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UNFOLDED REGULAR AND SEMI-REGULAR POLYHEDRA

Abstract: *This paper proposes a presentation unfolding regular and semi-regular polyhedra. Regular polyhedra are convex polyhedra whose faces are regular and equal polygons, with the same number of sides, and whose polyhedral angles are also regular and equal. Semi-regular polyhedra are convex polyhedra with regular polygon faces, several types and equal solid angles of the same type. A net of a polyhedron is a collection of edges in the plane which are the unfolded edges of the solid. Modeling and unfolding Platonic and Arhimediene polyhedra will be using 3dsMAX program. This paper is intended as an example of descriptive geometry applications.*

Key words: *3D modeling, regular, semi-regular polyhedral, unfold, net*

I. INTRODUCTION

Regular polyhedra are convex polyhedra whose faces are regular and equal polygons, with the same number of sides and whose polyhedral angles are also regular and equal. Regular polyhedra are a total of five: tetrahedron, cube, octahedron, dodecahedron, icosahedron. These polyhedra are also known as Platonic solids, named after the scientist and philosopher Platon [1].

The semi-regulate polyhedra are convex polyhedra, with regular faces, several types and solid equal angles, of the same type. The semi-regulate polyhedra are obtained by truncation, halving edges and bevel. The semi-regulate polyhedra are in number of 13. These polyhedra are also known as Archimedean solids [1].

This paper is intended as an example of descriptive geometry applications.

2. REPRESENTATION UNFOLDED REGULAR AND SEMI-REGULAR POLYHEDRA

To unfold a surface of a polyhedron is to bring all its faces in the same plane, without such side to break or overlap. A net of a polyhedron is a collection of edges in the plane which are the unfolded edges of the solid.

By unfolding, keep the size of polyhedron faces. Therefore, the construction of polyhedral surfaces requires knowledge of the true size of each surface faces, the distance between the edges, angles faces polyhedral surfaces [2].

Depending on the solution adopted for the joining polyhedron faces, can be obtained net in various configurations.

I realized unfolded using 3dsMAX program. It can be animate development. All these modeling and developed can be used in descriptive geometry classes to achieve a more easy polyhedra.

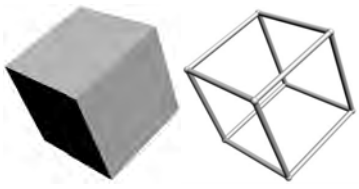
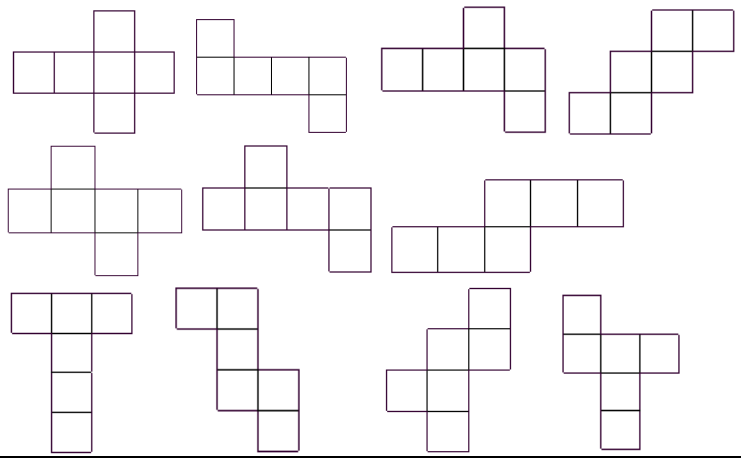
In table 1 are displays all unfolded tetrahedron, cube and octahedron. There are also represented a few of dodecahedron and icosahedron developed.

The order of presentation of polyhedra is made according to the layout.

In table 2 are the semi-regular polyhedra obtained by chamfering unfolded regular polyhedra. I made some performed for each semi-regular polyhedron.

Table 1

Unfoldings Platonic solids

Platonic solids	***Unfoldings***
Cube (Hexahedron)  6 faces (6 squares) 11 unfoldings	

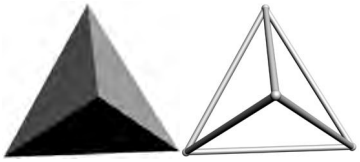
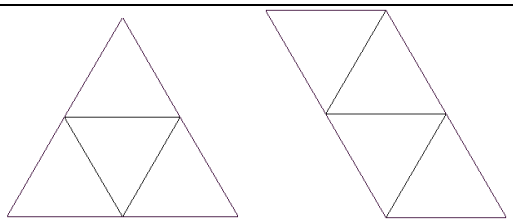
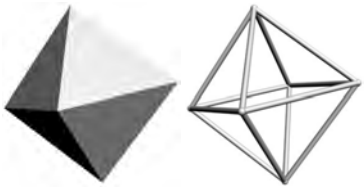
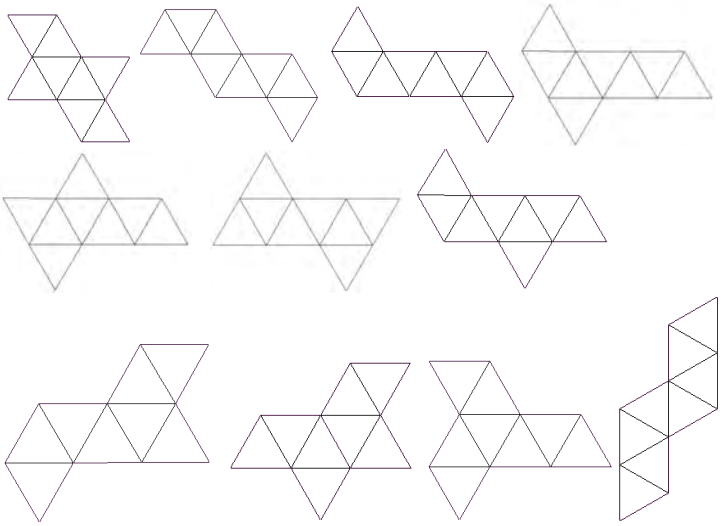
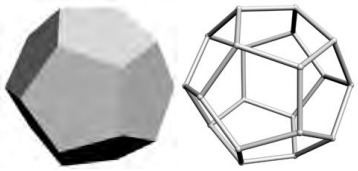
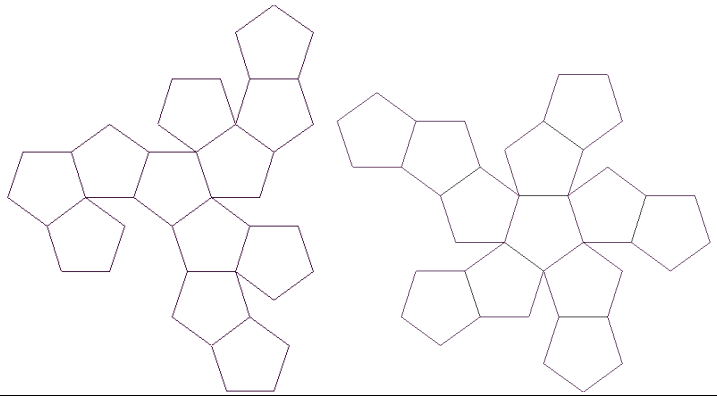
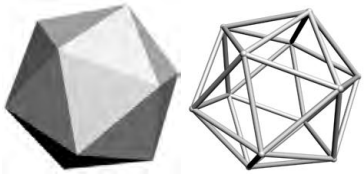
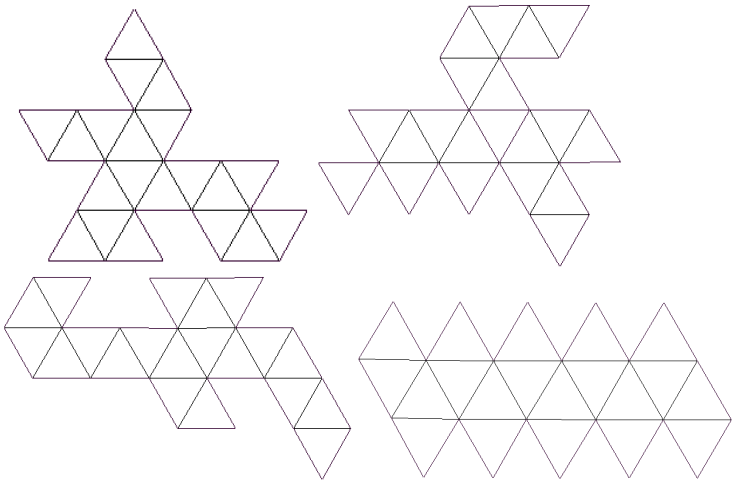
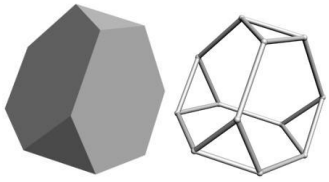
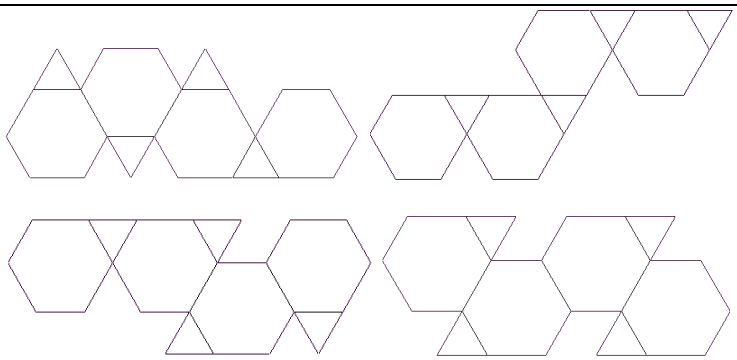
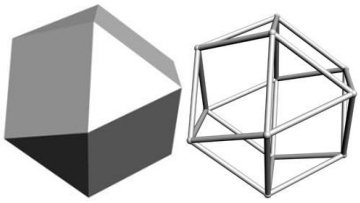
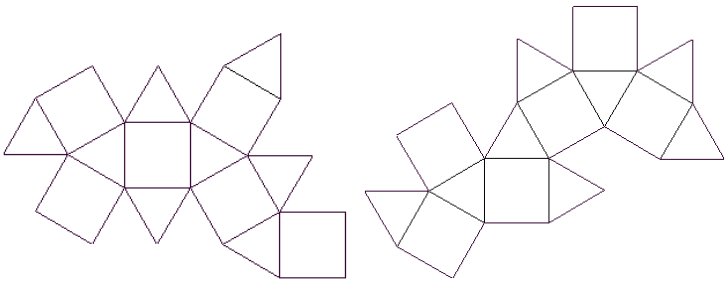
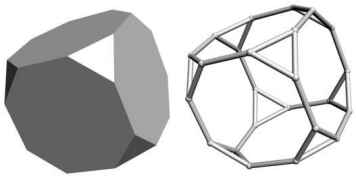
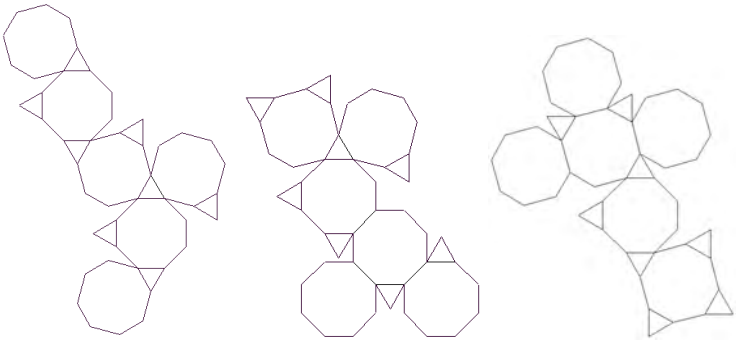
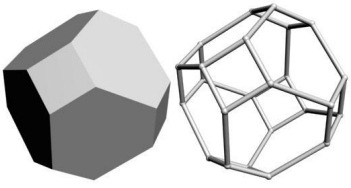
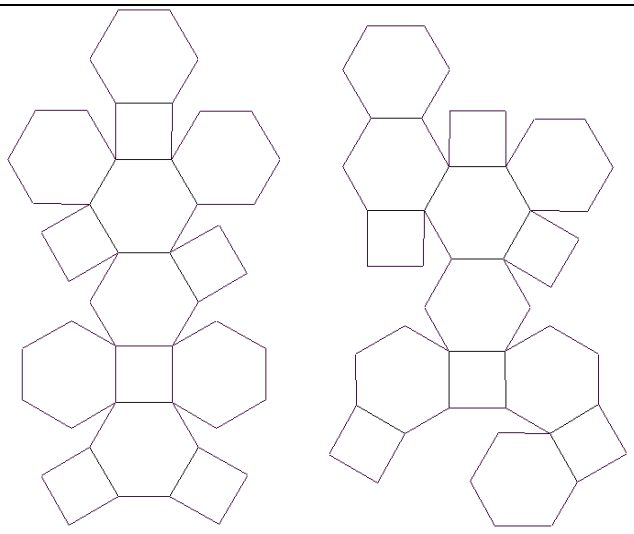
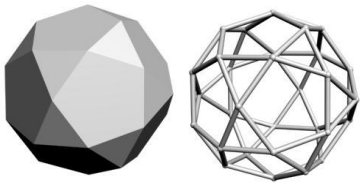
Tetrahedron  4 faces (4 triangles) 2 unfoldings	
Octahedron  8 faces (8 triangles) 11 unfoldings	
Dodecahedron  12 faces(12 pentagons) 43380 unfoldings [3]	
Icosahedron  20 faces (20 triangles) 43380 unfoldings [3]	

Table 2

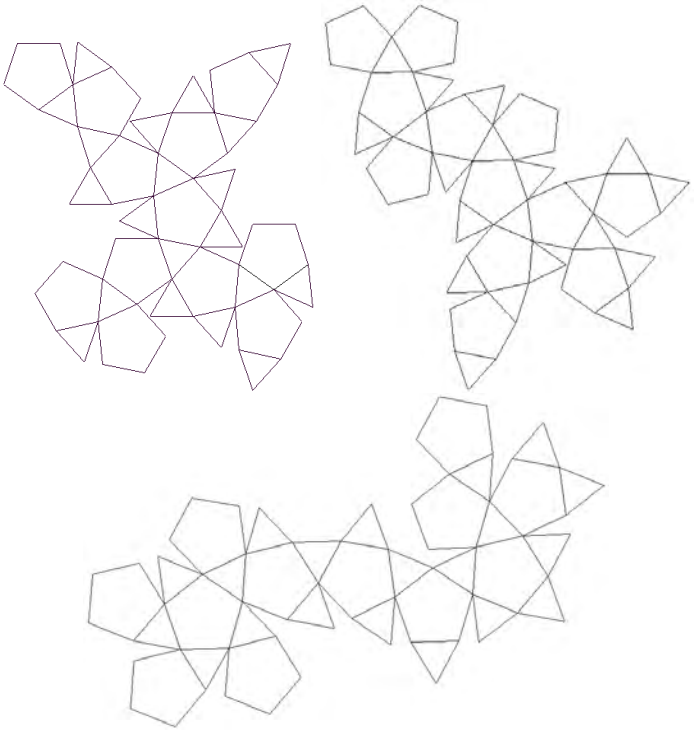
Unfoldings Archimedean solids

Archimedean solids	***Unfoldings***
Truncated tetrahedron  8 faces (4 triangles, 4 hexagons)	
Cuboctahedron  14 faces (8 triangles, 6 squares)	
Truncated cube or Truncated hexahedron  14 faces (8 triangles, 6 octagons)	
Truncated octahedron  14 faces (6 squares, 8 hexagons)	

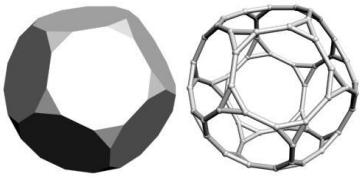
Icosidodecahedron



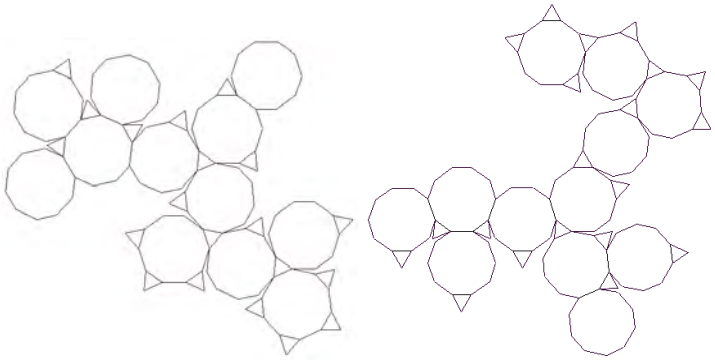
32 faces
(20 triangles, 12 pentagons)



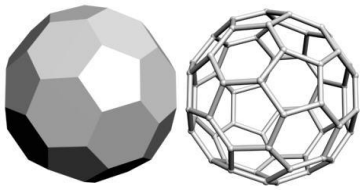
Truncated dodecahedron



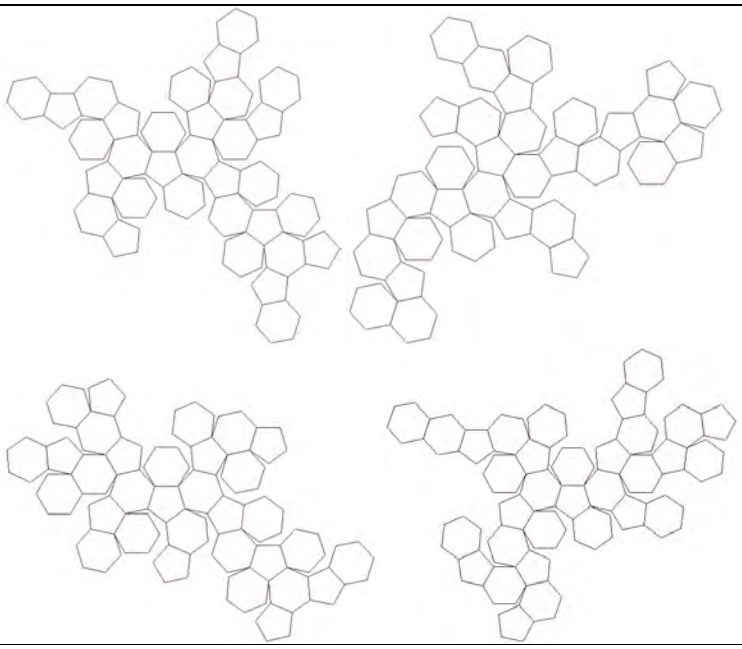
32 faces
(20 triangles, 12 decagons)



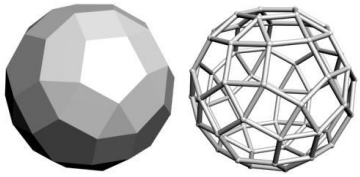
Truncated icosahedron



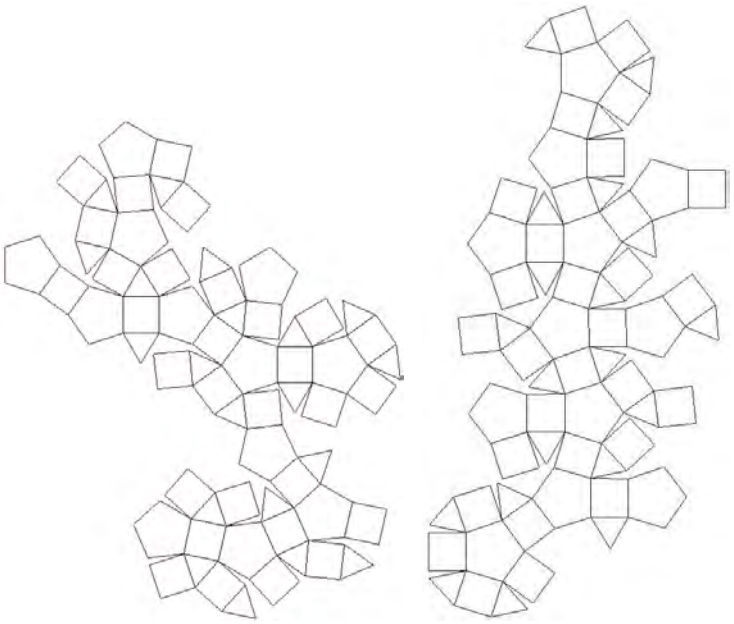
32 faces
(12 pentagons, 20 hexagons)



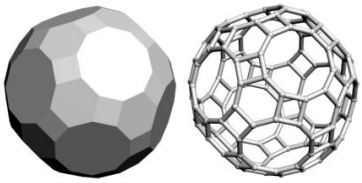
Rhombicosidodecahedron



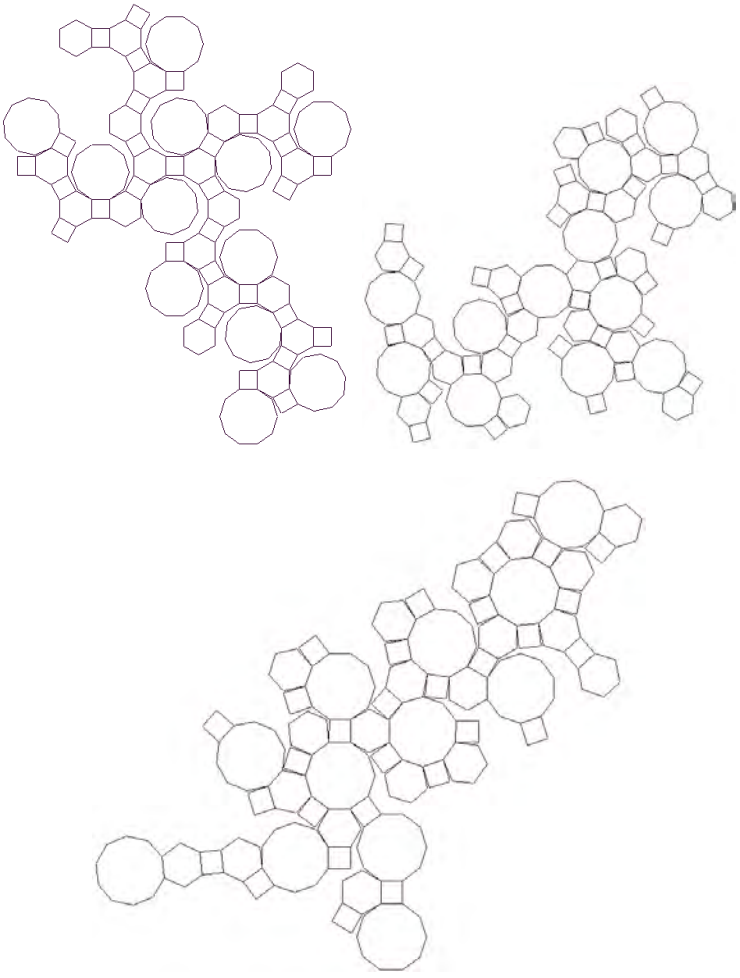
62 faces
(20 triangles, 30 squares,
12 pentagons)

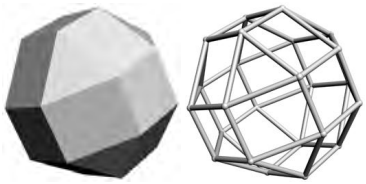
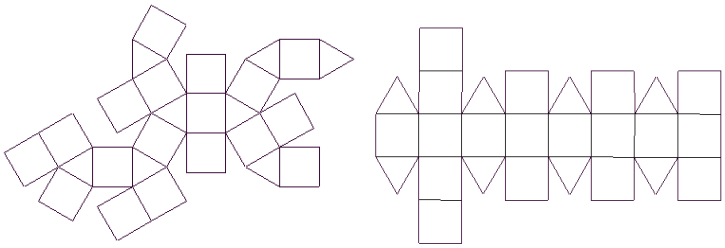
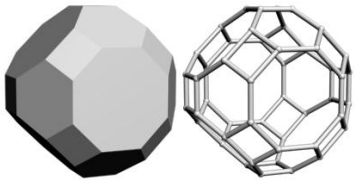
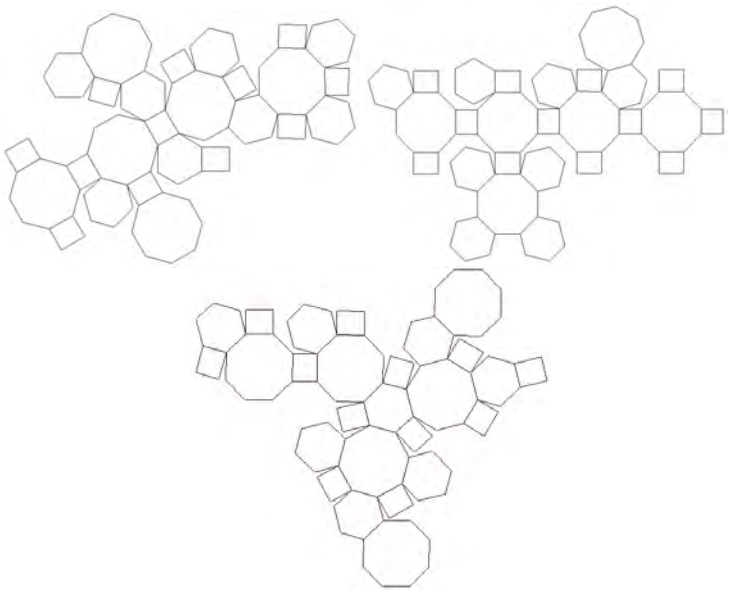


Truncated icosidodecahedron



62 faces
(30 squares, 20 hexagons,
12 decagons)



Rhombicuboctahedron  26 faces (8 triangles, 18 squares)	
Truncated cuboctahedron  26 faces (12 squares, 8 hexagons, 6 octagons)	

3. CONCLUSION

Modeling and unfolding Platonic and Arhimediene polyhedra will be using 3dsMAX program. Polyhedra modeling has been obtained with Hedra control and the Lattice modifier [1]. To obtain unfolded, I use UnwrapUVW command. Using 3dsMAX, we can animate polyhedra development, that is easier to understanding the process.

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