Raised Floor Components

If you choose to use a raised floor system in your Data Center, there are several elements that you must specify as part of its design. These include:

- Floor height
- Mechanisms for bringing in equipment
- Weight-bearing capacity
- Types and numbers of floor tiles
- Instructions for terminating infrastructure
- Other subfloor details

Floor Height

Data Center raised floors vary significantly in height from one facility to another. The ideal elevation for your particular floor depends upon several factors:

- Size and shape of the server environment
- How much equipment it contains
- How much cold air you want to channel in to the space
- How much infrastructure is routed under the floor

Except for that last detail, all of the factors are tied directly to the use of the under-floor area for cooling. Once the floor is tall enough to clear whatever infrastructure you route along the subfloor, the rest of the space is really only necessary for air circulation.

So, what's the ideal floor height for your particular Data Center? You can pay a cooling engineer to calculate an optimal height, but the general principle is simple: the greater the height of your raised floor, the more air that can be circulated through that space. A taller raised floor means that more chilled air can collect and pass through. The greater the volume of chilled air, the more effect it has when it is then channeled above the floor. Also, air obviously flows more freely through a 24-inch (61 centimeter) cavity than one half the size, especially if there are electrical conduits, structured cabling, or other items running through the area that act as barriers.

While every server environment is different, 18- and 24-inch (45.7 and 61 centimeter) raised floors are very common and may be considered default heights for most Data Center designs. This distance enables an ample volume of air to pass through the plenum, even with a large amount of infrastructure routed through the space, but isn't so deep that someone lifting a floor tile cannot easily reach the subfloor. This is helpful for contractors installing infrastructure under the raised floor and for Data Center users who later use that infrastructure.

NOTE

In late 1998, I refurbished a server environment in Dallas, Texas. The pre-existing room was about 850 square feet (79 square meters). It had a raised floor, but only in the most generous use of the term. The floor was just 4 inches (10.2 centimeters) high, barely tall enough to route infrastructure under the floor. Power cables from server cabinet power strips had to be carefully threaded so as to not bend too sharply when plugged into under-floor receptacles. These outlets often tipped on to their sides after a floor tile was removed, and it was impossible to replace the panel without first rotating the receptacle upright again and carefully tucking power cables out of harm's way. The plenum was considered too small to channel cooling through, so the server environment's air handlers were configured to circulate air above the ceiling. Fortunately, this room was a temporary space. Within 18 months, all of its servers and networking devices were relocated to a more properly designed Data Center.

I used the under-floor space because it was there, but in my opinion such a small raised floor is useless. Putting any infrastructure under such a short floor inhibits airflow, and connecting to under-floor data ports or power receptacles is awkward and tedious and has the potential to damage patch cords or power cables. Even without placing any infrastructure in that space, I'm skeptical that the under-floor air volume can effectively cool even a moderately sized Data Center. If you are not going to have a raised floor that is at least 12 inches (30.5 centimeters) high, I say don't bother having one at all. A small raised floor might make your server environment look neater, but it is not worth the price tag and other drawbacks that come with it.

If you have the building space to spare and you want vendors to work on under-floor infrastructure without actually entering your Data Center space, you may consider a *very* tall raised floor—high enough for workers to stand upright and install, remove, or test structured cabling or electrical conduits. For this design, cable trays or some other management systems are needed to elevate the infrastructure so that it is within easy reach from the top of the raised floor as well as from the work area. Lighting is also necessary for this space, so that workers are not forced to rely on flashlights or other portable light sources. As with the innovative idea of installing air handlers in a secure corridor adjacent to the Data Center, mentioned in Chapter 4, "Laying Out the Data Center," this is a commendable design idea that is only rarely implemented due to the additional space and money it requires.

Even if you don't make your raised floor tall enough to walk in to, be aware that as the height of your raised floor increases additional air handlers may be needed to cool and circulate the increased volume of air.

In conjunction with calculations about the height of the raised floor, you must choose whether the top surface of your Data Center floor is to be elevated or at the same level as other (non-raised) floors in the building. The simplest and therefore most common option is having the raised-floor height elevated. This enables the bottom level of the floor—the concrete—to be one consistent level throughout the building. It requires the use of a lift or ramp to bring equipment onto the Data Center, however.

The second option, making the *top* of the raised floor flush with other floor surfaces, requires the Data Center subfloor to be set into the ground. In this configuration, what is normally called the height of the raised floor becomes its depth. The more space needed for the subfloor, the deeper the cavity below the surface this space must be. Constructing a sunken Data Center floor in this manner is more expensive, but does provide certain advantages.

A major benefit from this arrangement is that no ramps or lifts are needed to transport equipment into the Data Center. The floor surface never changes elevation between the Data Center and adjoining rooms or corridors, so items can be rolled in or out of the room without assistance. Eliminating these mechanisms from a Data Center conserves floor space and adds convenience for users. Materials and equipment can be brought in to the room from multiple access points—any door that is wide enough—rather than only by way of specially equipped entrances. Depending upon how the areas are designed and where they are located in relation to the Data Center, a level floor may enable you to forgo otherwise-needed construction of raised floors in adjacent support areas such as a Build Room or storage area—recouping at least some project costs due to the sunken floor.

If you choose to have a viewing area into your server environment, perhaps for a control center or to facilitate tours, the uniform floor surface height also enables you to avoid making the choice between having to look up into the elevated server environment or building up the height of the viewing area.

Because this decision can affect the building's foundation or require greater heights between stories, depending on what level the Data Center is located on, it should be made as early in the design process as possible.

Ramps and Lifts

Assuming that your Data Center's raised floor surface is elevated, there are two mechanisms for bringing equipment into the room and level with the floor—ramps and lifts.

Ramps are the most popular choice. They enable either people or materials to be brought into the Data Center and have no moving parts to malfunction. Their length is determined by two factors—the height of the raised floor and the slope used to reach that height. In the Unites States, Data Center ramps feature a 1 in 12 incline—a 1 inch increase in height for every 12 inches in length. Such a slope is considered acceptable under the Americans with Disabilities Act of 1990, which is designed to make all workplace areas accessible to those with disabilities. Using such an incline, a room with a 15-inch high raised floor needs a ramp that is 15 feet long, while one with a 24-inch raised floor needs a ramp 24 feet long. (Although the formula doesn't translate as gracefully in the metric system, that is 4.6 meters long for a 38.1-centimeter high floor, or 7.3 meters for a 61-centimeter high floor.)

Although this requirement doesn't apply in other countries, still consider a 1:12 incline. A shallower incline requires more space for the ramp, which doesn't help your design. A steeper incline means a shorter ramp, but makes it significantly more difficult to steer heavy equipment in or out of the Data Center. Full server cabinets can be quite heavy, and if you have ever had to push an object up an incline—say a stalled car or a piece of heavy furniture—you know that it is much harder to move it up a steep rise than a shallow one.

Data Center ramps are ideally going to be 6 feet (1.8 meters) wide and have landings at both ends that are 6 feet (1.8 meters) square. These dimensions enable sufficient room for maneuvering large equipment in or out of the Data Center. When designing your Data Center ramp, keep in mind the advantages of having floor space serve multiple functions. It is completely acceptable to have the bottom landing for the server environment located in the building's hallway, for example, as long as there is sufficient clearance.

Building codes in many regions require some form of handrail on both sides of the ramp, to prevent a person or piece of equipment from accidentally slipping off a ramp edge. For the same reasons, it is advisable to install slip-resistant tread on the ramp. Depending upon the size of your Data Center and the wording of regional building codes, you may be required to have more than one ramp.

The alternative to having a ramp for your Data Center is a lift, an adjustable platform that enables you to raise an item up to the height of the raised floor or down to the level of the regular floor in the adjoining room or corridor. A lift occupies less floor space than a ramp, but is more expensive. As such, it is best reserved for sites where floor space is at a premium.

Weight Bearing Ability

Arguably the most important element of any Data Center floor, whether it includes a raised floor system or not, is its weight-bearing ability. The more weight your Data Center floor can support, the more equipment, large and small, that can potentially be installed in the room. Ideally, your Data Center floor should be able to support 1500, 2000, or more pounds (680.4, 907.2, or more kilograms) per server cabinet location. Those were considered exorbitant weight loads a few years ago, but current design trends for servers and other Data Center devices are producing heavier and heavier equipment. The most prudent approach is to assume those trends are to continue and to design your server environment accordingly.

Ultimately, the overall weight-bearing ability for a Data Center floor is limited by the structural makeup of the building—the thickness and integrity of the building's concrete slab if the room is on the bottom floor and the same characteristics of its steel skeleton if the server environment is above the ground.

Specify in your design package how much weight you want your raised floor system to bear. You want the system to have essentially the same strength as the subfloor. Lesser weight-bearing ability doesn't take full advantage of the building's strength, while greater ability increases construction costs without providing any benefit.

Overall weight isn't the only characteristic that must be specified for your Data Center floor. There are several types of load that are applied to the floor, and they fall into two overall categories:

- **Static loads, which involve constant weight:**
  - **Concentrated or point load—** Weight applied on a small area, such as where the pegs or casters of a fully loaded server cabinet touch the floor. For example, if a cabinet is filled with equipment and weighs 2000 pounds, the load is distributed evenly among its four casters, 500 pounds each. To support this cabinet, floor tiles must be rated for a point load of at least 500 pounds.
  - **Uniform or static load—** Weight distributed over a larger area. Common occurrences in a Data Center are heavy boxes or large equipment that sits flush on the ground and possesses no support pegs or wheels. This load can also be an accumulation of point loads. If two of the casters from the previous example rested upon the same floor tile, that tile would have a static load of 1000 pounds upon it. To successfully support such weight, the panel must be rated for a static load of at least that amount.
- **Dynamic loads, which involve the movement of weight over an area:**
  - **Rolling load—** Weight rolled over an area from passing equipment. This load is defined not only by the weight of the object but also by the size and hardness of the wheels that make contact with the tile and how many passes are made. Practically anything transported across a Data Center floor—server cabinets on casters, supplies moved by way of a pallet jack, backup media transported by mobile cart, even a person sliding across the floor in an office chair with wheels—is a rolling load.
  - **Affect load—** The force put on a raised floor by a dropped object. This is defined by the weight of the item and distance it falls. Although items aren't regularly dropped or tipped over in a Data Center, the floor must be able to withstand such force in the event that an accident does occur.
  - **Ultimate load—** The minimum weight that exceeds a floor tile's ability to support a load. This is essentially the breaking point of a floor panel, past which an object crashes through to the subfloor. This may be represented as an independent weight or as a multiple of a panel's concentrated load.

Although concentrated and uniform loads place ongoing pressure on the raised floor, the dynamic loads have the most potential to cause damage in the Data Center. Rolling items over the same floor tiles can cause wear and tear over time, while dropping an item on the floor may cause small cracks in the floor system as well as damage panel surfaces.

When specifying the weight load requirements of your Data Center, apply them to whatever ramps or lifts the room is equipped with as well. It does little good for your server cabinet locations to be able to support thousands of pounds each if the equipment can't make it past the entrance because of a weaker lift or ramp.

NOTE

Consider setting the structural capacity of the Data Center so that all cabinet locations can support at least 20 percent more than the heaviest item you ever expect to house. So, if the heaviest fully loaded server cabinet will be 1500 pounds (680.4 kilograms), specify 1800 pounds (816.5 kilograms) per tile location. This provides a buffer to accommodate unanticipated equipment weights and density in the future.

If you are constructing a server environment in an existing building, obtain a map that indicates the weight-bearing abilities of the structure. Such information can typically be acquired through the architectural firm and can help you lay out the Data Center space most efficiently.

Types of Floor Tiles

Three types of floor tiles are involved in a raised floor system:

- Blanks
- Perforated
- Notched

These floor tiles come in one standard size—2 feet (61 centimeters) square—and are typically made of steel, with wood or concrete at the core, or cast aluminum. Tiles can be ordered in various colors, or even made transparent, although beige and light gray are the most common.

Blank or solid tiles are the most abundant in any Data Center. They have no openings and are capable of supporting the most weight, and therefore are traditionally placed in all aisle locations, directly under Data Center equipment, and on the room's ramp.

Perforated or vented tiles have dozens of tiny holes in them, enabling air to flow through. These panels are most often placed immediately in front of server rows, although they may be located anywhere in the room depending upon how you want to direct airflow. Where specifically to place them in your Data Center is explained in Chapter 8, "Keeping It Cool." Perforated tiles can be configured with a sequence of adjustable metal plates on the bottom. Adjusting a single control mechanism on the tile, usually with a hexagonal wrench, shifts the position of the plates. In this way you can restrict as much or little airflow through a perforated tile as you want.

NOTE

So, if perforated tiles enable you to better control airflow in the Data Center and it is possible to completely close them, why not put them in the ramp and aisles, too, and not bother with any blank tiles? It is because perforated tiles are weaker than blanks due to all of the holes in them. Installing perforated tiles throughout the room would reduce the weight-bearing ability of your raised floor.

Notched or cut tiles are similar to blanks except that they have one or more openings for patch cords and power cables to be threaded through. You can have the openings made to practically any size or shape and placed anywhere on the tile. You want the openings to be large enough to accommodate an average-sized bundle of power and data cables routed through your Data Center, but not so large that air from the floor can escape. The more air that escapes out of your Data Center's cut tiles, the less that comes out of your perforated tiles, which are where you want the cooling.

There are multiple products available to help prevent air from leaking out of oversized tile cut-outs. Some consist of foam padding or wiry bristles that enable cables to be threaded through a tile opening but prevent air from passing through. They work reasonably well but, over time, might become weighted down or frayed and no longer function as effectively.

Others are caps of wood, metal, or plastic that rest in tile cut-outs. These can be adjustable in size, enabling cables to pass through while occupying the remainder of the opening. These continue to function for years, but are vulnerable to human nature. Data Center users often remove and set tile caps aside, requiring additional time from the room's support staff to track down and replace them. The caps, no matter what they are made of, may also give people a false impression about how much weight they can hold. Data Center users transporting cabinets or equipment across the raised floor are usually conscientious enough to steer around notched tiles with open cut-outs, but may not think twice about rolling heavy equipment over one with a cap. The result is a broken or damaged cap and possibly a toppled server cabinet.

It is important to maintain air pressure in a server environment so that air can circulate properly through the room and thereby regulate ambient temperatures humidity. Data Center air pressure is affected by how floor tiles are deployed—the more openings in the floor from perforated and notched panels, the harder it is to maintain pressure. Your proposed deployment of floor tiles in the Data Center should therefore be reviewed by the project vendor responsible for the room's cooling. They may recommend a limit for the total number of perforated tiles in your Data Center.

NOTE

Because a raised floor system is, literally, the foundation of your server environment, it is important to protect it. Here are several recommended practices for maintaining your raised floor system:

- When lifting floor tiles, limit how many are removed from their normal position at any given time. Also remove panels in a line rather than a block. Removing several tiles or even a small number in a block exposes support pedestals to damage or displacement.
- Avoid placing heavy items on notched tiles because they are weaker than blank tiles. If you must position equipment on a cut tile, keep concentrated loads, such as the support pegs of a device, as far from the cutout as possible.
- After removing floor tiles, set them back down carefully upon the raised floor. The panels can be heavy and awkward to handle. With rough edges on the bottom and sharp corners, one tile can easily damage another if dropped or set down roughly.
- When transporting heavy equipment across the Data Center raised floor, take measures to protect the tile surfaces. Place protective covering along the path of travel and avoid rolling items over cut or perforated tiles.
- If a floor tile becomes damaged for any reason, replace it immediately. Don't allow minor cracks or gouges to worsen.

If you're concerned about wear and tear on your floor panels, you may want to periodically rotate tiles between high-traffic and rarely traveled areas of the Data Center.

Floor Tiles and Static

The raised floor panels installed in your Data Center should have static-control qualities. Because static can disrupt or damage sensitive electronic equipment, you want to limit how much static your servers are exposed to. Static control tiles help reduce the voltage that is generated from people walking across the surface of the floor.

Floor tiles are commonly either static dissipative, which means that they inhibit the creation of static, or conductive. Raised-floor vendors typically recommend dissipative tiles for areas where various users will walk across the floor, and conductive tiles for rooms where personnel will wear static-control footwear. Choose accordingly based upon what type of foot traffic will occur in your Data Center.

The Electrostatic Discharge Association is a good resource for more information about electrostatic discharge (ESD), including various ESD-related industry standards. The association's website is at http://www.esda.org.

Termination Details

There are several methods and components for routing and terminating Data Center infrastructure under a raised floor. Electrical outlets, for example, can be individually terminated as follows:

- At the end of a flexible conduit
- In a cluster on the same conduit
- Along a floor-mounted guide rail
- In a stationary raceway, on a vertical power pole
- Up in a server cabinet.

Equivalent options are available for structured cabling, too. Each approach has its advantages and disadvantages.

Running individual electrical conduits and cable bundles to each server cabinet location is the most flexible configuration, enabling quick and easy redistribution of Data Center infrastructure. This is a tremendous advantage when incoming servers arrive with new or additional requirements for power or connectivity. Infrastructure can be repositioned or altered with minimal disruption to the environment as a whole.

Cable bundles and electrical conduits can be routed along the Data Center subfloor, carefully secured to the raised floor system's vertical pedestals by soft cable ties or fasteners such as Velcro. If you design your Data Center in this manner, include specific instruction in your design package about what paths electrical conduits and data cables are to follow under the raised floor. This configuration involves a significant number of power receptacles and multimedia boxes under the floor, and careful routing enables them to be managed more easily and efficiently.

NOTE

I recommend against terminating Data Center infrastructure into under-floor raceways or directly into cabinets, although both are common practices. While raceways help organize infrastructure under the floor, they also restrict airflow, inhibit flexibility, and add expense to the price of your server environment. It is much easier to relocate freestanding structured cabling bundles and electrical conduits than those terminated in raceways or cabinets.

If you decide to use cable trays or raceways under the raised floor, place them strategically so that Data Center users can easily access infrastructure. If you intend for people to plug patch cords into under-floor data ports directly under server cabinet locations, make sure that whatever combination of cable trays, wire management, and multimedia panels you use keeps the structured cable bundles out of the way while situating the data ports within easy reach.

Don't restrict access by overlapping or criss-crossing the infrastructure management devices. For example, don't terminate power into a raceway and then run a cable tray directly on top of it, forcing someone to put his or her hand through the lattice of the tray—and between bundles of structured cabling—to reach the electrical outlets. The two distinct raceways should instead be staggered so that one is not directly over the other.

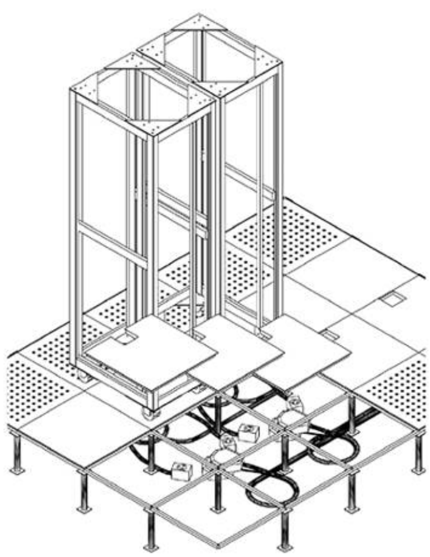
Prepare for additional power and data cables in the future. Choose management systems that have space for growth and that are expandable. If your Data Center cable trays are completely filled by structured cabling the day the room comes online, they are too small. If space under the floor permits, choose deeper or wider trays that enable more cable bundles to be added. It is much better to have large cable trays and raceways that are half-full than small ones that are bulging with infrastructure.

Also, choose infrastructure management components that have a low profile and that can be easily dismantled and reassembled elsewhere. This limits their effect on under-floor airflow and provides an opportunity to reconfigure your Data Center infrastructure.

The last option is terminated power and cabling above the Data Center floor directly into a server cabinet. The primary advantage of this practice is that once infrastructure is in place, there is no need to lift floor tiles to access connections. Servers and networking devices can be installed with no risk of damaging a patch cord or power cable when moving floor panels. This is a very inflexible design, however, because it is very difficult to relocate either infrastructure or individual server cabinets without incurring downtime. This approach should therefore be implemented only in Data Centers that have minimal turnover of equipment.

Figure 5-3 shows power, data, and cooling routed under a raised floor. Electrical conduits and structured data cabling follow parallel but distinct paths under the floor.

Figure 5-3. Under-Floor Termination Example



The Subfloor

If you use a raised floor system, make sure that that the subfloor is sealed. This prevents the Data Center air handlers from stirring up minute concrete dust that can in turn damage servers or networking equipment.

Also consider designing troughs into your subfloor. These can provide a degree of protection for your infrastructure in the event that water intrudes into the Data Center. Run the troughs parallel to the server rows, out of the way of under-floor infrastructure. The deeper they can be, the better, because you want them to catch and carry away moisture before it can reach any of the cabling under the floor.

Common Problems

Routing the hundreds or even thousands of cable runs and electrical conduits in your Data Center can be very complicated, so errors of one type or another are likely to occur. The sections that follow discuss some of the more common errors to look out for.

Tile Cut-outs Are Poorly Sized or in the Wrong Location

While a contractor may misread the instructions in your design package, these errors most often occur during the Data Center planning stage. It is easy to miscalculate sizes for tile cut-outs, by either not providing a big-enough opening at cabinet locations where several cable bundles pass through or else making the notches so large that air escapes wherever only a handful of patch cords is routed. One solution to this problem is use of two cut-out sizes for your notched tiles and strategic placement of them. Perhaps use an 8-inch (20.3-centimeter) square opening for panels near cabinets packed with cables and a 4-inch (10.2-centimeter) square cut-out for tiles near sparsely cabled cabinets.

Still more potential for error exists when cutting notched tiles and orienting their cutouts in relation to servers in the Data Center. If cabinets in your Data Center don't have the same width as your floor tiles—2 feet (61 centimeters)—pay careful attention to how they align with your room's notched floor tiles. Different widths can cause tile cutouts and the equipment cables that are to pass through them to drift apart.

NOTE

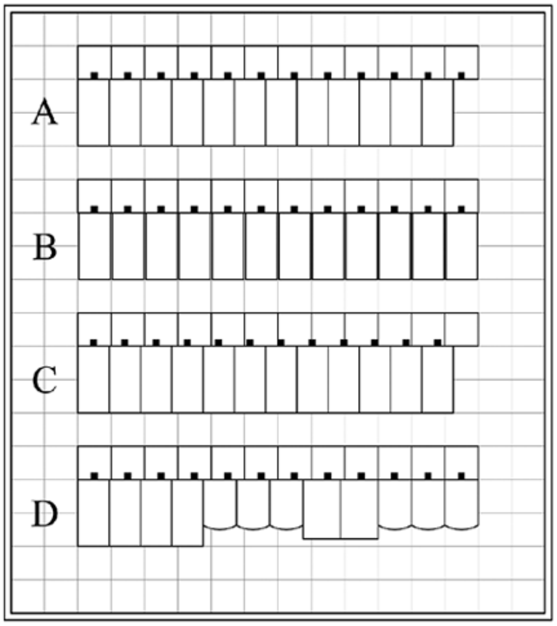
Many of the Data Centers I manage use server cabinets that are 22.5 inches (57.2 centimeters) wide. While only slightly narrower than the panels on the raised floor, the cabinets are typically situated flush with one another. Over the span of an entire server row, each cabinet drifts a bit more from the center of the floor tile it sits upon. At the end of a server row with 13 cabinets, that is a gap of 19.5 inches (49.5 centimeters). I can—and have—still run cables through cutouts that are offset by this much, but it is awkward, and I have to use longer patch cords and electrical cables. The same problem occurs when cabinets in a row are wider than the floor tile. The drift between servers and tile cutouts just occurs in the opposite direction.

There are three ways to address drifting cabinets:

1. Don't let cabinets become misaligned from floor tiles. Space out cabinets, narrow or wide, so that that they are always centered on your Data Center floor tiles. For wider cabinets, this may mean skipping over tile locations and potentially wasting floor space.
2. Adjust the placement of the notched tile cutouts as you progress down the row, so that they are always centered near the equipment intended to use them. This requires additional customization and may not meet your needs when new equipment arrives for the space.
3. Make sure that your server rows are interspersed with wide and narrow cabinets. This dovetails with the approach of organizing servers by function and getting a heterogeneous mix of equipment, as mentioned in Chapter 4.

Figure 5-4 illustrates how cabinets narrower than Data Center floor tiles can be separated from the notched tiles that their cabling is intended to pass through. Row A shows cabinets becoming misaligned with cut-out tiles, while rows B, C, and D show the possible measures to realign them.

Figure 5-4. Preventing the "Drift" of Floor Tile Cutouts



Cabling Installed in Plenum Spaces Aren't Properly Rated

Clearly specify the type of structured cabling you want installed in your Data Center and double-check that you receive the correct materials. Some manufacturers use similar part numbers for their plenum and non-plenum cables, identical except for a single digit.

Mistakes can occur, and you want to quickly catch any errors so there is adequate time to receive replacement supplies. Review the items as soon as possible. Even if you have experience with non-plenum, plenum, and low smoke/zero halogen cables, you may not immediately recognize an incorrect item without close scrutiny.

The Raised Floor System Isn't Strong Enough to Accommodate Equipment

It is easy to plan your Data Center for today's servers, but hard to make accurate predictions for future equipment. Remember: If future devices become larger, they are likely to add weight onto your Data Center floor; if future devices become smaller, they are *also* likely to add weight, because Data Center users are going to install more of them in each server cabinet. For example, a floor-standing machine that occupies one floor tile and weighs 750 pounds (340.2 kilograms) might be replaced by a device that occupies two floor tiles and weighs 1800 pounds (816.5 kilograms), or by a server cabinet filled with 20 narrow servers weighing 75 pounds (34 kilograms) each. That third configuration may seem lighter at first glance, but when you do the math it works out to the heaviest load of all—1500 pounds (680.4 kilograms) in one tile location, with extra space still left in the cabinet! Make your building as strong as physical conditions and your budget allowenable, and then design the Data Center floor to match the weight-bearing ability of the building.

Summary

Power, data cabling, and cooling may be routed above a Data Center's false ceiling or below a raised floor.

An overhead installation is less expensive and takes up less space that an under-floor one. Patch cables and power cords all connect above your Data Center server cabinets when infrastructure is installed overhead. This makes them unlikely to be snagged in passing but requires Data Center users to climb a stepladder every time they want to connect to or disconnect from the infrastructure, which is inconvenient and carries its own snagging risks. If you install power and data overhead, use twist-lock plugs and receptacles and patch cords with sturdy connector tabs to reduce the risk of accidental unplugs.

Most Data Centers have a raised floor system despite their cost and space needs. Chilled air can be channeled through the under-floor and directed with greater precision to server cabinet locations by way of perforated and solid tiles better than from overhead vents. Routing infrastructure under a raised floor also makes it easy to access but out of sight, therefore protecting it from accidental damage or disconnects.

Electrical wiring generates electromagnetic interference, so keep it physically separate from any structured data cabling. Do this by routing them along separate paths in the Data Center and, if using an overhead installation, terminating them in distinct raceways.

You must use specially rated cabling and associated materials in the spaces that distribute air through your Data Center, typically located above the ceiling or below the raised floor. These are plenum-rated cabling in the United States or low smoke/zero halogen in most European countries. Non-plenum cabling is acceptable for use in other areas of the server environment.

When routing infrastructure overhead, structured cabling and electrical conduits are typically installed above the Data Center suspended ceiling, routed by cable trays or ladder racks and terminated in raceways below the ceiling. Provide space between automatic sprinkler heads mounted in the false ceiling and any solid objects such as raceways, cable trays, server cabinets, or other Data Center equipment; building codes in many regions call for a minimum clearance of 18 inches (45.7 centimeters). To keep power and data adequately separated, route them in back-to-back raceways, with power over the front of server cabinet locations and data over the back.

When routing infrastructure under floor, begin by establishing the height of the raised floor system. The higher the elevation, the greater the volume of cooled air that can pass through the plenum, and the less obstruction that is presented by infrastructure installed along the subfloor. Floor heights of 18 or 24 inches (45.7 or 61 centimeters) are typical.

Unless you create a Data Center with a sunken subfloor, which requires a compatible building design and additional expense, you must bring equipment onto the raised floor by way of a ramp or lift. Ramps are the most common, and are sized based upon the height of the floor. The taller the floor, the longer the ramp must be. Lifts are a second, more expensive alternative in which equipment is placed on a platform and then elevated to match the height of the Data Center floor.

A critical element of a Data Center raised floor is its weight-bearing ability. The more it can support, the more servers and networking equipment that can potentially be installed in the room. Strive for a raised floor that can support 1500, 2000, or more pounds per floor tile—or whatever the maximum strength of the building is, whichever is greater. Servers are becoming heavier each year, and you want your Data Center to be able to support future equipment.

Three types of floor panels are used in the raised floor system: solid tiles, which are the strongest; perforated tiles, which control airflow; and notched tiles that enable cabling to connect from server cabinets to under-floor infrastructure. Caps or other air-blocking devices may be placed in panel cutouts to prevent air from being misdirected.

Under-floor infrastructure can be terminated in several ways. The most flexible design is to run individual electrical conduits and cable bundles to each server cabinet location. Cable trays and raceways may also be used. If you do install raceways, seek components that are easily reconfigured or expandable. A final option is to terminate directly into Data Center cabinets. This is the least flexible design, but removes the slight risk of patch cords or power cables being damaged when someone lifts or replaces floor tiles.

Properly seal the subfloor to avoid concrete dust in the room.

Common infrastructure-related problems include improper placement or sizing of tile cutouts, installation of non-plenum cabling in plenum spaces, or failing to design a strong-enough raised floor.