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Building facility requirements for University's IT centers in the Afghanistan context

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Abstract
All we know, that technology plays a vital role in every work environment. IT facilitates accelerates the process of working and increases the productivity in every place including universities and academic centers. Specially, the internet as a source of knowledge paved the way for academic staff in universities to communicate, research, browse for scientific papers, use digital library and it serves them as an information provider and connector to worldwide. In addition, providing computer labs and delivering IT training for students are prominent for an academic institution. Hence, existing of an IT center in academic campus is an essential requirement, that we cannot ignore it. Afghanistan as a third world countries need to complete its path of maturity for IT infrastructure, which is acceptable right now, and must be developed for the future. Currently, Afghanistan universities are poor in the viewpoint of IT infrastructure (Buildings) except few of them that have it, especially in major cities. Therefore, it's a need for Afghanistan to establish basic and standard IT centers in coming years for all cities to meet the demands of time, students and staffs. So as a result, prior to construction we need to have a manual or at least a paper to start this mission. Hence, this article provided the basic and standard requirements, along with proposed a simple architectural layout and detailed accommodation for networking and duct system including raised floors and suspended ceiling for IT centers in the context of Afghanistan, hope this paper will be used as a guideline for engineering and construction of IT centers for the future and existing universities.

Keywords: Afghanistan, information technology (IT) center, server room, duct, raised floor, suspending ceiling, outlets

1. Introduction

Technology mostly came to Afghanistan after the Taliban horrid regime in 2001, and according to need and demand of the market gently developed. Of course not only information technology rather general technology improved in Afghanistan after 2001 and had ascended gradually. After 2001 computer and internet skill was a must and market needed people who had foresaid skills to work with them and it made eligible someone for recruiting. These skills expanded and became a necessary criterion for she/he want to work in an office, hence everyone wants to have these skills. Universities as a human resource graduated institution realized that, the establishment of an IT center is a must for each university and the student must have the information technology (IT) and computer knowledge that can work and compete in markets. Hence, the ministry of higher education settled a small IT center (only one office) in every university. These small IT room after 2001 served for professors and student to access internet and computers rarely, and still it is going on in most universities specially in provinces because they don't have desirable IT centers and computer labs. For instance: in Faryab university we have IT center only an office size 6x6 meter for all campus and out of 40 state universities in Afghanistan only two of them, namely Kabul Polytechnic University and Kabul University have dedicated building for IT center. Most of professors and student are used their own computers and self-paid internet packages for accessing to information, research and routine affairs. Therefore, to overcome these problems and to provide computer labs for conducting training of software and provide access to internet for student and staff, it is imperative to establish a standard and dedicated IT center for each university to accommodate all the computer labs, server room, technical rooms, lecture rooms and administration offices to fulfill the requirements as an accredited university in the future. In another hand, these centers will facilitate the ground for Afghan professors to access new researches and update their knowledge according to new technology and innovation around the world.

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Furthermore, information technology enhances the Afghan student's level of knowledge and increase the quality of education and gives access and joint student to across the world. We want each university in Afghanistan has a standard and dedicated building for the IT center in the coming years, that all the academician can utilize it for prosperity, peace and development of Afghanistan.

IT center is a dedicated facility that houses the server and the core networking infrastructure, including administrative offices, E-learning studio and computer labs.

Thinking about its criticality hardware's (24x7 activities) and its activity prerequisites, for example, cooling, encompassing temperature, technical spaces (raised floors, cable tray, duct, suspended ceiling, etc..) and specially care needs to be taken to ensure that the optimum environment exists for foresaid equipment's operation, a number of criteria are needed to be considered by the consultant in setting up such an IT center in the Afghanistan context that will be covered in following: (Division and February 2014) (Lowe, Green, and Davis 2016) (Pichard 2002) [6, 10, 11]

- Considering the requirements for site/location selection of an IT center
- considering the technical/engineering/architecting criterions for an ideal IT center

2. Research purpose
This research aims to acquire the requirements for design and construction of information technology facilities (ITF) for Afghan universities including but not limited to:
- Architectural and technical requirements of ITF
- ITF Site selection
- Structural loading
- Raising of floors
- Pathways
- Determining of Outlet Boxes (floor and wall)
- Special Spaces
- Wall Requirements
- Clearances
- Server Rooms
- Dust and Static Electricity
- Other Requirements

3. Methods of study
The method which is used in this research is the descriptive analytical method, and has valid scientific sources meanly, books, and libraries. All requirements and needs for IT facilities are compiled from valid scientific resources and global standards and interview with IT Managers of key universities, of course in Afghanistan context in spite of existing limitation to at least fulfill the function of a basic IT center for universities.

4. Standard technical requirement and site selection for IT center building
IT center is a little special than any other building and need its own requirement in viewpoint of architecture and engineering according to its function that it can serve. Appropriate idea and thought must be done while planning IT facilities. Planning IT Centers and bolster framework to be adaptable and be capable oblige future development with practically zero disturbance to administrations. Key contemplations while capacity planning for IT centers are as follow: (Division and February 2014) [6]

1. Determining the recent limit of frameworks to dissect how they are addressing the necessities of the utilizer.
2. Determine the business demands and the degree of administration expected or potentially dedicated by the IT division
3. Using gauges of future business movement, deciding the future framework prerequisites. Executing the necessary changes in framework arrangement will guarantee that adequate limit will be accessible to keep up administration levels, even as conditions change later on.

4.1. Site selection
Location for IT center can be either selected for new construction or for existing site inside the campus, the following items should be considered upon selection of site: (Division and February 2014) [6]
- The area of the IT buildings ought to be unnoticeable so as not to pull in undue consideration.
- Zone study for 100 years flood history should be done
- Adjacent transportation, shall not be beneath a final approach path within 2 miles of a major airport
- Adjacent Hazards, No high risk occupancies (Refinery, Chemical Plant, Hazardous Manufacturing Facility, etc.) within ¼ mile distance.
- The buildings must comply with current seismic and wind requirements, for zone in which it is located, rack supports should be seismically isolated and supported
- Do not place the information/server room straightforwardly underneath water pipelines (washrooms, canalization pipes, air conditioning water pipes, and so forth.) as it has the danger of water spilling through the walls and roof.
- The server room ought not have outside confronting windows. (Outside confronting windows have the danger of simpler break-ins and it's difficult to control IT room temperature).

4.2. Structure loading
contemplating the basic strength of the building structure and the heaviness of (Dead load 150 psf with the exception of the structure load, and live load equal to 100 psf) as indicated by ASCE-7-05 that the structure and the floor can suffer, particularly if the data room will locate on a higher floor (after second floor). See ASCE-7-05 for more detail. (Division and February 2014) [6]

4.3. Floor requirements
- The server room and PC labs with a raised floor gives a shrouded void to the entry of mechanical, electrical and data services. Be sure, that such floor surface should be sufficient and strengthened with extra supports to take the load of weighted equipment that placed in the server room or PC labs. (CISCO 2017) (Division and February 2014) [4, 6]
- Many of IT centers likewise utilize overhead plate for directing mechanical, electrical and IT services rather than raised floors. (Division and February 2014) [6]
- Air dissemination or cooling is another factor that could influence the choice on utilization of raised floors. (Lepp 2013) [9]
- An appropriately model raised floor ups in improving the strength and load bearing capacity of the Server room floor (Division and February 2014) [6]

- The raised floors height must be 10 to 18-inch and are assumed to accommodate the height of your Data Center server cabinets
- Designing the quantity of racks (servers, networking and equipment), alongside the space required for specialized hardware while computing the floor zone required. The territory ought to have the option to meet necessities of the upcoming future too.
- The Data Center/server room with the raised floor consisting of 2 x 2 feet floor tiles. Vertical stanchions holding the floor up will be anchored to the subfloor with glue and metal anchors. (Lepp 2013) [9]
- The Data Center's raised floor, including ramps, and its subfloor must be sufficient to support fully loaded server cabinets weighing at least (250-300 psf).
- Replaceable tacky mats will be installed atop the raised floor, immediately inside every rooms with the raised floor
- The subfloor cement pad will be coated with a static dissipative and nonconductive porous surface sealant designed for high-technology environments. (Lepp 2013) [9]
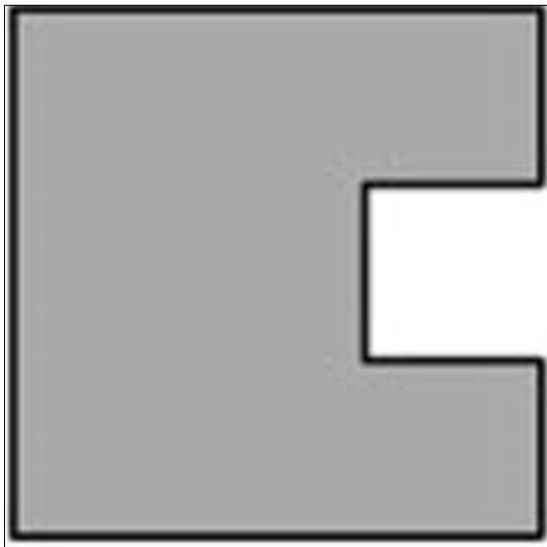

Fig 1: Cut/Notched, Cutout dimensions 8 × 8 inches (20 × 20 centimeters) for behind server cabinets and below network cabinets
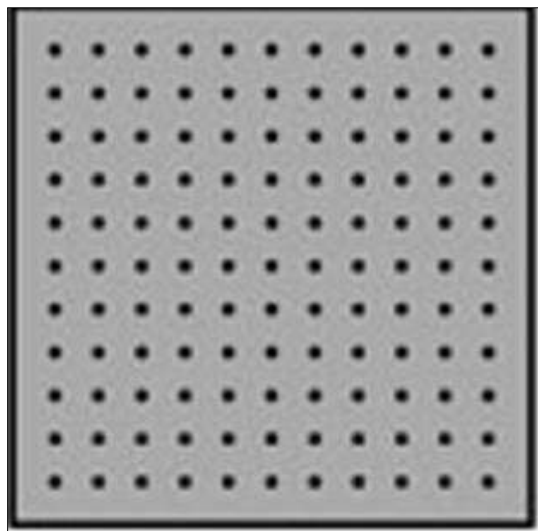

Fig 2: Perforated, Cutout dimensions 8 × 8 inches (20 × 20 centimeters) for in front of all cabinet locations

Fig 3: Plain, Cutout dimensions 8 × 8 inches (20 × 20 centimeters) For All other floor locations
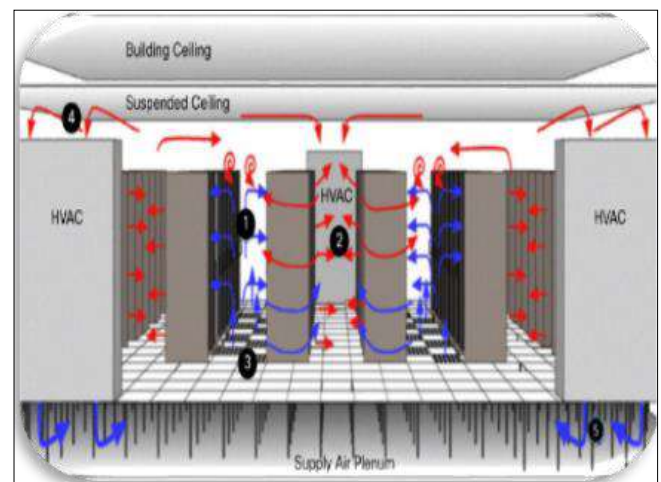

Fig 4: Raised Floor and supports

Fig 5: Raised Floor and supports
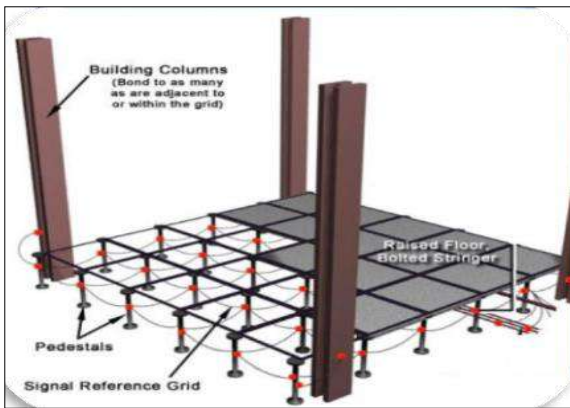

Fig 6a: Raised Floor and supports
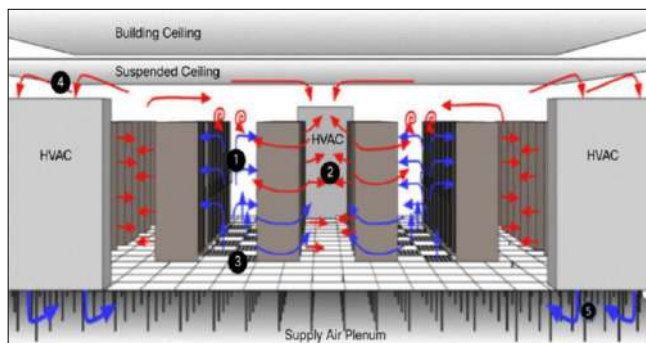
Figure 6b: Raised Floor and supports

Fig 7: Raised Floor and support

4.4. Pathways- structure
Pathways or platform that gives a perpetual and reusable shelving rack for lodging and sheltering of media cable and networking mounted between points. These structures additionally give a lasting fenced in area or system that encourages the option or substitution of cables after some time. Intra-room pathways incorporate cable tray and channel (conduit), which might be utilized for horizontal or vertical directing of networking or cables according to technological and correspondence prerequisite communication plan. The Intra-room communication system cable structure incorporates the pathway and axillary stands that ensures transferring the horizontal cabling between its beginning point in the data center or server room to the workstation outlet district. (Thorning 2008) [14]

Fig 8: Elevated Pathway (cable tray)

4.5. Vertical pathways
Column pathways (vertical pathways) are characterized as structures that hide, save, support, and give access to cables between broadcast telecommunications spaces (stories). Spine pathways comprise of channels or conduit, sleeves, openings, cable tray, media transmission spaces, and other support utilities. For intra-building vertical pathway installation, give at least two 4-inch (10 cm) channel between technical rooms situated on a similar floor or pathway that gives identical capacity (cable tray assembled to help the column pathway and horizontal dissemination). In multilevel structures, give at least three 4-inch (10 cm) channel (conduits), sleeves, or a proportional measured space between stacked technical rooms on next floors. (For, Release, and Unlimited 2016)(STANDARD 2012) [7, 13]

4.6. Horizontal pathways
Flat (horizontal) pathways are characterized as structures that disguise, secure, support, and give access to cables between the broadcast telecommunications spaces and the work zone outlet. Flat pathways comprise of channel, cable tray, roof dissemination, connect floors, and non-ceaseless pathways (J-hooks).
There are numerous strategies to convey the cable from broadcast communications space to the work region and numerous buildings may need a blend of at least two kind of pathway frameworks to meet all the circulation needs. Use the cable tray for flat (horizontal) dissemination to the greatest distance conceivable (80 to 90 percent of the horizontal cable length). The rest of the pathway to the work zone outlet might be implemented in an assortment of ways merged channel or conduit, non-stopped cable supports, and stub-ups. (For, Release, and Unlimited 2016)(STANDARD 2012) [7, 13]

4.7. Inter building pathways
Both direct covered and cement encased pipes for the steering of most of the university's inheritance correspondence communication cabling system. aerial cabling system are additionally instances of Entomb Building Pathways, in any case, underground pathways will be built any place conceivable as indicated by communication plan, and Elevated Pathways will possibly be utilized when covered or concrete encased offices are impossible. (Thorning 2008) [14]

4.8. Wall-mounted outlet box
Give two gang electrical boxes to walls, least standard size (10cm) square and (5.4 cm) profound with a mortar ring for joint of the single gang faceplate. Outlet box for mounting with the faceplate to the wall surface, ought to be at a similar level from the bottom as electrical outlets. Place a quadruplex electrical outlet inside 15cm of all work region outlets to serve broadcast communications loads related with that outlet. For the electrical plug circuits, expect that every zone of two duplex receptacles are going to charge one PC with a screen alongside office appurtenances alike, task lights, and accept that there will be no expansion of this heap. (For, Release, and Unlimited 2016) [7]
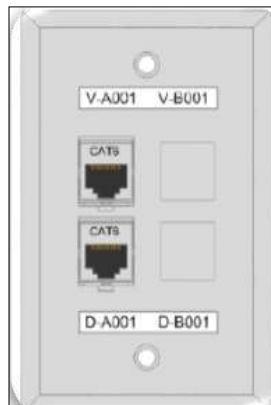
Fig 9: Quadruplex/Double gang

Fig 10: Wall Faceplate

Fig 11: Wall recess mounted Outlet

4.9. In-floor outlet boxes
Utilize in-floor outlet boxes just if no other option exists for taking care of furniture arrangement, such as study hall work areas, podiums in auditoriums, classrooms desk, and other detached furnishings. In certain situation, an in-floor upright network type might be required to give vital adaptability. (For, Release, and Unlimited 2016) [7]

Fig 10: In-Floor Outlet box

4.10. Special spaces
Perpetual structures that give a secured zone to the end of cables and position of equipment and hardware, take into account the dissemination and dispersion of cables and labors access to ease the positioning of the cable. Intra-building Spaces contain equipment rooms, services entrances, server rooms, IT rooms, termination spaces alike, pedestals, hand holes, maintenance holes and pull boxes. (Thorning 2008) (Version and Resale 2014) (Publication 2014) (Pichard 2002) [14, 11, 12, 15]

4.11. Wall requirements
Server room walls ought to reach out from the completed floor to the structural roof, painted white and be fire-resistant for at least a couple of hours. The data room walls should not have windows installed, nor is it desirable to locate the data room on perimeter/curtain walls where windows locate the entire surface of the walls. In construction phase, take care of the placement of horizontally and vertically ducts/holes to accommodate proper networking. (Thorning 2008) (Publication 2014) (Version and Resale 2014) [14, 12, 15]

4.12. Clearances
The accompanying clearances will be kept up for equipment and cross-link fields in the technical Rooms:
- A minimum of 100 cm of clear working spaces for aisles, in front, behind network equipment and patch panels, doorways, electrical panels and another equipment
- A minimum of 15 cm clear depth off wall for wall-mounted equipment
- Verify equipment's footprints and fixtures to ensure working clearances with future growth of minimally one rack (Thorning 2008) (Publication 2014) (Commscope 2018) [14, 12, 5]

4.13. Server rooms
The Server Room needs racks, stepping stool racks, devoted and comfort electricity and cooling system. There have to be at any rate one technical room for every floor or up to 10,000 square feet. Several rooms are required if the cable length between the technical room and the broadcast communications outlet, including slack, surpasses 295 feet.
Technical rooms will be at least 100 to 120 Square feet in size, based on the frameworks they will contain. The rooms will be generally square, with a dimension of at least 10 feet one side. The size of the technical room must be controlled by the size of equipment to be placed to assure appropriate estimating. The arrangement of other affirmed low voltage system in the technical room will require extra space portion to the room. Ensure the space for special data systems such as LANS and CATV. (Thorning 2008) (Publication 2014) [14, 12]

4.14. Dust and static electricity
Exposed surface floors are an extensive wellspring of dust, and regular vinyl floor tile boosts the process of electricity produced via friction. Anti-static electricity floor tiles ought to be given in every equipment room. Before putting in place of technical equipment, cable distribution and termination, make sure that rooms are perfect and liberated from dust and filth. (Thorning 2008) (Publication 2014) (Pichard 2002) [14, 12, 11]

4.15. Green IT center

Use a green methodology while planning the IT center to make sure that the IT Center is environmentally acceptable and energy efficient from development to destruction. Advantages of a green project in an organization is various and we can incorporate green policies in our project by different ways. It brings about unmistakable investment funds through decreased energy utilization, more noteworthy durability and affordable use of natural resources, if we compliance with developing Green norms. (Division and February 2014) [6]

4.16. Other Requirements

- All entrance into the server room/information room must be guarded (Division and February 2014) [6]
- Surrounding walls ought to be run from floor to roof/ceiling without any cease (Publication 2014) [12]
- All walls in server room should be full height, and well-constructed with hard material. no window is allowed because of dust and filth infiltration (Publication 2014) [12]
- There ought to be no entrance through the data center to another room such as, workplaces or an electrical room.
- Server room and racks must be arranged in a way to ensure the dissemination/circulation of hot/cold air. Considering raised floor and false ceiling if exist.
- Control and evaluate the temperature inside the server room to be somewhat in the range of 18C and 22C.
- Maintain moistness in the server room in the range of 22% and 30% (less humidity will cause static electricity production, more humidity will make buildup and lead corrosion)
- The encompassing walls ought to have in any event a two-hour fire-rated resistance. (Division and February 2014) [6] (Bussiness 2015) [3]
- The server room will have no structure outside entryways or outside windows. On the off chance that outside windows must be available, they will be protected, furred out, encased with drywall board, and afterward covered with whatever outer windows adorned. (Publication 2014) [12]
- Building will have an automatic mechanism (sensors) that monitor and gives alert for the beneath items: (Access 2018) [1]
  - Electricity
  - Uninterruptable Power Supply
  - HVAC system
  - Power Diesel Generators
  - Air conditioner
  - Cameras (security camera)
- The IT center building must be appropriately furnished with fire extinguisher system This comprise detection, including, Fire identifiers alarm (detectors), Fire sensors and smoke alarms, and protection, such as, automatic fire extinguisher system must be set up. (Division and February 2014) [6] (Group 2013) [8]

5. Deliverable phase based engineering documents for an IT center

Prior to design and construction phases, the professionals must provide the following documentation for the IT center establishment in order to prevent any missing items and deficiencies.

5.1. Schematic design phase

After the finishing of the schematic planning stage, the designers ought to give the below items but not limited to: (Thorning 2008) [14]

- Existing site layout indicating utility zone and profiles
- Demolition plan if necessary
- Floors and outlets distribution layouts
- Drawing of building
- General plans of the building with utilities layouts
- IT symbol list
- IT equipment and special equipment footprint

5.2. Design phase

After the finishing of the design planning stage, the designers ought to give the below items but not limited to: (Bell 2005) (Thorning 2008) (Commscope 2018) (Publication 2014) [14, 5, 12]

- Details of IT distribution and components for building and local distribution
- Riser Diagrams for networks (duct)
- Wall mounted outlet and Locations detail
- Room's plan with raised floors
- Raceway Distribution Plan
- IT offices network distribution and equipment layouts (server rooms, data centers, and technical room with special spaces, cable tray directions, pathways, locations and sizes)
- Footprint including cable tray, ground bar, backboard, equipment racks locations, etc. Ghost electrical, lighting, fire protection, HVAC and other support systems. Verify all clearances are met.
- Site layouts which describe all ITs and other facilities
- Infrastructure. Include the locations of connection to nearest available connection points
- Typical detail of penetrations including firestop assemblies
- Typical detail of cable support systems
- Typical detail of pull box, raceways, and conduit assemblies
- Typical detail of elevated floor sections
- Typical detail of floor's boxes, including conduit entrance and power assemblies containing all device required for mounting
- Typical detail of the phone
- Typical detail of outlet components
- Detail of the outlet box and conduit assembly to wall, floor, ceiling or access point
- Wireless points and installation details
- Interface outlets and interface of Alarms and Building Management Systems
- Typical detail of all other accessory and support apparatus
- Typical detail of all classroom equipment installations
- Typical detail of special IT equipment installations
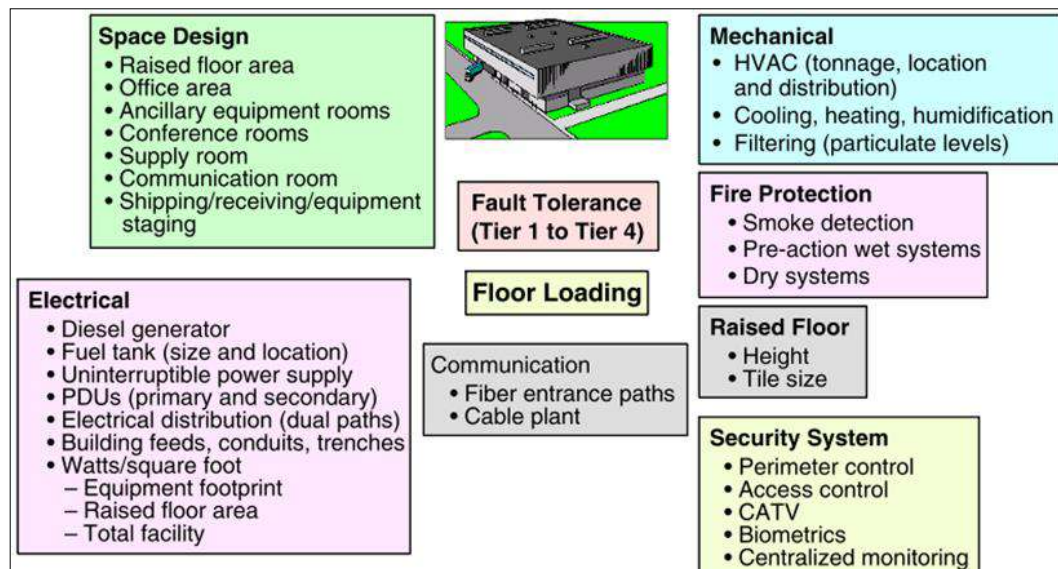- Typical detail of entire cameras and media devices location and installation

Fig 11: Engineering Plan and space design

5.3. Construction phase

After the finishing of the construction planning stage, the contractor ought to give the below items but not limited to: (Thorning 2008) (Publication 2014) (Commscope 2018) [14, 12, 5]

- Reports and as-built drawing with approved changes or modifications documentation for all project activities
- Journal of construction and instruction for special items (walls, floors, ceiling and etc.) and project stakeholder approved orders for each task
- Suspended board ceiling plans for technical rooms.
- Floor plans, elevations and layout specifics
- Define details and changes to IT equipment
- Raised floor as-built layout with outlet location and number that already reflected in IT's equipment Plans
- Drawings indicating paths of distributed cable runs
- The test results for all IT cabling, including optical fiber, building distribution and horizontal cabling
- Provide Trainings and information on all IT and equipment support systems, including fire protection, HVAC, alarm systems, etc.
- Provide guideline for each equipment (installation, usage and repair)
- Provide guideline for whole system operation and maintenance

6. Conclusion

As a conclusion in this paper the following items are distinguished for designing and construction of a standard IT center in Afghanistan universities:

- The Study and survey of existing IT center infrastructures including background and future capacity planning if a university has
- Study characteristics of an ideal IT centers
- Define and provide architecture and engineering requirements
- Define special requirement and site location
- Calculate structural capacity (equipment's loads)
- Define and provide wall, floor, ceiling and special spaces requirements
- Consider pathways and its requirements
- Documenting the related manuals for end user

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