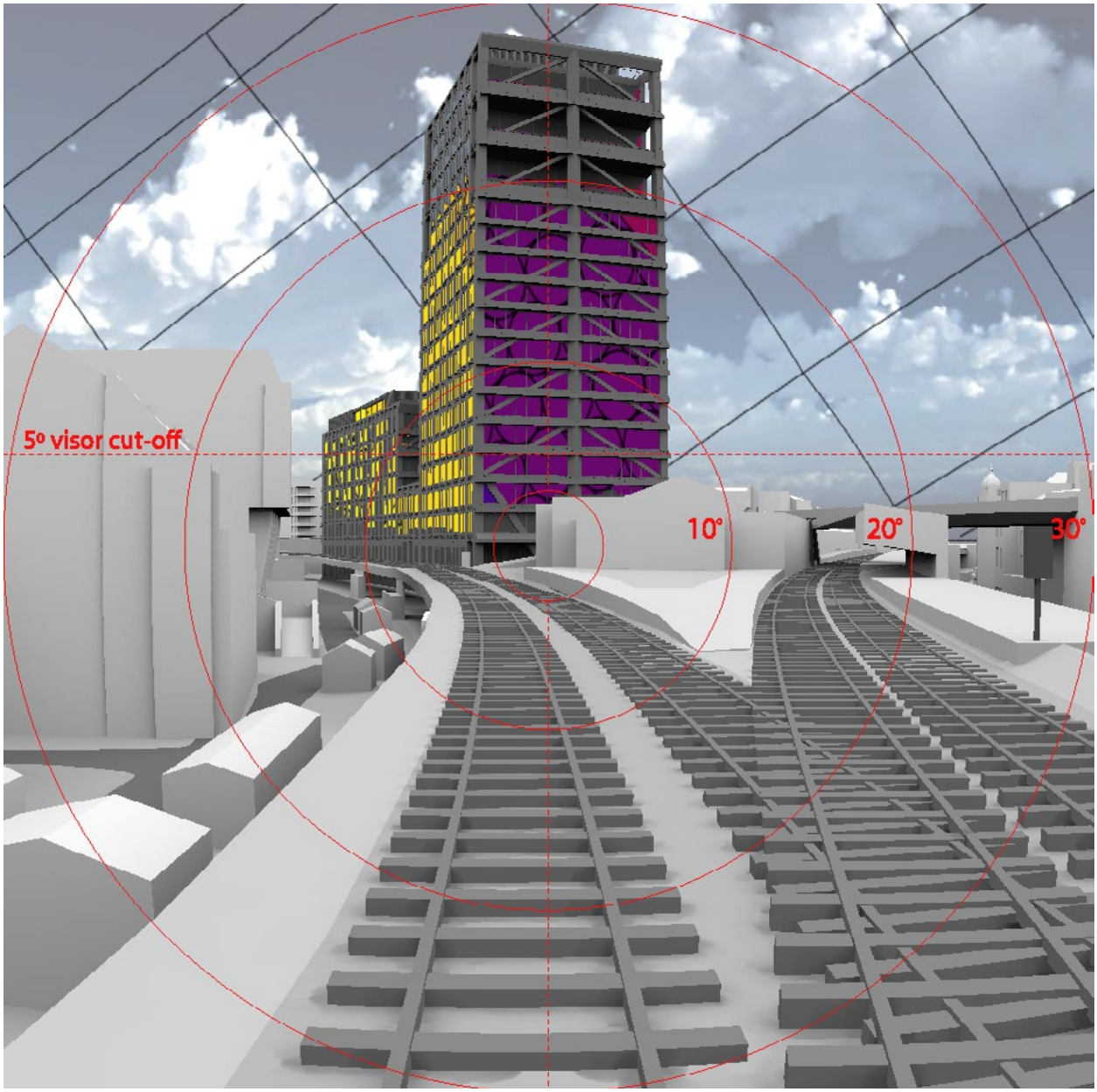
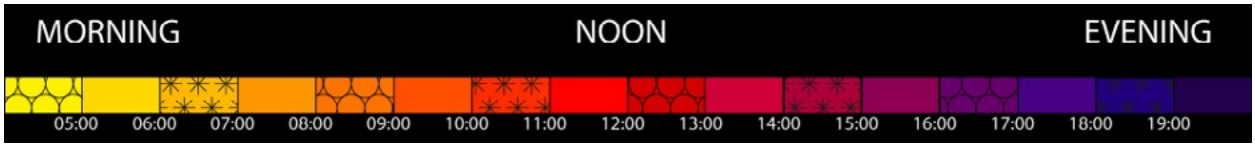


Fig. 59: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 377

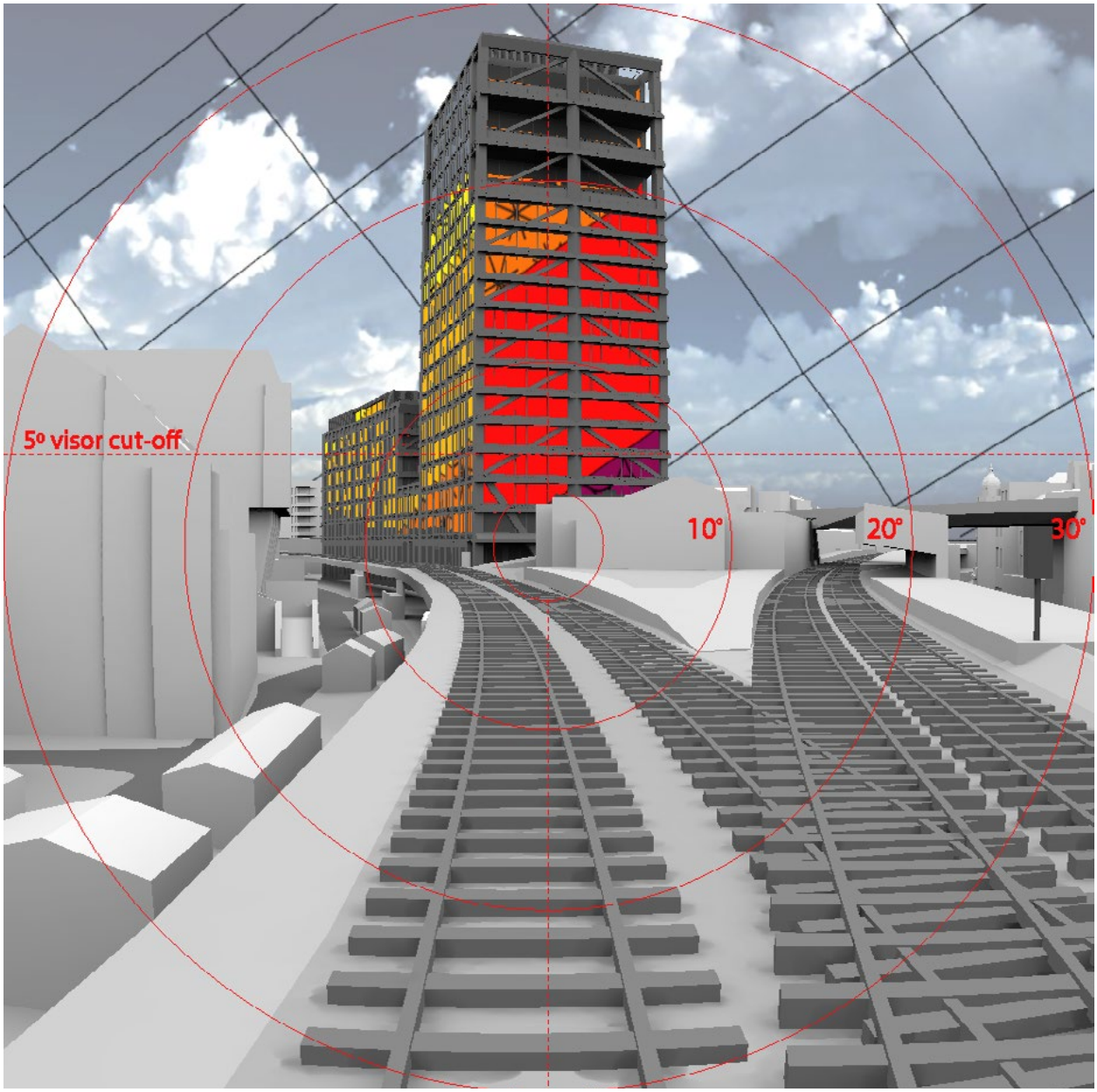


Fig. 60: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 407

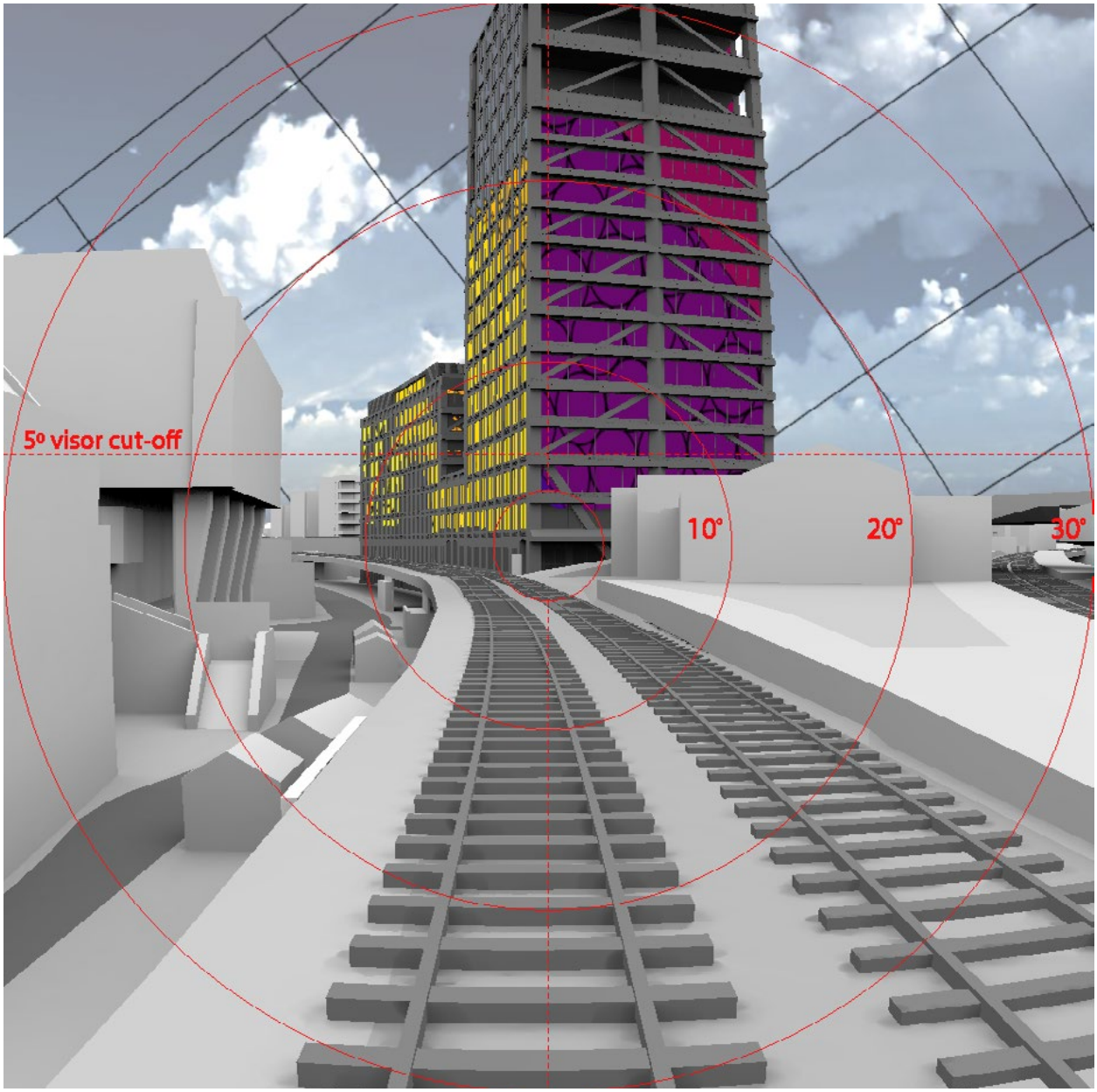
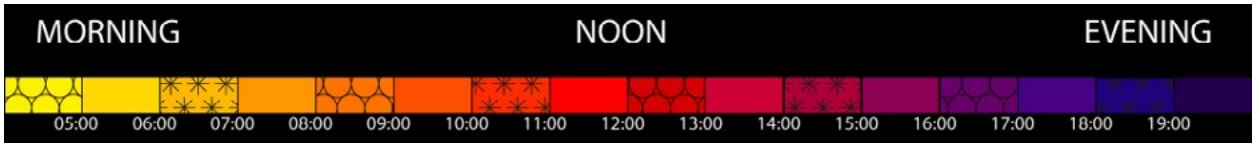


Fig. 61: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 407

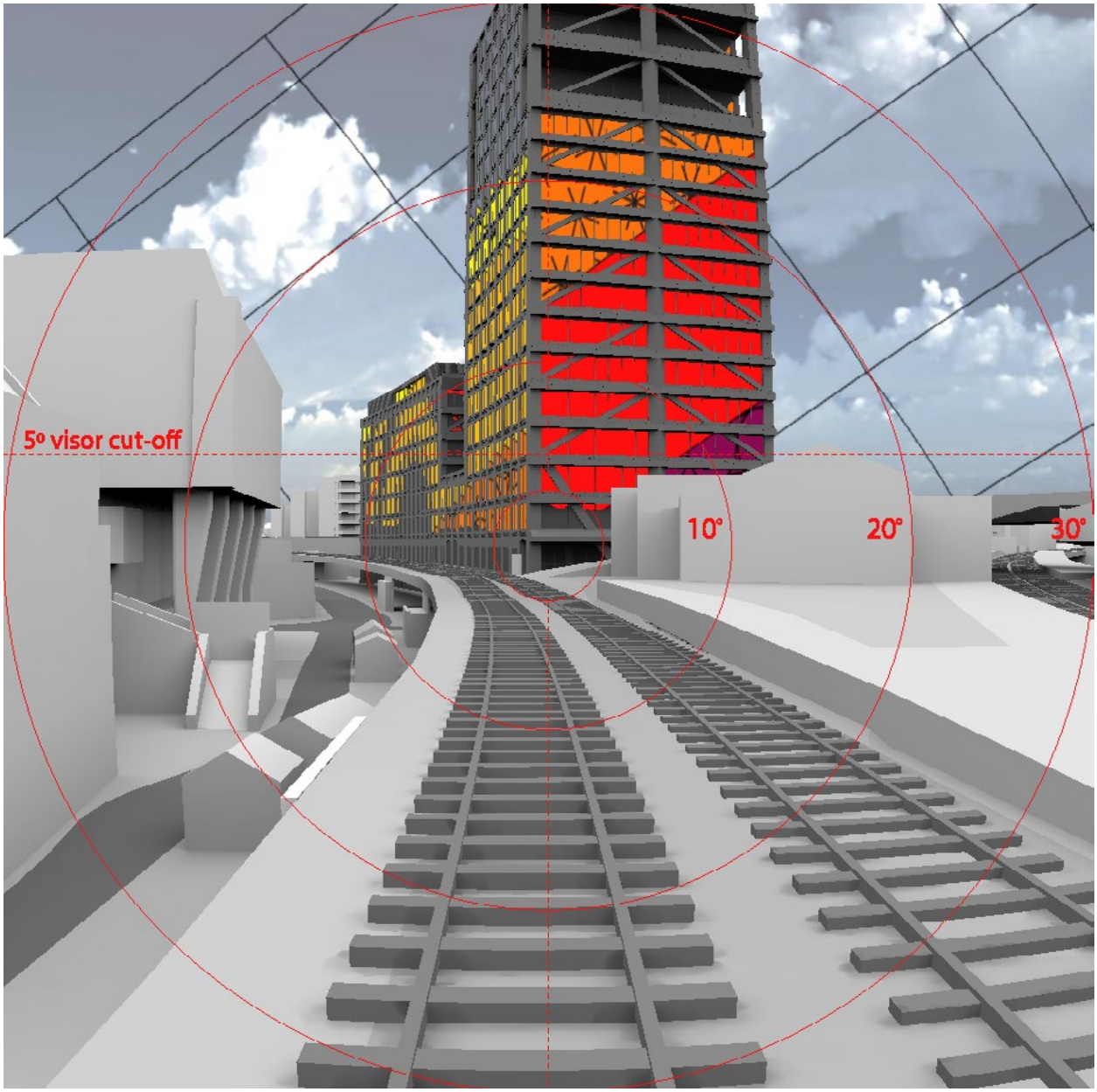


Fig. 62: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 469

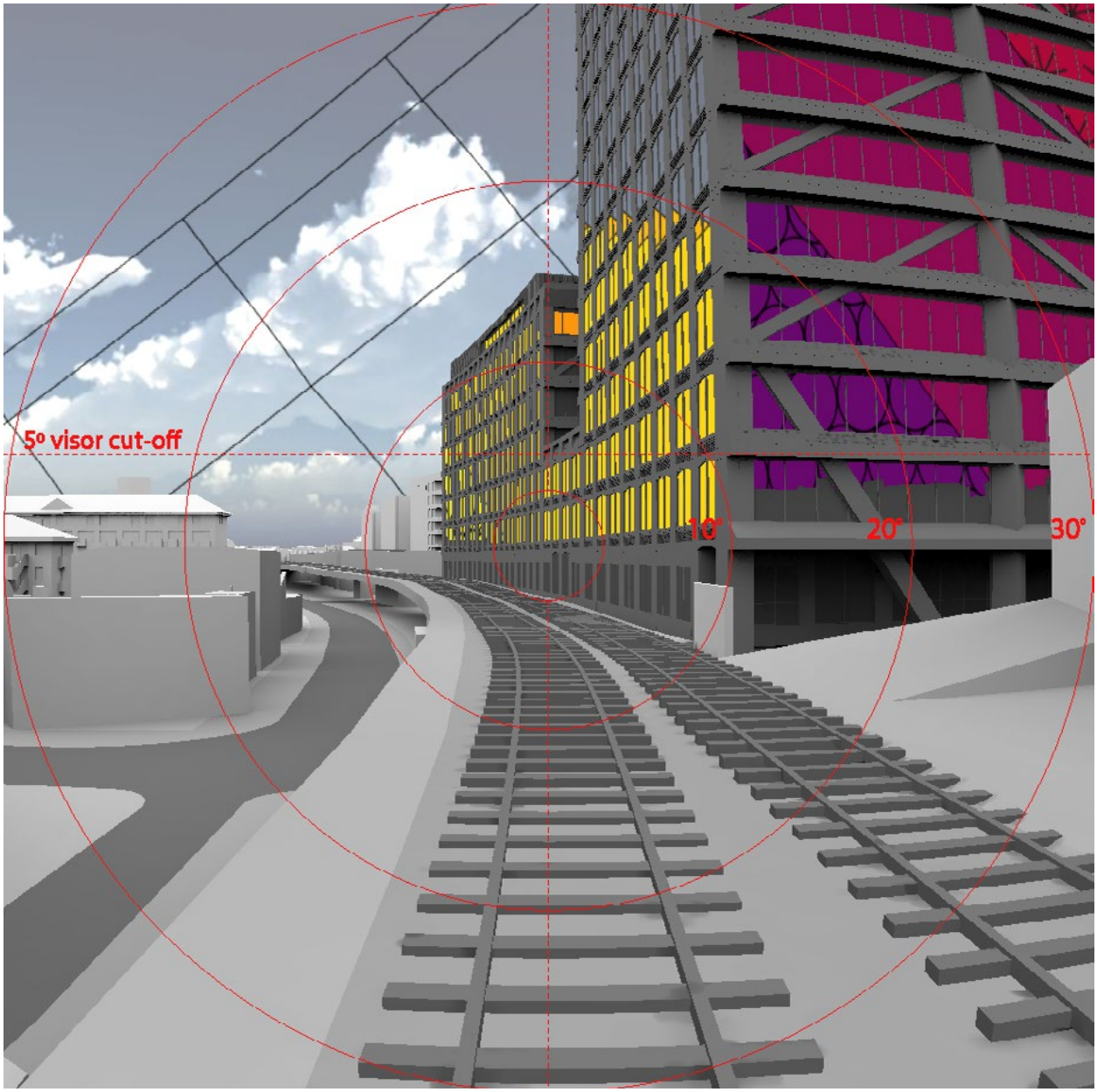
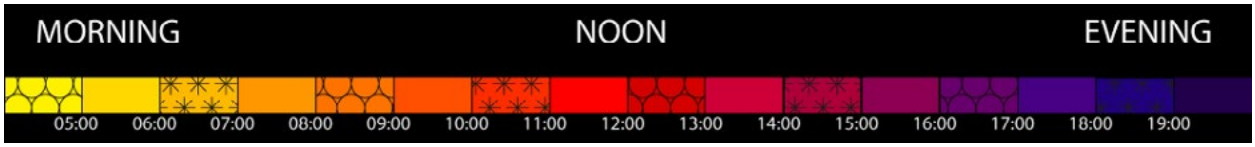


Fig. 63: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 469

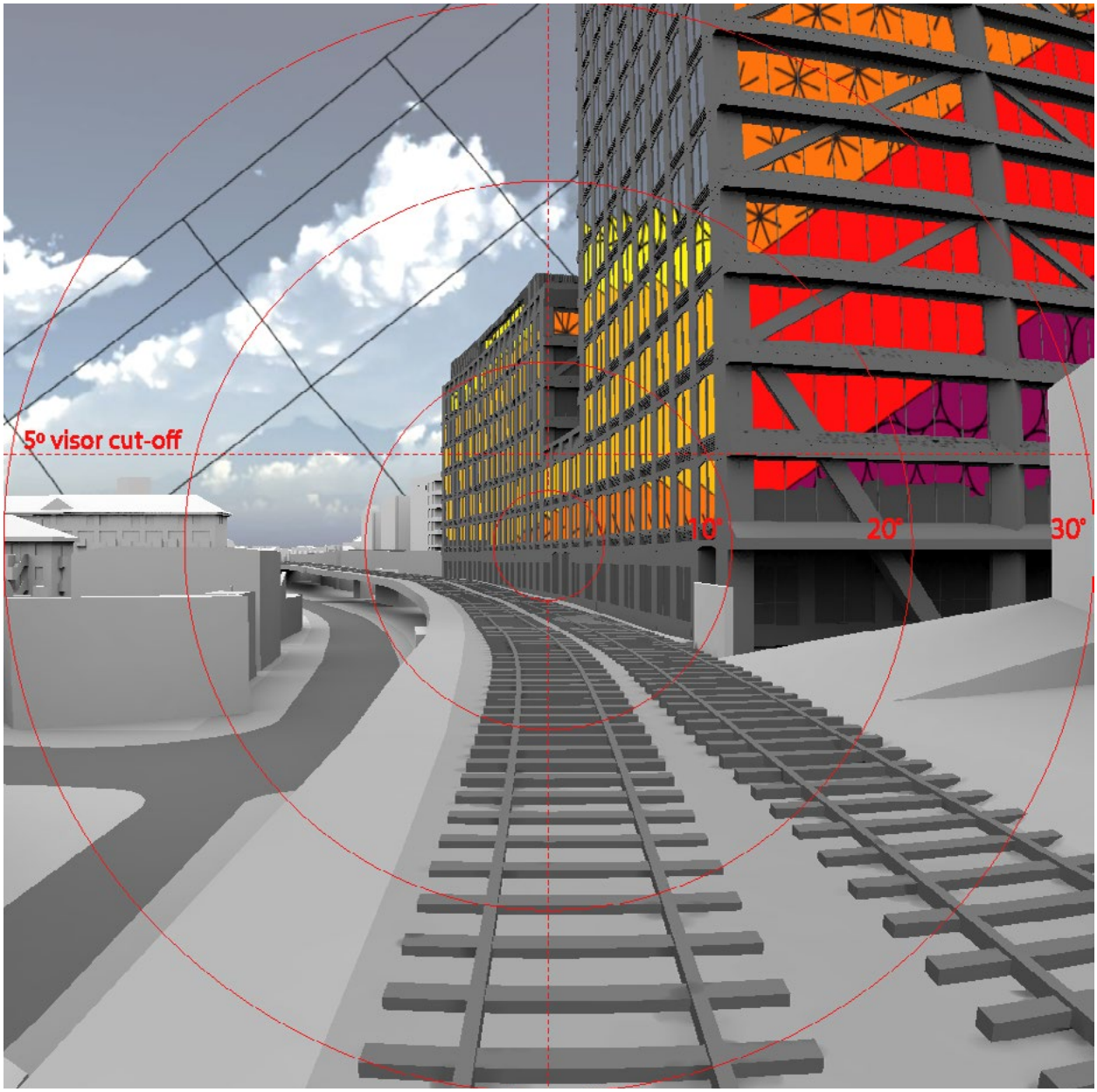


Fig. 64: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 561

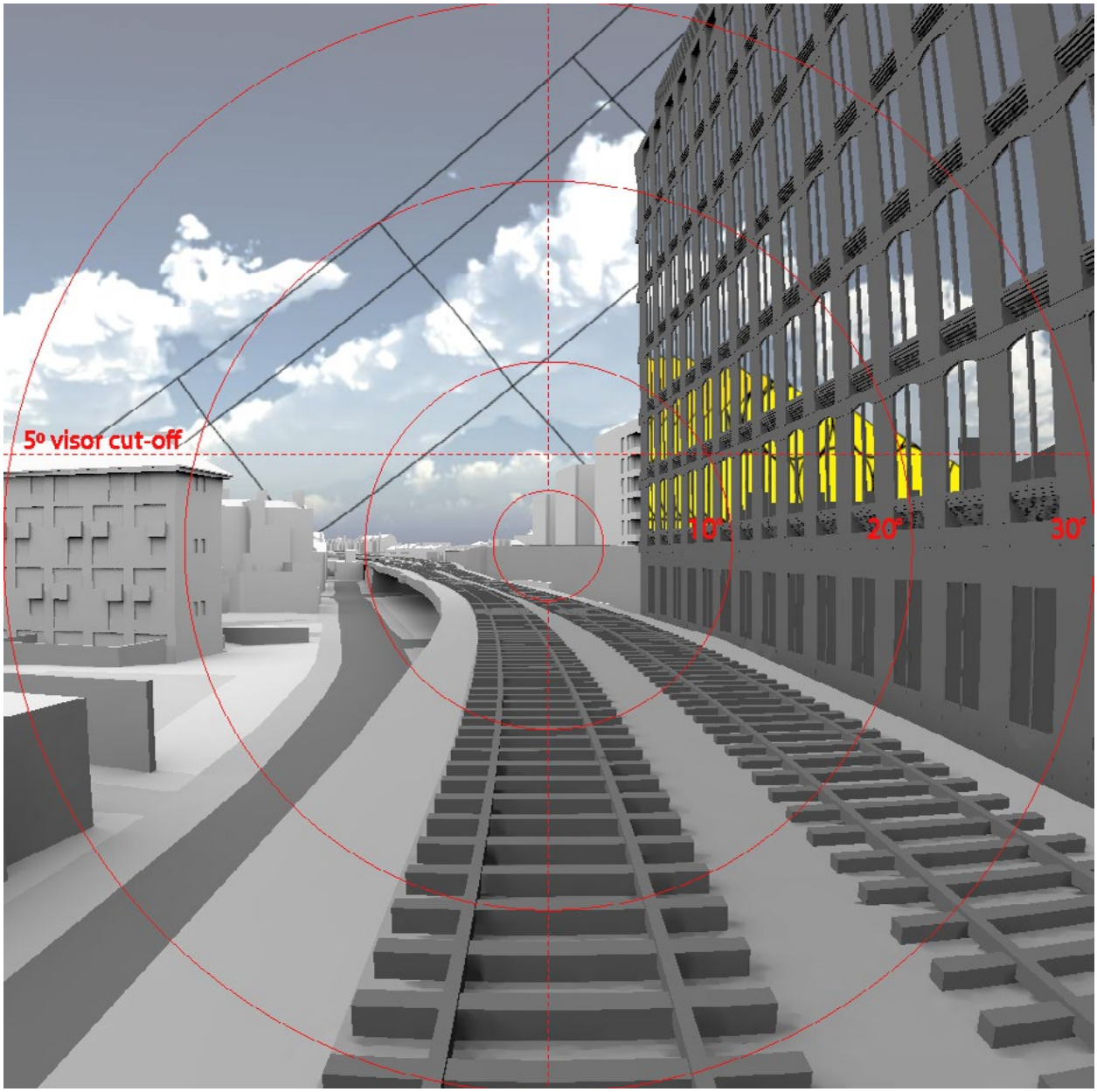
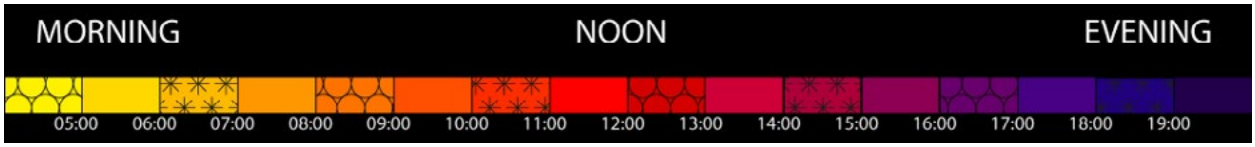


Fig. 65: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 561

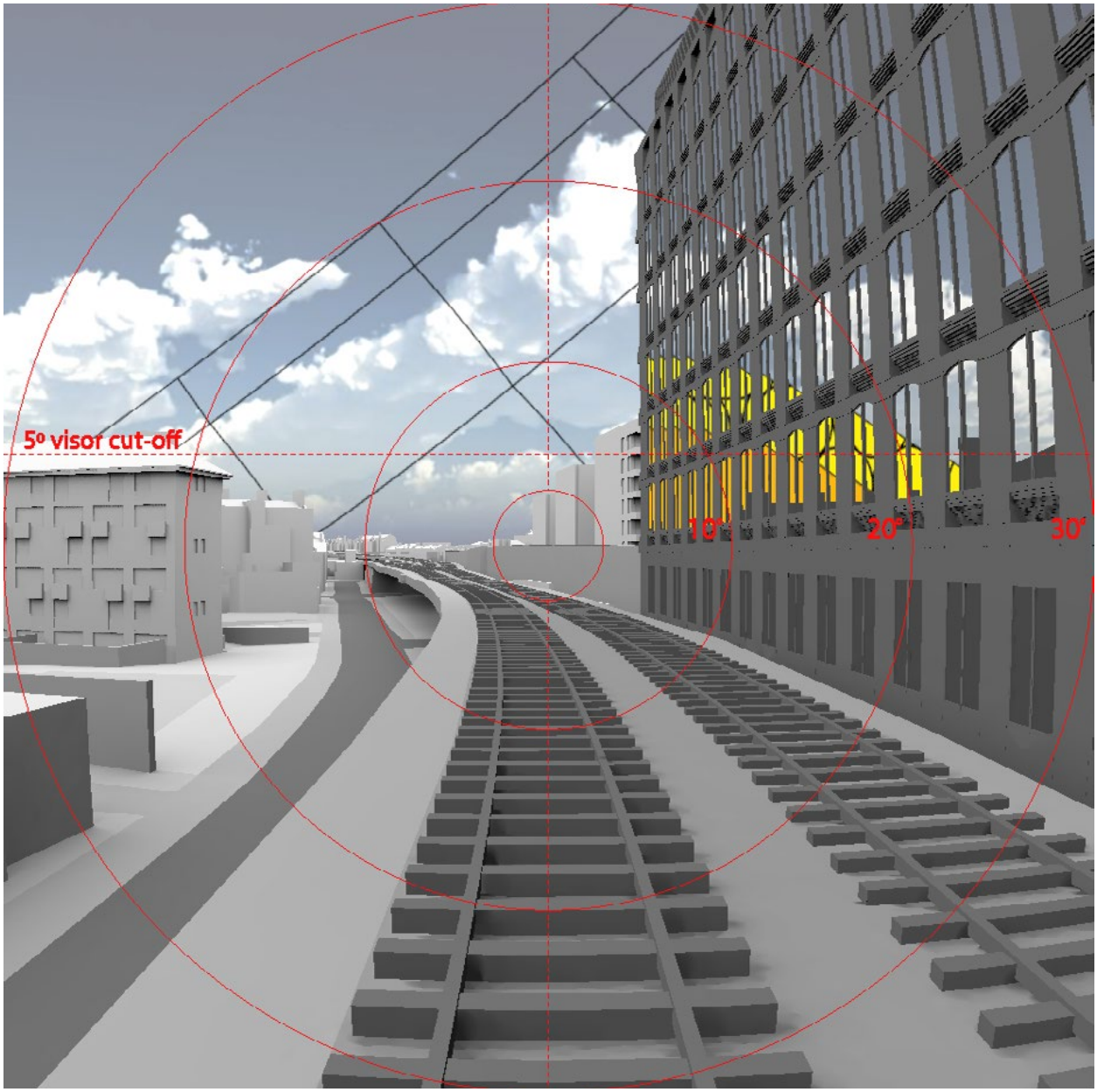


Fig. 66: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 578

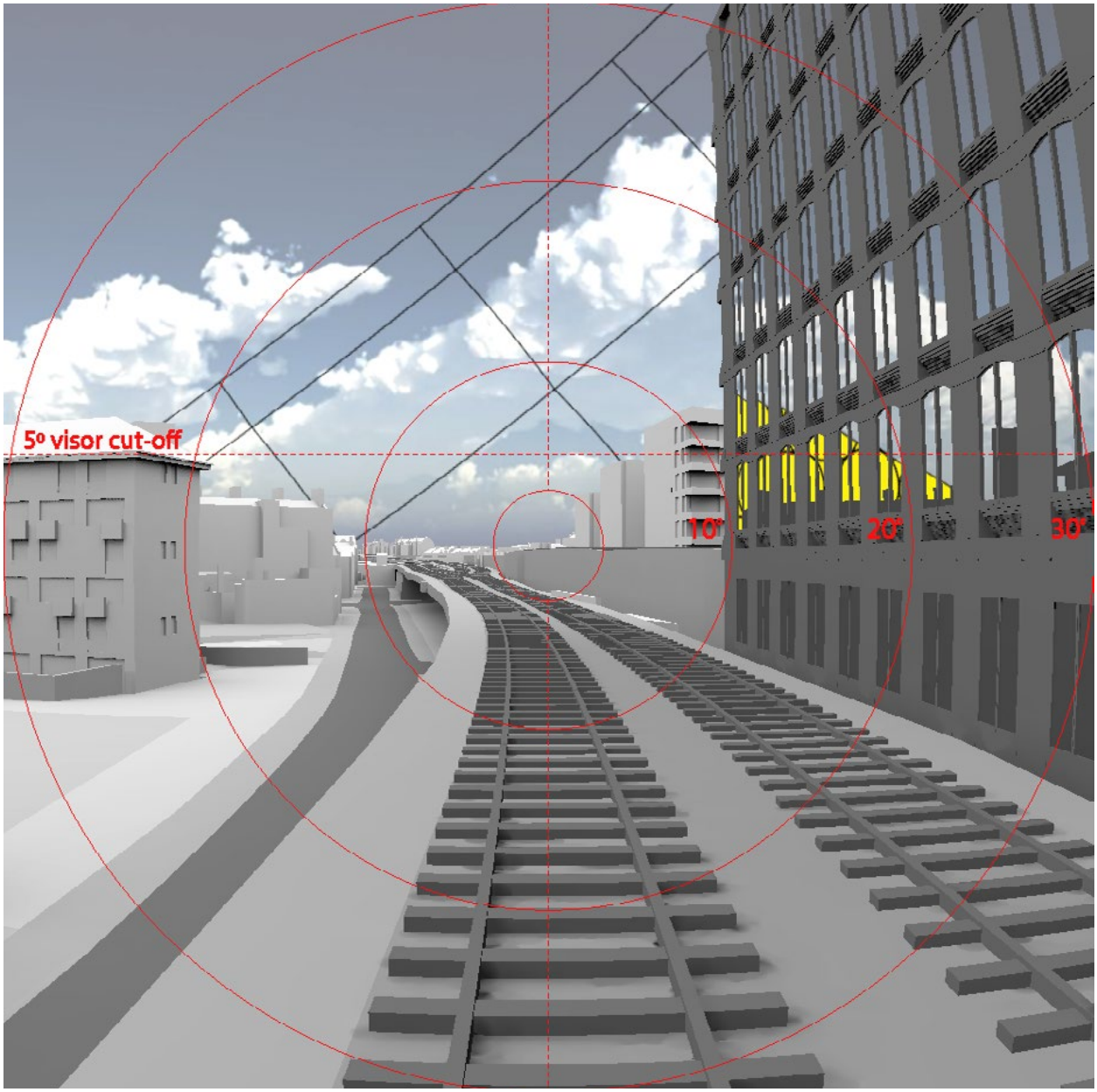
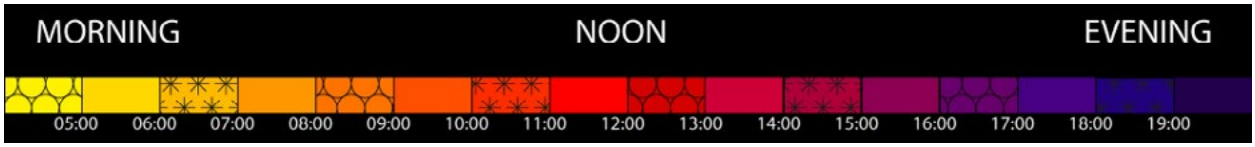


Fig. 67: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 578

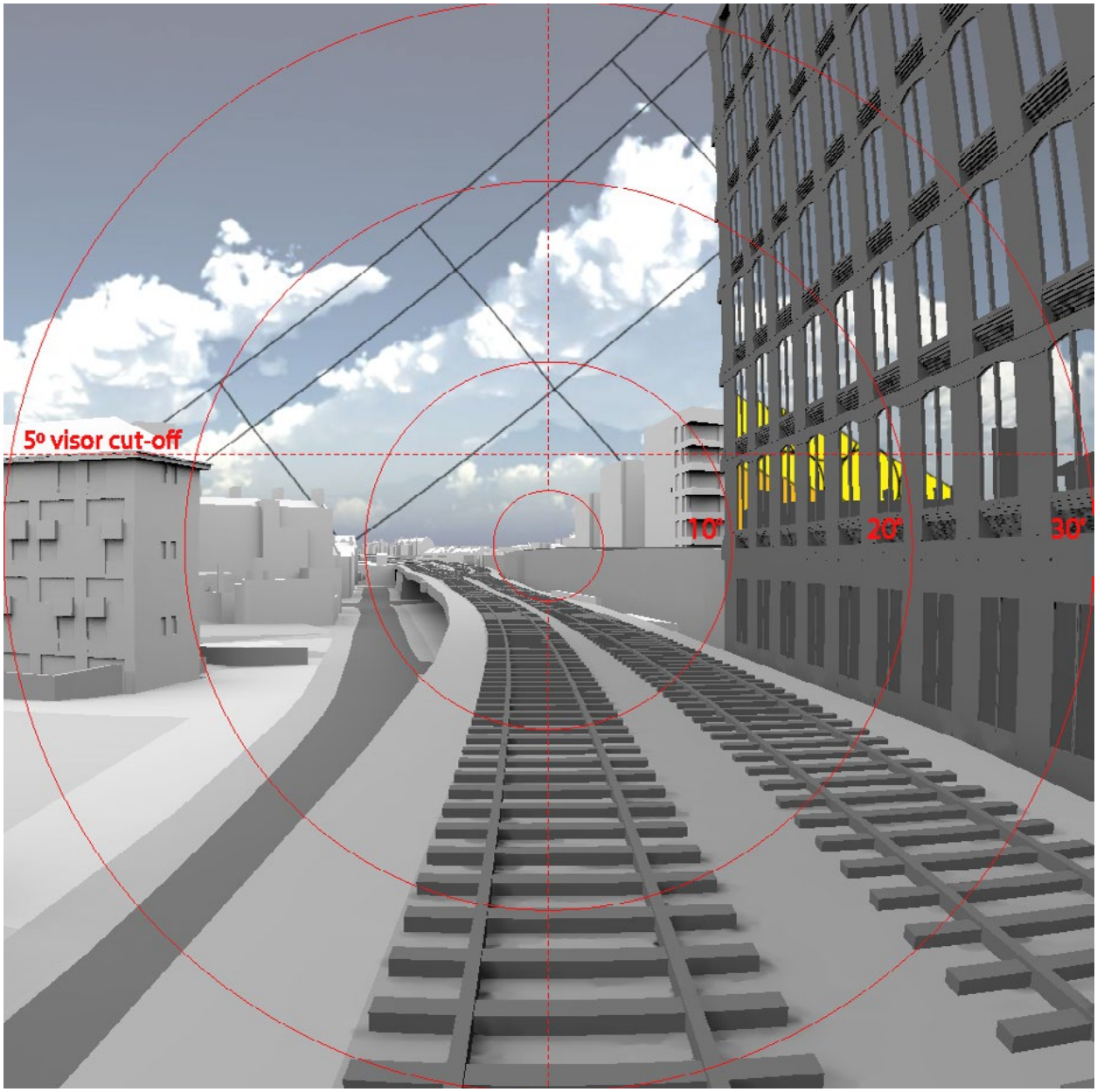


Fig. 68: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR2 - FRAME 595

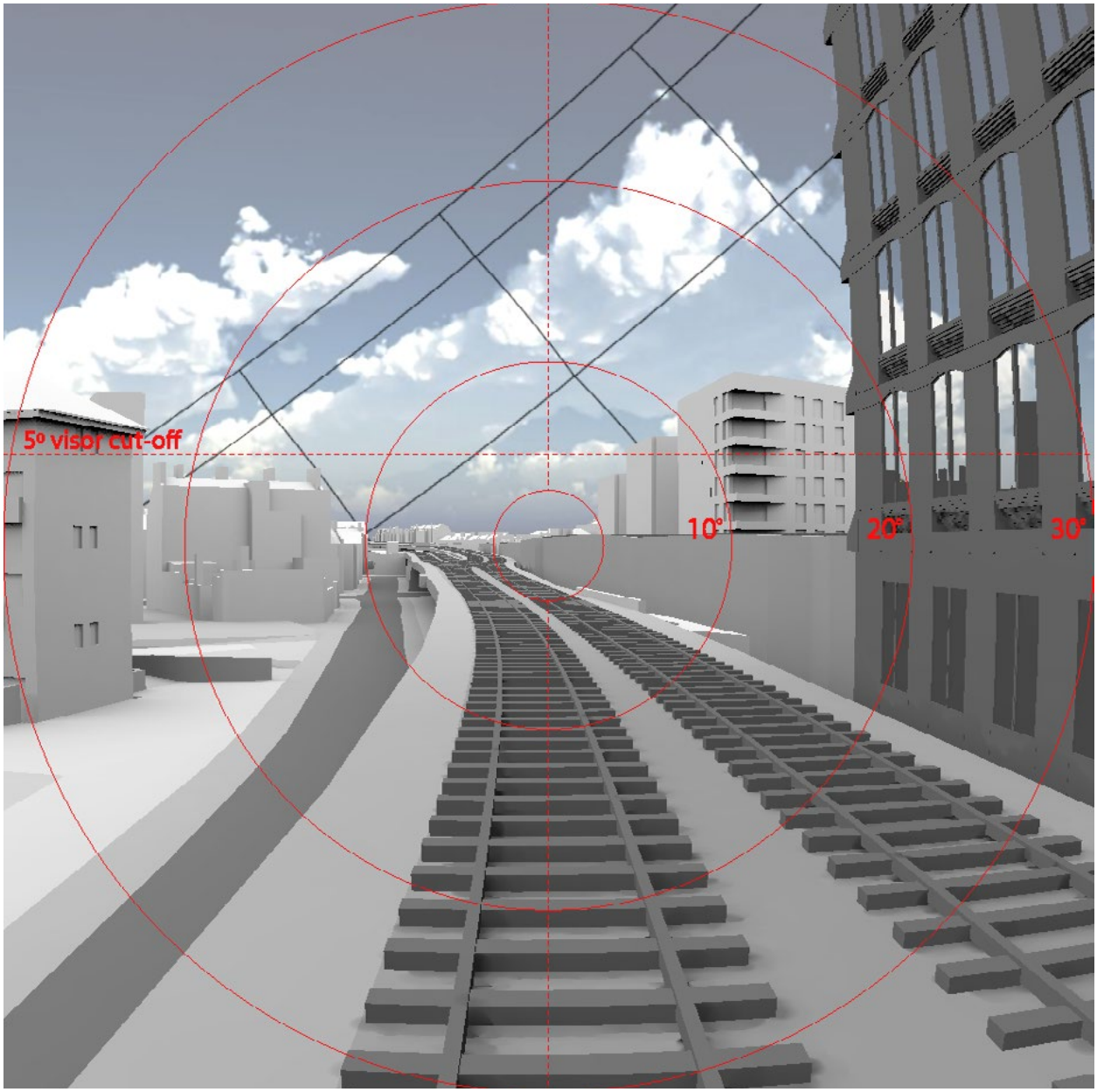
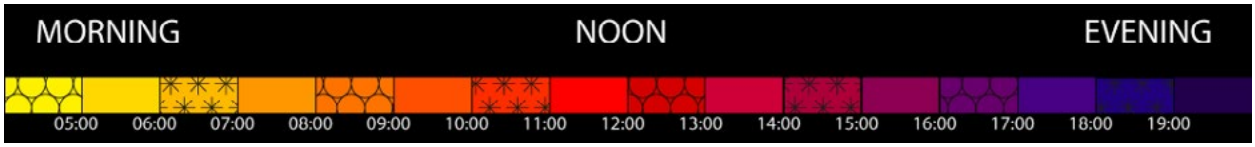


Fig. 69: Solar reflections



60° FIELD OF VIEW: SEASON
SWR2 - FRAME 595

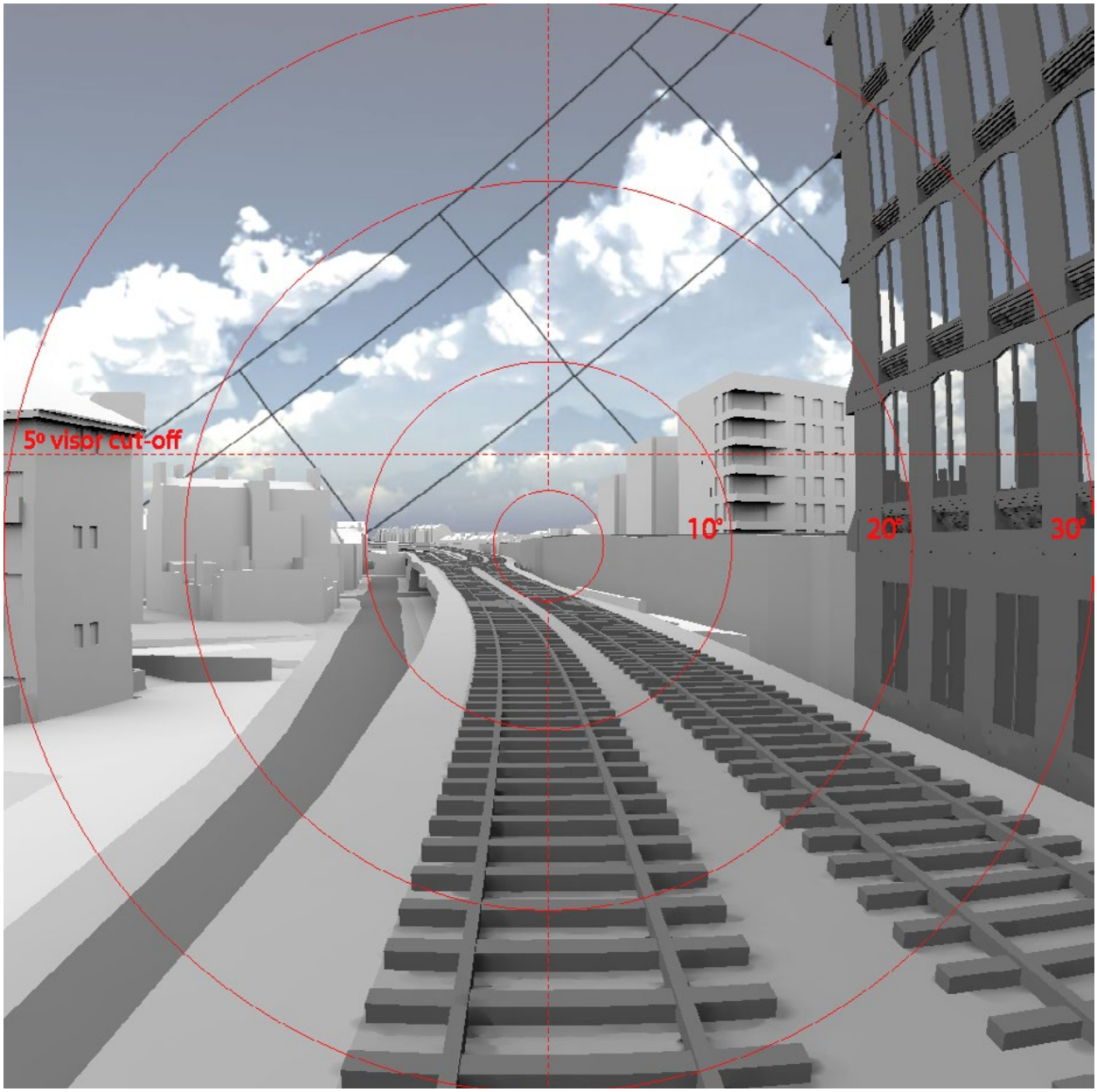


Fig. 70: Solar reflections

60° FIELD OF VIEW: VEILING LUMINANCE
SWR2 - FRAME 113

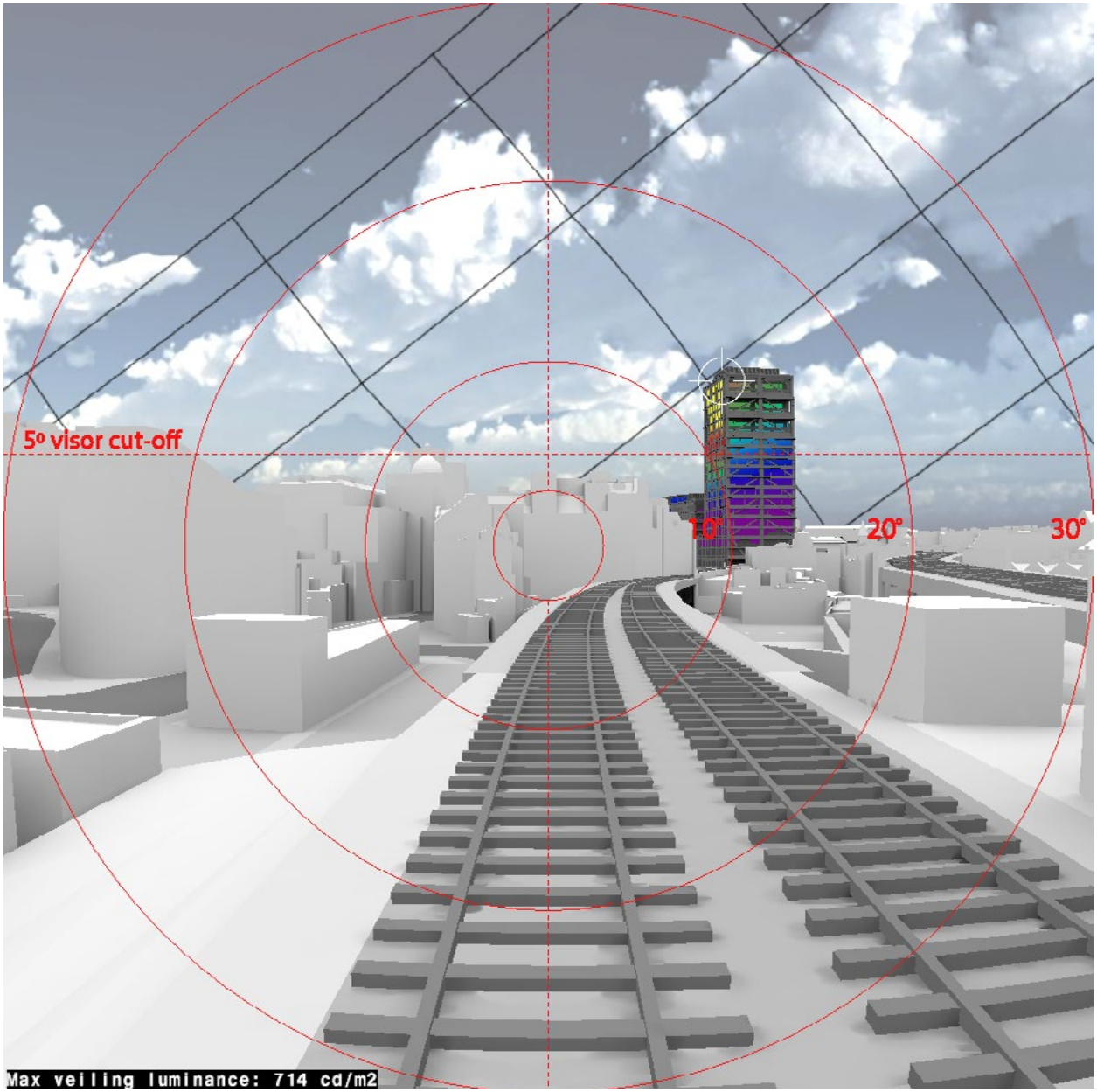
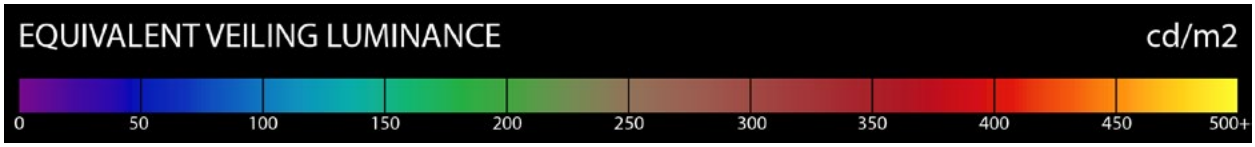


Fig. 71: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR2 - FRAME 269

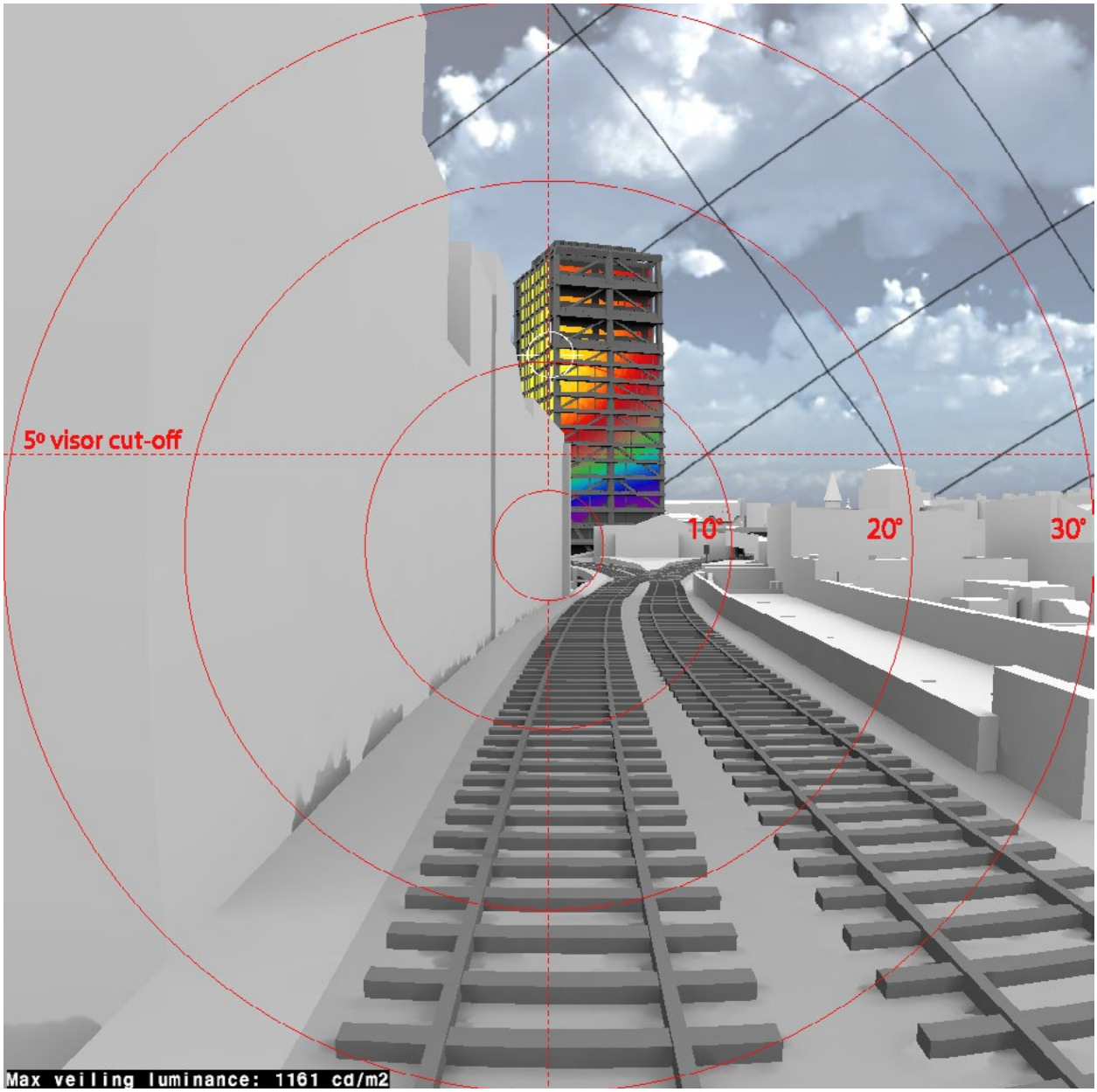
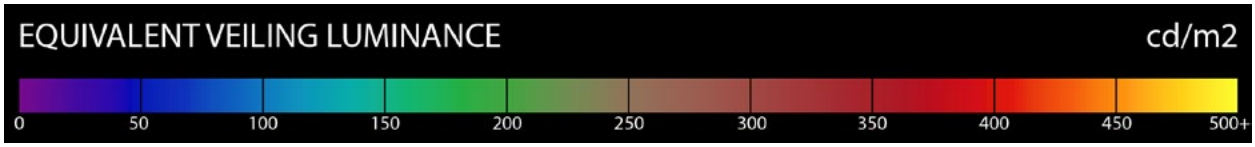


Fig. 72: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR2 - FRAME 345

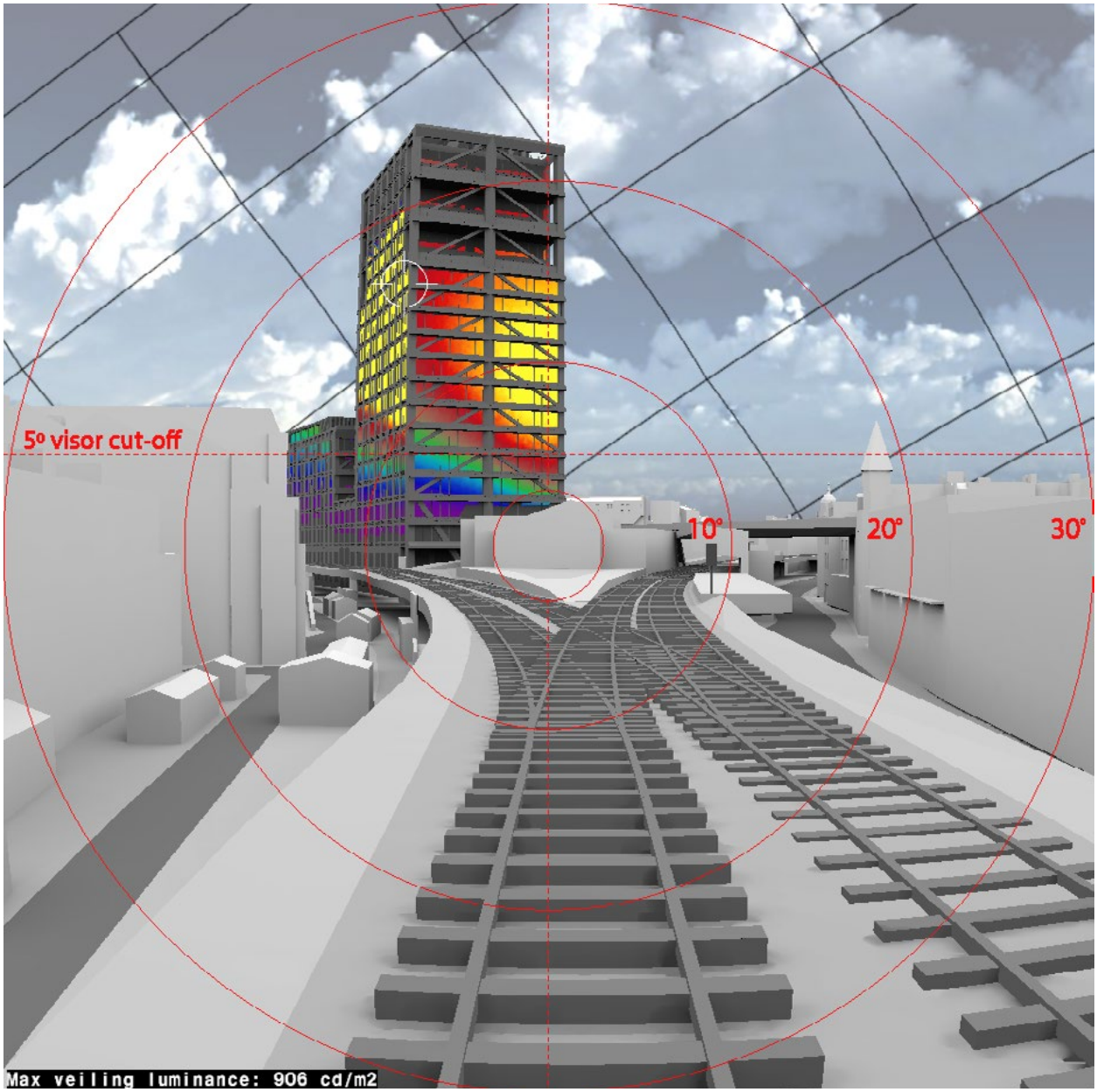
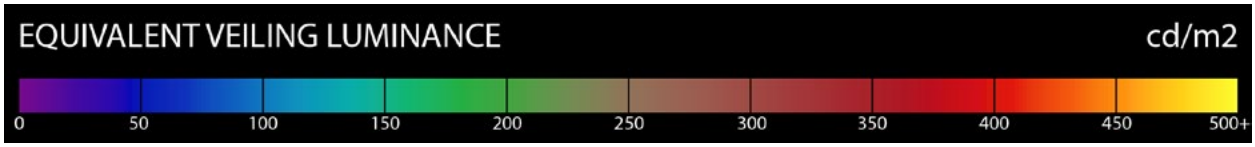


Fig. 73: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR2 - FRAME 352

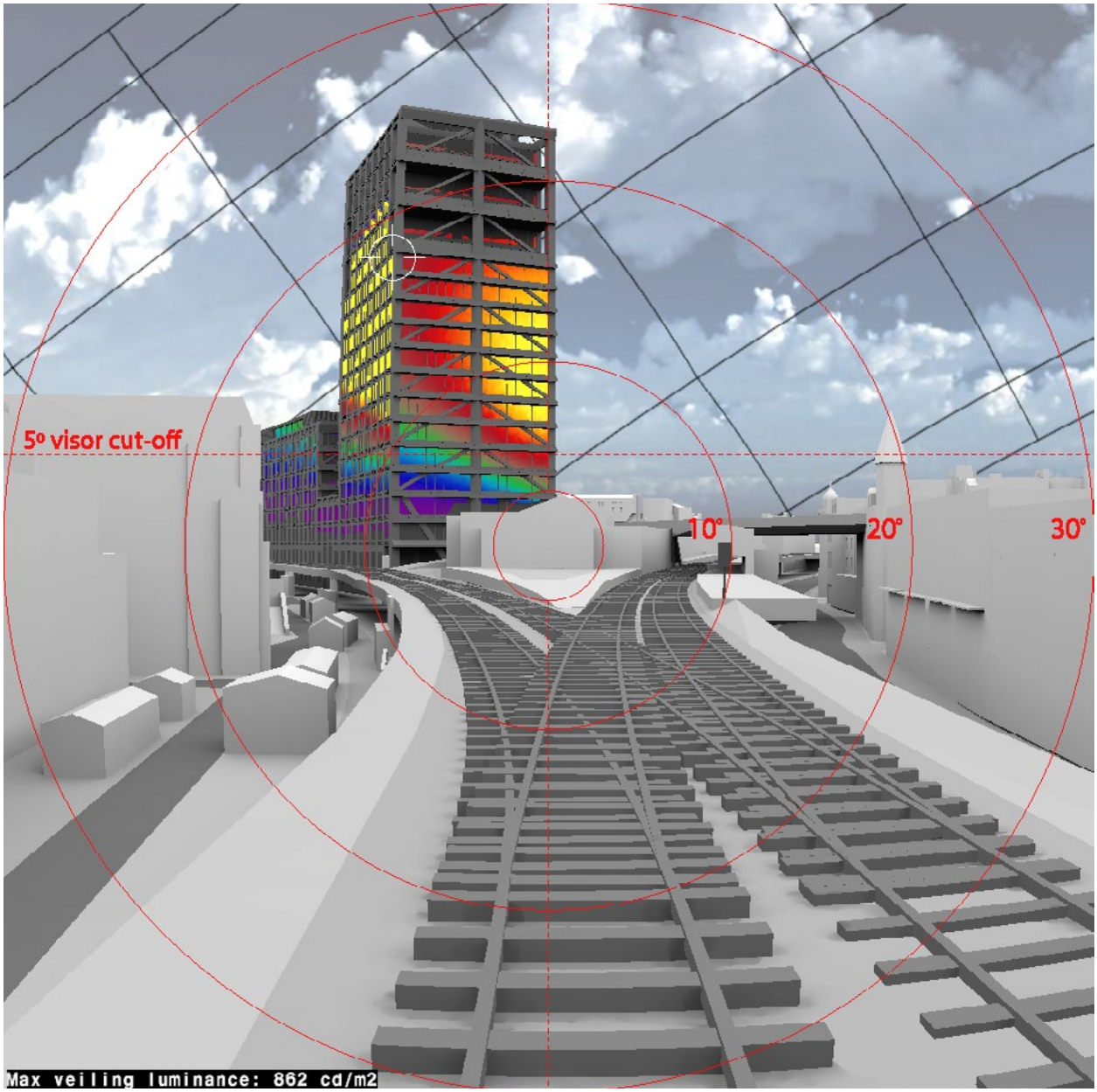
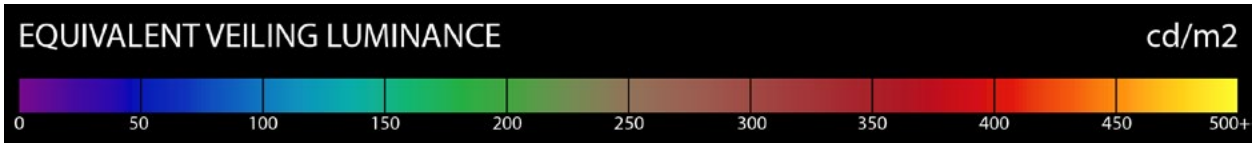


Fig. 74: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR2 - FRAME 377

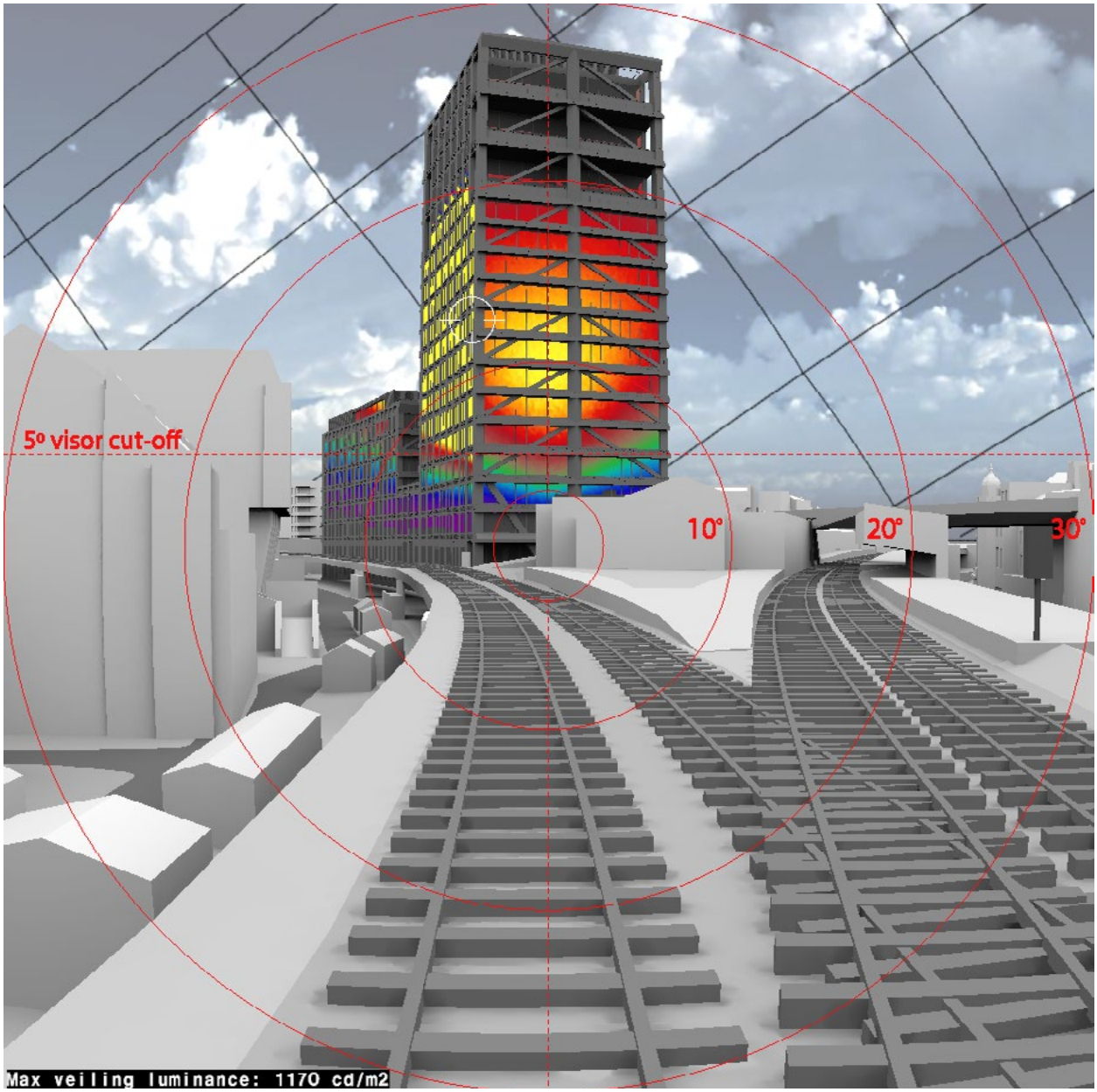
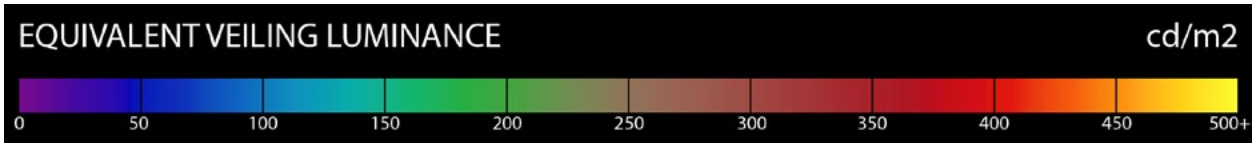


Fig. 75: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR2 - FRAME395

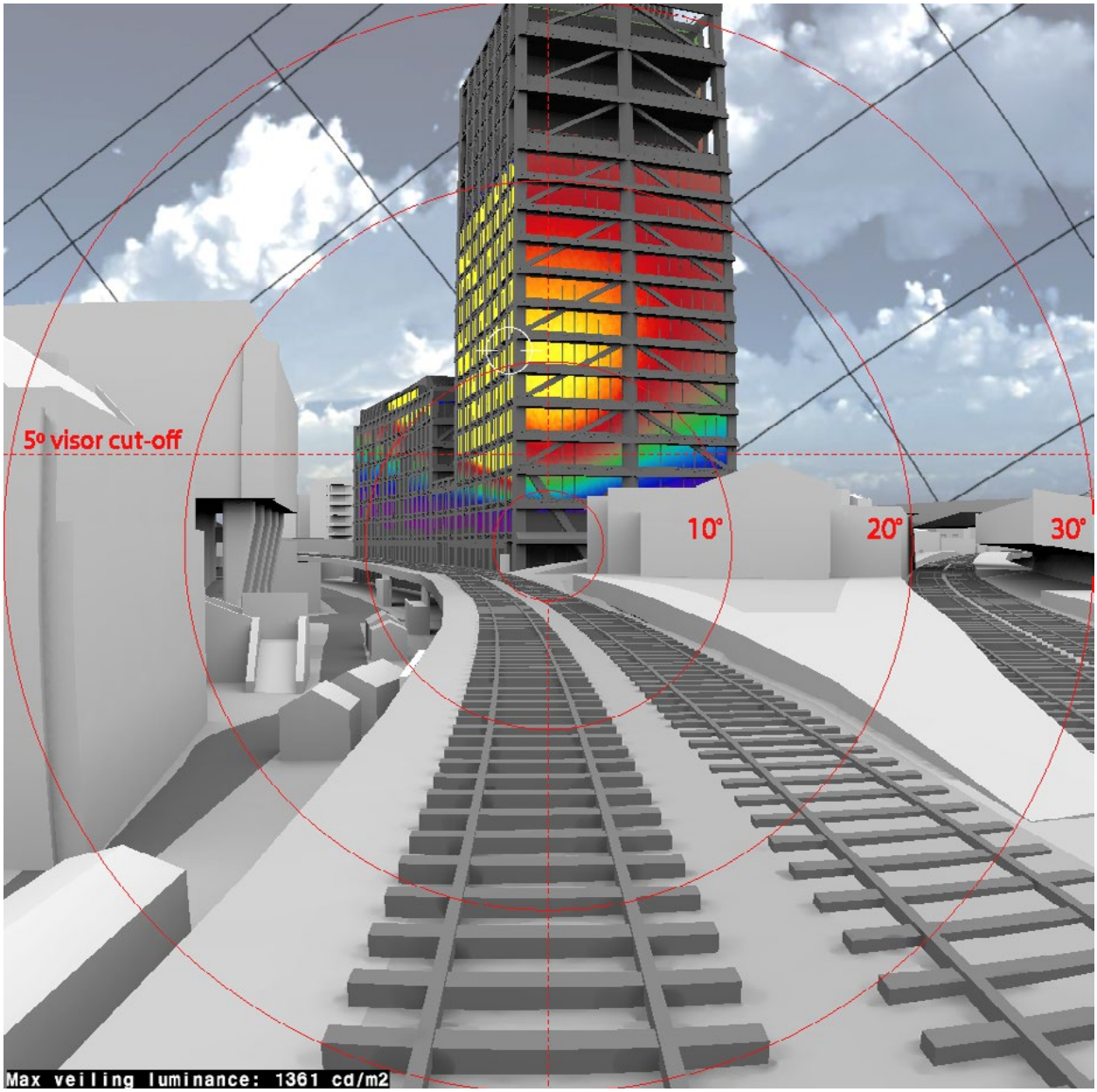
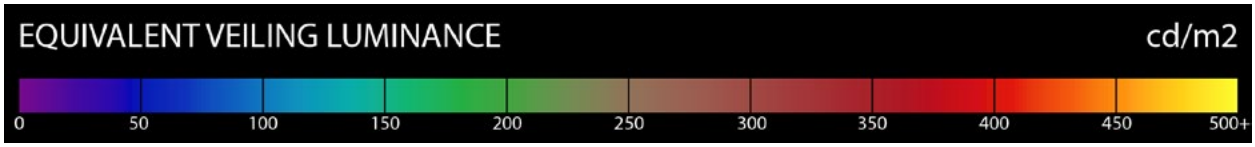


Fig. 76: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR2 - FRAME 416

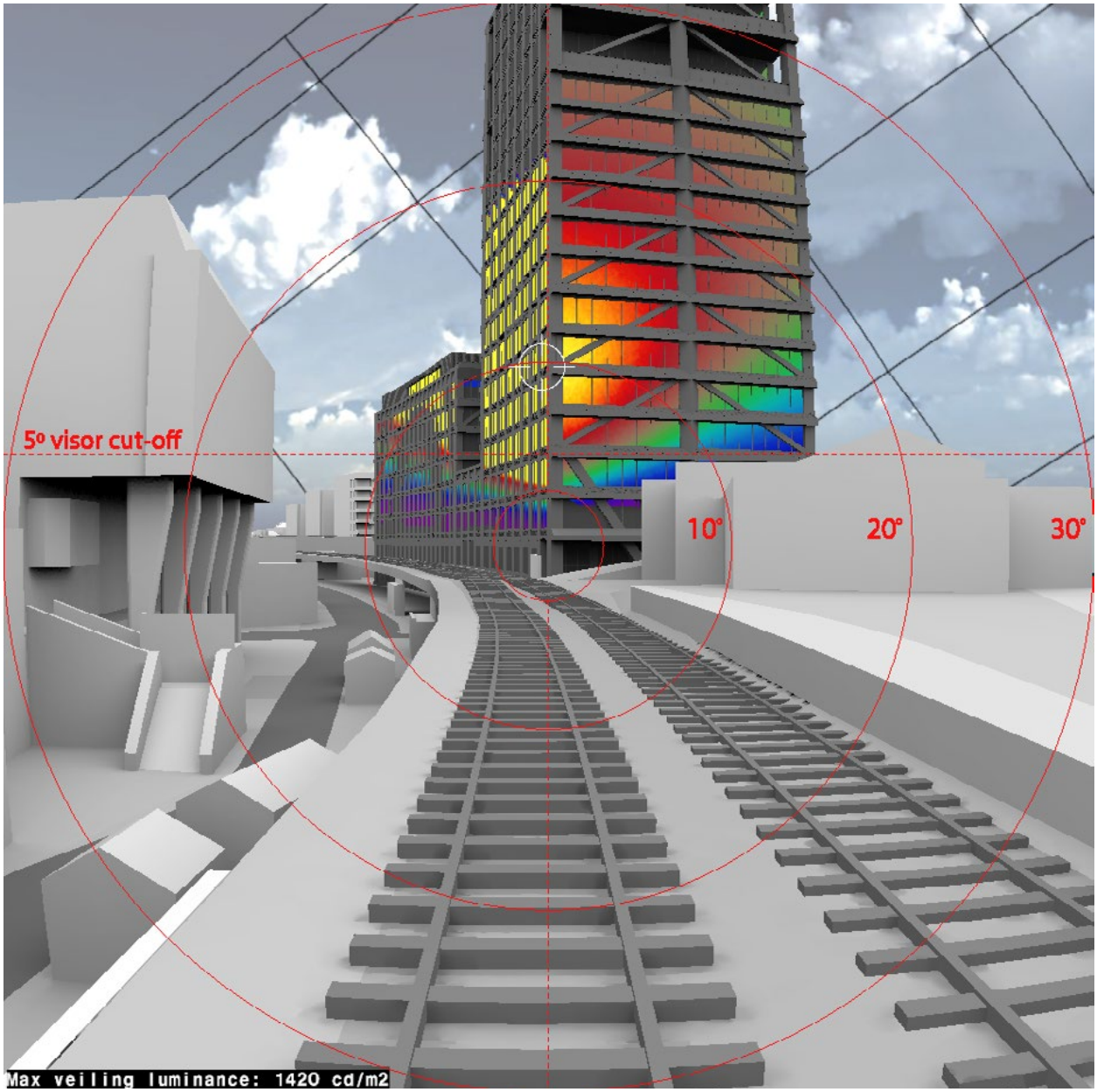
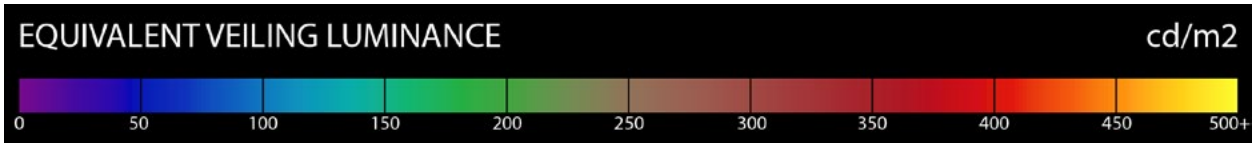


Fig. 77: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR2 - FRAME 469

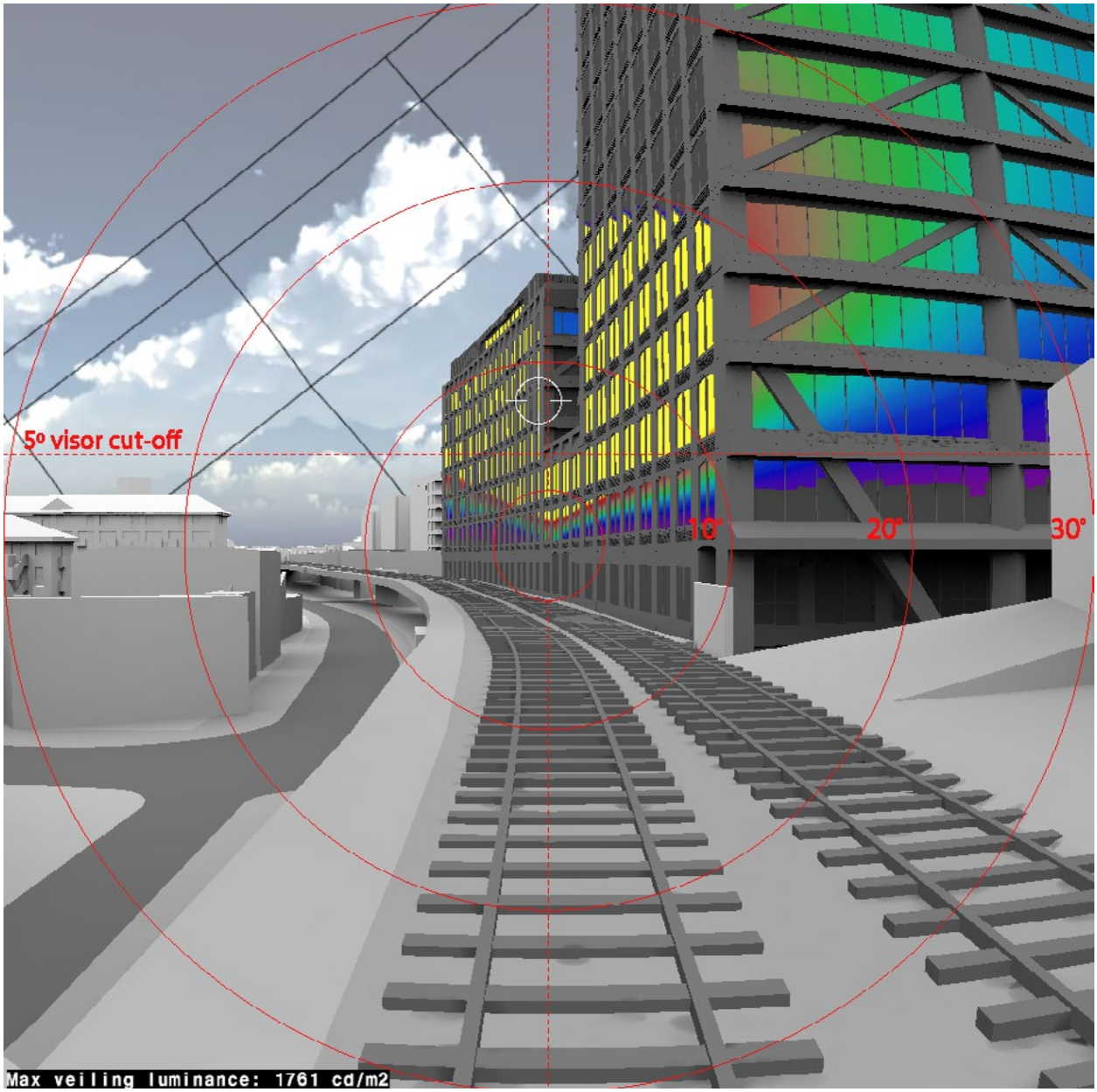
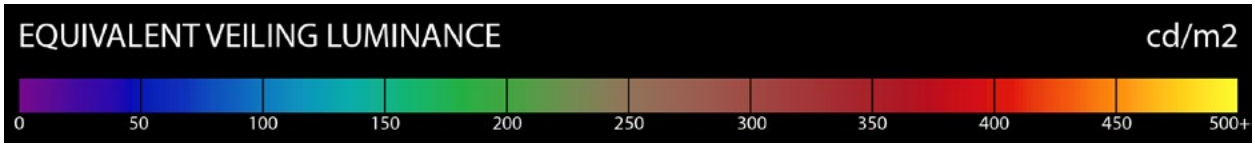


Fig. 78: Solar reflections



APPENDIX 03

SWR3 - NORTHBOUND SOUTHWEST RAIL/THAMESLINK LINE

VIEWPOINTS & FRAME NUMBERS
SWR 3

Fig. 79: Viewpoints and frame numbers

60° FIELD OF VIEW: TIME OF DAY
SWR3 - FRAME 140

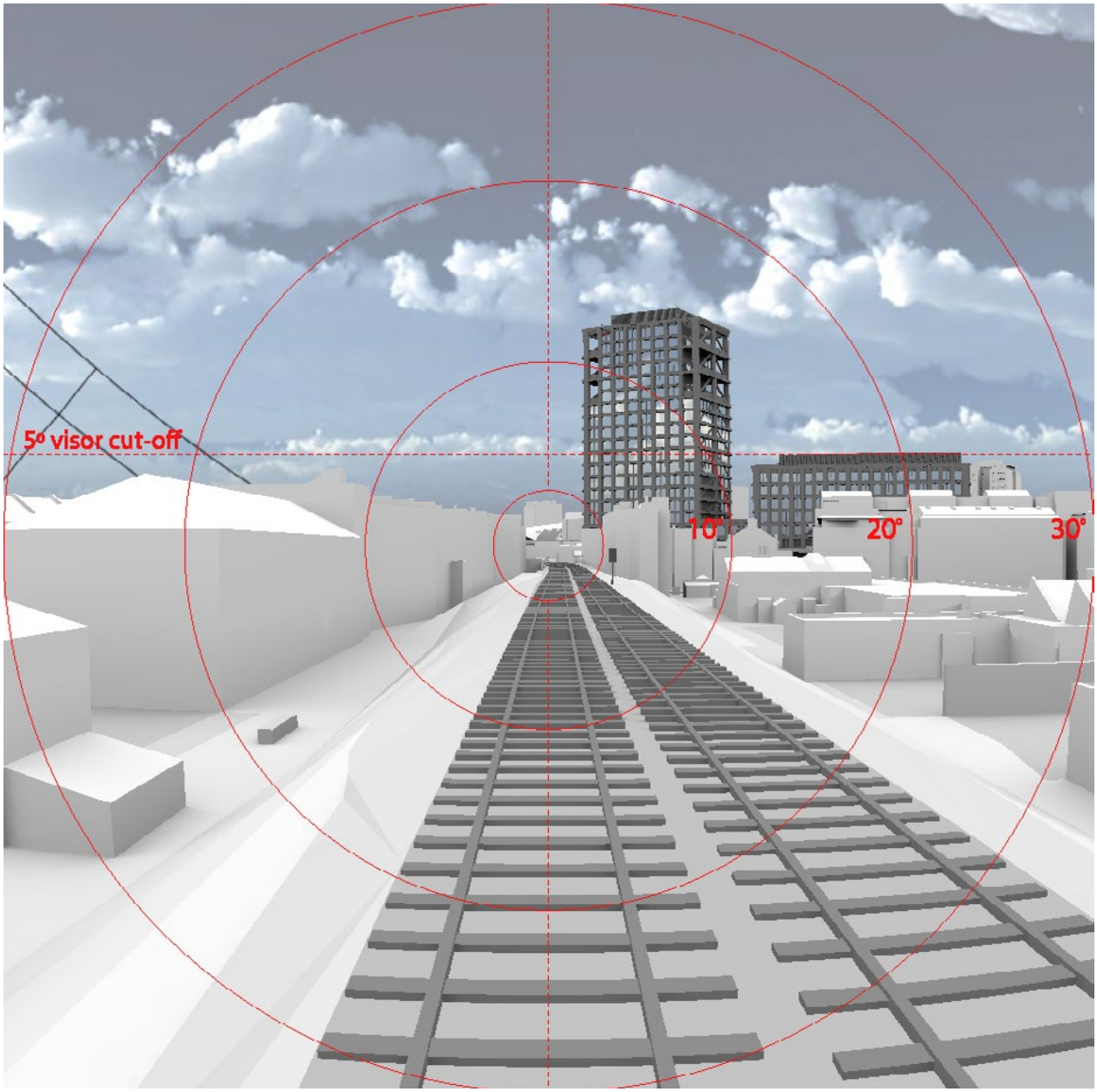
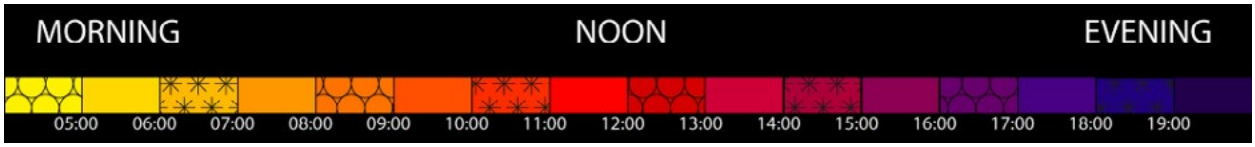


Fig. 80: Solar reflections



60° FIELD OF VIEW: SEASON
SWR3 - FRAME 140

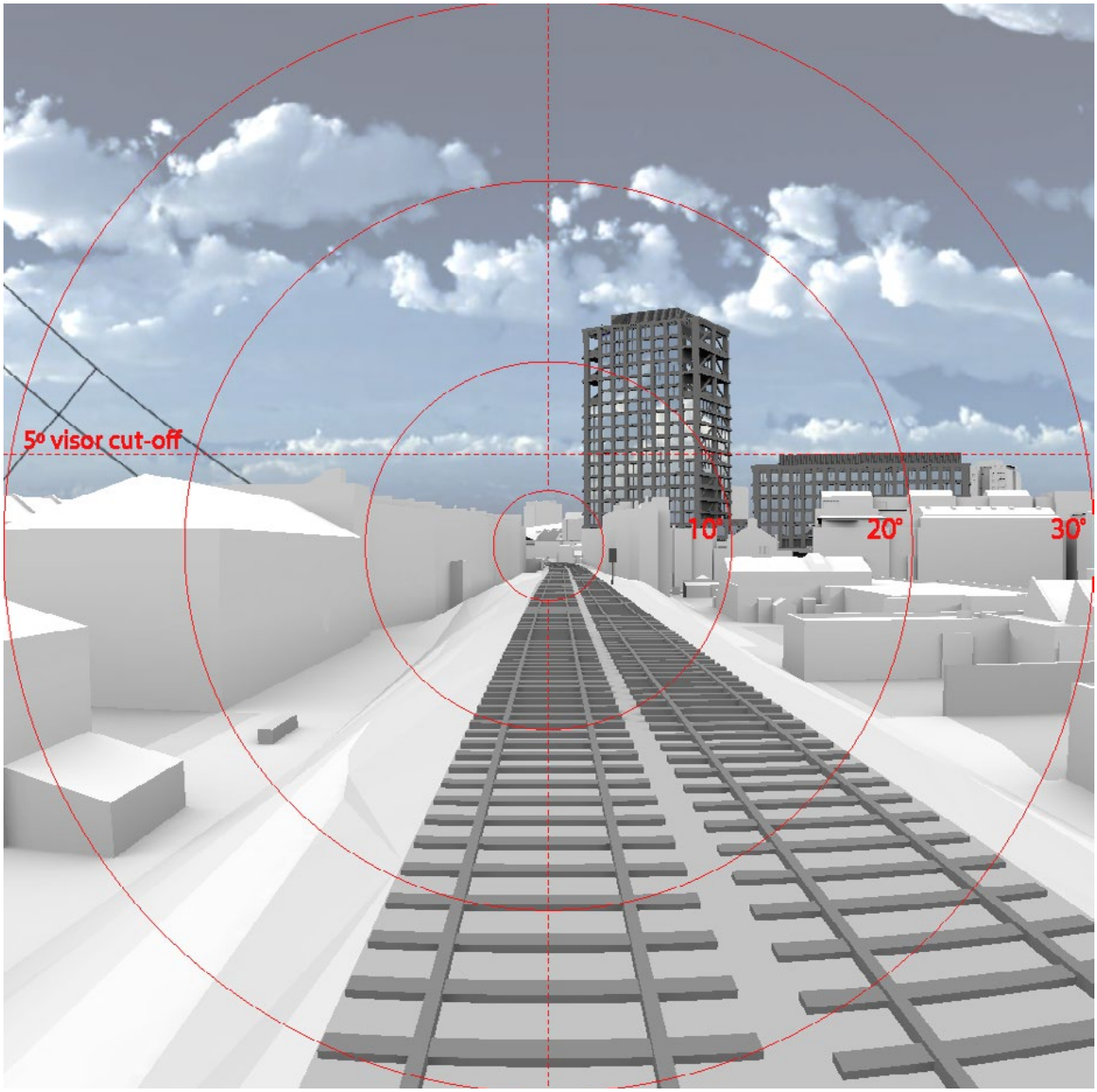


Fig. 81: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR3 - FRAME 265

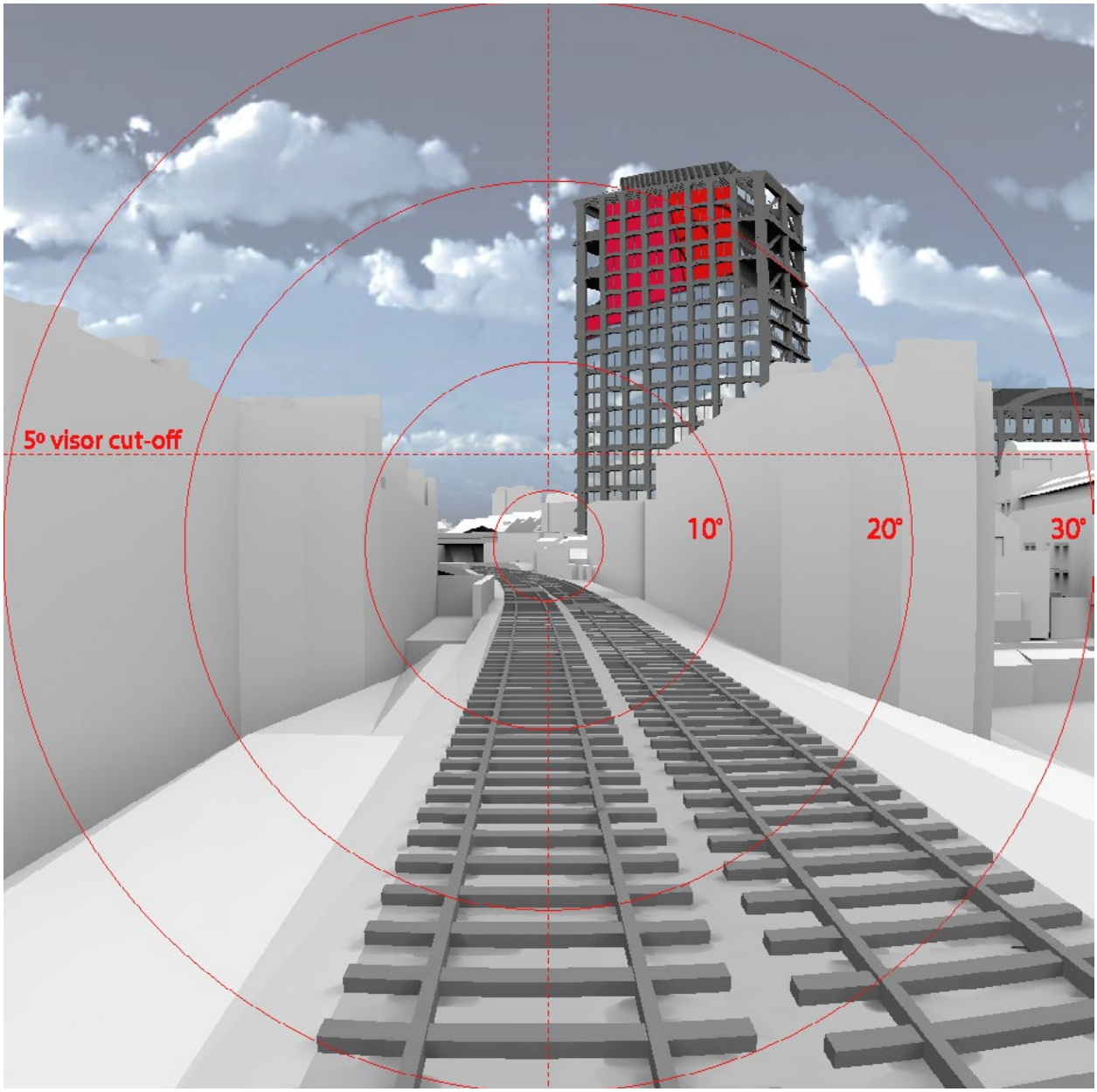
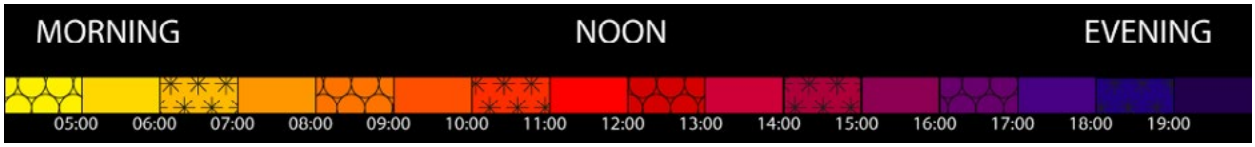


Fig. 82: Solar reflections



60° FIELD OF VIEW: SEASON
SWR3 - FRAME 265

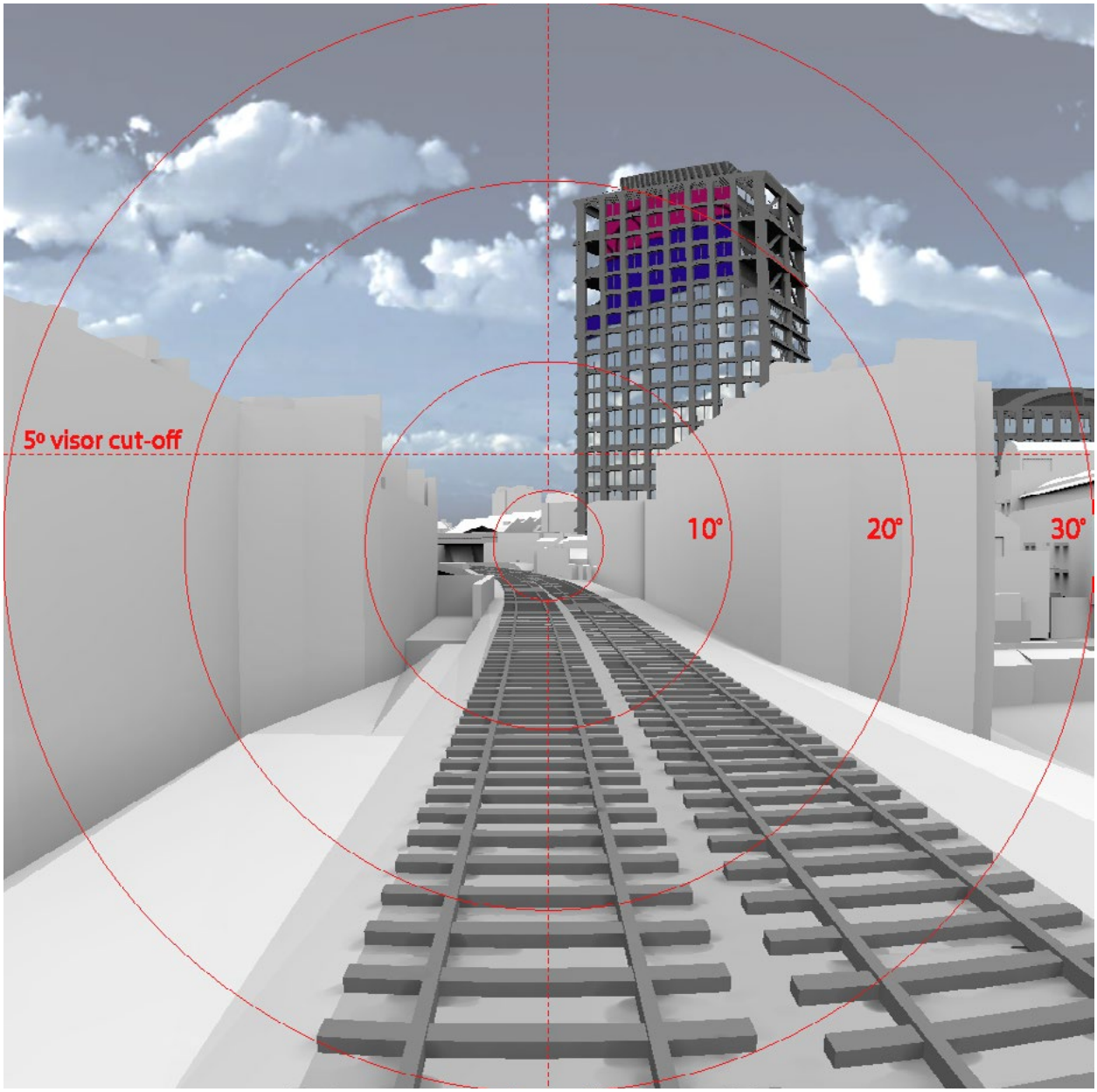


Fig. 83: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR3 - FRAME 360

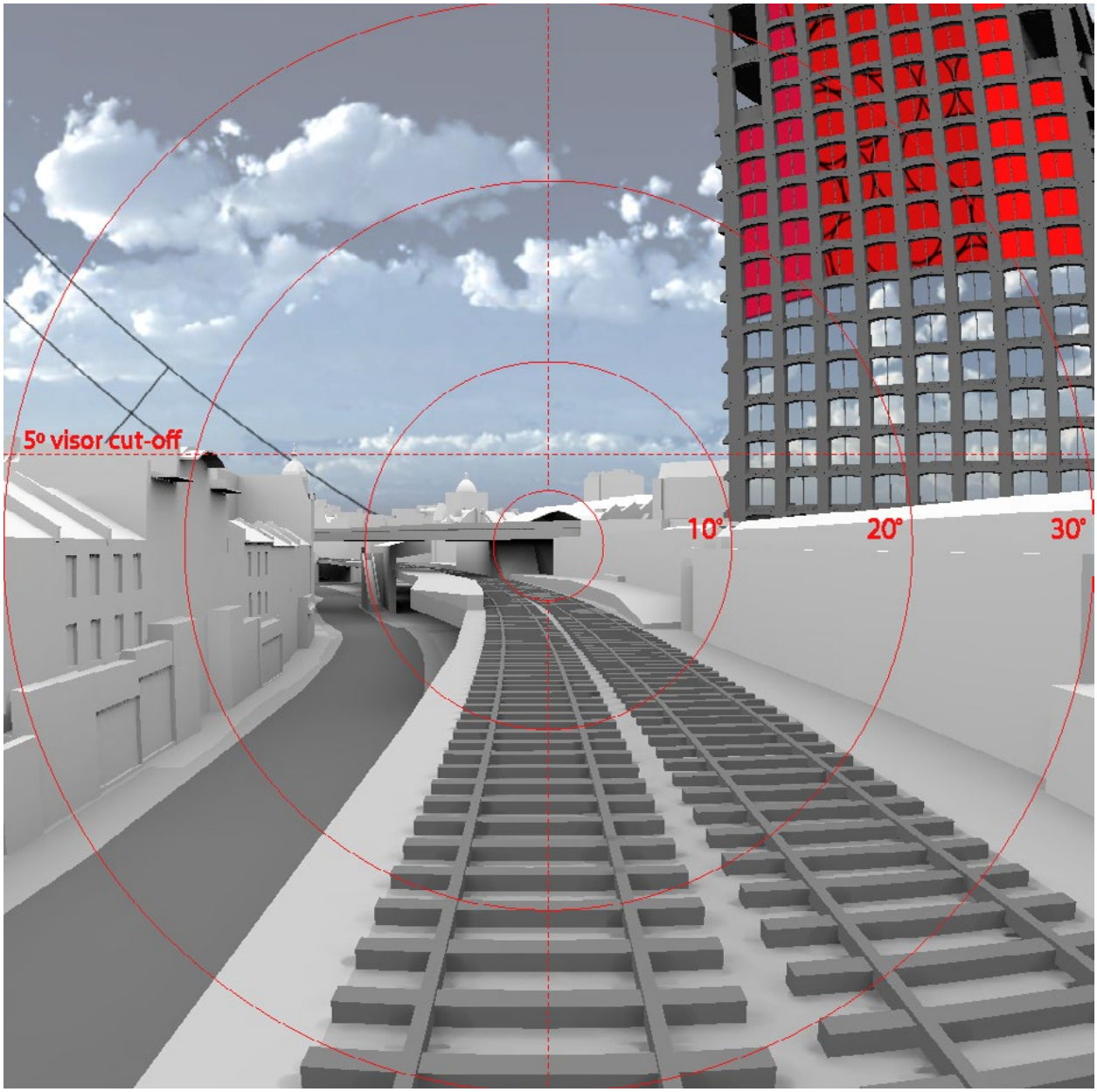
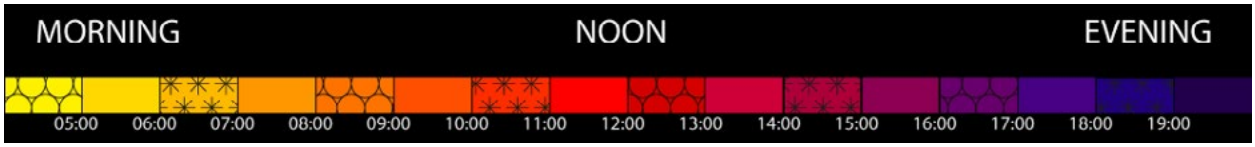


Fig. 84: Solar reflections



60° FIELD OF VIEW: SEASON
SWR3 - FRAME360

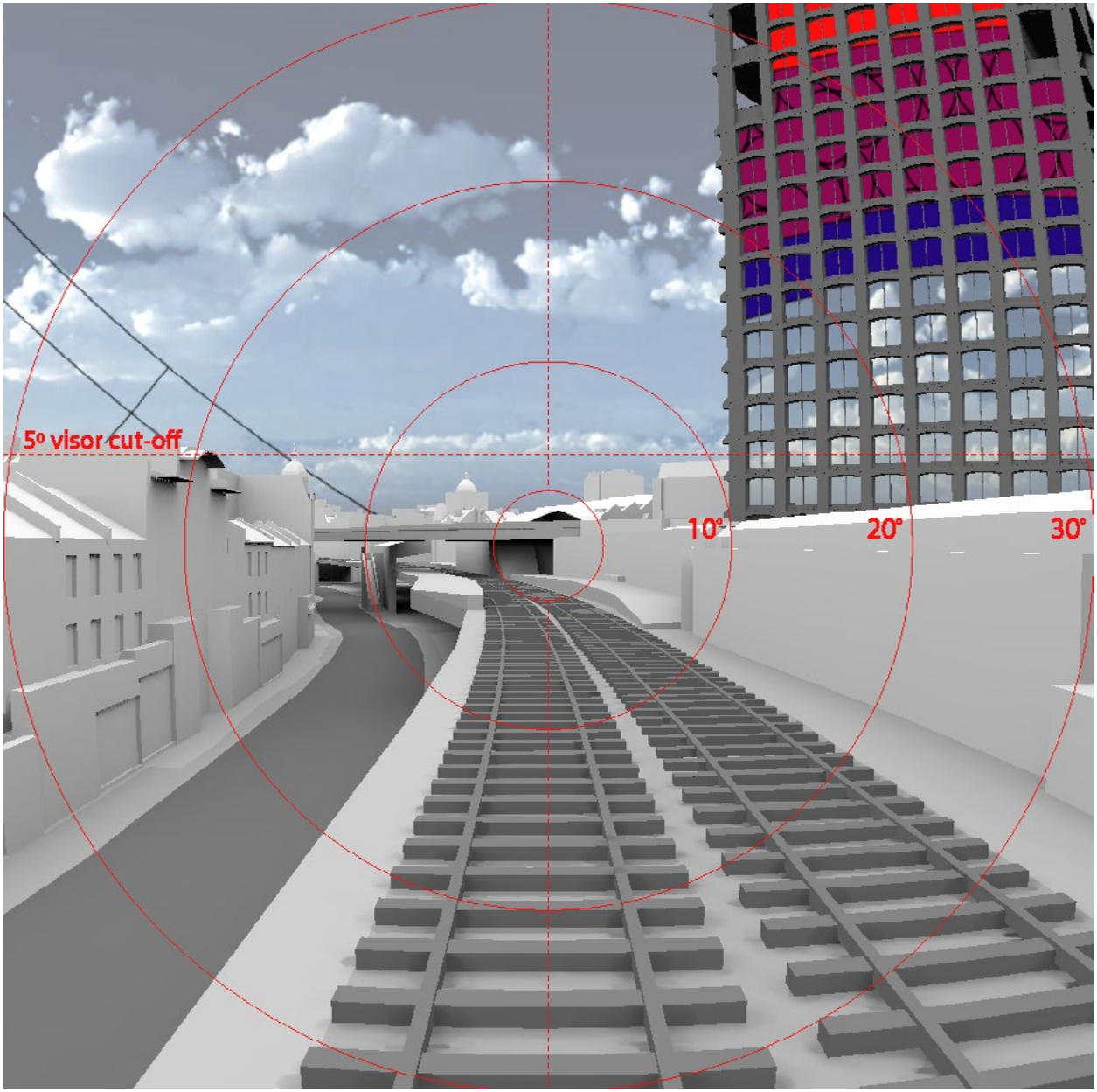


Fig. 85: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR3 - FRAME 420

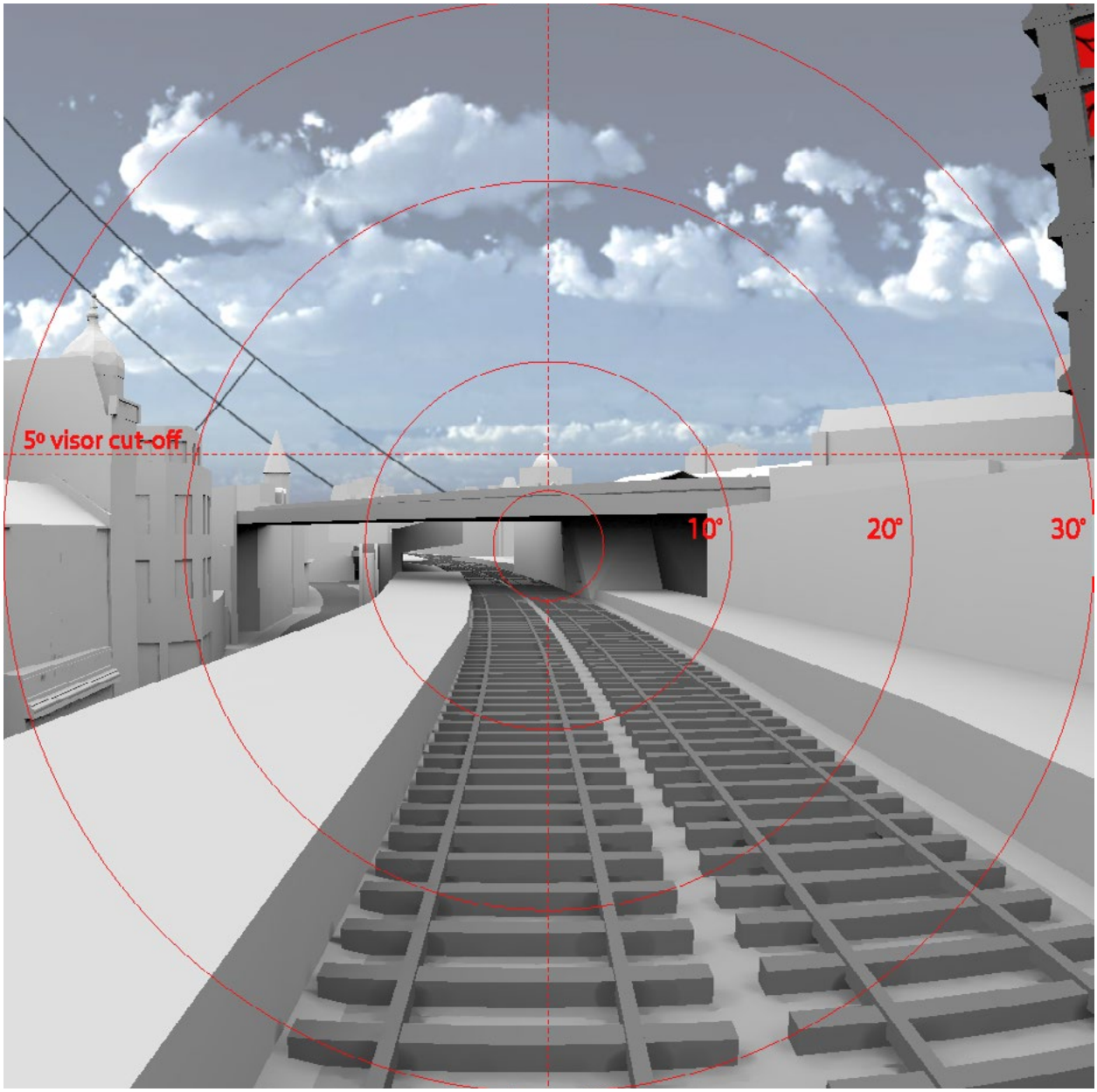
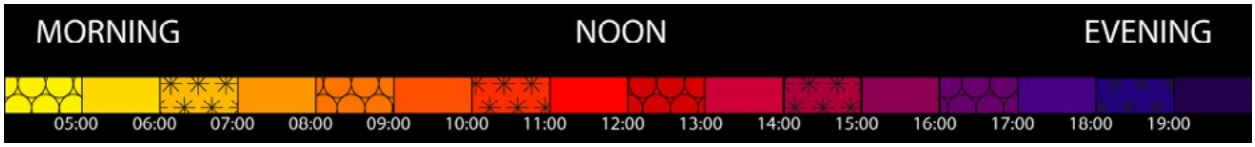


Fig. 86: Solar reflections



60° FIELD OF VIEW: SEASON
SWR3 - FRAME 420

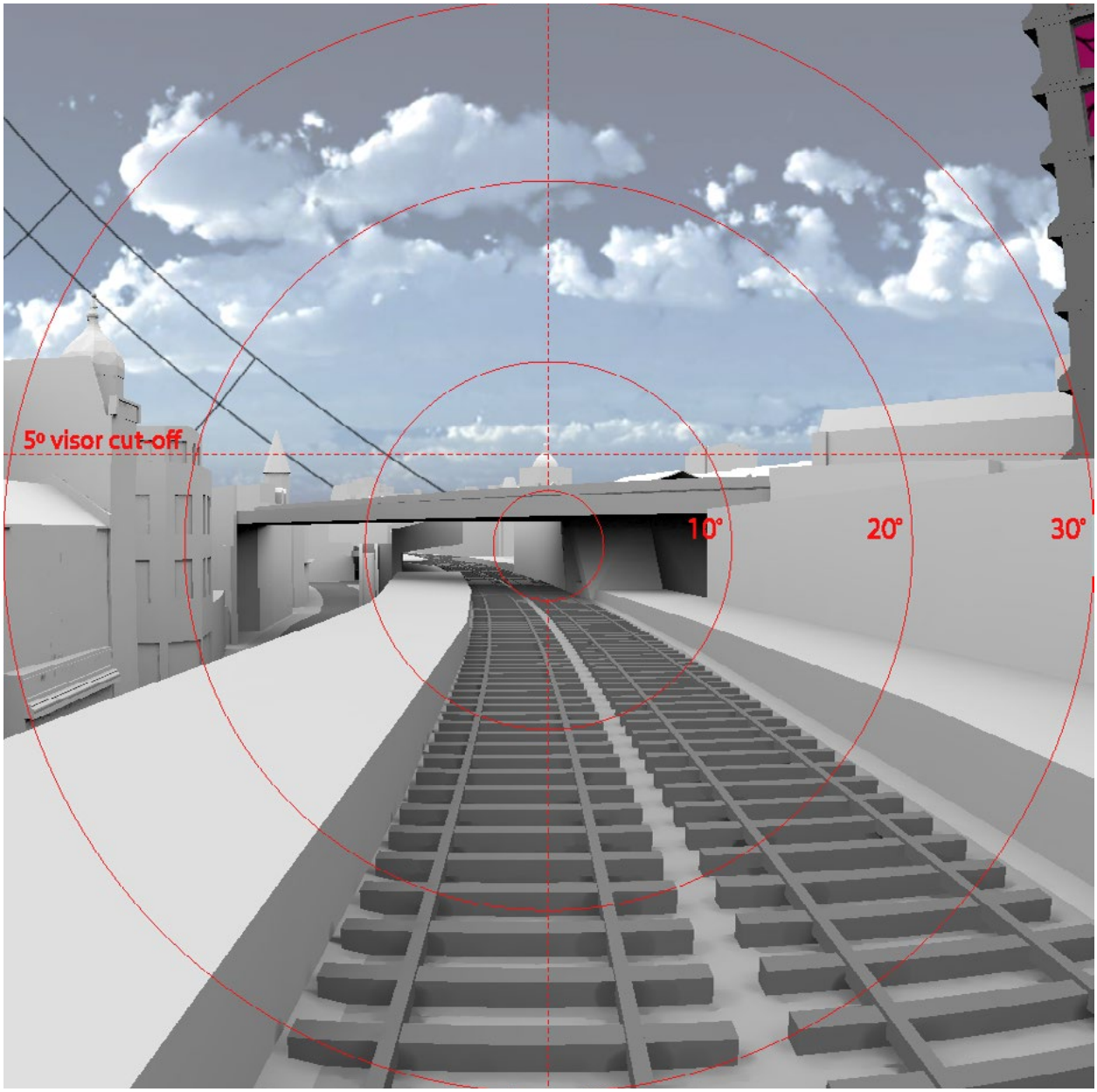
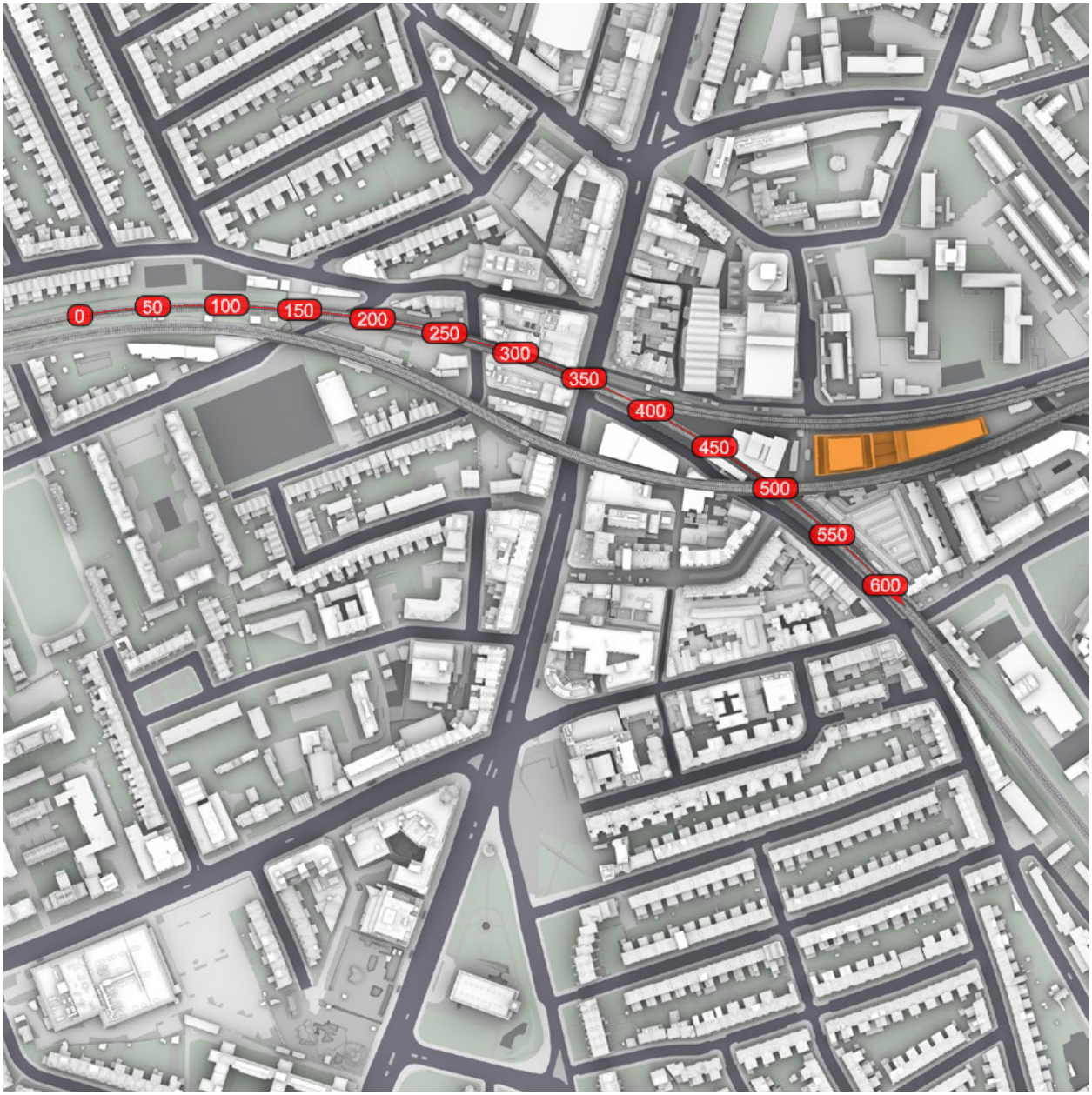


Fig. 87: Solar reflections

APPENDIX 04

SWR4 - SOUTHBOUND SOUTHWEST RAIL/THAMESLINK LINE

VIEWPOINTS & FRAME NUMBERS
SWR 4



60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 1

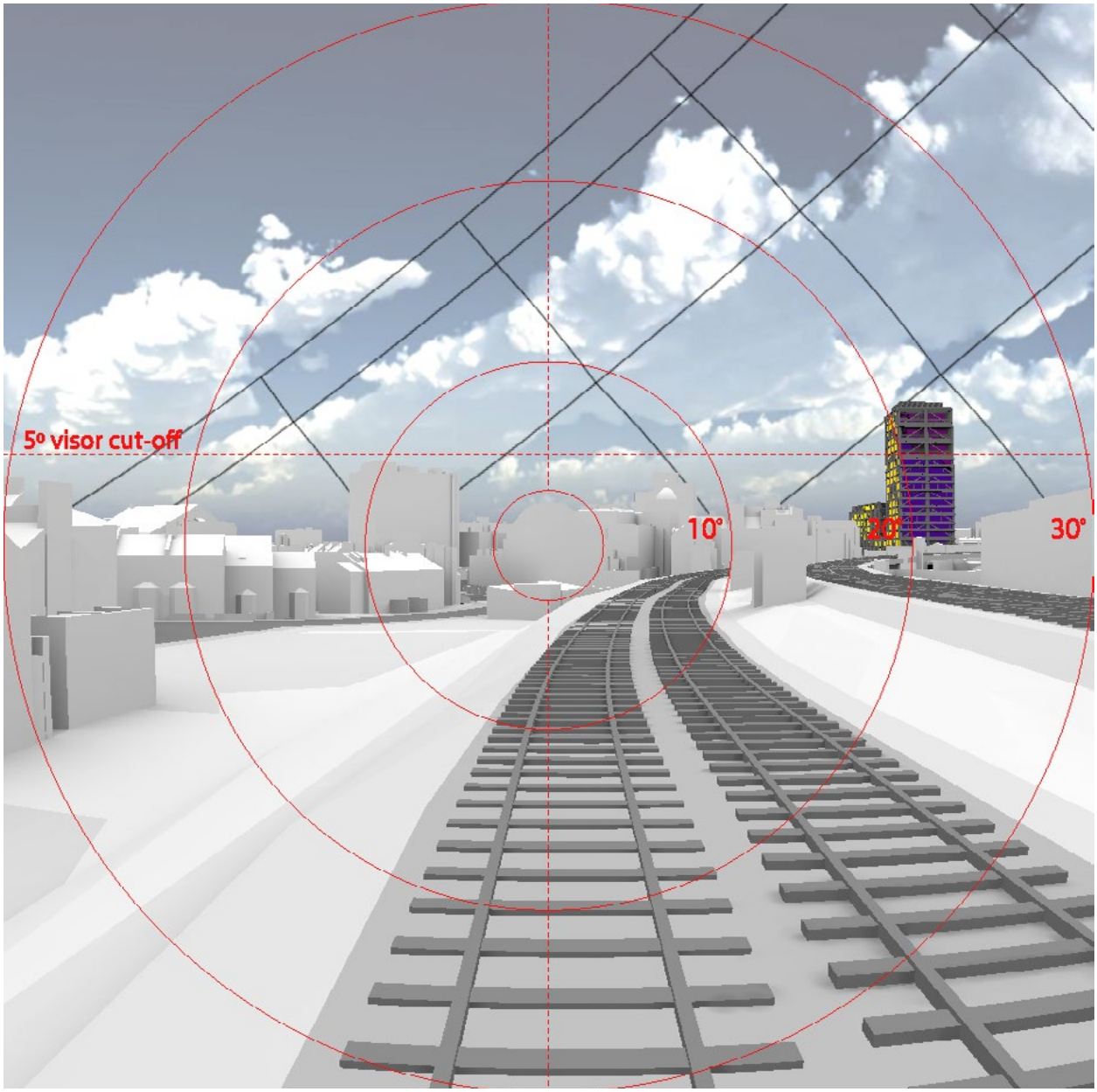
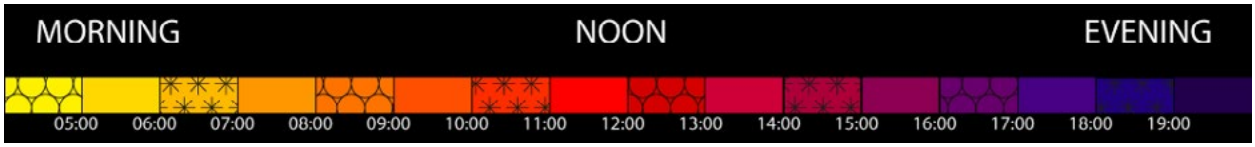


Fig. 88: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 1

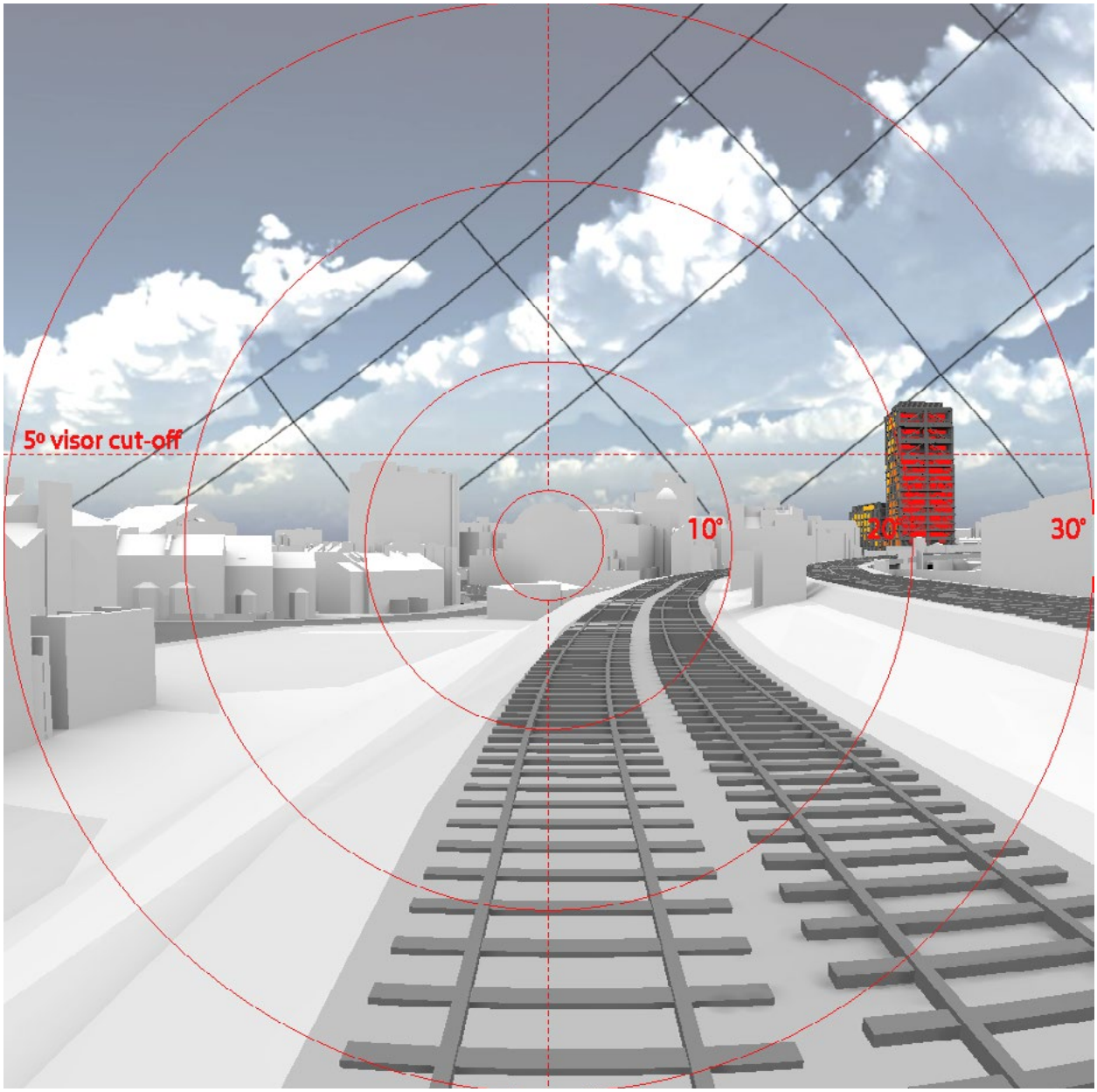


Fig. 89: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 66

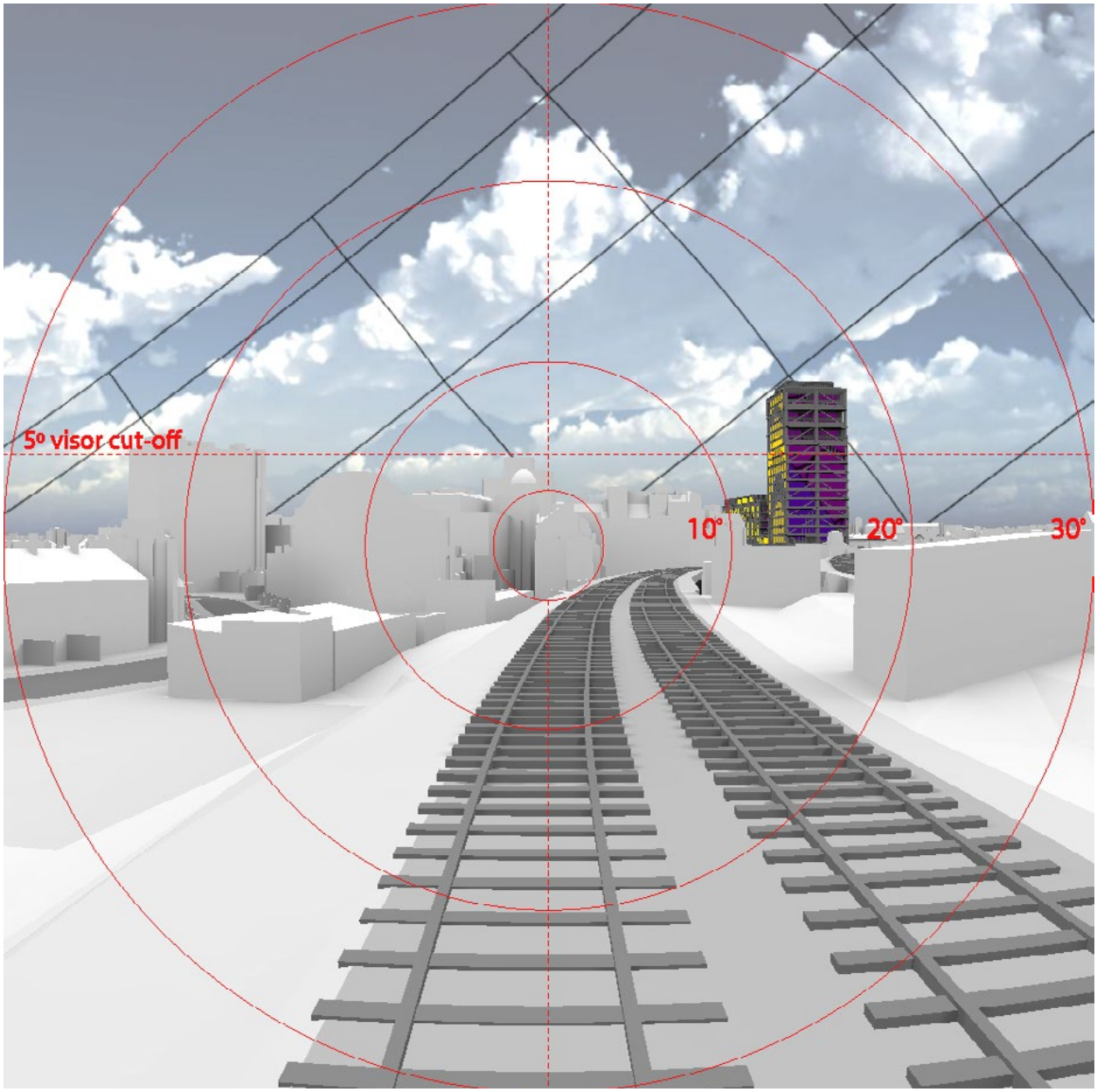
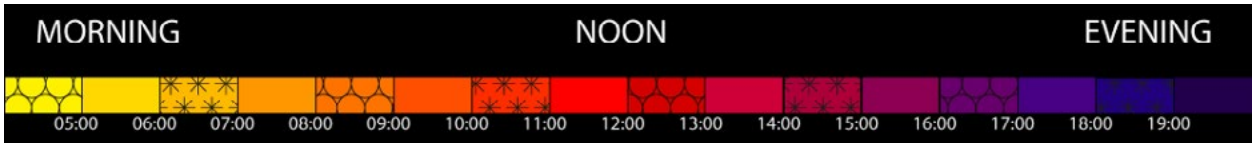


Fig. 90: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 66

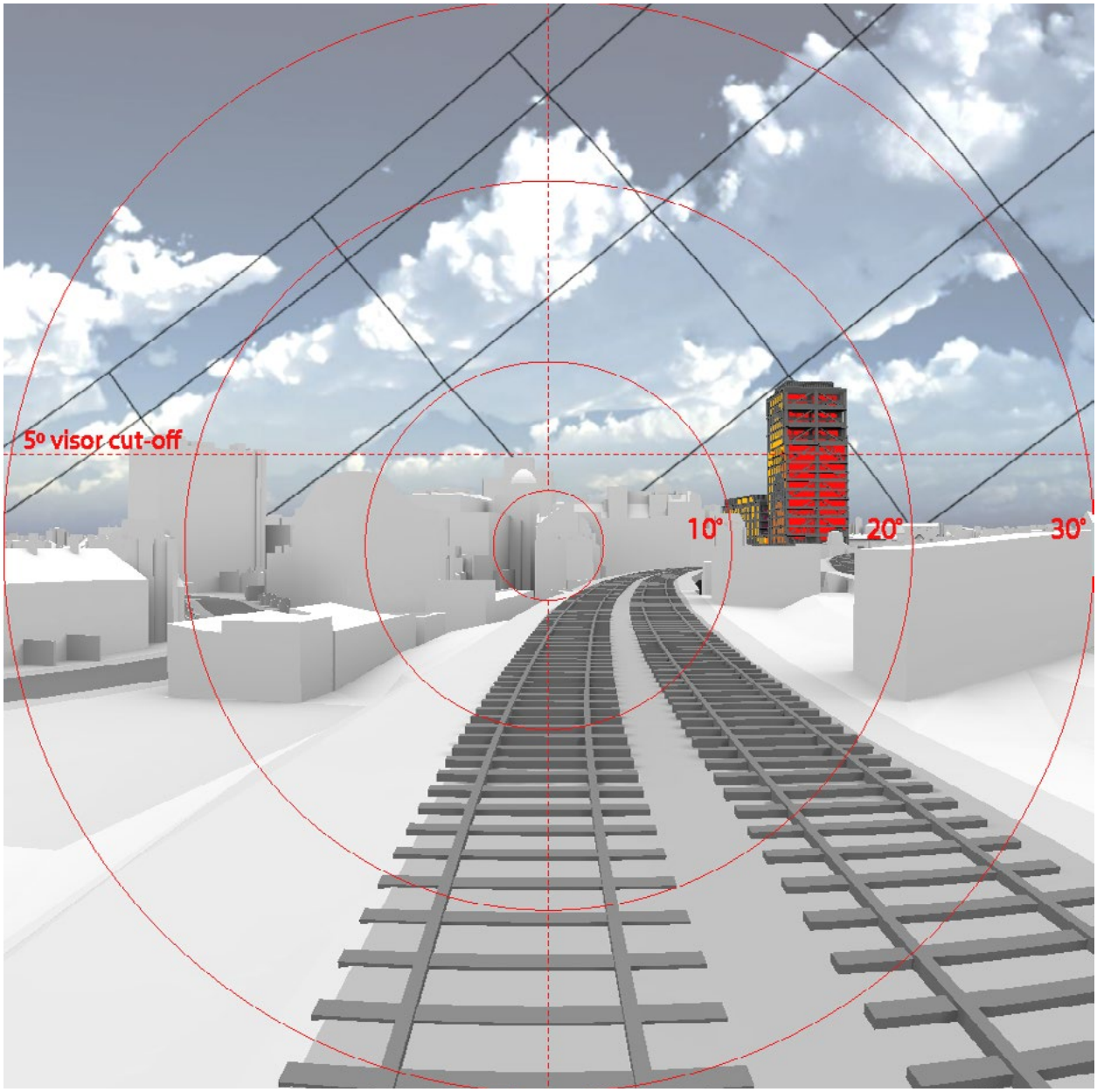


Fig. 91: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 100

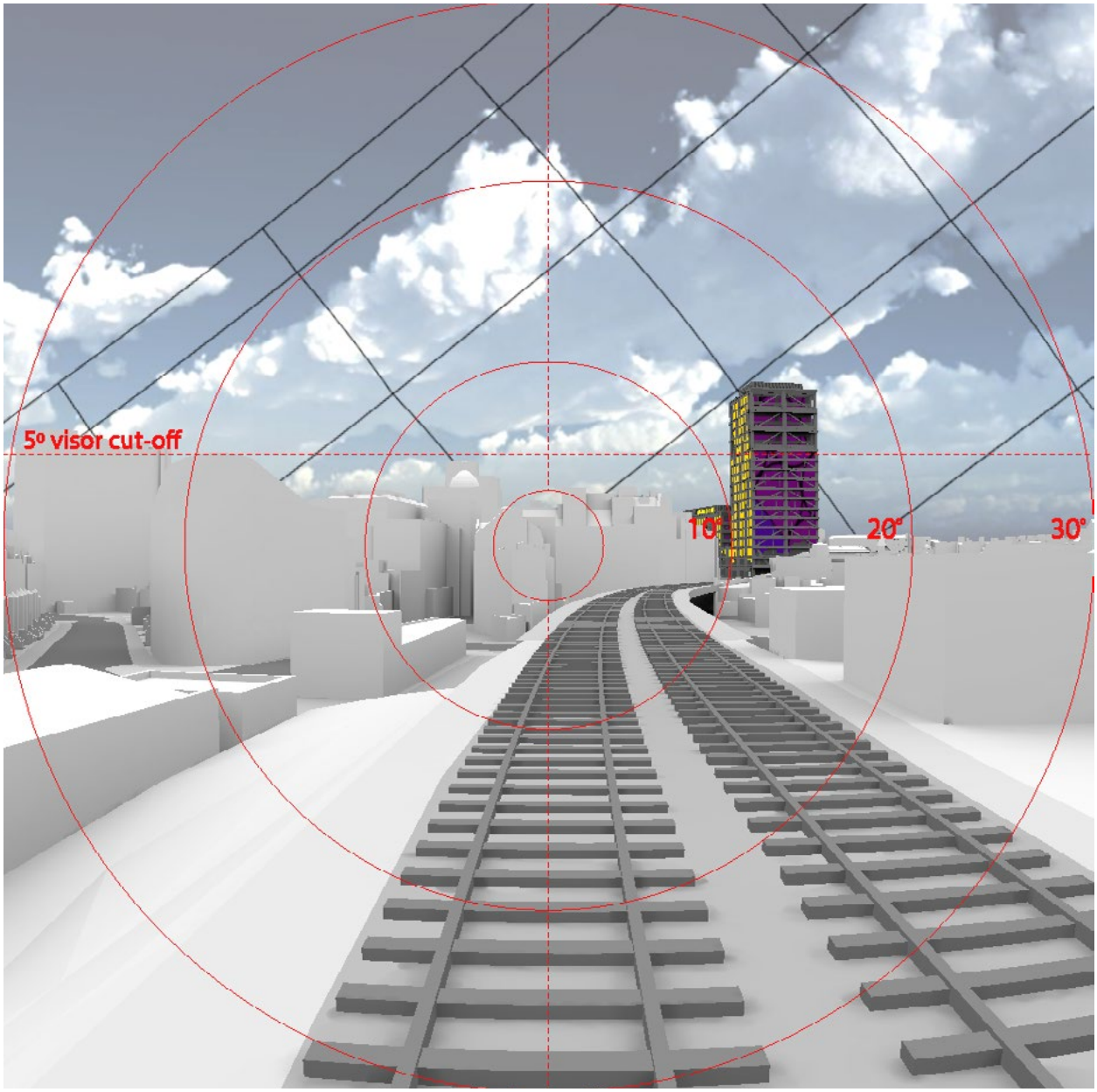
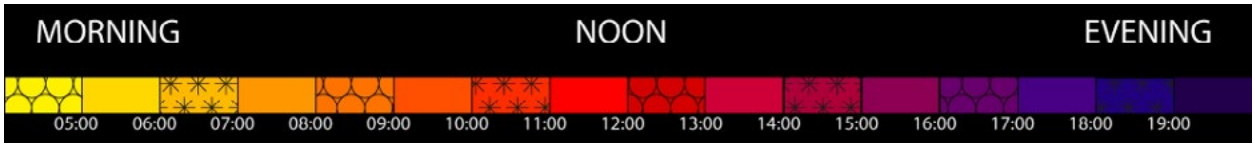


Fig. 92: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 100

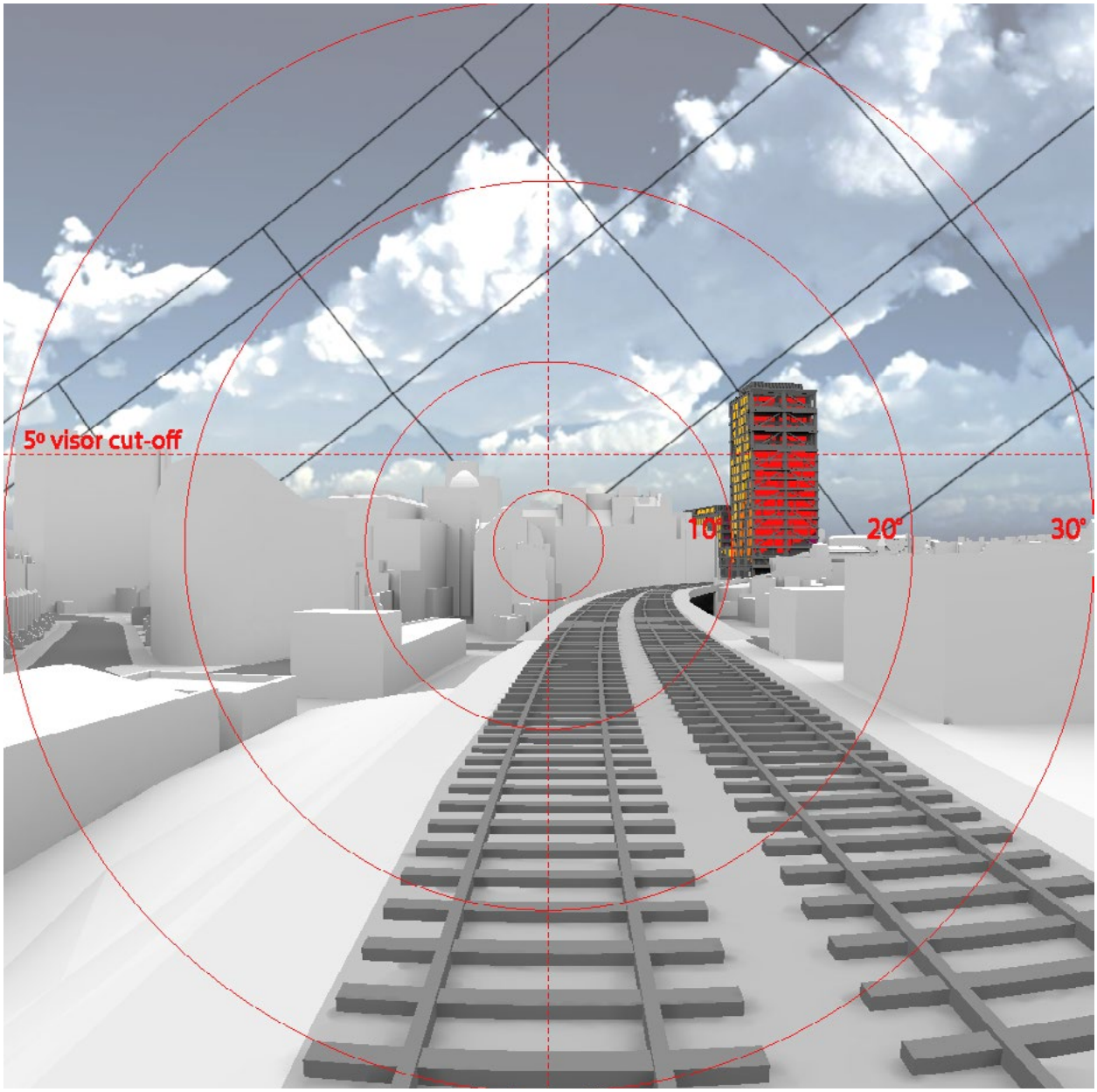


Fig. 93: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 112

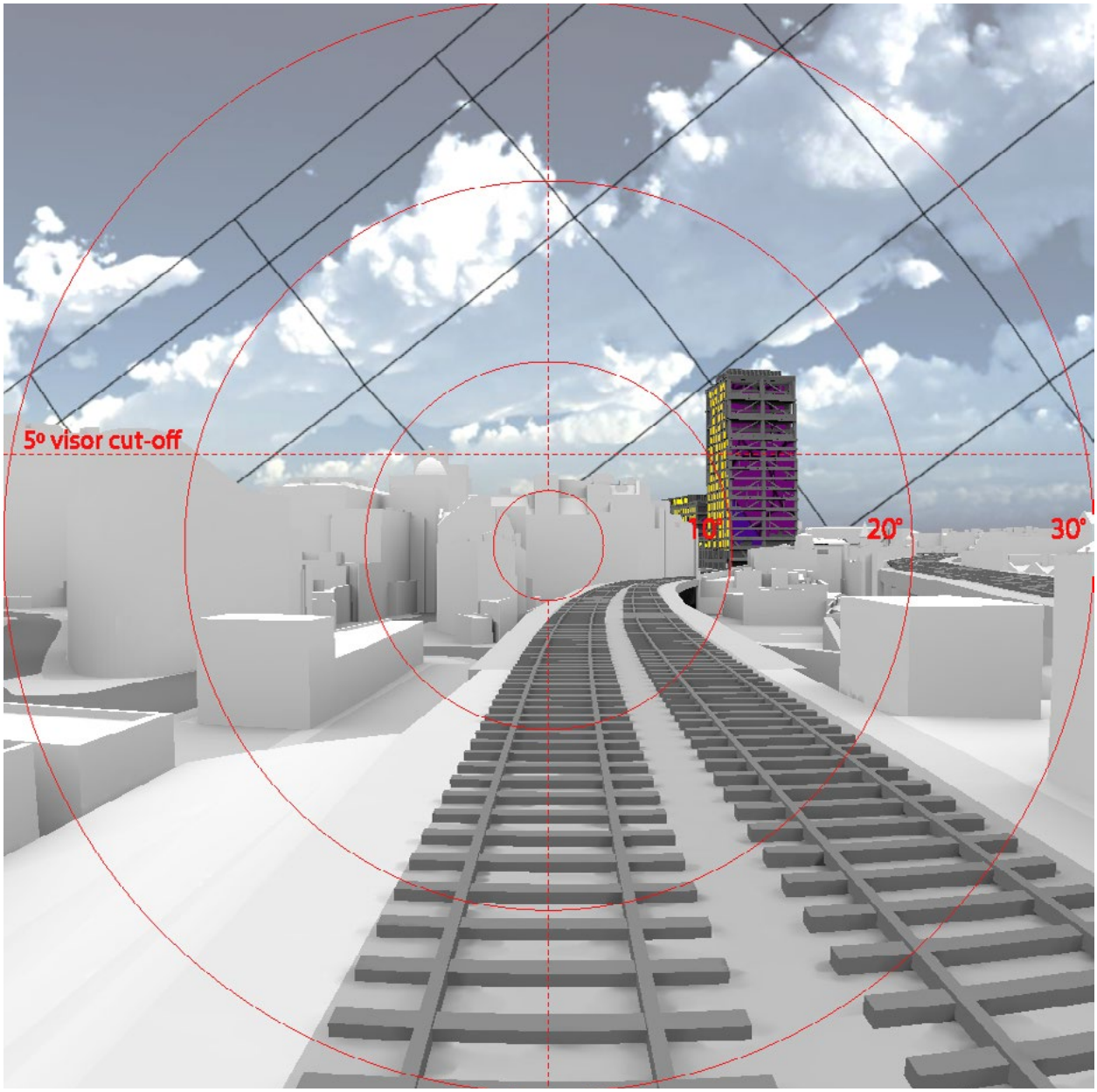
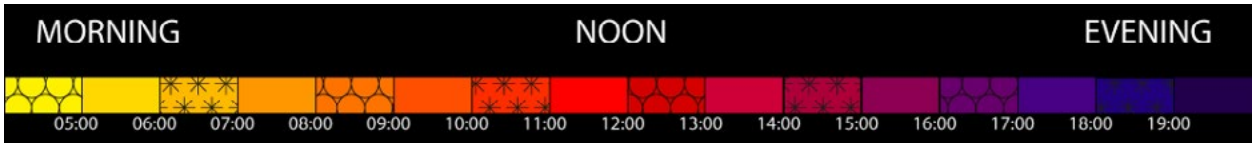


Fig. 94: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 112

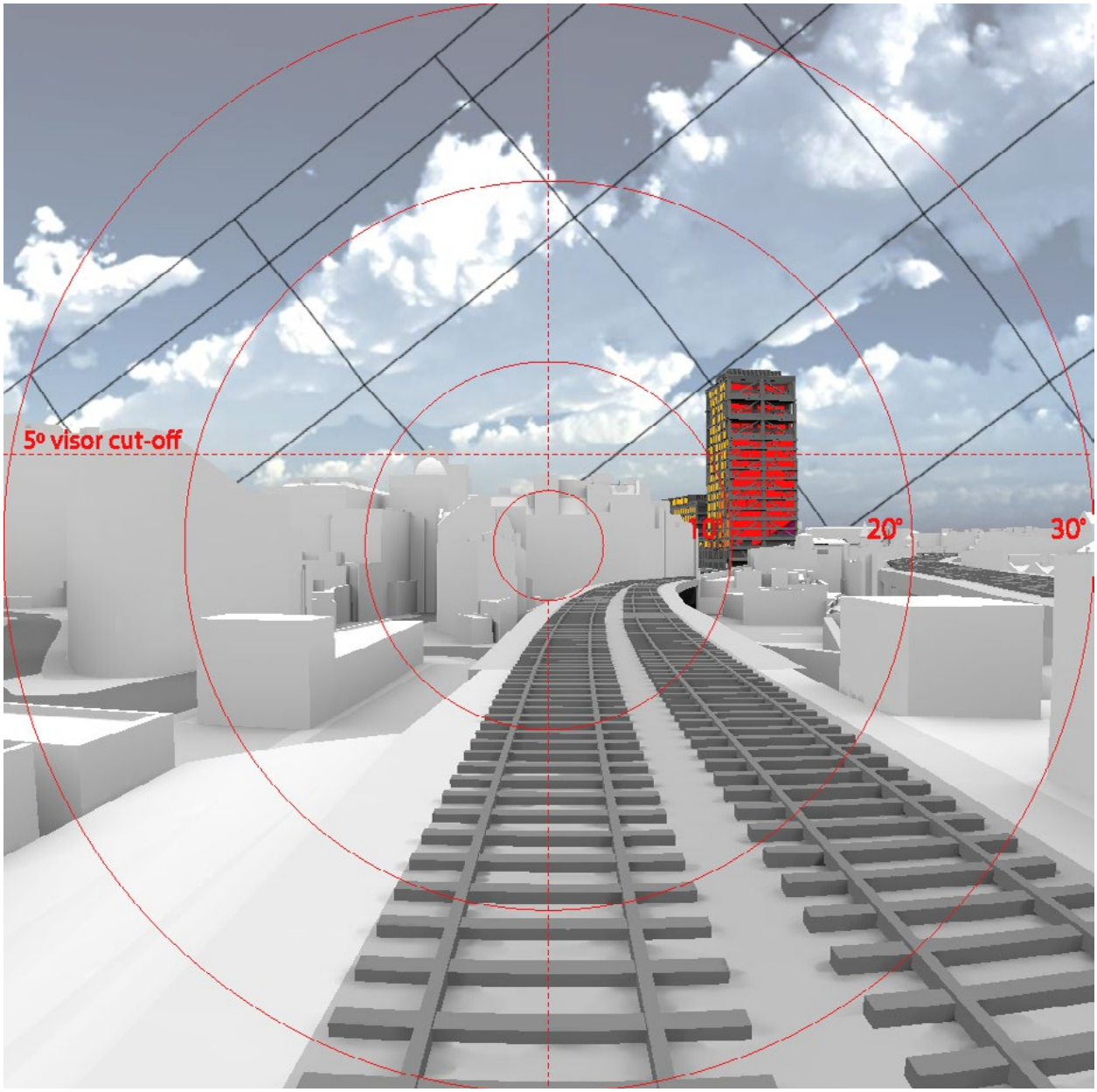


Fig. 95: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 220

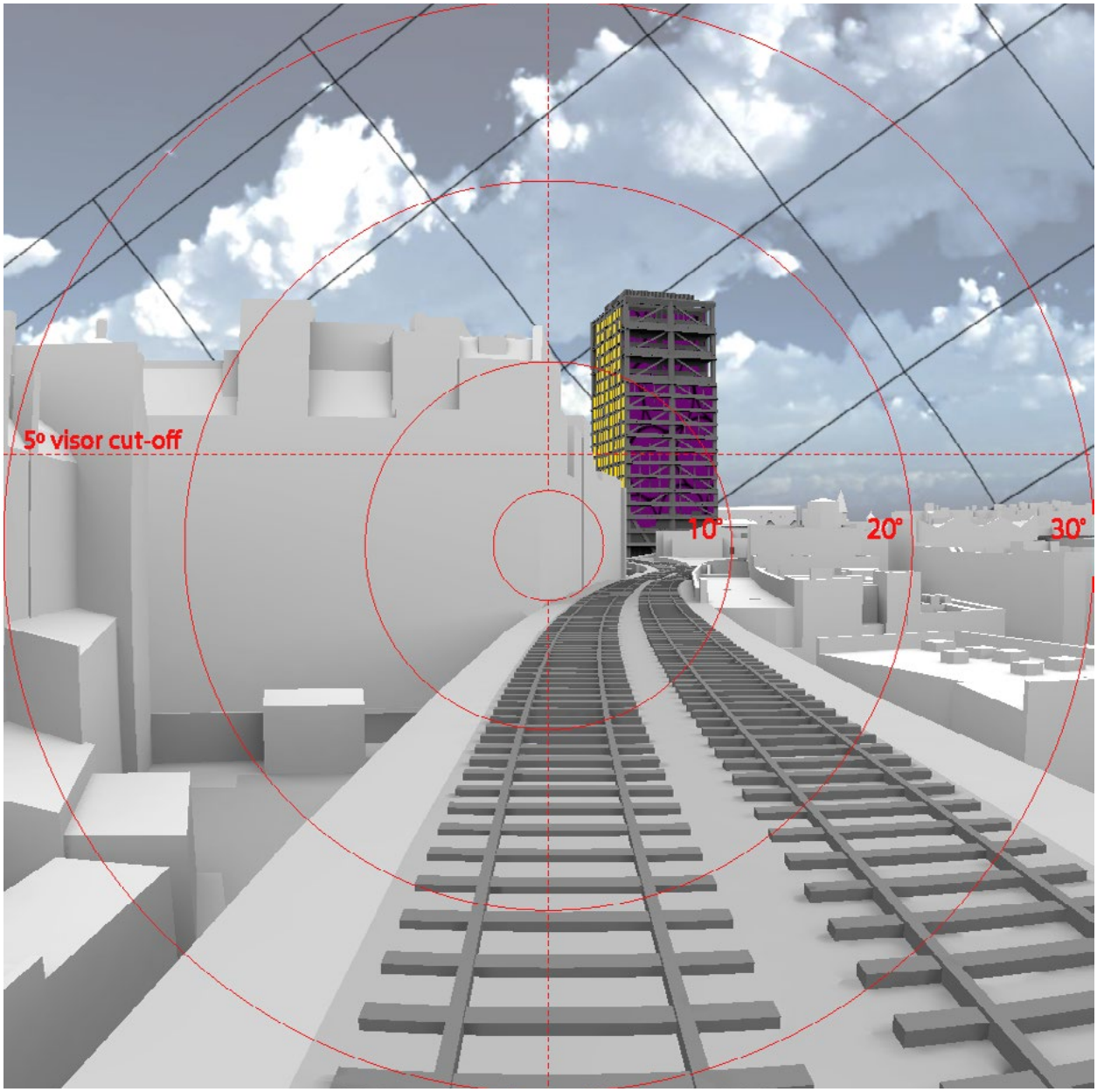
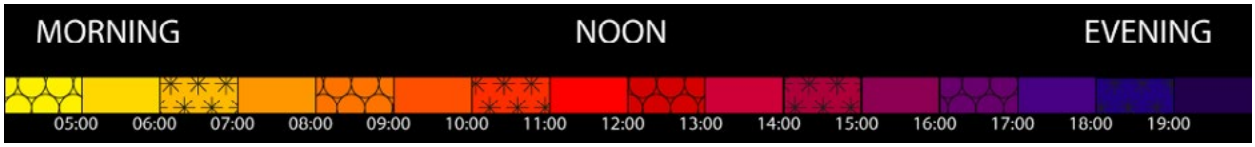


Fig. 96: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 220

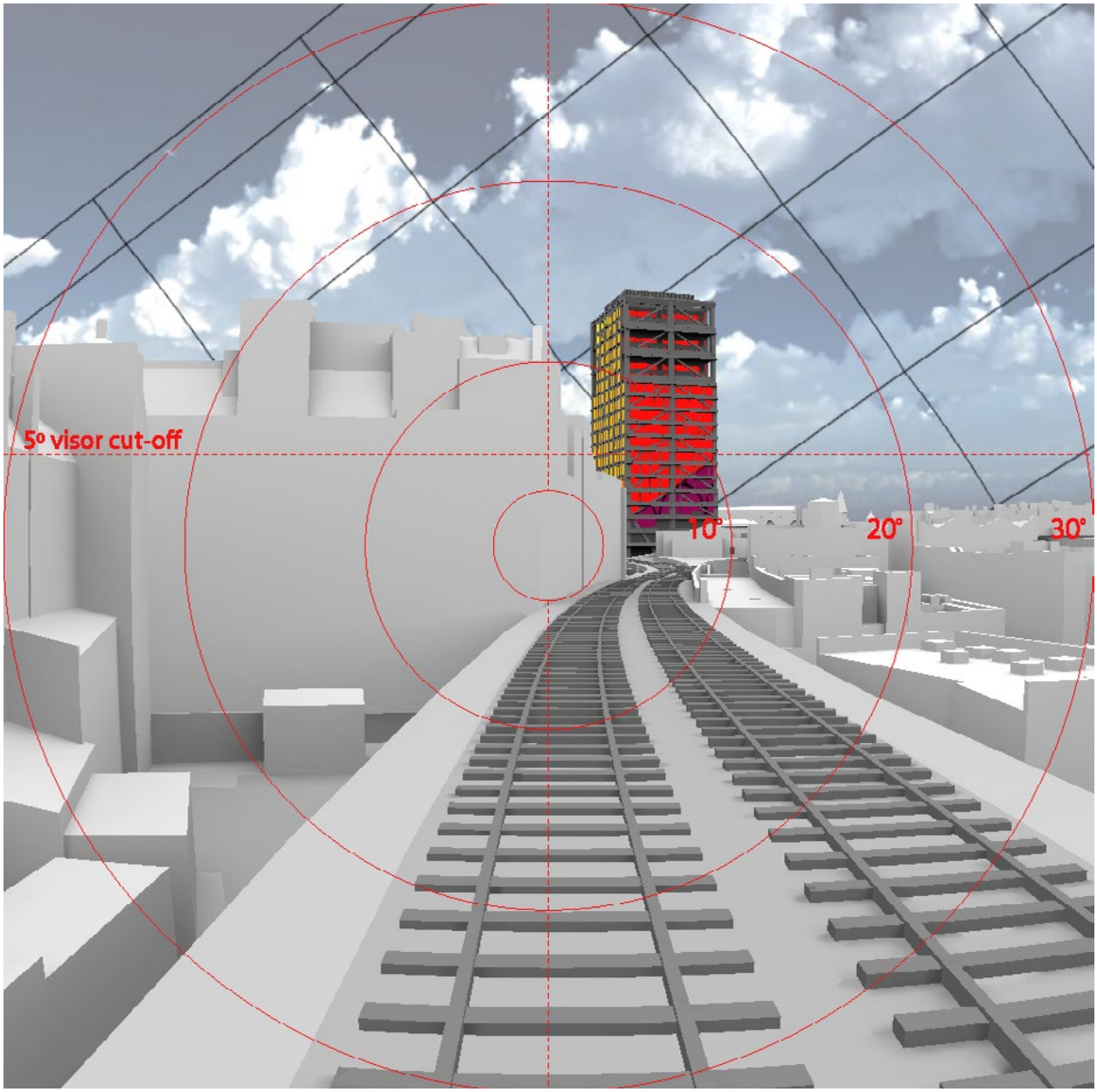


Fig. 97: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 321

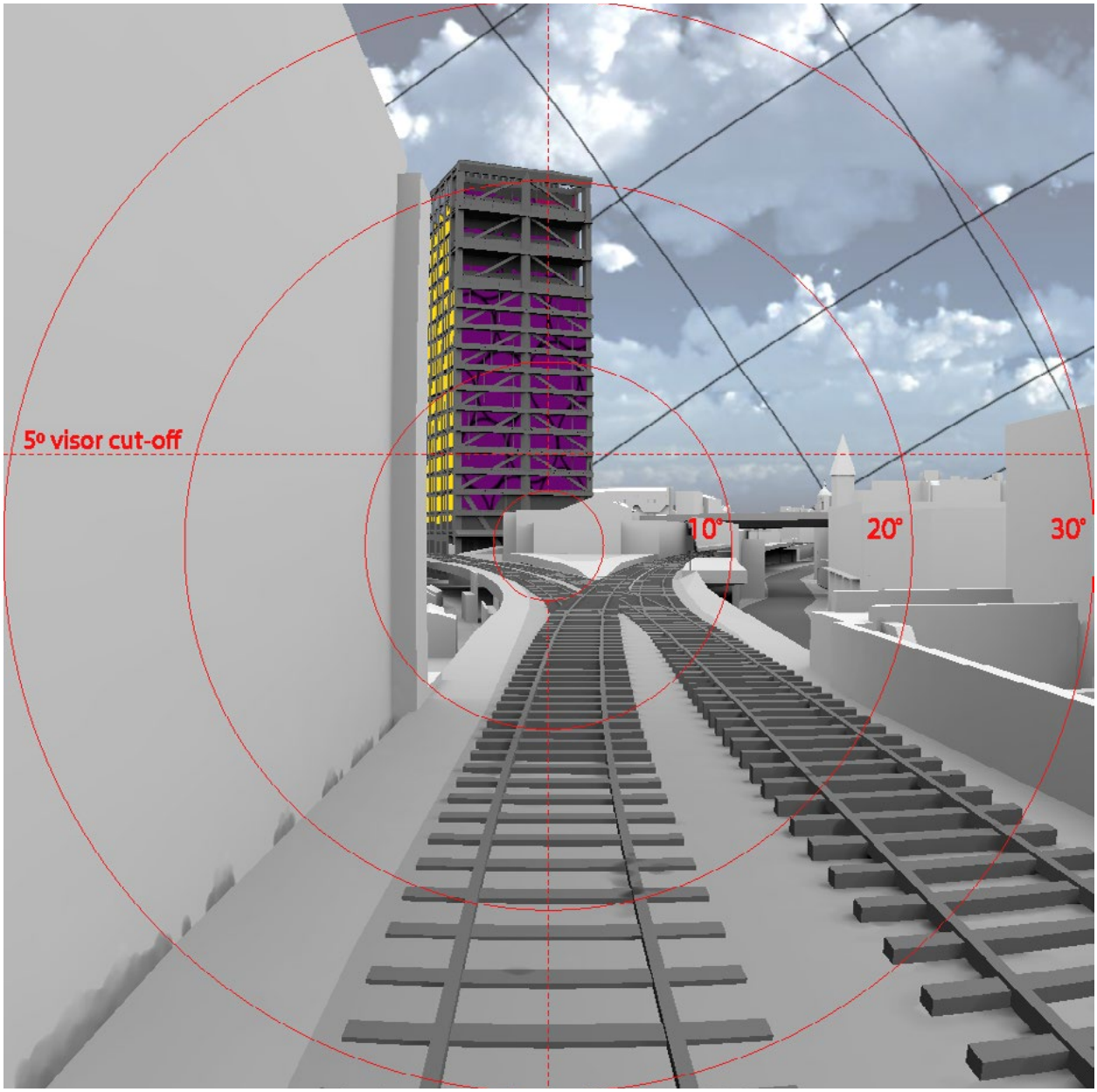
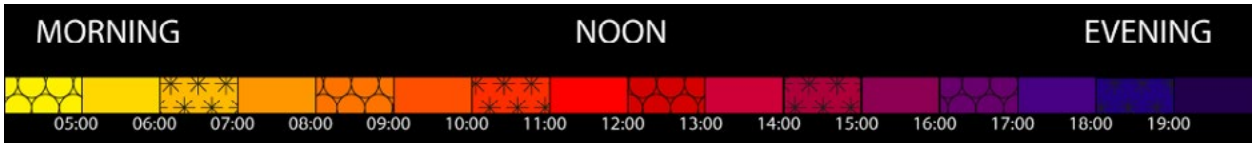


Fig. 98: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 321

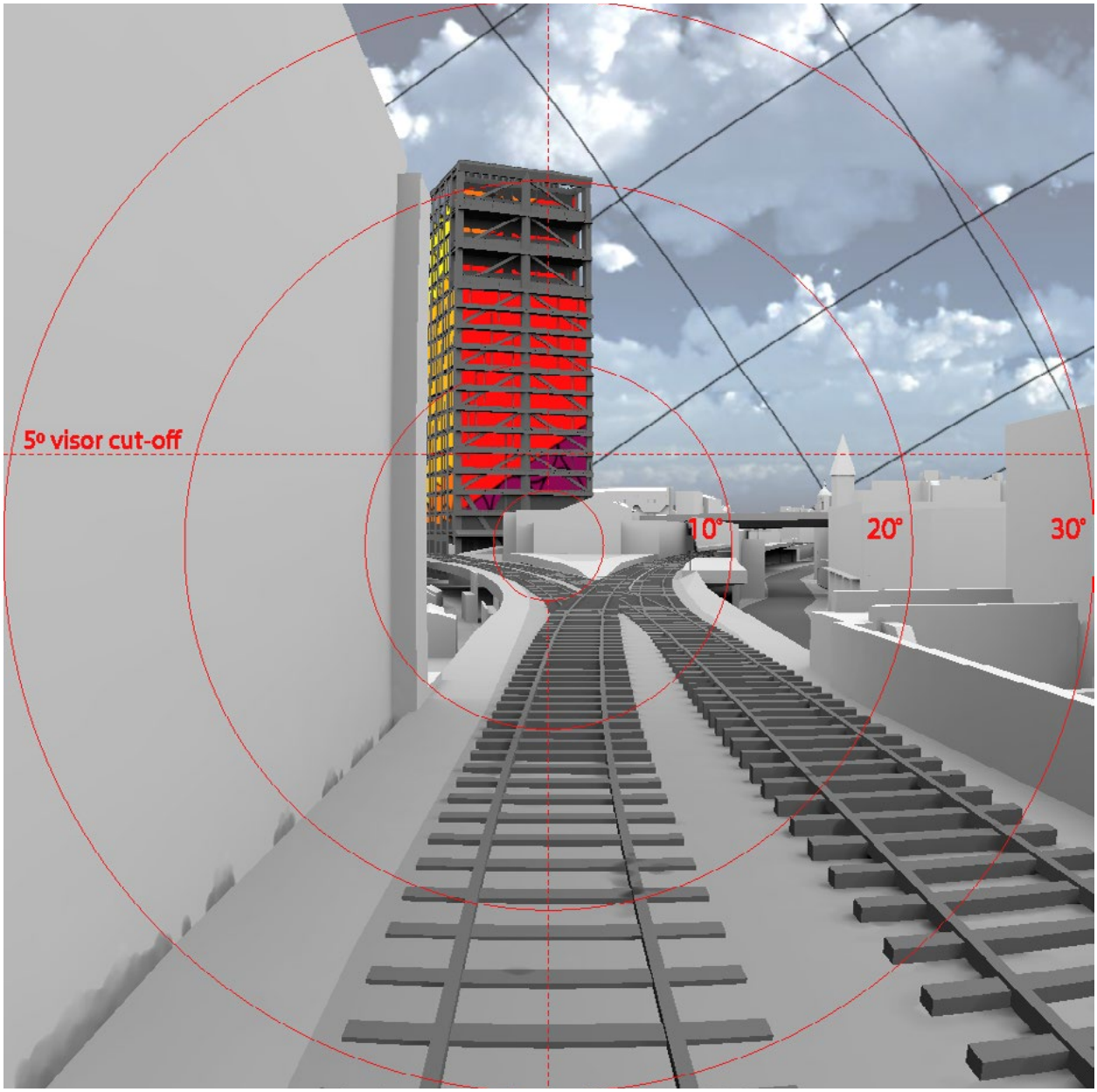


Fig. 99: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 370

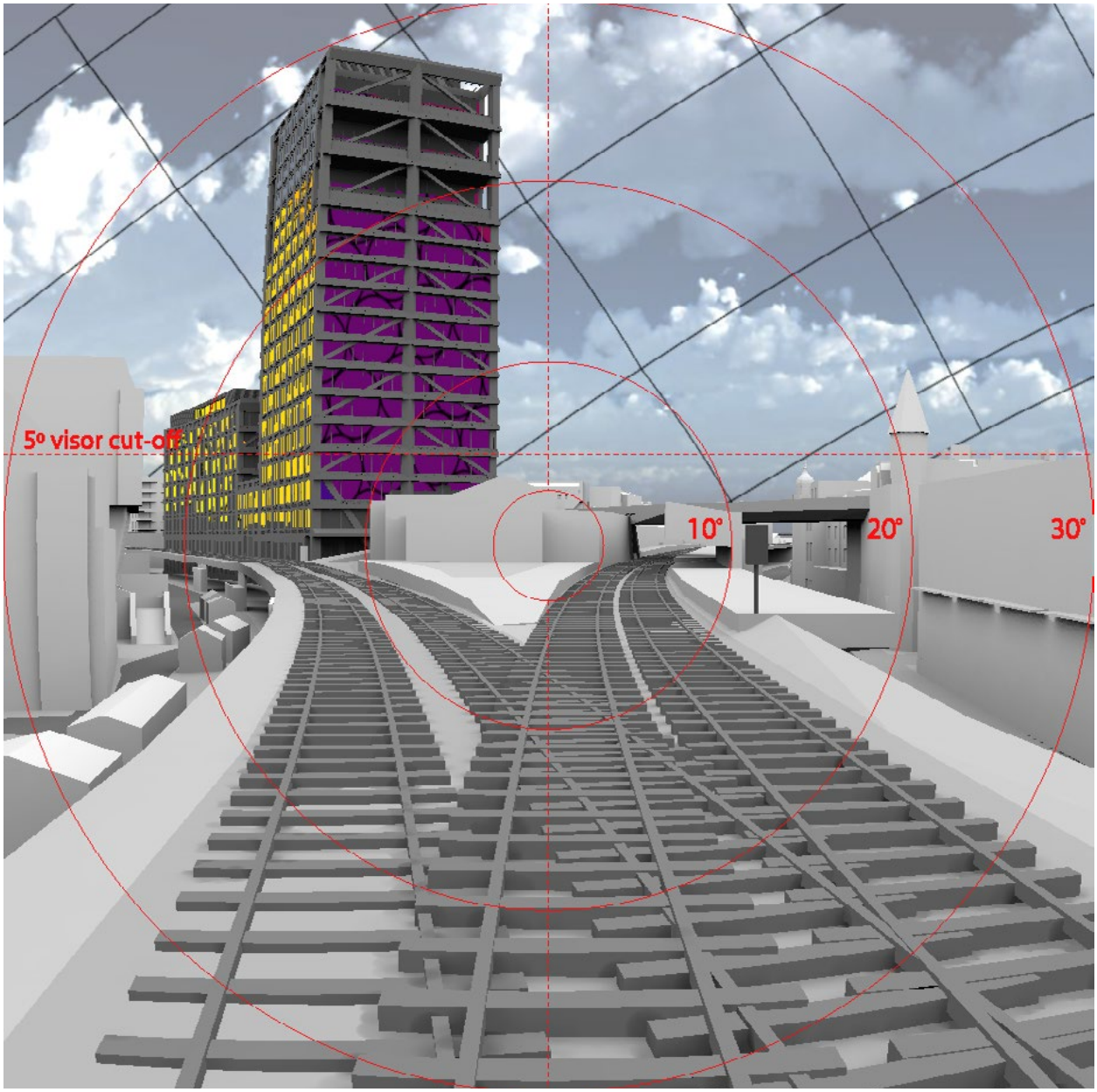
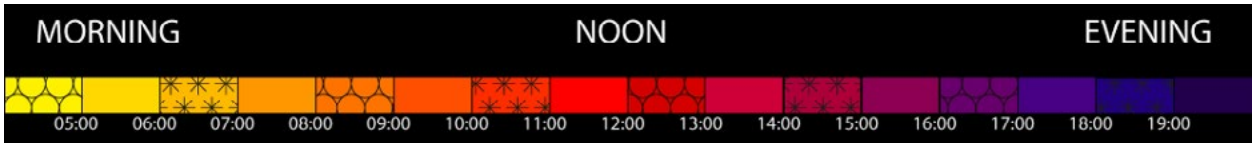


Fig. 100: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 370

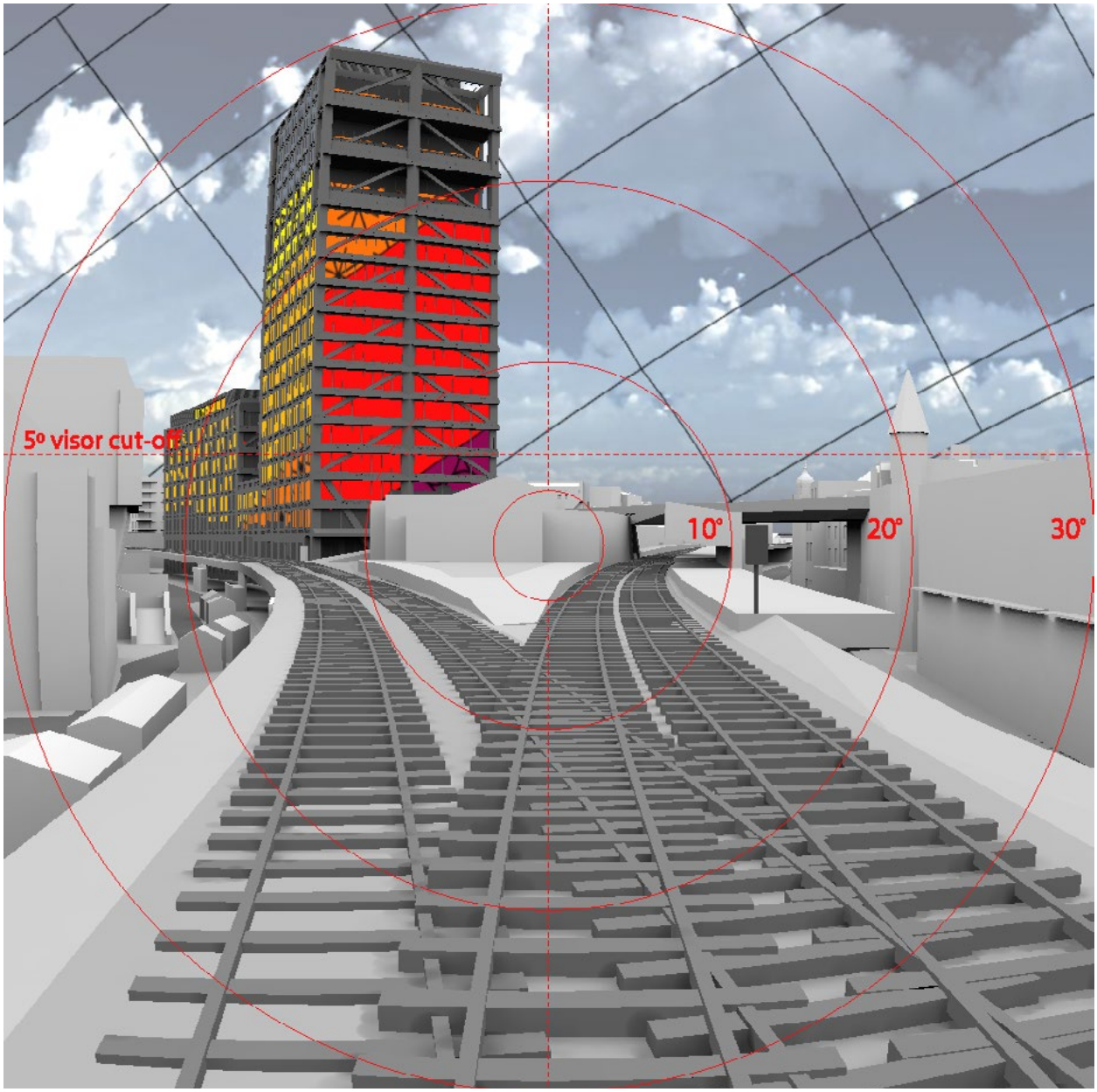


Fig. 101: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 413

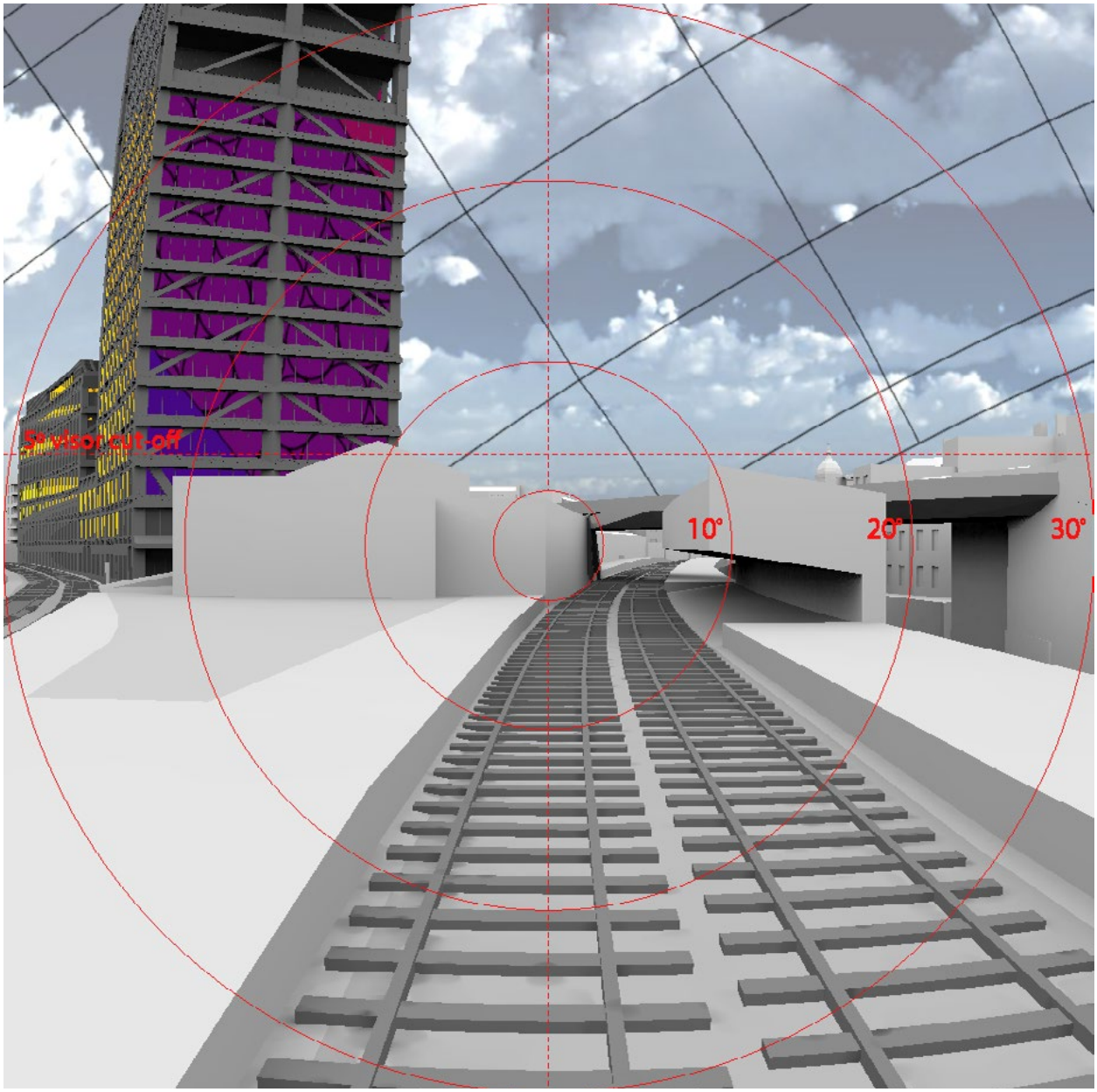
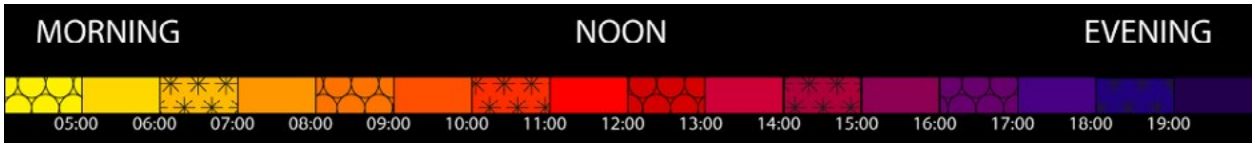


Fig. 102: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 413

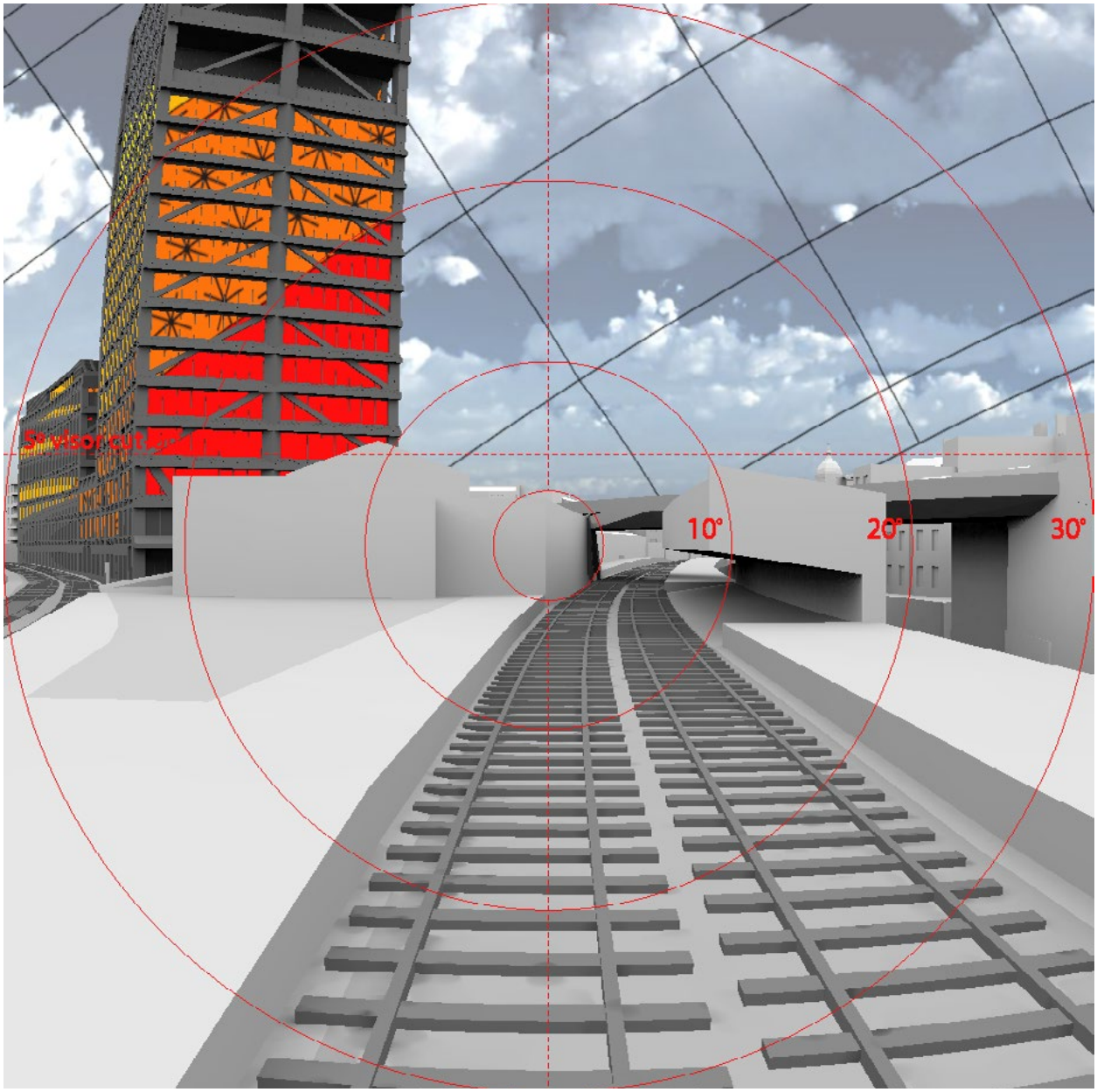


Fig. 103: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR4 - FRAME 460

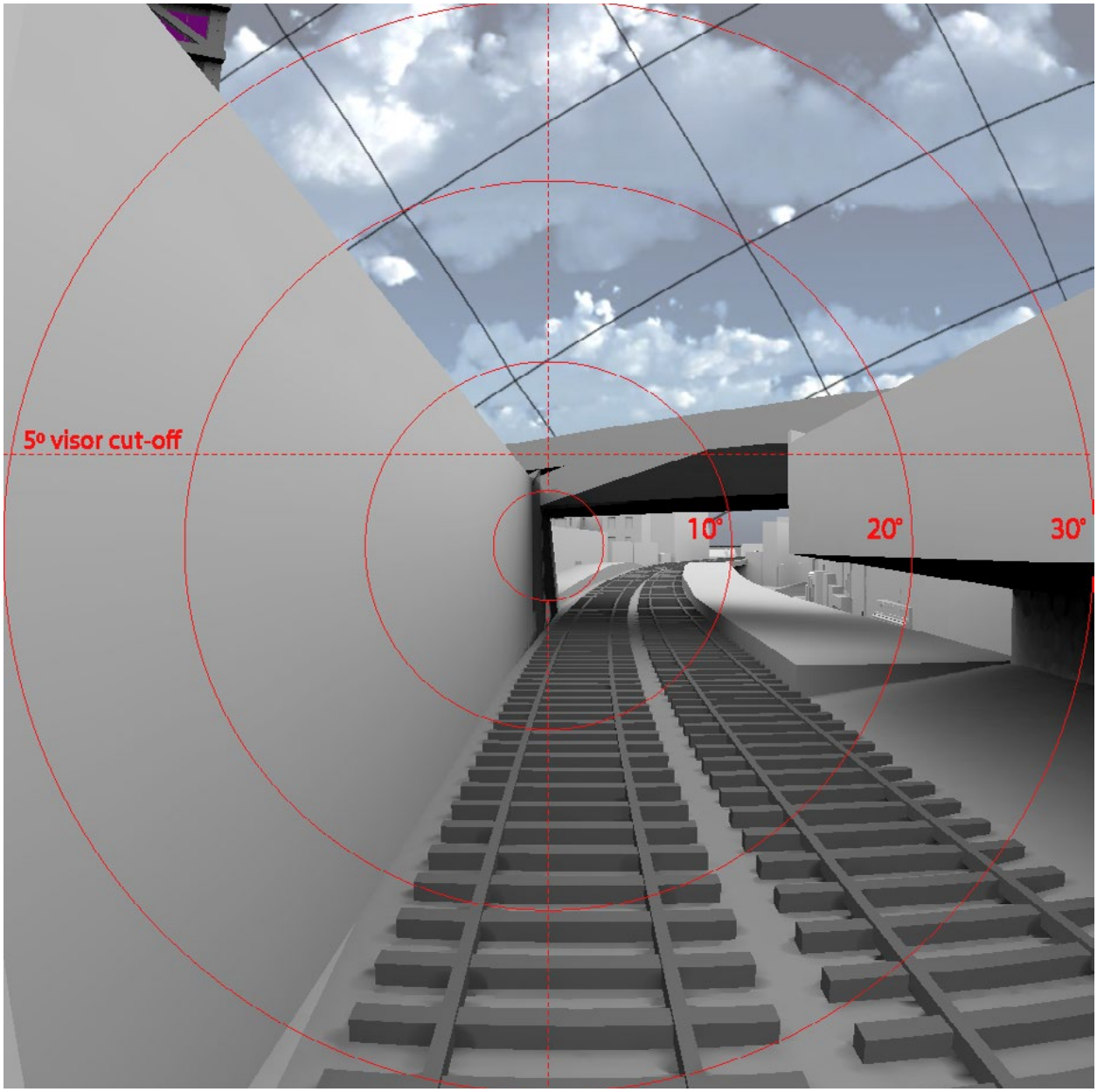
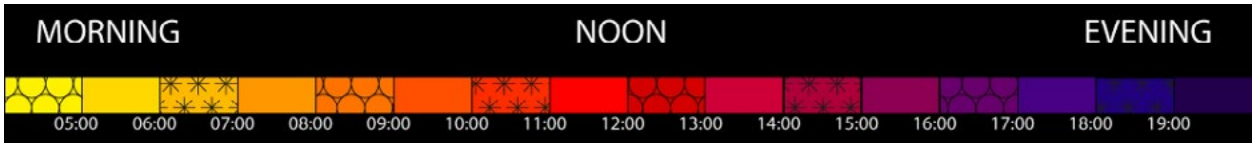


Fig. 104: Solar reflections



60° FIELD OF VIEW: SEASON
SWR4 - FRAME 460

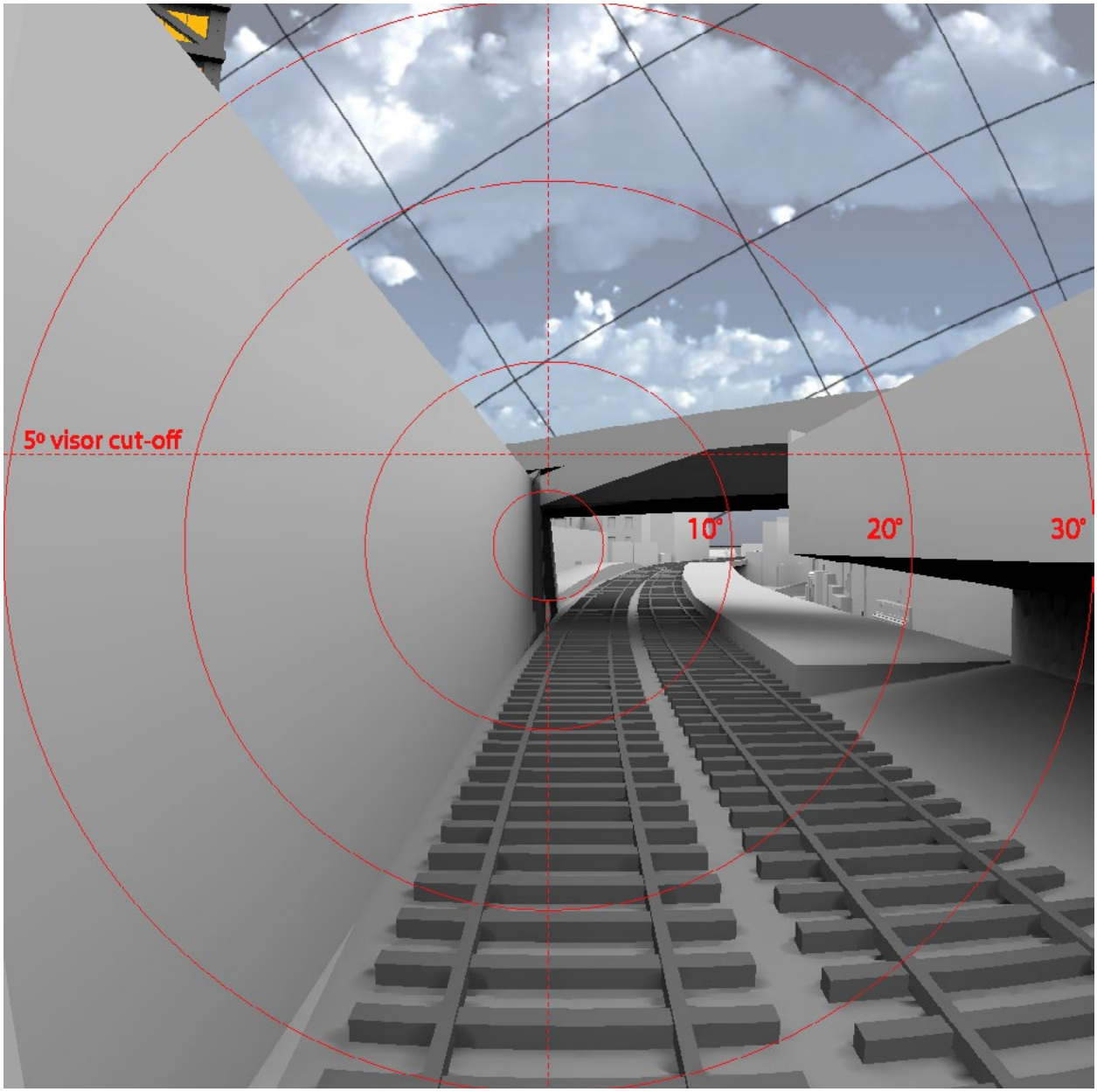


Fig. 105: Solar reflections

60° FIELD OF VIEW: VEILING LUMINANCE
SWR4 - FRAME 112

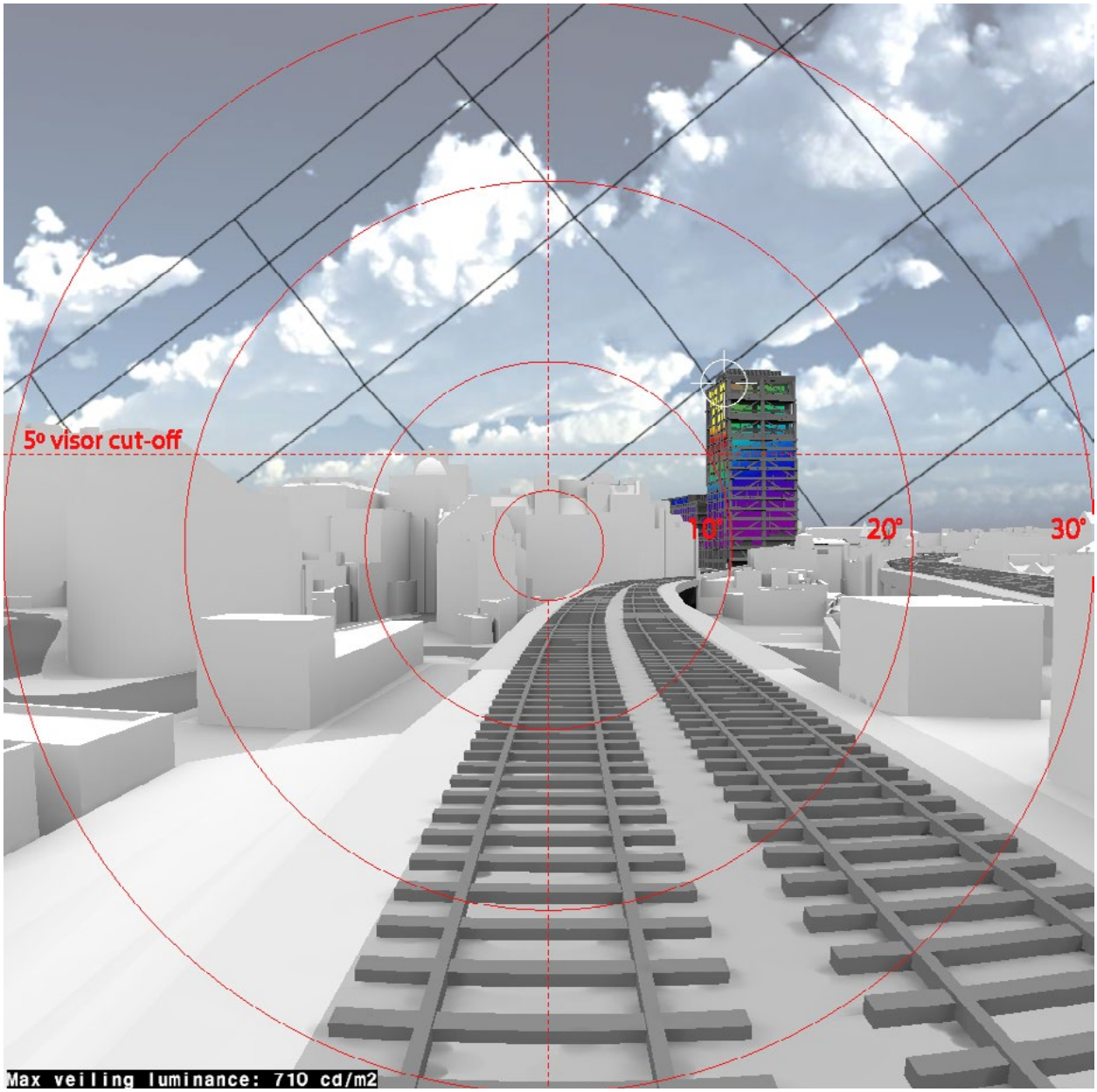
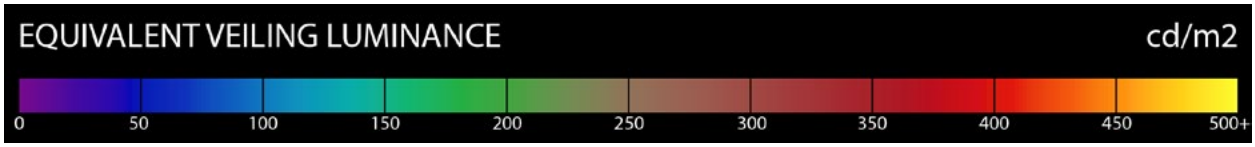


Fig. 106: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR4 - FRAME 263

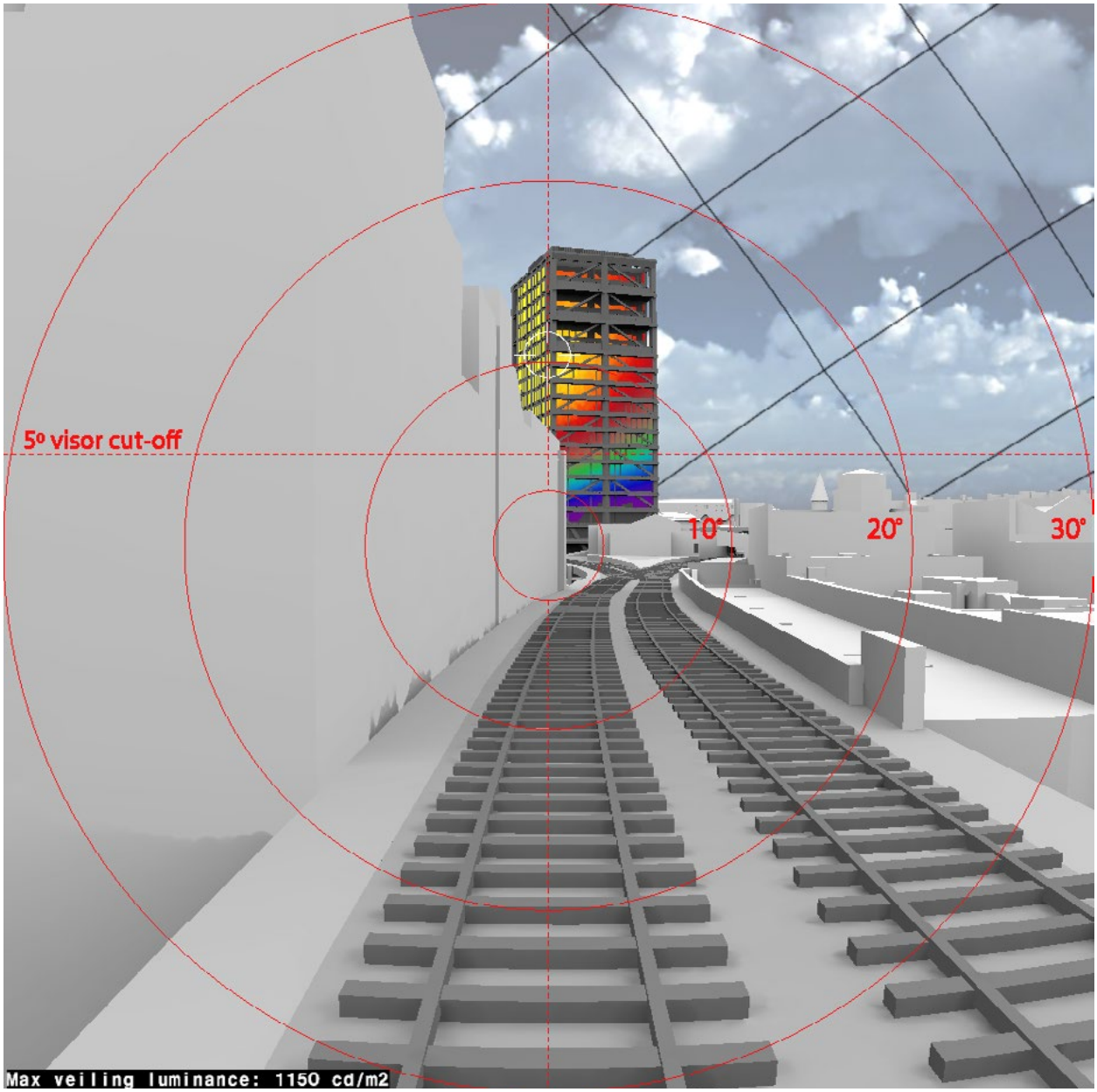
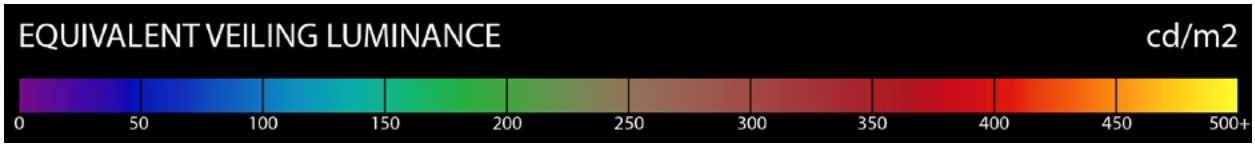


Fig. 107: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR4 - FRAME 286

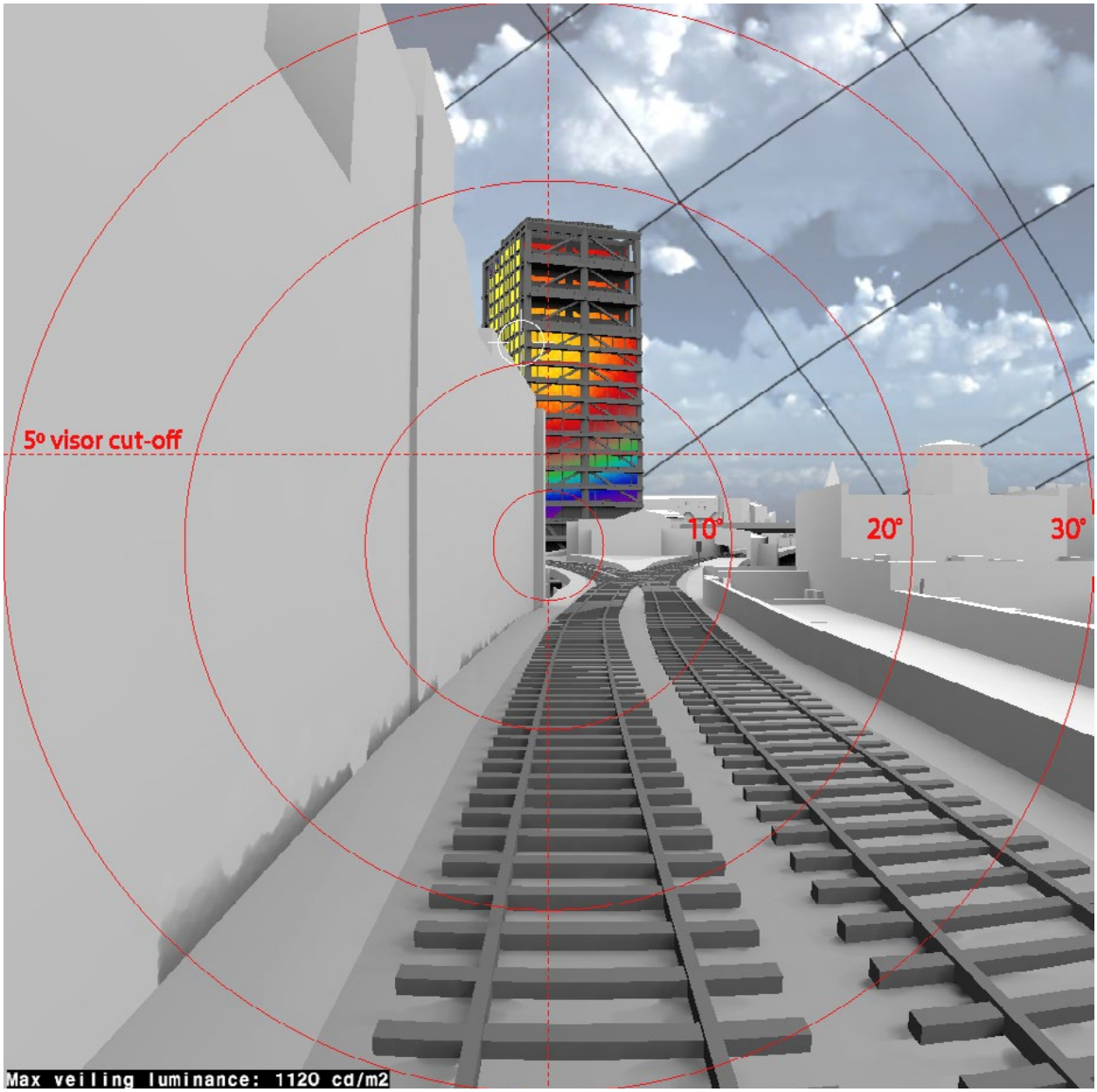
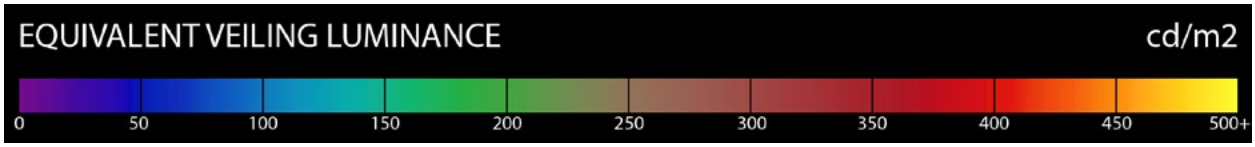


Fig. 108: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR4 - FRAME 341

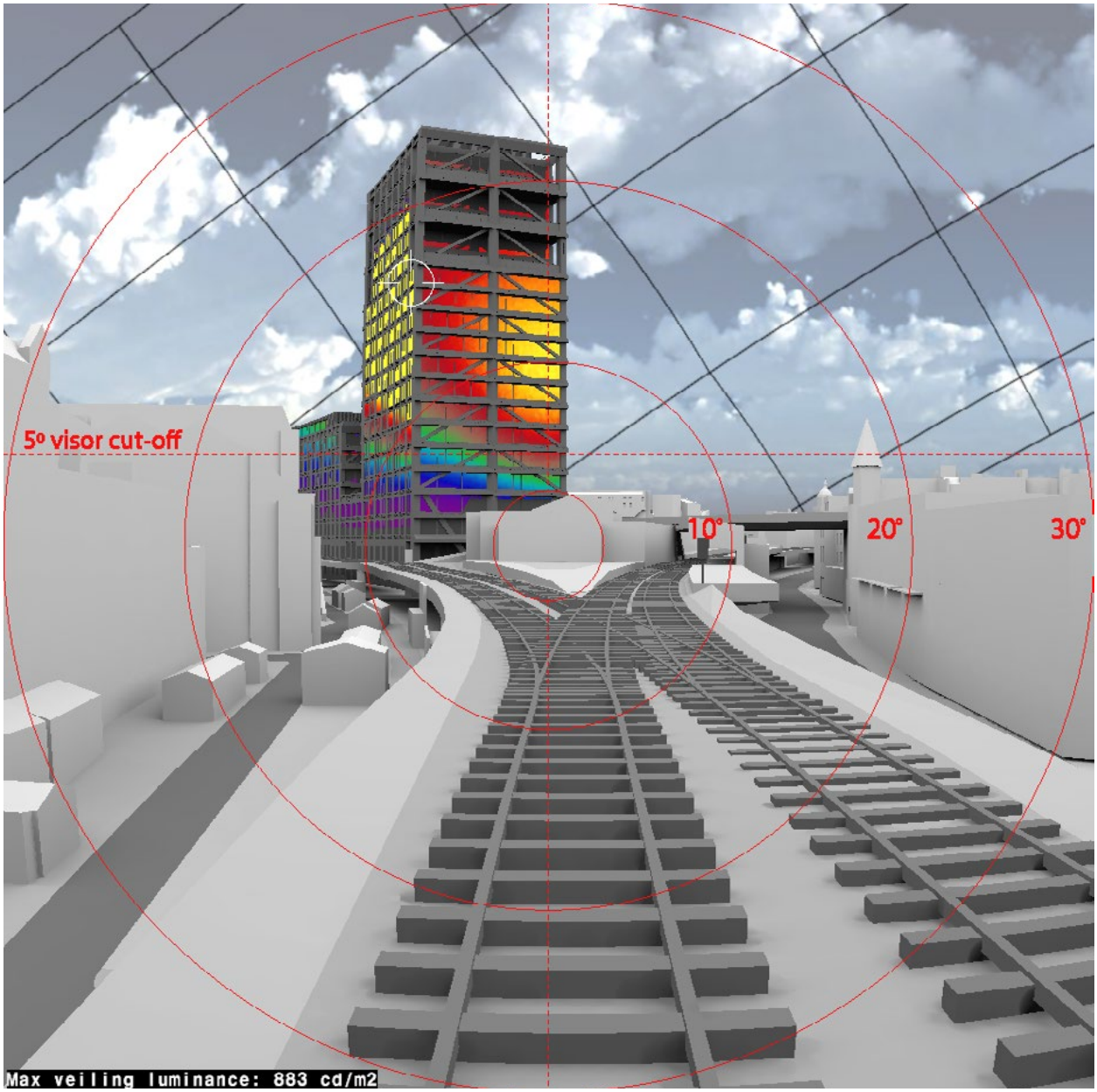
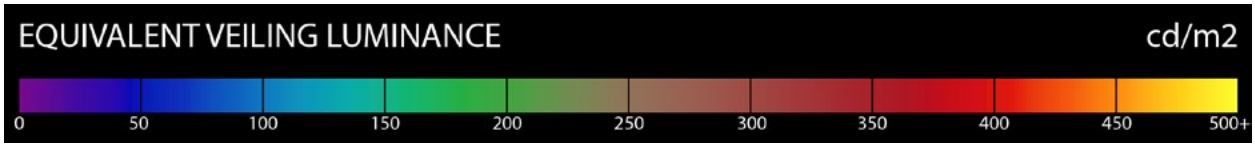


Fig. 109: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR4 - FRAME 356

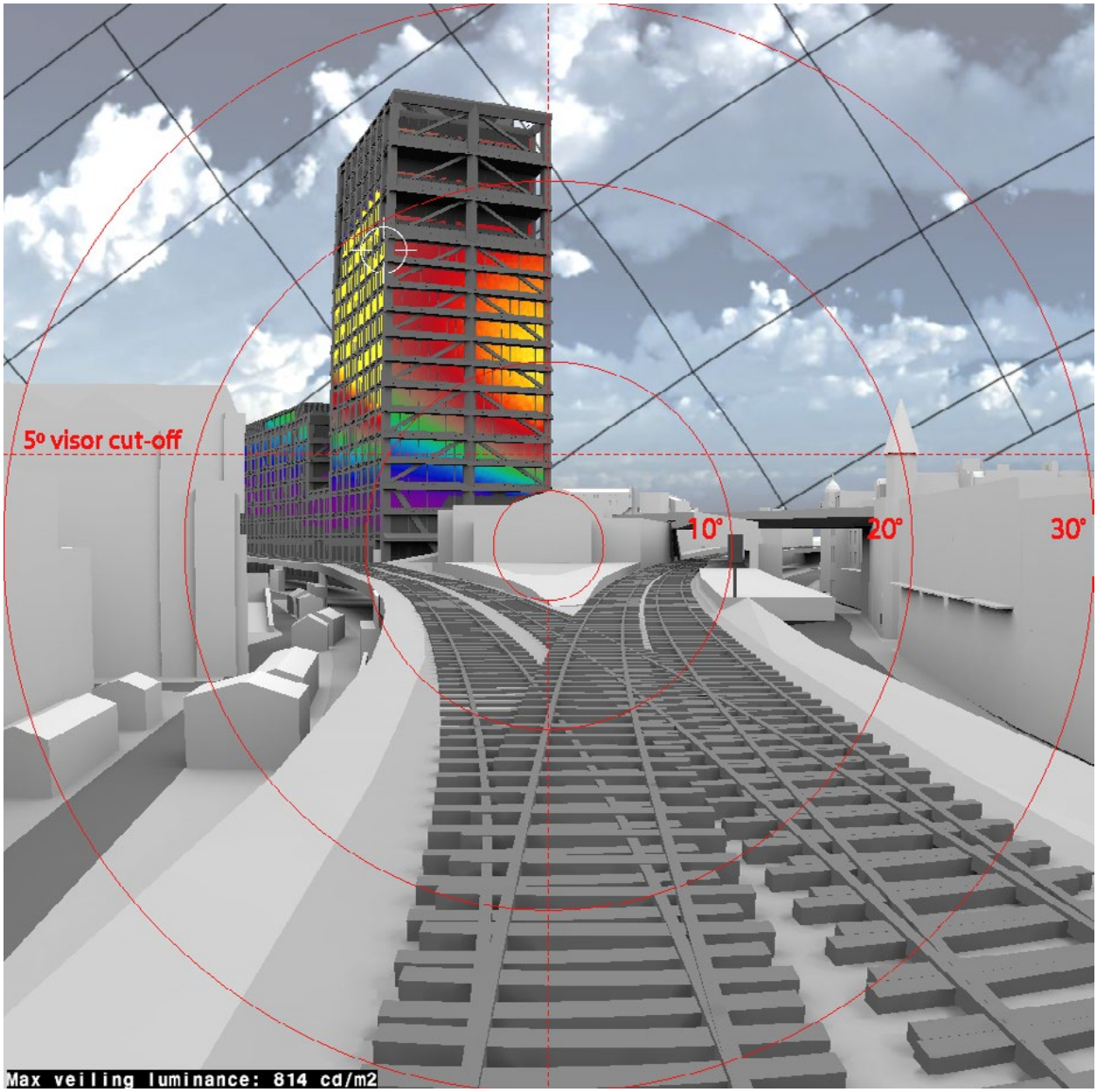
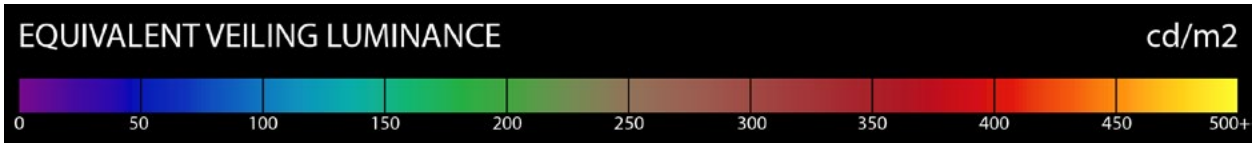


Fig. 110: Solar reflections



60° FIELD OF VIEW: VEILING LUMINANCE
SWR4 - FRAME 413

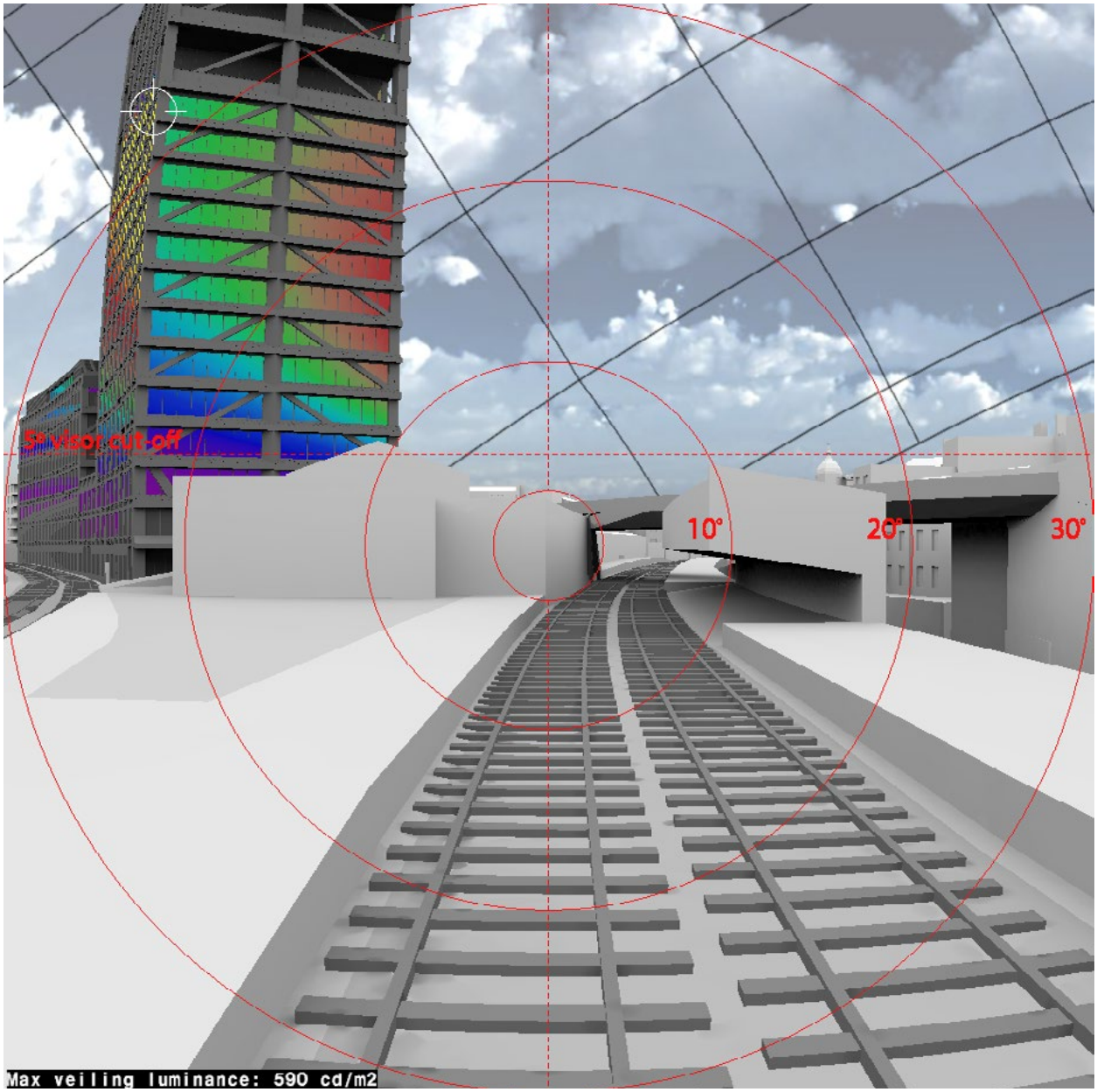
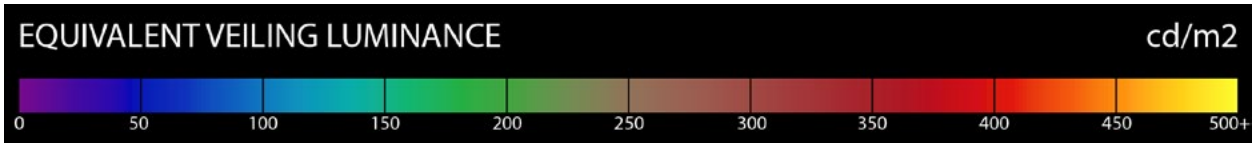


Fig. 111: Solar reflections



APPENDIX 05

SWR5 - WESTBOUND SOUTHWEST RAIL/THAMESLINK LINE

VIEWPOINTS & FRAME NUMBERS
SWR 5

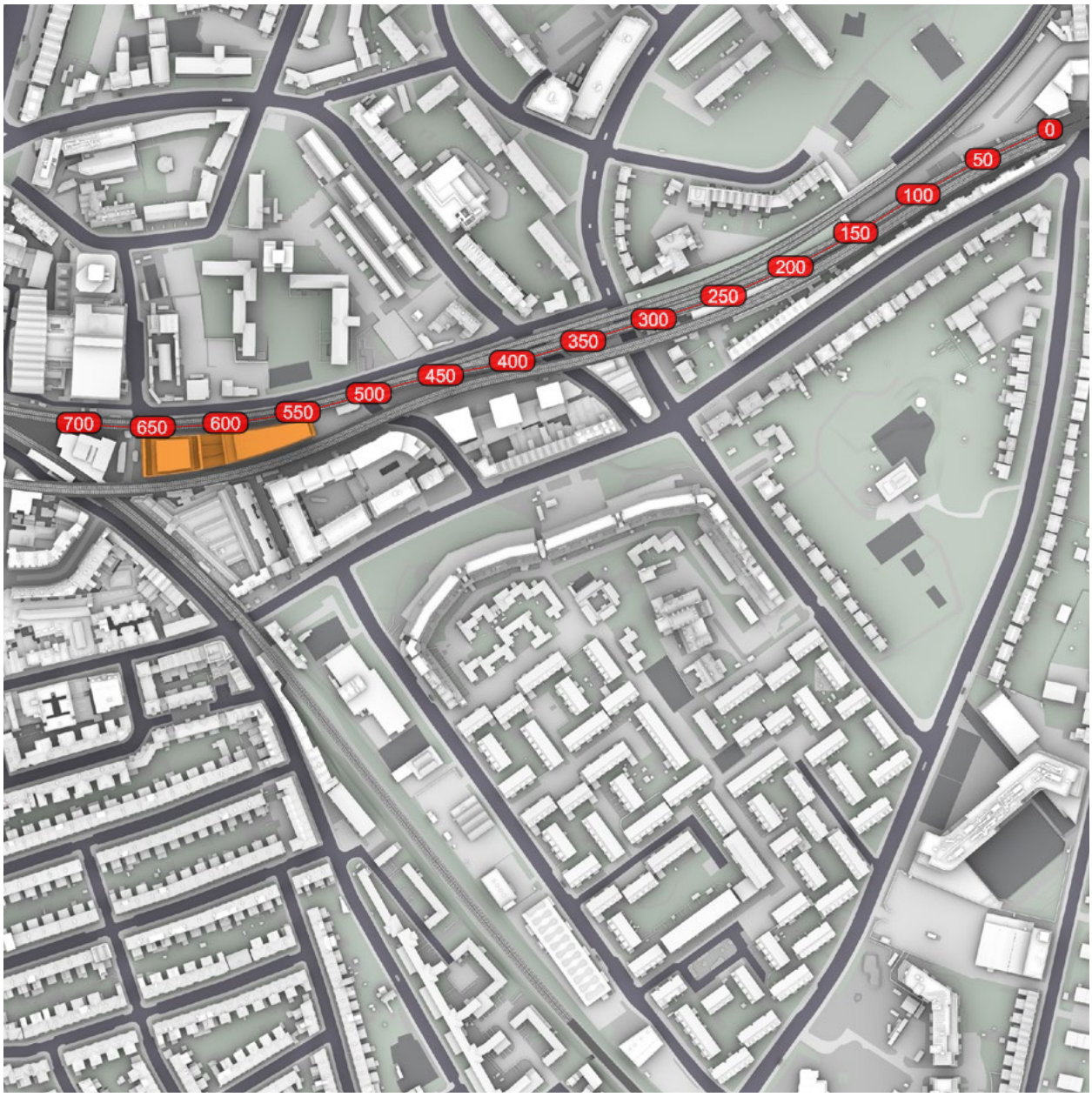


Fig. 112: Viewpoints and frame numbers

60° FIELD OF VIEW: TIME OF DAY
SWR5 - FRAME 1

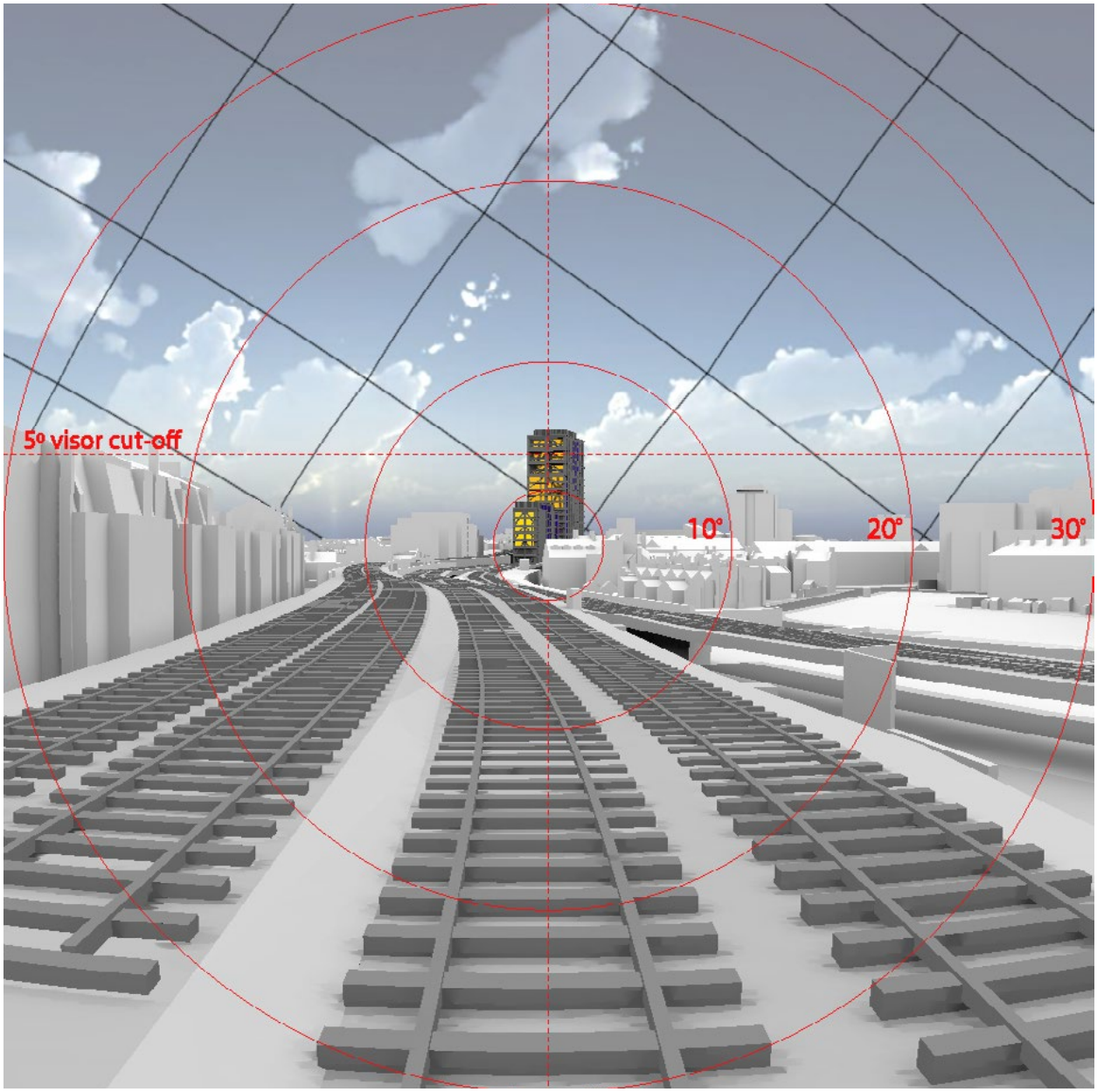
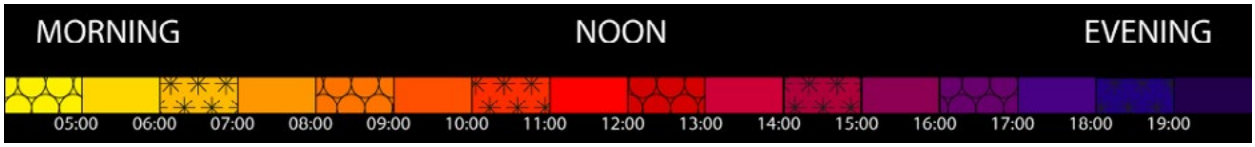


Fig. 113: Solar reflections



60° FIELD OF VIEW: SEASON
SWR5 - FRAME 1

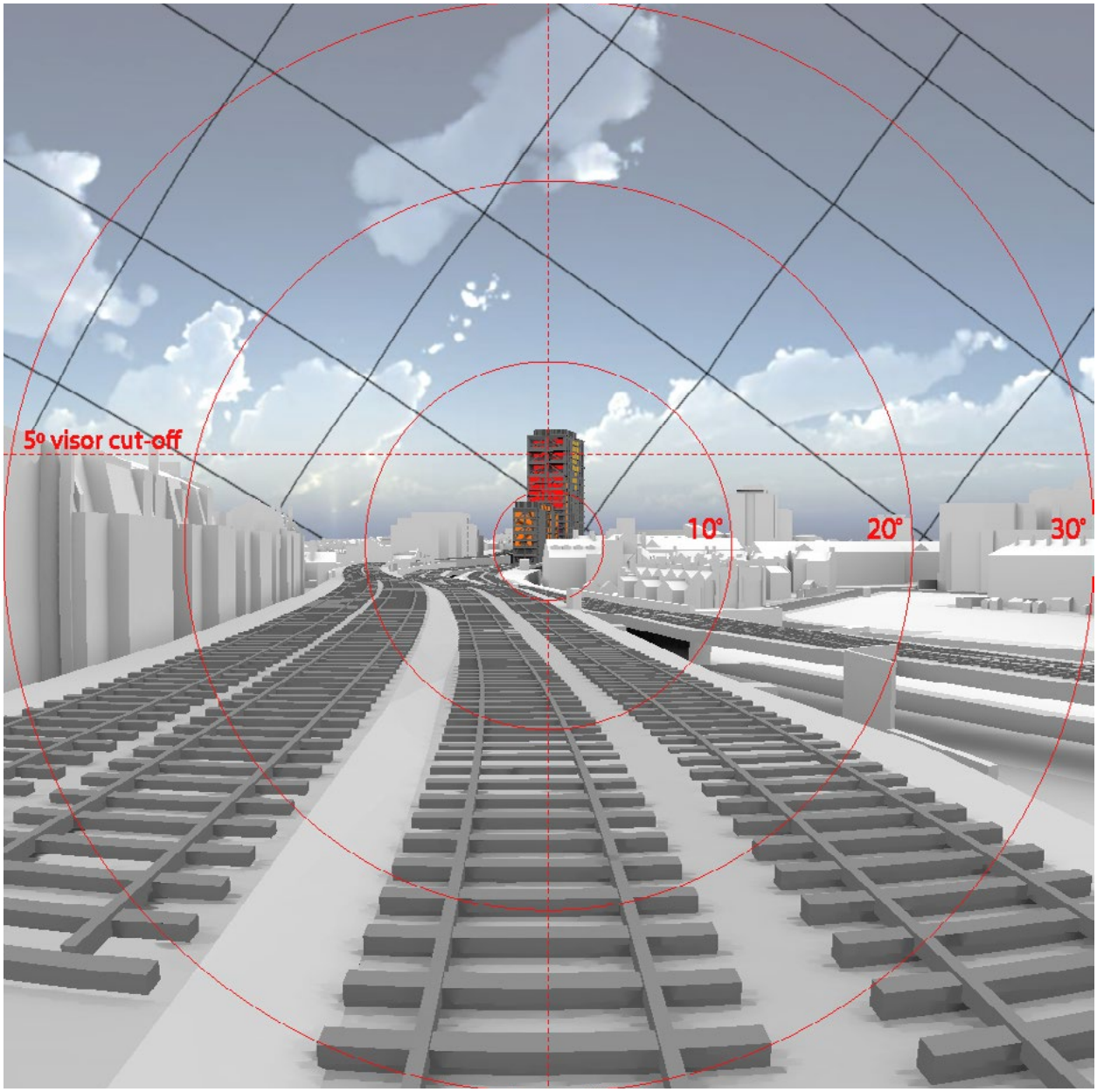


Fig. 114: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR5 - FRAME 50

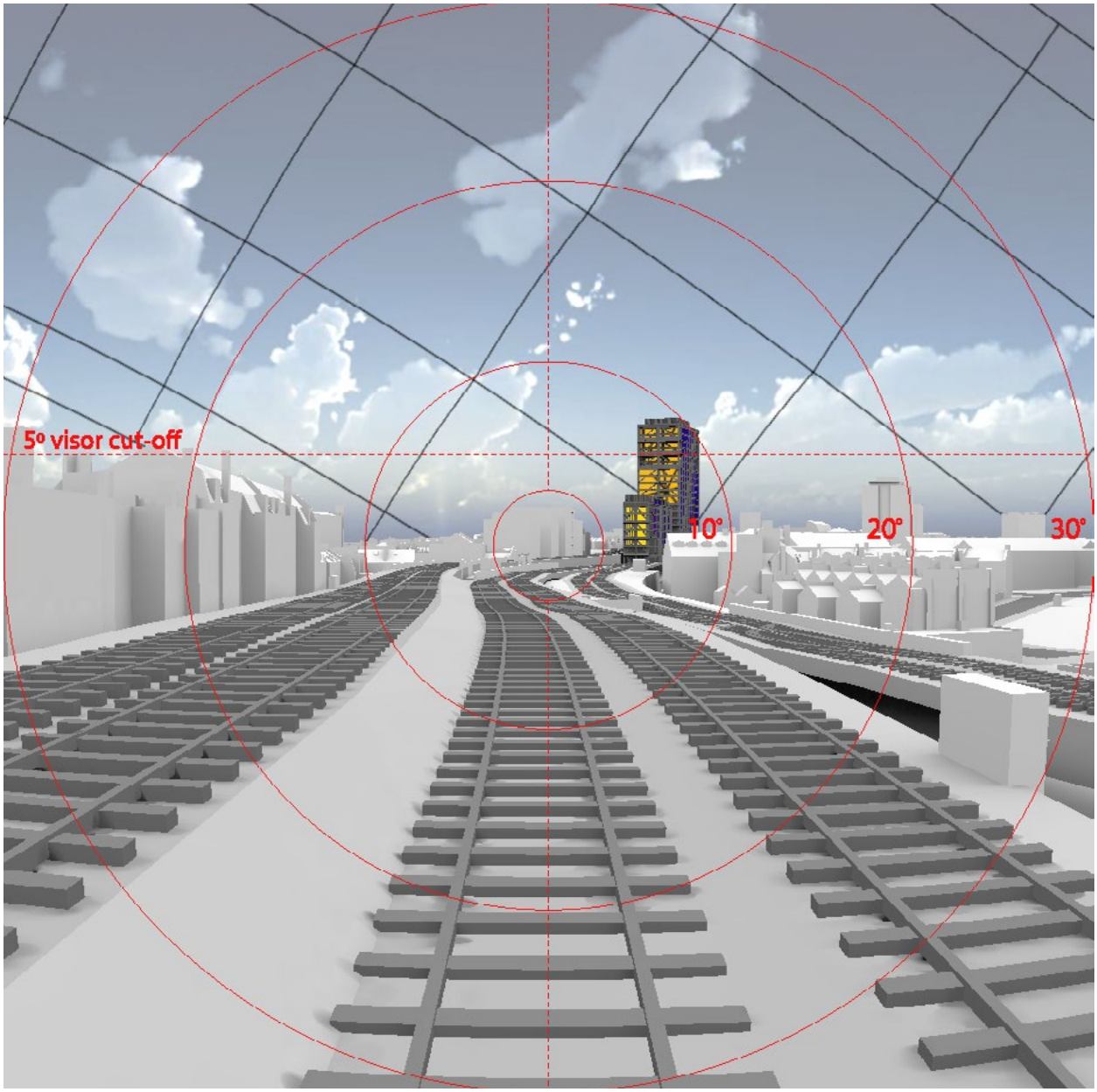
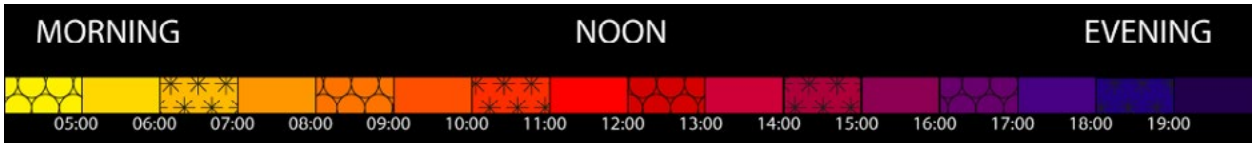


Fig. 115: Solar reflections



60° FIELD OF VIEW: SEASON
SWR5 - FRAME 50

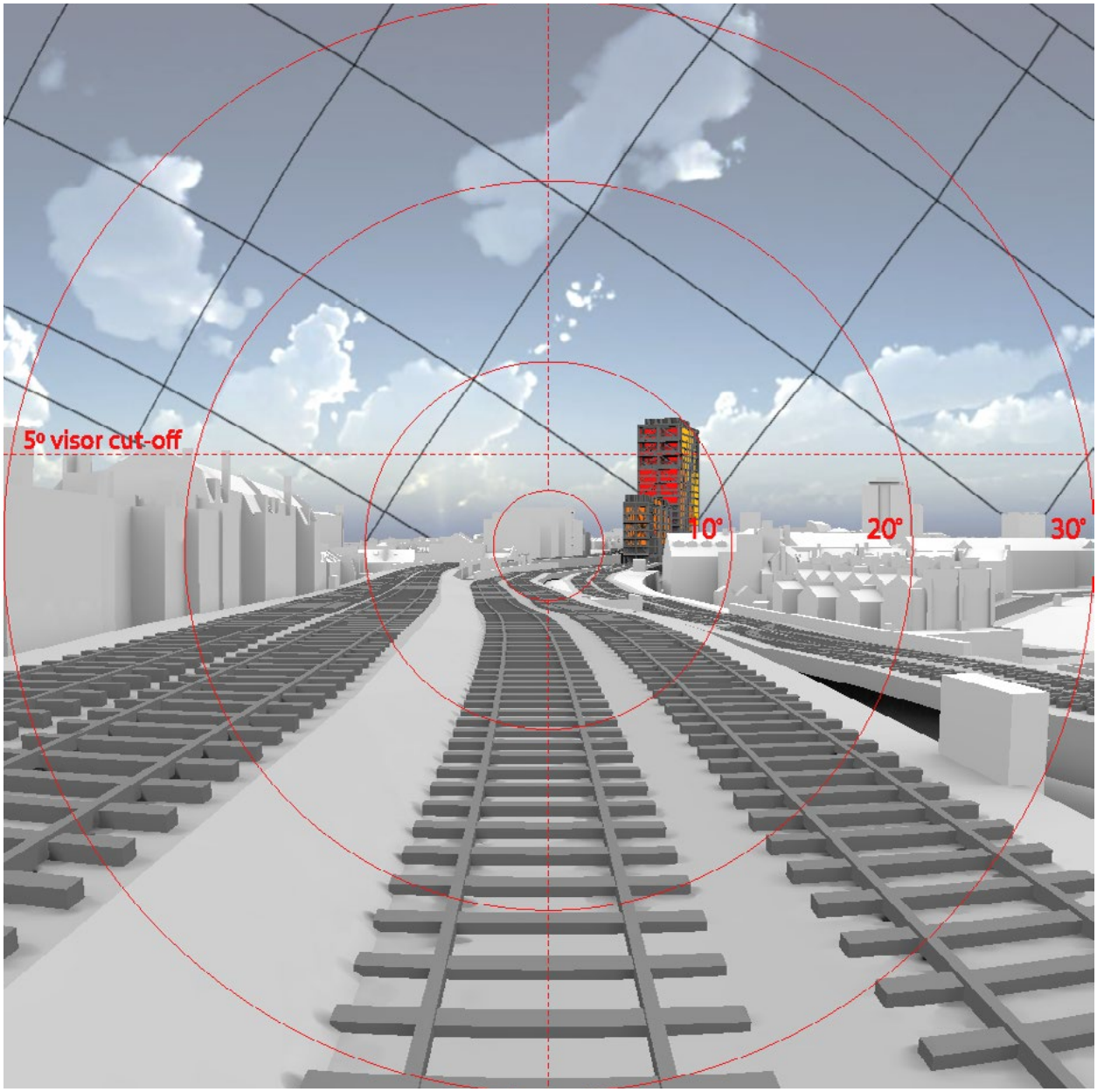


Fig. 116: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR5 - FRAME 120

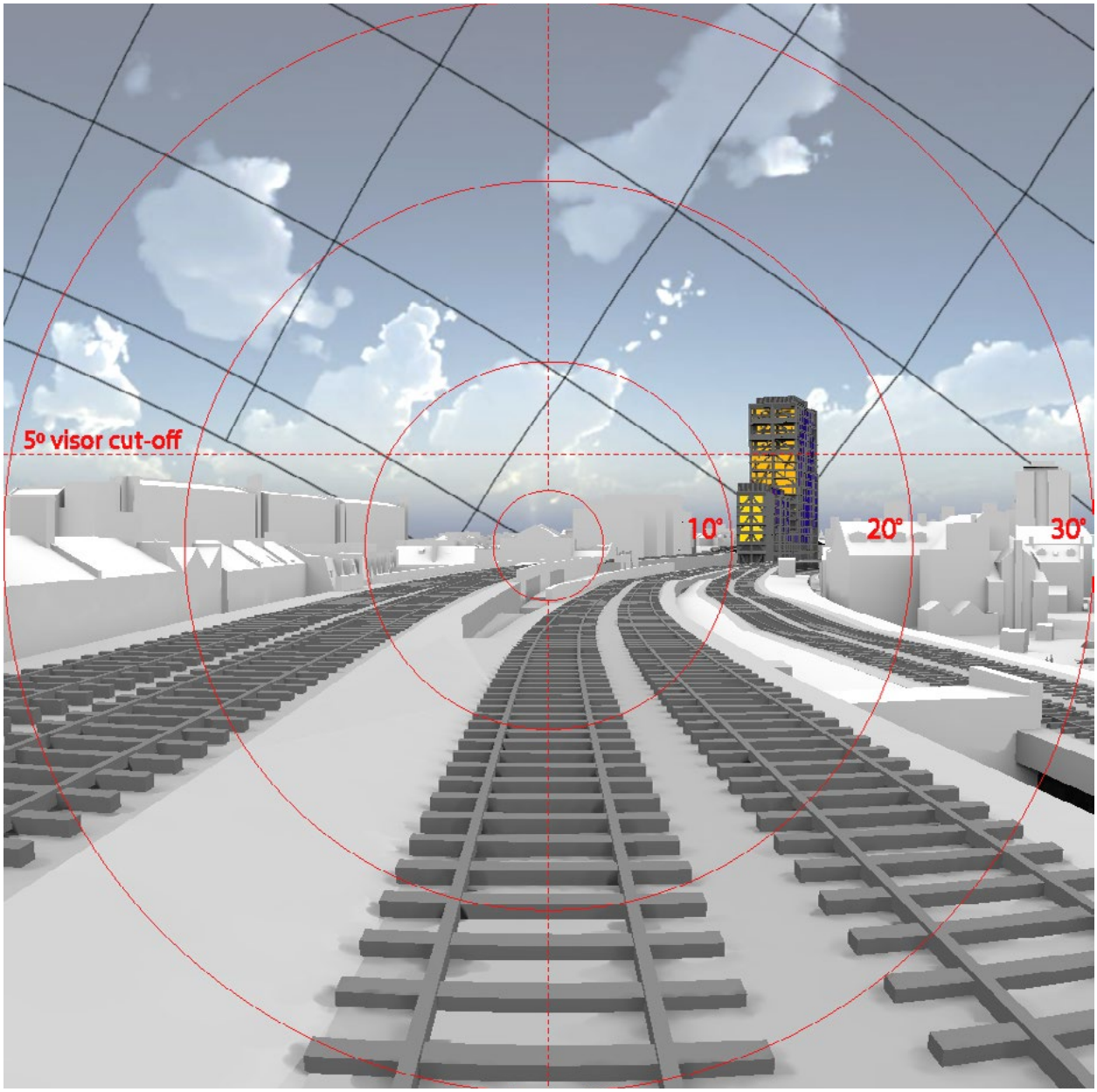
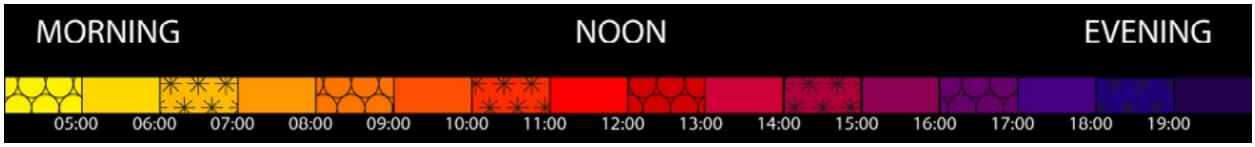


Fig. 117: Solar reflections



60° FIELD OF VIEW: SEASON
SWR5 - FRAME 120

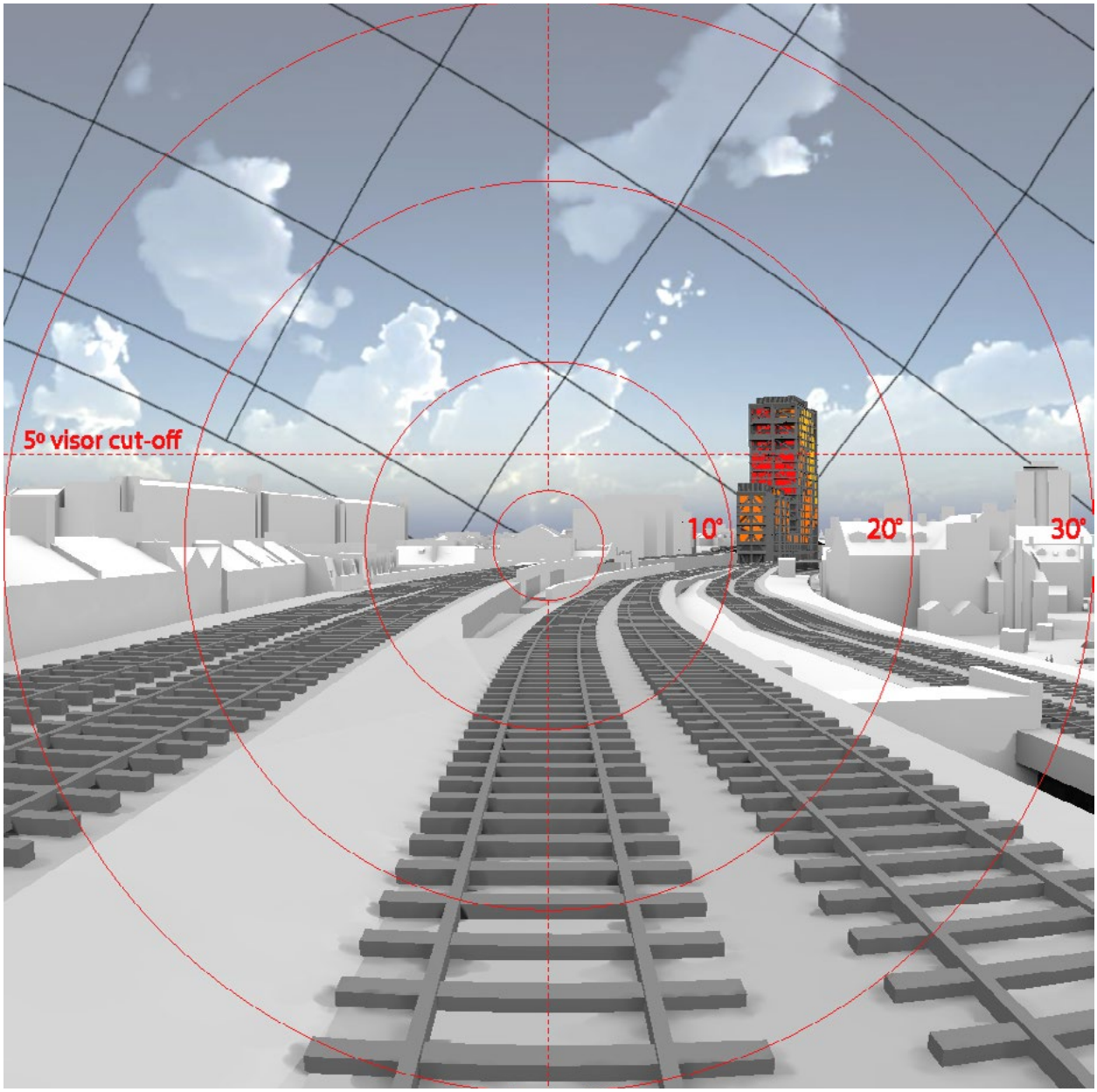


Fig. 118: Solar reflections

60° FIELD OF VIEW: TIME OF DAY
SWR5 - FRAME 147

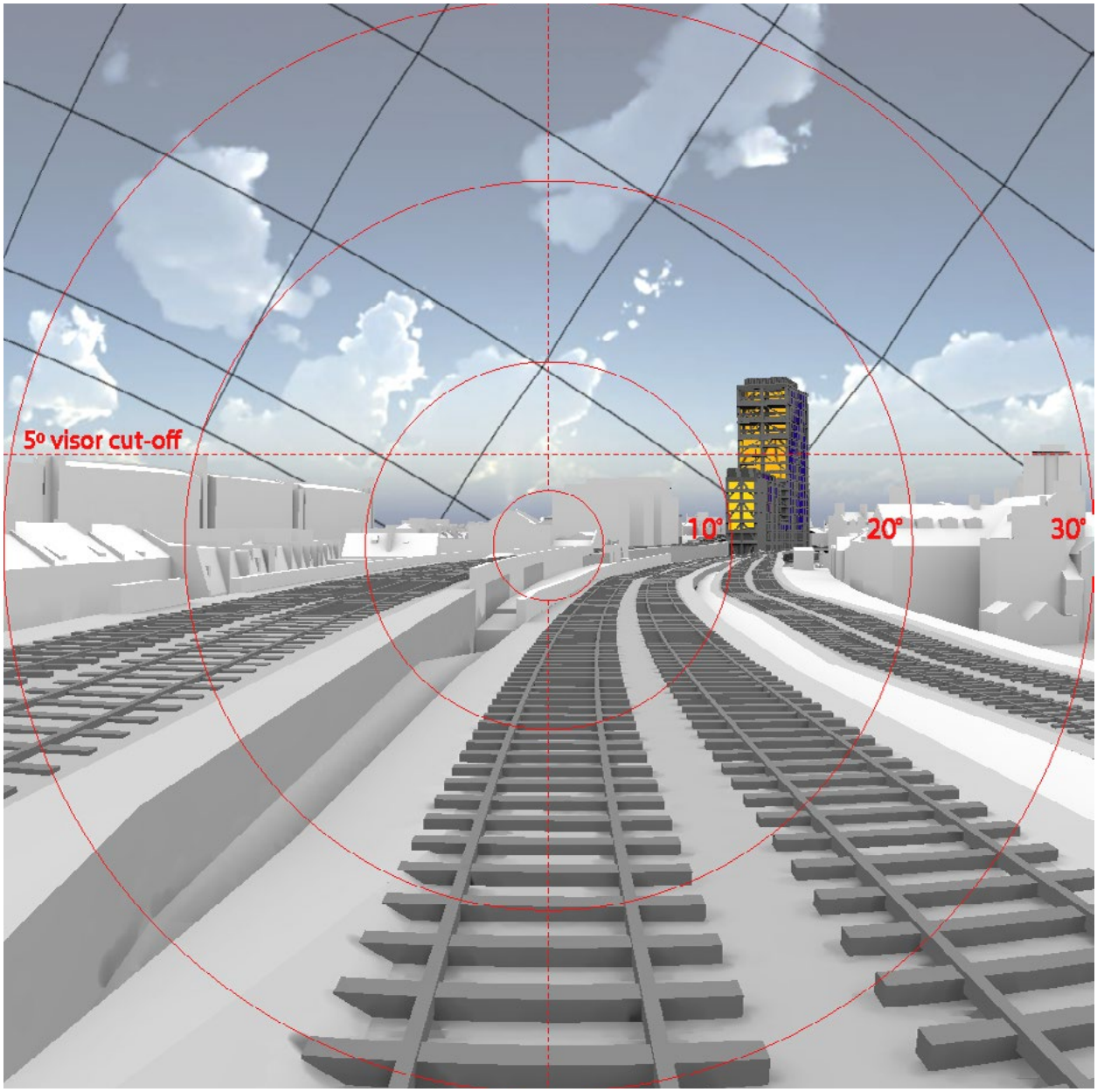
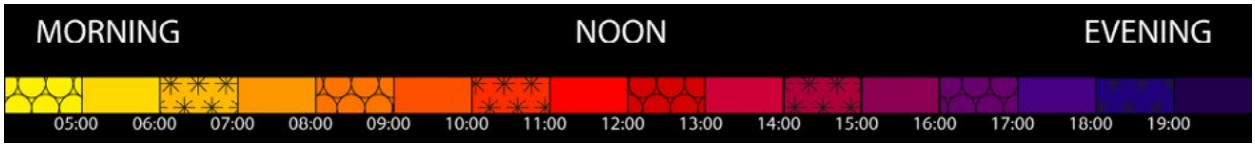


Fig. 119: Solar reflections



60° FIELD OF VIEW: SEASON
SWR5 - FRAME 147

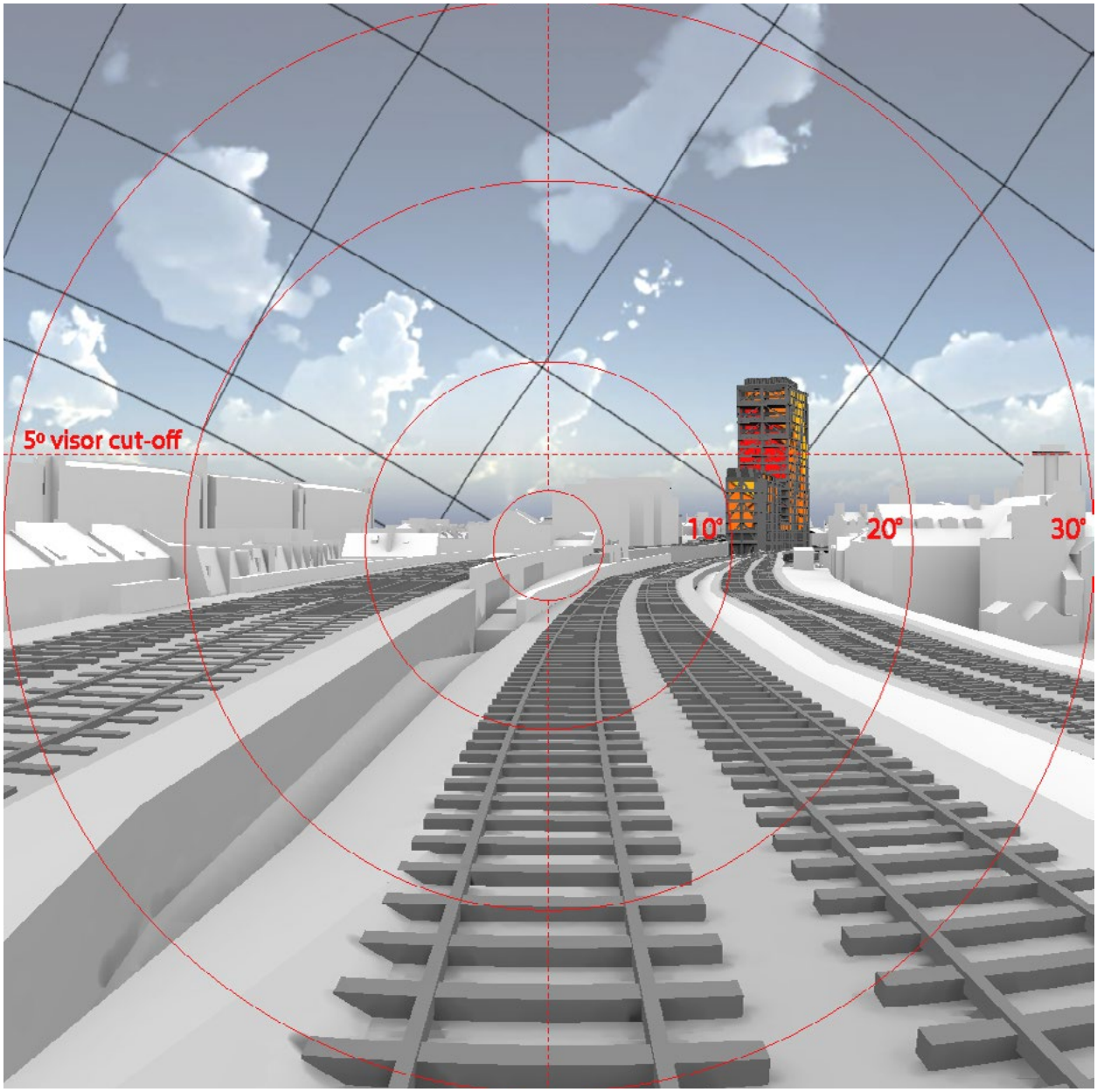


Fig. 120: Solar reflections