

# CTS-Prep Workshop I

## Aspect Ratio and DISCAS

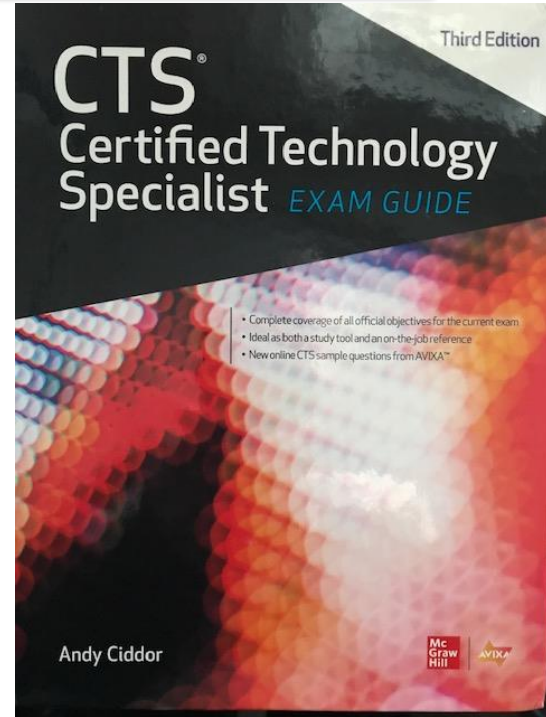
### Italy, April 2020

#### Jose Mozota CTS, CTS-I



# Image View-ability Factors

- Size
- Shape
- Target of vision (screen)
- Obstructions
- Brightness
- Contrast
  - Image System Contrast Ratio (formerly PISCR)
  - STATUS: Published as ANSI/INFOCOMM 3M-2011; Under Revision as Image System Contrast Ratio



Ch 5 and 14

# Aspect Ratio

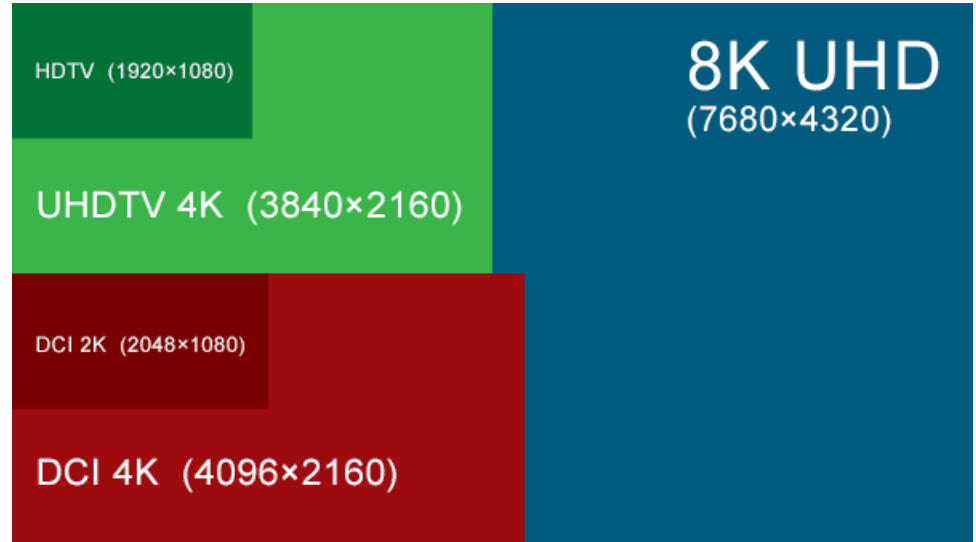
- Aspect ratio is the ratio of image width to image height. It can be expressed as two whole numbers separated by a colon.
  - 4:3 (1.33) for Standard-Definition (SD) video very common in late 20th century
  - 16:9 (1.78) for High-Definition (HD) video
- Some computer and video production displays added space below the 16:9 aspect ratio of HD video and made a 16:10 (1.6) aspect ratio.

# Note

When 4K was introduced as (4096X2160), it had an aspect ratio of 17:9 = 1.89, the same as DCI 2K (2048x1080).

To keep TV's and Displays with the same aspect ratio as HD (1.78), UHD was created at 3840x2160.

“Real 4K” was kept for DCI (digital Cinema Initiative)



**UPSCALING!**

# Aspect Ratio: 4x3 Examples

- 4x3 Screen with



4x3 Image



16x9 Image



16x9 Image  
Stretched

# Aspect Ratio: 16x9 Examples

- 16x9 Screens with:



16x9 Image



4x3 Image  
Stretched








4x3 Image

CTS

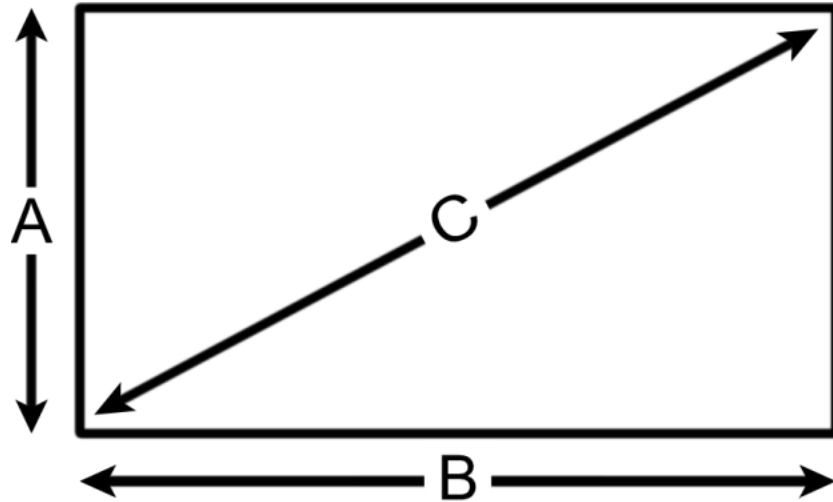
Present an Experience - Designing Projection Properly

## Current Projector Aspect Ratios

1.33:1		Standard Definition (4:3): NTSC, SDTV
1.60:1		Wide Computer (16:10): WXGA, WUXGA
1.78:1		High Definition (16:9): 720p, 1080p, 4K-UHD
1.90:1		Full Container: 2K/4K projector native res, DCP Full Container
2.39:1		Scope: 2K/4K projector w/anamorphic lens, DCP Scope

# Calculating Aspect Ratio

Relationship between the width and height of a displayed image





# How to Calculate Aspect Ratio

- Find the width of an image with a 60 inch (1.5 meter) height and a 16:9 aspect ratio.
- To solve: cross multiply and divide
- US Customary:  $\text{Width/Height} = 16/9 = X / 60$
- Metric:  $\text{Width/Height} = 16/9 = X / 1.5$

If you keep the units consistent, you can use metric or imperial

# Calculating Screen Diagonal: Pythagorean Theorem

$$a^2 + b^2 = c^2$$

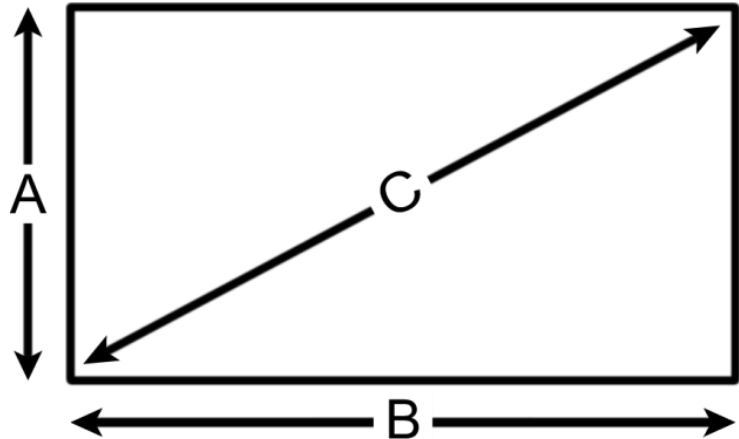
$$16^2 + 9^2 = \text{diagonal}^2$$

$$256 + 81 = 337$$

$$\text{Diagonal} = \sqrt{337}$$

$$\text{Diagonal} = 18.36$$

$$16:9:18.36$$



# Using Ratios: Sample Diagonal Ratio Calculations

1. A screen has an aspect ratio of 16:9:18.36. The diagonal of the screen is 2.5 m. What is the width?
  - $\text{Diagonal/Width} = 18.36/16$
2. A screen has an aspect ratio of 16:9:18.36. The diagonal of the screen is 2.5 m. What is the height?
  - $\text{Diagonal/Height} = 18.36/9$

# Sample Aspect Ratio Calculations

The height of the screen is 54 inches (1372 mm) and the width is 72 inches (1829 mm). What is the diagonal?

- $A^2 + B^2 = C^2$
- $54^2 + 72^2 = C^2$
- $2,916 + 5,184 = C^2$
- $8,100 = C^2$
- $\sqrt{8100} = C$
- $C = 90$  inches (2,286 mm)

# Aspect Ratio Practice Problems

1. A screen has an aspect ratio of 16:9 and the following height dimension: 165.3 inches (4199 mm). Determine the width and diagonal of the screen.
2. An existing screen is 216.5 inches (5499 mm) wide by 216.5 inches (5499 mm) high. A projected image with a 16:9 aspect ratio covers the entire width of the screen. What is the image's height?
3. A screen's dimensions are 96 inches (2438 mm) x 96 inches (2438 mm). What width does an image on that screen need to be for a 16:9 aspect ratio image?

# Aspect Ratio Practice Problems Answer Key

1.  $W=293.9$  inches (7465 mm) and  $D=337.2$  inches (8,565 mm)

a.  $AR = W / H$   
 $16 / 9 = W / 165.3$   
 $165.3 * 16 = 9 * W$   
 $2644.8 = 9W$   
 $293.866667 = W$

b.  $A^2 + B^2 = C^2$   
 $293.866667^2 + 165.3^2 = C^2$   
 $113681.708 = C^2$   
 $\sqrt{113681.708} = \sqrt{C^2}$   
 $337.167181 = C$

# Aspect Ratio Practice Problems Answer Key

2. 121.8 inches (3,093 mm)

- a.  $AR = W / H$   
 $16 / 9 = 5499 / H$   
 $16H = 49491$   
 $H = 3093.1875$

3. 96 inches (2438 mm)

- a. **The image should be 96 inches (2438 mm) wide.**  
Assume the image fills the full width of the screen. If it filled the full height instead, the entire image would not fit on the screen.

# Aspect Ratio Practice Problems (Cont.)

4. What is the aspect ratio of a screen with a width of 108 inches (2743 mm) and a diagonal of 135 inches (3429)?
5. You require a 16:9 screen with a height of 60 inches (1524 mm). What will the screen's diagonal be?
6. A 16:9 screen will be installed in a lecture hall. The screen's diagonal is 72 inches (1829 mm). What is its width?



# Aspect Ratio Practice Problems Answer Key

4. 81 inches (2,058 mm); AR=1.33:1 or 4:3

a.  $A^2 + B^2 = C^2$

$$108^2 + B^2 = 135^2$$

$$11,664 + B^2 = 18,225$$

$$(11,664 + B^2) - 11,664 = 18,225 - 11,664$$

$$B^2 = 6,561$$

$$\sqrt{B^2} = \sqrt{6,561}$$

$$B = 81$$

**The screen height is 81 inches.**

$$AR = W / H$$

$$AR = 108 / 81$$

$$AR = 1.3333333...$$

# Aspect Ratio Practice Problems Answer Key

5. 122.4 inches (3,109 mm)

a.  $AR = W / H$   
 $18.36 / 9 = D / 60$   
 $9D = 101.6$   
 $D = 122.4$

**Rounded to the nearest tenth of an inch, the screen height is 122.4 inches.**

6. 63 inches (1,594 mm)

a.  $W / 1829 = 16 / 18.36$   
 $W / 1829 = 0.871459...$   
 $(W / 1829) * 1829 = (0.871459...) * 1829$   
 $W = 1593.89978...$

**Rounded to the nearest millimeter, the screen diagonal is 1594 mm.**

# Viewing Parameters

- Perception Limitations
- Viewing requirements of the Task
- Text Size (or detail) to be displayed
- Viewing Distances
- Image (and hence screen) Height
- Aspect Ratio of Image

# Introduction to Display Image Size

- Display Image Size Considerations:
  - Application of client
  - Size of the display
  - How close to sit to a display
  - How far to sit from a display
  - How large should the information on the display be



# The Old Way of Doing Things 4/6/8

**Critical Viewing:** 4 x image height

**Presentation:** 6 x image height

**Standard Video:** 8 x image height



**Analytical Decision Making:** 4 x image height

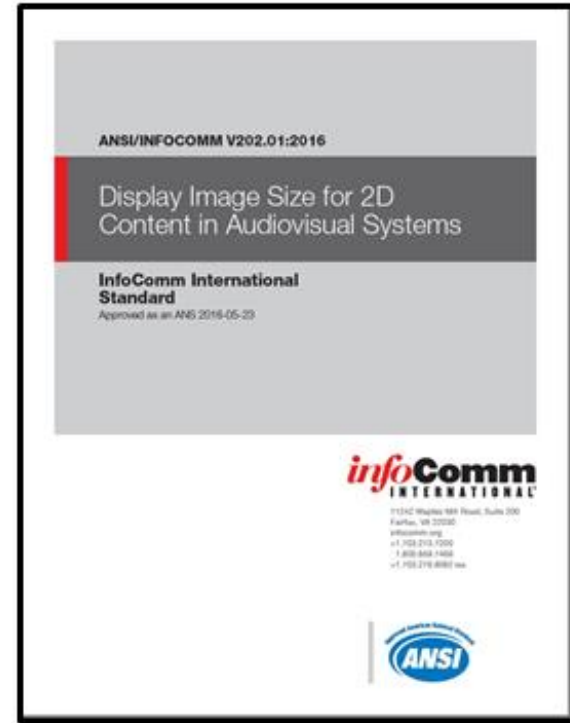
**Basic Decision Making:** 6 x image height

**Passive Viewing:** 8 x image height

- Does not account for different aspect ratios
- Does not account for different resolutions
- Only a Best Practice
- Origins are unclear

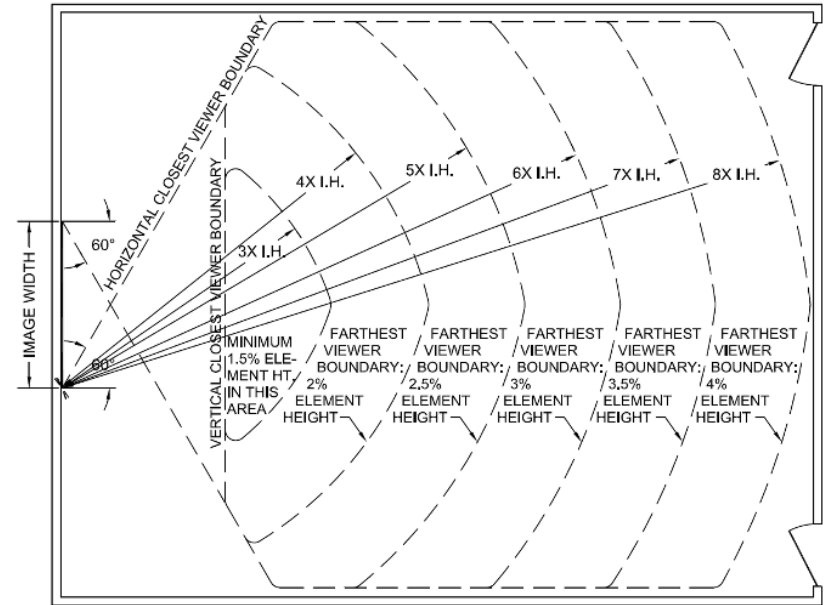
# The New Standard: Display Image Size for 2D Content in Audiovisual Systems

- V202.01:2016 Display Image Size for 2D Content in Audiovisual Systems
- The goal of DISCAS is to create a scientific standard, based on human vision, to define the screen size for a given audiovisual system based on audience viewing distance
- [www.infocomm.org/standards](http://www.infocomm.org/standards)



# What DISCAS Addresses

- Comprehensive Human Factors for visual acuity and position relative to the image
- Including:
  - Image Height
  - Image Resolution
  - Size of Image Content
  - Closest and Farthest Viewer Distances
  - Relative Horizontal and Vertical Viewing Locations

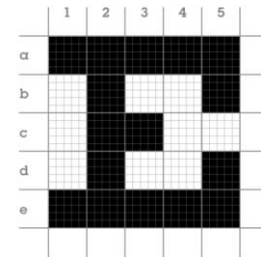
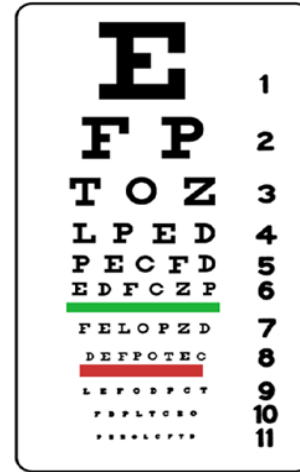


## VIEWING PARAMETERS FOR BDM

NO SCALE I.H. = IMAGE HEIGHT  
IMAGE HEIGHT BASED ON 16:9 (1.78:1) ASPECT RATIO

# What is Visual Acuity?

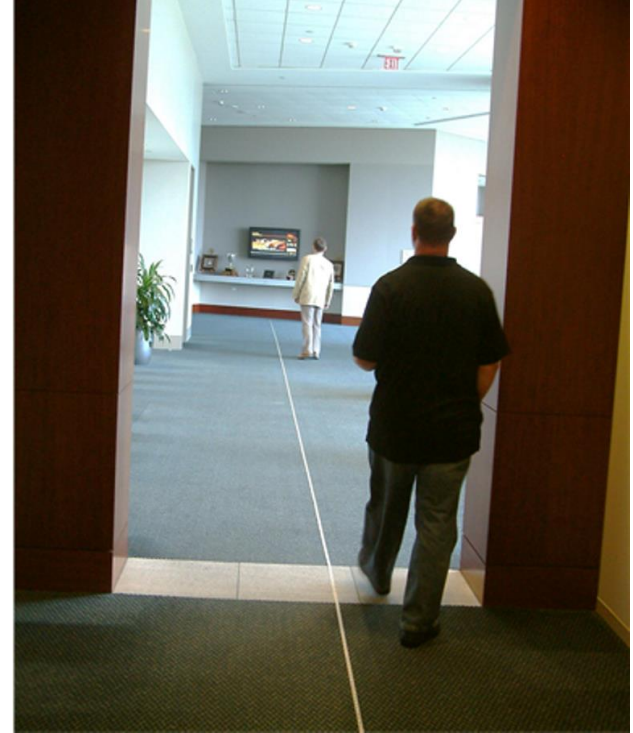
- Ability to see clearly
- 5 minutes of arc for optotype
- 1 minute of arc for line





# Defining Closest and Farthest Viewer

- Closest Viewer: Minimum distance to a display
- Farthest Viewer: Maximum distance from a display



# What is an Element?

- Element:
  - A group of pixels conveying an item of information
- What constitutes an element depends upon the user's purpose
- Not just text



# What is Percent Element Height?

- Percent Element Height
  - Percentage of display that the element takes up
- With text: lowercase letter

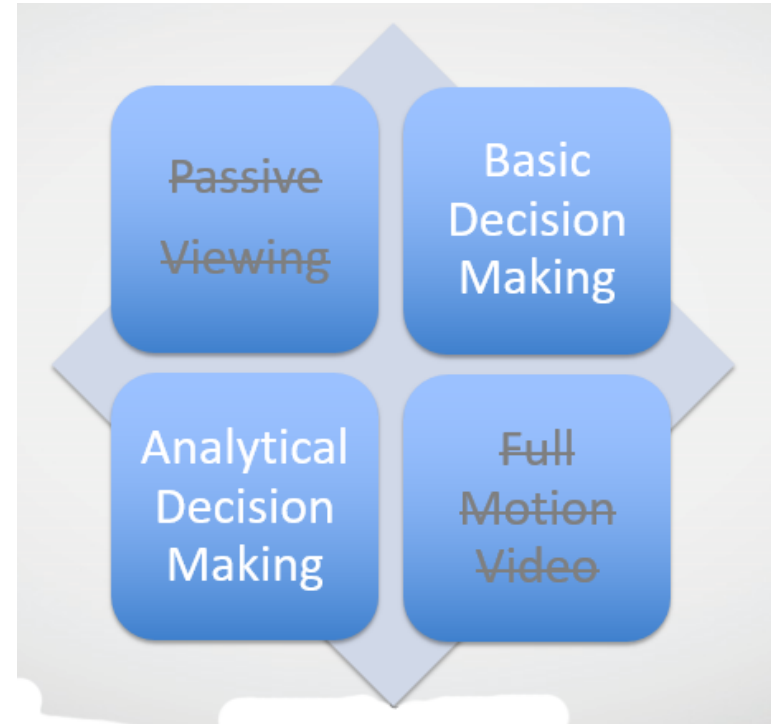


An element is a letter or symbol  
(based on lowercase letter  
or smallest symbol)

$$EH/IH=\%Element\ Height$$

# Defining Viewing Categories

DISCAS only deals with Analytical Decision Making (ADM) and Basic Decision Making (BDM) although there are four viewing categories in PISCR



# What is Analytical Decision Making?

- ADM is more specialized of the two
- Concerned with the finest of details
- Pixel-level detail required
- Used for things like medical imagery, technical drawings, and photographic evaluation



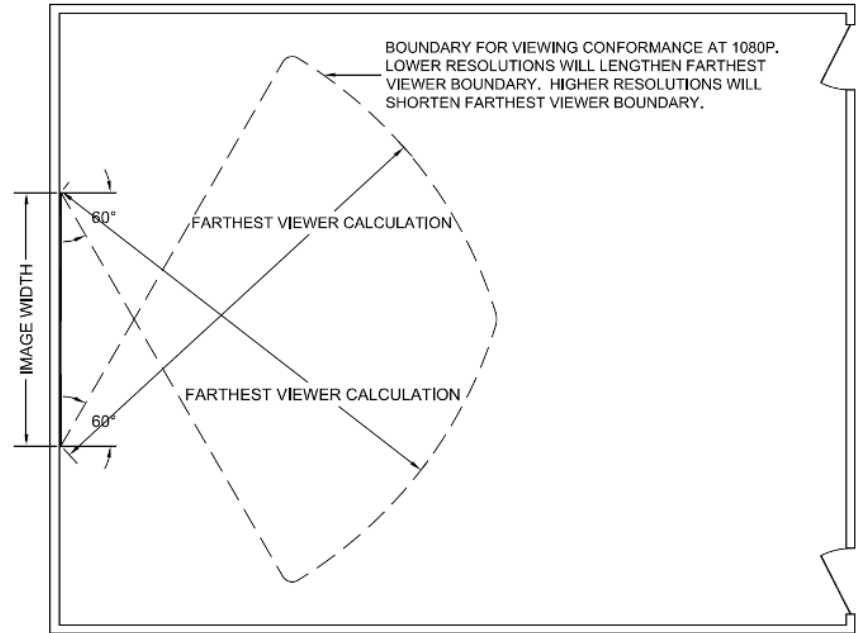
# What is Basic Decision Making?

- BDM is the most common type of viewing category
- Concerned with overall content rather than detail
- Used for PowerPoint, word processing, and spreadsheets



# Analytical Decision Making

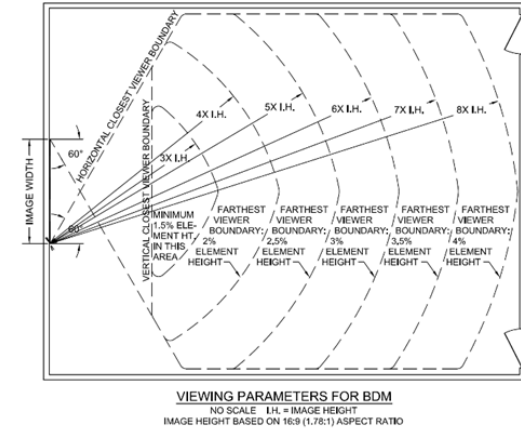
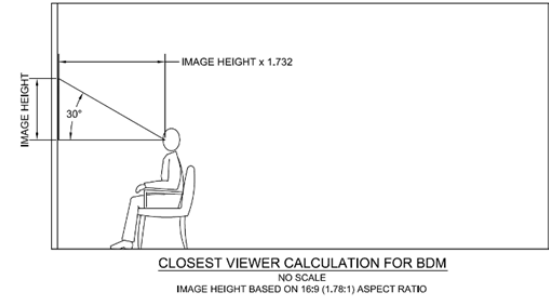
- Closest Viewer:
  - Not defined for ADM (the closer the better!)
- Required Drawings:
  - Plan View
  - No Elevation View Required



VIEWING PARAMETERS FOR ADM  
NO SCALE  
IMAGE HEIGHT BASED ON 16:9 (1.78:1) ASPECT RATIO

# Basic Decision Making

- **Closest Viewer:**
  - Is a Closest Viewer formula
  - No more than 30 degrees from eye level to top of image
- **Required Drawings:**
  - Plan View
  - Elevation View





# When to use both ADM and BDM

- In spaces used for ADM and BDM:
  - Farthest Viewer defined by ADM
  - Closest Viewer and Percent Element Height determined by BDM
  - Image Size and viewing distances determined by ADM



# ADM and BDM Practice

Q: What Viewing Category applies to a space used for technical drawings?

- ADM
- BDM
- Both ADM and BDM

Q: What Viewing Category applies to a space used for PowerPoint presentations?

- ADM
- BDM
- Both ADM and BDM

Q: What Viewing Category applies to a space used for word processing and technical drawings?

- ADM
- BDM
- Both ADM and BDM

# Are the Calculations Unit Specific?

- Will the formulas for Basic and Analytical Decision Making still work? Absolutely!
- The formulas are not unit specific and they will work as long as you are consistent with your units.

# Calculating for Analytical Decision Making

- Calculating for ADM Image Height

- $IH = \frac{IR \times FV}{3438}$

- Where:

- IH is the image height
  - IR is the vertical image resolution
  - FV is the farthest viewer distance
  - 3438 is the Acuity Factor for ADM

# Practical Example of ADM

- 75 inch (1905 mm) 16:9 LCD display
- Image Height= 36.8 inches (934 mm)

# Practical Example of ADM

- FV for UltraHD (2160p) =  $(36.8 \times 3438)/2160$  or  $(934 \times 3438)/2160$
- FV for UltraHD (2160p) = 58.6 inches (1487 mm) or 4.9 feet
- FV for 1080p =  $(36.8 \times 3438)/1080$  or  $(934 \times 3438)/1080$
- FV for 1080p = 117.1 inches (2973 mm) or 9.8 feet

# Calculating for Basic Decision Making

- Calculating BDM Image Height

- $$IH = \frac{FV}{200 \times \%EH}$$

- Where:

- IH is the minimum Image Height for the space
- FV is the farthest distance a viewer will be from the image
- %EH is the Element Height, which is the height of the element being viewed expressed as a percentage of overall Image Height
- 200 is the Acuity Factor for Basic Decision Making

# Practical Percent Element Height

- Typically use something from 2% Element Height to 4% Element Height
- Depends upon client's needs
- **A 3% Element Height is a good starting point**

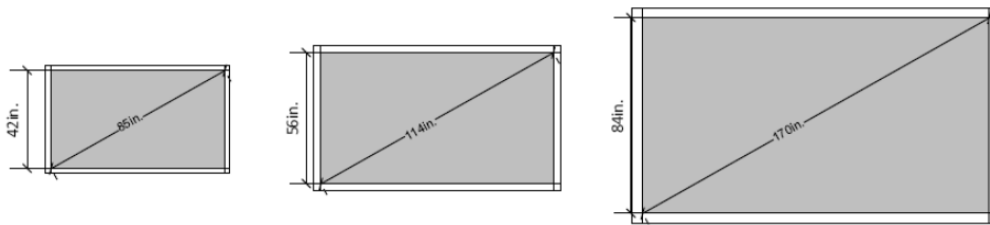


# Percent Element Height Example

- Image Height for a conference room with a Farthest Viewer position at 28 feet (336 inches; 8534 mm)
- This conference room will not depend upon pixel-level detail, so we will use the Basic Decision Making (BDM)
- Determine the Image Height for
  - 2%Element Height
  - 3%Element Height
  - 4%Element Height

# Practical Percent Element Height Discussion

- Three different image sizes:
- 42 inches high (1054 mm) for a 4% Element Height
- 56 inches high (1406 mm) for a 3% Element Height
- 84 inches high (2109 mm) for a 2% Element Height
- Which display would you choose and why?



# Font Size, Percent Element Height, and PowerPoint



# 1 Percent Element Height

12-1% There are many types, sizes, and complexity levels of audiovisual systems. The user should apply this standard as appropriate to fit the particular project circumstances. Two common approaches are described here, although there are many possible variations in contractual agreements and relationships between the design and construction team. For example: Consultant-led projects when the monetary value of the audiovisual systems is high, the building design and construction timeframe is long, or the installation work must be competitively bid. Independent consultants are persons or firms having neither financial interest in the products specified nor obligations or partnerships with equipment integrators, contractors, manufacturers, and their representatives. Design-build projects (also known as turnkey projects) when the construction timeframe is accelerated, the installation systems are proprietary, and/or the project does not require competitive bidding. Professional AV integrator firms are in the business of selling, engineering, installing and providing ongoing service and support for a wide variety of audiovisual and related technologies, systems, and equipment. Equipment manufacturers may also provide turnkey systems design, installation, and service. In addition, owners may choose to have audiovisual systems designed and/or built by their in-house staff. InfoComm International® is the leading non-profit association serving the professional AV communications industry worldwide. Founded in 1939, the association has 5,000 members, including manufacturers, systems integrators, dealers and distributors, independent consultants, programmers, rental and staging companies, end users, and multimedia professionals from more than 80 countries. InfoComm offers industry expertise and market research serving press and others seeking information about the industry. Through activities that include tradeshow, education, certification, government relations, outreach, and information services, InfoComm promotes the industry and enhances members' ability to conduct business successfully and competently. InfoComm International is the ANSI Accredited Standards Developer (ASD) dedicated to the dissemination of the knowledge of audiovisual systems performance parameters. About ANSI The American National Standards Institute, Inc. (ANSI) is the national coordinator of voluntary standards development and the clearinghouse in the United States for information on national and international standards. An American National Standard implies a consensus of those substantially concerned with its scope and provisions. Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered and that a concerted effort be made toward their resolution. The use of an American National Standard is completely voluntary. Its existence does not in any respect preclude anyone, whether he or she has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. The purpose of this standard is to provide a description of the methods, procedures, tasks, and deliverables typically recommended or applied by professionals in audiovisual (AV) systems design and integration projects. The intention of the structure outlined in this Standard is to enable clients and other design and construction team members to assess confidently whether the responsible parties are providing the expected services. Modern AV systems have become increasingly complex and interconnected to other building systems such as network, electrical, HVAC and building automation/energy conservation. In many instances, AV systems provide critical operational functions for the owner, warranting a thoughtful and well-organized approach to commonly accepted planning, design, and integration procedures. In addition, the AV systems design and integration process may span and parallel a lengthy design and construction cycle, including input and review by many key personnel from divergent disciplines, trades, and backgrounds. This standard provides a practical guideline for defining the audiovisual system requirements and a clear accountability structure for the development and execution of the system design components. It provides a consistent reference for the project team from the initial design phase through construction, project completion, and building occupancy. This document is a Standard Practice Guide outlining design considerations and accepted procedures for accomplishing the task of integrating audiovisual systems into the design and construction of facilities in the built environment. This guide outlines a comprehensive set of procedures for the design and construction of professional audiovisual systems, and does not suggest a specific course of action. Qualified, experienced professionals are required to interpret,

## 2 Percent Element Height

24-2% There are many types, sizes, and complexity levels of audiovisual systems. The user should apply this standard as appropriate to fit the particular project circumstances. Two common approaches are described here, although there are many possible variations in contractual agreements and relationships between the design and construction team. For example: Consultant-led projects when the monetary value of the audiovisual systems is high, the building design and construction timeframe is long, or the installation work must be competitively bid. Independent consultants are persons or firms having neither financial interest in the products specified nor obligations or partnerships with equipment integrators, contractors, manufacturers, and their representatives. Design-build projects (also known as turnkey projects) when the construction timeframe is accelerated, the installation systems are proprietary, and/or the project does not require competitive bidding. Professional AV integrator firms are in the business of selling, engineering, installing and providing ongoing service and support for a wide variety of audiovisual and related technologies, systems, and equipment. Equipment manufacturers may also provide

# 3 Percent Element Height

36-3% There are many types, sizes, and complexity levels of audiovisual systems. The user should apply this standard as appropriate to fit the particular project circumstances. Two common approaches are described here, although there are many possible variations in contractual agreements and relationships between the design and construction team. For example: Consultant-led projects when the monetary value of the audiovisual systems is high, the building design and construction timeframe is long, or the installation work must

## 4 Percent Element Height

48-4% There are many types, sizes, and complexity levels of audiovisual systems. The user should apply this standard as appropriate to fit the particular project circumstances. Two common approaches are described here, although there are many possible variations in contractual agreements and

# Practical Example of BDM

- 75 inch (1905 mm) 16:9 LCD display
- Image Height= 36.8 inches (934 mm)



# Practical Example of BDM

- For 2%EH:  $36.8 \times .02 \times 200$  or  $934 \times .02 \times 200$
- FV for 2%EH = 147.2 inches (3736 mm) or 12.3 feet
- FV for 3 %EH =  $36.8 \times .03 \times 200$  or  $934 \times .03 \times 200$
- FV for 3 %EH = 220.8 inches (5604 mm) or 18.4 feet
- FV for 4 %EH:  $36.8 \times .04 \times 200$  or  $934 \times .04 \times 200$
- FV for 4 %EH = 294.4 inches (7472 mm) or 24.5 feet

# Calculating Closest Viewer for Basic Decision Making

- Calculating the Vertical Viewing Factor

- $VF = IH + IO$

- Calculating the Closest Viewer

- $CV = VF \times 1.732$

- Where:

- VF is the vertical viewing factor
  - IH is the image height
  - IO is the image offset

- Where:

- CV is the closest viewer distance
  - VF is the vertical viewing factor.

# Calculating Closest Viewer for Basic Decision Making

- Horizontal Closest Viewer Distance
  - $CV = 6 \times VF - IW$
- Where:
  - CV is the closest viewer distance
  - VF is the vertical viewing factor
  - IW is the image width
- This calculation determines how wide the closest viewer area extends.
- The result of this calculation may be wider than the room. In this case, the room width determines the overall length of the closest viewer boundary.

# Practical Example of BDM Closest Viewer

- 75 inch (1905 mm) 16:9 LCD display
- Image Height = 36.8 inches (934 mm)
- Image Width = 65.4 inches (1660 mm)
- Bottom of display = 48 inches (1220 mm) for room of seated viewers

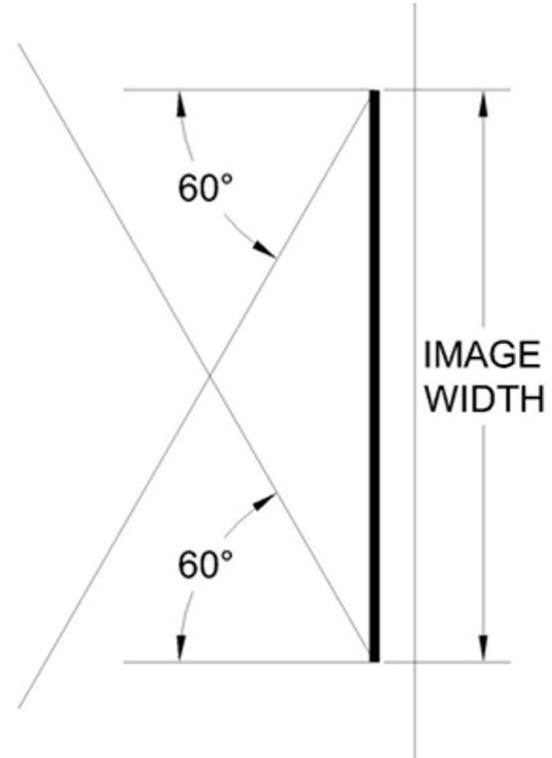
# Practical Example of BDM Closest Viewer

- Vertical Viewing Factor = 36.8 inches (934 mm) + 0
- $CV = 36.8 \times 1.732$  or  $934 \times 1.732$ 
  - $CV = 63.7$  inches (1618 mm)
- Horizontal Closest Viewer:
  - $CV = 6 \times 36.8 - 65.4$  or  $6 \times 934 - 1660$ 
    - Horizontal CV = 155.4 inches (3944 mm)

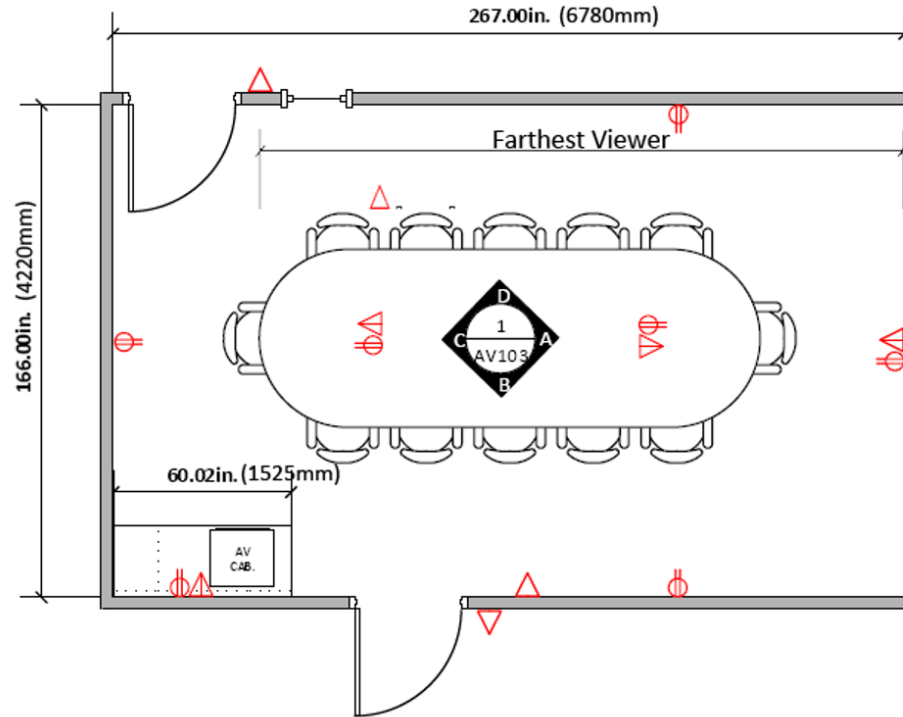
# Good Viewing Angles

## Good Viewing Angle:

- No more than 60 degrees from perpendicular edge of opposite side of screen
- No viewing position exceed 60 degrees at any part of the displayed image



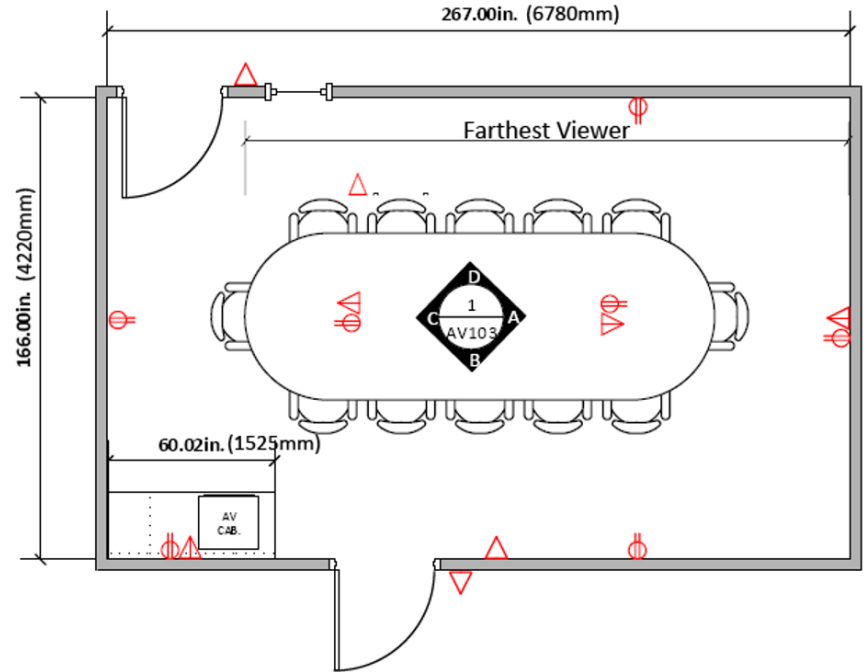
# Display Image Size Example



The Farthest Viewer position, set at the farthest chair, is 215 inches (5460 mm).

# Display Image Size ADM Example

- Let's imagine this room will be used for viewing technical diagrams
  - Analytical Decision Making
- Client wants a 1080p display
- Farthest Viewer is 215 inches (5460 mm) away from the display
- Determine the Image Height required for the room



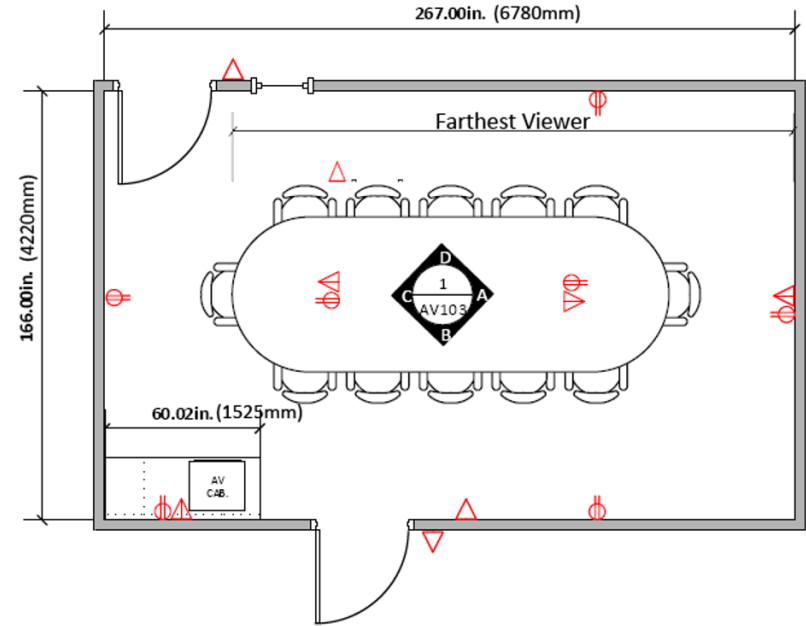


# Display Image Size ADM Example Answer

- This means our display must be at least 67.54 inches tall (1715 mm) for proper ADM viewing. For 16:9, this would make for a 138 inch diagonal!
- Note: If we were to want a 4K screen in the same space, our display would need to be at least 135.08 inches (3430 mm) tall, which, for 16:9, would make for a 275 inch diagonal and would not even fit in the room!

# Display Image Size BDM Example

- Room used to display spreadsheets, PowerPoint presentations, and word processing documents
  - Basic Decision Making
- Seated viewers with a standard 48 inch (1220 mm) eye level; Display mounted 48 inches from the floor
- Farthest Viewer is 215 inches (5460 mm)
- Project documentation stipulates a minimum 3% Element Height
- Determine Image Height and Closest Viewer



# Display Image Size BDM Example Answer

- This means our display must be at least 35.83 inches (910 mm) tall for proper BDM viewing. For 16:9, this would make for a 73 inch diagonal. And the Closest Viewer would be 62 inches (1576 mm).
- Note: A 2%EH would result in a display that is 53.75 inches tall (1365 mm) or a 110 inch diagonal for 16:9. The Closest Viewer would then be 93.2 inches (2364 mm).

# Conforming to DISCAS

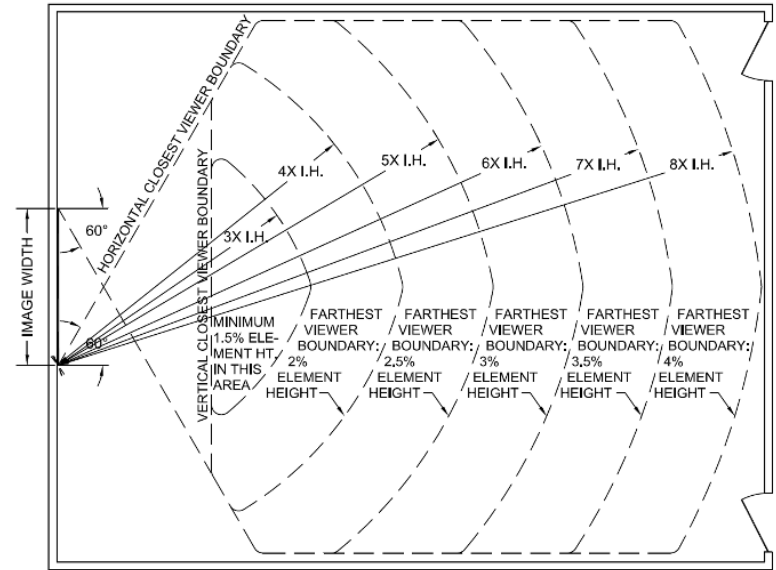
The Verification Sheet shall include, as appropriate:

- Displayed image width
- Displayed image height
- Displayed image resolution
- %Element Height
- Room layout and dimensions, including ceiling height and any space features affecting sightlines
- Closest viewer distance
- Farthest viewer distance
- Distance between the bottom of the image and the finished floor
- Eye height of viewers
- Room description
- Any available or relevant data concerning system application or content to be displayed

# Conforming to DISCAS

Measurements shown on the drawings shall include:

- Plan view for BDM
  - Display image width
  - Room layout and dimensions
  - Horizontal viewing angles as lines drawn from either edge of the image at a 60-degree angle toward the opposite side of the image.
  - Line showing Closest Viewer, parallel to the screen
  - Arc showing Farthest Viewer Distance



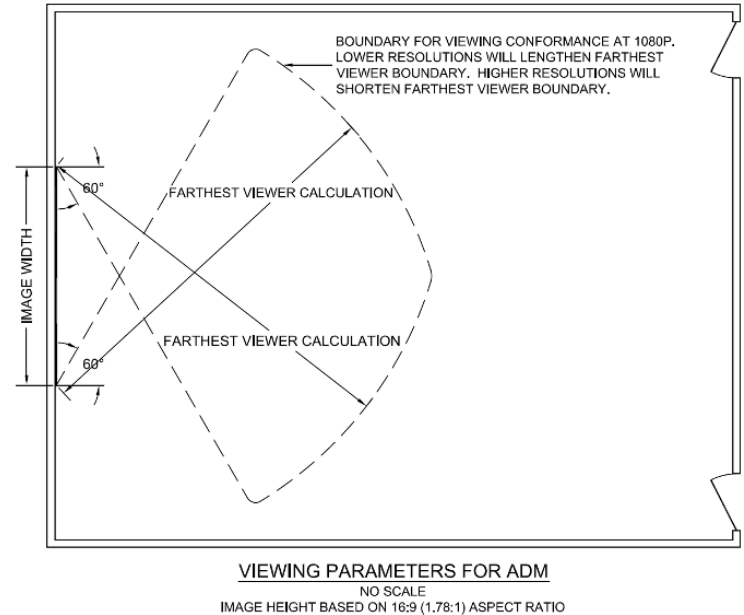
## VIEWING PARAMETERS FOR BDM

NO SCALE I.H. = IMAGE HEIGHT  
IMAGE HEIGHT BASED ON 16:9 (1.78:1) ASPECT RATIO

# Conforming to DISCAS

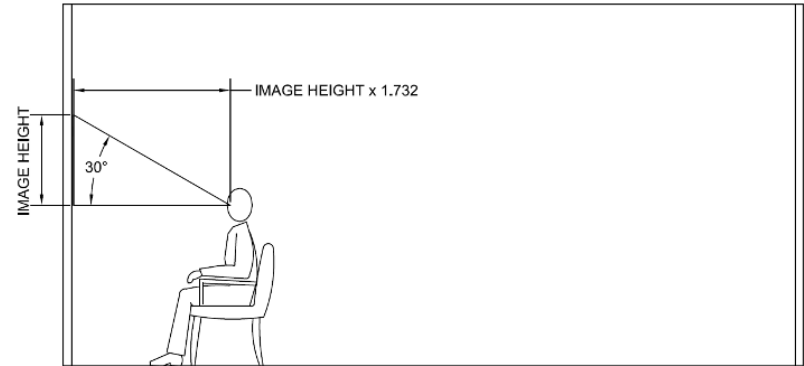
## Plan view for ADM

- Display image width
- Room layout and dimensions
- Horizontal viewing angles as lines drawn from either edge of the image at a 60-degree angle toward the opposite side of the image.
- Arc showing Farthest Viewer Distance



# Conforming to DISCAS

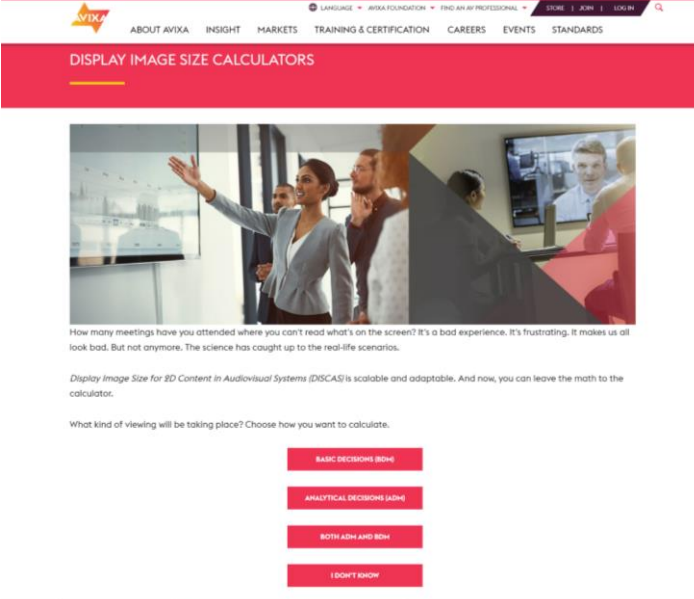
- Elevation view for BDM
  - Elevation dimensions, including ceiling height, room length, and any features that affect viewing positions
  - Display image height
  - Distance between the bottom of the image and the finished floor
  - Line drawn at 30 degrees from top of image
  - Seated and/or standing eye height of viewers
- Elevation view for ADM
  - No elevation drawing is required for ADM as vertical viewing distances are not considered.



CLOSEST VIEWER CALCULATION FOR BDM  
NO SCALE  
IMAGE HEIGHT BASED ON 16:9 (1.78:1) ASPECT RATIO

# Using the ADM/BDM Web App

- Request a link in the AVIXA standard tools page
- It will take you to : <https://www.avixa.org/standards/discas-calculators/discas>




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## DISPLAY IMAGE SIZE CALCULATORS



How many meetings have you attended where you can't read what's on the screen? It's a bad experience. It's frustrating. It makes us all look bad. But not anymore. The science has caught up to the real-life scenarios.

*Display Image Size for 3D Content in Audiovisual Systems (DISCAS)* is scalable and adaptable. And now, you can leave the math to the calculator.

What kind of viewing will be taking place? Choose how you want to calculate.

BASIC DECISIONS (BDH)

ANALYTICAL DECISIONS (ADH)

BOTH ADH AND BDH

I DON'T KNOW



# Display Image Size Summary

You now know how to calculate for display image size.

You are familiar with the two types of viewing category, ADM and BDM, and you can use the Web App or formulas to correctly calculate for Image Height, Farthest Viewer, and Closest Viewer.



# Questions?



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