INVESTIGATION OF FORM CLUSTERS MADE OF SMALLEST SEMANTIC UNITS AND PATTERNS THEY CREATE AS BUILDING BLOCKS OF *KUNDAN* JEWELLERY

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India has a rich tradition of jewellery and there are a number of styles of jewellery making in practice. Kundan is a type of traditional Indian jewellery that uses a framework of gold crafted in intricate details. A smallest semantic unit, often identifiable by a name, is fundamental building block of Kundan jewellery. An assemblage of these put together in a certain manner constitutes a form cluster, which in turn by repetition, constitute an article. This study is focussed on forms created by smallest semantic units and their interplay with each other. To study those methodically, photographs, renderings and shop floor presentation montages were meticulously traced out and converted into vector artworks. Each artwork was then labelled and various semantic units used in construction of that article tabulated. Study elucidates preferential semantic units, arranged in a particular manner as form clusters. Form clusters created by these preferential semantic units consequently influence likeness in a positive way.

Keywords: Kundan, Jewellery, Form Clusters, Semantics.

1. INTRODUCTION

India has a rich tradition of jewellery and there are a number of styles of jewellery making in practice. *Kundan* is a type of traditional Indian jewellery that uses a framework of gold crafted in intricate details. The gemstone is set from visible front using a foil of very high purity, 24 carat, gold foil. For the purpose of setting a very thin foil (rolled in a mill) is used. At such fineness and low thickness gold becomes very pliable. Parts and pieces of this foil are pressed in cavities left around the gemstone, partly set with setting paste Figure 1. By pressing layer after layer of gold, space around gemstone is slowly filled with solid gold, this pressing is done by a pointed tool that gives good pressure and negotiates tight corners. Sometimes mild heat is applied to fuse gold together, creating flush stone close setting [1]. Gold surface holding gemstone in place is evened out using an engraver that leaves behind a lustrous surface. This style of setting was different from the western style of prong or claw setting brilliant cut diamonds and formally cut gemstones [2, 3], in this style both cabochons and minimally faceted stone are used for flush setting. Backside of *Kundan* jewellery is embellished with hard enamel typically red green and red blue colours. This makes back side of jewellery equally pleasurable to look at. Backs often outshone the front [4], a feature that makes jewellery wearable from both sides.

A smallest semantic unit, often identifiable by a name, is fundamental building block of *kundan* jewellery. An assemblage of these put together in a certain manner constitutes a form cluster, which in turn by repetition, constitute an article, Figure 2. A theme created by a form cluster is carried to

Figure 1. Gemstone setting using pliable gold foils. *Source*: Kundan workshop, Ahmedabad.
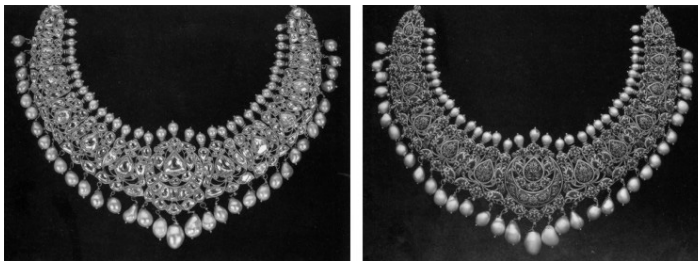

Figure 2. Kundan Necklace, smallest semantic units & form. *Source*: Balakrishnan R. U., 2004, Dance of the Peacock.

various pieces in a particular set, typically neck pieces (or *Kanthi*/necklaces), wrist pieces (*Kangan*), ear pieces (*Latkan*) and rings (*Angoothi*).

Semantic units have their own symbolism and draw inspiration from nature, both plant and animal (Flora & Fauna) [5, 6]. In another study by Vyas & Bapat, 99 of such smallest semantic units were recognized [7] that were individually identifiable by their names like *Koile, Daudi paan* and *Jau* etc. These smallest semantic units, by way of analogy of letters (and ligatures) of alphabet, were used in combination with other semantic units to constitute form clusters (words), these in turn were used to form the article (sentences) and sets (paragraphs as, several coherent lines on a theme). Jewellery articles namely, a neck piece, two bangles, a *Mangteeka* and a pair ear rings constitute a basic set. A progression from basic curves that make smallest semantic units to a set of jewellery comprising of various articles could be seen as Figure 3.
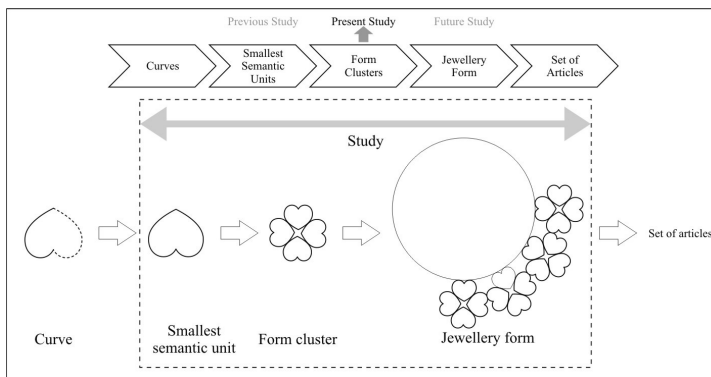

Figure 3. Progression from basic curves that make smallest semantic units to a set of jewellery.

- Curves
- Smallest semantic units
- Form clusters
- Jewellery (overall form)
- Set of articles (following a theme)

   Curves which created smallest semantic units were kept out of study as they acquired a pertinent name and meaning only as a smallest semantic unit. Similarly, sets were also kept out of study as the same visual language of a necklace was carried to other article like bangles and ear pieces (*Latkan*).

1.1. Form Clusters

As observed, in a previous study, 99 semantic units were identifiable by their names. These as basic building blocks were used in creation of *Kundan* articles. The semantic units, aesthetically pleasing themselves were even more interestingly presented in combination with others. At a glance there appeared a vast number of possibilities even with a limited number of smallest semantic units. In practice, it was found, certain principles and guidelines are followed in structure of *Kundan* articles. There were four particular ways in which a meaningful combination of a form clusters, a right *Gothavani* was achieved. There are several combination possibilities by altering following facet either alone or in combination, as follows.
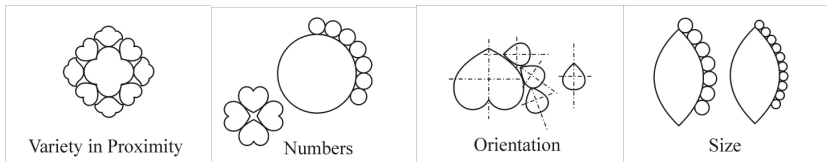

Figure 4a,b,c&d. Ways to achieve a meaningful form cluster, *Gothavani*.

   There existed an order in which semantic units have a natural inclination to gel with a select few, whereas it may not gel as effective with others. Following these guidelines meaningful combinations, that are aesthetically pleasing, are achievable. An unsystematic use does not lead to a meaningful and significant form clusters, form clusters therefore are made of combination of semantic units in a manner that is having an important visual effect. Combinations that had the right *Gothavni* result into a meaningful form cluster.

1.2. Gothavani

Gothavani is a process in which an aesthetically pleasing combination is achieved. A form cluster has a focal semantic unit, usually placed centrally or slightly larger. Other constituting semantic units that gel well with the theme were placed around that central unit in proximity, orientation and size that is appealing to eye.

   Processof strategically placing these semantic units, fulfilling these objectives, to achieve a pleasing composition is good *Gothavani* as demonstrated by example in Figure 5.
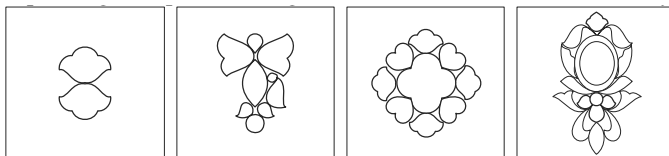

Figure 5. Compositions of Semantic units that gel well, *Gothavani*.
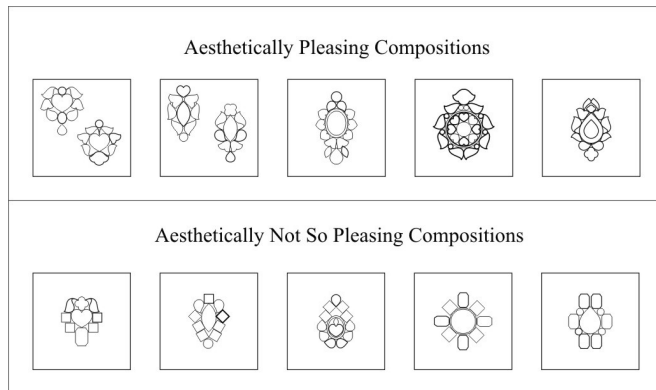
Figure 6. Examples of aesthetically Pleasing and not so pleasing compositions.

Gothavni as a concept is explained with illustrations, a central member is chosen in form of a particular semantic unit and two combinations are drawn depicting combinations marked check and cross. The pleasing combinations were due to a rhythmic motion, while the other had something that hits the eye as something out of place, depicted in Figure 6.

2. METHODOLOGY (TO FIND MOST FREQUENTLY USED SEMANTIC UNITS)

From initial studies, inductively, it was found that there are some semantic units that are more frequently used as compared to others. This was further investigated to see if there are preferential semantic units a reason for preference. Literature was silent on existing methodologies for this type of research so new techniques were worked out. The research though in early stages was path breaking and significant. For this purpose a sample of fifty five neck pieces in form of sketches, was collected from books, photographs and ongoing works [8]. Collecting ongoing works proved to be the most difficult part as Information and resources are not easily available and rather protected for the fear of competition by other jewellers. Jewellers and *Kundansaaz* were approached with a request to share line arts or photographs of live works and it took considerable time, efforts and confidence building measures to win their trust to have access to their material. Once convinced about academic nature of research they started sharing information and resources. Material collected from these ongoing works had merits of being contemporary and up to date with time spirit [9].

To methodically study photographs, renderings and shop floor presentation montages were meticulously traced out and converted into vector artworks. The vector artworks had a technical drawing like quality, were drawn in form of single line, free from perspective. A full frontal picture was taken for the purpose of conversion to artworks, that gave maximum details and effect angle of presentation was taken care of. A folio in form of set of 55 artworks was created that were independent of depiction of colour and fuzzy boundaries in photography. This method had a merit in studying overall form and at the same time minute details like cluster forms could be studied. Interplay of smallest semantic units with other semantic units was revealed in a clear way.

Each artwork was then labelled and various semantic units used in construction of that article tabulated. This was done on a DIN A4 size paper providing ample space for labelling and listing of semantic units, as depicted in Figure 7. These tables contained name, that particular semantic unit was identified with and number of times the same were used in construction of that particular article.

The contents of these tables were compiled in excel sheet, frequency distribution was used to determine frequently used semantic units. Most frequently used semantic units reveal a preferential inclination towards symmetric forms. As methodical research in domain of jewellery was in its early emerging stages, findings were presented to panel of five *Kundan* experts for validation. Panel
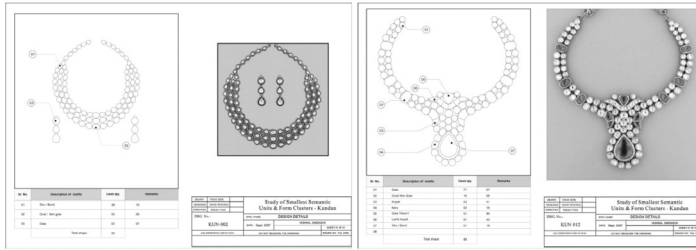
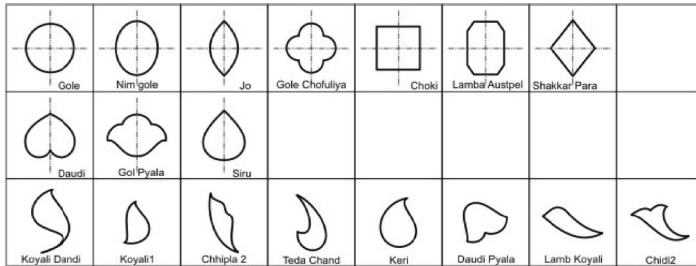**Figure 7.** Labelled Artworks for methodical study.

Figure 8. Preferred semantic units, primarily having symmetry.

consisted of three *Kundansaaz*, one jeweller and one designer to cover identified aspects. Findings were discussed at length and a concurrence of views was evident. Their suggestions were incorporated in study. Following illustration Figure 8, shows most frequently used semantic units, these were used for development of form clusters for further studies.

It is evident that smallest semantic units, having two or one axis of symmetry were more preferred. In list there were 7 with two axis of symmetry and 3 with one axis of symmetry. There is a plausible explanation for this occurrence on two levels. These units were not only familiar shapes but they were also fabrication friendly due to their simple geometry. These semantic units were used primarily for creation of form clusters and thereafter patterns in further research to gain insight into factors influencing user preferences.

3. FORM CLUSTER AND PATTERN CREATION

A dark background made of wax was used as a surface by jewellers to test overall form of an article. A colour such as, Prussian blue, from carbon papers was used to provide good contrast against metallic gold. They drew a curve (*Chaap*) as a visual reference and scribed a vertical central line prior to placing semantic units to make a form cluster as central piece. The same was repeated to left and right of the centreline to achieve overall jewellery form. This approach was adaptable to be developed as a research tool.

This was further explored to find out geometry of these curves. They were found to be best fitting between two circles of diameters 108 to 125 millimetres. The most frequently used had a diameter of 115 millimetres, as depicted in Figure 9.

These dimensions were found to be in conformance with Anthropometric dimensions (for ergonomic design practice) for Indian population of women [10]. Quarter to two third, of an arc of this circle is used for compositions. It is an established practice to use a central form cluster and add even numbers to left and right sides, making it symmetrical around a central axis. This arrangement regardless of numbers on either side, always gave an odd number ($2n + 1$, an additive odd number
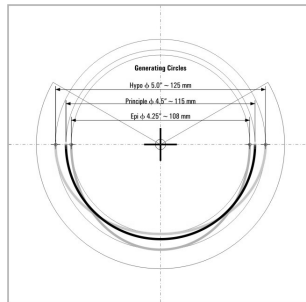
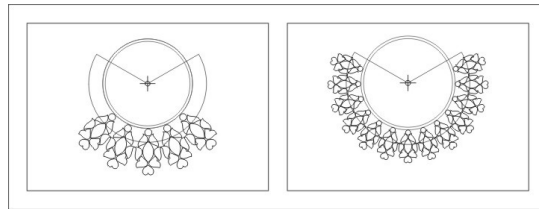**Figure 9.** Geometry of curves, best fitting circles.

Figure 10. Articles with a heavy and dense appearances.

generator was used, considered auspicious in traditionally held beliefs). A more rational explanation was a focal attraction of a central piece, with a visual balance achieved by symmetry.

Articles with a heavy appearance having larger size of constituting semantic units, form clusters were used in fewer numbers. Articles with a dense appearance constituted of relatively smaller semantic units, form clusters were used more in numbers as in Figure 10.

Kundan jewellery is normally made as a complete set which comprises of a necklace, a pair of bangles, a pair of ear pieces and a *Mangteeka* having same visual language. Jewellers start composition of form clusters to create neckpieces, as they are best viewed from the front having largest area and are the heaviest article in terms of weight. Once most pleasing appearance is created in a neckpiece, Form clusters are scaled down to create ear pieces and bangles. A necklace, therefore, was a natural choice, well suited for development as a research tool.

A design method followed for making overall form was establishing a centreline and scribing an arc as mother curve, as reference. At the intersection of centreline and mother curve, first form cluster is drawn and optimized visually for the right size. Having achieved a visual balance same form cluster was repeated on either sides to complete neckpiece. This covers a quarter to two third arc of a circle rest of the perimeter required for fitting users neck is covered by a silken tassel with a slider for adjustments. For use the slider was moved to backside, enough to pass over head. Once piece is worn and sits well in place the slider is slid back.

4. PROPOSITION OF A TOOL

Jewellers have to struggle with this interpretation of 'a little bigger', 'a little smaller', 'a little closer' or 'a little loose' often, ironically, translating them into precise instructions for fabrication. There was a strongly felt need to have a tool which made measurements possible, enabling mathematical interpretation of these feedbacks expressing needs. The inspiration came in form of stone mason's marks [11] which was used as underlying mother grid as base to make identification marks as in Figure 11.
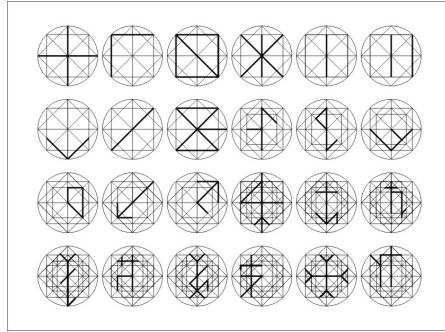
Figure 11. Stonemasons grid as underlay. *Source*: Mollerup P.,2004, Marks of Excellence-The history and taxonomy of trademarks.
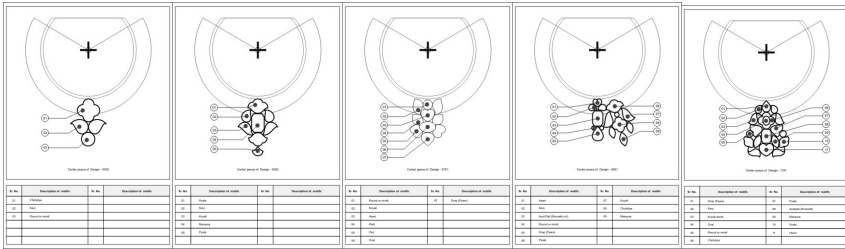

Figure 12. Form clusters with progressively increasing number of smallest semantic units.

A mother circle is proposed as an underlay reference grid to measure these aspects empirically. Three concentric circles were drawn, depicting maximum and minimum range around a central principle circle of diameter 115 millimetres, this circle was the measurement most often found in use on shop floor. The circle inside this is called epi-circle the one outside is called hypo-circle for purpose of understanding. They draw inspiration from words epi and hypo cycloids. A crosswire was laid in the centre of these circles and a two third sector of the principle circle was marked out as guideline for placing the semantic units.

For testing the effect of numbers of constituting semantic units in a from cluster, a form cluster was created using three smallest semantic units. A set of five form clusters as in Figure 12, was created progressively by increment of two semantic units at a time, thus creating a scale to gauge preferences amongst form clusters made of three semantic units to eleven semantic units.

A meaningful form cluster that followed *Gothavani* was placed on the principle circle with its apex touching the bottom of principle circle, centre aligned. This form cluster was rotated around the centre of principle circle to create overall form of the necklace. This point, where the apex touched the principle circle was called the point of contact and for calculation of cluster pitch the angular distance between two points of contact was converted to linear measurement as in, Figure 13.

The maximum angular limit was set at two third of the overall circle. With use of a principal circle as a basic grid, Different levels of fineness were made by making size of the cluster larger or smaller, as in Figure 14a &b. A larger size of form cluster required lesser number to cover the arc while a smaller size called for more numbers to be repeated.

With this approach Cluster pitch from conceptual description thus became defined and measureable. Typical advantages and merits of this scientific method were as follows:

• Cluster pitch became calculable by conversion of angular measurement to linear measurement. The arc length covered by form clusters divided by total number of form clusters gives a cluster pitch in millimetres. It became possible to study effect of altering the same with firmness.
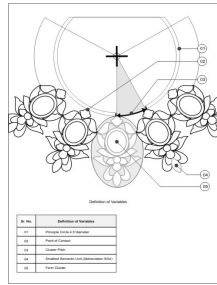
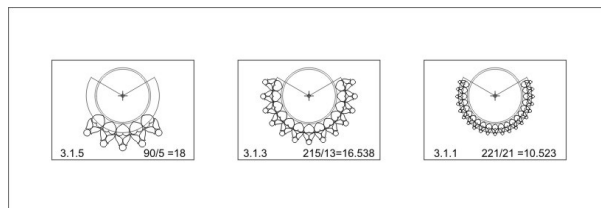**Figure 13.** Principle circle, form cluster and cluster pitch.

Figure 14. Diffrent levels of fineness of cluster pitch.

- Cluster size became measurable in vertical as well as horizontal dimensions, calculable as box dimensions (along with other features like orientation and relative placement)
- A total number of clusters can be predetermined for purpose of calculations.
- Within a cluster the variety, size, orientations and numbers became controllable.
- It gave a visual comparison, in form of proportion, with reference to the principle circle.

5.   LIMITATION OF THE STUDY

Meticulous work was carried out in form of illustration and cataloguing, still there were limitations felt during study. Primary limitation was even with a controlled number of semantic units plausible combinations of form clusters were numerous. This was, to an extent, controlled by making three form clusters, within given parameter of numbers of semantic units. These were deliberated upon by *Kundansaaz* before selecting one for development as a tool. Second limitation was effect of gradually reducing size within a neckpiece. However, even sized form clusters became contemporary practice for ease of manufacturing, preferred by both jewellers and customers.

The effects of colour of metallic gold and gemstones were not part of present study. It presents again a huge potential to be explored in form of colour, transparency, glaze levels and their combinations. A single necklace with a variety of three gemstones itself presents numerous plausible combinations for study.

6.   DISCUSSION & CONCLUSION

There was a noticeable preference found during the first part of study for smallest semantic units having symmetry around two or one axis. These were often used both as central semantic unit as well as embellishment around them. *Koilee* was a preferred form and three of its variations were amongst preferred semantic units, however, this particular semantic unit was used more as embellishment around rather than a central unit. Teardrop was by far the most preferred smallest semantic unit and was used both as a central unit creating a theme as well as embellishment around.

These studies articulate various factors pertaining to configuration of form clusters and their interplay that has an impact on preferential likeness of articles of jewellery. The study further continues into Development of a Tool to Study Preferential Likeness of Articles Using Mother Grid and Form Clusters in a Methodical Manner. This tool being developed is expected to be portable, thus able to cover large number of subjects, as jewellery cannot be carried freely due to logistics and security purposes.

Methodology used in these studies can be adapted for form based research in design for small and miniature size products, where small details play a key role.

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