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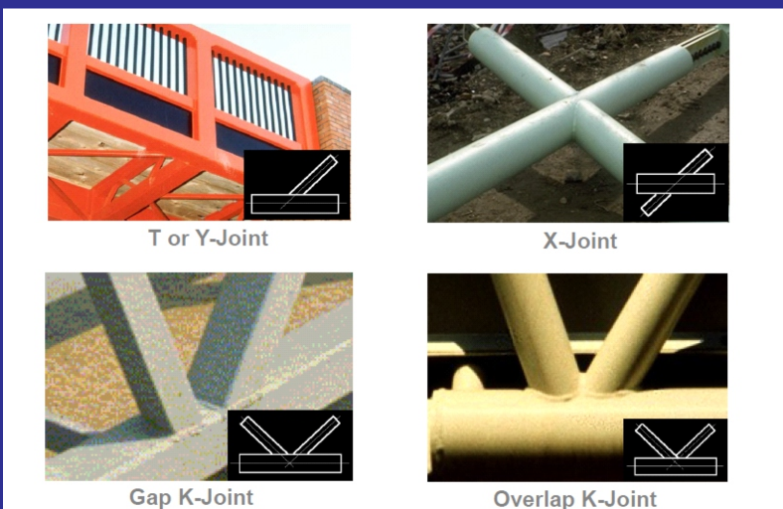

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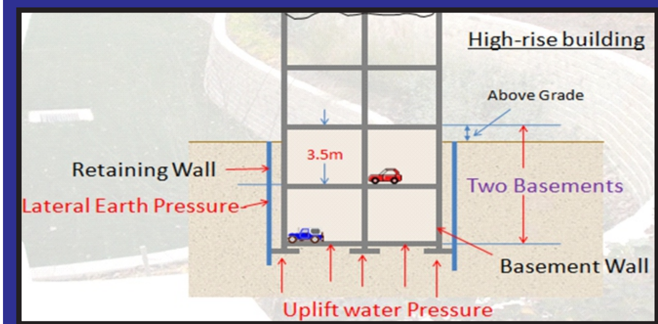

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Members : 1823   Junior Members 52   IM : 01

Student Members : 159

TOTAL STRENGTH : 2109

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- Materials Technology, Ferrocement
- Teaching, Research % Development
- Rehabilitation of Structures
- Construction Technology & Management
- Geo-Tech & Foundation Engineering
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1. To restore the desired status to the Structural Engineer in construction industry and to create awareness about the profession.
2. To define Boundaries of Responsibilities of Structural Engineer, commensurate with remuneration.
3. To get easy registration with Governments, Corporations and similar organizations all over India, for our members.
4. To reformulate Certification policies adopted by various authorities, to remove anomalies.
5. To convince all Govt. & Semi Govt. bodies for directly engaging Structural Engineer for his services.
6. To disseminate information in various fields of Structural Engineering, to all members.

GEM 23: SRINIVASA "HAL" IYENGAR
AN INNOVATIVE STRUCTURAL DESIGNER

by Dr. N. Subramanian

Srinivasa "Hal" Iyengar (6 May 1934 - 4 July 2019**)**

Srinivasa "Hal" Iyengar, an Indian American civil engineer and a senior structural consultant at Skidmore, Owings & Merrill LLP (SOM), was known for his work on Chicago's John Hancock Center (now known as 875 North Michigan Avenue) and the Sears (now Willis) Tower. He was instrumental in the development of several innovative and efficient structural concepts and systems for high-rise, long-span and stadium structures.

EARLY LIFE

Born in India on May 6th 1934, Iyengar received his bachelor's degree in civil engineering from the University of Mysore in 1955 and a master's in hydraulic and civil engineering from the Indian Institute of Science in Bangalore in 1957. When he was 23 years old, he joined University of Illinois at Urbana-Champaign and earned a master's in civil and structural engineering in 1959.

PROFESSIONAL CAREER WITH SKIDMORE, OWINGS & MERRILL (SOM)

A year later, Iyengar began working at Skidmore, Owings & Merrill LLP (SOM), where his mentor was the well known and brilliant structural engineer Fazlur Khan. During his long-running career at Skidmore, Owings & Merrill LLP (SOM), Iyengar moved from Project Engineer to Senior Structural Engineer, and eventually to General Partner and Director of structural engineering, holding the post from 1975 to 1992. During his tenure, he garnered reputation as a man who often pushed the limits by turning visions of ultra-high structures into reality.

With a career that spanned five decades, Srinivasa (Hal) Iyengar brought a philosophy of rational, clearly expressed structures to everything from stadiums to skyscrapers. Along with Fazlur Khan and SOM's architect Bruce Graham, he developed the innovative framing system for the X-braced John Hancock Center (now known as 875 N. Michigan Ave.), the Sears (now Willis) Tower (which remained for decades as the world's tallest building), both in Chicago (see Fig. 1), as well as more recent creations such as the Guggenheim Museum in Bilbao, Spain (See Fig. 2) and the Broadgate Building in London (See Fig. 3), the Anaheim Stadium expansion, the Soldier Field renovation, the McCormick Exposition Center in Chicago, the Convention Center in Hong Kong.

Fig. 1 For many, Hal Iyengar will always be best known for his work on the Sears Tower(left) and the John Hancock Building (right), both in Chicago.

After retiring from SOM, Iyengar started his own firm, 'Structural Design International' in 1992. However, he continued to serve as a consultant to SOM and played a key role on the engineering team that worked with another famous architect Gehry on the Bilbao Guggenheim, a powerfully sculpted, titanium-clad museum that created a sensation when it opened in 1997.

Splitting residency between Evanston, IL and Sanibel Island, FL, Iyengar continued to design. He recently worked on Chicago's Millennium Park band shell with Frank O. Gehry (Fig. 5). Iyengar was also a primary consultant on Chicago's future plan to recapture the world's tallest building title with a 610 m (2,000 feet) structure that will stand at Dearborn and Madison Streets.

Photo: Ben Atman, Sadin Photo Group, Ltd.,]
Source: www.SOM.com

Fig. 2 The Guggenheim Museum in Bilbao, Spain, and Chicago's McCormick Place Convention Center expansion are radically different, yet both set the standard for their type of facility

DESIGN INNOVATIONS

Along with the late Fazlur Khan, with whom he began working with in 1960 at the start of his professional career, Iyengar created new concepts for high-rise building structural systems. These included the bundled tube design of the Sears Tower and the diagonal truss tube of the John Hancock Center. The Hancock was completed in 1970, while the 110- story Sears Tower – the world's tallest building at that time – reached completion three years later. The landmark skyscrapers, like many of Iyengar's works, have been praised for being highly innovative, yet practical.

Those buildings, said Iyengar, were perhaps his most exciting to work on. “Both evolved very quickly. That doesn't happen these days,” said Iyengar, who moved to the United States from India to study engineering but considers himself a Chicagoan. “Given that and working with Faz, I would say that was the most exciting thing.” At that time, Khan and Iyengar were doing things that no one had before, not to mention going much higher. “It was a time when it was a new thing to build towering structures,” SOM associate partner Robert Sinn said, “World War II was over and things were on the rise. Faz and Hal were the innovators. The buildings were like nothing ever built.” (Weger, 2000).

Iyengar and Graham teamed up on a striking, cable-stayed addition to Chicago's convention center, now called McCormick Place North (Fig. 2). The building's steel roof, which measures 238 m by 146 m and weighs 4,500 tons, is hung from cables affixed to concrete pylons. Completed in 1986, this significant expansion made McCormick Place the largest convention center in the United States, a record it still holds.

FLUID DESIGNS

When asked which project was the most innovative of his career Iyengar cited the Broadgate Exchange House (Phase 11) in London with its innovative bridge concept design. This 11-story Exchange House - an office building that is a hybrid of bridge and building. Finished in 1990, it spans over working railroad tracks with the help of distinctive parabolic arches. The form of this unique structure is based on an exposed steel bridge spanning a 78-m long rail yard. The building is located directly over the top of Liverpool Street Station, a high traffic railroad station. As the rail station could not be disturbed, no supporting column was allowed within the 78 m span. To solve these unique problems, three different structural systems were used by Iyengar and associates to support the 10 story tall building over the 78 meter clear span. These were an X-braced truss system, a 10 story catenary suspension system, and a parabolic arch system. Four parallel structural arches, two expressed externally and two internally, provide the skeleton for the building, enabling column-free interior spaces (See Fig.3).

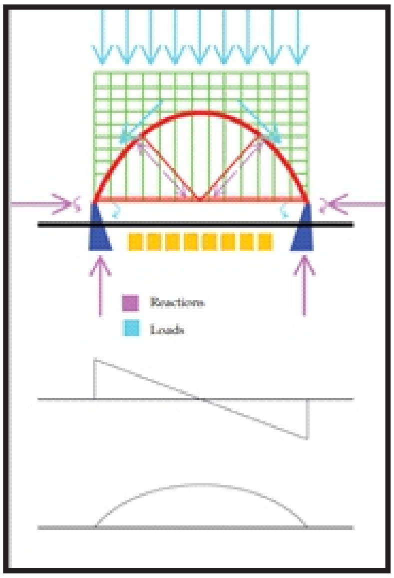


Fig. 3 Iyengar considered the Broadgate Exchange House in London (1990) as his most innovative.

The three bays created by the arches are spanned by composite floor trusses, which provide lateral bracing. Along both ends of the building perpendicular to the arches, an exposed vertical truss in the middle bay connects with the floor diaphragm to resist wind loads on the broad building. It also provides out of plane stability to the arches (Nowell, 1995). All of the exterior exposed structure is offset from the 78 meter by 52 meter rectangular plan of the building by 2 meters. Due to the use of such strict modularity, all of these structural units came to the site pre-fabricated. This allowed for savings in material costs and labor, not to mention time. An all glass and steel curtain-wall is hung from the exposed frame to keep a constant backdrop for the exposed structure. Fire-engineering methods were utilized to completely expose the building's steel exterior structure, which stretches over an active railway right-of-way at Liverpool Street station. The construction process was much more of an evolving process, commented Iyengar about this design. “We had to lift the building and that was a challenge,” Iyengar explained, “With Broadgate we were really pushing” (Weger, 2000).

In terms of materials, Iyengar loved the adaptability of steel. “Steel has strength and can have very bold lines, but, especially lately, can also be used for a more fluid look,” Iyengar used to say. The Hancock Building is an example of the former, while Bilbao's Guggenheim set a new standard for steel aesthetics. The structural system uses curvature to resist wind loads, without attempting to control the building's overall nature. “It is an remarkable building, unlike anything before,” Iyengar said (Weger, 2000). SOM's engineers persuaded Gehry to use steel instead of concrete for the project because steel could more easily span the long, column-free spaces inside the museum. In addition, the steel was stacked in self-supporting trusses that did not disturb the curves of building's exterior. “Hal was very heavily involved with Gehry on that,” said retired Skidmore engineer John Zils, who also worked on the Guggenheim.

Fig. 4 The 45 storey Hotel De Las Artes Tower, at Vila Olimpica in Barcelona, Spain (1992) expressed many of Iyengar's design philosophies (*Photo:* **James Morris/Axiom, Source: www.SOM.com**)

Iyengar played a smaller role in the design of Gehry's ultracurvy Pritzker Pavilion band shell in Millennium Park (See Fig.5), his Skidmore colleagues said, but the architect still cited him in 2000 when critics questioned whether the band shell, then a proposal, could withstand Chicago's high winds and heavy snows. Gehry replied: "I have one of the best structural engineers working on this project, Hal Iyengar of Skidmore, Owings & Merrill" (Weger, 2000).

Fig. 5 Millennium Park and the serpentine BP Pedestrian bridge, Chicago, USA

STUBBORN PROFESSIONALISM

"Hal had professionalism and integrity", SOM's associate partner John J. Zils said. "Anything he did was because he knew what was best for the project. He would never do anything if it wasn't absolutely necessary." But Iyengar's practically was matched by his passion for the work. "You've got to have passion," he exclaimed. Iyengar never was a big fan of the ins and outs of corporate must-do operations. "I think he really liked being able to concentrate solely on his work without having to think about the paperwork," Zils said. "He adjusted better than I even thought possible to the down time after being in such a fast-paced environment for so long. But I think this gave him just what he wanted. It's really been a great thing." Of being a consultant at SOM and being able to spend some quiet time in mildly serene Florida, Iyengar said, "I'm having my cake and I'm eating it too." (Weger, 2000).

For one thing, he kept up with technology, learning the latest in computer innovations. "There are a lot of things we used to do that the computer does now," Iyengar used to say. "Times are changing, and it's important to stay up with them." And meshing the past with the present, Iyengar may become an avatar of sorts, as teaching could be on his horizon. "I would like to instruct on a seminar basis," he said, adding that his preference would be the University of Illinois, where he received a Master's in Civil and Structural Engineering and began working toward his Ph.D. before joining SOM (Weger, 2000) .

AWARDS AND RECOGNITION

For the several innovative structures designed by him, he gained several recognitions from his peers: He received the ASCE Ernest E. Howard Award, Innovations in Civil Engineering Award by ASCE for the Guggenheim Museum, a Lifetime Achievement Award by the Structural Section of ASCE's Illinois Division, and the Structural Engineering Association of Illinois's John Parmer Award for Lifetime Achievement in Structural Engineering.

In 1995 the American Society of Civil Engineers (ASCE) presented him with a lifetime achievement award (and honorary membership in 1999), Iyengar was inducted into the National Academy of Engineering in 2000. He also received lifetime achievement award from the American Institute of Steel Construction (AISC) in 2000 for his contributions to AISC and the structural steel industry's success, and also 2006 Fazlur Rahman Khan Medal. He was a fellow of the Institution of Structural Engineers UK, and a member of the Structural Engineers Association of Illinois.
He has published extensively (over 100 technical articles) and has participated in numerous conferences and symposiums.

EPILOGUE

Iyengar previously lived in Chicago, Northfield and Evanston, after he retired, he and his wife, Ruth Yonan Iyengar, spent part of the year in Sanibel Island, Florida. They later moved their home to Fort Myers, Florida. According to his daughter Sona Iyengar, Iyengar died on July 4th 2019 in Fort Myers, of complications from Parkinson's disease and heart disease, at a ripe age of 85. In addition to Iyengar's daughter and wife, survivors include his son Jay; two sisters, Kumuda Doreswamy and Praha Bhashyam; and three grandchildren.

References:

1. Khan, F. R., Iyengar, S. H,. Colaco, J. P. (1968), " Calcul et étude du projet du "John Hancock Center" à Chicago", Acier - Stahl - Steel, V. 33, June 1968, pp. 273-276.
2. Iyengar, Hal, Novak, L. , Sinn, R., Zils, J. (1996), " The Guggenheim Museum, Bilbao, Spain", Structural Engineering International, V. 6, No. 4, Nov., pp. 227-229. https://doi.org/10.2749/101686696780496337
3. Iyengar, Hal (1992)," Concrete Core Braced System for Ultra-Tall Buildings", Structural Engineering International, V. 2, No. 3, Aug., pp. 168-169. https://doi.org/10.2749/101686692780628406
4. Iyengar, Hal, Baker, W., Sinn, R. (1993), "The Broadgate Exchange House, London, UK", Structural Engineering International, V. 3, N. 4, Nov., pp. 214-216. https://doi.org/10.2749/101686693780607651
5. Iyengar, Hal (1992), "Hotel De Las Artes Tower, Barcelona, Spain", Structural Engineering International, V. 2, No. 3, Aug. 1992, pp. 172-174. https://doi.org/10.2749/101686692780628442
6. Iyengar, H., Baker, W. and Sinn, R. (1993), "The Broadgate Exchange House, London, UK", Structural Engineering International, Oct. V.3, No.4, pp. 214-216.
7. Iyengar, H., Rockey, C., Sinn, R., and Zils,J., (2006) "Millennium Park BP Pedestrian Crossing, Chicago, USA", The Structural Engineer, 4th July, pp.33-37.
8. Iyengar, H., Novak, L., Sinn, R. and Zils, J., (2000) "The Structural Design of the Guggenheim Museum, Bilbao, Spain", The Structural Engineer, 78/12, 20 June
9. Nowell, D., (1995) Broadgate Phase 11, http://www.victorbuyck.be/uploads/projects/doc_7.pdf, 14pp.
10. Weger, T.(2000) "Hal Iyengar's three decades at SOM: From Chicago's Sears Tower to Spain's Guggenheim Museum" , Modern Steel Construction, AISC, V. 40, No.5, https://www.aisc.org/globalassets/modern-steel/archives/2000/05/2000v05_sears.pdf
11. https://www.som.com/projects/broadgate__exchange_house
12. www.som.com/projects/
13. https://www.chicagotribune.com/columns/blair-kamin/ct-biz-iyengar-obituary-kamin-0711-20190710-o35bd7bxw5aujdwtbzegwdjci4-story.html
14. https://www.nae.edu/30412/Mr-Srinivasa-H-Iyengar

Author :

Dr. N. Subramanian

Dr. N. Subramanian is a Civil/structural consultant and Author, currently based at Maryland, USA, with over 40 years of experience in Industry (including consultancy, research and teaching). He was awarded with a 'Life Time Achievement Award' by the Indian Concrete Institute and many other awards for his contributions towards Structural Engineering. He is the author of 26 books, including the famous books on 'Design of Steel Structures', 'Design of RC Structures' and 'Space Structures' (email - drnsmani@yahoo.com).

CHALLENGES IN MULTIPLE LEVEL BASEMENT CONSTRUCTIONS

By Prof. G. B. Chaudhari

1. Preamble-

A city or a metropolis is a large human settlement wherein significant economic, political, and cultural activities are taking place of a country or region, and it is an important hub for regional or international connections, commerce, and communications. It has extensive system for housing, transportation, sanitation, utilities, land use and communication except agriculture.In the recent period,in cities and metropolis, there is considerable growth inconstructions of buildings and of infrastructure has been witnessed mainly due to:rapid growth in urbanization; scarcity of land and high cost of land. These factors necessitated to go deeper into the ground and construct multiple level basements that created additional useful floor space and go upwards towering vertically towards the sky to construct high rise structures. Multilevel basements are used for- parking, storage, commercial purpose, metros, shelter in war, habitation, and research laboratory, etc.
Basement is that portion of a building that is partly or completely below grade / FGL. One or more numbers of basements can be constructed below grade/FGL

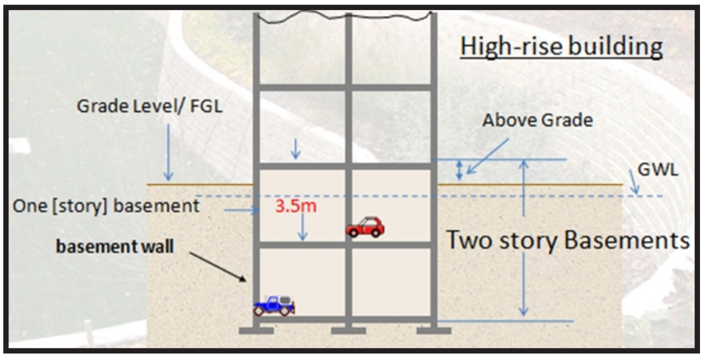


Fig- 1: Shows-two basements for parking

Typical examples of deep basements constructed in ancient times in India are given below-
*__Chand Baori__ [Carved Step Well]-35m x 35m in plan and 30m in depth
It was constructed in 9th century in village Abhaneri, Jaipur, Rajasthan
It is the deepest 'step well' in the World. Three out of the four sides have steps that lead down to the bottom of the well. These steps were used to draw water from the well.

Fig-2a-On three sides steps are provided that lead down to the bottom of well.

Figs-2b- On fourth side residential facilities are provided.

*__Kailas Temple__- Ellora, Aurangabad. Its construction is generally attributed to the eighth century Rashtrakuta king Krishna I.It is more than 1100 years old. It is constructed from'top down' below hill top GL by carving the megalith rock mass. It is the rare and unique of way of construction of a structure in one piece of basalt rock mass, in the world.

Fig-3a-Perspective view of Kailas Temple, Ellora, Aurangabad.

Fig-3b-A rare Rock mass 'Cantilever Canopy'-about 6m wide and 24m in Height is standing for past more than 1100 years.

***Sydney Opera House, Australia Car Parking** is having 120 feet [36.6m] depth below GL is the Deepest multi level basement in the world constructed in1973.

Fig-4a-Sydney Opera House, Australia [1973]

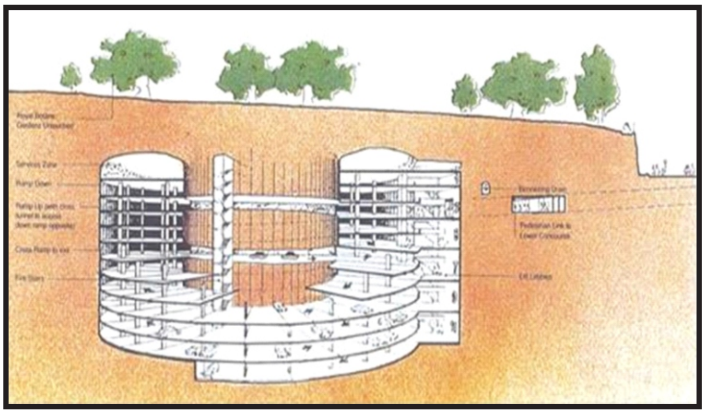


Fig-4b: Multiple Basements for Sydney Opera House, Australia [1973].
The huge doughnut shaped car park extends 12 storeys into the earth [36.6m deep]

2. Designing of basements for important tasks-
It is very essential to note that for continuous and proper use of multilevel basements, one has to design four important tasks-such as-i) Ventilation ii) Energy iii) Fire and iv) Safety. Basements shall be properly and regularly maintained.Basement moisture problems are very common. It can be annoying and uncomfortable. It can lead to loss of property and cause health problems.

3. Multiple basements construction problems-
*Multiple basements demand deep excavation into the ground to create additional floor space.During construction of deep depth of excavation, if rock is met close to ground,then it can pose excavation problems; if sandy soil is met, then it is always considered dangerous; if clayey soils is met then, in general, it presents less risk than sand; if soft clay is met, then it can prove to be very treacherous, and ifsilty soils are met, then its behaviour is also unreliable and requires the same precautions and support provision as sand.
*During deep depth of excavation, instability can be caused due to a) Changes in the water table and continuous dewatering to lower the ground water table that can activate the 'confined and unconfined aquifers' present in sub surface ground' which can cause subsidence of ground and distress to structures near to and far away to excavation area. b) Vibrations from-blasting, earthquakes,heavy traffic, heavy machinery movement and material loads near the cut can causecollapse of excavation in sandy soil, soft clay, and silty soil.

*Deep depth of excavation can pose problems to structures in the immediate vicinity of excavations; to dense traffic and presence of underground utilities such as metros, storm water drains and tunnels, etc

*Therefore, before to carry out deep depth of excavation below ground-it is necessary, first, to provide properly designed and properly constructed retaining wall on all sides of excavation of the proposed building. Then, the deep excavation is to be carried out using equipments of excavations such as JCB/ Pocklan/ Crane mounted grabs, etc.

*It is to be noted that, now a days, due to availability of advanced modern equipments of construction of retaining wall system for deep depth of excavation, capable contractors, consultants and project management consultant all of them having highly learned and experienced engineer, it has become possible to do underground deep depth of constructions work even in complicated modern settings wherein deep depth retaining wall system have been deployed successfully by overcoming the construction challenges.

4. Sub surface ground geotechnical investigation through soil rock strata using concept of scanning of ground-

It is essential to carry out 'sub surface ground geotechnical investigation' through soils and rocks met up to required depth so as to determine thedesign parameters for evaluation of lateral loads of soils, etc,acting on retaining wall system and for determination of depth of fixity [Df] and depth of socketing [Ds] for embedment of foundations below depth of excavation. Soil investigation is to be done using proper drilling machines such as 'rotary drilling machines or rotary hydraulic drilling machines, adopting the concept of scanning of the sub surface ground'.

*Concept of scanning the ground involves three steps.

*First, drilling through soils having in situ spt N values equal to and less than 50blows [hard stratum]; wherein it is aimed to “collecting uds soil samples and conduct spt test below bottom level of uds sample” and repeat this procedure-with a gap of 15cms spacing.

*Secondly, drilling through soils having in situ spt N values greater than 50 blows [hard stratum] and equal to or less than 100 blows [soft rock/weak rock]; wherein it is aimed to 'conduct spt test' and repeat this procedurewith a gap of 50 cms spacing.

*Thirdly, drilling through stratum having sptN values more than 100 blows; wherein it is aimed to use double tube core barrel attached with rock drilling tool such as 'diamond coring tool' for 1.5m /3m depth of drilling to collect better quality of in situ rock cores from rock mass so as to obtain reasonably good rock core recovery [RCR] and rock quality designation [RQD].

*At the same time, it is necessary to record the time required for each 30cms depth of drilling through rock mass which can help in locating weak rock mass/ joints/ aquifers, etc. Then prepare the drilled bore log as shown below

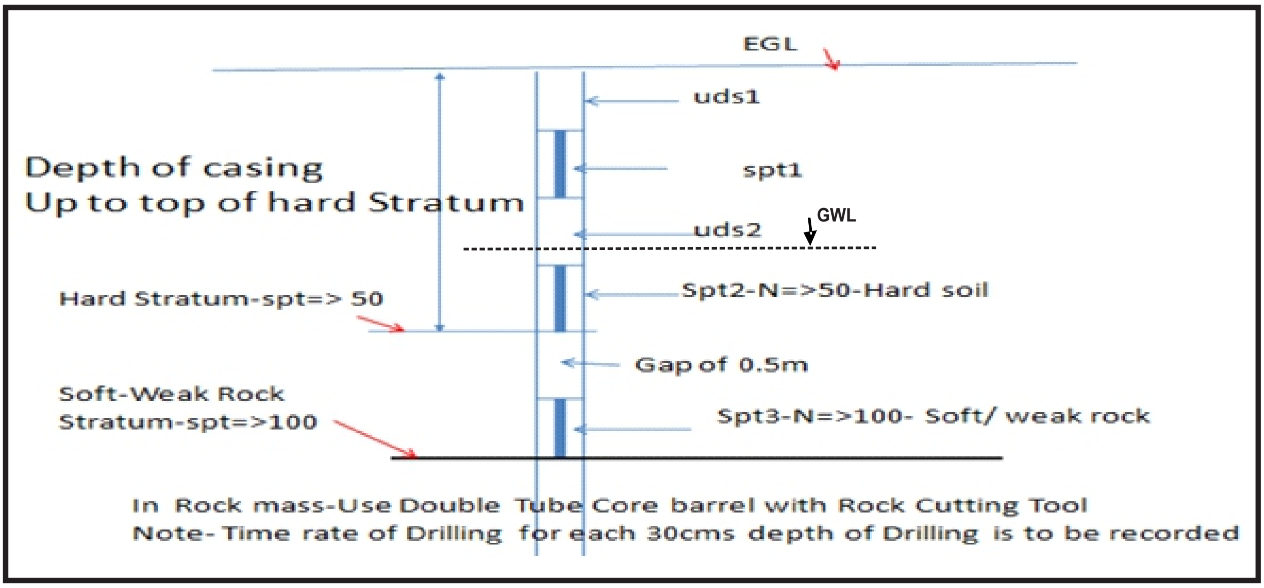


Fig-5- Log of rotary drilled borehole through soil and rock mass

*Determine-%RCR & %RQD
*In addition, conduct number of dcpt tests to ascertain the depth of hard stratum.
Further it should be made mandatory that *i] All above said works are to be carried out in presence of Geologist/Civil Engineer and *ii) Take photographs, videos during drilling, sampling, field testing like spt, dcpt..

5. Laboratory testing on soils and rock samples-

In NABL laboratory/ or in Institute laboratory, following tests can be conducted on undisturbed and disturbed soil samples and rock cores and ground water samples.
*i) On uds samples-a) Natural Moisture Contentb) Field Dry Densityc) Specific Gravityd) Sieve analysis & LL, PL, and SLe) Partially consolidated U Direct Shear
f) Fully consolidated Triaxial Compressiong) One Dimensional Consolidation
h) Chemical analysis on soil & ground water
*ii] On ds samples-tests Sr. Nos: a, c, d, e & h.Note- tests 'e' is done onremoulded soil samples
*iii) Conduct on Rock core samples-i) Dry density and %water absorption, ii) Specific gravity, iii) UCC Test, iv) Modulus of elasticity, v)Point Load Test, and vi)Petro graphic analysis.
*As per Karl Terzaghifor clay soils-[ϕ=0] following inter relation can be used-
*Cohesion=c= SPT N/15. Then for stiff dense clay-spt=>50, c=50/15=3.3kg/sq.cm;
For weak soft rock-spt=>100, c=6.6 kg/sq.cm.

6.Forces acting on retaining wall

Forces acting on multiple basements Retaining Wall/ Basement wall are
i) lateral earth pressure due to soil
ii) On foundation-uplift pressure due to water and
iii) Polluted sub surface soil and water Refer fig-6

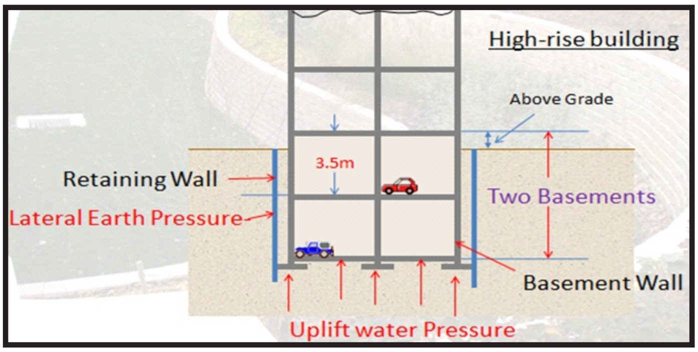


Fig-6-Shows forces acting on Retaining wall/Basement wall and foundation

7 (A) Recommendation for Depth of Fixity [Df] of piles of diameter 'd' in soils/Rock for piled retaining wall.

*Soft rock-Df=1.5d or 1.5m depth-whichever is more.
*Hard Rock-Df=0.5d or 0.5m depth- whichever is more.
*Hard/ Dense/Stiff Soil-DF=2.5m or2.5d whichever is more
*Soft clay& Loose sand- Df=5m or 5d whichever is more

7 (B) Recommendation for Depth of socketing [Ds] of piles of diameter'd' in soils/Rock for piled retaining wall, below depth of fixity, Df.

*For soft rock Ds=5m minimumand for Hard rock=1.5d or 1.5m whichever is more, below depth of fixity.
*For Hard/ Dense/Stiff Soil=7.5m or 7.5 d whichever is more- below depth of fixity
*For Soft clay& Loose sand =10m or 10 d whichever is more-below depth of fixity.

8. Determination of lateral earth pressure - σ3

As per Rankin theory of lateral earth pressure-

*A) Activelateral earth pressure=σ3-is induced when wall moves away from soil-

1. For sandy soil- [c=0]: σ3= {σ1+q}/Nϕ.
2. For c-ϕ soil-σ3=[(σ1+q)/Nϕ]-[2c/Nϕ^0.5]

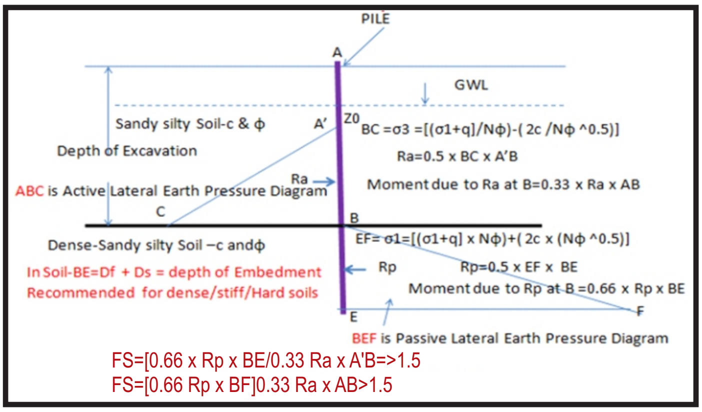
Wherein Nϕ = tan^2[45°+ϕ/2] = [1-sinϕ]/[1+sinϕ]
*Then for loose sand-ϕ=<28°,σ3= [σ1+q]/[Nϕ=>0.35]
*For dense sand-ϕ=>40°,σ3= [σ1+q]/[Nϕ=<0.26]
3. For clay soil [ϕ=0]: σ3= ([σ1+q]-2c). When, σ3=0.0 at depth Z0 below GL, then, z0=[2c-q]/ϒ. Z0 depth indicates- that soil may stand in stable condition without collapsing up to Z0 depth because in the depth between GL to z0 depth- the soils are in tension and therefore do not give any lateral pressure on Retaining wall.
*Then, as per Terzaghi: Z0-Depth for clayey soilsare evaluated for clayey soils having various spt values, considering q=2t/sq.m and ϒ=2t/cum as given below-
*For very soft saturated clay. Spt N value =<2, c= 1t/sq.m, Z0=[2x1 -2]/2 =0.0m
* For stiff saturated clay-Spt N value =15, c=10 t/sq.m; Z0=[2 x 10-2]/2 =9.0m
*For hard saturated clay-Spt N value =60, c=40t/sq.m; z0=[2x40-2]/2 =39.0m

*For soft weak saturated rock-Spt N value=100, c=66t/sq.m; Z0=[2x66-2]/2 =65m Recommended-Shear Strength,s = c, parameters are given below-
Soft weak Rock- c=>4kg/sq.cm; ϕ=0º & Nϕ =1; andHard Rock-c=>10kg/sq.cm; ϕ=0º & Nϕ =1

*<u>**B) Lateral earth pressure at Rest**= σ3</u> is induced when wall do not move from its original position. Then, σ3 for c and ϕ soils can be evaluated by two methods.

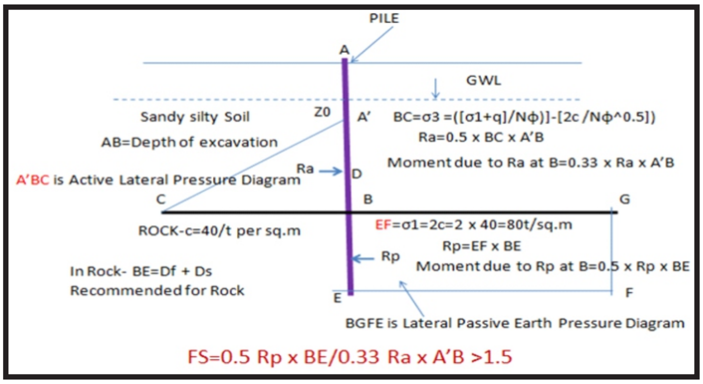
*1)σ3= {μ/ [1-μ]}σ1where σ1=rZ, where Z is the depth of soil retained by wall.
For dense sand/stiff clay-μ=0.3; then σ3=0.43 σ1 t/sq.m
For loose sand/soft clay-μ=0.45 then σ3=0.82 σ1 t/sq.m
*2)σ3 = [1-sinϕ] σ1 for c-ϕ soil
For loose sand soil-ϕ=<28º; then σ3=>0.53 σ1 t/sq.m
For dense sand soil- ϕ=>40º; then σ3=<0.36 σ1 t/sq.m
For clay soil-ϕ=0º; then σ3=σ1 t/sq.m = hydro static pressure

<u>(C) Case-1-Determination of lateral active earth pressure on piled retaining wall placed inc-ϕ soil, where rock stratum is not met/ or not available-[Fig-8a below]</u>



[Fig-8a]

<u>**(D) Case-2-Determination of lateral active earth pressure on piled retaining wall** placed in c-ϕ soil where rock stratum is met at depth below excavated GL-</u>



[Fig-8b]

<u>**(E) Case 3:-Pre Stressed [PS] anchored piled retaining wall**</u>

Important Note-Legally andpreferably it is advisable to providePS Anchor in soil and rock met in given Plot Boundary. This will not cause distress to foundation of structures located in adjacent plot/s. Care shall be taken while placing while placing PS Anchors that it will not cause damage to underground facility such as Metro, Storm water drains, Tunnels, etc located in or beyound the plot boundary.

***Case-3-Determination of lateral active earth pressure for PS anchored piledretaining wall in c-ϕ** soil where rock stratum is not met/or is met-

Note- From the lateral earth pressure of soil, Ra, deduct the horizontal tensile component of PS anchors, in both the cases, and then check the factor of safety.

<u>9. Types of Retaining Wall to support the soils/rocks</u>

9.1. a) [m. s.] Sheet Pile Retaining Wall

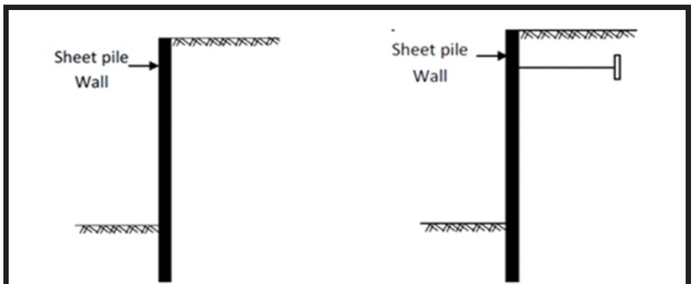


Figure 9a Sheet Pile wall   Figure 9b Sheet Pile wall

9.1 b) Precast concrete sheet piles
9.1 c) Prestressed concrete sheet piles
9.1 d) Other materials sheet piles , *Light-gauge aluminum sheet piles,
*Vinyl sheet piles, *Fiberglass sheet piles

9.2. a) Cast in situ RCC diaphragm wall

9.2 b) Precast concrete diaphragm wall

9.3. a) Contiguous or Touching cast in situ rcc pile wallspiled retaining wall
*Casing temporary/ permanent-can be provided up to hard stratum
*Gunniting can be done on exposed surface of piles-Fig-10-below

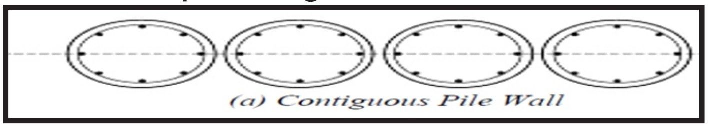


Fig - 10

9.3. b)*Laterally Nailed Contiguous piles

9.3.c)*Pre stressed anchored contiguous piles

10.1.a) Secant Pile Wall -Hard/Soft or Hard/Firm

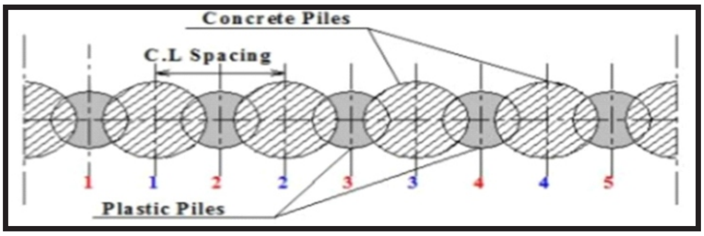


Fig-11-Secant pile-Hard/soft or Hard/Firm

10.2.b)Secant Pile Wall – Hard/Hard

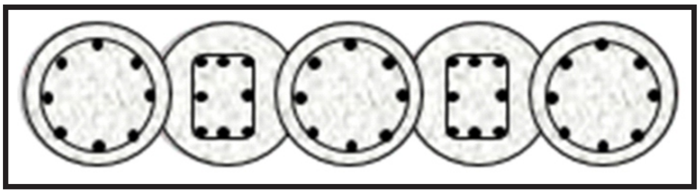


Fig-12- Secant pile wall-Hard/hard

10. a) Up lift pressure due to water Case-I

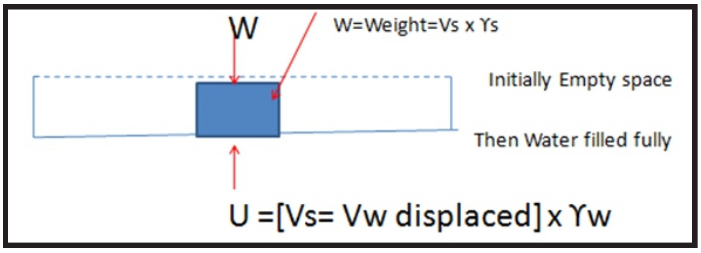


Fig-13-A structure initially in large empty space and later on filled space

Uplift pressure Uis equal to the weight of the fluid that the body [having weight W]and volume Vs displaces weight of water=W' =Vs x Yw =Uand acts in the upward direction at the center of mass of the displaced fluid.
If W>U-then the body will not get lifted up. If W< U-then the body will be lifted up

10. b) Case-II-Uplift pressure due to water-

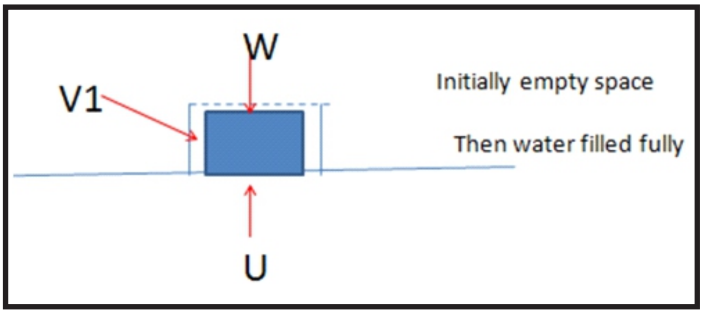
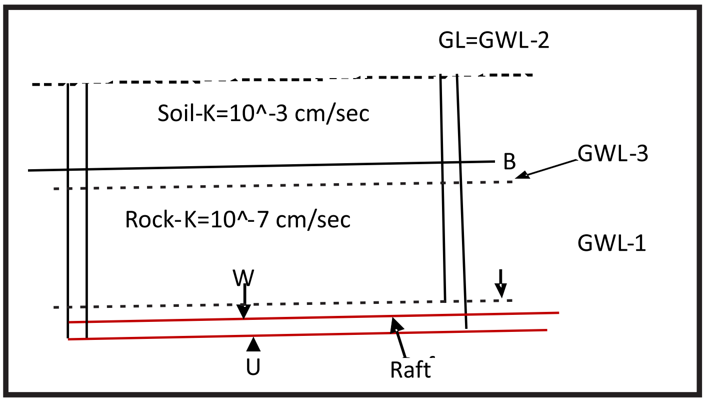


Fig-14-A structure in initially in small empty space and later on filled space

Volume-V1 of water present in the container in vicinity of solid. U=V1 x Yw
W> U then body will not get lifted up. If U> W then body will get lifted up.

10. c) Case III- Uplift pressure due to water-U-on raft resting on rock [Fig-15]



10. c).01-GWL at GWL-1-Water is trickling through rock at K=> 10^-7cms/sec. This water can be slowly dewatered and water level can be maintained at GWL-1. Then, raft will not have any uplift pressure, U, because weight of raft W is > U.
10.c). 02-GWL at GWL-2, water is trickling through rock at K=>10^-7cms/sec and water is flowing through soil at K=10^-3cms /sec. U> W, raft can get lifted. In this case- water through soil is flowing

at faster rate and therefore dewatering is to be done at faster rate so that water level can come down below rock level AB. In the process of rapid dewatering there is possibility of subsidence of ground and it may affect the stability of structures in the vicinity of the plot.

10.c). 03-GWL-3, water level comes below rock level AB, and then dewatering can be slowly done to lower the GWL at GWL-1. When the outside GWL-3 is at and below rock level AB and inside water level is at GWL-1, the uplift pressure due to water U is less than the weight of the raft [W] and raft will not get lifted up.

11. Examples of 'The World's Deepest Buildings' in modern time-

11.1) Deepest multi level basement constructed [1973] for Sydney Opera House,Australiafor Car Parking is having 120 feet [36.6m] depth.

11.2) GJØVIK OLYMPIC CAVERN HALL has been carved out of the rockwithin a mountain- built for the 1994 Winter Olympics, is an ice hockey rink located within a mountain hallwhere it hosted 16 ice hockey matcheswith a capacity of 5,500-the world's largest underground auditorium is buried 180 feet (55 meters) beneath a mountain.

Fig-15a-Entrance to
GJØVIK OLYMPIC CAVERN HALL, NORWAY

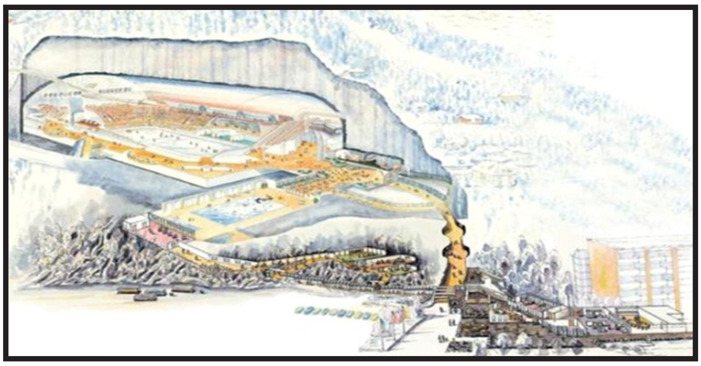


Fig-16-GJØVIK OLYMPIC CAVERN HALL, NORWAY-Auditorium- buried 180 feet (55 meters) beneath a mountain.

11.3) ARSENALNA METRO STATION in Kiev, UKRAINE-350 feet deep under Kiev city.

This station is the deepest underground Metro station in the world.

The station's depth is due to the geography of Kiev, where parts of the city stand on a hill with others almost at sea level on the banks of the Dnieper River.

The journey from surface to platform takes more than five minutes.

Fig-17a

Fig-17b

Fig-17-ARSENALNA METRO STATION in Kiev, UKRAINE -350 feet deep under Kiev city

11.4) Large Hadron Collider, France / Switzerland -[2008]– 575 feet deep

The world's most impressive underground structure-Constructed 575 feet (175 m) below the border of France and Switzerland is the Large Hadron Collider built by the European Organisation for Nuclear Research, better known as CERN.The 27km long structure is the world's largest single machine and it's most powerful particle accelerator


Fig-18a


Fig-18b-27km dia Tunnel Constructed 575 feet [175m] below


Fig-18c-LARGE HADRON COLLIDER Machine the World

Fig-18-Large Hadron Collider, France / Switzerland -[2008]–
575 FEET-[175m] DEEP

11.5) Jinpingunderground laboratory, China [2010]- Structures located at incredible depth 7,900 feet (2.4 kilometers) under a mountain in western China is built deep into the earth's crust to enable experiments to take place in conditions with extremely low levels of background radiation-the laboratory is an ideal site to do low background neutrino physics research and investigate dark matter.

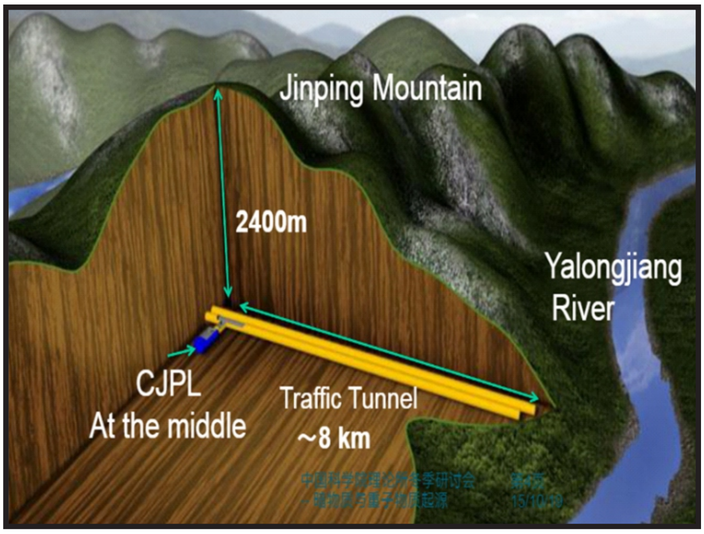


Fig-19-Jinping underground laboratory, China [2010]

11.6) Note- Humans have gone far deeper.
11.6.1-Example-1-In South Africa the world's deepest mine extends more than four kilometers into the earth.
11.6.2-Example-2- Borehole drilled 12.2 kilometers deep (7.5 miles) –called as"Kola Super deep Borehole" in Russia-is the deepest point in Earth crust.

Author

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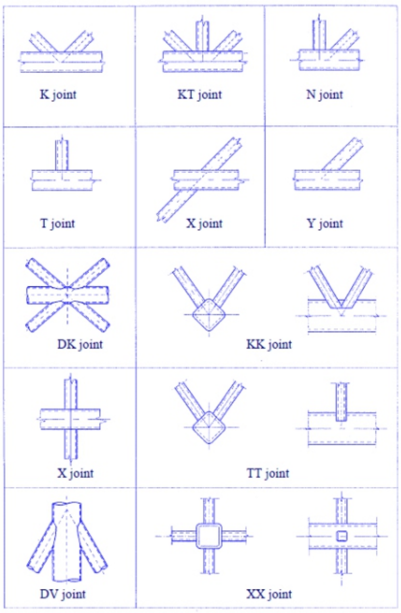
STEEL TUBULAR CONNECTIONS AN OVERVIEW

by Sameer Sawant

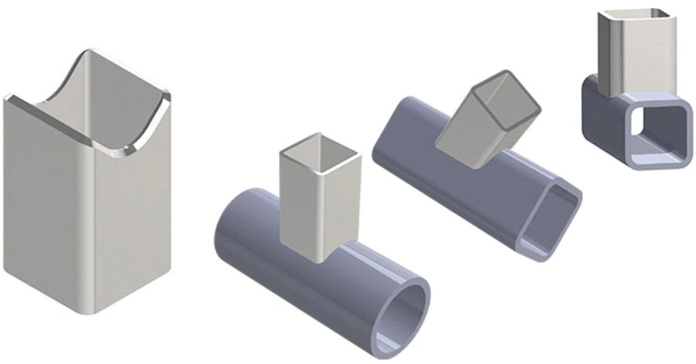
Introduction : Steel tubular connections are very important in any steel structure. Hollow section connections are tricky and different from the normal I and C sections. There are two types of connections bolted and welded. Now a days all the majors structures are built using hollow steel sections which has better aesthetic appeal. So, architects prefer hollow tube sections. Different type of possible connections are discussed in this small write up which will be useful for design engineers.

WELDING

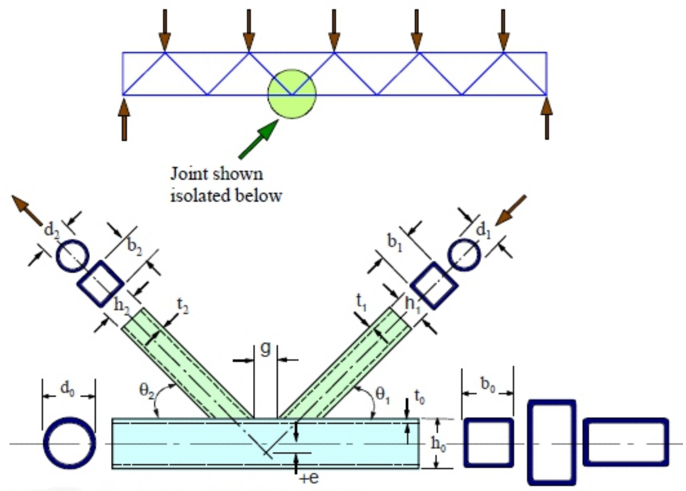


Types of joints in hollow section lattice girders

PROFILE CUT FOR VARIOUS SHAPES OF HOLLOW TUBE SECTIONS

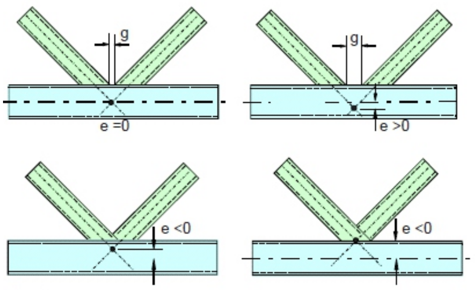


TRUSS CONNECTIONS



Symbols used for K gap joints

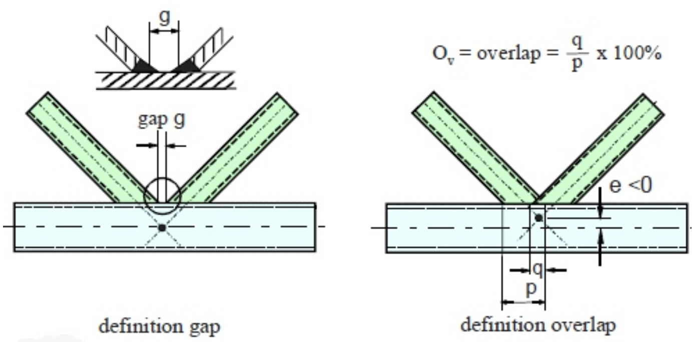
NODING ECCENTRICITY



$-0.55 \leq \frac{e}{h_0}$ or $\frac{e}{d_0} \leq 0.25$

Noding eccentricity

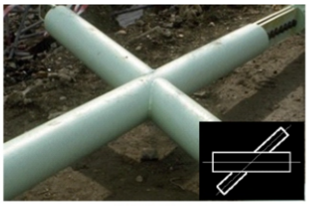
GAP & OVERLAP

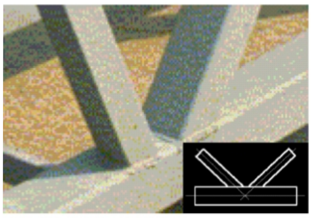


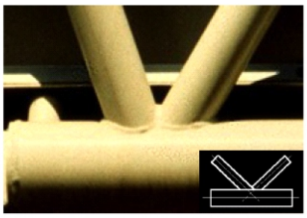
Gap and overlap

TRUSS CONNECTIONS : JOINT TYPES

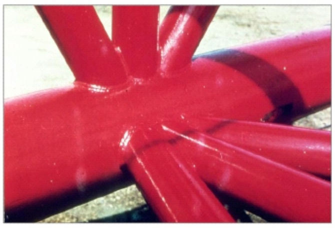

T or Y-Joint

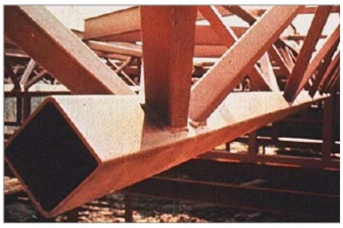

X-Joint


Gap K-Joint

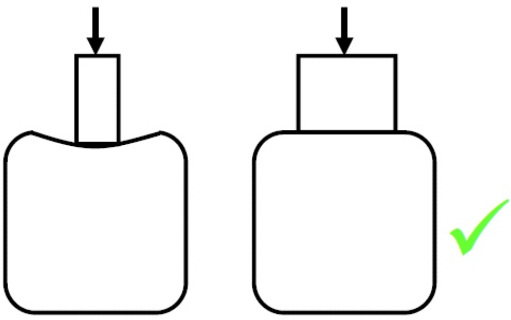

Overlap K-Joint

TRUSS CONNECTIONS : MULTI PLANAR

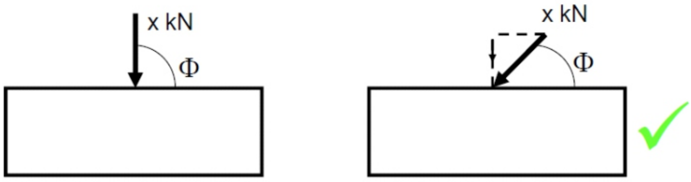




PARAMETER EFFECTS

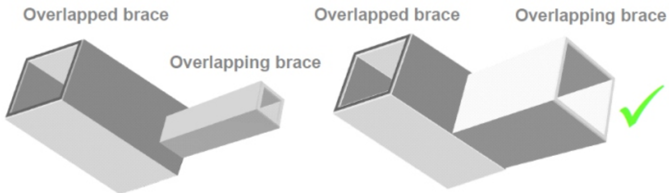


Bracing to chord width ratio
Keep ratio up to increase joint capacity
Keep B_b/B as high as possible and
keep t_b/t as low as possible

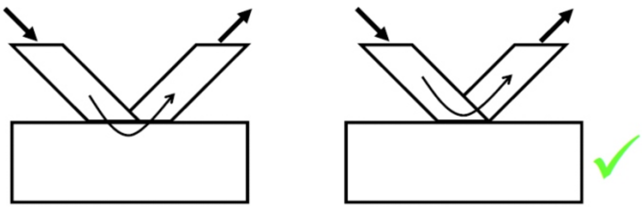


Bracing angle
Keep bracing angle Φ down to increase joint capacity

OVERLAP JOINTS

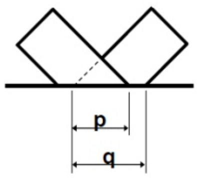


Bracing width to thickness ratio
Try to match branch members width to increase joint capacity



Overlap
The higher percentage of overlap, the higher the joint strength

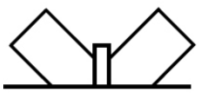
OVERLAP DETAIL



Overlap = p
Overlap % = p/q x 100

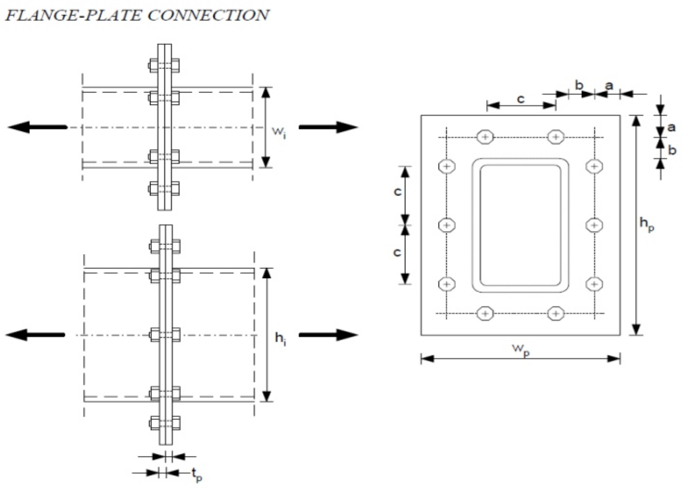
Overlap bracings should NEVER be made like this >

- Difficult to fabricate
- Up to 20% weaker

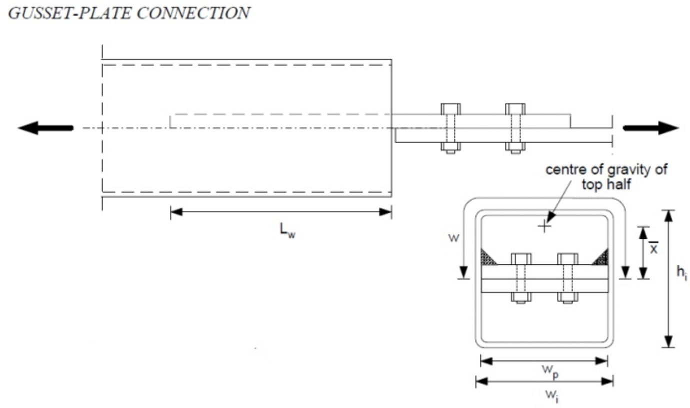


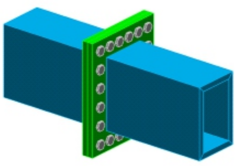
- Use division plate as alternative
- Helps to reinforce joint

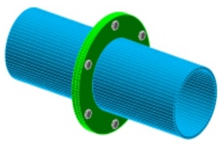
BOLTING

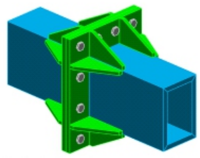


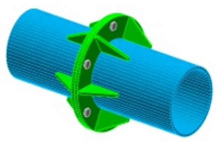
HIDDEN GUSSET PLATE CONNECTION

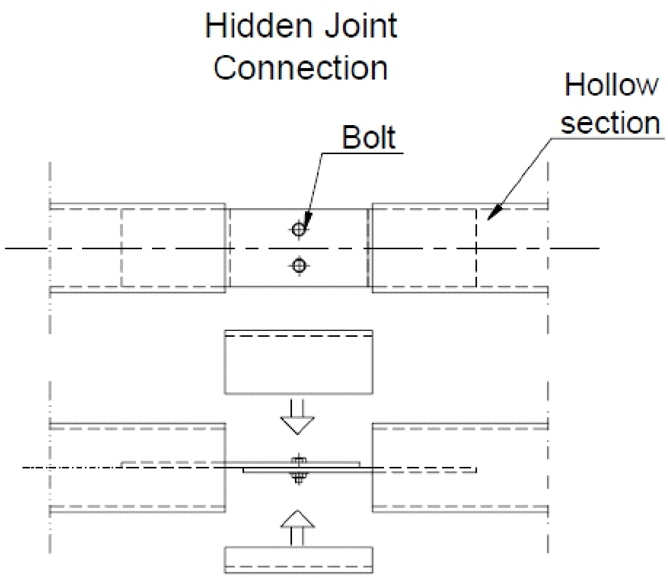



End plate splice connection without stiffener

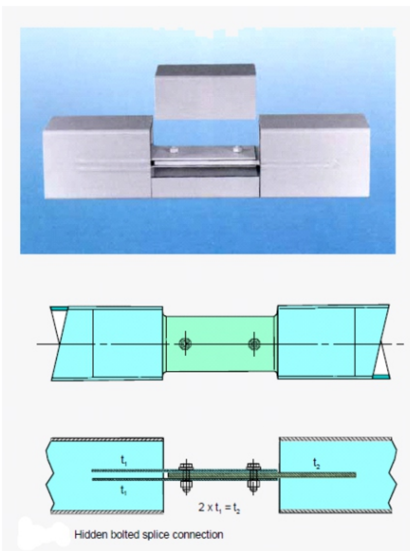

End plate splice connection without stiffeners

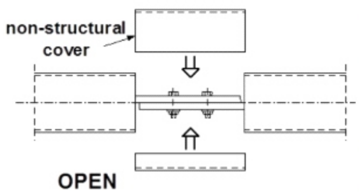

End plate splice connection with stiffeners

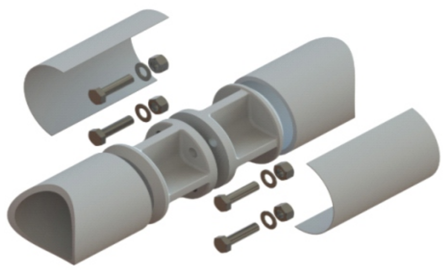

End plate splice connection with stiffeners



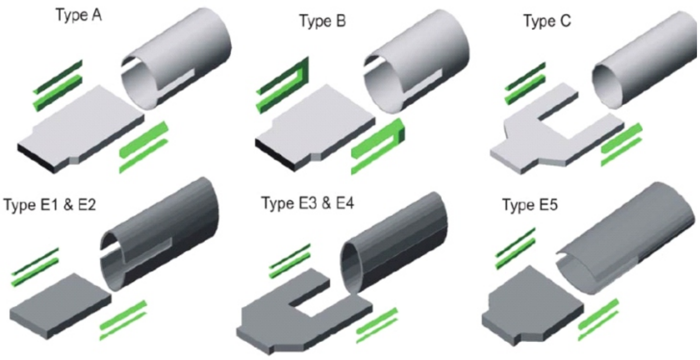
HIDDEN BOLTED SPLICE CONNECTION USING GUSSET PLATES



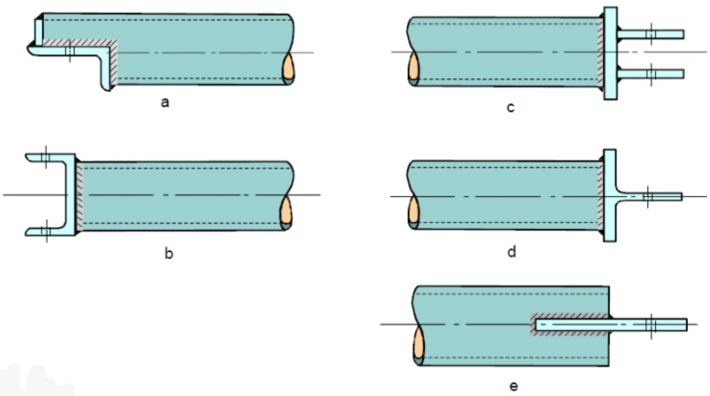




GUSSET PLATE – VARIOUS STYLES

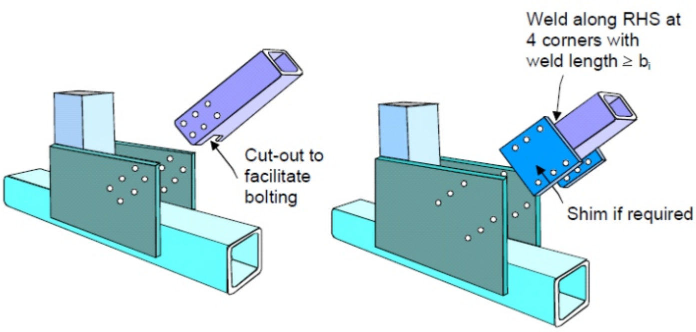


BOLTED SHEAR END CONNECTION



Bolted shear end connections

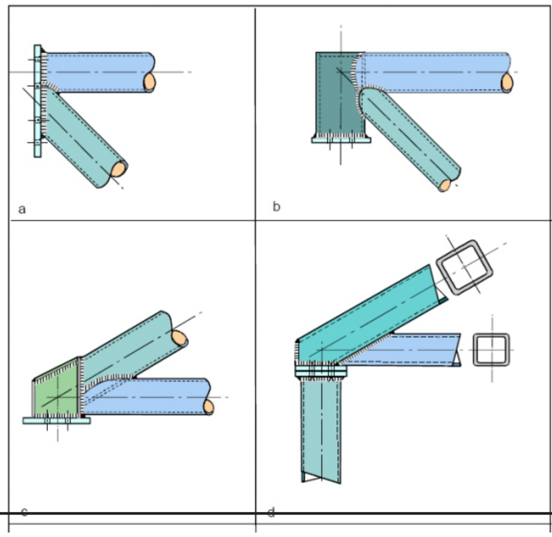
BOLTED GUSSET PLATE CONNECTIONS



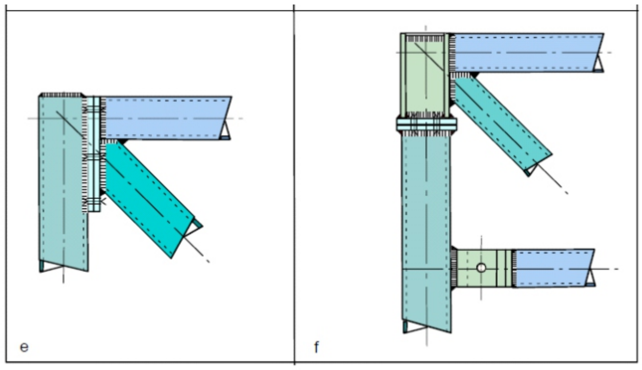
a) Simple shear splice   b) Modified shear splice

Some examples of bolted gusset plate connections

BOLTED CONNECTION FOR A LATTICE GIRDER

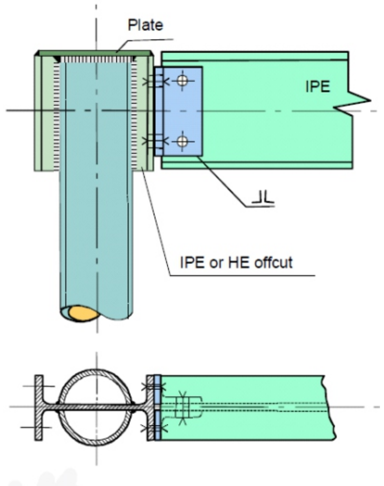


BOLTED CONN FOR A LATTICE GIRDER



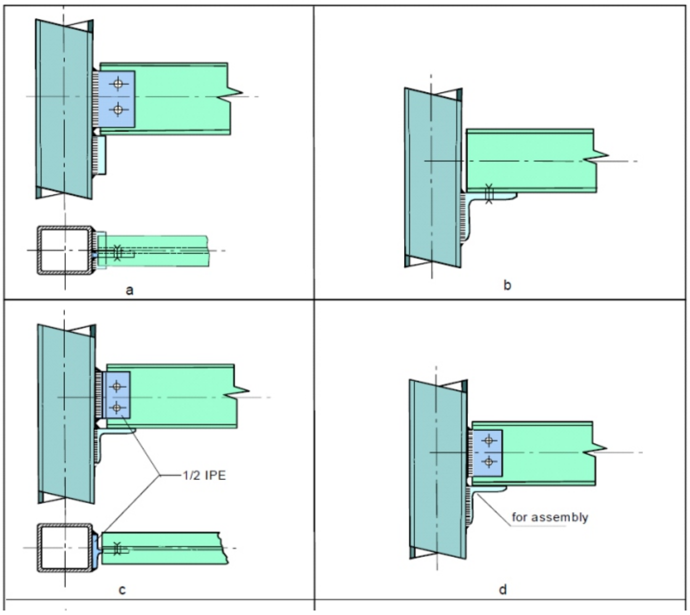
Bolted connections for lattice girder supports

I -SECN BEAM TO CHS COLUMN (SIMPLE SHEAR CONN)

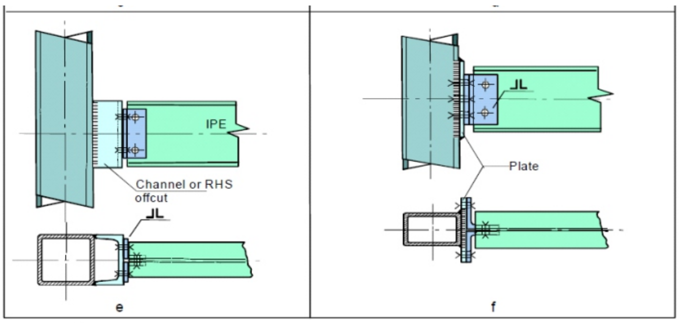


I-section beam to CHS-column conne

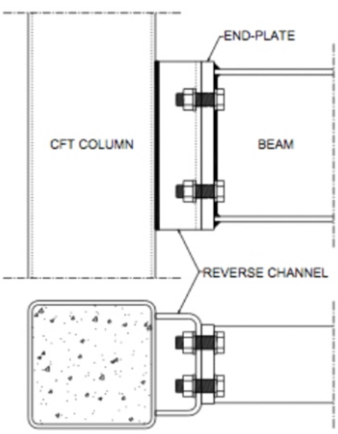
I -SECN BEAM TO SHS COLUMN (SIMPLE SHEAR CONN)



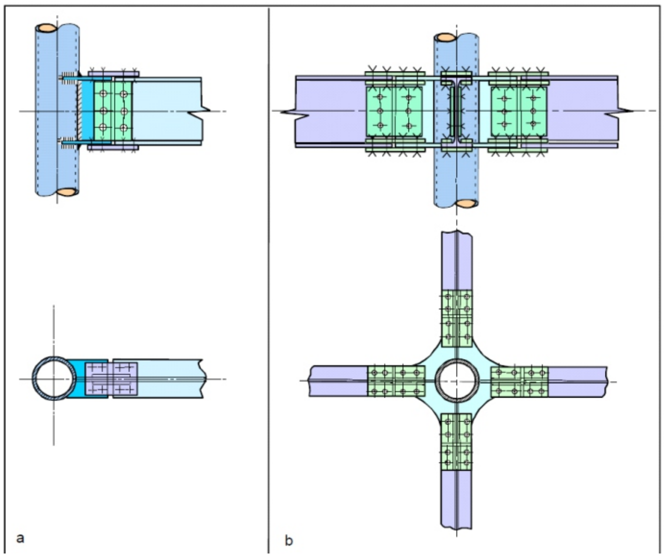
I -SECN BEAM TO SHS COLUMN (SIMPLE SHEAR CONN)



I-section beam to RHS column simple shear connections



I -SECN BEAM TO CHS COLUMN (MOMENT CONN)



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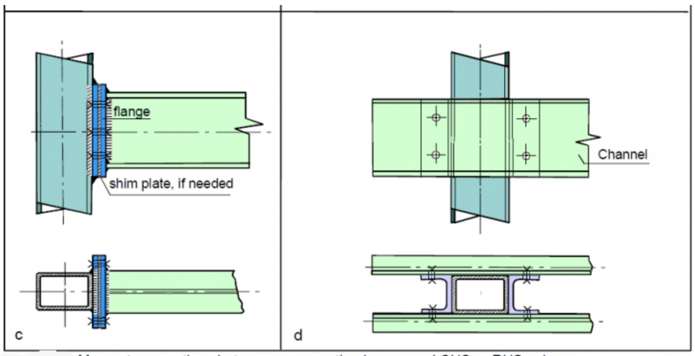
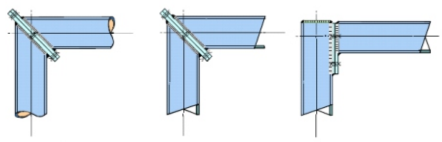
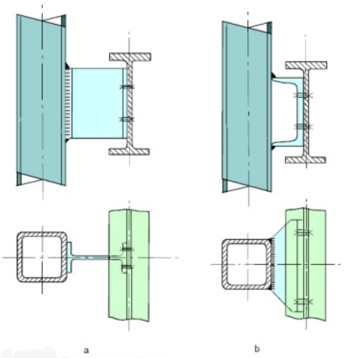


Moment connections between open section beams and CHS or RHS columns

KNEE JOINT ASSEMBLY FOR PORTAL FRAME & BRACKET CONNECTION

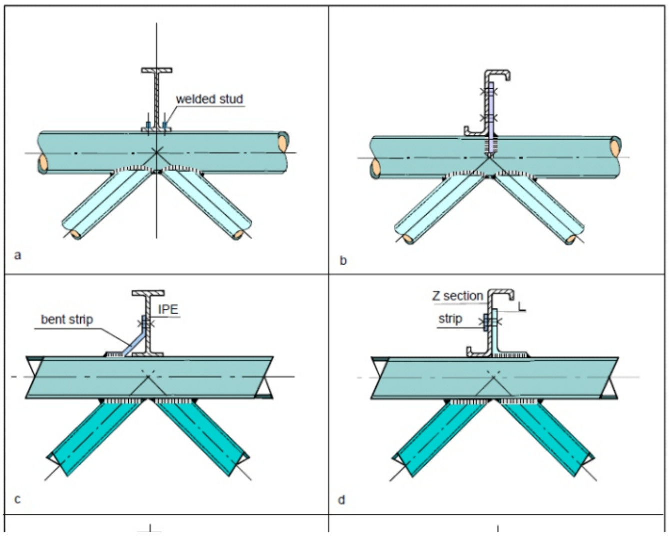


Knee joint assemblies for portal frames



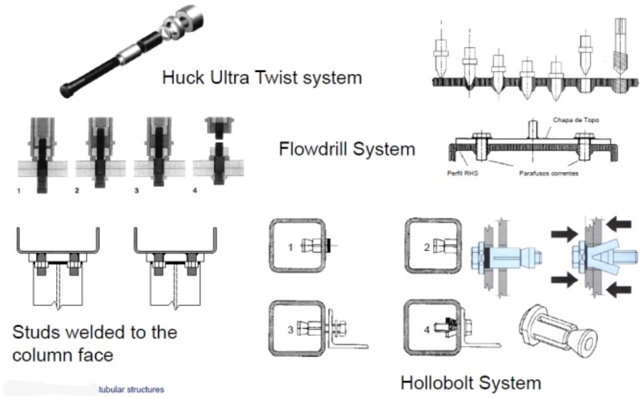
a Bracket connections b 12.13

PURLIN CONNECTION ON LATTICE TRUSS TOP



CONNECTION JOINTS

NEW VARIANTS OF CONNECTION JOINTS FLOWDRILL & HOLLOWFAST BOLTS



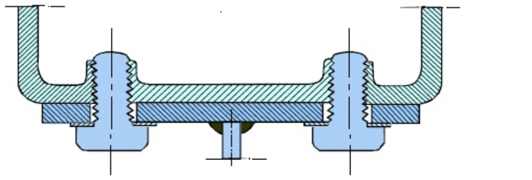
FLOWDRILL SYSTEM

The flowdrill system is a special patented method for extruded holes [114]. CIDECT has carried out extensive test to prove the load bearing capacity of this type of joint using this method in structural hollow sections [114, see F.g 1`2.20.

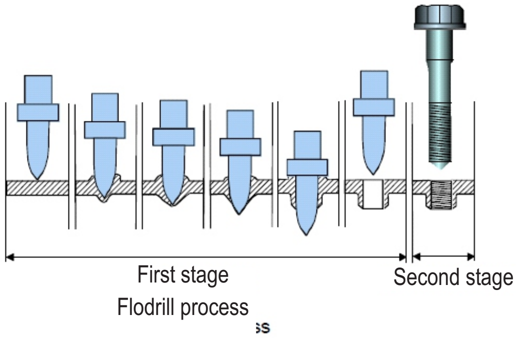
Flowdrilling is a thermal drilling process (Fig. 12.21 to make a hole through the wall of a hollow section by bringing a tungsten carbide bit into contact with the hollow section wall and generating sufficient heat by friction to soften the steel. As the bit moves through the wall, the metal flows from an internal bush. In the subsequent step, the bush is treaded using a roll tap.

At the present stage of investigation, the bolting of hollow sections with wall thicknesses up to 12.5 mm can be recommended by using the flowdrill method. Recommendations are given in [114].

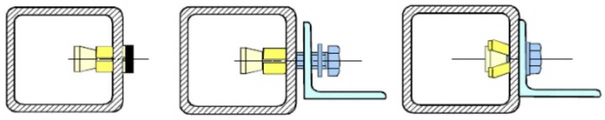
FLOWDRILL SYSTEM



Flow drill connection for joining doble angle web cleats or flexible end plates to RHS

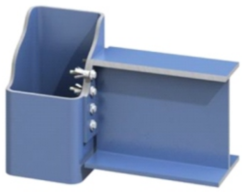


LINDAPTER "HOLLOW FAST"

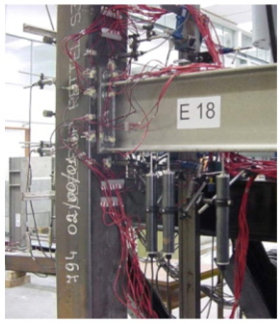


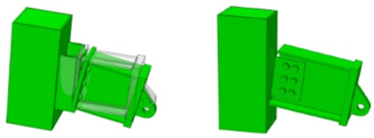
Lindapter "HolloFast"

LINDAPTER " HOLLOW FAST"



http://cms.esi.info/Media/documents/
Linda_Cavityfixing_ML.pdf





MODULE B – Design of tubular structures

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NEWS AND EVENTS DURING JAN - FEB - MAR 2020

by Hemant Vadalkar

9 Jan 2020 : Practising Engineers Architects and Town Planners Association (PEATA) organised a seminar on Responsibilities of Professionals in MAHARERA. Presentation by legal experts, real estate laws and taxation experts have been arranged. Officers from MAHARERA Shri D R Hadadare (MAHARERA Technical Head), Dr. Vasant Prabhu (Secretary MAHARERA) and Chairman Shri Gautam Chatterjee addressed the gathering and elaborated on the responsibilities of architects and engineers involved in the project. Certification by architects and engineering regarding % work completion and quality of material and workmanship is to be certified by engineers in a responsible way.

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18 Jan 2020 : ISSE National Workshop" Structural Health Evaluation Vis-À-Vis Prescriptive Mandatory Format Of Structural Audit "

Indian Society Of Structural Engineers (ISSE) with active supports of other civil engineering associations & institutions arranged full day National Workshop " Structural Health Evaluation Vis-À-Vis Prescriptive Mandatory Format Of Structural Audit " on 18th January 2020 at Hotel Kohinoor , Dadar , Mumbai . Mr. Satish Dhupelia senior most structural consultant was principal coordinator of this workshop. Workshop aim was to highlight the points / problems faced by engineers during structural audit of the existing buildings. Mr Shantilal jain President of ISSE gave Welcome speech to the gathering . Mr Dharmadhikri past president of ISSE informed about the activities of ISSE Workshop was inaugurated by publishing the proceedings of workshop papers . Keynote speech was delivered by convener Mr. Satish Dhupelia.

Topics discussed at workshops include different approaches taken by various consultants for structural evaluation, Structural assessments, statutory provisions of NDT & its relevance which made mandatory for structural engineer during structural audit. Prominent experts in the field of structural engineering made the presentations. Technical articles were shared by Mr. Umesh Dhargalkar, Chetan Raikar, Jayant Kulkarni, Dhairyashil Khairepatil, Ravi Ranade, Arvind Parulekar, Shrinivas Karnam, S . H. Jain , Umesh Joshi and Hemant Vadalkar.

Panel Discussion & Q/A session was the climax of the programme. Director Engineering Municipal Corporation of Greater Mumbai Shri Chitore was the chief guest. Prominent experts in the field were on the panel which includes Satish Dhupelia, Shashank Mehendale, Chetan Raikar, Shantilal Jain and Hemant Vadalkar. ISSE submitted the summary and recommendations of the workshop to MCGM for necessary action. The copy of this letter is available on ISSE website. The function was supported by Dhirendra Group of Companies, Structwel Designers and Consultants Pvt.Ltd and INDU Corporation. Engineers from far away places like Bhubaneshwar, Goa, Pune, Kolhapur also attended the function. ISSE Team and Ranganath Satam, Paresh Unnarkar had taken special efforts in organizing this activity. Workshop was a grand success and attended by more than 180 engineers.

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29 Jan 2020 : ISSE Foundation day function - Technical Lecture An Overview Of The Mumbai Coastal Road Project,.

Indian society of structural engineers (ISSE) in association with Ultratech Cement Celebrated foundation day of ISSE by organizing a technical lecture (3rd lecture of technical series of 6). The topic of lecture was " AN OVERVIEW OF THE MUMBAI COASTAL ROAD PROJECT" by Assistant Engineer Coastal Road MCGM Dr Vishal. R. Thombare . It was organized on 29th January 2020 at Sasmira Auditorium, worli, Mumbai. ISSE president Mr Shantilal Jain inaugurated the function and delivered the welcome address to the gathering of the civil engineering professionals.

On the eve of the foundation day of ISSE, felicitation of engineers was done who are helping ISSE for conducting technical events , Authors for the ISSE journals, speakers for technical lectures, supporters & sponsors for the various events organised by ISSE. Hon secretary of ISSE Mr. Hemant Vadalkar thanked all supporters of ISSE by felicitating them with ISSE memento .

Assistant Engineer Coastal Road MCGM Dr Vishal. R. Thombare covered the overview of the Mumbai coastal road project. He explained salient features of the project right from its conceptual stage, tendering stage , awarding contract to the various vendors and phase in which work is under progress. He run the walkthrough presentation of the coastal road project which was very interesting to understand final picture of the Mumbai coastal Line once project is completed.Ultratech cement gave presentation and overview of their product after the technical lecture. Various building materials offered by Ultratech Cement were on display at venue. Mrs Mansi Nadgaonkar treasurer of ISSE proposed vote of thanks. There was huge response from civil engineering professionals and students. Function was attended by around 150 delegates.

8 Feb 2020 : ISSE Pune Team met Hon. Minister Ajit Pawar for our demands not to arrest structural engineer for any accident or building collapse without investigations.

ISSE Pune center managing committee members Er. Ajay Kadam, Er. Shishir Dhawade, Er. Pradeep Patil, Er. Kishor Jain and Er. Narayan Kochak had a meeting with Honorable Deputy Chief Minister Mr. Ajit Pawar on February 8, 2020. A letter was submitted to the DCM regarding long pending issues related to accidents on construction site, use of IPC 304 & 304(A) against structural engineers, responsibilities of the structural engineer and supervising engineer as per DCPR. The DCM was requested to instruct the police department not to use IPC 304 & 304(A) against structural engineers since site accidents can not be considered as murder. He was also requested to form a committee of structural engineering teachers and practicing structural engineers which would study the accident and submit its detailed report on cause of the accident and on basis of such report the police department would determine the IPC section to be used if at all necessary in cases of the concerned structural engineer. Third request was to instruct the department of urban development to finalize the responsibilities of the supervising engineers and the structural engineers in up coming DCPR. Now that the owner would be required to appoint a supervising engineer for the construction activities and day to day supervision of the construction activities was his responsibility, structural engineers would not be responsible for supervision of the construction activities and so he would not be held responsible for site accidents in anyway.

The deputy chief minister clearly understood structural engineer's problems and promised to hold a meeting of ISSE members with the secretary of the urban development department as soon as possible in order to settle the issues.

8 Feb 2020 : Alpa Sheth , eminent Structural Engineer was felicitated during ISSE monthly meeting on 8 Feb 2020 for her contribution to ISSE activities. She is planning a seminar on Revision of IS456 code with the help of code committee members and in association with ISSE at Mumbai.

15 FEB 2020 : One day workshop on Swachhata technologies by department of Nuclear Agriculture and Bio-technology division of BARC was arranged at Anushakti Nagar. Officers from various municipal corporations, Government organisations, NGOs, Housing Society office bearers attended the event. BARC scientists discussed various technologies developed at BARC. This includes bio-gas plat using wet waste and kitchen waste, composting of garden waste using Techoderma fungus which accelerates the composting process. It was mentioned by experts that the commercial composting machines which claims to convert the wet waste into compost in 24 hours should not be used as it involves high energy consumption and heating process which burns the wet waste and does not compost properly. Sewage treatment using advance GS SBR (Granular Sequencing batch reactor) technology was discussed which needs very less space. The sludge from various STPs can be treated using Gamma radiation and then can be used as fertilizer. BARC developed various type of filters for obtaining clean drinking water even without electricity. Site visit to BARC composting and bio-gas plant was arranged. BARC is partnering with interested individuals or companies and transferring the technology for the benefit of the society. More information can be obtained from their website http://www.barc.gov.in/technologies/technology.html

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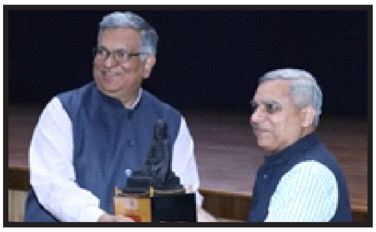
18 Feb 2020 : ISSE, Pune convened technical site visit to the Statue of Unity and IIT Gandhinagar on 18-02-2020 and 19-02-2020. 18 structural engineers participated under the leadership of Er. N. Y. Kochak. L & T team led by Er. A. Thiyagarajan arranged technical presentation regarding the construction sequence & structural aspects. He also explained various majors taken during as well as after the construction for serviceability. They facilitated exhilarating demonstration of connection details in the Statue of Unity.

On the way to Gandhinagar ISSE members visited 'Adlaj ki baav' (Step well in Adlaj) ; a 700 year old heritage structure which survived major earthquake. It emphasized the importance of simple, regular, symmetric structures in earthquake prone area which also can be aesthetically appealing.

Members of ISSE, Pune also visited ongoing construction of various buildings in the premises of IIT Gandhinagar especially G+3 structures in confined masonry (Interest area of Dr. S. K. Jain). Some salient features of structures included form finish RC structures, crocodile staircase, measures adopted to make the structures Regular as per IS1893. Engineers from CPWD and Er. N.Y.Kochak; peer reviewer of the project, explained various aspects adopted to make structures code compliant. This group also met Dr. S. K. Jain, Director, IIT Gandhinagar and had a brief interaction with him. They congratulated him for being awarded with Padmashree.



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21 Feb 2020 : International Tube Association (ITA) conducted workshop in Mumbai on Tube and Pipe for Structural Applications – Complete solution for the new age. Prominent speakers from industry and professors from IIT's addressed the gathering. Various aspects of steel tubes used in infrastructure projects like airports , bridges and buildings was discussed. More papers on concrete filled steel tubes were presented on the behaviour of composite section under compression, ductility and fire resistance. Apollo Steel pipes, TATA tubes, Welspun Group presented their product range. Architect Charanjit Singh Shah showed the designs of new airports at Chennai, Raipur, Ahmedabad and Vadodara using tubular sections. He had also shown images of Kartarpur corridor project which was completed in record time of 4 months. Sameer Sawant Consulting engineer talked on innovative architecture and connections of tubular structures. Himani Joshi, from JSW provided overview of Construction solution business. Mr. Khushwah from Western Railway shown the use of tubular sections in new foot over bridges. Prof. Anil Agarwal form IIT Hyderabad talked on behaviour of concrete filled steel tubular columns exposed to non-uniform heating. Dr. J Rajasankar Chief Scientist with CSIR-SERC Chennai elaborated research facilities at their Centre. Dr. Pramod Kumar Gupta from IIT Roorkee made presentation on strength and ductility of concrete filled steel tubular short column on concentric loading and shown that these columns are more ductile than RCC or bare steel column. Ankur Jadhav presented case study of L&T business tower project which is using concrete filled steel tubes, prefabricated steel structure, deck sheets for composite floor slabs which is saving substantial construction time and reduces construction space requirement at site. Mr. Vasudeo Rao from Zamil Steel Buildings shown how tube sections are used in PEB projects where weight reduction of 15-20% can be achieved if tapered I steel frames are replaced by tube trusses and built up sections. The workshop was attended by around 100 delegates.

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29 Jan 2020

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ISSE Pune Team Meets Hon. Minister for
Various Demands - 8 Feb. 2020

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ISSE Pune Technical Visit
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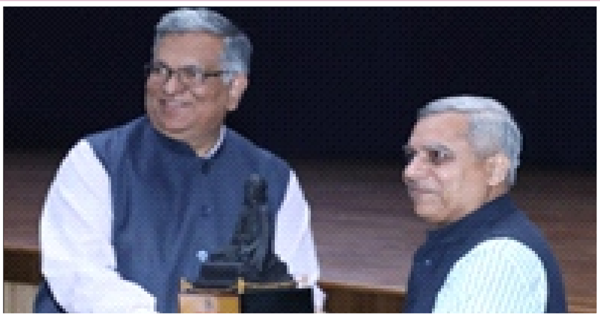

ISSE Pune - Er. N. Y. Kochak Felicitating
Dr, Sudhir Jain - Director IIT Gandhinagar
19 Feb. 2020