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SELECTING THE APPROPRIATE HD RESOLUTION SCREEN SIZE IN A CONTROL ROOM

The primary purpose of a display wall in any control room is to provide Situational Awareness and a useful large Common Operating picture for multiple operators to simultaneously see relevant information (data, graphics and video) and collaborate in critical decision-making processes.

Display systems in control rooms are more demanding than display systems used in boardrooms, auditoriums, signage and short-term viewing applications, because operators need to sit in front of the screens for longer hours monitoring critical information and handling incidents. The capability to interact efficiently with the display wall defines operational efficiency and alertness.

If the display wall screen size is not properly selected, the resulting strain on operator eyes can negatively affect operational efficiency and investment in the control room display system could be wasted.

Screen size, resolution of the individual screens, the resulting optimal visual acuity, sill height (distance from floor to bottom of screens) and available ceiling height are critically important considerations in the control room design.

Optimal Visual Acuity is the maximum distance at which a person with normal vision can resolve the given pixel size. In a control room this is the recommended distance from the screen to the first (1st) row of operators. Beyond this optimal distance, resolution is wasted. Closer than this optimal distance, information space is wasted and the display may be fatiguing to the operators.

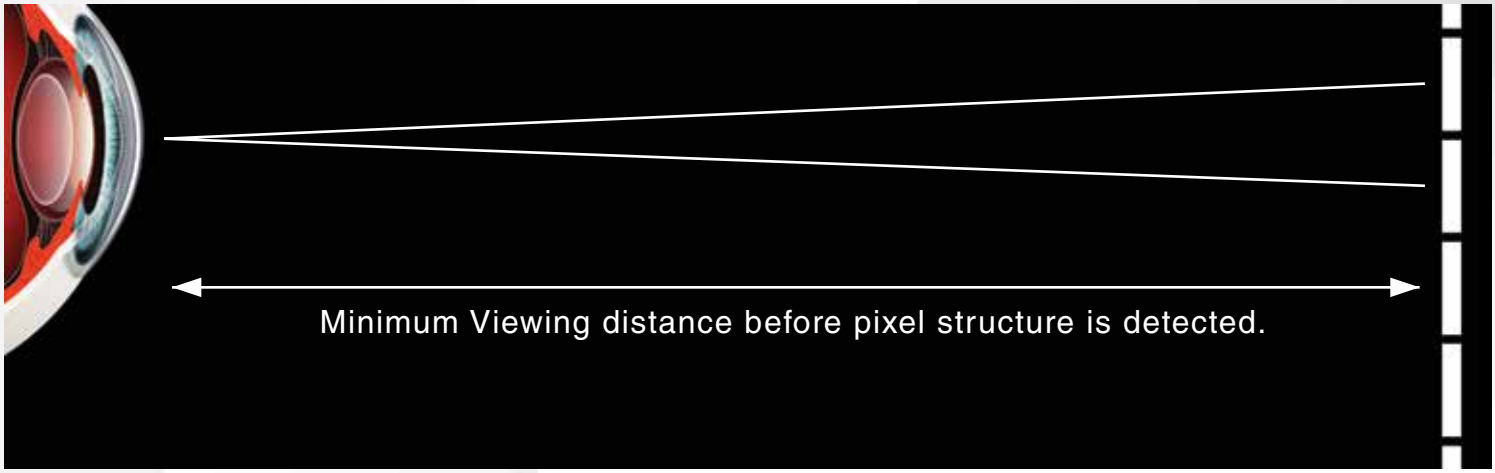
Other important considerations include:

- ***Space between the first row of operators and screen.*** Depth of the operators' desks (consoles) and the available space in between the console and screen should be considered to permit free movement in the control room (especially important during an incident to avoid accidents). These are clearly defined in accessibility laws and fire code regulations.

- ***Available ceiling height and sill height*** (distance from floor to bottom of screens) to ensure that when seated or standing at the console, the operators have clear visibility of the entire image area.

Optimal Visual Acuity:

An industry standard for human visual acuity is defined to be “1 minute arc” which is equivalent to 1/60 degree.



To avoid eye strain, it is recommended that the closest operators to the display wall should not be able to see the pixel structure of the displays. Optimum Viewing Distance is the distance before pixel structure is detected.

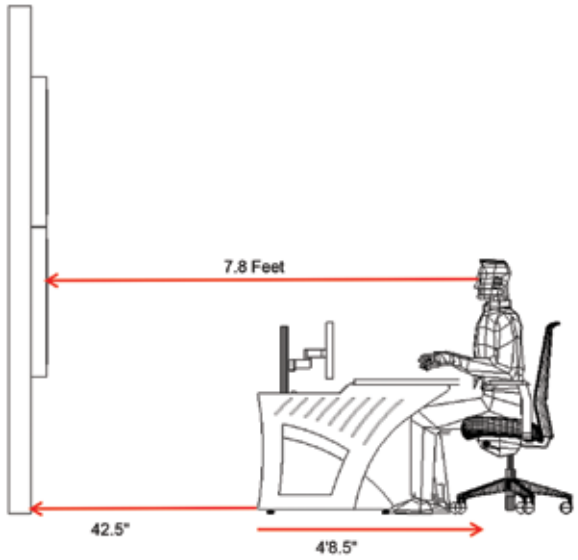
Viewing Distance = (1/2) / tan (1/120)

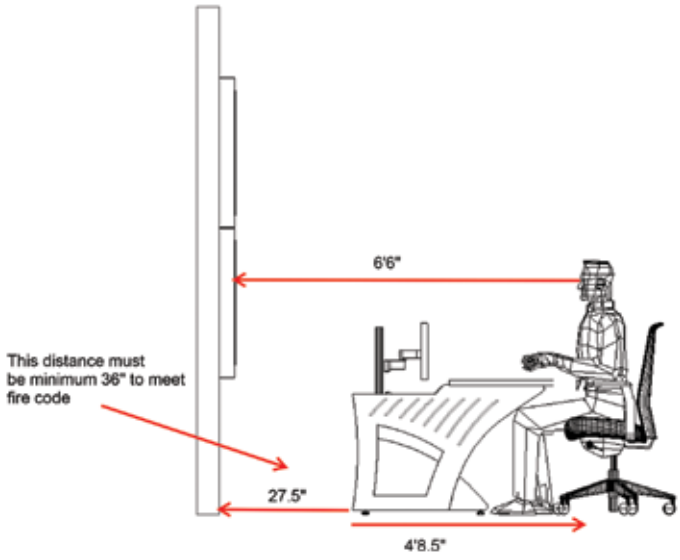
3438 / (number of vertical pixels) x Screen Height is the distance at which pixel definition is no longer seen.

Based on this, we obtain the following values for the three (3) currently available sizes of HD (1920 x 1080) resolution display wall cubes [LCD panels are available in other sizes and resolutions too and we can extrapolate these details to them when required]. And for comparison purposes, let us consider a 2 Wide x 2 High array of HD (1920 x 1080) resolution cubes in all three available screen sizes for DLP cubes:

Screen Size	HD Resolution		Individual Screen Size (diagonal)		Pixel Size (mm)	Image Size (2x2 array)			Calculation for Optimal Visual Acuity	Optimal Viewing Distance	
	H	V	Width	Height		Width	Height	Area		Inches	Feet
50"	1920	1080	43.6"	24.5"	0.58	7.3	4.1	29.7	3438/1080 x 24.5	77.98"	6.5"
60"	1920	1080	52.3"	29.4"	0.69	8.7	4.9	42.7	3438/1080 x 29.4	93.59"	7.8"
70"	1920	1080	61.0"	34.3"	0.81	10.2	5.7	58.2	3438/1080 x 34.3	109.2"	9.1"

The drawings below depict optimal visual acuity for 60” & 50” cubes in a 2 high array and ***space between screen and console:***





As shown in the drawing, if the optimal visual acuity is 6.5 feet (50” HD resolution cubes), the space between a standard console and screen is only about 27.5” and this may violate accessibility laws and fire code regulations. It is possible that as people may move in front of the screen (especially during an incident), there is a potential risk of damage to the screen or hurting the person. With optimal visual acuity of 7.8 feet (60” HD resolution cubes), the space between the standard console and screen is 42.5” and is sufficient to allow unhindered and safe movement in front of the screen.

Sill height & ceiling height are also important considerations. It is important that the bottom of screen be at a suitable height so that the operators have a clear view of the entire screen area. Often operators need to look over the monitor on their desk to the display wall for situational awareness and collaborative decision-making. If the bottom of the screen is too low, important information may be lost and screen resolution is wasted.

It is important that the cubes are easily mounted on an appropriate base support structure to raise the image to a suitable height and yet fit below the available ceiling height without affecting ventilation and vertical viewing angles.

As such, in control rooms with low ceilings the 70” HD resolution cube may not be appropriate.

A global evaluation of control room display wall cube requirements indicated that:

- ***the 60”HD resolution cube would be appropriate for small-to-medium control room applications, and***
- ***the 70”HD resolution cube would be appropriate for medium-to-large control room applications.***

It was determined that 50” HD resolution cubes would not be suitable for control room applications, but would be acceptable for some applications where operators did not need to view information for extended hours – example: public displays & signage.

It may also be worth noting that smaller displays would have more screen gap area than larger screens. The largest screen size that can meet the application’s minimum viewing distance would be preferred from a screen-to-screen gap point of view, cost (less units to fill the same size array) and power consumption point of view.

Currently, Mitsubishi Electric offers the following HD resolution DLP cubes for control room applications:

Model	Access	Suitablility	Key Features
60" diagonal screen size [52.6 inches x 29.5 inches image area per display]			
VS-60WE120U	Rear	Small to Medium Control Rooms where space is available behind display wall for maintenance	100,000 hours light source
VS-60HE78U	Rear		80,000 hours light source & flexibility
VS-60HE120U	Rear		80,000 hours light source & lower cost option
VS-60WEF120U	Front	Small to Medium Control Rooms where space in the control room is at a premium	100,000 hours light source
VS-60HEF78U	Front		80,000 hours light source & flexibility
VS-60HEF120U	Front		80,000 hours light source & lower cost option
VS-60HS12U	Front	Space and Budget restricted control room applications	60,000 hours light source, low cost, small footprint (only 20.5" / 1.7" depth), low power consumption, low heat dissipation
70" diagonal screen size [61.1 inches x 34.3 inches image area per display]			
VS-70WE120U	Rear	Small to Medium Control Rooms where space is available behind display wall for maintenance	100,000 hours light source
VS-70HE78U	Rear		80,000 hours light source & flexibility
VS-70HE120U	Rear		80,000 hours light source & lower cost option
VS-70WEF120U	Front	Small to Medium Control Rooms where space in the control room is at a premium	100,000 hours light source
VS-70HEF78U	Front		80,000 hours light source & flexibility
VS-70HEF120U	Front		80,000 hours light source & lower cost option

Mitsubishi Electric also offers a choice of other cube resolution & sizes

- WUXGA (1920 X 1200): 62" & 72" with both front and rear access options
- XGA+ (1400 x 1050): 50", 60", 67" with both front and rear access options and 80” with only rear access
- XGA (1024 x 768): 50", 60", 67" with both front and rear access options

Pixel Pitch = Viewing Distance x tan (1 arc minute / 60 arc minutes per degree)
= Viewing Distance x tan (0.0167°)
= Viewing Distance x 0.000291
Viewing Distance = Pixel Pitch / 0.000291

Display Technology	Diagonal (inches)	Resolution	Dot Pitch (mm)	Minimum Viewing Distance	
				Meters	Feet
Rear Projection Cubes	50	XGA	0.99	3.41	11.19
		SXGA+	0.73	2.49	8.18
	60	XGA	1.19	4.09	13.42
		SXGA+	0.87	2.99	9.82
	67	XGA	1.33	4.57	14.99
		SXGA+	0.97	3.34	10.96
	80	SXGA+	1.16	3.99	13.09
	60	FHD	0.69	2.38	7.80
	62	WUXGA	0.70	2.39	7.84
	70	FHD	0.81	2.77	9.10
	72	WUXGA	0.81	2.78	9.11
LCD Panel	55	FHD	0.63	2.18	7.15
	84	4K2K	0.48	1.66	5.46
Direct LED	n/a	n/a	2.5	8.59	28.19
	n/a	n/a	2.0	6.87	22.55
	n/a	n/a	1.5	5.15	16.91
	n/a	n/a	1.2	4.12	13.53
	n/a	n/a	1.0	3.44	11.27

REPORT INFORMATION:

This report has been created by Mitsubishi Electric US Visial & Imaging Systems Division (www.me-vis.com) and Mitsubishi Electric Sales Canada (www.mitsubishielectric.ca)

Mitsubishi Electric is the global leader for command and control display wall products, with a wide variety of rear-projection DLP display wall cubes and LCD display wall panels.

This report has been created agnostically to compare different sizes of HD resolution DLP cubes and for certain specifications, and it is based on Mitsubishi Electric products.

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