3 Science Applied to Life™

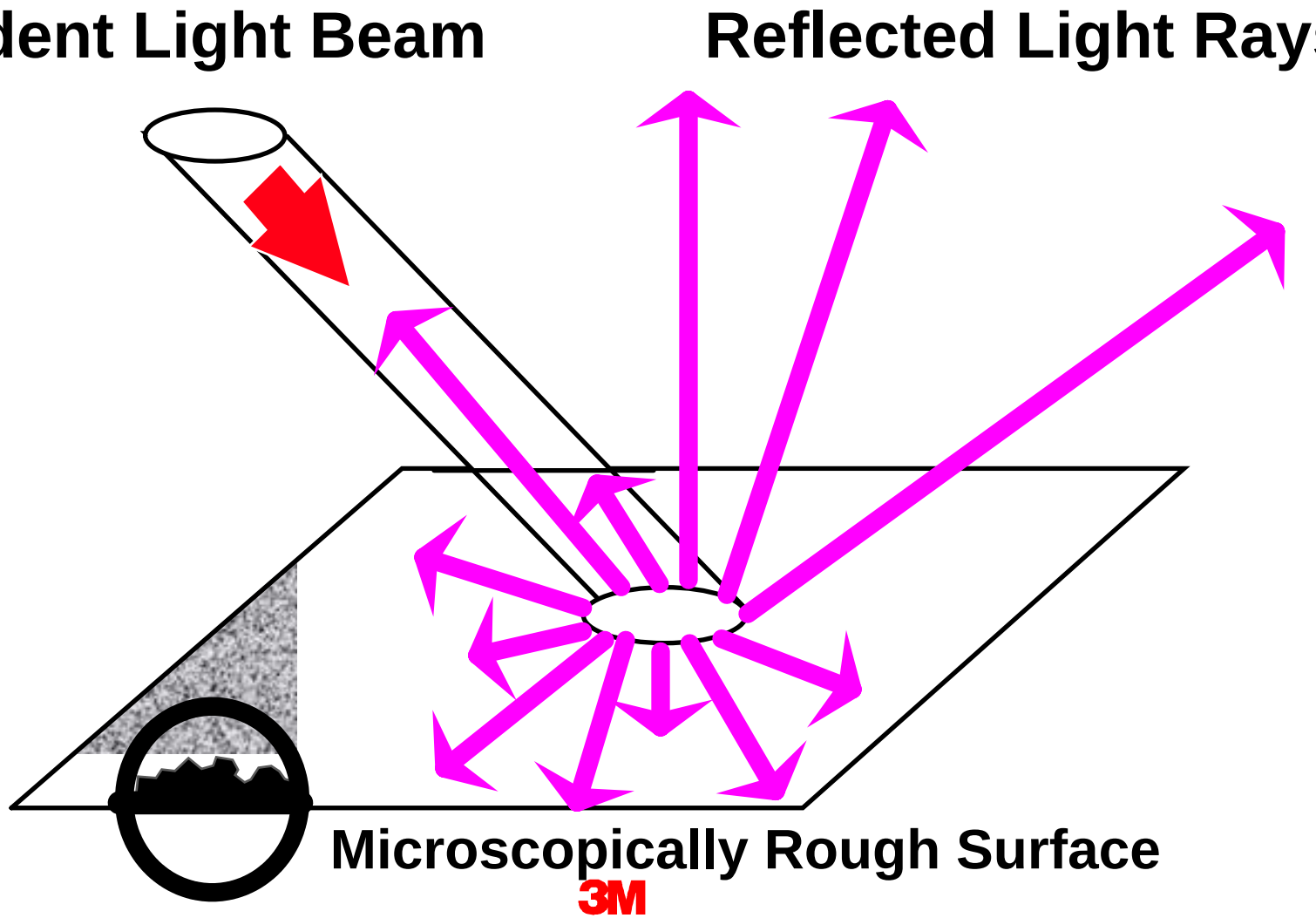
3M Science. Applied to Life.™

The Science of Signage

Michael Holderness
3M Traffic Safety Division

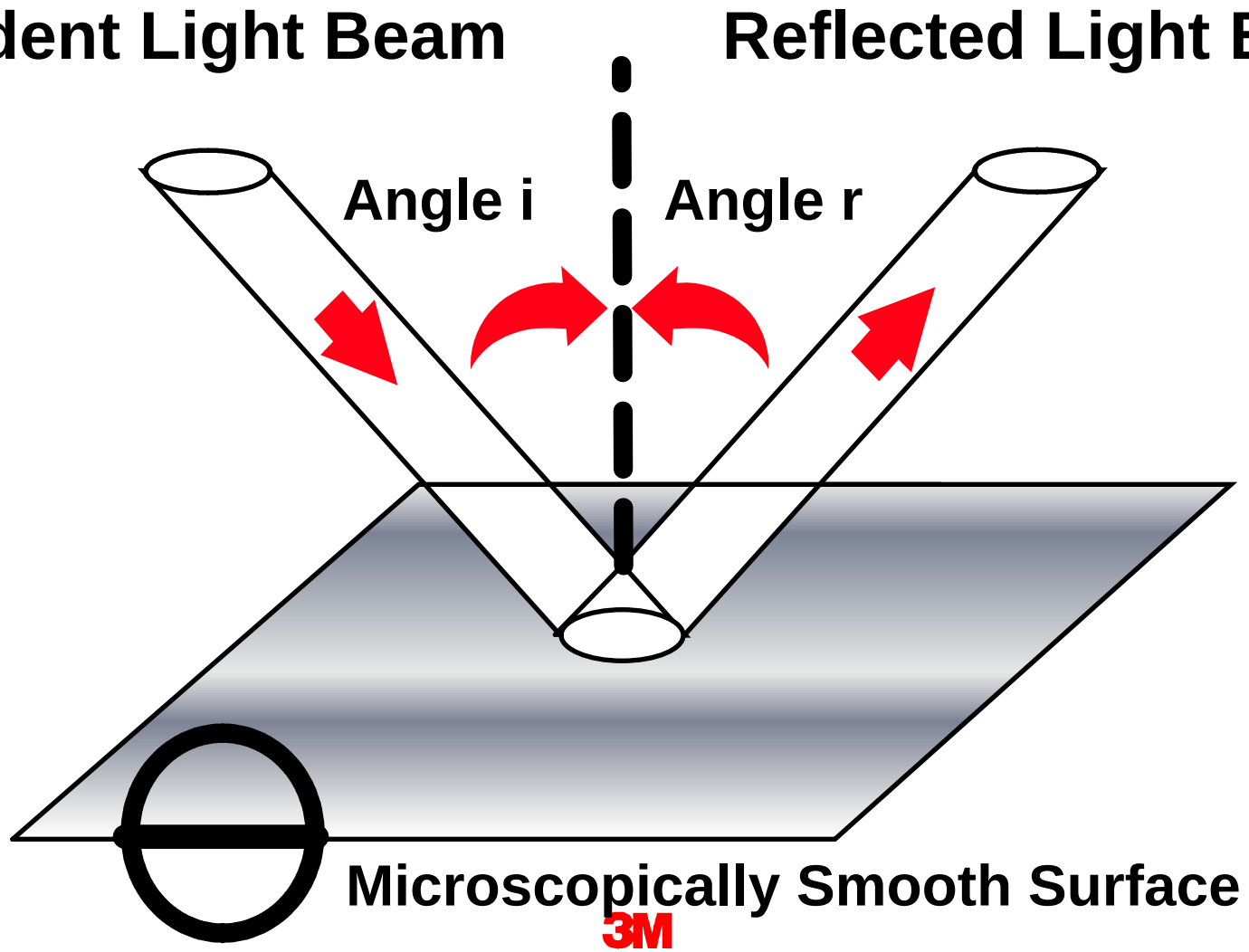
Retroreflection Overview

Diffuse Reflection

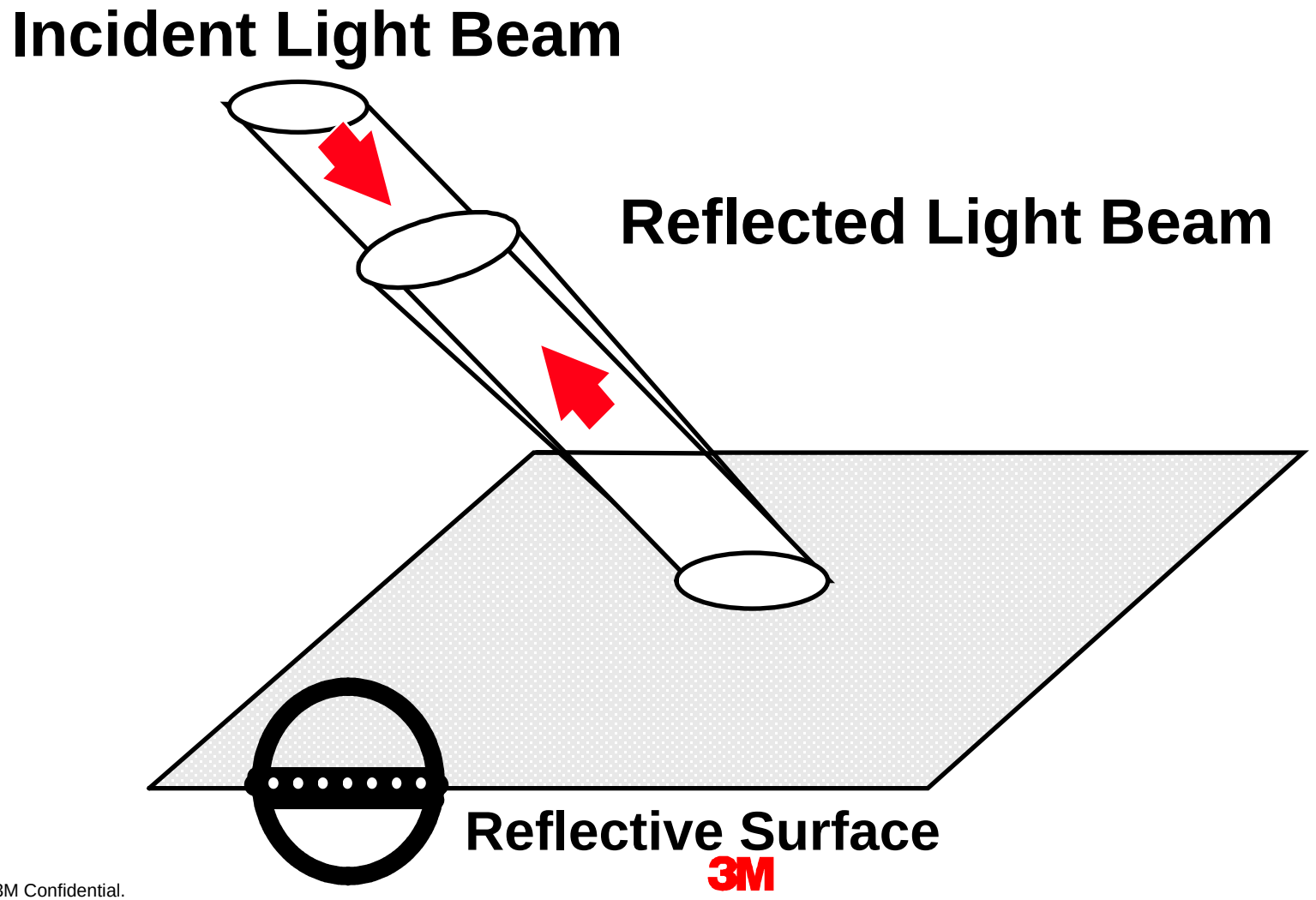


Mirror Reflection

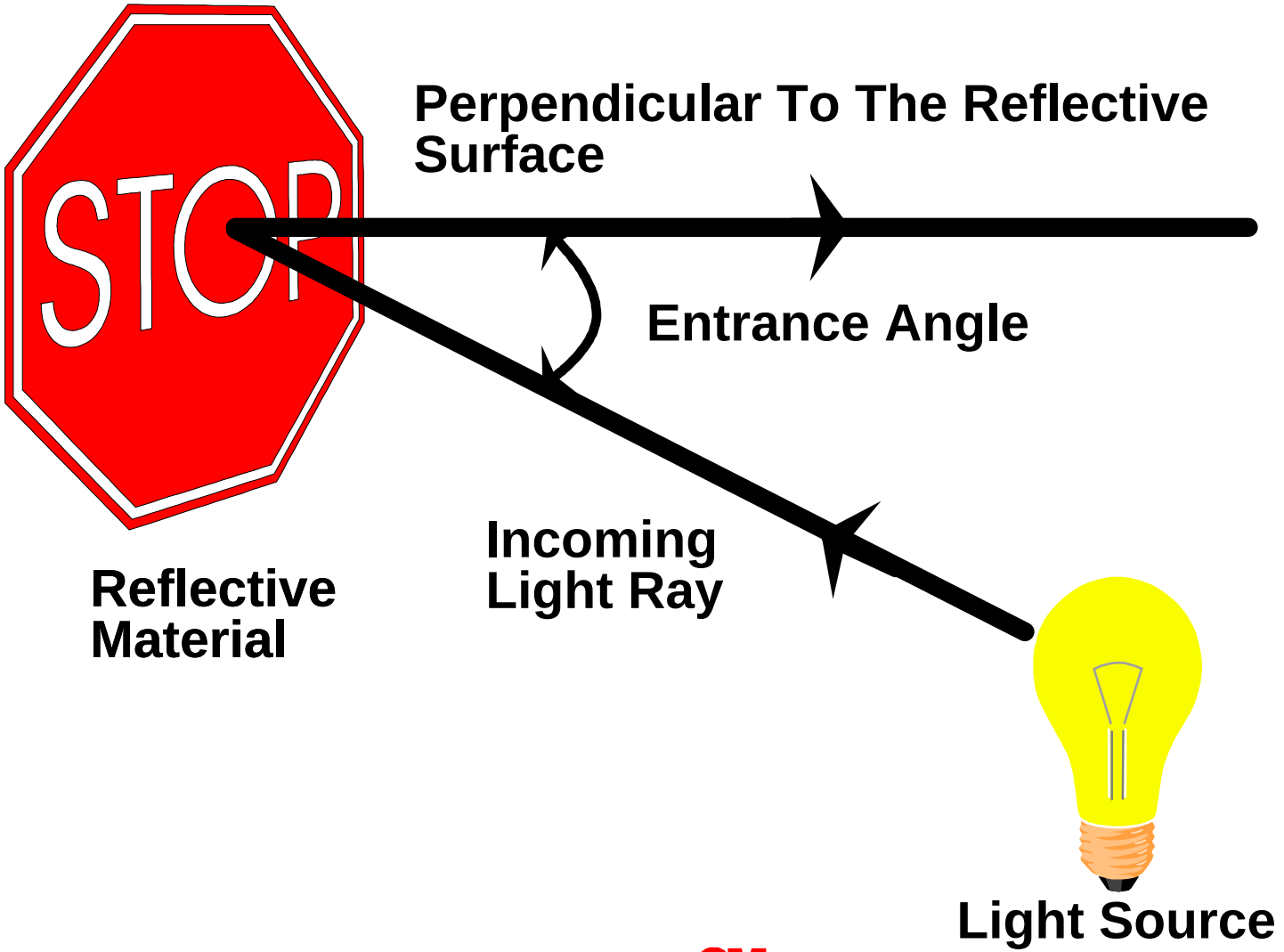
(Specular Reflection)



Retroreflection



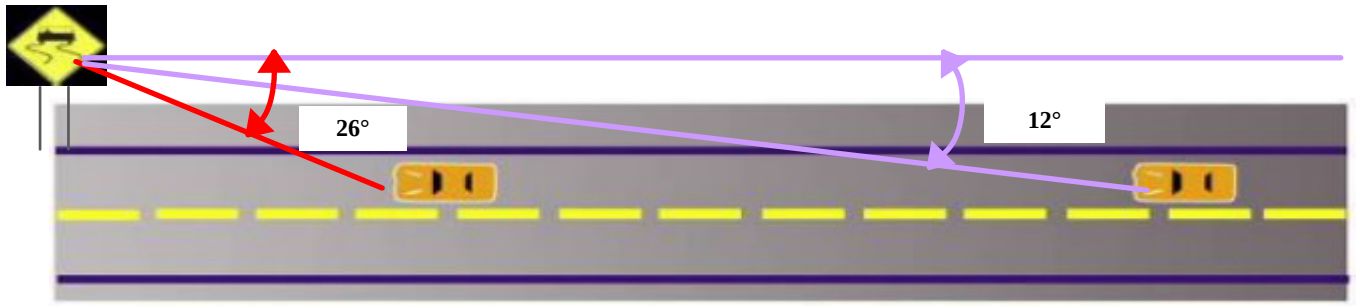
Entrance Angle



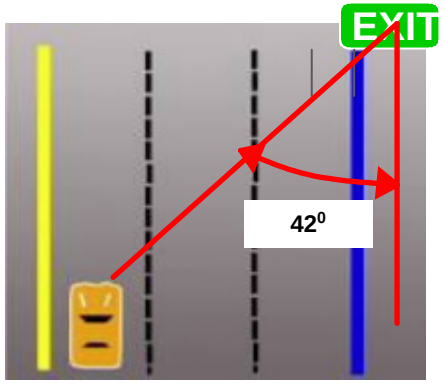
Entrance Angle

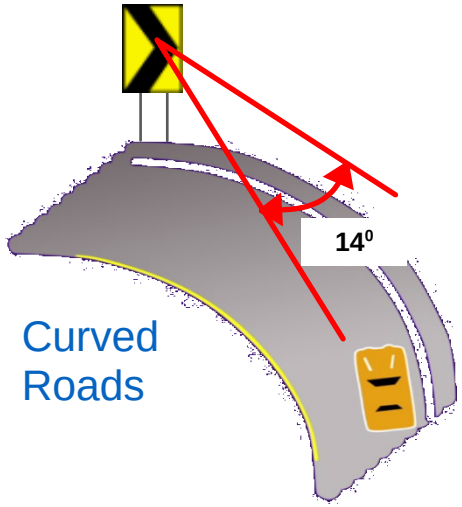
Why is entrance angle so important?

Entrance angle changes every second when a vehicle approaches the sign



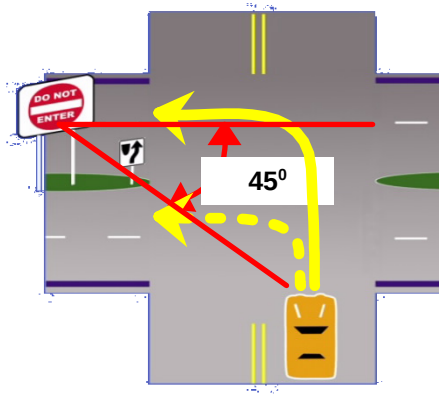
Multi-lane Traffic



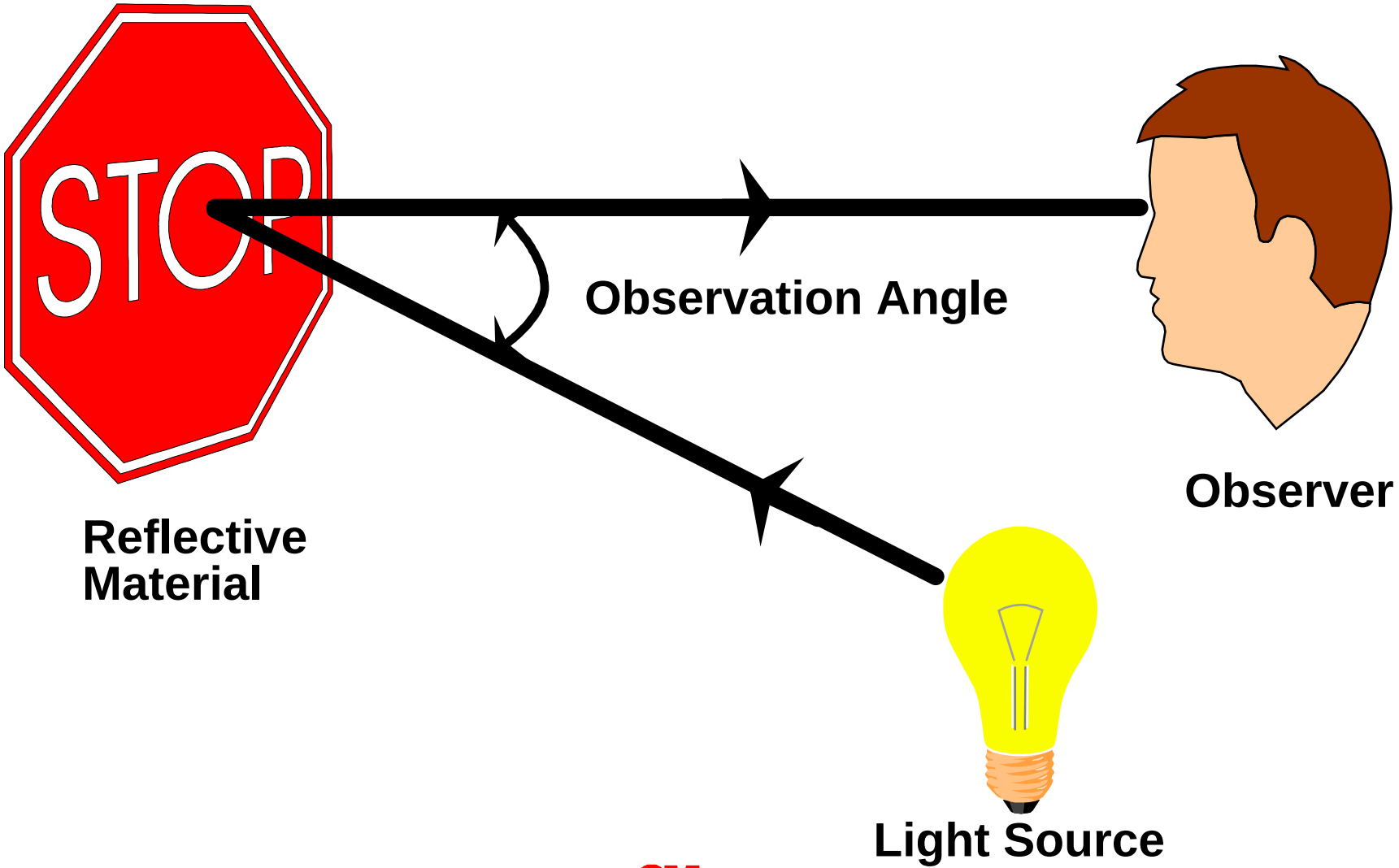


Curved Roads

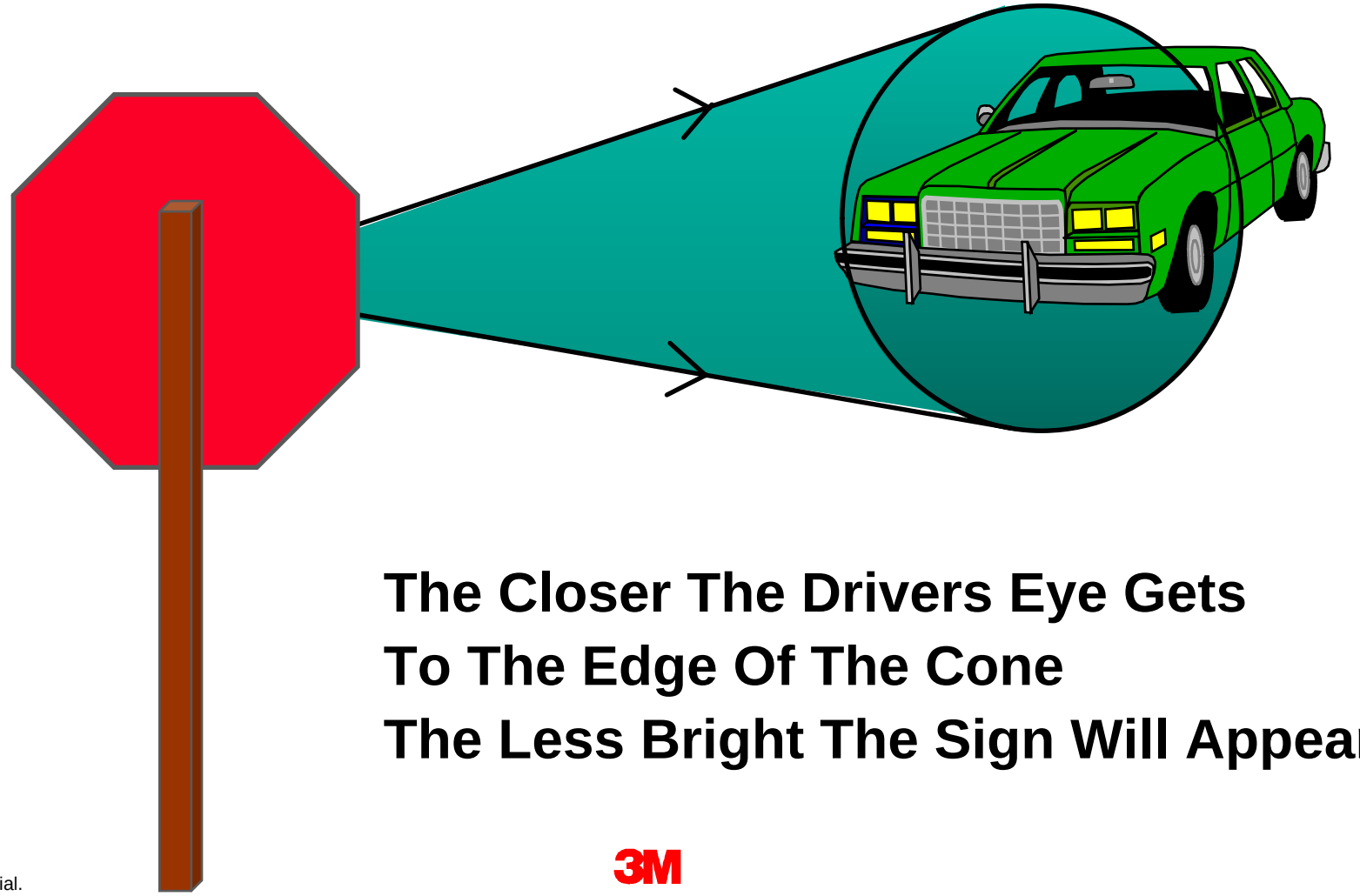
Critical Signs at Intersections



Observation Angle



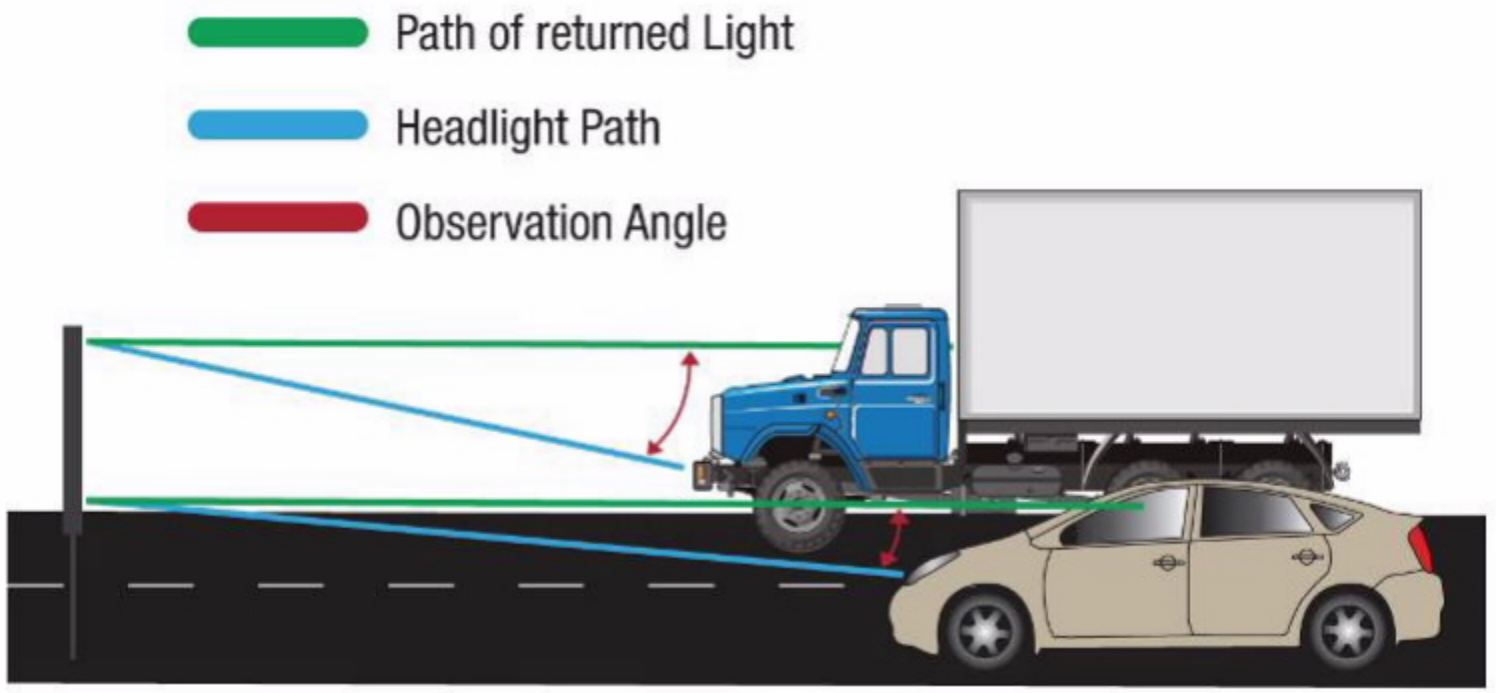
Cone Of Retroreflected Light



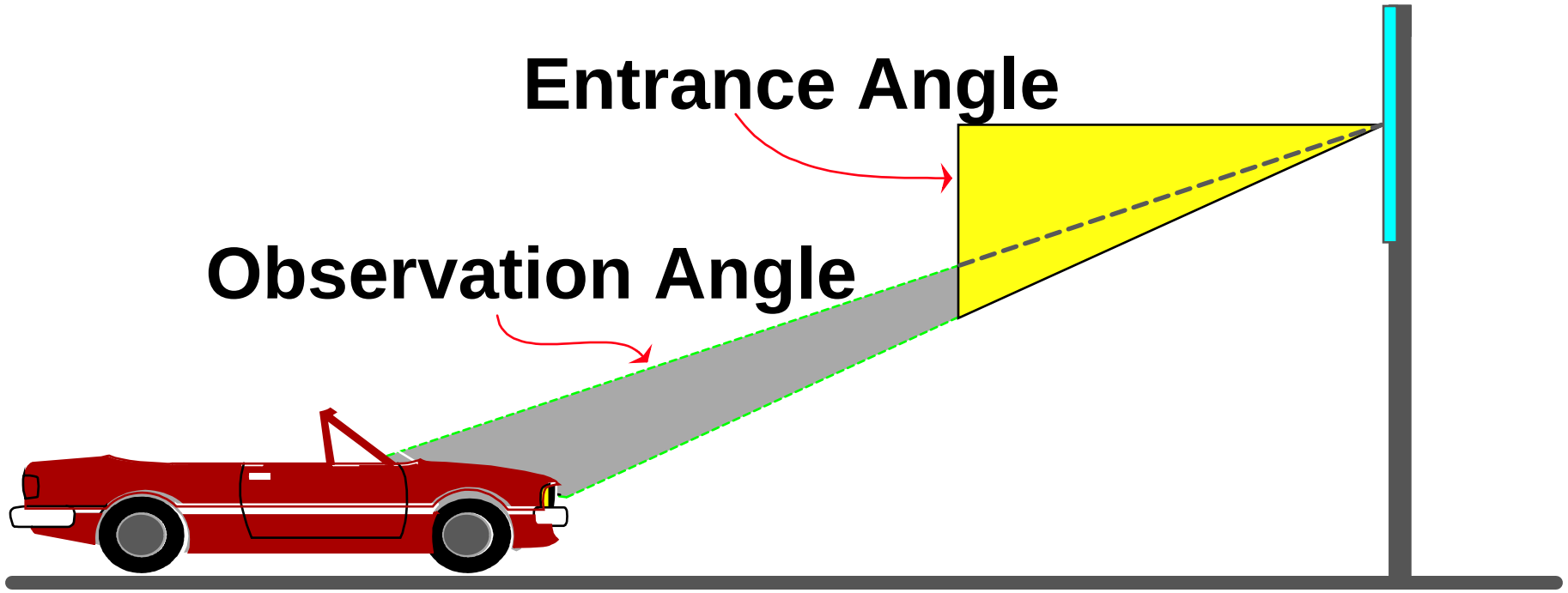
The Closer The Drivers Eye Gets
To The Edge Of The Cone
The Less Bright The Sign Will Appear

Observation Angle

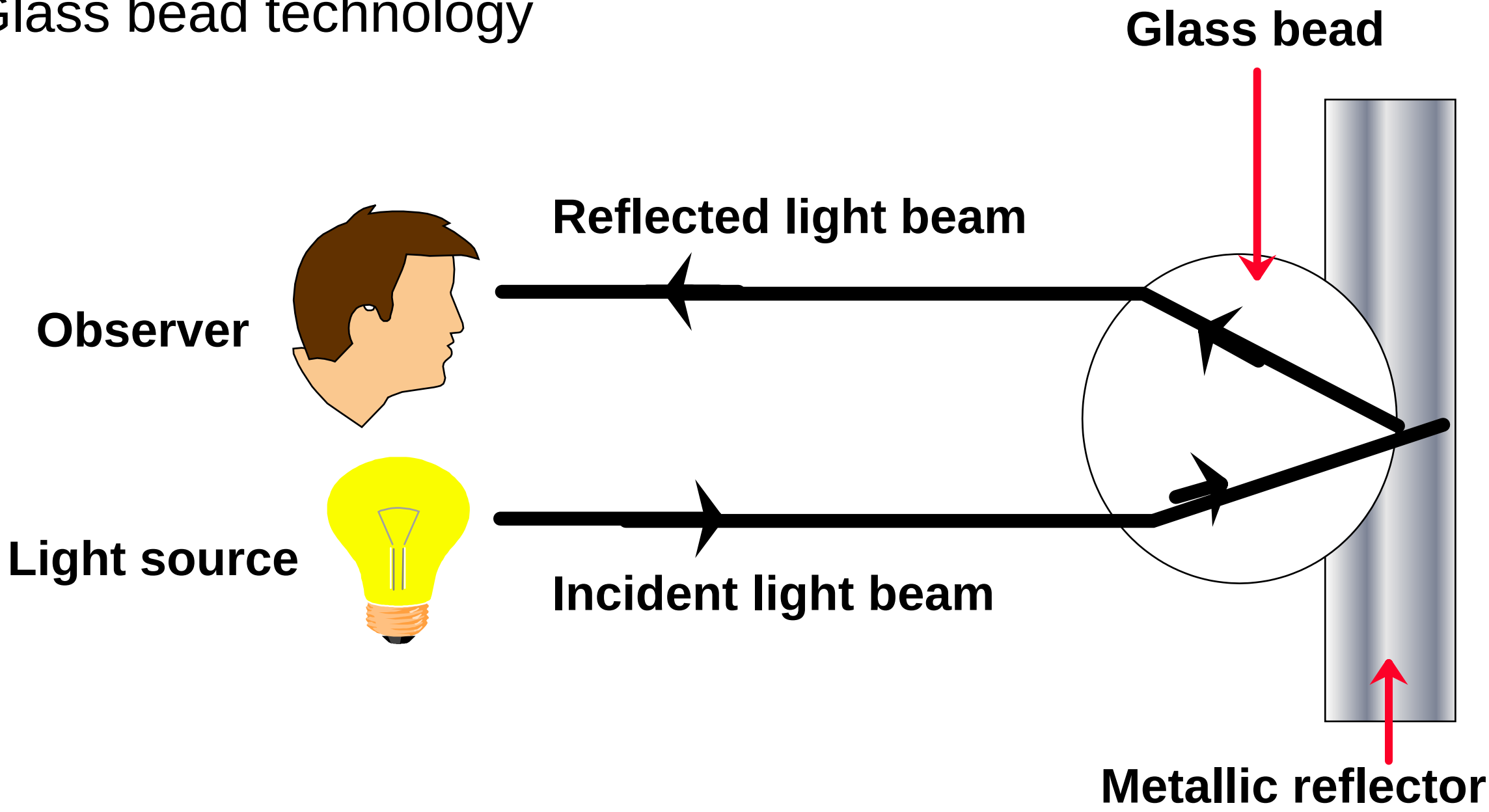
The angle created between the light path and its reflected path, back to the driver



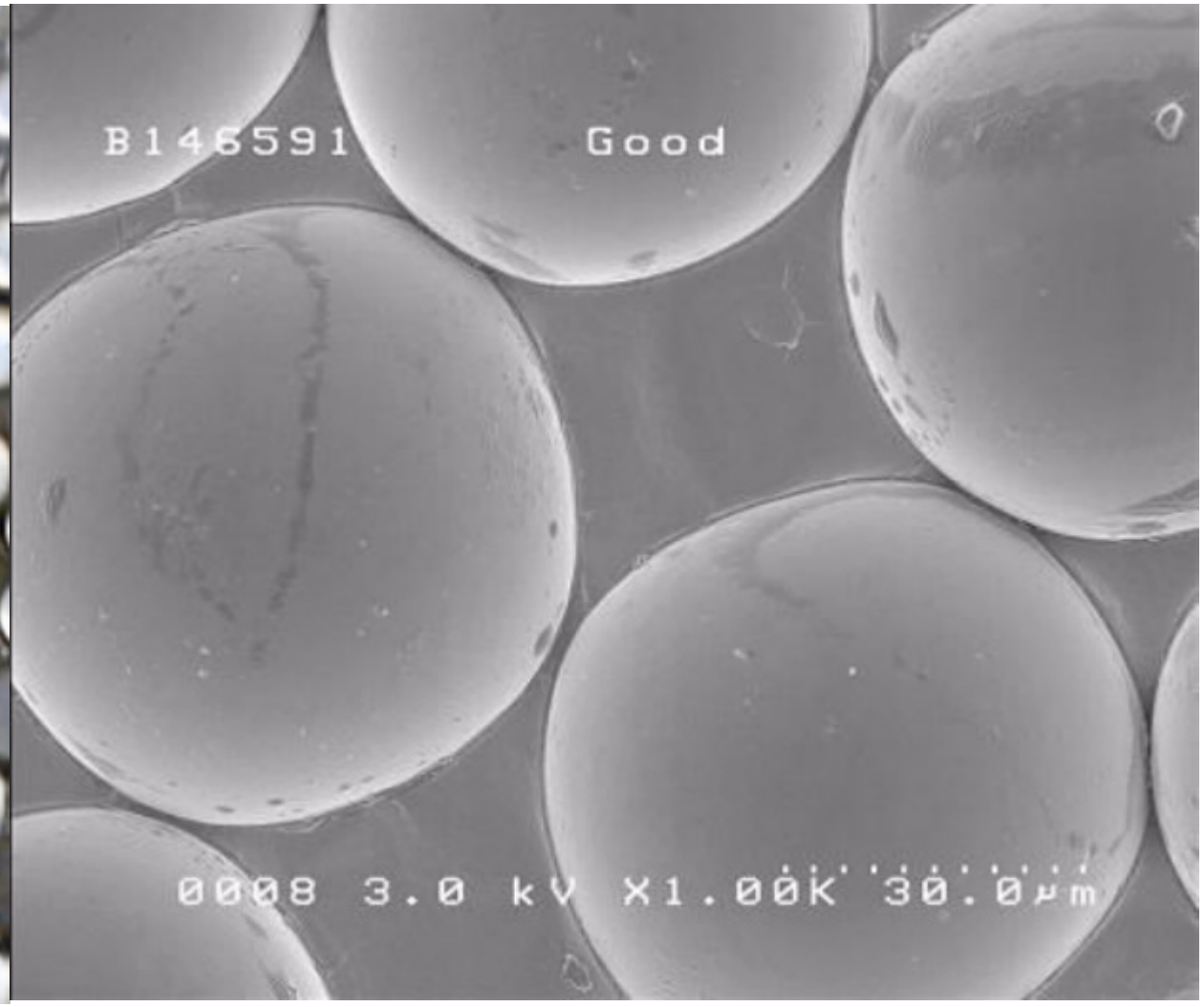
Critical Angles In Retroreflectivity



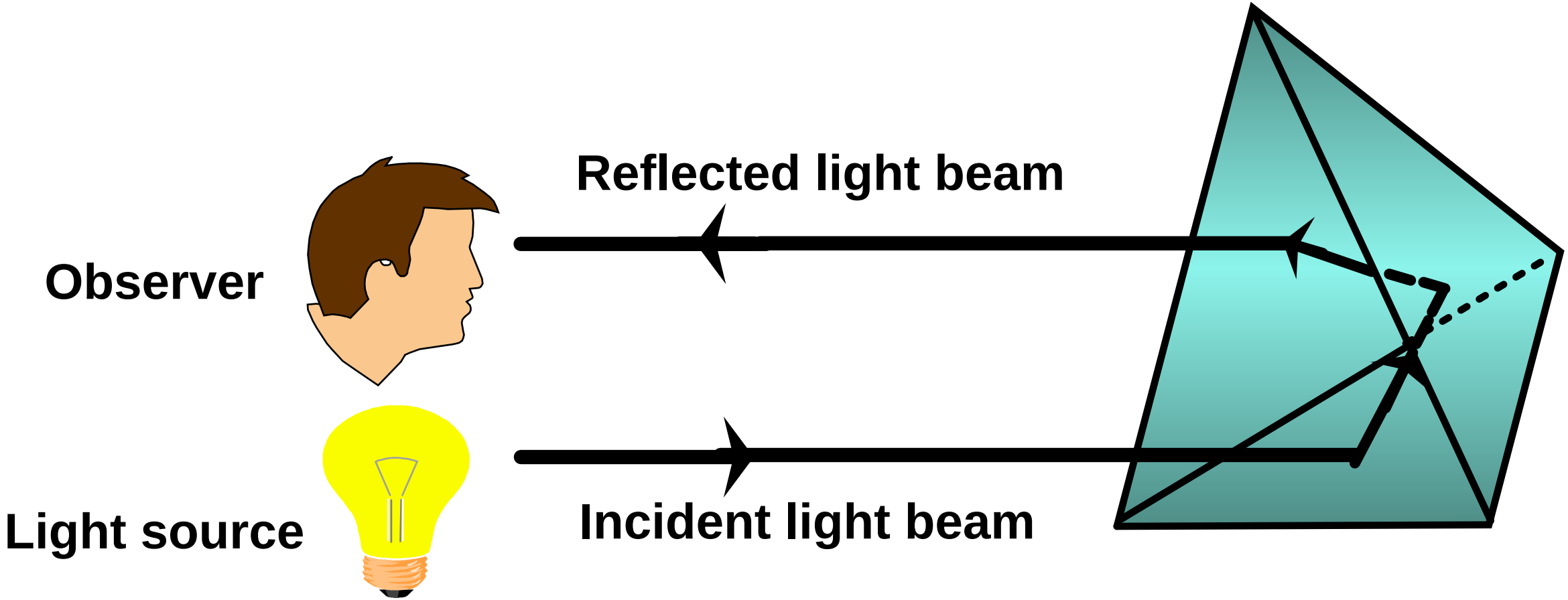
Glass bead technology



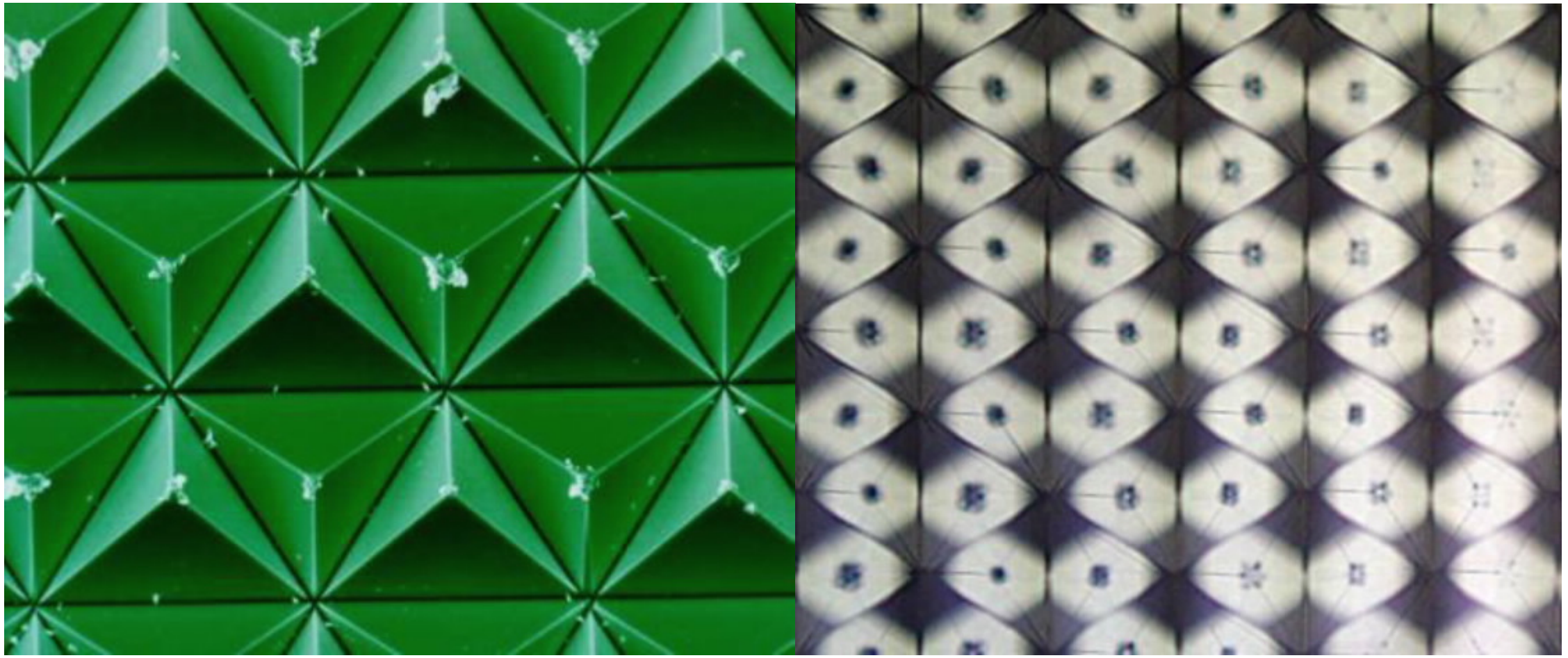
Glass Bead Technology



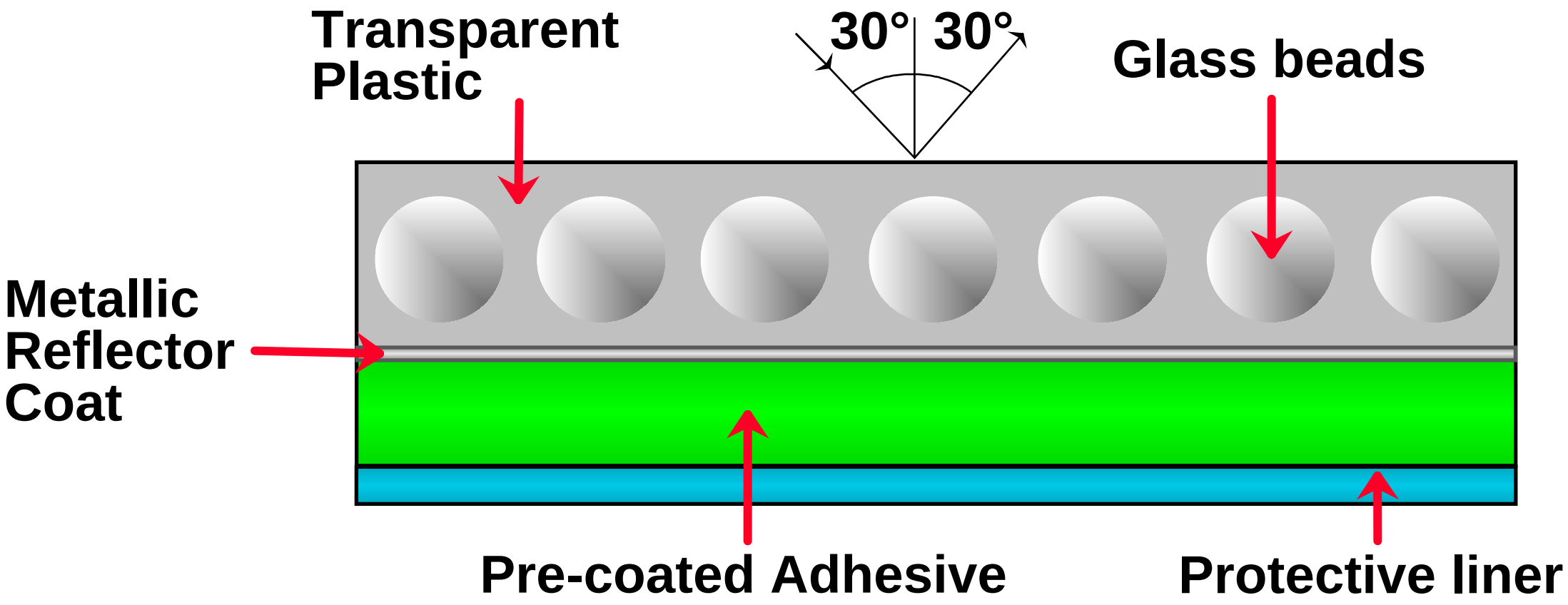
Cube Corner Technology



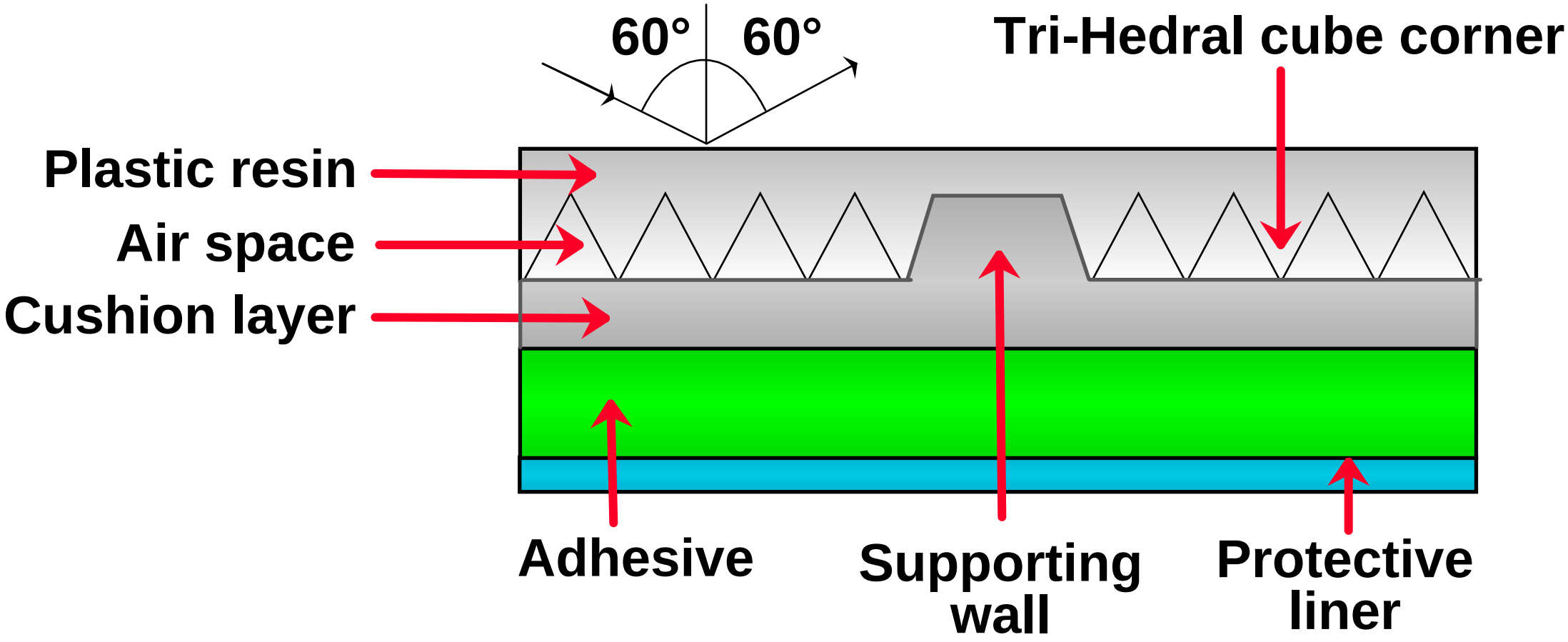
Cube Corner Technology



Engineer Grade Reflective Sheeting



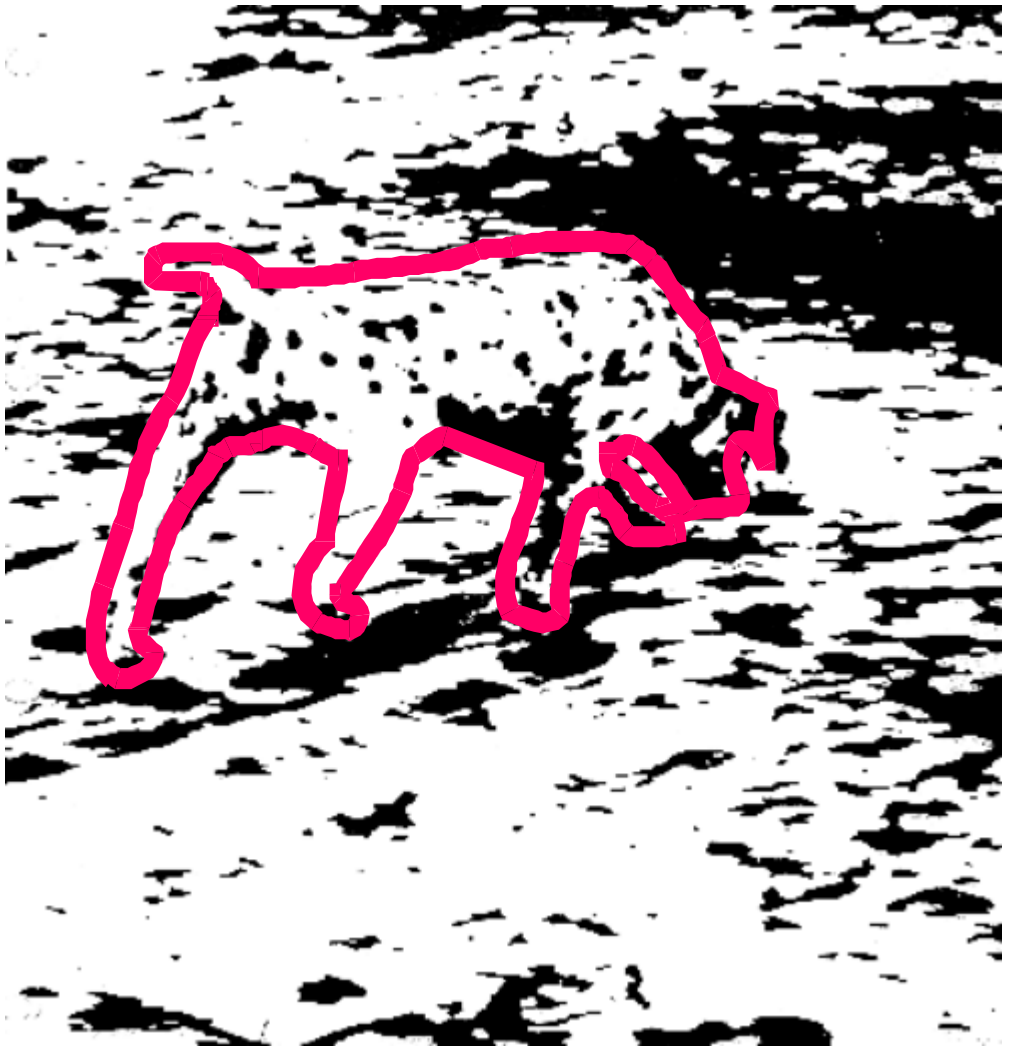
Diamond Grade Reflective Sheeting



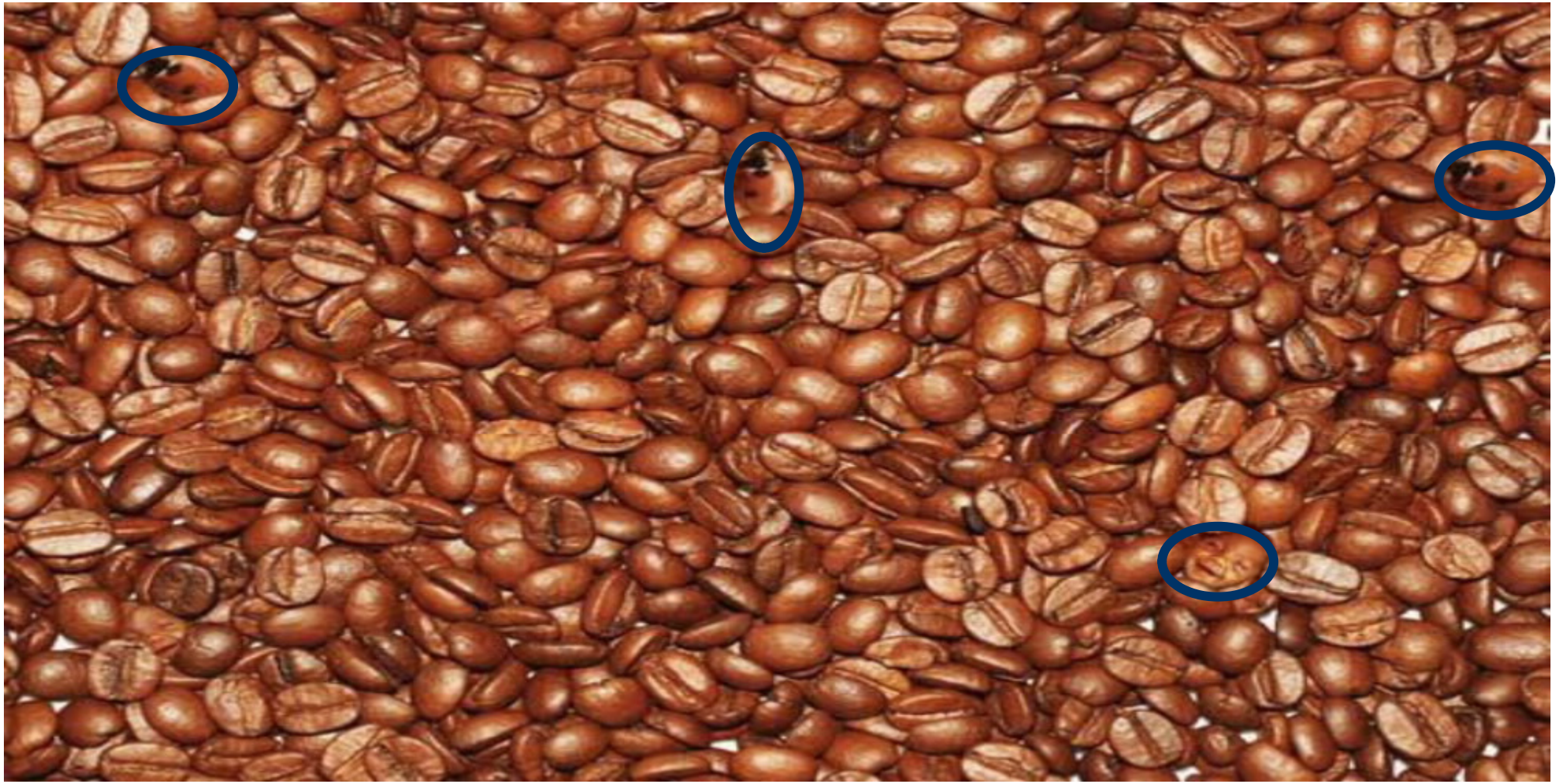
Human Factors Affecting Visibility

Human Factors - Spot the objects

VISIBILITY?



Human Factors - Spot the objects

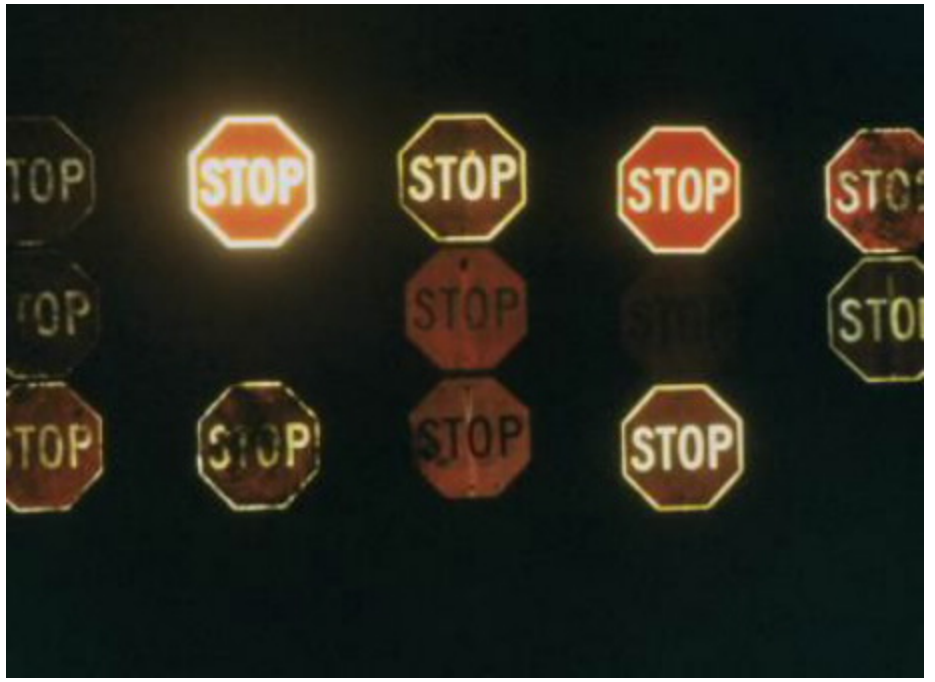


Human Factors - Night Time Visibility

Just 5% of the information
we see in daylight are caught
by the eye at night.

Human Factors - Day vs. Night Performance

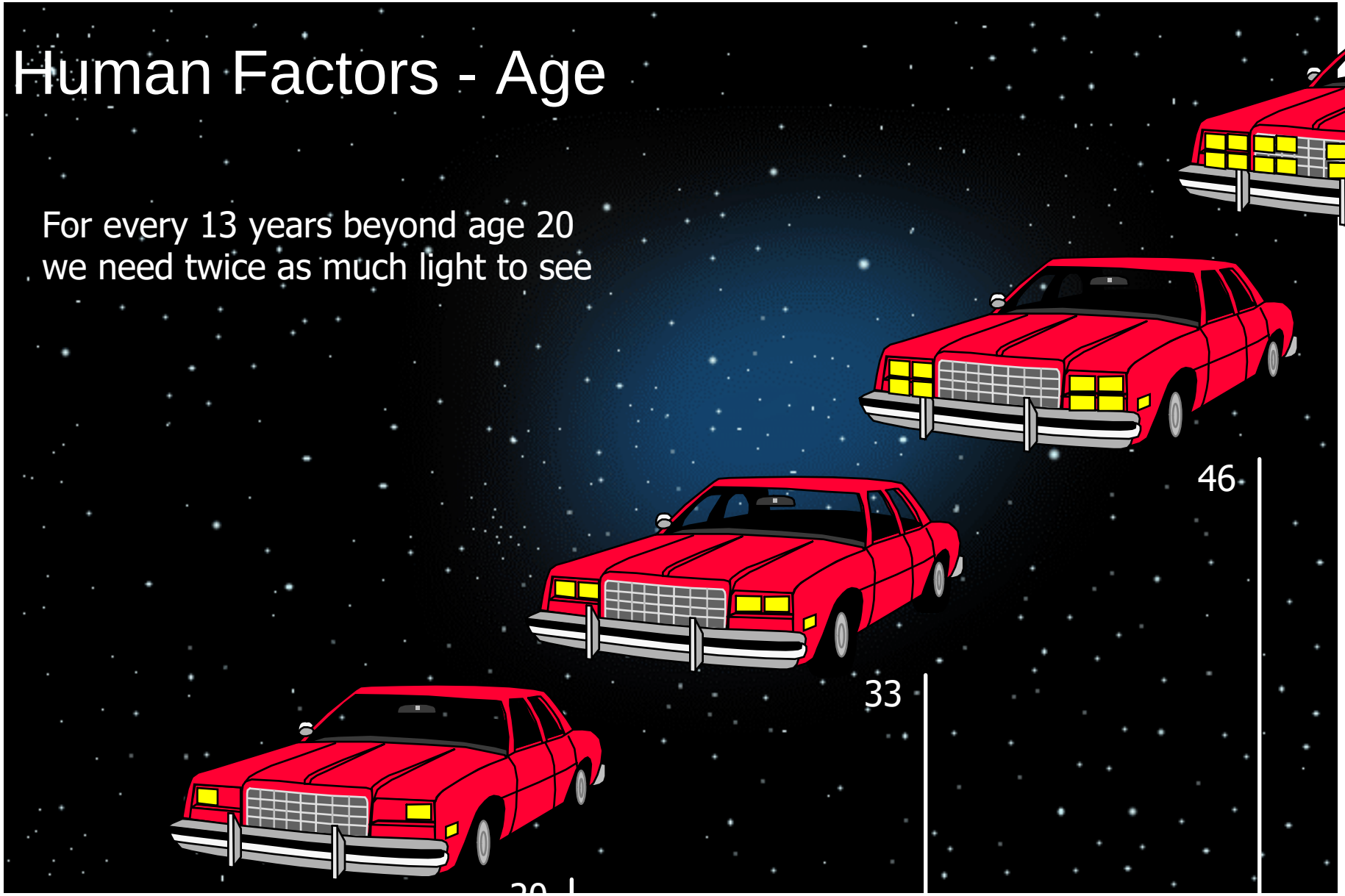
What we see during the day ...



Is not always what we see at night !

Human Factors - Age

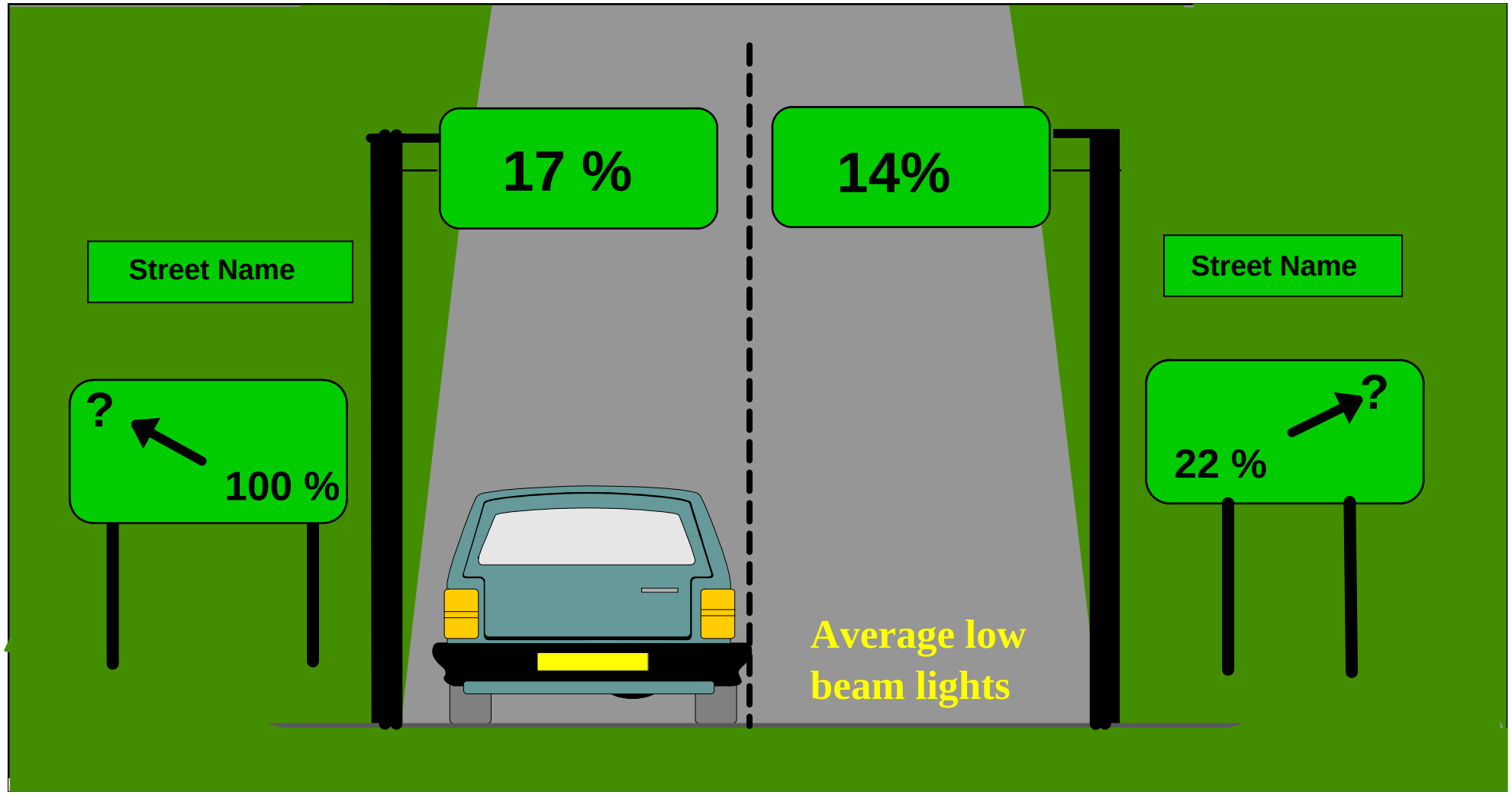
For every 13 years beyond age 20
we need twice as much light to see



Source: Harvard Medical School - Eyesight Deteriorates with age

Signs in Disadvantaged positions

The correct sheeting technology must be specified

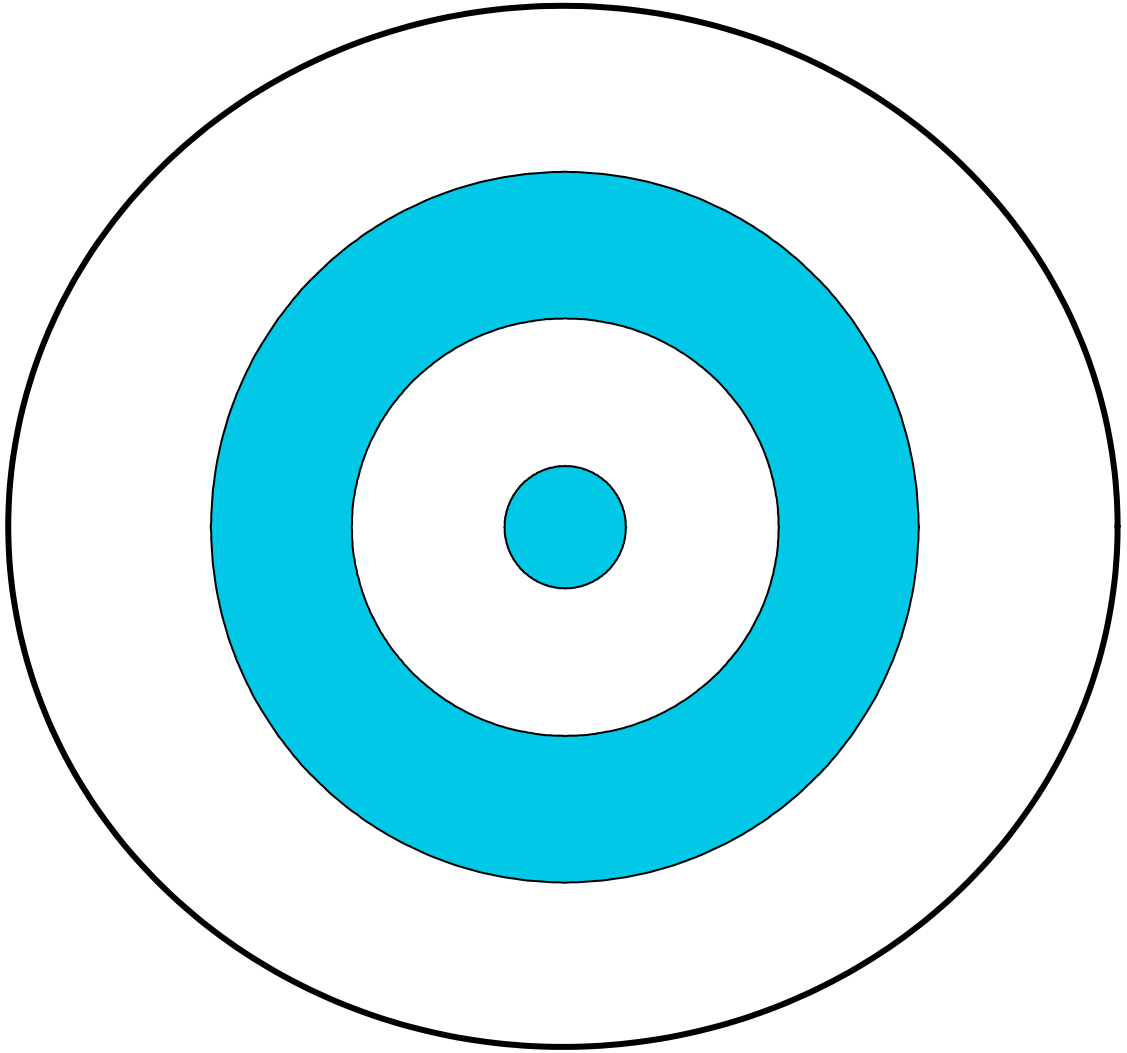


Using new technologies to maximise the value and performance of your assets

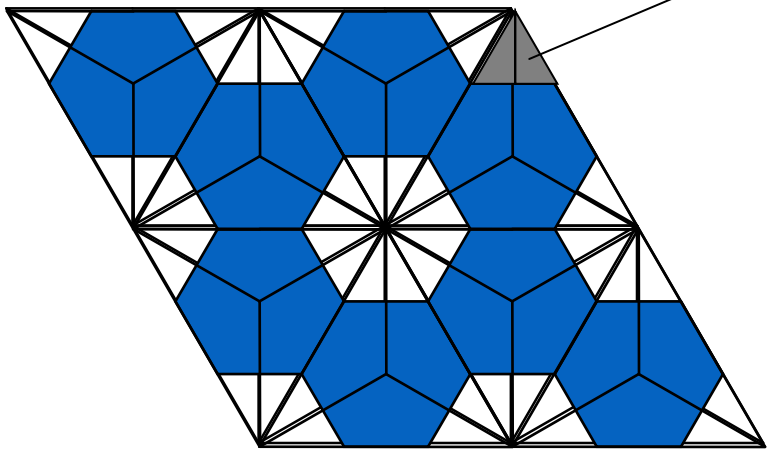
PERMANENT SIGNAGE

Glass Beads as Retroreflectors

Only 28% of Spherical Bead Surface
Bends Light Just Right to Cause Retroreflection



Truncated Cube Corners Have Limitations Too

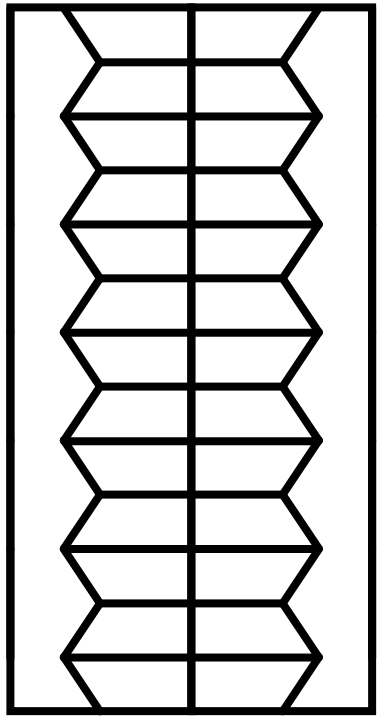


Light Entering the Corner only Reflects Twice

Those Rays are NOT Retroreflected!

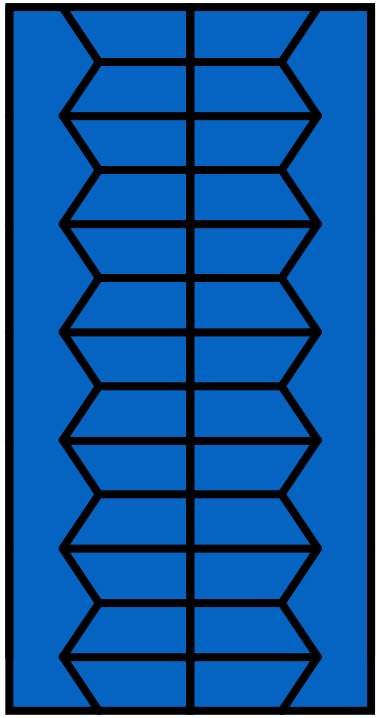
Only 65% of the truncated cube surface is retroreflected!

Full Cube Corner Optics

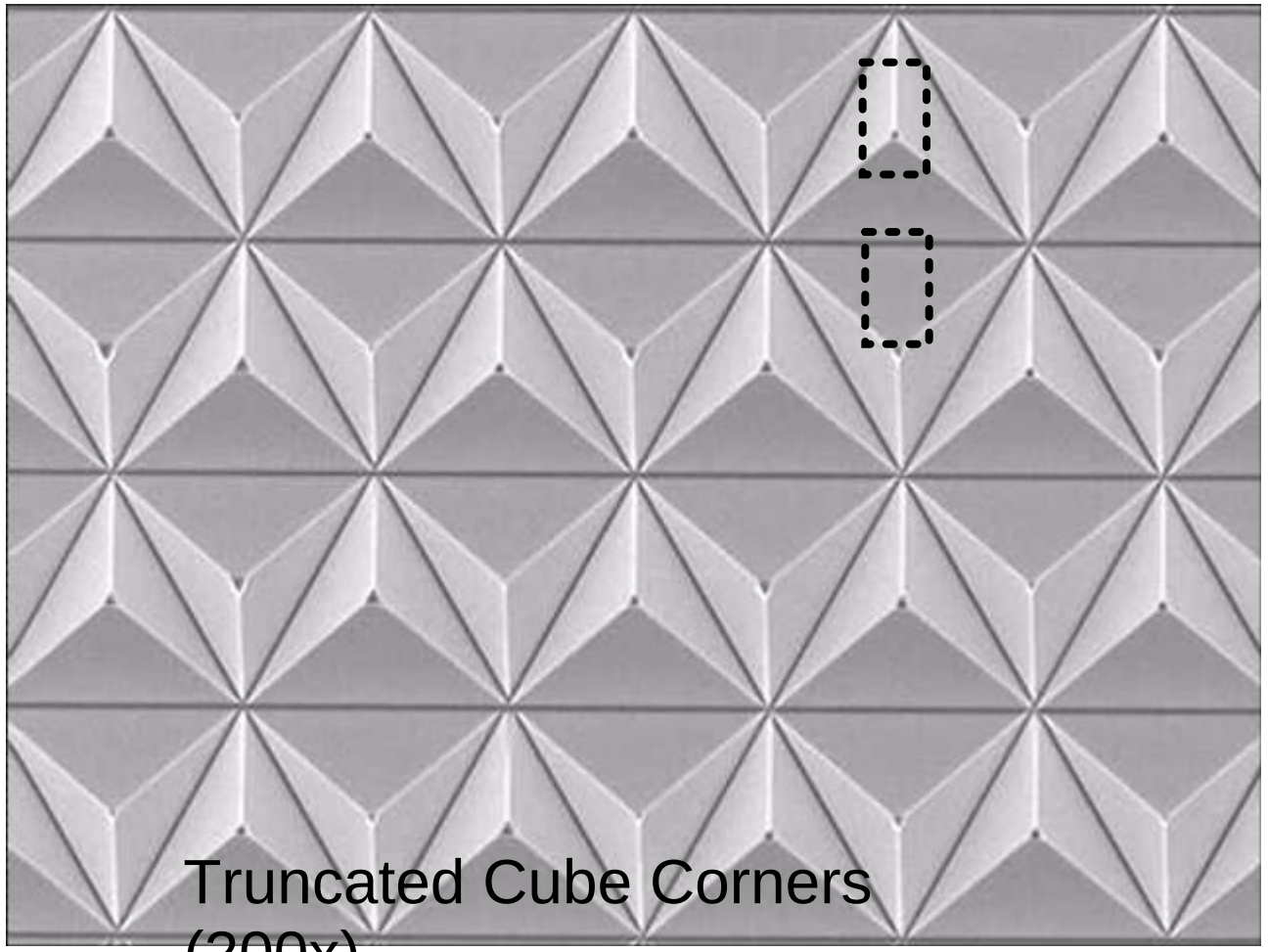


Still Uses 3 Bounce Mirror Reflection

100% of Full Cube Surface is Retroreflected!

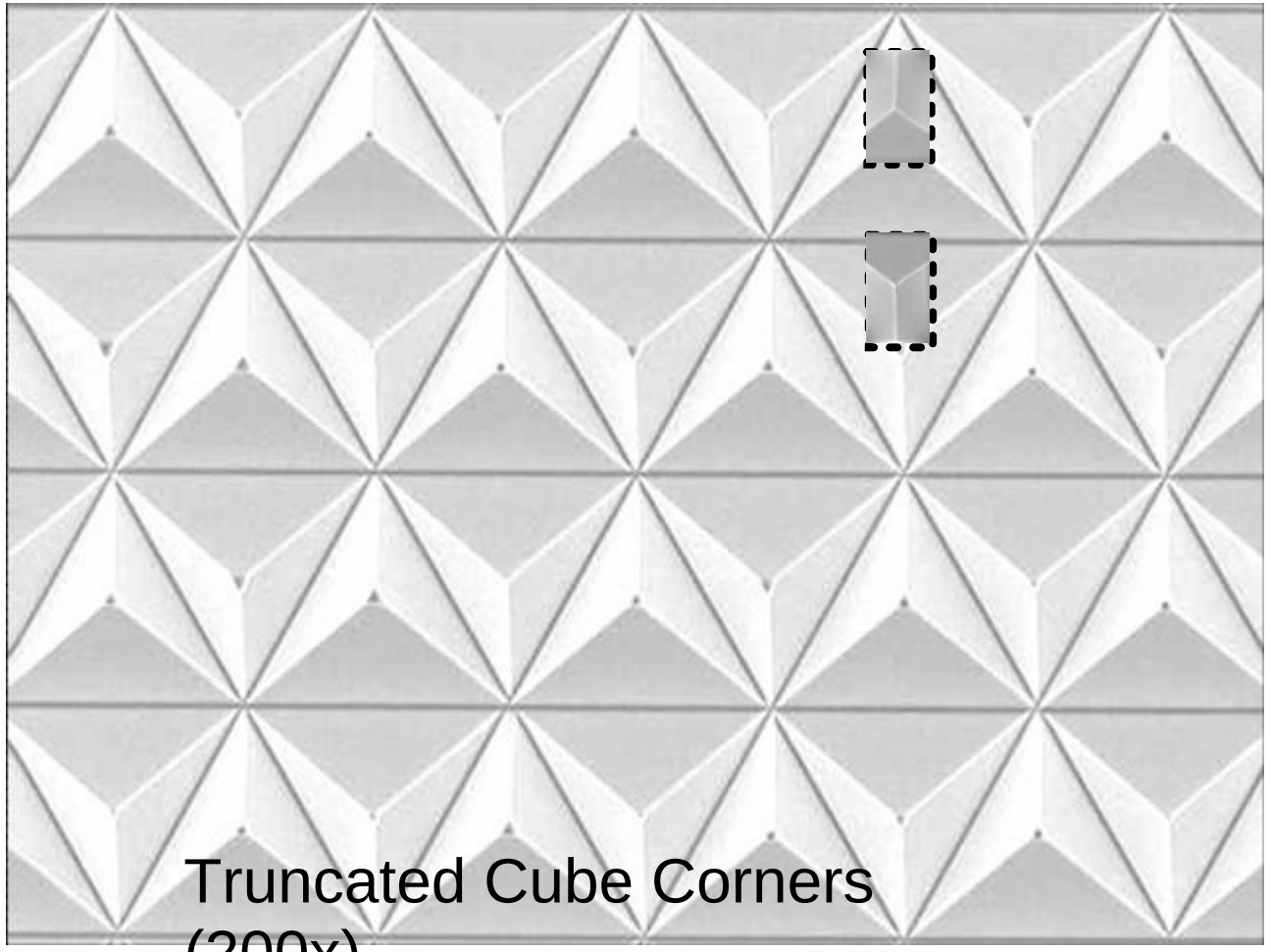


But, There Are No Dead Corners!

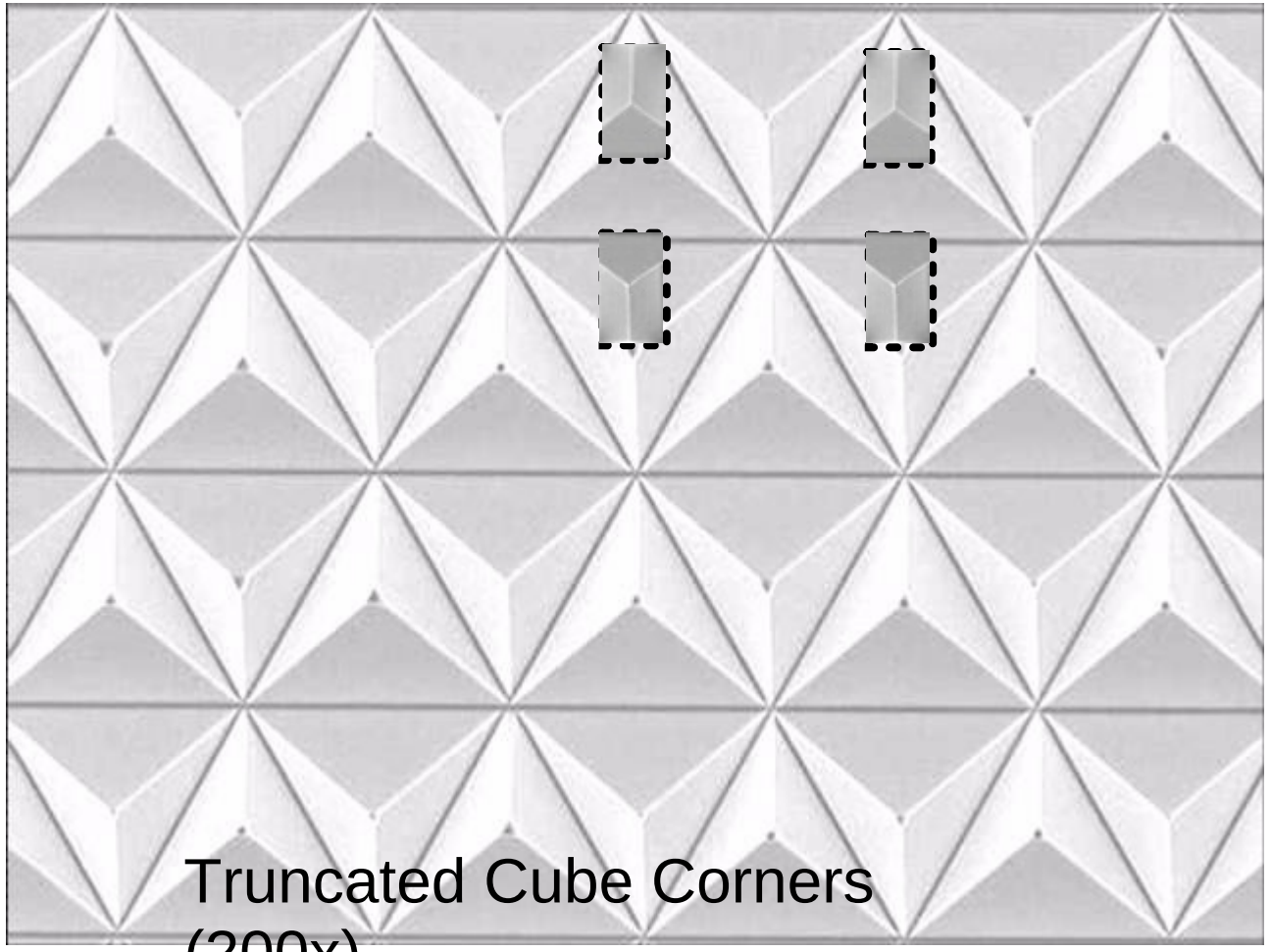


Truncated Cube Corners
(200x)

Making Full Cube Corner Optics



Truncated Cube Corners (200x)



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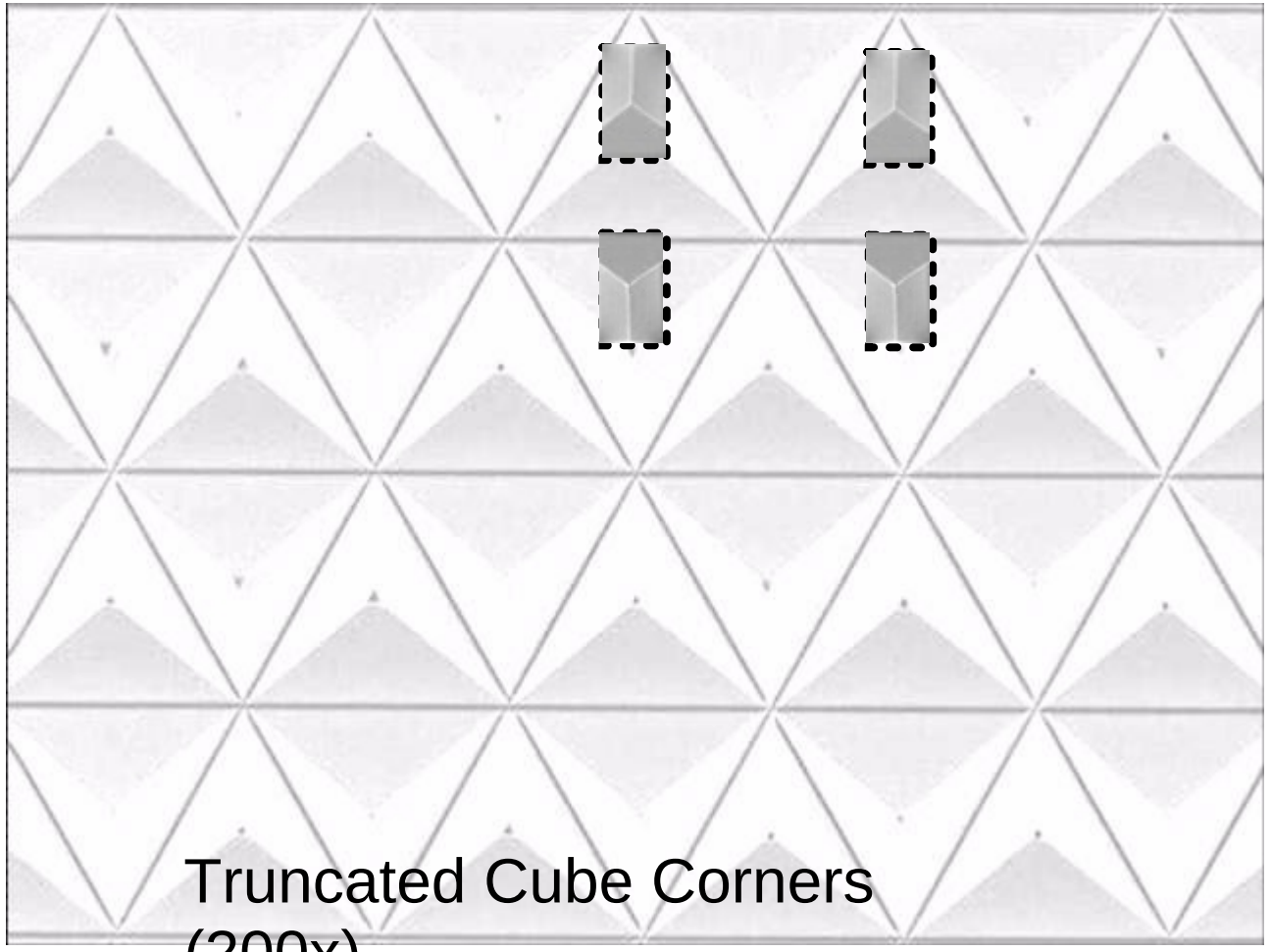

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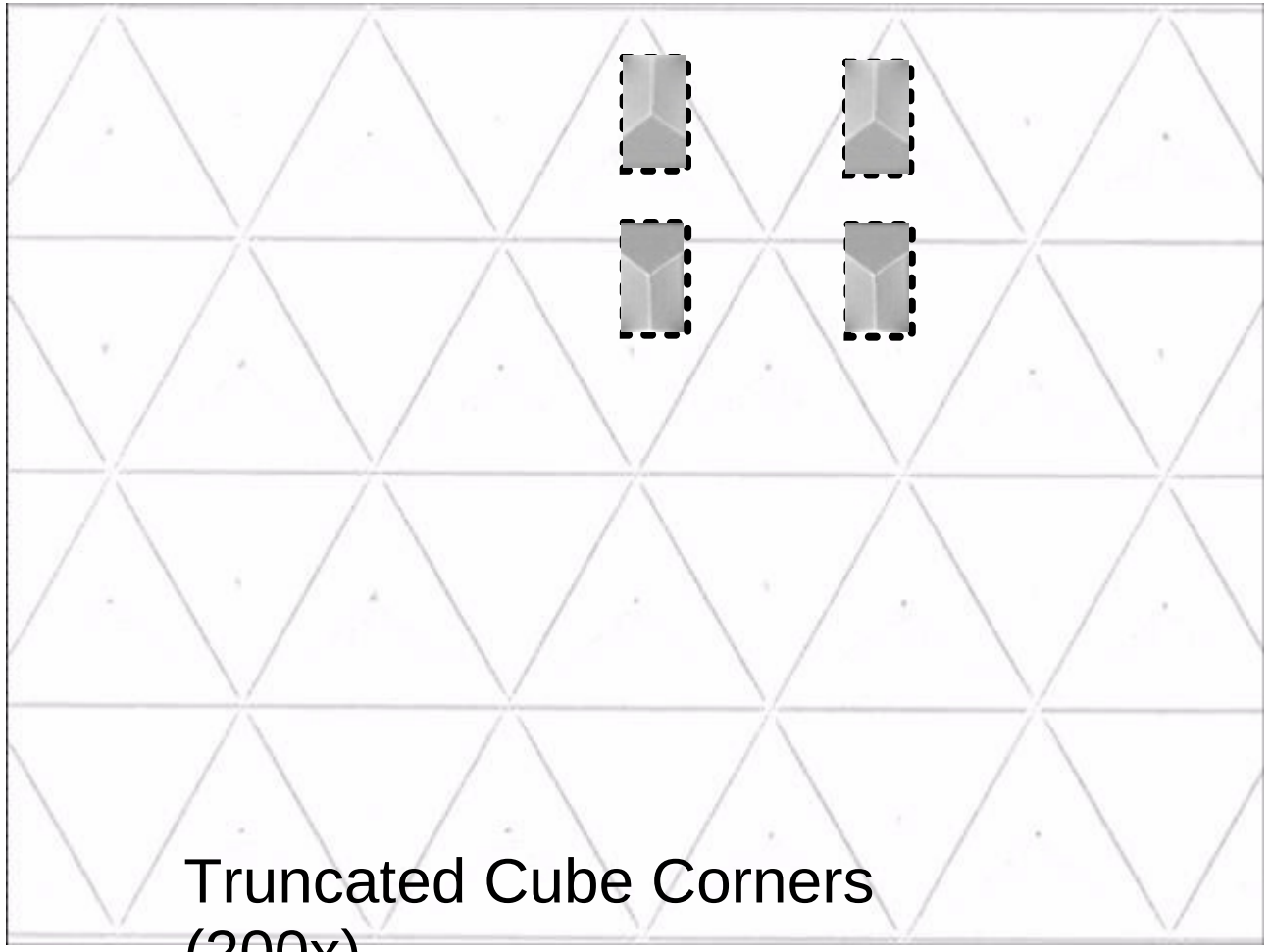

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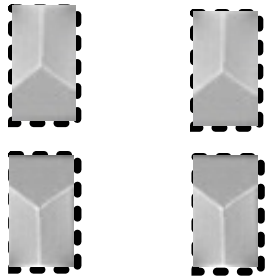
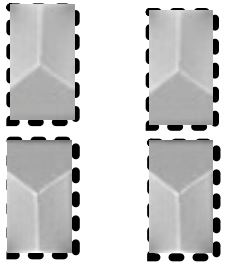
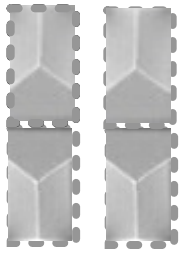
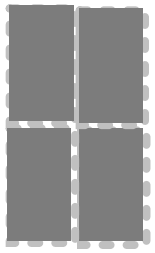
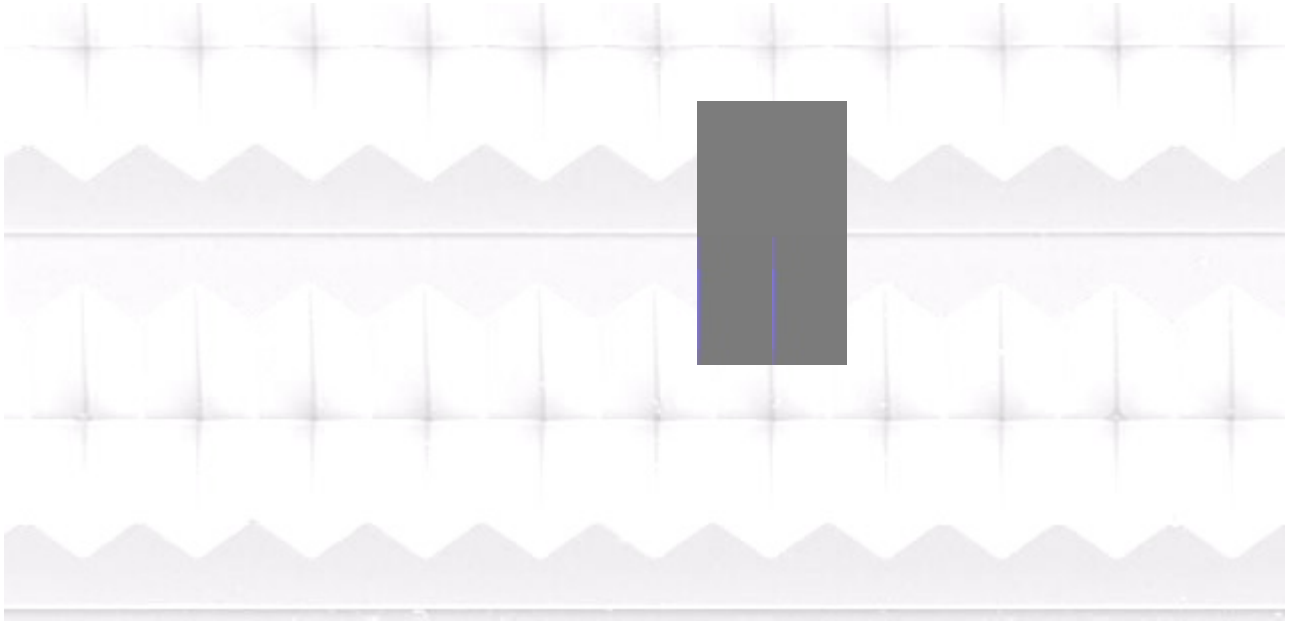


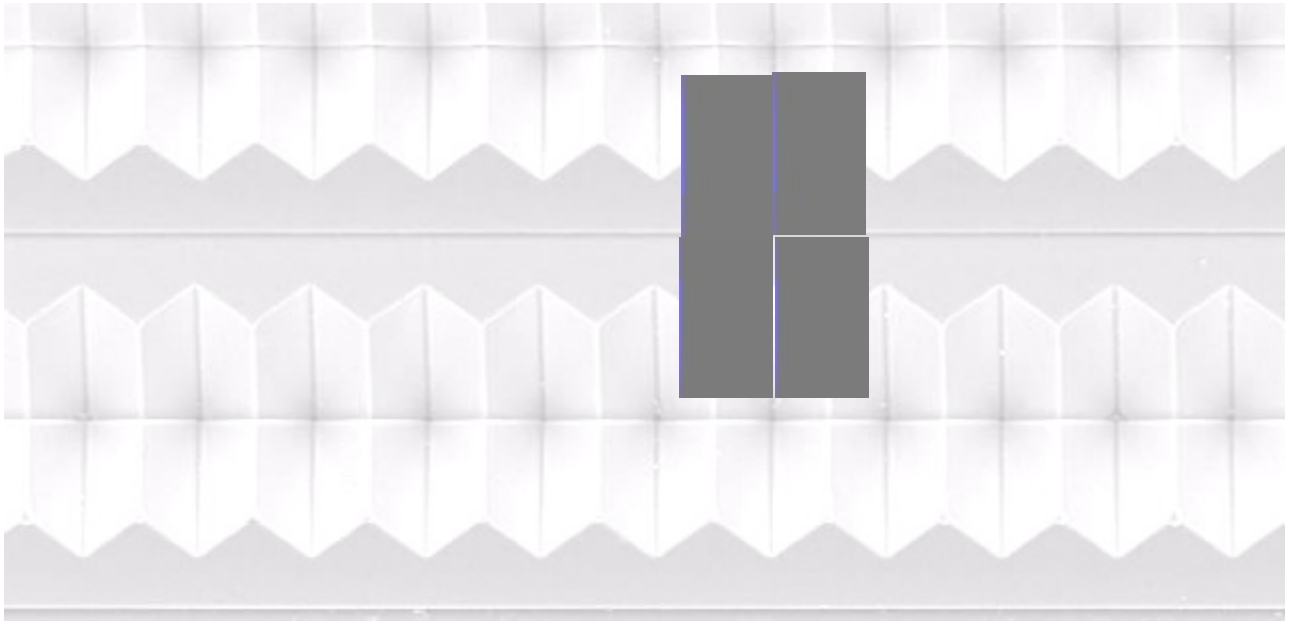




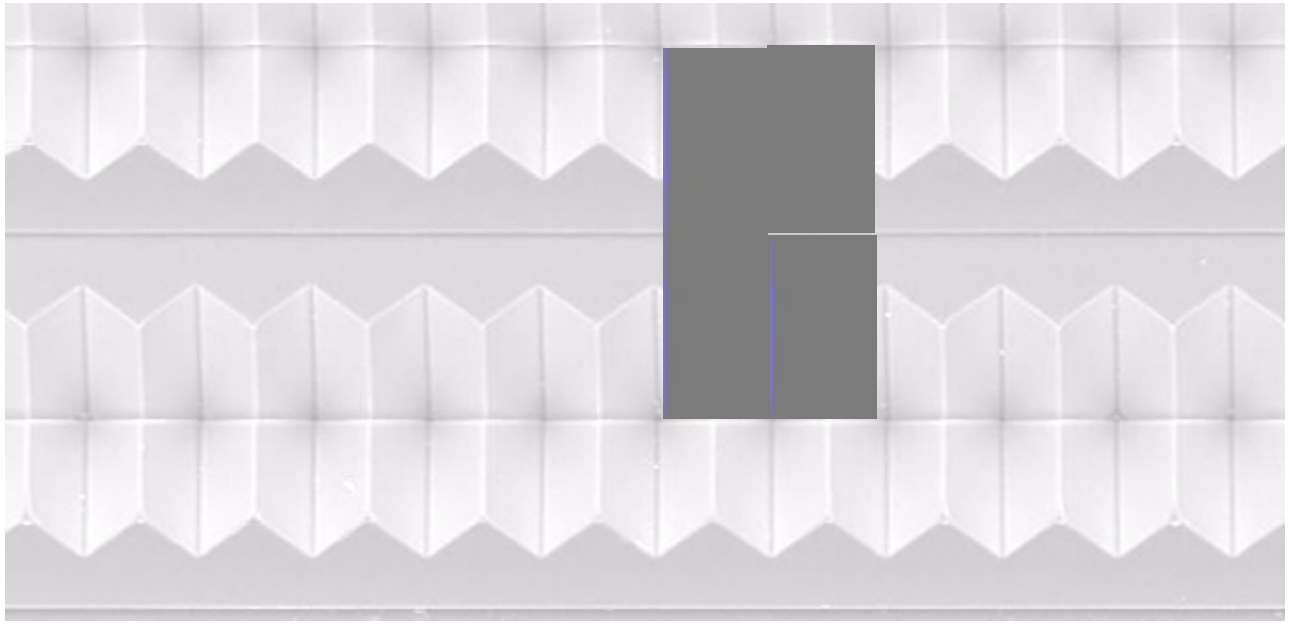




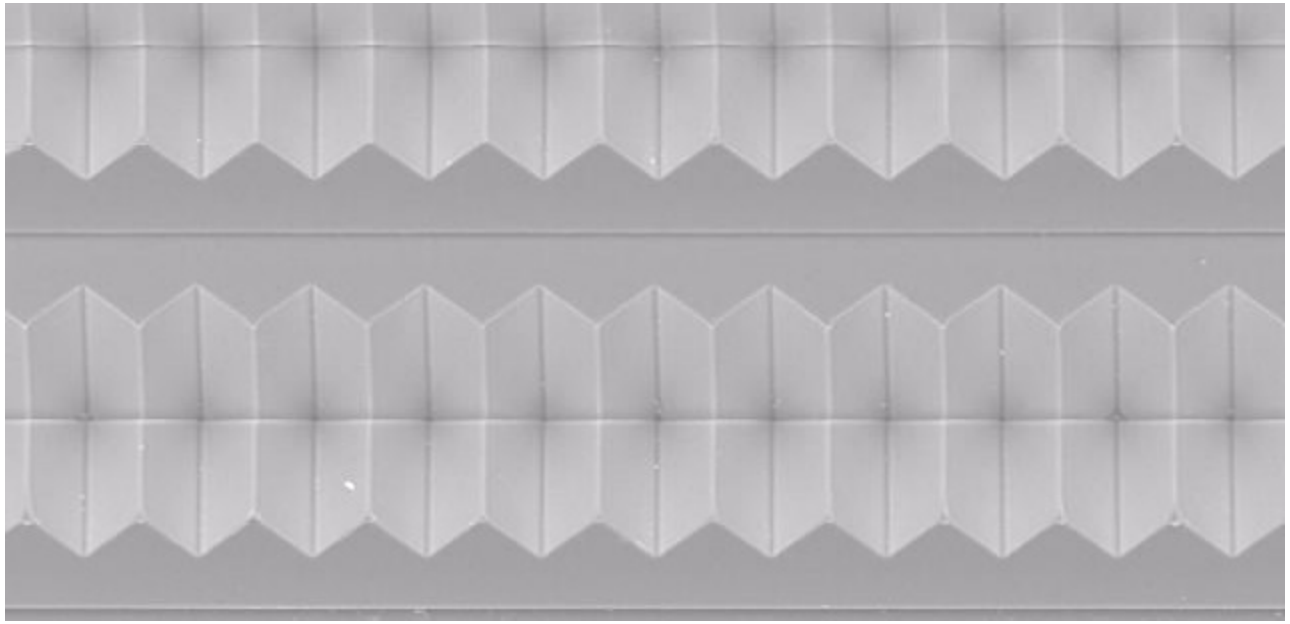
Full Cube Corners



Full Cube Corners



Full Cube Corners



Full Cube Corners

Advancements in 3M technologies

Sheeting performance

What is a sign trying to do?

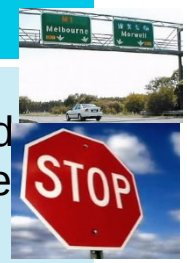
Give information to as many road users as possible

How is this done:

- Providing enough returned light to the driver so that they can read and comprehend it before the sign moves out of view
- Thus standardization of signs encourages comprehension / easy to read fonts / common format of signs / images

Changes to the Standard for Reflective Sheeting

AS/NZS1906.1-2017 Quick Overview

Class	Comparison to previous 1906.1- Class	Attributes of the sheeting	How we would recommend it is used:
Class 1100	Higher performance than in previous classes – meets NSW QA3400 Class 1X level.	Provides both wide entrance and observation angle performance.	Ideal for high truck traffic, multi-lane road for disadvantaged signs. Or where there high sign clutter / interference 
Class 900	Higher performance than previous Class 1W.	Provides wide angle performance at short distances (often when sign acknowledgement occurring so brightness needed to minimize time off the road).	Left hand mounted signs on rural roads, chevrons  
Class 400	Incorporates the previous prismatic Class 1	Good general use sheeting, for single lane carriage way, predominately car use.	Left hand mounted signage, street name blades.  
Class 300	Incorporates the previous beaded Class 1	Older technology beaded sheeting, wide angle but short visibility distance.	Retained in standard predominately for use in New Zealand for cone sheeting.
Class 100	Incorporates the previous engineer grade, Class 2.	Low level reflective sheeting used where sign information is of low importance.	Main usage for parking signs commercial applications. 

Where Do I Use Which Sheeting?

Sign	Road category	Reflectivity specification
Stop Give way	All roads	Class 1100
Speed circles	Speed reduction All others	Class 1100 Class 900
Keep Left		Class 1100
No Turning Signs	All roads	Class 900
Street name blades	Urban arterials/ main roads Collectors/ district highways Local/Low volume roads	Class 900 Class 400 Class 100
Guide signs	Overhead gantry Ground mount (>2m wide) Ground mount (<2m wide)	Class 1100, Consider Dew resistant overlay too Class 1100, Consider Graffiti resistant overlay too Class 900 High intensity prismatic sheeting

Where Do I Use Which Sheeting?

Sign	Road category	Reflectivity specification
Reflective Belisha disc	All locations	Class 1100 Fluorescent orange prismatic sheeting
Pedestrian X pole	All locations	Class 400
Permanent Warning Signs – vulnerable road user	All locations	Class 1100 Fluorescent yellow green prismatic sheeting
Other Permanent Warning signs	Main roads, highways Rural and urban roads Low volume roads	Class 1100 Class 400 Class 100
Parking Signs	All roads	Class 100

Documents that specifications should refer to and include

RSMA - Road Safety Manufacturers Association

Gazette - Sheetings approved for use in NZ

NZTA TCD Rule - Manual of traffic control devices

AS/NZS Standard 1906.1 2017 - industry joint standard

Unique individual specification - pertinent to organisation

Thank you