Courtroom Technology: Infrastructure for Audiovisual Systems in New Spaces

Version 1.2

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a. Forward

The Office of Facilities and Security, Space and Facilities Division (SFD) recognize CTA Architects Dickson Stewart, CTS-D Design Engineer for leading the development effort of the document. Thank you to the Assistant Circuit Executives for Space, the Facilities Program Managers, and Matt Wright, Courtroom Technology Specialist, Department of Technology Services, Technology Solutions Office for their input and feedback to the document.

The document provides reference points and best practice guidance in understanding the complexities of developing audiovisual supportive infrastructure requirements United States courthouse space.

1. Introduction

This portion of the Courtroom Technology document set describes the essential facilities and provisions needed in the Courthouse for a successful installation of the requisite AudioVisual systems.

For the purposes of this portion of the document set, it is necessary that we segregate what is to be provided by the AudioVisual contractor vs. GSA or a general contractor. In this manner, the reader will better understand what type of information is provided to each trade.

The current nature of AV technology suggests that the passive cable and cable termination plant associated with the AudioVisual equipment should be installed directly by the AudioVisual contractor or a direct subcontractor to them.

Primarily, this is due to the varied equipment types that dictate the needed cable types. The cable types and quantities needed vary with each system design. Because of its relatively old age, the AudioVisual Industry does not have a Structured Cable system that the IT Industry adopted early in its history.

Therefore, for this section, we will not consider the "infrastructure" to include passive cabling or cabling terminations since the "equipment" contractor will provide them.

Infrastructure provided by *other* trades such as carpenters, electricians, furniture makers and heating and cooling technicians would be our primary focus in that section.

This document also focuses on new construction whether that is an all-new courthouse, a building addition or a new courtroom within an existing courthouse.

Future sections will address the unique complications found in retrofitting older facilities with new technology.

2. AudioVisual Infrastructure Components

There are very few aspects of a space – a Courtroom in this case – that are not affected by the AudioVisual systems' needs. The following is a generalized brief list:

- Location of building site related to Radio Frequency Interference and external noise
- Understanding spatial impact of technology in courtroom planning
- Sightlines
- Sight distances
- Structural column spacing
- Types of Structural Floors
- Slab thickness
- Split-slab locations where recessed floor systems are used
- Finished floors and covering types
- Wall construction types
- Recessed or hidden technology locations
- Wall finishes
- Wall color or patterns
- Placement of glass or other reflective surfaces
- Ceiling construction type
- Above ceiling access
- Ceiling finishes
- Sightlines
- Technology friendly casework
- Modularity of casework
- Cooling load requirements
- 24/7 Cooling requirements
- Location of diffusers in the Courtroom
- Venturi Effect noise of air diffusers
- Fan noise
- Low frequency rumble

- Quality of Power utility
- Quantity, size, location and distance to IT and AudioVisual technology equipment support rooms
- Availability of technology storage locations
- Power load
- Power locations
- Power conditioning
- Light fixtures type and placement
- Lighting fixture zones
- Lighting levels
- Color Temperature of lamps
- Lighting Control systems
- Low Voltage raceway
- IT Structured Cable systems
- Electrical Grounding
- Acoustic performance within the Courtroom
- Acoustic performance between the Courtroom and surrounding spaces, including vertically
- Technology friendly furniture

3. Infrastructure Scalability

The AudioVisual industry is rapidly evolving. Indeed, media and information technology in general will continue to evolve well past the lifetime of a courtroom or building design to last 50 years or more.

It is therefore safe to assume that AudioVisual technology will change many times within the lifetime of a single facility. This means that infrastructure in that building or building addition will be reused each time an upgrade is performed. This may mean a dozen or more upgrades over the course of a 50-year building lifespan- all of which will rely on the quality and flexibility of the infrastructure provided it.

Ideally, new technology introduced into the building would require no infrastructure modifications. This will reduce costs and minimize the disruption of daily work after people occupy the building.

One could argue that designing the infrastructure tailored around the requirements of the technology initially installed is foolhardy and bound to be outdated in a few short years.

4. Identifying Design Disciplines

Starting very early in the process and all through the course of developing the courtroom design, the AudioVisual Designer or Engineer will work with the various building and courtroom designers to coordinate the infrastructure needs.

When one first considers AudioVisual infrastructure requirements, it is the various electrical provisions that first come to mind however, this is certainly not the only infrastructure that is needed to deploy a properly designed and integrated AudioVisual system.

In simple terms, nearly all of the needs listed above ultimately become the design responsibility of one of four separate design specialists, or “disciplines”. These are:

- The Design **A**rchitect
- The **M**echanical Design Engineer
- The **E**lectrical Design Engineer
- The Interior Designer

These professionals produce a product often generically referred to as the “AME” set. The Interior Designer is commonly a part of the Architect’s scope of work.

There are indeed many more specialists needed for today's complex buildings. On any large project, it is not unusual to find specialized consultants for space relationships, LEED/energy-use, acoustics, lighting, elevators, security, IT cabling, roofing, kitchens, specialty woods, landscape, etc. In most cases, these consultants work under one of the major design disciplines if not all directly for the Project Architect.

Since the AudioVisual Designer must provide very different sets of information to each discipline, we will segregate discussions targeted for each discipline.

4.1 For the Design Architect

From the above list, the following AudioVisual infrastructure needs will be adapted to the project space by the Design Architect or a consultant working for the Design Architect.

- Understanding spatial impact of technology in courtroom planning
- Quantity, size, location and distance to IT and AudioVisual technology equipment support rooms
- Availability of technology storage locations
- Sightlines
- Sight distances
- Structural column spacing
- Types of Structural Floors
- Slab thickness
- Split-slab locations where recessed floor systems are used
- Finished floors and covering types
- Wall construction types
- Recessed or hidden technology locations
- Wall finishes
- Wall color or patterns
- Placement of glass or other reflective surfaces

4.2 For the Mechanical Engineer

The Mechanical Design Engineer in general is responsible for heating and cooling systems, plumbing, waste systems, life safety fire sprinklers, From the above list, the following AudioVisual infrastructure needs will be adapted to the project space by the Mechanical Design Engineer or a consultant working for the Mechanical Design Engineer:

- Cooling load requirements
- 24/7 Cooling requirements
- Location of diffusers in the Courtroom
- Venturi Effect noise of air diffusers
- Fan noise
- Low frequency rumble including that from water movement

4.3 For the Electrical Engineer

The Electrical Design Engineer in general is responsible for electrical power, cable raceways and conduits, alarm systems, and lighting systems. In some cases, the Electrical Design Engineer will also provide the design of the Structured Cable Distribution System. The Electrical Design Engineer will be involved to varying degrees with any technology that will be in the building that uses any type of power or inter-room cable connectivity.

From the above list, the following AudioVisual infrastructure needs will be adapted to the project space by the Electrical Design Engineer or a consultant working for the Mechanical Design Engineer:

- Split-slab locations where recessed floor systems are used
- Recessed or hidden technology locations
- Wall finishes
- Above ceiling access
- Technology friendly casework

- 24/7 Cooling requirements
- Quality of Power utility
- Quantity, size, location and distance to IT and AudioVisual technology equipment support rooms
- Power load
- Power locations
- Power conditioning
- Light fixtures type and placement
- Lighting fixture zones
- Lighting levels
- Color Temperature of lamps
- Lighting Control systems
- Low Voltage raceway
- IT Structured Cable systems
- Electrical Grounding

4.4 For the Interior Designer

The Interior Designer focuses on interior materials, carpeting, finishes, colors and furniture selection to assemble a balanced aesthetic palette for the project. They typically work hand-in-hand with the Project Architect. They are often employees of the Architectural firm itself.

Even though, we have separated this design service from the others due to the unique arrangement the United States Courts has regarding furniture acquisition. The "AME" design scope may include carpet and wall finishes but does not automatically include furniture or furniture design.

This is due to the arrangement most Courts have with the GSA; Tenant Construction Improvement does not include furniture only "casework". Simplified, casework is built-in furniture. This would include items like kitchen cabinets and built-in counters at the Clerk's office intake area. Items such as chairs, file cabinets, table lights, computers and photocopiers, anything that is movable, is considered furniture.

In fact, there is an abbreviation used for this type item- FF&E. FF&E is short for "Furniture, Fixtures and Equipment".

An easy way to remember what might be considered FF&E that otherwise would be a building item, think of what the Court may take with them if they were to move to a new facility. All the government owned items that are moved is considered FF&E.

The possible separate design of furniture from the main Design Team becomes particularly important where custom furniture design needs to be provided. There is no better example of that need than in a courtroom.

Casework and Furniture usually breaks down in a courtroom as follows:

- Casework
  - Judge's Bench
  - Witness stand
  - Law Clerk/Deputy cabinets and countertops
  - Jury box
- Furniture
  - Evidence presentation lectern
  - Oral presentation lectern
  - Attorney tables
  - Evidence table
  - Flat panel TV stands

Normally, for the furniture selection process in offices or chambers spaces, the Interior Designer would choose products from manufacturers that offer dozens of colors and formats of pre-designed products to suit the need or perhaps the judge's preference.

However as noted, this method does not normally work for courtrooms. In the new courtroom, the Architect may want the furniture to match the look of the casework. The casework is the built-in items.

The available "Catalog" or Off-the-Shelf products are not appropriate for the courtroom style and finishes. If the architect is not providing any services related to FF&E, the FF&E selection and design work may

become the direct responsibility of Court Administration.

Court Administration regularly deals with carpeting and furniture upgrades, but not always in new construction. Therefore, it is important to understand early in the process who will be providing the Interior Design services for the FF&E. Custom furniture for courtrooms should be added to the Project Architect's scope of work if possible.

Carpeting, drapes and blinds also play a role in affecting Audiovisual systems, both the sound and video sub-systems. Again, these are not always the responsibility of Court Administration for new construction, but the Court must carefully consider what the Designer is proposing and how it will affect sound and video.

5. AudioVisual Driven Architectural Items

While acoustic, lighting, power, cable access and other details are being coordinated, the single most important issues facing the Architect and Design Consultant is that of working the visible equipment into the walls, millwork and casework in the occupied spaces.

Some Design Professionals may argue that exposed technology should be judged by its own aesthetic merits so little if any effort should be made to "hide" it.

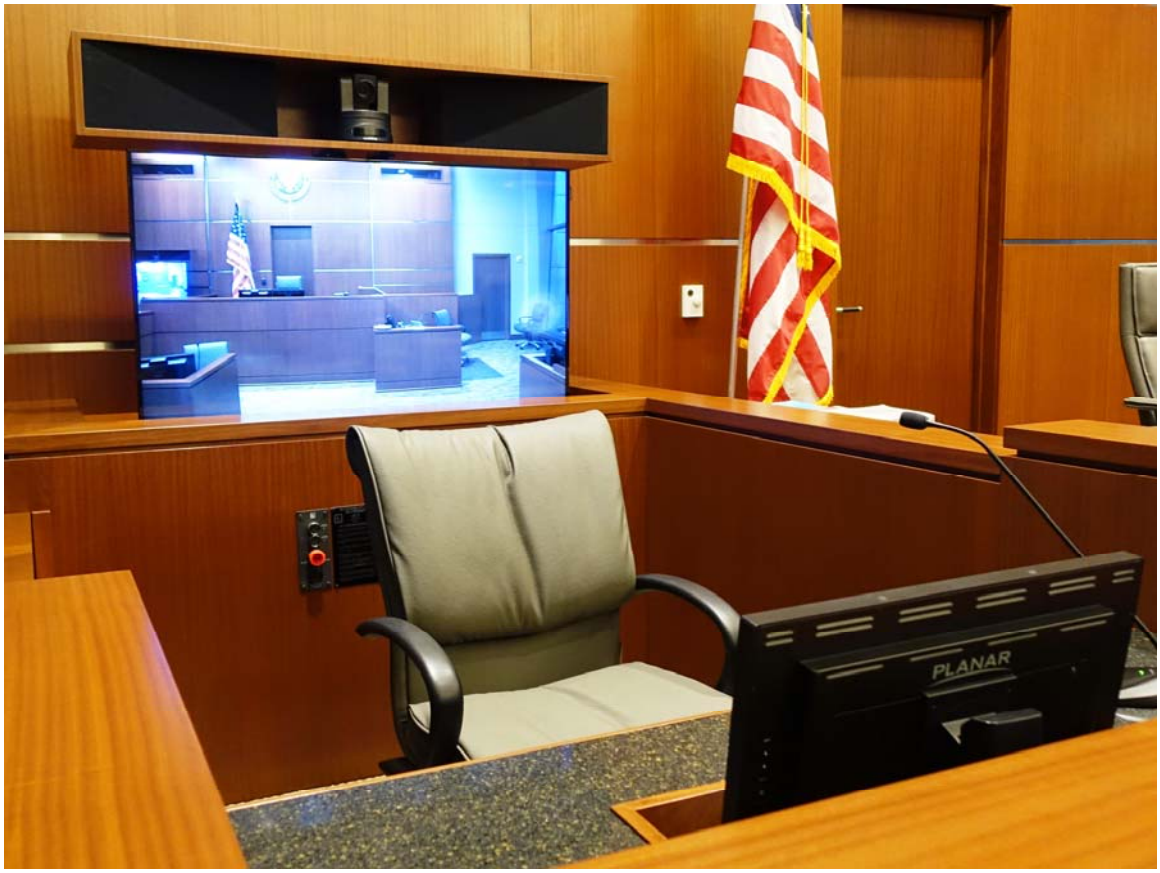
On the other hand, exposed technology can introduce functional disabilities into the working space. Take for example the ~24" monitor at the judge or counsel table as an example; without (at least) partially recessing the monitor into the bench or table, the monitor will become a sightline hazard.

Partially recessed Display improves sightlines over its top

Another example is the large flat panel display that is wheeled in for use. When displays are not mounted on or in walls, the advantage of having a 2" deep display is lost when the cart it is mounted on is 3 feet deep-furthering the clutter and sightline problem. The cart must also be placed on the lowest floor in the courtroom that may not offer the best angle for viewing.

This section will assume that the design decision has been made to integrate the equipment into the courtroom environment to a reasonable degree.

However, successful implementation of the technology initially installed will have provided optimized ergonomics while taking into account equipment growth and revisions and the architectural aesthetic. Only the Audiovisual Designer can help with that.



Casework Design that Integrates a Pop-up Display and camera for use with Witnesses Appearing Remotely

5.1 Spaces

5.1.1 Equipment Rooms

Other than the Courtroom itself, there needs to be an equipment room where the actual audio and video processing equipment is housed. This equipment is not directly handled by the end users and provides the same function to AudioVisual that Server Rooms provide to IT.

Most courtrooms operating at the turn of the 21st century still had relatively small systems – in some cases only audio – and these were in short equipment cabinets placed commonly under the Deputy's or Judge's bench.

The equipment needs have grown and have moved past the days when they were able to fit within the courtroom or in separate small spaces usually referred to as "equipment closets". While it is true that equipment has been getting smaller, this is more common in portable consumer electronics than in professional audio and video equipment.

As additional technology and features are added to courtrooms, so is the amount of equipment found in these rooms.

The advent of fast digital processors and smaller circuit boards also increase the heat load per square foot and make the functionality of maintenance access space more critical. In the end, the proper configuration for the AudioVisual Equipment Room is a small version of an IT server room. It must have these qualities:

- 24/7 Cooling and humidity control
- For each courtroom, space for two floor standing equipment racks each measuring 22"W x 30"D x 74"H. These need full walk-around access,

so this adds 36” in front and 36” behind.

- Restricted key access. These cannot be installed in shared GSA space or electrical rooms.
- Proximity to the courtroom. Many times in newer construction, courtrooms are paired so they can share a single USMS elevator. The space between two courtrooms is ideal for the AudioVisual Equipment Room. Two courtrooms with three to four equipment racks total is an ideal configuration.

Typical Contemporary AudioVisual Equipment Room

5.2 Floors

5.2.1 Access floors

There is an ongoing conversation about the need for access (aka “raised” or “computer”) floors in courtrooms. Briefly, here are some of the tests that need to pass before access floor should even be considered:

- The courtroom well is large enough to accommodate rearrangement and adding council tables.
- Various judges use the courtrooms that prefer different table arrangements from one another.
- The presentation lectern needs to be able to operate from more than two positions in the courtroom.
- If in new construction, the slab elevation offset has been accounted for and the cost is acceptable.
- If in renovated construction, suitable ramps can be added at each door – whether inside or outside the courtroom perimeter. (A 5 inch high floor requires a 5 foot long ramp.)
- If the ramps can only be added outside of the courtroom perimeter, it is acceptable to raise the affected courtroom doors, which will require wall modifications.
- The Court accepts that carpet tile will be needed and the style/color available and the finished look (mild carpet seams) are acceptable. (It is nearly pointless to install an access floor with rolled carpet over it.)

When all of these factors are weighed, it becomes clear that an access floor system can only be successfully realized in all-new construction.

Access Floor being installed in an Equipment Room

5.2.2 Other Floor Types

In lieu of an access floor, the most common new floor systems today are concrete floors where floorbox penetrations have not been roughed-in prior to pouring the concrete or where pre-cast concrete sections have been used.

5.3 Walls

5.3.1 Block, Drywall or Plaster

The walls of a courtroom have special construction requirements for acoustic isolation reasons. Federal courtrooms have premium wall finishes inside; rarely is exposed painted drywall the overall finished look.

5.3.2 Wood

The walls in most new courtrooms will be primarily wood with some exposed drywall. It is important to work with AudioVisual Designer on the wood trim, access, niches and cavities that may be needed in order to properly mount and conceal radio antennas, Radio Frequency (RF) and Infrared (IR) emitters used for assisted listening, cameras, WAN points, etc. Care must be taken so these recesses do not penetrate either a fire barrier on an acoustic isolation barrier.

A Contemporary Courtroom with cameras and other technology integrated into a wood-sheathed wall

5.3.3 Stone

Stone or a tile material is popular for accents and wall segments. It is common to see stone of some type used behind the judge- both for visual appeal and to reflect sound from the bench area out into the well if the surface is smooth. Stone or other similar materials should not be employed where technology needs to be placed or access to it will be required. Smooth stone and glass are acoustically very reflective and must be used sparingly in courtrooms.

5.4 Ceilings

Ceiling designs in new Courtrooms vary greatly. Each type can present different challenges to the AudioVisual Designer. The AudioVisual Designer must work carefully with the Architect at most stages of the ceiling development. Important elements of the design will be:

- The change in ceiling heights including the introduction of coffers, drop soffits, etc. that

would affect the types of loudspeakers.

- The average height of the ceiling that will help define the number of loudspeakers and the energy they each need to produce.
- The amount and locations of sound absorptivity of the materials used. This will affect the type of loudspeakers and quantities.
- Acoustically reflective surfaces that can introduce undesirable sound anomalies.
- Accessibility to install or update wiring.
- Areas reserved for ceiling devices such video projectors, IR emitters, in-ceiling cameras and antennas. These areas must be free of lights, life safety detectors, etc. In some cases, structural support is needed so a clear area between the finished ceiling and the structural ceiling is required.

6. AudioVisual Driven Mechanical Items

6.1 Types

HVAC and plumbing influence the AudioVisual infrastructure planning in the following ways:

6.1.1 Heating and Cooling

Heating is rarely a problem in the non-occupied spaces where equipment is located. Cooling on the other hand is a serious issue that needs to be addressed by the Mechanical Design Engineer early in the process.

A contributor to the design challenge is that most GSA owned buildings have cooling systems that shut off or allow higher temperatures and humidity after business hours. As with Data equipment, much of the AudioVisual equipment remains on or in a standby mode after business hours. A small equipment room can quickly overheat. 24/7 air treatment is necessary to keep the ambient air directly in front of each rack in a 70-75 degree Fahrenheit range.

6.1.2 Cooling units

Installing a stand-alone cooling unit in an equipment room is an acceptable solution for maintaining 24/7 cooling requirements as long as the unit is implemented properly. The unit placement or the ducting from it must simulate the hot/cold aisle technique used in Data Centers as much as possible. Most importantly, air must continuously flow in a circular pattern starting with cold air being introduced near the rack bases.

It is critical that a unit that will have condensation not be placed over electronic equipment; a water leak or overflow of the catch-pan could be catastrophic to the equipment below.

6.1.3 Specialized Applications

The AudioVisual Designer will occasionally ask for specialized cooling or airflow applications. Cooling sealed camera cavities in a courtroom wall is one such example. It is not always possible to open the cavity to the courtroom (by eliminating the glass) and let the camera be cooled by room air. Some

cameras make a slight sound when they pan, tilt and zoom. This can be heard by the courtroom occupants more easily in courtrooms where the cavities are lower on the walls, so glass is used.

Another example of specialized cooling is needed when a large amount of equipment must be placed in a cabinet within the courtroom. It will be necessary cool that equipment directly so that the cabinet does not overheat.

6.1.4 Ducting and Diffusers

The Mechanical Design Engineer should note where the AudioVisual Designer has placed devices in the ceilings that need clear space above. This would include loudspeaker back boxes that can extend to 12" above the finished ceiling.

Flush mount in-ceiling document cameras also need clearance above, as do the heavier video projectors. The Mechanical Drawings should specifically indicate to the Mechanical Contractor where ductwork should not be placed.

The locations of drop down projection screens should also be noted by the Mechanical Design Engineer and air diffusers should not be oriented in their direction. The lightweight of the screen fabric can easily start flagging and distort the video image being projected onto it.

6.1.5 Noise

United States courtrooms require that their Noise Criteria (NC) not exceed about 30. Calculations and design of the HVAC system need to assist with the compliance of this requirement.

7. AudioVisual Driven Electrical Items

7.1 Spaces

Other than the Courtroom itself, other spaces will be impacted by the AudioVisual systems and must be taken into consideration during the building's planning.

7.1.1 Equipment Rooms

The specialized rooms for AudioVisual equipment will require a similar electrical infrastructure to that of a server room, although raised floor systems are not normally needed. More common is an overhead, constantly accessible open ladder tray. The ladder tray should provide access into the cable-pull corridor and then branch to each of the standing vertical racks using industry Best Practices. The AudioVisual Designer will define power requirements for each project, but it is safe to assume that a dedicated 20amp circuit for each rack will suffice. All technical power in the equipment rooms should be from the same phase of the power distribution panel. Power should not be hardwired from the rack for a number of reasons, primarily in order to avoid earth ground from touching the metallic rack enclosure. If access floor is not used, the power outlets should be mounted in a location that allows the rack power cable to be routed above or to the side of the racks in order to provide for a clear walking path.

Clear space behind equipment racks

7.1.2 Floor Terminations

7.1.2.1 Trench-Duct

A great many existing older courthouses used a "trench-duct" network that was placed in a grid-like fashion before the concrete was poured around it. This style of access was very popular in early open office concepts since they allowed multiple penetrations for access to it along the linear grid. A typical grid may be spaced twelve feet apart with multiple potential activation points along each trench. This way, the duct could be accessed in two to six foot increments along each trench line, but only in a single direction.

The flexibility of this approach freed the Electrical Design Engineer from having to know exactly where each cubicle would be located as long as a cubicle wall sat on top of it.

Additionally, this allows for relatively simple future reconfiguration of the open space. The cubicles and other equipment could be moved and resized as long as they sat on top of a trench line. If an existing activation point was not already present, then one could be made where they were pre-designed permitted along the trench line.

Exposed Trench-Duct prior to lid and carpet covers

This style was readily adopted for the courtrooms. The thinking was that if it worked for office cubicles, it should also work for attorney tables and lecterns. While this is ostensibly true, there are different types of "movable". In an open office space remodeling, selected areas may be out of service for a week or more. In a

courtroom, furniture may need to be moved a few times a week. The Court's calendar cannot tolerate a week to close a courtroom while the furniture is moved.

The solution to that issue was to provide a great many connection points that were already available and pre-connected to the AudioVisual systems. This would allow staff to move furniture with technology quickly. However, this proves both expensive and unsightly.

Typical Trench-Duct activation point

More significantly, the fine resolution of movement needed to place tables and lecterns exactly where the judge needs them cannot be achieved practically with a normal trench duct design. Many courtrooms were built with closely spaced access points- some a little as one foot- but this only helped in one direction since the trenches were still spaced about ten feet or so apart. Again, the result was unsightly.

Multiple Unattractive Access Points in a Trench-Duct Floor to Provide Fast Access

7.1.2.2 Access Floor

As noted in Part 5, access floors are practical only in all-new construction. The fundamental concept is to provide 100% cable connection location flexibility, in this case, in the courtroom well space.

However, the details of how the electrical infrastructure is designed will dictate the practical day-to-day usability of the space.

Primarily, the AudioVisual Designer will assess the frequency that furniture and other devices need to be relocated. These can be put into three categories:

- Multi-position: Multi-position is a term used here to indicate that a connected item may need to move several times a week, if not every day. The most common example of this is a small lectern that is often moved around the courtroom depending on the stage of a trial; the lectern may need to be in front of the jury for opening or closing arguments, but in the center

of the courtroom otherwise. This type of technology needs active AudioVisual connections at predefined locations. It is important that the connectivity be provided that allow courtroom staff (not support personnel) to disconnect, move and reconnect easily. Courtroom staff cannot be expected to lift out floor tiles. This move should take no more than 10 minutes.

- Removable: Removable would most often refer to a portable evidence presentation system, portable video conference system or large roll-in displays. This type of technology needs active AudioVisual connections at predefined locations. Typically, support staff would have approximately one hour to install or remove this equipment.
- Movable: Movable is a term used here to indicate that a connected item may need to move several times a year. This is most common when attorney tables are being added for multi-defendant trials or when a different judge uses the courtroom that prefers a different arrangement in the well. This type of movement should be planned so that support staff can make the adjustments in a half-day increment.

In all cases, the electrical design should never leave grommet holes or cable umbilicals exposed at the location the device was moved from, both for safety and aesthetic reasons.

In the case of movable devices, these abandoned locations should have no trace of a connection point- not even an exposed flush mounted floorbox.

Where access floor is paired with a staggered carpet tile alignment, (see more information on this under the Interior Design Surfaces section), the best way to accomplish this is to use a “mousehole” on the side of a floor tile, even when there is a stringer.

A "mousehole" at the edge of a floor tile. Also, note how the carpet tile overlaps the intersection of four floor tiles.

This is advantageous for the low voltage cable installer if for no other reason than to allow cable installation from above the floor to the access area without having to thread the cable through the hole in the tile.

An enclosed hole in the tile requires the cable to be threaded through it, making installation more time consuming. Also, note that the hole cut in the carpet prevents its' re-use at another location in the courtroom.

The primary advantage to this approach allows the floor tile to be moved to a new location and used with a relocated or different cable umbilical. The solid floor tile it replaces can be moved to the position where the tile with the mousehole came from.

Of course, the staggered carpet tiles on top of the floors tiles will only line up at its original position. They cannot be moved to a new position since each floor tile and carpet tile in the room will have a unique position relationship. This makes it difficult to move the carpet tiles along with the relocated floor tile.

This becomes increasingly difficult, as the carpet pattern repeat measurement gets larger.

The simple, often overlooked solution to this is to avoid cutting the mousehole in the carpet tile itself. Instead, only a slit should be made and no carpet should be cut away or discarded.

This will still not allow a slit carpet tile to be relocated, but it can be left over the abandoned position where the solid floor tile is now installed. The unused slit can be flattened and left at its original location.

At the new location of the cable umbilical and the relocated floor tile with the mousehole, either a previously slit carpet tile can be used, or a new slit made in an existing carpet tile where the new mouse hole appears.

In any case, the Court should own a few spare floor tiles with mouse holes cut in them as well as a few solid floor tiles. These will come in particularly helpful when extra attorney tables are needed in the courtroom well, or when furniture must be removed for an event such as a naturalization or swearing-in ceremony.

7.1.2.3 Poke-Through Devices

In modern construction at areas where access floor is not used, the concrete is rarely poured around roughed-in trench-duct, conduit or flush mounted floor boxes. This practice is common and leads to the popularity of the "poke-through" connectivity option.

A poke-through is a wiring device characterized by how it is installed into the slab. All true poke-through devices are inserted (hence the name) into round holes of varying dimensions Round holes are drilled post-pour and are much easier to add than true floor boxes that require rectangular saw cuts.

Poke-through devices are suited for limited connections for the typical types of furniture found in the office environment. A contemporary poke-through can be

fitted with several data connections and up to two power outlets.

The extending conduit or cables are connected to the tail of the poke-through above the finished ceiling of the floor below where the poke-through will be used.

The low voltage connection points must find their way back to the AudioVisual equipment location and in some cases to data and lighting dimmer rooms.

The drawback to the typical poke-through is that it has limited if any connections for AudioVisual needs. It also allows the tops of connectors exposed above the carpet level where they can be damaged by chair casters and vacuum cleaners. They also do not sit entirely flush in the floor presenting a minor tripping hazard if present in open walking pathways.

Typical round Poke-Through Device. Note that the trim is not flush to the floor and that connectors must stick up where they are susceptible to damage

Another type of Poke-Through Device referred to as a "doghouse" or "tombstone" type

7.1.2.4 *Flush-mount Floor Boxes*

True floor boxes are characterized by having to be saw cut into an existing poured or precast concrete slab- if they were not pre-set in the structural grid before the concrete pour.

Contemporary floor box versions are further characterized in that the power and low voltage connection points are below the finished floor line. A removable or hinged lid is on top to bring it flush to the finished floor material (i.e. carpeting).

Clearly, AudioVisual and Data connectors are better protected when under a lid that can withstand foot traffic, chairs, etc. The cables themselves only protrude from the floor box lid and are much more resistant to damage.

Additionally, true floor boxes can provide a great deal more surfaces for connectors. This is particularly important for AudioVisual cables since many of the industry standard connectors are larger than those used for data connectors.

Since there is no surface that is raised above the finished floor

level, floor boxes are preferred where they will be in walking pathways when they are not in use.

Floor box that is below the finished floor and suitable for AudioVisual use

7.1.3 Low Voltage Conduit and Raceway

For the purposes of defining the raceway used for AudioVisual systems, the EIA/TIA 569 code standard should be applied during the design process. In nearly all instances, the 569 standard exceeds that of the NEC.

The stricter requirements are dictated by the engineering standards path the AudioVisual industry is taking for new systems; many new digital video systems operate with shielded twisted 4-pair cables that have a limited run distance. Therefore, it is safe to assume that many video components (not so with all audio) have cable connectivity that is very similar to that of data backbones and equipment.

In fact, many of the audio and video standards currently supported are *not* run over twisted pair cable; AudioVisual cabling schemes are unique to each design and cannot operate on a generic backbone.

The AudioVisual Designer will be a key part of developing the correct electrical interconnectivity infrastructure. The AudioVisual Designer will understand the uniqueness of each technical position in the courthouse and be able to anticipate what types of cables will be needed.

The type of raceway needed at any given location will of course be determined by the building conditions, the accessibly and the amount of cable that needs to be transported. Most commonly, these are:

7.1.3.1 No Raceway

Most AudioVisual cables used in today's courthouses are rated to be installed in a plenum space without the protection of a sealed conduit. This solution is acceptable where there is limited wiring needed and full access to it is available.

A good example of this is for in-ceiling loudspeakers where the cable is accessible above the ceiling. J-hooks can be used for cable management to keep the cables off the ceiling surface.

The specifications must be clear that this cannot be a solution if local rules or codes exclude this practice. For example, some Districts adhere to local fire codes that can require conduit regardless of the cable's plenum rating. Some specialized AudioVisual equipment has proprietary cabling schemes and some of that needs to run inside conduit as well.

7.1.3.2 *Electrical Metallic Conduit Raceway (EMT) Raceway*

This is a solid metal tube that as a rule, AudioVisual Designers will prefer. This type of conduit must be bent with a tool.

A primary advantage to this is that this conduit must be measured and cut in the field; an electrician will be much more likely to pay attention to the overall end-to-end distance of the pathway as dictated by the EIA/TIA 569 standard.

Another advantage of EMT is that it offers the best rejection of radio frequency interference (RFI) that can wreak havoc on low-level audio signals. This allows the AudioVisual signals to pass near possible noise sources such as 244V florescent fixtures, light dimmers and transformers.

AudioVisual EMT near Equipment Room

7.1.3.3 *Flexible Metallic Conduit Raceway (FMC) Raceway*

Flexible Metallic Conduit (FMC): The use of this type of raceway, often referred to as “flex”, is not a popular choice with AudioVisual Designers. One reason is that it is too easy for the electrician to exceed the bending radius limits and the restricted lengths imposed by various standards and codes. The interior of the conduit is rough and makes cable pulls more difficult foot-for-foot. It is usually necessary to upsize the conduit dimension by at least one trade size when FMC is used. It should only be used when it is absolutely needed and only then in limited segment lengths.

AudioVisual FMC used where EMT would have been more appropriate

7.1.3.4 *Special Conditions in the Jury Box*

If the Design calls for displays in the jury box, the conduit and power there can be some of the most complicated in the project.

Partial conduit rough-in for a jury box

The methods will vary greatly based the following variables:

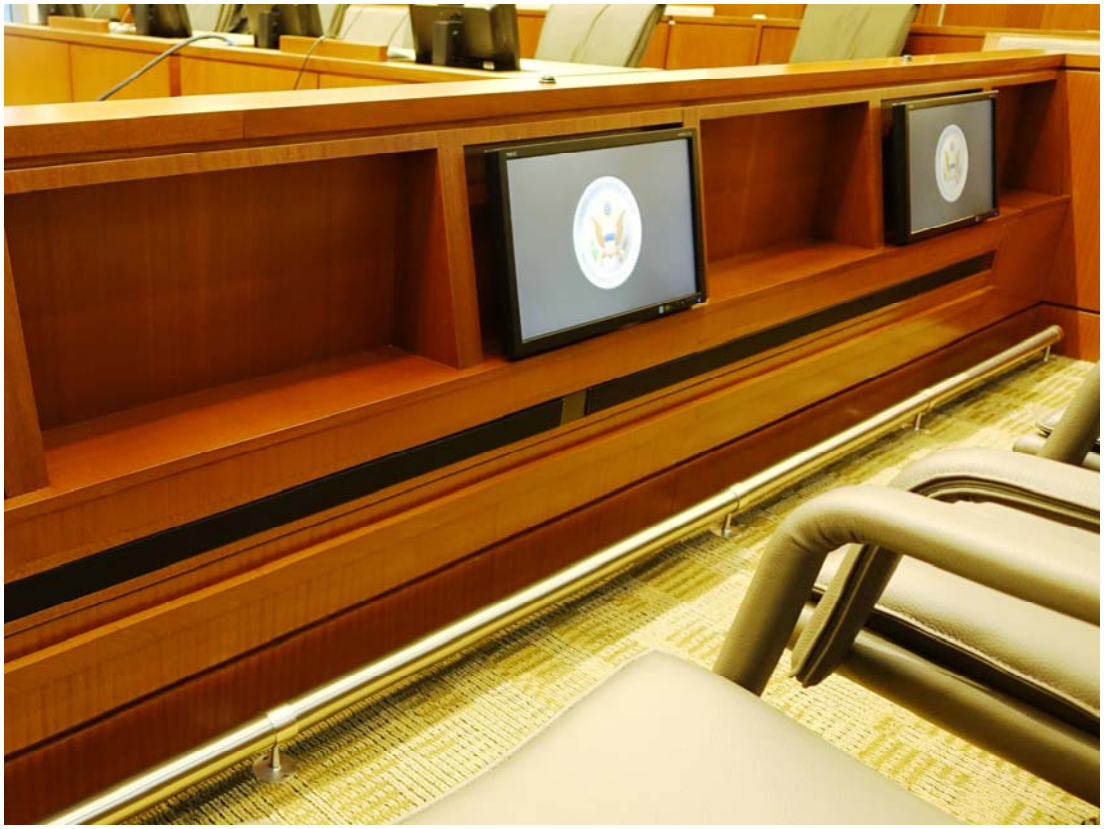
- The number of displays in the jury box: In a typical 16-seat jury box, 7 to 16 displays may be called for by the AudioVisual

Designer. There are often microphones, loudspeakers and real-time transcription jacks in the jury box.

- The platform on which the jurors sit: In some cases, the jury box is built on top of an access floor that greatly reduces the electrical work needed. Other designs will have one or both jury rows raised above the main floor in which case conduit may need to route into a wall behind or the floor below for access.
- The nature of the jury rail design: In some designs, the rail will be too thin or open which will dictate a different approach to the wiring.

Mount for jury box display where Jury rail mounting is not an option

- Nature of the jury chairs: These may be fixed with tilt and swivel capabilities or chairs only on casters. The size of the chair and its mounting can affect the nature of the electrical rough-in.
- The presence of a wall in front of the rear row of jurors: If the wall is not present, the method for mounting the rear row displays will be quite different than used for the front row displays.



A Contemporary Jury Box where the Casework is designed for the Displays. Note Built-in Speaker Strips below Displays

- An additional equipment placement location: AudioVisual designers often will need to place some distribution equipment under the riser or at a location near the end of the box. This will require metal junction boxes with cascading conduit or a shelf with conduits and power provided in it.

Special electrical requirements for the jury box

7.1.3.5 *Open Cable Trays and Ladders*

Cable trays and ladders are most often found above public corridor spaces. It is common to see low voltage Data, AudioVisual, Environmental Control, Life Safety, Security, CCTV and other control systems shared in a single tray. Trays should be wide enough to accommodate all of the cable needs so there are no more than 2 - 3 cables stacked on top of one another. A master cable color-code is also suggested so that technicians making future updates will be more motivated to remove abandoned cable rather than leaving it in place and adding new cable on top. This technique allows them to identify easily the cable that should be removed.

Ladders are seen most often in equipment rooms and used for both horizontal and vertical transitions. Again, it is important that point-to-point calculations be made to ensure that nothing exceeds the distance limits imposed by the standards and codes that apply.

AudioVisual cable can use this type of raceway very effectively, as long as it shares parallel runs with only other low-voltage signals.

7.1.3.6 *AudioVisual Equipment by Electrical Contractor*

The Electrical Contractor will on occasion need to provide and install AudioVisual equipment.

Equipment that the Electrical Contractor will need to provide and install will be determined by the AudioVisual Designer on a case-by-case basis.

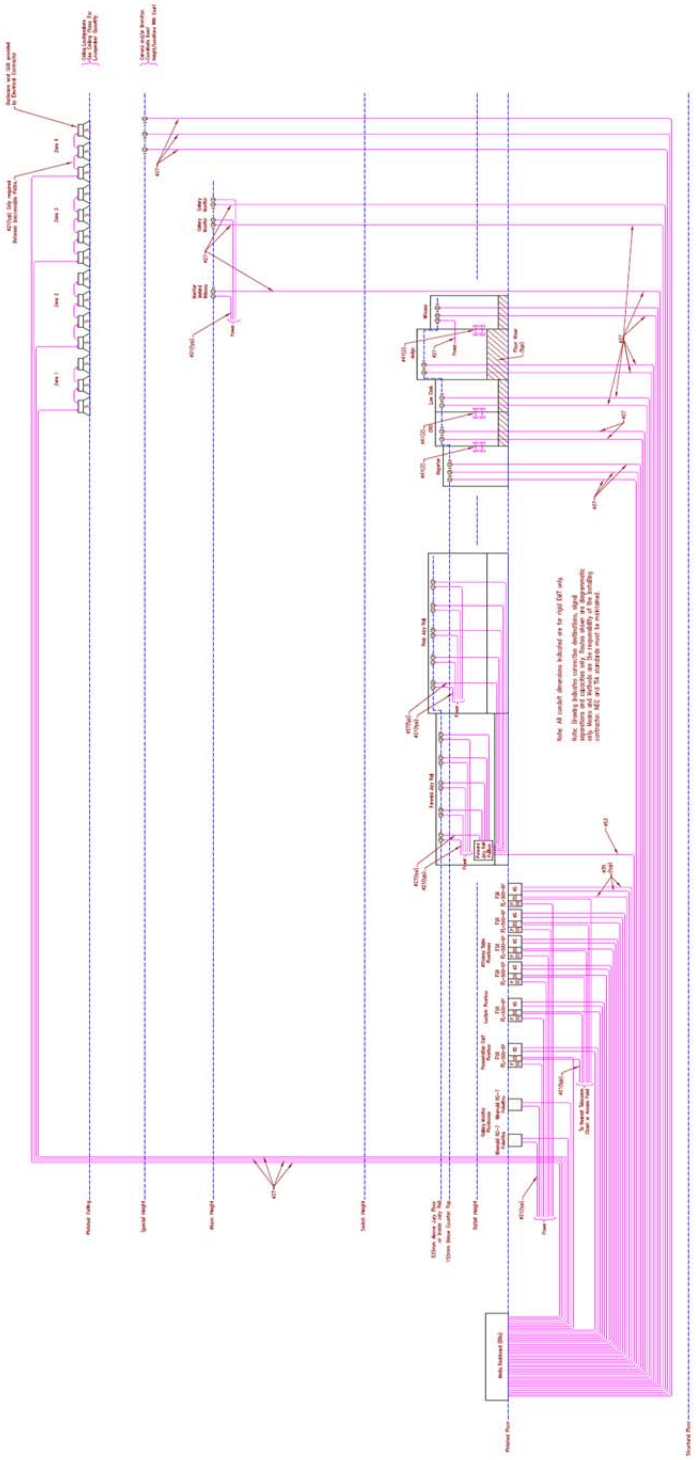
Typically, this type of equipment is the type that would be truly built-into the building or abandoned if the tenant were to move out. Built-in projection screens, special flat panel display back boxes and in-ceiling loudspeakers are good examples.

Having the Electrical Contractor install the in-ceiling loudspeakers in concert with other project trades is beneficial because the assemblies must be coordinated with HVAC ducts, lighting, plumbing etc. When the AudioVisual Integrator arrives on site, they can wire and tune the loudspeakers as needed.

Self-contained loudspeaker solution being installed in an "old work" ceiling. Pre-planned clearance above is critical

Self-contained loudspeakers as well as stand-alone backbox enclosures should ideally be provided and installed by the Electrical Contractor.

Clear space needed behind equipment racks for access



Typical Customized AudioVisual conduit/raceway within a new courtroom

See APPENDIX A for larger image of conduit raceway drawing.

8. AudioVisual Driven Interior Items

8.1 Surfaces

The finish surfaces the Interior Designer chooses will have an impact on both the sound and video in the Courtroom. The absorptivity of the carpet and drapes or shades will affect reverberation time, that is, the "liveness" or "deadness" in the space. Colors, patterns and textures of the selected interior finishes can be unfriendly the video camera.

8.1.1 Carpet

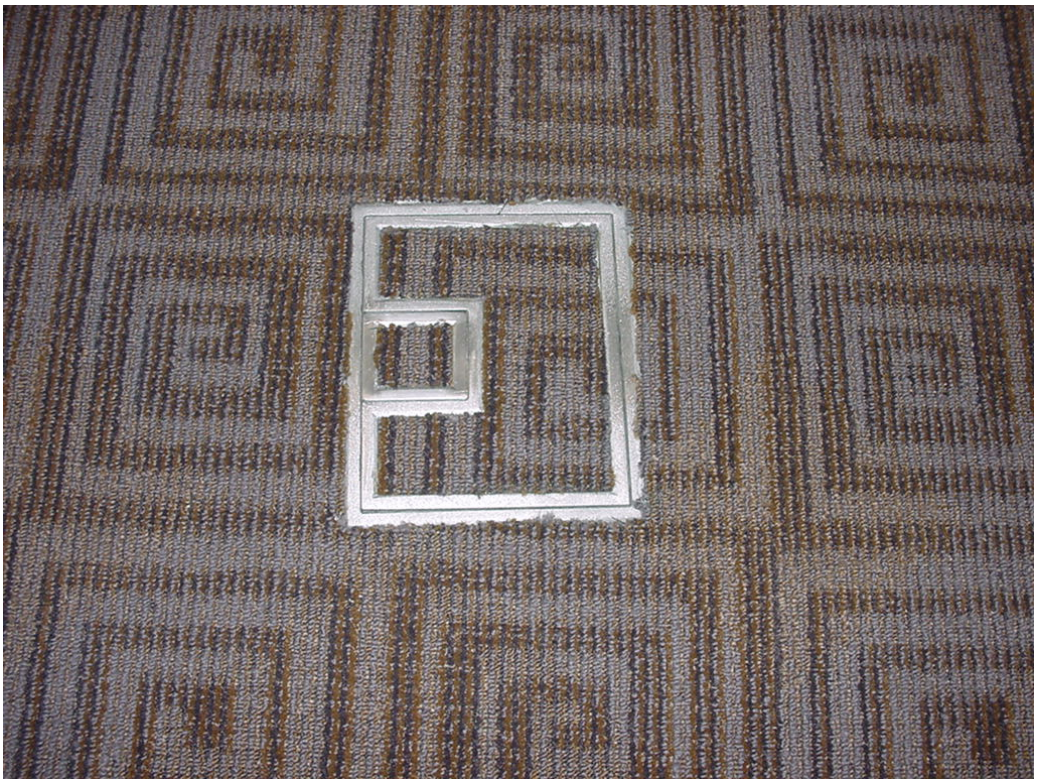
With the rare exception, courtrooms are being built with carpet as the main floor finish surface. Other types of floor surfaces were found in older courtrooms such a marble, stone, asbestos tile or even cork, but these each have their own challenges and dangers as well as extra expense. It is safe to assume that a new courtroom will have a carpeted floor, at least in the main areas of the courtroom floors.

The types of carpeting that can be used in the main courtroom floor area were discussed earlier under Floor Types. Indeed, the type of carpet, tiles or roll goods must be chosen first. Only then can the Interior Designer be able to search options in that carpet type for color, pile, etc.

Here are some things to consider when selecting carpet from an Audiovisual perspective:

- Pile and acoustic absorbability: Since courtrooms are large and typically have hard surfaces for the walls, they naturally tend to be more reverberant. (Think about sound in an indoor basketball court). The more reverberation there is in a space, the more difficult it is to understand what others may be saying. The Audiovisual Designer cannot really "fix" a reverberant space with the sound system that is going in; only cope with what is there. Since the room is quite "live", the Audiovisual Designer will be looking at what they can do to help tame the liveliness of the courtroom. One way is making the carpet more sound absorbent, expect then that the Audiovisual Designer will ask the Interior Designer to specify the most sound absorptive carpet possible.
- Minimize footfall noises: Here again, the Audiovisual Designer is looking to eliminate extraneous sounds that can compete with the ability to hear talkers in the Courtroom. Normally, the thicker or softer the carpet can be, the less walking noise is heard. Beware of "crunching" carpet as well. This phenomena is most often heard when the carpet is still new, but the Interior Designer should vet the product to ensure the sound disappears after a few weeks in use.
- Patterns: Strictly an aesthetic issue, linear patterns can draw attention to exposed crooked floorboxes (as well as casework). They can also be troublesome when using floorbox lids that need a

carpeted top to finish the floorbox lid. The pattern must be selected to match during the installation and the end user has to take care about the lid be rotated or changed with other lids. On the other hand, patterns, particularly linear ones, are quite helpful with carpet tile as the pattern distracts the eye away from the seams.



Crooked floorbox is made more noticeable with patterned carpet

- Floor tile alignment: The actual access floor tiles under the carpet will be in 24" squares, but it is very rare to see 24"x24" carpet tiles lined up directly on the tile below in a Courtroom environment. First, not all carpet tiles are available in 24"x24" sizes. Even if the Interior Designer's choice happens to come in the 24"x24" size, it is still not desirable to install it lined up on top of the floor tiles. This may be desirable from an access and maintenance standpoint but the practice cannot be maintained with precision across the entire floor area. The result would be seams that are more pronounced and even linear depressions where the tiles meet. As long as the tile installer used appropriate reusable mastic and the carpet installation direction is stamped on the carpet tile backing, the extra inconvenience of removing carpet tiles and then the floor tiles separately is minimal.

8.1.2 Wall Materials

Today's courtrooms are designed with a vast array of surface materials including stone, drywall, wood and glass. Some of these surfaces will have additional materials added onto them; paint, wall covering or fabric wrapped panels.

When the Interior Designer has the option of adding color and patterns to these surfaces, the courtroom design can be taken to a new aesthetic level.

Caution must be taken and some colors and patterns should be avoided. From an AudioVisual standpoint, the primary concerns revolve around cameras in the courtroom that are used for video conferencing and/or courtroom gallery overflow.

With regard to backgrounds, colors should only be chosen for camera backgrounds that are complementary to skin tones. Generally staying in the earth-tone color family is safest.

Avoid high contrast color combinations and "busy" backgrounds.

Small, particularly linear patterns in wall coverings should also be avoided. These have a tendency to moiré on camera and generally distract the viewer's eye.

A poor color or background choice behind a judge or witness on camera can make them appear unnatural.

Busy Horizontal Pattern in Wall Surface will Moire' in the Camera and Distract the Eye

8.2 Furniture

8.2.1 "Smart" Tables

The term "Smart" Table found its way into courtroom technology years ago when attorney tables were being customized to accommodate the increasing need to support attorney laptop connectivity.

Today's Smart Tables can be found with microphones and desktop sized flat panel displays along with connections for language interpreters, headphones, public LAN, Real-Time Transcription as well as video and audio presentation inputs, extra monitor outputs and intercom connections.

Many of these devices require power as well as the laptops and tablets the attorneys bring to Court with them. The best Smart Tables have hidden power for the built-in devices and easily accessible outlets for use with ad hoc equipment such as the attorney's laptops and tablets.

This technology cannot be easily installed on "standard" tables without unsightly cables and add-on interface boxes. Locations where the attorney needs to connect will be inconveniently placed for them and may even be out of sight and out of reach.

The increasing use of larger sized monitors on the attorney tables now dictate a need to recess part of them in new tables to allow for reasonable sightlines to and from the witness and judge.

The tables should be custom designed to match the courtroom aesthetic and finishes. All tables within the courtroom should have a light top surface. Glossy tops should be avoided.

The result of customizing these tables will result in an attractive element that functions well in the environment for which it was designed.

Unfortunately, attorney table designs vary and there is no gold standard for the ideal configuration. If the users will sit only on one side of the table, a modesty panel or hollow wall can be planned on the judge's side to hide equipment and cables. If the table is to be ambidextrous – allowing seating on the left and/or right side - then the underside of the table top will be open for seating all around, restricting the areas where the technology can be placed and where cables can transition vertically from the table top to the floor.

In many cases, the Court decides that tables must be movable within the courtroom space in order to accommodate the needs of a specific event. The AudioVisual technology for these table types requires an extra level of design care particularly where it comes to cable connectivity; the table may need to be connected at the "left end" in some positions and the "right end" in others.

Since the needs of the tables are complex, it is best to work with the AudioVisual Designer to develop a custom solution for each type of table needed.

Custom Designed Ambidextrous Smart Table. Note Recessed Displays, video presentation and Headphone Connections

8.2.2 Presentation Lectern

A Presentation Lectern, (sometimes referred to as a Presentation Cart), is normally a freestanding, often movable piece of furniture that serves as the command center for an attorney or technical assistant presenting video and/or audio evidence to the court.

Presentation of evidence electrically is so common now that many Courts have only the Presentation Lectern (or Cart) as their only presenting position. Other Courts prefer to also have a smaller, separate lectern for just oral arguments - an Oral Lectern if you will.

Before widespread use of the personal computer, the Presentation Lectern required a number of separate presentation appliances to deal with the various media formats used for evidence storage. Common were audio cassette players, VHS VCRs, Audio CD and DVD players along with the evidence camera.

The PC in its various sizes and brand forms and other storage media such as the Apple iPod have allowed the transfer of the audio and video from these various older formats into various types of electronic storage files that can connect to the courtroom evidence system with a single audiovisual interface.

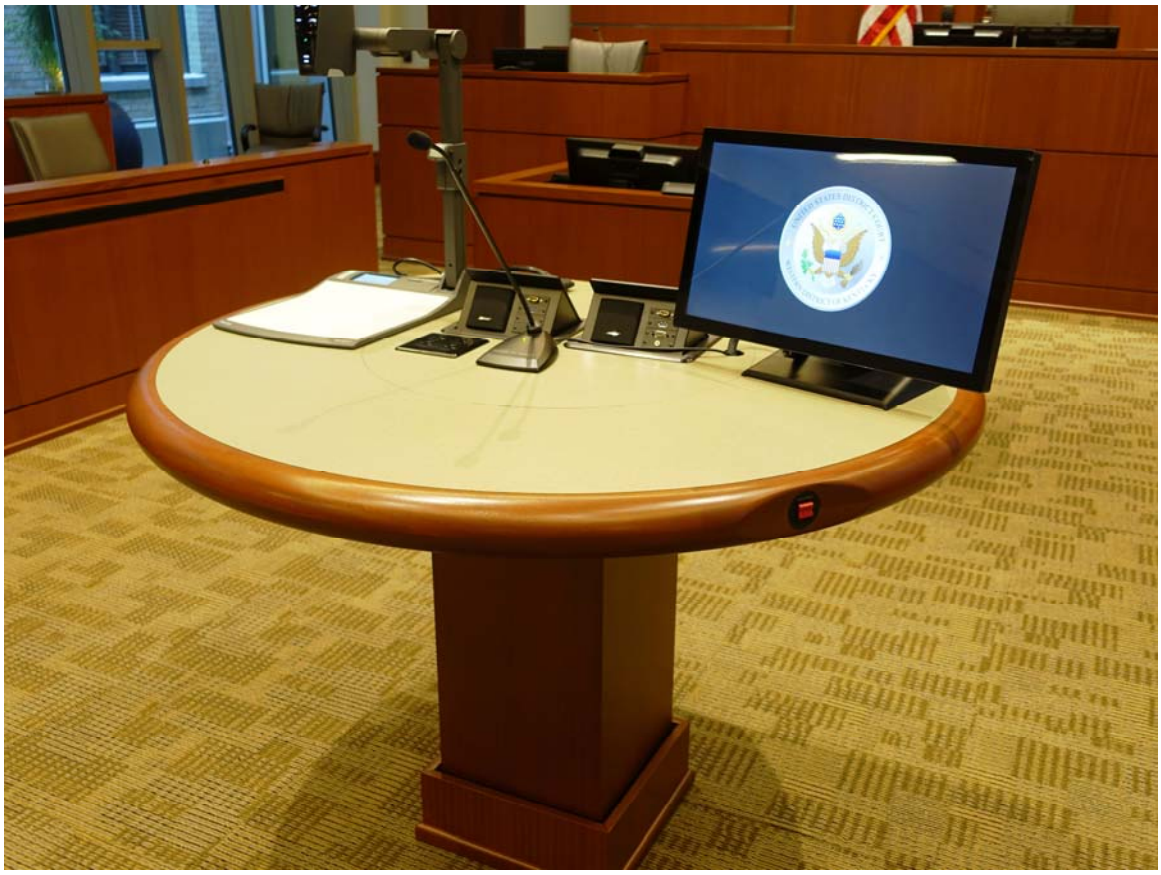
Today there are mostly interchangeable interfaces from these PC-like devices that greatly simplify the connectivity needs at the Presentation Lectern. Most commonly, these are referred to as DVI, HDMI, DisplayPort or Thunderbolt® connections.

Once the legal team has organized all of their audio, video and picture files to one of these formats, they can use a single device, such as

a tablet, to present the material to the court. There are also applications that are made specifically assist the attorney with organizing and presenting the materials stored in this way.

The presentation tool that seems to remain today however at the Presentation Lectern is the Evidence Camera. Often referred to as "ELMO", visual presenter or document the camera, it is not ideally suited to show actual flat documents. Its best use is for the display and live manipulation of evidence such as a small weapon or other three-dimensional objects.

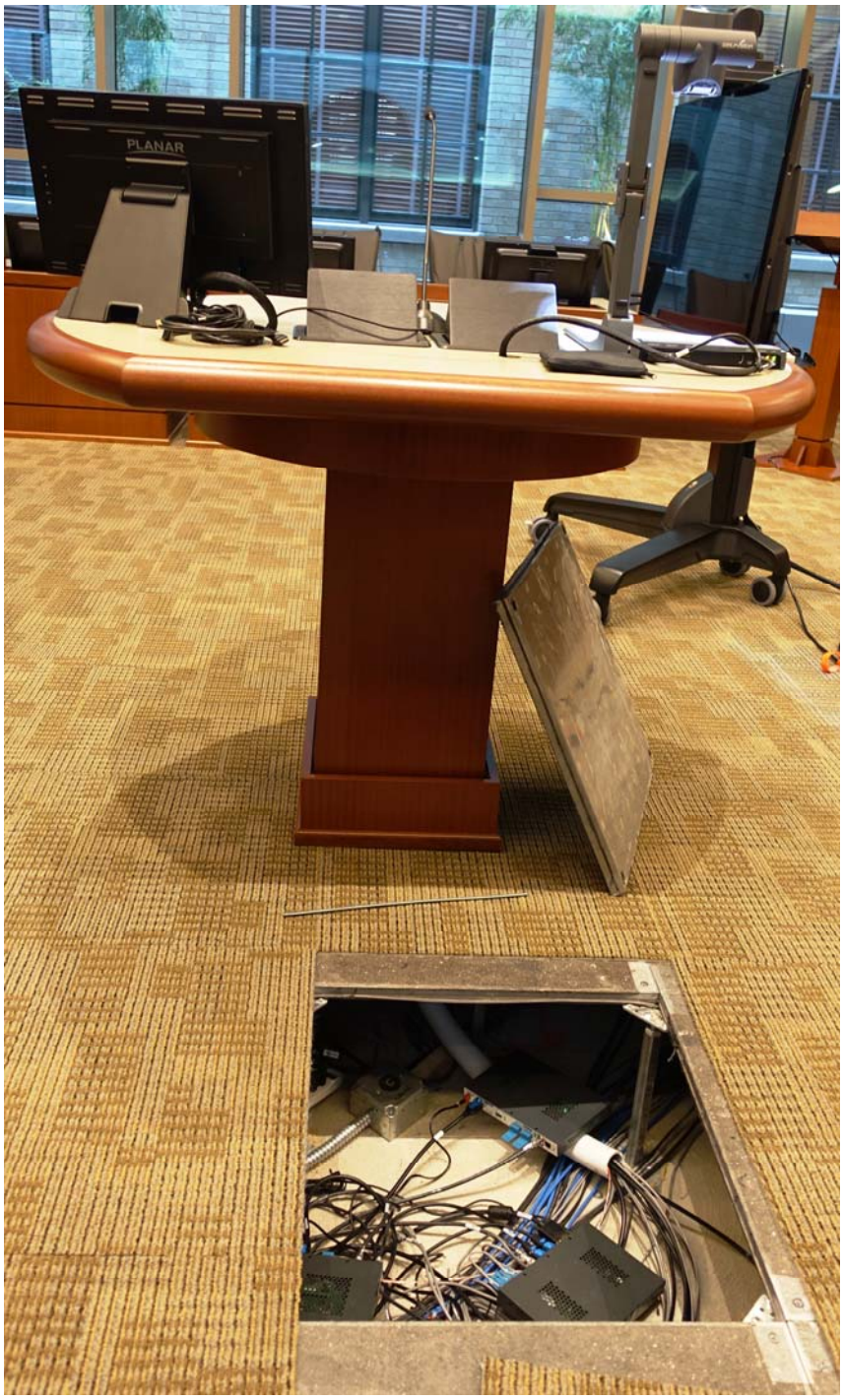
Since these relatively large cameras remain an important part of today's courtroom, their physical impact must be taken into account during the courtroom design.



A Contemporary Presentation Lectern that supports High Definition PCs and an Evidence camera

Some Presentation Lecterns will also have a small control panel, typically 5-7" wide, to allow the presenter to control restricted features on the devices located at the Presentation Lectern. Since the most common controls included Play, Pause, Fast Forward, etc. of the various media playback appliances, the control panels have largely despaired from many Presentation Lectern design as the tools they control have disappeared. The zoom and focus controls on the evidence camera are within easy reach directly on the camera itself.

The remaining space for a presentation lectern needs to be an empty one to allow for the attorney's laptop or tablet as well as a place for reference notes or binders.



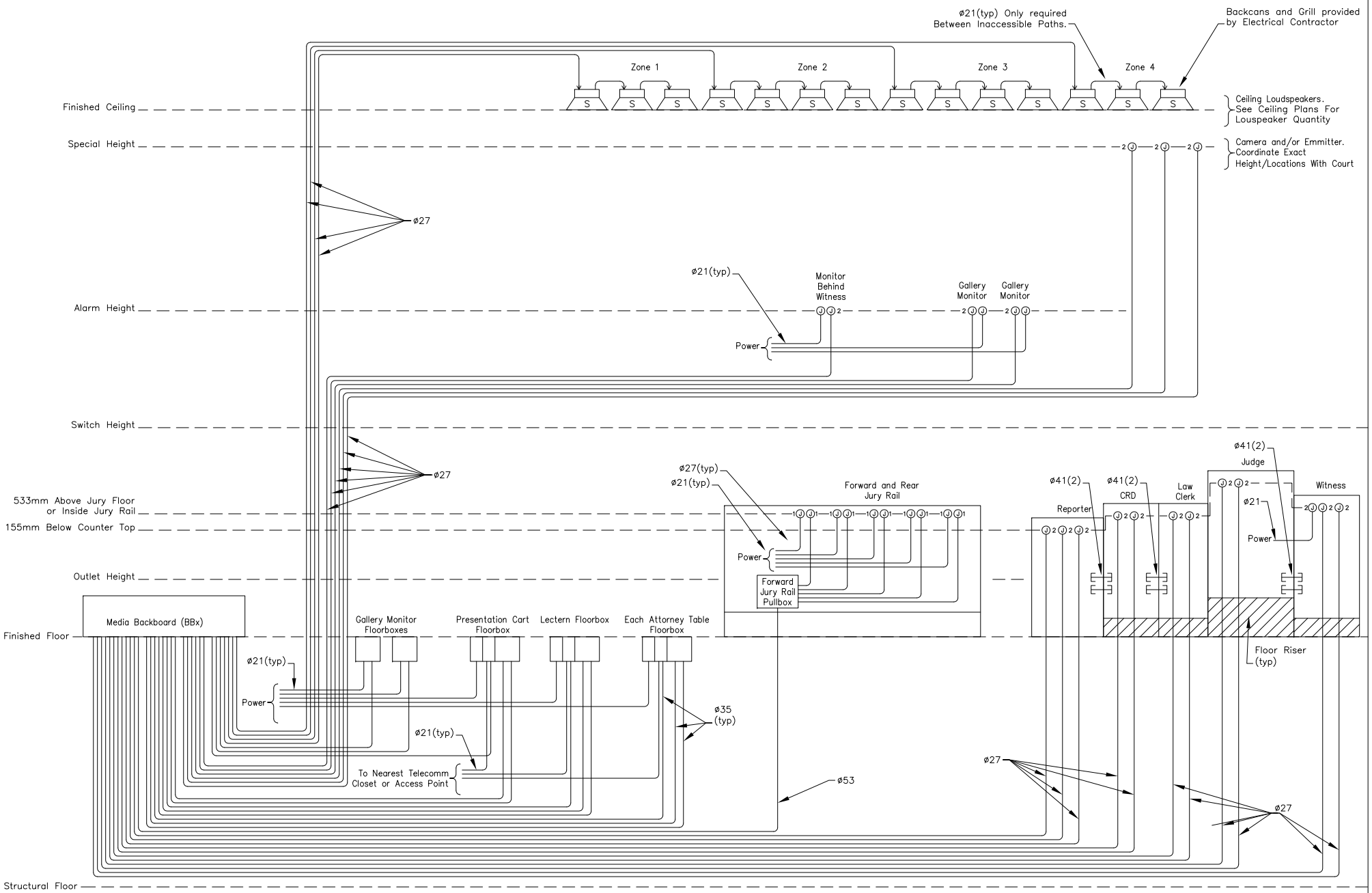
Fixed-Position Presentation Lectern on Access Floor

10. Appendix A.

SEE INCLUDED CONDUIT/RACEWAY DRAWINGS

11. References

1. J. Willard (Chair), Jay Farbstein, Martin Gruen, Frederic Lederer, Donald Palmer, David Samura, Bob Schwartz, Dickson Stewart, (2013). *AV/IT Infrastructure Guidelines for Courts.* Fairfax,VA: InfoComm International.



CONDUIT RISER DIAGRAM