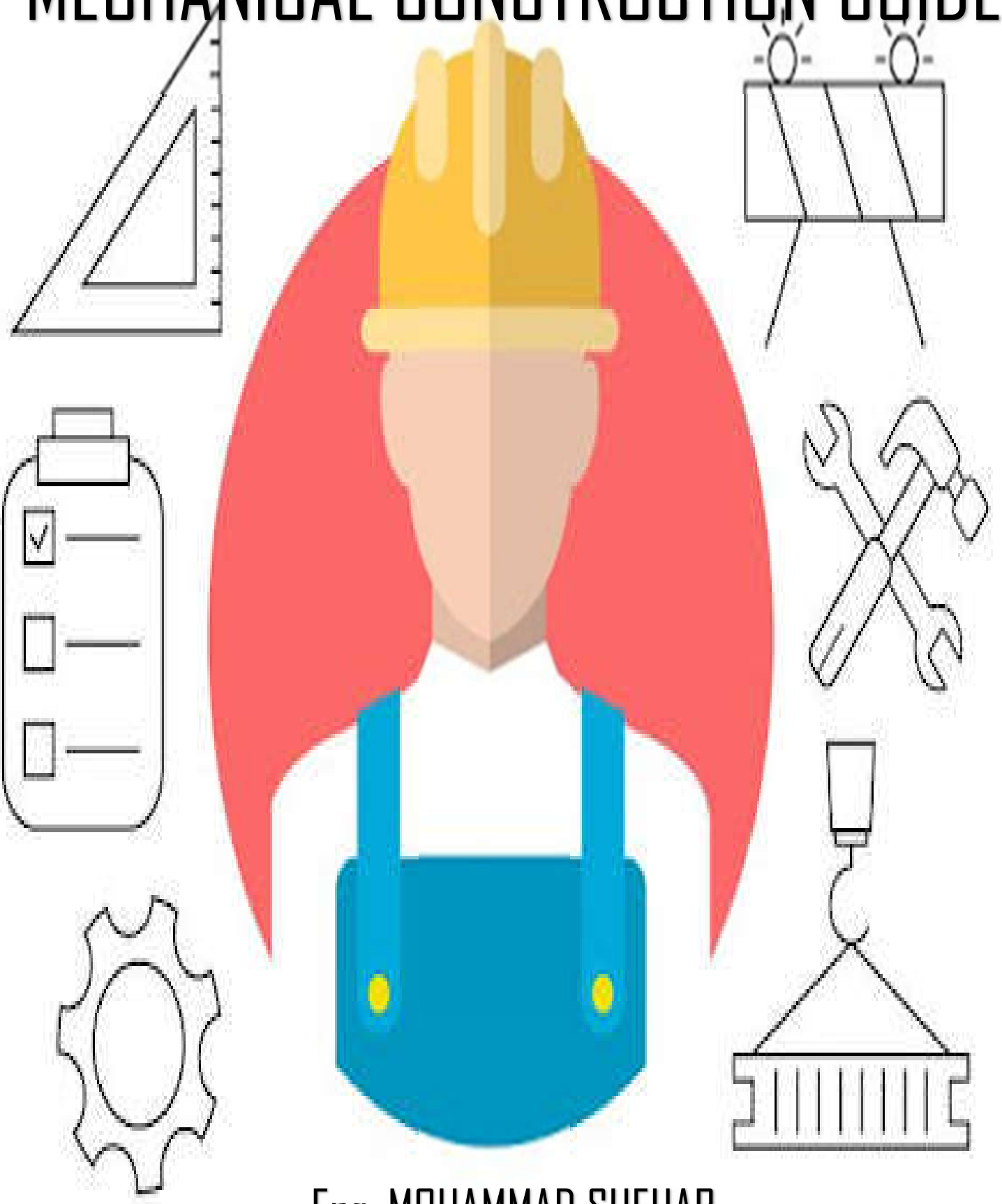
MECHANICAL CONSTRUCTION GUIDE



Eng. MOHAMMAD SHEHAB

MECHANICAL CONSTRUCTION GUIDE

بسم الله الرحمن الرحيم والحمد لله رب العالمين . أما بعد :

هذا الكتاب هو بمثابة دليل وشرح مبسط لجميع الأنشطة الميكانيكية الخاصة بمجال المقاولات, يستهدف بالمرتبة الأولى مهندسين الميكانيك حديثي التخرج , بهدف ايصال فكرة عامة وشاملة لعمل مهندس الموقع والأعمال التي من الممكن ان تكون مرافقة لة مع بداية مسيرتة المهنية .

من ناحية أخرى , هو بوابة لتوسيع مدارك المهندس والاطلاع على المعلومات القيمة التي تحقق نتائج حتمية للقبول في مقابلات العمل . وذلك لان الكتاب يشمل اجابات معظم اسئلة مقابلات العمل لمهندسين الميكانيك ضمن نطاق حديث التخرج الى سنتين خبرة .

هذا الدليل لا يعتبر مرجع أبدا . بل هو عصارة خبرة أكثر من خمسة عشر سنة فعلية بمجال المقاولات بالأقسام المختلفة , لذا فهو قابل للنقد والمراجعة والأضافة من القراء الأكارم .

هذة هدية مني لكم واتمنى للجميع الفائدة والتطور بالحياة المهنية .
بالمقابل أرجو منكم الدعاء لي ولعائلتي

واقبلو مني فائق الأحترام

م.محمد شهاب

بدء مشروع جديد (Project Initiation) :

تبدء فكرة انشاء المشروع عند رغبة المالك (قطاع خاص / قطاع حكومي) استثمار المال في مبنى تجاري , سكني , او احدى المرافق العامة لخدمة المواطنين في شتى مجالات الحياة (سكني / صحي / ترفيهي / .... الخ) .

بعد الانتهاء من وضع ميزانية محددة للمشروع بالتنسيق العميق بين المالك (Client) و المصمم (Designer) , تتضح المعالم الاساسية في المشروع وترتسم المبادى الاولية لخطة تنفيذة (جدول زمني / ميزانية / جودة / مستوى الرفاهيه /.....الخ) .

الان موصفات المشروع جاهزة للدراسة والتنفيذ .

- موصفات المشروع (Project Specification) : هي شرح مفصل يعكس رغبة وتصورات المالك لألية تنفيذ المشروع . ويتضمن ولا يقتصر غلى ما يلي :
  1. يحدد اللغة الرسمية (عربي / انجليزي) للتواصل في المشروع (Letter and Mail).
  2. يحدد ضوابط العلاقة بين المالك وجميع الاطراف (كألية التواصل وعدد الاجتماعات) .
  3. المرجع الوحيد لاختيار المواد المختلفة وتفضيل بعضها على بعض .(كاختيار مواسير النحاس فضلا عن مواسير البلاستك في Water Supply System.
  4. شرح عام ومفصل لجميع الانظمة المراد تنفيذها من حيث موصفات التخزين والتركيب والتشغيل .
  5. مستوى الأختبارات والتشغيل لجميع الأنظمة (Testing & Commissioning) .
  6. لائحة بجميع قطع الغيار اللازمة عند التسليم النهائي .
  7. وغيرها .....

بعد ذلك يقوم المالك بتعين شركة استشارية / مكتب استشاري (Consultant / Engineer)بعقد رسمي و تعيين المقاول الرئيسي (Main Contractor) لبدء بمرحلة جديدة من مراحل المشروع .

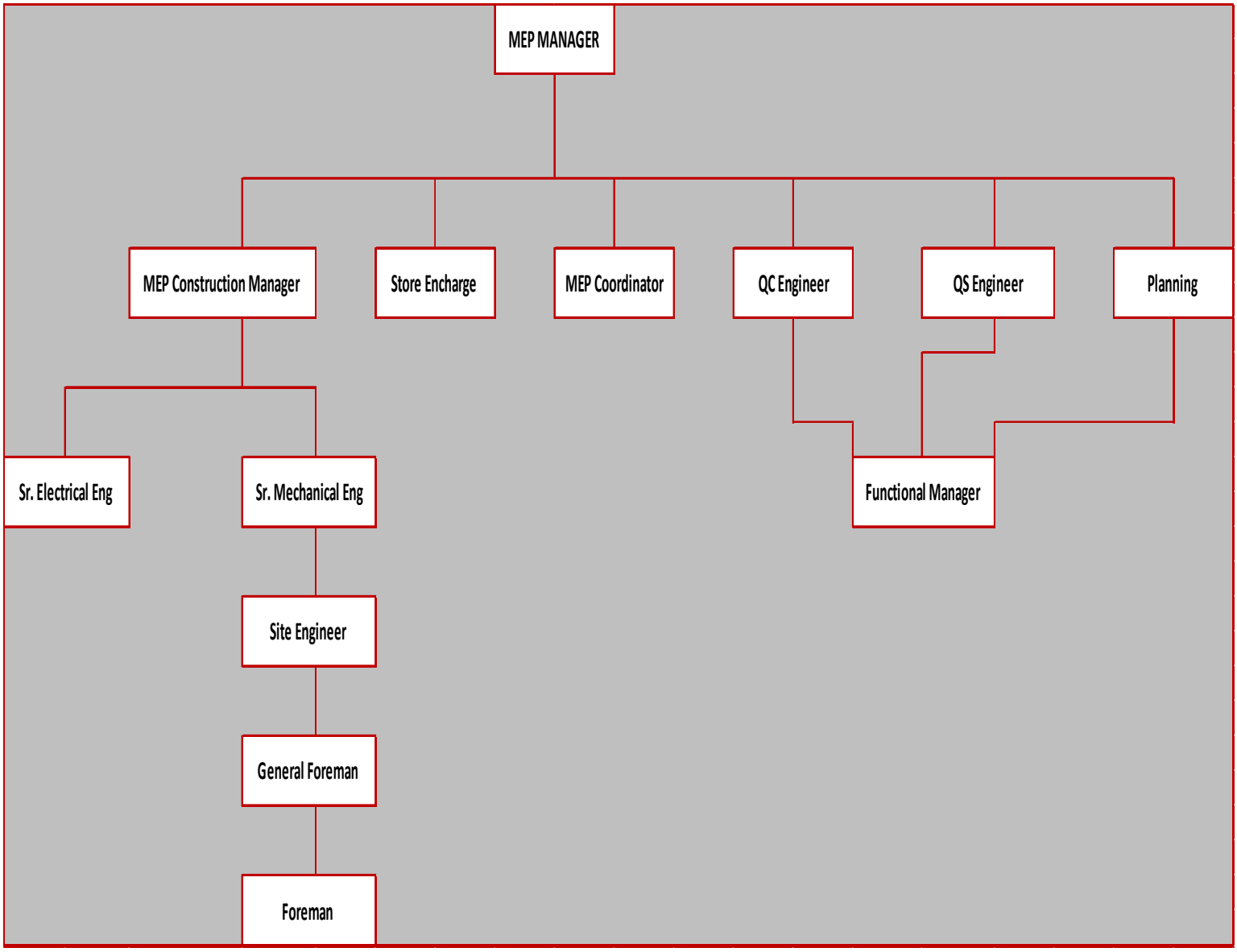
- شركة استشارية / مكتب استشاري (Consultant): شركة تضم مجموعة مهندسين ذو خبرة كبيرة تقوم بالاشراف على عمل المقاول الرئيسي للتاكد من تنفيذ جميع الاعمال حسب رغبة وتصور المالك .

- ألمقاول الرئيسي : شركة معتمدة تتولى ادارة تنفيذ المشروع ويمكن ان يعين عدة مقاولين بالباطن (Sub-Contractor) تحت اشراف ومتابعى المقاول الرئيسي .

- الخريطة التنظمية (Organization Chart): خريطة تنظمية تستخدم لتوضيح التنظيم والتسلسل الاداري لكافة الموضفين . وفي ما يلي مثال يوضح التنظيم الاداري للمقاول الرئيسي MEP ويتضمن جميع الاقسام اللازمة لاتمام سير العمل تحت ادارة مدير المشروع MEP Manager: وفيما يلي بعض الأقسام المهمة الواجب التعرف عليها :

  - ✓ قسم العمليات (مهندسين الموقع) (Operations Team): يترأس القسم MEP Construction Manager يدير مهندسين الميكانيك والكهرباء لاتمام سير الاعمال التنفيذية فب الموقع .
  - ✓ قسم التنسيق (Coordinator) : وهو من اهم الاقسام المسؤلة غن التنسيق بين جمع الاقسام التنفيذية في الموقع ويحدد الاولويات أثناء عملية التركيب . وتكمن أهمية التنسيق خلال اصدار المخططات التنفيذية (Shop Drawing) وأيضا خلال تنفيذ غرف المضخات , الخزنات , التبريد ,... الخ .
  - ✓ قسم مراقبة الجودة (Quality Control QC) : القسم المعني بالحفاظ على مستوى الجودة بتنفيذ الأعمال حسب الموصفات والمعايير العالمية .
  - ✓ قسم حساب الكميات (Quantity surveyor QS) : المهندسين المسؤلين عن حصر الكميات قبل , خلال وبعد التنفيذ . وهم المسؤلين عن ترجمة الاعمال المنفذة الى فواتير شهرية . اضافة الى المطالبة بأعمال المتغيرات التنفيذية (Variation Orders) (وهي أعمال مطلوب تنفيذها لاتمام سير العمل لكنها خارج جدول الكميات المعتمدة من قبل المالك للمقاول .

- ✓ قسم التخطيط (Planning) : القسم المسؤل عن وضع الجداول الزمنية لاتمام الأعمال المختلفة باستخدام برامج التخطيط .
- ✓ مسؤول ادارة المستودع (Store Keeper).



- التواصل والتنظيم الاداري (Communication and reporting) : التعرف على موقعك الوظيفي ضمن التنظيم الاداري في الشركة من اهم الامور لضمان التواصل الصحيح واتباع التسلسل الاداري .

مرحلة التخطيط (Planning Phase) :

بعد تحديد الأطراف الرئيسية بالمشروع (المالك / الاستشاري / المقاول) يبدأ التخطيط بتفاصيل اعمق لضبط وتحديد الثوابت التالية التي تحدد مدى نجاح المشروع بمقدار الاتزام بها والعكس صحيح :

- ✓ نطاق العمل (Project Scope) : تحديد الاطار العام الدقيق لجميع الاعمال الموكلة من قبل الملك للمقاول الرئيسي . من ثم تقسيم نطاق العمل الاجمالي الى عدة مجالات صغيرة والتي يسهل التحكم بها .

- ✓ الجدول الزمني (Project Schedule) : يتم تحديد موعد بدء والانتهاء من المشروع من خلال انشاء موعد زمني يتم الاتفاق علية من جميع الأطراف وبالتالي التعهد بما يتضمن من تواريخ . لانشاء الجدول يتم تحديد جميع المجالات الصغيرة وترتيبها حسب الأولوية من ثم حساب الموارد المطلوبة لاتمام هذة الأعمال وبالتالي المدة المطلوبة الكلية لجميع هذة النطاقات الصغيرة .

- ✓ الميزانية (Budget): المبالغ المالية المحجوزة لتنفيذ المشروع وتتضمن جميع التكاليف .

- ✓ جودة المشروع (Project Quality): الجودة المطلوبة لتنفيذ الاعمال والتي يشرف عليها مهندس الاستشاري .

- تحديد واختيار الكوادر والعمالة المطلوبة للمشروع (Manpower and Staff nomination and selection): وذلك حسب كمية الاعمال و اولوية المشروع . مرفق جدول تخطيط العمالة الميكانيك للمشروع .

مرحلة التنفيذ (Execution Phase) :

1. قراءة جميع مستندات المشروع بتمعن لفهم الصورة العامة للمشروع وتلخيص النقاط المهمة التي يبنى عليها ما يلي . مستندات المشروع (Project specification / Minimum Technical MTR / Basis of Design BOD).

2. قراءة ومراجعة المخططات التصميمية (Design Drawing) ووضع الملاحظات اذا امكن (تحتاج خبرة تصميمية وعملية) .

3. تقديم موصفات فنية لجميع المواد المراد استخدامها (Technical Materials Submittal) من ثلاث موردين على الاقل على ان تكون متوافقة مع موصفات المشروع .

4. طلب جميع الأدوات اليدوية و المعدات الكهربائية التي تتناسب مع متطلبات المشروع . مرفق لائحة بجميع الادوات اليدوية بالصور.

5. انشاء ورشة صناعية اذا اقتضى الأمر وهي من الأمور الضرورية ايضا والتي تحتوي على ما يلي :
   - ✓ Steel Welding Machine.
   - ✓ Groove Machine
   - ✓ Threaded machine

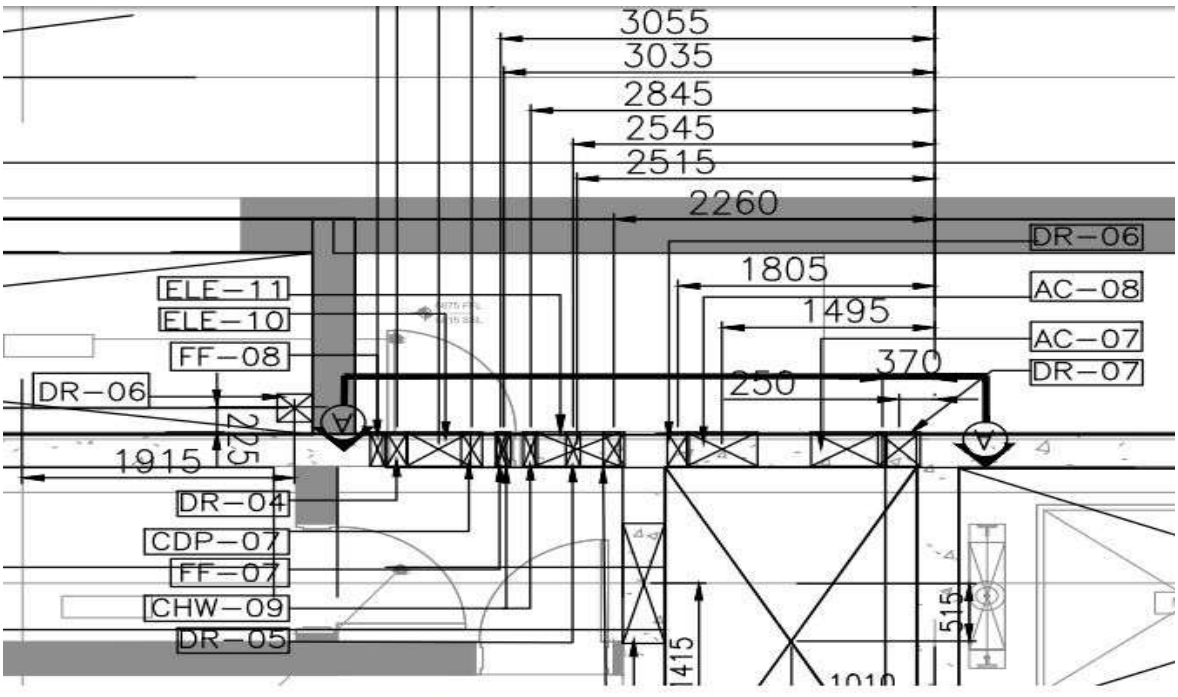
- ✓ Oxygen and Acetylene Cylinders
- ✓ Stand Drill Machine
- ✓ Cutting Machine
- ✓ Coring Machine
- ✓ Painting compressor
- ✓ Insulation Field
- ✓ Steel Fabrication yard
- ✓ Sand blast area

6. حصر وطلب بعض المواد الأولية (First Fix Materials) بشكل مبدأي بكميات قليلة جدا لضمان عدم تعطيل او ايقاف الأعمال المدنية (الخراسنية تحديدا). مثال : المواسير البلاستيكية (UPVC pipes and fittings) .

7. طلب مواد التثبيت (Hanger and support) . سوف يتم التطرق الية بقسم منفصل بالأسفل .

8. طلب بعض المواد المستهلكة التي قد يحتاجها المشروع (Consumables).مرفق جدول بأهم هذة المواد .

9. في هذة الاثناء على الأغلب يكون قسم الأعمال المدينة منشغل في صب القواعد الخرسانية (Slab and Raft) لذلك يتوجب عليك المتابعة والتنسيق معهم لتزويد الموقع بما يحتاجة لاتمام اعمال الخرسانة . كالتزويد بفتحات لعبور الانظمة الميكانيكية والكهربائية بالمستقبل (Sleeve and Opening) وتنفيذ شبكات الصرف الصحي في القواعد ان وجدت .



PLAN VIEW

10. تحويل المخططات التصميمية الى مخططات واضحة قابلة للتنفيذ (Shop Drawing) : يتم اضافة الابعاد والمقاسات الدقيقة وتفاصيل الموقع الحقيقية والتنسيق الكامل مع جميع الاقسام (كهرباء / انشائي / معماري) .

11. عمل حصر لجميع المواد (Materials Take-off) استنادا على المخططات التنفيذية (Shop Drawing) . سنتطرق الى عملية الحصر بالتفصيل لكل نظام على حدى .

12. تنفيذ الطلبات الشرائية لجميع المواد المحصورة (Material Request) .

13. عمل قائمة متابعة (Tracking List) للمواد المطلوبة للمتابعة و تتبع تواريخ التوريد (Delivery Schedule) وهي عامل مهم للتخطيط الزمني للمشروع .

14. عمل قائمة بالقوى العاملة التي يحتاجها المشروع (Manpower Histogram) بالعدد والتصنيفات المطلوبة . مرفق مثال .

15. البدء بتنفيذ التركيبات الاولية (First Fix Installation) :
- ✓ Pipes and fitting
- ✓ Support
- ✓ Ducting
- ✓ Dampers
- ✓ Pressure and gravity test

16. رفع طلبات التسليم للأعمال التنفيذية الى المهندس الاستشاري (IR-Inspection request) وتسليم المواد الواصلة الى المشرع عن طريق (MIR – Material Inspection) .

17. تركيب المعدات والأجهزة الميكانيكية (.../ Chillers / AHU / FCU / Pumps / Heaters Long Lead Items :).

18. البدء بالتركيبات النهائية (Final Fix):
- ✓ Fire Sprinkler
- ✓ Final Pressure Test
- ✓ Sanitary Fixture
- ✓ Air Outlet
- ✓ Dampers
- ✓ Valves and control devices
- ✓ BMS connection

19. مرحلة الأختبار والتشغيل (T&C – Testing and Commissioning) : البدء بتشغيل واختبار جميع الأنظمة بحضور الاستشاري والمالك .

مرحلة الانتهاء واغلاق المشروع (Closing Phase) :

1. اعداد ملفات الصيانة والتشغيل لجميع الأنظمة (O&M Manual – Operation and Maintenance Manual)
2. دعوة الجهات الحكومية (Authority) للتسليم النهائي لبعض الأنظمة وذلك للتاكد من انها متوافقة مع معايير الدولة وبالتالي يمكن ربطها مع المنظومة الحكومية دون مشاكل :
   - ✓ Civil Defence
   - ✓ Civil Aviation
   - ✓ Water and sewage municipality
3. التسليم النهائي للاستشاري والمالك .والعمل على انهاء اية ملاحظات .
4. الحصول على خطاب التسليم النهائي .
5. جمع الدروس المستفادة للعمل لتعزيز الايجابي و تفادي السلبي (Lesson Learned).

الأنظمة الميكانيكية (Mechanical System) :

في ما يلي الأنظمة الميكانيكية الأكثر شيوعا الواجب توافرها في أي منشأءة حسب مجال العمل والفئة المستهدفة :

1. Drainage system.
2. Water Supply System.
3. Fire Protection system.
4. HVAC- Chilled Water.
5. HVAC- Refrigerant pipes.
6. HVAC – Ducting.
7. Fuel System.

كما يوجد عدد من الأنظمة ولكنها اقل شيوعا . لذلك تحتاج شركات متخصصة لتنفيذها :

1- Irrigation system.
2- Swimming pool and Jacuzzi.
3- Chilled water Flushing and chemical dosing.
4- Fountains.
5- Generator.
6- Grey water treatment plant.
7- Sewage treatment plant.
8- Lifting station.
9- RO plant.
10- Medical Gas.
11- LPG system.
12- Medical equipment.
13- Workshop equipment.
14- Kitchen equipment.
15- Dye-injection system.
16- Water mist system.

DRAINAGE SYSTEM

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Drainage system:

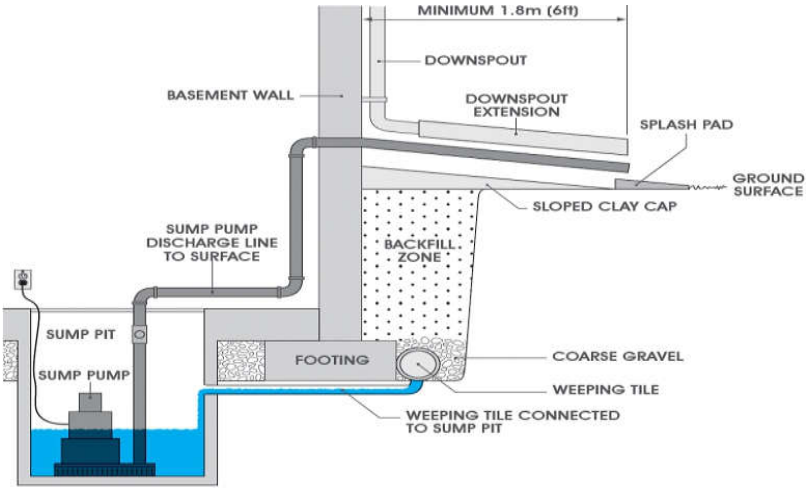
- For Design and Installation Follow local standard (GCC , SBC , …etc) or International one (UPC / IPC) .

- Design and install to drain excess water (Soil / Waste / Condensate / Rain) from buildings.

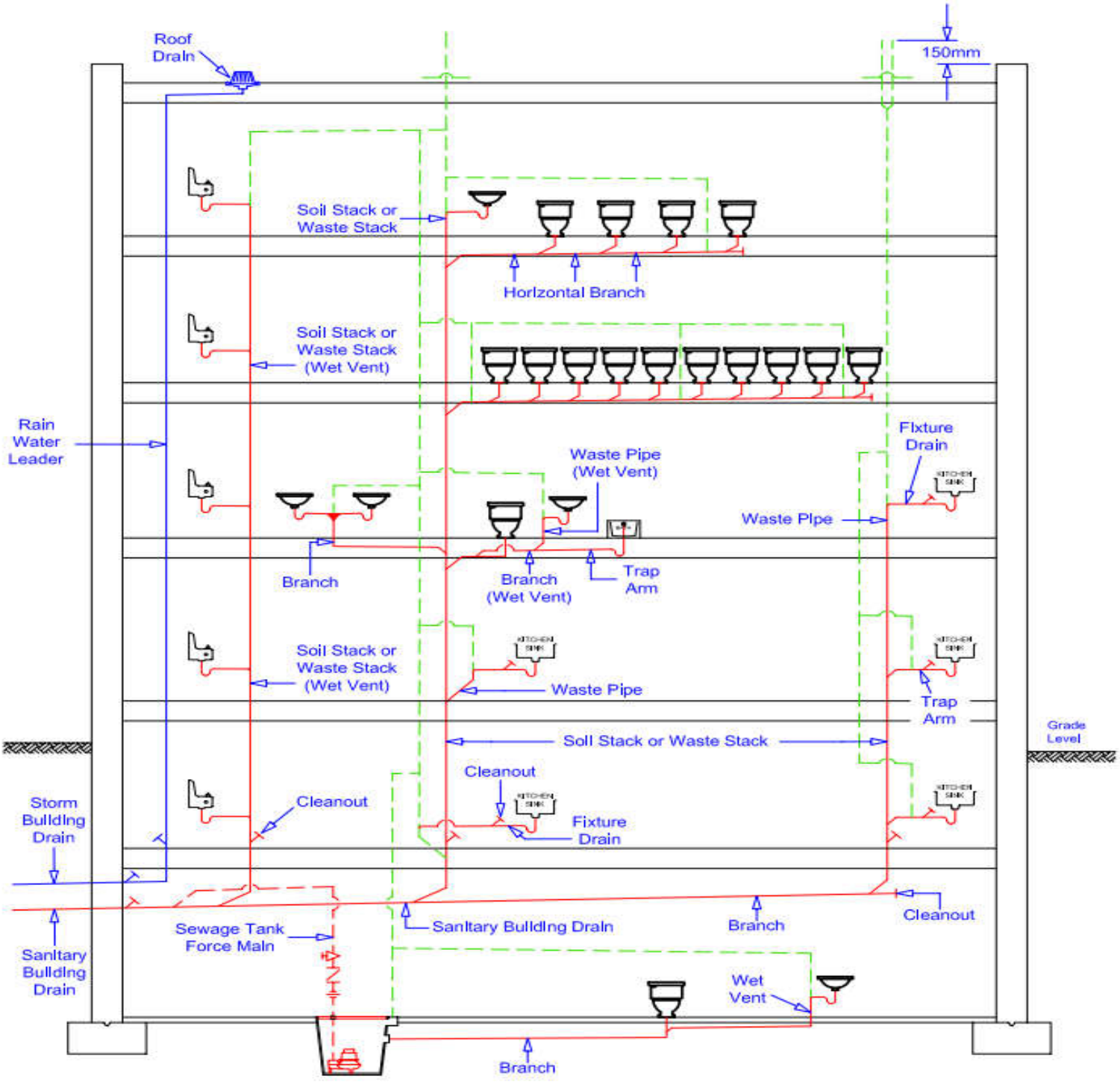
- Drainage System designed either as single pipe (All drain water source connected in single pipe and discharged outside the building to public sewage network).
  Or, as double pipe system (Divide drain system in to two main drainage riser. Soil pipe for direct discharge and Waste pipe for treatment and then reused).

- Definition and example for excess water types :
  - ✓ **Soil Water:** Black water which it can't be reused (recycled). It come from WC , Urinal and Bidet.
  - ✓ **Waste Water**: Drain water can be treated through grey water treatment plant in order to reused for (Toilet Flushing / Irrigation / Process Water) . It come from Shower, Wash Basin, Bathtub and Sink.
  - ✓ **Condensate drain Water** : condensate water from HVAC units (FCU / AHU /…etc) . It can be reused without any further action (treatment).
  - ✓ **Rain (Storm) Water** : Rain water collected from building's landscape and it might be reused without treatment .

- Drain system normally run by gravity to public manhole unless if some drain points below ground level then submersible pump should be installed.



DRAINAGE SYSTEM



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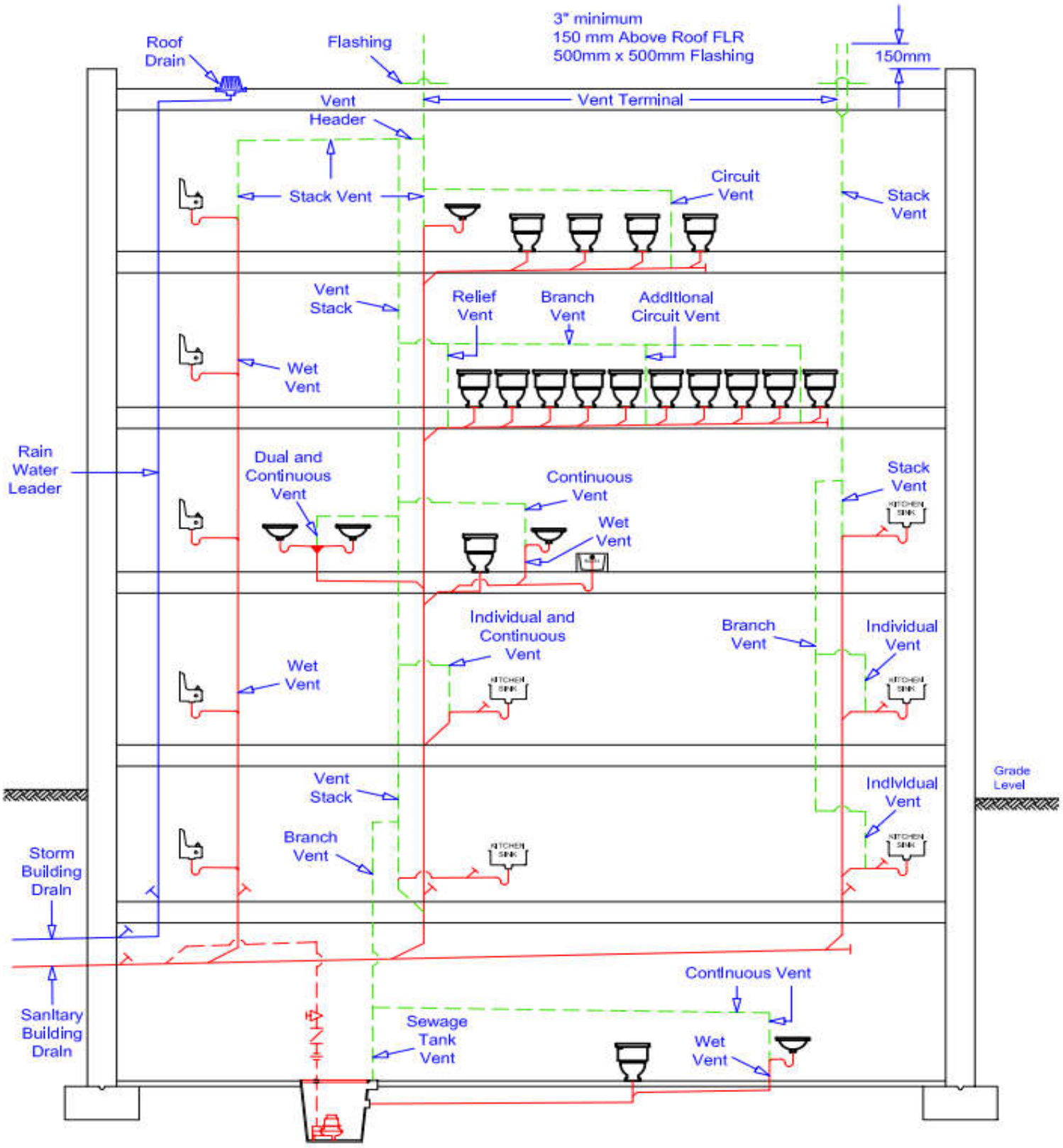
VENTING SYSTEM



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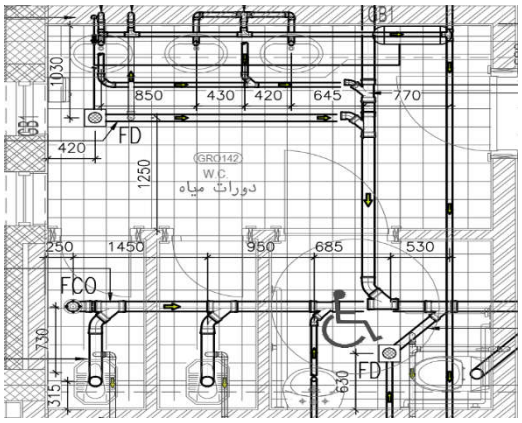
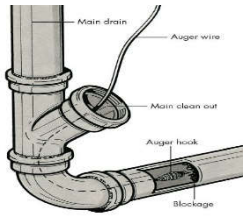
- **Toilet cell Sanitary Fixture :**



  - ✓ Water Closet WC : Eastern / Western / Handicap .
  - ✓ Wash Basin WB .
  - ✓ Sink: Kitchen / Janitor / Laboratory.
  - ✓ Urinal.
  - ✓ Bidet.
  - ✓ Bathtub.

- **Drain Accessories :**

  - ✓ Floor Drain **FD**: Used to collect Waste pipe water and to prevent bad smell .
  - ✓ Roof Drain **RD**: Used to collect rain water from roof .



  - ✓ Clean Out **CO** / Floor Clean out **FCO**: Installed if pipe direction changed or in some certain location that need permeant maintenance.
  - ✓ **Downspout Nozzle**: Decorative drain outlet for free discharge rain water from the building.

  - ✓ **Vent Cowl**: Necessary to close vent pipe at the roof in order to block vents riser from birds and debris.

- **Pipes and fitting Used :**

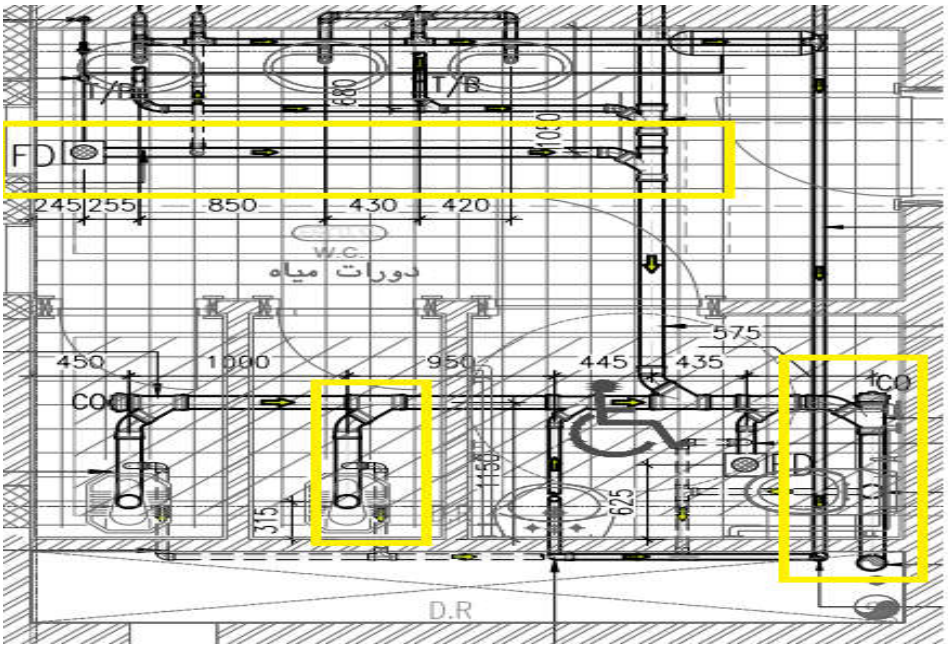
There is a lot of pipes types used in drainage system based on application and location, below is the common types:

- ✓ UPVC: Connection (Solvent or rubber push fit) / Common used in drainage system.
- ✓ Cast Iron: Connection (Stainless steel coupling) / Used in area required higher temperature and noise absorption (Hotel guest room , offices).
- ✓ Ductile Iron: Connection (Flanged or rubber push fit) / in high Pressure application and buried network (external).
- ✓ Stainless steel: Connection (Coupling or rubber push fit) / used in rain water but its expensive .
- ✓ Concrete pipe: Used for large pipe diameter in external network (main sewer city network).

- **Take-Off :**

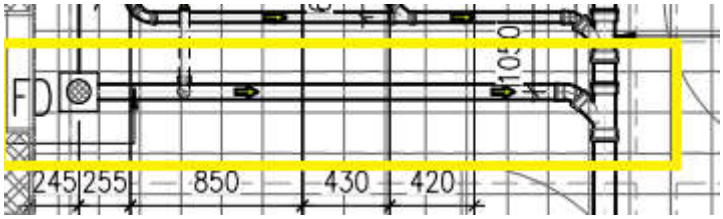
- ✓ You should know what drainage materials are used in approved shop drawing.
- ✓ Check the approved technical material submittals TMS .
- ✓ Review manufacture catalogue from TMS to identify available pipes, fitting list and sizes.
- ✓ Measure the straight lines (pipe) and count the number of fitting.
- ✓ For connection with drain accessories and sanitary fixture, you should review the standard detail, which will show extra connection information.

Example:



Area 1 :

- **UPVC PIPES AND FITTING**
- **CAST IRON FD**



For main line:

1- Y (110mm x 75mm) – 1 Pcs.
2- Elbow 45Degree (75mm) – 1 PCs.
3- Pipe (75mm) – 4 meter.

For vent line :

4- Y (75mm x 50mm)-1Pcs.
5- Elbow 45Degree (50mm)-1 PCs.
6- Elbow 90Degree (50mm)-1 Pcs.

From FD detail :

7- Floor Gully 75mm-1 PCs.

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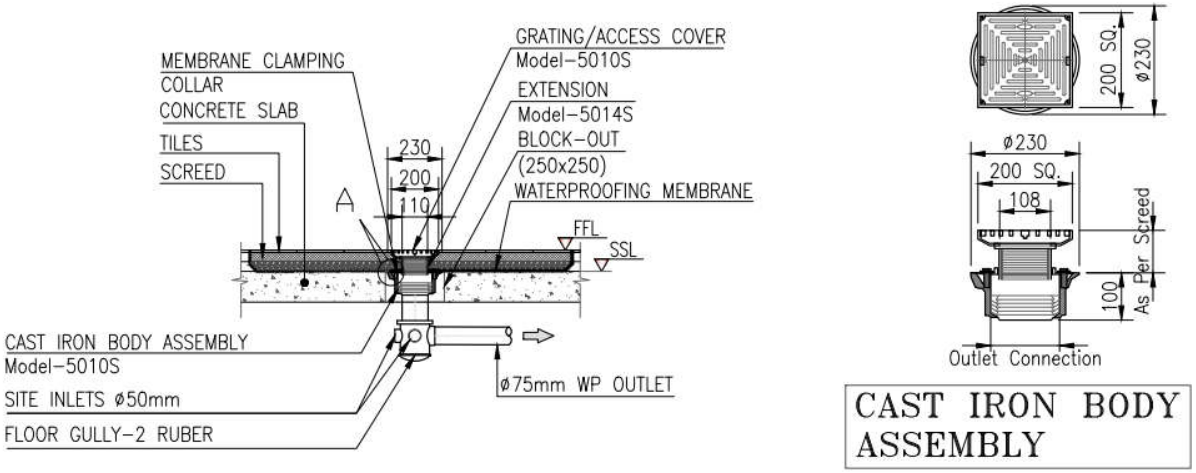
Note: Its depend in your project's drawing; in some FD detail it required P-trap while other connect the main line with double 45Degree Elbow.



01 KAP2B TYPICAL FLOOR DRAIN DETAIL

SCALE N.T.S.

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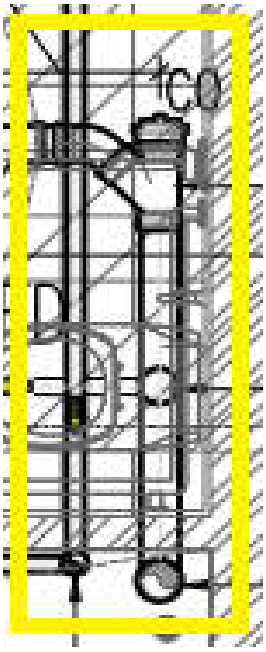
Area 2 :



- **UPVC PIPES AND FITTING.**
- **UPVC CLEAN OUT**
- **HANDICAP WC**

For main line:

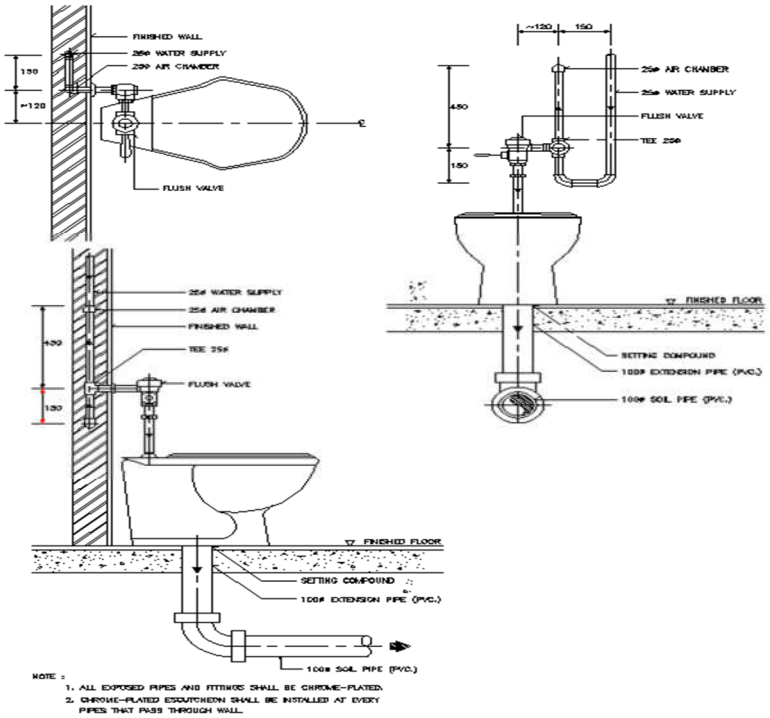
1- Pipe (110mm)-2 Meter.
2- Y (110mm) – 1 Pcs.
3- Elbow 45Degree (110mm)-1 Pcs.
4- Clean out (110mm)-1 Pcs.

For WC connection :

5- Y (110mm) – 1 Pcs.
6- Elbow 45Degree (110mm)-1 Pcs.
7- Black Push fit rubber .

For Riser Connection :

8- Elbow 90Degree (110mm) -1 Pcs.



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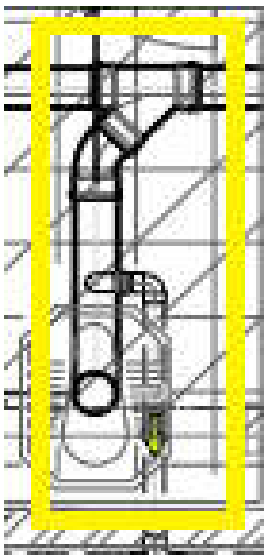
Area 3 :

- **UPVC PIPES AND FITTING.**
- **EASTERN ARABIC WC**



For main line:

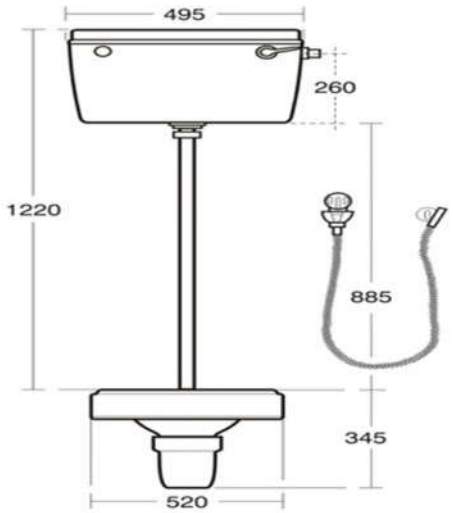
1- Y (110mm) – 1 Pcs.
2- Elbow 45Degree (110mm) – 1 PCs.
3- Pipe (110mm) – 2 meter.

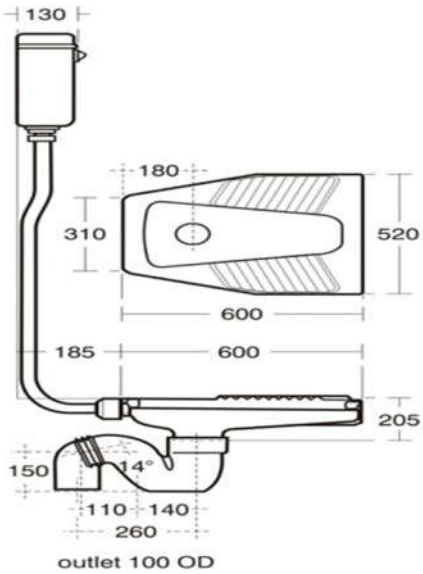
For vent line :

4- Y (110mm x 50mm)-1Pcs.
5- Elbow 45Degree (50mm)-1 PCs.
6- Elbow 90Degree (50mm)-1 Pcs.

For Eastern WC :

7- P-Trap (110mm) – 1 Pcs.





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- **Installation Process :**

1. Review shop drawing and verify the pipeline slope . Knowing that the (Waste / Soil / Vent) slope is no more than 0. 5-1 % . Every 1 meter keep 0.05/0.1 meter slope and the slope is reverse in vent lines.
   Pipes slope: Inclined percentage required to drain water and waste by gravity (naturally) .
2. Marking the pipe line using chalk liner by taking the measurement from drawing (drawing scale 1:100 or 1:150) .
3. Drilling, Anchorage, threaded rod and fixing support.
4. Install pipe and fitting (Solvent / Rubber) .
5. Proceed with Gravity test (by tapping all network and filling water with 10 feet (3 meter) riser) or pressure test for forced lines (by using test pump to pressurize the system by 1.5 x operating pressure) .
6. Install the drain accessories and toilet cell sanitary fixture (Final Fix) .

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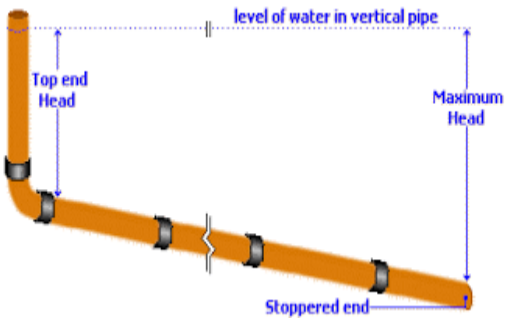
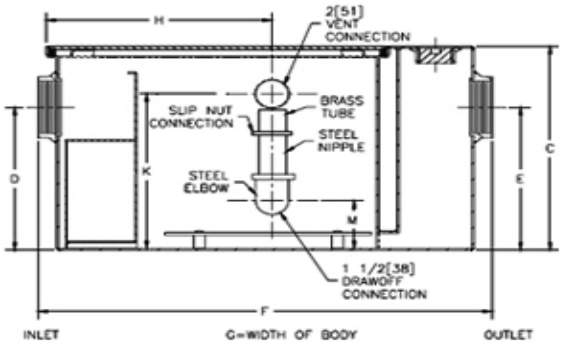
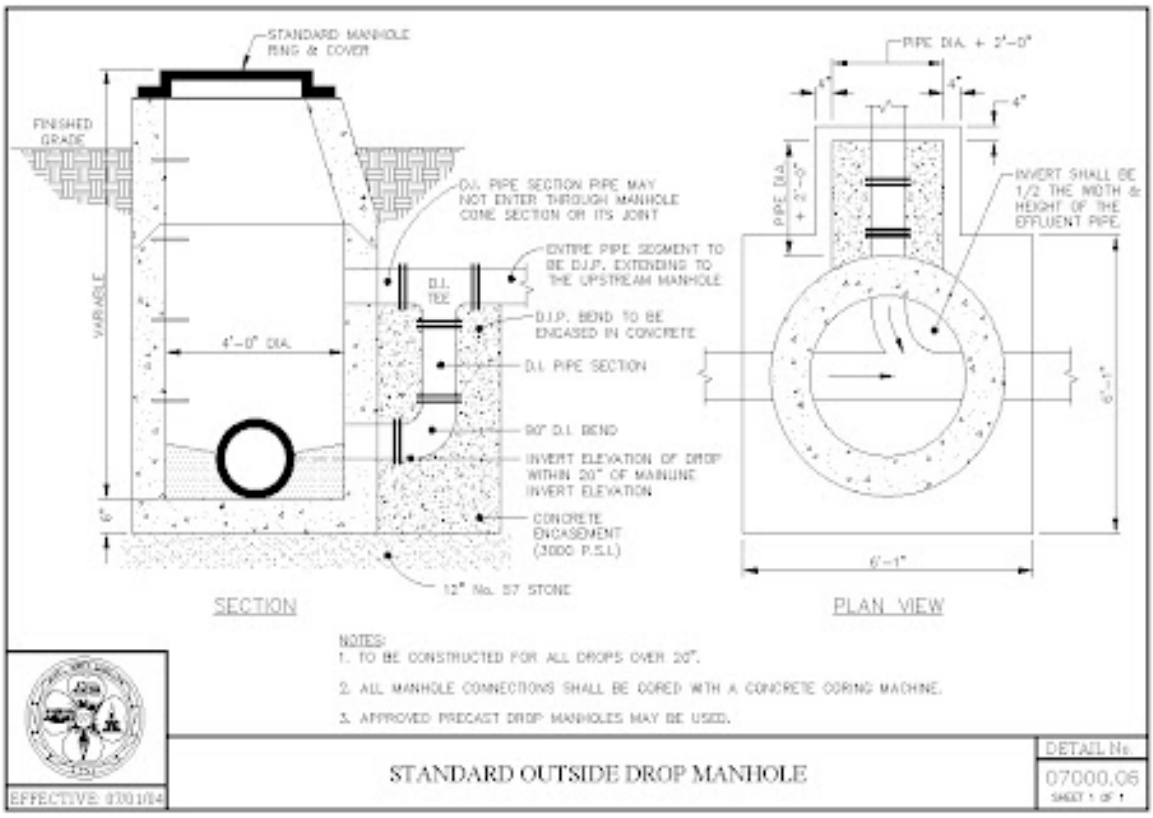


- **Additional Definition :**

✓ **Interceptor:** Tank used to separate oil and waste water from interior drainage systems before connect to main external network in order to avoid future blockage. Usually used in generator room .



✓ **Manhole :** Buried chamber used in external drainage network to facilitate the future maintenance and to control the pipeline slope . It has required in every change in direction and every certain horizontal distances as per local / international standard.



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WATER SUPPLY SYSTEM

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Water Supply System:

- For Design and Installation Follow local standard (GCC , SBC , …etc) or International one (UPC / IPC) .

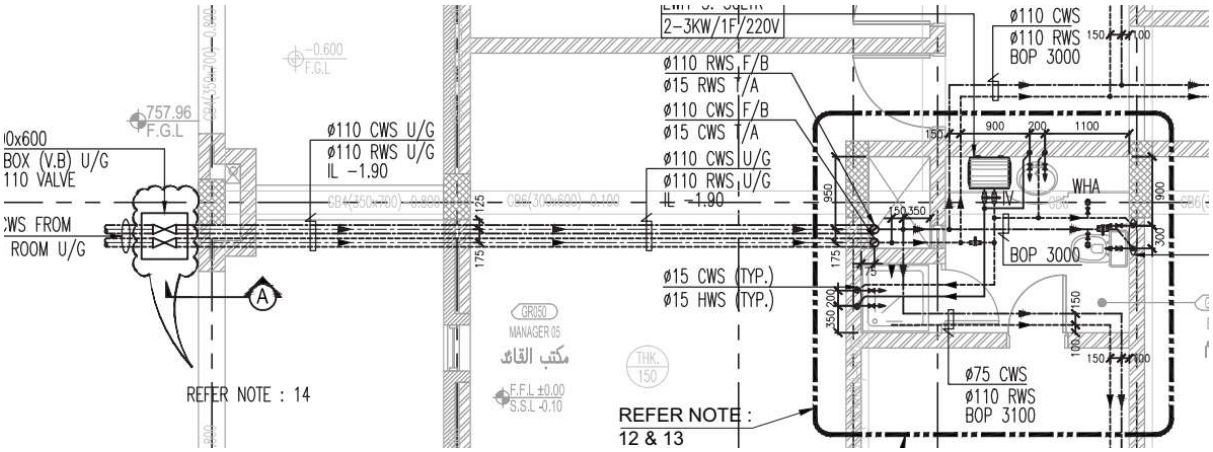
- To Supply water for all end use points (demand) via booster/ Transfer pump .

- Water supply pipe is designed (sized) based on the number of fixture units (Mixer, ablution, shower, Etc.) number, from the UPC code based on the fixture units the pipe will be sized .

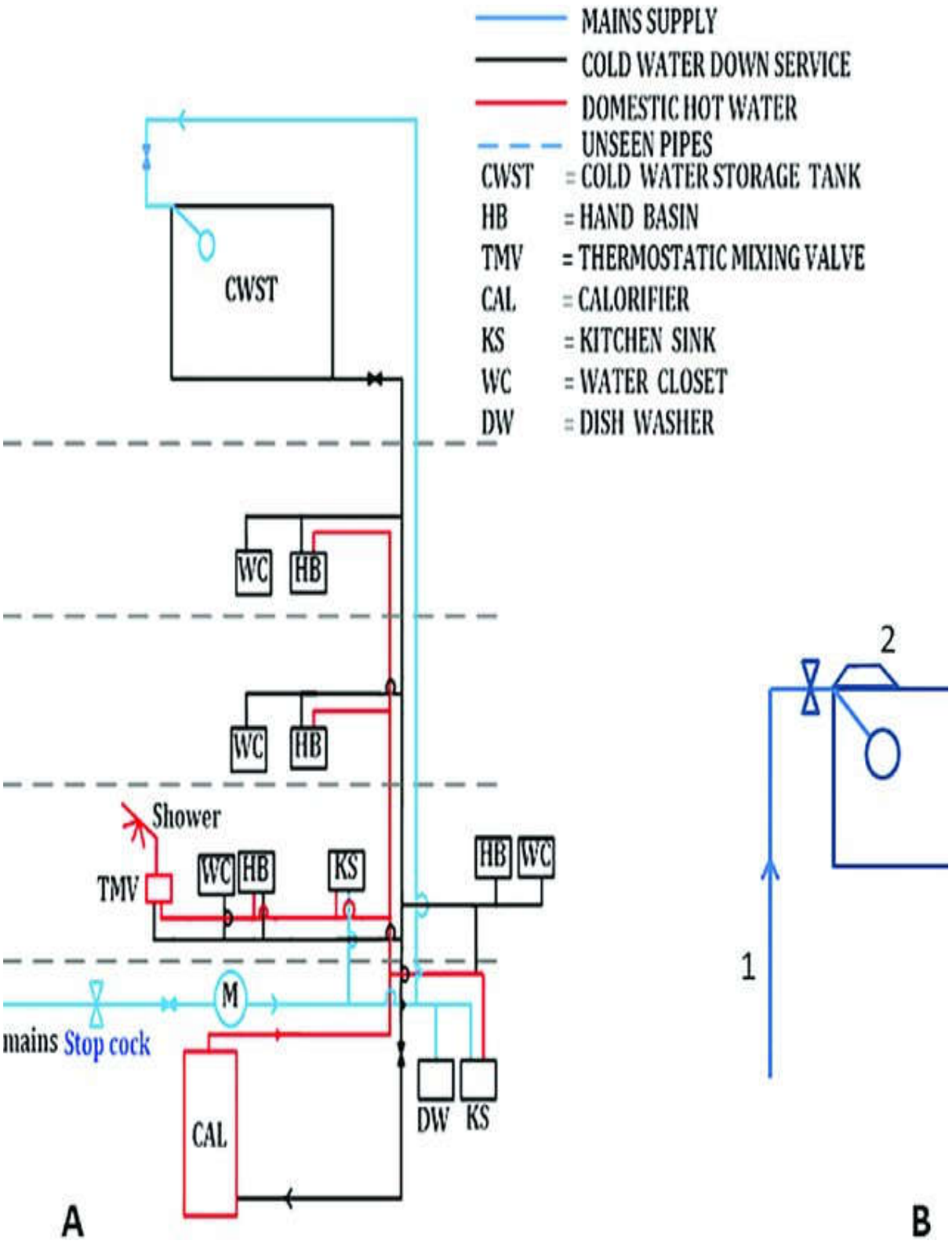
- Potable water & non potable water are the main Water supply pipelines types : Potable Water is Water suitable for human consumption mainly for drinking and the opposite is true for non-potable water .

- Potable water (Cold water / Drinking water) . Non- potable water (Grey water / Process water / Hot water).

- Potable water supply from municipality line or onsite deep well and collected in water tank (GRP / Concrete) then it will be transferred from the tank through booster pump to all end points (Mixer / Shower / Hand spray / Water heater / Bath tub / hose bib).



- Grey Water Supply from Grey Water Treatment plant or STP (Sewage treatment plant) then it will transferred through booster pump to flushing system / Irrigation system .


MAINS SUPPLY
COLD WATER DOWN SERVICE
DOMESTIC HOT WATER
UNSEEN PIPES
CWST = COLD WATER STORAGE TANK
HB = HAND BASIN
TMV = THERMOSTATIC MIXING VALVE
CAL = CALORIFIER
KS = KITCHEN SINK
WC = WATER CLOSET
DW = DISH WASHER
CWST
WC
HB
WC
HB
Shower
TMV
WC
HB
KS
HB
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M
mains Stop cock
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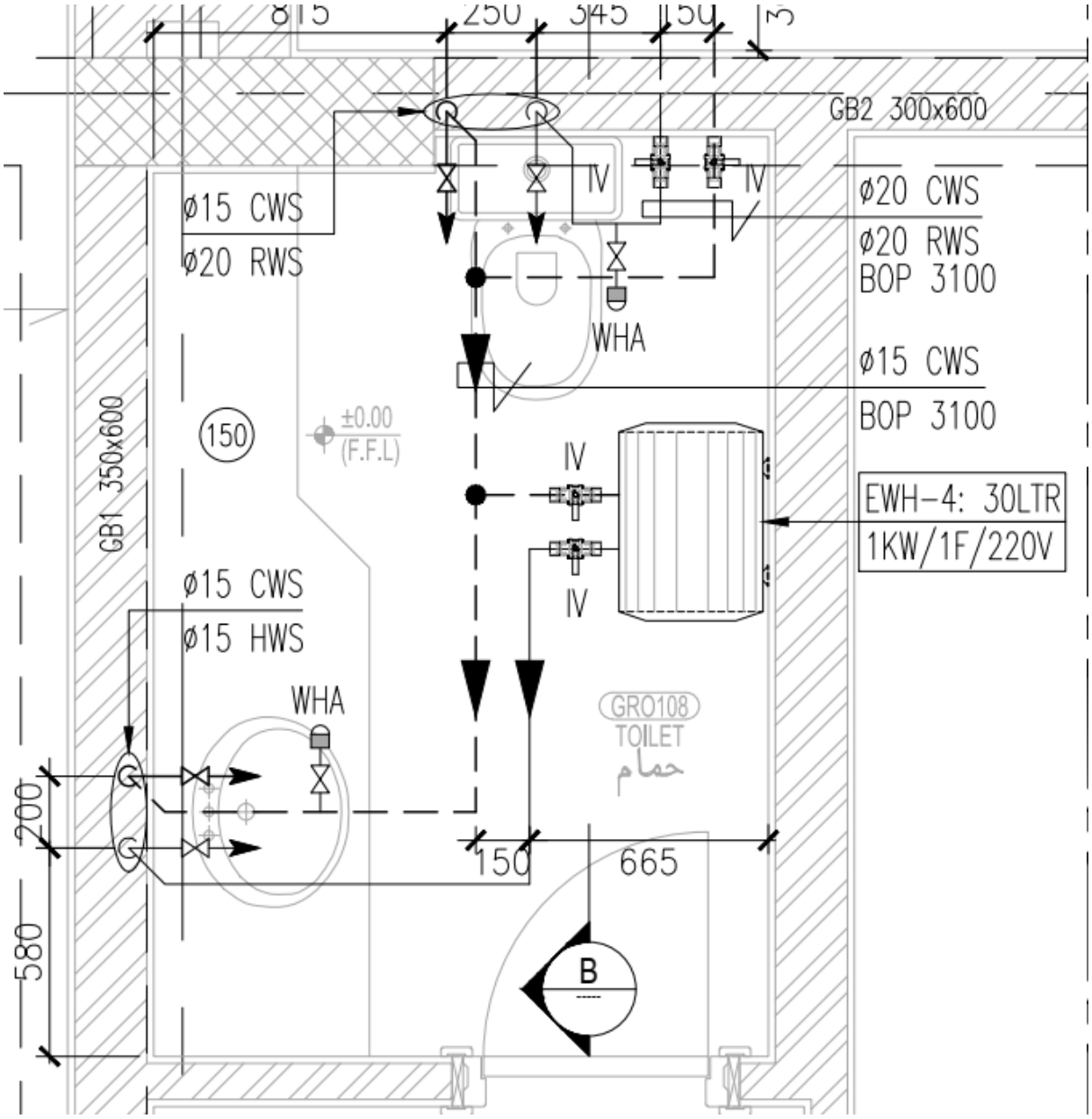
DW
KS
A
2
1
B



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- Water heater or Central water heater used to supply hot water.

- Hot water pipeline should be insulated with (Fiberglass / rubber – Armaflex / Foam) insulation with proper thickness and density based on pipes Diameter and location (Conditioned or Un-conditioned spaces).

- **Pipes and fitting Used :**

There is a lot of pipes types used in Water Supply system based on application and location, below is the common types :

- ✓ Copper: There is three copper pipe type (K / L / M) where is type L is the common used , Connection: Brazing (Welding) / Soldering (Welding) / Flaring using flaring tools .
- ✓ PPR: Connection: Thermal Welding / Threaded / Flange .
- ✓ Galvanized Steel: Connection : Threaded / Welding .
- ✓ PVC : Connection : Solvent / Rubber .
- ✓ CPVC : Connection : Solvent .
- ✓ PEX pipe .

- **Valve Used :**

1. Gate Valve **GV** : Used to shut of water flow in one direction .

2. Check Valve **CV** / Non Return Valve **NRV** : Used to allow water flow in one direction only .

3. Pressure reducing valve **PRV** : Used to regulate the pressure to the required set point .

4. Ball Valve **BV** : Used to shut of water flow in one direction .

5. Angle Valve **AV** : Used to shut of water flow in one direction with 90 Degree angel Shape .

6. Float Valve **FV** : Used to Shut of water supply in tank when reaching to maximum filling level.

7. Pressure relief valve **PRV** : Used to protect equipment and guarantee safe operation due to residue excess pressure (for safety purposes) .on another hand , it release system's water

8. Strainer: Valves body with steel mesh to filter water from small debris that can damage the pump or sanitary ware .

- **Water Supply accessories Used :**

1. Water Hammer arrestor **WHA** : Device used to absorb hydraulic shock , located in water network between last two fixture unit .

.

2. Air Vent **AAV** : Used to release excess air for the system due to temperature variances .

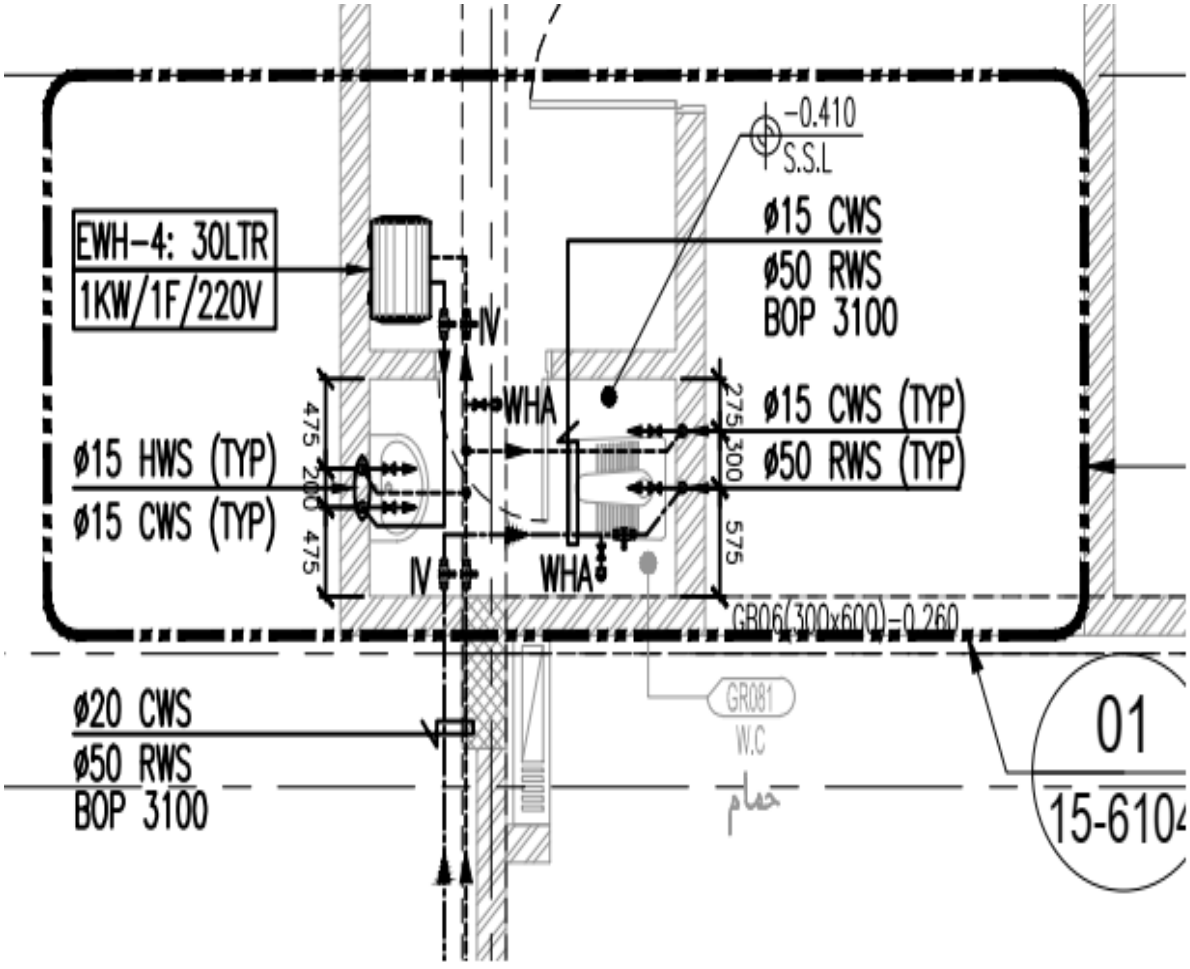
3. Pressure Gauge : Used to show the network pressure rating .

4. Thermometer : Used to show the network temperature .

- **Take-Off :**

- You should know what drainage materials are used in approved shop drawing.
- Check the approved technical material submittals TMS .
- Review manufacture catalogue from TMS to identify available pipes, fitting list and sizes.
- Measure the straight lines (pipe) and count the number of fitting.
- For connection with sanitary fixture and water heater, you should review the standard detail, which will show extra connection information.

Example :



❖ **Copper Pipes and Fitting.**

For main line:

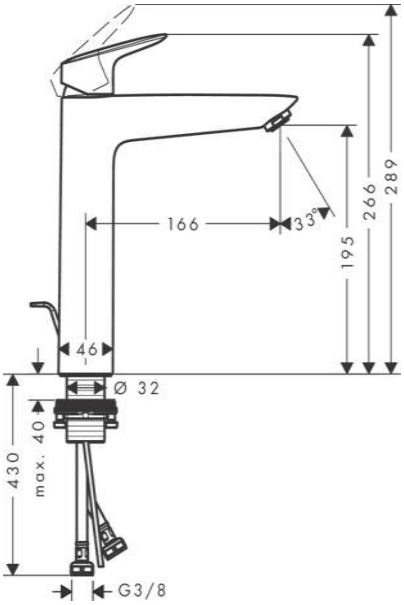
1- Pipe (50mm) - 6 Meter .
2- Pipe (20mm)- 6 Meter.
3- Elbow 90Degree (50mm)-1 Pcs.
4- Male adaptor with union (50mm) -2 Pcs (For gate valve).
5- Male adaptor (50mm) -2 Pcs (For gate valve).
6- Tee (50mmx25mm)- 1 Pcs (For Water hammer arrestor).
7- Elbow 45Degree (50mm) – 1 Pcs.

For WC flush tank connection:

8- Male or female adaptor (further to manufacture recommendation).

For Wash Basin:

9- Angel valv– 2 Pcs.
10- Flexiable hose – 2Pcs.



- **Installation Process :**

1. Review shop drawing and verify the pipeline size and dimension .
2. Marking the pipe line using ‘ chalk liner ’ by taking the measurement from drawing (drawing scale 1:100 or 1:150) .
3. Drilling, Anchorage, threaded rod and fixing support.
4. Install pipe and fitting (Solvent / Rubber / Welding / Threaded / Coupling) .
5. Proceed with pressure test for forced lines (by using test pump to pressurize the system by 1.5 x operating pressure) .
6. Make the final connection to all sanitary fixture .

FIRE PROTECTION SYSTEM

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Fire Fighting System:

- For Design and Installation Follow local standard (GCC , SBC , …etc) or International one (NFPA) .
- Below is the most used NFPA standard:

✓ **NFPA 10 :** Portable fire extinguisher .
✓ **NFPA 13 :** Installation of fire sprinkler .
✓ **NFPA 14 :** Installation of standpipe , privet hydrant and hose system .
✓ **NFPA 20 :** Installation of pump .
✓ **NFPA 72 :** National fire alarm .
✓ **NFPA 101 :** Life Safety code .
✓ **NFPA 1961 :** Fire hose .
✓ **NFPA 2001 :** Standard on clean agent fire extinguisher system .

- All materials used in fire protection system should be UL / FM approved (All materials are tested to resist the fire heat to guarantee the normal operation of fire materials during fire case)

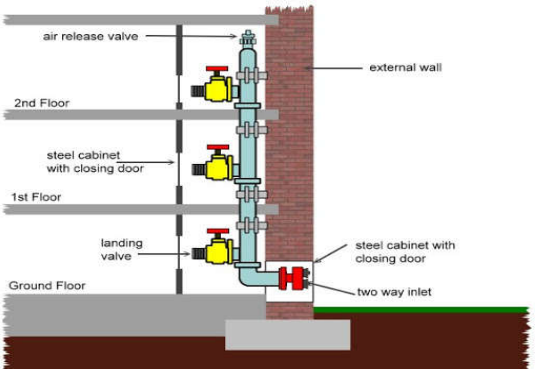
- Fire protection scope of work Divided in to three category :

1. Architectural (Fire and life safety) : Generate plans shows the exit and emergency egress inside and outside the buildings, fire rated wall and partition , fire zone , smoke management And shows the location of civil defence trucks park location in case of fire to fill fire department connection / Siamese connection .

2. Electrical (Fire alarm) : Audio / Visual alarm in case of fire , by providing signal from (tamper switch , pump , ZCV , detectors) to main fire alarm panel .

3. Mechanical : Active system of fire protection (Water / Gas) :
   - ✓ Sprinkler System.
   - ✓ Fire Hose cabinet and landing valve.
   - ✓ External Fire hydrant.
   - ✓ Fire Suppression System .

- Staircase design and requirement :
  - ✓ It should be at least 2- Hr fire rated (Wall and door material resist fire for 2 hr) .
  - ✓ Pressurization fan should be installed inside the staircase to maintain the positive pressure inside to keep the smoke outside and keep the staircase safe for exit.
  - ✓ Install landing valve (Valve supply water to civil defence inside the stair) , if the building height more than 23 meter .



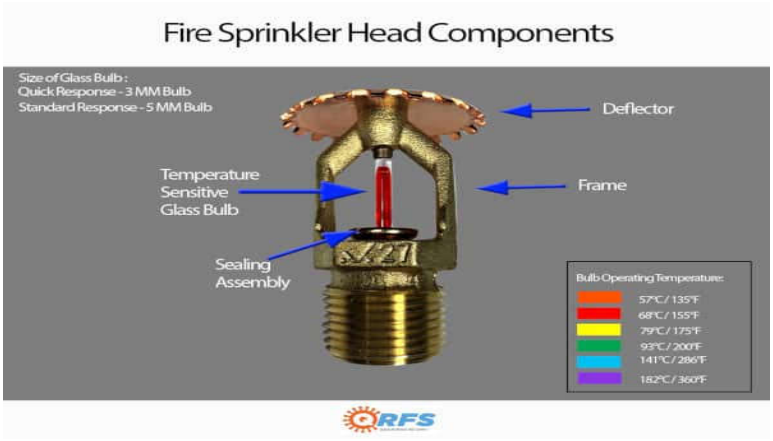
- Fire systems are (Wet / Dry) :

1. Wet System :
   - ✓ Network always pressurized by water inside.
   - ✓ In case of fire , Sprinkler will broke by the heat and the water will flow .
   - ✓ Flow switch will send signal to the pump to operate .

2. Dry System :
   - ✓ Used in unstable weather condition (very cold weather- high Freeze risk area) .
   - ✓ Network pressurized by gas (Nitrogen) to avoid freezing water .
   - ✓ In case of fire , sprinkler will broke and the air will flow through and send command to pump to operate and transfer water .

- **Sprinkler System :**

- **Sprinkler response category** : Both type's operating temperature is selected based on working area and sprinkler size:
  1. Glass bulb type:
     At certain temperature, the gas inside the bulb expand and broke the glass to allow water to flow through the sprinkler to the fire area.



2. Fusible link type:
   At certain temperature the link metal melt and allow water to flow through the sprinkler to the fire area.

- **Sprinkler Type :**

1. **Upright Sprinkler :** Install in areas without ceiling like garage and stores .

2. **Sidewall Sprinkler :** Install in wall horizontally .

3. **Pendent Sprinkler :** Install in ceiling areas.

- **Hazard Type :**

Project, Building and areas are divided in three fire hazard category. Sprinklers number and pipe size will be varies consequently:

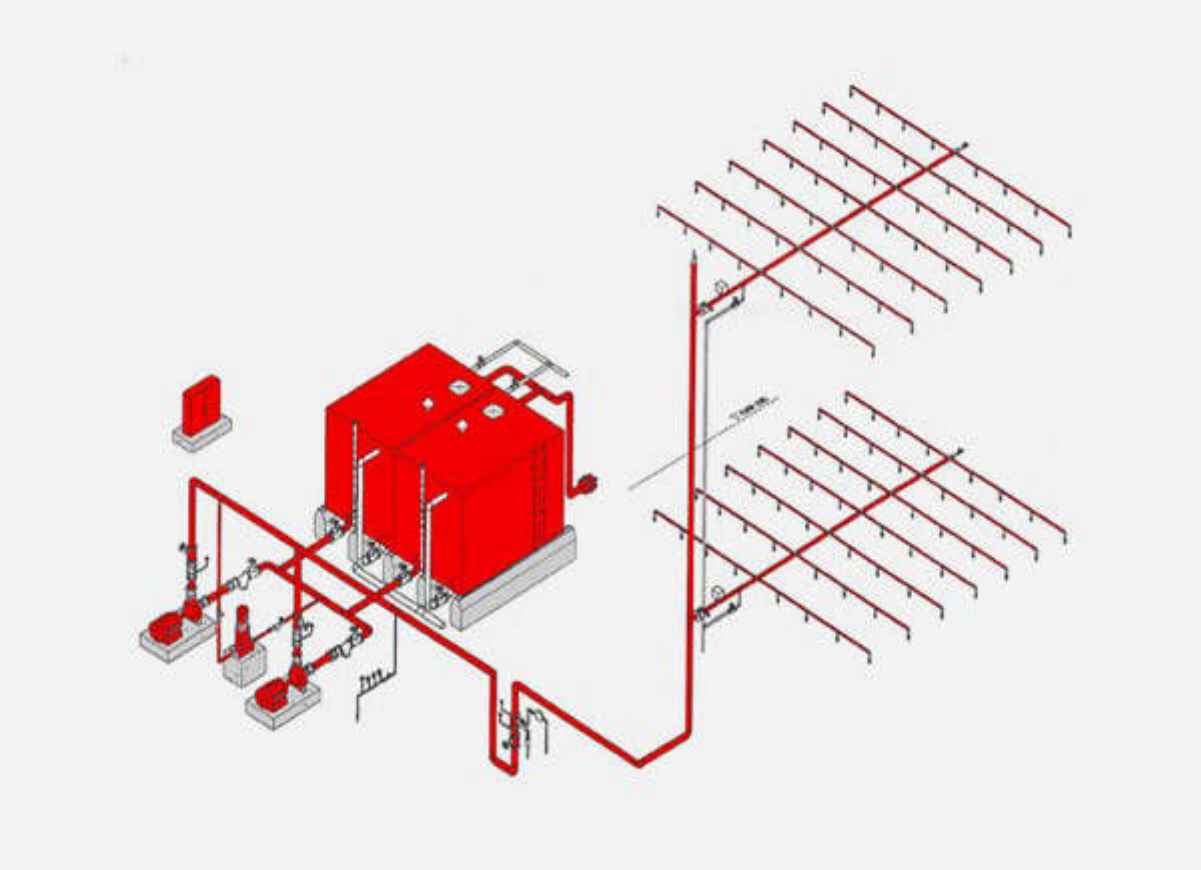
1. Light Hazard: Offices, club, hospital, restaurant, theatre ….Etc .
2. Ordinary Hazard: Garage, bakery, food and glass production, laundry, Etc .
3. Extra Hazard : Chemical , oil , cleaning , paint , …. Etc .

Protection Area Limitations per Sprinkler Table :

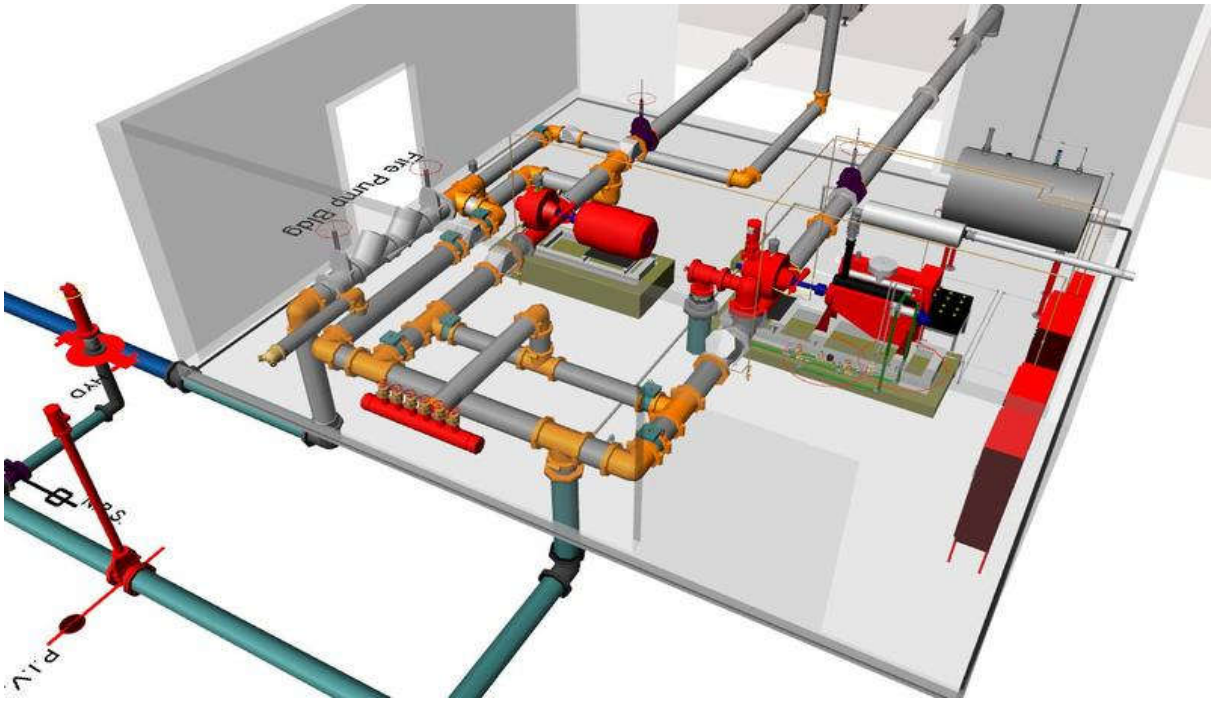
Hazard	Area (m2)	Distance between Sprinkler (m)
Light	**21**	**4.6**
Ordinary	**12**	**4.6**
Extra	**9**	**3.7**

- Minimum distance between two sprinklers is 1.8 meter to maintain proper protection by avoiding sprinkler cool down by other sprinkler.
- The distance between sprinkler and the wall should not exceed the half distance between two sprinklers. And minimum to 0.5 meter .
- Each sprinkler is manufacture to handle a specific temperature. Normally, 67 Degree Celsius and 76 Degree for hot area like kitchen.

- **Sprinkler System Component :**

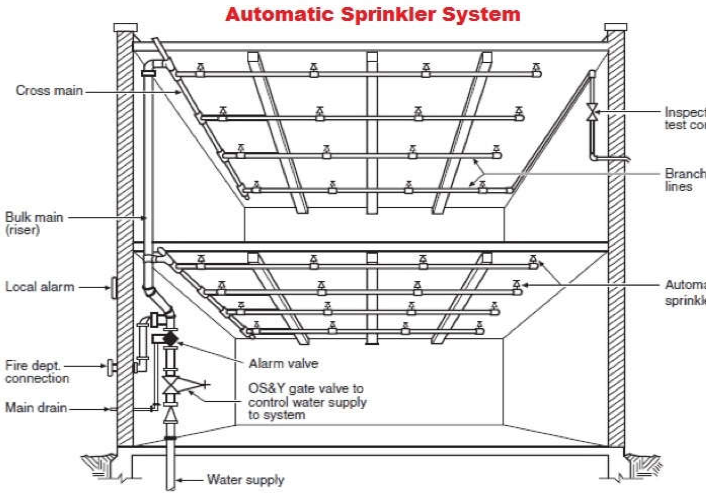


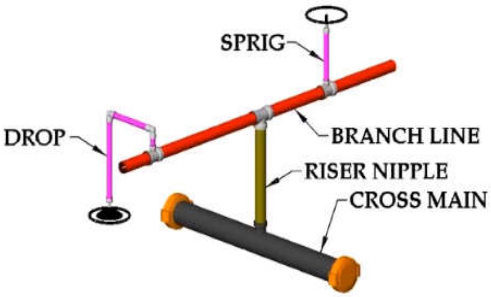
1. **Fire Pump :** Pump set contain from two main pumps (Duty & Standby) Electrical and diesel engine or two electrical connected with ATS switch (emergency generator) **,** and Jockey pump (small pump required to maintain the closed loop pressure to set point and its capable to cover two or three sprinklers in



case of fire before the main pump start). Moreover , jockey pump should be at least 10% of the main pump flow (GPM) and 0.5 bar higher the main pump design pressure .

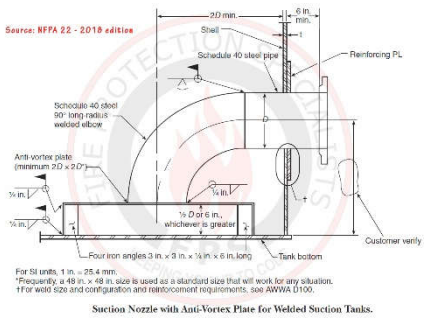
2. **Riser and pipe network** **:** Water will transfer to the building and pressurize the fire network through main riser to main line , ZCV , cross main , branch and sprinkler .





3. **Water Tank:** it could be concrete or GRP panel. Capacity calculated based of pump flow and hazard type .

- ✓ GRP panel assemble by SS threaded rod , washer and nut .
- ✓ Anti- Vortex plate should be installed inside tank in suction line in order to prevent turbulence flow and damage the pump consequently.
  Generally made from Stainless steel or UPVC for water resistance.



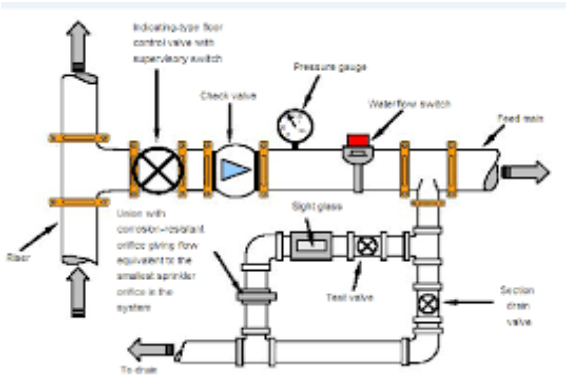
Suction Nozzle with Anti-Vortex Plate for Welded Suction Tanks.

4. Alarm Check Valve ACV :

Installed after FF pump and before distribution to the building to provide manual and automatic alarm in case of fire.

5. Zone control Valve :

Valve package located in each floor / fire zone to regulate the operating pressure , start the pump , and drain the network .ZCV component are (OS&Y gate valve , check valve , tamper switch , flow switch , PRV , test and drain valve)



- **OS&Y Valve** : Outside screw and yoke valve , include rising stem shows valve position (on / off) . In addition , Tamper switch could be connected to provide signal to Fire alarm panel , BMS and FF pumps .



- **Flow Switch**: Installed in main line within ZCV assembly and send signal to FF pump in case of water flow through it.In addition , help to identify which exact zone are in fire .

- **Test and Drain Valve** : For general maintenance to clean the network and used during T&C process to verify the system operation.

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- **Fire hose cabinet and landing valve System :**

- There is separate riser for FHC network for Most of the project.

- There is two type of fire hose : (Hose reel) rubber hose wrapped inside the cabinet used by buildings occupant . (Hose rack) solid hose in rack , mainly used by civil defence .

- Coverage area for FHC is depend on Hazard type :
  - ✓ 800 m2 for light hazard.
  - ✓ 600 m2 for ordinary hazard.
  - ✓ 400 m2 for light hazard.

- Maximum length of the reel is 30 meter .

- Pipe size based on the number of connected FHC :
  - ✓ One FHC --- 32mm Dia pipe .
  - ✓ Two FHC --- 40mm Dia pipe .
  - ✓ Three FHC--50mm Dia pipe .
  - ✓ Four FHC -- 65mm Dia pipe .

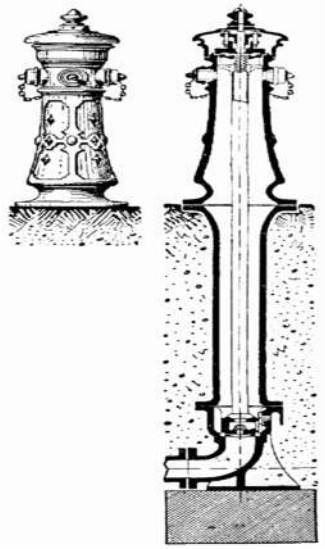
- FHC installed near staircase , car park , near main entrance and other occupied area .

- FHC type: Exposed (installed back of hose) and Reassessed (decorative usage) .

- Fire extinguisher is added normally to FHC .

- **External Fire Hydrant System :**

- Fire hydrant installed in external network to protect open space.
- Used by civil defence.



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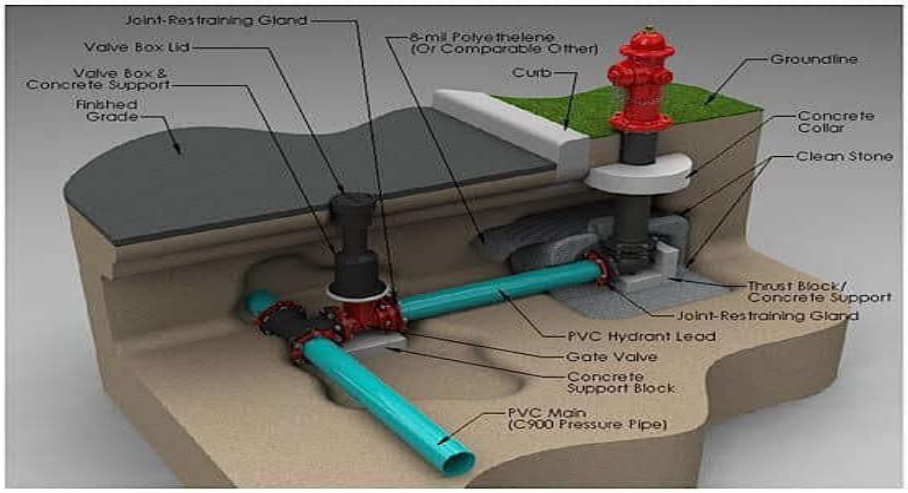


- External network pipes and fitting :

✓ Ductile iron pipe : Connection (Flange / push fit) .
✓ HDPE : Connection (Thermal Weld) .
✓ UPVC : Connection (Rubber push fit / Solvent) . Not recommended.

- **Fire department / Siamese connection :**

- Installed in front of each buildings or in external area as long as it accessible to civil defence trucks.
- It used to feed the network or FF tanks with water during fire.

- **Installation :**

1. Review shop drawing and verify the below :
   a- Check the pipe sizes if they are match with number of sprinklers. For each hazard area, it has special table shows the maximum number of sprinkler for each pipe diameter.
   b- Check the coverage area of sprinklers and the minimum distances.

Table 23.5.2.2.1 Light Hazard Pipe Schedules

Steel		Copper	
1 in.	2 sprinklers	1 in.	2 sprinklers
1¼ in.	3 sprinklers	1¼ in.	3 sprinklers
1½ in.	5 sprinklers	1½ in.	5 sprinklers
2 in.	10 sprinklers	2 in.	12 sprinklers
2½ in.	30 sprinklers	2½ in.	40 sprinklers
3 in.	60 sprinklers	3 in.	65 sprinklers
3½ in.	100 sprinklers	3½ in.	115 sprinklers
4 in.	See Section 8.2	4 in.	See Section 8.2

For SI units, 1 in. = 25.4 mm.

Table 27.3.3.4 Ordinary Hazard Pipe Schedule

Steel		Copper	
1 in. (25 mm)	2 sprinklers	1 in. (25 mm)	2 sprinklers
1¼ in. (32 mm)	3 sprinklers	1¼ in. (32 mm)	3 sprinklers
1½ in. (40 mm)	5 sprinklers	1½ in. (40 mm)	5 sprinklers
2 in. (50 mm)	10 sprinklers	2 in. (50 mm)	12 sprinklers
2½ in. (65 mm)	20 sprinklers	2½ in. (65 mm)	25 sprinklers
3 in. (80 mm)	40 sprinklers	3 in. (80 mm)	45 sprinklers
3½ in. (90 mm)	65 sprinklers	3½ in. (90 mm)	75 sprinklers
4 in. (100 mm)	100 sprinklers	4 in. (100 mm)	115 sprinklers
5 in. (125 mm)	160 sprinklers	5 in. (125 mm)	180 sprinklers
6 in. (150 mm)	275 sprinklers	6 in. (150 mm)	300 sprinklers
8 in. (200 mm)	See Section 4.5	8 in. (200 mm)	See Section 4.5

2. Copy drawing dimension and mark the ceiling with support location as per support distances table.

3. Drilling , anchorage and fixing pipes support.

4. Clean steel pipes and start three coat layer (1st is primer coat , 2nd first coat red paint , 3rd is the final red coat).

5. Fabricate pipes based on required length for main lines and branches .

6. Use threaded machine For branches (below than 2 ½").

7. Used Grooved machine for main lines (More than 2").

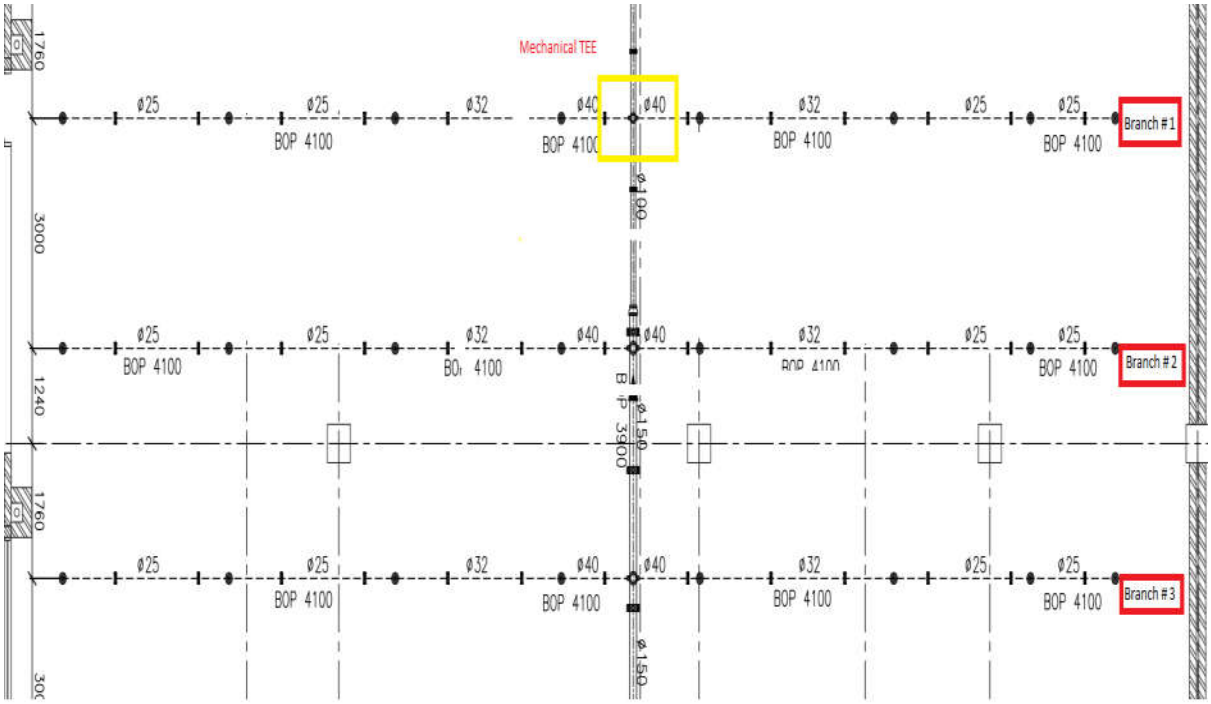
8. Plug all opening then Proceed with pressure test (1.5 x Operating pressure).

9. Touch up paint for all services .

10. Install valves and final fix items (Sprinklers , FHC).

- **Take-Off :**

Example:



- **Black Steel Pipes ERW.**
- **Threaded Fitting (for Dia 2" and less).**
- **Grooved Fitting (for Dia 2 ½" and more).**

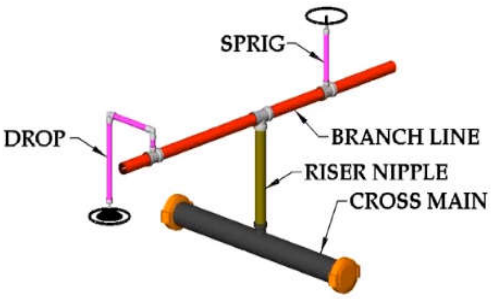
For main line :

1- Pipe (150mm) – 6 Meter.
2- Reducer (150mmx100mm)- 1 Pcs.
3- Grooved Coupling (150mm)-1 Pcs .
4- Grooved Coupling (100mm)-1 Pcs .

Note: We used Mechanical Tee in FF system because it is simple, easy to install and reduce the number of fitting was used before.

(Mech. Tee = Tee + Reducer + 2 Coupling)

Review manufacture catalogue for available sizes.



For Branch line # 1 :

5- Mech. Tee (100mmx50mm)-1 Pcs.

Note : We need to count the number of sprinklers in branch line and then check pipes table with specific hazard area to find out Riser nipple size .

In our case , branch # 1 sprinkler is 8 Pcs . So the riser nipple size is 50mm .

6- Equal Tee (50mm)-1 Pcs .
7- Reducer (50mmx40mm)- 2 Pcs.
8- Tee (40mm x 25mm)-1 PCs

Note : 25mm for drop size and then should be reduced to 15mm to match with sprinkler size.

9- Pipe (25mm)- 1.5 Meter.
10- Elbow 90Degree (25mm)- 2 Pcs.
11- Reducer (25mmx15mm)- 1 Pcs.

Now we proceed to make materials take off for the next Sprinkler

12- Reducer (40mmx32)- 1 Pcs.

PIPE SCHEDULE

PIPE SIZE	LIGHT HAZARD OCCUPANCY	ORDINARY HAZARD OCCUPANCY	ABOVE FALSE CEILING
ø25	2	2	2
ø32	3	3	4
ø40	5	5	7
ø50	10	10	15
ø65	30	20	30
ø80	60	40	60
ø100	100	100	100
ø150	230 OR AS PER ZONE AREA LIMITATION , WHICH EVER IS GREATER.	275 OR AS PER ZONE AREA LIMITATION, WHICH EVER IS GREATER.	300

NOTE:
DESIGN STANDARD: NFPA-13.
PIPE SIZES AS PER HYDRAULIC CALCULATION FOR FINAL APPROVAL.

- **Fire Suppression System :**

- Gas system used in places where water can't be used specially electrical / Communication rooms.

- FM200 , CO2 and NOVEC system are the most gas used in fire suppression system .

- System components are the same but the filling gas is different.

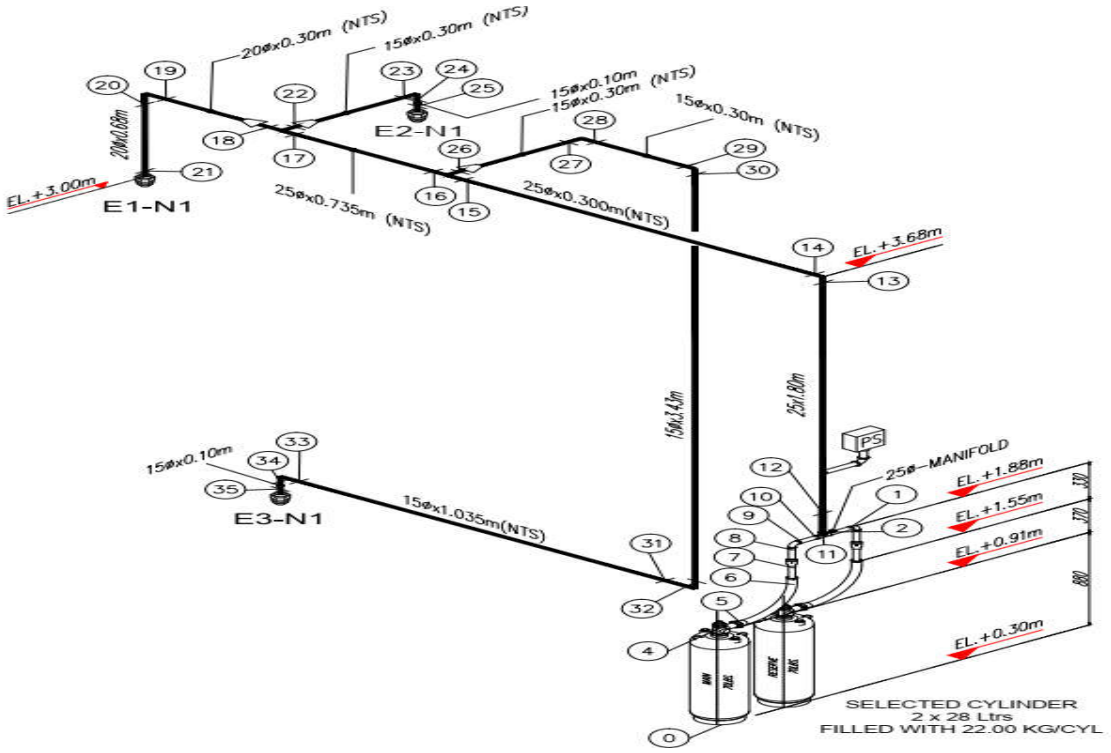
- System Component :

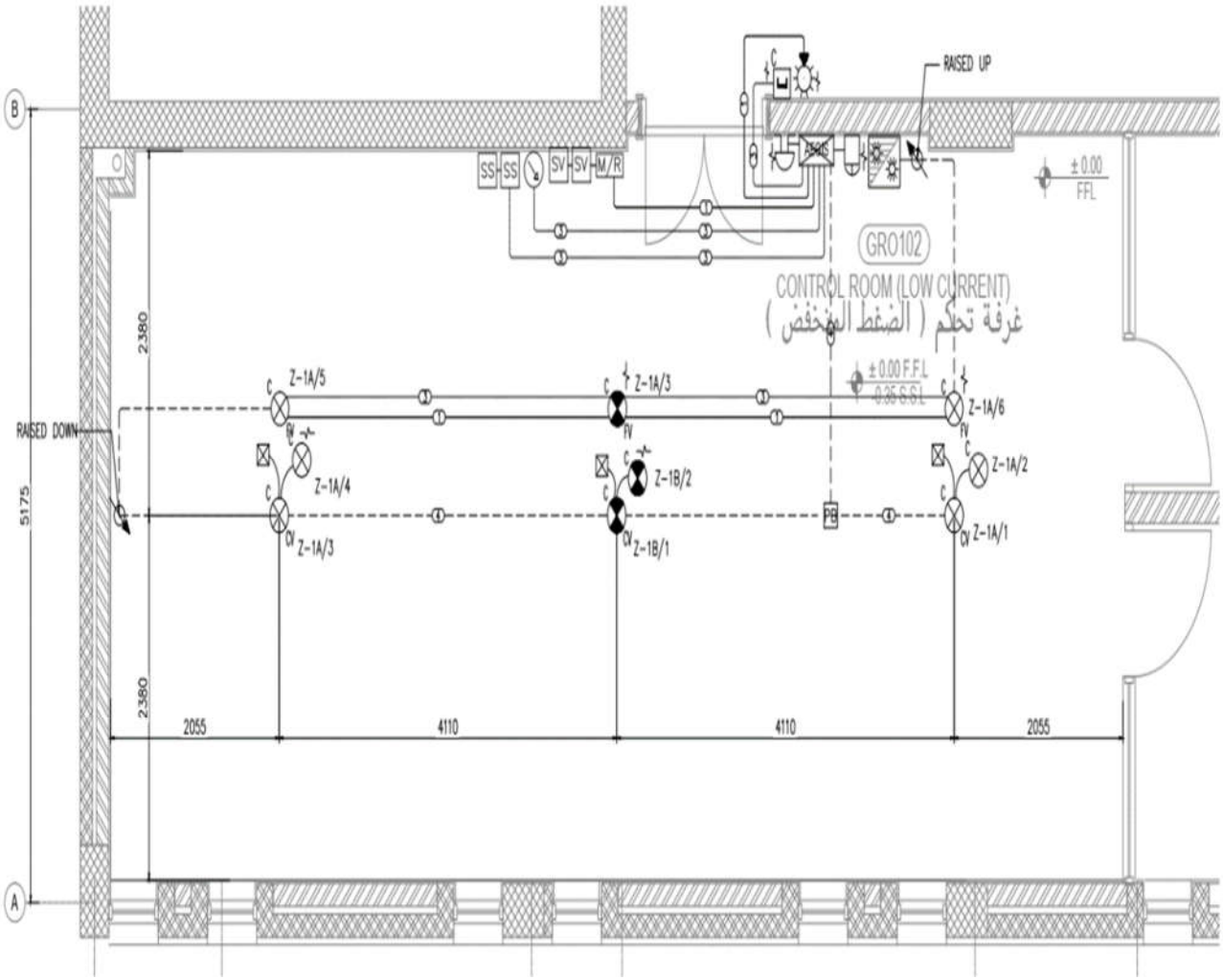
  - ✓ Pipes and fitting (black steel Sch 80 / Stainless steel / Ductile iron) .It should be with higher thickness to handle the extreme operating gas pressure .

  - ✓ Heat and smoke detectors. Distributed based on coverage area of each detectors .

  - ✓ Electrical panel (BMS / FA provision) . Connection required between system panel and FA and BMS are specified on sequence of operation.

  - ✓ Cylinder . Tanks holding the cleanagent gas
  - ✓ Manifold .
  - ✓ Nozzle (90 , 180 , 360).
  - ✓ Manual release.





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CHILLED WATER SYSTEM

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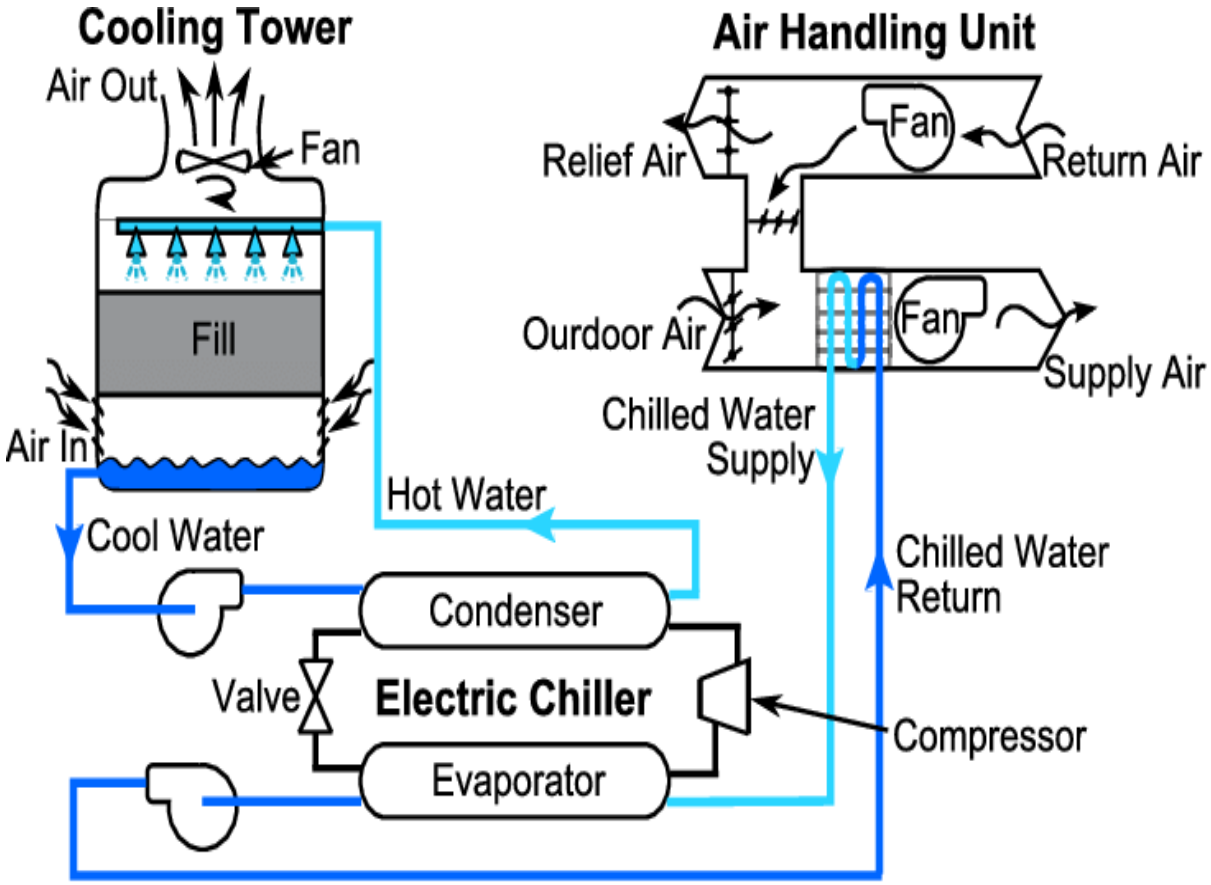
HVAC- Chilled Water System:

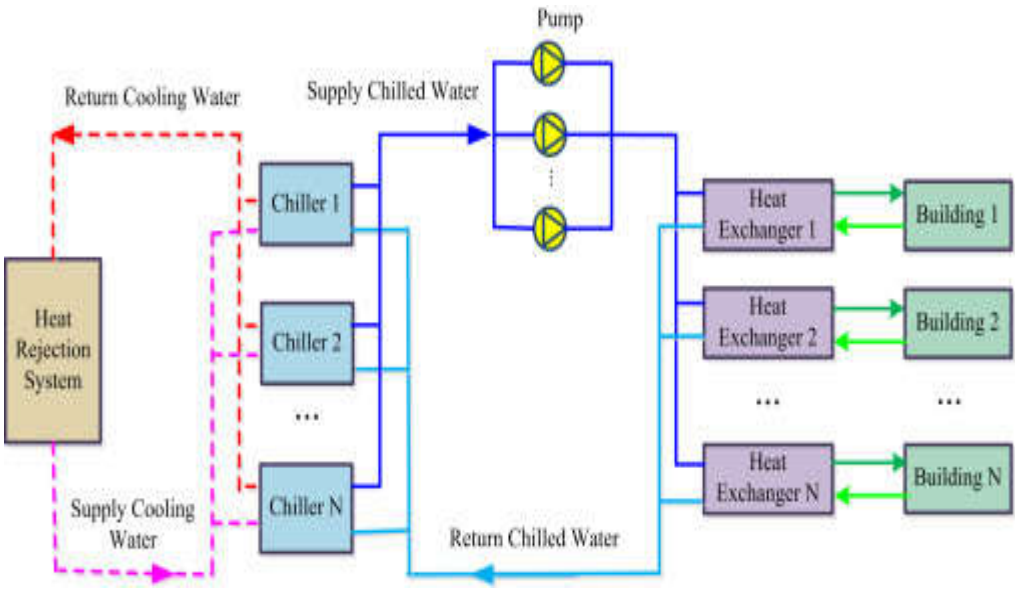
- For design and installation Follow local standard (GCC , SBC , …etc) or International one (ASHRAE) .

- Chilled water system is closed loop network used to cool the air through HVAC units (FCU , AHU) .

- Normal Water enters chiller at high temperature (Ambient temperature) and leave at low (required design Temp.) Then transferred through pumps to the building's units directly or to the heat exchanger of each buildings in case of district cooling system.

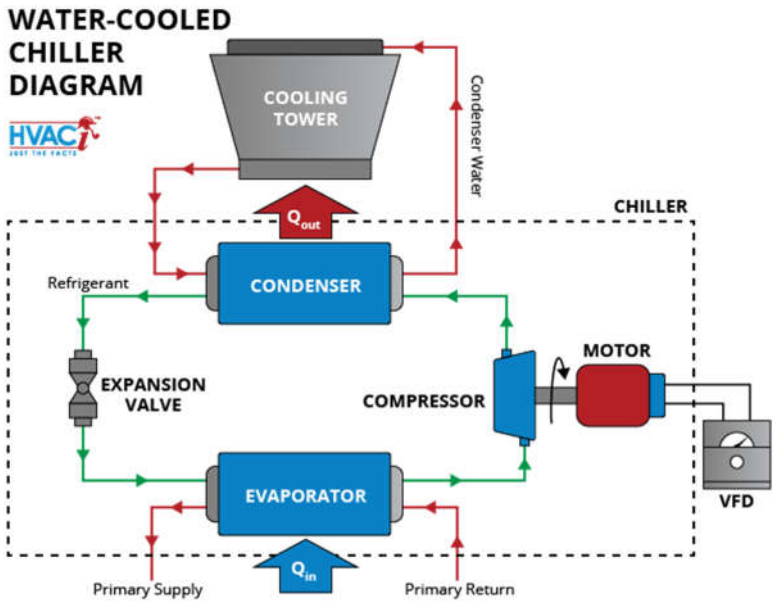


- **District cooling system**:
  Used when there is a series of chillers feeding multiple buildings in the same area (Campos , Compound) , Heat exchanger is the connection point in each buildings .

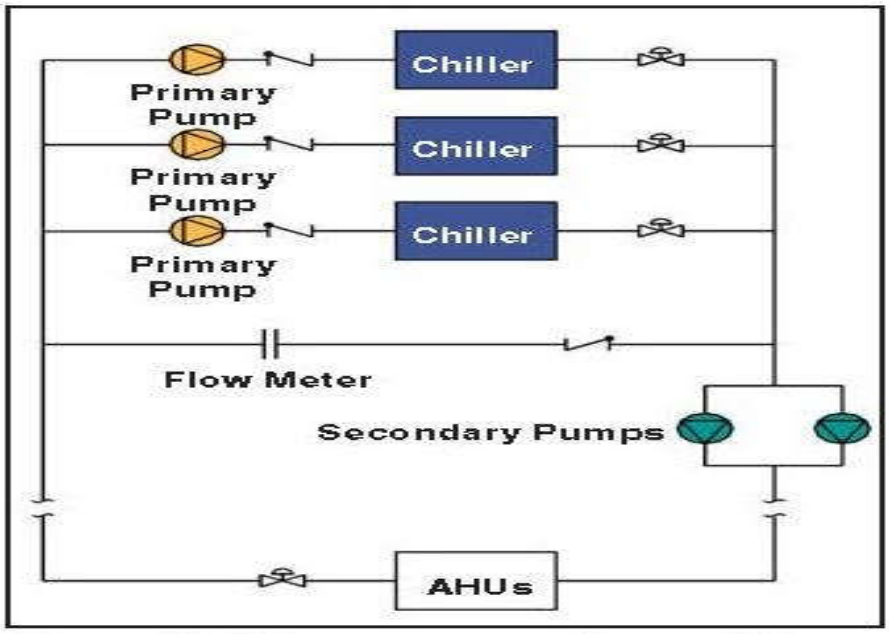


- **Chilled Water network component :**

1. **Chiller** : Refrigeration cycle Unit used to lower the water temperature through heat exchanger . There is water and air cooled chiller.



2. **Pumps** : chilled water system contain a primary pump set (to transfer chilled water from building to chiller) and secondary pump set (to supply CHW to Building's unit) .
   According to controller , can be either a Variable frequency drive (VFD) which it can change water flow based of demand OR Constant flow drive.



3. **Pipes and fitting:** Normally we used black steel pipe sch40 seamless for CHW system, or we can used any pressure pipe.
   - ✓ Connection : Based on project specification or :
     Threaded for smaller diameter below than 2" .
     Grooved for 2 1/2" and higher .
     Welding for 10" and higher.
   - ✓ Insulation : CHW water pipes should be insulated to maintain cold temperature .
     Insulation materials can be (fibber glass , Foam , Rockwool , Arm flex – rubber) .
     Insulation thickness and density are specify in project specification / ASHRAE standard in each project and it vary between conditioned and un-conditioned spaces.

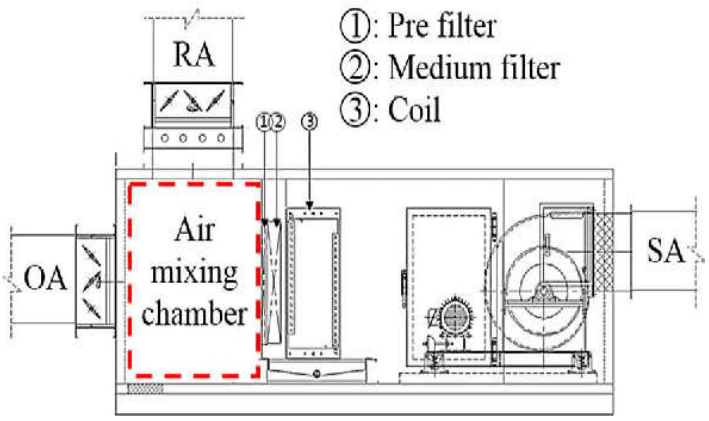
4. **HVAC Units :** There is several HVAC unit which is work as heat exchanger between chilled water coil and moving air . AHU / FCU .

   - ✓ **FCU :** Fan coil unit connected with duct for proper distribution and control or exposed type used in open area .
   - ✓ **AHU :** Customized unit with more option (filtration / air mixing / heat recovery wheel) .

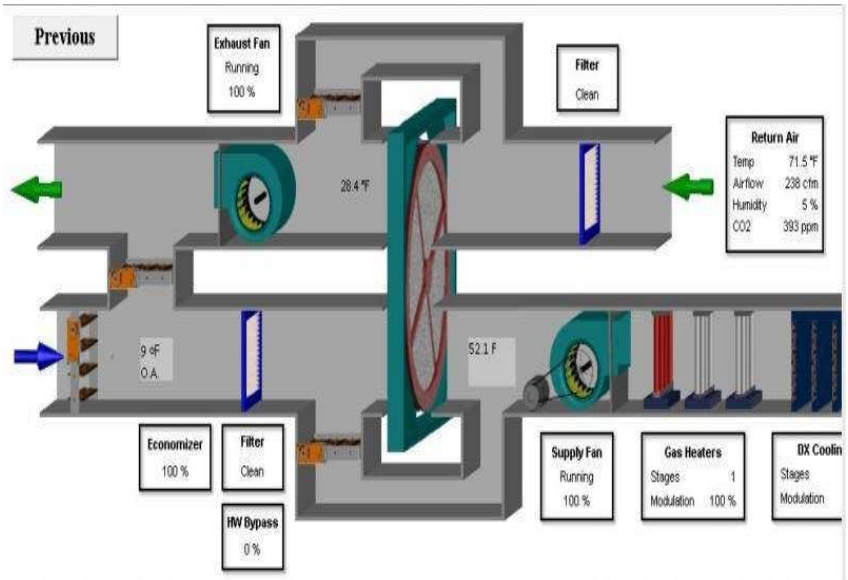
Filtration media: To control distributed air quality , there is bag filter , V-filter , Metallic filter . Pressure drop before and after filter is a indication to clean or replace it .

Air mixing: AHU can be operate as one of below :

1- 100% fresh air (outdoor air) .
2- Mixing with return air .
3- Recovery wheel AHU .

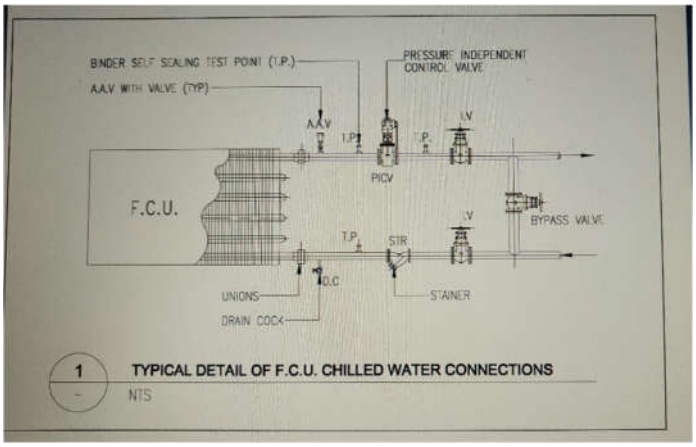


Heat Recovery wheel: used to recover thermal energy from exhaust air and used to lower fresh air (outdoor) temperature . consequently , increase the efficiency and lower the energy / electricity used .



FCU and

AHU connection and valve assembly as below installation detail:



VALVES PACKAGE (HOOK-UP) :

1. Dielectric union : Normally units coil is copper and chilled water network is black steel . Therefore , to avoid electric corrosion of connection to different metal together we used it .

2. Flexible connector : Used to isolate units vibration away from chilled water network to protect it.

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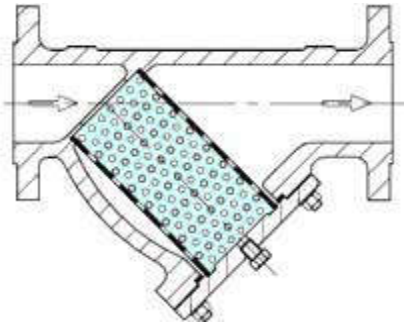
3. Drain cock : Isolating valve Installed in lower point to drain the network .

4. Test Point : During testing and commissioning we use it by insert TAB device and take measurements (flow / pressure / temperature) . In addition, it can be considered as provision for gauges .

5. Gate valve : Isolate the lines , normally installed with electrical actuator to control the flow and temperature during operation .

6. Strainer : Installed in supply line before enter the units . to make sure the water enter clean without any debris .



7. DRV Double regulating valve : to Control the chilled water flow entering and leaving the units .

8. TWO/ THREE way valve : to Control the chilled water flow entering and leaving the units . and for bypass.

.

9. PICV : Pressure independent control valve to control the flow to the design set point . Note : " PICV replaced in old installation details by two valves (double regulating valve DRV **and** 2-way / 3-way valves) .

10. Bypass line valve : Used during flushing process and units maintenance .

11. Butterfly valve : Gate valve function with compact size , recommended for bigger pipes diameter .

5. **Pressurization unit:** used to pressure the network at the first time. In addition, to maintain network pressure to the set point (pressure vary due to temperature differences between pipe and outer running spaces).

.

6. **Air Separator :** Device installed at the lowest point of the network in return line , in order to remove the air which may network include due to temperature variances .

7. **Chemical dosing set :** After and during flushing process , chilled water should be treated by adding chemical before entering HVAC units and pumps . Therefore , water tested periodically to make sure water within accepted figure .

REFFRIGERANT PIPES SYSTEM

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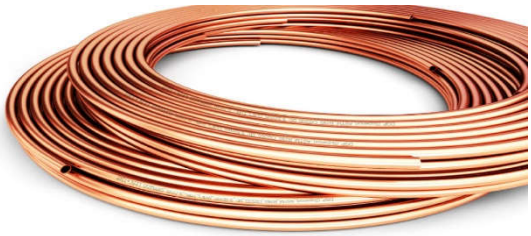
HVAC- Refrigerant pipes system:

- For Design and Installation Follow local standard (GCC , SBC , …etc) or International one (ASHRAE) .

- Copper pipes used for refrigerant system with three type (K,L,M) which type (L) is the most used (Rigid pipe).

- ACR coils are used widely in AC application especially domestic one.



- Refrigerant pipes connect the HVAC units (outdoor and indoor) as below :
  Connect liquid line and gas line between Indoor and outdoor unit .

- Copper pipe connection either by Welding (solder / brazing) or flared joint .

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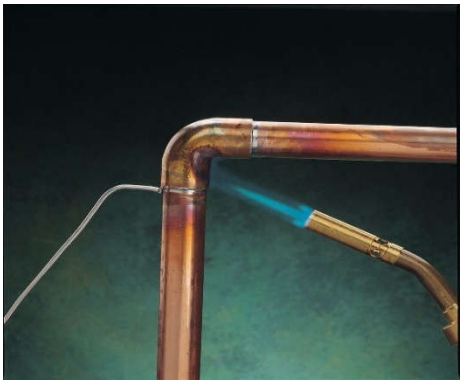
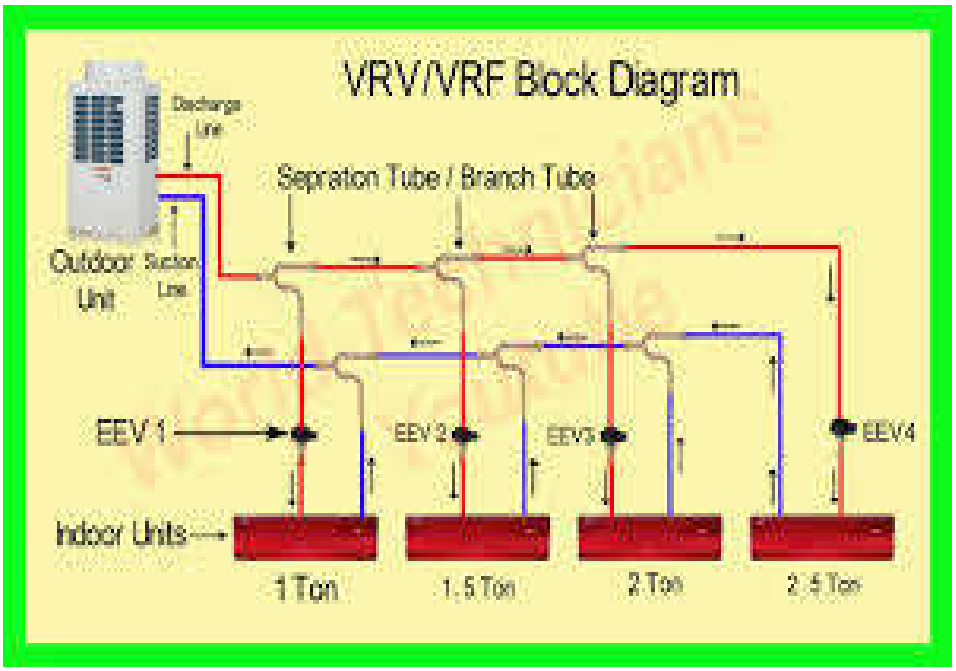


- DX unit : Direct expansion unit used refrigerant as cooling media . copper pipes used for connection between indoor and outdoor units . (FCU / AHU / Heat exchanger) .

- VRV or VRF (Variable refrigerant volume-flow) system : use refrigerant as cooling and heating medium. This refrigerant is conditioned by one or more condensing units (which may be outdoors or indoors, water or air cooled), and is circulated within the building to multiple indoor units.



DUCTING SYSTEM

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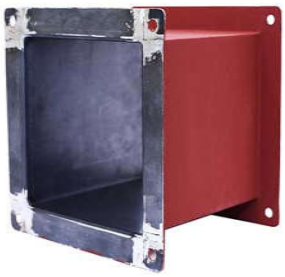
HVAC – Ducting System :

- For Design and Installation Follow local standard (GCC , SBC , …etc) or International one (ASHRAE / SMACNA) .

- SMACNA standard is extremely important for duct design, fabrication, installation and testing.

- Duct used to transfer air from one location to another based on the working system.

- Type of duct :
    1. Galvanized duct-Rectangular.
    2. Galvanized duct- Round.
    3. Black steel duct-: Used for high temperature application like kitchen hood.
    4. Stainless Steel duct: Used as anti-corrosion media.
    5. Fire rated duct : G.I duct with fire rated paint , normally used in smoke management system specially fire rated wall penetration .



- Duct Connection: By using clips for smaller sizes , duct-mate (flanged) for the bigger. and angel bar in some situation .

- Duct Heat Insulation: Insulation thickness and density based on site running condition . also , there is two main type of insulation (board – duct riser and roof / roll – horizontal duct) .
  Insulation materials: Fibber glass / Foam / Rockwool / Calcium Silicate for black steel duct).

- Duct Sound Insulation (Acoustic) : Used to damping the sound level passing through installed duct.
  Installed in supply and return duct.
  Sound insulation material is Armaflex.

- Duct working system (**Ventilation and cooling**)
  - ✓ Ventilation: Fresh duct / Exhaust duct / Smoke duct / staircase pressurization.
  - ✓ Cooling: Supply duct / Return duct.

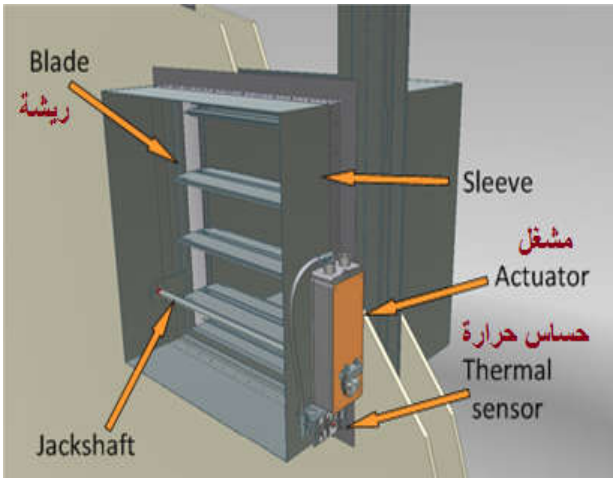
- **Dampers** :used to control air flow through duct .
  Dampers type: (Volume -VCD / Fire -FD / motorized / fire smoke) .

  VCD: Manual damper used to control air flow in specific area to achieve design CFM .

  Motorized VCD: Same VCD but controlled via electrical motorized actuator.

  Fire damper FD: Damper installed in fire rated wall to prevent smoke transferred from one area to another. FD contain lead pullet, which is melt in certain temperature cause to close the damper.

  Motorized fire and smoke damper MFSD: the same function of FD but it controlled via electrical actuator connected with smoke and heat detector.



- **Fans :**
  Machine used to transfer air from one location to another based on air pressure differences. Air flow measure by CFM (Cubic feet per minute) .

  Fan types:

  1. (Centrifugal and axial) based on motor and flow direction.
  2. (Fresh / Exhaust / Smoke) based on working system.
  3. (Constant flow / variable flow VFD drive) based on control design.

FUEL SYSTEM

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Fuel System:

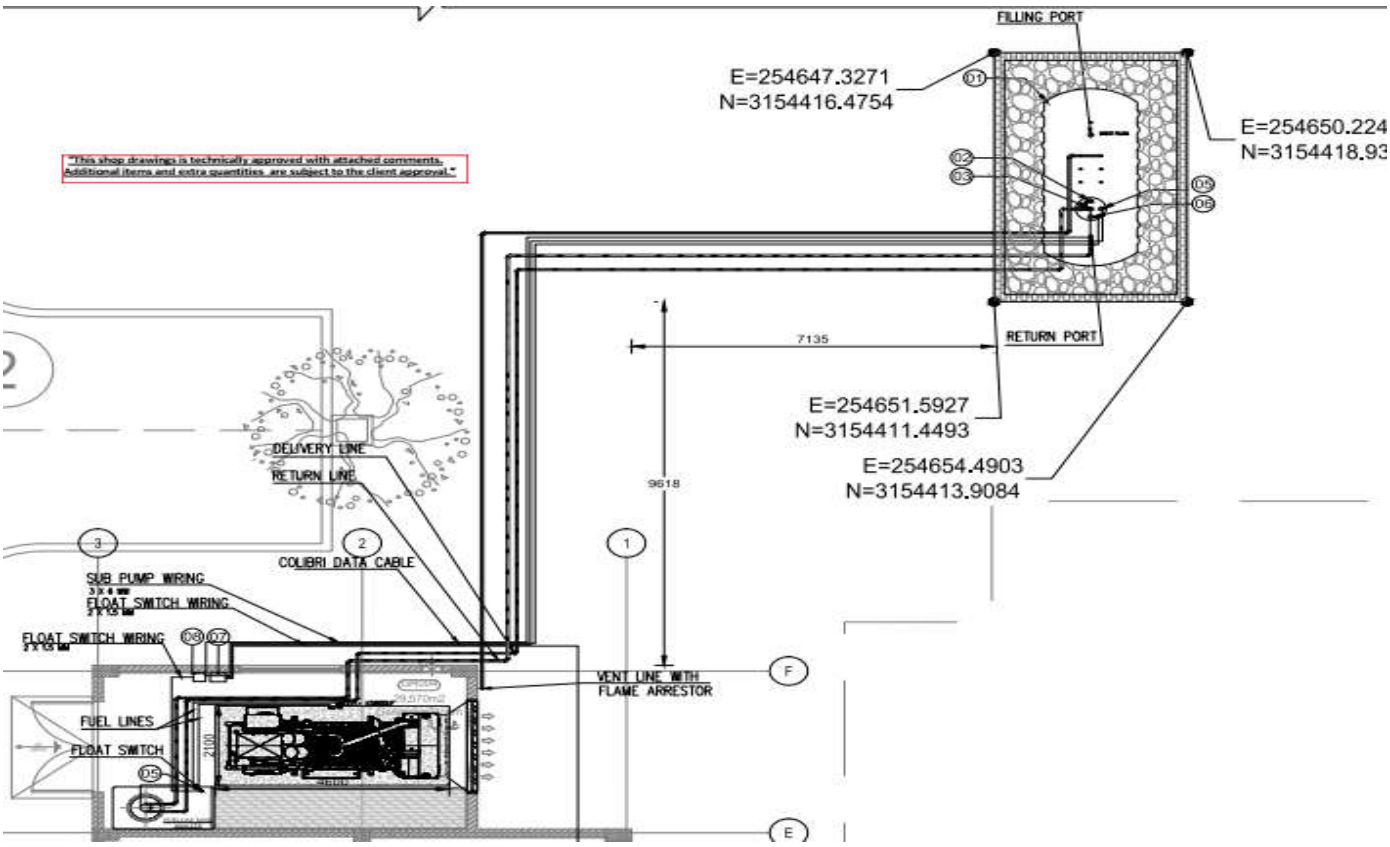
- Fuel system used to supply generator with fuel or petrol station.

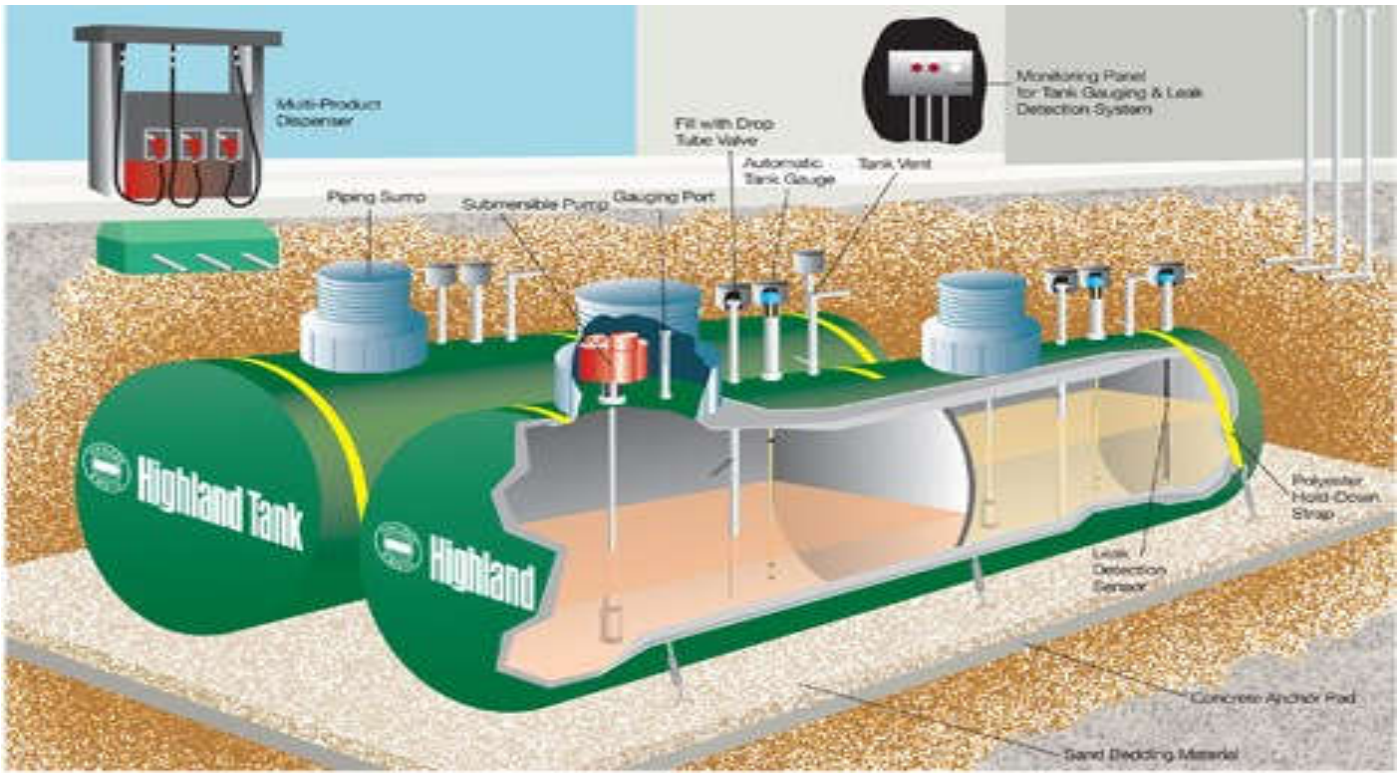
- Generator: Machine convert burning fuel to electricity.

- Generator are two type: Air cooled (built-in fan) or Water cooled (by add radiator network) .
- Normally connect with main electrical panel and used in emergency case while main electrical source is out of service.

- Fuel System component :

1. Bulk tank : Underground tank store fuel at least for seven days of generator daily consumption . Can be either steel or GRP .
2. Pipes and fitting : black steel pipe .
3. Pumps : It could be booster pump or submersible pump in bulk tank for transfer fuel to daily tank.
4. Daily Tank : Steel tank store a day consumption of generator fuel.
5. Control system :
   - ✓ System with control panel that measure the fuel level with at least three indicator (low : filling / High : Overflow alarm).
   - ✓ Start and shut off pumps.
   - ✓ Leak detection system.
6. Valves : Isolation valve / Check valve / Solenoid valve /.. etc.
7. Filling point : point to fill the bulk tank .
8. Fuel meter : installed after the filling point to measure consumed fuel .
9. Flame arrestor : device installed in tank for safety and for emergency case of fuel leakage.
10. Air vent : installed in fuel tank and the network to released air .





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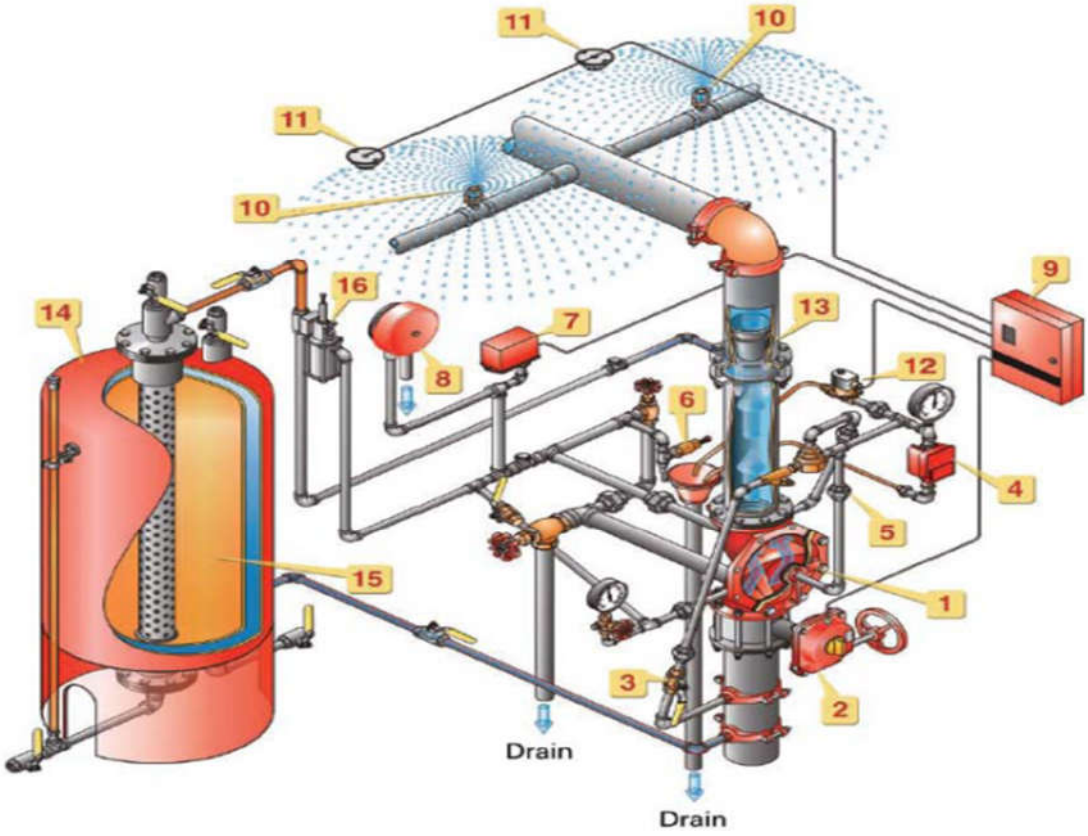
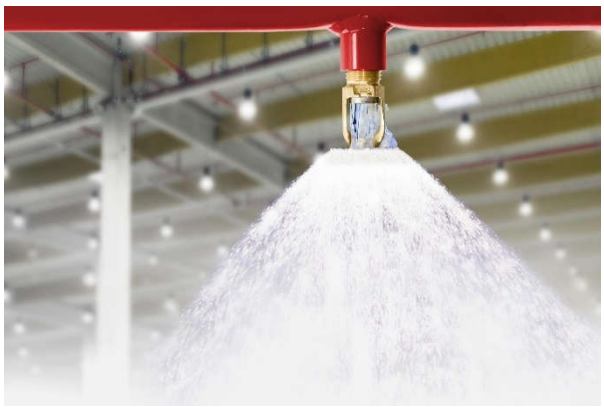
- Fuel system and generator room required special fire protection system. Foam namely is the most popular used system.



LEGEND

1 Deluge Valve (DV-5)	7 Pressure Switch	13 Foam Proportioner
2 Isolation Valve	8 Water Motor Gong	14 Foam Bladder Tank
3 Diaphragm Supply Valve	9 Releasing Panel	15 Foam Concentrate
4 Manual Control Station	10 Spray Nozzle	16 Hydraulic Ball Valve
5 Automatic Shut-off Valve	11 Smoke/Heat Detector	
6 Automatic Drain Valve	12 Solenoid Valve	



SUPPORTING SYSTEM

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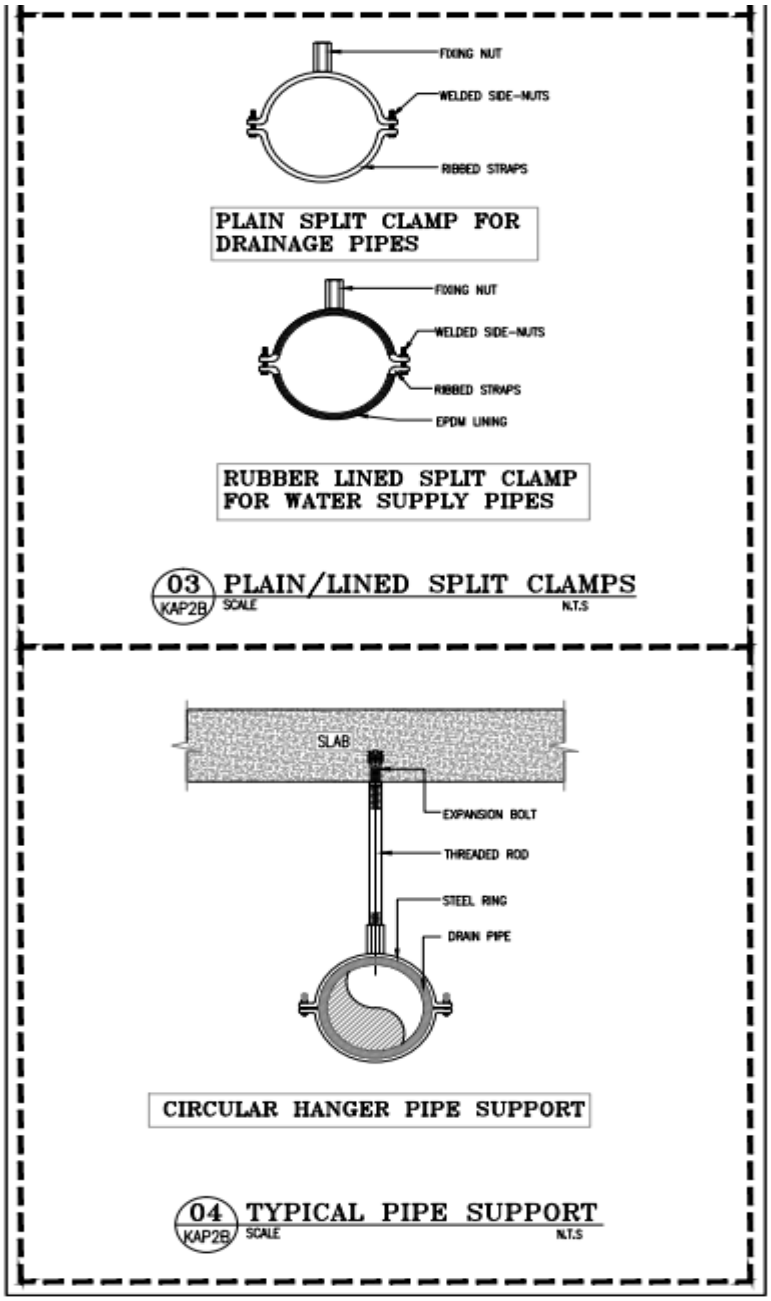
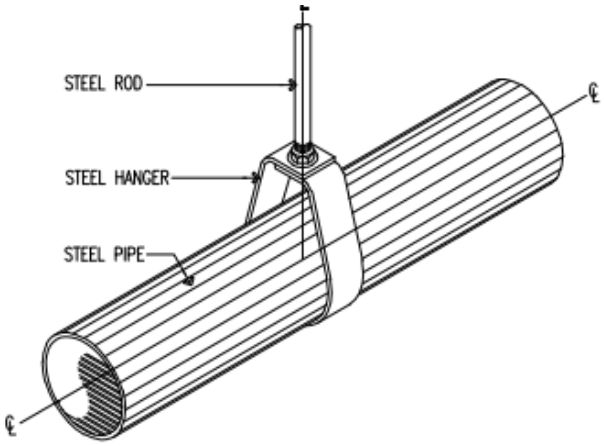
Plain Split Clamp:

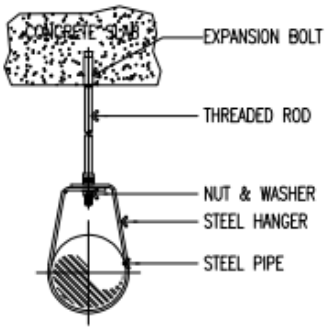
- Used for Drainage pipes without rubber, and with rubber for water supply services.
- Threaded rod size and the distance between supports based on pipe size and project specification.
- May it will used for copper and hot water pipes (Insulated)but it not recommended because it will damage the insulation .



Sprinkler Clamp:

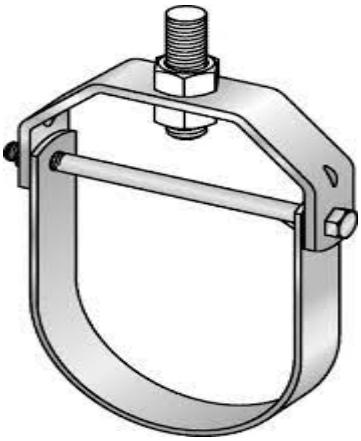
- Used for fire protection services especially for branch line.
- Threaded rod size and the distance between supports based on pipe size and project specification.

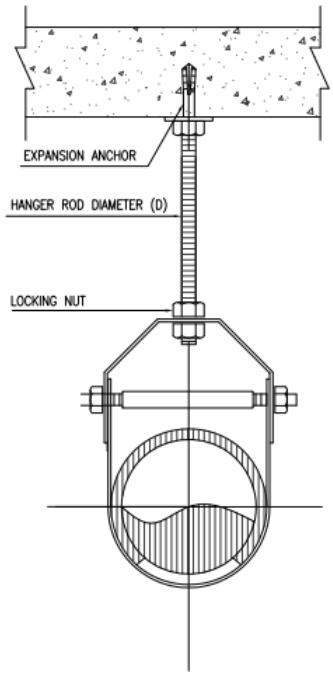




Clevis Clamp:

- Used for Fire protection main line.
- Threaded rod size and the distance between supports based on pipe size and project specification.





PIPE SUPPORT SCHEDULE

(AS PER NFPA 13, TABLE 9.2.2.1, 2013 EDITION)

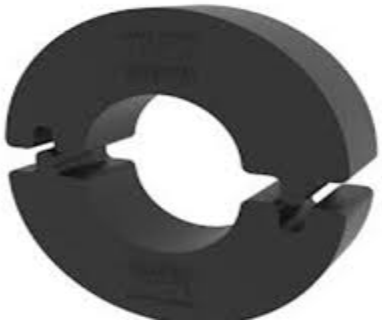
PIPE BORE	MAXIMUM SUPPORT SPACING(M) STEEL PIPE		THREADED ROD SIZE
	HORIZONTAL	VERTICAL	ø
25	2.4	3.0	9.5mm
32	2.7	3.0	9.5mm
40	3.0	3.6	9.5mm
50	3.0	3.6	9.5mm
65	3.7	4.6	9.5mm
80	3.7	4.6	9.5mm
100	3.7	4.6	9.5mm
150	4.5	5.4	12.7mm

Refrigerant Clamp:

- Used for insulated small diameter pipes (refrigerant and hot water pipes).
- Threaded rod size and the distance between supports based on pipe size and project specification.

Chilled Water Pipes Clamp:

- Rubber insert used for insulated chilled water pipes with U- Bolt fixed on angel bar or U-Chanel.
- Sizes (Rubber insert, U-bolt, Threaded rod, angel bar) are based on pipes and insulation size.



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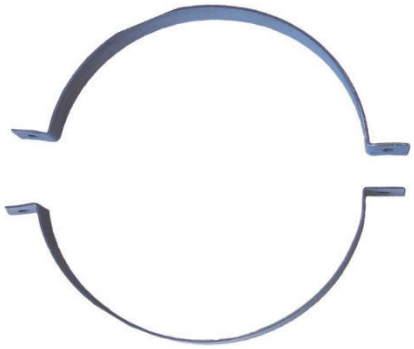
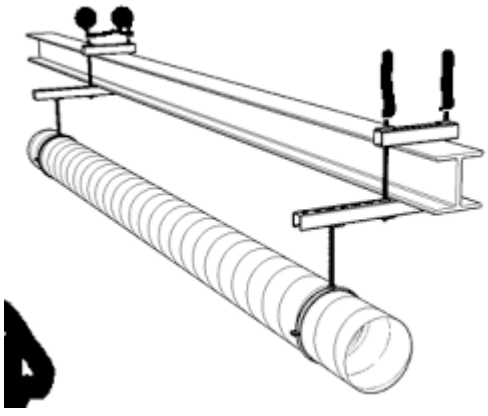
Ducting support:

- It is simple angle bar/ U channel and threaded rod.
- Angel bar size and threaded rod based on duct weight and dimension.
- For round duct, we use U strap hanger.





Cantilever Support:

- Used to fix MEP services on the wall .
- U-channel assembly. It can be fabricated By Welding or by bolt and nut .

Roof Support:

- Used to fix MEP services on the wall .
- U-channel assembly. It can be fabricated By Welding or by bolt and nut.

Seismic Support:

- Used to protect MEP services from earthquake and extreme vibration.
- Worked as shock absorber.
- Provide extra supporting properties and extend supporting system expected life.

Order and take-off :

✓ Contact with support specialist (HILTI / FISCHER/….) in order to start study your project and provide support calculation based on site conditions and elevation.

✓ Specialist will required from you below information:

1. Service type.(Duct / Steel pipe / UPVC pipe /….).
2. Service weight.(….. Kg/M2).
3. Service mounted element (Wall / Ceiling / Floor).
4. Distance between the service and mounted element .

✓ Calculation now is ready and support assembly will be provided for each case.

✓ Some system can be combined to use the same support.

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MECHANICAL ITEM DATA SHEET

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Mechanical Items data sheet:

Below is links contain useful related catalogue.

- **UPVC pipes and fitting :**

https://aplaco.com.sa/wp-content/uploads/2020/10/APLACO_Pressure_Catalouge.pdf

- **Copper pipes :**

https://fliphtml5.com/dase/ewof/basic

- **PPR :**

http://www.cosmoplast.com/catalogue/PPR-catalogue-July-2019-31-05-2020.pdf

- **HDPE :**

http://www.shieldglobal.com/wp-content/uploads/SHIELD-HDPE-Catalogue-1117-2.pdf

- **CPVC :**

https://www.eslon-plant.jp/web-en/catalog/Catalog-E_SCH80PipeSystem.pdf

- **Black Steel – Threaded Fitting :**

https://www.cctf.com/catalogues/malleable_iron_threaded_fittings.pdf

- **Black steel – Groove Fitting :**

https://www.victaulic.com/assets/uploads/literature/G-103.pdf

- **Plumbing Valves :**

https://www.econosto.fi/en/products/

- **Sanitary Fixture :**

http://www.zoombathrooms.com/wps/wcm/connect/8b534b0042d892b39a1cba73d300c517/Zoom_catalogue_FR_EN.pdf?MOD=AJPERES

https://pdf.archiexpo.com/pdf/grohe/specifiers-catalogue-2020/88802-380430.html

- **Water heater :**

https://pdf.archiexpo.com/pdf/ao-smith/product-catalogue/137018-239672.html

- **FF Valves and Sprinkler :**

https://fakhribrothers.com/wp-content/uploads/2020/01/shield-main-catalogue-2015.pdf

- **Fire Pump :**

http://ofs-bd.com/wp-content/uploads/2018/04/fire-pump-catalogue.pdf

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- **AHU :**

https://www.carrier.com/commercial/en/sa/media/39HQ-Product-Data_tcm198-51091.pdf

- **FCU :**

https://www.shareddocs.com/hvac/docs/1013/Public/08/42DC-J14-8PD.pdf

- **Chiller :**

https://www.trane.com/content/dam/Trane/Commercial/lar/br/produtos-sistemas/equipamentos/Chillers/Chillers_Parafuso/Condensacao_Ar/RTAC-Serie_R/RTAC_Plus-Nacional/Catalogo_Produto-RTAC(RLC-PRC001B%20EN)%20small.pdf

- **Dampers :**

https://cgproducts.johnsoncontrols.com/cat_pdf/PUBL-7211.pdf

- **Oil Interceptor :**

https://www.zurn.com/media-library/web_documents/pages/technicalinformation/interceptors/oil-int-combined-pdf.aspx

- **Drainage accessories :**

http://www.rundumswasser.com/fileadmin/rundumswasser/movs/Ablaeufe.pdf

https://www.saudicast.com/wp-content/uploads/2019/06/Saudi-Cast-Catalogue-2018-2020.pdf