

Measure the Immeasurable

David Fung

*HKIA Registered Architect
HKIBIM Vice-Chairman*



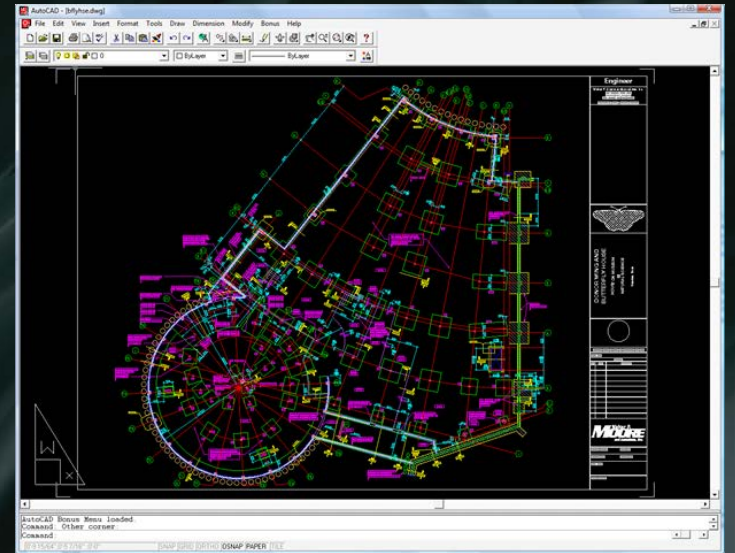
Immeasurable:

1. Measurement of Organic Architecture (Cost)
2. Measurement of As – Built vs Design?

Immeasurables



Measure the right thing with the right tool !



Measure the right thing with the right tool !



Measure the right thing with the right tool !

Frank O. Gehry



Frank O. Gehry



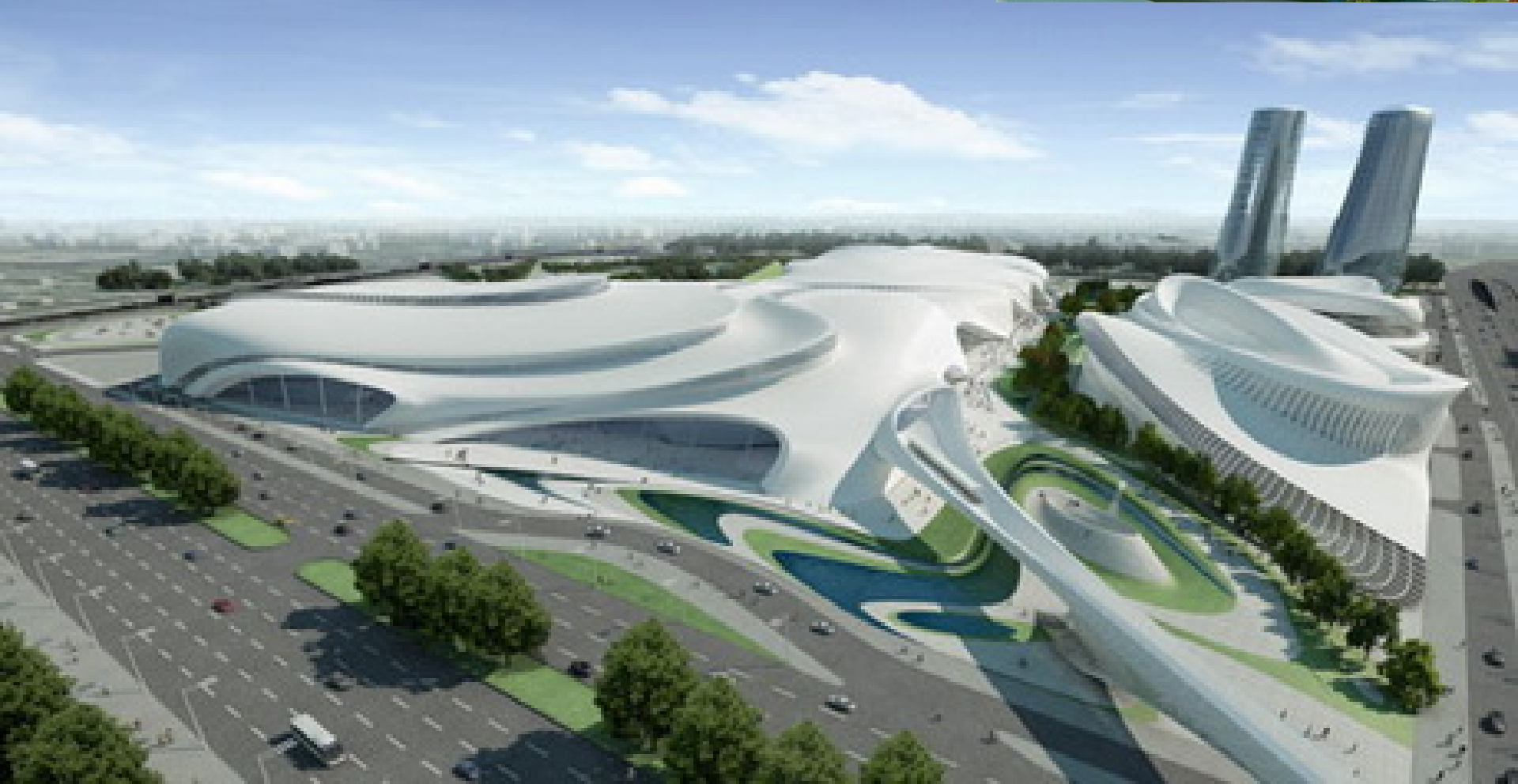
Frank O. Gehry



Santiago Calatrava



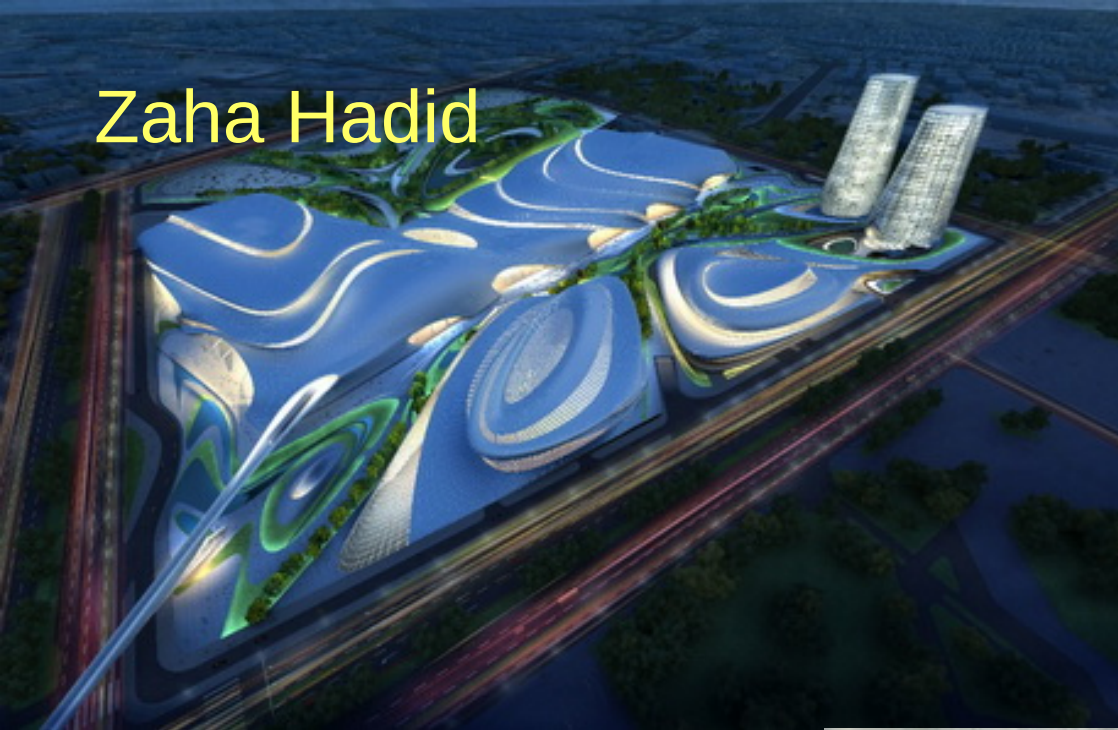
Zaha Hadid



Zaha Hadid



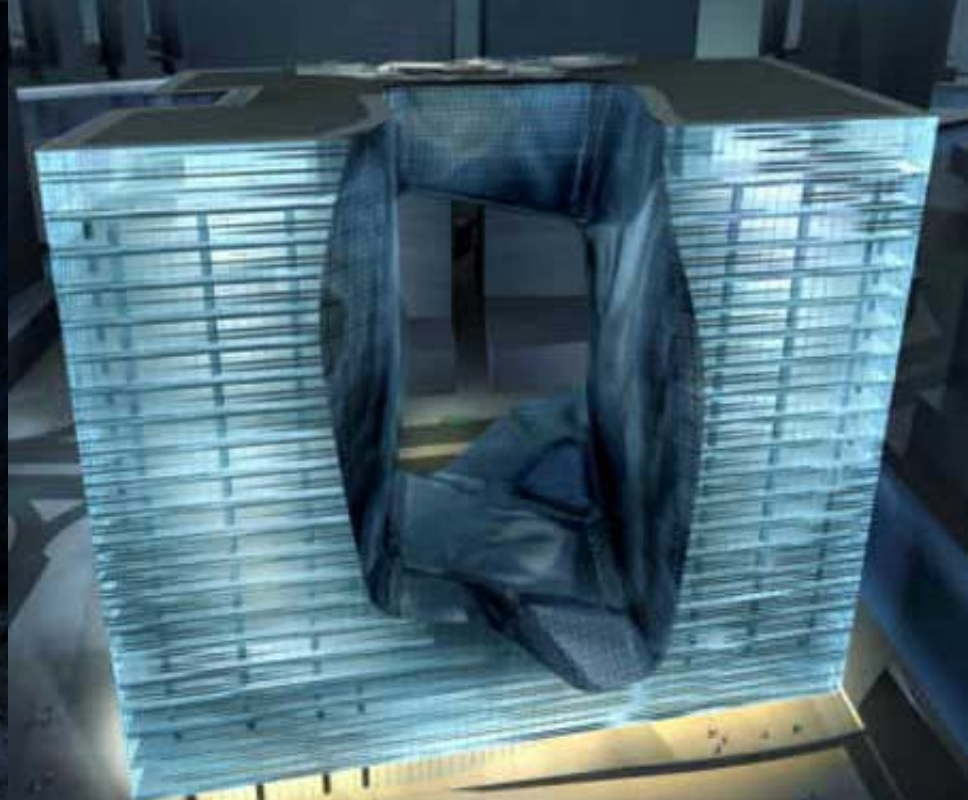
Zaha Hadid



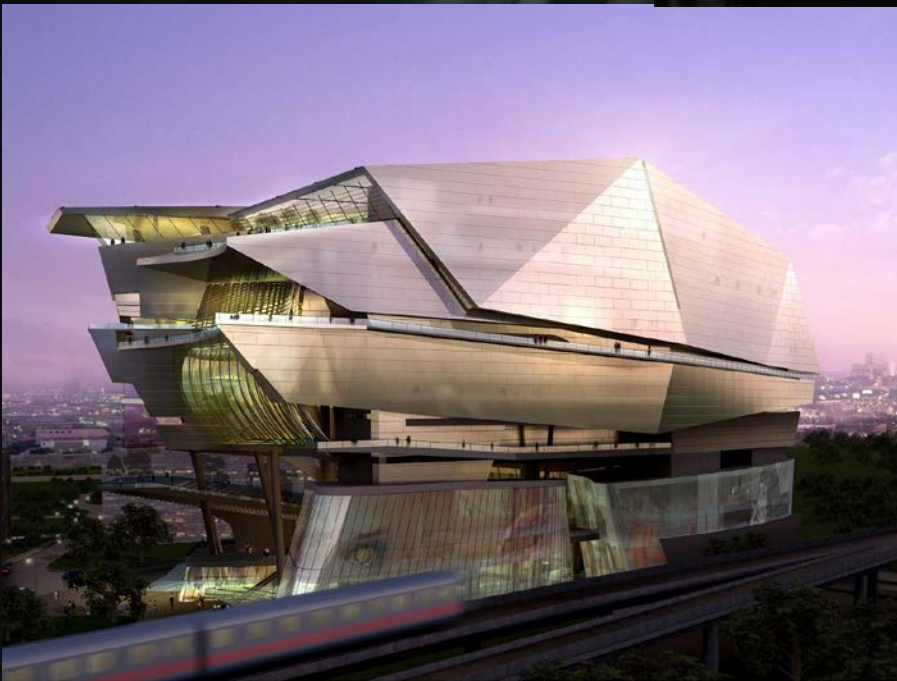
Zaha Hadid



Zaha Hadid



Aedas



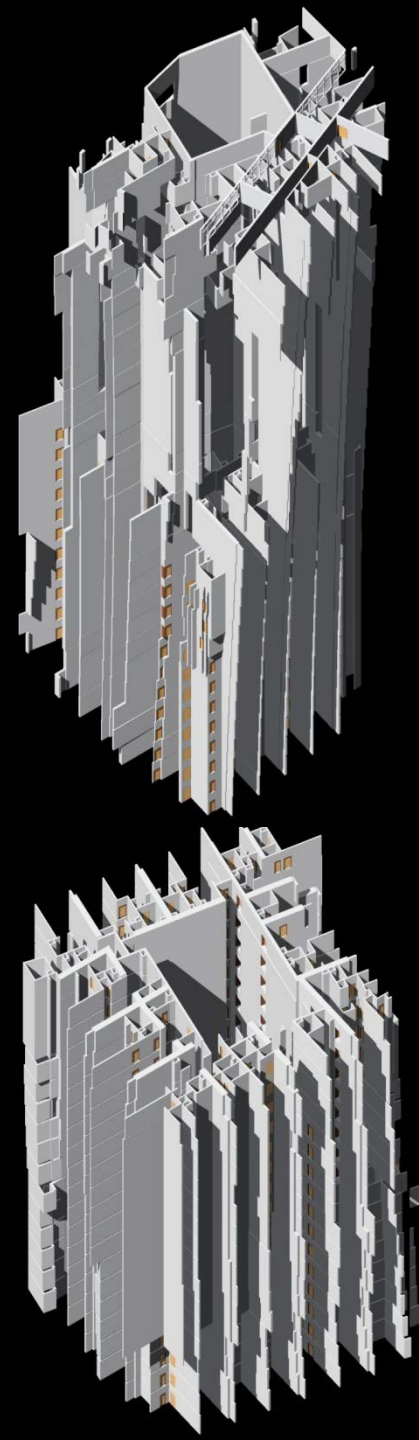
Aedas

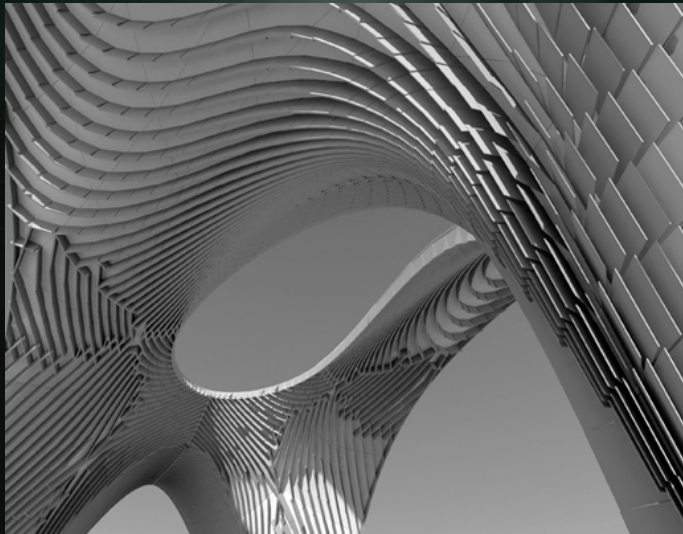
THE FUTURE IN DUBAI
edit: www.viu.cn/blog





Dubai Construction Update
ImreSolt.com - 2010 ©





Design



Information
Technology



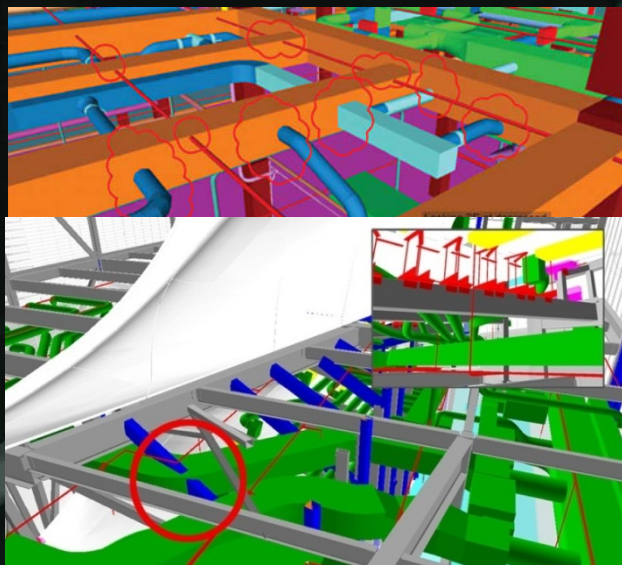
Reality

Why Organic? Because architects wants to push the limit!

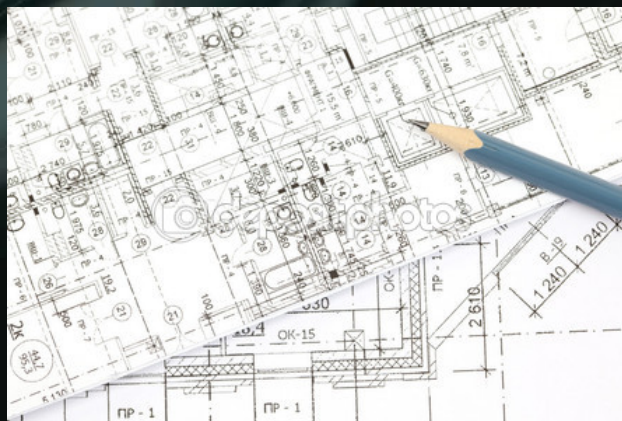
Design



REVIT/
NAVIS WORKS



CAD



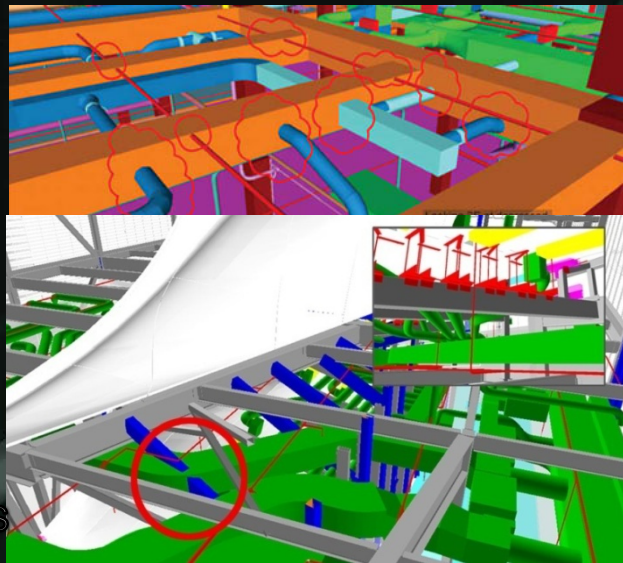
??? Problem

半BIM

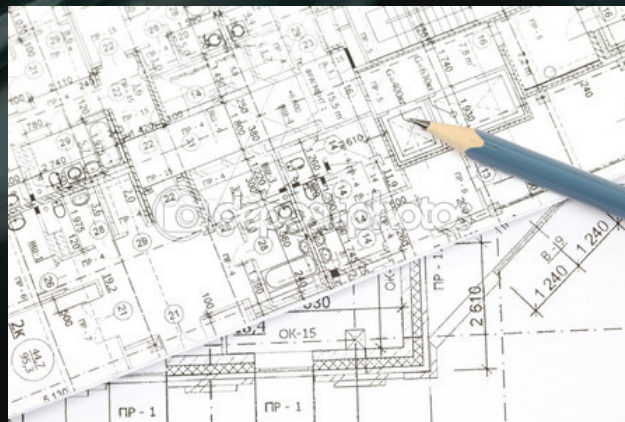


REVIT/
NAVIS WORKS

Design



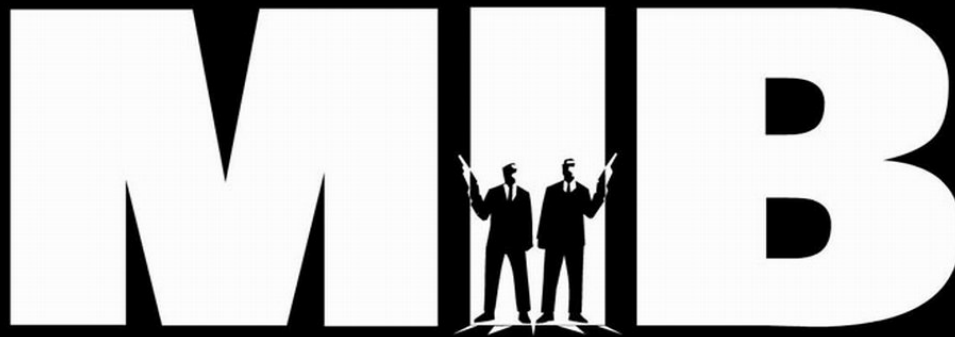
+



B I M

Building Information Modelling

=



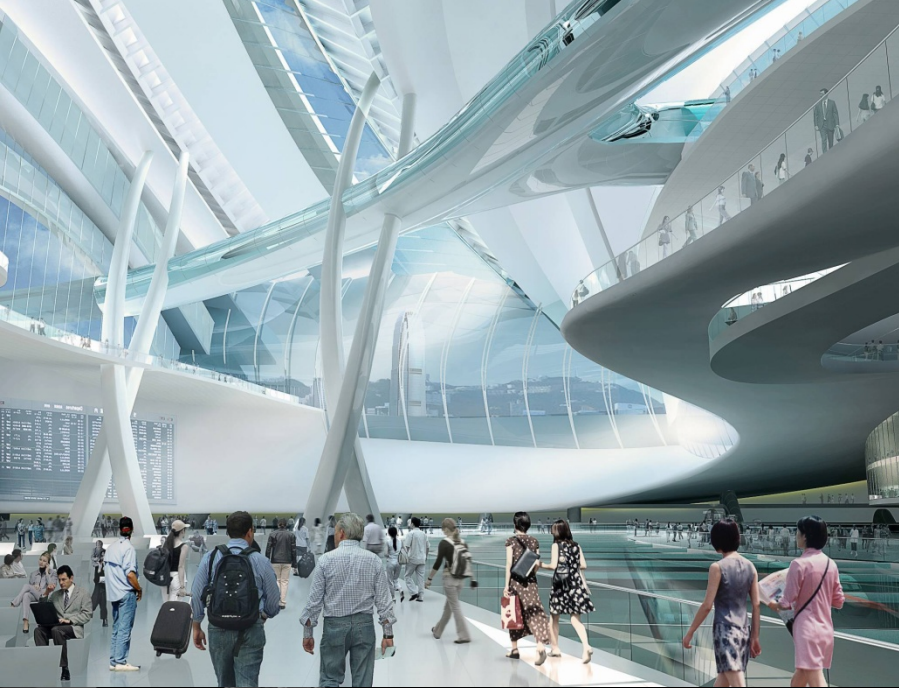
MIB

Modelling

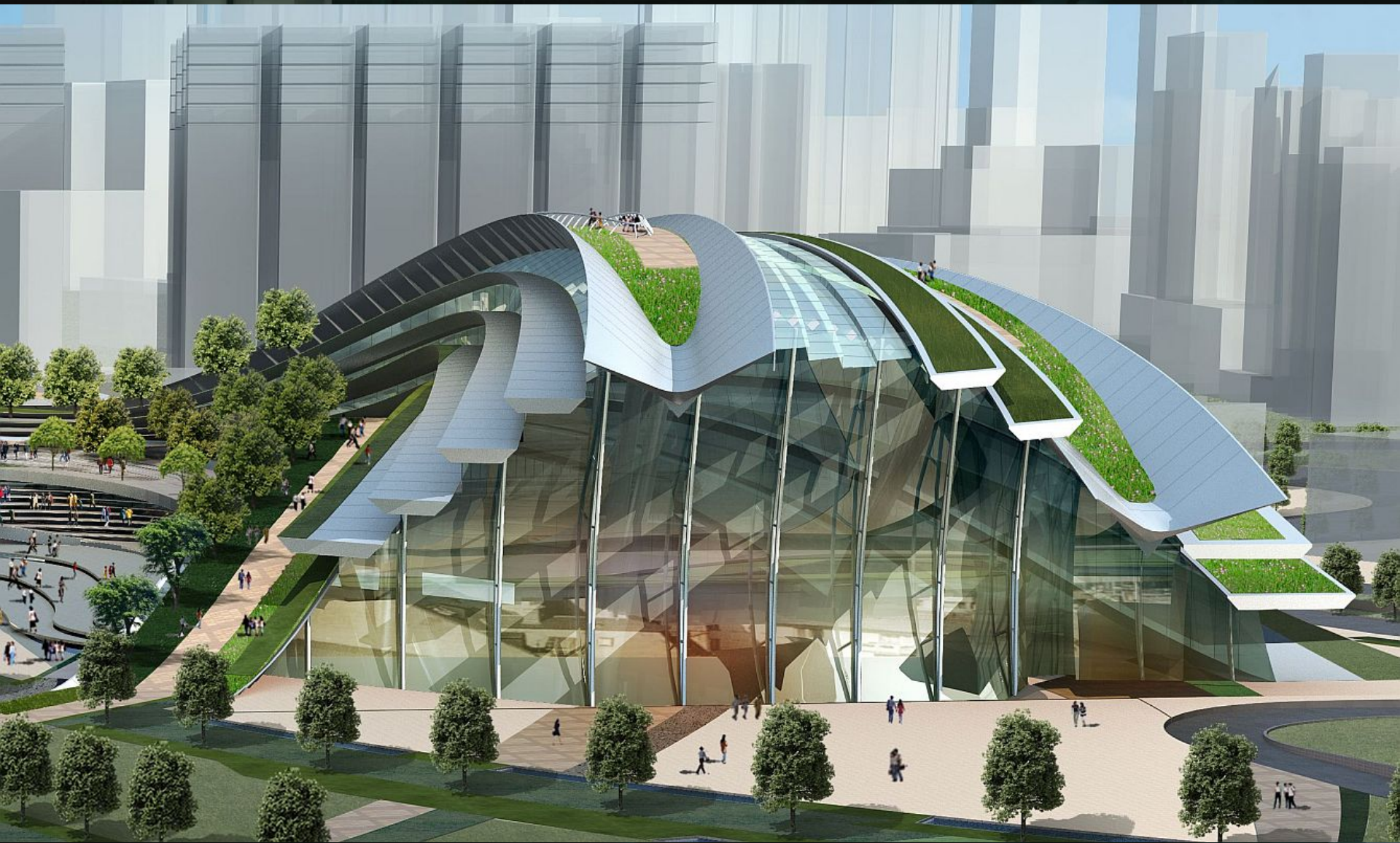
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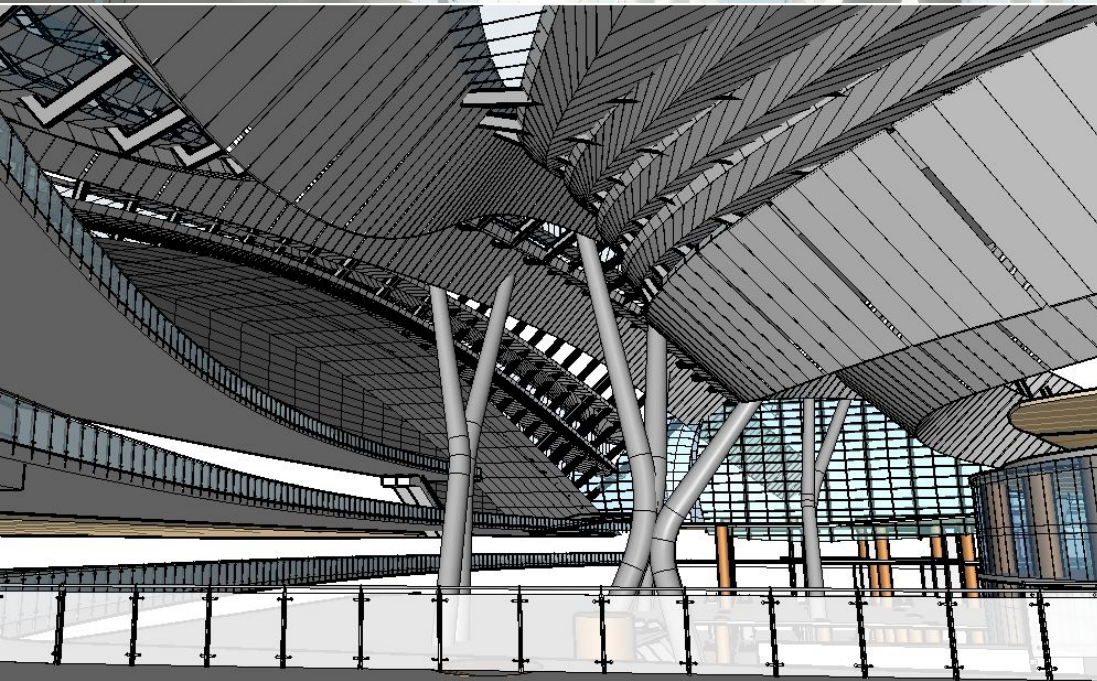
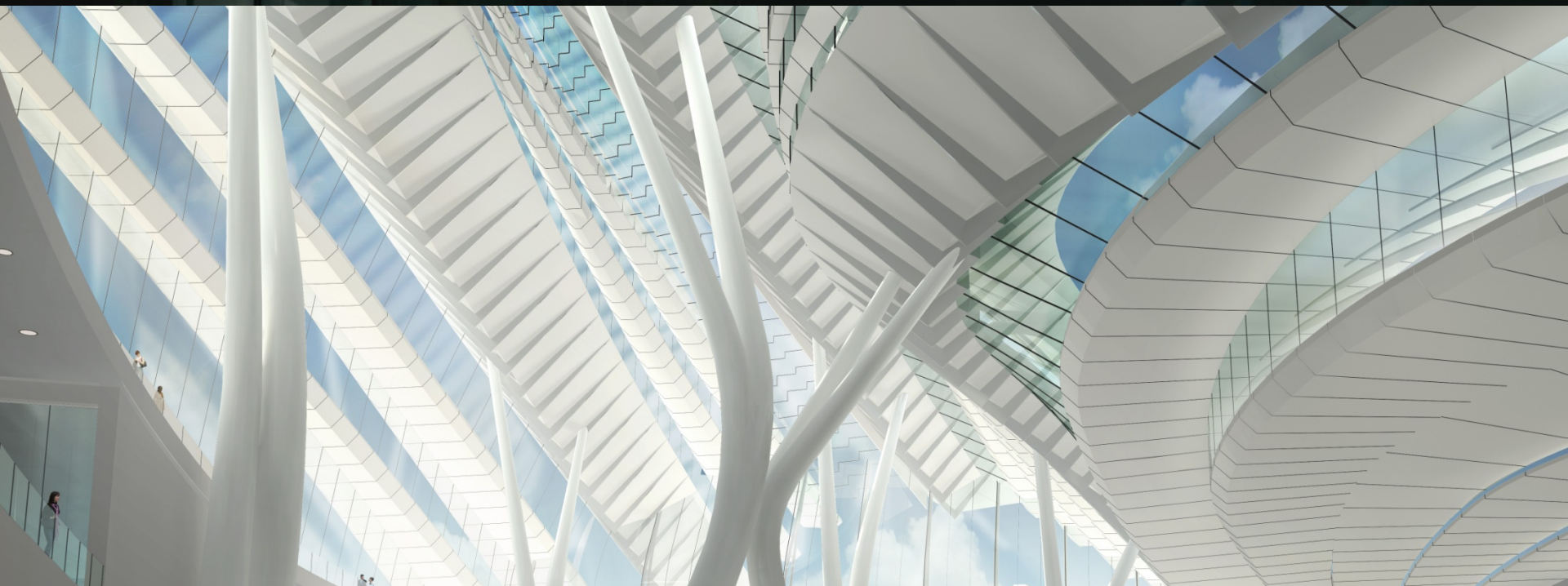
Business

(Measurement)











DESIGN

RHINO



PANELIZATION

GRASSHOPPER



EXPORT

DATABASE

REVIT API



IMPORT

RATIONALIZATION

REVIT API



BIM RECREATION

REVIT



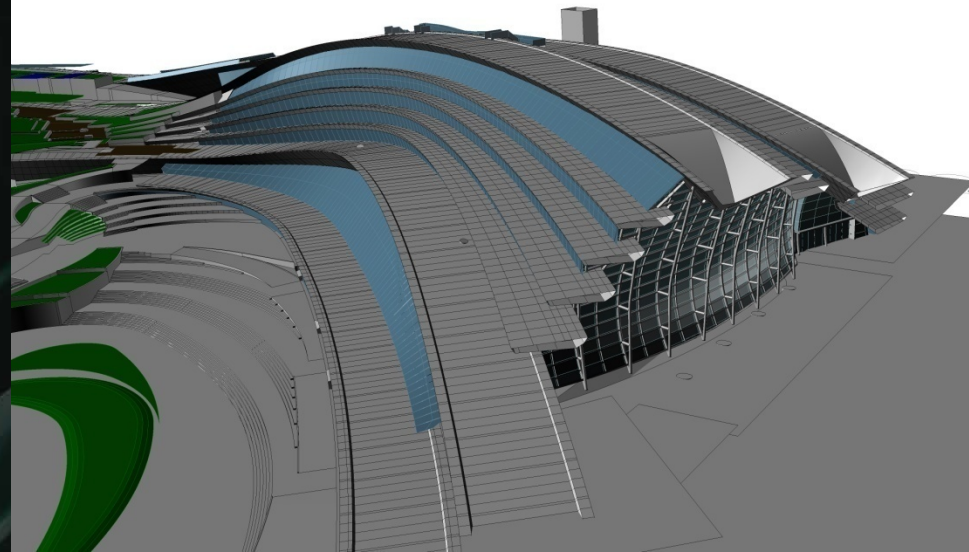
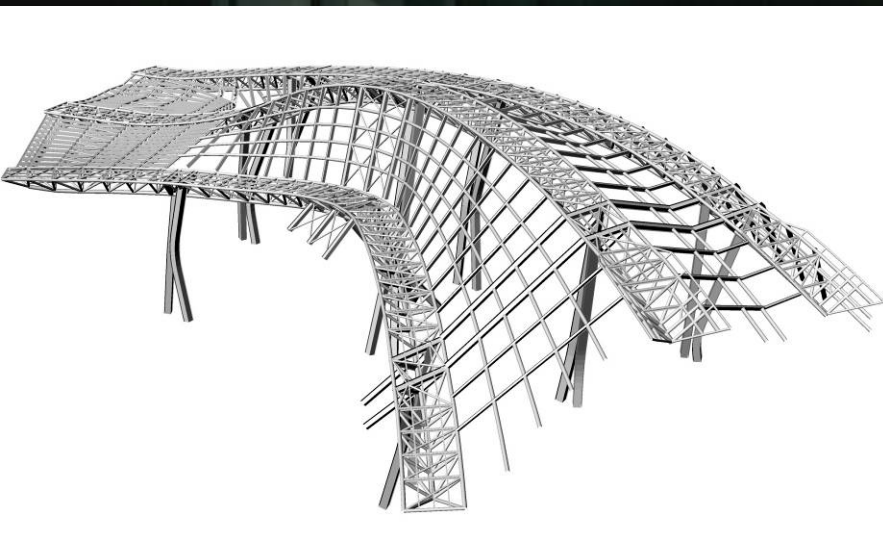
DOCUMENTATION

REVIT



TENDER

MANUF/CONSTRUCTION

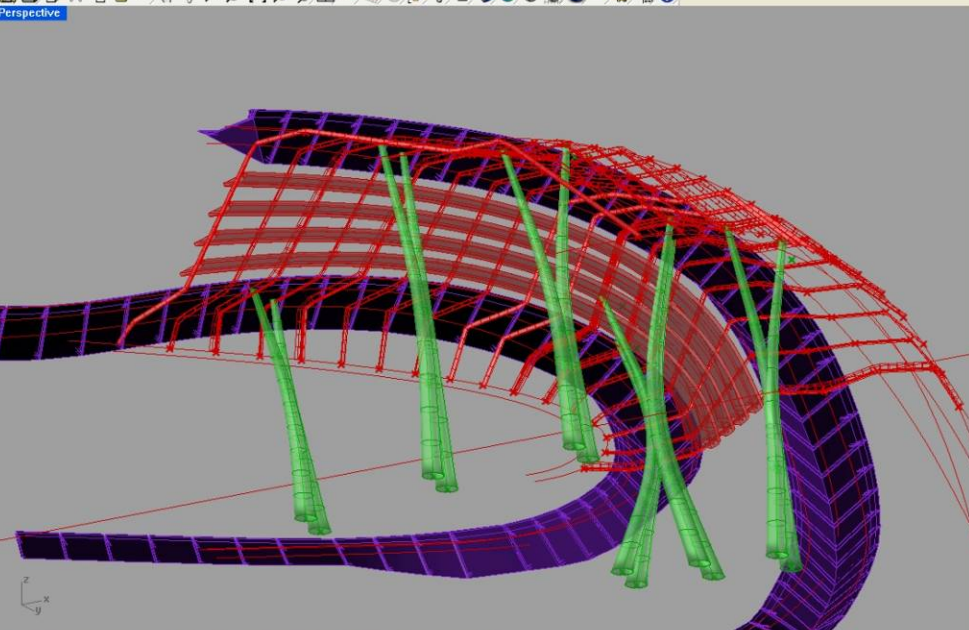


COLUMN HEAD STUDY - Rhinoceros [Commercial] - [Perspective]

File View Curve Surface Solid Mesh Dimension Transform Tools Analyze Render Help
 Hide
 Invert
 Instances, 111 hatches, 452 points, 1924 curves, 117 polysurfaces, 126 surfaces, 36 text added to selection.
 Hide



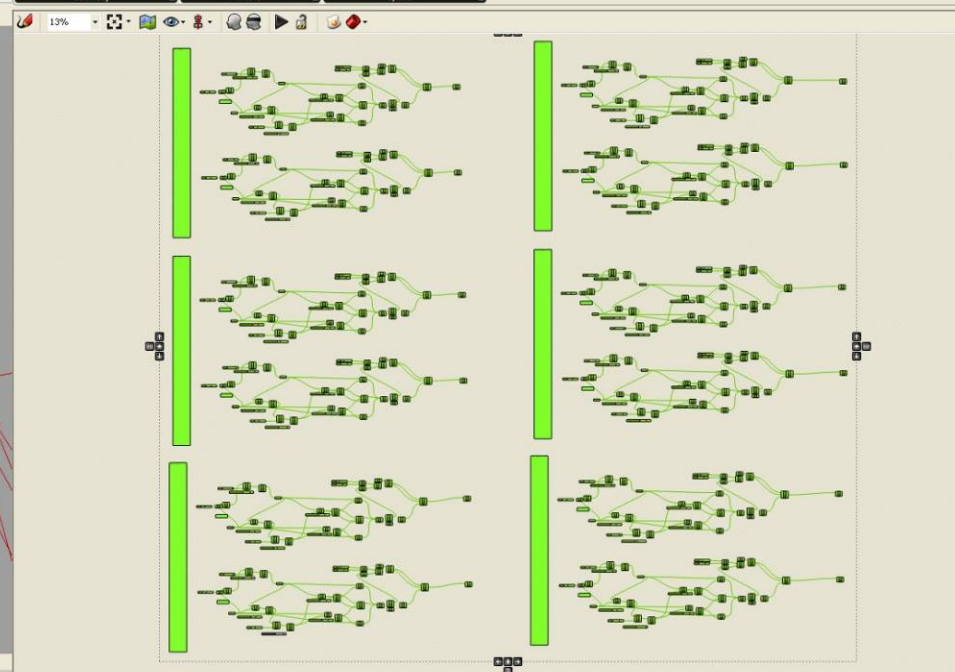
Perspective

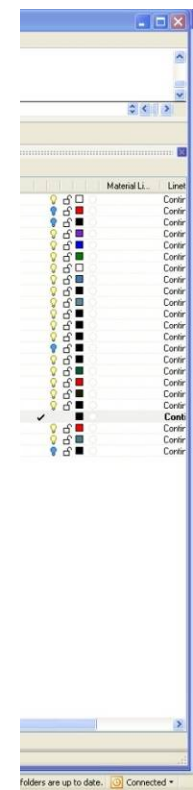
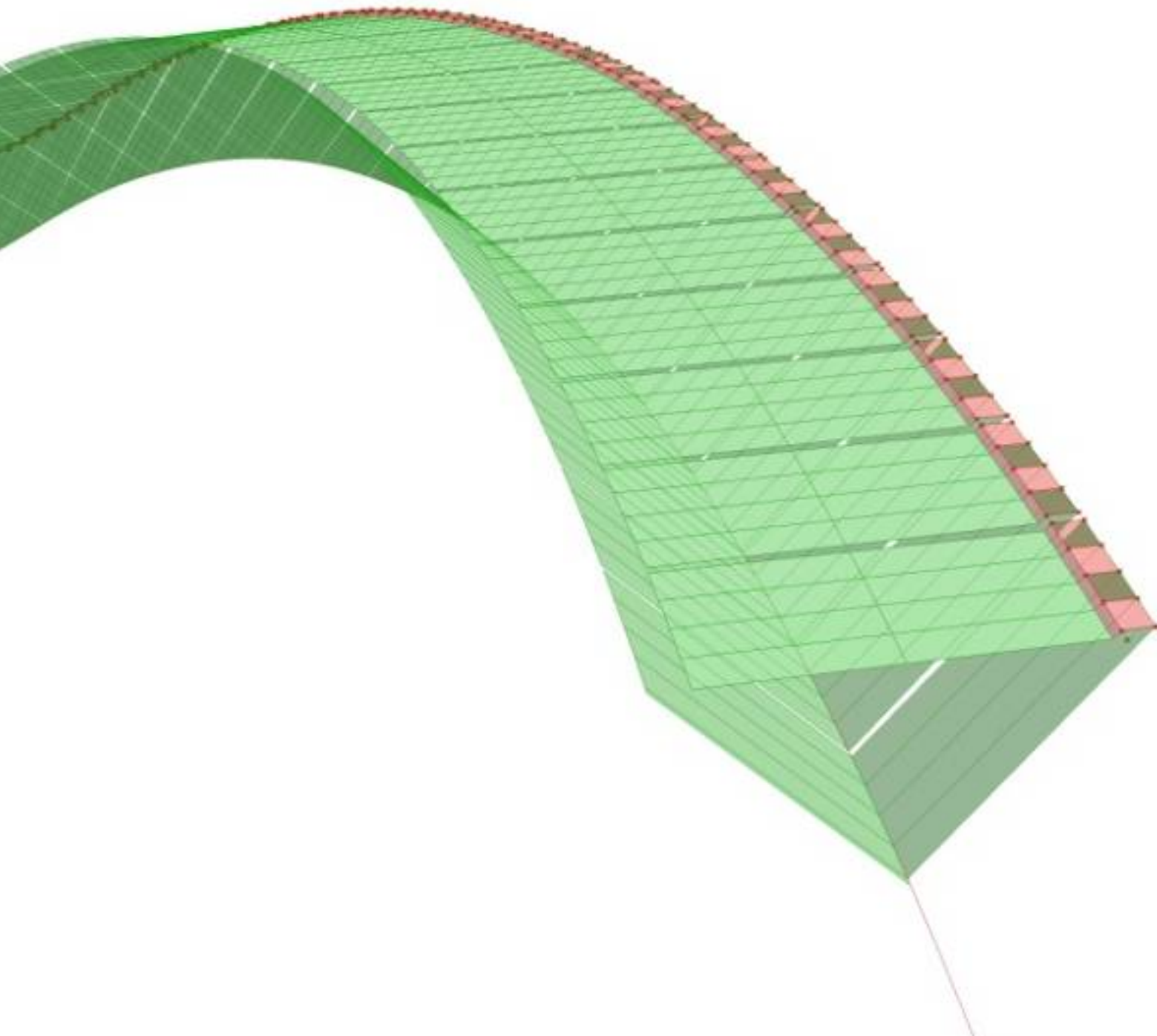


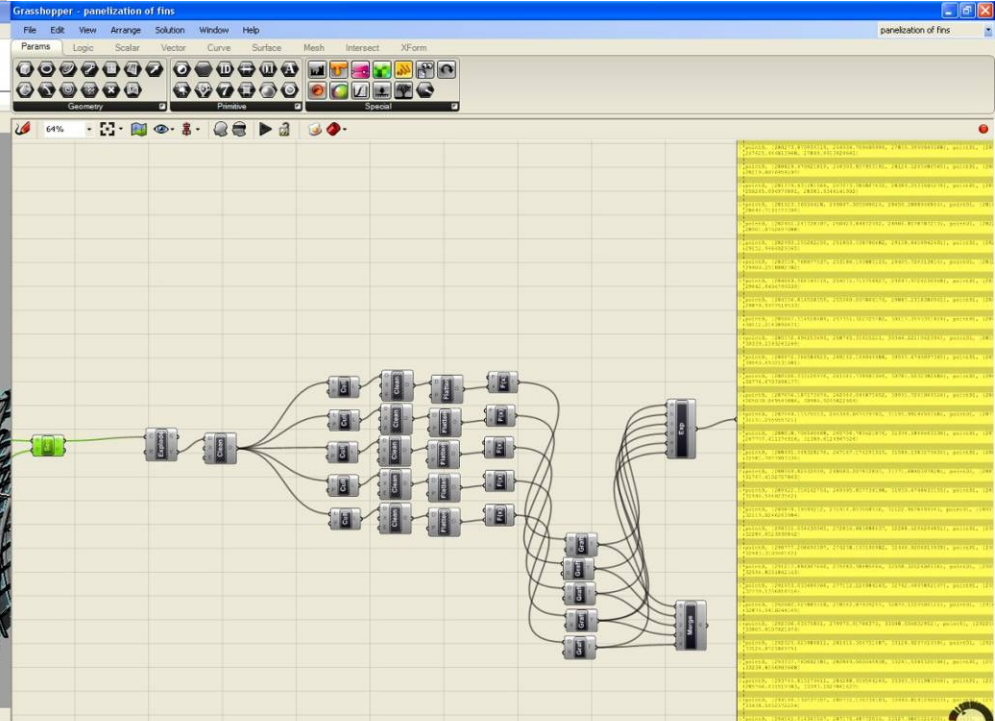
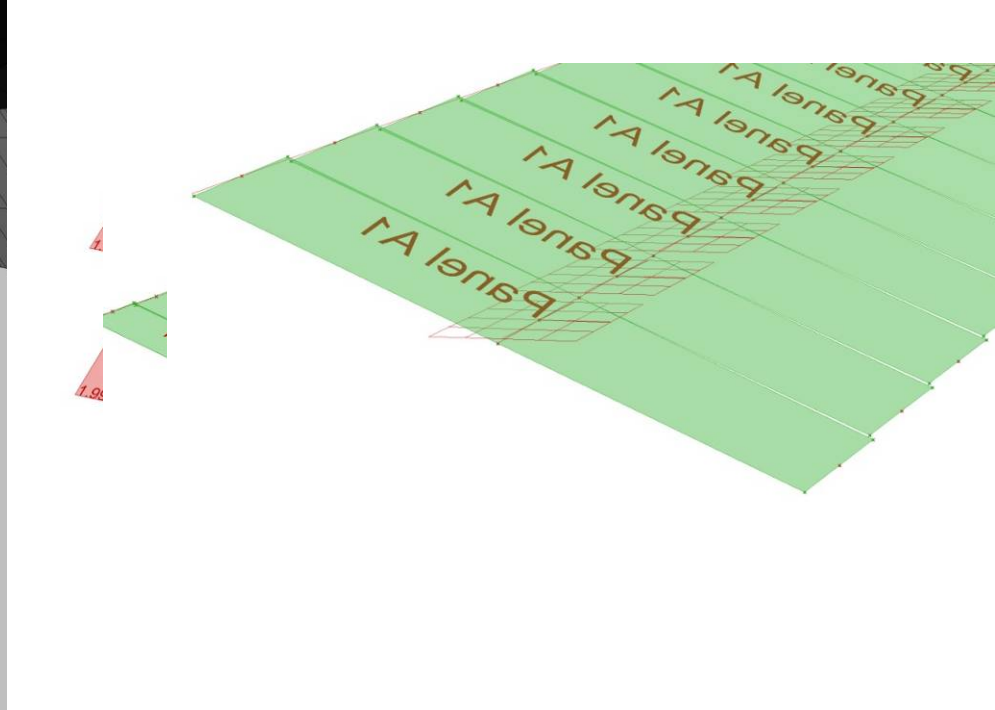
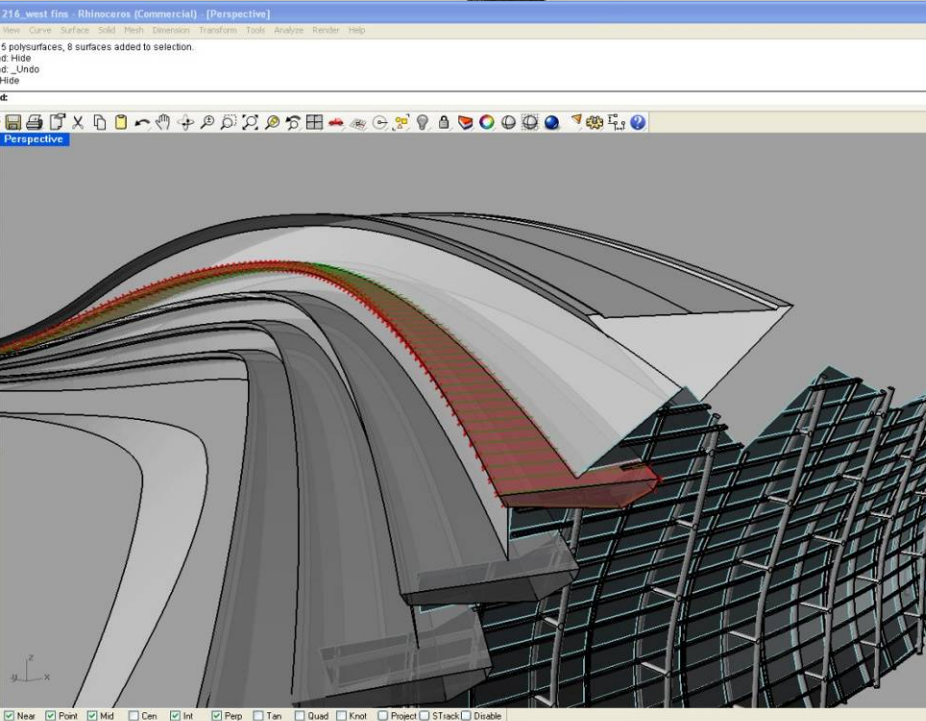
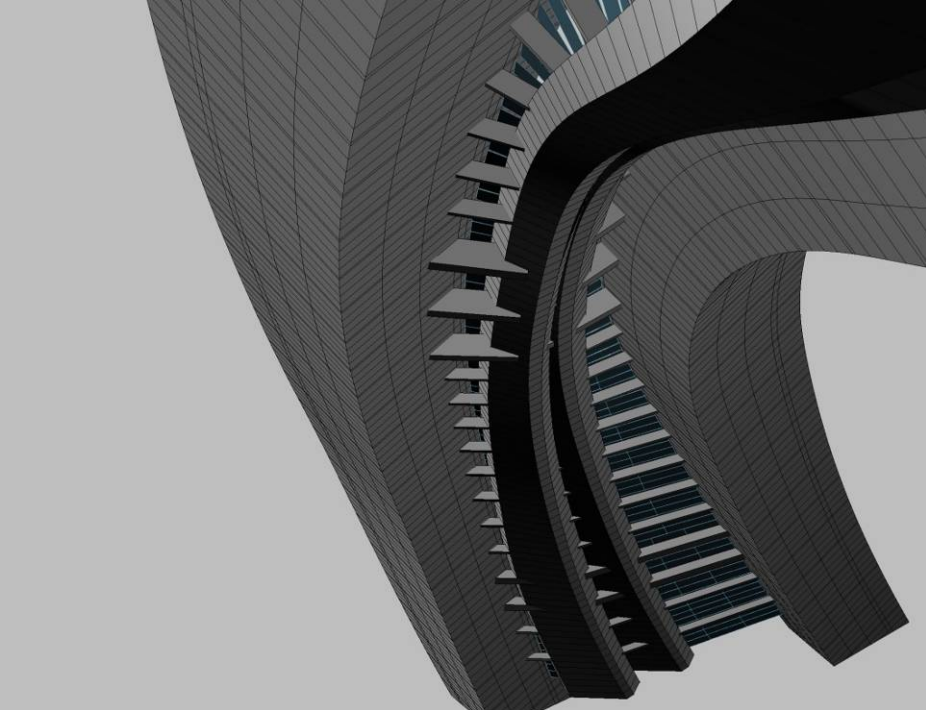
☒ Near ☒ Point ☒ Mid ☐ Cen ☐ Int ☐ Perp ☐ Tan ☐ Quad ☐ Knot ☐ Project ☐ STrack ☐ Disable

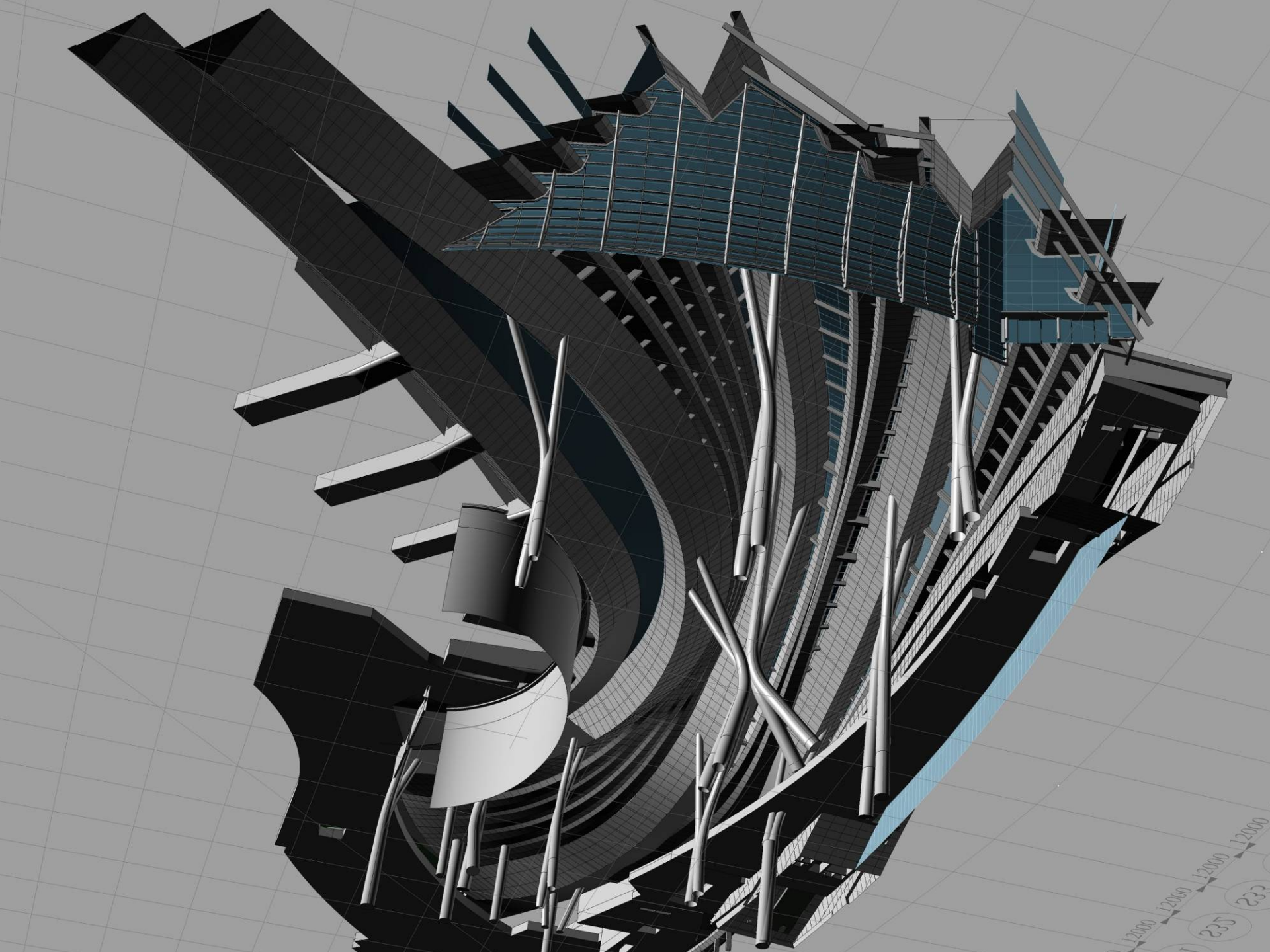
356.991 y 191.236 z 0.000 0.000 Layer 12 Snap Ortho Planar Osnap Record History

Grasshopper - column head with secondary structure until eastern arch

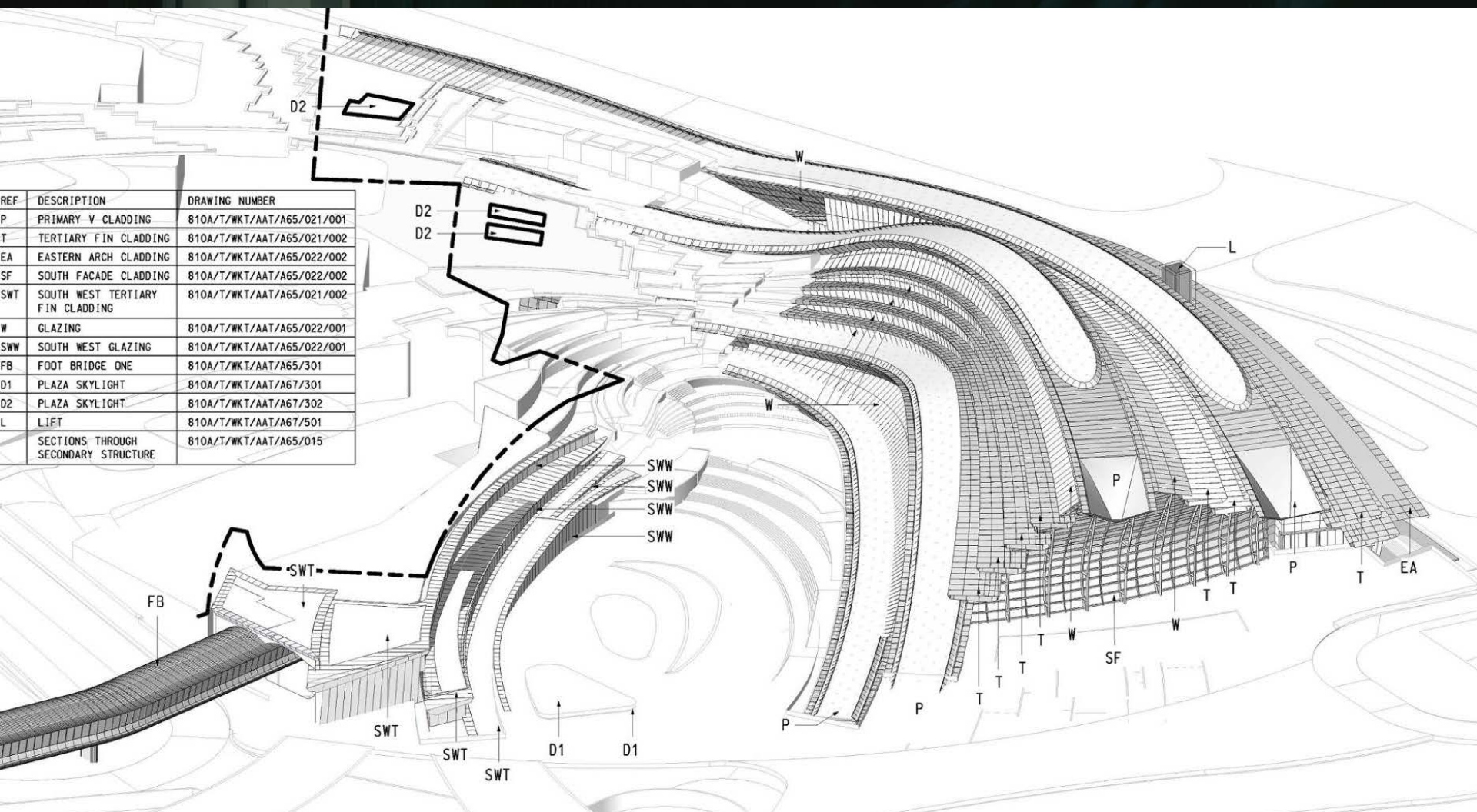


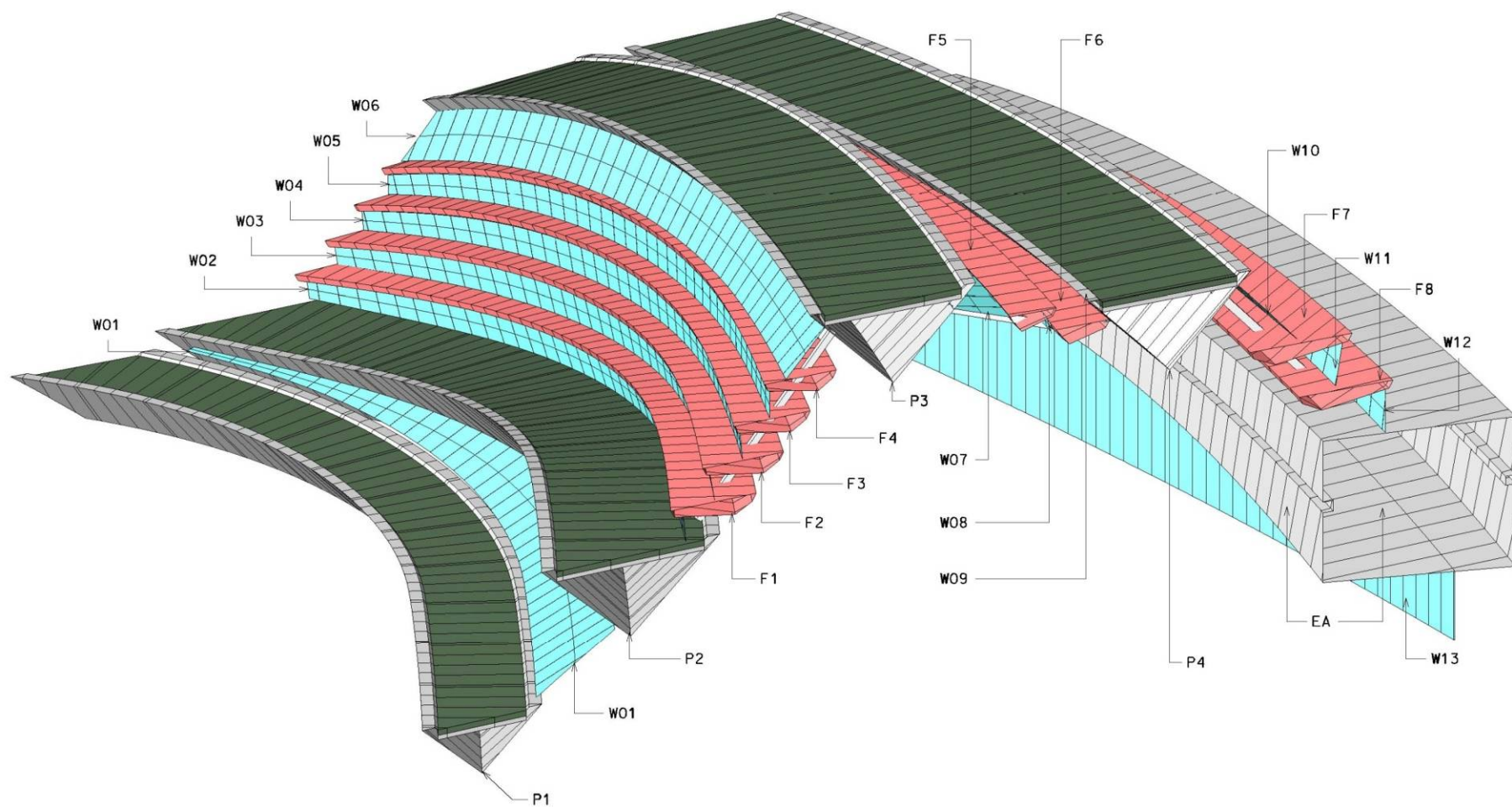


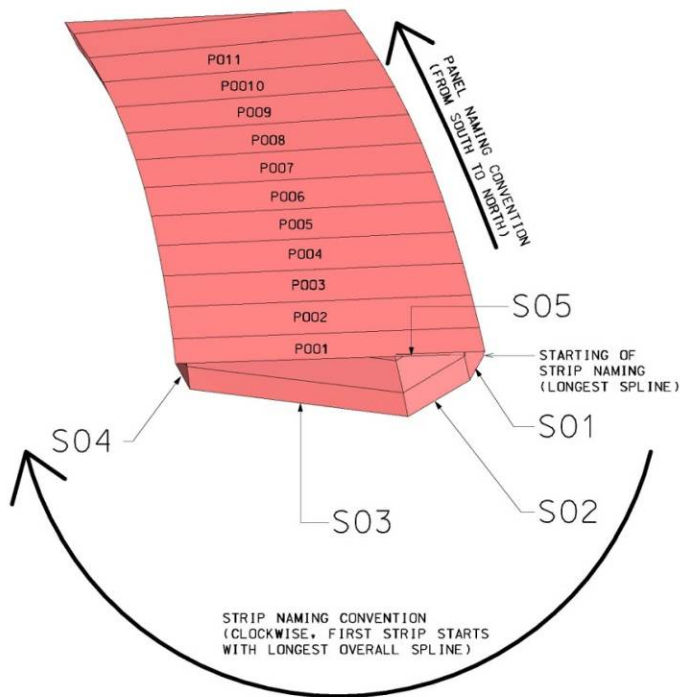




REF	DESCRIPTION	DRAWING NUMBER
P	PRIMARY V CLADDING	810A/T/WKT/AAT/A65/021/001
T	TERTIARY FIN CLADDING	810A/T/WKT/AAT/A65/021/002
EA	EASTERN ARCH CLADDING	810A/T/WKT/AAT/A65/022/002
SF	SOUTH FACADE CLADDING	810A/T/WKT/AAT/A65/022/002
SWT	SOUTH WEST TERTIARY FIN CLADDING	810A/T/WKT/AAT/A65/021/002
W	GLAZING	810A/T/WKT/AAT/A65/022/001
SWW	SOUTH WEST GLAZING	810A/T/WKT/AAT/A65/022/001
FB	FOOT BRIDGE ONE	810A/T/WKT/AAT/A65/301
D1	PLAZA SKYLIGHT	810A/T/WKT/AAT/A67/301
D2	PLAZA SKYLIGHT	810A/T/WKT/AAT/A67/302
L	LIFT	810A/T/WKT/AAT/A67/501
	SECTIONS THROUGH SECONDARY STRUCTURE	810A/T/WKT/AAT/A65/015



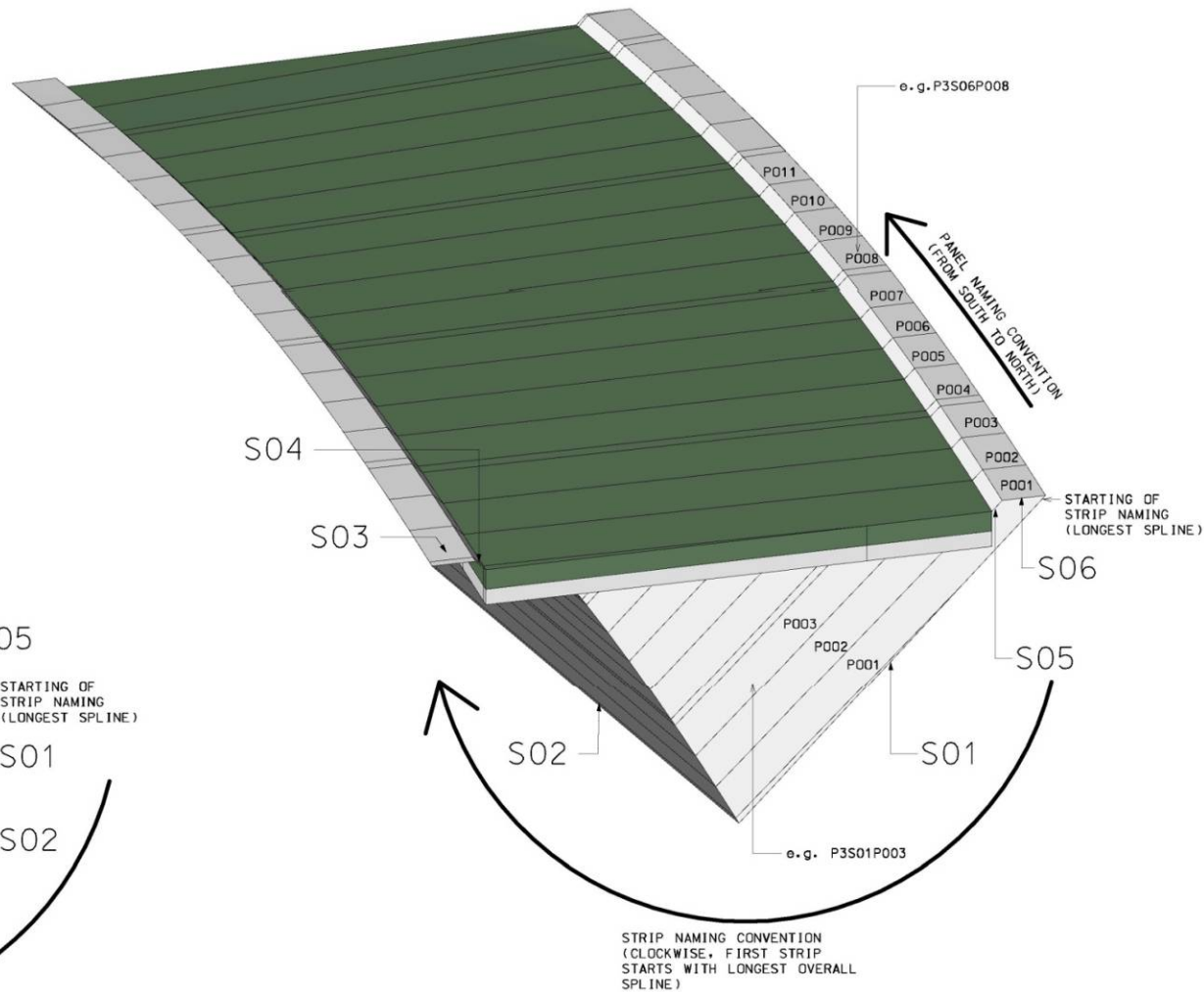




Nomenclature - Fin Cladding

2 e.g. F1

NAMING CONVENTION:
ELEMENT / STRIP(S) / PANEL(P)
E.G. F1 / SXX / PXXX
F1S03P078



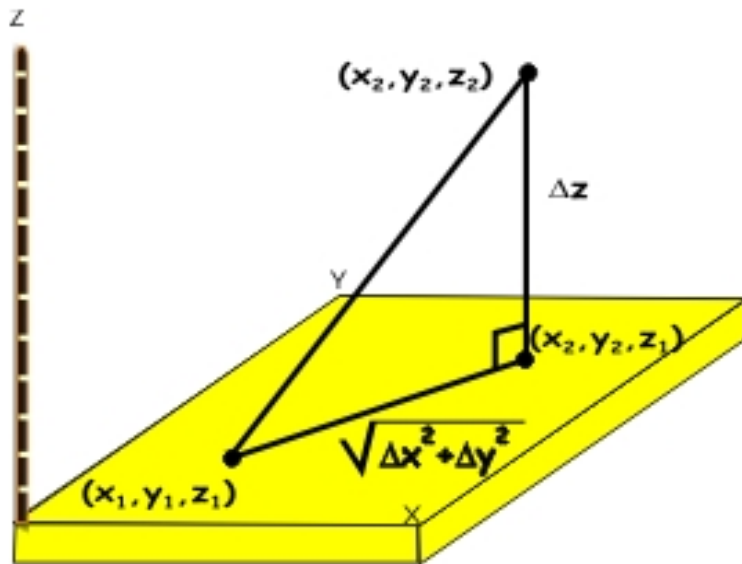
Nomenclature - V Cladding

1 e.g. P3

NAMING CONVENTION:
ELEMENT / STRIP(S) / PANEL(P)
E.G. P3 / SXX / PXXX
P3S17P123



1		P01x###	lengt	P01y###	lengt	P01z###	lengt	P02x###	lengt	P02y###	lengt	P02z###	lengt	P03x###	lengt	P03y###	lengt	P03z###	lengt	P04x###	lengt	P04y###	lengt	P04z###	lengt	Panel Type	##not
2	P3S06P001	149572.632		43124.1138		30997.4089		150034.096		44497.0923		31201.1007		151479.165		44220.6936		29756.4955		151017.994		42846.0425		29553.4116		P3S06P001	
3	P3S06P002	150034.096		44497.0923		31201.1007		150490.205		45872.5015		31400.2904		151935		45597.7674		29955.086		151479.165		44220.6936		29756.4955		P3S06P002	
4	P3S06P003	150490.205		45872.5015		31400.2904		150940.93		47250.3052		31594.9821		152385.473		46977.2334		30149.1841		151935		45597.7674		29955.086		P3S06P003	
5	P3S06P004	150940.93		47250.3052		31594.9821		151386.267		48630.4698		31785.1616		152830.57		48359.0618		30338.7828		152385.473		46977.2334		30149.1841		P3S06P004	
6	P3S06P005	151386.267		48630.4698		31785.1616		151474.689		48906.7825		31822.6539		152918.944		48635.7079		30376.1616		152830.57		48359.0618		30338.7828		P3S06P005	
7	P3S06P006	151474.689		48906.7825		31822.6539		151913.575		50289.7323		32007.3872		153357.585		50020.3276		30560.3477		152918.944		48635.7079		30376.1616		P3S06P006	
8	P3S06P007	151913.575		50289.7323		32007.3872		152347.08		51674.9657		32187.576		153790.836		51407.2369		30740.0246		153357.585		50020.3276		30560.3477		P3S06P007	
9	P3S06P008	152347.08		51674.9657		32187.576		152775.147		53062.4739		32363.2813		154218.667		52796.4316		30915.2314		153790.836		51407.2369		30740.0246		P3S06P008	
10	P3S06P009	152775.147		53062.4739		32363.2813		153197.744		54452.3272		32534.6167		154641.09		54188.0429		31086.0665		154218.667		52796.4316		30915.2314		P3S06P009	
11	P3S06P010	153197.744		54452.3272		32534.6167		153281.603		54730.5766		32568.3694		154724.924		54466.654		31119.7184		154641.09		54188.0429		31086.0665		P3S06P010	
12	P3S06P011	153281.603		54730.5766		32568.3694		153697.624		56123.188		32734.5715		155140.841		55861.1282		31285.4274		154724.924		54466.654		31119.7184		P3S06P011	
13	P3S06P012	153697.624		56123.188		32734.5715		154108.128		57517.7498		32896.4211		155551.199		57257.4509		31446.8027		155140.841		55861.1282		31285.4274		P3S06P012	
14	P3S06P013	154108.128		57517.7498		32896.4211		154513.02		58914.0007		33053.6684		155955.863		58655.1793		31603.5689		155551.199		57257.4509		31446.8027		P3S06P013	
15	P3S06P014	154513.02		58914.0007		33053.6684		154912.275		60311.9726		33206.0604		156354.833		60054.3601		31755.4605		155955.863		58655.1793		31603.5689		P3S06P014	
16	P3S06P015	154912.275		60311.9726		33206.0604		154991.455		60591.8003		33235.9403		156433.956		60334.4167		31785.2395		156354.833		60054.3601		31755.4605		P3S06P015	
17	P3S06P016	154991.455		60591.8003		33235.9403		155384.039		61992.164		33382.3144		156826.258		61735.9125		31931.1206		156433.956		60334.4167		31785.2395		P3S06P016	
18	P3S06P017	155384.039		61992.164		33382.3144		155771.104		63394.5402		33523.6095		157213.036		63139.4019		32071.9532		156826.258		61735.9125		31931.1206		P3S06P017	
19	P3S06P018	155771.104		63394.5402		33523.6095		156152.641		64799.0536		33659.8994		157594.329		64545.1147		32207.8035		157213.036		63139.4019		32071.9532		P3S06P018	
20	P3S06P019	156152.641		64799.0536		33659.8994		156528.665		66205.8406		33791.3989		157970.193		65953.318		32338.8909		157594.329		64545.1147		32207.8035		P3S06P019	
21	P3S06P020	156528.665		66205.8406		33791.3989		156603.207		66487.4657		33817.1437		158044.711		66235.2527		32364.5566		157970.193		65953.318		32338.8909		P3S06P020	
22	P3S06P021	156603.207		66487.4657		33817.1437		156972.591		67896.8372		33943.1573		158414.002		67646.2548		32490.1972		158044.711		66235.2527		32364.5566		P3S06P021	
23	P3S06P022	156972.591		67896.8372		33943.1573		157336.329		69307.9002		34064.607		158777.619		69058.83		32611.2857		158414.002		67646.2548		32490.1972		P3S06P022	
24	P3S06P023	157336.329		69307.9002		34064.607		157694.338		70720.5482		34181.3772		159135.5		70472.822		32727.6793		158777.619		69058.83		32611.2857		P3S06P023	
25	P3S06P024	157694.338		70720.5482		34181.3772		158046.558		72134.4265		34293.1711		159487.514		71887.6646		32839.0806		159135.5		70472.822		32727.6793		P3S06P024	
26	P3S06P025	158046.558		72134.4265		34293.1711		158116.297		72417.2914		34314.8748		159557.191		72170.6364		32860.703		159487.514		71887.6646		32839.0806		P3S06P025	
27	P3S06P026	158116.297		72417.2914		34314.8748		158461.474		73832.0687		34419.7934		159901.955		73585.5129		32965.2043		159557.191		72170.6364		32860.703		P3S06P026	
28	P3S06P027	158461.474		73832.0687		34419.7934		158800.798		75247.6674		34518.1928		160240.723		75000.5299		33063.172		159901.955		73585.5129		32965.2043		P3S06P027	
29	P3S06P028	158800.798		75247.6674		34518.1928		159134.34		76664.522		34609.6099		160573.676		76416.4942		33154.1589		160240.723		75000.5299		33063.172		P3S06P028	
30	P3S06P029	159134.34		76664.522		34609.6099		159462.105		78082.6818		34693.7628		160900.837		77833.534		33237.8995		160573.676		76416.4942		33154.1589		P3S06P029	
31	P3S06P030	159462.105		78082.6818		34693.7628		159526.964		78366.4655		34709.6976		160965.574		78117.0662		33253.7554		160900.837		77833.534		33237.8995		P3S06P030	
32	P3S06P031	159526.964		78366.4655		34709.6976		159847.917		79786.6698		34784.8936		161285.941		79536.0393		33328.5833		160965.574		78117.0662		33253.7554		P3S06P031	
33	P3S06P032	159847.917		79786.6698		34784.8936		160163.369		81209.1412		34852.7734		161600.864		80957.3769		33396.1369		161285.941		79536.0393		33328.5833		P3S06P032	
34	P3S06P033	160163.369		81209.1412		34852.7734		160473.329		82633.6703		34913.5237		161910.348		82380.8678		33456.5958		161600.864		80957.3769		33396.1369		P3S06P033	
35	P3S06P034	160473.329		82633.6703		34913.5237		160777.356		84058.5399		34967.1102		162213.944		83804.7494		33509.9212		161910.348		82380.8678		33456.5958		P3S06P034	
36	P3S06P035	160777.356		84058.5399		34967.1102		160837.419		84343.4967		34976.9482		162273.925		84089.5132		33519.7114		162213.944		83804.7494		33509.9212		P3S06P035	
37	P3S06P036	160837.419		84343.4967		34976.9482		161133.92		85768.179		35021.638		162570.037		85513.2534		33564.1916		162273.925		84089.5132		33519.7114		P3S06P036	
38	P3S06P037	161133.92		85768.179		35021.638		161424.472		87194.961		35058.7408		162860.157		86938.7178		33601.1181		162570.037		85513.2534		33564.1916		P3S06P037	
39	P3S06P038	161424.472		87194.961		35058.7408		161710.115		88626.5835		35088.1259		163145.242		88368.1089		33630.3397		162860.157		86938.7178		33601.1181		P3S06P038	
40	P3S06P039	161710.115		88626.5835		35088.1259		161991.372		90062.1491		35109.5513		163425.853		89800.6144		33651.6209		163145.242		88368.1089		33630.3397		P3S06P039	
41	P3S06P040	161991.372		90062.1491		35109.5513		162046.965		90348.8387		35112.8371		163481.328		90086.742		33654.8892		163425.853		89800.6144		33651.6209		P3S06P040	
42	P3S06P041	162046.965		90348.8387		35112.8371		162320.456		91777.2531		35124.1735		163754.377		91513.2313		33666.1912		163481.328		90086.742		33654.8892		P3S06P041	
43	P3S06P042	162320.456		91777.2531		35124.1735		162582.475		93187.6147		35126.9896		164016.659		92925.0915		33668.9867		163754.377		91513.2313		33666.1912		P3S06P042	



4. With this right triangle, we can again use Pythagoras to conclude that the distance from (x_1, y_1, z_1) to (x_2, y_2, z_2) is $\sqrt{\left(\sqrt{\Delta x^2 + \Delta y^2}\right)^2 + \Delta z^2} = \sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}$. This is the general formula for the distance between two points in three dimensions.

Calculate distance between two 3D points in space

```

    {
        case 'x':
            p[index].x = System.Convert.ToDouble(para.AsValueString());
            break;
        case 'y':
            p[index].y = System.Convert.ToDouble(para.AsValueString());
            break;
        case 'z':
            p[index].z = System.Convert.ToDouble(para.AsValueString());
            break;
        default:
            MessageBox.Show("Wrong format of parameter name");
            break;
    }
}

}

CladdingPanel c1 = new CladdingPanel(p, PanelCounter); // new panel created from list of points.
double Area_m2 = c1.PanelArea / 1000000; // division by 1000000 to get area in m2 from mm2

//current family type parameter is updated with value of Area_m2 ;
document.BeginTransaction();
if( symbol.ParametersMap["Area"].Set(Area_m2) == false )
{
    MessageBox.Show("Wrong parameter type");
}
document.EndTransaction();

ArrayOfPanels.Add(c1); // new panel inserted into the array of panels

output += c1.UniqueNumber + " " + Area_m2 + " " + c1.T_edge[0] + " " + c1.T_edge[1] + " " + c1.T_edge[2] + " " + c1.T_edge[3]

// creating panel objects in space
document.BeginTransaction();
FamilyInstance instance = document.Create.NewFamilyInstance(location, symbol, StructuralType.NonStructural);
document.EndTransaction();
}

//MessageBox.Show(output);

```

```

public bool CompareEdgesWith(EdgeGroup otherPanel, double tolerance)
{
    if
    (
        Math.Abs(nextPanel.G_edge[0] - G_edge[0]) <= tolerance
        &&
        Math.Abs(nextPanel.G_edge[1] - G_edge[1]) <= tolerance
        &&
        Math.Abs(nextPanel.G_edge[2] - G_edge[2]) <= tolerance
        &&
        Math.Abs(nextPanel.G_edge[3] - G_edge[3]) <= tolerance
        &&
        Math.Abs(nextPanel.G_diagonal_1 - G_diagonal_1) <= tolerance * Math.Sqrt(2)
    )
    { return true; }
    else
    { return false; }

}

}

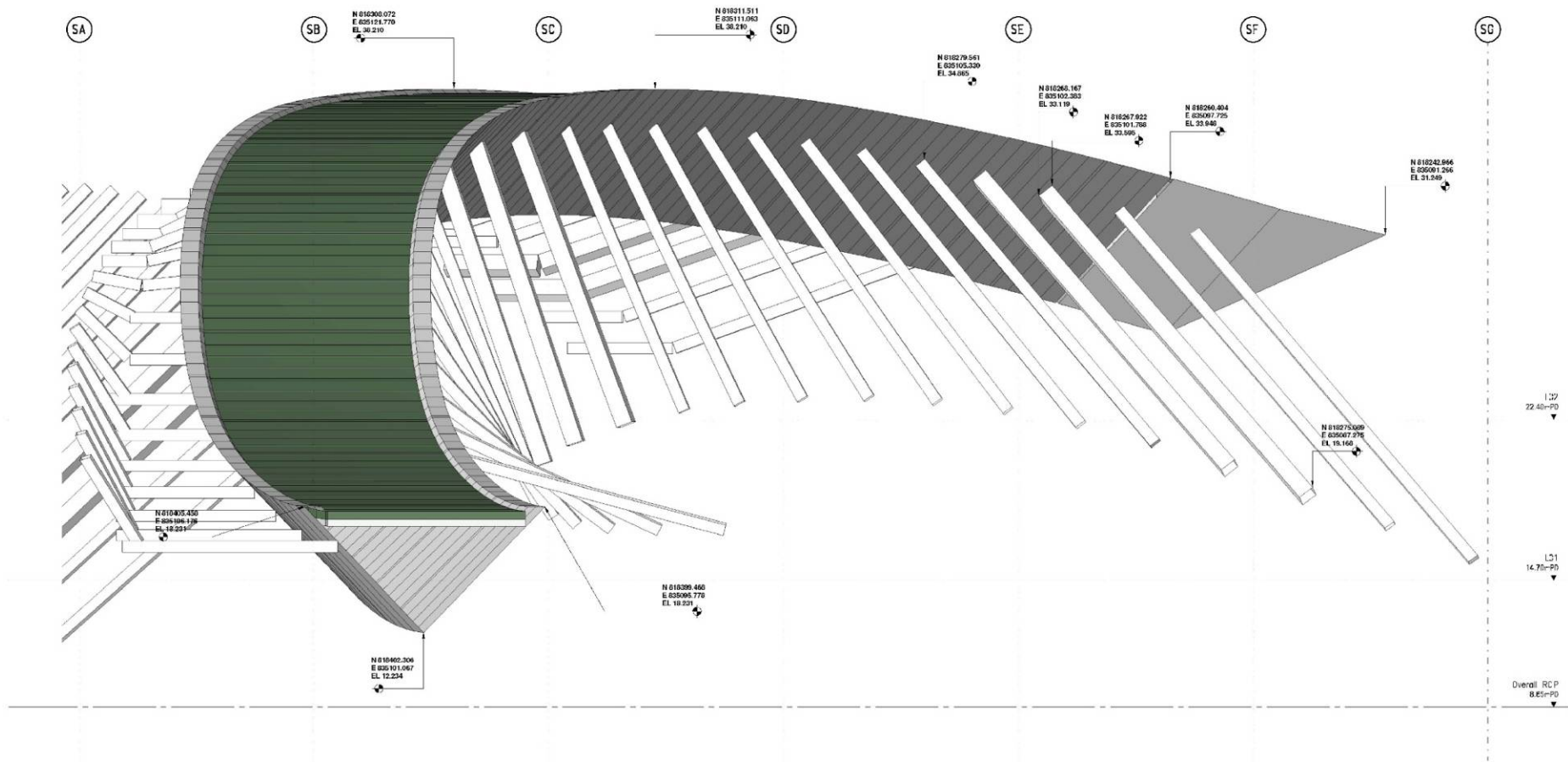
#endregion

public class Group
{
    public int GroupNumber;
    public double[] Edge; //array of lengths of groups's edges.
    public double Diagonal; //length of group's diagonal.
    public double Area; //area of a grouped panel;
}

double toFeet(double value) //conversion of linear sizes for family instances
{
    return value * FACTOR_MMtoFT;
}

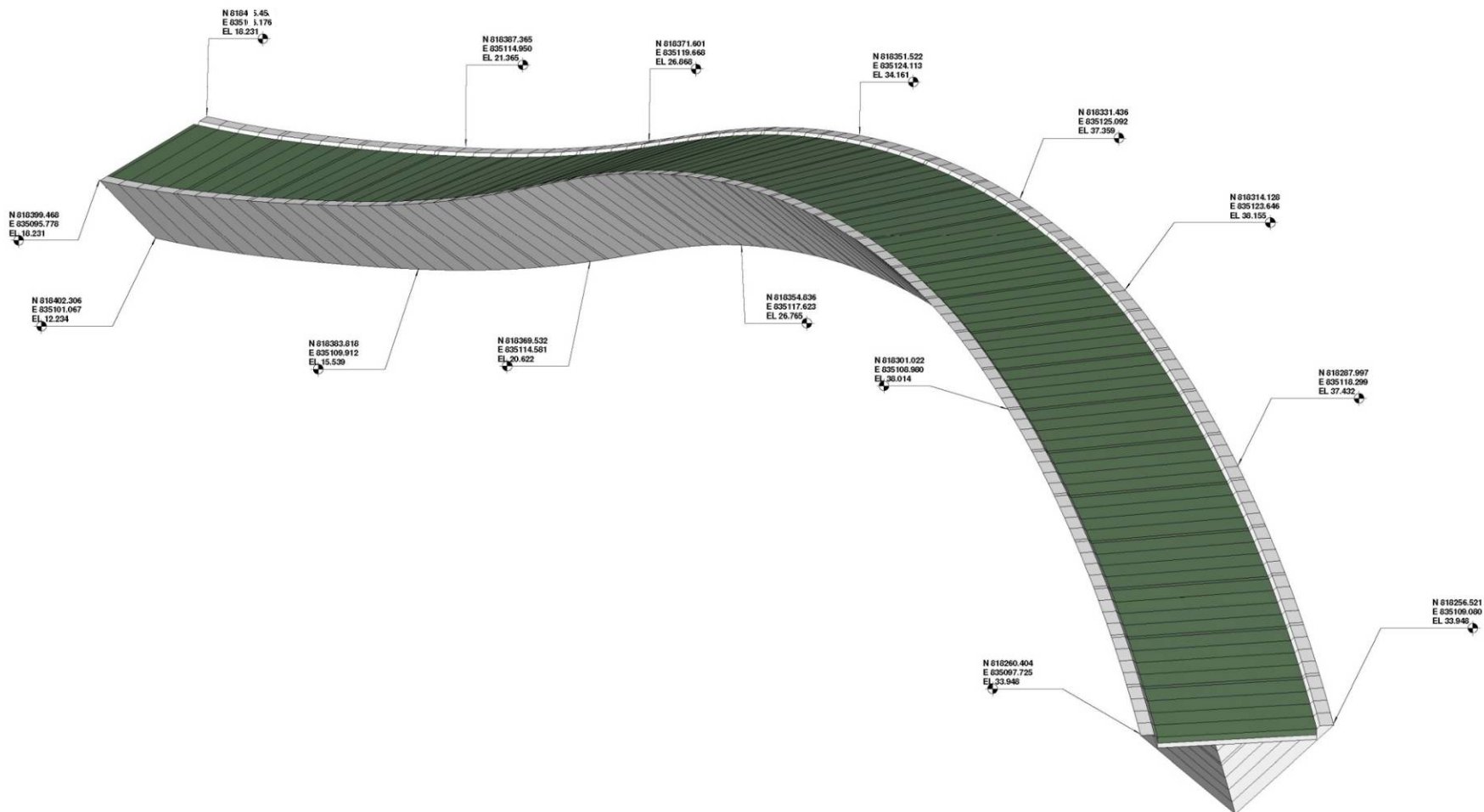
double toSqFeet(double value) //conversion of areal sizes for family instances
{

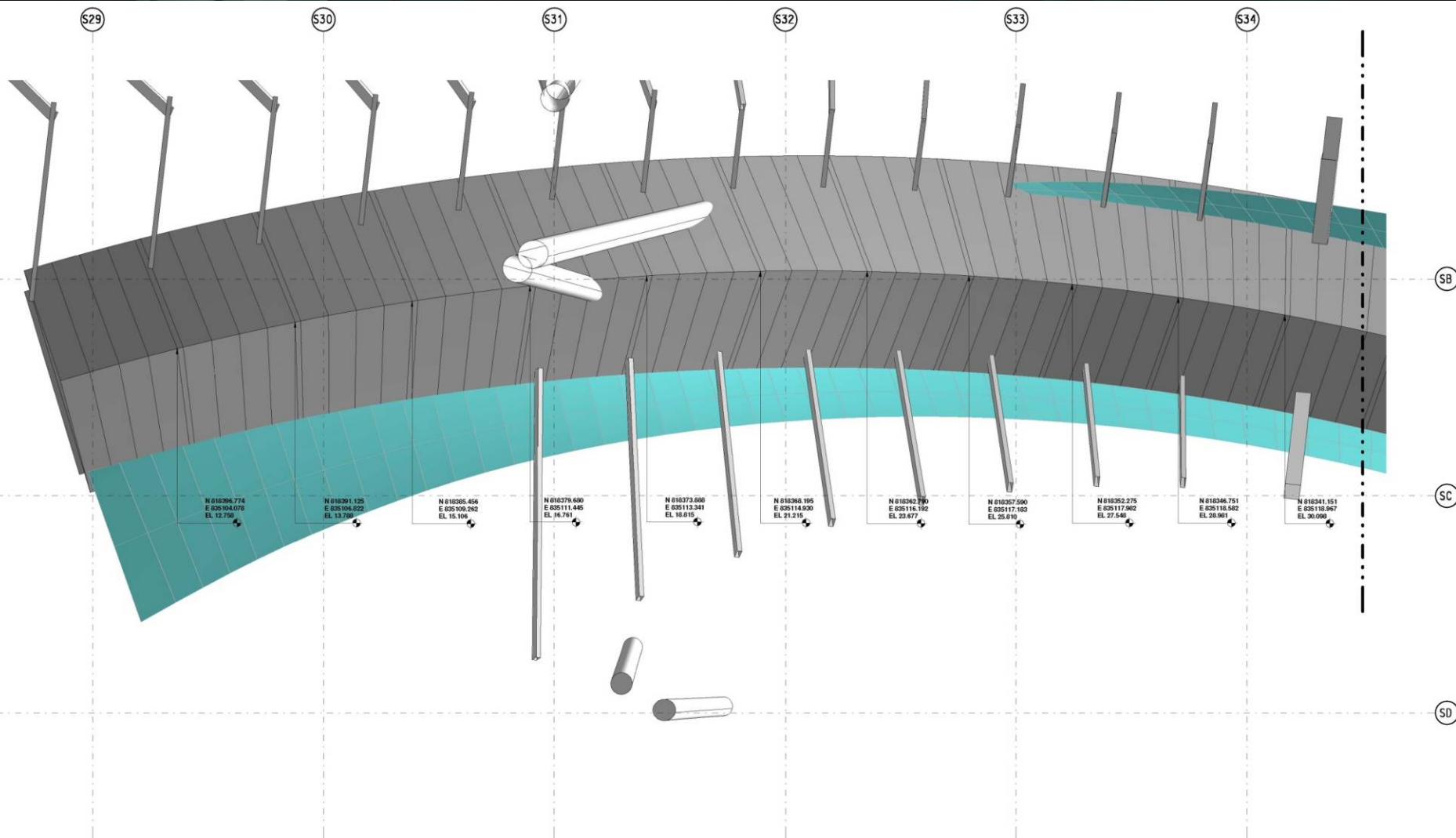
```



Component Elevation P3 North

1 : 100





LEFT_Component RCP P3

1 : 100

Panel P3S03P082

Group AL 36
Edge 1 1391 mm
Edge 2 839 mm
Edge 3 1398 mm
Edge 4 839 mm
Diagonal 1628 mm
Area 1.197 m²

Panel P3S03P081

Group AL 33
Edge 1 1358 mm
Edge 2 839 mm
Edge 3 1366 mm
Edge 4 839 mm
Diagonal 1600 mm
Area 1.169 m²

Panel P3S03P080

Group AL 34
Edge 1 267 mm
Edge 2 824 mm
Edge 3 269 mm
Edge 4 824 mm
Diagonal 867 mm
Area 0.234 m²

Panel P3S03P079

Group AL 33
Edge 1 1358 mm
Edge 2 839 mm
Edge 3 1366 mm
Edge 4 839 mm
Diagonal 1600 mm
Area 1.169 m²

Panel P3S03P078

Group AL 33
Edge 1 1358 mm
Edge 2 839 mm
Edge 3 1366 mm
Edge 4 839 mm
Diagonal 1600 mm
Area 1.169 m²

Panel P3S03P077

Group AL 33
Edge 1 1358 mm
Edge 2 839 mm
Edge 3 1366 mm
Edge 4 839 mm
Diagonal 1600 mm
Area 1.169 m²

Panel P3S04P082

Group AL 43
Edge 1 1378 mm
Edge 2 276 mm
Edge 3 1378 mm
Edge 4 276 mm
Diagonal 1405 mm
Area 0.400 m²

Panel P3S04P081

Group AL 40
Edge 1 1347 mm
Edge 2 276 mm
Edge 3 1354 mm
Edge 4 276 mm
Diagonal 1379 mm
Area 0.392 m²

Panel P3S04P080

Group AL 41
Edge 1 265 mm
Edge 2 271 mm
Edge 3 266 mm
Edge 4 271 mm
Diagonal 381 mm
Area 0.078 m²

Panel P3S04P079

Group AL 40
Edge 1 1347 mm
Edge 2 276 mm
Edge 3 1354 mm
Edge 4 276 mm
Diagonal 1379 mm
Area 0.392 m²

Panel P3S04P078

Group AL 40
Edge 1 1347 mm
Edge 2 276 mm
Edge 3 1354 mm
Edge 4 276 mm
Diagonal 1379 mm
Area 0.392 m²

Panel P3S04P077

Group AL 40
Edge 1 1347 mm
Edge 2 276 mm
Edge 3 1354 mm
Edge 4 276 mm
Diagonal 1379 mm
Area 0.392 m²

Panel P3S02P082

Group AL 30
Edge 1 1412 mm
Edge 2 8443 mm
Edge 3 1400 mm
Edge 4 8443 mm
Diagonal 8559 mm
Area 11.992 m²

Panel P3S02P081

Group AL 29
Edge 1 1400 mm
Edge 2 8443 mm
Edge 3 1367 mm
Edge 4 8443 mm
Diagonal 8551 mm
Area 11.801 m²

Panel P3S02P080

Group AL 23
Edge 1 272 mm
Edge 2 8298 mm
Edge 3 272 mm
Edge 4 8298 mm
Diagonal 8296 mm
Area 2.361 m²

Panel P3S02P079

Group AL 29
Edge 1 1400 mm
Edge 2 8443 mm
Edge 3 1367 mm
Edge 4 8443 mm
Diagonal 8551 mm
Area 11.801 m²

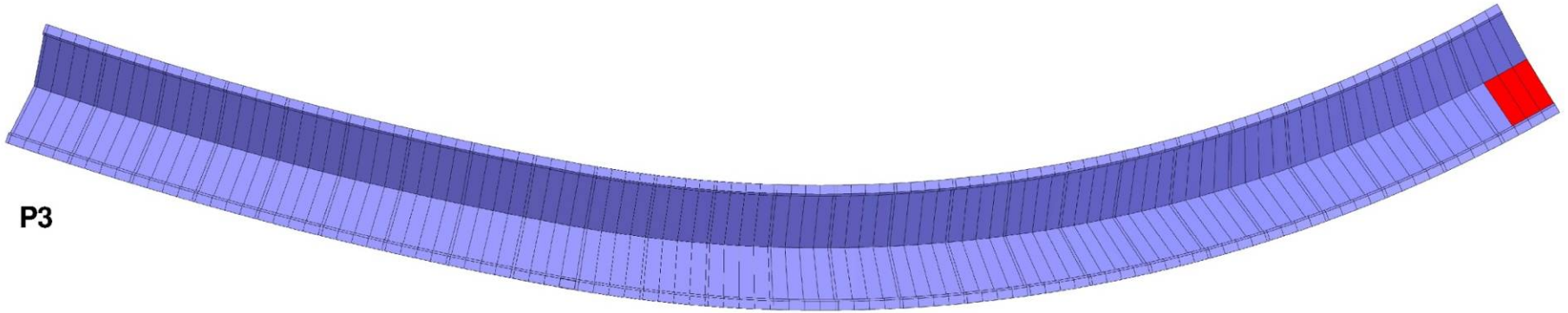
Panel P3S02P078

Group AL 29
Edge 1 1400 mm
Edge 2 8443 mm
Edge 3 1367 mm
Edge 4 8443 mm
Diagonal 8551 mm
Area 11.801 m²

Panel P3S02P077

Group AL 29
Edge 1 1400 mm
Edge 2 8443 mm
Edge 3 1367 mm
Edge 4 8443 mm
Diagonal 8551 mm
Area 11.801 m²

P3



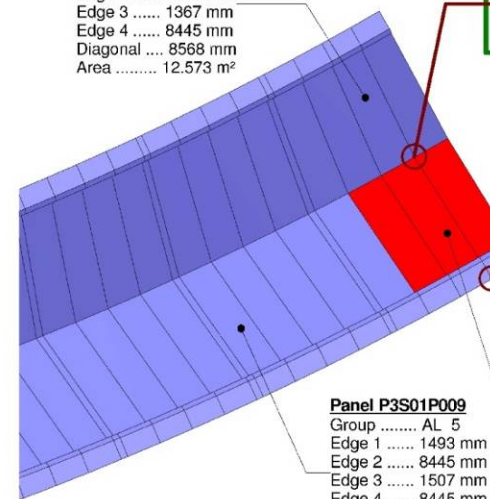
Schedule of panels																										
Panel	Point 1				Point 2				Point 3				Point 4				Center of weight				Edges				Area	Group
	P01 x	P01 y	P01 z		P02 x	P02 y	P02 z		P03 x	P03 y	P03 z		P04 x	P04 y	P04 z		C x	C y	C z		Edge 1	Edge 2	Edge 3	Edge 4	Diagonal	
P3S01P001	8351061129	8184055541	18298	835101017	818402394	12231	835106871	818404239	18290	835101802	818401012	12299	835103955	818403297	15262	1493	8446	1583	8446	8565	13.111	m²	AL 1			
P3S01P002	835106871	818404239	18290	835101802	818401012	12299	835107598	818402931	18391	835102588	818399625	12410	835104710	818401952	15347	1493	8446	1583	8446	8565	13.111	m²	AL 1			
P3S01P003	835107598	818402931	18391	835102588	818399625	12410	835108310	818401617	18528	835103312	818398241	12560	835105447	818400604	15472	1493	8446	1583	8446	8565	13.111	m²	AL 1			
AL 1.3																										
P3S01P004	835108310	818401617	18528	835103312	818398241	12560	835109007	818400300	18696	835104033	818396862	12745	835106166	818399255	15633	1493	8446	1559	8446	8583	13.010	m²	AL 2			
AL 2.1																										
P3S01P005	835109007	818400300	18696	835104033	818396862	12745	835109144	818400036	18736	835104175	818396588	12786	835106560	818398446	15741	294	8313	305	8313	8318	2.594	m²	AL 3			
P3S01P010	835111765	818394722	19674	835106783	818391211	13770	835111890	818394544	19728	835109506	818390943	13826	835109336	818392833	16760	294	8313	305	8313	8318	2.594	m²	AL 3			
P3S01P015	835114256	818398075	20334	835109228	818385543	15084	835114368	818388805	21001	835109337	818395271	15154	835111797	818387174	18043	294	8313	305	8313	8318	2.594	m²	AL 3			
P3S01P020	835116476	818393092	22499	835111414	818379769	16734	835116575	818383121	22582	835111511	818379492	16822	835113994	818381444	19659	294	8313	305	8313	8318	2.594	m²	AL 3			
P3S01P025	835118417	818377721	24432	835113315	818373975	16781	835118503	818377451	24534	835113398	818373701	16888	835115906	818375712	21659	294	8313	305	8313	8318	2.594	m²	AL 3			
P3S01P030	835120084	818372092	26716	835114909	818368280	21178	835120157	818371825	26332	835114977	818368015	21297	835117532	818370053	24006	294	8313	305	8313	8318	2.594	m²	AL 3			
AL 3.6																										
P3S01P008	835109144	818400036	18736	835104175	818396588	12786	835109622	818398714	18942	835104883	818390527	13005	835107001	818397641	16867	1493	8446	1534	8446	8561	12.901	m²	AL 4			
P3S01P018	835115454	818386100	21710	835110405	818382531	15899	835115973	818384746	22094	835110918	818381150	16305	835113167	818383632	19002	1493	8446	1534	8446	8561	12.901	m²	AL 4			
P3S01P019	835115973	818384746	22094	835110918	818381150	16305	835116476	818383092	22499	835114124	818379769	16734	835113995	818380264	19408	1493	8446	1534	8446	8561	12.901	m²	AL 4			
P3S01P021	835116575	818383121	22582	835111511	818379492	16822	835117059	818381769	23013	835111987	818378111	17278	835114283	818380623	19924	1493	8446	1534	8446	8561	12.901	m²	AL 4			
P3S01P022	835117059	818381769	23013	835111987	818378111	17278	835117528	818380417	23465	835112447	818376730	17767	835114755	818379257	20378	1493	8446	1534	8446	8561	12.901	m²	AL 4			
P3S01P023	835117528	818380417	23465	835112447	818376730	17767	835117980	818379088	23938	835112890	818375351	18258	835115211	818377891	20855	1493	8446	1534	8446	8561	12.901	m²	AL 4			
P3S01P024	835117980	818379088	23938	835112890	818375351	18258	835118417	818377721	24432	835113315	818373075	16781	835115550	818376629	21353	1493	8446	1534	8446	8561	12.901	m²	AL 4			
P3S01P026	835118503	818377451	24534	835113398	818373701	16888	835118921	818376718	25052	835113802	818372392	19436	835116156	818374988	21978	1493	8446	1534	8446	8561	12.901	m²	AL 4			
AL 4.8																										
P3S01P007	835109822	818386714	18942	835104883	818390527	13005	835110485	818397388	19170	835105522	818393885	13245	835107673	818396303	16000	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P008	835110485	818397388	19170	835105522	818393885	13245	835111332	818396057	19414	835109161	818392551	13500	835106325	818394070	16332	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P009	835111332	818396057	19414	835109161	818392551	13500	835111765	818394722	19674	835106783	818391211	13770	835109960	818393635	16590	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P011	835111890	818394544	19728	835109506	818385093	13826	835112504	818393115	20006	835107510	818386599	14116	835108702	818382028	16919	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P012	835112504	818393115	20006	835107510	818386599	14116	835113103	818391771	20300	835108097	818388252	14422	835110304	818390654	17211	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P013	835113103	818391771	20300	835108097	818388252	14422	835113688	818390425	20609	835108670	818386600	14745	835110890	818390837	17519	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P014	835113688	818390425	20609	835108670	818386600	14745	835114256	818389075	20934	835109228	818385543	15084	835111450	818387968	17943	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P016	835114368	818388805	21001	835109337	818385271	15154	835114919	818387453	21346	835109678	818383806	15516	835112126	818386359	18254	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P017	835114919	818387453	21346	835109678	818383806	15516	835115454	818386100	21710	835110405	818382531	15899	835112654	818384998	18918	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P027	835118921	818376106	25052	835113802	818372332	19436	835119324	818373428	26145	835114189	818370671	20002	835116559	818373544	22520	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P028	835119324	818373428	26145	835114189	818370671	20002	835119711	818373428	26145	835114589	818369618	20585	835116948	818372196	23081	1493	8445	1507	8445	8578	12.786	m²	AL 5			
P3S01P029	835119711	818373428	26145	835114589	818369618	20585	835120084	818372092	26716	835114909	818368280	21178	835117316	818370855	23656	1493	8445	1507	8445	8578	12.786	m²	AL 5			
AL 5.12																										
P3S01P031	835120157	818371825	26332	835114977	818368015	21297	835120513	818370490	27416	835115304	818366697	21896	835117738	818369257	24360	1493	8445	1477	8445	8574	12.661	m²	AL 6			
AL 6.1																										

Panel P3S02P002

Group AL 14
Edge 1 1583 mm
Edge 2 8445 mm
Edge 3 1367 mm
Edge 4 8445 mm
Diagonal 8568 mm
Area 12.573 m²

N 818401012
E 835101802
EL 12299

N 818404239
E 835106871
EL 18290



Panel P3S01P009

Group AL 5
Edge 1 1493 mm
Edge 2 8445 mm
Edge 3 1507 mm
Edge 4 8446 mm
Diagonal 8585 mm
Area 13.111 m²

Panel P3S01P002
Group AL 1
Edge 1 1493 mm
Edge 2 8446 mm
Edge 3 1583 mm
Edge 4 8446 mm
Diagonal 8585 mm
Area 13.111 m²

Remark: An above table is a portion extracted for presentation purpose from the full schedule of panels included in the BIM model.

P3

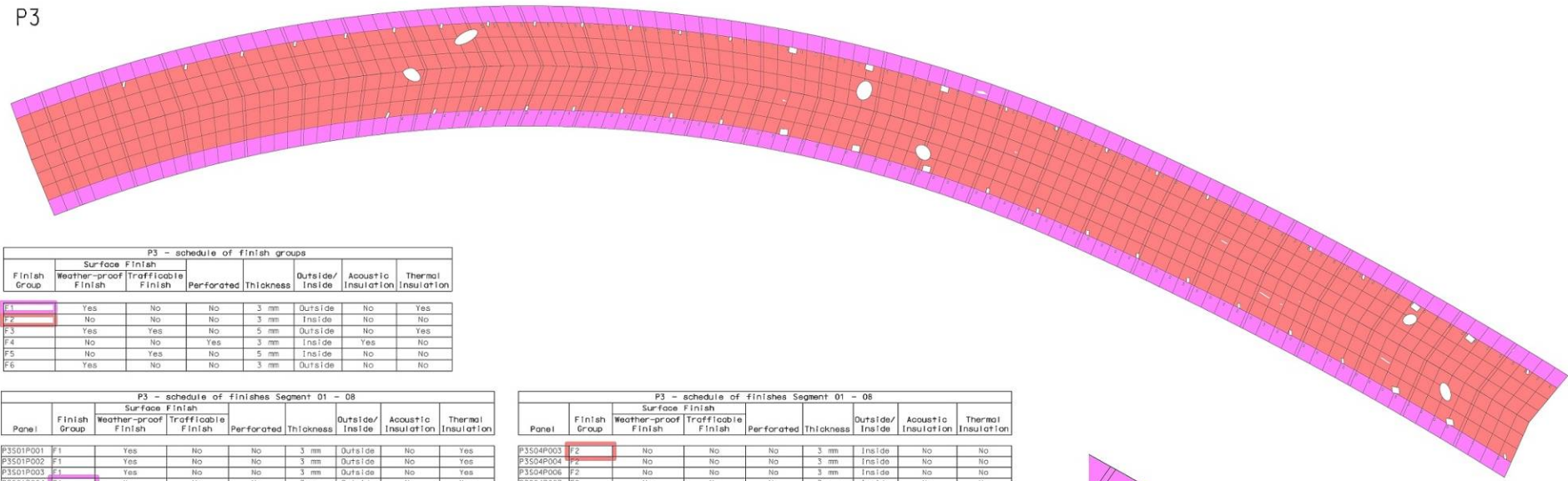
Schedule of panel groups								
Group Name	Number of panels	Edge 1	Edge 2	Edge 3	Edge 4	Diagonal	Panel area	Group Area
AL 1	3	1493	8448	1583	8448	8585	13 111 m²	39 333 m²
AL 2	1	1493	8448	1583	8448	8583	13 010 m²	13 010 m²
AL 3	6	294	8313	305	8313	8318	2 594 m²	15 564 m²
AL 4	8	1493	8448	1534	8448	8581	12 901 m²	103 208 m²
AL 5	12	1483	8445	1507	8445	8578	12 786 m²	153 433 m²
AL 6	1	1493	8445	1477	8445	8574	12 661 m²	12 661 m²
AL 7	32	1493	8444	1452	8444	8572	12 554 m²	401 734 m²

Year	Number of people (millions)
1960	50
1970	50
1980	50
1990	60
2000	75
2010	100

N 818398353
E 835096414
EL 18290

Schedule of panel groups									
Group Name	Number of panels	Edge 1	Edge 2	Edge 3	Edge 4	Diagonal	Panel area	Group Area	
AL 1	3	1493	8446	1583	8446	8595	13.111 m ²	39.333 m ²	
AL 2	1	1403	8446	1559	8446	8563	1.010 m ²	13.010 m ²	
AL 3	6	294	8313	305	8313	8318	2.594 m ²	15.564 m ²	
AL 4	8	1493	8446	1534	8446	9581	12.901 m ²	100.206 m ²	
AL 5	12	1453	8445	1507	8445	8578	12.789 m ²	153.433 m ²	
AL 6	1	1453	8447	1545	8447	8574	12.661 m ²	12.661 m ²	
AL 7	32	1493	8444	1452	8444	8572	12.554 m ²	401.734 m ²	
AL 8	5	1493	8444	1424	8444	8569	12.438 m ²	62.180 m ²	
AL 9	13	1493	8444	1398	8444	8567	12.325 m ²	166.227 m ²	
AL 10	33	294	8303	272	8303	8307	2.453 m ²	80.933 m ²	
AL 11	25	1443	8364	1369	8443	8564	12.199 m ²	304.979 m ²	
AL 12	2	1493	8443	1354	8443	8562	12.139 m ²	60.676 m ²	
AL 13	3	1493	8443	1338	8443	8560	12.069 m ²	36.208 m ²	
AL 14	3	1583	8445	1357	8445	8568	12.573 m ²	37.718 m ²	
AL 15	1	1559	8445	1358	8445	8569	14.719 m ²	12.479 m ²	
AL 16	8	1445	8353	1368	8445	8566	12.377 m ²	98.979 m ²	
AL 17	3	1519	8445	1374	8445	8547	12.301 m ²	36.932 m ²	
AL 18	1	1497	8446	1385	8445	8536	12.200 m ²	12.200 m ²	
AL 19	1	1477	8445	1387	8445	8534	12.209 m ²	12.209 m ²	
AL 20	1	1452	8445	1387	8445	8531	12.102 m ²	12.102 m ²	
AL 21	1	1424	8445	1387	8445	8529	11.984 m ²	11.984 m ²	
AL 22	1	1398	8444	1386	8444	8527	11.871 m ²	11.871 m ²	
AL 23	11	272	8298	272	8298	8298	2.976 m ²	25.974 m ²	
AL 24	6	1369	8444	1385	8444	8526	11.742 m ²	70.452 m ²	
AL 25	7	1354	8444	1384	8444	8524	11.674 m ²	81.718 m ²	
AL 26	3	8443	1383	8443	8443	8523	11.588 m ²	34.785 m ²	
AL 27	6	1362	8442	1389	8442	8519	11.649 m ²	93.185 m ²	
AL 28	3	1390	8442	1367	8442	8543	11.714 m ²	35.143 m ²	
AL 29	10	1400	8443	1357	8443	8551	11.801 m ²	115.005 m ²	
AL 30	1	1412	8443	1400	8443	8559	11.992 m ²	11.992 m ²	
AL 31	10	1427	8444	1431	8444	8564	12.187 m ²	121.867 m ²	
AL 32	24	1440	8444	1453	8444	8568	12.334 m ²	296.014 m ²	
AL 33	52	1358	839	1366	839	1600	1.169 m ²	60.791 m ²	
AL 34	16	1267	824	1269	824	1617	0.204 m ²	3.748 m ²	
AL 35	13	1372	839	1379	839	1611	1.181 m ²	15.348 m ²	
AL 36	31	1392	839	1399	839	1618	1.197 m ²	1.197 m ²	
AL 37	31	1422	839	1426	839	1653	1.222 m ²	37.880 m ²	
AL 38	3	1444	839	1447	839	1671	1.240 m ²	3.720 m ²	
AL 39	34	284	825	285	825	873	0.348 m ²	8.448 m ²	
AL 40	54	1347	276	1354	276	1379	0.923 m ²	21.163 m ²	
AL 41	24	265	271	268	271	381	0.078 m ²	1.883 m ²	
AL 42	11	1361	276	1366	276	1396	0.396 m ²	4.353 m ²	
AL 43	1	1378	276	1378	276	1405	0.400 m ²	0.400 m ²	
AL 44	32	1406	276	1406	276	1432	0.948 m ²	13.052 m ²	
AL 45	2	1426	276	1425	276	1452	0.914 m ²	0.827 m ²	
AL 46	27	281	271	282	271	392	0.083 m ²	2.154 m ²	
AL 47	100	1456	276	1455	276	1481	0.422 m ²	42.209 m ²	
AL 48	100	1474	839	1483	839	1700	1.269 m ²	128.892 m ²	
Grand total:	750							2823.908 m ²	

P3

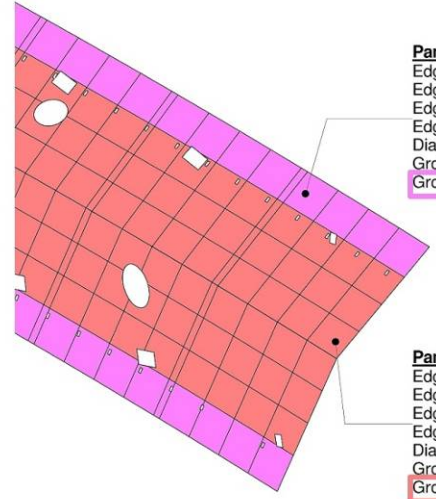


P3 - schedule of finish groups							
Finish Group	Surface Finish		Perforated	Thickness	Outside/ Inside	Acoustic Insulation	Thermal Insulation
	Weather-proof Finish	Trafficable Finish					
F1	Yes	No	No	3 mm	Outside	No	Yes
F2	No	No	No	3 mm	Inside	No	No
F3	Yes	Yes	No	5 mm	Outside	No	Yes
F4	No	No	Yes	3 mm	Inside	Yes	No
F5	No	Yes	No	5 mm	Inside	No	No
F6	Yes	No	No	3 mm	Outside	No	No

P3 - schedule of finishes Segment 01 - 08								
Panel	Finish Group	Surface Finish		Perforated	Thickness	Outside/ Inside	Acoustic Insulation	Thermal Insulation
		Weather-proof Finish	Trafficable Finish					
P3501P001	F1	Yes	No	No	3 mm	Outside	No	Yes
P3501P002	F1	Yes	No	No	3 mm	Outside	No	Yes
P3501P003	F1	Yes	No	No	3 mm	Outside	No	Yes
P3501P004	F1	Yes	No	No	3 mm	Outside	No	Yes
P3501P005	F1	Yes	No	No	3 mm	Outside	No	Yes
P3501P006	F1	Yes	No	No	3 mm	Outside	No	Yes
P3501P007	F1	Yes	No	No	3 mm	Outside	No	Yes
P3501P008	F1	Yes	No	No	3 mm	Outside	No	Yes
P3501P009	F1	Yes	No	No	3 mm	Outside	No	Yes
P3508P001	F1	Yes	No	No	3 mm	Outside	No	Yes
P3508P002	F1	Yes	No	No	3 mm	Outside	No	Yes
P3508P003	F1	Yes	No	No	3 mm	Outside	No	Yes
P3508P004	F1	Yes	No	No	3 mm	Outside	No	Yes
P3508P005	F1	Yes	No	No	3 mm	Outside	No	Yes
P3508P006	F1	Yes	No	No	3 mm	Outside	No	Yes
P3508P007	F1	Yes	No	No	3 mm	Outside	No	Yes
P3508P008	F1	Yes	No	No	3 mm	Outside	No	Yes
F 1: 17								
P3502P001	F2	No	No	No	3 mm	Inside	No	No
P3502P002	F2	No	No	No	3 mm	Inside	No	No
P3502P003	F2	No	No	No	3 mm	Inside	No	No
P3502P004	F2	No	No	No	3 mm	Inside	No	No
P3502P005	F2	No	No	No	3 mm	Inside	No	No
P3502P006	F2	No	No	No	3 mm	Inside	No	No
P3502P007	F2	No	No	No	3 mm	Inside	No	No
P3502P008	F2	No	No	No	3 mm	Inside	No	No
P3502P009	F2	No	No	No	3 mm	Inside	No	No
P3503P001	F2	No	No	No	3 mm	Inside	No	No
P3503P002	F2	No	No	No	3 mm	Inside	No	No
P3503P003	F2	No	No	No	3 mm	Inside	No	No
P3503P004	F2	No	No	No	3 mm	Inside	No	No
P3503P005	F2	No	No	No	3 mm	Inside	No	No
P3503P006	F2	No	No	No	3 mm	Inside	No	No
P3503P007	F2	No	No	No	3 mm	Inside	No	No
P3503P008	F2	No	No	No	3 mm	Inside	No	No
P3503P009	F2	No	No	No	3 mm	Inside	No	No
P3504P001	F2	No	No	No	3 mm	Inside	No	No
P3504P002	F2	No	No	No	3 mm	Inside	No	No

P3 - schedule of finishes Segment 01 - 08								
Panel	Finish Group	Surface Finish		Perforated	Thickness	Outside/ Inside	Acoustic Insulation	Thermal Insulation
		Weather-proof Finish	Trafficable Finish					
P3504P003	F2	No	No	No	3 mm	Inside	No	No
P3504P004	F2	No	No	No	3 mm	Inside	No	No
P3504P006	F2	No	No	No	3 mm	Inside	No	No
P3504P007	F2	No	No	No	3 mm	Inside	No	No
P3504P008	F2	No	No	No	3 mm	Inside	No	No
P3504P009	F2	No	No	No	3 mm	Inside	No	No
F 2: 25								
P3503P005	F2	No	No	No	3 mm	Inside	No	No
P3504P005	F2	No	No	No	3 mm	Inside	No	No
P3505P001	F2	No	No	No	3 mm	Inside	No	No
P3505P002	F2	No	No	No	3 mm	Inside	No	No
P3505P003	F2	No	No	No	3 mm	Inside	No	No
P3505P004	F2	No	No	No	3 mm	Inside	No	No
P3505P005	F2	No	No	No	3 mm	Inside	No	No
P3505P006	F2	No	No	No	3 mm	Inside	No	No
P3505P007	F2	No	No	No	3 mm	Inside	No	No
P3505P008	F2	No	No	No	3 mm	Inside	No	No
P3505P009	F2	No	No	No	3 mm	Inside	No	No
P3506P001	F2	No	No	No	3 mm	Inside	No	No
P3506P002	F2	No	No	No	3 mm	Inside	No	No
P3506P003	F2	No	No	No	3 mm	Inside	No	No
P3506P004	F2	No	No	No	3 mm	Inside	No	No
P3506P005	F2	No	No	No	3 mm	Inside	No	No
P3506P006	F2	No	No	No	3 mm	Inside	No	No
P3506P007	F2	No	No	No	3 mm	Inside	No	No
P3506P008	F2	No	No	No	3 mm	Inside	No	No
P3506P009	F2	No	No	No	3 mm	Inside	No	No
P3507P001	F2	No	No	No	3 mm	Inside	No	No
P3507P002	F2	No	No	No	3 mm	Inside	No	No
P3507P003	F2	No	No	No	3 mm	Inside	No	No
P3507P004	F2	No	No	No	3 mm	Inside	No	No
P3507P005	F2	No	No	No	3 mm	Inside	No	No
P3507P006	F2	No	No	No	3 mm	Inside	No	No
P3507P007	F2	No	No	No	3 mm	Inside	No	No
P3507P008	F2	No	No	No	3 mm	Inside	No	No
P3507P009	F2	No	No	No	3 mm	Inside	No	No
F 6: 29								

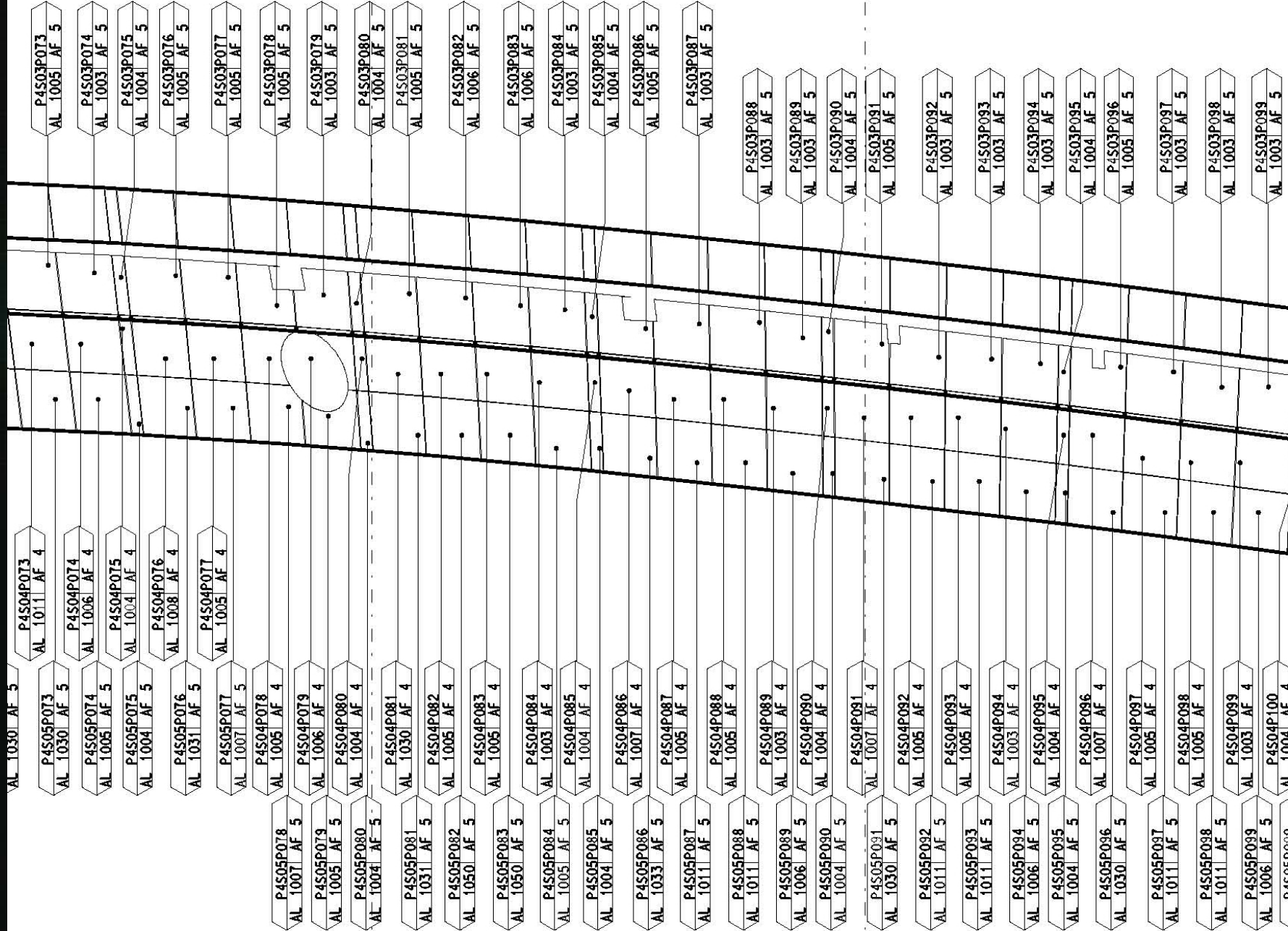
Remark: An above is a portion extracted for presentation purpose the full schedule of panels included in the BIM model.



Panel P3S01P004
 Edge 1 1488 mm
 Edge 2 2279 mm
 Edge 3 1476 mm
 Edge 4 2279 mm
 Diagonal 2720 mm
 Group(Size) A 1
 Group(Finish)... F 1

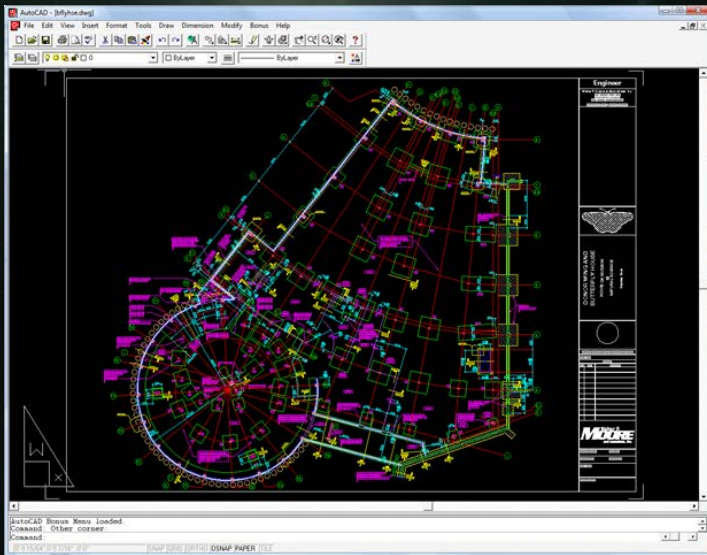
Panel P3S04P001
 Edge 1 1460 mm
 Edge 2 2042 mm
 Edge 3 1445 mm
 Edge 4 2042 mm
 Diagonal 2508 mm
 Group(Size) A 13
 Group(Finish)... F 2







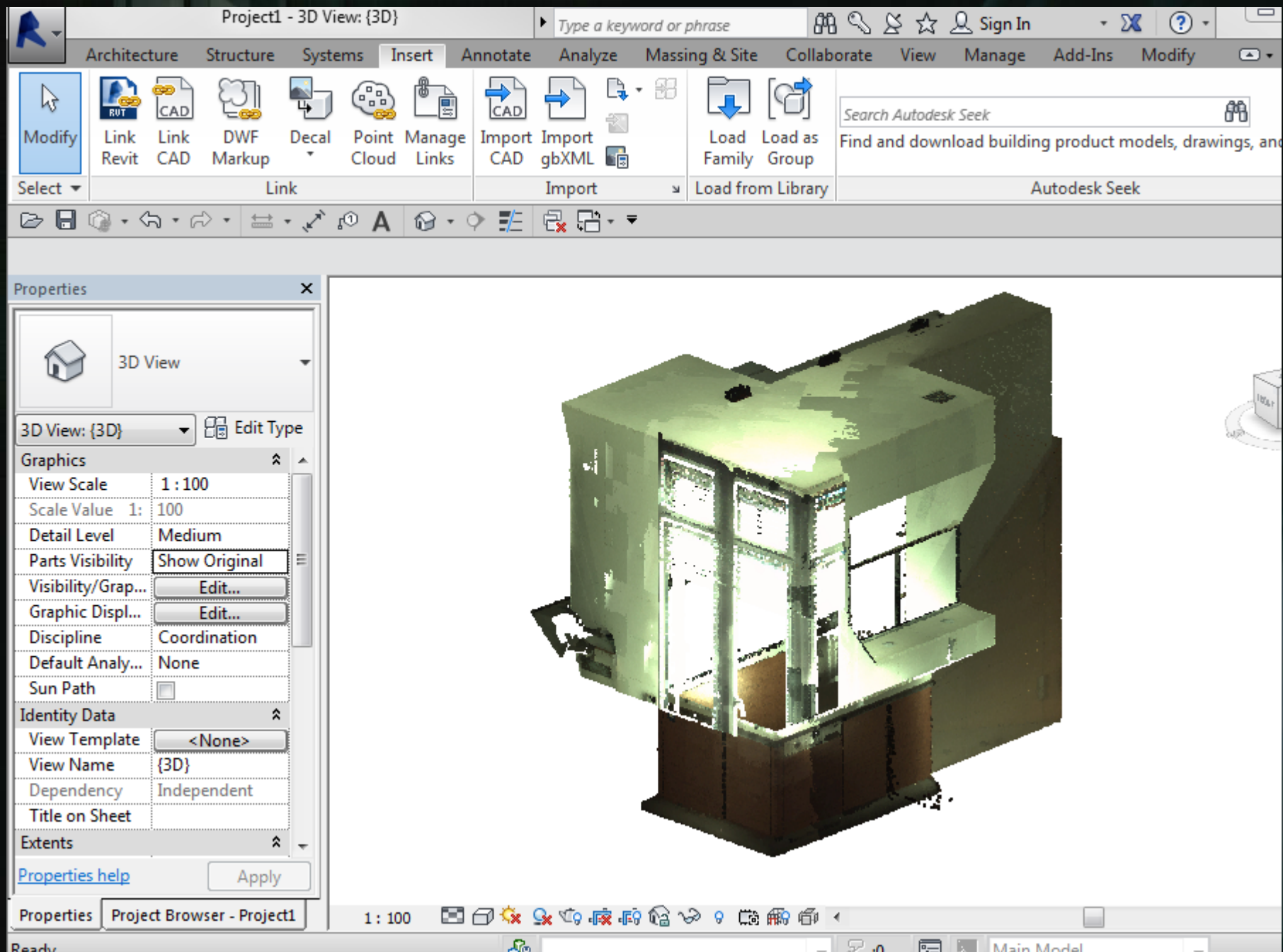
Architect is
in Control of
the smallest detail!

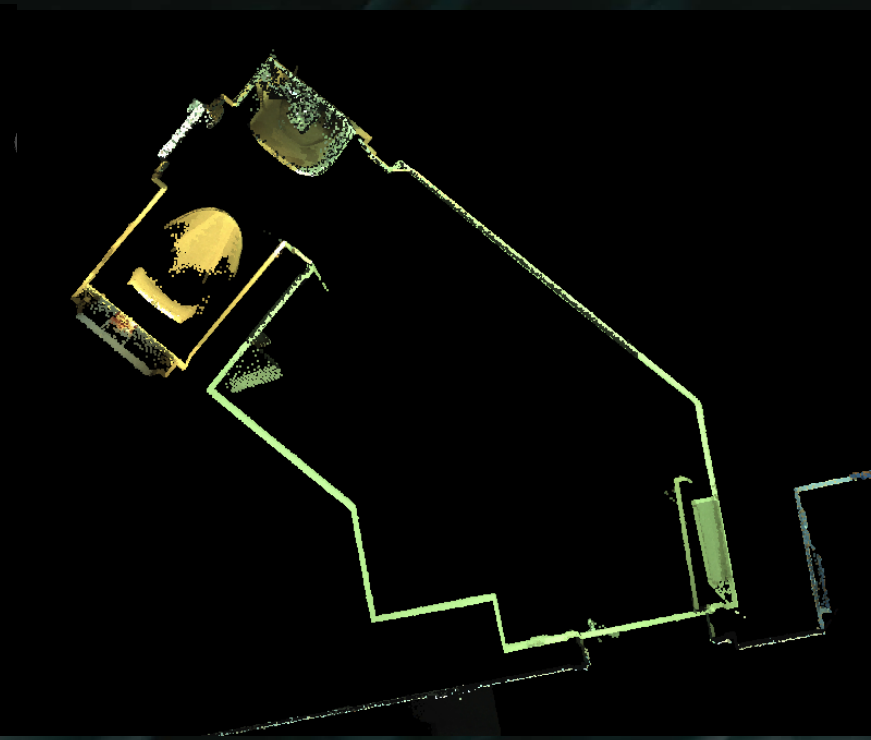
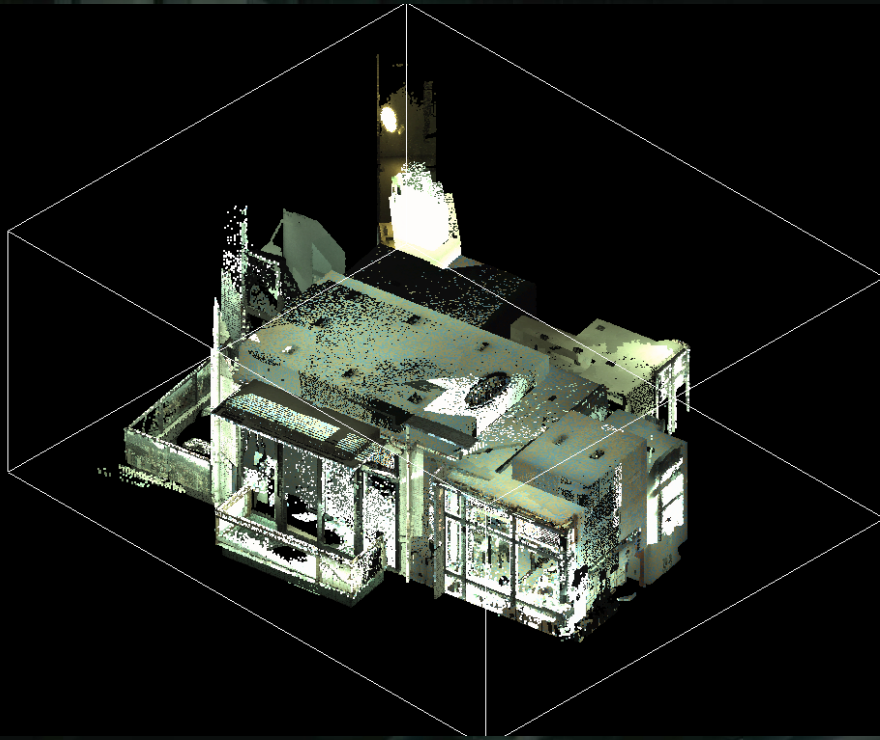


Design / Approved = As built ?

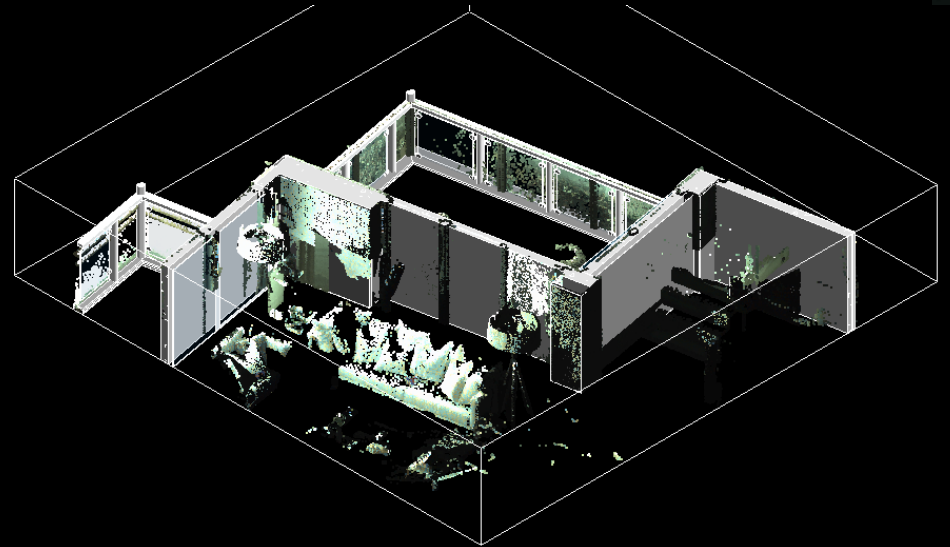
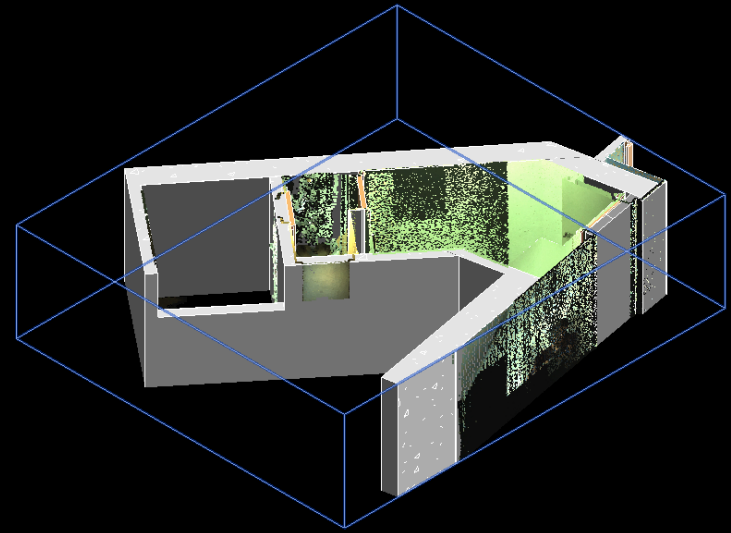
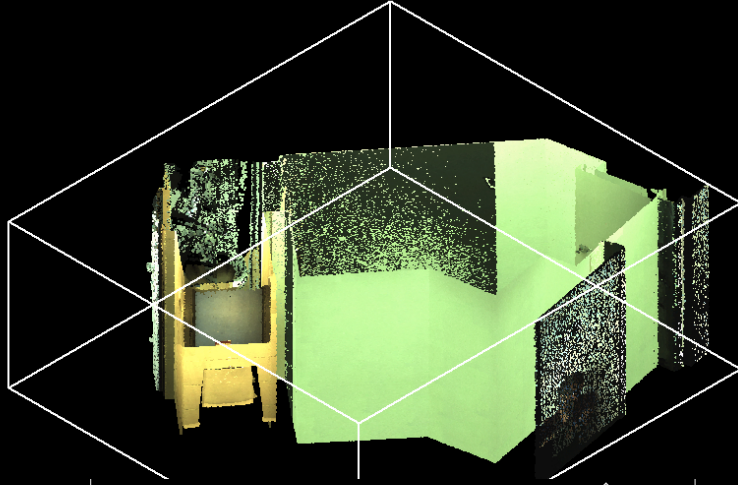


Laser Scanner - 50,000 pts /s; Range: 300m; Accuracy 6mm

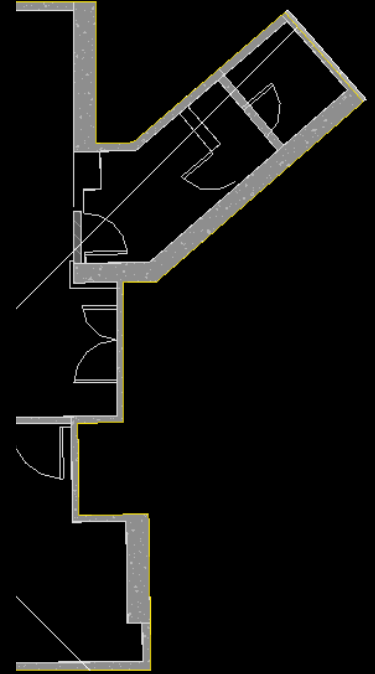
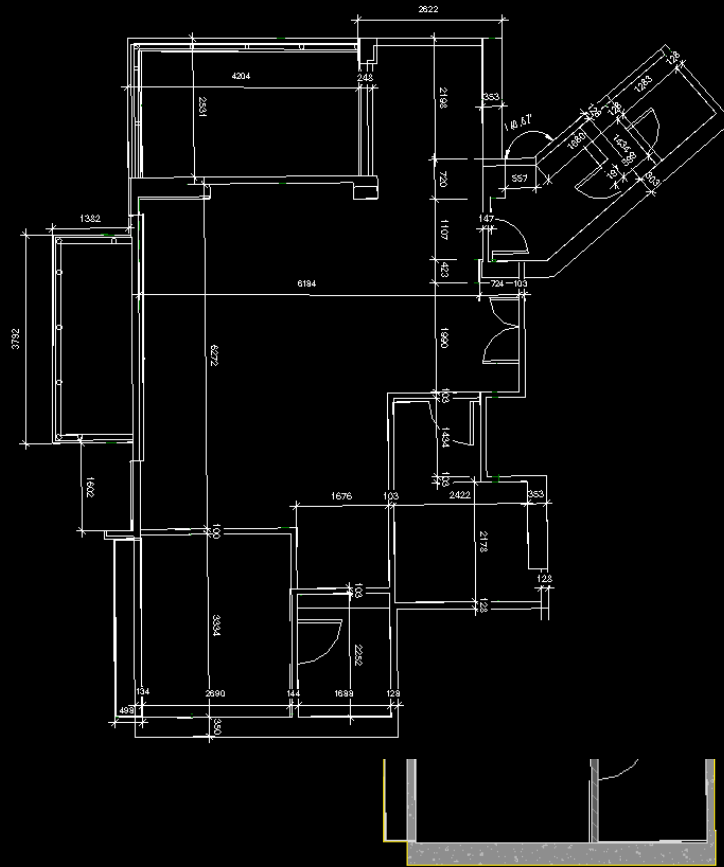




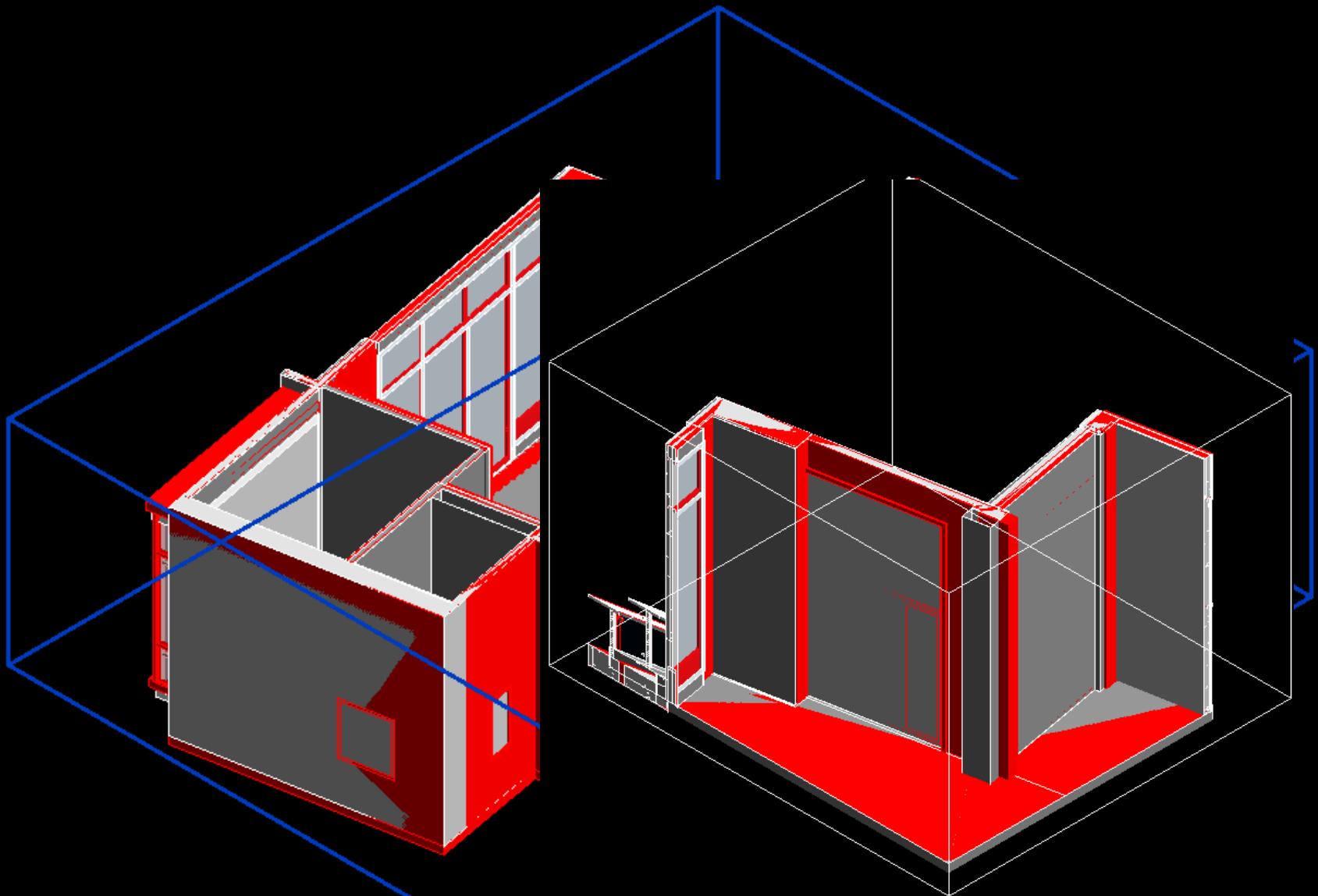
Point Cloud Data



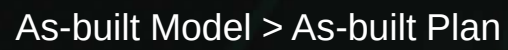
Point Cloud to BIM Model

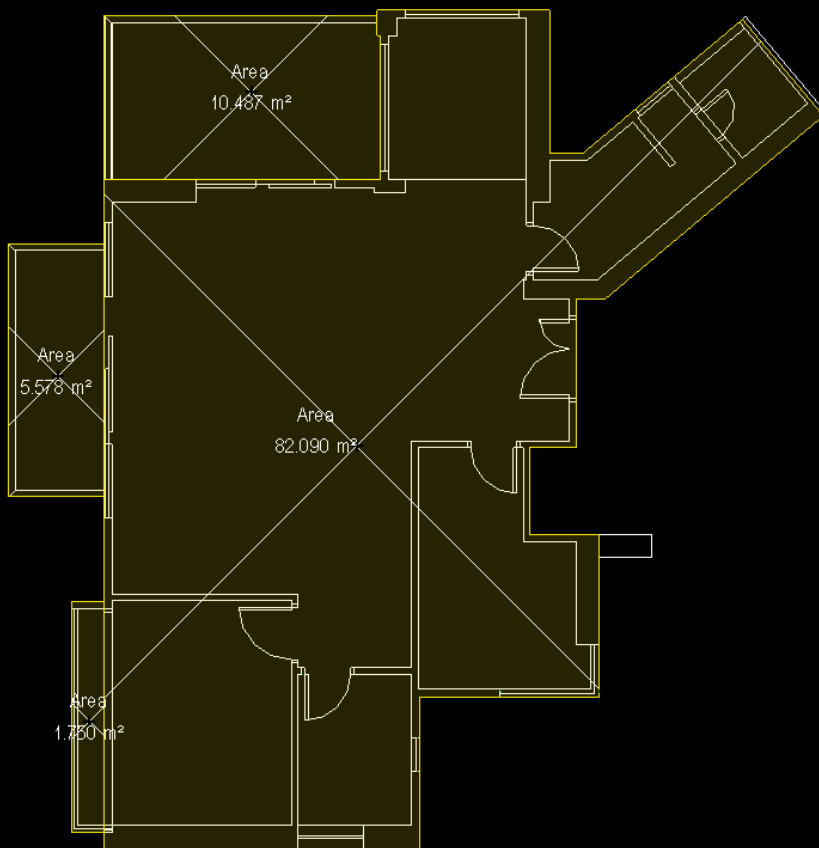


Design / Approved Model + As-built Model

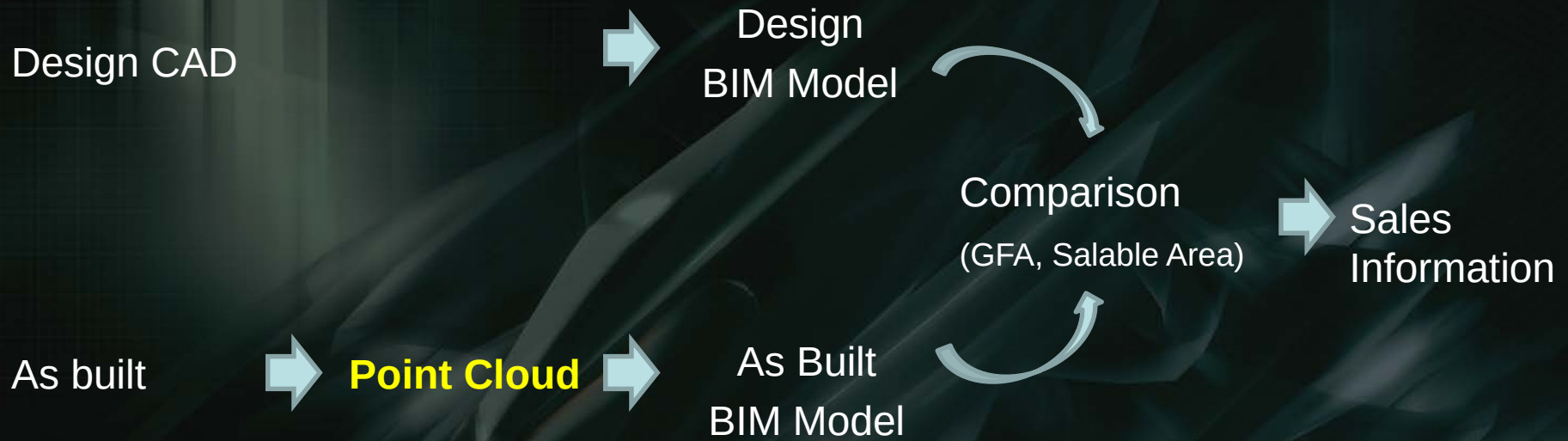


Building Information Modelling





Area Comparison As-built Model > As-built Plan



1. Measurement of Organic Architecture (Cost)
2. Measurement of As-Built vs Design

Immeasurables



Measurable

Conclusion



THANK YOU!