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SEISMIC STUDY OF STEEL STRUCTURE WITH BRACE FRAME AND SHEARWALL FRAME SYSTEM ON TEKLA STRUCTURE

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ABSTRACT:-

INTRODUCTION:-

These days ,The population and industrialization are growing rapidly progressively.Various architects and engineers are focusing on the growth and raised development of multystorey buildings and skyscrapers. Although, increasing the height of such building is problematic.Several criterion play an important role in designing and construction, including various loads such as longitudinal loads and lateral loads.(Examples are wind and seismic loads). The further concederation of the designer is to design and analyse a building that will be more sustainable. There are three major class of construction. Composite buildings ,Steel buildings

and Reinforced concrete buildings. The steel building Structural differs from concrete in its attributed compressive strength as well as tensile strength in tall buildings. Because of its high strength, stiffness, toughness, and ductile properties ratio, and also easy in installation as it can be developed into nearly any shape and easy in transportation, among which the steel buildings Structural can be erected as soon as the materials are delivered on site, whereas concrete must be cured at least 1–2 weeks after pouring before construction can continue, making steel a schedule-friendly construction material .steel structure are mostly considered for tall buildings because of its high strength /weight ratio, It is also economical in transportation and availability of various sections. On the other hand, different structural systems are available for resisting lateral load for high-rise buildings such as shear wall system, frame system ,tubular system ,braced frame system(V,X,K), diagrid system, and rigid frame system.

The main concern of this research work is to analyze the seismic behavior and performance of the g+30 story steel structure (building) and compare with the best performance with x-bracing and shear wall.In order to find out its viability for high-rise construction.

In this structural analysis of G+30 story steel frame, with two other frame using x-bracing at all faces at corner, in one steel frame and shear wall at corner on other steel frame.In which the

plan considered for all models was 30m X 30m and the method use for analysis is Response spectrum analysis method. All the members of the framed section was designed as per IS456:2000, IS800:2007 and load combination for seismic force were considered as per IS1893(Part-1):2016.
In the design analysis on the TEKLA structure software It was found that maximum story displacement and story drift of the structure lies within the permissible value as per IS1893(Part-1):2016.While comparing the specified parameters, it was found that the shear wall and X-bracing frame structure performing better than the simple framed structure and x-bracing frame structure thus it can be consider to be more effective for high rise construction. From all the four-models shear wall and X-bracing structure gives less required value of story displacement and story stiffness compare to other models. Hence, the structure with both the shear wall and X- bracing can be considered as the sustainable solution in terms of high-rise construction.

KEYWORDS:-
Simple framed structure ,X-bracing framed structure ,shear wall ,lateral load ,response spectrum method, TEKLA STRUCTURE software.

1:-INTRODUCTION:-

The designers need to design the most durable building types .The building with x-bracing and shear wall is a structure of steel, concrete and timber beams that are placed vertically at the time of construction of buildings and roofs. As the hight of the structure is increased of the building, the more important the lateral pulling mechanism of the gravity system. The physical stability of the vertical structure is linear in shape and resists gravity and lateral loads due to the axial tension of the element. Some of these systems include the design of pipes, joints, cross joints, cantilever joints, transition walls, and diode structures. The braced system is used as a ceiling to create large transparent areas without pillars. Use building materials that are 20-25% less than other materials. In the brace structure, beams and columns are designed only under vertical loads, assuming that all lateral loads are in the brace system. Shear walls are concrete walls designed to resist the lateral forces acting on skyscrapers. The shear system is the vertical element of the resistance system against horizontal forces

The Braced frames are very powerful structural systems commonly used in structures that are subject to lateral loads such as wind pressure and earthquakes. The structural elements of the clad frame are usually made of structural steel and work effectively with tensile and compressive forces.The beams and columns that make up the frame have vertical loads, and the brace system supports lateral loads. However, fixing the cross brace can interfere with the exterior design and the position of the openings, which can cause problems. Buildings with high-tech or aesthetic styles respond by expressing the brakes as a feature of interior or exterior design.
The shear wall system element is the vertical part of the system designed to withstand lateral forces on the structure, typically wind loads and earthquakes. In many authorities, shear wall designs comply with international building codes and housing standards.

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The shear wall keeps the load parallel to the plane of the wall. Collectors, also known as tension elements, transfer the shear from the diaphragm to the shear walls and other vertical members of the seismic system. Shear walls are generally steel framed walls or are reinforced concrete walls with shear panels, reinforced concrete walls, armor masonry walls or steel plates
Tekla Institutions is a software that supports BIM (Building Information information). A powerful tool for creating and managing advanced 3DProblems and design of materials and structures. Naturally Organizational design can be used in all phases of construction, from design to design. From construction to production, construction and construction supervision. Tekla Structures companies have a long history in the construction industry. Embedded, technical computer technology In **February 1966 in Helsinki, Finland** by the same spring company.
The name was shortened to Tekla and is now Trimble. The main function of this system is the BIM (*BUILDING INFORMATION MODELING)* model. It is very difficult to draw 2D concepts, display views and sections. It is much easier to make a detailed 3D model of the building.It is a view of all connections that integrates physical modeling and analysis. It can then be used for various analyzes. Paper design. Therefore, the result of Tekla Process is as follows.
Complete concept structure submission process bar. Tekla Systems software solutions are available in a variety of professional configurations. To help customers choose a program that suits their needs

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Tekla, Complete is a complete configuration including modules.Retail sale of prefabricated and concrete products. It isIt allows you to create 3D models of metal and concrete structures.The infrastructure and the complete Tekla module enable the implementation of many tasks. From live maps to automatic maps.
Tekla instructions, metal design in the project. Can be used to create detailed 3D imagesIt simulates all metal parts and collects production and assembly data. Tekla instructions, preliminary data supplemented Find out more about precast concrete elements.
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Special architectural and manufacturing programs such as Archicad, ADT, Revit
All buildings, Needs to check All plan, Bentley Architecture as well as all IFC compatible devices. In various formats.

2:-OBJECTIVE OF WORK:-

1:-Study of seismic behavior of buildings for periodic planning under load and seismic combinations in accordance with IS 1893: 2016
2:-Evaluate the relationship between the brace frame and the structure of the lateral resistance system of the brace wall frame
3:-Stimulates various seismic parameters as base shear, vibration modes, time period , historic collapse, story constrain

3:-DESCREPTION OF BUILDING :-

S. no	STRUCTURL PART	DIMENSION
1	Type of structure	Steel structure
2	Length x:direction	30m
3	Length y:direction	30m
4	Bays in x:direction	7No@5m
5	Bays in Y:direction	7No@5m
6	Over all hight b/w floors	3.m
7	Total height of designed building	90 m
8	Slab thickness	150mm
9	Column	ISHB 600-2
10	Beam	ISMB 600
11	Grid Angle	61
12	Secondary Beam	ISLB 300
13	Bracing	ISMB 400
14	Thickness of Core	400mm

Table 3(a) Geometrical Properties

S. NO	MATERIAL	GRADE
1	Concrete (slab)	M25
2	Concrete (Core)	M35
3	Steel section (I-shape)	Fe345
4	Density of Steel	$7850 kg/m^3$
5	Young Modulus (E)	2.1×10^5 N/mm^2
6	Shear Modulus	$80000 N/mm^2$
7	Poisson's Ratio	0.3

Table 3(b) Material properties (I.S 456:2000,I.S 800:2007)

1	Zone of earthquake	III
2	Zone factor[z]	0.16[Table no3, clause no 6.4.2]
3	Damping ratio	5% [clause 7.2.4]
4	Important factor[I]	1.2 [Table no 8, clause no 7.2.3]
5	Soil type	Medium soil [clause no 6.4.2.1]
6	[R] response reduction factor	5[SMRF][Table no 9,clause no 7.2.6]

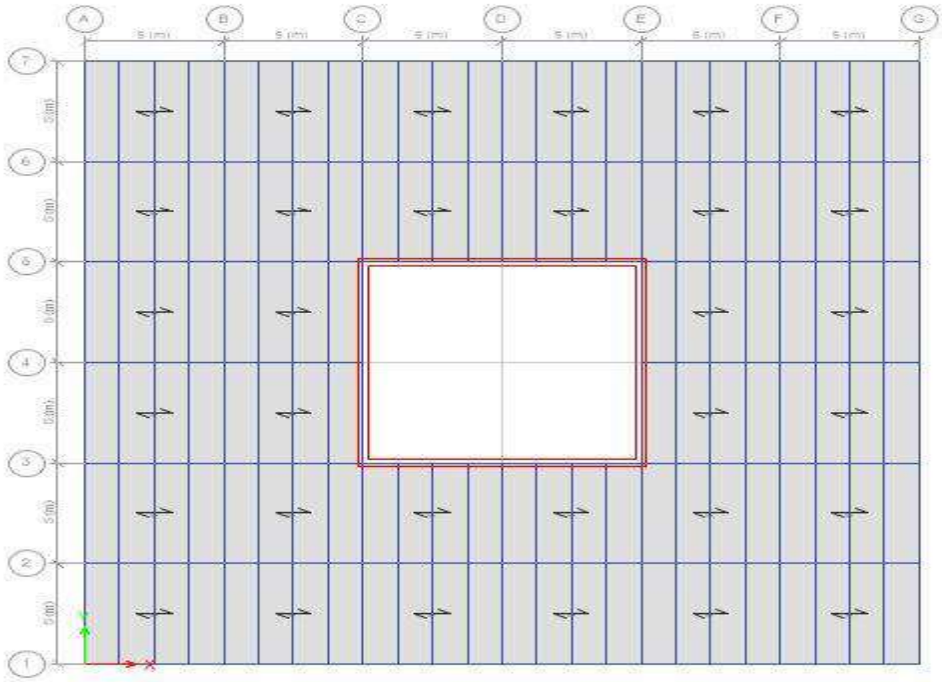
Table 3(c) Seismic Data(I.S 1893:2016 (part 1)

4:- STRUCTURAL MODELLING:-

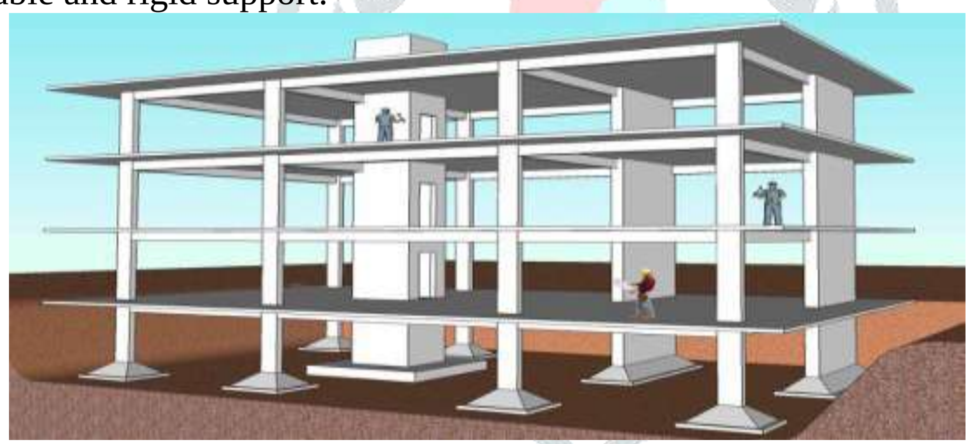
Model-1 Shearwall
Model-2 X-Bracing Structure (All faces)

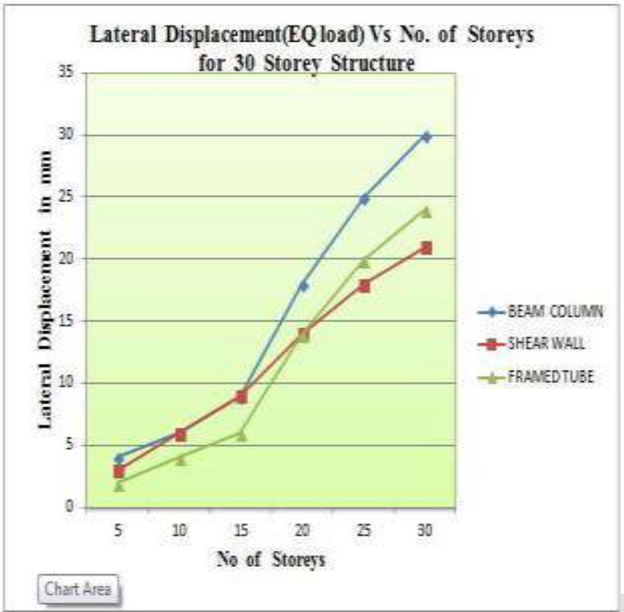
Modelling done by the help of **TEKLA STRUCTURE** software.

MODEL:-1



SHEARWALL:- This system is used in reinforced concrete buildings as well as in composite buildings. The shear wall can be considered as a vertical barrier, resistant to side winds and seismic loads on the building. The sliding wall can be raised and held in the structure, providing a very stable and rigid support.



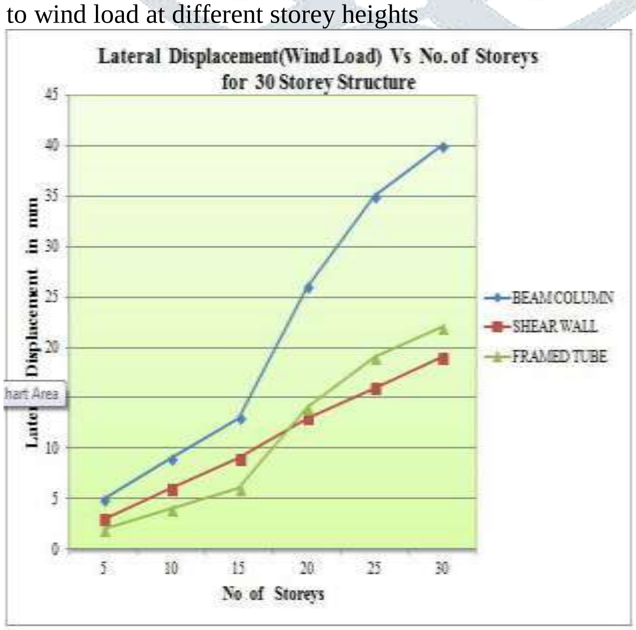


	Beam–Column Frame	Shear wall Frame	External Tube Frame
Maximum Support Reactions in kN	9.59E+04	8.94E+04	7.33E+04
Maximum Support Reactions in kN(outer Periphery)	5.26E+04	40625	10916

(1.a)Result obtained for support reactions for the 30 storey structures

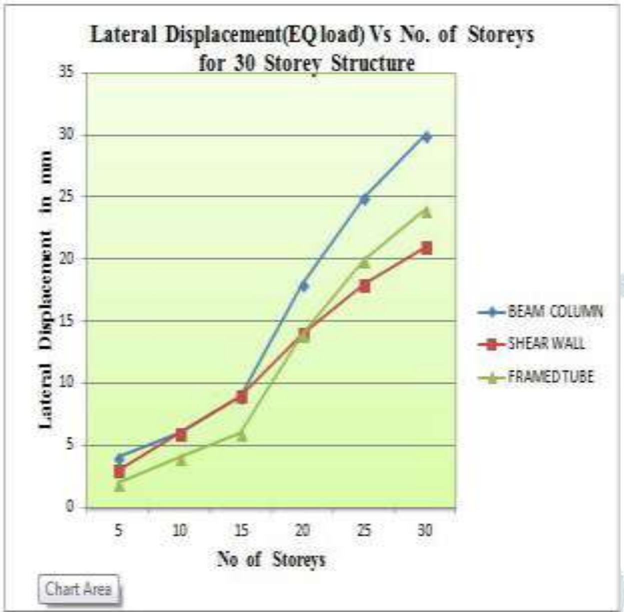
Number of storey	Displacement for baem and column frame	Displacement for shear wall frame	Displacement for bracing frame (tube)
05	5	03	02
10	9	06	04
15	13	09	06
20	26	13	14
25	35	16	19
30	40	119	22

(1.b)Lateral displacements due to wind load at different storey heights



Storey Number	Displacement (mm) for Beam – Column Frame	Displacement (mm) for Shear wall Frame	Displacement (mm) for External Tube Frame
5	8	7	5
10	16	14	9
15	24	21	13
20	32	28	18
25	49	37	24
30	66	46	31

(1.c)Lateral displacements due to earthquake load at different storey heights



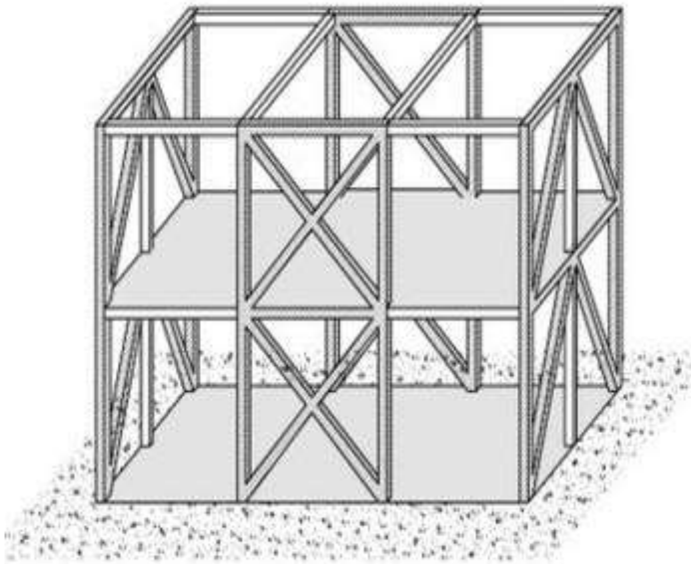
Storey Number	Displacement (mm) for Beam – Column Frame	Displacement (mm) for Shear wall Frame	Displacement (mm) for External Tube Frame
05	03	03	03
10	06	07	06
15	09	10	09
20	13	13	12
25	26	18	16
30	21	23	20

(1.d) Lateral displacement due to earthquake load at different storey heights

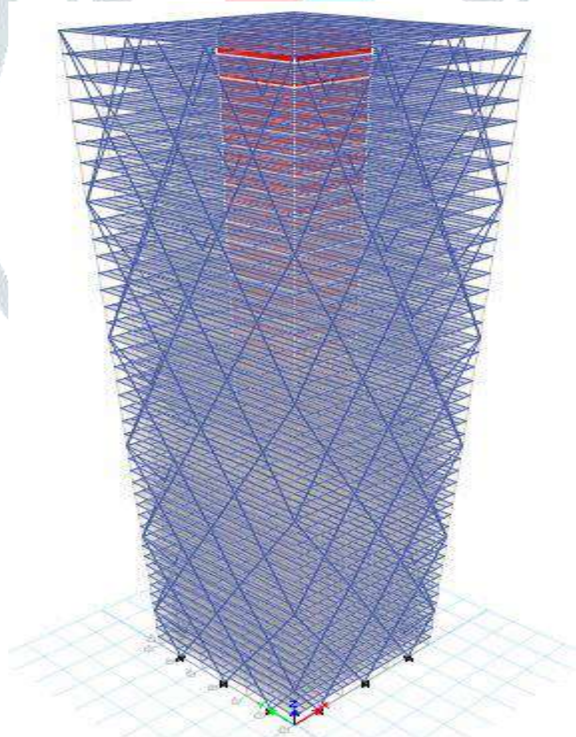
MODEL:-2

Braced Frame System:-

This structure is used in steel construction. The use of wireframe methods (see Fig. 1.3) makes the construction of a rigid shell more efficient by bending columns and beams due to their stronger tension. On the other hand, it is a vertical connection consisting of gravitational columns and beams.



(2.a) **Plan of X-Bracing (center) structure**



(2.b)Plan of X-Bracing (all faces) structure

(2.b) :-Story drift

Story	Drift(mm)	Permissible(mm)
1	0.178	12
2	0.365	12
3	0.521	12
4	0.669	12
5	0.772	12
6	0.903	12
7	1.03	12
8	1.155	12
9	1.287	12
10	1.397	12
11	1.5	12
12	1.597	12
13	1.663	12
14	1.745	12
15	1.826	12
16	1.905	12
17	1.991	12
18	2.057	12
19	2.118	12
20	2.175	12
21	2.211	12
22	2.256	12
23	2.298	12
24	2.339	12
25	2.385	12
26	2.415	12
27	2.44	12
28	2.464	12
29	2.477	12
30	2.489	12

(2.C):-Story Displacement

Story	Displacement(mm)	Permissible(mm)
1	0.736	12
2	1.615	24
3	2.62	36
4	3.744	48
5	4.977	60
6	6.315	72
7	7.751	84
8	9.28	96
9	10.897	108
10	12.597	120
11	14.375	132
12	16.227	144
13	18.148	156
14	20.134	168
15	22.18	180
16	24.282	192
17	26.436	204
18	28.638	216
19	30.882	228
20	33.165	240
21	35.483	252
22	37.168	264
23	40.204	276
24	42.6	288
25	45.012	300
26	47.439	312
27	49.874	324
28	52.314	336
29	54.755	348
30	57.194	360

(2.D):-Story Stiffness

Story	Stiffness X dir. (KN/m)	Stiffness Y dir. (KN/m)
Story1	23603049.1	23602148.21
Story2	13287922.39	13287993.51
Story3	9522098.358	9522814.456
Story4	7504123.735	7503721.857
Story5	5324271.124	5323827.736
Story6	4430119.541	4430443.912
Story7	3798572.674	3799242.705
Story8	3341870.901	3341363.405
Story9	3088971.218	3088568.762
Story10	2716787.779	2717213.049
Story11	2430655.133	2431083.231
Story12	2233859.773	2233456.548
Story13	1866444.249	1866164.356
Story14	1634880.376	1635228.678
Story15	1452989.153	1453345.179
Story17	1357128.108	1356865.795
Story16	1327309.211	1326944.354
Story18	1221582.587	1221909.425
Story19	1122504.588	1122761.619
Story20	1077200.904	1076934.716
Story21	904764.791	904596.618
Story22	808354.258	808575.295
Story23	752267.657	752512.11
Story24	744096.249	743864.517
Story25	852749.619	852576.449
Story26	837264.079	837449.884
Story27	843980.429	844187.531
Story28	876017.702	875842.679
Story29	712401.081	712265.291
Story30	697105.807	697250.754

RESULTS AND DISCUSSION :-

Fundamental Natural Time Period

Mode Shape	X-Bracing
1	3.817
2	3.646
3	1.263
4	1.025
5	0.937
6	0.508
7	0.457
8	0.421
9	0.343
10	0.306
11	0.258
12	0.253

Base shear

Model	Base Shear (kN)
Model-1	5021.0252
Model-2	2682.3112

Result Summery:-

- X-Bracing movement is minimal on all sides, but overall comparisons show respect. for Diagrid design the maximum displacement value is 5.16% lower with X stiffness in all positions, 81.5% cruciate ligaments more than corners, 150.5% more cruciate ligaments than middle ligaments, 73.77% more corners Attenuation in the corner and 128.16% more in the central shock

- Displacement is minimal for all structures except diagrides and diagrids. Structure, 4.49% more X support on all sides, 95.69% more X support on corners,169.75% at X-stay center, 85.36% at cornering damper, 137.64% Details of the central shock absorber.

- Base shear is minimum in shear wall structure cause of less weight of structure and in other all with respect to shear wall structure, 27.49% more in X-bracing in all faces, 23.29%
- Story stiffness is maximum for Diagrid structure from both models.

CONCLUSION AND FUTURE SCOPE

Plan 30m X30m G + 30 Seismic survey of the ground, "DIAGRID SEISMIC" FRAME STRUCTURAL FRAMEWORK AND HEIGHT OF THE SYSTEM "containing shear wall structure, X-bracing in the middle,Panic in the corner and panic in the middle. Based on the TEKLA STRUCTURE (BIM) analysis for the result and conclusions

1. Among all the structural analysis braced and shear wall model analysed, gives least value in considered parameter. Only value of maximum drift is more from one model.

2. From among all fundamental natural time period (sec.) it is evaluated that Model-1having minimum value. Which is more efficient model as compared to all models.

3. Model-1 having least value of story drift in all models but after 28th story model-2 having less value of story drift. It happens cause of model-2 behave as a tube, fully tied structure.

4. Model-1 having less value of story displacement from all others models. Which is more efficient model as compared to all models.

5. It is observed that model-1 having minimum base shear value compared to other models. Which is shows that weight of model-1 is also minimum from other all models.

6. From among all model-1 having maximum value of story stiffness in both directions.

Future Scope

We may investigate all aspects of the opposition to systematic network systems, such as pipe

We can explore the difference between traditional(regular) and non-traditional (irregular) plans.

We can study different arrangement of bracing (Y,K,V)

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