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Paper

# REPRODUCTION OF WORK OF ART BY AWJ:

# FLOOR OF THE SAINT MARK BASILICA

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ABSTRACT

This article describes step by step, the history of the reproduction of a work of art, that is a marble floor of the Saint Mark Basilica in Venice, Italy. A photograph of the floor has been used as a model and its reproduction served for the confection of a circular table surface. With this, a cooperation work between University and Private Sector begins and the cited table was born. For the reproduction of the constituent parts with high precision, the advanced technology of abrasive water jet cut of the University of São Paulo was used, where ceramic paving-tiles had been cut imitating the original workmanship. Laborious work of meeting these parts was followed and its glue for the confection of the cover table, elaborated by artists of the Raposo Atelier, that was crowned of success.

## 1. INTRODUCTION

Figure 1 shows the original photograph of the floor of the related work of art of mandala sent by the Raposo Atelier in January 2006, which served as the beginning of this project in an interaction between University and Sector of artistic rendering of services at Raposo Atelier. The objective of the photo was to serve as a model to carry through works of cut tiny the parts or component forms for this mosaic in the module of ultra-high pressure abrasive waterjet in the University of São Paulo to create the surface of a circular table.

Initially the surface of the table should have been built with a diameter of 2.40 m and the floor would be reproduced from paving-tiles in marble in several similar colors to the originals in which 5 colors composed the surface of the table. Later, it was modified, and the drawing dimension to a diameter of 1.50 m and instead of marble tiles was used ceramic paving-tile.

In the next items, there are described all the stages of confection of this mandala, initiating by some pertinent generalities.

## 2. GENERALITIES

Saint Mark's Church, Venice, (Figure 2) named after the tutelary saint of Venice. The original Romanesque basilica church, built in the 9th century as a shrine for the saint's bones, was destroyed by fire in 967. Byzantine architects assisted in its reconstruction, the main fabric being completed 1071. In the 12th and following centuries alterations and elaborate adornments were made and it became a splendid Byzantine monument, reflecting Venice's pre-eminent position in trade with the East. In the 14th century the front received Gothic additions. The present structure is thus a mixture of Byzantine and Gothic and incorporates materials taken from temples and Eastern ruins. Its plan is a Greek cross, with a dome over the centre and one over each arm of the cross. Across the west front extends a vestibule from which five portals open upon the Piazza San Marco. The front is incrusted with marble slabs and mosaics. In the interior the lower walls are sheathed with veined marbles. The vaults and domes are completely covered with beautifully coloured mosaics spread on a golden background. This variety of materials combine into unique harmonic architectural polychromes, effectively illuminated by a hazy light admitted through narrow openings in the domes. The so-called Four Horses of St. Mark's, in gilded bronze, stand upon the gallery over the main entrance. The only existing specimen of an ancient quadriga, or monumental four-horse chariot, they may have originally adorned a Roman triumphal arch. They were found in Constantinople and in 1204 were brought to Venice. In 1797, Napoleon carried them off to Paris but in 1815 the horses were returned to Venice. In recent years they have suffered from the effects of atmospheric pollution.

The floor of St. Mark's church is an actual marble carpet spread over no less than 2099 square meters. Following the tenets of Byzantine religious architecture, St. Mark's complies very well the principle of bipartition into earthly zone (floor and walls) and celestial part (vaulted ceilings and cupolas). The different materials used to cover the masonry underline purpose and function. The upper part of the building has a strikingly celestial and metaphysical connotation due to the light produced by the tesserae in colour glass or gold leaf, symbolising the light of paradise,

whereas the lower zone underlines earthliness with the solidity of the marbles of the floor and of the walls (rich in colours, but dull ones, and in geometrical signs).

The floor of St. Mark's includes *opus sectile* (obtained by setting out pieces of different coloured marble to create the most varied geometrical forms) and *opus tessellatum* (obtained with tiny pieces of marble or glass used to create floral motifs or animal figures), with a clear prevalence of the former technique over the latter. Both techniques have their origins in antiquity, as documented by Varro, Vitruvius and Pliny. Coexistence of the two in St. Marks testifies to the great wealth of the dukedom: it not only bought up highly precious marbles but also secured a workforce of craftsmen who, in all probability, were brought to Venice from Constantinople or Byzantine Greece, as were the architects and mosaicists. The overall floor consists of various panels, of different sizes, with geometrical and figured motifs. Certain surfaces in well-illuminated zones, such as the areas beneath the Pentecost and Ascension cupolas, are faced with great slabs of Greek Proconnesio marble, one of the first marbles to be cut into slabs. The geometrical organisation is regular and the positioning observes the principles of symmetry where possible. The nave has a sequence of larger fairly linear decoration. Near the entrance there is a large herringbone inside a large rectangle, which includes a smaller central rectangle with similar decoration. Further on towards the presbytery there is a second large rectangle that contains two rows of rhombuses and polychrome rote ("wheels") punctuated by four squares alternated with three rhombuses. The arms of the transept contain two squares: the northern includes decorations of five large Byzantine rote and four small ones interposed between them; in the southern, a lozenge-design carpet with frame is followed towards the south by four Byzantine rote. In this rigorously geometrical scheme there are also, on the margins, symbolic animals and floral elements: outstanding for their chromatic preciousness and refined execution are two pairs of peacocks in the small southern or right aisle, which have been preserved almost intact. Along the arc of the Upper Adriatic there are many examples of mosaic floors. But the floor of St. Mark's stands out for its grandeur and the preciousness and rarity of the eastern, western and North African marbles employed, as well as for the splendour of the enamels and the variety of scenes drawn from symbolism and mediaeval literature, or inspired by oriental and western fabric. The whole piece is based on an iconographic programme which is very complex for us but which could be more easily intuited by the people of the middle Ages.

Mandala is a term that comes of the Sanskrit and means circle. In the Hinduism and the Buddhism it is a used symbolic diagram in the performance of sacred rites and as a meditation instrument. Mandala is basically a representation of the universe, an intent area that serves as stowage for gods and as a point of the collection of universal forces. Team (the microcosm), mentally entering in mandala (a visual symbol of macrocosm) and continues tward its, center, is, following the analogy, guided with the cosmic processes of disintegration and reintegration. In China, the man-paths between mountains of Japan and the Tibet are basically of two types, representing different aspects of the verse of joined it: garbha-dhãtu (in the Sanskrit of the "world womb"; Japanese Taizõ-kai), where the movement is from this to many; e vajra-dhãtu (in the Sanskrit "diamond or world of thunderbolt" Japanese Kon-gõ-kaí), of many in one.

Coming back to the reality, we have examined the photograph accurately and concluded that it is a geometric drawing which needed to be reproduced, so the first step would be to try to draw the curves and straight lines that limit its constituent parts.

Thus two stages for the confection of mandala had been defined.

In the first stage the drawing of the parts in CAD (Computer Aided Design) are made for its cut, and generate archives with the extension .dxf. Additional lines are drawn and the plotline is linked from an origin point to an end point, and this is called order, made to create a path for the nozzle cut movement line in the abrasive waterjet module creating an archive with the extension of .ord. This order archive is used by the system to manufacture the parts on the CAM (Computer Aided Manufacture) of the machinery.

With two software programs named Layout and Make of the OMAX system, it is possible to generate the needed achieves. To order the way of the nozzle there is a command named path.

A second stage consisting on the assembly of the cut parts as a great puzzle and its glue was a carried out by the artists in the Atelier during the manufacture table surface while the reproducting of the mandala or the work of art.

## 3. WORKMANSHIP GEOMETRIC ANALYSIS

Careful examination of mandala sample shows the geometric forms in the mosaic, resulted from a drawing carried through with help of two types of single lines that are arcs and straight lines.

The creative artist of this mandala additionally used five diverse colours of marble that for its better visualization here are better assigned as black, yellow, red, white and green. A drawing simplified and colour of the central and peripheral region are shown in the Figure 3 and Figures 4, respectively.

When analysing of this mandala it is verified that there is  a central circle involved by a circular ring, next comes two sequences of triangles, another sequence of triangles, lozenges, and again triangles and a second ring. The ring is then surrounded by triangles, lozenges, and two kinds of mirror reflected pentagons in green and black colours. Next follows 11 tours of 36 trapezes and triangles to complete the mosaic 36 black triangles and one third external green ring to complete the mosaic. In general the polygons are composed by sides in arcs. In these polygons rarely more than a side is rectilinear, and the line straight line is radial.

Being numbered the types of geometric forms beginning from the centre until the periphery, the conclusion is that the mandala possesses 52 types of geometric forms (circle, rings triangles, lozenges and pentagons).

A more detailed analysis discloses that in the central part the artist used 8 similar forms to complete a circle later these forms were duplicated to 16, and later on to 36 per circle. In Figure 5 it is the numeration of 1 up to 52, of the geometric form of the parts with the respective colour above cited. It is seen, in this drawing that while in a direction all the forms in trapeze are red in a tour where 36 red trapezes exist, mirror forms of these trapezes are 18 whites and 18 yellows in alternating arcs. Something similar occurs with black and green triangles of this more external area. As example, part 17 can be a white or yellow trapeze.

Associating the geometric form and the colour, the artist created in a bi-dimensional space a sensation of apparent three-dimensional depth in the workmanship.

In Table 1 the relation of all the geometric forms was placed using the convention presented in Figure 5 and the corresponding colour to have an idea of the total number of parts that compose the mandala. As a result, it can be verified that the total number of parts comes to 1664. This total number of parts however is bigger, since the rings have superior dimension than paving-tiles, either being made of marble or ceramics, and therefore it is necessary to define a square, or rectangle, of which the parts would be cut. As the paving-tiles of ceramics or diemension stone square shaped parts measuring 400 for 400 mm side.

## 4. CAD DRAWING OF THE PARTS

As already related, to confection ate a part of the mosaic in the abrasive waterjet module this part needs to be drawn CAD in a program computer and saved in an archive that has the extension dxf.

It was also defined, in this phase for the accomplishment of the cuts the final dimension of the total diameter of mandala, that must have a ray of 750 mm, or diameter of 1.50 m.

Moreover, it was decided that the mosaic would be made in ceramic paving-tiles supplied by Raposo Atelier, in five diverse colours. Drawings then had been prepared with the name of archive of DES001.dxf, enclosing the square of 400 mm of side. Figures 6, 7, 8, 9 and 10 show some of the done and commanded drawings. In each one of the drawings the number of the part is written down.

The lines in green in these drawings indicate simple movement of the nozzle. In each one of the parts to be cut, in order to have a better result it is necessary to make an extra live both in the beginning and at the end o f the cut.

The external green line is only the limit the tiles that are a square with 400 mm side. The background net in clear grey tonality serves as scale and has a spacing of one inch (25,4 mm).

When the line is coloured the same one indicates the quality of the cut. In the five Figures above of numbers 5 up to 9 the cut colour has intermediate quality 3 or middle. This colour goes from red until blue. Dark blue is the best quality. Choosing a quality, the system automatically gives to the nozzle a translation speed that is slower as better the selected quality is.

In Table 2 the relation of the 35 drawings is presented, they are necessary to manufacture of the workmanship. Five of there, are presented in the Figures 5 until 9. In this table the first column indicates the name of the archive, whose extension is dxf. When the path command orders this archive, another with the same name is created only with an extension ord. This archive informs to the program make or confection when the nozzle must only dislocate or work and cut.

Table 2 was constructed indeed for two reasons, first to have an initial evaluation of the cut time in the abrasive water jet module of EPUSP and second to determine the number of tiles of each of the five colour needed for the confection of the mandala. In this Table there are the following:

1 The first column identifies the name of the drawing in CAD with its extension that is DXF.
2 The second column gives the number of the geometric form or motive in the used convention of Figure 5.
3 In the third column appears the colour of the tile.
4 The fourth column gives the total number of parts which drawing can be put in one tile with square dimension and side of 400 mm.
5 The five next columns are the number of tiles with black, red, yellow, white or green colour needed to manufacture the mandala.
6 The tenth column gives the total number of tiles.
7 The eleventh column gives the time in minutes for the cut of any of these tiles when quality of 3 or good finishing is chosen.
8 Finally, the twelfth column gives the abrasive consume in kilograms.

Therefore, examining, the last Table line it is possible to verify that the total number of part composing the workmanship is 1,597. The necessary materials for its manufacture are 37 square ceramic tiles of 400 mm side. The following tiles were used: 9 black, 10 red, 5 yellow, 5 white and, 8 green.

The total time to cut the mandala, if a quality of 3 or good finishing is used, in 697 minutes or any over 11 hours. The abrasive consume are in the order of 241 kilograms.

A similar simulation was made for highest quality 5. In this case, the cut time is increased to 926 minutes, or about 16 hours. On the other hand, the abrasive consume in this second alternative was of 396 kilograms.

## 5. PARTS CUT

Carry out the 35 drawings of Table 2 in CAD archives the next step was the cut of the parts in the abrasive waterjet module, that use the software named make.

In the utilization of this program it is necessary to indicate the material that is the target to cut, and also its thickness (30 mm in our case). With these information, the program calculates the consumed time to cut the parts and the consumed abrasive quantity, and the total perimeter that where cut, and also other important data. In the cut the following parameters where used: sapphire jewel orifice with a diameter of 0.3556 mm (0.014 inch) focus tube in the length of 90 mm and inner diameter of 0.762 mm (0.030 inch). The abrasive was garnet with 80 #. The stand off was 3 mm.

Table 2 presented this time and the abrasive consumption. The normally employed abrasive is a mineral named garnet, granulated powder that is accelerated by the water jet and attacks

perpendicularly the target material with speeds of the order of 200 m/s; 720 km/h. The total perimeter to be cut for the manufacture of all the parts is in the order of 238 meters.

Some photographs of final cut parts in the abrasive water jet module are presented next. In the Figure 11 is shown the part number 1 in cut in a ceramic tile. Figure 12 presents the part number 2 that is the first ring cut in a black ceramic tile. In the Figure 13 (part number 52) parts of the outer ring that were cut in green ceramic tiles can be seen. In the Figure 14 a set of parts in the form of trapeze with a yellow colour are shown. Figure 15 presents also trapezes but in white colour. Figure 16 is a photograph of retails that was created by the system in manufacture of the parts.

## 6. PARTS ASSEMBLAGE AND GLUE

The Raposo Atelier received the cut parts and assembled them as a great puzzle of pieces. During this work, a set of defects wass noticed and new drawings were needed for preparing new parts to be cut. These defects were the following: Some parts were drawn in greater dimension than the original model others presented some cracks that occurred during its cut. Thus, in a second phase an optimisation work was done and is described in the next item.

## 7. CUT OPTIMIZATION

Atelier Raposo prepared the Table 3 with a relation of the parts that present some defect and use for its identification the number of Figure 5.

In this Table 3, about 239 parts were cut and the most frequent were little cracks, mainly related to some non-homogeneity of the original ceramic tile material the jet impact can be diffracted some original micro fracture. In the total of the work this quantity is relatively low and corresponds to only 15%.

For the realization of this optimisation work to cut the parts 5 new ceramic tiles were necessary one of each colour.

## 8. CONCLUSION

Figure 17 shows a photograph of the mandala of the nice workmanship floor on the Basilica of Saint Mark in Venice, Italy, reproduced as a surface of a circular table in ceramic tiles. The original circle of the floor has a dimension of 3.5 meters and its reproduction as circular table a diameter of 1.5 meters.

## 9. ACKOWLEDGMENT

The Authors wish to register here his acknowledgment to FAPESP and CNPQ for the financial support of the waterjet project researches.

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## 11. TABLES

**Table 1**. Geometric forms of the mosaic and its colour.

| **N°** | **Form** | **Qnty** | **Colour** | **No** | **Form** | **Qnty** | **Colour** |
|---|---|---|---|---|---|---|---|
| 1 | Central circle | 1 | Red | 27 | Triangles 2 arc sides | 36 | Black |
| 2 | 1st ring | 1 | Black | 28 | Triangles 2 arc sides | 36 | Green |
| 3 | Triangles arc sides | 8 | Yellow | 29 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye |
| 4 | Triangles arc sides | 8 | Red | 30 | Trapezes 3 arc sides | 36 | Red |
| 5 | Triangles arc sides | 32 | Black | 31 | Triangles 2 arc sides | 36 | Black |
| 6 | Lozenges arc sides | 32 | Red | 32 | Triangles 2 arc sides | 36 | Green |
| 7 | Triangles arc sides | 32 | Black | 33 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye |
| 6 | 2nd ring | 1 | Red | 34 | Trapezes 3 arc sides | 36 | Red |
| 9 | Triangles arc sides | 36 | Black | 35 | Triangles 2 arc sides | 36 | Black |
| 10 | Lozenges arc sides | 36 | Yellow | 36 | Triangles 2 arc sides | 36 | Green |
| 11 | Pentagons arc sides | 36 | Black | 37 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye |
| 12 | Pentagons arc sides | 36 | Green | 38 | Trapezes 3 arc sides | 36 | Red |
| 13 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye | 39 | Triangles 2 arc sides | 36 | Black |
| 14 | Trapezes 3 arc sides | 36 | Red | 40 | Triangles 2 arc sides | 36 | Green |
| 15 | Triangles 2 arc sides | 36 | Black | 41 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye |
| 16 | Triangles 2 arc sides | 36 | Green | 42 | Trapezes 3 arc sides | 36 | Red |
| 17 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye | 43 | Triangles 2 arc sides | 36 | Black |
| 18 | Trapezes 3 arc sides | 36 | Red | 44 | Triangles 2 arc sides | 36 | Green |
| 19 | Triangles 2 arc sides | 36 | Black | 45 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye |
| 20 | Triangles 2 arc sides | 36 | Green | 46 | Trapezes 3 arc sides | 36 | Red |
| 21 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye | 47 | Triangles 2 arc sides | 36 | Black |
| 22 | Trapezes 3 arc sides | 36 | Red | 48 | Triangles 2 arc sides | 36 | Green |
| 23 | Triangles 2 arc sides | 36 | Black | 49 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye |
| 24 | Triangles 2 arc sides | 36 | Green | 50 | Trapezes 3 arc sides | 36 | Red |
| 25 | Trapezes 3 arc sides | 36 | 18 Wh, 18 Ye | 51 | Triangles 3 arc sides | 36 | Black |
| 26 | Trapezes 3 arc sides | 36 | Red | 52 | 3rd Ring | 1 | Green |
| | Subtotal | 763 | | | Subtotal | 901 | |
| | **Total** | **1664** | | | | | |

**Table 2.** Part Drawing name, its colour, and quantity, number of tiles by colour and totals, time of cut and abrasive consumed.

| Drawing | motive | colour | Part | Black | Red | Yellow | White | Green | Σ | Time | Abrasive |
|---|---|---|---|---|---|---|---|---|---|---|---|
| des001 | 1 4 6 | Red | 41 | | 1 | | | | 1 | 16.197 | 5.54 |
| des002 | 3 10 13 | Yellow | 44 | | | 1 | | | 1 | 23.591 | 5.11 |
| des003 | 2 5 7 9 | Black | 65 | 1 | | | | | 1 | 30.826 | 9.78 |
| des004 | 8 14 | Red | 37 | | 1 | | | | 1 | 17.154 | 6.15 |
| des005 | 11 | Green | 36 | | | | | 1 | 1 | 20.222 | 7.62 |
| des006 | 12 | Black | 36 | 1 | | | | | 1 | 21.021 | 7.51 |
| des007 | 13 17 21 | White | 54 | | | | 1 | | 1 | 22.860 | 7.91 |
| des008 | 17 21 25 | Yellow | 54 | | | 1 | | | 1 | 23.854 | 8.37 |
| des009 | 29 33 | Yellow | 36 | | | 1 | | | 1 | 17.595 | 6.28 |
| des010 | 37 41 | Yellow | 36 | | | 1 | | | 1 | 18.580 | 6.74 |
| des011 | 45 49 | Yellow | 36 | | | 1 | | | 1 | 19.270 | 7.06 |
| des012 | 25 | White | 18 | | | | 1 | | 1 | 12.214 | 5.11 |
| des013 | 29 33 | White | 36 | | | | 1 | | 1 | 17.595 | 6.28 |
| des014 | 37 41 | White | 36 | | | | 1 | | 1 | 18.580 | 6.74 |
| des015 | 45 49 | White | 36 | | | | 1 | | 1 | 10.147 | 3.70 |
| des016 | 18 22 | Red | 72 | | 1 | | | | 1 | 31.074 | 10.84 |
| des017 | 26 | Red | 36 | | 1 | | | | 1 | 16.651 | 6.85 |
| des018 | 30 | Red | 36 | | 1 | | | | 1 | 17.191 | 6.14 |
| des019 | 34 | Red | 36 | | 1 | | | | 1 | 17.791 | 7.41 |
| des020 | 38 | Red | 36 | | 1 | | | | 1 | 18.173 | 6.62 |
| des021 | 42 | Red | 36 | | 1 | | | | 1 | 18.841 | 6.82 |
| des022 | 46 | Red | 36 | | 1 | | | | 1 | 19.191 | 6.98 |
| des023 | 50 | Red | 36 | | 1 | | | | 1 | 19.518 | 7.10 |
| des024 | 15 16 19 20 | Black | 72 | 1 | | | | | 1 | 21.323 | 6.63 |
| des025 | 15 16 19 20 | Green | 72 | | | | | 1 | 1 | 21.323 | 6.63 |
| des026 | 23 24 27 28 | Black | 72 | 1 | | | | | 1 | 21.157 | 6.54 |
| des027 | 23 24 27 28 | Green | 72 | | | | | 1 | 1 | 21.157 | 6.54 |
| des028 | 31 32 35 36 | Black | 72 | 1 | | | | | 1 | 24.354 | 7.97 |
| des029 | 31 32 35 36 | Green | 72 | | | | | 1 | 1 | 24.354 | 7.97 |
| des030 | 39 40 43 44 | Black | 72 | 1 | | | | | 1 | 25.645 | 8.51 |
| des031 | 39 40 43 44 | Green | 72 | | | | | 1 | 1 | 25.645 | 8.51 |
| des032 | 47 48 | Black | 36 | 1 | | | | | 1 | 13.323 | 4.43 |
| des033 | 47 48 | Green | 36 | | | | | 1 | 1 | 13.323 | 4.43 |
| des034 | 51 | Black | 18 | 2 | | | | | 2 | 20.710 | 7.66 |
| des035 | 52 | Green | 6 | | | | | 2 | 2 | 16.194 | 6.76 |
| **Totals** | | | **1597** | **9** | **10** | **5** | **5** | **8** | **37** | **697.000** | **241.00** |

**Table 3**. Parts that were repeated by diverse reasons.

| Number | Colour | Quantity | Reason |
|---|---|---|---|
| 3 | Yellow | 8 | Greater |
| 4 | Red | 8 | Greater |
| 6 | Red | 2 | Lacked |
| 7 | Black | 1 | Cracked |
| 12 | Green | 1 | Cracked |
| 13 | Yellow | 18 | Inverted |
| 13 | White | 3 | Cracked |
| 14 | Red | 36 | Inverted |
| 18 | Red | 1 | Cracked |
| 23 | Black | 36 | Equal to 16 |
| 24 | Green | 36 | Equal to 15 |
| 27 | Black | 36 | Equal to 19 |
| 28 | Green | 36 | Equal to 20 |
| 29 | Yellow | 1 | Cracked |
| 31 | Black | 2 | Cracked |
| 33 | Yellow | 1 | Cracked |
| 36 | Black | 1 | Cracked |
| 37 | Yellow | 1 | Cracked |
| 38 | Red | 1 | Cracked |
| 39 | Black | 4 | Cracked |
| 43 | Black | 2 | Cracked |
| 44 | Green | 1 | Cracked |
| 45 | Yellow | 1 | Cracked |
| 47 | Black | 1 | Cracked |
| 48 | Green | 1 | Cracked |
| | **Total** | **239** | |

## 12. GRAPHICS

**Figure 1**.Photograph of the marble floor in Saint Mark Basilica, in Venice, in the shape of mandala.

**Figure 2.** General view of Saint Mark Basilica at Venice, Italy.

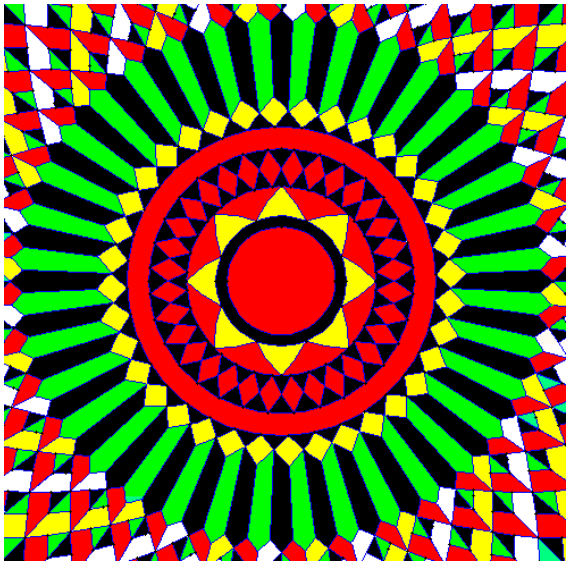

**Figure 3**. Central view of the mandala.

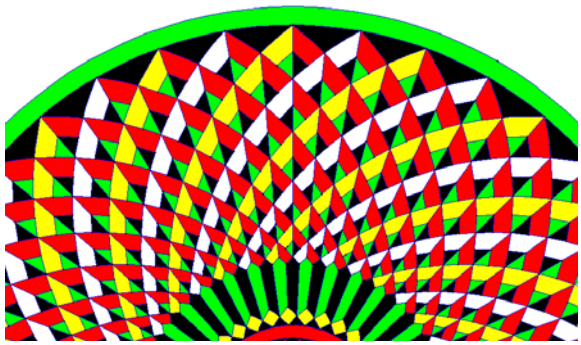

**Figure 4**. Periphery view of the mandala.


**Figure 5.** Number Convention of geometric forms.

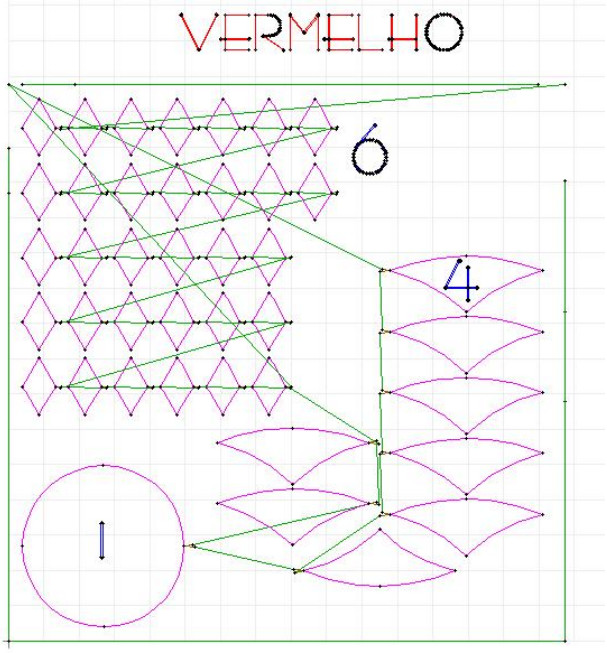


**Figure 6.** Red tiles with drawings of parts number 1, 4 and 6.

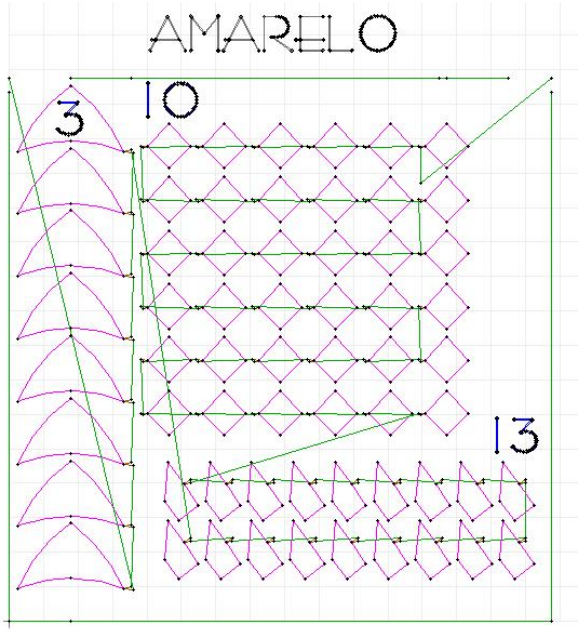


**Figure 7** Yellow tiles with drawing of parts 3, 10 and 13.

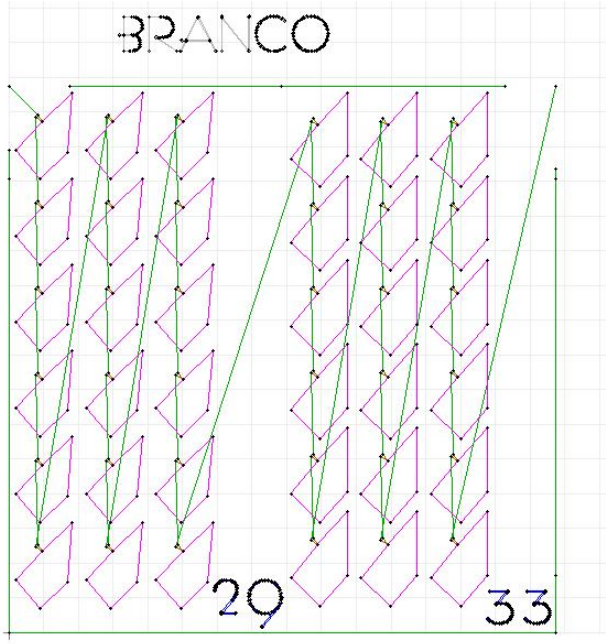


**Figure 8.** White tiles with drawing of parts 29 and 33.

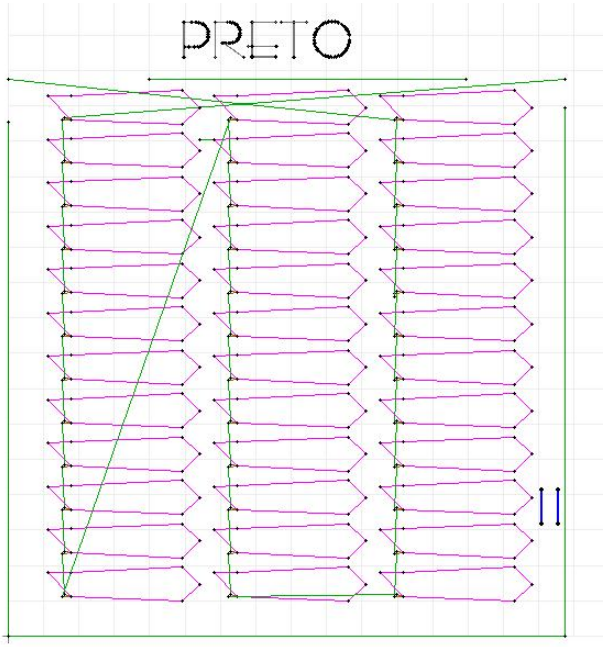


**Figure 9.** Black tiles with drawing of part 11.

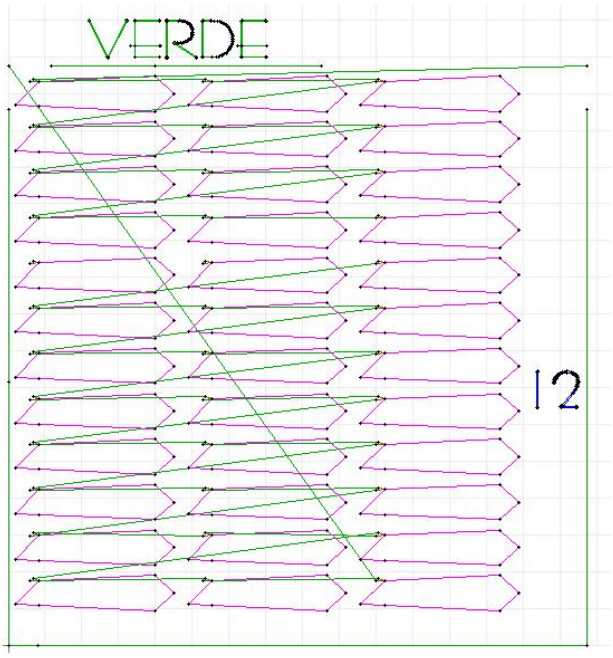


**Figure 10.** Green tiles with drawing of part 12.

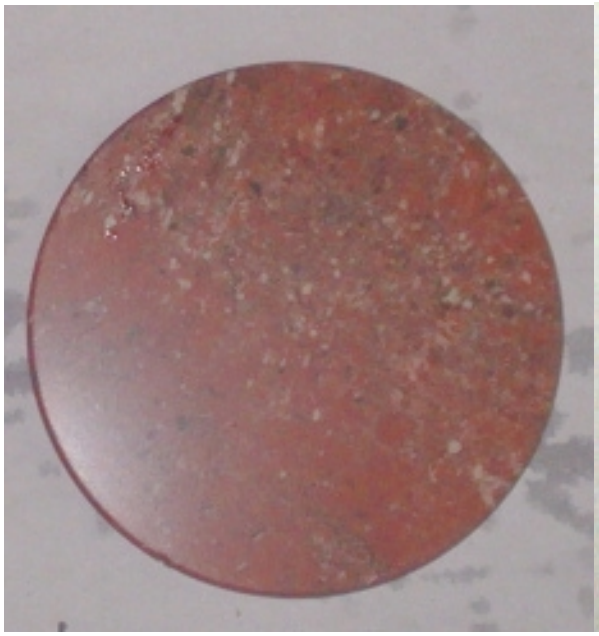

**Figure 11.** Red central circle – part number 1.

**Figure 12.** Black first ring – part number 2.

**Figure 13.** Green last ring – parts number 52.

**Figure 14.** Yellow trapezes – part number 13.

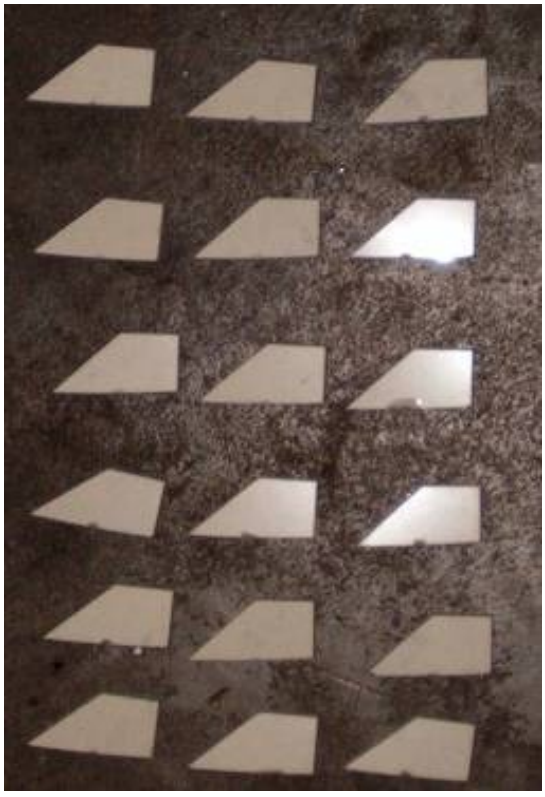

**Figure 15.** White trapezes – part number 13.

**Figure 16.** Retails of the used tiles to cut the parts.

**Figure 17.** View of Saint Mark Mandala after assembling the parts and used as circular table.