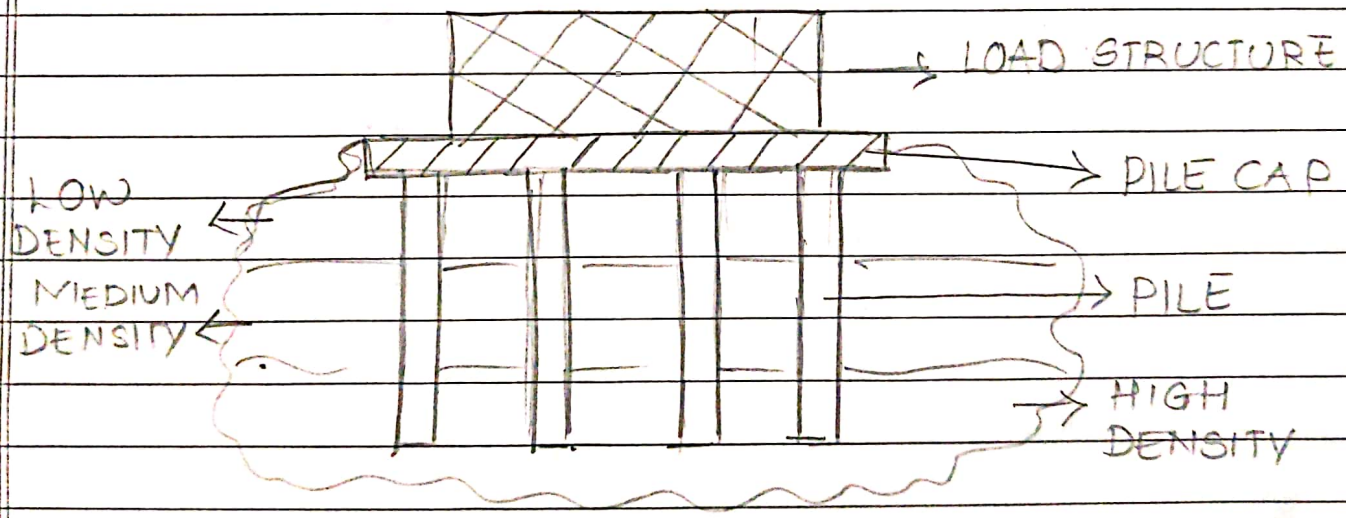
PILE FOUNDATION

* WHAT IS PILE FOUNDATION?

PILE FOUNDATION A KIND OF DEEP FOUNDATION IS ACTUALLY A SLENDER COLUMN OR LONG CYLINDER MADE OF MATERIALS SUCH AS CONCRETE OR STEEL WHICH ARE USED TO SUPPORT THE STRUCTURE AND TRANSFER THE LOAD AT DESIRED DEPTH EITHER BY END BEARING OR SKIN FRICTION.



* WHERE IT IS USED?

→ WHERE THE SOIL IS COMPRESSIBLE
→ WHERE THE SOIL IS WATER LOGGED
→ THE TOP SOIL HAS POOR BEARING CAPACITY
→ THE SUBSOIL WATER LEVEL IS HIGH
→ WHERE THE AREA OF THE SITE IS LESS.

TYPES OF PILE FOUNDATION

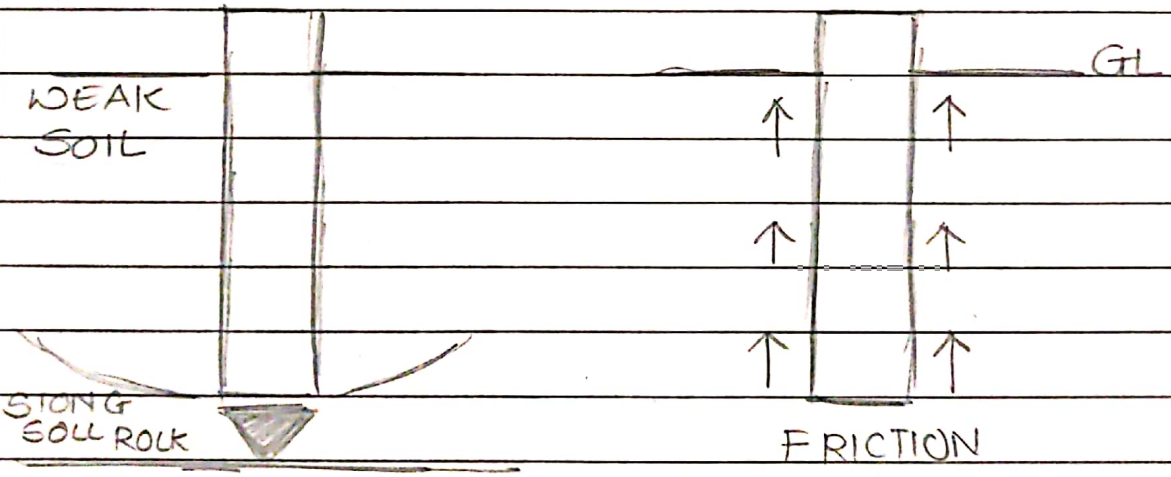
1) LOAD BEARING PILE :-

IT BEAR THE LOAD COMING FROM THE STRUCTURE THE ARE DIVIDED INTO :-

(1) BEARING PILES
(2) FRICTION PILES.

2) NON LOADING BEARING PILES :-

THE PILES ARE USED TO FUNCTION AS SEPARATING MEMBERS BELOW GROUND LEVEL AND THEY ARE GENERALLY NOT DESIGNED TO TAKE VERTICAL LOAD



END BEARING PILE

FRICTION PILE.

* CLASSIFICATION OF PILES.

→ BASED ON FUNCTIONS
→ BASED ON MATERIAL
→ BASED ON METHOD OF INSTALLATION

* ADVANTAGES

→ THEY CAN BE PRECAST TO SPECIFICATIONS.

→ THEY CAN BE PREMADE WHICH REDUCES THE AMOUNT OF TIME AND LABOURS AT THE SITE.

→ THEY CAN VERY EFFICIENT AT PLACES WITH A FOUNDATION SIZE LIMIT.

→ THEY ARE A GREAT OPTION WHILE WORKING OVER WATER FOR EG- BRIDGES., DOCKS, PORTS ETC.

→ THEY ARE ESSENTIAL IN THE CONSTRUCTION OF HIGH RISE BUILDING.

* DISADVANTAGES

→ THE WHOLE PROCESS REQUIRES HEAVY EQUIPMENTS AND SKILLED LABOURS.

→ ADEQUATE PRE-PLANNING IS REQUIRED AND THERE IS NO MARGIN FOR ERROR.

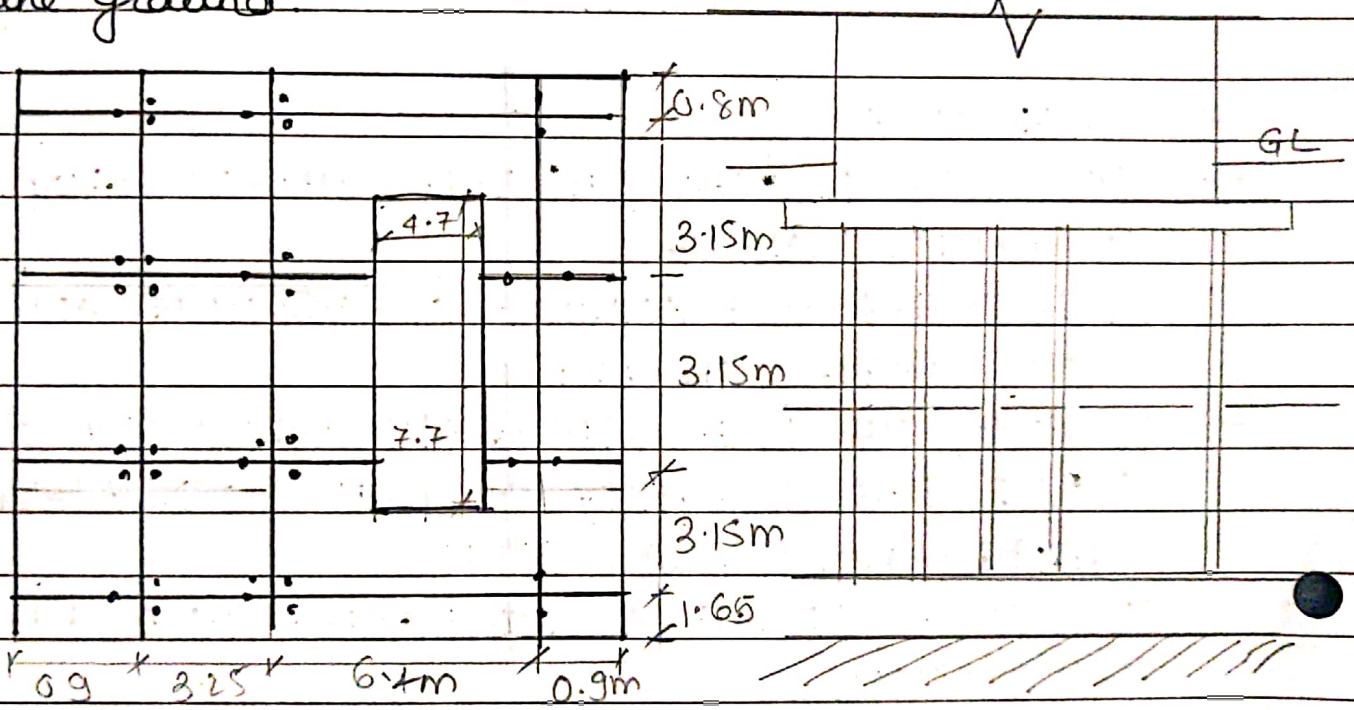
→ DRIVING THE PILES GENERATE VIBRATION THAT CAN AFFACT THE INTEGRITY OF THE FOUNDATION OF NEIGHBOVERING STRUCTURES

→ IT IS AN EXPENSIVE AS COMPARED TO A REGULAR FOUNDATION.

CASE STUDY

* CUSTOMS OFFICE TOWER AT KANDLA PORT BHUT KUTCH

→ 6 Storeyed customs office tower to coast
→ 32 short cast in place Concrete pile
→ It is 18 m long
→ The part of kandla is lmas on Natural ground Comprising recent unconsolidated deposits of interbedded clays, silts and sands.
→ The watertable is about 1.2-3.0m below the ground.



Column and pile plan at GL . Section of pile foundation.

→ Column = 0.45 × 0.45m
→ Column = 0.25 × 0.25m
→ Concrete pile dia = 0.4m
→ Flat foundation = 11.45m × 11.9m × 0.5m
→ No. of Columns = 12
→ No of Rafts = 92
→ length of pile = 18m

HIGH RISE

* WHAT IS HIGH RISE?

→ THE NATIONAL BUILDING CODE (NBC) DEFINES A HIGH RISE BUILDING AS ONE WITH FOUR FLOORS OR MORE OR 15+ METER IN HEIGHT.

→ EMPORIS STANDARDS DEFINES A HIGH RISE AS A MULTI-STORY STRUCTURE BETWEEN 35-100 HEIGHT FROM 12-39 FLOORS.

→ MOST BUILDING ENGINEERS, INSPECTORS, ARCHITECTS, AND SIMILAR PROFESSIONALS DEFINS A HIGH RISE AS A BULLDING THAT IS AT LEAST 75 FEET (23m) TALL.

* FIRST TALL STRUCTURE

THE HOME INSURANCE BUILDING WAS A SKYSCRAPER THAT STOOD IN CHICAGO FROM (42.1m) TALL, WAS DESIGNED BY WILLIAM LE ~~NEXT~~ BARON JENNEY IN 1884 AND COMPLETED THE NEXT YEAR AND WAS DEMOLISHED 46 YEARS LATER IN 1931.

* WHAT GAVE RISE TO TALL STRUCTURES?

→ POPULATION GROWTH :- SCARCITY OF LAND IN URBAN AREAS.

→ INCREASING DEMAND FOR RESIDENTIDAL AND BUSINESS SPACE.

→ INDUSTRIAL REVOLUTION LEADING TO ECONOMIC GROWTH.

→ TECHNOLOGICAL ADVANCEMENTS IN TERMS OF VERTICAL TRANSPORTATION.

→ INNOVATION IN STRUCTURAL SYSTEM.

→ HUMAN ASPIRATION TO BUILD HIGHER.

* TYPES OF LOADS ACTING ON TALL STRUCTURES :-

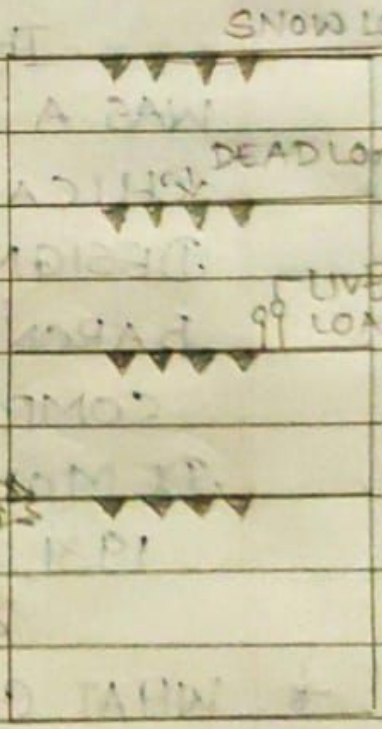
→ DEAD LOAD

→ LIVE LOAD

→ SNOW LOAD

→ LATERAL LOAD - WIND LOAD EARTHQUAKE LOAD

→ DYNAMIC LOAD - IMPACT LOAD BLAST LOAD.



* TUBE SYSTEM :-

→ THE TUBE SYSTEM IS A STRUCTURAL ENGINEERING SYSTEM THAT IS USED IN HIGH RISE BUILDING ENABLING THEM TO RESIST LATERAL LOADS FROM WIND, SEISMIC PRESSURES AND SO ON. IT ACTS LIKE A HALLOW CYLINDER AND CANTILEVERED ~~LIKE~~ A PERPENICULAR TO THE GROUND.

→ THE FIRST BUILDING DESIGNED BY KHAN USING A TOBE FRAME WAS THE DEWITT-CHESTON BUILDING, CHICAGO IN 1963

→ THE TUBE SYSTEM CAN BE CONSTRUCTED USING CONCRETE, STEEL OR A COMPOSITE OF BOTH

* TUBE IN TUBE :-

→ THIS SYSTEM IS ALSO KNOWN AS HULL & CORE & CONSIST OF A CORE TUBE INSIDE THE STRUCTUR WHICH HOLDS SERVICES SUCH AS VTILITIES AND LI AS WELL AS THE USDAL TUBE SYSTEM AND ON THE EXTERIOR WHICH TAKES THE MAJORITY OF THE GRAVITY AND LATERAL LOADS.

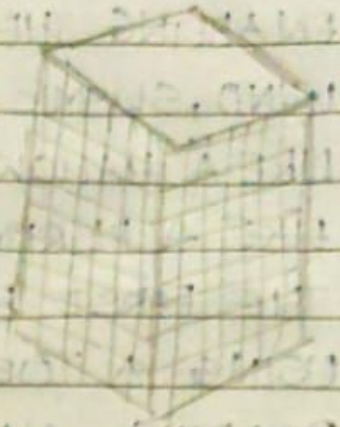
* BUNDLED TUBE :-

→ THE BUNDLED TUBE SYSTEM INVOLES INSTEA OF ONE TUBE, SEVERAL INDIVIDUAL TUBES INTER-CONNECTED TO FORM A MULTI-CELL TUBE. TOGETHE THEY WORK TO RESIST THE LATERAL LOADS AND OVERTURING MOMENTS. WHEN THE TUB FALLS WITHIN THE BUILDING ~~ENE~~ ENVELOPE INSTERIOR COLUMNS ARE POSITIONED ALONG THEIR PERIMETERS.

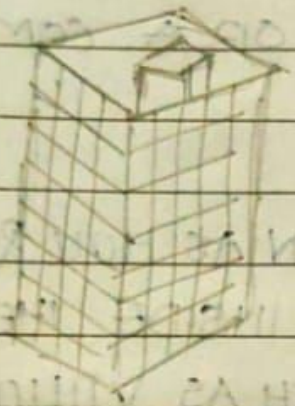
* TYPES OF STRUCTURE.

① BRACED FRAME

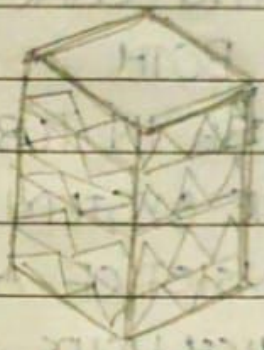
② RIGID TUBE



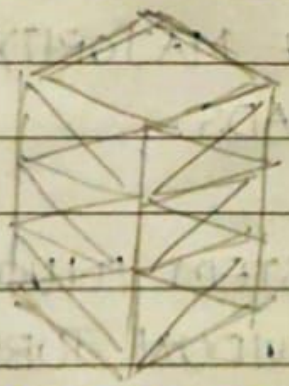
③ TUBE IN TUBE



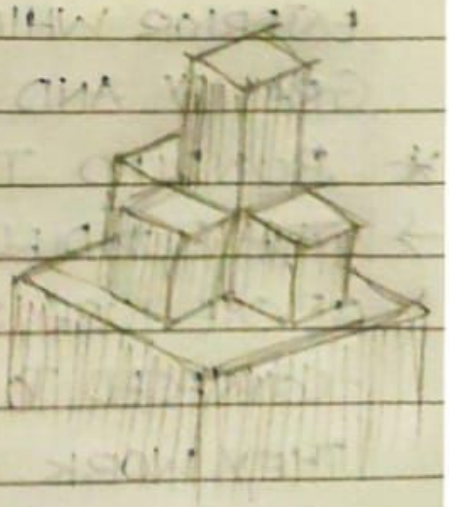
④ DIAGRID



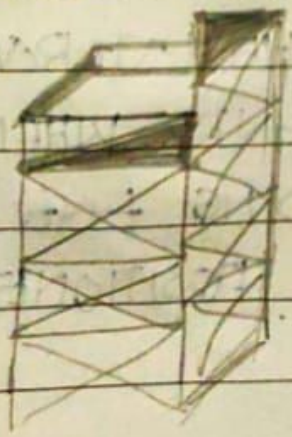
⑤ TRUSSED TUBES



⑥ BUNDLED TUB



⑦ SPACED FRAMES.



EXAMPLE - TAIPEL 101

TAIPEL 101 HAS A COMPLEX STRUCTURAL SYSTEM IT IS NEENED FOR THE BUILDING TO WITHSTAND ITS HARSH ENVIRONMENT AND THE POTENTIAL DANGERS - PAGODA STYLE PLAN AREA -50m x 50m, BUILDING USE - OFFICE COMPLEX + MALL, CONSTRUCTION TOOK 5 YEARS TO COMPLETE., DESIGNED TO BE FLEXIBLE WELL AS STRUCTURE.

* SEISMIC DESIGN.
- CENTRAL CORE
- TRUSSES AND BRAGING
- TRUNCATED PYRAMID BASE.
- FLEXIBLE BUT STURPY MATERIAL
- MASS DAMPER
- MINI DAMPER ON SPIRE.

* BUILDING COMPONENTS & SYSTEM.
- CENTRAL BRACED CORE· RESIST MOMENTS AND GRAVITY LOADS LARGE MEGA· COLUMNS CONCRETE FILLED STEEL BOXES, REFORCED BY MOMENTS FRAME OUTRIGGER.
- TRUSSES 8 SEGEMENTS OF 8 INCCUDES A STORY FOR STRUCTURE DIAGONAL THROUGH OCCUPIED SPACE
- MASS DAMPER 18' DIA (LARGEST IN WORLD)
  728-TON TUNNER
  SUSPENDEN FROM THE 92nd & 87th FLOOR
  REDUCES OVERALL, BUILDING SWAG BY 40.

EARTHQUAKE RESISTANCE STRUCTURE REPORT

WHAT IS AN EARTHQUAKE?

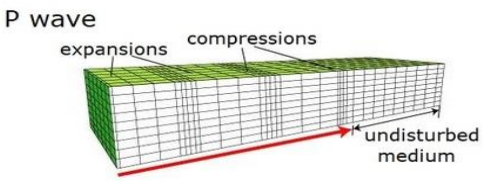
- EARTHQUAKES ARE CAUSED DUE TO SUDDEN LATERAL OR VERTICAL MOVEMENTS IN THE CRUST OF THE EARTH OR WE CAN SAY THAT WHEN TECTONIC PLATES RIDE OVER THE ORTHER AND CAUSE THE COLLISION OF OROGENY OR MOUNTAIN BUILDING.
- THE LARGEST FAULTS ARE FORMED ON THE SURFACE OF THE EARTH DUE TO BOUNDARIES BETWEEN MOVING PLATES.
- THEY ARE NATURAL DISASTERS OF A GENERALLY UNPREDICTABLE NATURE.
- IT IS SHAKING OF THE EARTH,DUE TO THE MOVEMENT OF EARTH CRUST.

CAUSES FOR EARTHQUAKE:

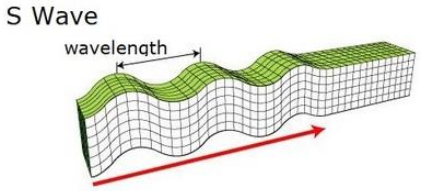
- TECTONIC EARTHQUAKE OCCURS WHEN DUE TO GEOLOGICAL FORCE ON ROCKS AND THE ADJOINING PLATES CAUSES PHYSICAL AND CHEMICAL CHANGES AND RESULTS IN THE BREAKING OF THE EARTH CRUST.
- VOLCANIC EARTHQUAKE RESULTS FROM TECTONIC FORCES AND OCCURS IN CONJUNCTION WITH VOLCANIC ACTIVITY.
- COLLAPSE EARTHQUAKE ARE GENERALLY SMALL EARHQUAKE THAT OCCURS IN UNDERGROUND CAVERNS AND MINES CAUSED BY SEISMIC WAVES WHICH ARE PRODUCED FROM THE EXPLOSION OPF ROCK ON THE SURFACE.
- EXPLOSION EARTHQUAKE OCCURS DUE TO THE DETONATION OF A NUCLEAR OR CHEMICAL DEVICE.

TYPES OF EARTHQUAKES:

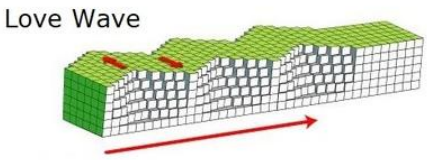
- BODY WAVES: BODY WAVES IS A SEISMIC WAVE THAT MOVES THROUGH THE INTERIOR OF THE EARTH. THEY ARE DIVIDED INTO TWO TYPES:
    1. P-WAVES: IT'S KNOWN AS PRIMARY WAVES. THEY TRAVEL AT THE GREATEST VELOCITY THROUGH THE EARTH. IT CAN MOVE THROUGH ROCK, SOLID AND FLUIDS.



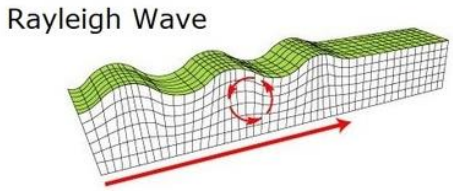
    2. S-WAVES: IT'S KNOWN AS SECONDARY WAVES. THEY TRAVEL LOWER THAN P-WAVES. IT TRAVELS THROUGH SOLIDS ONLY.



- SURFACE WAVES: SURFACE WAVES TRAVEL JUST UNDER THE EARTH'S SURFACE.THEY CAN BE MUCH LARGER IN AMPITUDE AND CAN BE THE MOST DESTRUCTIVE TYPE INSPITE OF BEING SLOW.
    1. LOVE: IT'S THE FASTEST SURFACE WAVES AND MOVES THE GROUND SIDE TO SIDE. THESE WAVES PRODUCE ENTIRELY HORIZONTAL MOTION.



    2. RAYLEIGH: A RAYLEIGH WAVE ROLLS ALONG THE GROUND JUST LIKE A WAVE ROLLS ACROSS A LAKE OR AN OCEAN. BECAUSE IT ROLLS, IT MOVES THE GROUND UP AND DOWN, AND SIDE TO SIDE IN THE SAME DIRECTION THAT THE WAVE IS MOVING.



DESIGN CRITERIA FOR EARTHQUAKE RESISTANT STRUCTURES:

- SIMPLER THE PLAN BETTER THE PREFORMANCE.
- RCC PEFERABLE THAN PCC.
- STRONG COLUMN WEAK BEAMS.
- AVOID SOFT STOREY /RATHER PROVIDE CONTINUE WALLS ON GROUND STOREY.
- HORIZONTAL BAND NECESSARY THROUGHOUT THE MANSORY.

STRUCTURAL CRITERIA FOR EARTHQUAKE RESISTANT STRUCTURES:

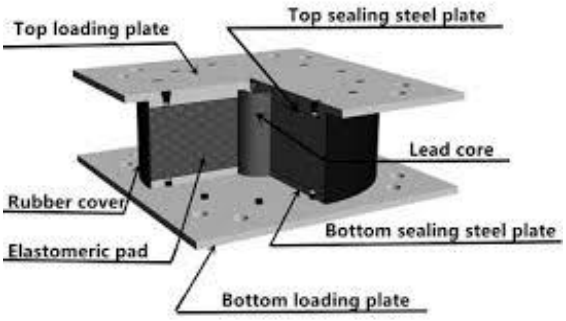
- COMPACT THE CONCRETE BY MEANS OF NEEDLE VIBRATOR.
- CURE THE CONCRETE FOR AT LEAST A MINIMUM PERIOD.
- EXPERIENCED SUPERVISOR SHOULD BE EMPLOYED TO HAVE.
- GOOD QUALITY CONTROL AT SITE.

TECHNIQUES USED FOR EARTHQUAKE RESISTANT STRUCTURE:

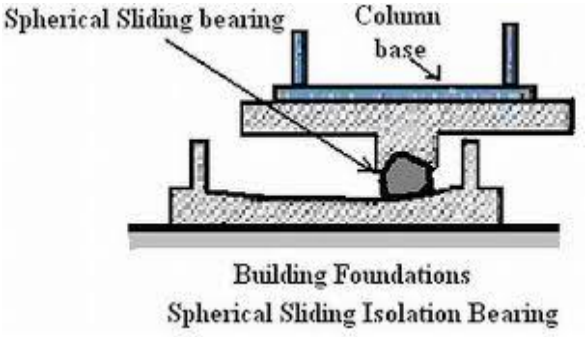
BASE ISOLATION:

- INTRODUCES FLEXIBILITY TO THE STRUCTURES.
- BUILDING IS RESTED ON FLEXIBLE PADS (BASE ISOLATORS).
- WHEN EARTHQUAKE STRIKES BUILDING DOES NOT MOVE.
- IT IS SUITABLE FOR HARD SOIL ONLY.

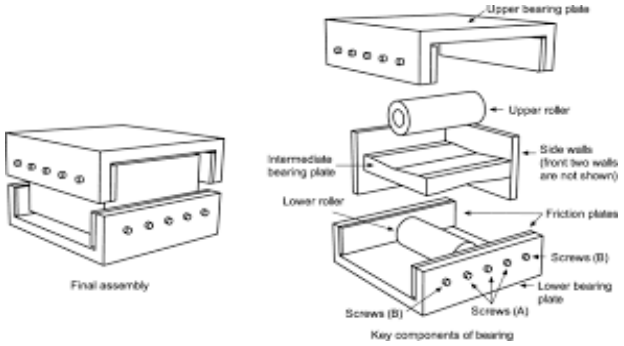
1. LEAD RUBBER BEARING :
    - FREQUENTLY USED FOR BASE ISOLATION.
    - MADE FROM LAYERS OF RUBBER SANDWICHED TOGETHER WITH LAYERS OF STEEL.
    - VERY STIFF AND STRONG IN THE VERTICAL DIRECTION.
    - FLEXIBLE IN HORIZONTAL DIRECTION.



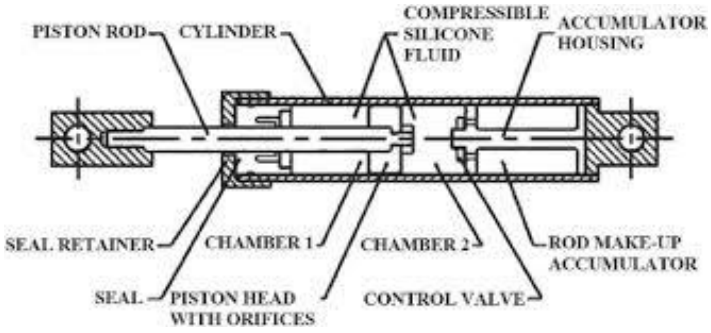
2. SPHERICAL SLIDING ISOLATOR :
    - IT USES BEARING PADS THAT HAVE A CURVED SURFACE AND LOW FRICTIO MATERIAL SIMILAR TO TEFLON.
    - DURING AN EARTHQUAKE THE BUILDING IS FREE TO SLIDE BOTH HORIZONTALLY AND VERTICALLY.
    - IT WILL RETURN TO ITS ORIGINAL POSITION AFTER THE GROUND SHAING STOPS.



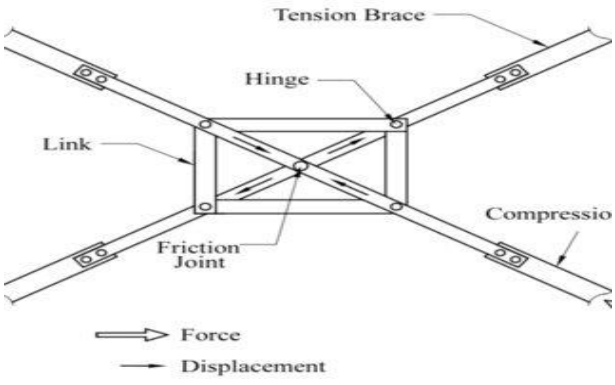
ROLLERS:



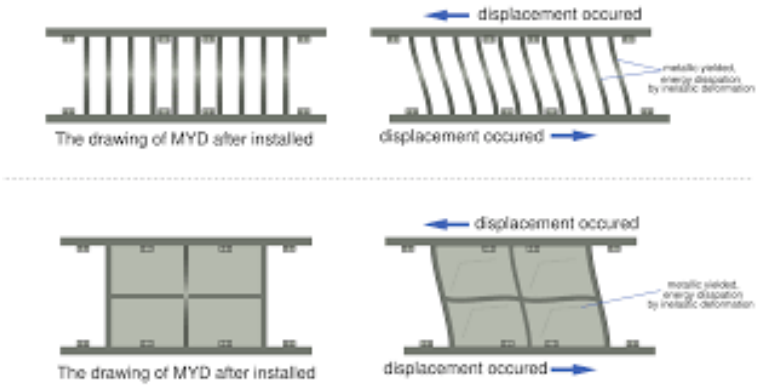
VISCOUS DAMPER:



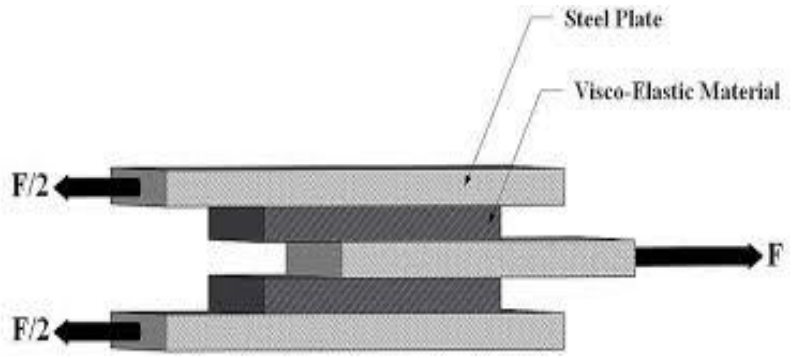
FRICTION DAMPER:



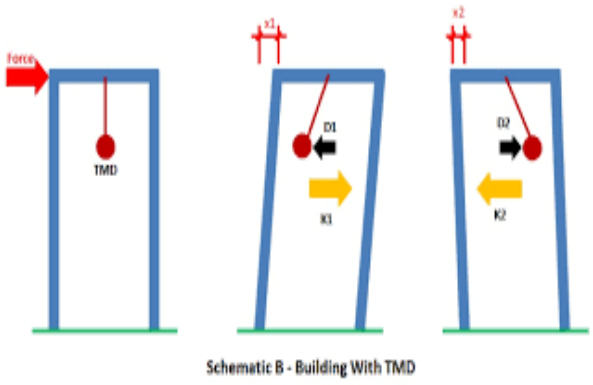
YEILDING DAMPER:



VISCOELASTIC DAMPER:



TUNED MASS DAMPER:



ADVANTAGES:

- THIS IS TO PROTECT THE PRIMARY STRUCTURE FROM DAMAGE.
- AVOIDING DANGEROUS BUILDING COLLAPSE.
- BASE ISOLATION WILL ENHANCE OCCUPANT SAFETY DURING A MAJOR EARTHQUAKE AND PROJECT THE BUILDING CONTENTS.
- A RESILIENT BUILDING MAY ALLOW YOU EARLY OCCUPATION AFTER AN EARTHQUAKE AND BUISNESS CONTINUITY.
- IT CAN INCREASE STAFF CONFIDENCE.

DISADVANTAGES:

- AN EARTHQUAKE CAUSES COURSE DEATH AND DESTRUCTION OF ROAD AND HOUSES AND BUILDING.
- THEY CAN MAKE BUILDING FALL DOWN AND SET OFF LANDSLIDES, AS WELL AS HAVING MANY OTHER DEADLY EFFECTS.
- HIGHER NUMBER ON THE SCALE THE MORE POWERFUL THE QUAKE THE MORE POWERFUL A QUAKE IS MORE DAMAGE IT CAN CAUSE.

CASE STUDY:

PHILIPPINES ARENA

LOCATION: CIUDAD DE VICTORIA, SANTA MARIA, BULACAN, PHILIPPINES 30 KM NORTH OF MANILA.

ABOUT:

- ONE OF THE LARGEST ARENA IN THE WORLD.
- CAPACITY OF ARENA:50,000
- EARTHQUAKE RESISTANT STRUCTURE
- WIND AND FLOOD RESISTANT STRUCTURE
- THE LARGEST NON-COLUMN AREA IN THE WORLD, MEASURED TO BE AROUND 227 M × 179 M.
- INSPIRED BY THE TRADITIONAL FILIPINO NIPA HUT AND THE INDIGENOUS NARRA TREE, THE PHILIPPINE ARENA SYMBOLISES THE ENDURANCE, STRENGTH AND INDOMITABLE SPIRIT OF THE PEOPLE.
- ARCHITECTURE FIRM: POPULOUS
- CONSTRUCTED BY 14TH MAY 2014 (DURATION: 3 YEARS)

MAJOR PROBLEMS:

- CAPACITY: THE PHILIPPINES' CAPITAL OF MANILA IS THE WORLD'S MOST DENSELY POPULATED CITY, AND ANCHORS A METROPOLIS OF MORE THAN 12 MILLION PEOPLE.

- LOCAL FOCAL POINT: IT IS DIFFICULT TO GIVE 50,000 PEOPLE A GOOD VIEW OF A SINGLE FOCAL POINT AND CREATE AN INTIMATE ATMOSPHERE.

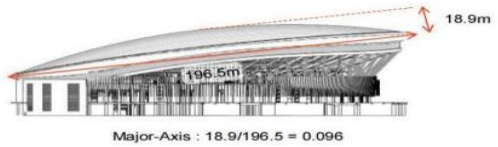
- CLIMATE AND EARTHQUAKE ZONE: EARTHQUAKES – SOME AS POWERFUL AS 8.2MW ON THE RICHTER SCALE – FREQUENTLY ROCK THE PHILIPPINES. SUCH SEISMIC ACTIVITY IGNITES VOLCANOES AND SUMMONS TSUNAMIS. GALE-FORCE WINDS FROM TROPICAL TYPHOONS TEAR ACROSS THE LANDSCAPE.

- MULTI-PURPOSE ARENA: A FACILITY OF THIS SIZE ALSO NEEDS TO AVOID FEELING EMPTY DURING SMALLER EVENTS. IT NEEDS TO HOLD DIFFERENT EVENT AT THE SAME VENUE.

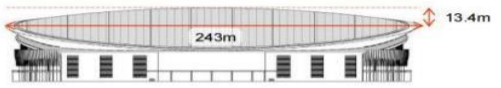
- SAFE POINTS: THE DESIGN HAD TO ENABLE LARGE CROWDS TO ENTER AND EXIT THE ARENA QUICKLY AND SAFELY, AND ACCOUNT FOR MANILA'S HUMID, TROPICAL CLIMATE AND LOCATION IN AN EARTHQUAKE ZONE.

HOW CHALLENGES ARE APPROACED:

- HIGH CAPACITY OF ARENA:
  LARGEST NON-COLUMN ARENA
  CAPACITY: 50,000 + LIVE SITE 50,000
  ELLIPTICAL DOME ROOF WITH GRID SYSTEM SPACE FRAME
  DIMENSIONS: 227 M × 179 M



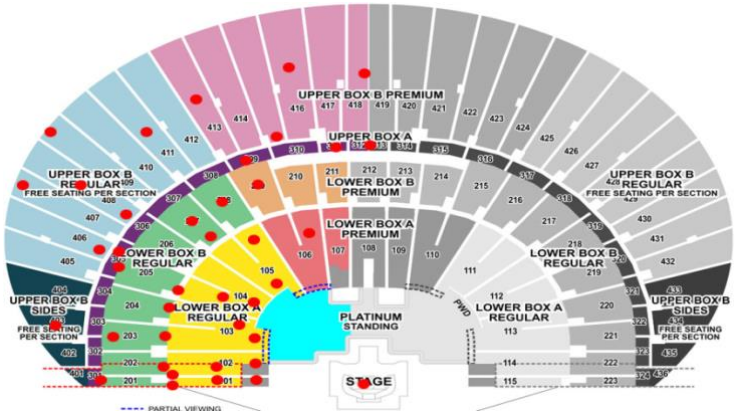
Major-Axis : 18.9/196.5 = 0.096



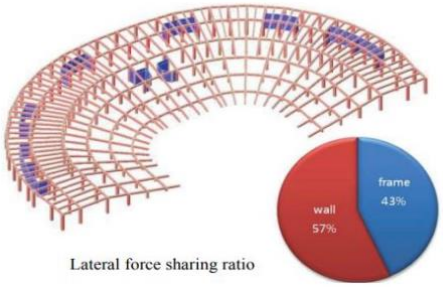
Minor-Axis : 13.4/243.0 = 0.055

Overall geometry of roof structure.

- CLEAR VIEW FOR ALL:
  - ONE-SIDED BOWL
  - FOCAL POINT IN ONE DIRECTION
  - SIMILAR DESIGN LIKE A THEATER
  - CENTRAL STAGE WITH VIDEO BOARD OF EITHER SIDES OF STAGE.



- CLIMATIC CONDITIONS AND EARTHQUAKE ZONE:
  - DUAL SYSTEM & LRB
  - FULLY AIR CONDITIONED
  - RC BEAM & GIRDER SYSTEM
  - LEAD RUBBER BEARING
  - WIND TEST ON STEEL SPACE FRAME
  - THE SHEAR WALLS AND THE GIRDER SYSTEM SHARED THE LATERAL FORCES DURING A MODEL TEST.
  - THUS IT CAN TAKE ON STANDARD SEISMIC FORCES.

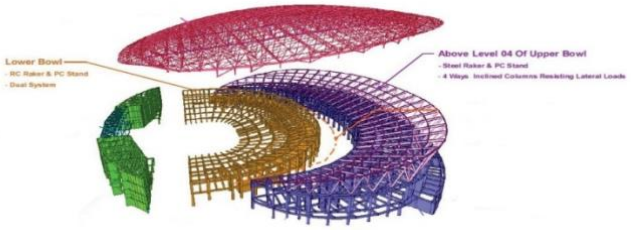


Lateral force sharing ratio

- LARGE OR SMALL CROWD:

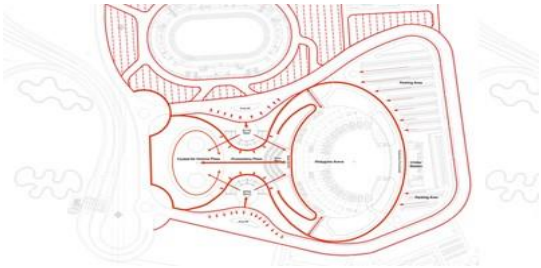
  TWO SEPARATED BOWLS

  TO RETAIN INTIMACY DURING SMALLER EVENTS, THE LOWER BOWL IS THE MOST FREQUENTLY USED PART OF THE BUILDING. IT CAN BE EASILY SEPARATED FROM THE UPPER TIER THROUGH CURTAINING WITH ACOUSTIC AND THERMAL PROPERTIES.



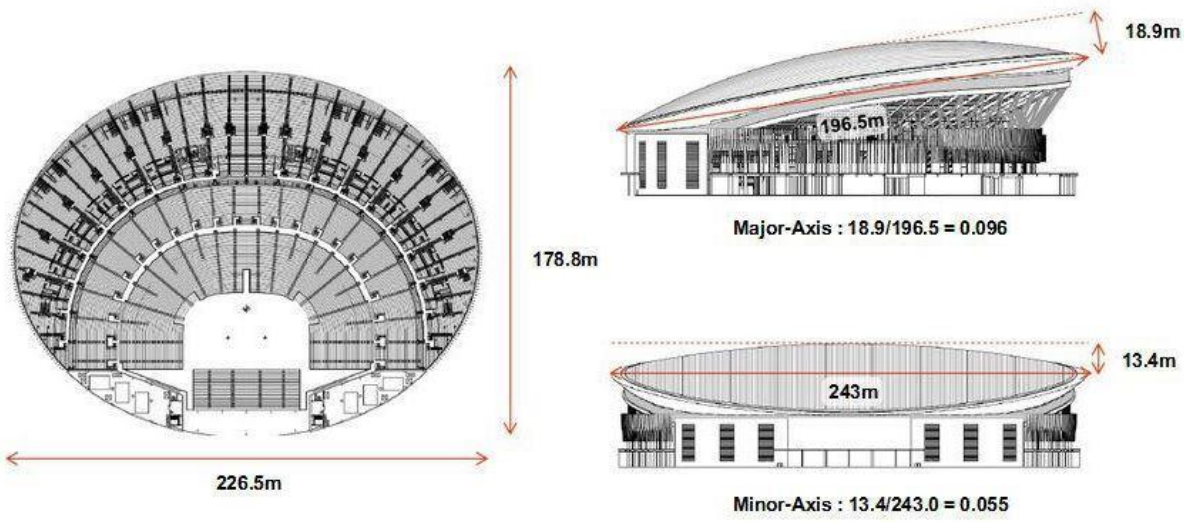
- CROWD FLOW:

  TO COPE WITH LARGE NUMBERS ARRIVING FOR AN EVENT SIMULTANEOUSLY, THE ARENA'S ENTRANCES IMMEDIATELY REDIRECT PEOPLE TO CLEAR PATHWAYS.

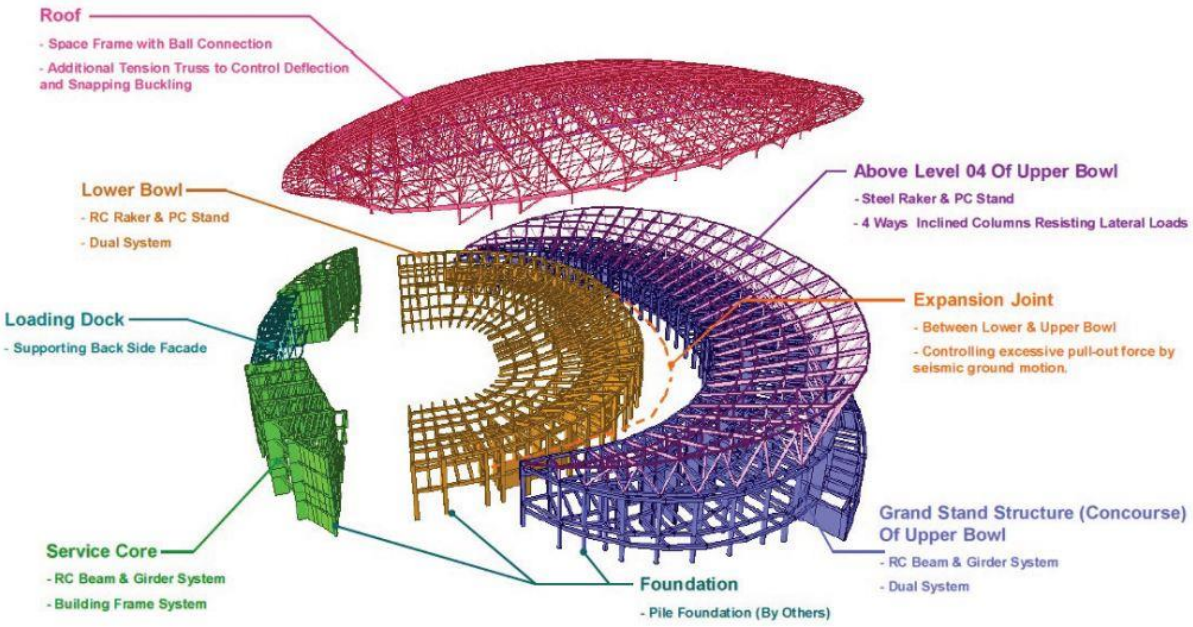


STRUCTURAL DETAILS:

- DIMENSIONS:



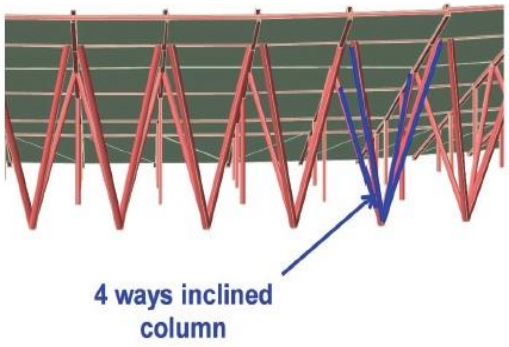
- OVERVIEW:



- 4 WAY INCLINED COLUMN:

2 COLUMNS JOINED TO THE RING OF THE ROOF AND 2 COLUMNS JOINED TO INCLINED PRE-CAST SANDWHICH PLATE SYSTEM STAND.

ALL COLUMNS CONNECTED AT THE BASE BY ISOLATOR- LRB(LEAD RUBBER BEARING)



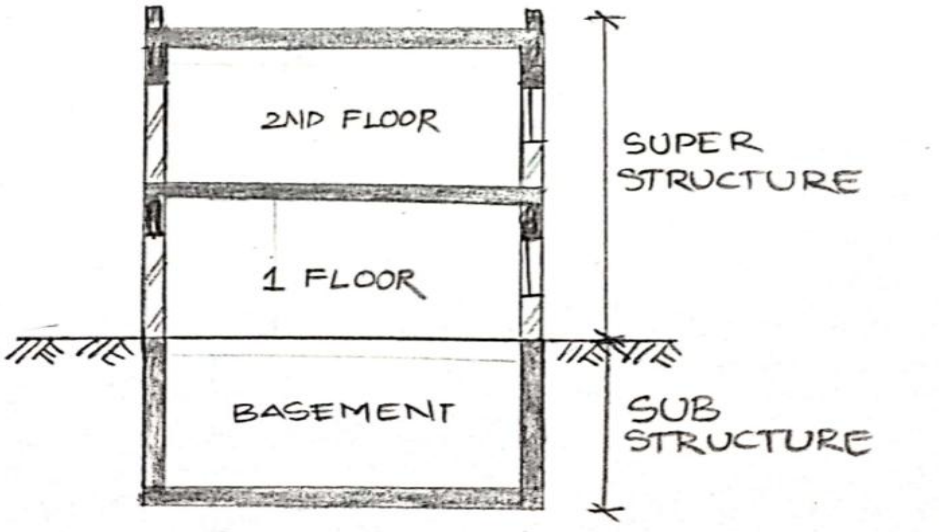
CONCLUSION:

- IN EARTHQUAKE RESISTANT BUILDING IS EARTHQUAKE DISTROY THE BUILDING, MONEY AS WELL AS LIFE TOO.
- MAIN MOTIVE TO DESIGN THE EARTHQUAKE RESISTANT STRUCTURE TO SAVE PEOPLES LIFE AS WELL AS WEALTH.

BASEMENT REPORT

○ BASEMENT:

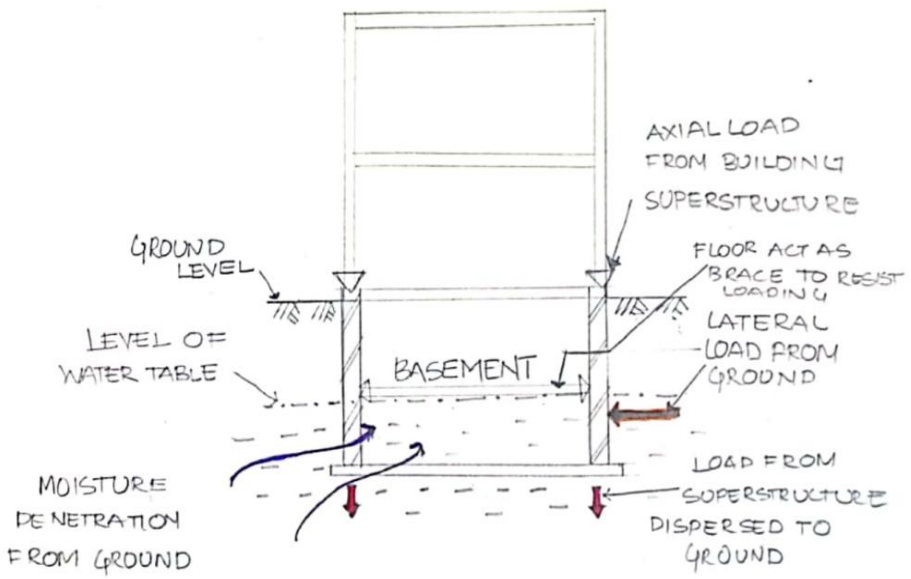
- A BASEMENT IS ONE OR MORE FLOORS OF BUILDING THAT ARE EITHER COMPLETELY OR PARTIALLY BELOW THE GROUND FLOOR.
- BASEMENT ARE TYPICALLY USED AS A UTILITY SPACE FOR A BUILDING WHICH IS USED TO PROVIDE ACCOMMODATION, STORAGE, CAR PARKING, SERVICES.
- THE MAJOR STRUCTURAL COMPONENTS OF A BASEMENT ARE THE WALL, THE FOOTING AND THE FLOOR.



SCHEMATIC REPRESENTATION OF BASEMENT

○ PURPOSE OF BASEMENT:

- BASEMENT WALLS MUST BE DESIGNED TO RESIST LATERAL LOADS FROM THE SOIL AND VERTICAL LOADS FROM THE STRUCTURE ABOVE.
- IN CASE WHERE BASEMENT ARE ACTUALLY NEEDED FOR THEIR FUNCTION IN REDUCING NET BEARING PRESSURE THE ADDITIONAL FLOOR SPACE IN THE SUBSTRUCTURE IS AN ADDED BONUS.
- IN SOME CASES, BASEMENT MAY BE NEEDED FOR REDUCING NET BEARING PRESSURE BY THE REMOVAL OF THE SOIL.



○ USE OF BASEMENT:

- AS PER THE GOVERNMENT RULE BASEMENT SPACES CANNOT BE ALLOWED FOR RESIDENTAIL PURPOSE.
- ACCORDING TO THE REGULATION OF THE NATIONAL BUILDING CODE OR BUILDING BY LAWS, A BASEMENT CAN BE USED ONLY AS A STORAGE , DARK ROOM, BANK CELLAR , PARKING SPACE OR TO KEEP EQUIPMENT REQUIRED CONSTANT AIR CONDITIONING.
- ACCOURDING TO THE BUILDING BY LAWS, KITCHEN, BATHROOM AND TOILET ARE ALSO NOT ALLOWED IN A BASEMENT, UNLESS THE SEWER LEVELS PERMIT THE SAME AND THERE IS NO CHANCE OF BACK FLOW AND FLOODING OF THE SEWERAGE.
- FOR COMMERICAL PURPOSE THE GOVERNMENT ALLOWS YOU TO BUILD OFFICES IN BASEMENTS. HOWEVER THE SPACE WILL BE INCLUDED IN THE CALCULATION OF FAR USAGE IN THIS CASE.
- FOR GROUP HOUSING BASEMENT CONSTRUCTION IS ALLOWED FOR PARKING, UTILITIES AND SERVICES AND IS NOT COUNTED IN FAR THUS. THE CONCEPT OF BASEMENT PARKING IS NOW GETTING POPULAR IN HOUSING PROJECT.

○ GRADE OF BASEMENT:

GRADE	POSSIBLE USE	CONDITION REQUIRED	MOISTURE EXCLUSION
GRADE 1: BASIC UTILITY	CAR PARKING, MECHANICAL PLANT ROOM, ETC	>65% RELATIVE HUMIDITY 15-32˚C TEMPERATURE.	MINOR WET SEEPAGE AND VISIBLE DAMP PATCHES MAY BE ACCEPTABLE.
GRADE 2: BETTER UTILITY	RETAIL STORAGE, ELECTRICAL PLANT ROOMS	35-50% RELATIVE HUMIDITY TEMPERATURE DEPENDS ON USE : <15˚C FOR STORAGE, UP TO 42˚C FOR PLANT ROOMS.	WET SEEPAGE UNACCEPTABLE. NO VISIBLE MOISTURE PATCHES.
GRADE 3: HABITABLE	OFFICES, RESIDENTIAL USE, KITCHENS, RESTAURANTS, ETC	40-60% RELATIVE HUMIDITY TEMPERATURE RANGE 18-29˚C, DEPENDING ON USE.	SEEPAGE AND WET PATCHES UNACCEPTABLE. POSSIBLE ACTIVE CONTROL OF INTERNAL ENVIRONMENT REQUIRED ENVIRONMENT REQUIRED TO CONTROL TEMPERATURE AND HUMIDITY.
GRADE 4: SPECIAL	ARCHIVE STORAGE OF BOOKS, DOCUMENTS, ART, ETC	35-50% RELATIVE HUMIDITY TEMPERATURE RANGE TYPICALLY 13-22˚C	ENVIRONMENT TIGHTLY CONTROLLED BY ACTIVE MEASURES. SEEPAGE AND VISIBLE DAMPNESS UNACCEPTANCE.

○ ADVANTAGES OF BASEMENT:

1. ADDITIONAL STORAGE SPACES
2. BETTER UTILISATION OF LAND
3. OFFERS SEASONAL COMFORT
4. MULTIPURPOSE SPACE
5. PERFECT AS AN EMERGENCY SHELTER
6. EASY ACCESS FOR UNDERGROUND REPAIRS

○ DISADVANTAGES OF BASEMENT:

1. ADDITIONAL CONSTRUCTION COST
2. DAMP AND MOSISTURE CONCERNS
3. DANGERS OF FLOODING
4. REQUIRES PROFESSIONAL FOR CONSTRUCTION
5. INCONVENIENT ACCESS ROUTES FOR FURNTTURES

○ TYPES OF BASEMENT:

ALL EXCAVATION OPERATORS MOST KNOW THE LINE THE FINAL DEPTH OF THE EXCAVATION, THE APPOXIMATE WIDTH OF THE EXCAVATION AT THE TOP AND THE LOCATION OF ANY SERVICES OR OTHER HAZARDS A) BOTTOM UP EXCAVATION

1. OPEN CUT

- IF THERE IS SUFFICIENT RIGHT OF WAY OPEN CUT TRENCHES CAN BE USED IN ALMOST ANY SOIL CONDITION.
- GENERALLY A SLOPE OPEN CUT EXCAVATION IS THE MOST COST AND SCHEDULE EFFECTIVE METHOD OF TEA TRENCHING
- WHEN THE TRENCH IS VERY DEEP AND EXPENSIVE BACKFILL MATERIALS ARE REQUIRED THEN VERTICAL CUT AT THE TOE OF THE SLOPE SUPPORTED BY SHORING OR FLATTENING OF EXCAVATION SLOPES.

ADVANTAGES:

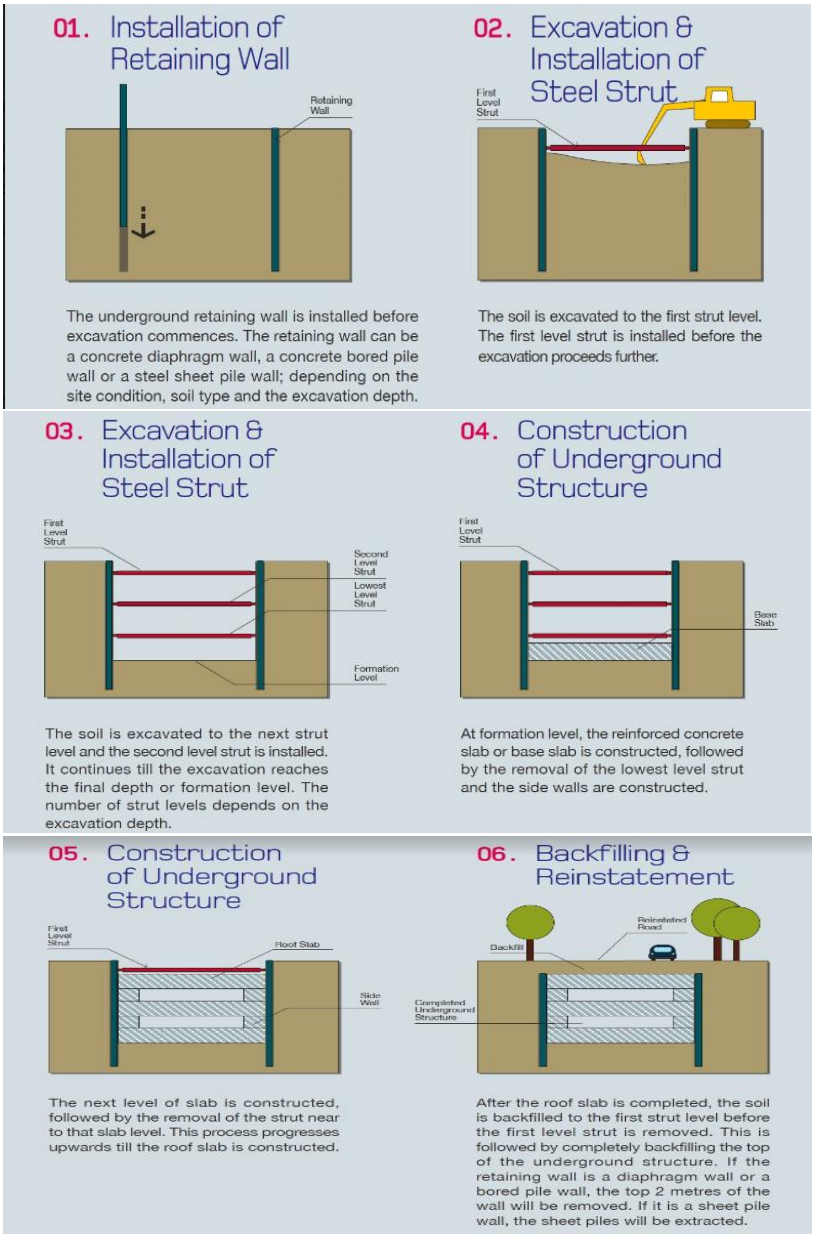
- ALLOWS CONTINOUS EXCAVATION , LAYING AND BACKFILLING OPERATION
- MINOR BREAKDOWN USUALLY DO NOT CAUSES DELAYS TO ALL ACTIVITES
- THE OPEN TRENCH NEEDS ONLY THE DESIGN OF THE CUT BANK SLOPE.GUIDELINES CAN BE USED ALTHOUGH COST SAVING USUALLY WILL RESULT IF THE BANK SLOPE IS CHECKED AND DESIGNED BY A REGISTERED ENGINEER FOR STEEDER SLOPE SLOPING THE EXCAVATION IS THE SIMPLEST METHOD AND RUNNING SANDS
- OPEN CUT METHOD IS SUITABLE FOR MOST GROUND CONDITION EXCEPT FOR OOZING MUD AND RUNNING SAND
- THE OPEN TRENCH PROVIDES EASY ACCESS TO THE WORK BEACAUSE EQUIPMENT AND CONSTRUCTION MATERIALS ARE MINIMIZED
- THE SLOPE OF THE BANK REQUIRES MORE EXCAVATION AND BACKFILL VOLAUME THAN THE OTHER OPTIONS.

DISADVANTAGES:

- THE ONLY BANK SUPPORT IS THE STRENGTH OF THE SOIL.IF DRYING, FLOODING OR CHANG OF SOIL PROPERTIES WEAKNENS THE SOIL, THEN SLOUGHING AND COLLAPSE CAN HAPPEN WITH LITTLE OR WORK AREA
- THE SLOPED BANKS REQUIRES A WIDER WORK AREA
- THE BANK SLOPE MAY FORCE THE USE OF LARGER EQUIPMENT BEACAUSE THE DISTANCE TO REACH INTO THE TRENCH IS INCREASED AND GREATER VOLUMN OF SOIL MUST BE EXCAVATION AND BACKFILLED.

2. BOTTOM UP EXCAVATION:

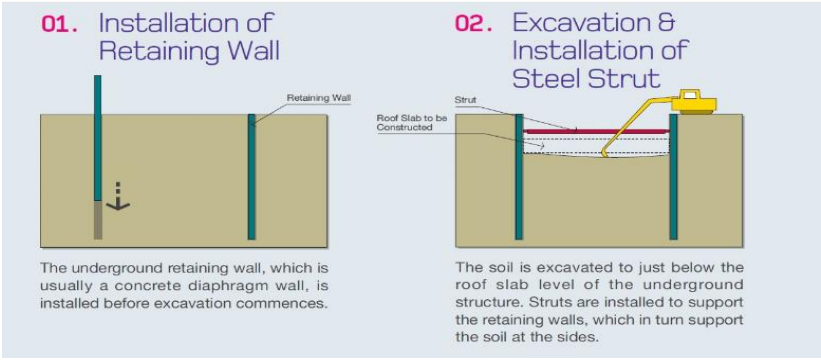
- THIS CONVENTIONAL METHOD INVOLVES FIRST SINKING TEMPORARY DIAPHRAGM WALLS TO THE REQUIRED DEPTH BELOW GROUND, DIGGING AND REMOVING SOIL, INSTALLING TEMPORARY STEEL STRUTTING AND THEN CREATING THE COMPLETE HOLE WITH A CONCRETE SLAB BASE AND OPEN TO THE SKY.
- FORM PERIMETER WALLS TO ENCLOSE THE AREA TO BE EXCAVATED.
- PROCEED UPPER WORKS: EXTENDED COLUMN, CONTINUE UPPER SLABS TOWARDS GROUND LEVEL.
- EXCAVATION->INSTALL PROPS->CONSTRUCTION OF FOUNDATION + COLUMNS->SLAB (SUSPENDED SLAB)

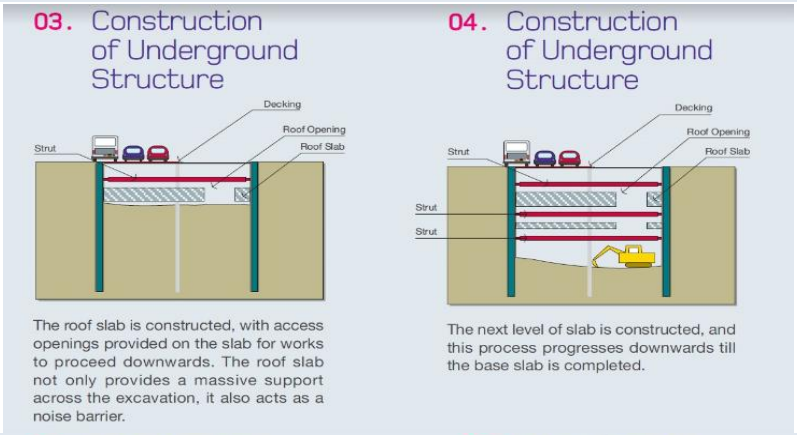


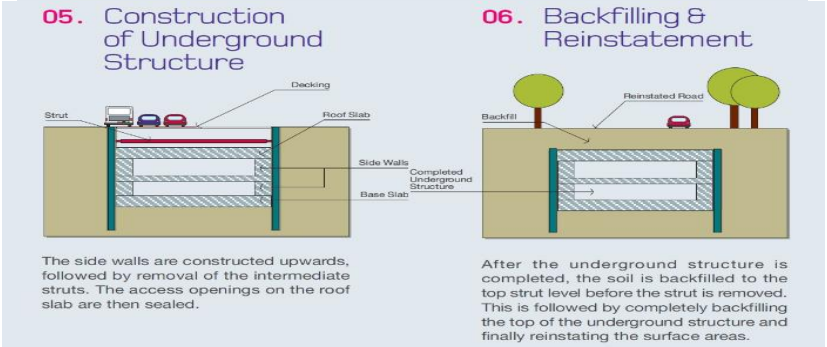
3. TOP DOWN EXCAVATION:

- FORMATION OF PERMANENT RETAINING WALSS TO THE PERIMETER OF BASEMENT AREA
- FROM INTERNAL FOUNDATION AND COLUMN SUPPORT BY USING PLUNGE METHOD
- CREATE THE UPPERMOST FLOOR SLAB
- EXCAVATE DOWNWARDS OPENING ON SLAB OR SERVICES SHAFTS
- REMOVE TEMP BASE, EXCAVATE UNTIL THE DEPTH OF NEXT FLOOR LEVEL
- CAST THE NEXT FLOOR LEVEL, REPEAT THE PROCESS.
- CAN USE NON SUSPENDED SLAB FOR THE BASEMENT SLAB.

-



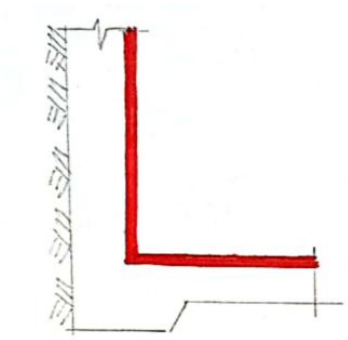




○ TYPES OF WATERPROOFING:

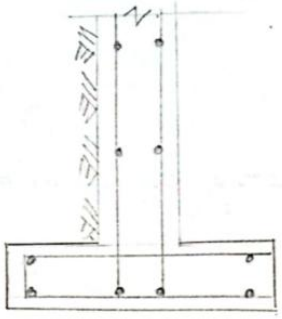
BASEMENT WATER PROOFING INVOLVES TECHNIQUE AND MATERIALS USED TO PREVENT WATER FROM PENETRATING THE BASEMENT OF HOUSE OR BUILDING.

TYPE A



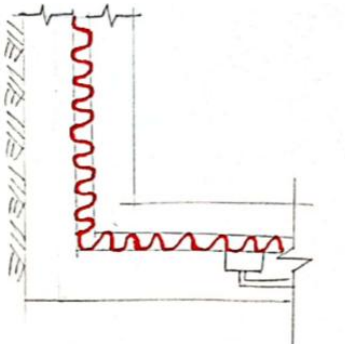
(BARRIER PROTECTION TANKED)

TYPE B



(STRUCTURALLY INTEGRAL PROTECTION)

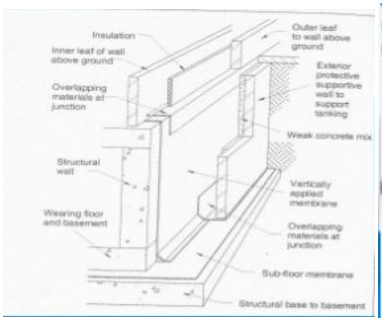
TYPE C

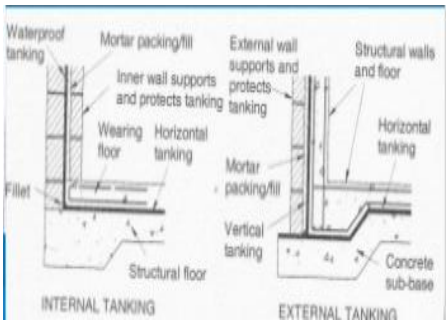


(DRAINED PROTECTION)

I. TYPE A (BARRIER / TANKED PROTECTION)

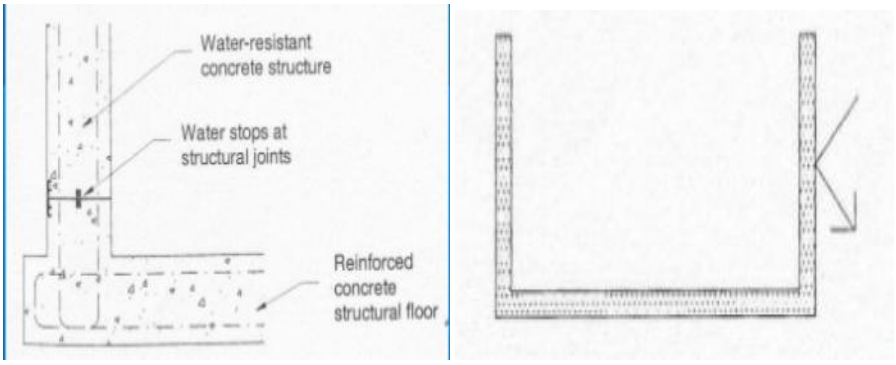
- USE IMPERVIOUS MATERIAL INTERNALLY OR EXTERNALLY TP EXCLUDE MOISTURE
- THE SELECTED WATERPROOFING ELEMENT MUST BE CAPABLE TO WITHSTAND HYDROSTATIC PRESSURE FROM GROUND WATER & OTHER LOADING
- CREATE A TANKING EFFECTS
- THE OBJECTIVE OF TANKING IS TO PROVIDE A CONTIOUS WATERPROOF MEMBRANE WHICH IS APPLIED TO THE BASE SLAB AND WALLS WITH COMPLETE CONTINUITY BETWEEN THE TWO APPLICATIONS
- THE TANKING CAN BE APPLIED EXTERNALLY OR INTERNALLY
- ALTERNATIVES TO MASTIC ASPHALT ARE POLYTHENE SHEETING BITUMINOUS COMPOUNDS EPOXY & RESINCOMPOUNDS AND BITUMEN LAMINATES





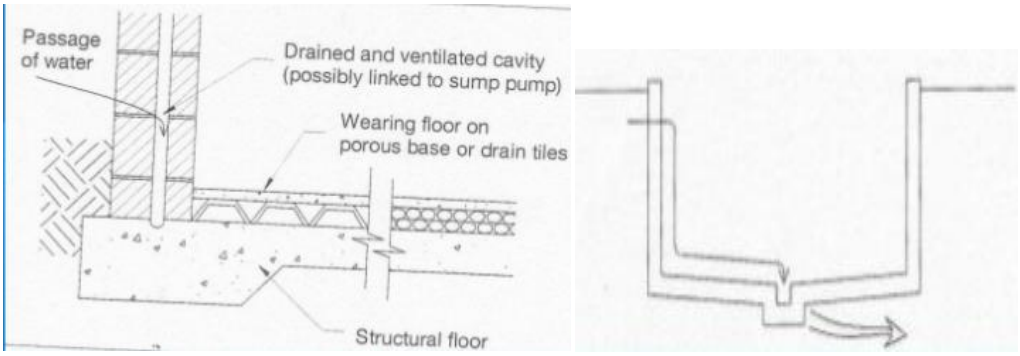
II. TYPE B (STRUCTURALLY INTERNAL SYSTEM)

- STRUCTUREAL INTERAL PROTECTION REINFORCED OR PRESTRESSED CONCRETE DESIGNED THROUGH COMPOSITE AND INTERATED DETAILS SUCH AS WATER BARS TO BE WATER RESISTANT
- Type B Protection relies heavily on the design and materials incorporated into the external shell of the structure.
- Design, materials, as well as the quality of the workmanship contribute to the success of Type B Systems.
- The pattern of any seepage encountered is often associated with poor joints, cracks or other discontinuities such as service penetrations.



III. TYPE C (DRAINED PROCTECTION) SYSTEM

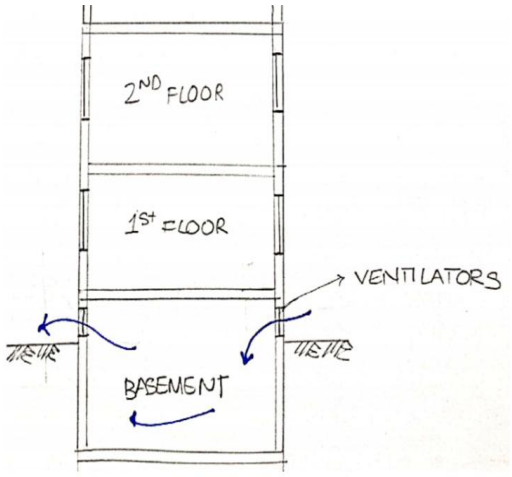
- THE BASIC CONCEPT IS VERY SIMPLE. IT ACCEPT THAT A SMALL AMOUNT OF WATER SEEPAGE IS POSSIBLE THROUGH A MONOLITHIC CONCRETE WALL AND THE BEST METHOD OF DEALING WITH SUCH MOISTURE IS TO COLLECT IT AND DRAIN IT AWAY
- ANY WATER SEEPING THROUGH EXTERNAL WALL AND FLOOR IS DRAINED TO A SUMP VIA AN INTERNAL CAVITY TYPICALLY CREATED BY PROPRIETARY CAVITY SYSTEM AND PUMPED OR DRAINED AWAY



○ BASEMENT VENTILATION:

1 NATURAL VENTILATION METHOD:

- NATURAL VENTILATION MAKES USE OF NATURAL AIR CURRENTS, BUT THIS TYPE OF VENTILATION WORKS ONLY FOR BASEMENTS WITH WINDOW THAT ARE STATEGICALLY PLACED AND ARE TO OPEN AND CLOSED
- WHILE THE NATURAL METHOD CONSERVES ENERGY IT DOES REQUIRE MORE WORK
- WINDOW MUST BE OPEN AT REGULAR INTERUALS AND CLOSED DURING TIMES OF RAINFALL OR AT NIGHT TO PREVENT INTRUDERS FROM ENTERING THE BASEMENT
- WINDOW SHOULD BE OPPOSITE EACH OTHER ACROSS THE BASEMENT SPACE FOLLOWING THE NATURAL DRAFT OF THE BASEMENT.



2 MECHANICAL VENTILATION METHOD:

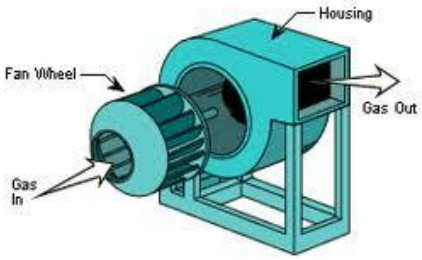
- MECHANICAL VENTILATION USES FANS & VENTS TO EXHAUST EXISTING BASEMENT AIR AND BRING IN FRESH OUTDOOR AIR
- THIS TYPE OF SYSTEM MAY BE AS SIMPLE AS PLAYING SMALL WINDOWS OR AS TECHICAL AS INSTALLING AN EXHAUST FAN WITH VENTILATION PIPE
-

AXIAL FANS:

- AXIAL FANS ARE NAMED FOR THE DIRECTION OF THE AIRFLOW THEY CREATE
- BLADES ROTATING AROUND AN AXIS DRAW AIR IN PARALLEL TO THAT AXIS AND FORCE AIR OUT IN SAME DIRECTION
- AXIAL FANS CREATE AIRFLOW WITH A HIGH RATE MEANING THEY CREATE A LARGE VOLUME OF AIRFLOW HOWEVER THE AIRFLOW THEY CREATE ARE OF LOW PRESSURE.

CENTERIFUGAL FANS:

- THE CENTRIFUGAL FANS OFFTEN CALLED BLOWERS
- THE PRESSURE OF AN INCOMING AIRSTREAM IS INCREASED BY A FAN WHEEL, A SERIES OF BLAADES MOUNTED ON A CIRCULAR HUB CENTRIFUGAL FAN MOVE AIR RADIALLY. THE DIRECTED THROUGH A SYSTEM OF DUCTS OR TUBES
- THE AIRFLOW CREATE BY CENTRIFUGAL FANS IS DIRECTED THROUGH A SYSTEM OF DUCTS OR TUBES. THIS HEPLS CREATE A HIGHER PRESSURE AIRFLOW THAN AXIAL FANS
- DESPITE A LOWER FLOW RATE, CENTRIFUGAL FANS CREATE A STEADIER FLOW OF AIR THAN AXIAL FANS.



○ TYPES OF CONTRUCTION:

- RAFT FOUNDATION :- THIS IS THE GENERAL FORMAT FOR BASEMENT CONSTRUCTION AND CONSISTS OF A SLAB RAFT FOUNDATION WHIVH FORMS THE BASEMENT FLOOR AND HELPS TO DISTRIBUTE THE STRUCTURAL LOADS TRANSMITTED DOWN THE RETANING WALLS
- RETAINING WALL :-
  - A RETANING WALL IS A STRUCTURE DESIGNED AND CONSTRUCTED TO RESIST THE LATERAL PRESSURE OF SOIL WHEN THERE IS A DESIRED CHANGED IN GROUND ELEVATION THAT EXCEED THE ANGLE OF REPOSE OF THE SOIL
  - A BASEMENT WALL IS ONE KIND OF RETAINING WALL

- RETAINING WALL AND PERIPHERAL WALLS TO BASEMENTS ARE SUBJECT TO LATERAL PRESSURE FROM RETAINED EARTH LIQUIDS OR A COMBINATION OF SOIL AND WATER
- THEY ARE NORMALLY MADE IN STRUCTURAL WORK OF CONCRETE OR BRICK
- THE WALLS ARE BASICALLY VERTICAL CANTILEVER EITHER FREE OR PRODPED
- THE WALLS MAY BE ACTING AS PURE CANTILEVER PRODPED CANTILEVER TIED CANTILEVER SIMPLY SUPPORTED OR CONTINOUS SPANNING SLAB ETC.
- THEY MAY BE STIFFEND BY SHAPING INTO FINS COUNTERFORTS, DIAPHRAGRAM, ZIG-ZIG, AND MANY ORTHER PROFILES
- THEY CAN BE MASS FILLED RENIFORCED OR POST TENSIONED

○ RAFT FOUNDATION

- RAFT FOUNDATION ARE FORMED BY REINFORCED CONCERET SLABS OF UNIFORM THICKNESS THAT COUER A WIDE AREA OFTEN THE ENTIRE FOOTPRINT OF A BUILDING
- THEY SPREAD THE LOAD IMPOSE BY A NUMBER OF COLUMNS OR WALLS OVER THE AREA OF FOUNDATION AND CAN BE CONSIDERED TO FLOAT ON THE GROUND AS RAFT FLOATS ON WATER
- WHEN THE GENERAL SOIL IS HAVING THE LOW VALUE OF BEARING CAPACITY LIKE SOFT CLAY MADE UP GROUND SANDY SOIL OR UNCERTAIN BEHAVIOUR DUE TO SUBSOIL WEAK CONDITION
- IN SUCH CASE THE PILE FOUNDATION OR INDEPENDENT COLUMN BECOME DIFFICULT AND UNECONOMICAL THEREFORE THE FOUNDATION OF THE STRUCTURE IS SPREAD FOR THE ENTIRE AREA OF THE BOTTOM OF THE STRUCTURE LIKE OF A FLOOR
- RAFT FOUNDATION CONSIST OF THICK REINFORCEMENT CONCRETE SLAB COVERING THE SAID AREA OF THE FLOOR
- THE SLAB IS REINFORCED WITH BARS RUNNING IN RIGHT ANGEL TO EACH OTHER BOTH NEAR BOTTOM AND TOP FACE OF THE SLAB

○ SUITABLE WHERE:

- FLOOR IS SMALL AND STRUCTURAL LOADING ARE LOW SUCH AS IN ONE OR TWO STOREY DOMESTIC CONSTRUCTION.
- A BASEMENT IS REQUIRED
- GROUND CONDITION ARE POOR
- WHERE IT MAY BE IMPRATICAL TO CREATE INDIVIDUAL STRIP FOUNDATION FOR A LARGE NUMBEROF INDIVIDUAL LOAD. IN GERNRAL TERMS IF STRIP OR PAD

FOUNDATION WOULD COVER 50% OR MORE OF THE FLOOR AREA THEN A RAFT MAY BE MORE APPROPRIATE.

○ TYPES OF RAFT FOUNDATION:

1. **SLAB TYPE**
2. **SLAB AND BEAM TYPE**
3. **CELLULAR TYPE**

1 SLAB TYPE:

- THIS IS THE SIMPLEST FORM OF RAFT FOUNDATION
- RENIFORCEMENT IN THIS SLAB TYPE FOUNDATION IS PLACED IN BOTH DIRECTION & MORE REINFORCEMENT IS REQUIRED AT THE COLUMN LOCATION AND LOAD BEARING WALLS.
- MAT IS USED WHEN THE COLUMN & WALLS ARE UNIFORMALLY SPACED AT SMALL INTERVAL AND THE SUBJECTED.

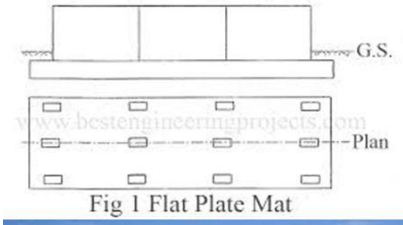
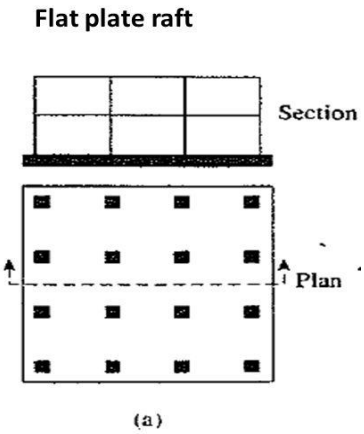
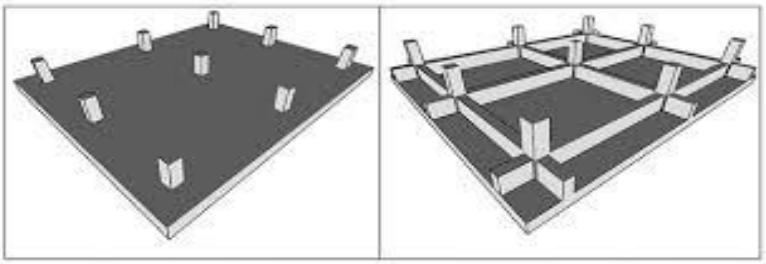


Fig 1 Flat Plate Mat



2 SLAB AND BEAM TYPE:

- BEAM ARE LAID IN PERPENDICULAR DIRECTION AND ALL OF THESE BEAMS CONNECTED BY RAFT SLAB
- COLUMNS ARE SUITUTED EXACTLY ON INTERSECTION OF BEAMS OF RAFT FOUNDATION
- THIS TYPE RAFT FOUNDATION IS SUITABLE WHEN THE COLUMN IS CARRYING UNEQUAL LOAD AND THERE IS LARGE SPACE BETWEEN THEM.
- AS A FOUNDATION TO SUPPORT THE HEAVIER LOADS OF WALSS OR COLUMN A SOILD SLAB RAFT WOULD REQUIRE CONSIDERABLE THICKNESS.
- THIS RAFT CONSISTS OF UPSTAND OR DOWN STAND BEAMS THAT TAKE THE LOAD OF WALLS OR COLUMNS AND SPREAD SLAB WHICH BEARS ON NATURAL SUBSOIL.



Flat slab type raft foundation

Slab-beam type raft foundation

3 CELLULAR TYPE:

- CELLULAR RAFT FOUNDATION IS ALSO KNOWN AS BOX TYPE RAFT FOUNDATION OR RIGID FRAMS. RAFT FOUNDATION WHERE BOXES LIKE STRUCTURE ARE FORMED WHERE THE WALSS OF EACH BOX ACTS AS BEAM AND THESE ARE CONNECTED BY SLAB AT TOP AND BOTTOM
- HERE TWO CONCERTE SLAB ARE PLACED ONE ON TOP AND ANOTHER AND CONNECTED WITH FOUNDATION WALSS IN BOTH DIRECTION & THUS FORMS A CELLULAR RAFT FOUNDATION
- THE BEAMS AND SLAB ARE UNITED IN SUCH A WAY THAT THEIR CROSS SECTION LOOK LIKE I-SECTION. THIS TYPE OF FOUNDATION CANS RESISTS VERY HIGH BENDING STRESSES AND SUITABLE FOR LOOSE SOIL WHERE SETTELMENT IS UNEVEN.