Excentro

Guilloche Design Generator for Macintosh

EXCENTRO OBJECTS REFERENCE

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EXCOURSE

Excentro Objects Reference book describes Excourse Excentro application version 1.5

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EXCENTRO OBJECTS REFERENCE

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CONTENTS

Contents

Contents

INTRODUCTION TO EXCENTRO OBJECTS REFERENCE

Excentro Objects Reference book provides complete reference of all objects used in guilloche design construction process in *Excentro* application. It is devised to be used in conjunction with accompanying reference books **Excentro Windows Reference**, **Excentro Commands Reference** and **Using Excentro** guide.

This book is not designed to be read from cover to cover, one chapter after another, though, of course, it could be used this way. We suggest you to use **Excentro Objects Reference** as reference (as it name implies): when you need to look up definition of some specific object or its attribute, appropriate chapter of the book will give you all information you need. You are advised to read complete chapters with specific object descriptions because they can contain other information on same subject you can find useful or interesting.

This book is organized in following way:

■ **Introduction** (the part you are reading right now) contains general information and basics of *Excentro* mechanical model. The same material as in **Using Excentro** guide is repeated here because it is referred to from almost all subsequent chapters of this book.

■ **Part 1** is dedicated to *base* elements, the ones that serve as root objects for guilloche designs and define design type: rosette, border, frame or background. It contains short introduction with description of most common actions with bases: creation, duplication or deletion. Rest of this part consists of four chapters each about one specific base type.

■ **Part 2** is dedicated to *regular elements*. Similar to **Part 1**, this part has introduction about elements creation, deletion and other common actions. After that, ten chapters provide descriptions of specific elements.

■ **Part 3** is about *content elements*. Similar to other parts, this one has introduction about elements creation, deletion, etc. and nine chapters with specific elements descriptions.

Type conventions used in this book are the same as in other *Excentro* references books:

Bold type style is used to expose titles of windows, menu commands and other interface elements like controls and buttons. It also is used for titles of other chapters and books of *Excentro* guides.

Italic type style is used for names of applications, software products and names of companies that produce them. This style is used also to show sample numeric and string values you can enter in attribute numeric fields.

Whenever possible we use *Mac OS 9* versions of screenshots for illustrations. There are two main reasons for us to do so:

1. Most of those who use *Mac OS X* used *Mac OS 9* not so long before it, so they are also accustomed to older windows and menus look, unlike those who still use *Mac OS 9*. Those who can not use *Mac OS X* for some reasons can be confused by new *Aqua* appearance, so we minimized use of new windows and menus.

2. Antialiased text and transparent windows with striped background are pretty cool features on computer screen. However older screenshots still look better when printed on paper and produce smaller size PDF format documents.

GRAPHICS DESIGN IN EXCENTRO

Graphics design process in *Excentro* application is different from that of standard graphics software packages like *Adobe Illustrator* or *Macromedia FreeHand*. Unlike those, *Excentro* does not allow you to draw vector paths directly in graphics window with mouse or graphics tablet. The design process in *Excentro* represents block construction procedure of guilloche structure instead. Guilloche tree-like structure is a set of interconnected objects (or elements) with every object producing a single path or whole set of paths. Shape of object paths is defined by this object attributes and path (and attributes) of its parent objects. As a result modification of single object attribute will change not only that object's path but also paths of all other objects connected to it.

This leads to two implications you should keep in mind while working with *Excentro*:

■ Geometric size and shape of vector paths are not fixed or invariable after the object was created. They will be changed together with changes of object's attributes, paths of parent objects or their attributes. So, you should have good understanding of document tree structure and guilloche creation process to avoid unpredictable or undesired consequences.

■ Whole guilloche design is very flexible even after its creation seems to be complete, you can change design type or its shape at any convenient time later. You are free to experiment with any attribute of any object, to investigate different possibilities and shape variations. *Excentro* allows you to revert all actions with **Undo** command and return to initial design state if you decide to.
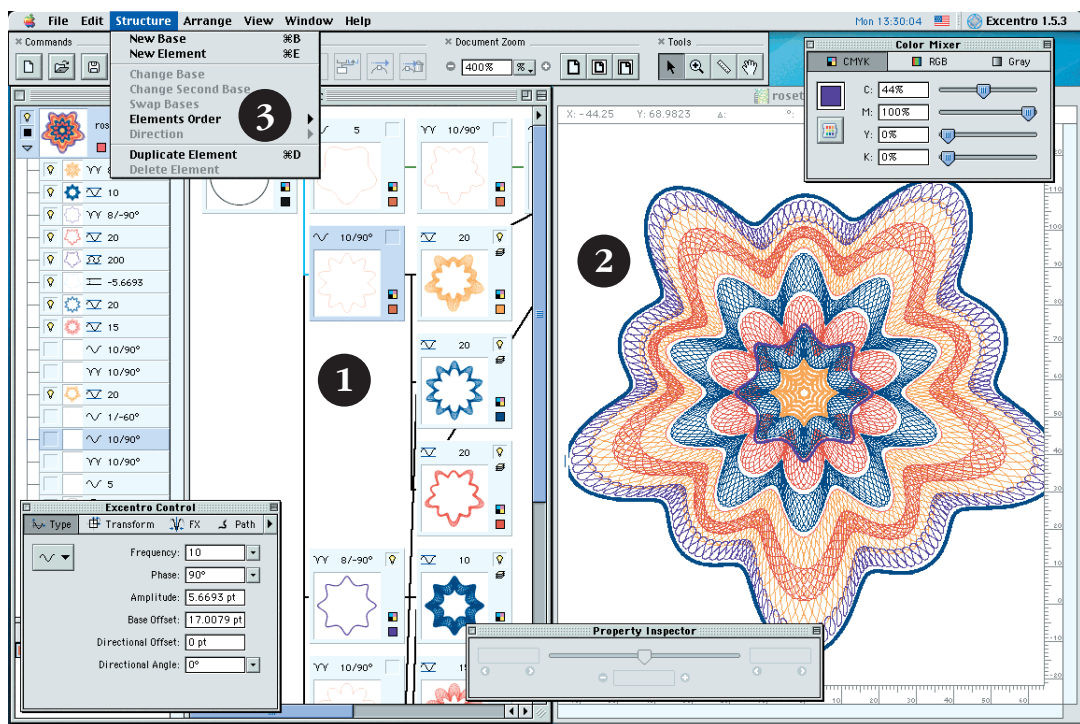
Main interface elements used in guilloche design creation in Excentro:
1–Main document window, 2–Document preview window, 3–Structure menu

Excentro uses two document windows to display guilloche design. First window (it is called **document preview window**) shows graphics of the design similar to that of *Adobe Illustrator* or *Macromedia FreeHand* document windows but does not allow any direct manipulations with vector paths (you can do it later in any of mentioned applications). Second window hosts guilloche tree-like structure. Objects creation and other

actions should be done in this second window (its called **main document window** for this reason). To manage tree-like structure: create new objects, delete or modify existing objects you should use commands from **Structure** menu of *Excentro* menu bar or its shortcuts in **Structure** section of **Toolbar**.

Other reference books **Excentro Commands Reference** and **Excentro Windows Reference** provide all required details about **document preview window**, **main document window** and commands of **Structure** menu. In this book we discuss guilloche tree structure and objects it can consist of.

EXCENTRO MECHANICAL MODEL

To make guilloche design process easier to understand and control *Excentro* uses mechanical model similar to that of traditional Guilloche machine (the mechanical device used to create guilloche graphics in previous centuries). *Excentro* mechanical model is different from traditional in that it uses terms like 'tabletop', 'sheet' and 'pencil' instead of 'cogs' and 'wheels'. It also allows you to create more complex designs that lay beyond the limits of mechanical devices, because computer graphics does not have limitations of real metal wheels. Nevertheless almost all designs typical for old Guilloche machines are within the possibilities of *Excentro*. Guilloche designs created in *Excentro* also have natural look and feel of mechanically engraved graphics. Some other computer simulations, that use mathematical formulas instead of mechanical model, are unable to repeat this quality.

1. Tabletop. The first term we introduce is '*tabletop*'. This is a flat surface all graphics is drawn on. You can regard **document preview window** as tabletop representation. It has a coordinate system with beginning point (*0, 0*) coinciding with center of tabletop. Measurements and coordinate values are expressed in application-wide units configured in **Excentro Preferences** dialog.
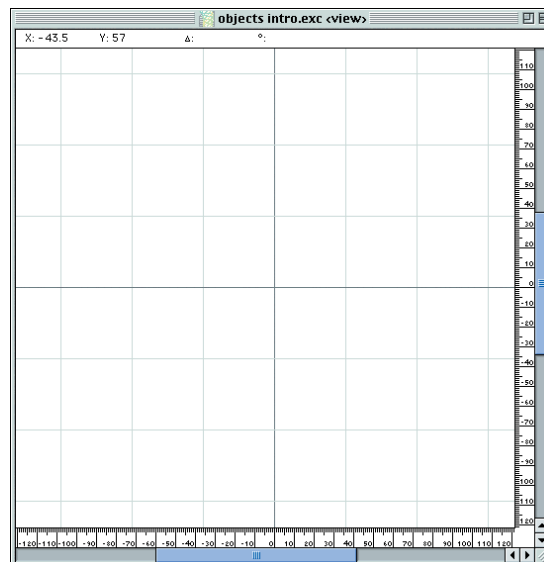
*Tabletop and graphics coordinates preview in* **document preview window**

2. Bases. To start with guilloche design construction we should create path of basic geometric shape on tabletop called '*base*'. This path sets initial guilloche size and defines design type. If base is closed circular shape we will create a rosette design, if base is linear we can make a border part or background, if base is rectangular then we can create a

simple frame design. The bases are root objects of guilloche tree-like structure all additional elements use as parent object. To create new base element you should use **New Base** command from **Structure** menu. See **Part 1** of this book for more information on bases and details of different base types.
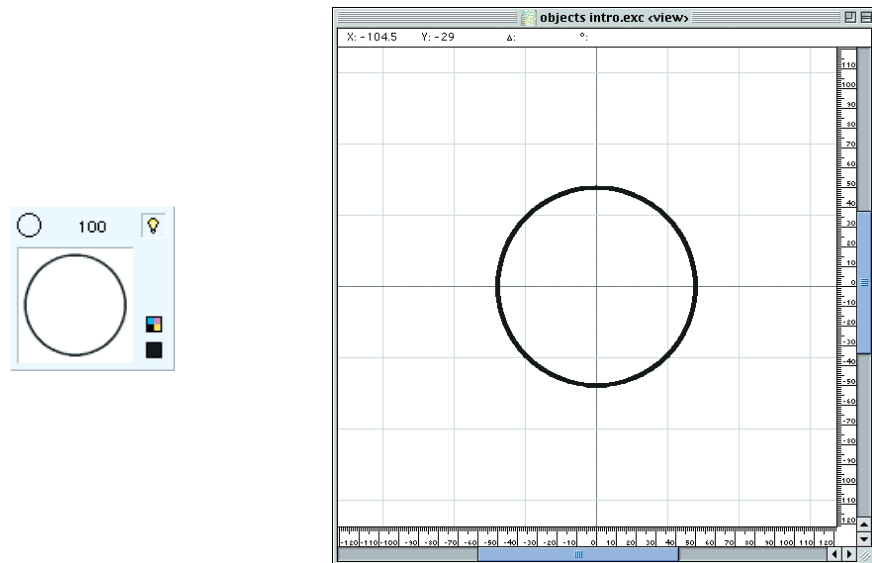
Circular base on tabletop and its representation in structure tree

3. Sheet, pencil and regular elements. Imagine another flat object '*sheet*' that moves on tabletop along path of existing base. At the same time second object '*pencil*' moves upon the sheet and draws simple shape like line, circle, semicircle or '8'-like figure on it.
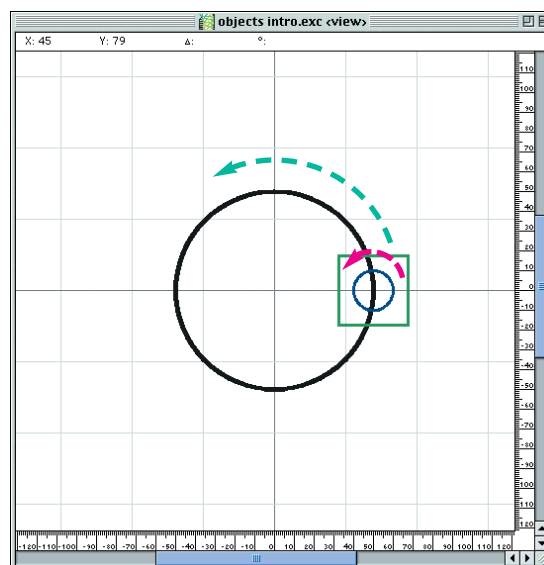
Sheet (green rectangle) moves along base path on table top as shown with green arrow. Pencil (not shown) moves as show with red arrow and draws blue circle on sheet.

Now imagine that 'sheet' is a sheet of copy paper, so pencil leaves trail on tabletop beneath the sheet as both objects move. As a result we will create new path that in case of circular pencil movements represents curly modification of base path (paths of this kind are called Epicycloid in mathematical books).

Sheet and pencil movement are represented as child objects in guilloche structure tree. They are connected to base objects which path they modify.
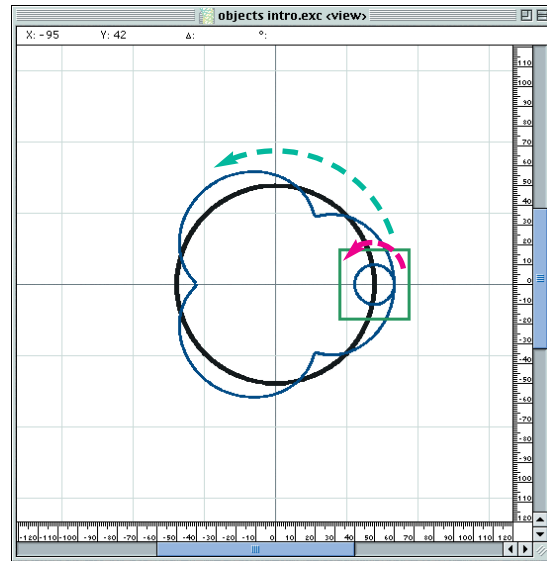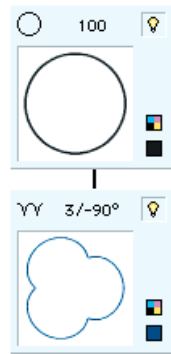
*Result of base path modification by sheet and pencil movement
and its representation in structure tree*

You can use new curly path on tabletop as base for further sheet and pencil movements and create even more complex paths like shown on picture below.
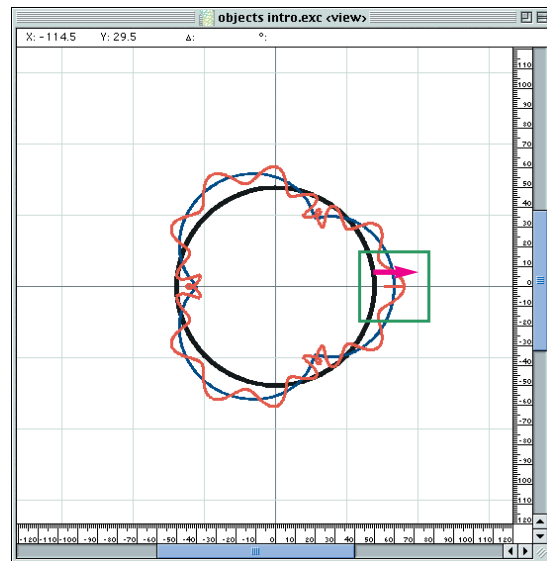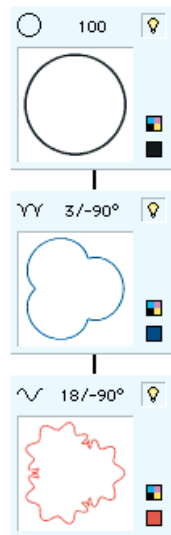
Result of further path modification and its representation in structure tree. Blue path created on previous step is used as base for new sheet and pencil movement. Pencil movements in this case are linear as shown with red arrow on green rectangle of the sheet.

Guilloche objects that represent sheet and pencil movements are called '*regular elements*' of structure tree. To create new element you should select some existing object (base element or another regular element) and use **New Element** command from **Structure** menu. See **Part 2** of this book for more information on regular elements and details of different elements types. Type of regular element defines pencil movement and kind of shape it draws on the sheet. It could be line (in this case you will get sine wave modification of base path), circle (base path will be covered with cycloid-like coils), semicircle (resulting path will have saw-like teeth), '8'-like figure, etc.

The term '*base element*' is applied not only to root objects of guilloche tree, but to any parent element of given regular element and this includes regular elements on previous levels of guilloche structure as well.

4. Direction. While the sheet moves along base path it can also rotate around its center point (or other point that fixed on base path). By default sheet rotation is controlled by shape of base path too so, that coordinates system on the sheet at any time is parallel to tangent direction of base path in the fixed point that moves along base path. If base path has twisty shape or sharp corners this can lead to path of regular element that has self-intersections (as on shown on example above) or other unwanted artifacts. To avoid these you can specify path of different element with more smooth shape to control sheet rotation. This element is called '*direction element*'.

If another element is specified as direction element for given regular element, sheet moves along base path as before, but its rotation is controlled by tangent direction to path of direction element. Sheet rotates as if it were moving along path of direction element instead of its base. As a result unwanted self-intersections disappear.
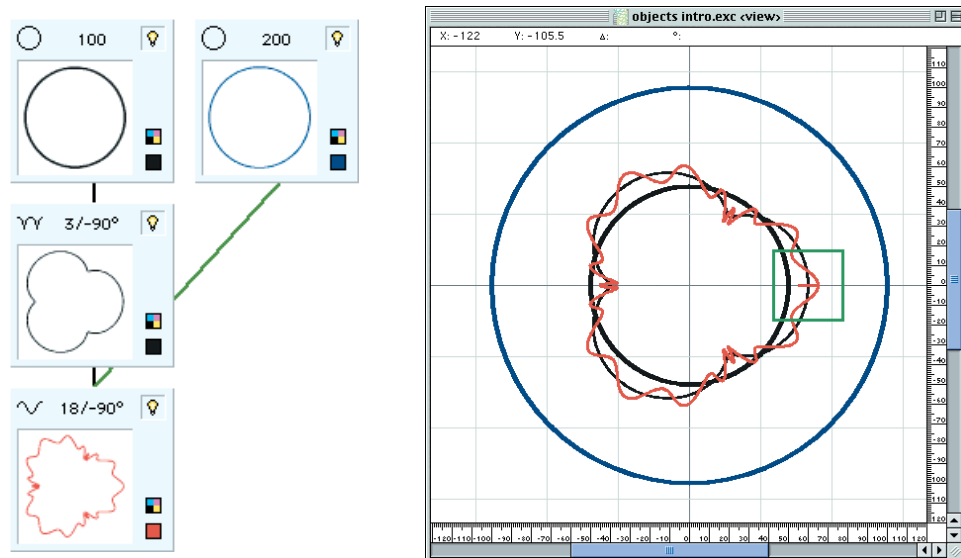
Result of specifying direction element to guide rotation of regular element and its represen-tation in structure tree. Red path of regular element created in section above now has new ellipse base (blue path) set as its direction element.
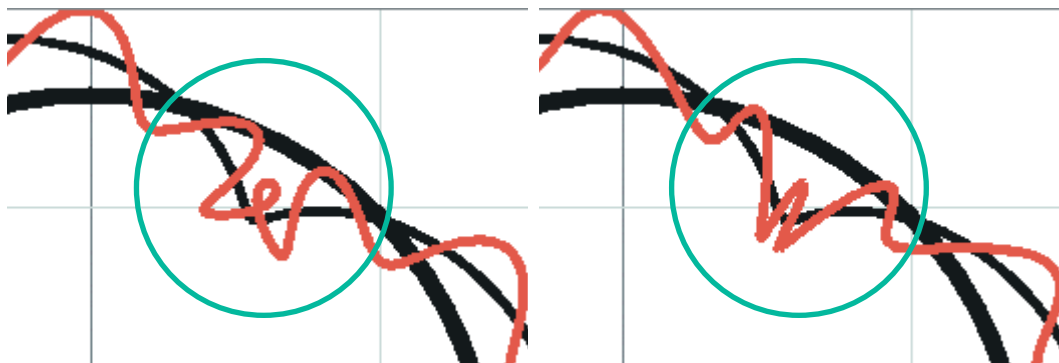

Magnified preview of examples above. Left picture shows the case when no direction ele-ment is set: red path has areas of self-intersections. Right picture illustrates the case with additional direction specified. Self-intersections are no longer present.

Direction elements are shown with green connection lines in guilloche structure tree, Green line leads from direction element to regular element which rotation they guide. To specify another element as direction element or restore sheet rotation to default one (controlled by path of parent element) you can use commands from **Direction** sub-menu of **Structure** menu.

As was briefly mentioned above there are two main cases when setting of direction element seems to be appropriate:

■ When base path of regular element has too many twists and coils. In this case you can set up as direction element the element with simpler path. Usually it is one of parent elements on previous levels of tree structure (parent element's parent) or the root element of whole guilloche tree.

■ When base path is not a smooth curve or has sharp corners (like base elements of rectangle type). In this case you can create new smooth path of similar size and set it up as direction element to avoid sudden jumps and path breaks in corner areas where direction of sheet movements is not defined.

4. Content elements. In addition to 'bases' (basic shapes on tabletop) and 'regular elements' (sheet and pencil modification of base paths) there is a third class of elements called '*content elements*' that are used to fill space between two existing paths. You may regard paths of these elements as a result of pencil movement between these two paths. Elements that these two existing paths belong to serve as two parent elements of the content element in guilloche tree.
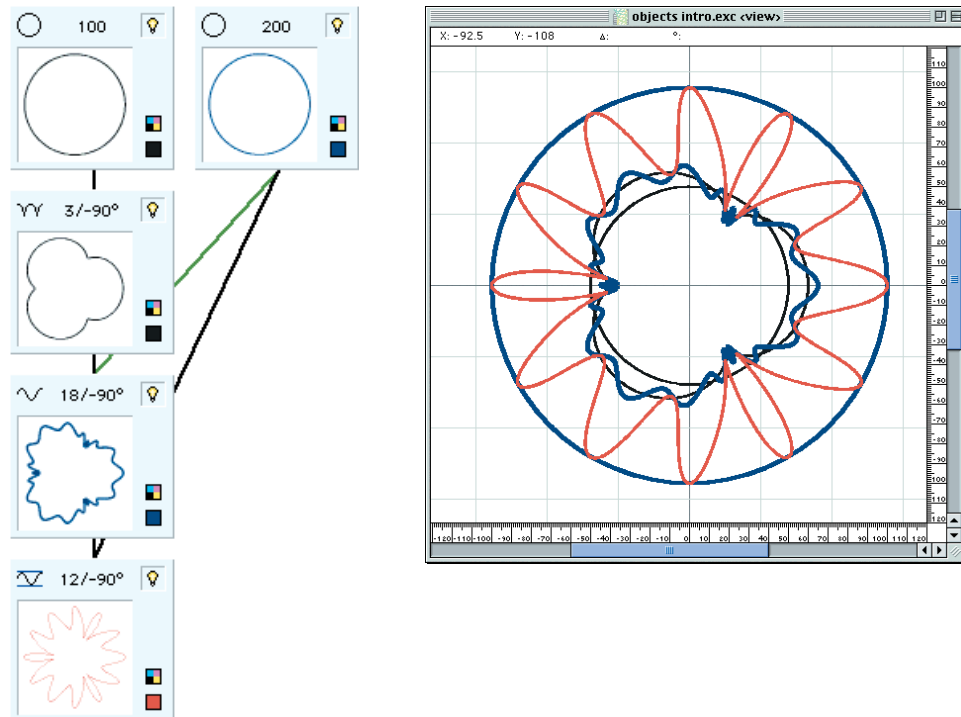
Content element with red path is added to the structure from previous examples. Regular element with blue path serves as base of new content element. Ellipse base, also with blue path, is a second base of new content element.

Black connection lines lead from content element representation in structure tree to both of its parent elements. First parent element is called '*base element*' of content element, second parent element is called '*second base element*'. To create new content element you should select two existing objects in guilloche structure (first selected object will be base element, second object — second base element of new content element) and use **New Element** command from **Structure** menu.

Very frequently content elements have Step & Repeat Sets added to them to create effect of filling space between base paths with uniform vector texture. Examples below show most typical illustrations.
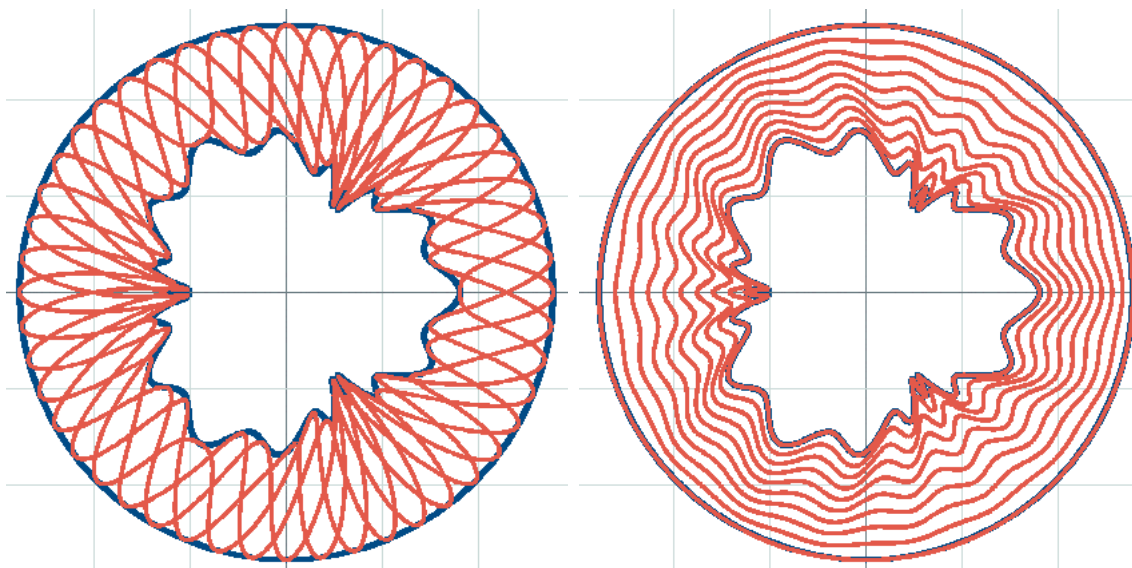

Two most common types of content elements with Step & Repeat Sets.

Part 3 of this book provides all information about content elements and details of different elements types. Type of content element defines kind of pencil movement between base paths. It could be linear (in this case you will get sine wave path between two bases), circular (base paths will be filled with cycloid-like coils), semicircle, '8'-like figure, etc. One of frequently used types of content elements represents blend-like filling between base paths, when path of content element resembles shape of either of base paths depending on how close it is to one of them (see example on right picture above).

PART I: BASES

CHAPTER 1: INTRODUCTION

This part of **Excentro Objects Reference** book contains full description of all *Excentro* application elements of base type. Base elements (or base objects, because terms 'elements' and 'objects' are interchangeable when we speak about guilloche tree of *Excentro* document) represent first basic geometric shapes drawn on 'tabletop' all subsequent guilloche design construction is based on. Base elements are located at top level in main document window and serve as root objects for guilloche tree.
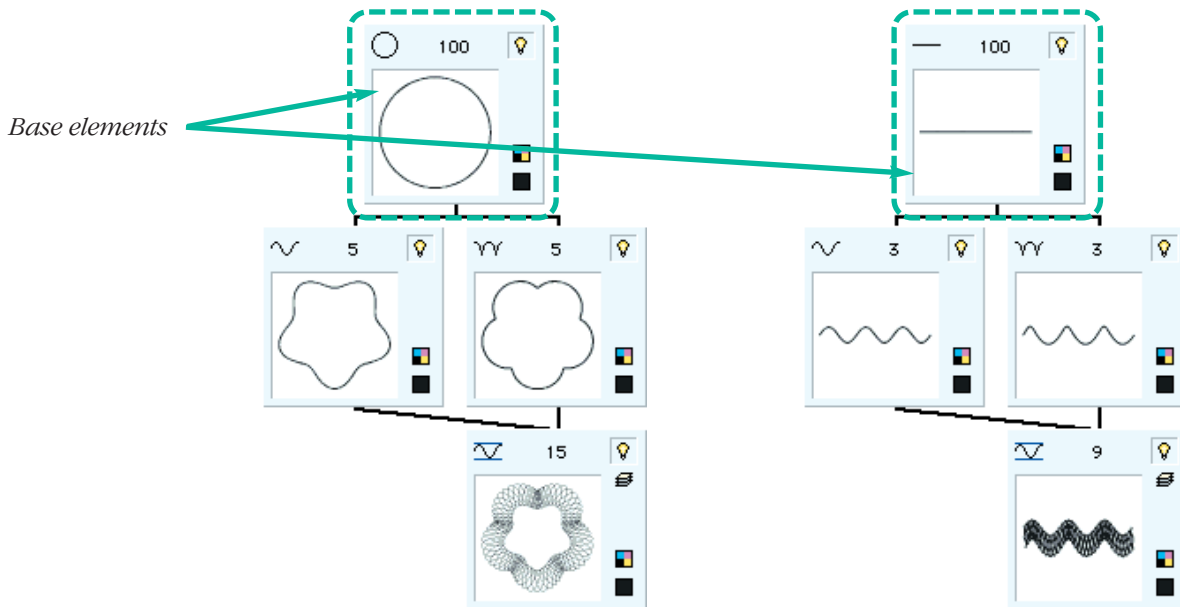
Base elements

TYPES OF BASES

There are four types of base elements in *Excentro* application:
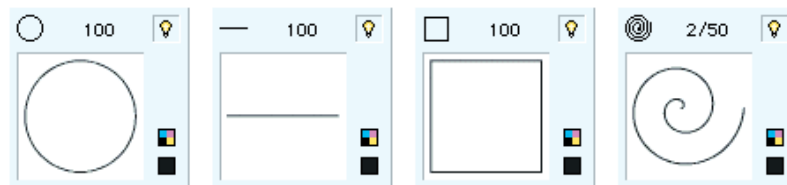
■ **Ellipse** (*Chapter 2*) is the most popular type of bases. It serves as base for all circular rosettes designs as well as for backgrounds of circular type.

■ **Line** (*Chapter 3*) is another frequently used type, it serves as base for linear borders and backgrounds.

■ **Rectangle** (*Chapter 4*) is type of base that could be used for fast and simple rectangular frames creation.

■ **Spiral** (*Chapter 5*) is a decorative base that is used for for non-standard designs.

Examples of guilloche designs with base types listed above are provided in appropriate chapters of this part of **Excentro Objects Reference** book.

CREATING BASES

To create new base object in *Excentro* document you can use **New Base** command from **Structure** menu or its shortcut button in **Structure** section of **Toolbar**. This command is always active when you have one of document windows in front of you:
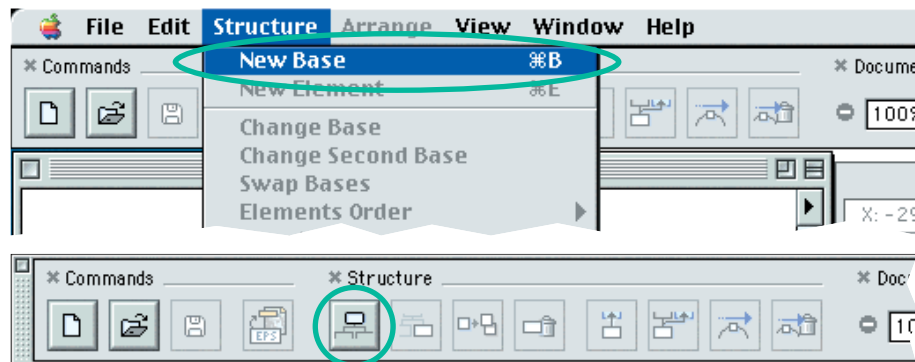

After **New Base** command was chosen rectangle representation of new base object will appear in main document window:
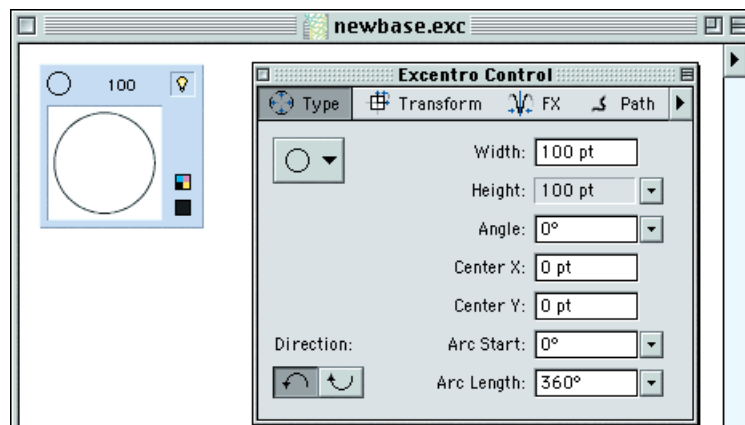
By default new base is a circle of **Ellipse** type with **Width** attribute set to '*100 pt*'. You can use fields in **Type** panel of **Excentro Control** inspector to modify **Ellipse** attributes or select different base type from **Type** pop-up menu:
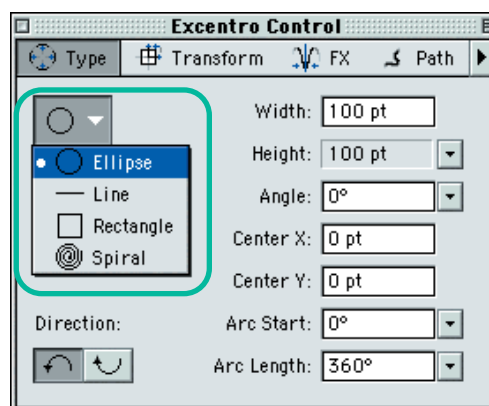
Shape of base element and number of attribute fields change according to **Type** pop-up menu selection. Following chapters of this part of **Excentro Objects Reference** provides full reference of all base elements types and their attributes in **Excentro Control** inspector.

DUPLICATING BASES

You can also create new bases by making copies of existing ones. You can do this in three different ways:

■ With **Duplicate Element** command from **Structure** menu.

■ With drag-and-drop action.

■ With **Copy-Paste** or **Cut-Paste** commands sequence from **Edit** menu.

1. To duplicate existing base with **Duplicate Element** command **(Cmd-D)** you should select the base you want to duplicate with mouse click on its rectangular representation in main document window and choose **Duplicate Element** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.
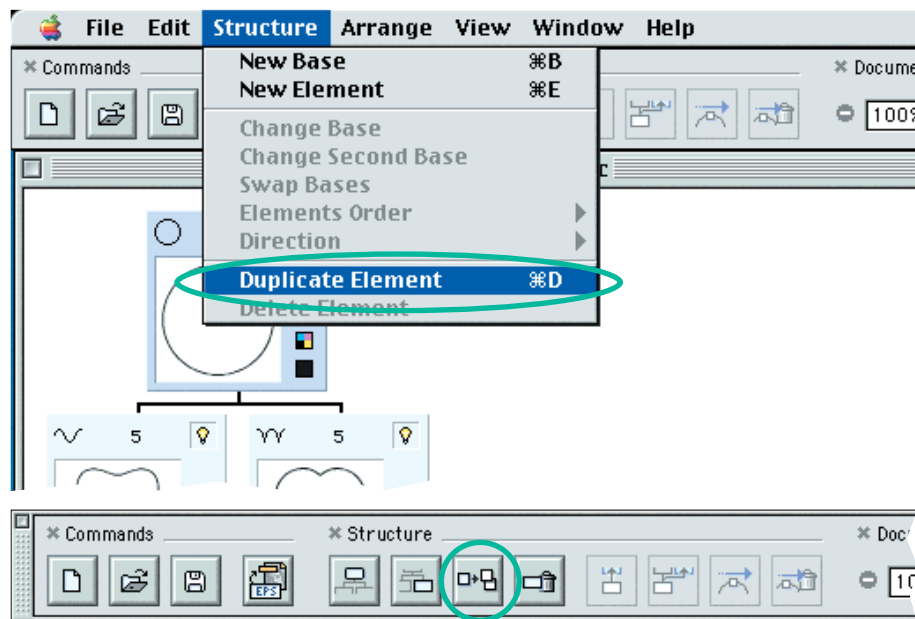
An exact copy of selected base will be created:
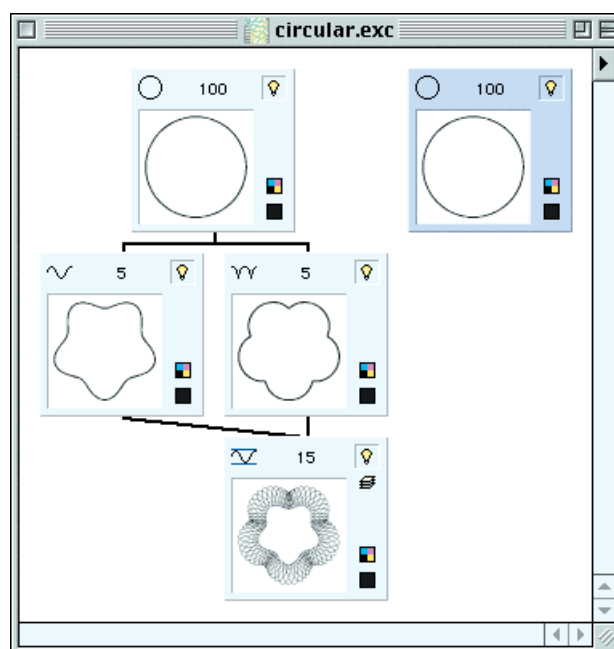
If you will press **Shift** key on keyboard, **Duplicate Element** command in **Structure** menu will change its title to **Duplicate All Elements (Cmd-Shift-D)** and choosing it will duplicate not only selected base element but all child elements this element has (and all child elements of these child elements too, etc.).
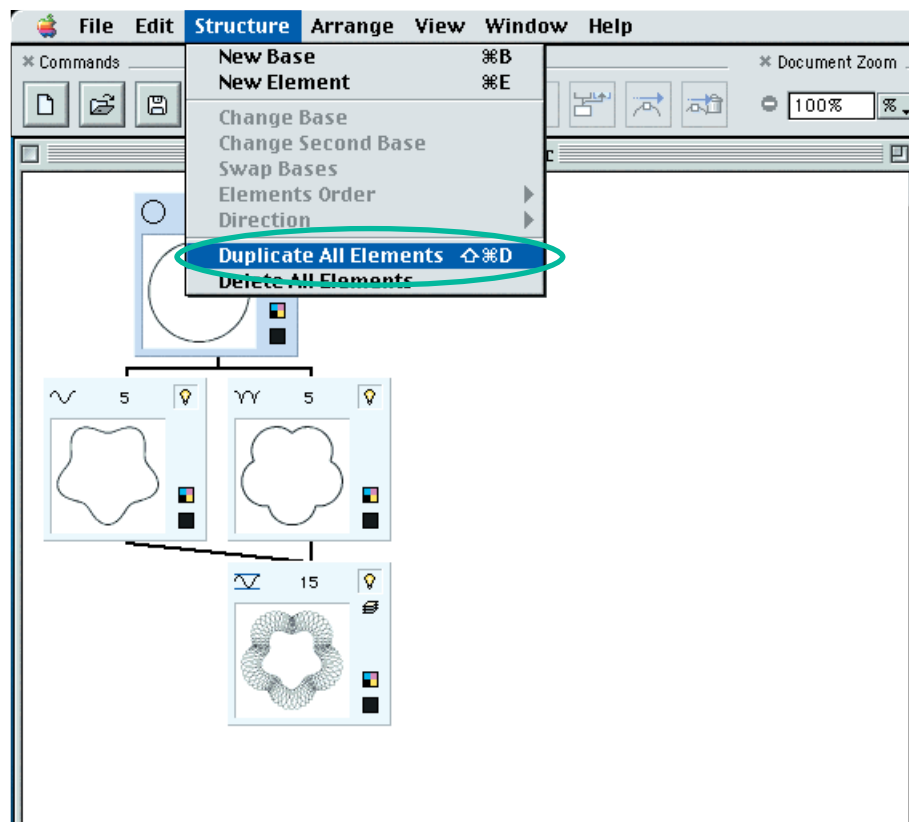
This way you can make a copy of whole structure tree with single command. All connections between child elements will be preserved in a new copy of guilloche tree.
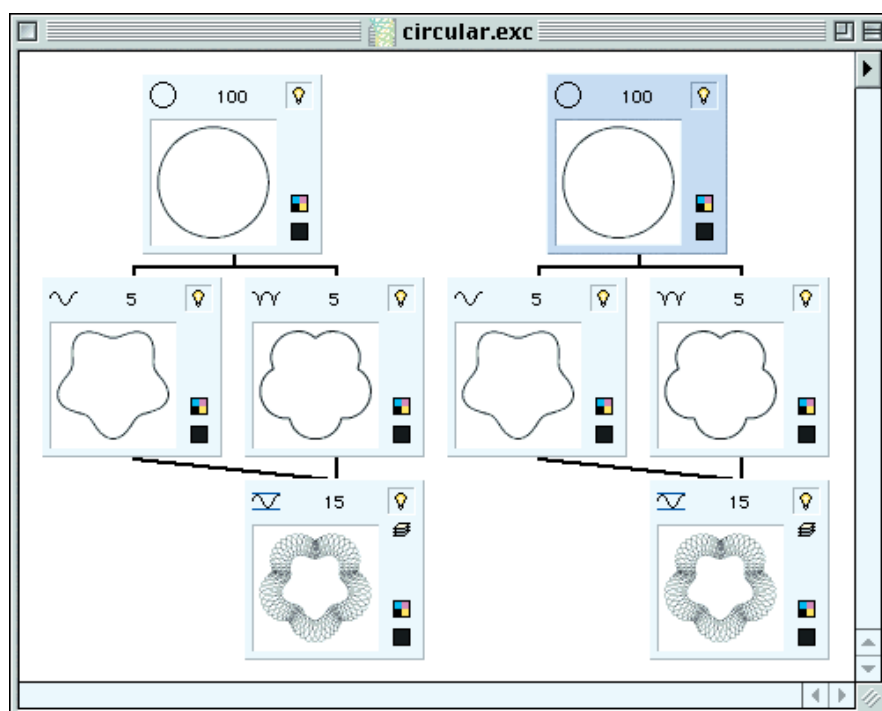
2. To make a copy of existing base element using drag-and-drop action you should select the base you want to copy with mouse click on its rectangular representation in main document window. After that press **Option** key on keyboard and drag the base to any arbitrary location inside structure pane of same main document window. Mouse pointer will change its cursor shape to 'copy cursor' (arrow with **plus (+)** sign) to indicate that current drag-and-drop action will make a copy of the object.

Release mouse button, then release **Option** key and new copy of dragged object will be created.
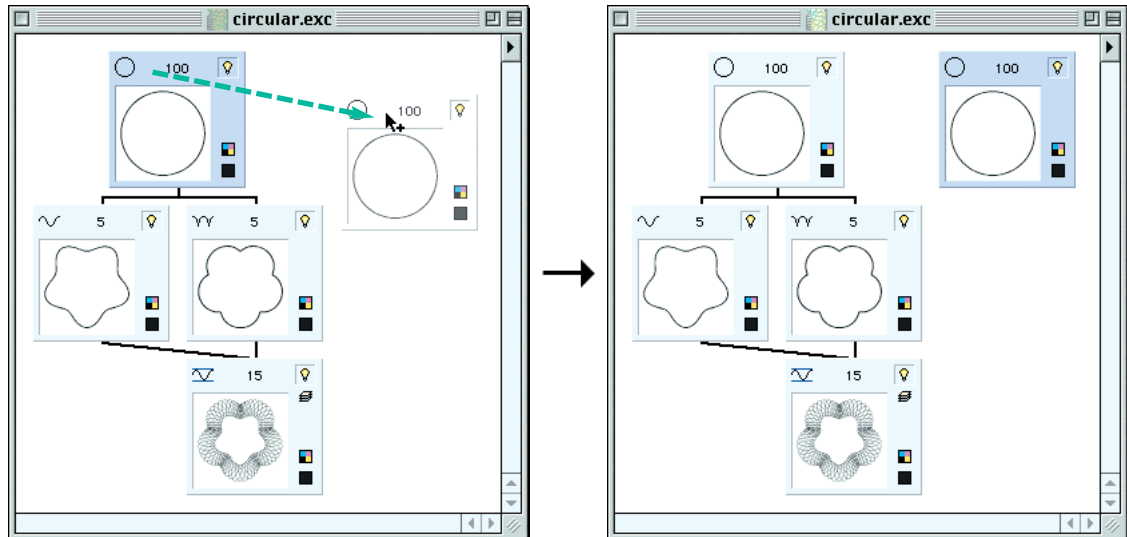
3. To create a copy of existing base element with **Copy-Paste** or **Cut-Paste** commands sequence you should select the base you want to make a copy of with mouse click on its rectangular representation in main document window and choose **Copy (Cmd-C)** or **Cut (Cmd-X)** commands from **Edit** menu to place an object to *Excentro* Clipboard buffer (**Cut** command will delete base from document **Copy** command will not).
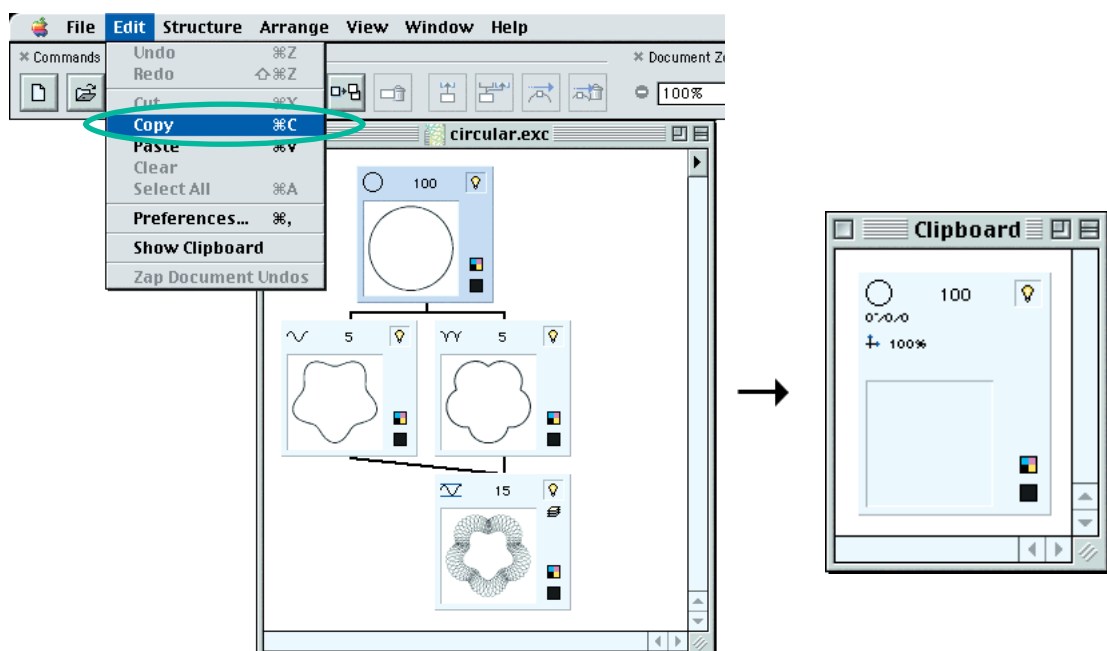
After that you should choose **Paste (Cmd-V)** command from **Edit** menu and new copy of object in Clipboard will be created.
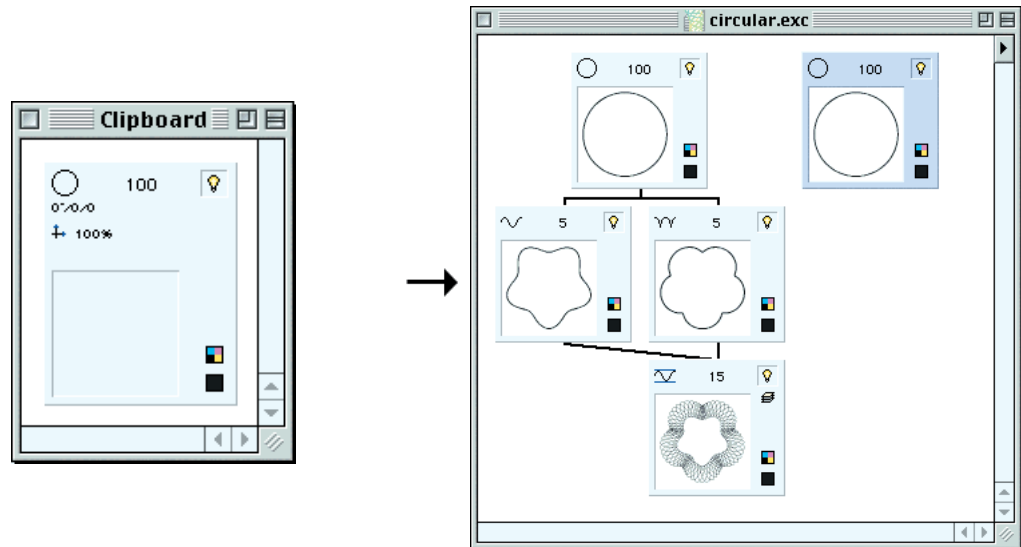
DELETING BASES

You can delete existing base objects in two different ways:

- ■ With **Delete Element** command from **Structure** menu.

- ■ With **Cut** or **Clear** commands from **Edit** menu.

1. To delete base element with **Delete Element** command you should select the base you want to delete with mouse click on its rectangular representation in main document window and choose **Delete Element** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.
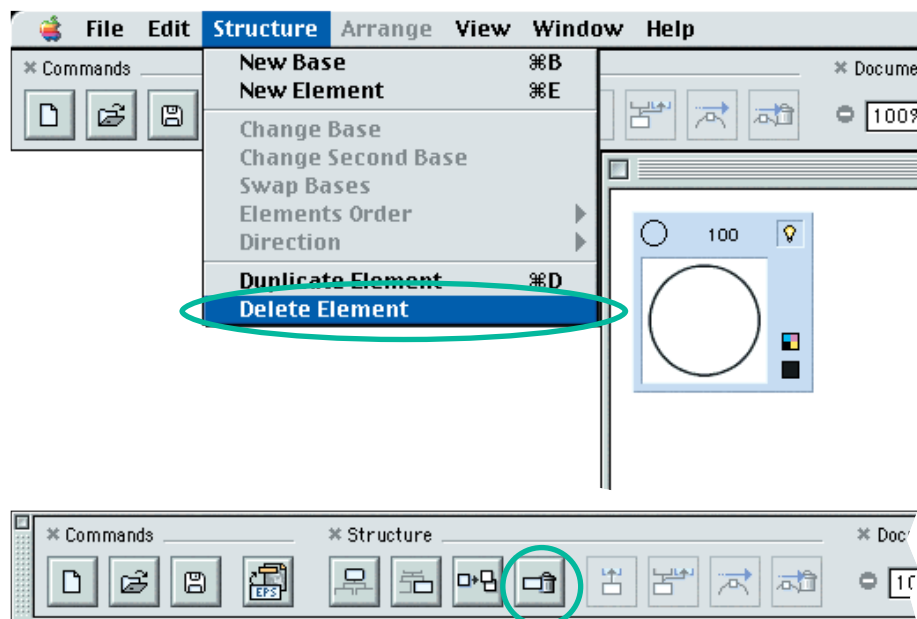
If the base object does not have child elements or connection lines to other elements of guilloche tree structure it will be deleted. If the object does have child elements or other connections to elements of guilloche tree, you can not delete it with **Delete Element** command. This command will be disabled in **Structure** menu.

To delete base object that has child elements you can use **Delete All Elements** command. To use this command press **Shift** modifier key and **Delete Element** command in **Structure** menu will change its title to **Delete All Elements**. Choosing **Delete All Elements** command will delete not only selected base element but all child elements this element has (and all child elements of these child elements, etc.). The base or its child elements should not have connections to objects in other parts of guilloche structure (that use another base element as root object), otherwise this command will be disabled.
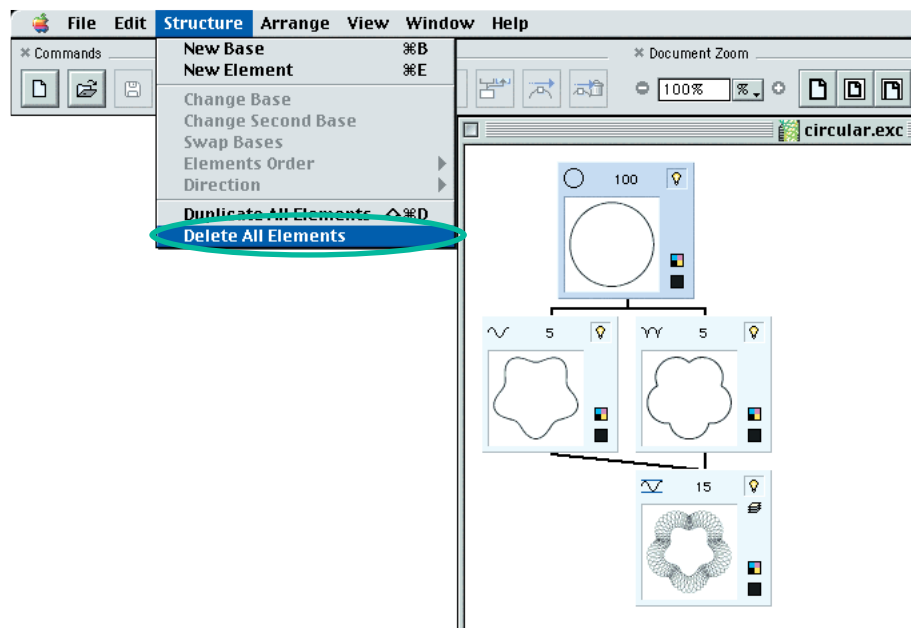
2. Cut (Cmd-X) and **Clear** commands from **Edit** menu are identical in effect to **Delete Element** command. They are provided to make *Excentro* behavior resemble that of standard *Macintosh* applications.

Cut command will also place copy of deleted object on *Excentro* Clipboard buffer, so you can create this object again using **Paste** command.
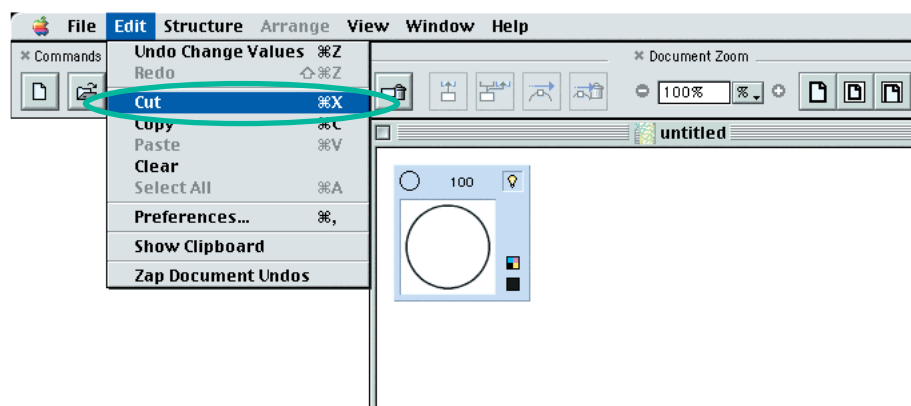
CHAPTER 2: ELLIPSE

Ellipse is the most frequently used and important type of base elements in *Excentro* application. It serves as base for all circular rosettes designs as well as for backgrounds of circular type.
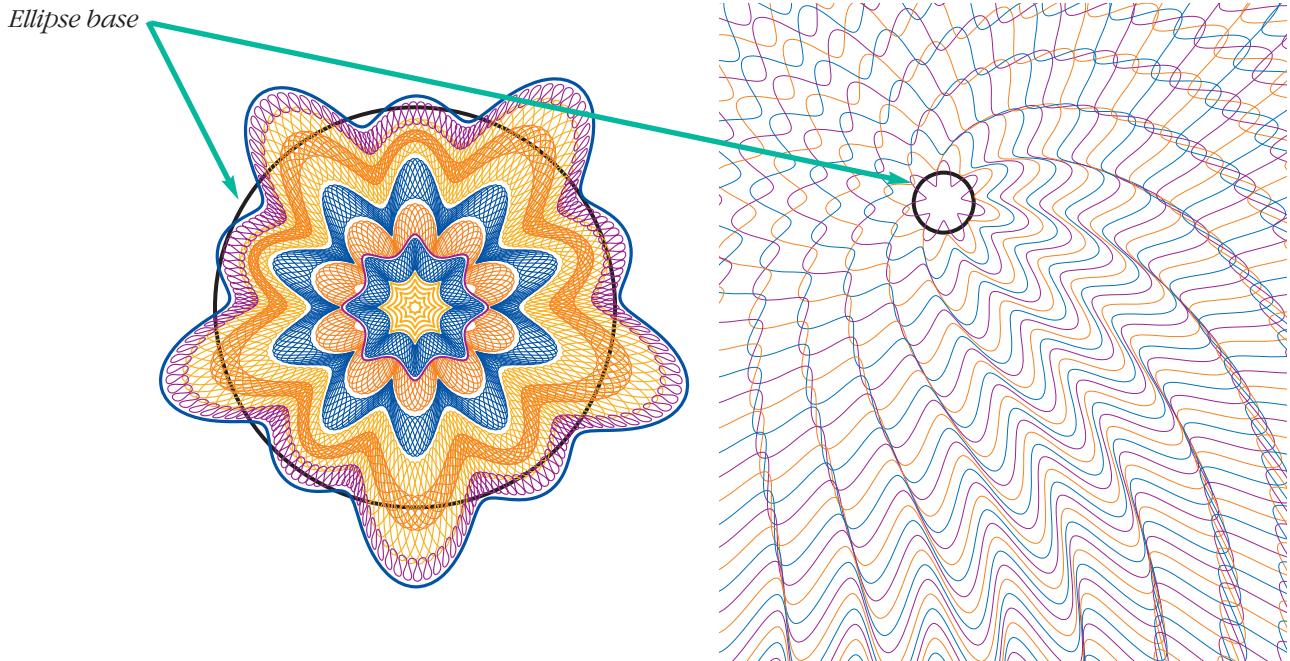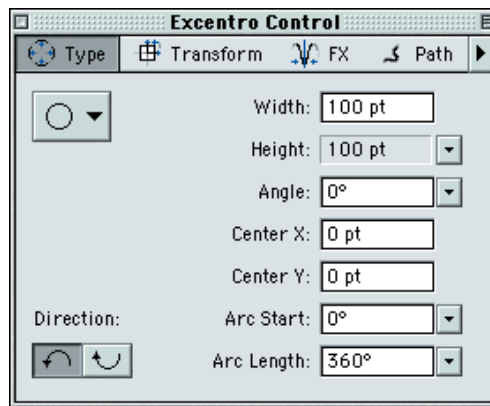
Ellipse base

*Rosette and circular background with **Ellipse** base elements*

Shape of **Ellipse** base element could be either 'circular' or 'elliptic' depending on its **Width** and **Height** attributes combinations. With its initial attribute settings **Ellipse** represents a circle with '*100 pt*' diameter drawn on 'tabletop' in counterclockwise direction. Examples below show **Ellipse** shape changes that could be achieved by its attributes modifications.
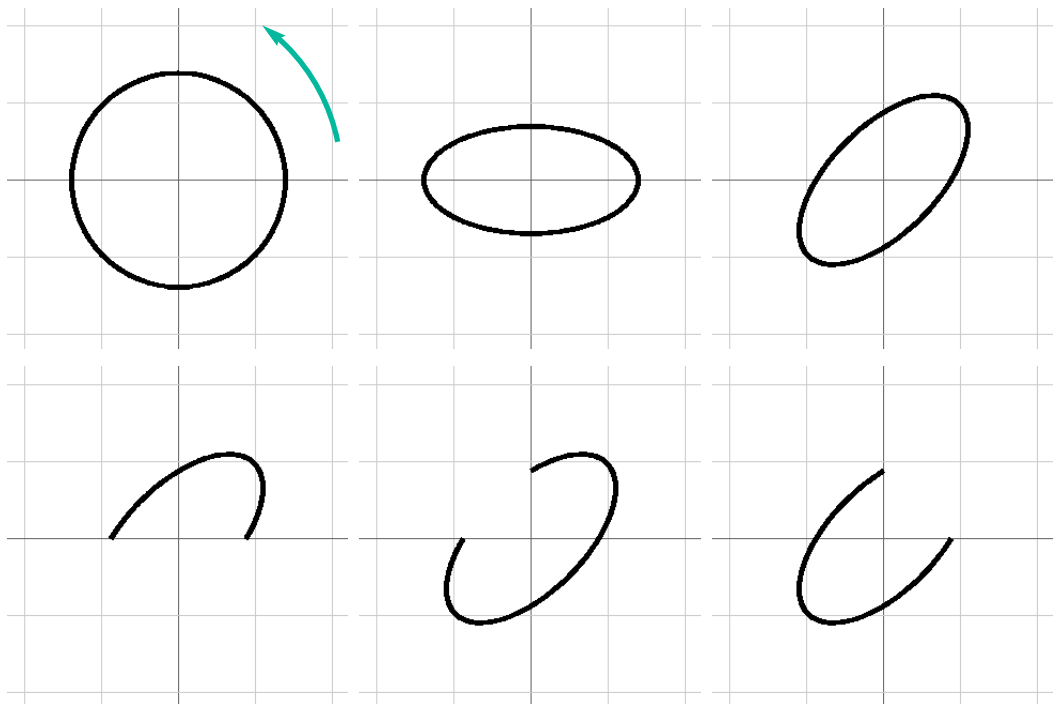
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has eight attribute fields for base elements of **Ellipse** type:

Note: *All pictures in this section show **Ellipse** base as thick black path. Second thin gray path illustrates example of **Sine Wave** element that uses the **Ellipse** as its base (parent) element. You can take a note of **Sine Wave** path modifications that accompany **Ellipse** shape changes.*

■ **Width** and **Height** attributes define geometric size of **Ellipse** path in application-wide measurement units. By modifying these values you can make path of **Ellipse** base on tabletop larger or smaller:
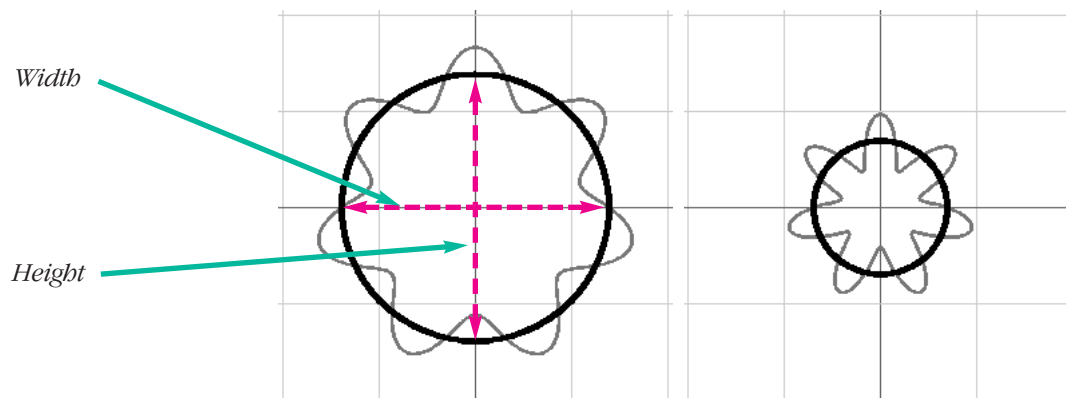
*Ellipse paths with **Width** and **Height** set to '100 pt' and '50 pt'*

Initially **Height** attribute is set to same value as **Width** attribute and shape of **Ellipse** base is rather 'circular' than 'elliptic'. This behavior is controlled by **Same as Width** option selected from pop-up menu beside **Height** attribute field.

If you need to specify different values for **Width** and **Height** attributes you can select **Other** option from the pop-up menu. After that numeric field of **Height** attribute will become editable and you can enter any desired value in this field using keyboard.
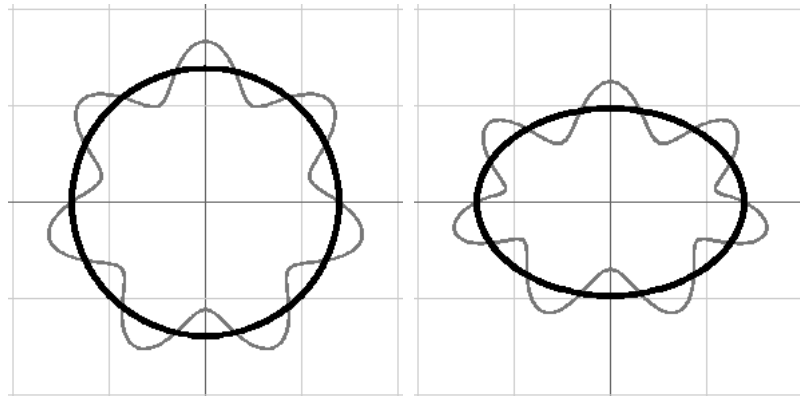
__Height__ attribute set to '100 pt' (same as __Width__ attribute) and '50 pt' values

■ **Angle** attribute controls rotation of **Ellipse** base. Effect of this attribute on **Ellipse** shape is only visible when **Ellipse** has 'elliptic' shape (**Width** and **Height** attributes have different values.) **Angle** attribute value is expressed in degrees ('°').
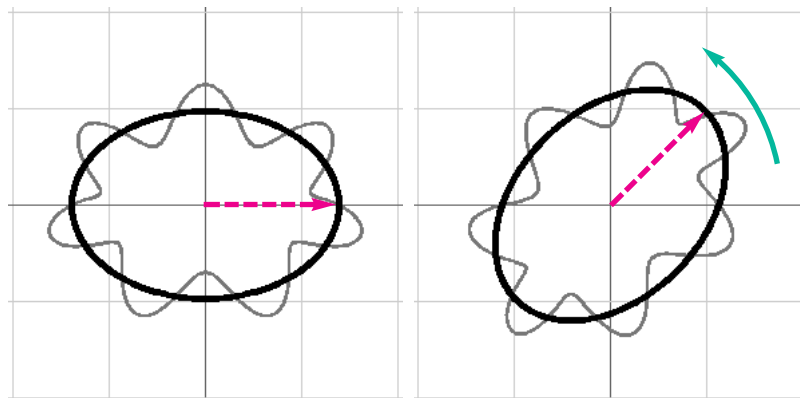
'45° modification of __Angle__ attribute

■ **Center X** and **Center Y** attributes define the center of **Ellipse** base in application-wide measurement units. Initially **Ellipse** center coincides with center of graphics coordinate system — point *(0 pt; 0 pt)*. You can change this point to any arbitrary position if needed.
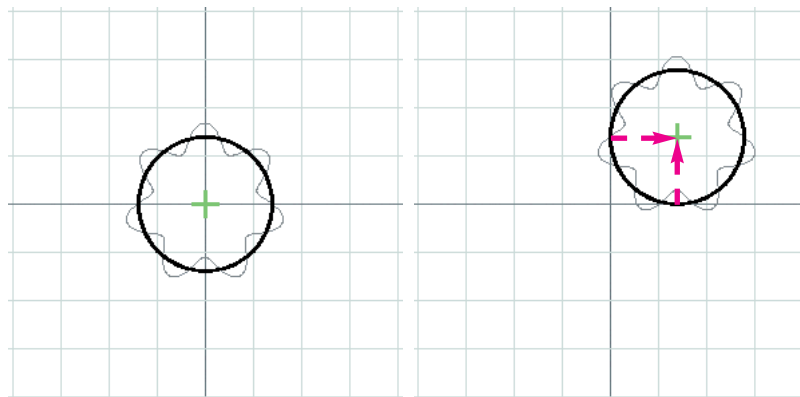
Initial __Ellipse__ center position (0 pt; 0pt) (left);
center position after __Center X__, __Center Y__ attributes modification (50 pt; 50 pt) (right)

■ **Arc Start** and **Arc Length** attributes allows you to create bases of semicircle and arc shape. Both attributes are expressed in degrees ("°"). **Arc Length** attribute defines length of ellipse arc. Value of '*360°*' corresponds to full circle, value of '*180°*' corresponds to semicircle bases.
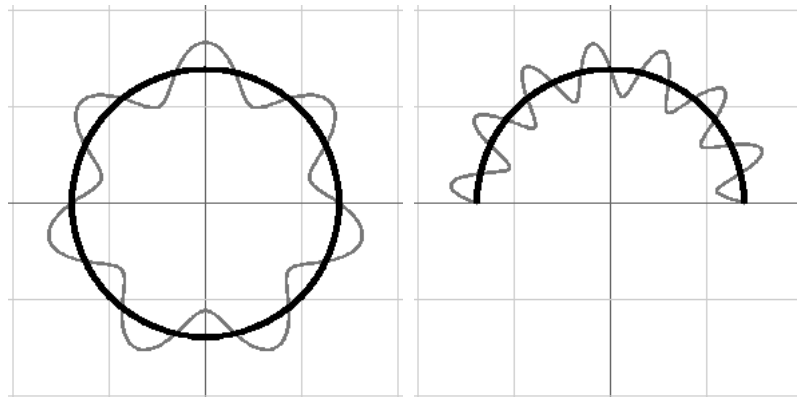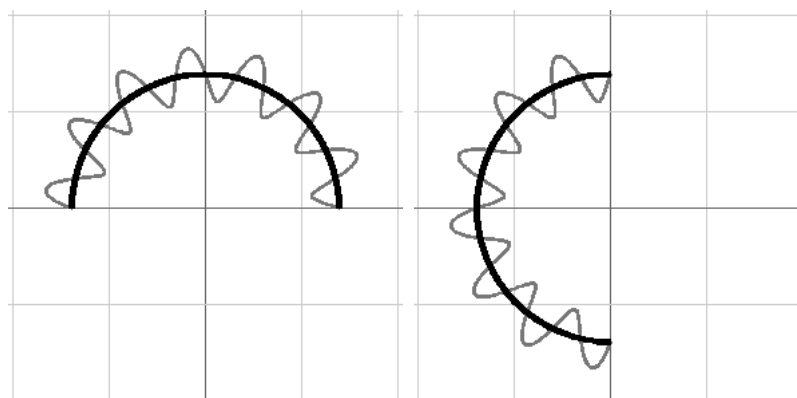
***Ellipse** paths with **Arc Length** attribute set to '360°' and '180°' values*

You can also use this attribute with values larger than '*360°*' to create bases with several full-circle rotations. In this case all subsequent elements that use this base as parent element will have long continous path that also does several full circle rotations together with the base.
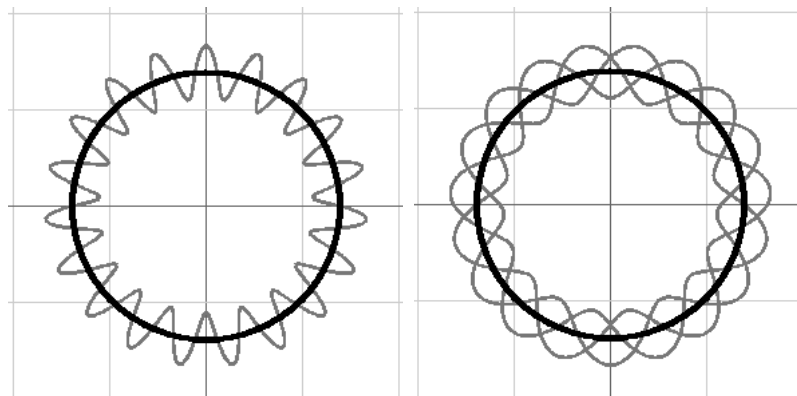
***Ellipse** paths with **Arc Length** attribute set to '360°' and '3×360°=1080°' values. Both base have single **Sine Wave** element with **Frequency** attribute set to '19'.*

Arc Start attribute controls starting point of the arc. Value '*0°*' corresponds to rightmost point of the **Ellipse** path, '*90°*' — to top point, '*180°*' — to leftmost point and '*270°*' — to bottom point.
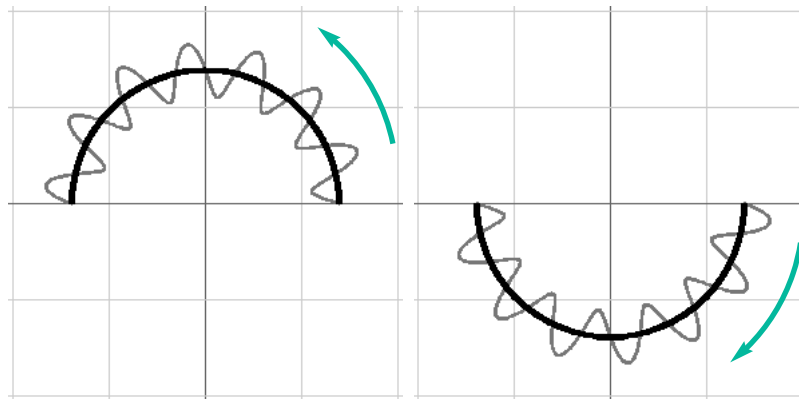
***Ellipse** paths with **Arc Length** attribute set to '180°' and **Arc Start** set to '0°' and '90°'*

■ **Direction** attribute allows you to change direction in which **Ellipse** path is drawn. There are two values for this attribute: **Clockwise** and **Counterclockwise**.
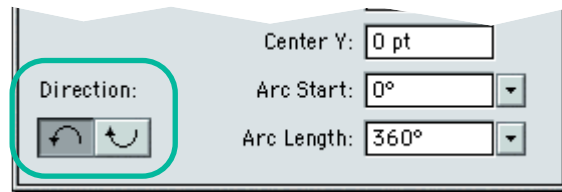

Counterclockwise is the initial **Direction** value, in this case top part of **Ellipse** is drawn first ('right-to-top'). You can modify this behavior and set **Direction** attribute to **Clockwise**, after that the bottom part of **Ellipse** will be first to be drawn ('right-to-bottom').

*Ellipse paths with **Arc Length** attribute set to '180˚'.*
***Direction** attribute set to '**Counterclockwise**' (left) and '**Clockwise**' (right)*

Direction attribute also sets direction in which 'sheet' travels along **Ellipse** base path on 'tabletop' while it draws element paths according to *Excentro* mechanical model. Because 'sheet' rotates together with tangent line direction to base path (that will be different after **Direction** attribute change), be prepared that paths of elements like **Cycloid** that use **Ellipse** base as parent element will look different after **Direction** attribute change too.
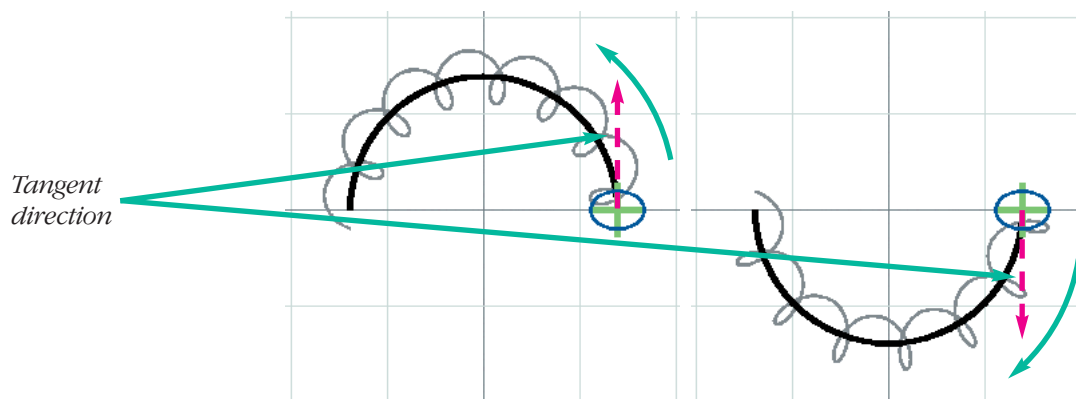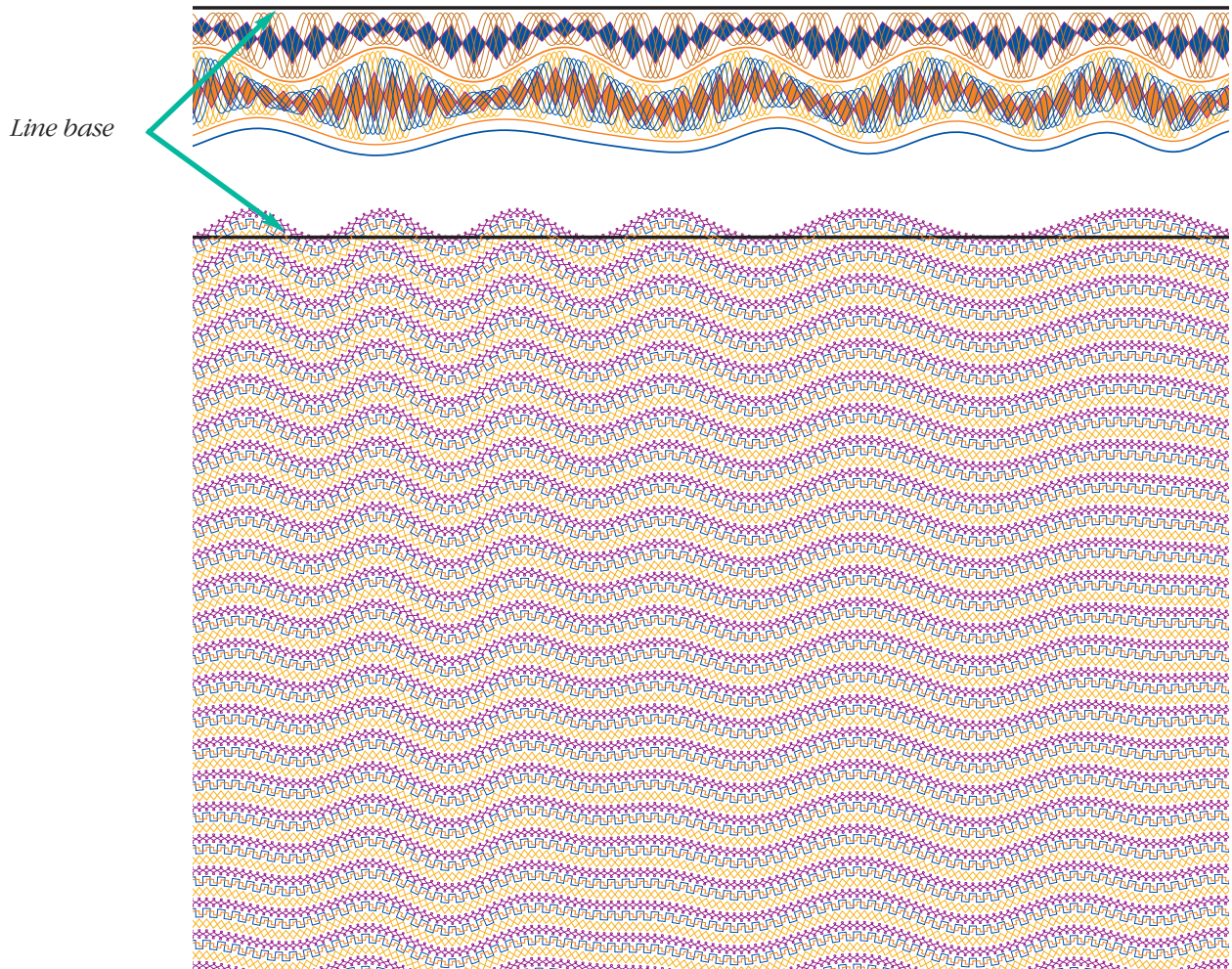

*Same pictures as above but with **Cycloid** element instead of **Sine Wave**.*
***Direction** attribute set to '**Counterclockwise**' (left) and '**Clockwise**' (right)*

CHAPTER 3: LINE

Line is another frequently used and important type of base elements in *Excentro* application. It serves as base for all linear borders and backgrounds designs.
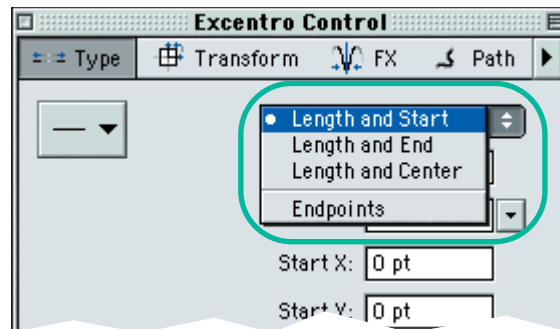
Line base

*Border and linear background with **Line** base elements*

Line base element could be defined as either line with specific length and angle that starts, ends or has center in certain point, or line that connects two specific end points. With its initial attribute settings **Line** represents a horizontal line with length '*100 pt*' and start point in the center of graphics coordinate system. Examples below show **Line** path variations that could be achieved by its attributes modifications.
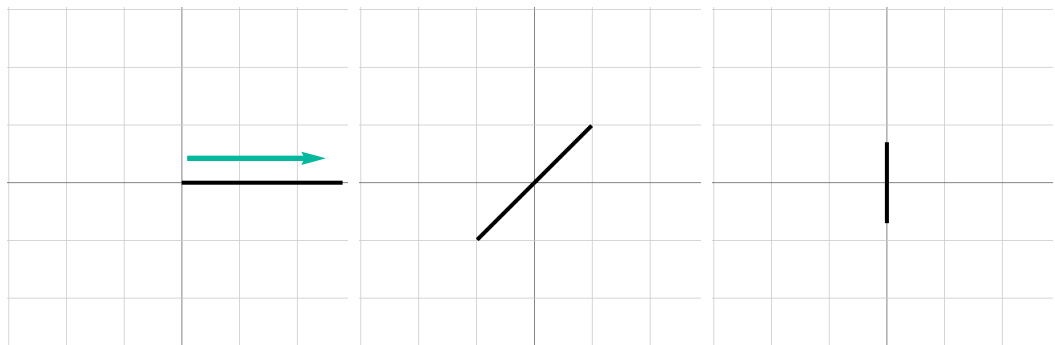
TYPE ATTRIBUTES

Line base element could be defined in one of four different ways similar to that of line objects in graphics design applications. First three of them allow you to specify length, angle and coordinates of single point: start point, end point or center point. Fourth way defines line using two points: start point and end point. You can choose between any of these ways using pop-up menu in **Type** panel of **Excentro Control** inspector. Titles of numeric fields change according to this selection.

Note: *All pictures in this section show* **Line** *base as thick black path. Second thin gray path illustrates example of* **Sine Wave** *element that uses the* **Line** *as its base (parent) element. You can take a note of* **Sine Wave** *path modifications that accompany* **Line** *path changes.*

■ **Length and Start** pop-up selection defines **Line** base element using four numeric attributes: **Length**, **Angle**, **Start X** and **Start Y**. This is the default option you will see when you convert base element to **Line** type:
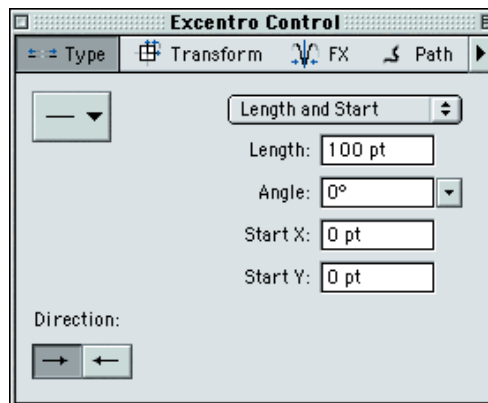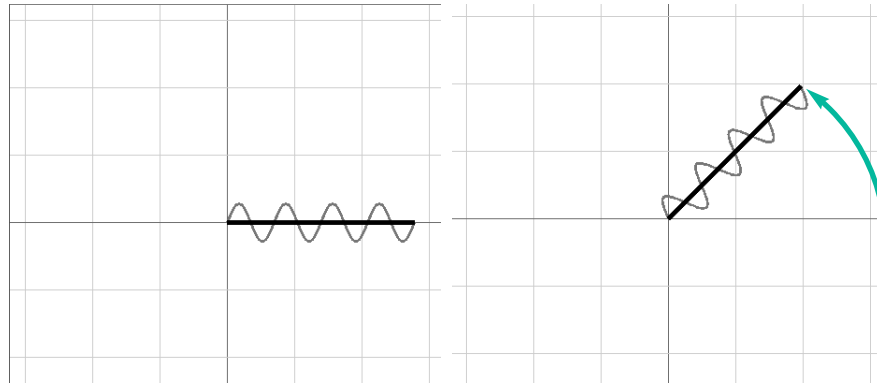
◆ **Length** defines line path length in application-wide measurement units. Initial value is '*100 pt*'. You can use this attribute to make **Line** path longer or shorter.
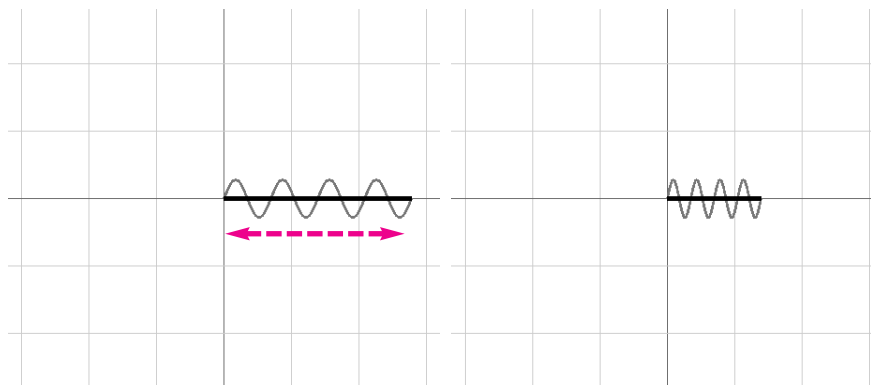
Line paths with **Length** *attribute set to '100 pt' and '50 pt'*

◆ **Angle** attribute controls rotation of **Line** path around its starting point. **Angle** attribute value is expressed in degrees ("°").

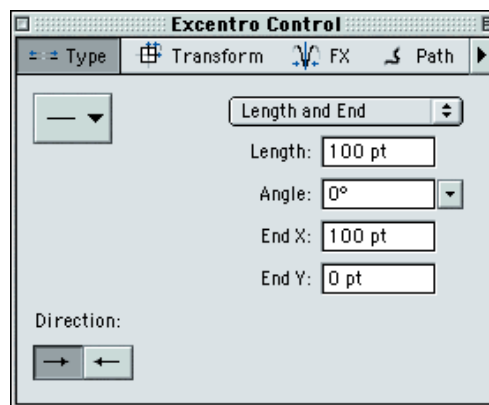
*'45° modification of **Angle** attribute*

◆ **Start X** and **Start Y** attributes define coordinates of start point of **Line** base in application-wide measurement units. Initially start point coincides with center of graphics coordinate system — point *(0 pt; 0 pt)*. You can change this point to any arbitrary position.
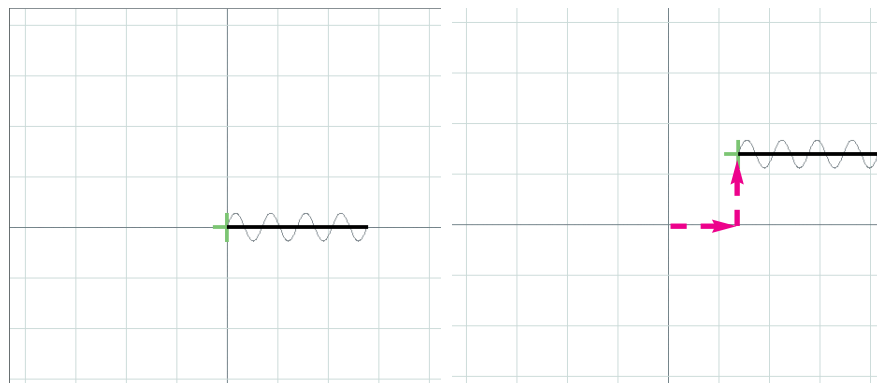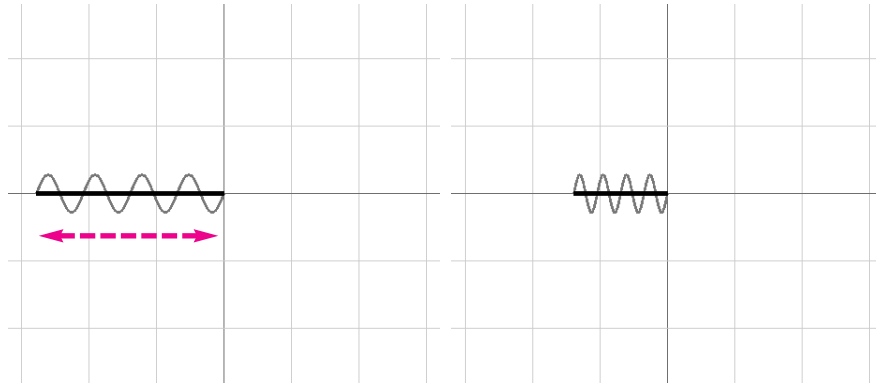

*Initial **Line** start point position (0 pt; 0pt) (left);*
*start point after **Start X**, **Start Y** attributes modification (50 pt; 50 pt) (right)*

■ **Length and End** pop-up selection defines **Line** base element using following attributes: **Length**, **Angle**, **End X** and **End Y**. When you choose **Length and End** option from pop-up menu new values of these attributes will be calculated so that line length and position will remain as they were with previous pop-menu selection.
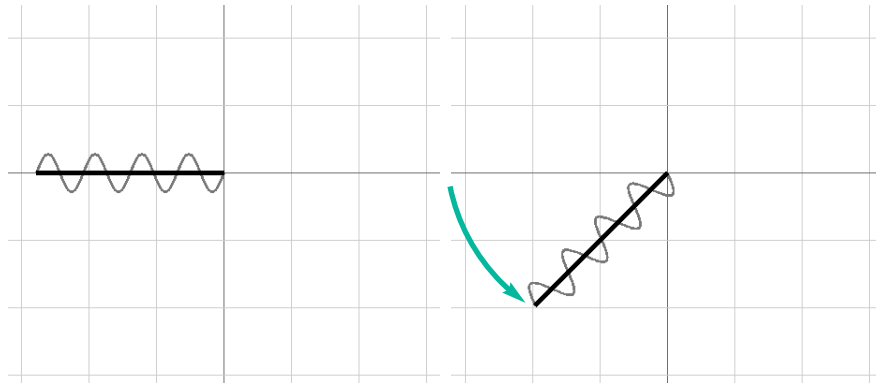
◆ **Length** defines line path length in application-wide measurement units. You can use this attribute to make path of **Line** base longer or shorter.

Line paths with Length attribute set to '100 pt' and '50 pt'

◆ **Angle** attribute controls rotation of **Line** path around its end point. **Angle** attribute value is expressed in degrees ('°').
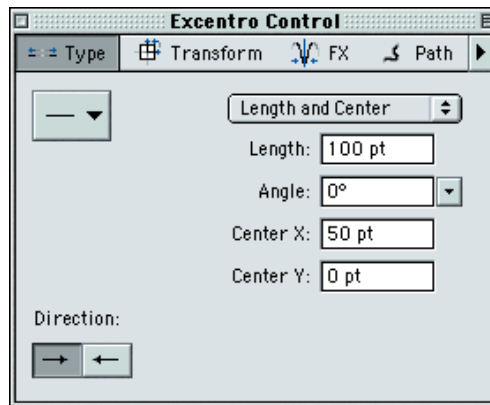
'45°' modification of Angle attribute

◆ **End X** and **End Y** attributes define coordinates of end point of **Line** base in application-wide measurement units. You can change this point to any arbitrary position you want.
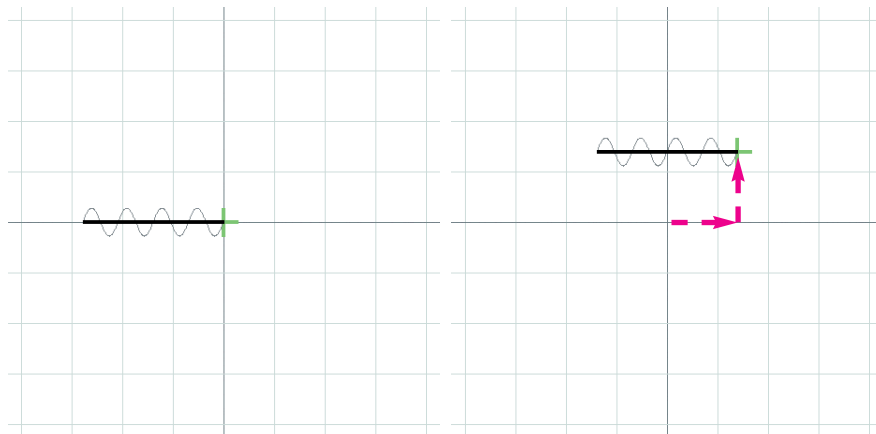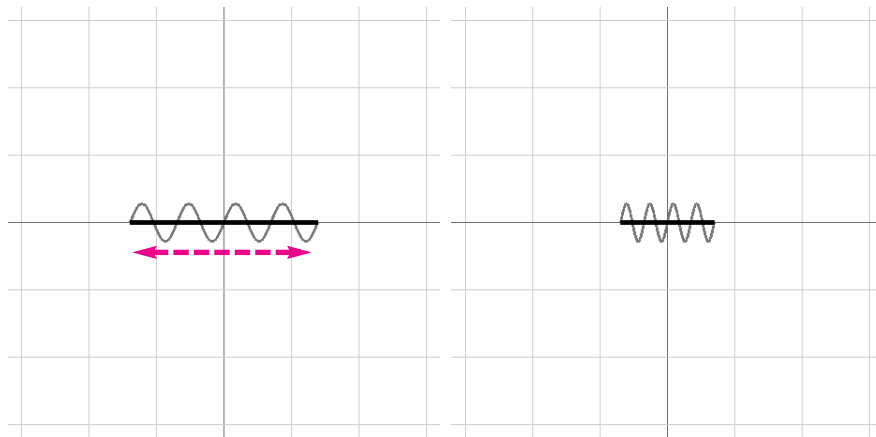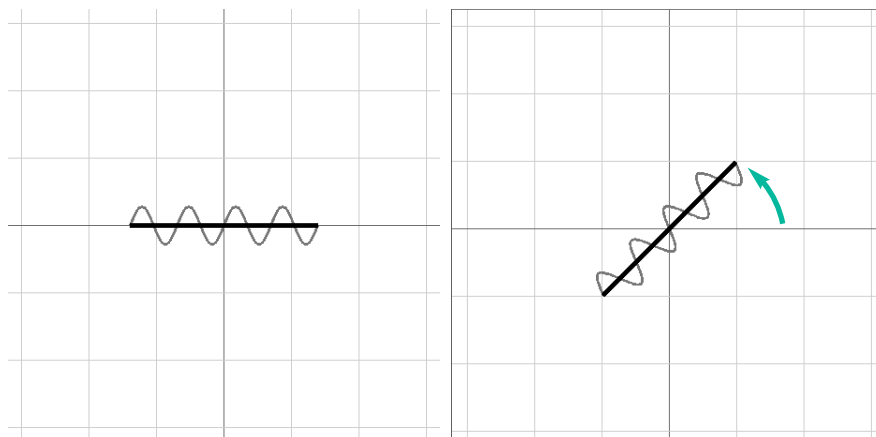
Line path with end point position (0 pt; 0pt) (left);
end point after End X, End Y attributes modification (50 pt; 50 pt) (right)

■ **Length and Center** pop-up selection defines **Line** base element using following attributes: **Length**, **Angle**, **Center X** and **Center Y**. When you choose **Length and Center** option from pop-up menu new values of these attributes will be calculated so that line length and position will remain as they were with previous pop-menu selection.

◆ **Length** defines line path length in application-wide measurement units. You can use this attribute to make path of **Line** base longer or shorter.
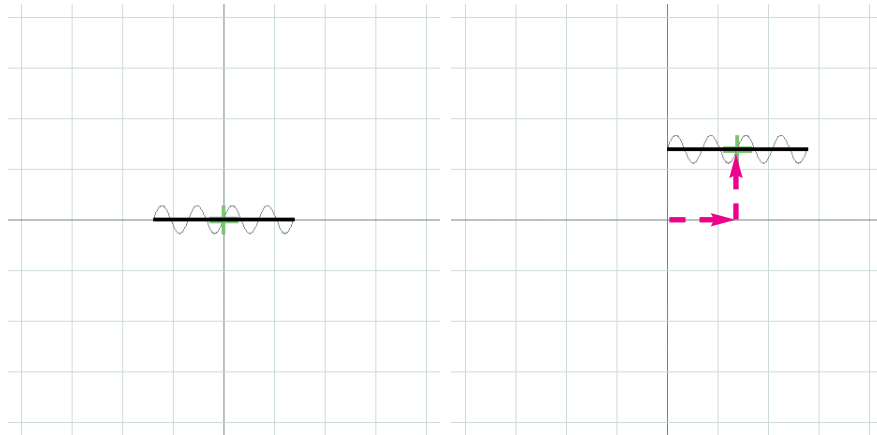

*Line paths with **Length** attribute set to '100 pt' and '50 pt'*

◆ **Angle** attribute controls rotation of **Line** path around its center point. **Angle** attribute value is expressed in degrees ('°').


*'45°' modification of **Angle** attribute*

◆ **Center X** and **Center Y** attributes define coordinates of center point of **Line** base in application-wide measurement units.


Line path with center point position (0 pt; 0pt) (left);
center point after Center X, Center Y attributes modification (50 pt; 50 pt) (right)

■ **Endponts** pop-up selection defines **Line** base element using following attributes: **Start X**, **Start Y**, **End X** and **End Y**. When you choose **Endponts** option from pop-up menu new values of these attributes will be calculated so that line length and position will remain as they were with previous pop-menu selection.
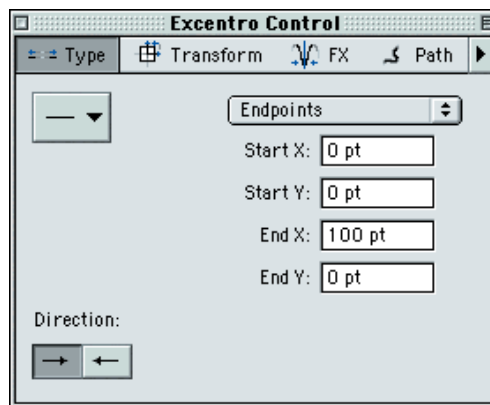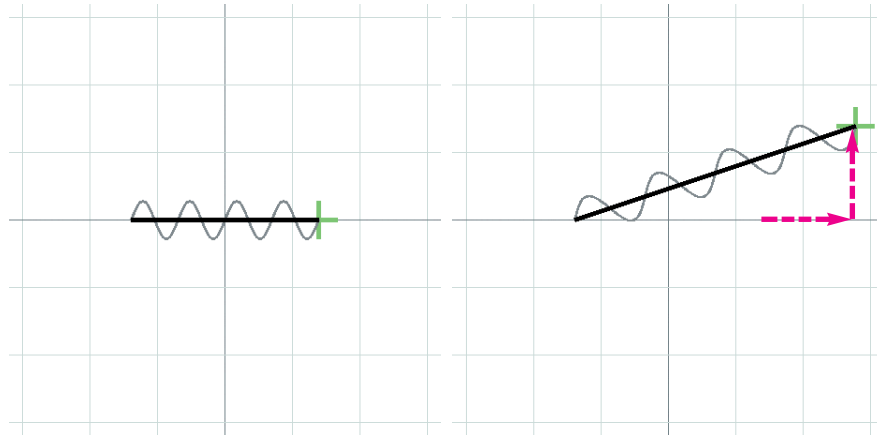

◆ **Start X** and **Start Y** attributes define coordinates of start point of **Line** base path in application-wide measurement units.
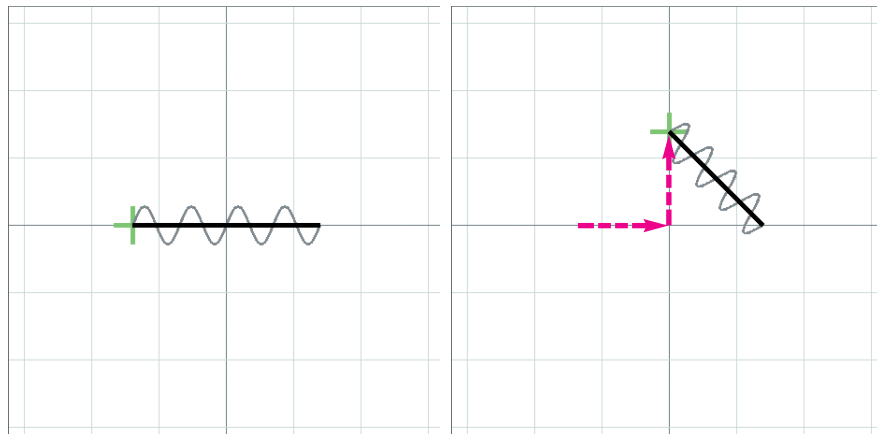
50 pt modifications of Start X and Start Y attributes

◆ **End X** and **End Y** attributes define coordinates of end point of **Line** base path in application-wide measurement units.


*50 pt modifications of **End X** and **End Y** attributes*

■ **Direction** attribute allows you to change direction in which **Line** path is drawn. There are two values for this attribute: **Normal** and **Reversed**.


Normal is the initial **Direction** value, in this case **Line** is drawn from start point to end point. You can modify this behavior and set **Direction** attribute to **Reversed**, after that the **Line** will be drawn backwards from end point to start point. **Direction** attribute also sets direction in which 'sheet' travels along **Line** base path on 'tabletop' while it draws element paths according to *Excentro* mechanical model. Because this direction changes as well, be prepared that paths of elements like **Cycloid** that use **Line** base as parent element will look different after **Direction** attribute change.
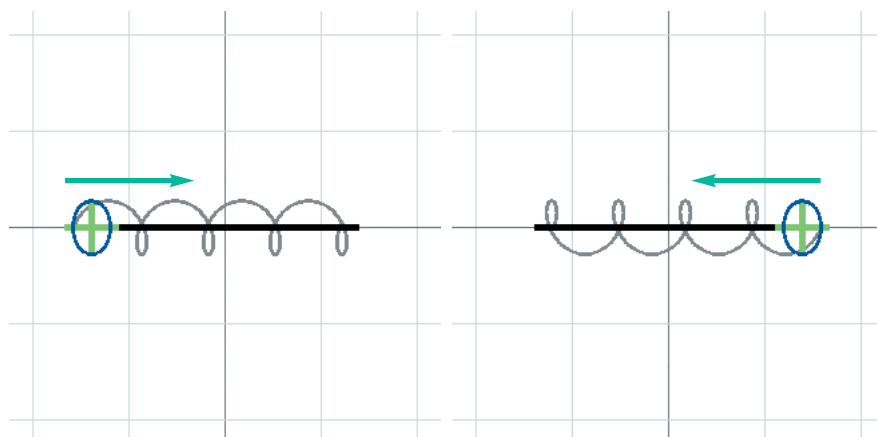
***Direction*** *attribute set to '**Normal**' (left) and '**Reversed**' (right)*

CHAPTER 4: RECTANGLE

Rectangle is type of base elements that could be used for fast and simple borders creation. Traditionally guilloche borders are created by cutting rectangular piece of circular rosette design and repeating pattern of its four reflections around desired border boundary. **Rectangle** base element represent simpler alternative to this process.
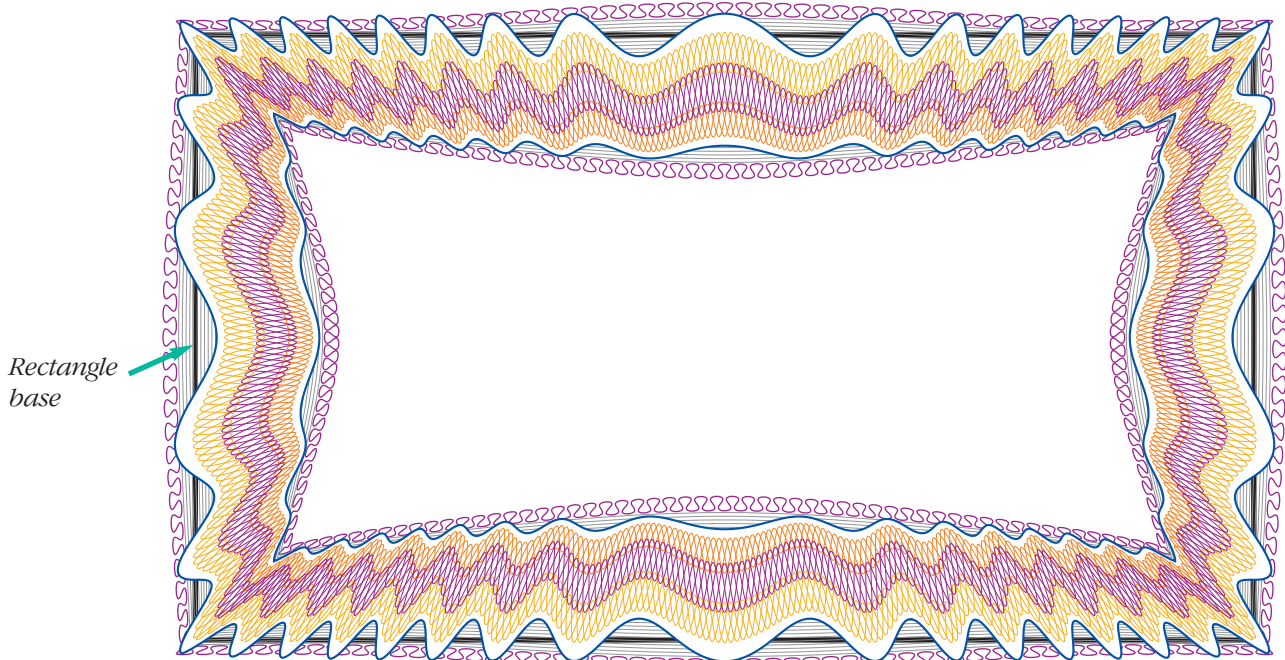
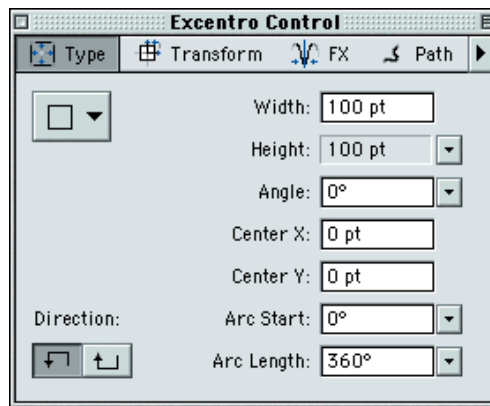*Rectangle base*

*Border with **Rectangle** base element*

Shape of **Rectangle** base element could be either 'squarish' or 'rectangular' depending on its **Width** and **Height** attributes combinations. With its initial attribute settings **Rectangle** represents a square with '*100 pt*' side size drawn on 'tabletop' in counterclockwise direction. Examples below show **Rectangle** shape changes that could be achieved by its attributes modifications.
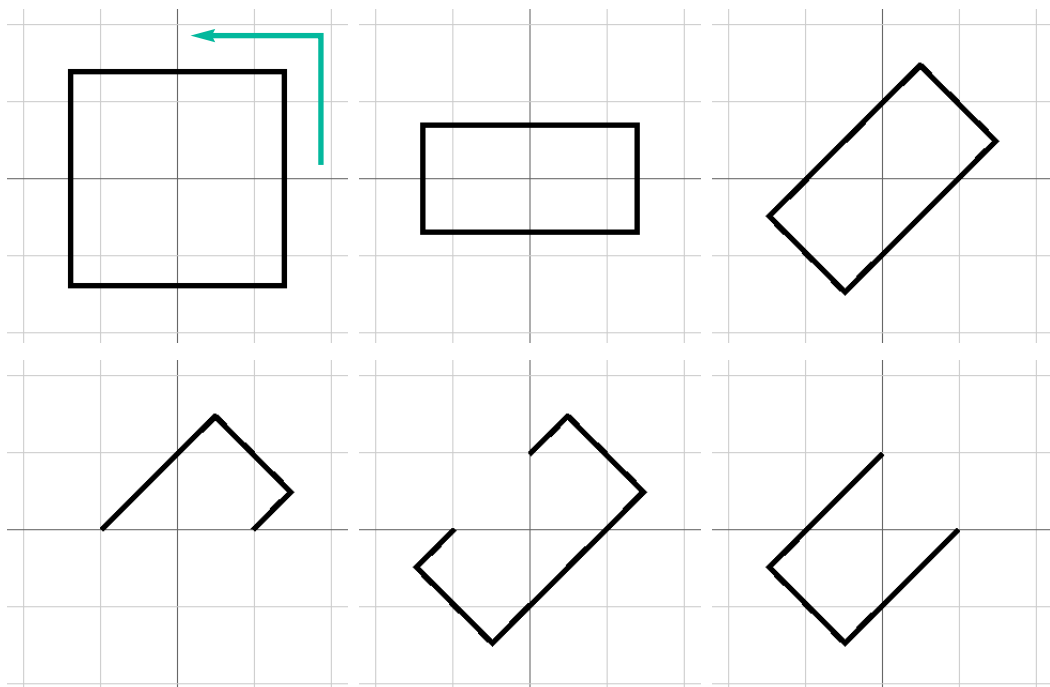
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has eight attribute fields for base elements of **Rectangle** type:
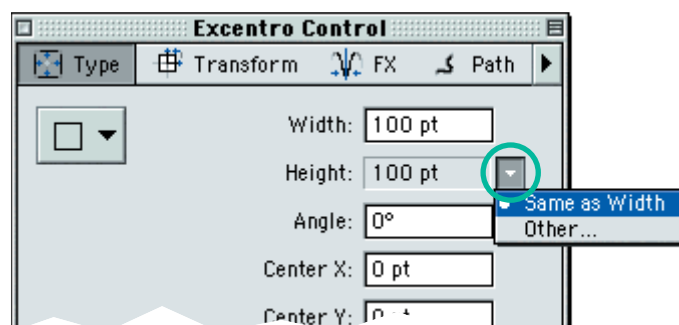

Note: *All pictures in this section show **Rectangle** base as thick black path. Second thin gray path illustrates example of **Sine Wave** element that uses the **Rectangle** as its base (parent) element. You can take a note of **Sine Wave** path modifications that accompany **Rectangle** shape changes.*

■ **Width** and **Height** attributes define geometric size of **Rectangle** path in application-wide measurement units. By modifying these values you can make path of **Rectangle** base on 'tabletop' larger or smaller:
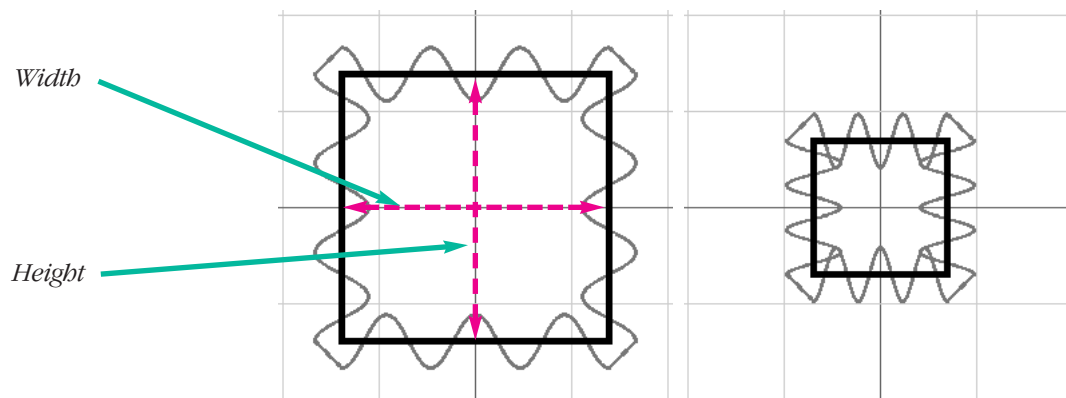

*Rectangle paths with **Width** and **Height** set to '100 pt' and '50 pt'*

Initially **Height** attribute is set to same value as **Width** attribute and shape of **Rectangle** base is rather 'squarish' than 'rectangular'. This behavior is controlled by **Same as Width** option selected from pop-up menu beside **Height** attribute field.

If you need to specify different values for **Width** and **Height** attributes you can select **Other** option from the pop-up menu. After that numeric field of **Height** attribute will become editable and you can enter any desired value in this field using keyboard.
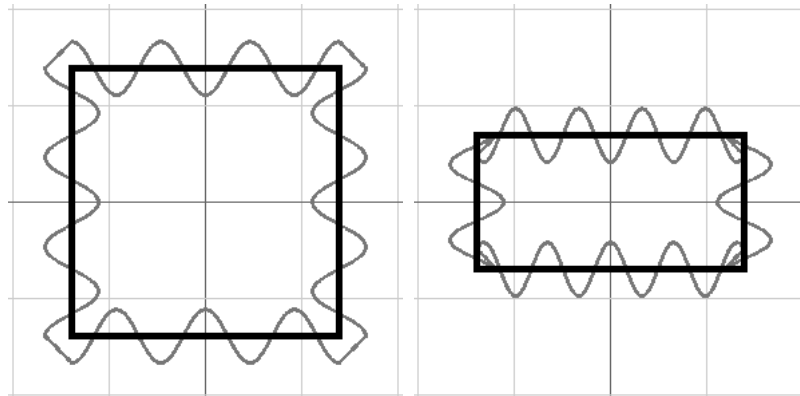

Height attribute set to '100 pt' (same as Width attribute) and '50 pt' values

■ **Angle** attribute controls rotation of **Rectangle** base around its center point. **Angle** attribute value is expressed in degrees ("°").
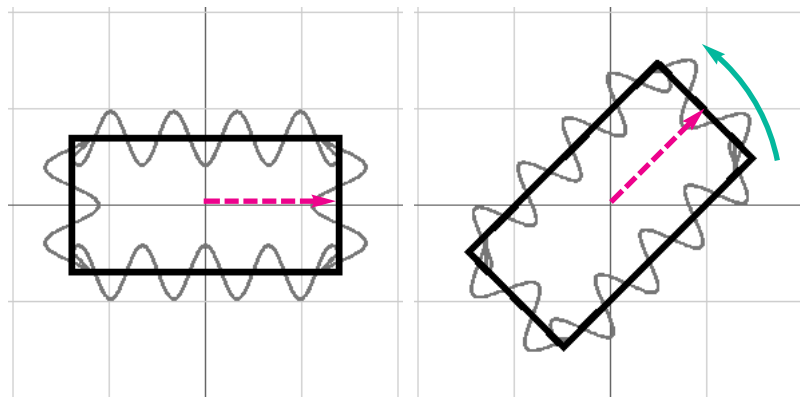

'45°' modification of Angle attribute

■ **Center X** and **Center Y** attributes define the center of **Rectangle** base in application-wide measurement units. Initially **Rectangle** center coincides with center of graphics coordinate system — point *(0 pt; 0 pt)*. You can change this point to any arbitrary position if needed.
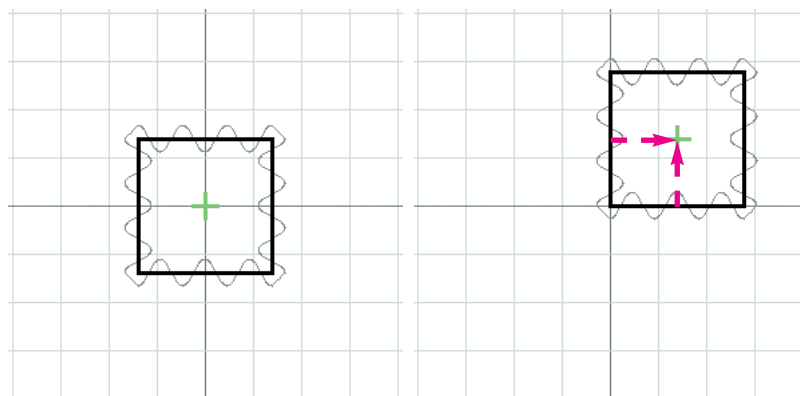

*Initial Rectangle center position (0 pt; 0pt) (left);
center position after Center X, Center Y attributes modification (50 pt; 50 pt) (right)*

■ **Arc Start** and **Arc Length** attributes allows you to create bases of open angular shape. Both attributes are expressed in degrees ('°'). **Arc Length** attribute defines length of rectangle path. Value of '*360°*' corresponds to full closed rectangle, value of '*180°*' corresponds to open path with half rectangle length.
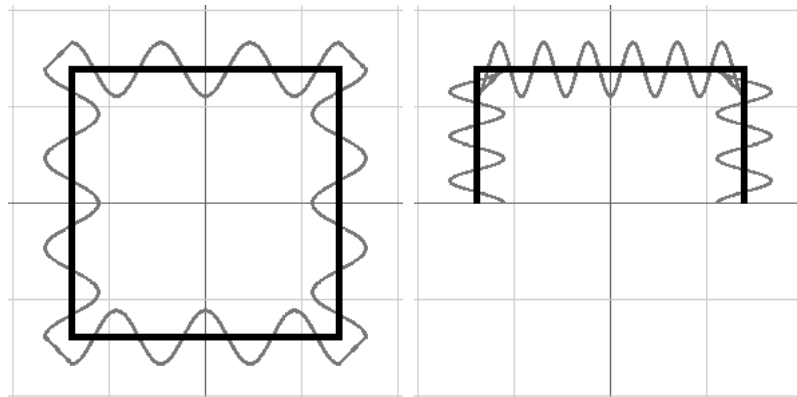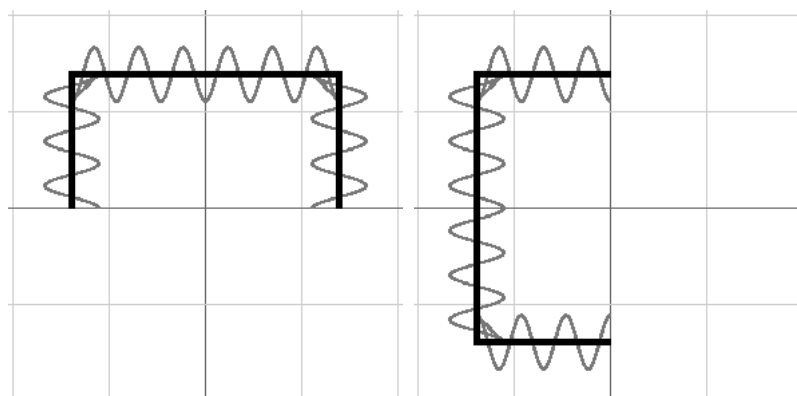

Rectangle paths with Arc Length attribute set to '360°' and '180°' values

You can also use this attribute with values larger than '*360°*' to create bases with several full-rectangles length. In this case all subsequent elements that use this base as parent element will have long continuos path that also does several full rectangle movements together with the base.
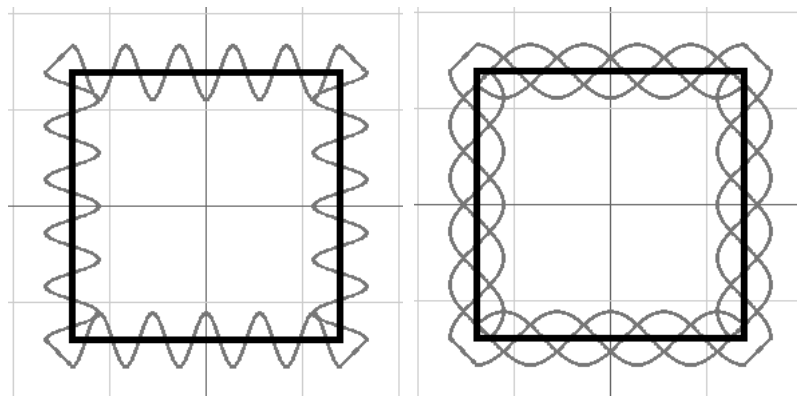

Rectangle paths with Arc Length attribute set to '360°' and '3×360°=1080°' values. Both base have single Sine Wave element with Frequency attribute set to '20'.

Arc Start attribute controls starting point of rectangle path. Value '*0°*' corresponds to middle of right rectangle side, '*90°*' — to middle of top side, '*180°*' — to middle of left side and '*270°*' — to middle of bottom side.

Rectangle paths with Arc Length attribute set to '180°' and Arc Start set to '0°' and '90°'

■ **Direction** attribute allows you to change direction in which **Rectangle** path is drawn. There are two values for this attribute: **Clockwise** and **Counterclockwise**.
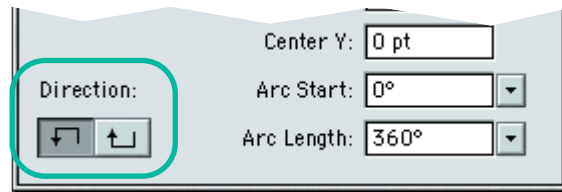

Counterclockwise is the initial **Direction** value, in this case top part of **Rectangle** is drawn first ('right-to-top side'). You can modify this behavior and set **Direction** attribute to **Clockwise**, after that the bottom part of **Rectangle** will be first to be drawn ('right-to-bottom side').
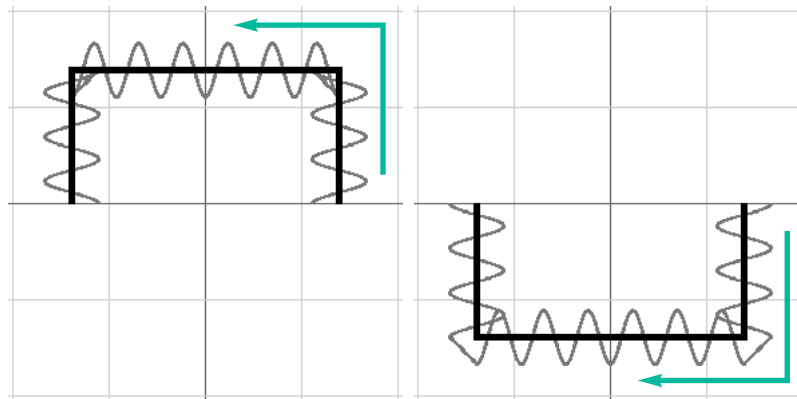
Rectangle paths with Arc Length attribute set to '180°.
Direction attribute set to 'Counterclockwise' (left) and 'Clockwise' (right)

Direction attribute also sets direction in which 'sheet' travels along **Rectangle** base path on 'tabletop' while it draws element paths according to *Excentro* mechanical model. Because this direction will also be changed to opposite one after **Direction** attribute change, be prepared that paths of elements like **Cycloid** that use **Rectangle** base as parent element will look different after **Direction** attribute change as well.
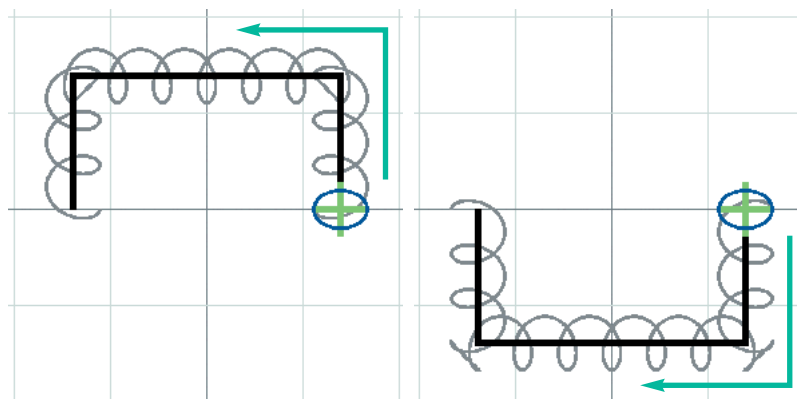

Same pictures as above but with Cycloid element instead of Sine Wave.
Direction attribute set to 'Counterclockwise' (left) and 'Clockwise' (right)

USAGE SUGGESTIONS

Path of **Rectangle** base element is not a smooth curve (unlike path of **Ellipse** base element, for example) and has four corners with right (90°) angles. According to *Excentro* mechanical model, 'sheet' travels around path of base element on tabletop and rotates together with tangent line to base path. The problem with **Rectangle** path is that it has two tangent directions at corner points at once. So, 'sheet' movement experience sudden 'jump' and direction changes when it reaches the corner. As a result smoothness of paths that use **Rectangle** as base element breaks.

To avoid this problem you can set up another element with smooth path as a ***direction*** element for elements that use **Rectangle** as base to guide 'sheet' rotation and preserve path smoothness. In most cases it is enough to create additional **Ellipse** base element with same **Width** and **Height** attributes as that of **Rectangle** and to set it as direction element for all elements that use **Rectangle** as their bases. Example below illustrates the case with single **Sine Wave** element.
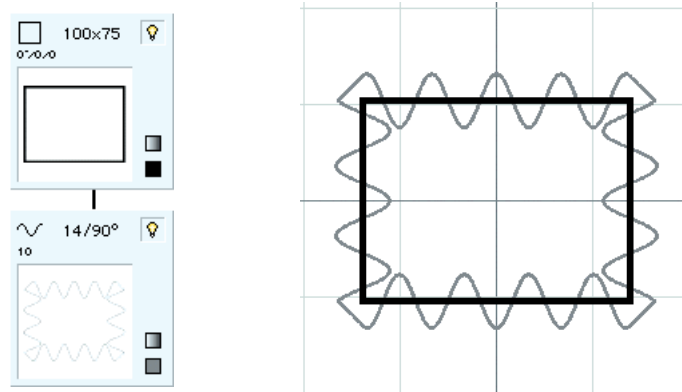

*Sine Wave element with **Rectangle** as its base.*
Sine Wave path smoothness breaks at four corner points.
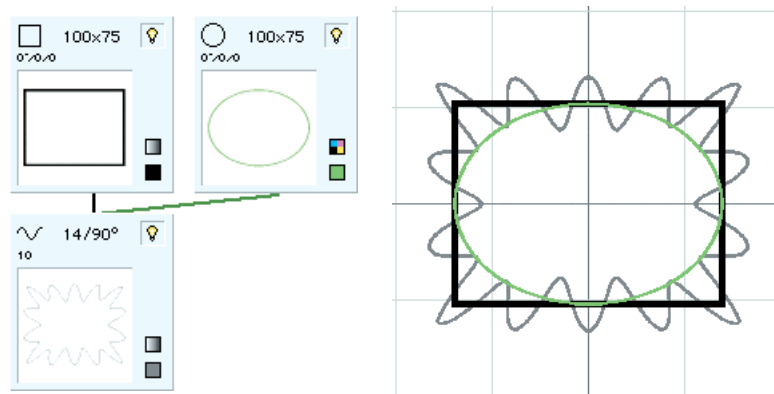
*Additional **Ellipse** base element is set as direction element for **Sine Wave** element.*
*Smoothness of **Sine Wave** path restored.*

CHAPTER 5: SPIRAL

Spiral is the decorative base element that could be used for for non-standard designs like the stylized '*e*'-letter shape we use for an icon of *Excentro* application.
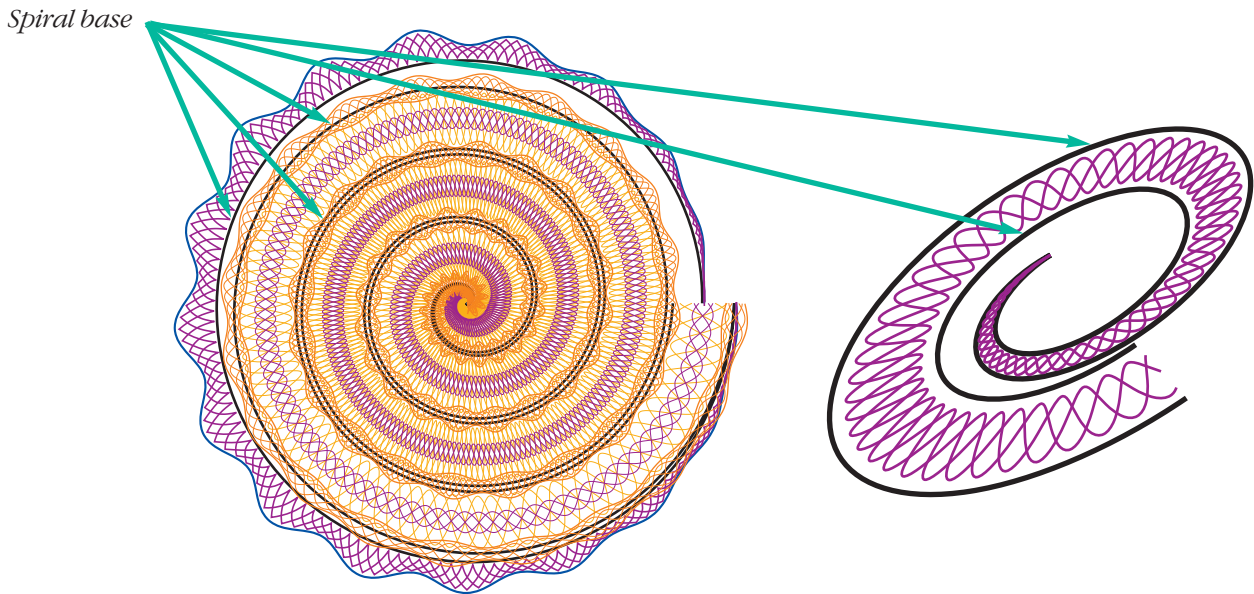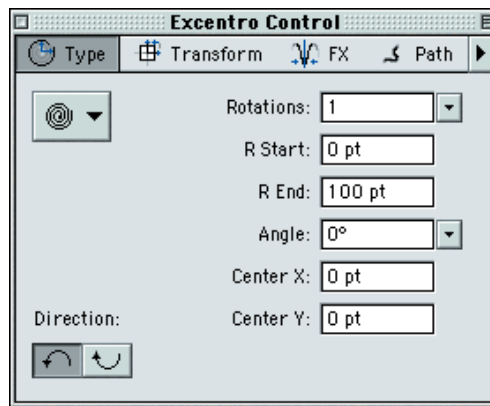
Spiral base

*Examples of **Spiral** base designs*

Shape of **Spiral** base element consists of several circular coils wound around a center point. Number of coils is defined by **Rotations** attribute, distance from center point to starting and ending point of **Spiral** is controlled by **R Start** and **R End** attributes. With its initial attribute settings **Spiral** represents a curl with single coil that unwinds in counterclockwise direction from center point to '*100 pt*' point on horizontal axis of coordinates system.radius. Examples below show **Spiral** shape changes that could be achieved by its attributes modifications.
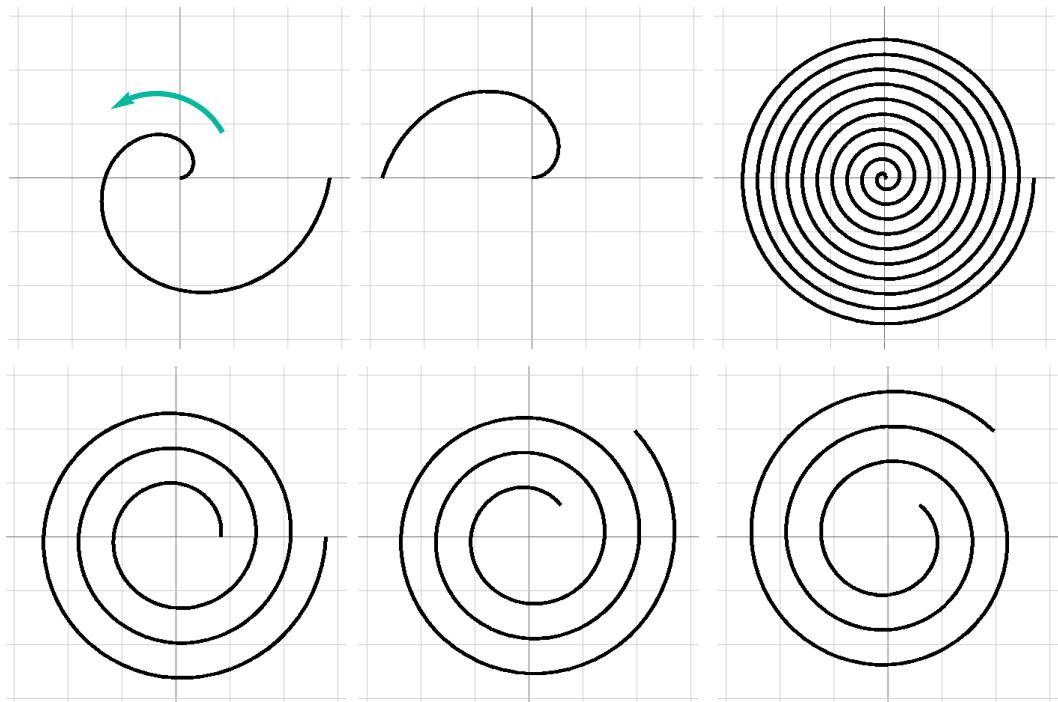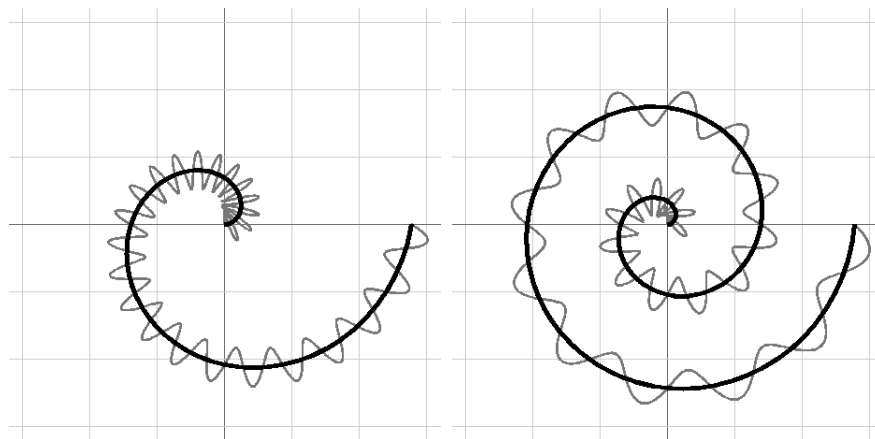
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has seven attribute fields for base elements of **Spiral** type:

Note: *All pictures in this section show **Spiral** base as thick black path. Second thin gray path illustrates example of **Sine Wave** element that uses the **Spiral** as its base (parent) element. You can take a note of **Sine Wave** path modifications that accompany **Spiral** shape changes.*

■ **Rotations** attribute controls number of times path of **Spiral** base element circles around its center point. Initial value of this attribute is '*1*', that corresponds to single full circle arc of 360°. You can increase this value, for example, to '*2*' to make **Spiral** path do two complete circles around center point, or decrease it, for example, to '*0.5*' to make **Spiral** path of semicircle arc (180°).

*Spiral paths with **Rotations** attribute set to '1' and '2'*

■ **R Start** and **R End** attributes define radius distances from center point to starting point and ending point of **Spiral** path. The values are specified in application-wide measurement units. Initially **R Start** attribute value set to '*0 pt*' and **R End** attribute value set to '*100 pt*', you can modify these values to whatever you like (see illustrations on next page).

If **R Start** attribute has same value as **R End** attribute, **Spiral** path turns into circle or arc depending on value of **Rotations** attribute.
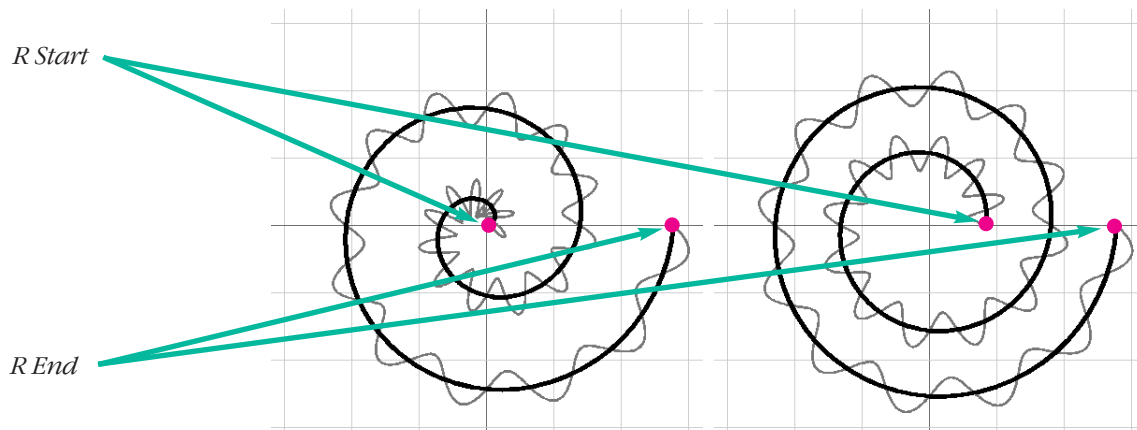
R Start

R End

*Spiral paths with **R End** set to '100 pt', **R Start** set to '0 pt' (left) and '30 pt' (right)*

■ **Angle** attribute controls rotation of **Spiral** base around its center point. **Angle** attribute value is expressed in degrees ("°").
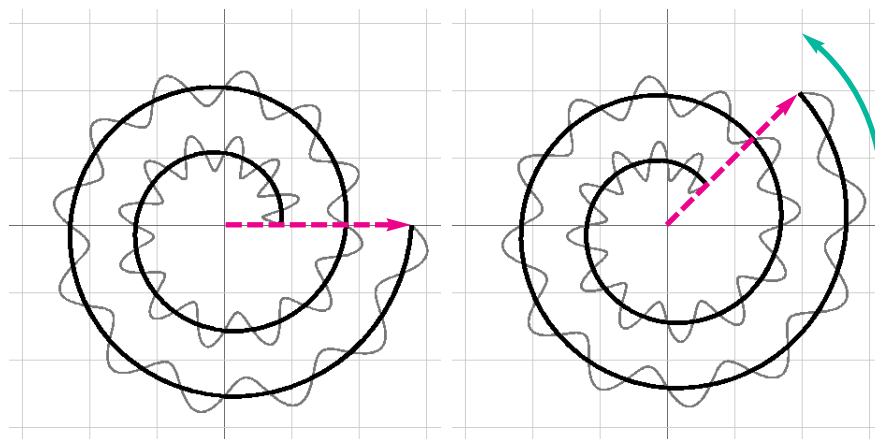

*'45° modification of **Angle** attribute*

■ **Center X** and **Center Y** attributes define position of **Spiral** base center point in application-wide measurement units. Initially **Spiral** center coincides with the center of graphics coordinate system — point *(0 pt; 0 pt)*. You can change this point to any arbitrary position if needed.
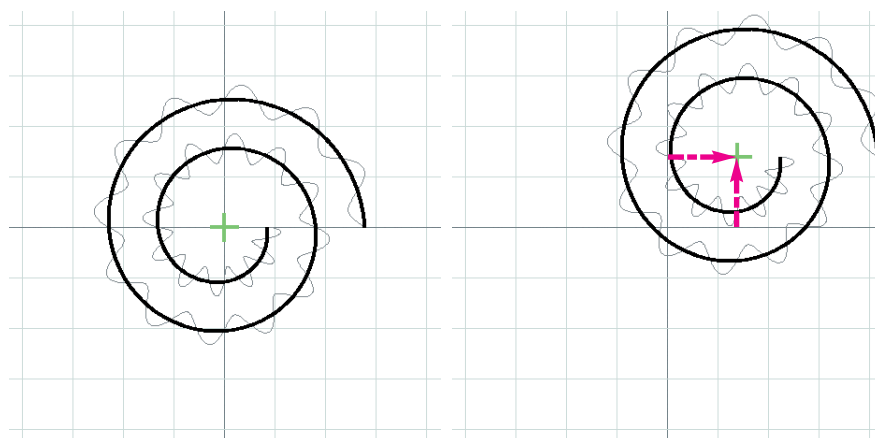

*Initial **Spiral** center position (0 pt; 0pt) (left);*
*center position after **Center X**, **Center Y** attributes modification (50 pt; 50 pt) (right)*

■ **Direction** attribute allows you to change direction in which **Spiral** path circles around its center point from starting point to end point. There are two values for this attribute: **Clockwise** and **Counterclockwise**.
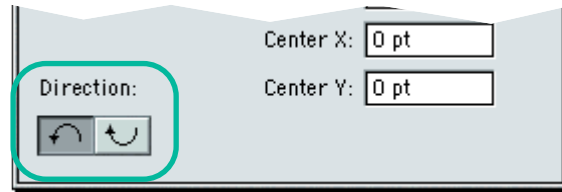

Counterclockwise is the initial **Direction** value, in this case top arc of **Spiral** is drawn first ('right-to-top'). You can modify this behavior and set **Direction** attribute to **Clockwise**, after that the bottom arc of **Spiral** will be first to be drawn ('right-to-bottom').
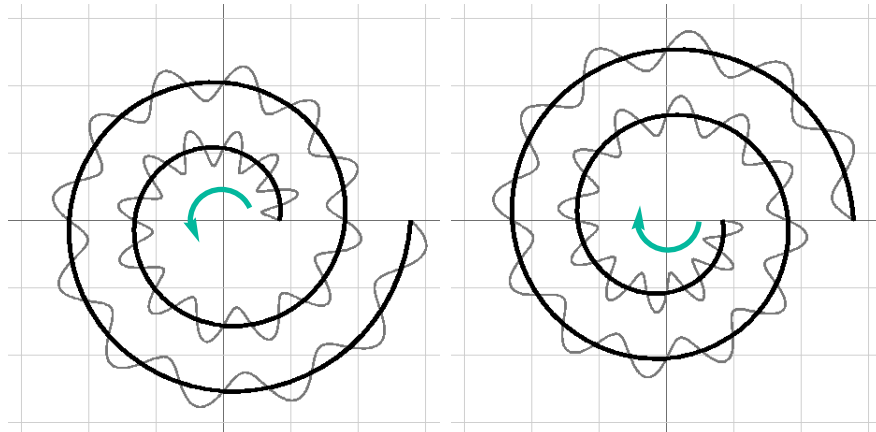
*Direction attribute set to '**Counterclockwise**' (left) and '**Clockwise**' (right)*

Direction attribute also sets direction in which 'sheet' travels along **Spiral** base path on 'tabletop' while it draws element paths according to *Excentro* mechanical model. Because 'sheet' rotates together with tangent line direction to base path (that will be different after **Direction** attribute change), be prepared that paths of elements like **Cycloid** that use **Spiral** base as parent element will look different after **Direction** attribute change.
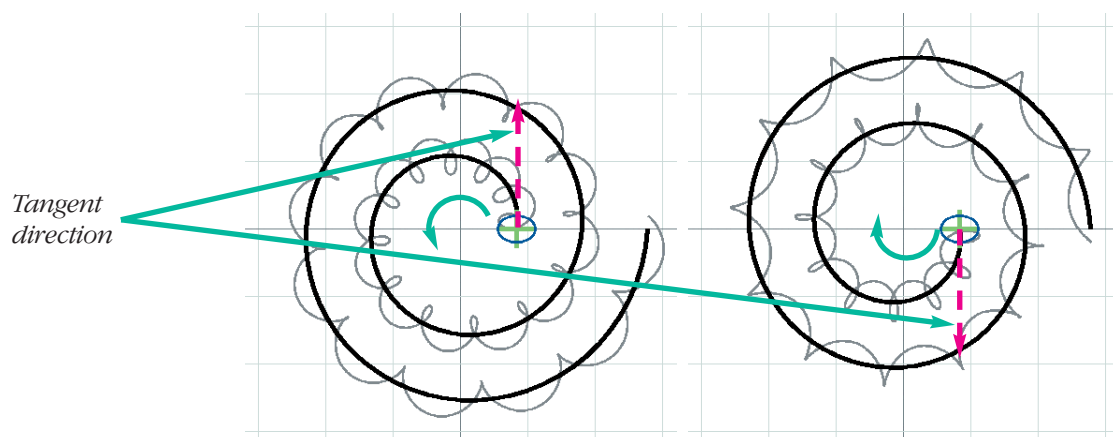

*Same pictures as above but with **Cycloid** element instead of **Sine Wave**.*
*Direction attribute set to '**Counterclockwise**' (left) and '**Clockwise**' (right)*

PART II: REGULAR ELEMENTS

CHAPTER 1: INTRODUCTION

Similar to the previous part of this book that was dedicated to objects of base elements class, this part of **Excentro Objects Reference** contains detailed description of *Excentro* application regular elements. Paths of elements of this class are created in *Excentro* using 'tabletop-sheet-pencil' mechanical model depicted in introduction to this book. This model involves drawing object called 'pencil' that moves on flat 'sheet' object that in its turn moves along existing base path on flat 'tabletop' surface. As a result pencil draws path on tabletop that represent 'curly', 'wavy', etc. modification of the base path that depends on the kind of shape pencil draws on sheet. There are several types of regular elements with each type defining its own specific shape the pencil draws.

Regular elements serve as skeleton bones that control shape of guilloche design. They are located on second, third and further levels of guilloche tree structure in main document window. Their rectangular representations have single black connection line that connects them to the element which path they modify. This element is a parent element of regular element in guilloche tree. It also is called 'base element' because its path is used as base path for the modification.
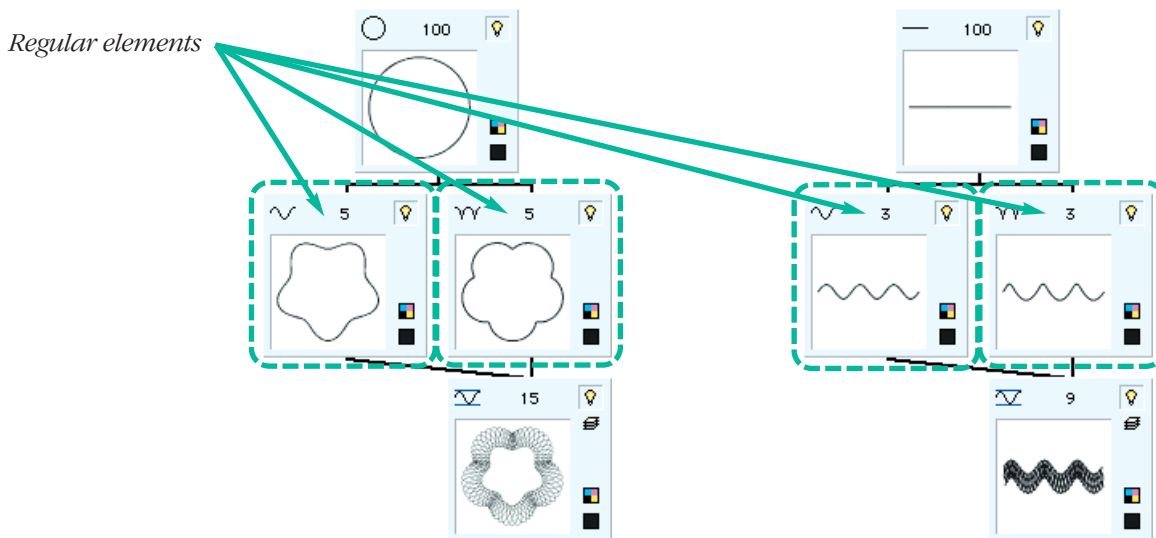
TYPES OF REGULAR ELEMENTS

There are ten types of regular elements in *Excentro* application. Illustrations below show examples of regular elements representations in main document window. These elements use standard circular base element of **Ellipse** type as their base path:
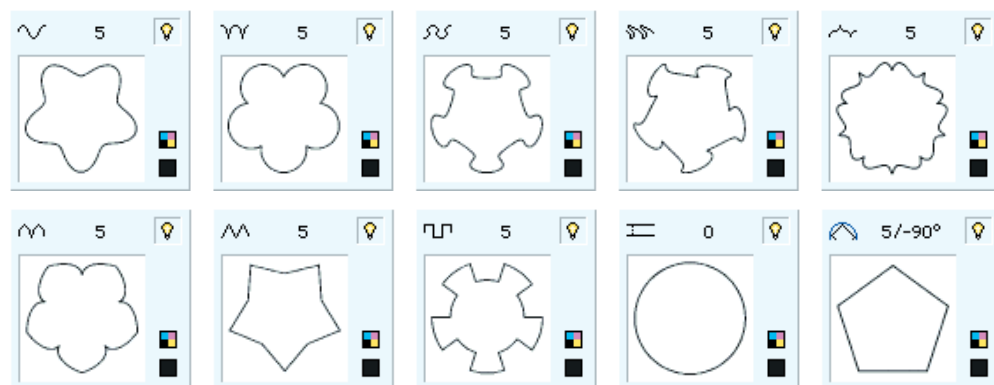
■ **Sine Wave** (*Chapter 2*) is the most common type of regular elements. It represents very simple up and down movements of pencil on the sheet while sheet moves along base path. As a result you get wavy modification of base path. Up and down movements are controlled by harmonic sine function, this is why the element has this name.

■ **Cycloid** (*Chapter 3*) represents circular movement of pencil on sheet while sheet moves along base path. In result you receive path that consists of series of coils. Depending on type of base path, paths created using this element are called cycloids, epicycloids, hypocycloids, etc. in mathematical books.

■ **Eight** (*Chapter 4*). The movement of pencil on sheet for this element looks like number eight ('8') figure. The path you receive on tabletop as result of sheet movement along base path will consist of series of twists with similar top and bottom parts.

■ **Saw** (*Chapter 5*) element represents semicircular movement of pencil on sheet while sheet moves along base path. In result you will get path that can resemble blade of hand saw (if base path is linear) or circular saw (if base path is circular).

■ **Brace** (*Chapter 6*) element represents more complex movement of pencil on sheet. The trail pencil leaves on tabletop will have regular twists that remind braces or bracket symbols placed one after another.

■ **Spade** (*Chapter 7*) element represents combination of two periodic movements of pencil on sheet: linear movement in orthogonal direction and harmonic sine movement in tangent direction. As a result path that sheet draws while it moves along base path on tabletop might look like decorative fence pikes or flower petals.

■ **Star** (*Chapter 8*) is a special kind of elements that does not use *Excentro* mechanical model for paths creation. Instead of complex 'pencil-sheet-tabletop' movement, path of **Star** element is created by connecting points set at equal offset distance from base path with straight line segments.

■ **Notch** (*Chapter 9*). Path of **Notch** element is created by stationary pencil that follows base path at fixed offset distance and at regular intervals jumps from one side of base path to opposite one. These breakpoints are connected by straight line segments.

■ **Offset** (*Chapter 10*) element allows you to create paths set at specified distance from base path. This kind of elements is usually used to create borders around specific parts of guilloche designs.

■ **Polygon** (*Chapter 11*) is another special kind of element that does not use *Excentro* mechanical model. Path of **Polygon** element consists of line segments that join points set at equal intervals on base path.

Mathematical details, illustrations of pencil movement on sheet and examples of guilloche designs that use elements of all these types are provided in chapters of this part of **Excentro Objects Reference** book. Numbers of chapters that cover specific element types are shown beside names of these types in the list above.

In next sections of this introduction we will discuss matters of regular elements creation, deletion and modification of their positions in structure tree.
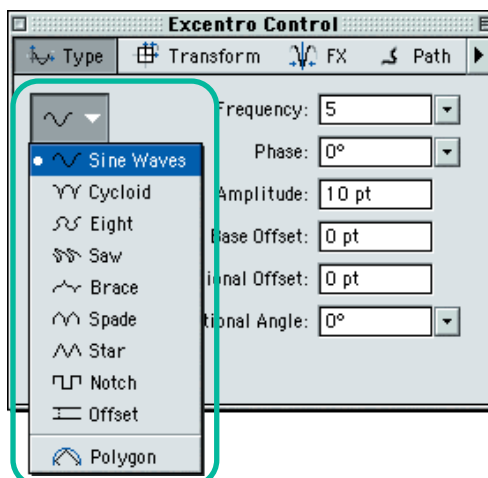
CREATING ELEMENTS

To create new regular element in *Excentro* document you should select some existing element (it could any kind of elements: base element, regular element or content element) in this document and use **New Element** command from **Structure** menu or its shortcut button in **Structure** section of **Toolbar**:
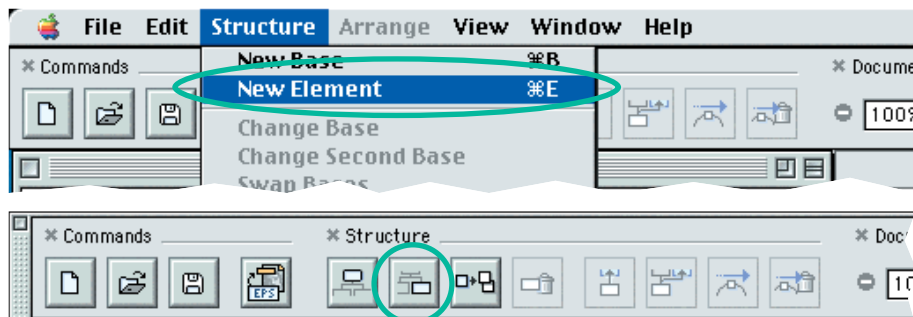
After **New Element** command was chosen new regular element that use selected element as its base element (it will be parent element of new regular element in guilloche tree and its path will be used as base path for new element) will be created and its rectangle representation will appear in main document window below selected element:
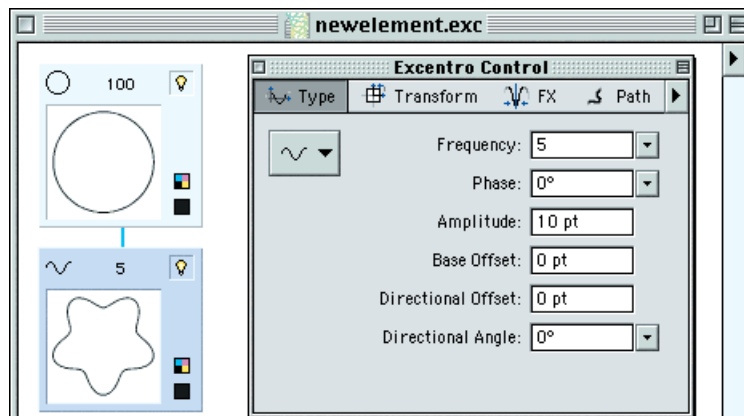
By default new regular element is of **Sine Wave** type with **Frequency** attribute set to '*1*'. You can use fields in **Type** panel of **Excentro Control** inspector to modify **Sine Wave** attributes or select different element type from **Type** pop-up menu:
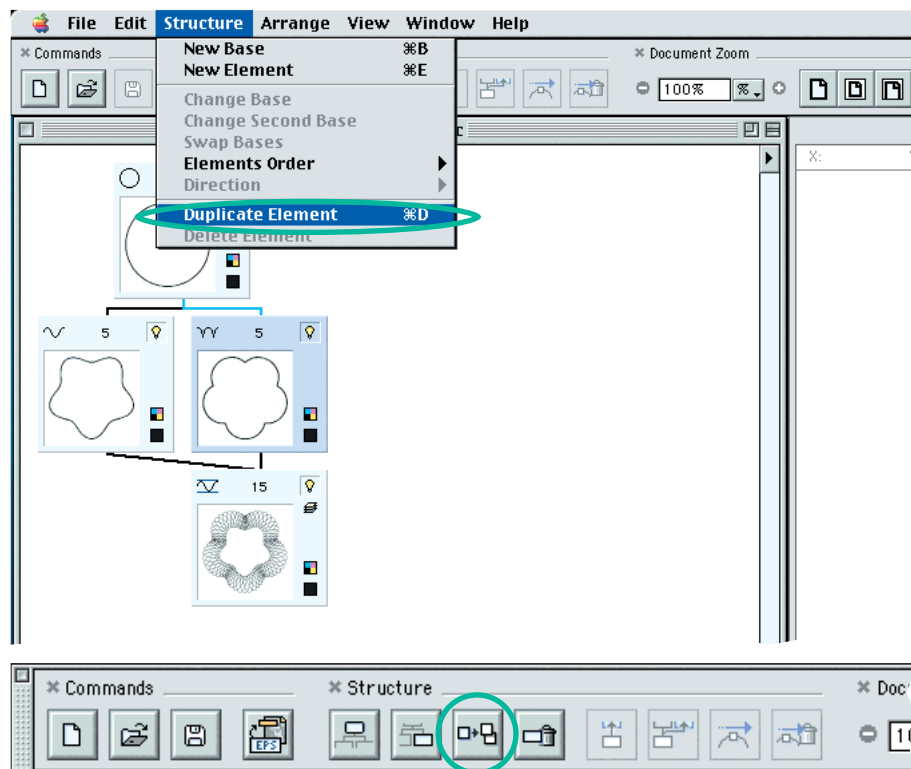

Shape of regular element and number of attribute fields change according to **Type** pop-up menu selection.
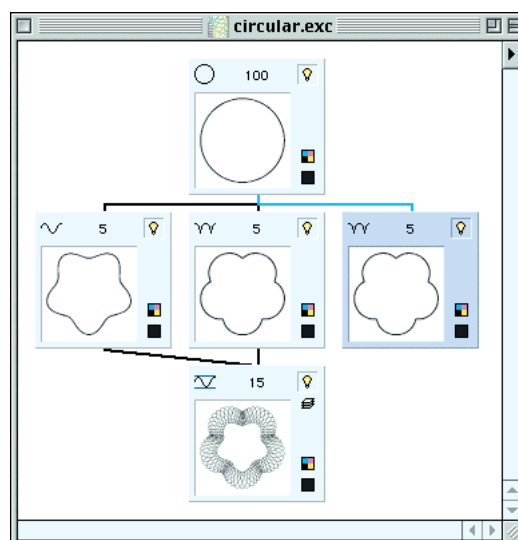
DUPLICATING ELEMENTS

You can also create new regular elements by making copies of existing ones. You can do this in three different ways:

■ With **Duplicate Element** command from **Structure** menu.

■ With drag-and-drop action.

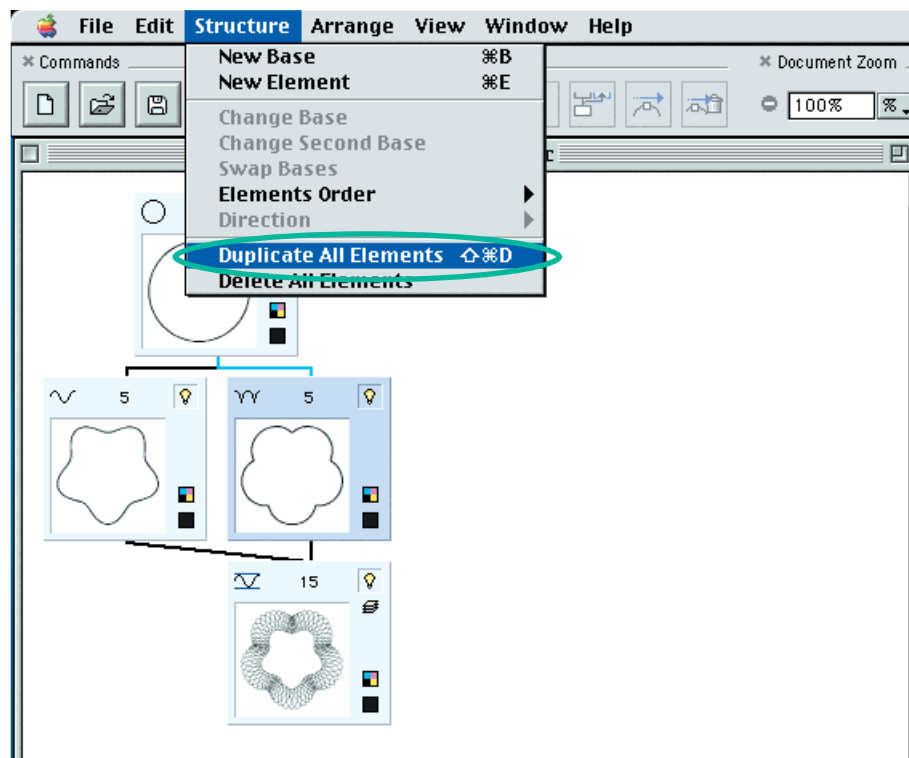■ With **Copy-Paste** or **Cut-Paste** commands sequence from **Edit** menu.

1. To duplicate existing element with **Duplicate Element** command **(Cmd-D)** you should select the element you want to duplicate with mouse click on its rectangular representation in main document window and choose **Duplicate Element** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.
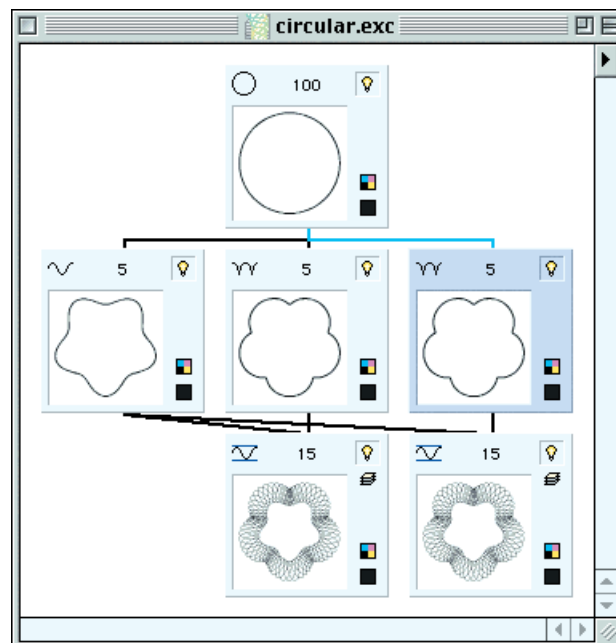
An exact copy of selected element will be created:

If you will press **Shift** key on keyboard, **Duplicate Element** command in **Structure** menu will change its title to **Duplicate All Elements (Cmd-Shift-D)** and choosing it will duplicate not only selected element but all child elements this element has (and all child elements of these child elements too, etc.).
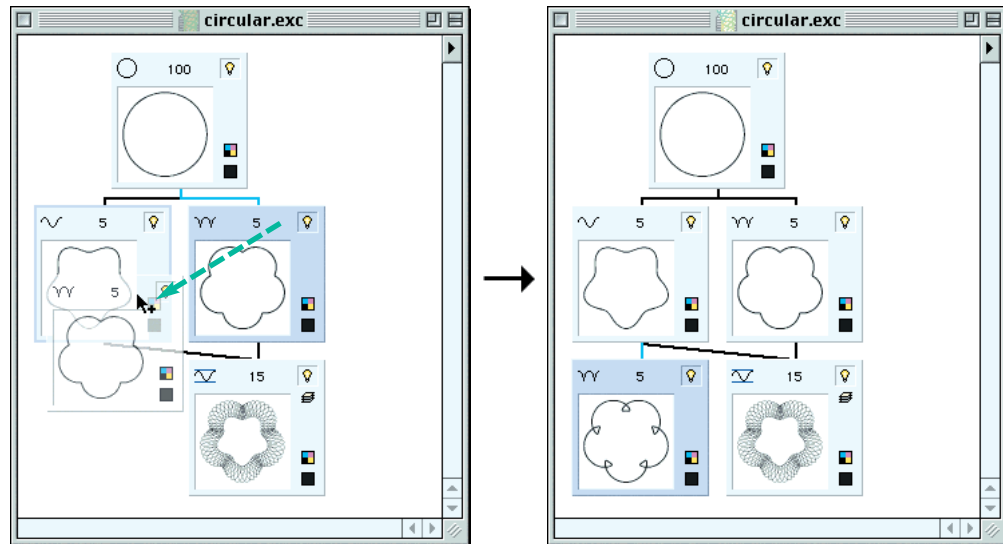

This way you can make a copy of whole set of elements on one branch of tree structure with single command. All connections between child elements will be preserved in a new copy of the elements set.
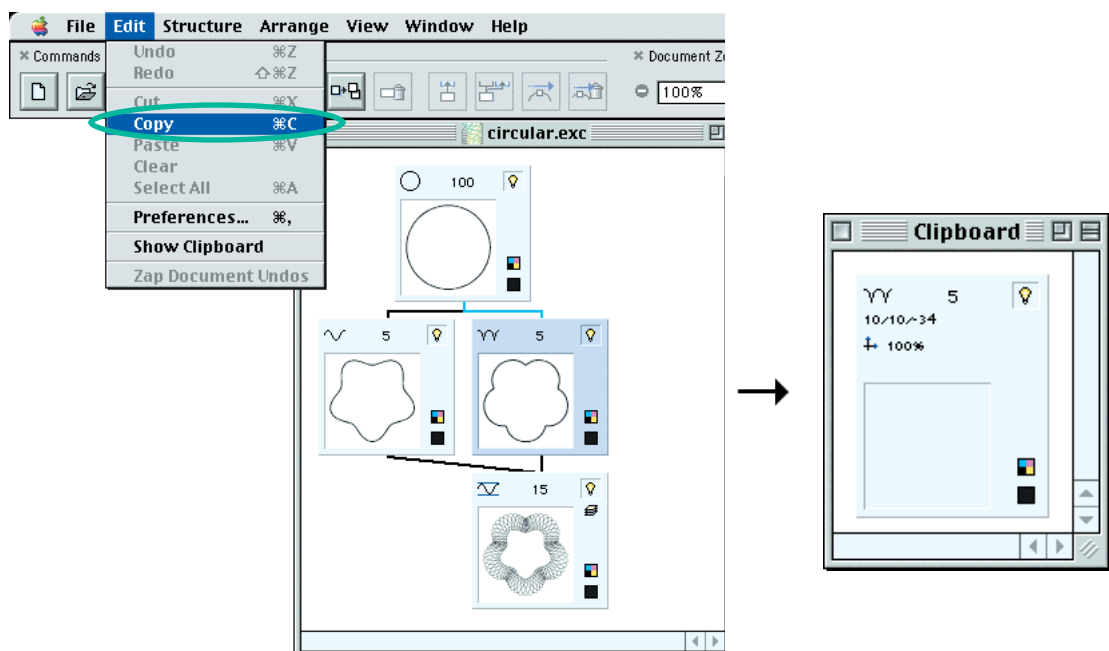
2. To make a copy of existing element using drag-and-drop action you should select the element you want to copy with mouse click on its rectangular representation in main document window. After that press **Option** key on keyboard and drag the element on rectangular representation of the element you want to become a parent of new element copy (it could be existing parent element of selected object, if you want to duplicate the element exactly). Mouse pointer will change its cursor shape to 'copy cursor' (arrow with **plus (+)** sign) to indicate that current drag-and-drop action will make a copy of the object.

Release mouse button, then release **Option** key and new copy of dragged object will be created.
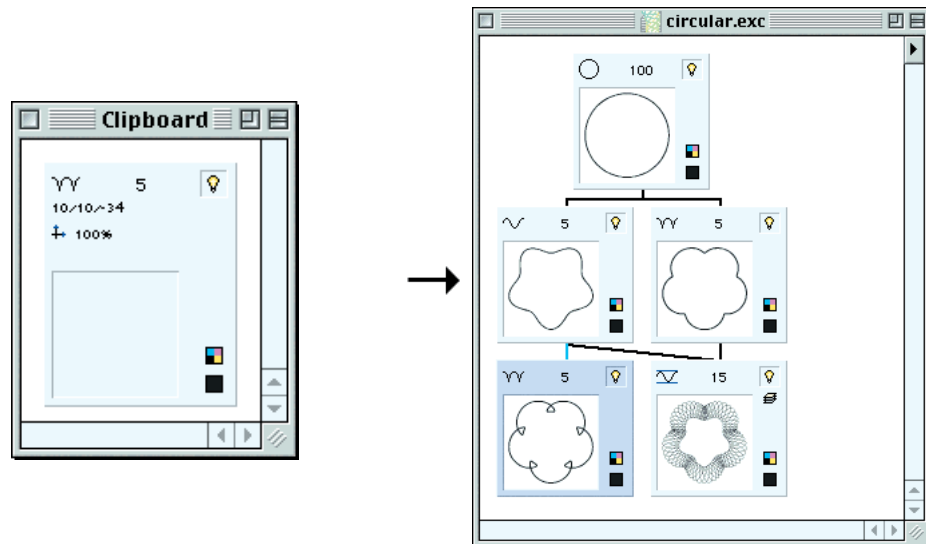

3. To create a copy of existing element with **Copy-Paste** or **Cut-Paste** commands sequence you should select the element you want to make a copy of with mouse click on its rectangular representation in main document window and choose **Copy (Cmd-C)** or **Cut (Cmd-X)** commands from **Edit** menu to place an object to *Excentro* Clipboard buffer (**Cut** command will delete element from document, **Copy** command will not).

After that you should select with mouse click in main document window the element you want to become a parent of new element copy (it could be existing parent element of the object that was copied to Clipboard, if you want to create an exact copy of the element) and choose **Paste (Cmd-V)** command from **Edit** menu and new copy of the object in Clipboard will be created.

DELETING ELEMENTS

You can delete existing elements in two different ways:

■ With **Delete Element** command from **Structure** menu.

■ With **Cut** or **Clear** commands from **Edit** menu.

1. To delete element with **Delete Element** command you should select the element you want to delete with mouse click on its rectangular representation in main document window and choose **Delete Element** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.
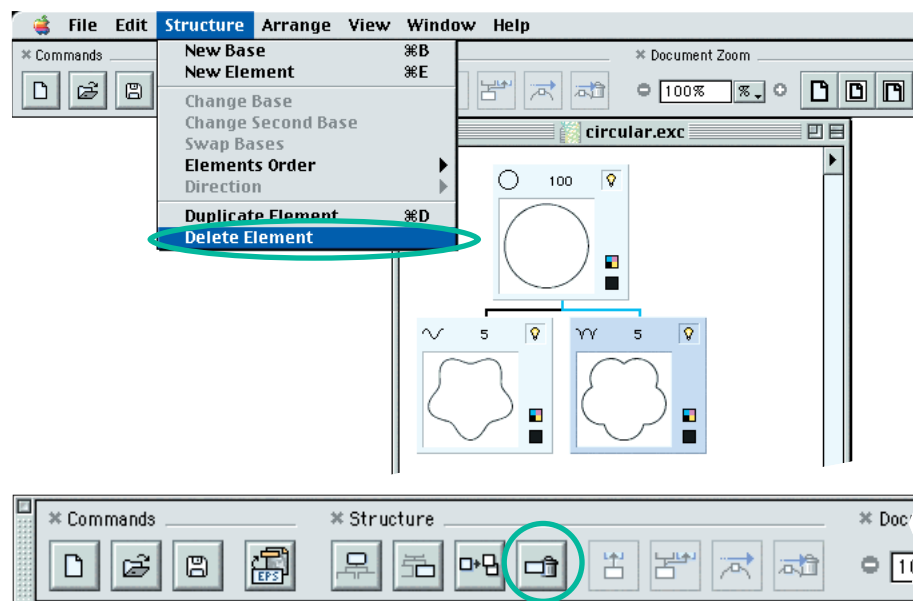
If the regular element object does not have child elements or connection lines to other elements of guilloche tree structure it will be deleted. If the object does have child elements or other connections to elements of guilloche tree, you can not delete it with **Delete Element** command. This command will be disabled in **Structure** menu.

To delete regular element that has child elements you can use **Delete All Elements** command. To use this command press **Shift** modifier key and **Delete Element** command in **Structure** menu will change its title to **Delete All Elements**. Choosing **Delete All Elements** command will delete not only selected regular element but all child elements this element has (and all child elements of these child elements, etc.). The regular element or its child elements should not have connections to objects in other parts of guilloche structure, otherwise this command will be disabled.
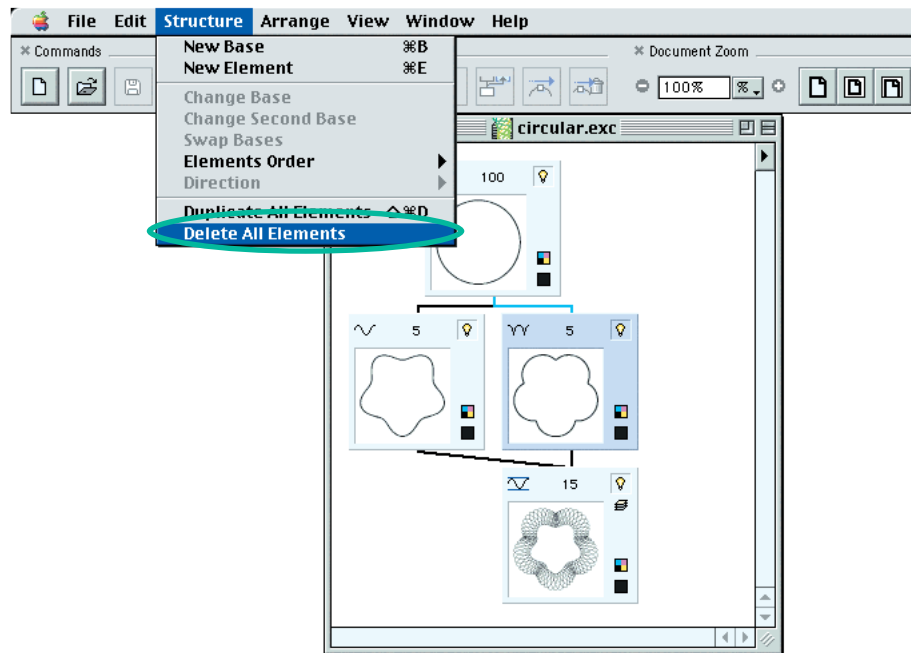
2. Cut (Cmd-X) and **Clear** commands from **Edit** menu are identical in effect to **Delete Element** command. They are provided to make *Excentro* behavior resemble that of standard *Macintosh* applications.

Cut command will also place copy of deleted object on *Excentro* Clipboard buffer, so you can create this object again using **Paste** command.
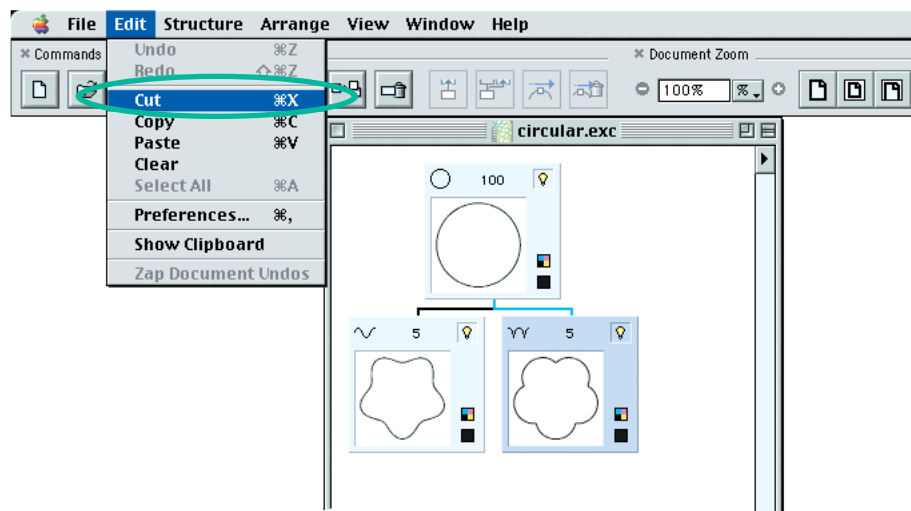
CHANGING ELEMENT'S BASE

You can change base element of the regular element (parent element of the regular element in guilloche tree structure) or put it in other words 'move the element to different branch of guilloche tree structure'. This will also change base path the regular element modifies and shape of guilloche design. You can accomplish this in two different ways:

■ With **Change Base** command from **Structure** menu.
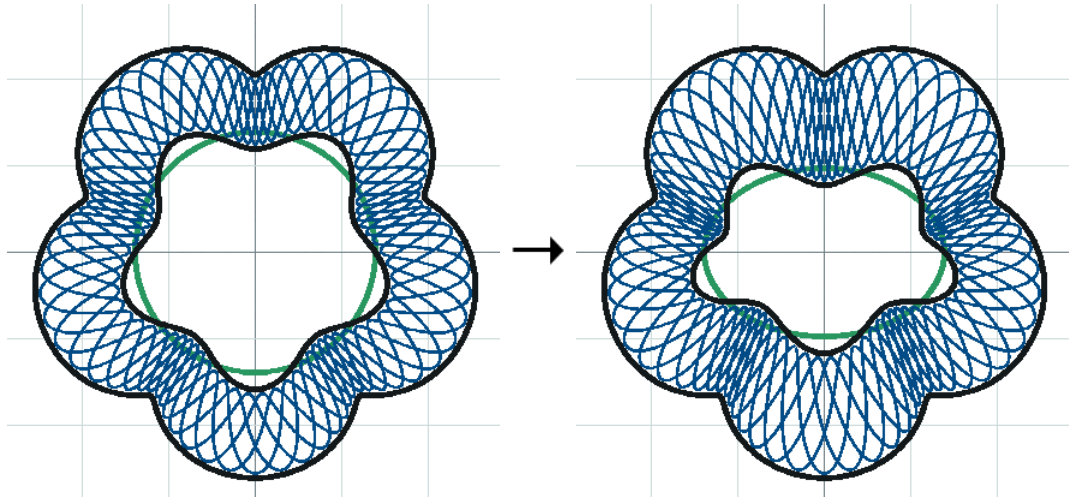
■ With drag-and-drop action.

1. To change base element with **Change Base** command you should select the regular element you want to change base of with mouse click on its rectangular representation in main document window, then press **Shift** modifier key on keyboard and click rectangular representation of the element you want to became its new base element, after that you should choose **Change Base** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.
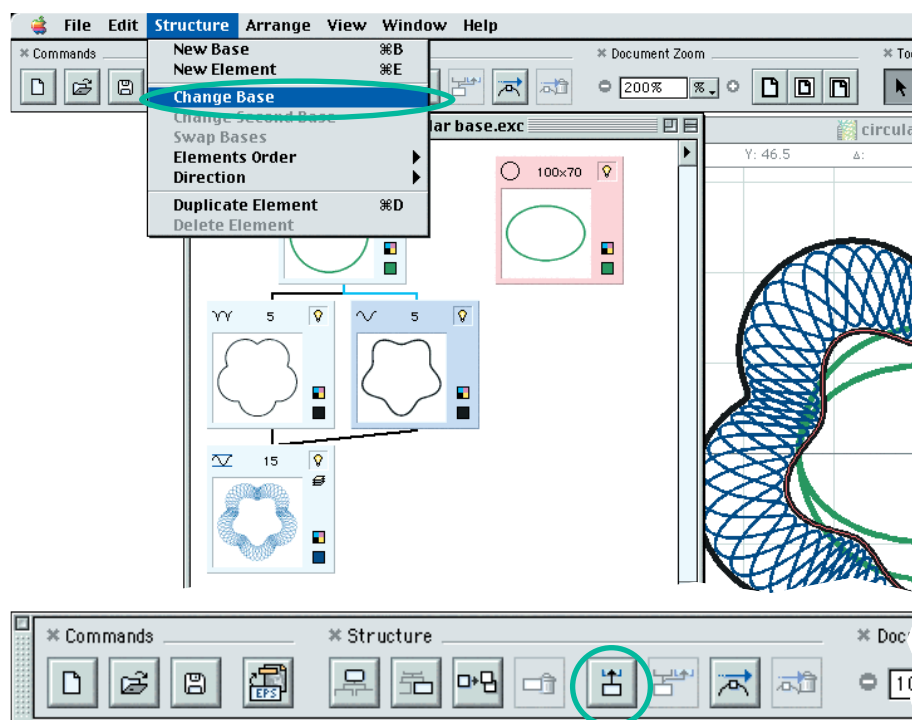

Base element of selected regular element will be changed and the element will be moved to different branch of guilloche structure:
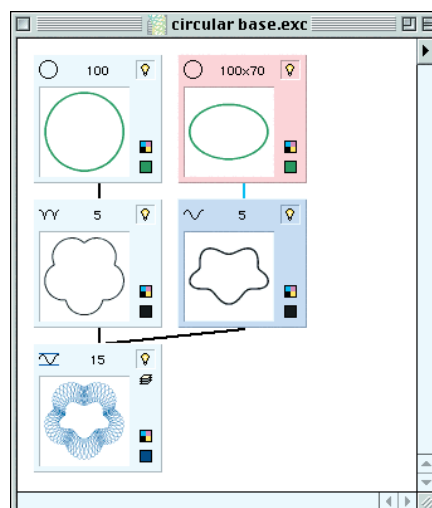
Guilloche design shape will change according to base path modification. Illustration of shape changes for guilloche design with structure from example above is shown on following pictures:

2. You can achieve same result (base element change for selected regular element) with simple drag-and-drop action. Select the regular element you want to change base of with mouse click on its rectangular representation in main document window and drag the element on rectangular representation of the element you want to became its new base element. Release mouse button and parent element of selected element, guilloche structure, shape of guilloche design will be changed accordingly.
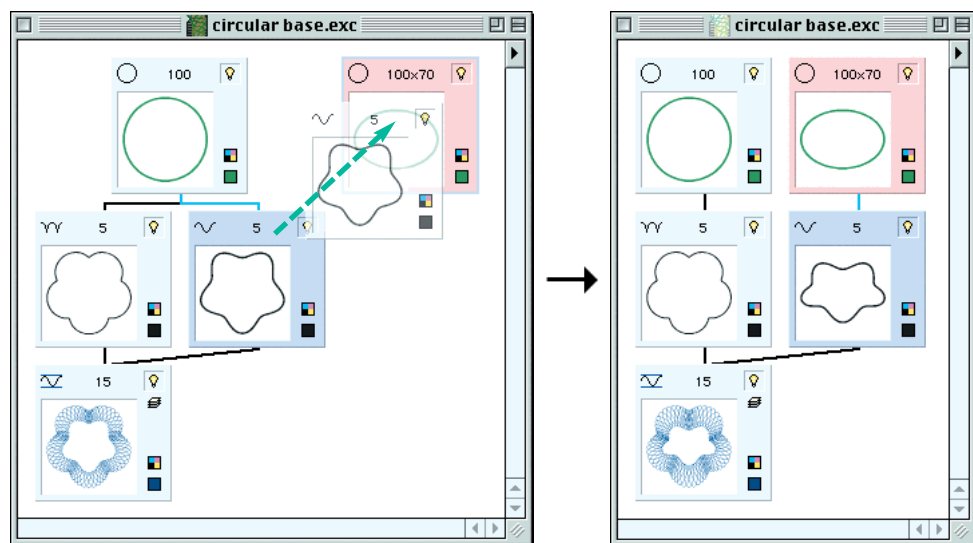

Note: *Please, note that if **Option** modifier key was pressed on keyboard at the time mouse button was released a copy of dragged object will be created instead of its base change. For more information on objects copies creation see **Duplicating Elements** section earlier in this introduction.*

As common sense suggests, the element you want to become new base of selected element may not be dependent in any way on selected element. That is: this element or its parent elements or their direction elements may not have connection lines to selected element. **Change Base** command is active only in this case.
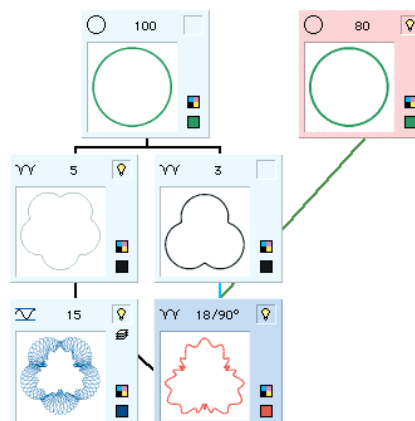
DIRECTION ELEMENT

According to *Excentro* mechanical model, direction element controls sheet rotation while sheet with pencil moves along base path on tabletop. By default, sheet rotation is defined by base element: coordinates system on the sheet at any given moment is parallel to tangent direction of base path in point that moves on base path. Sometimes, when base path is too twisty or has sharp corners this can result in path of the regular element having too many self-intersections or other unpleasant artifacts. In cases like that you can specify another element with smoother path to be 'direction' element for this regular element. After that coordinates system on the sheet will be parallel to tangent direction of direction element path in appropriate point.
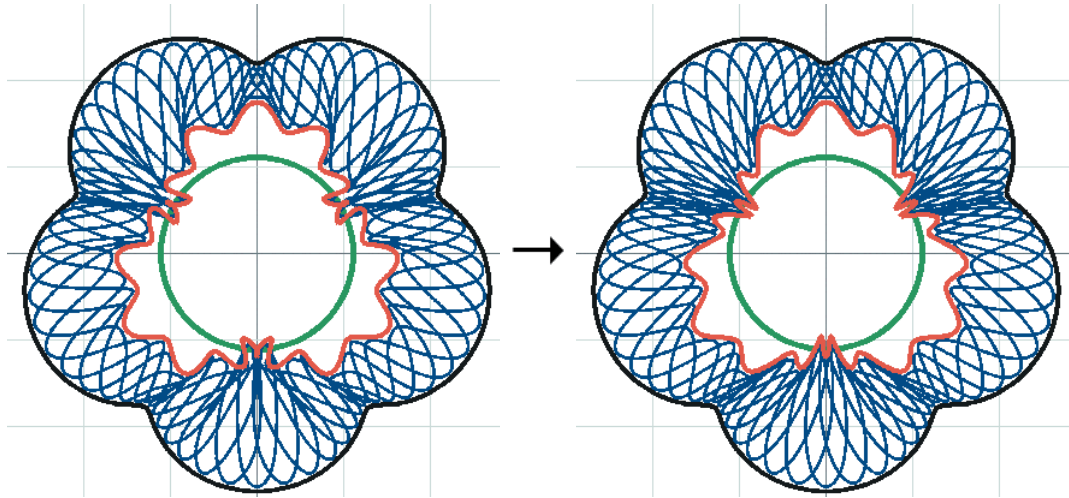
■ **Setting direction element.** To appoint another element as direction element you should select the regular element you want to set direction element for with mouse click on its rectangular representation in main document window, then press **Shift** modifier key on keyboard and click rectangular representation of the element you want to became its direction element, after that you should choose **Set** command from **Direction** submenu of **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.
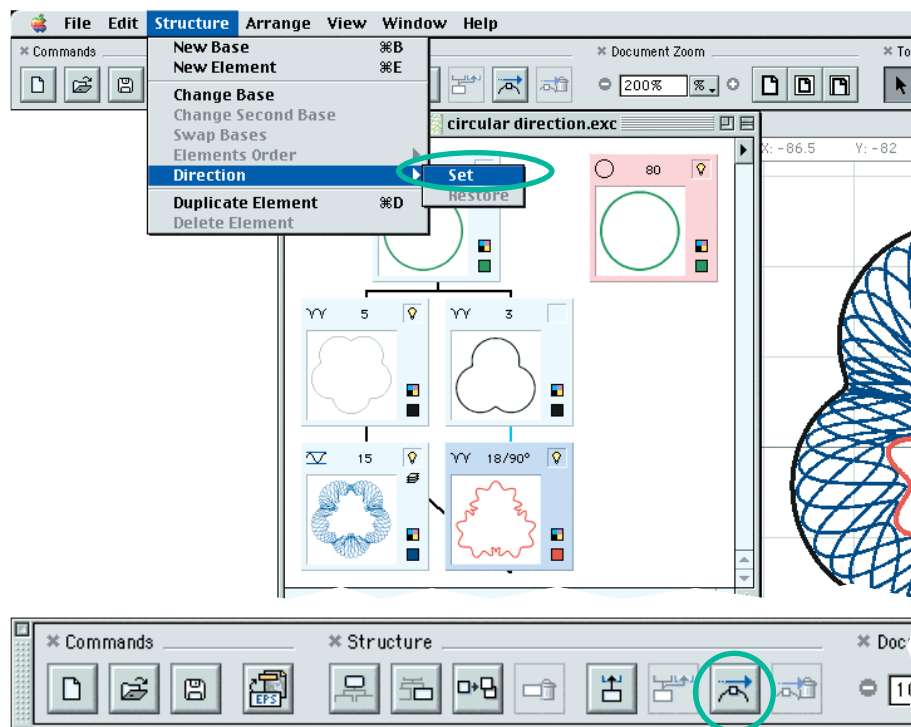
Green connection line will appear between selected regular element and its new direction element in structure tree of main document window:
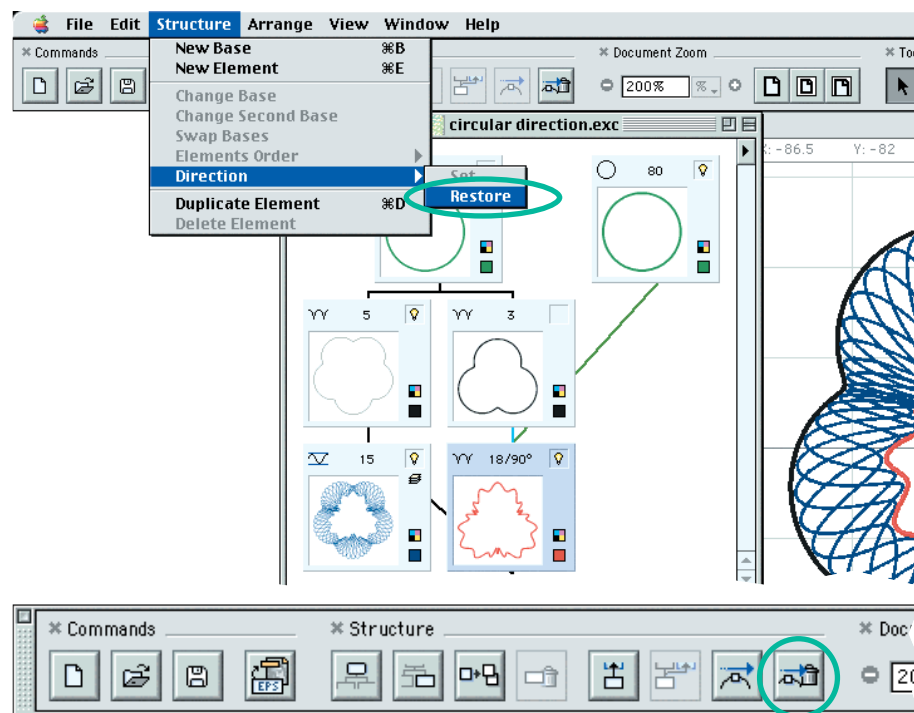
Guilloche design shape will change according to base path modification. Illustration of shape changes for guilloche design with structure from example above is shown on following pictures:

The element you want to become new direction element of selected element may not be dependent on selected element: this element or its parent elements or their direction elements may not have connection lines to selected element. **Set** command is active only in this case.

■ **Restoring direction element.** To restore direction behavior of regular element to the default one (when rotation of the sheet is controlled by its base path) you should select the regular element (with the direction element set as described above) with mouse click on its rectangular representation in main document window and choose **Restore** command from **Direction** submenu of **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.


Green connection line between the regular element and its direction element will disappear and guilloche design shape will change to the state it was before direction element was set.

CHAPTER 2: SINE WAVE

Sine Wave is the most common type for both regular elements and content elements. Actually you can create fairly complex guilloche designs using only elements of **Sine Wave** type. Picture below illustrates the example of such design.
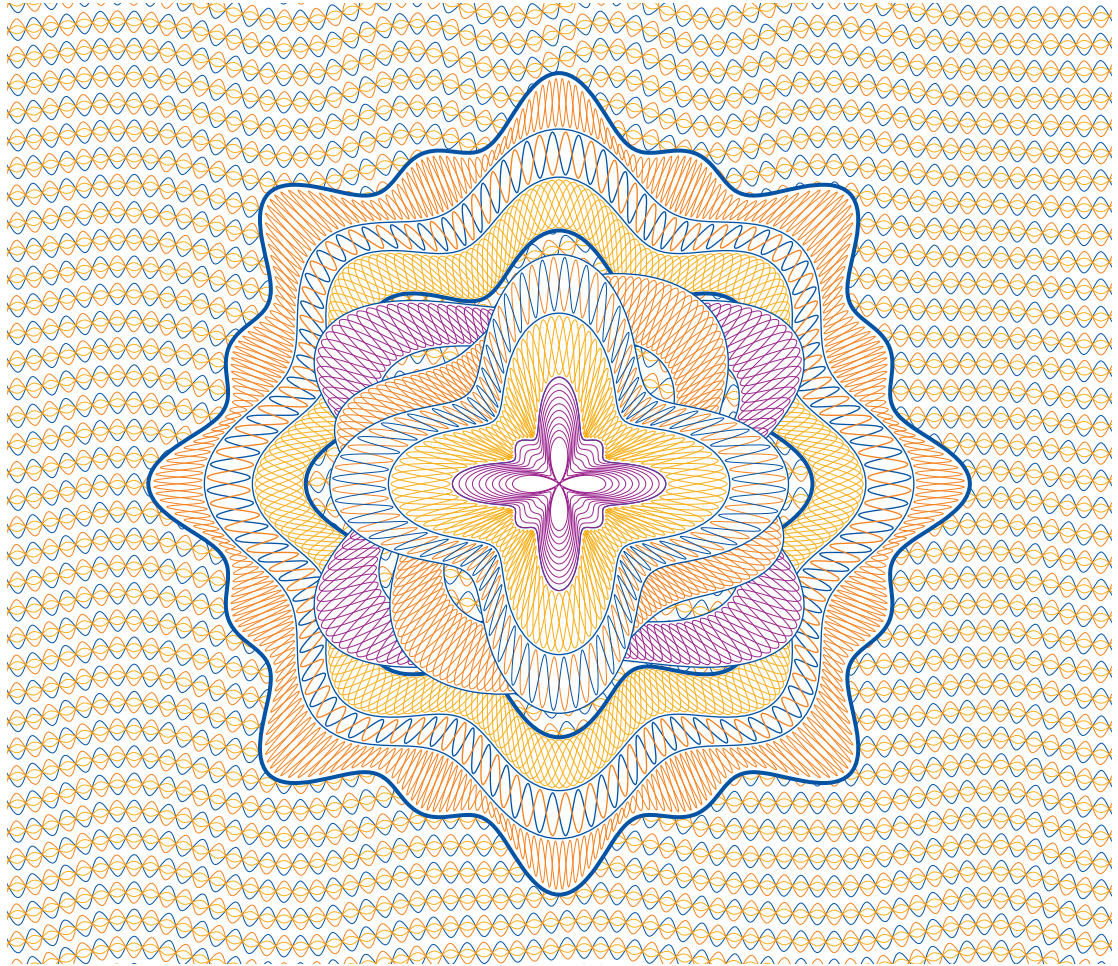

In terms of *Excentro* mechanical model described in introduction to this book **Sine Waves** represent very simple up and down movements of pencil on the sheet while sheet moves along basic curve on tabletop. As a result you get wavy modification of basic curve illustrated on following pictures.
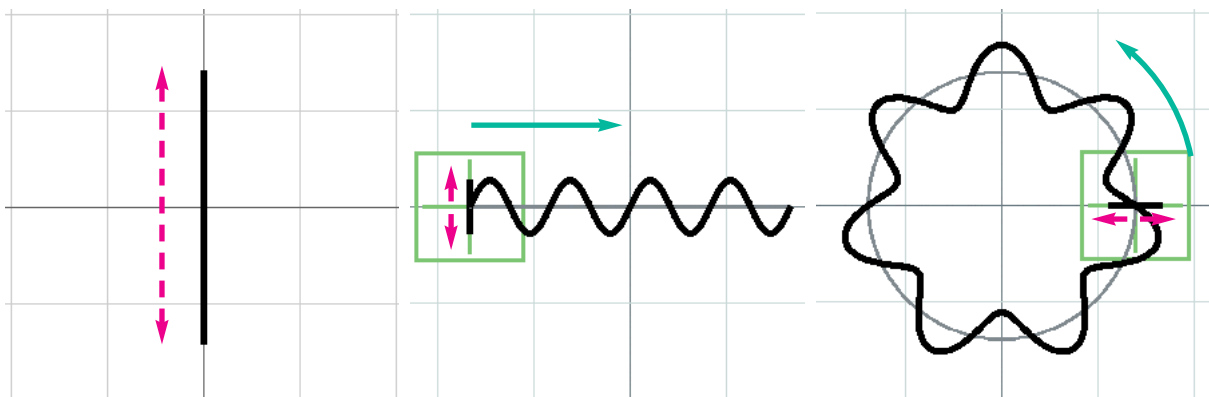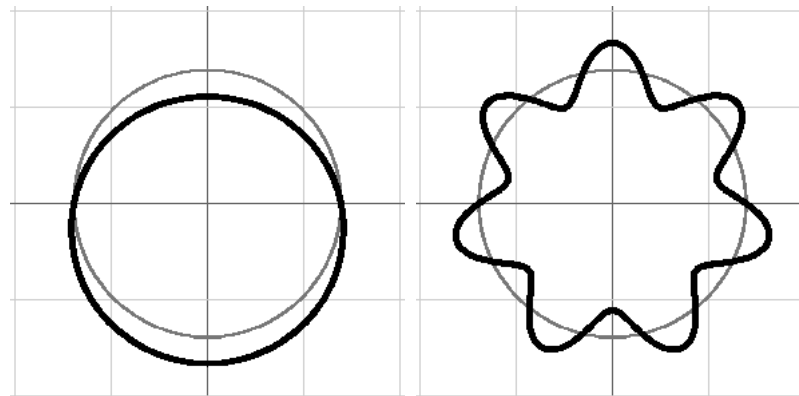

Sine Wave elemento: pencil movements on sheet;
results of linear and circular basic curves modifications

TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has six attribute fields for elements of **Sine Wave** type:
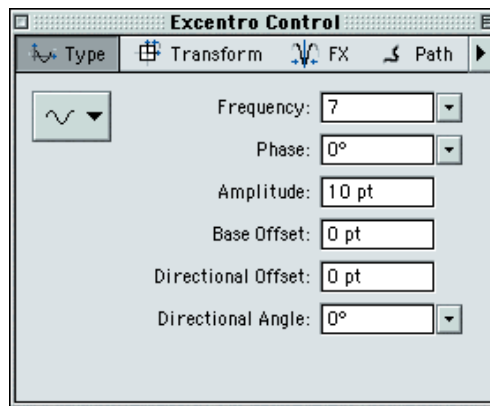

■ **Frequency** defines number of 'waves' path of **Sine Wave** element has. If you consider this attribute from *Excentro* mechanical model view, it is a number of times pencil goes up and down while sheet moves on tabletop. When you create new element its **Frequency** attribute is set to '*1*', so its path is not exactly what you can call 'wavy'. You may set this value to whatever you prefer, for example: '7'.

*Sine Wave paths with Frequency set to '1' and '7'*

■ **Phase** attribute controls starting position of path. From *Excentro* mechanics point of view this is starting position of pencil movement on sheet. This value is expressed in degrees "°" from [−180°; 180°] interval you can use it to change position of wave swells.
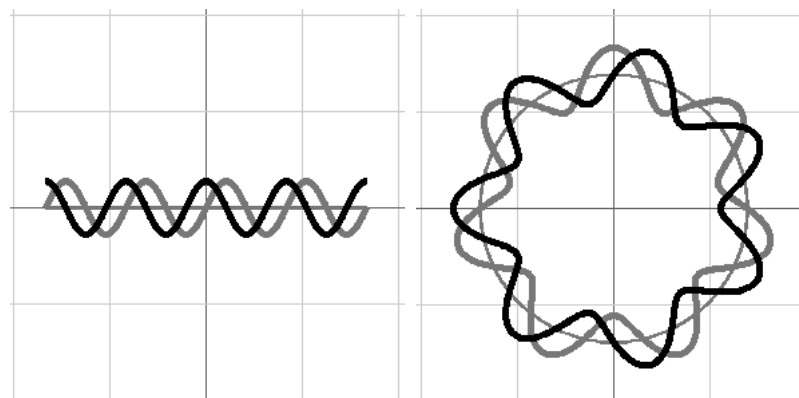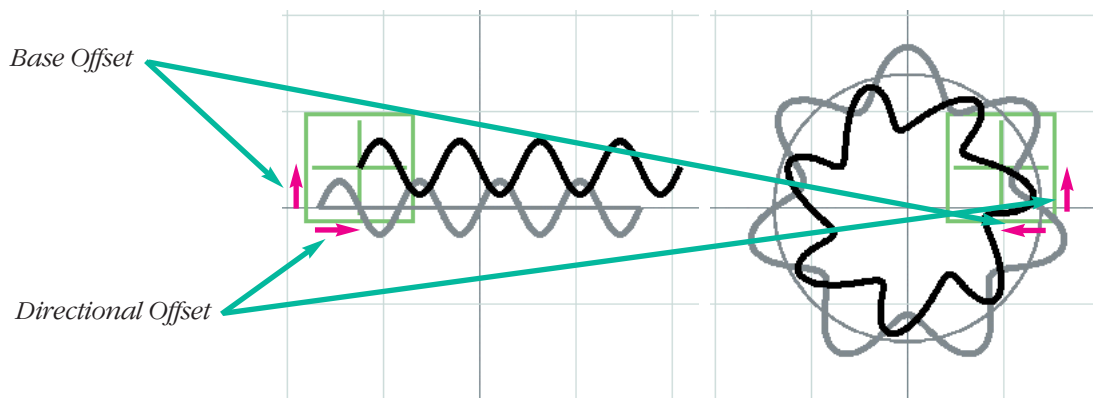

'90°' modification of Phase attribute

■ **Amplitude** attribute defines wave height. It is measured in application wide measurement units selected in **Excentro Preferences** dialog. Initial value is set to '*10 pt*', you can change it to whatever you like by entering numeric value in this field.
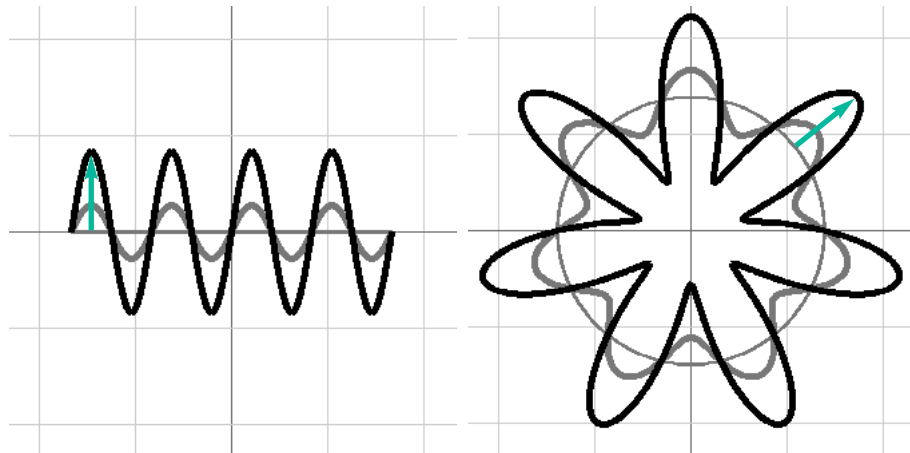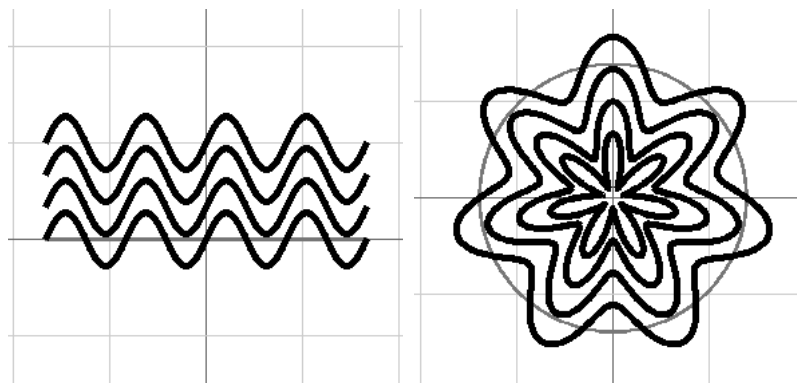

*Sine Wave paths with **Amplitude** set to '10 pt' (gray) and '30 pt' (black)*

■ **Base Offset** and **Directional Offset** attributes define distance to basic path (path of parent element). Expressed in terms of *Excentro* mechanics, **Base Offset** attribute sets vertical distance from center of the sheet to the point of the sheet that moves along basic path on tabletop. **Directional Offset** attribute sets horizontal distance between same points. These values are measured in application wide measurement units.
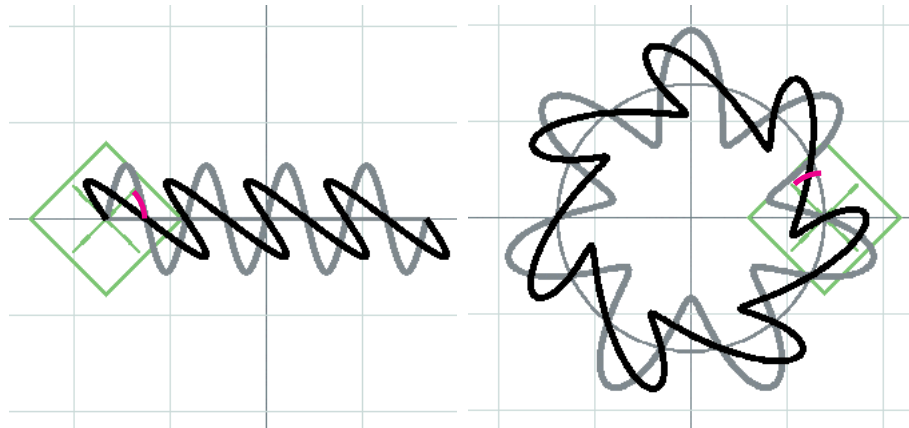

Base Offset and Directional Offset attributes set to '0 pt' (gray) and '15 pt' (black)

Base Offset attribute is very often modified during guilloche creation process. Pictures below illustrate examples of path variations you can get this way. **Directional Offset** value usually is not changed from its initial '*0 pt*'.
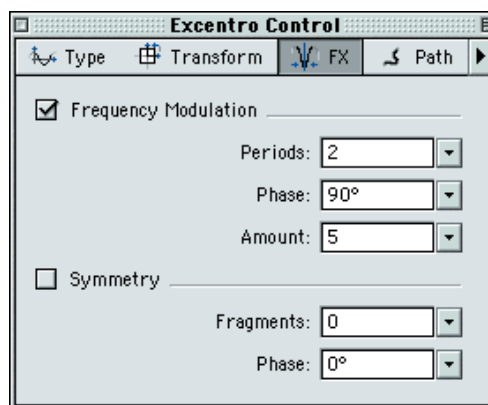
■ **Directional Angle** attribute sets initial angle of sheet rotation. While sheet moves along its base path it rotates together with tangent line to this path (unless path of another element is set as **direction** for the element). With **Directional Angle** attribute you can modify rotation angle by value specified in this field. Expressed in degrees '°'. This attribute is not usually modified from initial '*0*°' value.
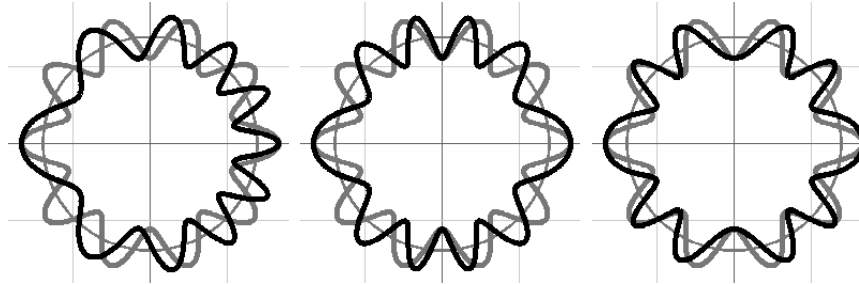

Directional Angle attribute set to '0°' (gray) and '45°' (black)

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to elements of **Sine Wave** type: **Frequency Modulation** effect and **Symmetry** effect.


■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Sine Wave** element. With this effect you can create **Sine Wave** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Gray path is unmodified **Sine Wave** element with **Frequency** attribute set to '10'; black paths have additional **Frequency Modulation** attributes: **Periods** = 1, **Phase** = 0°, **Amount** = 5 (left); **Periods** = 2, **Phase** = 0°, **Amount** = 5 (center); **Periods** = 4, **Phase** = 0°, **Amount** = 5 (right)*
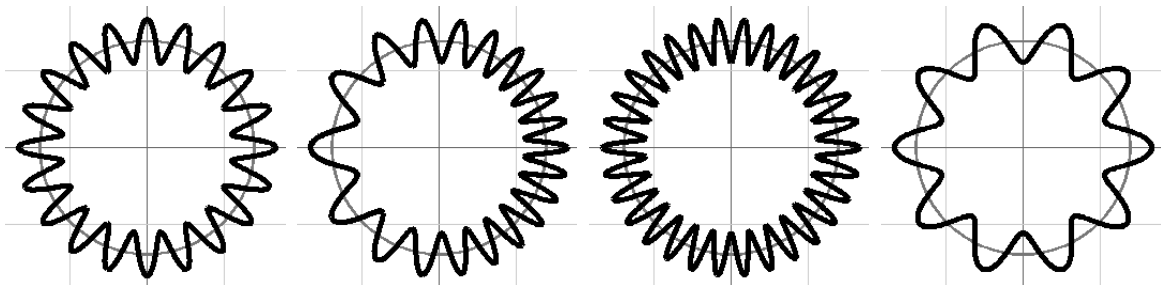
◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '*4*' in this field means that **Sine Wave** has 4 parts with higher frequency and 4 parts with lower frequency.

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '*0°*' means that center of first area with higher frequency corresponds to starting point of base path, with values '*180°*' and '*−180°*' first area with higher frequency coincides with middle of base path.
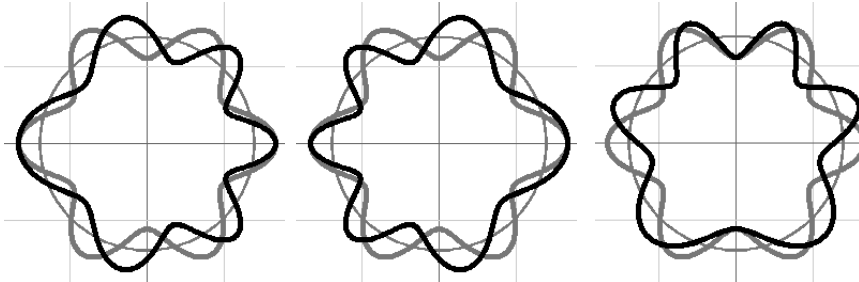

*Gray path is unmodified **Sine Wave** element with **Frequency** attribute set to '6'; black paths have **Frequency Modulation** effect **Periods** = 1, **Amount** = 2 and **Phase** attribute: 0° (left), 180° (center), 90° (right)*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Sine Wave** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*20*', **Amount** value of '*10*' will make areas with lower frequency similar to that of **Sine Wave** path with **Frequency** '*10*' and areas with higher frequency to **Sine Wave** path with **Frequency** '*30*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

*Left to right: **Sine Wave** element with **Frequency** '20'; **Sine Wave** element with **Frequency** '20' and **Frequency Modulation** effect with **Periods** = 1, **Phase** = 0°, **Amount** = 10; **Sine Wave** element with **Frequency** '30'; **Sine Wave** element with **Frequency** '10'.*
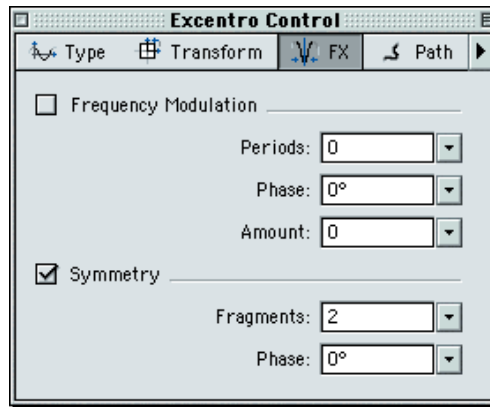
■ **Symmetry** effect does not have the correct name for what exactly it is or does. In terms of *Excentro* mechanical model this effect allows you to modify pencil movement on sheet so, that at certain points pencil movement suddenly stops and starts going in opposite direction. If base curve on tabletop is smooth shape like circle this effect results in symmetric pieces of **Sine Wave** reflected along this base path, like shown on pictures below.
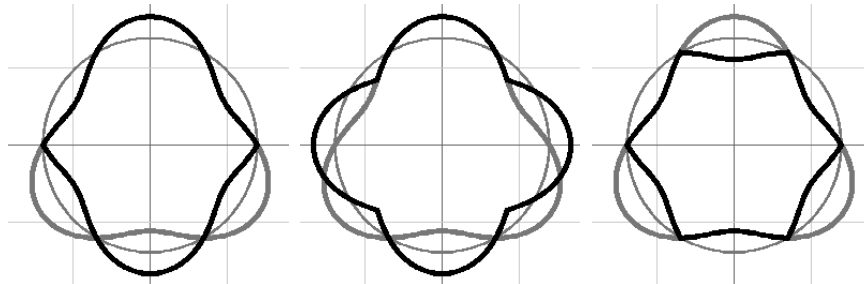
*Gray path is unmodified **Sine Wave** element'; black paths have additional **Symmetry** effects: **Fragments** = 2, **Phase** = 0° (left); **Fragments** = 4, **Phase** = 45° (center); **Fragments** = 6, **Phase** = 0° (right)*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Sine Wave** path will consist of. For example, is you set this value to '*2*', the base path will be divided into two parts and pencil movement on sheet while it moves along second half of base path will be reflection of pencil movement on sheet while it moves along first part.

◆ **Phase** attribute controls the starting point of first symmetric piece on base path. This value is expressed in degrees ('°') with [−180°, 180°] interval. For example, value '*0°*' means that first fragment starts at the beginning of base path, values '*180°*' and '*−180°*' means that first fragment starts at the middle of base path.
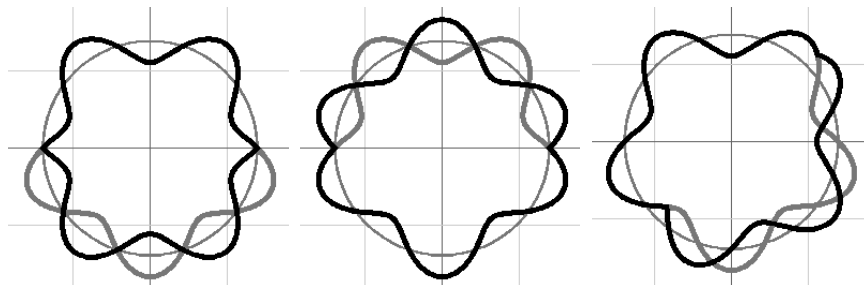
*Gray path is unmodified **Sine Wave** element; black paths have additional **Symmetry** effects with **Fragments** = 2 and **Phase** attribute: 0° (left), 180° (center), 45° (right)*

MATHEMATICAL DETAILS

If you are interested in exact mathematical formulation that define **Sine Wave** element as part of *Excentro* mechanical model, please find below equations that define pencil movement in *XY* coordinates of the sheet:

$x\,(t) = 0$

$y\,(t) = Amplitude \cdot sin(Frequency \cdot t + Phase)$

Where '*t*' is 'time' parameter that covers [0, 2π] interval while sheet travels along base path on tabletop.
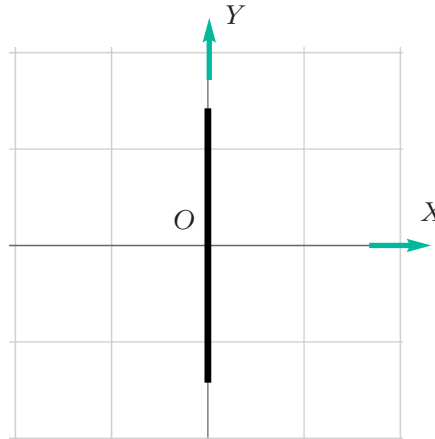
CHAPTER 3: CYCLOID

In *Excentro* mechanical model **Cycloid** elements represents circular movement of pencil on sheet while sheet moves along base path (path of parent element). In result you receive path that consists of series of coils with shape of coils controlled by **Frequency**, **Amplitude** and **Side Size** attributes of **Cycloid**. Circular movement of pencil on sheet is a combination of two periodic functions, see formula details at the end of this chapter.
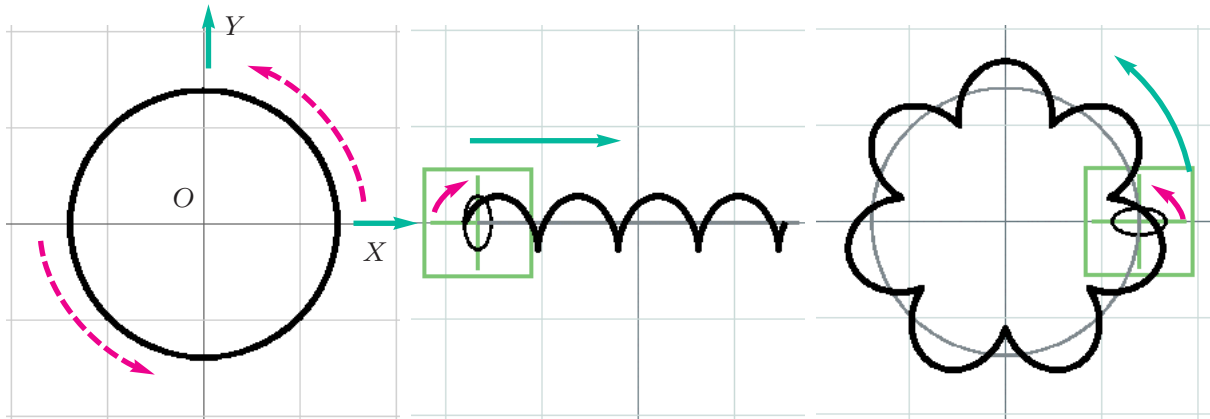

Cycloid element: pencil movement on sheet; results of linear and circular basic curves modifications

Because of large variety of shapes you can get with different **Amplitude** and **Side Size** attributes combinations **Cycloid** elements are very frequently used in guilloche designs. In fact **Sine Wave** element is just a single example of **Cycloid** path when **Side Size** attribute set to '*0*'. Paths of **Cycloid** elements are shown with color on example below.
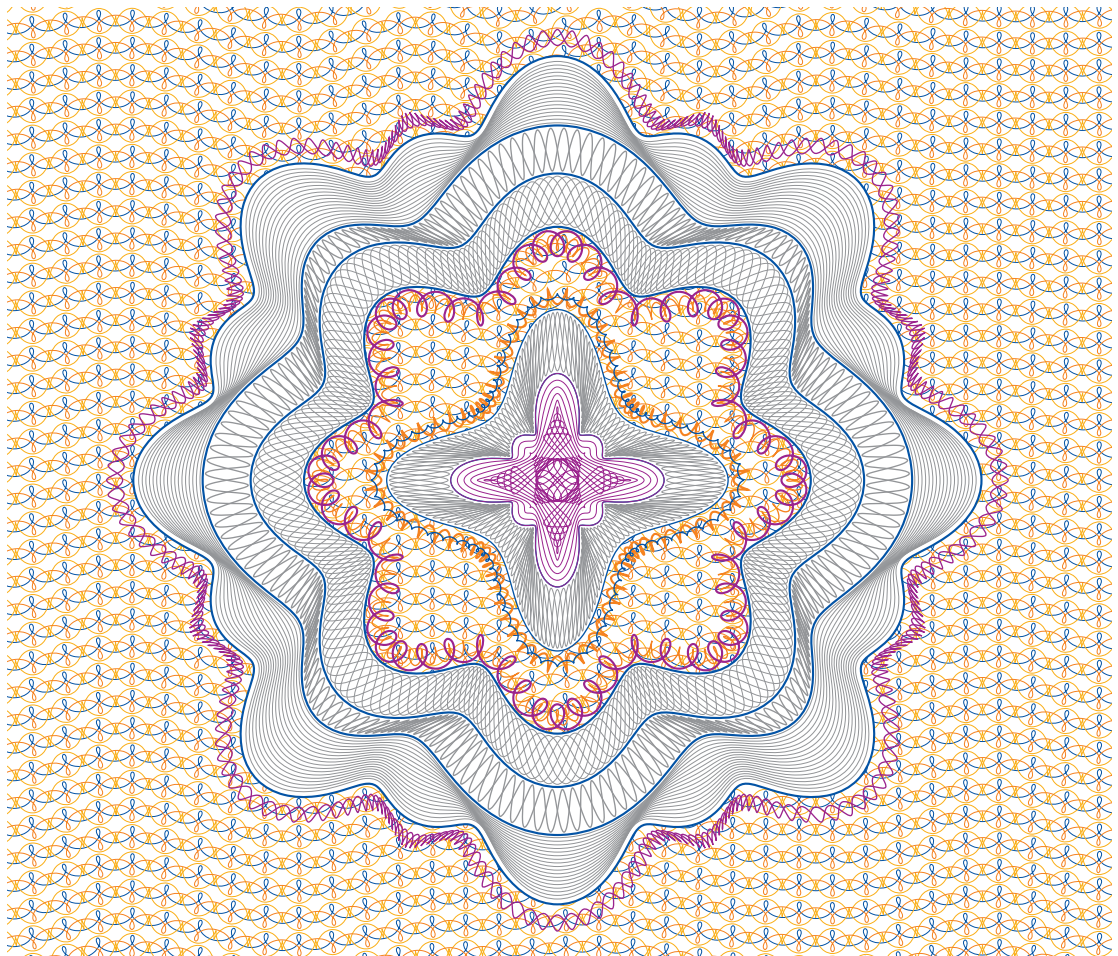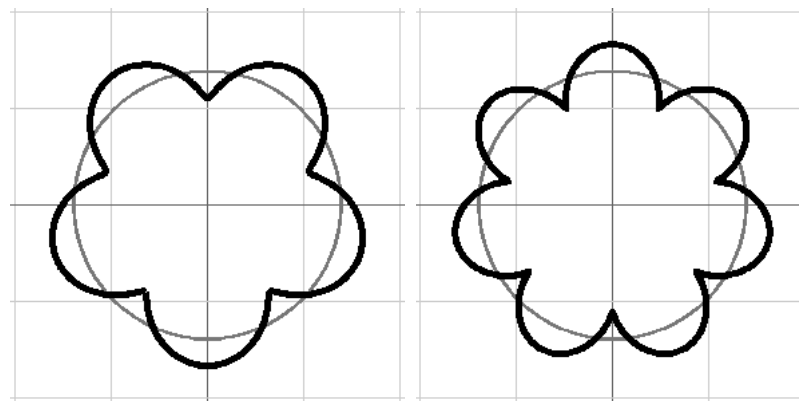
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has seven attribute fields for elements of **Cycloid** type:
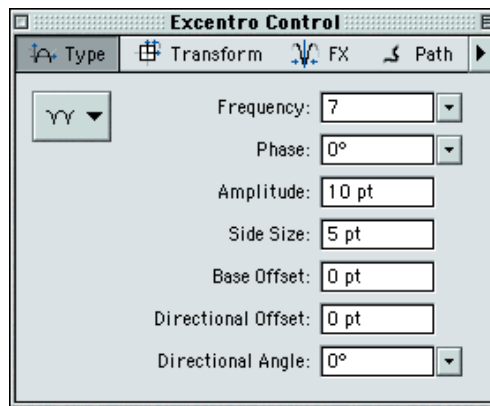

■ **Frequency** defines number of 'coils' path of **Cycloid** element has. If you consider this attribute from *Excentro* mechanical model view, it is a number of times pencil on sheet completes full circle trail while sheet moves on tabletop. To make shape of **Cycloid** element more suitable for guilloche design you should set this value to '3' or higher.


*Cycloid paths with **Frequency** set to '5' and '7'*

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement on sheet. This value is expressed in degrees '°' from [−180°; 180°] interval you can use it to change position of coils.
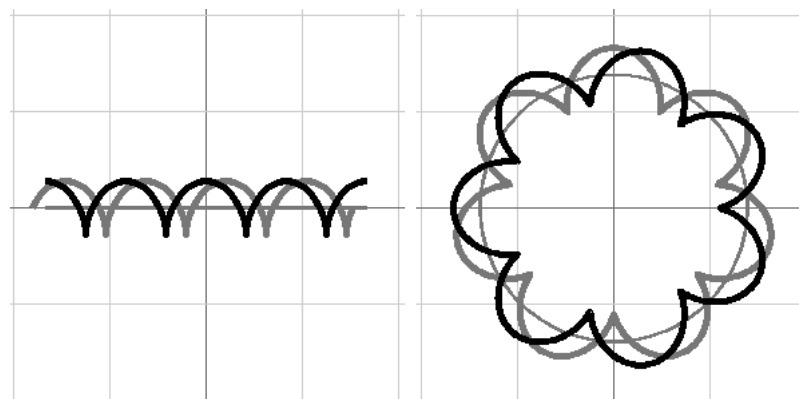

*'90°' modification of **Phase** attribute*

■ **Amplitude** attribute defines coils height. It is measured in application wide measurement units selected in **Excentro Preferences** dialog.
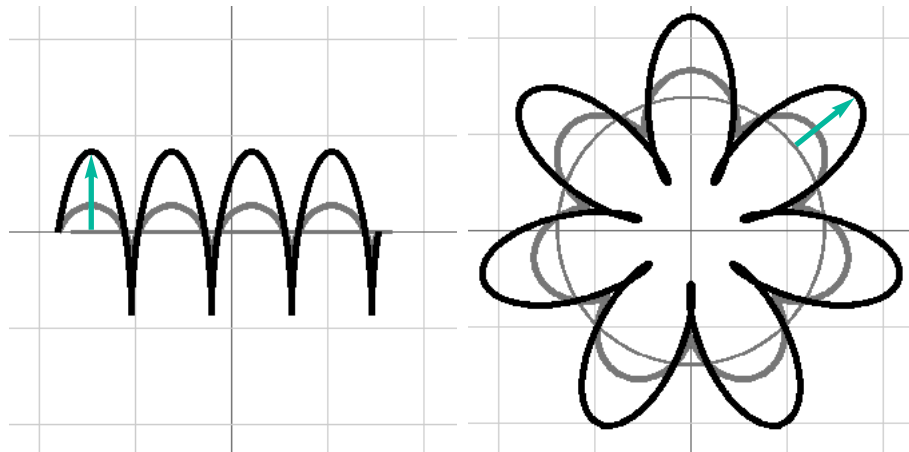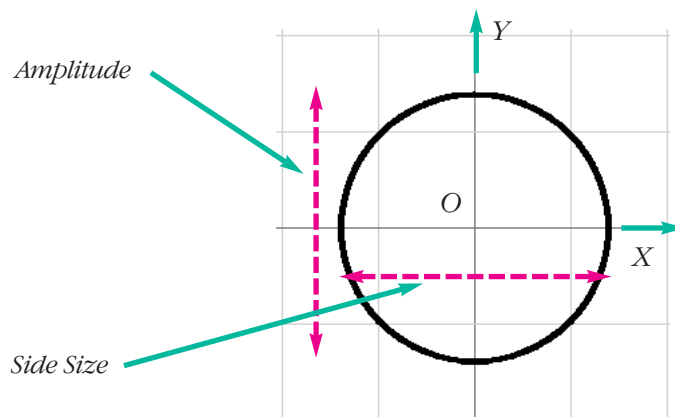

*Cycloid paths with **Amplitude** set to '10 pt' (gray) and '30 pt' (black)*

■ **Side Size** attribute defines width of coils. It also is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Cycloid** element.
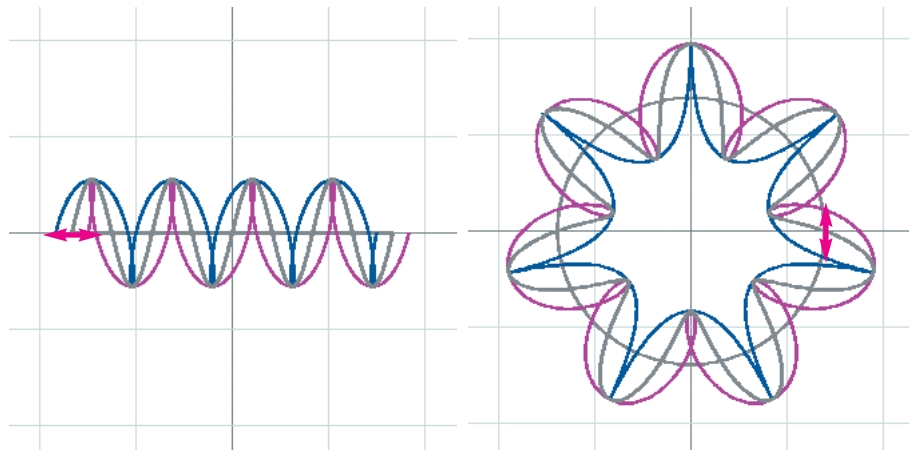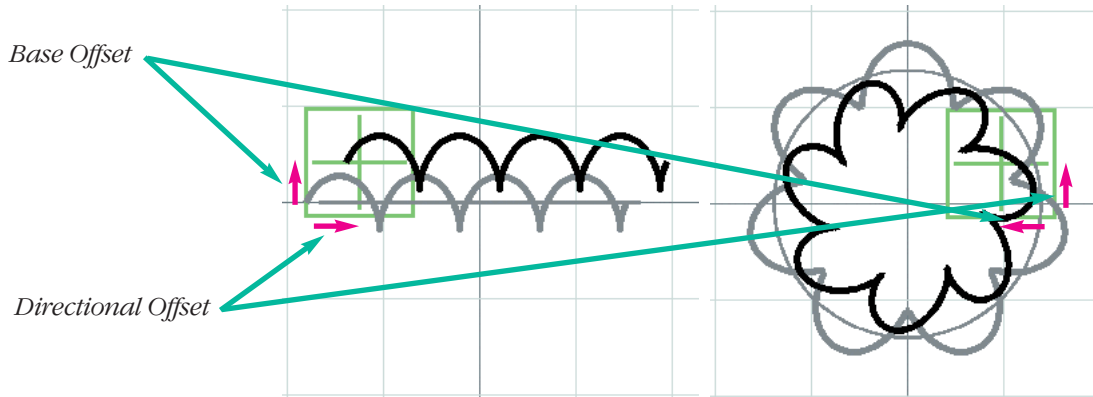

*Cycloid path with **Side Size** set to '0 pt' (gray), with positive (blue) and negative (magenta) values*

In terms of *Excentro* mechanical model **Amplitude** attribute defines extent of vertical pencil movement along *Y* axis of sheet coordinates while **Side Size** attribute sets extent of horizontal pencil movement along *X* axis. When **Side Size** attribute set to '0 pt', path of **Cycloid** element is identical to path of **Sine Wave** element.
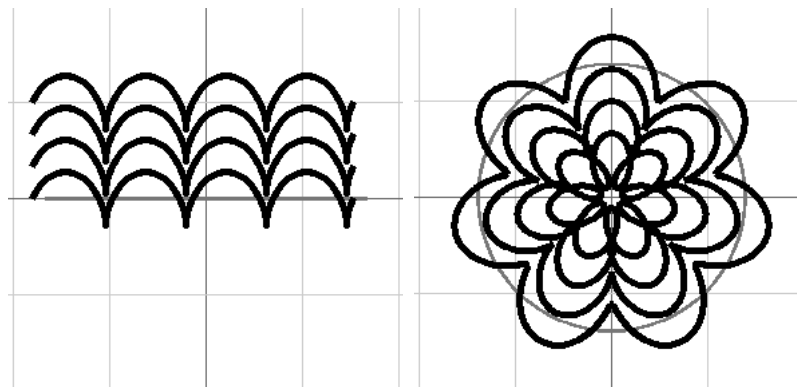
■ **Base Offset** and **Directional Offset** attributes define distance to base path (path of parent element). Expressed in terms of *Excentro* mechanics, **Base Offset** attribute sets vertical distance from center of the sheet to the point of the sheet that moves along base path on tabletop. **Directional Offset** attribute sets horizontal distance between same points. These values are measured in application wide measurement units.
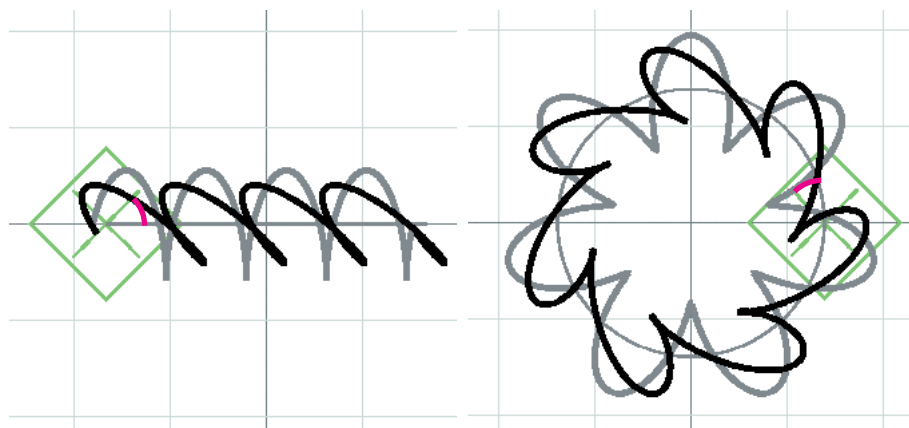
Base Offset

Directional Offset

Base Offset and Directional Offset attributes set to '0 pt' (gray) and '15 pt' (black)

Base Offset attribute is very often modified during guilloche creation process. Pictures below illustrate examples of path variations you can get this way. **Directional Offset** value usually is not changed from its initial '*0 pt*'.
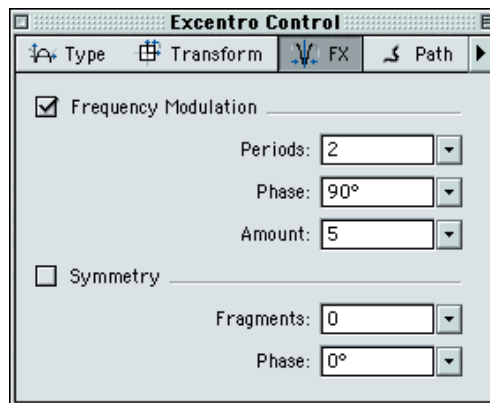
■ **Directional Angle** attribute sets initial angle of sheet rotation. While sheet moves along its base path it rotates together with tangent line to this path (unless path of another element is set as **direction** for the element). With **Directional Angle** attribute you can modify rotation angle by value specified in this field. Expressed in degrees '°'. This attribute is not usually modified from initial '*0°*' value.
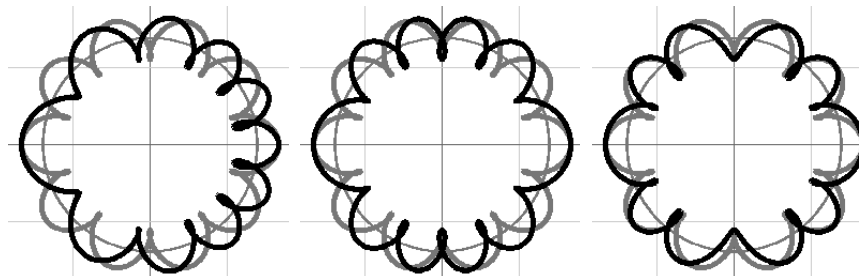
Directional Angle attribute set to '0°' (gray) and '45°' (black)

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to elements of **Cycloid** type: **Frequency Modulation** and **Symmetry** effects.
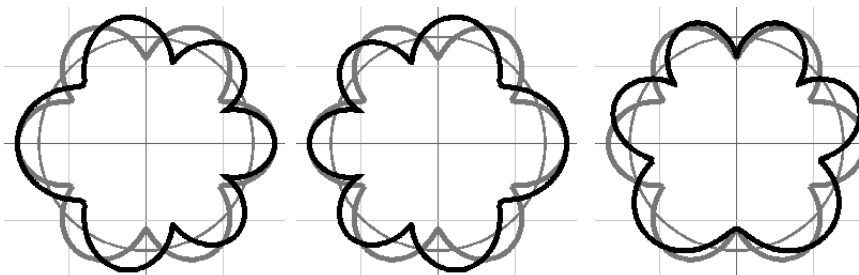

■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Cycloid** element. With this effect you can create **Cycloid** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Gray path is unmodified **Cycloid** element with **Frequency** attribute set to '10'; black paths have additional **Frequency Modulation** attributes: **Periods** = 1, **Phase =** 0°, **Amount** = 5 (left); **Periods** = 2, **Phase =** 0°, **Amount** = 5 (center); **Periods** = 4, **Phase =** 0°, **Amount** = 5 (right)*
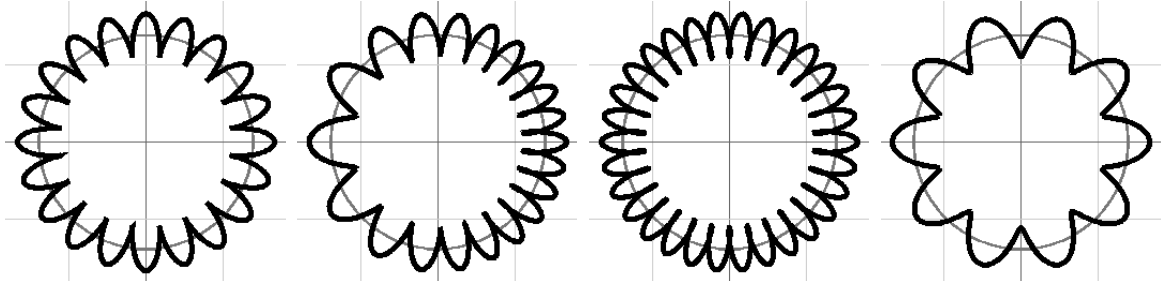
◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '*4*' in this field means that **Cycloid** has 4 parts with higher frequency and 4 parts with lower frequency.

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '*0°*' means that center of first area with higher frequency corresponds to starting point of base path, with values '*180°*' or '*−180°*' first area with higher frequency coincides with middle of base path.


***Cycloid** element with **Frequency** attribute set to '6' (gray); black paths with **Frequency Modulation** effect **Periods** = 1, **Amount** = 2 and **Phase =**: 0° (left), 180° (center), 90° (right)*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Cycloid** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*20*', **Amount** value of '*10*' will make areas with lower frequency similar to that of **Cycloid** path with **Frequency** '*10*' and areas with higher frequency to **Cycloid** path with **Frequency** '*30*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

*Left to right: **Cycloid** element with **Frequency** '20'; **Cycloid** element with **Frequency** '20' and Frequency Modulation effect with **Periods** = 1, **Phase** = 0˚, **Amount** = 10; **Cycloid** element with **Frequency** '30'; **Cycloid** element with **Frequency** '10'.*
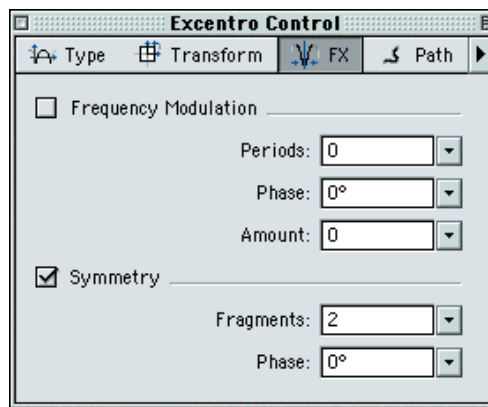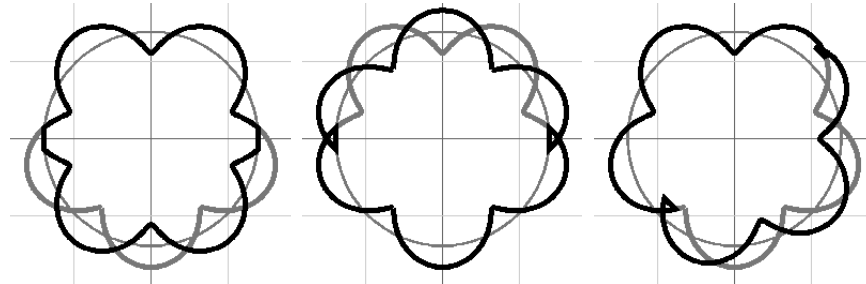

■ **Symmetry** effect does not have the correct name for what exactly it is or does. In terms of *Excentro* mechanical model this effect allows you to modify pencil movement on sheet so, that at certain points pencil movement suddenly stops and starts going in opposite direction from point reflected around vertical *Y* axis of sheet coordinates system. If base curve on tabletop is smooth shape like circle this effect results in symmetric pieces of **Cycloid** reflected along the base path, like shown on pictures below. In points where direction of pencil changes straight line segment is added to make **Cycloid** path closed. This also ruins smoothness of the path, so you should use this effect with caution.
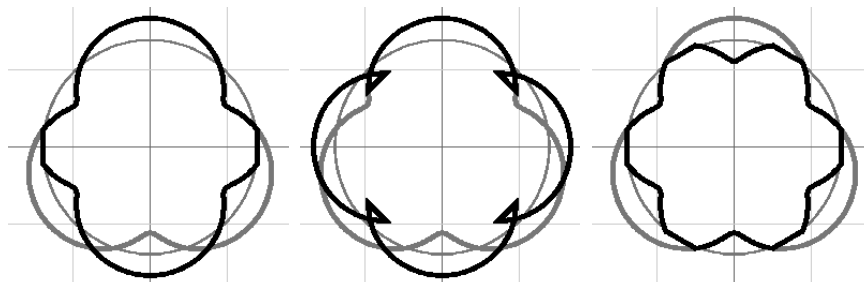
*Gray path is unmodified **Cycloid** element'; black paths have additional **Symmetry** effects: **Fragments** = 2, **Phase** = 0° (left); **Fragments** = 4, **Phase** = 45° (center); **Fragments** = 6, **Phase** = 0° (right)*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Cycloid** path will consist of. For example, is you set this value to '*2*', the base path will be divided into two parts and pencil movement on sheet while it moves along second half of base path will be vertical reflection of pencil movement on sheet while it moves along first part.

◆ **Phase** attribute controls the starting point of first symmetric piece on base path. This value is expressed in degrees ('°') with [−180°, 180°] interval. For example, value '*0°*' means that first fragment starts at the beginning of base path, values '*180°*' and '*−180°*' means that first fragment starts at the middle of base path.

*Unmodified **Cycloid** element (gray); black paths have additional **Symmetry** effects: **Fragments** = 2 and **Phase** =: 0˚ (left), 180˚ (center), 45˚ (right)*

MATHEMATICAL DETAILS

If you are interested in exact mathematical formulation that define **Cycloid** element as part of *Excentro* mechanical model, please find below equations that define pencil movement in *XY* coordinates of the sheet:

$x\,(t) = Side\ Size \bullet cos(Frequency \bullet t + Phase)$

$y\,(t) = Amplitude \bullet sin(Frequency \bullet t + Phase)$

Where '*t*' is 'time' parameter that covers [0, 2π] interval while sheet travels along base path on tabletop.
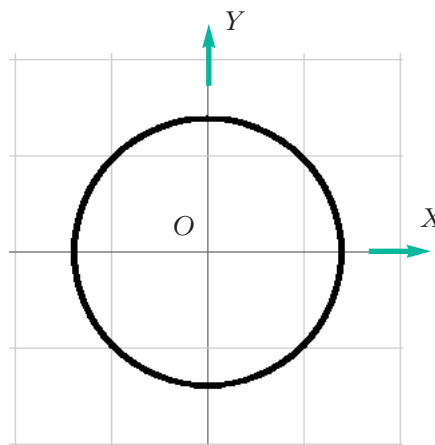
CHAPTER 4: EIGHT

In *Excentro* mechanical model pencil movement on sheet for **Eight** element looks what its name suggests: 'eight'-like figure ('8'). The path you get on tabletop as result of sheet movement along base path (path of parent element) consists of series of twists with symmetric top and bottom parts. The shape of 'eight'-like figure on sheet and twists of path on tabletop is controlled by **Frequency**, **Amplitude** and **Side Size** attributes of **Eight** element.
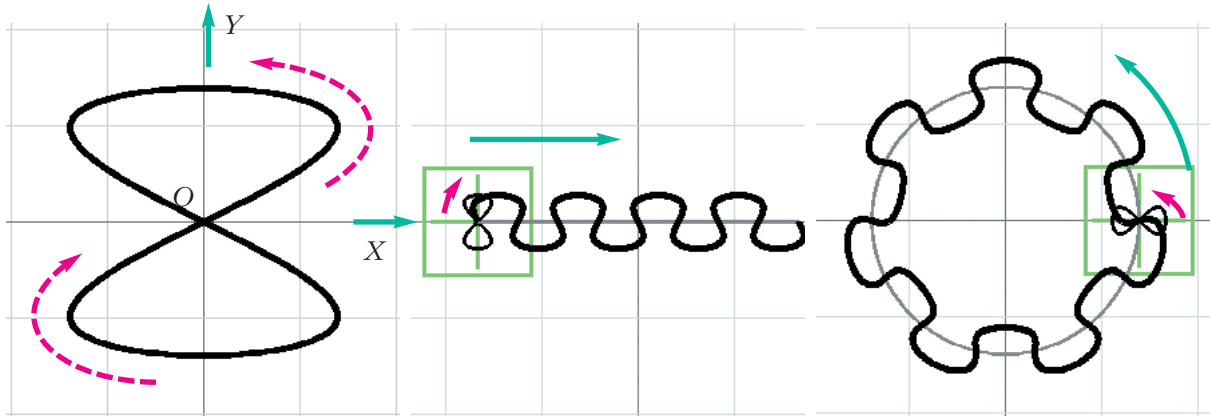

Eight element: pencil movement on sheet; results of linear and circular basic curves modifications

Eight elements are not that frequently used in guilloche designs as **Cycloid** or **Sine Wave** elements. Most often you can see them on external borders of design or as elements of linear backgrounds. Paths of **Eight** elements are shown with color on example below.
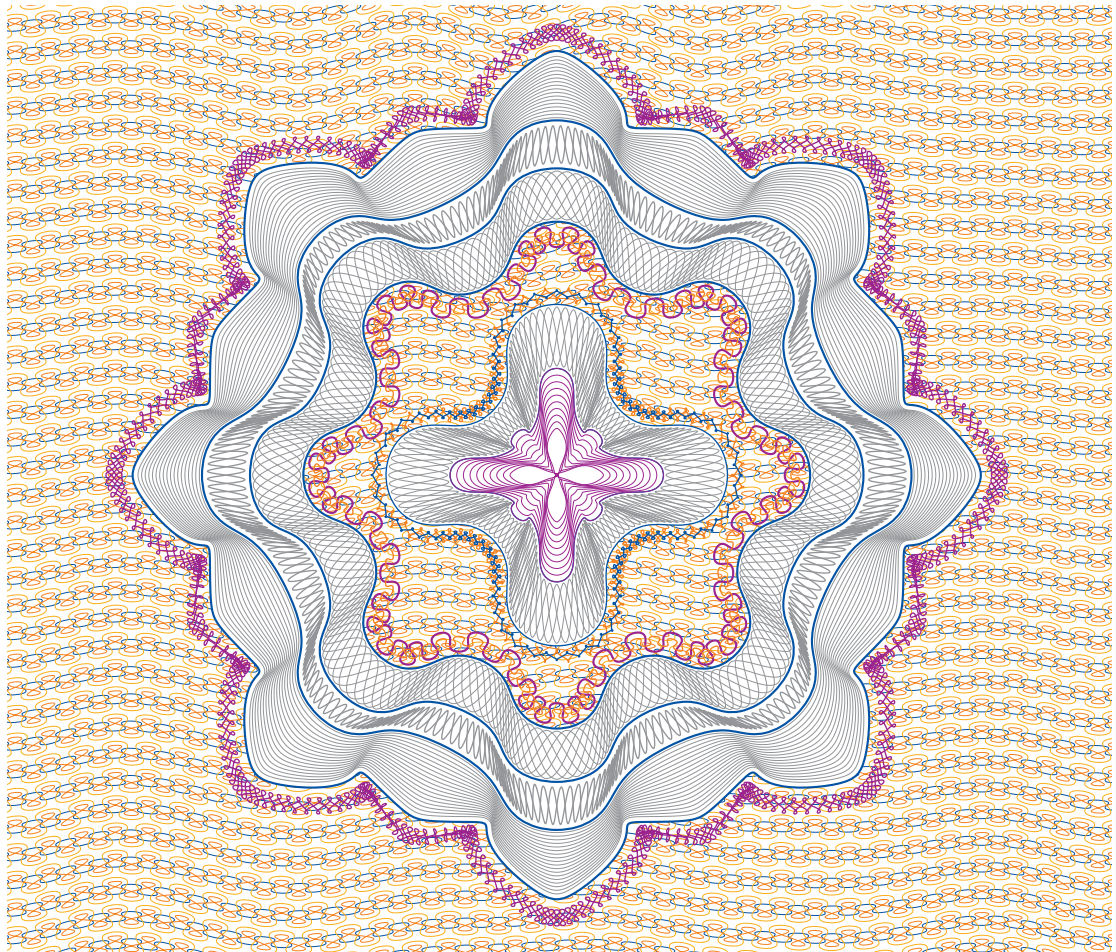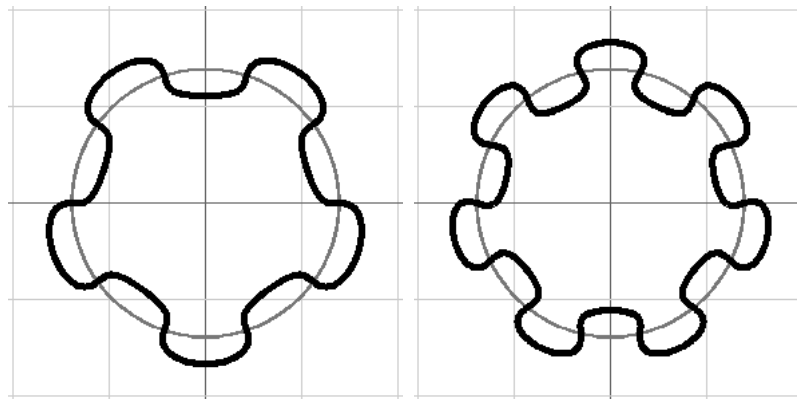
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has seven attribute fields for elements of **Eight** type:
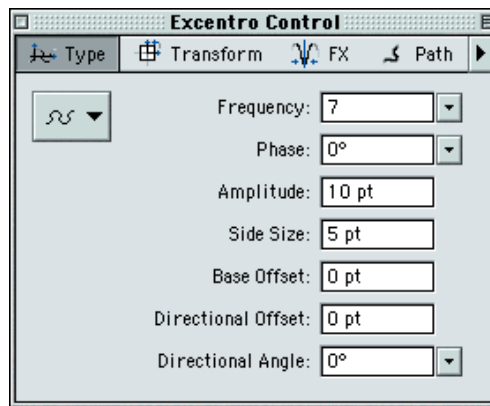

■ **Frequency** defines number of 'twists' path of **Eight** element has. If you consider this attribute from *Excentro* mechanical model view, it is a number of times pencil on sheet completes full 'eight' figure trail while sheet moves on tabletop. To make shape of **Eight** element more suitable for guilloche design you should set this value to '*3*' or higher.


*Eight paths with **Frequency** set to '5' and '7'*

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement on sheet. This value is expressed in degrees '°' from [−180°; 180°] interval you can use it to change position of twists.
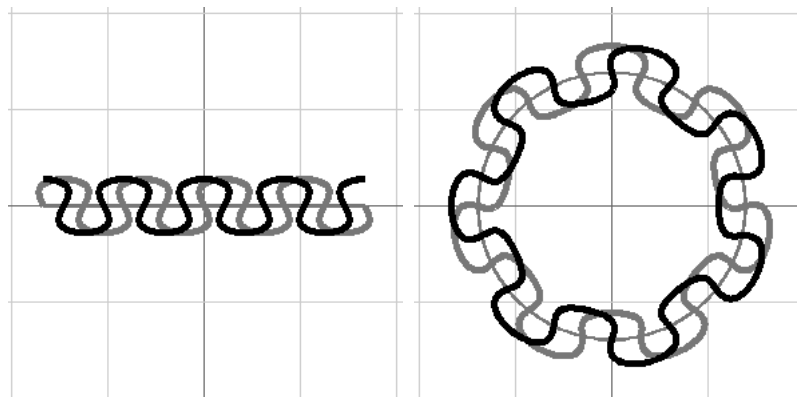

*'90°' modification of **Phase** attribute*

■ **Amplitude** attribute defines twists height. It is measured in application wide measurement units selected in **Excentro Preferences** dialog.
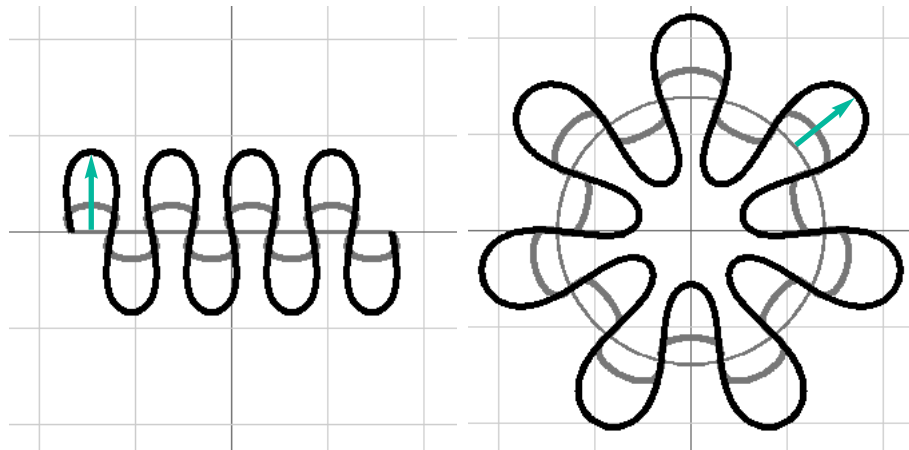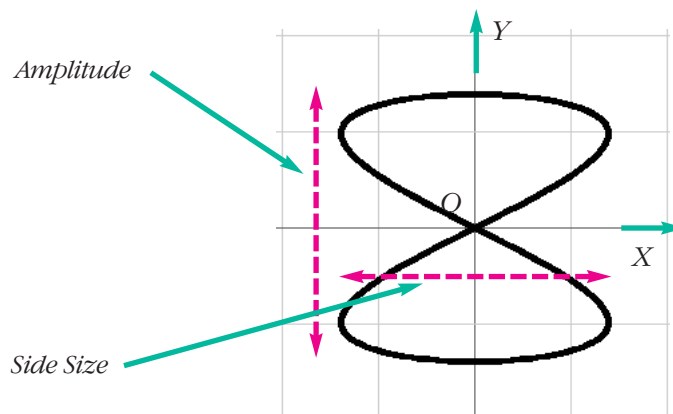

*Eight paths with **Amplitude** set to '10 pt' (gray) and '30 pt' (black)*

■ **Side Size** attribute defines width of coils. It also is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Eight** element.
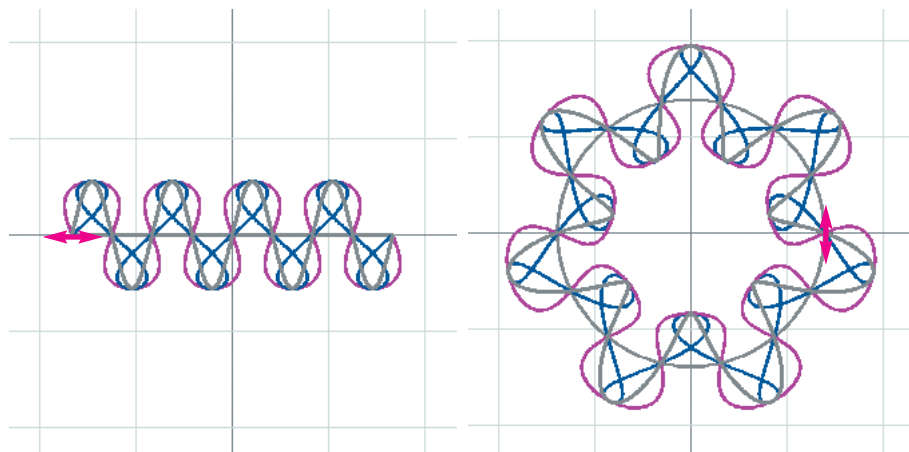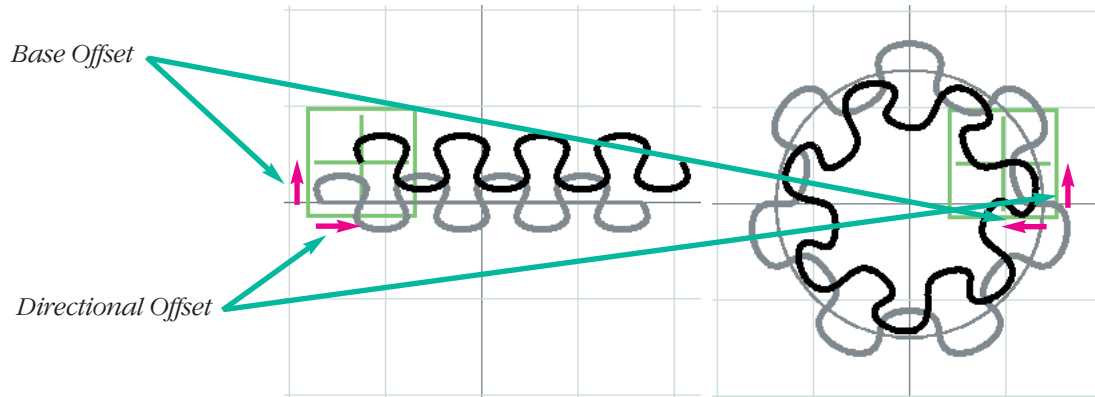

*Eight path with **Side Size** set to '0 pt' (gray), with positive (blue)
and negative (magenta) values*

In terms of *Excentro* mechanical model **Amplitude** attribute defines extent of vertical pencil movement along *Y* axis of sheet coordinates while **Side Size** attribute sets extent of horizontal pencil movement along *X* axis. When **Side Size** attribute set to '0 pt', path of **Eight** element is identical to path of **Sine Wave** element.
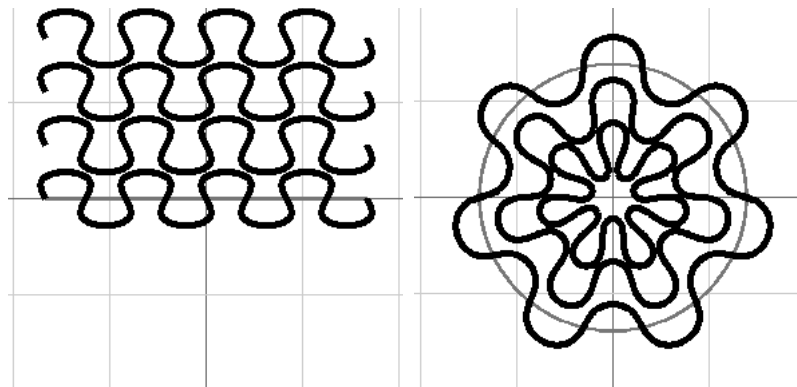
■ **Base Offset** and **Directional Offset** attributes define distance to base path (path of parent element). Expressed in terms of *Excentro* mechanics, **Base Offset** attribute sets vertical distance from center of the sheet to the point of the sheet that moves along base path on tabletop. **Directional Offset** attribute sets horizontal distance between same points. These values are measured in application wide measurement units.
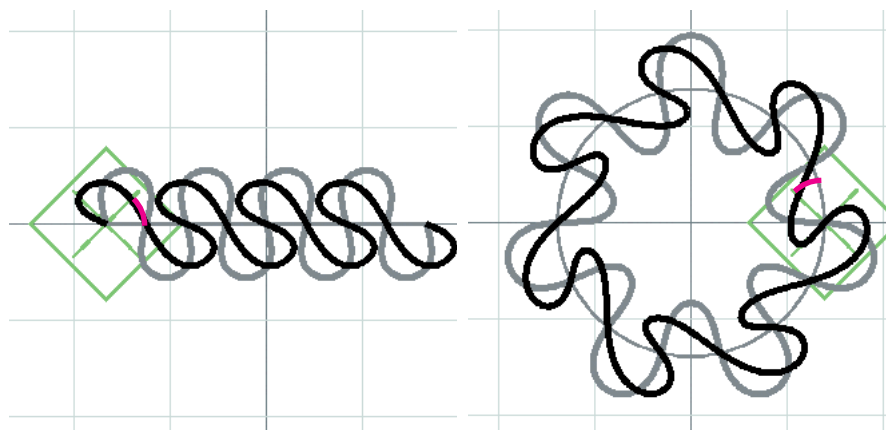

Base Offset

Directional Offset

***Base Offset** and **Directional Offset** attributes set to '0 pt' (gray) and '15 pt' (black)*

Base Offset attribute is very often modified during guilloche creation process. Pictures below illustrate examples of path variations you can get this way. **Directional Offset** value usually is not changed from its initial '*0 pt*'.
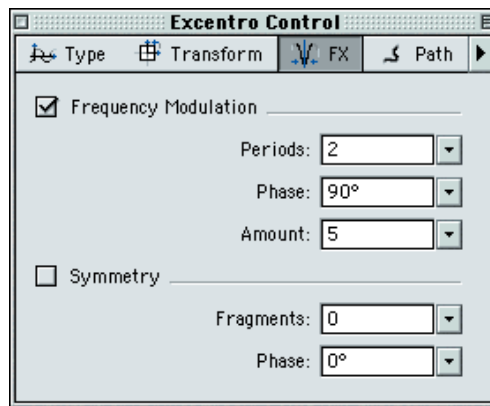

■ **Directional Angle** attribute sets initial angle of sheet rotation. While sheet moves along its base path it rotates together with tangent line to this path (unless path of another element is set as **direction** for the element). With **Directional Angle** attribute you can modify rotation angle by value specified in this field. Expressed in degrees '°'. This attribute is not usually modified from initial '*0°*' value.
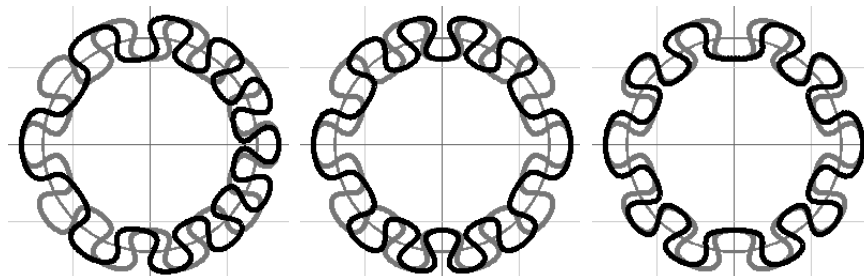

***Directional Angle** attribute set to '0°' (gray) and '45°' (black)*

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to elements of **Eight** type: **Frequency Modulation** and **Symmetry** effects.
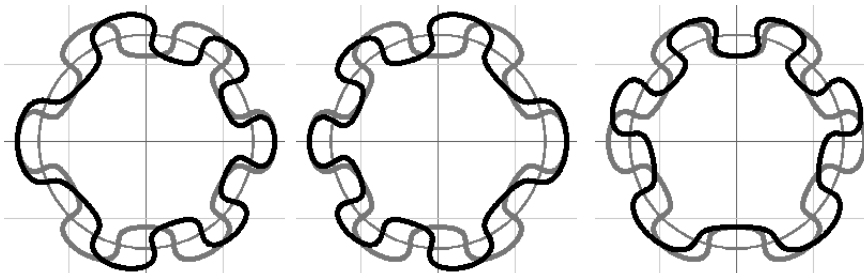

■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Eight** element. With this effect you can create **Eight** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Gray path is unmodified **Eight** element with **Frequency** attribute set to '10'; black paths have additional **Frequency Modulation** attributes: **Periods** = 1, **Phase** = 0°, **Amount** = 5 (left); **Periods** = 2, **Phase** = 0°, **Amount** = 5 (center); **Periods** = 4, **Phase** = 0°, **Amount** = 5 (right)*
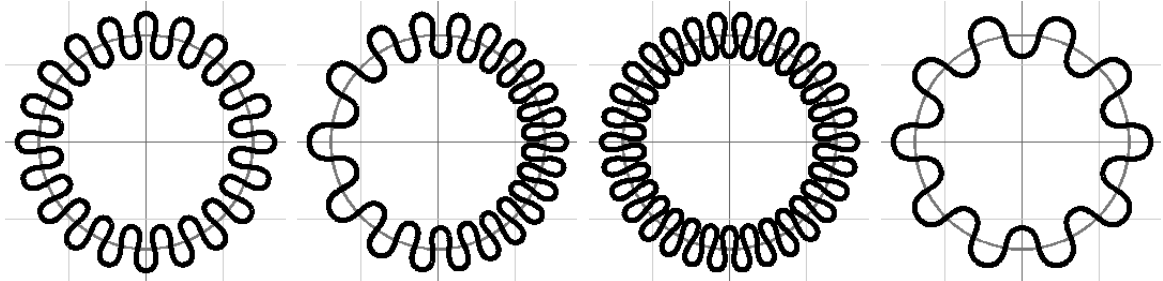
◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '*4*' in this field means that **Eight** has 4 parts with higher frequency and 4 parts with lower frequency.

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '*0°*' means that center of first area with higher frequency corresponds to starting point of base path, with values '*180°*' or '*−180°*' first area with higher frequency coincides with middle of base path.


*Eight element with **Frequency** attribute set to '6' (gray); black paths with **Frequency Modulation** effect **Periods** = 1, **Amount** = 2 and **Phase** =: 0° (left), 180° (center), 90° (right)*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Eight** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*20*', **Amount** value of '*10*' will make areas with lower frequency similar to that of **Eight** path with **Frequency** '*10*' and areas with higher frequency — to **Eight** path with **Frequency** '*30*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

Left to right: **Eight** *element with* **Frequency** *'20';* **Eight** *element with* **Frequency** *'20' and* **Frequency Modulation** *effect with* **Periods** *= 1,* **Phase** *= 0°,* **Amount** *= 10;*
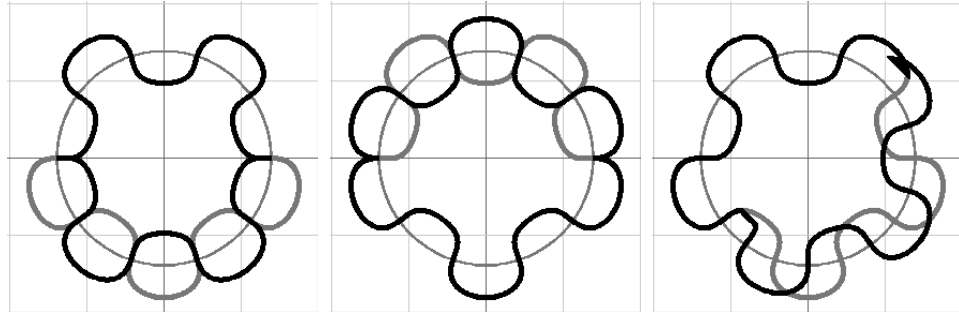**Eight** *element with* **Frequency** *'30';* **Eight** *element with* **Frequency** *'10'.*
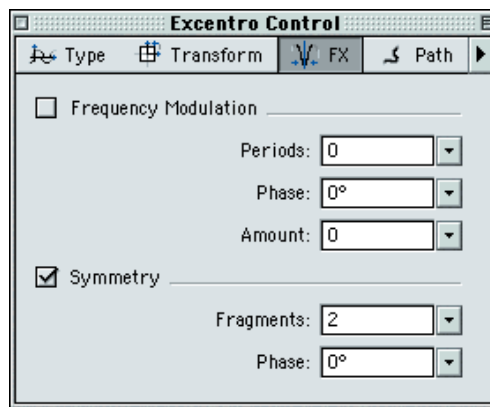
■ **Symmetry** effect does not have the correct name for what exactly it is or does. In terms of *Excentro* mechanical model this effect allows you to modify pencil movement on sheet so, that at certain points pencil movement suddenly stops and starts going in opposite direction from point reflected around vertical *Y* axis of sheet coordinates system. If base curve on tabletop is smooth shape like circle this effect results in symmetric pieces of **Eight** reflected along the base path, like shown on pictures below. In points where direction of pencil changes straight line segment is added to make **Eight** path closed. This also ruins smoothness of the path, so you should use this effect with caution.
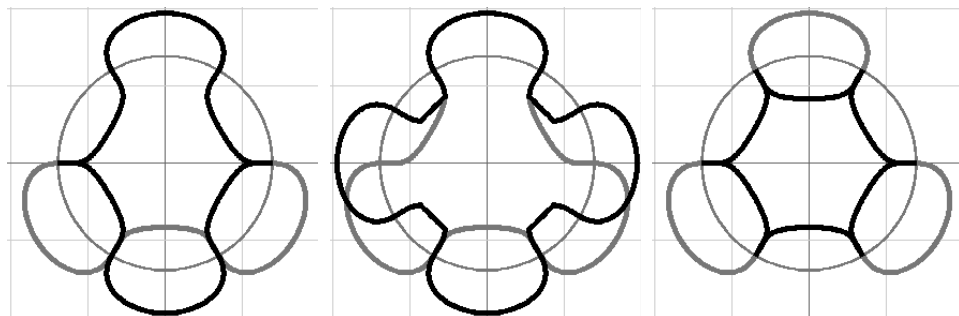
Gray path is unmodified **Eight** *element'; black paths have additional* **Symmetry** *effects:*
Fragments *= 2,* **Phase** *= 0° (left);* **Fragments** *= 4,* **Phase** *= 45° (center);*
Fragments *= 6,* **Phase** *= 0° (right)*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Eight** path will consist of. For example, is you set this value to '*2*', the base path will be divided into two parts and pencil movement on sheet while it moves along second half of base path will be vertical reflection of pencil movement on sheet while it moves along first part.

◆ **Phase** attribute controls the starting point of first symmetric piece on base path. This value is expressed in degrees ('°') with [−180°, 180°] interval. For example, value '*0°*' means that first fragment starts at the beginning of base path, values '*180°*' and '*−180°*' means that first fragment starts at the middle of base path.

*Unmodified **Eight** element (gray); black paths have additional **Symmetry** effects: **Fragments** = 2 and **Phase** =: 0° (left), 180° (center), 45° (right)*

MATHEMATICAL DETAILS

If you are interested in exact mathematical formulation that define **Eight** element as part of *Excentro* mechanical model, please find below equations that define pencil movement in *XY* coordinates of the sheet:

$$x (t) = Side\ Size \bullet sin(2 \bullet Frequency \bullet t + Phase)$$

$$y (t) = Amplitude \bullet sin(Frequency \bullet t + Phase)$$

Where '*t*' is 'time' parameter that covers [0, 2π] interval while sheet travels along base path on tabletop.
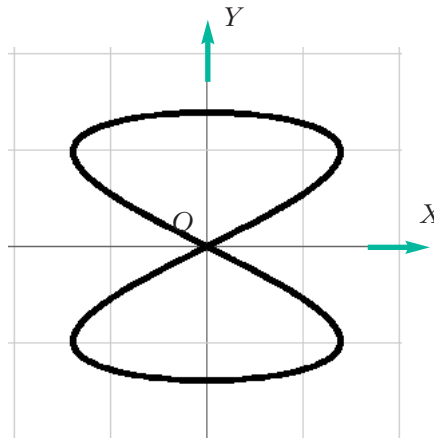
CHAPTER 5: SAW

In *Excentro* mechanical model **Saw** elements represents semicircular movement of pencil on sheet while sheet moves along base path (path of parent element). In result you receive path that can remind blade of saw (either hand tool or circular power tool) with shape of 'teeth' controlled by **Frequency**, **Amplitude** and **Side Size** attributes of **Saw** element.
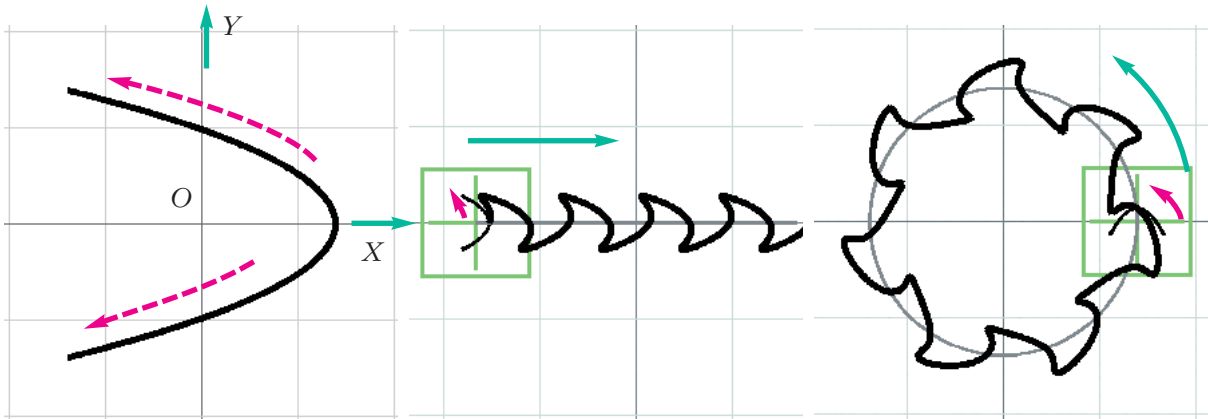

Saw element: pencil movement on sheet; results of linear and circular basic curves modifications

Saw elements are not that frequently used in guilloche designs as **Cycloid** or **Sine Wave** elements. Most often you can see them on external borders of design or as elements of linear backgrounds. Paths of **Saw** elements are shown with color on example below.
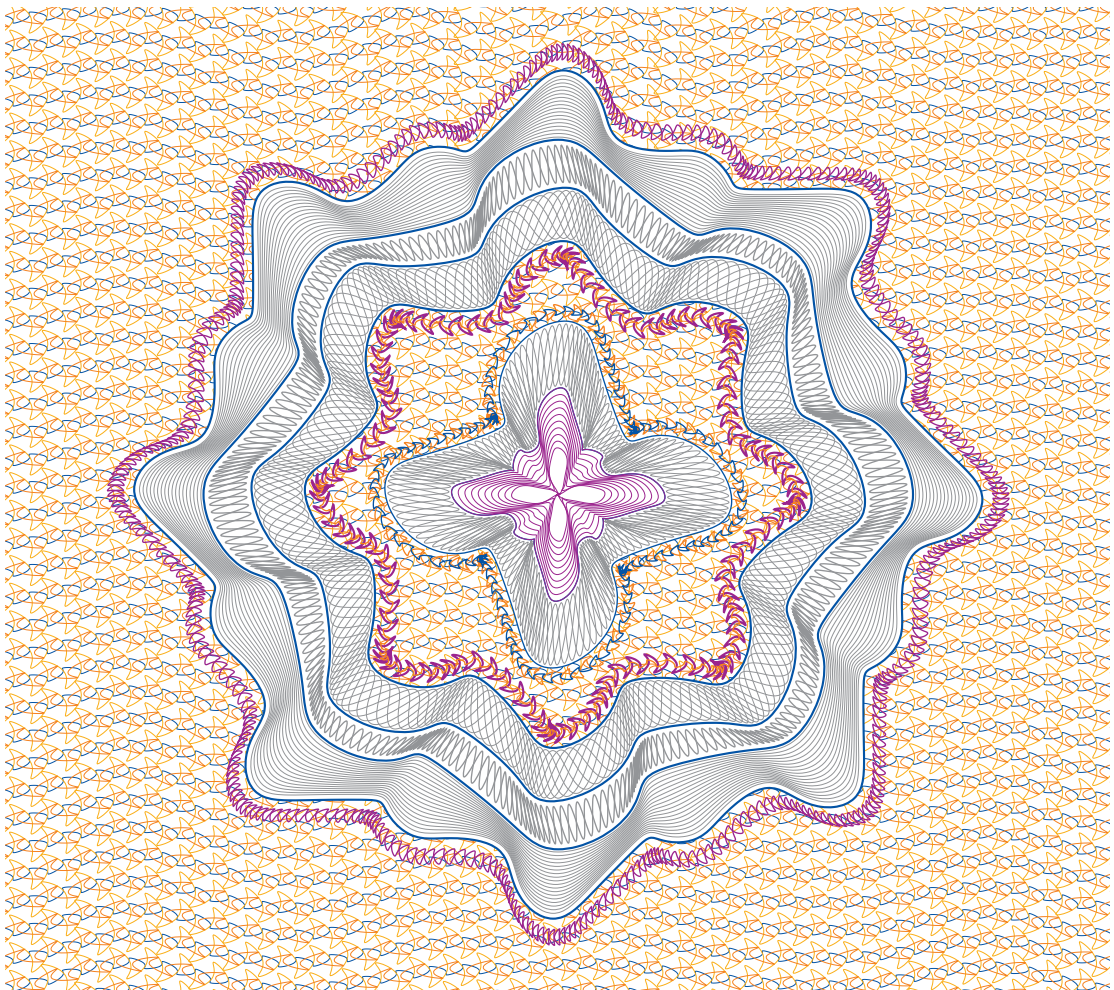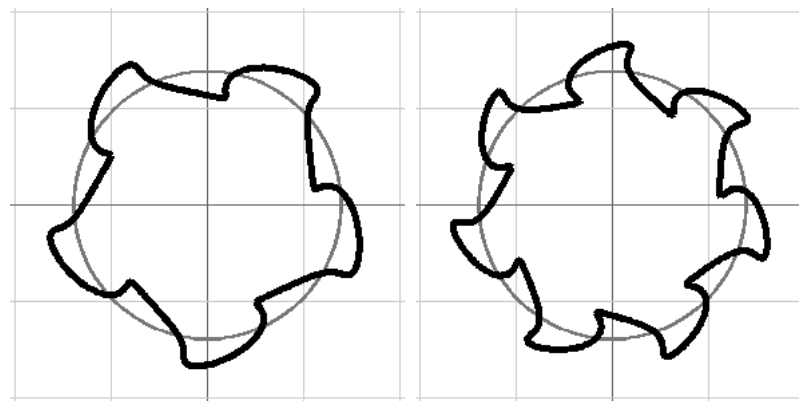
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has seven attribute fields for elements of **Saw** type:
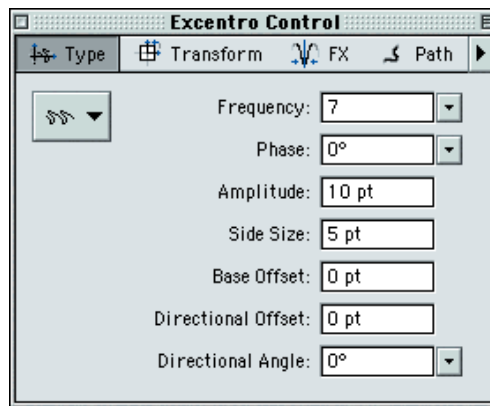

■ **Frequency** defines number of 'teeth' path of **Saw** element has. If you consider this attribute from *Excentro* mechanical model view, it is a number of times pencil on sheet completes full semicircle trail while sheet moves on tabletop. To make shape of **Saw** element more suitable for guilloche design you should set this value to '*3*' or higher.


Saw paths with **Frequency** set to '5' and '7'

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement on sheet. This value is expressed in degrees '°' from [−180°; 180°] interval you can use it to change position of teeth.
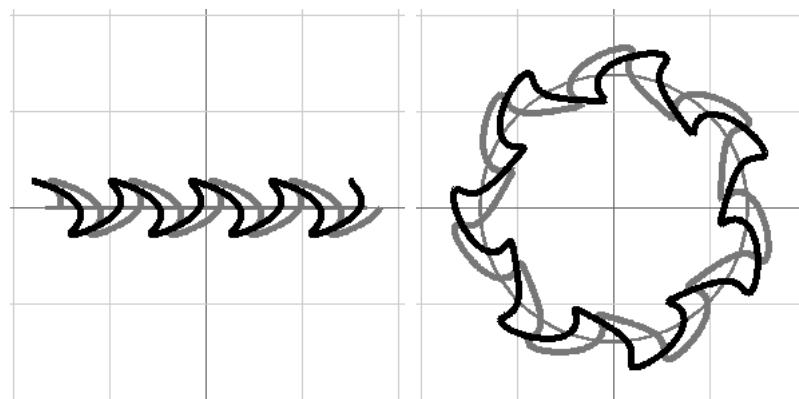
'90°' modification of **Phase** attribute

■ **Amplitude** attribute defines teeth height. It is measured in application wide measurement units selected in **Excentro Preferences** dialog.
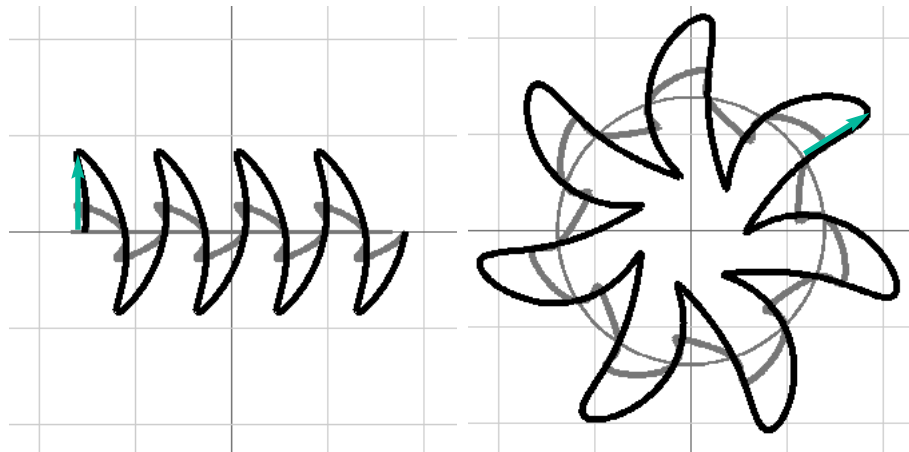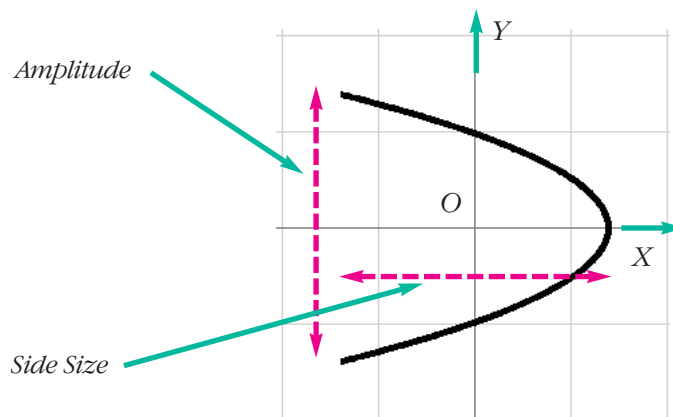

Saw *paths with* ***Amplitude*** *set to '10 pt' (gray) and '30 pt' (black)*

■ **Side Size** attribute defines width of teeth. It also is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Saw** element.
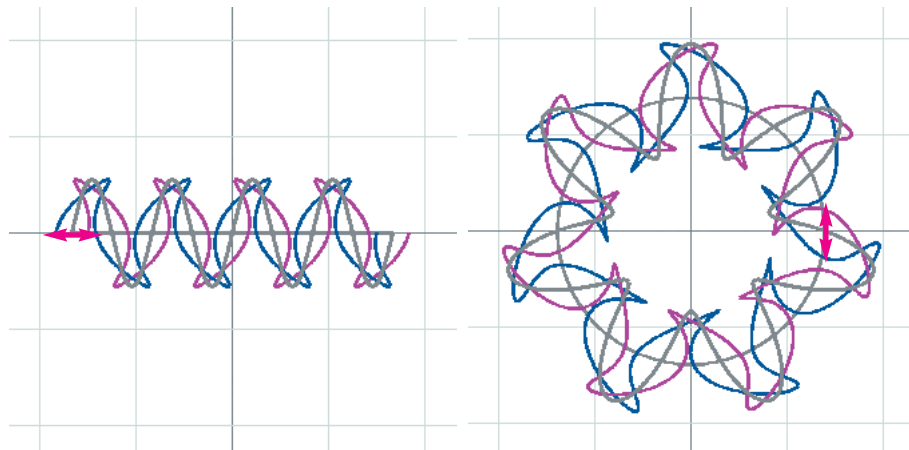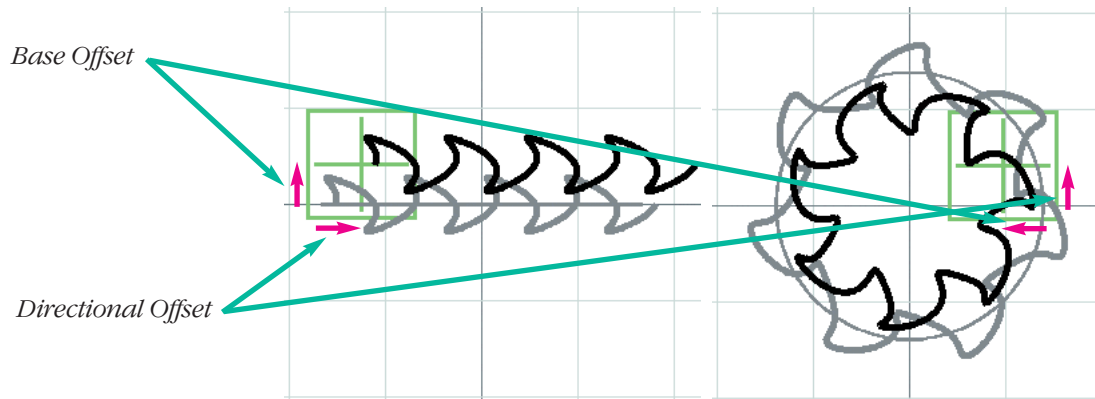

Saw *path with* ***Side Size*** *set to '0 pt' (gray), with positive (blue)*
and negative (magenta) values

In terms of *Excentro* mechanical model **Amplitude** attribute defines extent of vertical pencil movement along Y axis of sheet coordinates while **Side Size** attribute sets extent of horizontal pencil movement along X axis. When **Side Size** attribute set to '0 pt', path of **Saw** element is identical to path of **Sine Wave** element.
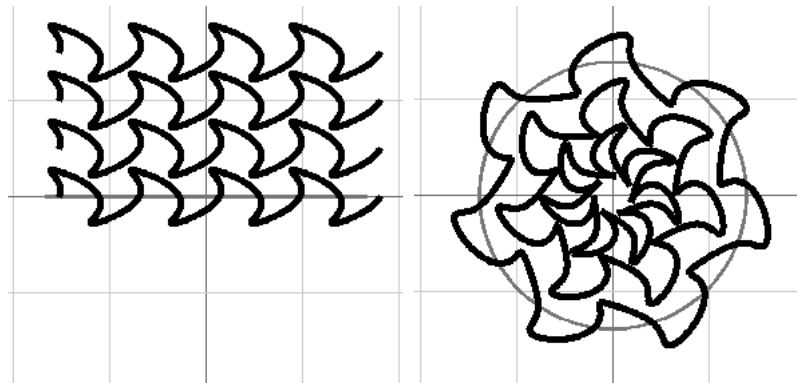
■ **Base Offset** and **Directional Offset** attributes define distance to base path (path of parent element). Expressed in terms of *Excentro* mechanics, **Base Offset** attribute sets vertical distance from center of the sheet to the point of the sheet that moves along base path on tabletop. **Directional Offset** attribute sets horizontal distance between same points. These values are measured in application wide measurement units.
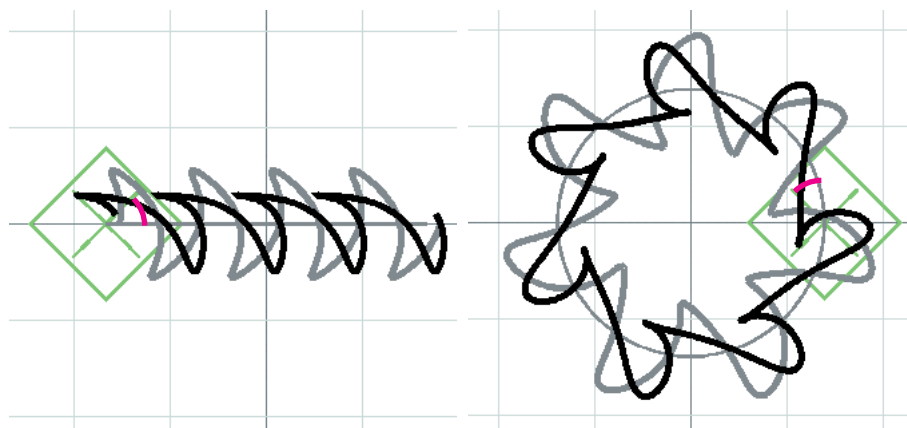

Base Offset and *Directional Offset* *attributes set to '0 pt' (gray) and '15 pt' (black)*

Base Offset attribute is very often modified during guilloche creation process. Pictures below illustrate examples of path variations you can get this way. **Directional Offset** value usually is not changed from its initial '*0 pt*'.
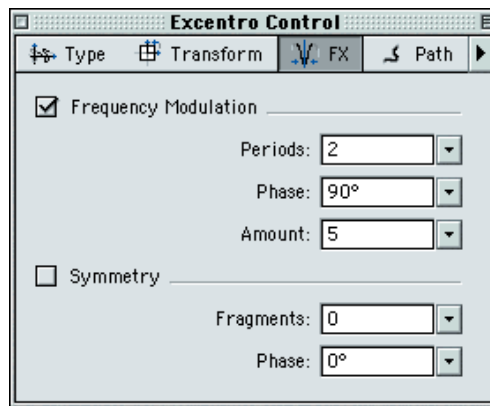

■ **Directional Angle** attribute sets initial angle of sheet rotation. While sheet moves along its base path it rotates together with tangent line to this path (unless path of another element is set as **direction** for the element). With **Directional Angle** attribute you can modify rotation angle by value specified in this field. Expressed in degrees '°'. This attribute is not usually modified from initial '*0°*' value.
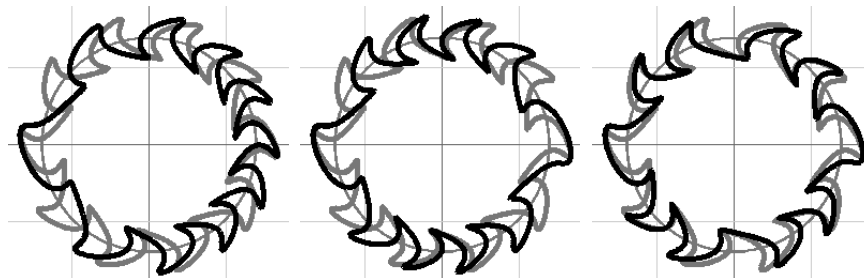

Directional Angle *attribute set to '0°' (gray) and '45°' (black)*

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to elements of **Saw** type: **Frequency Modulation** and **Symmetry** effects.
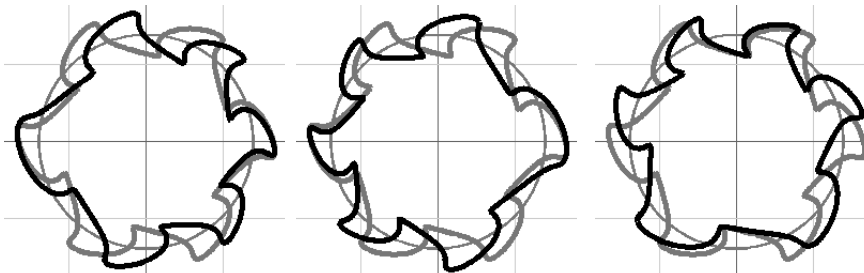

■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Saw** element. With this effect you can create **Saw** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Gray path is unmodified **Saw** element with **Frequency** attribute set to '10'; black paths have additional **Frequency Modulation** attributes: **Periods** = 1, **Phase =** 0°, **Amount** = 5 (left); **Periods** = 2, **Phase =** 0°, **Amount** = 5 (center); **Periods** = 4, **Phase =** 0°, **Amount** = 5 (right)*
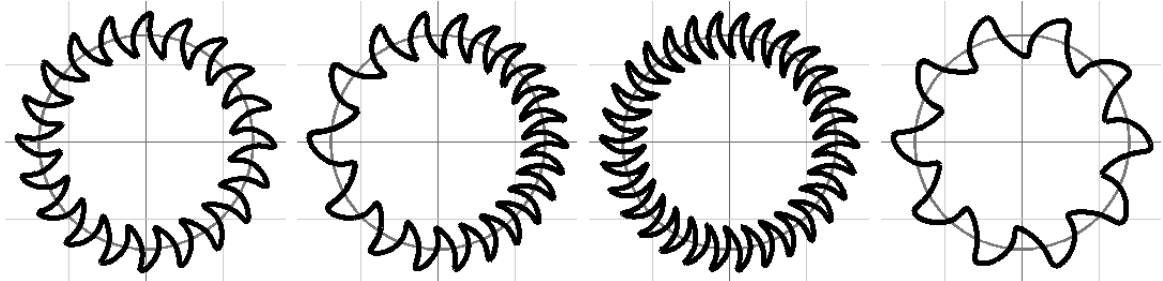
◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '*4*' in this field means that **Saw** has 4 parts with higher frequency and 4 parts with lower frequency.

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '*0°*' means that center of first area with higher frequency corresponds to starting point of base path, with values '*180°*' or '*−180°*' first area with higher frequency coincides with middle of base path.


*Saw element with **Frequency** attribute set to '6' (gray); black paths with **Frequency Modulation** effect **Periods** = 1, **Amount** = 2 and **Phase =**: 0° (left), 180° (center), 90° (right)*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Saw** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*20*', **Amount** value of '*10*' will make areas with lower frequency similar to that of **Saw** path with **Frequency** '*10*' and areas with higher frequency to **Saw** path with **Frequency** '*30*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

Left to right: Saw element with Frequency '20'; Saw element with Frequency '20' and Frequency Modulation effect with Periods = 1, Phase = 0°, Amount = 10;
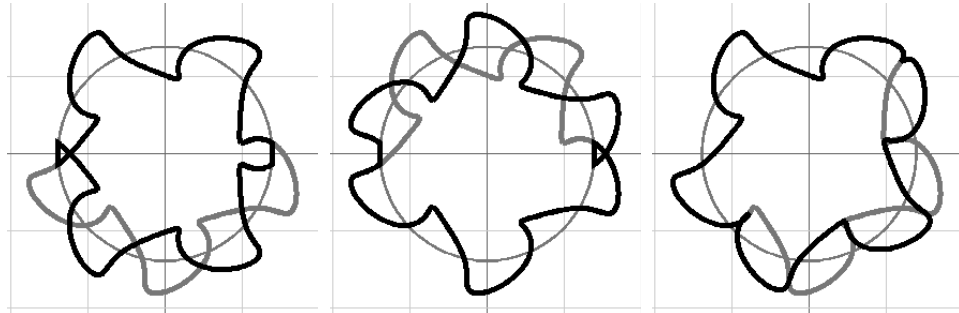*Saw element with Frequency '30'; Saw element with Frequency '10'.*
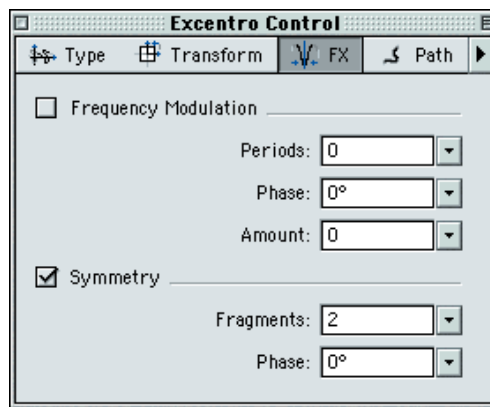
■ **Symmetry** effect does not have the correct name for what exactly it is or does. In terms of *Excentro* mechanical model this effect allows you to modify pencil movement on sheet so, that at certain points pencil movement suddenly stops and starts going in opposite direction from point reflected around vertical *Y* axis of sheet coordinates system. If base curve on tabletop is smooth shape like circle this effect results in symmetric pieces of **Saw** reflected along the base path, like shown on pictures below. In points where direction of pencil changes straight line segment is added to make **Saw** path closed. This also ruins smoothness of the path, so you should use this effect with caution.
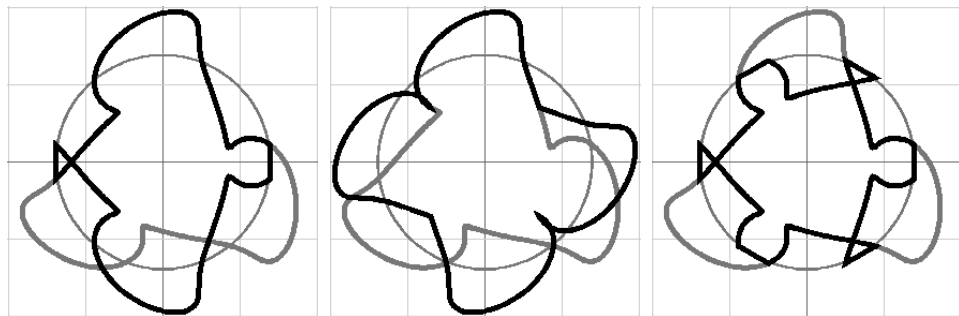
Gray path is unmodified Saw element'; black paths have additional Symmetry effects:
***Fragments** = 2, **Phase** = 0° (left); **Fragments** = 4, **Phase** = 45° (center);*
***Fragments** = 6, **Phase** = 0° (right)*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Saw** path will consist of. For example, is you set this value to '*2*', the base path will be divided into two parts and pencil movement on sheet while it moves along second half of base path will be vertical reflection of pencil movement on sheet while it moves along first part.

◆ **Phase** attribute controls the starting point of first symmetric piece on base path. This value is expressed in degrees ('°') with [−180°, 180°] interval. For example, value '*0°*' means that first fragment starts at the beginning of base path, values '*180°*' and '*−180°*' means that first fragment starts at the middle of base path.

*Unmodified **Saw** element (gray); black paths have additional **Symmetry** effects: **Fragments** = 2 and **Phase** =: 0° (left), 180° (center), 45° (right)*

MATHEMATICAL DETAILS

If you are interested in exact mathematical formulation that define **Saw** element as part of *Excentro* mechanical model, please find below equations that define pencil movement in *XY* coordinates of the sheet:

$$x\,(t) = Side\ Size \bullet cos(2 \bullet Frequency \bullet t + Phase)$$

$$y\,(t) = Amplitude \bullet sin(Frequency \bullet t + Phase)$$

Where '*t*' is 'time' parameter that covers [0, 2π] interval while sheet travels along base path on tabletop.
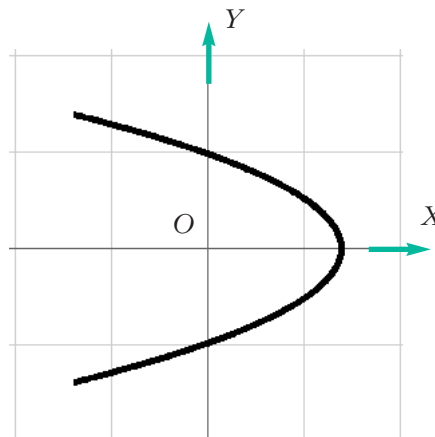
CHAPTER 6: BRACE

In *Excentro* mechanical model **Brace** elements represents complex movement of pencil on sheet with pencil completing three periodic movements along vertical axis of sheet coordinates and two periodic movements along horizontal axis. As a result the trail pencil leaves on tabletop while sheet moves along base path (path of parent element) has regular twists that remind braces or bracket symbols set one after another. Shape of twists is controlled by **Frequency**, **Amplitude** and **Side Size** attributes of **Brace** element.
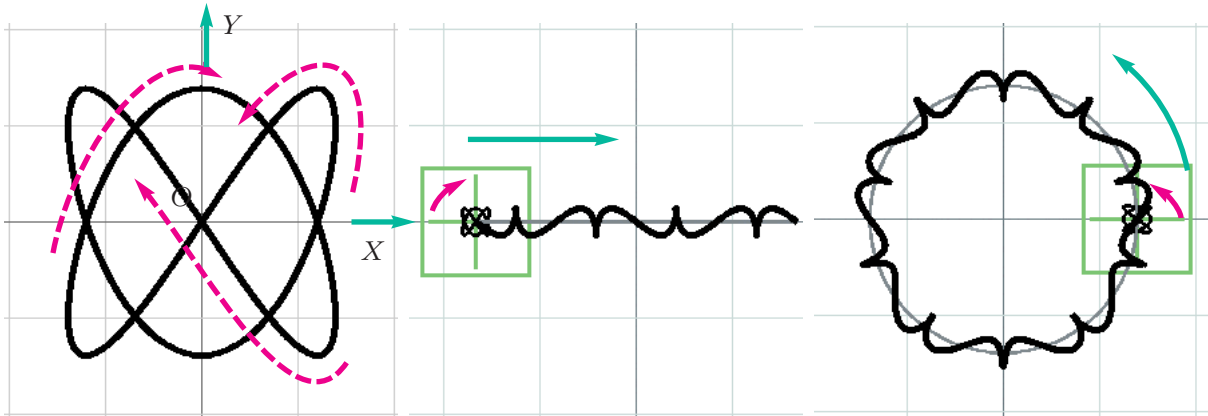

Brace element: pencil movement on sheet; results of linear and circular basic curves modifications

Because of its complex shape **Brace** elements are not frequently used in guilloche designs. Most often you can see them as parts of guilloche geometry where they are used to create ribbon-like designs or as elements of linear backgrounds. Paths of **Brace** elements are shown with color on example below.
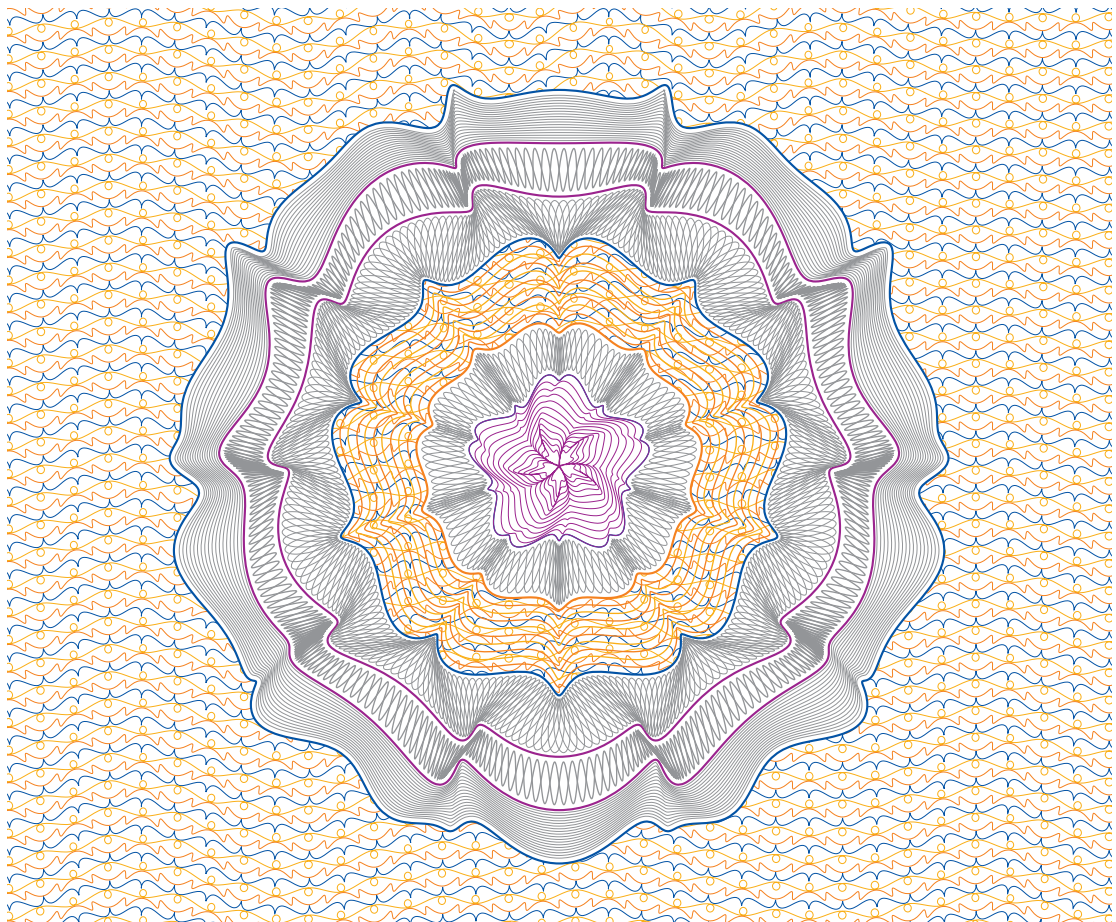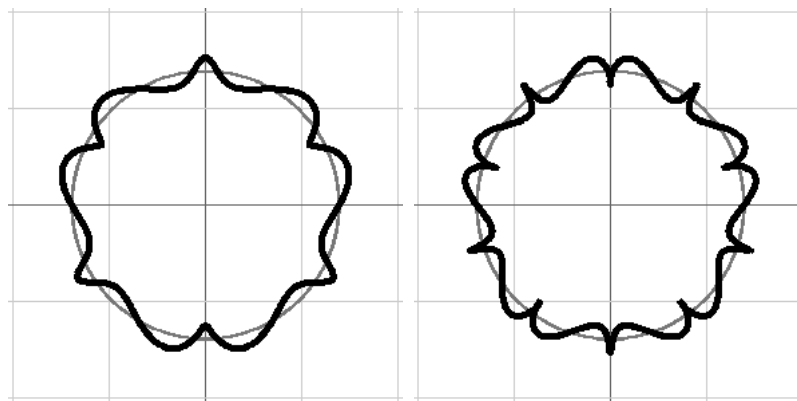
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has seven attribute fields for elements of **Brace** type:
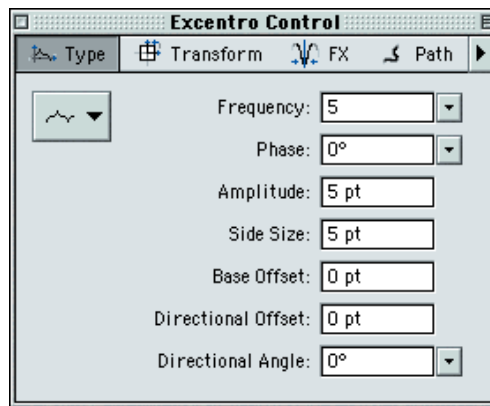

■ **Frequency** defines number of 'braces' path of **Brace** element has. If you consider this attribute from *Excentro* mechanical model view, it is a number of times pencil on sheet completes full periodic trail while sheet moves on tabletop. To make shape of **Brace** element more suitable for guilloche design you should set this value to '3' or higher.


Brace paths with Frequency set to '3' and '5'

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement on sheet. This value is expressed in degrees '°' from [−180°; 180°] interval you can use it to change position of braces of path.
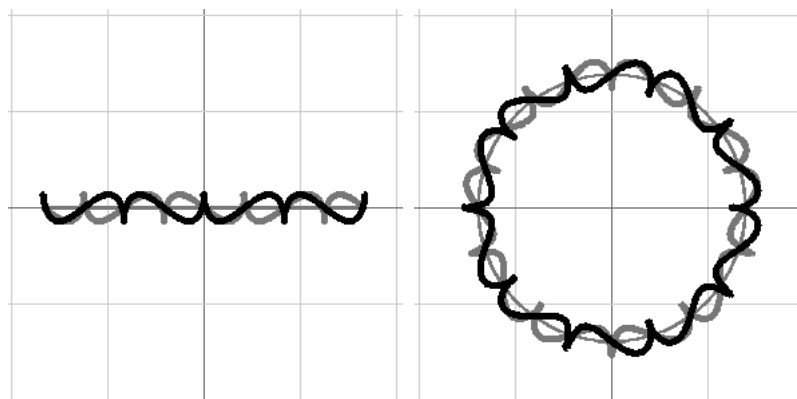

'90°' modification of Phase attribute

■ **Amplitude** attribute defines braces height. It is measured in application wide measurement units selected in **Excentro Preferences** dialog.
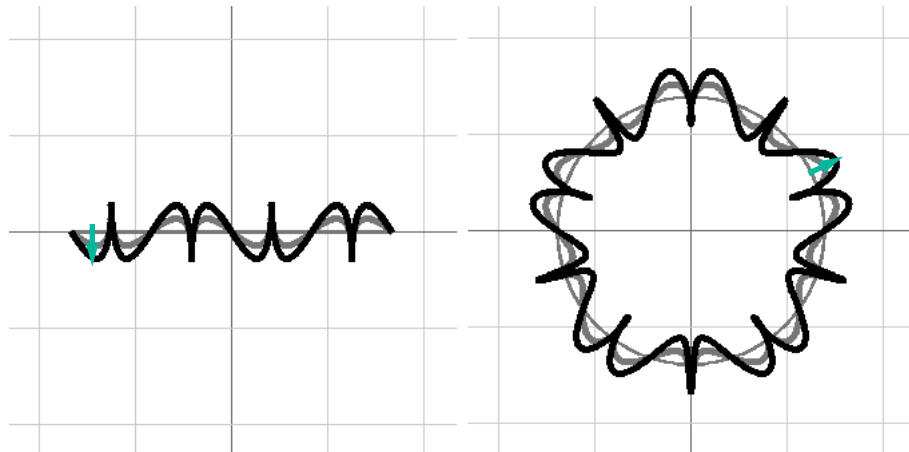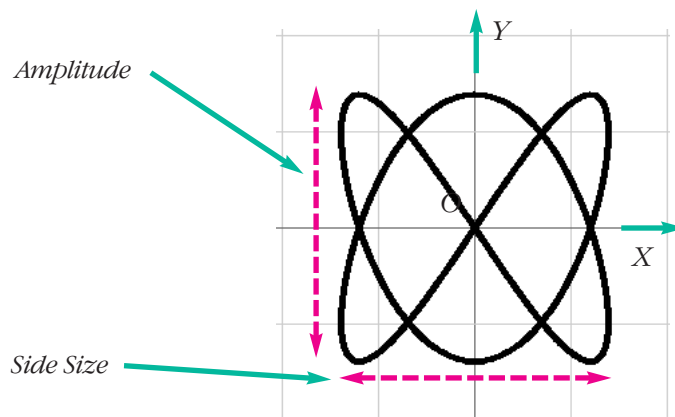

*Brace paths with **Amplitude** set to '5 pt' (gray) and '10 pt' (black)*

■ **Side Size** attribute defines width of braces. It also is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Brace** element.
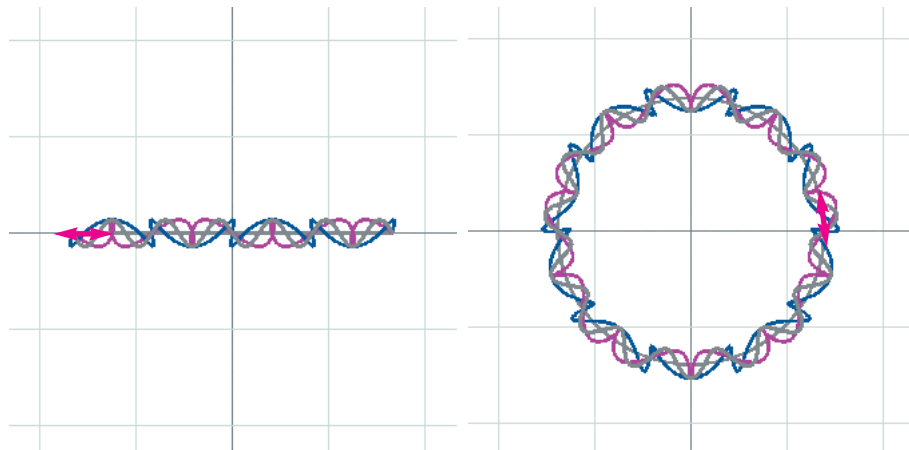
*Brace path with **Side Size** set to '0 pt' (gray), with positive (blue) and negative (magenta) values*

In terms of *Excentro* mechanical model **Amplitude** attribute defines extent of vertical pencil movement along *Y* axis of sheet coordinates while **Side Size** attribute sets extent of horizontal pencil movement along *X* axis. When **Side Size** attribute set to '0 pt', path of **Brace** element is identical to path of **Sine Wave** element with **Frequency** three times as high.

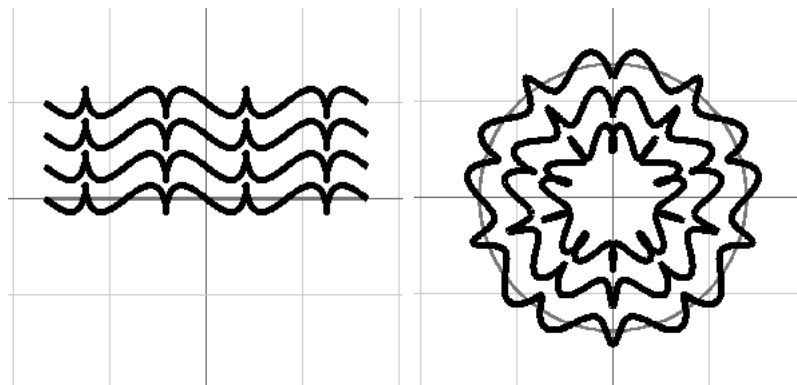■ **Base Offset** and **Directional Offset** attributes define distance to base path (path of parent element). Expressed in terms of *Excentro* mechanics, **Base Offset** attribute sets vertical distance from center of the sheet to the point of the sheet that moves along base path on tabletop. **Directional Offset** attribute sets horizontal distance between same points. These values are measured in application wide measurement units.
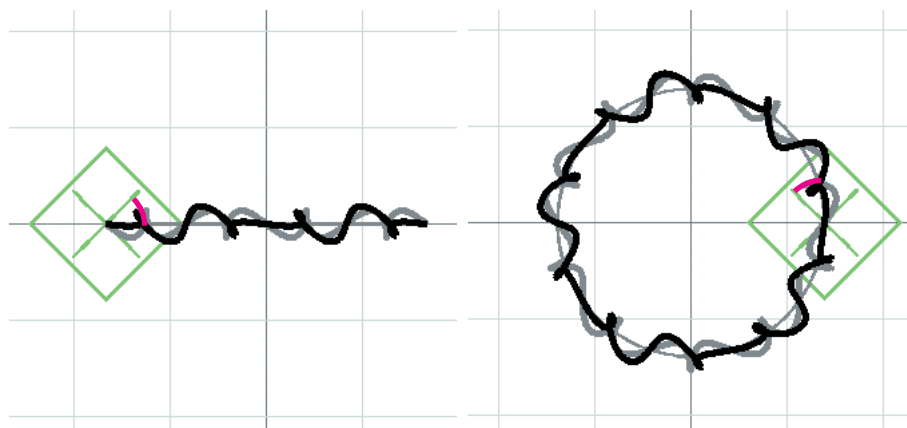

*Base Offset and **Directional Offset** attributes set to '0 pt' (gray) and '15 pt' (black)*

Base Offset attribute is very often modified during guilloche creation process. Pictures below illustrate examples of path variations you can get this way. **Directional Offset** value usually is not changed from its initial '0 pt'.

■ **Directional Angle** attribute sets initial angle of sheet rotation. While sheet moves along its base path it rotates together with tangent line to this path (unless path of another element is set as **direction** for the element). With **Directional Angle** attribute you can modify rotation angle by value specified in this field. Expressed in degrees '°'. This attribute is not usually modified from initial '0°' value.

Directional Angle attribute set to '0°' (gray) and '45°' (black)

FX ATTRIBUTES

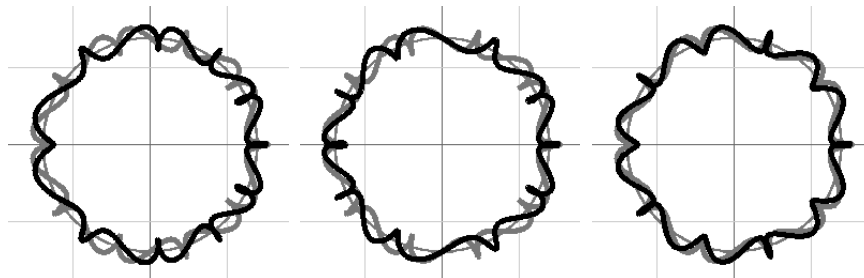**FX** panel of **Excentro Control** inspector contains two special effects that could be applied to elements of **Brace** type: **Frequency Modulation** and **Symmetry** effects.


■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Brace** element. With this effect you can create **Brace** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Gray path is unmodified **Brace** element with **Frequency** attribute set to '5'; black paths have additional **Frequency Modulation** attributes: **Periods** = 1, **Phase** = 0˚, **Amount** = 2 (left); **Periods** = 2, **Phase** = 0˚, **Amount** = 2 (center); **Periods** = 5, **Phase** = 72˚, **Amount** = 2 (right)*
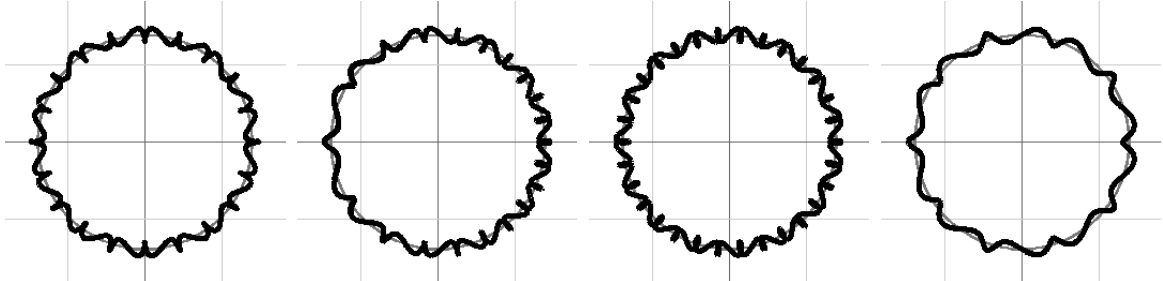
◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '*4*' in this field means that **Brace** has 4 parts with higher frequency and 4 parts with lower frequency.

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ("°") with [−180˚, 180˚] interval. For example, value '*0˚*' means that center of first area with higher frequency corresponds to starting point of base path, with values '*180˚*' or '*−180˚*' first area with higher frequency coincides with middle of base path.
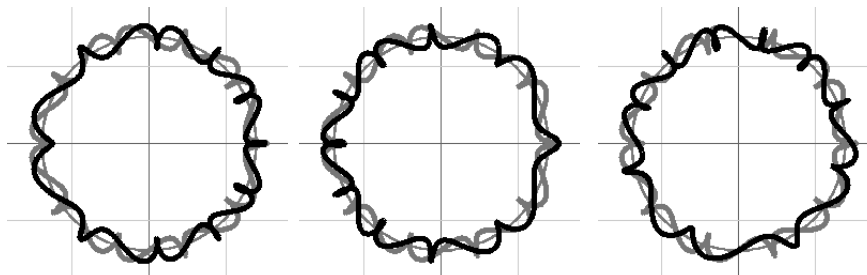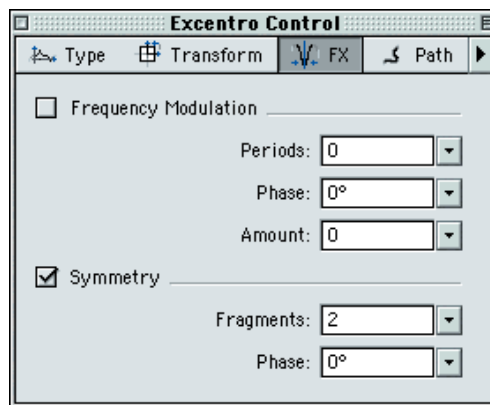

***Brace** element with **Frequency** attribute set to '5' (gray); black paths with **Frequency Modulation** effect **Periods** = 1, **Amount** = 2 and **Phase** =: 0˚ (left), 180˚ (center), 90˚ (right)*
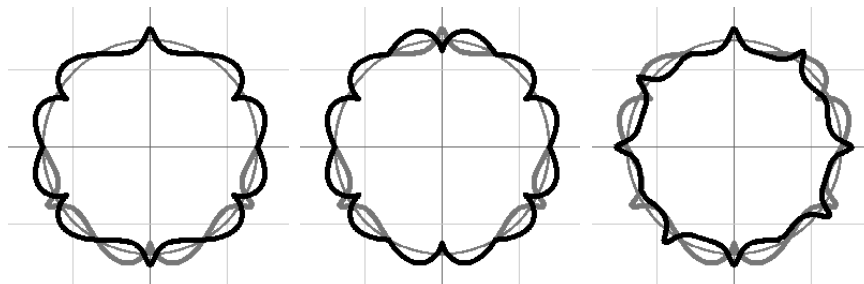
◆ **Amount** attribute defines value by which **Frequency** attribute of **Brace** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*10*', **Amount** value of '*5*' will make areas with lower frequency similar to that of **Brace** path with **Frequency** '*5*' and areas with higher frequency to **Brace** path with **Frequency** '15'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

Left to right: **Brace** *element with* **Frequency** *'10';* **Brace** *element with* **Frequency** *'10' and* **Frequency Modulation** *effect with* **Periods** *= 1,* **Phase** *= 0°,* **Amount** *= 5;* **Brace** *element with* **Frequency** *'15';* **Brace** *element with* **Frequency** *'5'.*
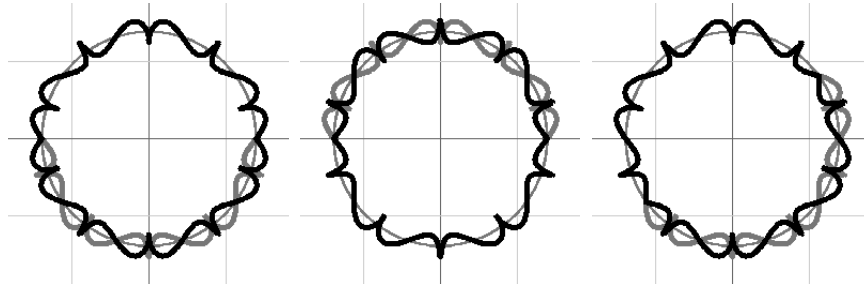

■ **Symmetry** effect does not have the correct name for what exactly it is or does. In terms of *Excentro* mechanical model this effect allows you to modify pencil movement on sheet so, that at certain points pencil movement suddenly stops and starts going in opposite direction from point reflected around vertical *Y* axis of sheet coordinates system. If base curve on tabletop is smooth shape like circle this effect results in symmetric pieces of **Brace** reflected along the base path, like shown on pictures below. In points where direction of pencil changes straight line segment is added to make **Brace** path closed. This also ruins smoothness of the path, so you should use this effect with caution.

Gray path is unmodified **Brace** *element'; black paths have additional* **Symmetry** *effects:* **Fragments** *= 2,* **Phase** *= 0° (left);* **Fragments** *= 6,* **Phase** *= 0° (center);* **Fragments** *= 8,* **Phase** *= 72° (right)*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Brace** path will consist of. For example, is you set this value to '*2*', the base path will be divided into two parts and pencil movement on sheet while it moves along second half of base path will be vertical reflection of pencil movement on sheet while it moves along first part.

◆ **Phase** attribute controls the starting point of first symmetric piece on base path. This value is expressed in degrees ('°') with [−180°, 180°] interval. For example, value '*0°*' means that first fragment starts at the beginning of base path, values '*180°*' and '*−180°*' means that first fragment starts at the middle of base path.

*Unmodified **Brace** element (gray); black paths have additional **Symmetry** effects: **Fragments** = 2 and **Phase** =: 0° (left), 180° (center), 36° (right)*

MATHEMATICAL DETAILS

If you are interested in exact mathematical formulation that define **Brace** element as part of *Excentro* mechanical model, please find below equations that define pencil movement in *XY* coordinates of the sheet:

$$x\,(t) = Side\ Size \bullet sin(2 \bullet Frequency \bullet t + Phase)$$

$$y\,(t) = Amplitude \bullet sin(3 \bullet Frequency \bullet t + Phase)$$

Where '*t*' is 'time' parameter that covers [0, 2π] interval while sheet travels along base path on tabletop.
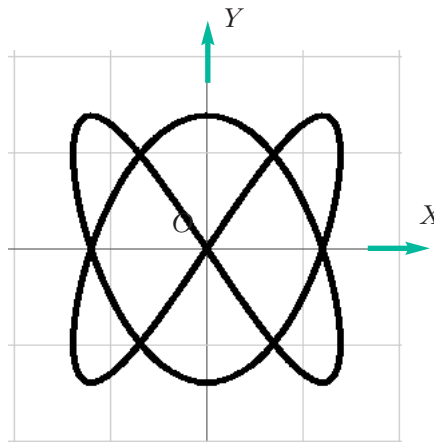
CHAPTER 7: SPADE

Spade element viewed from *Excentro* mechanical model side represents combination of two periodic movements of pencil on sheet: in horizontal direction (*X* axis on picture below) it moves using harmonic sine function, while in vertical direction (*Y* axis) it moves under linear law with sudden direction changes in top and bottom points. As a result path that sheet draws while it moves along base path on tabletop looks like decorative fence pikes or flower petals.
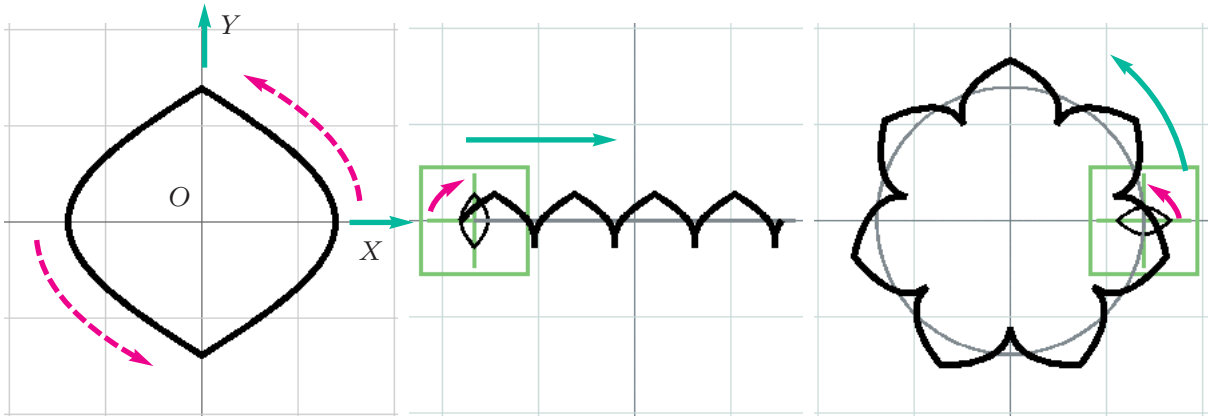
Spade element: pencil movement on sheet; results of linear and circular basic curves modifications

Because of its somewhat exotic shape and lack of smoothness, **Spade** elements are not that often used inside guilloche geometry. Typical usage for **Spade** elements includes external borders of design, concentric central pieces and linear backgrounds. Paths of **Spade** elements are shown with color on example below.
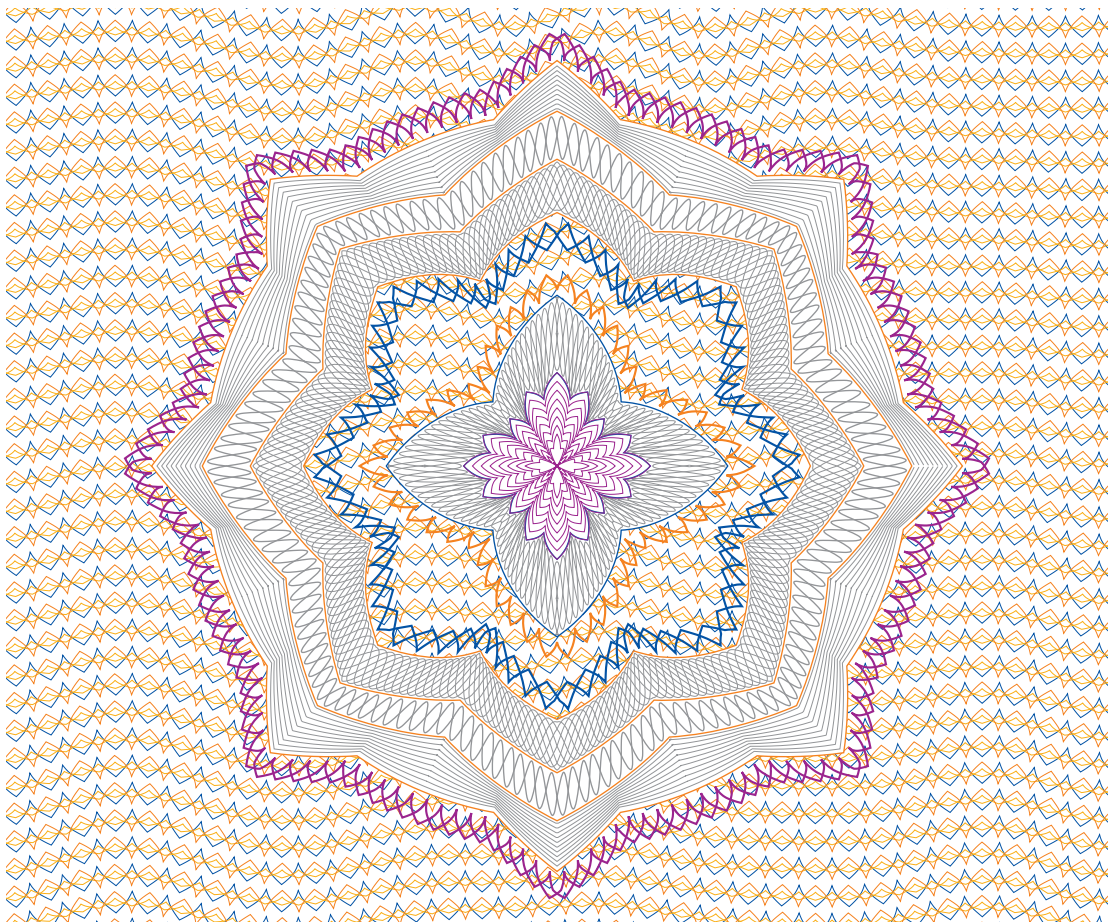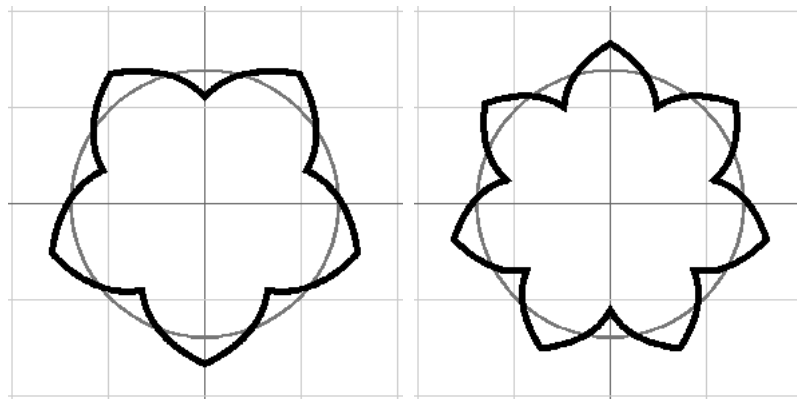
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has seven attribute fields for elements of **Spade** type:
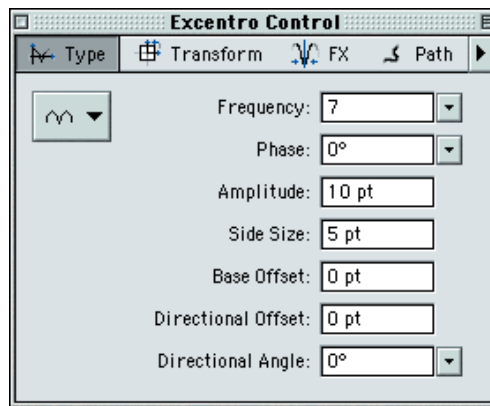

■ **Frequency** defines number of 'pikes' path of **Spade** element has. If you consider this attribute from *Excentro* mechanical model view, it is a number of times pencil completes its trail on sheet while sheet moves on tabletop. To make shape of **Spade** element more suitable for guilloche design purpose you should set this value to '*3*' or higher.


*Spade paths with **Frequency** set to '5' and '7'*

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement on sheet. This value is expressed in degrees '°' from [−180°; 180°] interval you can use it to change position of swells.
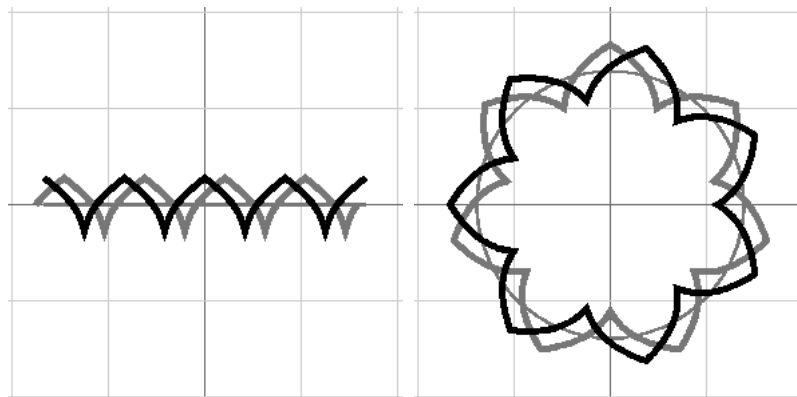

*'90°' modification of **Phase** attribute*

■ **Amplitude** attribute defines pikes height. It is measured in application wide measurement units selected in **Excentro Preferences** dialog.
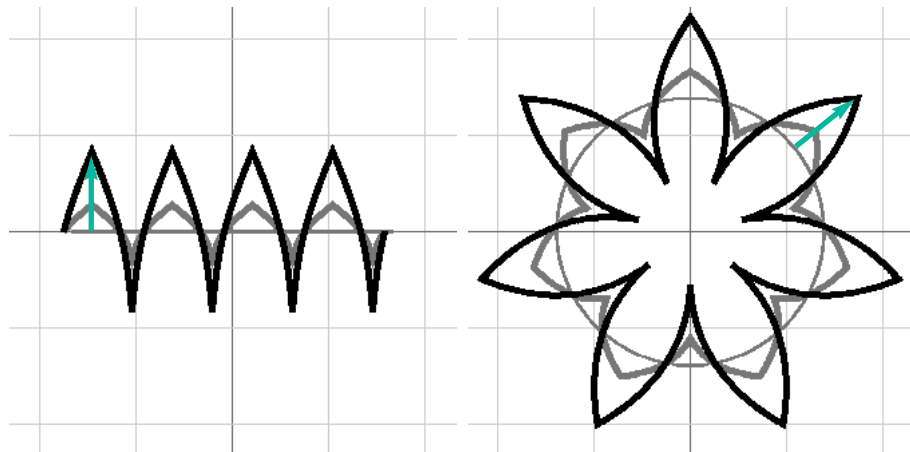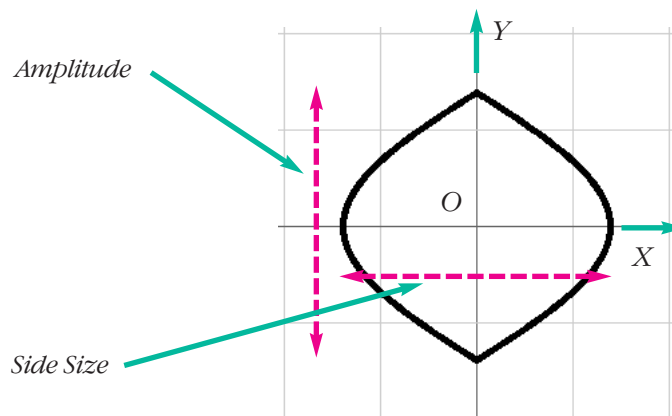

*Spade paths with **Amplitude** set to '10 pt' (gray) and '30 pt' (black)*

■ **Side Size** attribute defines width of pikes. It also is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Spade** element.
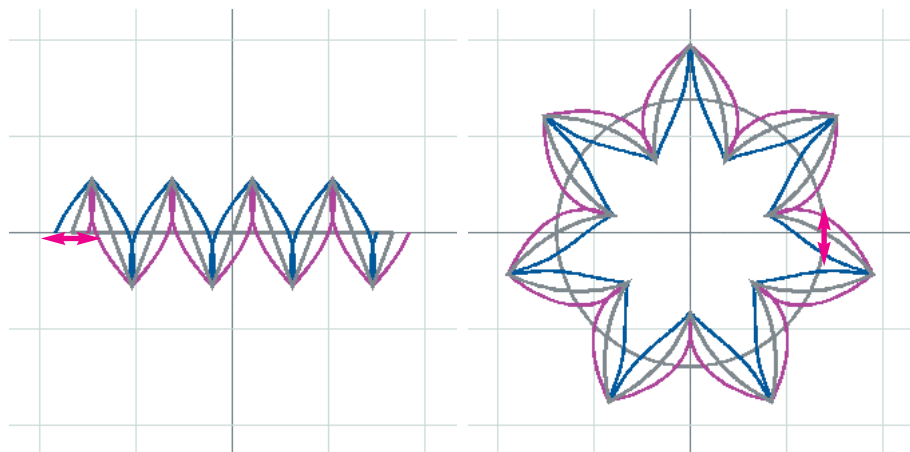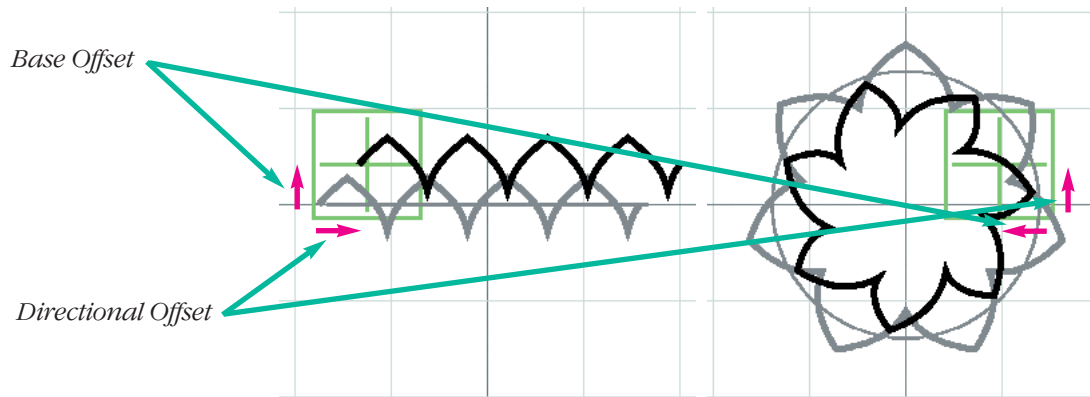

*Spade path with **Side Size** set to '0 pt' (gray), with positive (blue) and negative (magenta) values*

In terms of *Excentro* mechanics and pencil movement on sheet model **Amplitude** attribute defines extent of vertical pencil movement along *Y* axis of sheet coordinates while **Side Size** attribute sets extent of horizontal pencil movement along *X* axis.
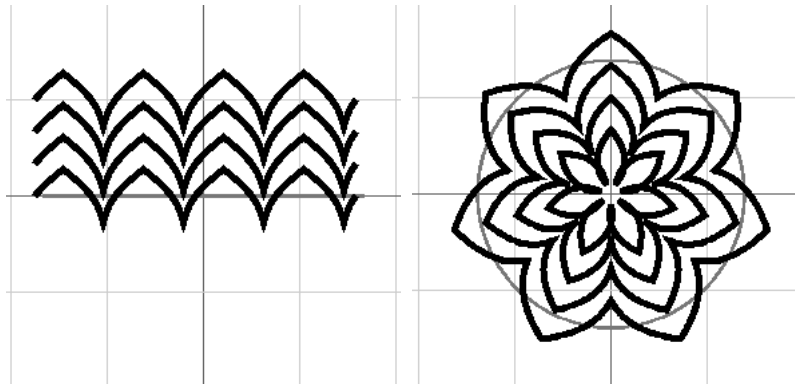
■ **Base Offset** and **Directional Offset** attributes define distance to base path (path of parent element). Expressed in terms of *Excentro* mechanics, **Base Offset** attribute sets vertical distance from center of the sheet to the point of the sheet that moves along base path on tabletop. **Directional Offset** attribute sets horizontal distance between same points. These values are measured in application wide measurement units.
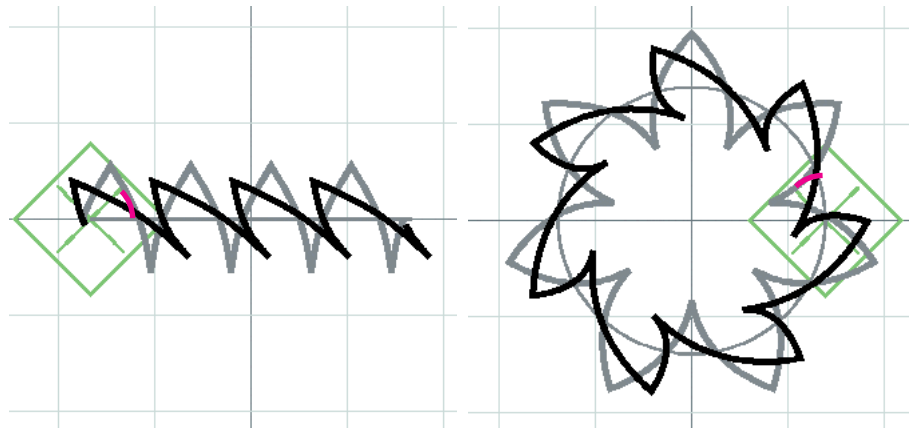

Base Offset *and* ***Directional Offset*** *attributes set to '0 pt' (gray) and '15 pt' (black)*

Base Offset attribute is more often modified during guilloche creation process. Pictures below illustrate examples of path variations you can get this way. **Directional Offset** value usually is not changed from initial '*0 pt*'.

■ **Directional Angle** attribute sets initial angle of sheet rotation. While sheet moves along its base path it rotates together with tangent line to this path (unless path of another element is set as **direction** for the element). With **Directional Angle** attribute you can modify rotation angle by value specified in this field. Expressed in degrees '°'. This attribute is not usually modified from its initial '*0°*' value.

Directional Angle *attribute set to '0°' (gray) and '45°' (black)*

TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has six attribute fields for elements of **Star** type:

■ **Frequency** defines number of points path of **Star** element has. These points are placed at equal distance along path of base element. To make shape of **Star** element really star-like you should set this value to '*3*' or higher.
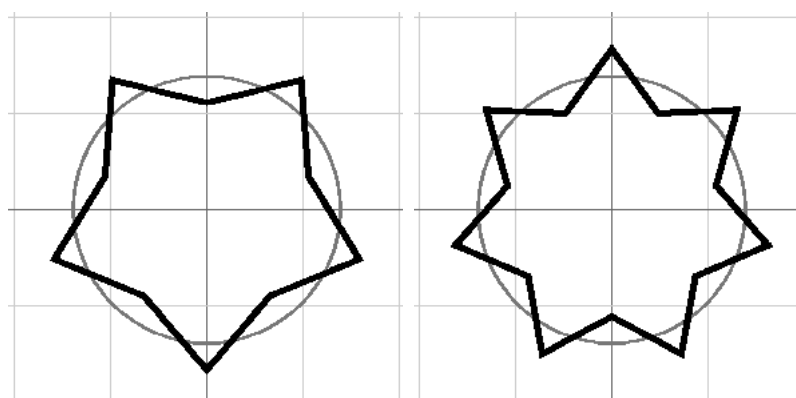
Star paths with Frequency set to '5' and '7'

■ **Phase** attribute controls position of star points. This value is expressed in degrees '°' from [−180°; 180°] interval.
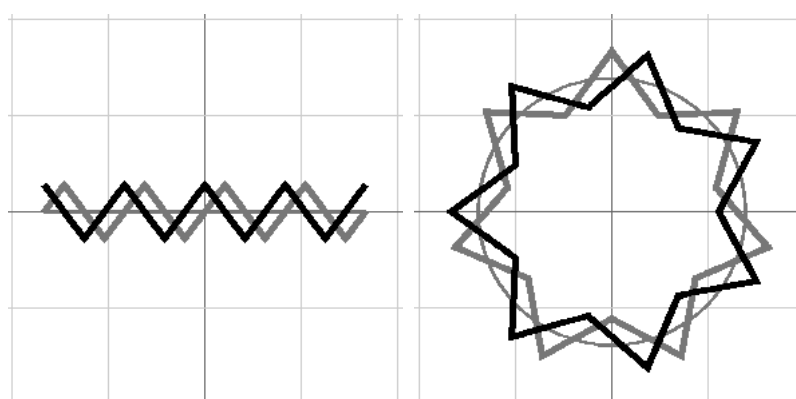
'90°' modification of Phase attribute

■ **Amplitude** attribute defines distance from points of **Star** path to its base path. It is measured in application wide measurement units set in **Excentro Preferences** dialog.
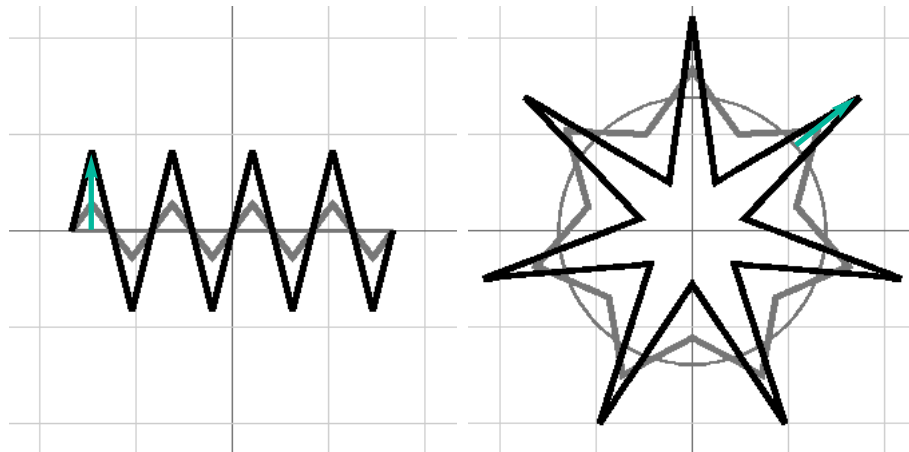
*Star paths with **Amplitude** set to '10 pt' (gray) and '30 pt' (black)*

■ **Base Offset** and **Directional Offset** attributes allow you to modify distance from base path to star points of **Star** element. If these attributes are not modified, star points are set at distance specified by **Amplitude** attribute at orthogonal direction to base path ('at right angle to tangent line to base path', if word 'orthogonal' is confusing for you). **Base Offset** attribute adds its value to this distance in same orthogonal direction, **Directional Offset** attribute value modifies star point in tangent direction to base path.
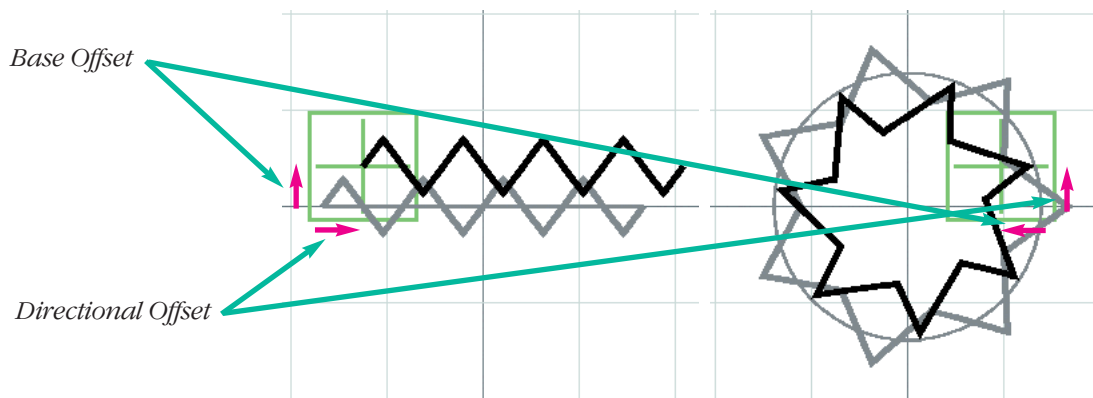
Base Offset and Directional Offset attributes set to '0 pt' (gray) and '15 pt' (black)

Base Offset attribute is very often modified during guilloche creation process. Pictures below illustrate examples of path variations you can get this way. **Directional Offset** value usually is not changed from its initial '0 pt'.
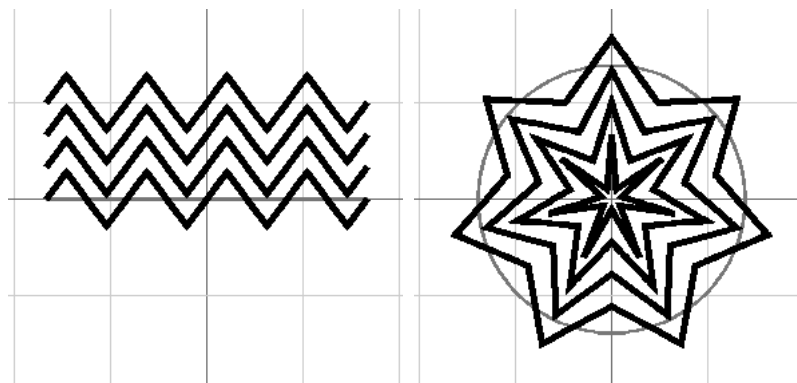
■ Similar to **Base Offset** and **Directional Offset** attributes that modify distance from base path to star points, **Directional Angle** attribute changes angle at that star points are set. Initially these points are set at orthogonal direction to base path (unless path of another element is set as **direction** for **Star** element). **Directional Angle** attribute allows you to modify this angle by specifying value in this field, after that this value will be added to orthogonal (*90°*) angle to calculate new position of star points. Expressed in degrees "*°*". This attribute is not usually modified from initial '*0°*' value.
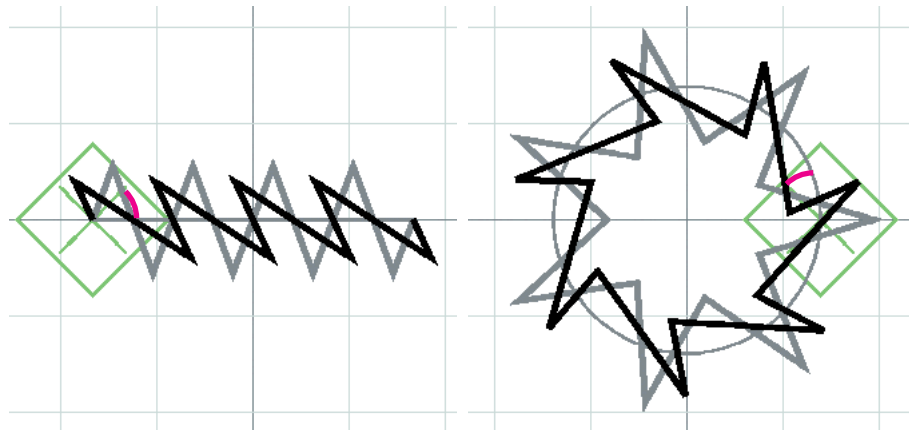
Directional Angle attribute set to '0° (gray) and '45° (black)

CHAPTER 9: NOTCH

In terms of *Excentro* mechanical model, paths of **Notch** element are created by stationary pencil that takes at given time one of two possible fixed positions on sheet while sheet travels on tabletop along base path. At regular intervals defined by value of **Frequency** attribute pencil jumps from one of these fixed position to another. These 'breakpoints' are connected by straight lines. In result you get segmented path that follows base path at fixed offset distance (set by **Amplitude** attribute) with each path segment located on either side of base path connected to each other by straight line segments.
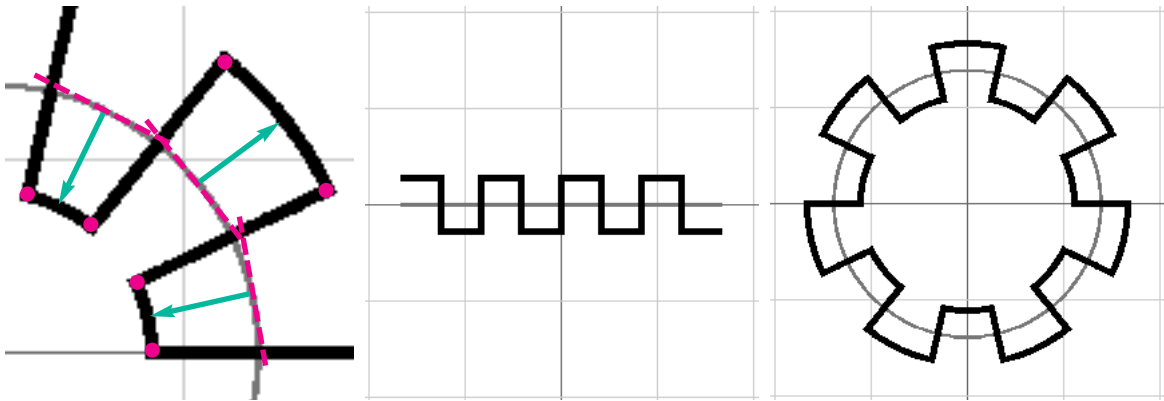
Notch element: segments and points; results of linear and circular basic curves modifications

Because of its segmented shape, paths of **Notch** elements are rarely used inside guilloche geometry. Typical usage for **Notch** elements includes external borders of design, concentric central pieces and linear backgrounds. Paths of **Notch** elements are shown with color on example below.
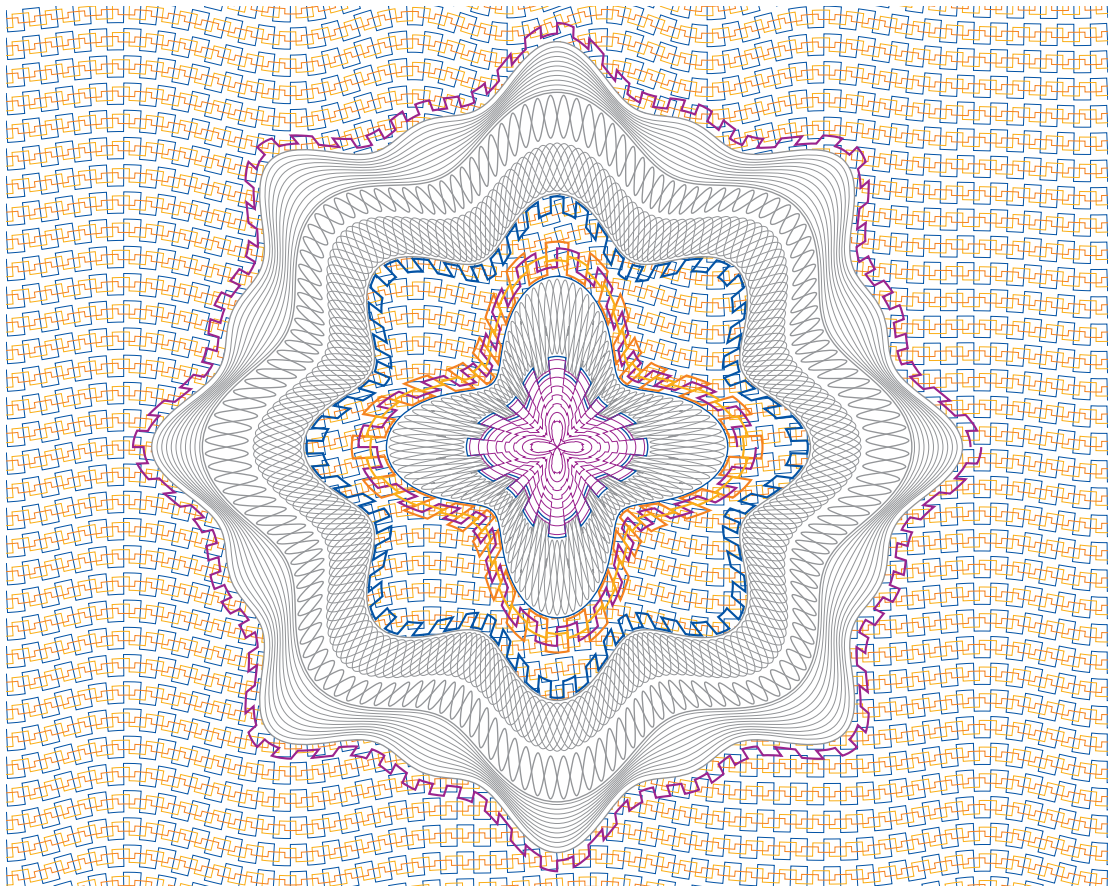
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has six attribute fields for elements of **Notch** type:
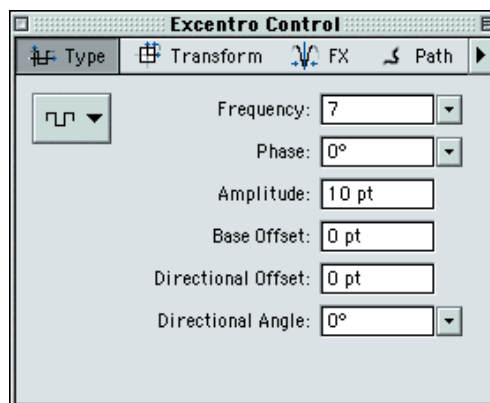
■ **Frequency** defines number of segments path of **Notch** element consists of. These segments divide base path in equal intervals. To make shape of **Notch** element more interesting you should set this value to '*3*' or higher.
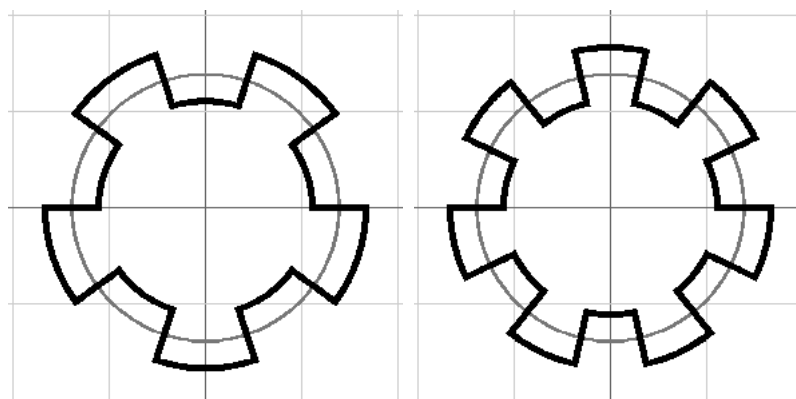
*Notch paths with **Frequency** set to '5' and '7'*

■ **Phase** attribute controls position of path segments. This value is expressed in degrees '°' from [−180°; 180°] interval.
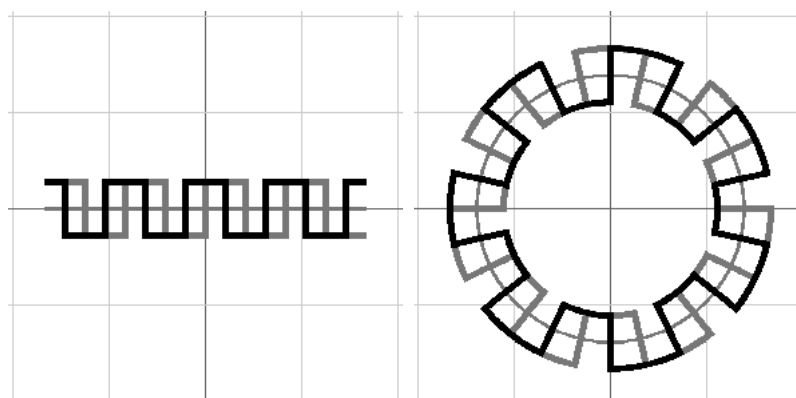
*'90°' modification of **Phase** attribute*

■ **Amplitude** attribute defines distance from points of **Notch** path to base path. It is measured in application wide measurement units set in **Excentro Preferences** dialog.
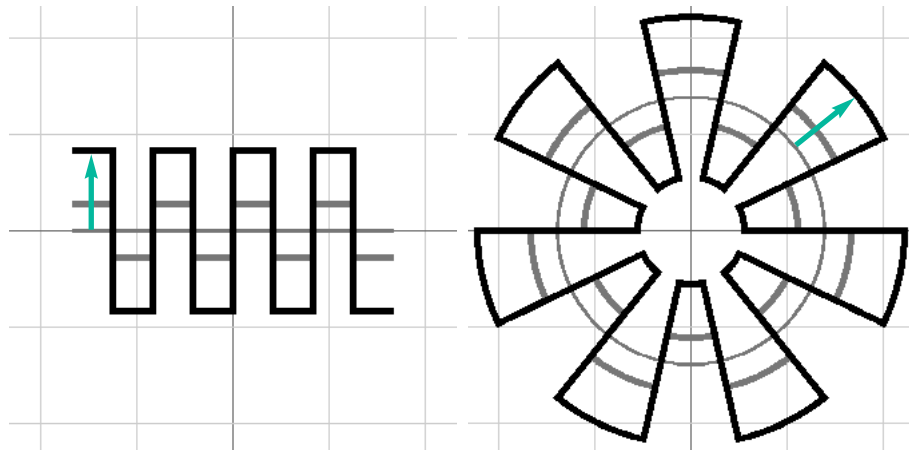
*Notch paths with **Amplitude** set to '10 pt' (gray) and '30 pt' (black)*

■ **Base Offset** and **Directional Offset** attributes allow you to modify distance from base path to segments of **Notch** path. If these attributes are not modified, the segments are set at distance specified by **Amplitude** attribute at orthogonal direction to base path ('at right angle to tangent line to base path'). **Base Offset** attribute adds its value to this distance in same orthogonal direction, **Directional Offset** attribute value modifies notch segments offset in tangent direction to base path.
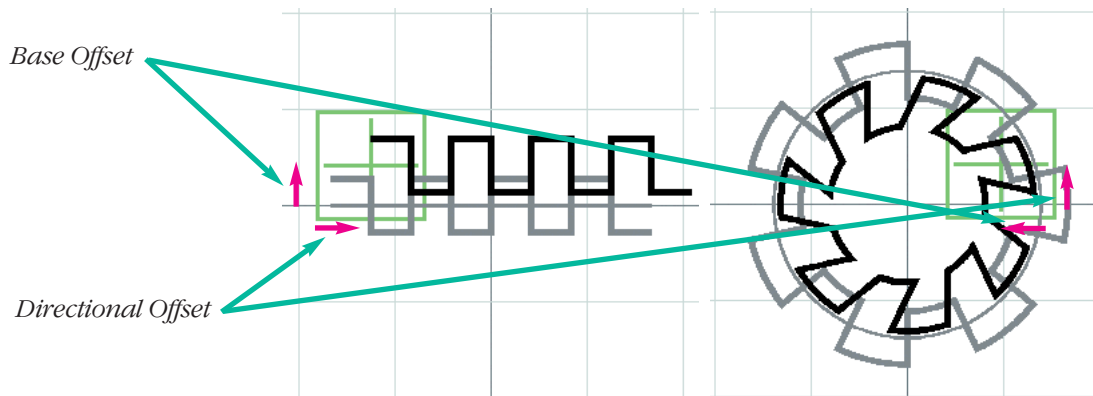
Base Offset

Directional Offset

*Base Offset and **Directional Offset** attributes set to '0 pt' (gray) and '15 pt' (black)*

Base Offset attribute is often modified during guilloche creation process. Pictures below illustrate examples of path variations you can get this way. **Directional Offset** value usually is not changed from its initial '0 pt'.
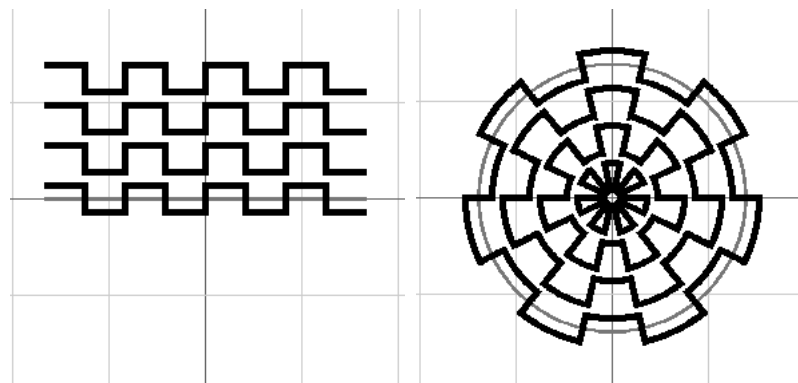
■ Similar to **Base Offset** and **Directional Offset** attributes that modify distance from base path to notch segments, **Directional Angle** attribute changes angle at that points of path segments are set. Initially these points are set at orthogonal direction to base path (unless path of another element is set as **direction** for **Notch** element). **Directional Angle** attribute allows you to modify this angle by specifying value in this field, after that this value will be added to orthogonal (*90˚*) angle to calculate new points positions. Expressed in degrees "˚". This attribute is not usually modified from initial '*0˚*' value.
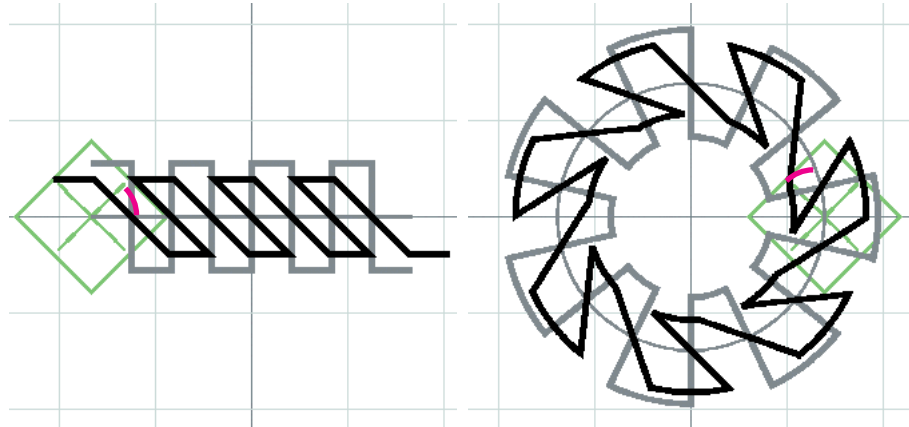
Directional Angle attribute set to '0˚' (gray) and '45˚' (black)

CHAPTER 10: OFFSET

Offset element allows you to create paths set at specified distance from its base path (path of its parent element). This kind of elements is usually used to create borders around specific parts of guilloche designs. If you consider *Excentro* mechanical model, paths of **Offset** element are created by moving sheet along base path on tabletop while pencil position is fixed on sheet. Pictures below illustrate examples of **Offset** element paths for different types of parent element.
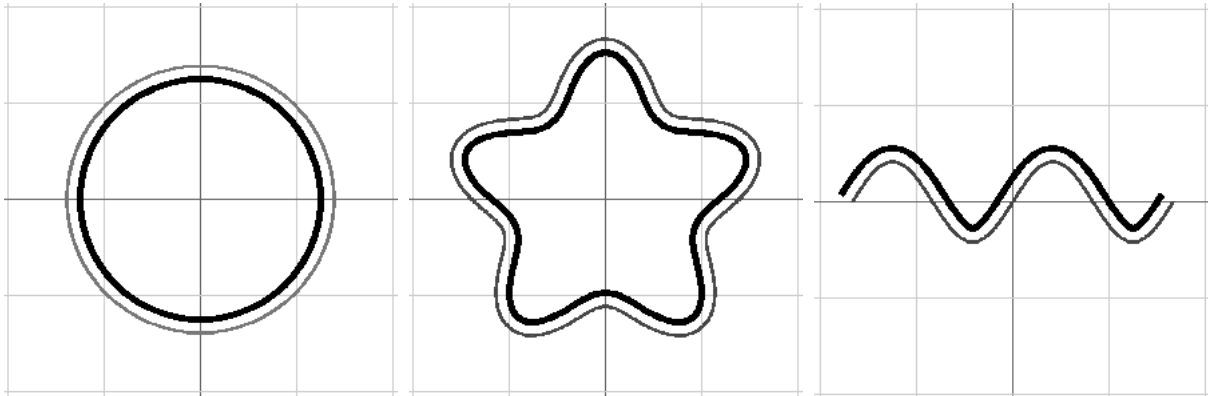
*Offset element (black): modifications for **Ellipse** base, circular and linear **Sine Wave** paths (gray)*

TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has only two attribute fields for elements of **Offset** type:
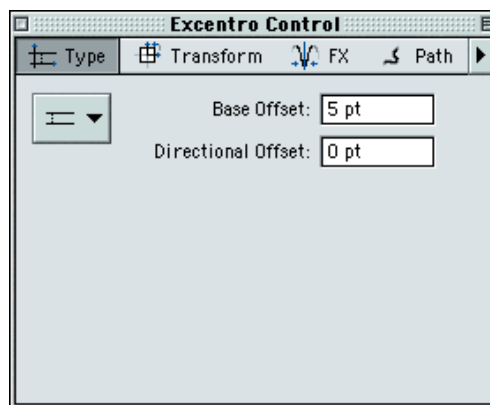
■ **Base Offset** and **Directional Offset** attributes allows you to modify distance from base path to path of **Offset** element. **Base Offset** attribute sets distance in orthogonal direction to base path ('at right angle to tangent line to base path'). **Directional Offset** attribute sets distance in tangent direction to base path. If other element is set as **Direction** element for **Offset** element, orthogonal and tangent offset directions are calculated for path of this element instead. These values are measured in application wide measurement units selected in **Excentro Preferences** dialog.

Base Offset

Directional Offset
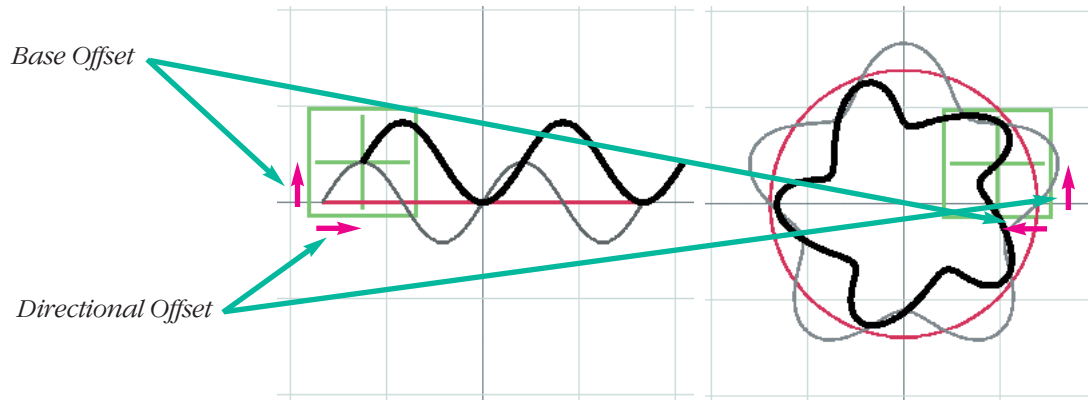
Base Offset *and* **Directional Offset** *attributes set to '15 pt'.*
(Basic paths of elements shown with magenta are set as **Direction** *for black paths of*
Offset *elements to make pictures easier to follow)*

Base Offset attribute is modified more often than **Directional Offset** attribute during guilloche creation process. Pictures below illustrate examples of path variations you can get by modifying **Base Offset** attribute.
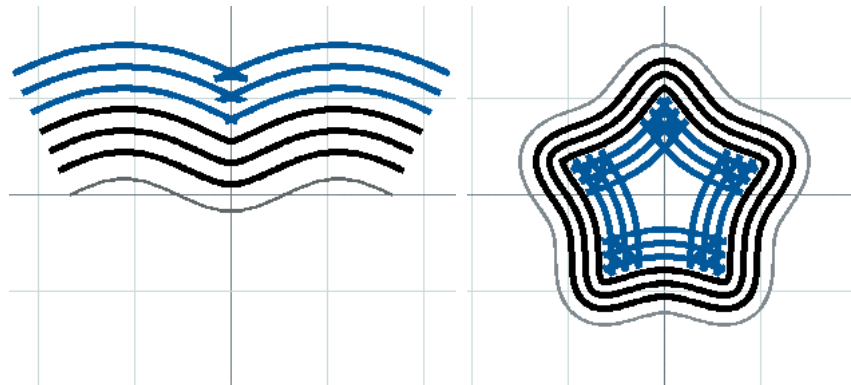
When values of **Base Offset** attribute and **Directional Offset** attribute exceed certain limit depending on shape of base paths you can notice areas of self-intersections in paths of **Offset** elements (paths with intersections are shown with blue on pictures above). To avoid these effects you can appoint another path as **Direction** for paths of **Offset** elements, like shown on following pictures where **Line** and **Ellipse** basic paths (shown with magenta) are used as **Direction** elements and blue paths no longer intersect themselves. Also keep in mind that in this case in some areas of the path actual distance from base path to path of **Offset** element will be different from **Base Offset** attribute value
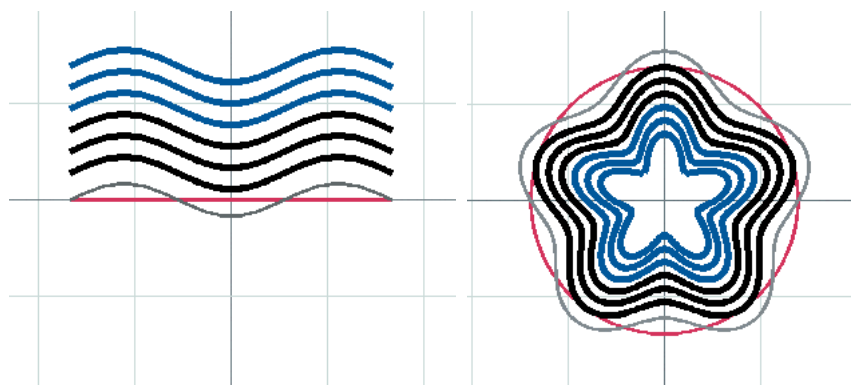
CHAPTER 11: POLYGON

Polygon is another special kind of element that does not use *Excentro* mechanical model with pencil-sheet-tabletop movement for paths creation. Path of **Polygon** element consists of line segments that join points set at equal intervals along base path (path of parent element). Number of points and their positions are controlled by **Frequency** and **Phase** attributes of **Polygon** element.
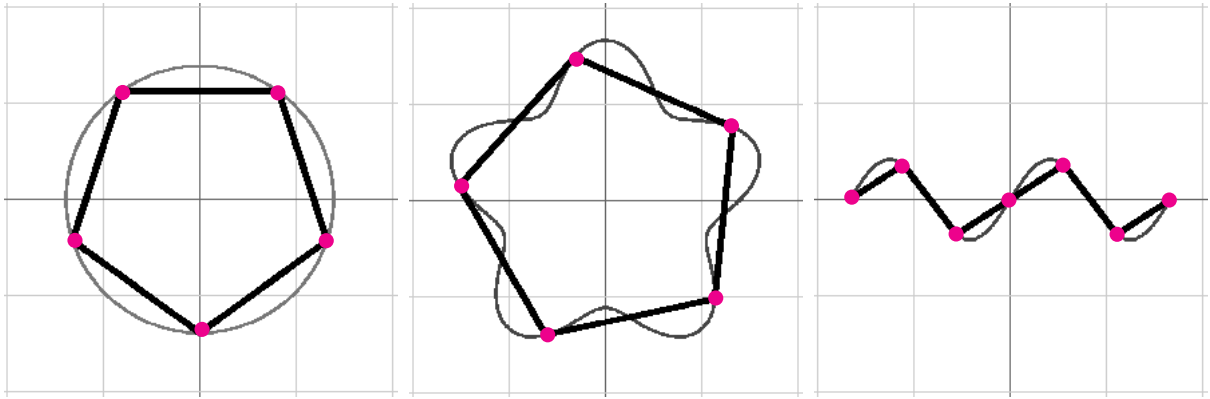
*Polygon element: modifications for **Ellipse** base, circular and linear **Sine Wave** paths*

Due to this paths creation specifics and lack of smoothness in points where line segments join, **Polygon** elements are not often used inside guilloche geometry. Typical usage for **Polygon** elements includes special star-like shapes for concentric central pieces and linear backgrounds. Paths of **Polygon** elements are shown with color on example below.
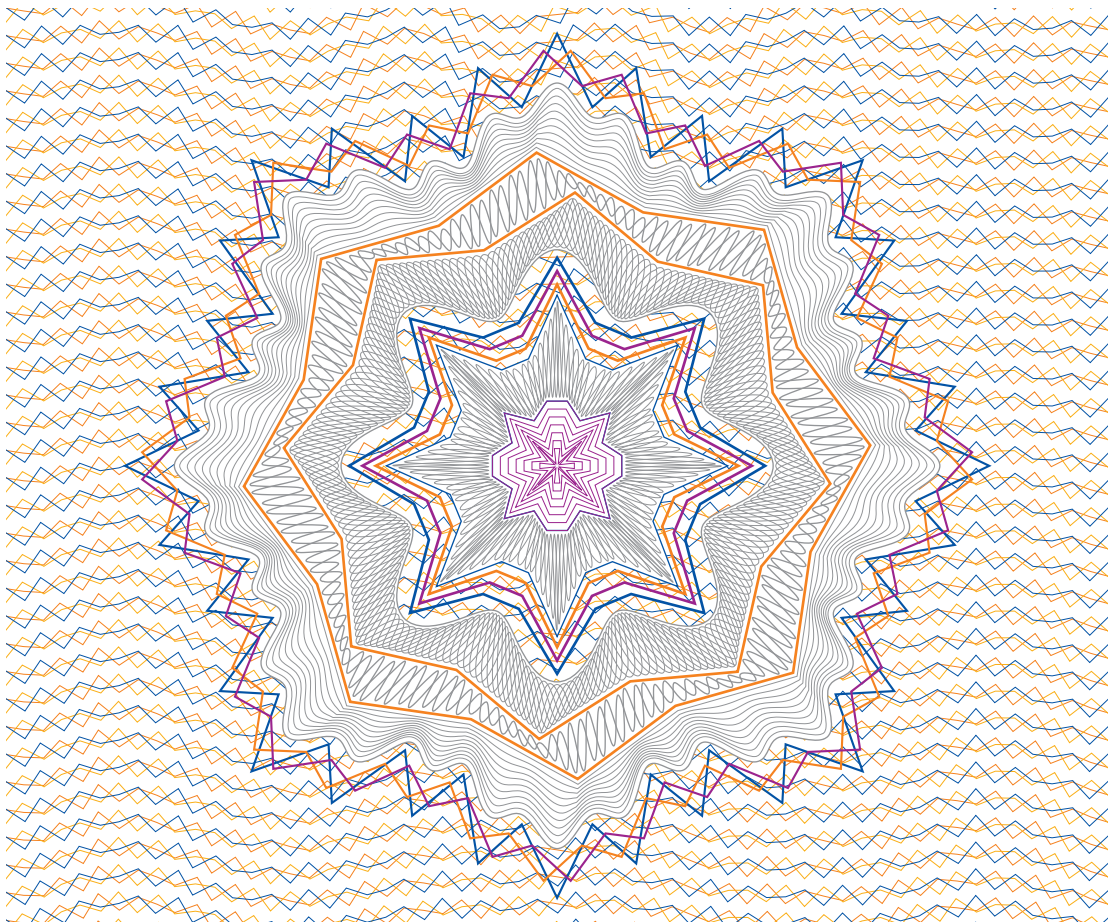
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has four attribute fields for elements of **Polygon** type:
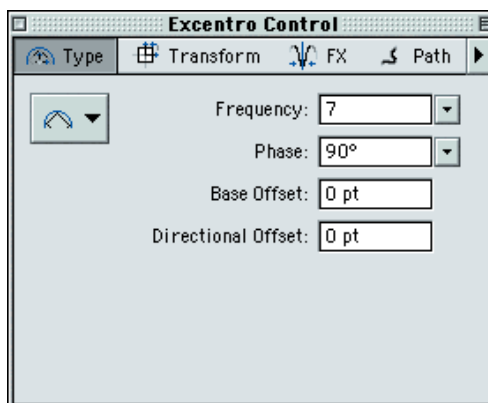
■ **Frequency** defines number of line segments path of **Polygon** element consists of. Endpoints of these segments are placed at equal intervals along path of base element. To make shape of **Polygon** element to look like real polygon (not dot or line) you should set this value to '*3*' or higher.
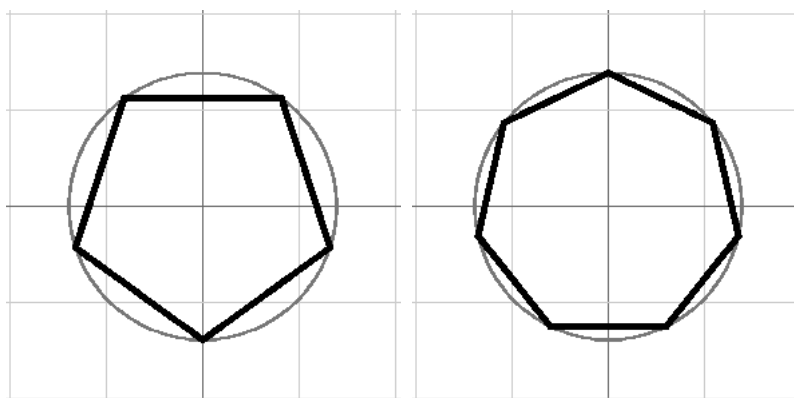
*Polygon paths with **Frequency** set to '5' and '7'*

■ **Phase** attribute controls position of endpoints of polygon segments. This value is expressed in degrees '°' from [−180°; 180°] interval.
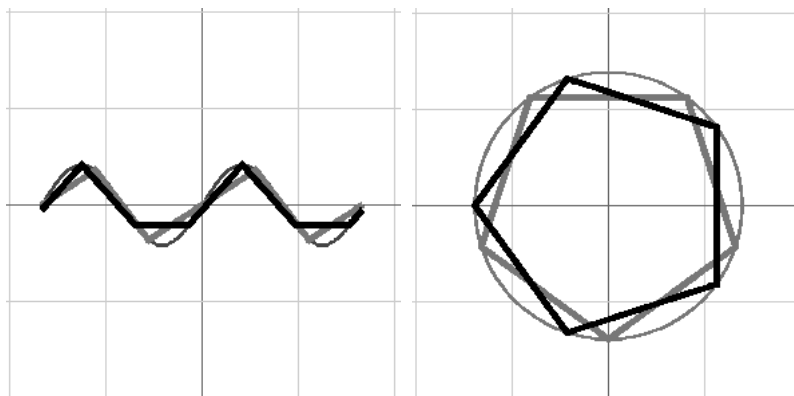
*'90°' modification of **Phase** attribute*

■ **Base Offset** and **Directional Offset** attributes allows you to modify distance from base path to endpoints of **Polygon** line segments. If these attributes are not modified, endpoints are set directly on base path. **Base Offset** attribute offset endpoint in orthogonal direction to base path ('at right angle to tangent line to base path'). **Directional Offset** attribute offset endpoint in tangent direction to base path. If other element is set as **Direction** element for **Polygon**, orthogonal and tangent offset directions are calculated for path of this element instead. These values are measured in application wide measurement units selected in **Excentro Preferences** dialog.
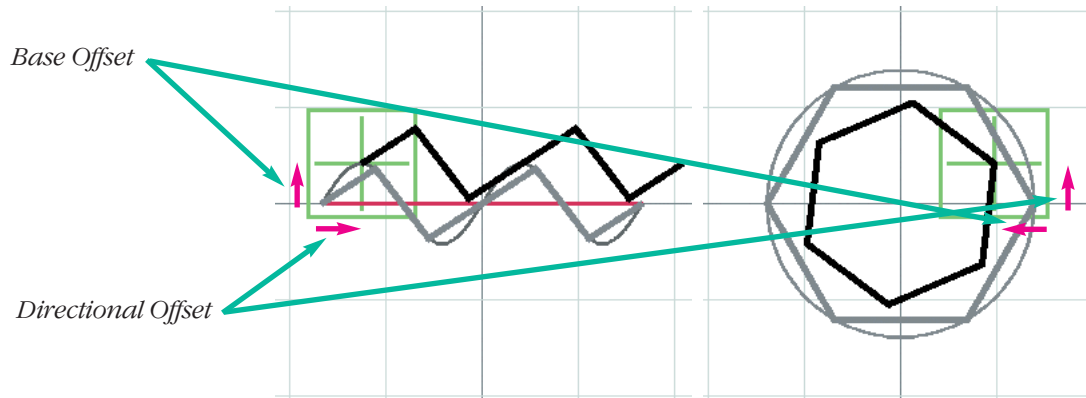
Base Offset and *Directional Offset* attributes set to '0 pt' (gray) and '15 pt' (black). *Polygon* element on linear example picture (left) has *Line* basic path set as *Direction*.

Base Offset attribute is modified more often than **Directional Offset** attribute during guilloche creation process. Pictures below illustrate examples of path variations you can get by modifying **Base Offset** attribute. **Polygon** element on linear example picture (left) has **Line** basic path set as its **Direction** element.
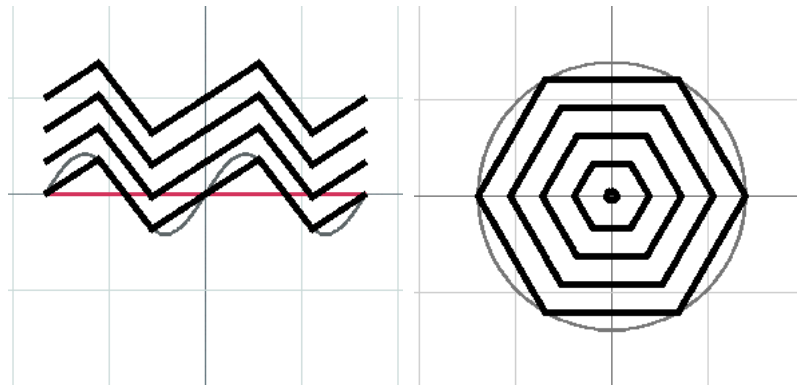
PART III: CONTENT ELEMENTS

CHAPTER 1: INTRODUCTION

This part of **Excentro Objects Reference** contains detailed description of *Excentro* application content elements. Paths of elements that belong to this class fill space between paths of two other existing elements. These two elements are called '*first base element*' and '*second base element*' of the content element, they could be of any elements class: base elements, regular elements or other content elements. Considered from *Excentro* mechanical model point of view, paths of content elements are created by pencil moving between two base paths. They also could be regarded as paths of regular elements that use as its base path middle line between two base paths of content elements and have variable **Amplitude** attribute defined by distance between these paths.

Rectangular representations of content elements in main document window have two black connection lines that connect them to two base elements. First base element serves as parent element of content element in guilloche tree. Content elements are used as vector texture that adds flesh to bones of guilloche design defined by regular elements.
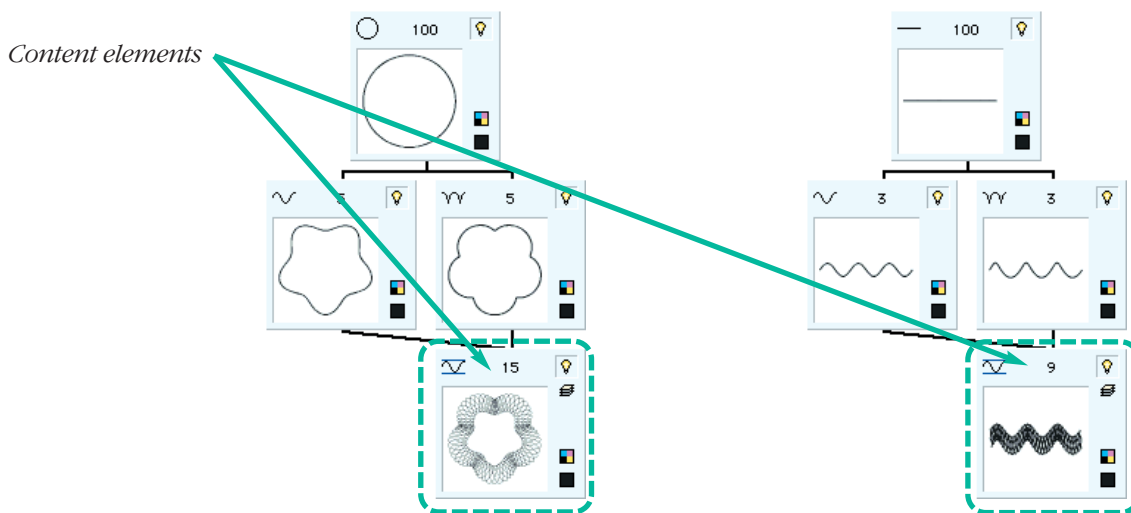
Content elements

TYPES OF CONTENT ELEMENTS

There are nine types of content elements in *Excentro* application. Illustrations on next page show examples of content elements representations in main document window. These elements use paths that belong to two regular elements of **Sine Wave** and **Cycloid** types as their base paths. Example of this structure tree is shown on following picture:
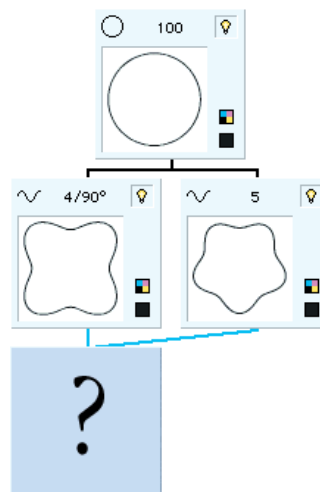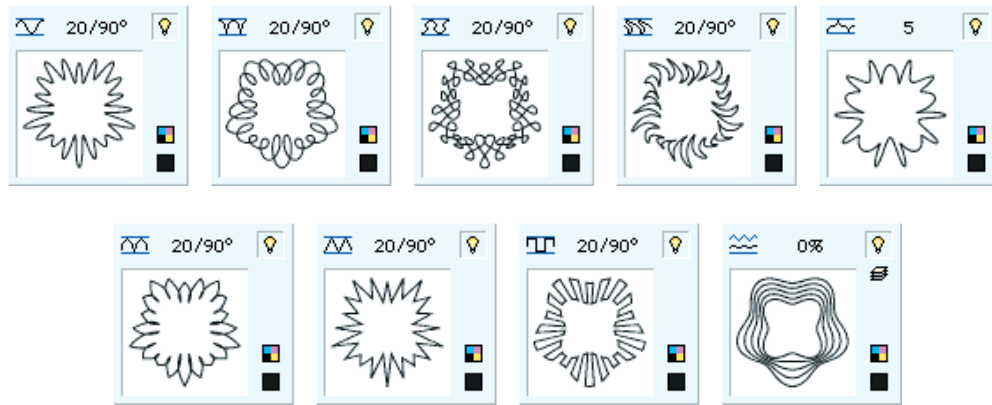
- **Sine Wave** (*Chapter 2*) is the most popular type of content elements. It also is the simplest one: pencil in **Sine Wave** content element case moves up and down between paths of its base elements in orthogonal direction to middle line between these paths.

- **Cycloid** (*Chapter 3*) content element has additional 'side size' modification added to up and down movement similar to that of **Sine Wave**. In result you get area between base paths filled by path can have coil-like self-intersections.

- **Eight** (*Chapter 4*) content element is similar to **Cycloid**, but 'side size' modification has double frequency comparing to that of up and down movement. So, resulting path can have twists and self-intersections remaining that of number eight figure ('8').

- **Saw** (*Chapter 5*) content element is similar to **Eight**, but 'side size' modification has different phase shift. So, in result you get path that can have teeth-like self-intersections.

- **Brace** (*Chapter 6*) content element has even more complex 'side size' modification that result in brace-like twists and self-intersections.

- **Spade** (*Chapter 7*) content element is similar to **Cycloid**, but up and down movement uses linear function instead of smooth sine. Resulting path in this case more looks like flower petals.

- **Star** (*Chapter 8*). Path of **Star** content element is created by connecting points set alternatively on paths of its two base elements with straight line segments. As result you get star-like or saw-like shape between base paths.

- **Notch** (*Chapter 9*). In **Notch** case path content element consists of segments of paths of its base elements connected with straight line segments.

- **Blend** (*Chapter 10*) content element represents effect of merging two paths of its base elements one into another. Illustration above shows Step & Repeat Set added to **Blend** content element.

Examples of guilloche designs that use element all these types are provided in chapters of this part of **Excentro Objects Reference** book. Numbers of chapters that cover specific element types are shown beside names of these types in the list above.

In next sections of this introduction we will discuss matters of content elements creation, deletion and modification of their positions in structure tree.

CREATING ELEMENTS

To create new content element you should select two existing elements in *Excentro* document (these could any kind of elements: base element, regular element or content element). First element should be selected with unmodified mouse click on its rectangular representation in structure tree, second element — with **Shift** modifier key pressed down on keyboard. When the elements are selected use **New Element** command from **Structure** menu or its shortcut button in **Structure** section of **Toolbar**:
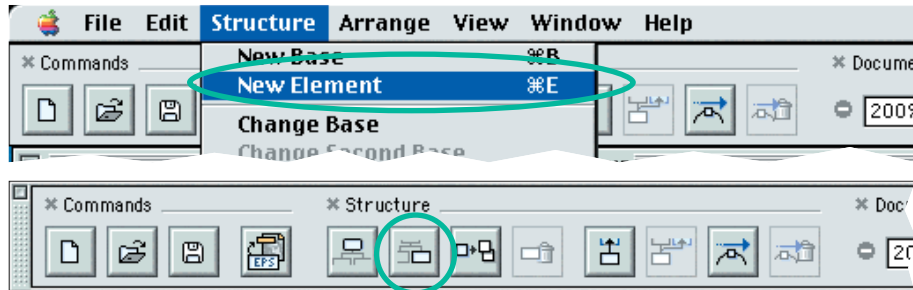
After **New Element** command was chosen new content element that use first selected element as its parent element in guilloche tree will be created and its rectangle representation will appear in main document window:
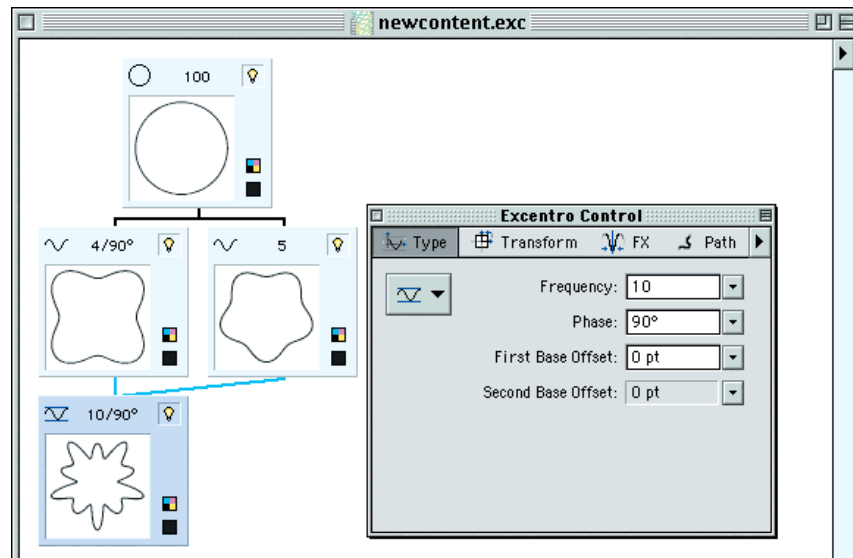
By default new content element is of **Sine Wave** type with **Frequency** attribute set to '*1*'. You can use fields in **Type** panel of **Excentro Control** inspector to modify **Sine Wave** attributes or select different element type from **Type** pop-up menu:
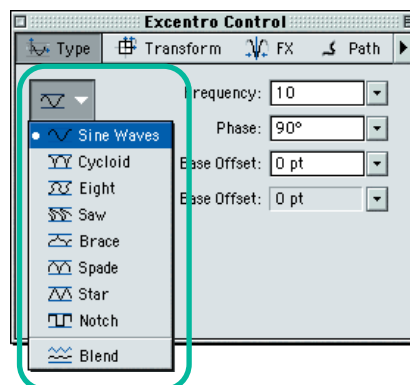
Path of content element and number of attribute fields change according to **Type** pop-up menu selection.

DUPLICATING ELEMENTS

You can also create new content elements by making copies of existing ones. You can do this in two different ways:

■ With **Duplicate Element** command from **Structure** menu.

■ With **Copy-Paste** or **Cut-Paste** commands sequence from **Edit** menu.

1. To duplicate existing content element with **Duplicate Element** command **(Cmd-D)** you should select the element you want to duplicate with mouse click on its rectangular representation in main document window and choose **Duplicate Element** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.

An exact copy of selected element will be created:

If you will press **Shift** key on keyboard, **Duplicate Element** command in **Structure** menu will change its title to **Duplicate All Elements (Cmd-Shift-D)** and choosing it will duplicate not only selected element but all child elements this element has (and all child elements of these child elements too, etc.).This way you can make a copy of whole set of elements on one branch of tree structure with single command. All connections between child elements will be preserved in a new copy of the elements set.

2. To create a copy of existing element with **Copy-Paste** or **Cut-Paste** commands sequence you should select the element you want to make a copy of with mouse click on its rectangular representation in main document window and choose **Copy (Cmd-C)** or **Cut (Cmd-X)** commands from **Edit** menu to place an object to *Excentro* Clipboard buffer (**Cut** command will delete element from document, **Copy** command will not).
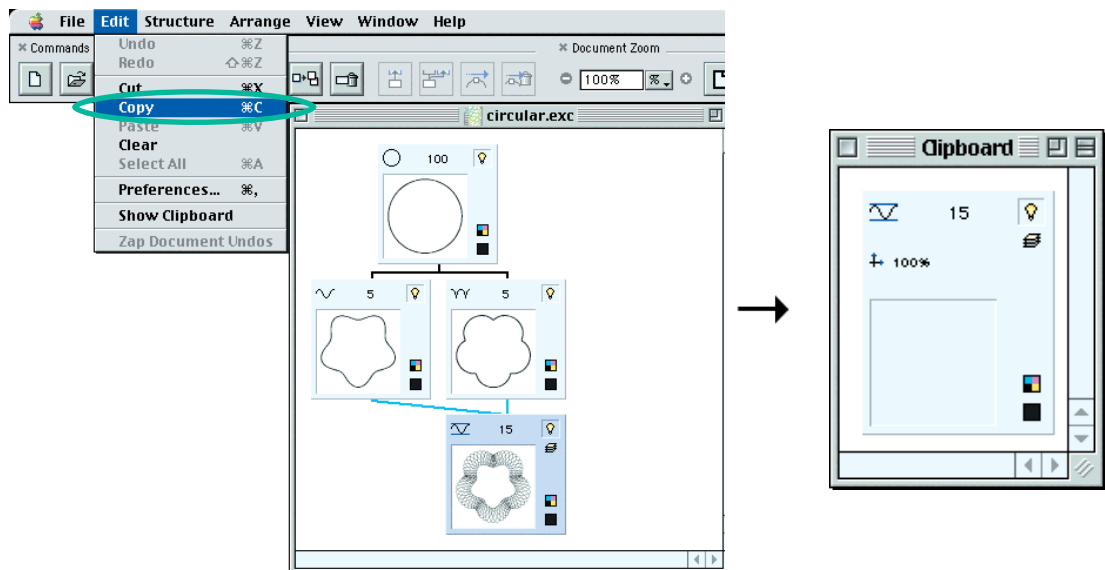
After that you should select with mouse clicks in main document window two elements you want to become base objects of new content element. First element should be selected with unmodified mouse click on its rectangular representation, second element — with **Shift** modifier key pressed down on keyboard. After that and choose **Paste (Cmd-V)** command from **Edit** menu and new copy of the object in Clipboard will be created. First selected element will become parent object of new element in guilloche tree, second selected element will become second base of new object.

DELETING ELEMENTS

You can delete existing elements in two different ways:

■ With **Delete Element** command from **Structure** menu.

■ With **Cut** or **Clear** commands from **Edit** menu.

1. To delete element with **Delete Element** command you should select the element you want to delete with mouse click on its rectangular representation in main document window and choose **Delete Element** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**.


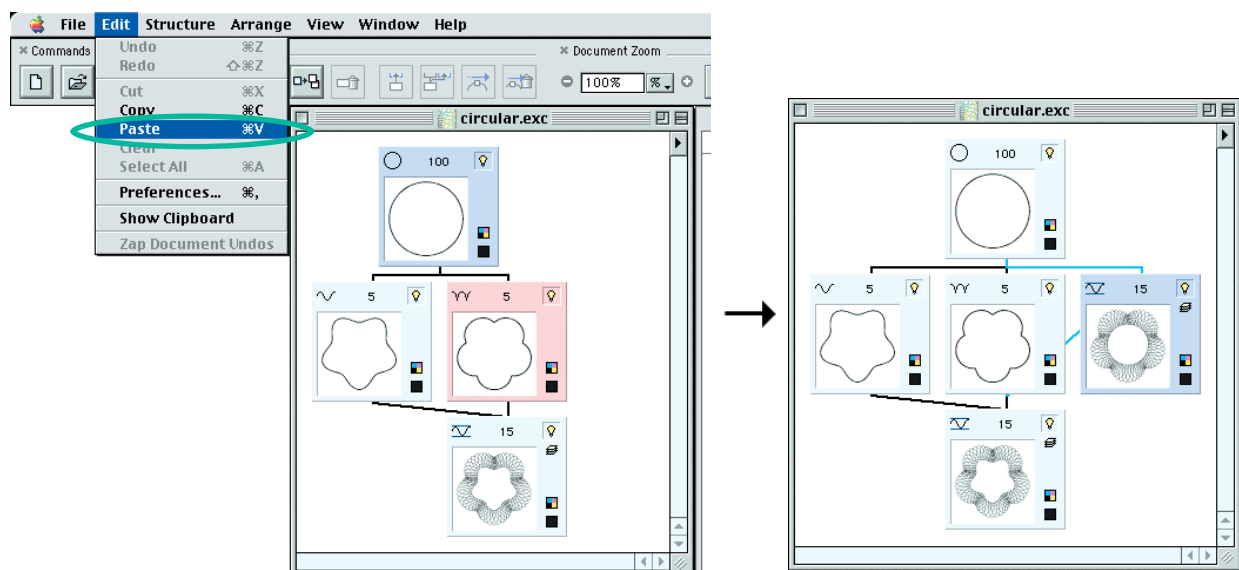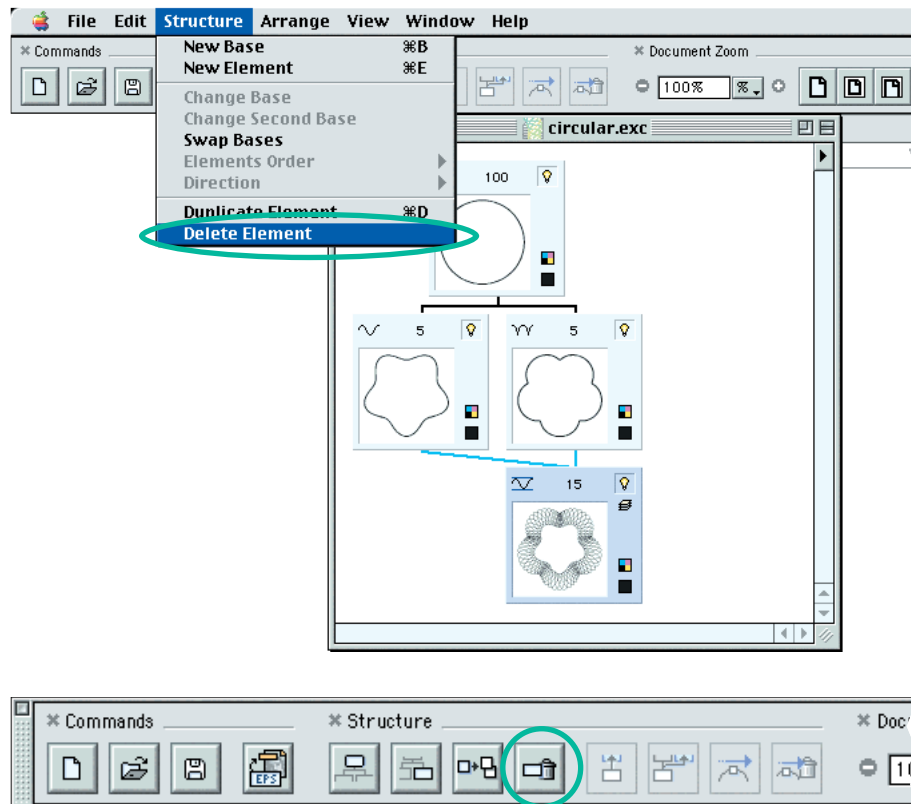If the element does not have child elements or connection lines to other elements of guilloche tree structure it will be deleted. If the object does have child elements or other connections to elements of guilloche tree, you can not delete it with **Delete Element** command. This command will be disabled in **Structure** menu.

To delete content element that has child elements you can use **Delete All Elements** command. To use this command press **Shift** modifier key and **Delete Element** command in **Structure** menu will change its title to **Delete All Elements**. Choosing **Delete All Elements** command will delete not only selected element but all child elements this element has (and all child elements of these child elements, etc.). The content element or its child elements should not have connections to objects in other parts of guilloche structure, otherwise this command will be disabled.

2. Cut (Cmd-X) and **Clear** commands from **Edit** menu are identical in effect to **Delete Element** command. They are provided to make *Excentro* behavior resemble that of standard *Macintosh* applications.

Cut command will also place copy of deleted object on *Excentro* Clipboard buffer, so you can create this object again using **Paste** command.

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2. Changing first base. You can change first base element of the content element (the one that serves as parent object of the content element in structure tree) in two ways: either with **Change Base** command from **Structure** menu or with simple drag-and-drop action.

■ To change first base element with **Change Base** command you should select the content element you want to change first base of with mouse click on its rectangular representation in main document window, then press **Shift** modifier key on keyboard and click rectangular representation of the element you want to became its new first base element, after that you should choose **Change Base** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**. First base element of selected regular element will be changed and the element will be moved to different branch of guilloche structure:
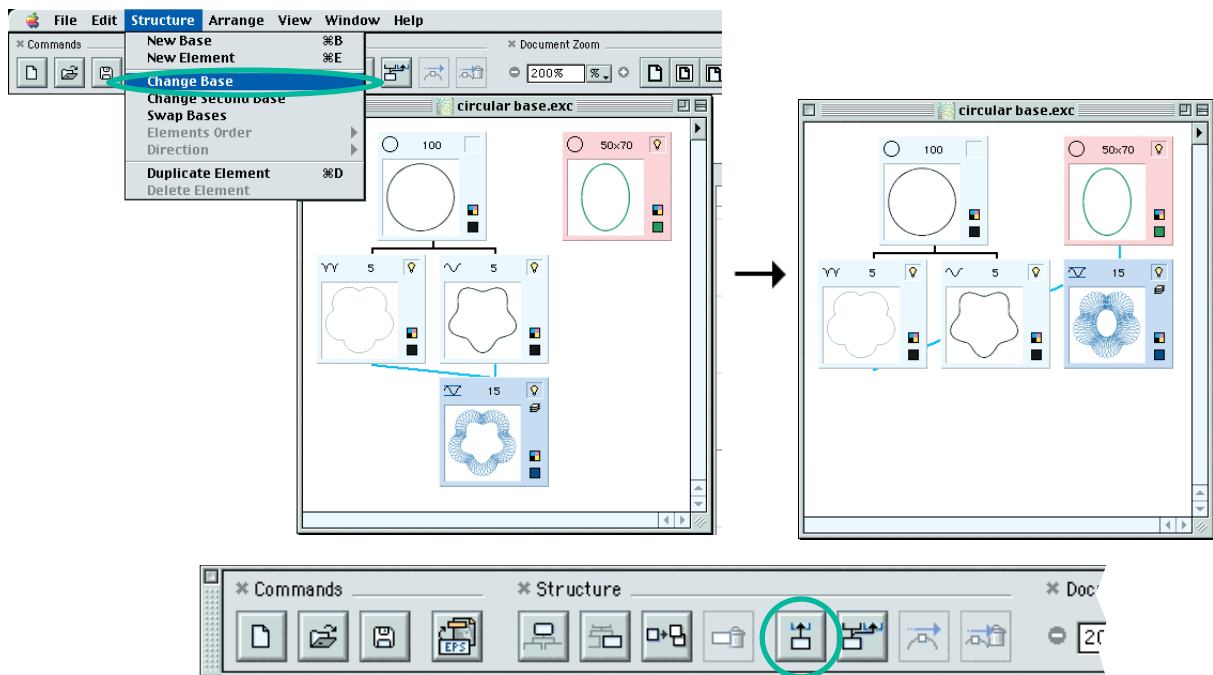
Guilloche design shape will change according to first base path modification. Illustration of shape changes for guilloche design with structure from example above is shown on following pictures:
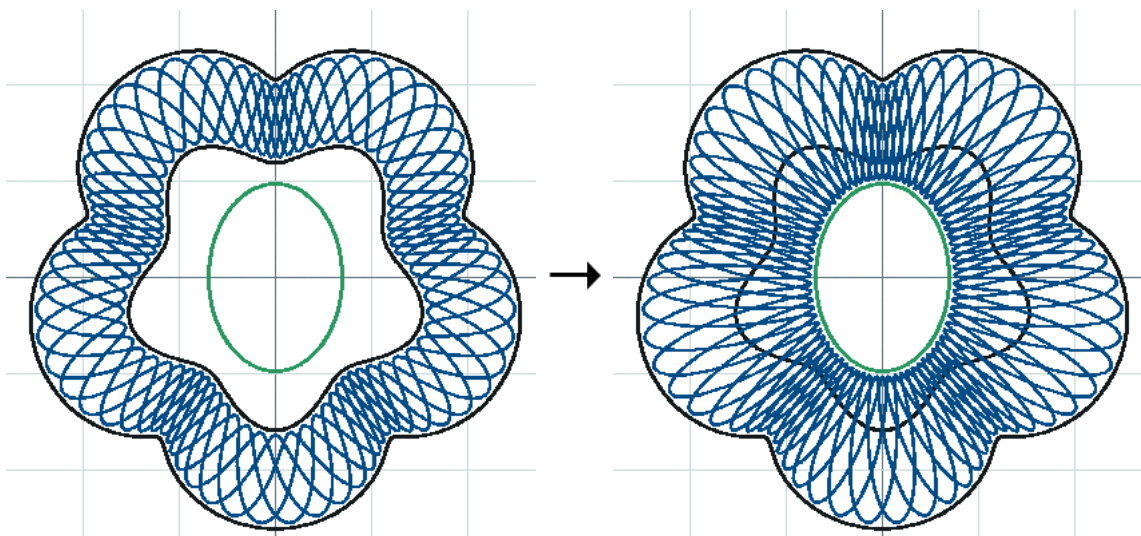
2. You can achieve same result (first base element change for selected content element) with simple drag-and-drop action. Select the regular element you want to change base of with mouse click on its rectangular representation in main document window and drag the element on rectangular representation of the element you want to became its new base element. Release mouse button and parent element of selected element, guilloche structure, shape of guilloche design will be changed accordingly.
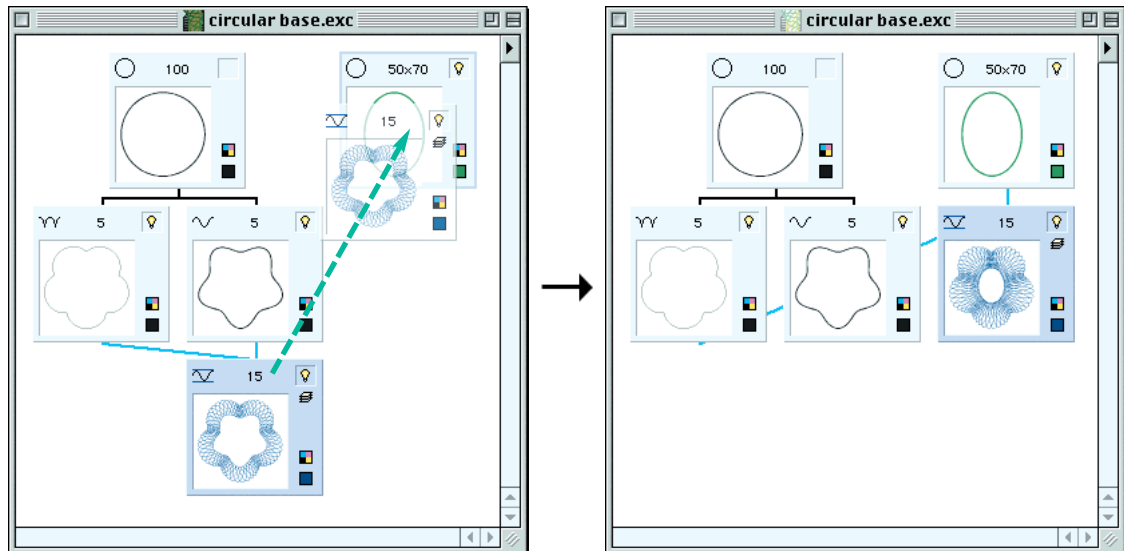
The element you want to become new first base of selected content element may not be dependent in any way on this content element. That is: this element or its parent elements or their direction elements may not have connection lines to selected element. **Change Base** command is active only in this case.

2. Changing second base. You can change second base element of the content element (the one that is connected with the content element by second black line) with **Change Second Base** command. Select the content element you want to change second base of with mouse click on its rectangular representation in main document window, then press **Shift** modifier key on keyboard and click rectangular representation of the element you want to became its new second base element, after that choose **Change Second Base** command from **Structure** menu or click its shortcut button in **Structure** section of **Toolbar**. Second base element of selected regular element will be changed and second black connection line will lead to this element:
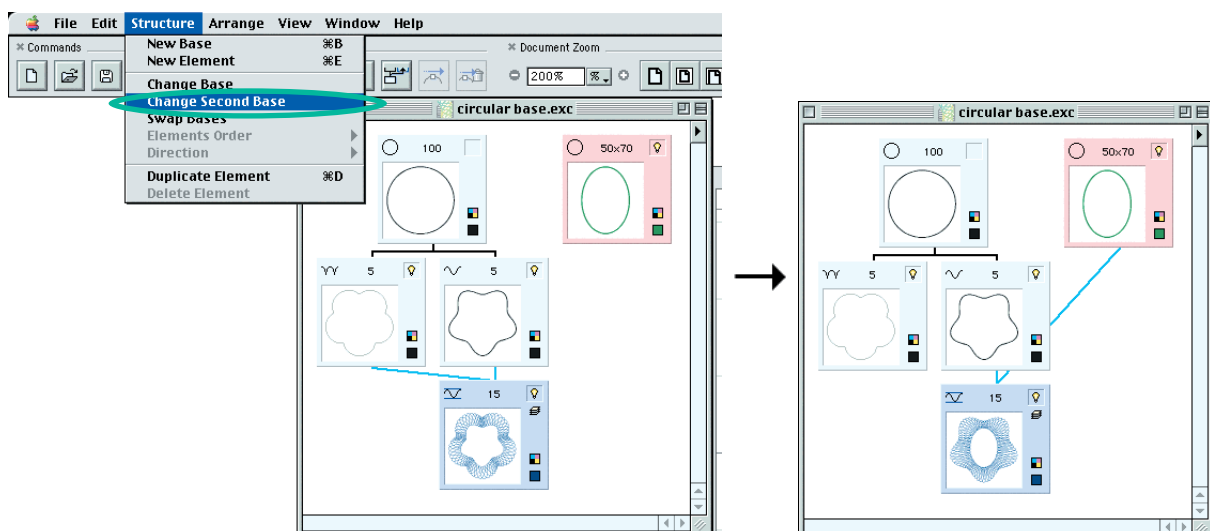
Guilloche design shape will change according to second base path modification. Illustration of shape changes for guilloche design with structure from example above is shown on following pictures:

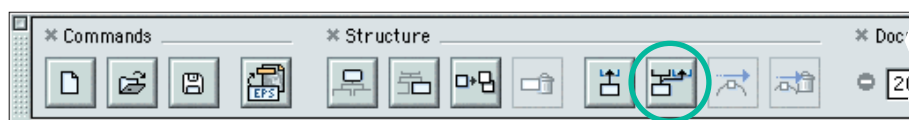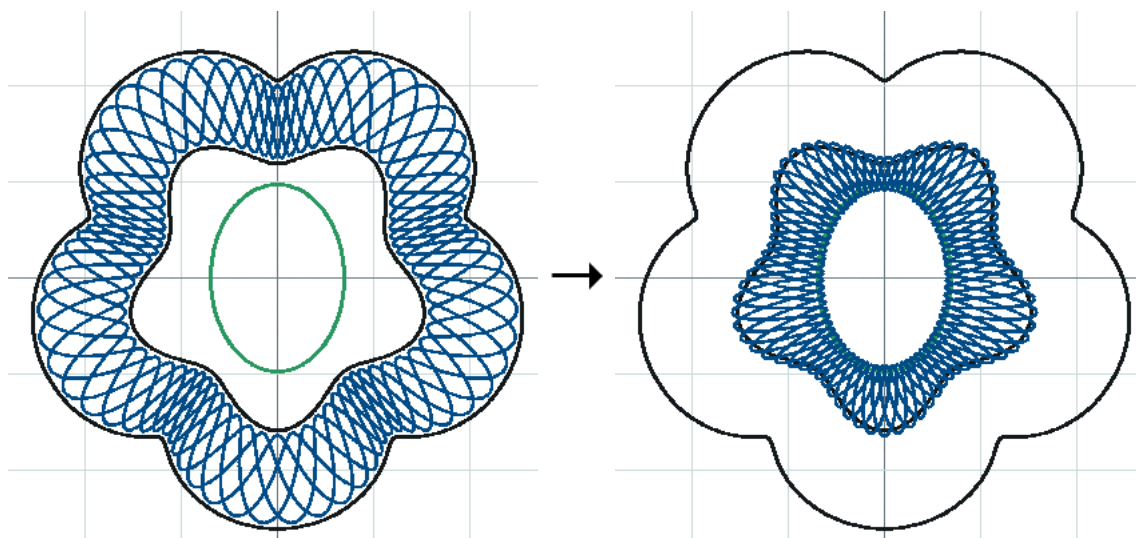The element you want to become new second base of selected content element may not be dependent in any way on this content element. This element or its parent elements or their direction elements may not have connection lines to selected element. **Change Second Base** command is active only in this case.

CHAPTER 2: SINE WAVE

Sine Wave is the most popular type of content elements you can see it almost on every security paper or certificate. It also is the simplest type of content elements: if you look at it from *Excentro* mechanical model view, pencil of **Sine Wave** content element case moves up and down between paths of its base elements in orthogonal direction (the direction that is at right angle to tangent line) to middle line between these paths.

Base paths
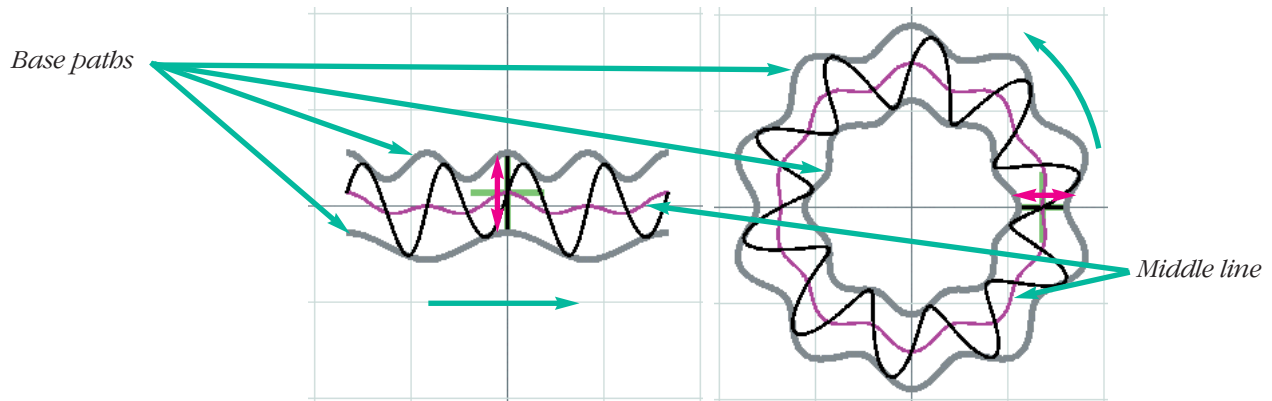
Middle line

***Sine Wave** content element: between linear and circular base paths*

You may regard **Sine Wave** content element as **Sine Wave** regular element which base path is middle line between paths of its base elements and **Amplitude** attribute at every point is defined by distance between these paths.

Example below shows typical applications of **Sine Wave** content elements with Step & Repeat Sets in guilloche designs. Paths of **Sine Wave** content elements are shown with color.
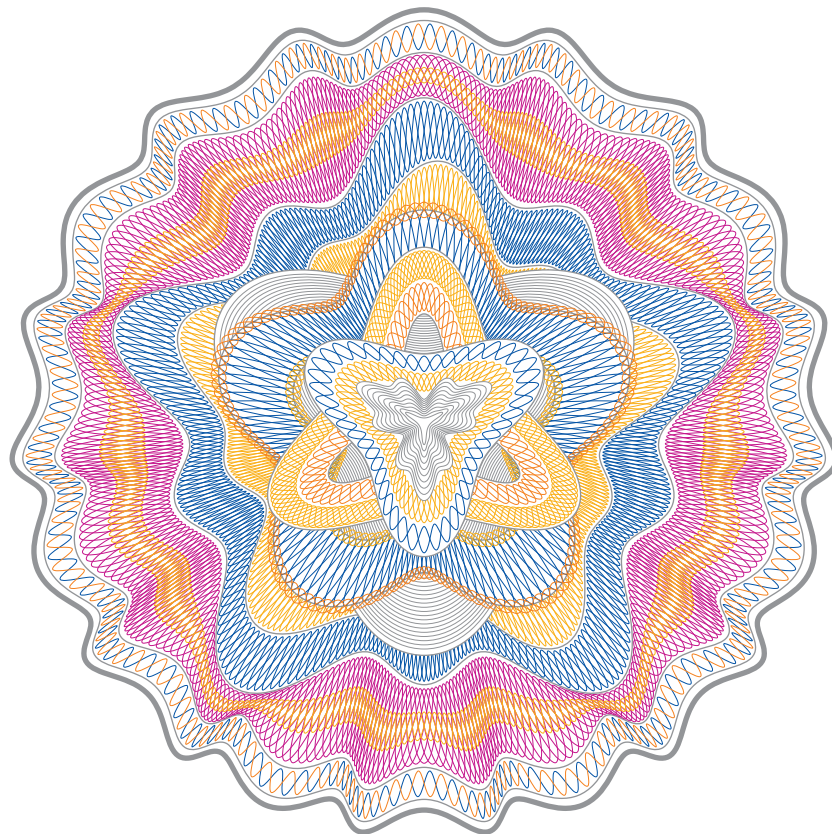
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has four attribute fields for content elements of **Sine Wave** type:
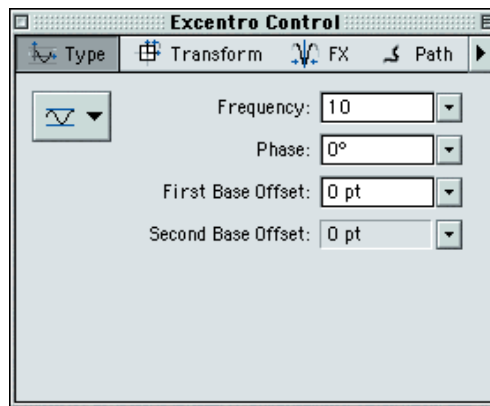
■ **Frequency** defines number of 'waves' path of **Sine Wave** element has. It is a number of times pencil moves up and down between base paths of content element. To make shape of content element more suitable for guilloche design you should set this value as high as highest **Frequency** attribute of its parent elements.

Sine Wave paths with Frequency set to '10' and '20'

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement between base paths. This value is expressed in degrees '°' from [−180°; 180°] interval. By creating Step & Repeat Set that covers whole [−180°; 180°] interval of **Phase** attribute you can create effect of filling space between base paths with uniform vector texture.

*'90°' modification of **Phase** attribute and 'texture' effect with Step & Repeat Set*

■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to points of content element path at maximum and minimum positions of periodic pencil movement. When **First Base Offset** and **Second Base Offset** attributes are set to '*0*' pencil and path of content element touches paths of base elements. There are three different choices for type of these attributes that could be selected from pop-up menu beside numeric value field:

◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on second picture. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.

*Base offset attributes with **Distance** option and values set to '1.5 pt' (left) and '3.5 pt' (right)*

◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units as well. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and could be used to avoid effects of path of content element intersecting itself.

*Base offset attributes: with **Distance With Base Direction** option and values set to '3.5 pt' (left); with **Percentage** option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one additional option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be edited directly from keyboard).

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to content elements of **Sine Wave** type: **Frequency Modulation** and **Symmetry** effects.

■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Sine Wave** element. With this effect you can create **Sine Wave** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Left to right: unmodified **Sine Wave** content element with **Frequency** attribute '15'; Step & Repeat Set of unmodified content elements; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect*

◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '*3*' in this field means that **Sine Wave** has 3 parts with higher frequency and 3 parts with lower frequency.

*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 1, **Phase =** 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 3, **Phase =** 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect.*

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '*0°*' means that center of first area with higher frequency corresponds to starting point of base paths, with values '*180°*' or '*−180°*' first area with higher frequency coincides with middle of base paths.

*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase =** 90°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase =** 45°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Sine Wave** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*15*', **Amount** value of '*6*' will make areas with lower frequency similar to that of **Sine Wave** path with **Frequency** '*9*' and areas with higher frequency to **Sine Wave** path with **Frequency** '*21*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

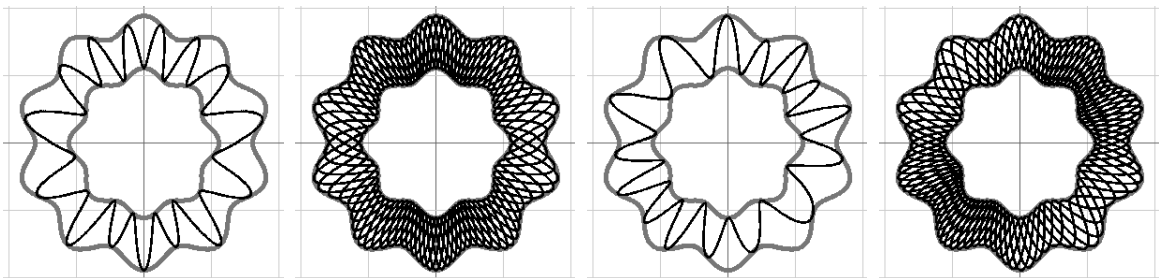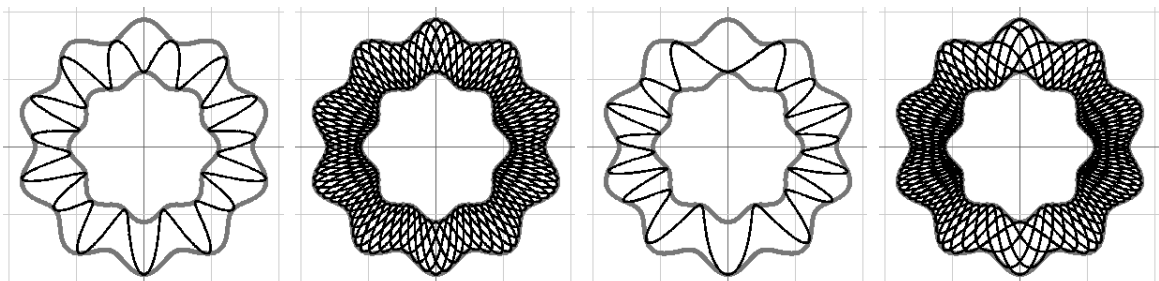*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase =** 0°, **Amount** = 4; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase =** 0°, **Amount** = 9; Step & Repeat Set with **Frequency Modulation** effect.*

■ **Symmetry** effect does not have the correct name for what exactly it is or does. This effect allows you to modify pencil movement so, that at certain points it suddenly stops and starts going in opposite direction. If base paths are smooth periodic shapes this effect results in symmetric pieces of **Sine Wave** reflected between them, like shown on pictures below.

*Left to right: unmodified **Sine Wave** content element, **Symmetry** effect with attributes **Phase =** 0°, **Fragments** =: 2, 4, 6.*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Sine Wave** path will consist of. For example, is you set this value to '*2*', the base paths will be divided into two parts and pencil movement while it moves along second half will be its own reflection on first half.

◆ **Phase** attribute controls the starting point of first symmetric piece. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '*0°*' means that first fragment starts at the beginning of base paths, values '*180°*' and '*−180°*' means that first fragment starts at the middle of base paths.

*Left to right: **Symmetry** effect with attributes **Fragments** = 2, **Phase =**: 0°, 90°, 180°, −90°.*

CHAPTER 3: CYCLOID

Path of **Cycloid** content element viewed from *Excentro* mechanical model side represents combination of two periodic pencil movements between paths of its base elements. In orthogonal direction to middle line between base paths (the direction that is at right angle to tangent line to middle line) pencil moves up and down just like in **Sine Wave** content element case. In tangent direction to middle line pencil movements are defined by another sine function with different phase and amplitude equal to **Side Size** attribute value. In result you get area between base paths filled by path that depending on attribute values and shape of base paths can have coil-like self-intersections. You may regard **Cycloid** content element as **Cycloid** regular element which base path is middle line between paths of its base elements and **Amplitude** attribute at every point is defined by distance between these paths.
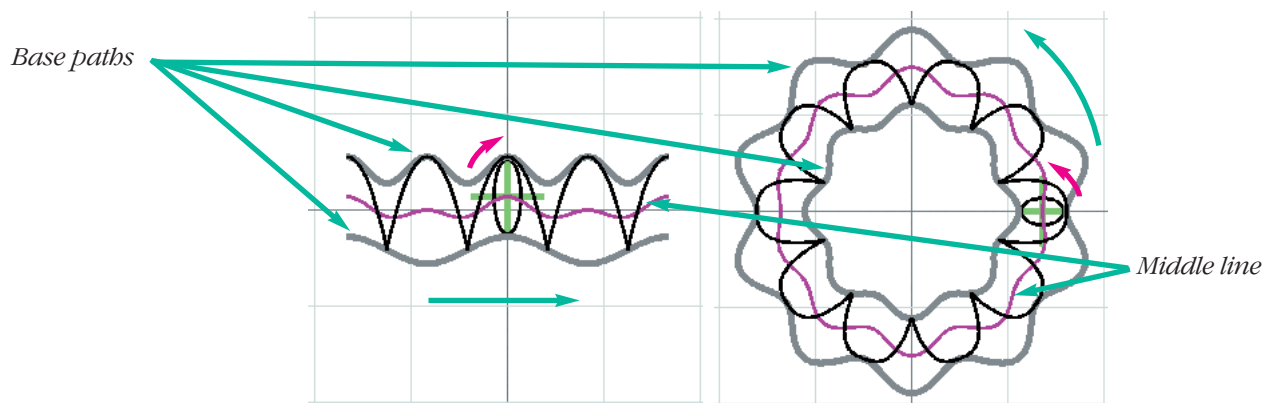
Cycloid content element: between linear and circular base paths

Paths of **Cycloid** content elements are shown with color on example below.
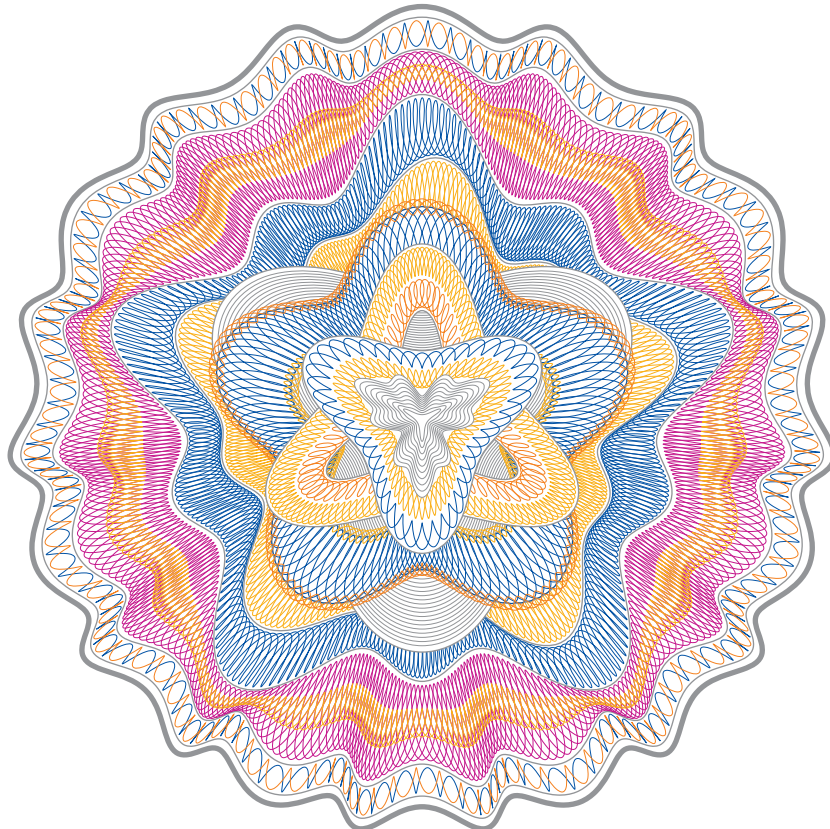
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has five attribute fields for content elements of **Cycloid** type:
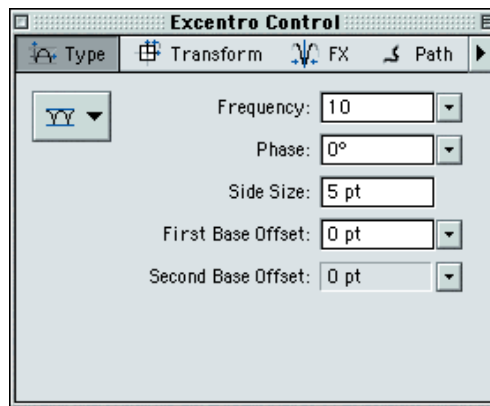
■ **Frequency** defines number of 'coils' path of **Cycloid** element has. It is a number of times pencil moves up and down between base paths of content element. To make shape of content element more suitable for guilloche design you should set this value as high as highest **Frequency** attribute of its parent elements.

*Cycloid paths with **Frequency** set to '10' and '20'*

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement between base paths. This value is expressed in degrees '°' from [−180°; 180°] interval. By creating Step & Repeat Set that covers whole [−180°; 180°] interval of **Phase** attribute you can create effect of filling space between base paths with uniform vector texture.

*'90°' modification of **Phase** attribute and 'texture' effect with Step & Repeat Set*

■ **Side Size** attribute defines width of coils. It is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Cycloid** element.
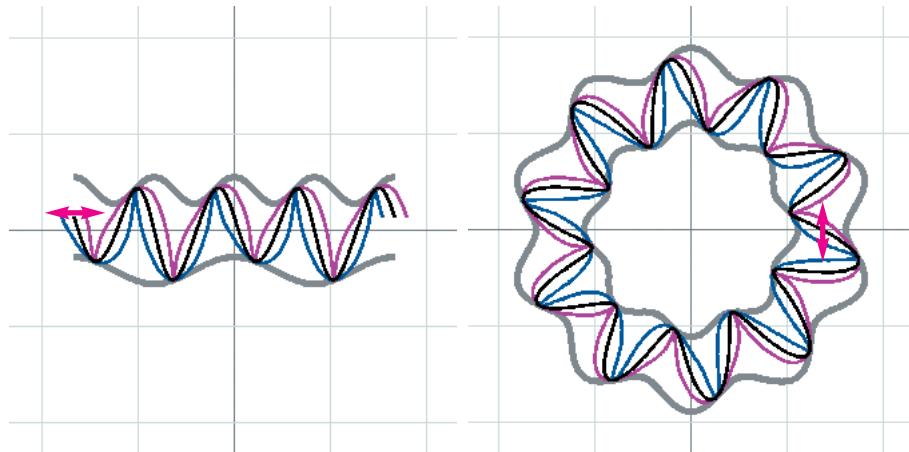
*Cycloid paths with **Side Size** set to '0 pt' (black), with positive (blue)
and negative (magenta) values*

■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to points of content element path at maximum and minimum positions of vertical pencil movement. When **First Base Offset** and **Second Base Offset** attributes are set to '*0*' pencil and path of content element touches paths of base elements. There are three different choices for type of these attributes that could be selected from pop-up menu beside numeric value field:

◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on second picture. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.

*Base offset attributes with **Distance** option and values set to '1.5 pt' (left) and '3.5 pt' (right)*

◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units as well. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and could be used to avoid effects of path of content element intersecting itself. Because offset distance is no longer measured in orthogonal direction in some areas of base path real offset value (if measured in orthogonal direction) to path of content element will be different from value specified.

*Base offset attributes: with **Distance With Base Direction** option and values set to '3.5 pt' (left); with **Percentage** option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one more option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be changed from keyboard).

Other options from **Second Base Offset** attribute pop-up menu are identical to that of **First Base Offset** pop-up menu and allow you to enter any desired value by hand (as **Distance**, **Distance With Base Direction** or **Percentage** offset types described above).

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to content elements of **Cycloid** type: **Frequency Modulation** and **Symmetry** effects.

■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Cycloid** element. With this effect you can create **Cycloid** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Left to right: unmodified **Cycloid** content element with **Frequency** attribute '15'; Step & Repeat Set of unmodified content elements; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect*

◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '3' in this field means that **Cycloid** has 3 parts with higher frequency and 3 parts with lower frequency.

*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 1, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 3, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect.*

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '0°' means that center of first area with higher frequency corresponds to starting point of base paths, with values '180°' or '−180°' first area with higher frequency coincides with middle of base paths.

Left to right: **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *90˚,* **Amount** *= 6;*
Step & Repeat Set with **Frequency Modulation** *effect;* **Frequency Modulation** *effect with attributes:*
Periods *= 2,* **Phase =** *45˚,* **Amount** *= 6; Step & Repeat Set with* **Frequency Modulation** *effect*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Cycloid** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*15*', **Amount** value of '*6*' will make areas with lower frequency similar to that of **Cycloid** path with **Frequency** '*9*' and areas with higher frequency to **Cycloid** path with **Frequency** '*21*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

Left to right: **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *0˚,* **Amount** *= 4;*
Step & Repeat Set with **Frequency Modulation** *effect;* **Frequency Modulation** *effect with attributes:*
Periods *= 2,* **Phase =** *0˚,* **Amount** *= 9; Step & Repeat Set with* **Frequency Modulation** *effect.*
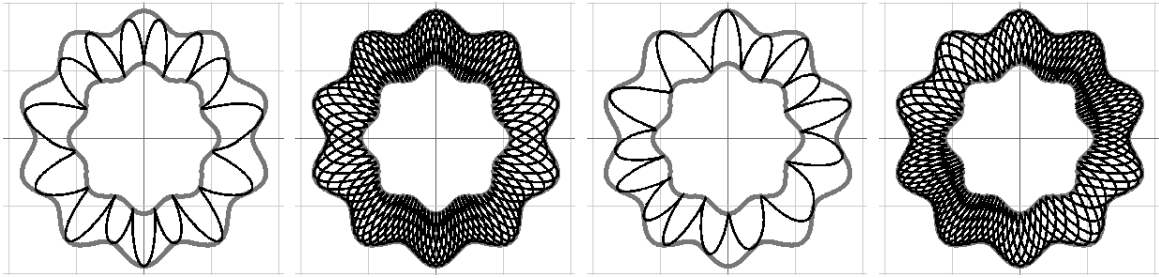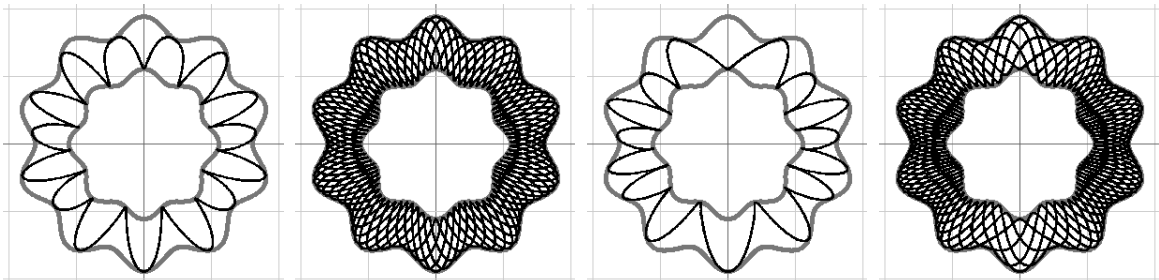

■ **Symmetry** effect does not have the correct name for what exactly it is or does. This effect allows you to modify pencil movement so, that at certain points it suddenly stops and starts going in opposite direction from point reflected around orthogonal to middle line axis. If base paths are smooth periodic shapes this effect results in symmetric pieces of **Cycloid** reflected between them, like shown on pictures below. In points where direction of pencil changes straight line segment is added to make **Cycloid** path closed. This also ruins smoothness of the path, so you should use this effect with caution.

*Left to right: unmodified **Cycloid** content element, **Symmetry** effect with attributes **Phase** = 0°, **Fragments** =: 2, 4, 6.*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Cycloid** path will consist of. For example, is you set this value to '2', the base paths will be divided into two parts and pencil movement while it moves along second half will be its own reflection on first half.

◆ **Phase** attribute controls the starting point of first symmetric piece. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '0°' means that first fragment starts at the beginning of base paths, values '180°' and '−180°' means that first fragment starts at the middle of base paths.

*Left to right: **Symmetry** effect with attributes **Fragments** = 2, **Phase** =: 0°, 90°, 180°, −90°.*

CHAPTER 4: EIGHT

Path of **Eight** content element viewed from *Excentro* mechanical model side represents combination of two periodic pencil movements between paths of its base elements. In orthogonal direction to middle line between base paths (the direction that is at right angle to tangent line to middle line) pencil moves up and down just like in **Sine Wave** content element case. In tangent direction to middle line pencil movements are defined by another sine function with frequency twice as high and amplitude equal to **Side Size** attribute value. In result you get area between base paths filled by path that depending on attribute values and shape of base paths can have twists and self-intersections. You may regard **Eight** content element as **Eight** regular element which base path is middle line between paths of its base elements and **Amplitude** attribute at every point is defined by distance between these paths.
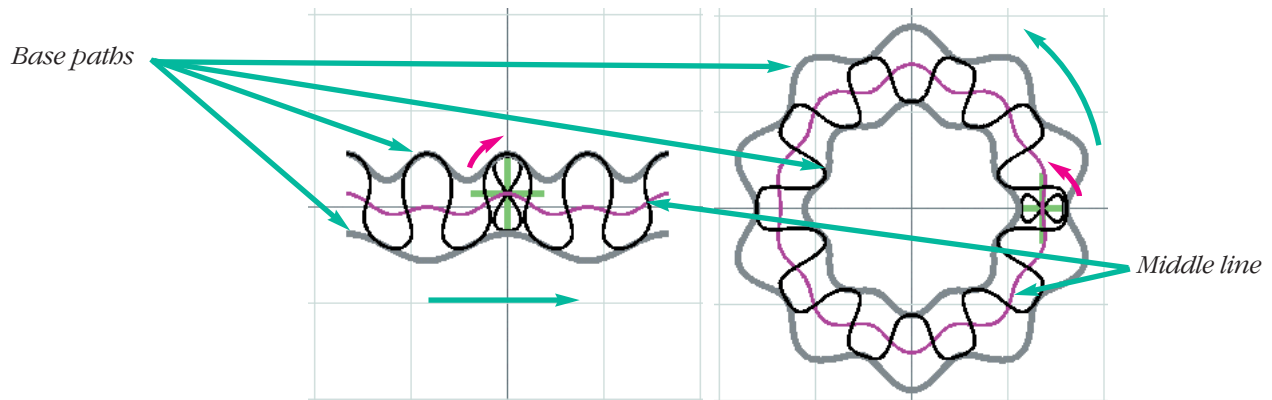
Eight content element: between linear and circular base paths

Typical application for **Eight** content elements could be found in ribbon like design parts. Paths of **Eight** content elements are shown with color on example below.
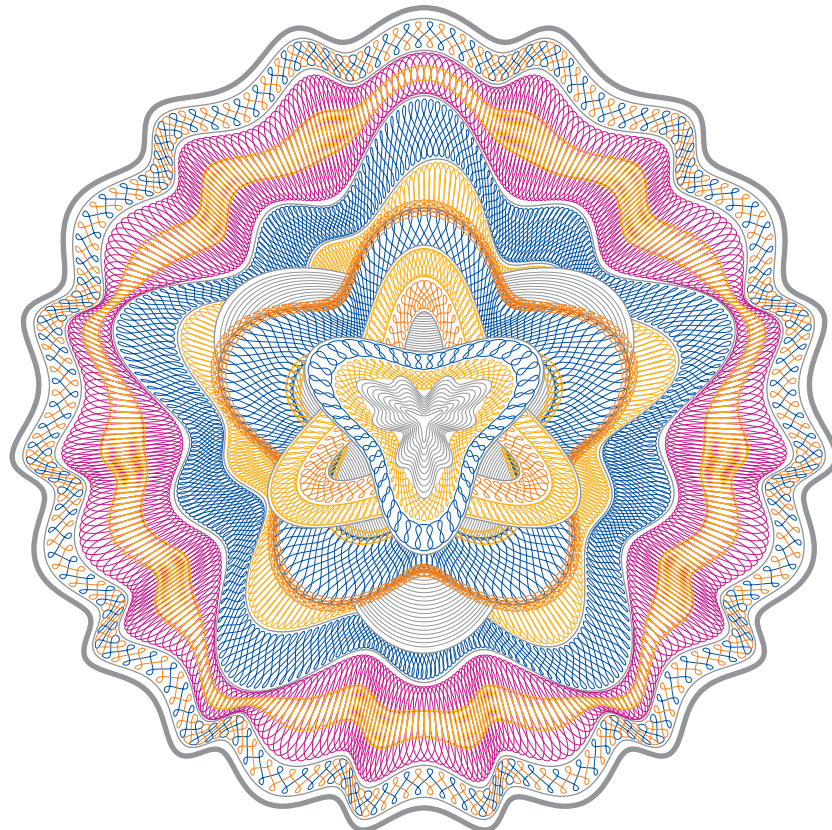
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has five attribute fields for content elements of **Eight** type:
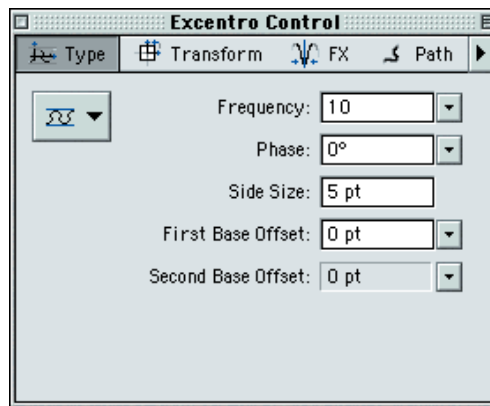
■ **Frequency** defines number of 'twists' path of **Eight** element has. It is a number of times pencil moves up and down between base paths of content element. To make shape of content element more suitable for guilloche design you should set this value as high as highest **Frequency** attribute of its parent elements.

Eight paths with Frequency set to '10' and '20'

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement between base paths. This value is expressed in degrees '°' from [−180°; 180°] interval. By creating Step & Repeat Set that covers whole [−180°; 180°] interval of **Phase** attribute you can create effect of filling space between base paths with uniform vector texture.

'90°' modification of Phase attribute and 'texture' effect with Step & Repeat Set

■ **Side Size** attribute defines width of twists. It is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Eight** content element.

*Eight paths with **Side Size** set to '0 pt' (black), with positive (blue) and negative (magenta) values*

■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to points of content element path at maximum and minimum positions of vertical pencil movement. When **First Base Offset** and **Second Base Offset** attributes are set to '0' pencil and path of content element touches paths of base elements. There are three different choices for type of these attributes that could be selected from pop-up menu beside numeric value field:

◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on second picture. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.

*Base offset attributes with **Distance** option and values set to '1.5 pt' (left) and '3.5 pt' (right)*

◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units as well. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and could be used to avoid effects of path of content element intersecting itself. Because offset distance is no longer measured in orthogonal direction in some areas of base path real offset value (if measured in orthogonal direction) to path of content element will be different from value specified.

*Base offset attributes: with **Distance With Base Direction** option and values set to '3.5 pt' (left); with **Percentage** option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one more option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be changed from keyboard).

Other options from **Second Base Offset** attribute pop-up menu are identical to that of **First Base Offset** pop-up menu and allow you to enter any desired value by hand (as **Distance**, **Distance With Base Direction** or **Percentage** offset types described above).

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to content elements of **Eight** type: **Frequency Modulation** and **Symmetry** effects.

■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Eight** element. With this effect you can create **Eight** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Left to right: unmodified **Eight** content element with **Frequency** attribute '15'; Step & Repeat Set of unmodified content elements; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect*

◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '3' in this field means that **Eight** has 3 parts with higher frequency and 3 parts with lower frequency.

*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 1, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 3, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect.*
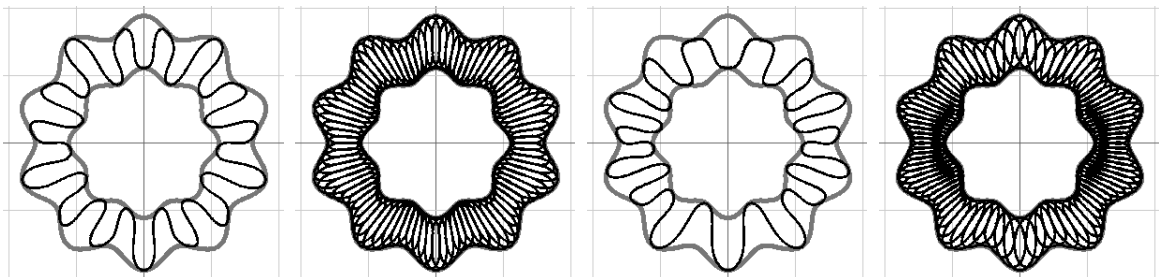
◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ('°') with [–180°, 180°] interval. For example, value '0°' means that center of first area with higher frequency corresponds to starting point of base paths, with values '180°' or '–180°' first area with higher frequency coincides with middle of base paths.

Left to right: **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *90˚,* **Amount** *= 6; Step & Repeat Set with* **Frequency Modulation** *effect;* **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *45˚,* **Amount** *= 6; Step & Repeat Set with* **Frequency Modulation** *effect*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Eight** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*15*', **Amount** value of '*6*' will make areas with lower frequency similar to that of **Eight** path with **Frequency** '*9*' and areas with higher frequency to **Eight** path with **Frequency** '*21*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

Left to right: **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *0˚,* **Amount** *= 4; Step & Repeat Set with* **Frequency Modulation** *eff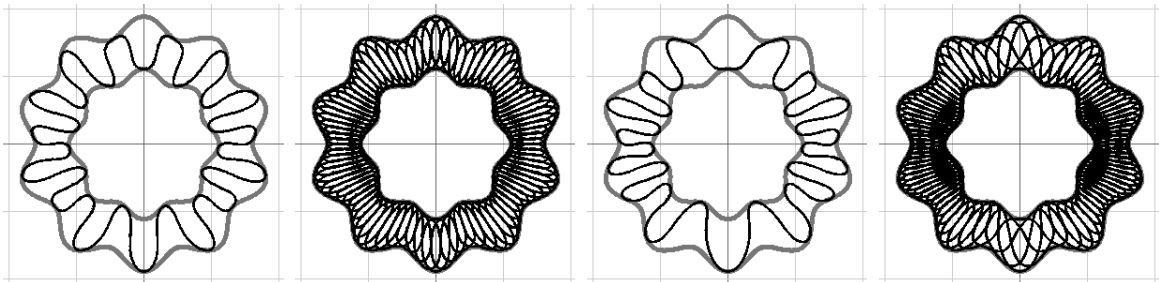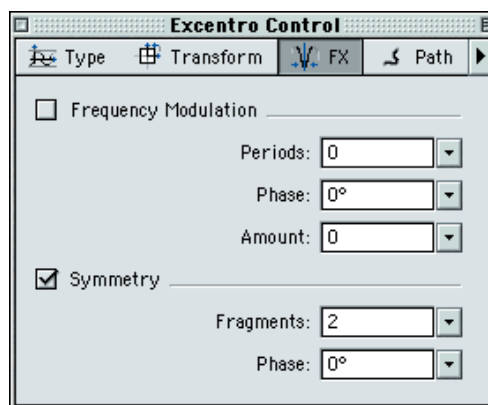ect;* **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *0˚,* **Amount** *= 9; Step & Repeat Set with* **Frequency Modulation** *effect.*

■ **Symmetry** effect does not have the correct name for what exactly it is or does. This effect allows you to modify pencil movement so, that at certain points it suddenly stops and starts going in opposite direction from point reflected around orthogonal to middle line axis. If base paths are smooth periodic shapes this effect results in symmetric pieces of **Eight** reflected between them, like shown on pictures below. In points where direction of pencil changes straight line segment is added to make **Eight** path closed. This also ruins smoothness of the path, so you should use this effect with caution.

*Left to right: unmodified **Eight** content element, **Symmetry** effect with attributes **Phase =** 0˚, **Fragments** =: 2, 4, 6.*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Eight** path will consist of. For example, is you set this value to '*2*', the base paths will be divided into two parts and pencil movement while it moves along second half will be its own reflection on first half.

◆ **Phase** attribute controls the starting point of first symmetric piece. This value is expressed in degrees ('˚') with [−180˚, 180˚] interval. For example, value '*0˚*' means that first fragment starts at the beginning of base paths, values '*180˚*' and '*−180˚*' means that first fragment starts at the middle of base paths.

*Left to right: **Symmetry** effect with attributes **Fragments** = 2, **Phase =**: 0˚, 90˚, 180˚, −90˚.*

CHAPTER 5: SAW

Path of **Saw** content element viewed from *Excentro* mechanical model side represents combination of two periodic pencil movements between paths of its base elements. In orthogonal direction to middle line between base paths (the direction that is at right angle to tangent line to middle line) pencil moves up and down just like in **Sine Wave** content element case. In tangent direction to middle line pencil movements are defined by another sine function with different phase, frequency twice as high and amplitude equal to **Side Size** attribute value. In result you get area between base paths filled by path that depending on attribute values and shape of base paths can have teeth-like self-intersections. You may regard **Saw** content element as **Saw** regular element which base path is middle line between paths of its base elements and **Amplitude** attribute at every point is defined by distance between these paths.
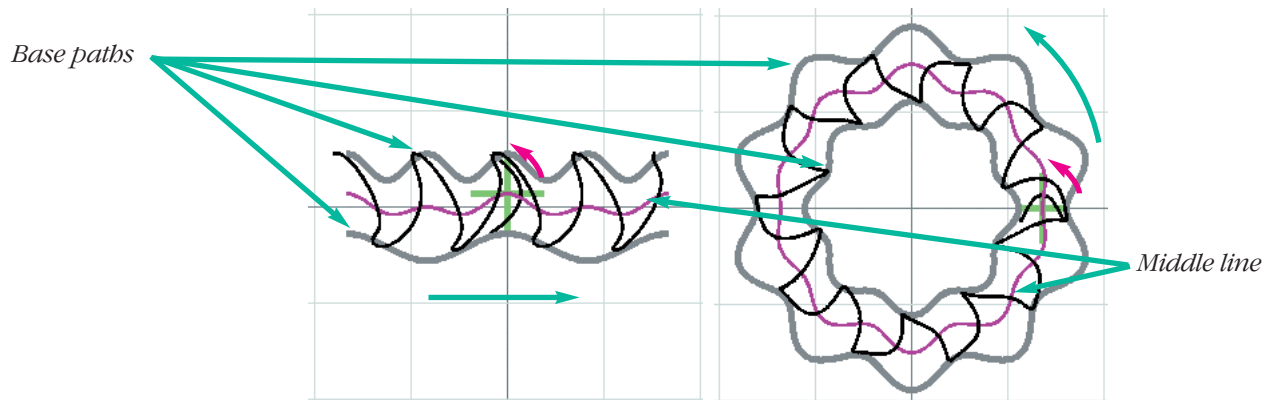
Saw content element: between linear and circular base paths

Typical application for **Saw** content elements could be found in ribbon like design parts. Paths of **Saw** content elements are shown with color on example below.
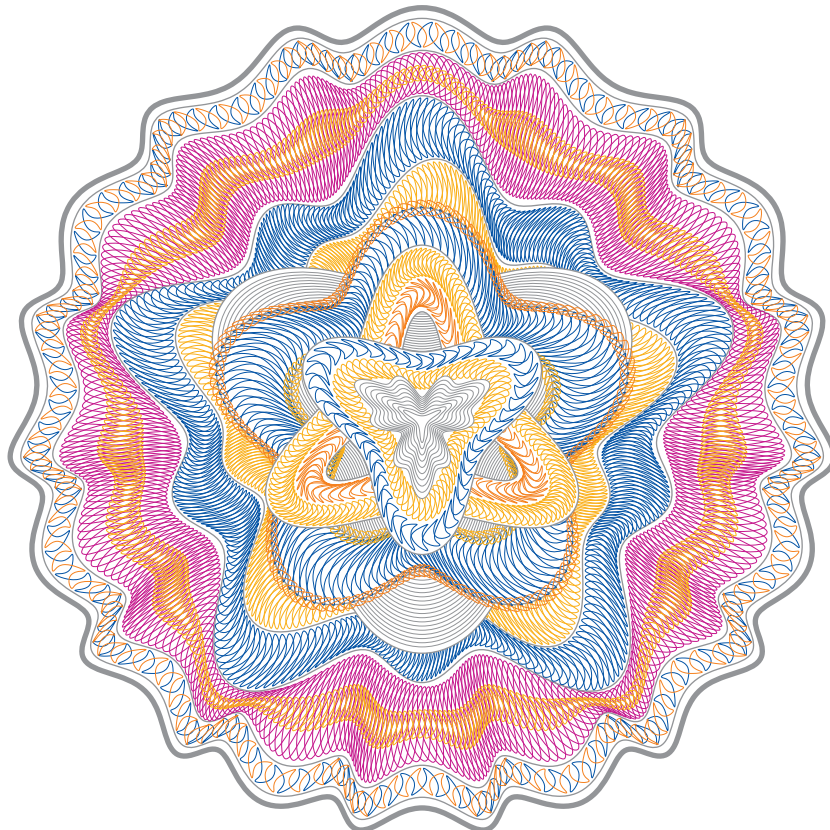
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has five attribute fields for content elements of **Saw** type:
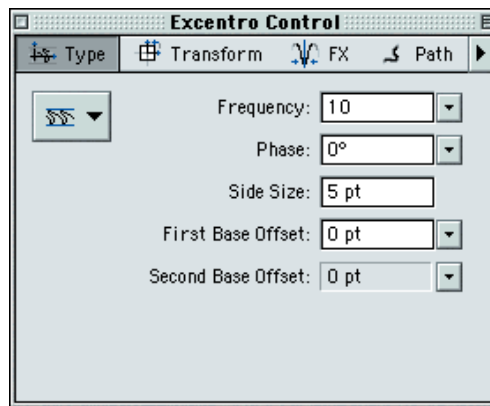
■ **Frequency** defines number of 'teeth' path of **Saw** element has. It is a number of times pencil moves up and down between base paths of content element. To make shape of content element more suitable for guilloche design you should set this value as high as highest **Frequency** attribute of its parent elements.

*Saw paths with **Frequency** set to '10' and '20'*

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement between base paths. This value is expressed in degrees '°' from [−180°; 180°] interval. By creating Step & Repeat Set that covers whole [−180°; 180°] interval of **Phase** attribute you can create effect of filling space between base paths with uniform vector texture.

*'90°' modification of **Phase** attribute and 'texture' effect with Step & Repeat Set*

■ **Side Size** attribute defines width of teeth. It is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Saw** element.

Saw paths with **Side Size** set to '0 pt' (black), with positive (blue) and negative (magenta) values

■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to points of content element path at maximum and minimum positions of vertical pencil movement. When **First Base Offset** and **Second Base Offset** attributes are set to '0' pencil and path of content element touches paths of base elements. There are three different choices for type of these attributes that could be selected from pop-up menu beside numeric value field:

◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on second picture. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.

Base offset attributes with **Distance** *option and values set to '1.5 pt' (left) and '3.5 pt' (right)*

◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units as well. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and could be used to avoid effects of path of content element intersecting itself. Because offset distance is no long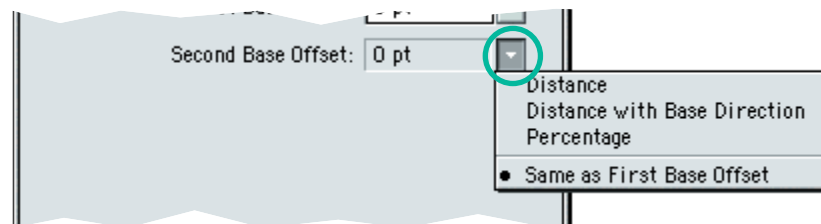er measured in orthogonal direction in some areas of base path real offset value (if measured in orthogonal direction) to path of content element will be different from value specified.

Base offset attributes: with **Distance With Base Direction** *option and values set to '3.5 pt' (left); with* **Percentage** *option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one more option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be changed from keyboard).

Other options from **Second Base Offset** attribute pop-up menu are identical to that of **First Base Offset** pop-up menu and allow you to enter any desired value by hand (as **Distance**, **Distance With Base Direction** or **Percentage** offset types described above).

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to content elements of **Saw** type: **Frequency Modulation** and **Symmetry** effects.

■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Saw** element. With this effect you can create **Saw** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

*Left to right: unmodified **Saw** content element with **Frequency** attribute '15'; Step & Repeat Set of unmodified content elements; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect*

◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '3' in this field means that **Saw** has 3 parts with higher frequency and 3 parts with lower frequency.
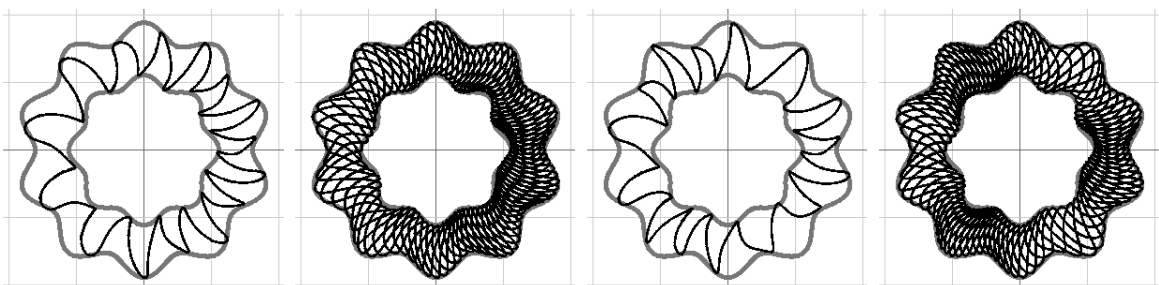

*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 1, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 3, **Phase** = 0°, **Amount** = 6; Step & Repeat Set with **Frequency Modulation** effect.*

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ("°") with [−180, 180] interval. For example, value '0°' means that center of first area with higher frequency corresponds to starting point of base paths, with values '180°' or '−180°' first area with higher frequency coincides with middle of base paths.

Left to right: **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *90˚,* **Amount** *= 6; Step & Repeat Set with* **Frequency Modulation** *effect;* **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *45˚,* **Amount** *= 6; Step & Repeat Set with* **Frequency Modulation** *effect*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Saw** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*15*', **Amount** value of '*6*' will make areas with lower frequency similar to that of **Saw** path with **Frequency** '*9*' and areas with higher frequency to **Saw** path with **Frequency** '*21*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

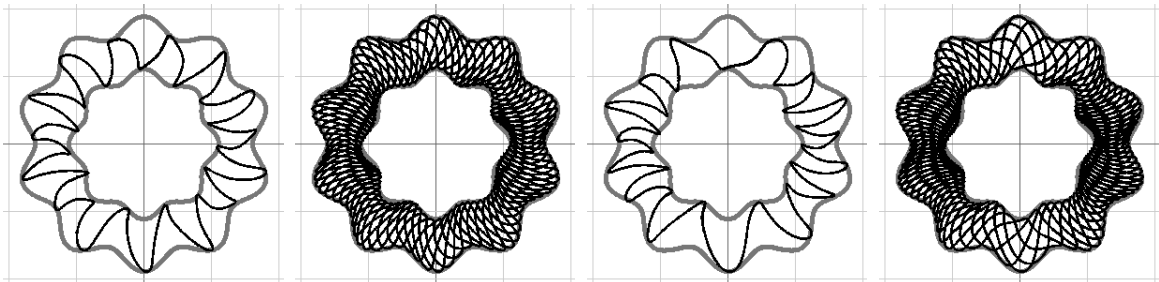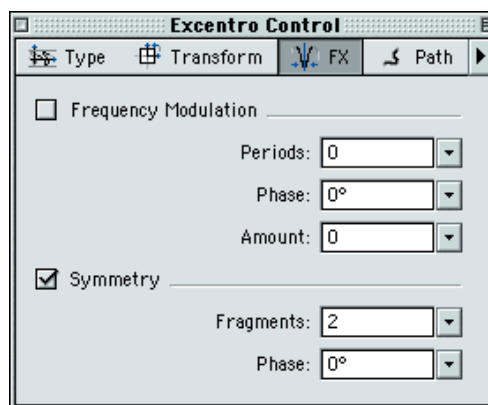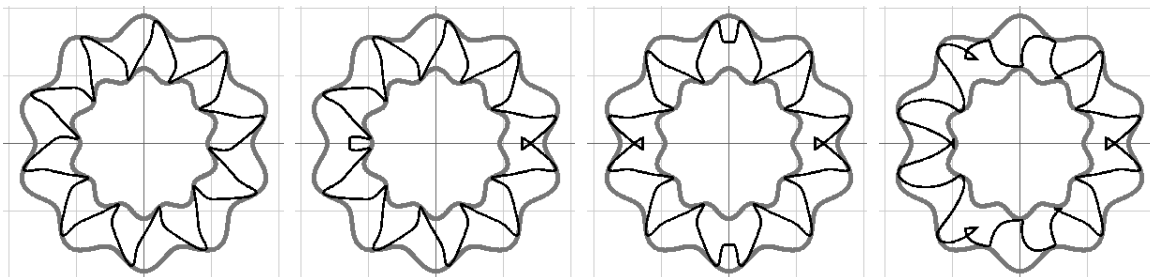*Left to right:* **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *0˚,* **Amount** *= 4; Step & Repeat Set with* **Frequency Modulation** *effect;* **Frequency Modulation** *effect with attributes:* **Periods** *= 2,* **Phase =** *0˚,* **Amount** *= 9; Step & Repeat Set with* **Frequency Modulation** *effect.*

■ **Symmetry** effect does not have the correct name for what exactly it is or does. This effect allows you to modify pencil movement so, that at certain points it suddenly stops and starts going in opposite direction from point reflected around orthogonal to middle line axis. If base paths are smooth periodic shapes this effect results in symmetric pieces of **Saw** reflected between them, like shown on pictures below. In points where direction of pencil changes straight line segment is added to make **Saw** path closed. This also ruins smoothness of the path, so you should use this effect with caution.

*Left to right: unmodified **Saw** content element, **Symmetry** effect with attributes*
***Phase =** 0˚, **Fragments** =: 2, 4, 6.*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Saw** path will consist of. For example, is you set this value to '*2*', the base paths will be divided into two parts and pencil movement while it moves along second half will be its own reflection on first half.

◆ **Phase** attribute controls the starting point of first symmetric piece. This value is expressed in degrees ("°") with [−180°, 180°] interval. For example, value '*0°*' means that first fragment starts at the beginning of base paths, values '*180°*' and '*−180°*' means that first fragment starts at the middle of base paths.

*Left to right: **Symmetry** effect with attributes **Fragments** = 2, **Phase** =: 0˚, 90˚, 180˚, −90˚.*

CHAPTER 6: BRACE

You may regard **Brace** content element as **Brace** regular element which base path is middle line between paths of its base elements and **Amplitude** attribute at every point is defined by distance between these paths. **Side Size** attribute is still independent value that is not influenced by base paths in any respect. In result you get area between base paths filled by path that depending on attribute values and shape of base paths can have brace-like twists and self-intersections.

Base paths

Middle line
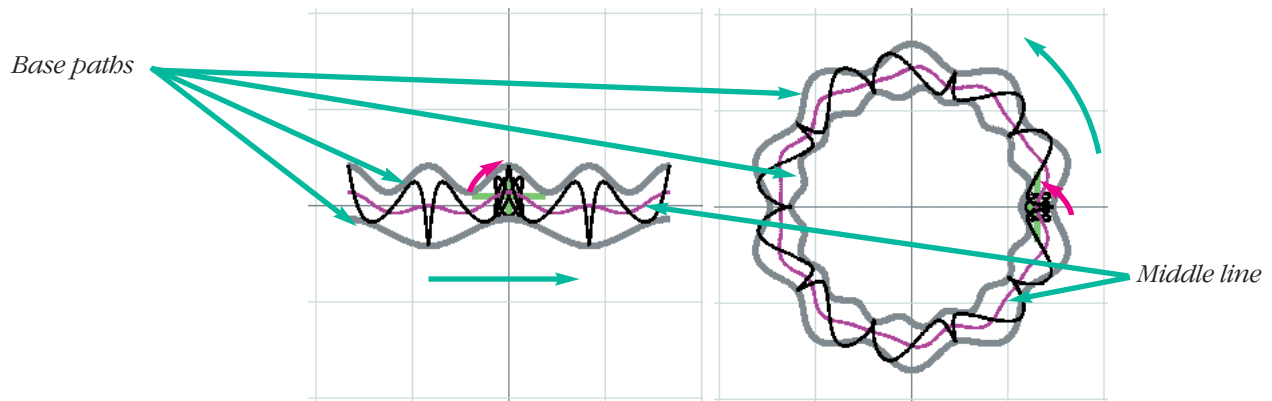
***Brace** content element: between linear and circular base paths*

Because of its complex shape and many twists usage of **Brace** content elements is limited to thin ribbon like design parts (where they are used in Step & Repeat Sets with small **Number of Steps** like '*2*'). Paths of **Brace** content elements are shown with color on example below.
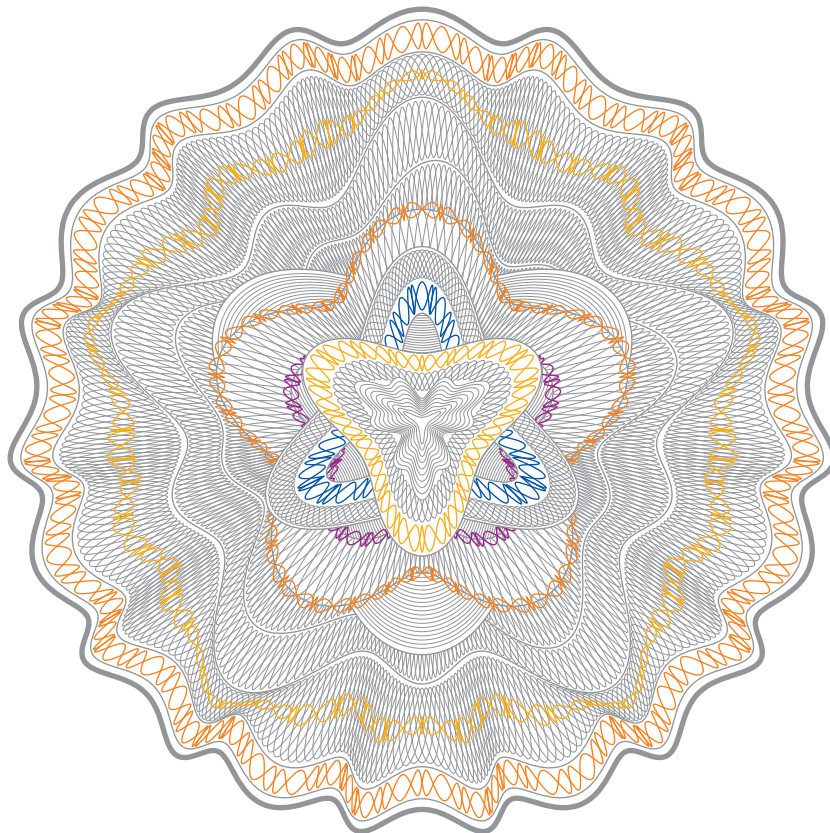
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has five attribute fields for content elements of **Brace** type:

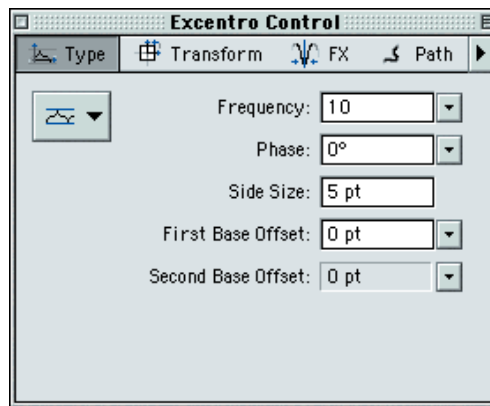■ **Frequency** defines number of 'braces' path of **Brace** element has. It is a number of times pencil moves up and down between base paths of content element. To make shape of content element more suitable for guilloche design you should set this value to half of **Frequency** attribute value of its parent elements or above.
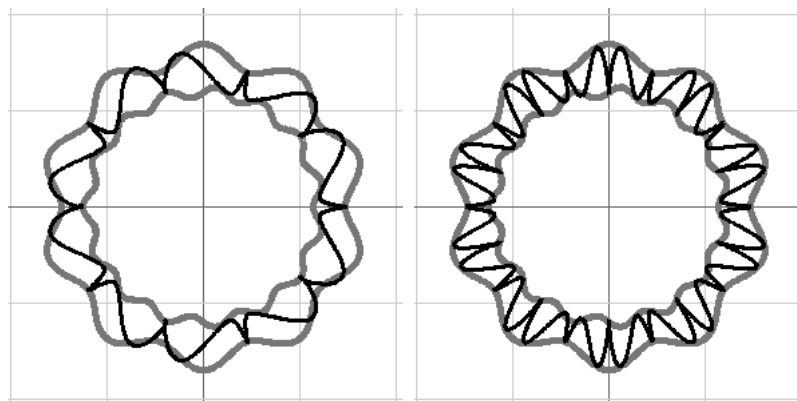
Brace paths with Frequency set to '5' and '10'

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement between base paths. This value is expressed in degrees '°' from [−180°; 180°] interval. By creating Step & Repeat Set that covers whole [−180°; 180°] interval of **Phase** attribute you can create effect of filling space between base paths with vector texture.
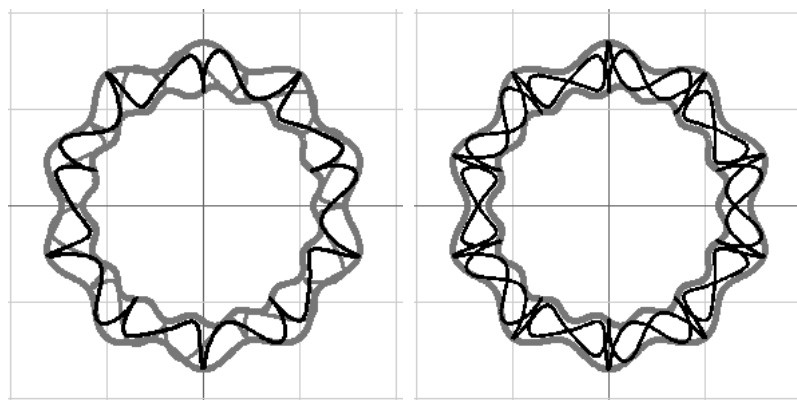
'90°' modification of Phase attribute and Step & Repeat Set of two paths

■ **Side Size** attribute defines width of braces. It is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Brace** element.

*Brace paths with **Side Size** set to '0 pt' (black), with positive (blue) and negative (magenta) values*

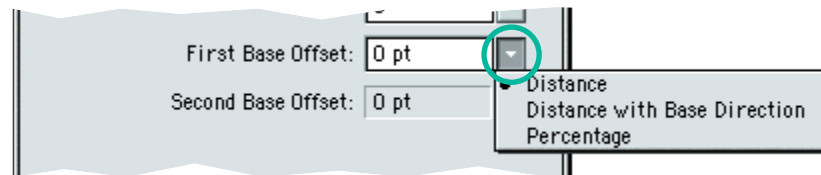■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to points of content element path at maximum and minimum positions of vertical pencil movement. When **First Base Offset** and **Second Base Offset** attributes are set to '0' pencil and path of content element touches paths of base elements. There are three different choices for type of these attributes that could be selected from pop-up menu beside numeric value field:

◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on second picture. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.

*Base offset attributes with **Distance** option and values set to '1.5 pt' (left) and '3.5 pt' (right)*
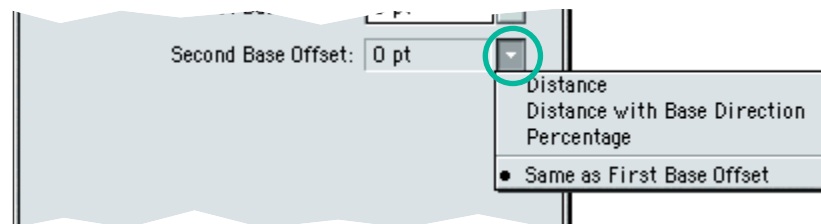
◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units as well. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and could be used to avoid effects of path of content element intersecting itself. Because offset distance is no longer measured in orthogonal direction in some areas of base path real offset value (if measured in orthogonal direction) to path of content element will be different from value specified.

*Base offset attributes: with **Distance With Base Direction** option and values set to '3.5 pt' (left); with **Percentage** option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one more option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be changed from keyboard).

Other options from **Second Base Offset** attribute pop-up menu are identical to that of **First Base Offset** pop-up menu and allow you to enter any desired value by hand (as **Distance**, **Distance With Base Direction** or **Percentage** offset types described above).

FX ATTRIBUTES

FX panel of **Excentro Control** inspector contains two special effects that could be applied to content elements of **Brace** type: **Frequency Modulation** and **Symmetry** effects.

■ **Frequency Modulation** effect allows you to make periodic modifications to **Frequency** attribute of **Brace** element. With this effect you can create **Brace** paths with irregular shapes that have areas with higher and lower **Frequency** than one specified in **Type** panel of **Excentro Control**. Examples below illustrate the usage of **Frequency Modulation** effect:

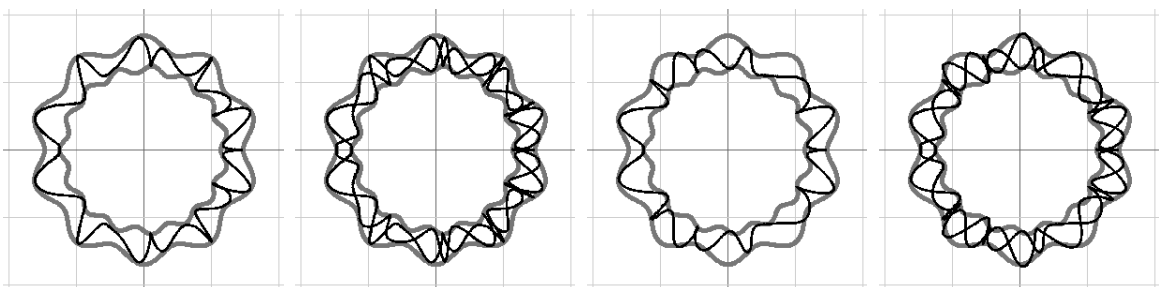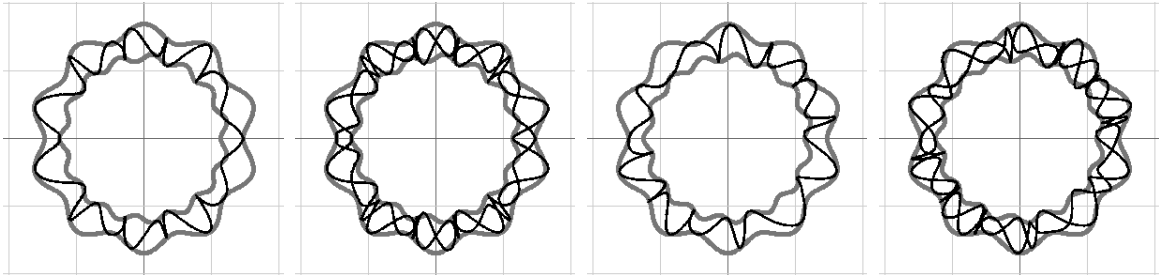*Left to right: unmodified **Brace** content element with **Frequency** attribute '15'; Step & Repeat Set of unmodified content elements; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase** = 0°, **Amount** = 2; Step & Repeat Set with **Frequency Modulation** effect*

◆ **Periods** attribute of **Frequency Modulation** effect defines number of areas with higher and lower frequency. These areas are evenly distributed along base path (path of parent element). For example, value '3' in this field means that **Brace** has 3 parts with higher frequency and 3 parts with lower frequency.

*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 1, **Phase** = 0°, **Amount** = 2; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 3, **Phase** = 0°, **Amount** = 2; Step & Repeat Set with **Frequency Modulation** effect.*

◆ **Phase** attribute controls position of areas with higher and lower frequency on base path. This value is expressed in degrees ('°') with [−180°, 180°] interval. For example, value '0°' means that center of first area with higher frequency corresponds to starting point of base paths, with values '180°' or '−180°' first area with higher frequency coincides with middle of base paths.
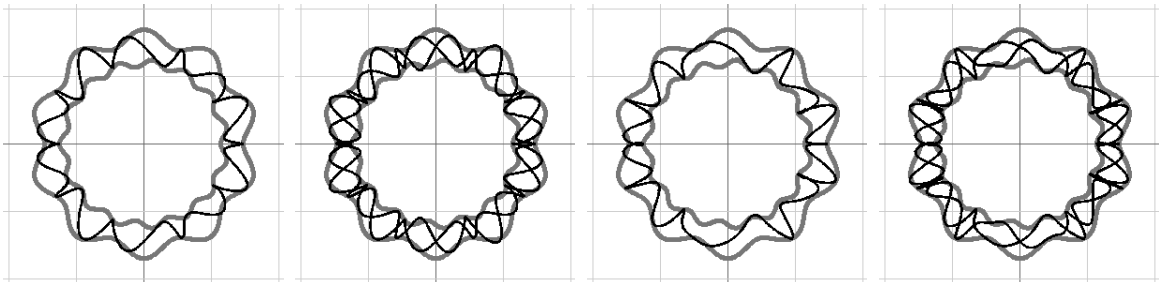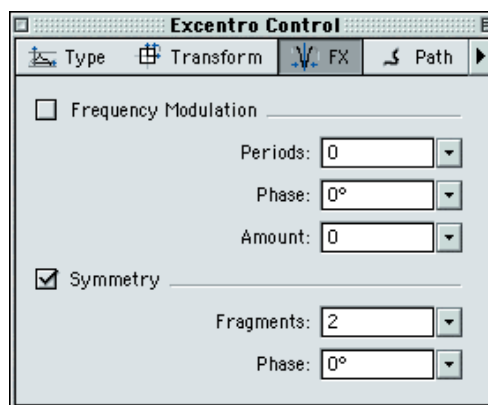
*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase =** 90˚, **Amount** = 2; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase =** 45˚, **Amount** = 2; Step & Repeat Set with **Frequency Modulation** effect*

◆ **Amount** attribute defines value by which **Frequency** attribute of **Brace** goes higher an lower in areas of higher and lower frequency. For example, if **Frequency** attribute in **Type** panel of **Excentro Control** is set to '*15*', **Amount** value of '*6*' will make areas with lower frequency similar to that of **Brace** path with **Frequency** '*9*' and areas with higher frequency to **Brace** path with **Frequency** '*21*'. Normally you shouldn't make **Amount** value exceed value of **Frequency** attribute in **Type** panel of **Excentro Control**.

*Left to right: **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase =** 0˚, **Amount** = 1; Step & Repeat Set with **Frequency Modulation** effect; **Frequency Modulation** effect with attributes: **Periods** = 2, **Phase =** 0˚, **Amount** = 3; Step & Repeat Set with **Frequency Modulation** effect.*

■ **Symmetry** effect does not have the correct name for what exactly it is or does. This effect allows you to modify pencil movement so, that at certain points it suddenly stops and starts going in opposite direction from point reflected around orthogonal to middle line axis. If base paths are smooth periodic shapes this effect results in symmetric pieces of **Brace** reflected between them, like shown on pictures below. In points where direction of pencil changes straight line segment is added to make **Brace** path closed. This also ruins smoothness of the path, so you should use this effect with caution.
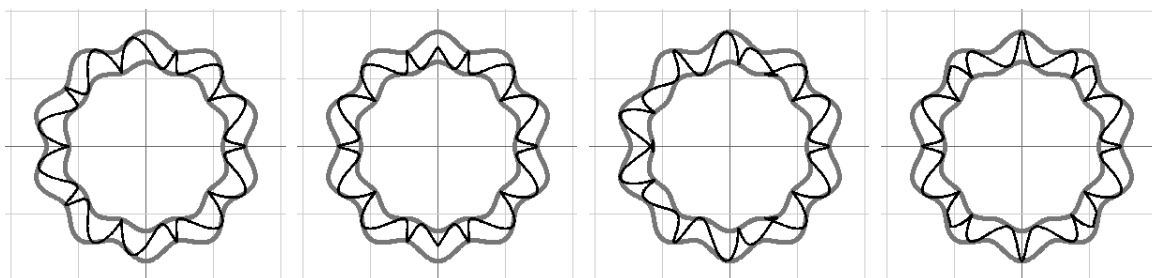
*Left to right: unmodified **Brace** content element, **Symmetry** effect with attributes **Phase =** 0˚, **Fragments** =: 4, 6, 8.*

◆ **Fragments** attribute of **Symmetry** effect allows you to specify number of symmetric pieces modified **Brace** path will consist of. For example, is you set this value to '*4*', the base paths will be divided into four parts and pencil movement while it moves along next part will be its own reflection on previous part.

◆ **Phase** attribute controls the starting point of first symmetric piece. This value is expressed in degrees ("˚") with [−180˚, 180˚] interval. For example, value '*0˚*' means that first fragment starts at the beginning of base paths, values '*180˚*' and '*−180˚*' means that first fragment starts at the middle of base paths.
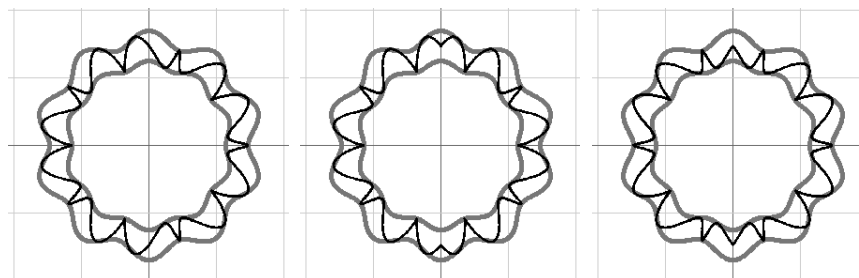

*Left to right: **Symmetry** effect with attributes **Fragments** = 2, **Phase =**: 0˚, 90˚, −90˚.*

CHAPTER 7: SPADE

Path of **Spade** content element viewed from *Excentro* mechanical model side represents combination of two periodic pencil movements between paths of its base elements. In orthogonal direction to middle line between base paths (the direction that is at right angle to tangent line to middle line) pencil moves up and down under linear law with sudden direction changes in top and bottom points. In tangent direction to middle line pencil movements are defined by sine function with amplitude equal to **Side Size** attribute value. You may regard **Spade** content element as **Spade** regular element which base path is middle line between paths of its base elements and **Amplitude** attribute at every point is defined by distance between these paths.
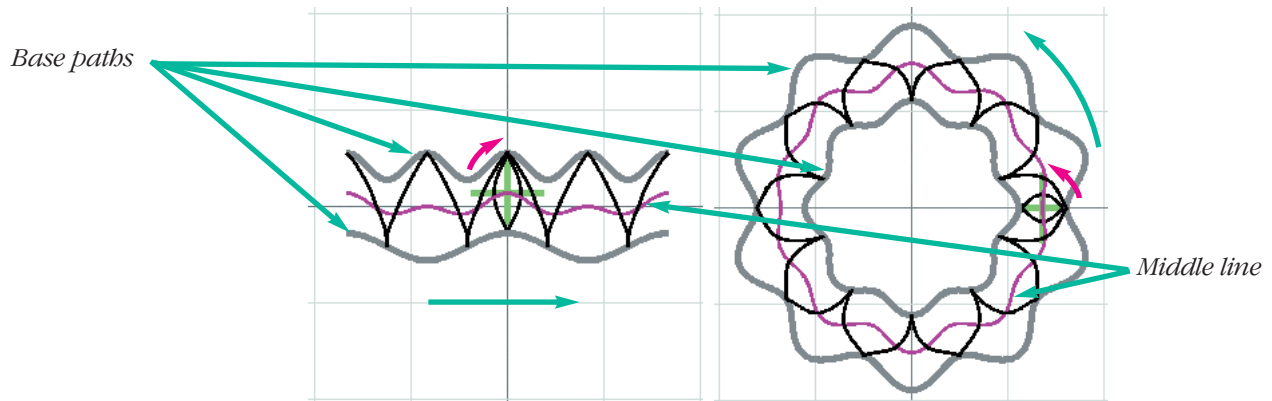
***Spade** content element: between linear and circular base paths*

Because of its somewhat exotic shape and lack of smoothness, **Spade** elements are not often used. Typical application for **Spade** content elements could be found in thin ribbon like design parts, for example, on external borders of design. Paths of **Spade** content elements are shown with color on example below.
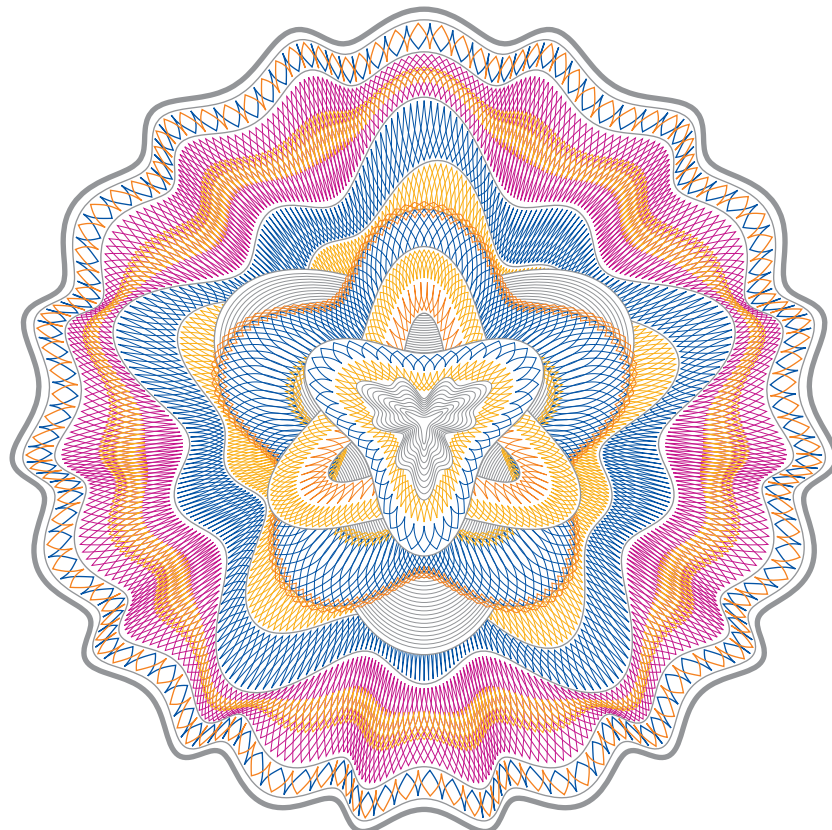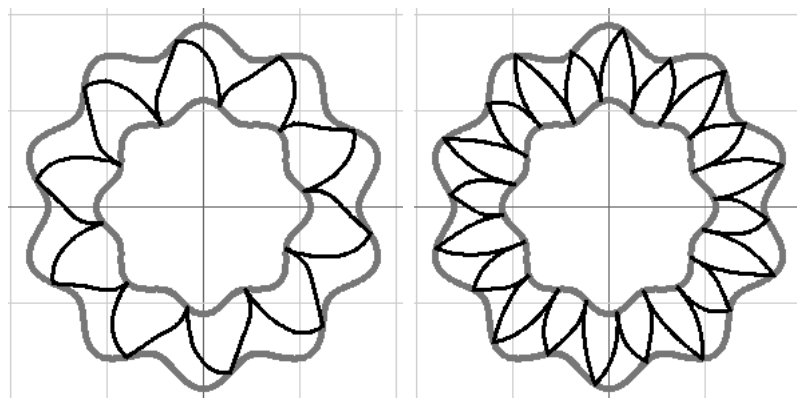
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has five attribute fields for content elements of **Spade** type:
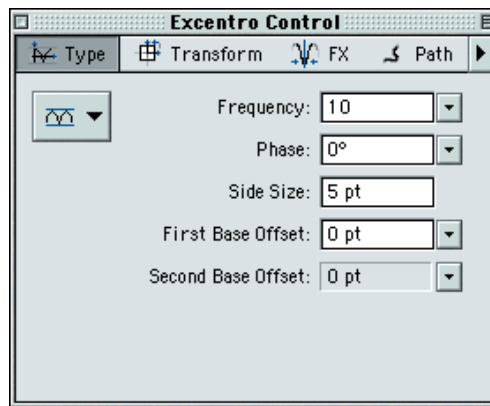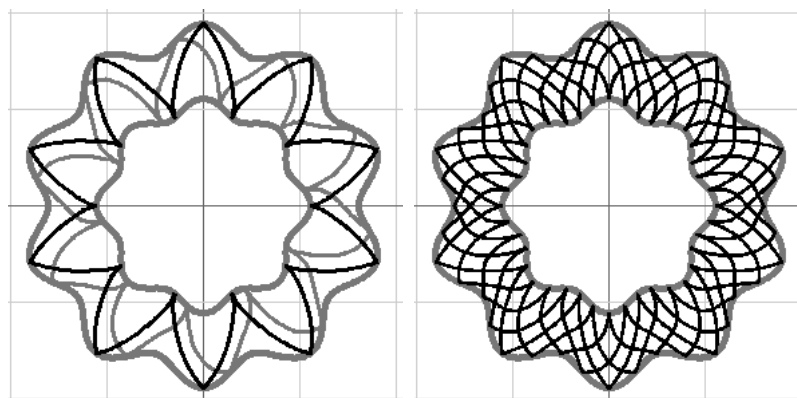

■ **Frequency** defines number of 'pikes' path of **Spade** element has. It is a number of times pencil moves up and down between base paths of content element. To make shape of content element more suitable for guilloche design you should set this value as high as highest **Frequency** attribute of its parent elements.

*Spade paths with **Frequency** set to '10' and '20'*

■ **Phase** attribute controls starting position of path. It is a starting position of pencil movement between base paths. This value is expressed in degrees '°' from [−180°; 180°] interval. By creating Step & Repeat Set that covers whole [−180°; 180°] interval of **Phase** attribute you can create effect of filling space between base paths with uniform vector texture.

*'90°' modification of **Phase** attribute and 'texture' effect with Step & Repeat Set*

■ **Side Size** attribute defines width of pikes. It is measured in application wide measurement units. Pictures below give you illustration of shape changes you can get by modifying **Side Size** attribute of **Spade** element.
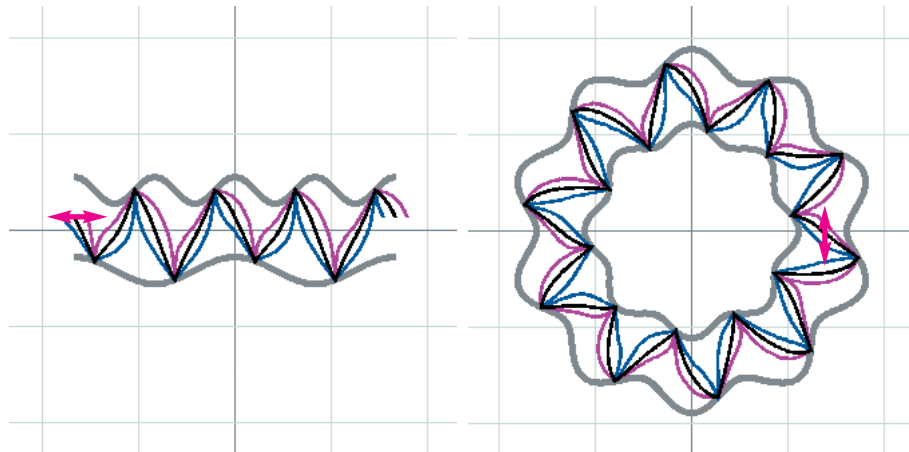
*Spade paths with **Side Size** set to '0 pt' (black), with positive (blue) and negative (magenta) values*
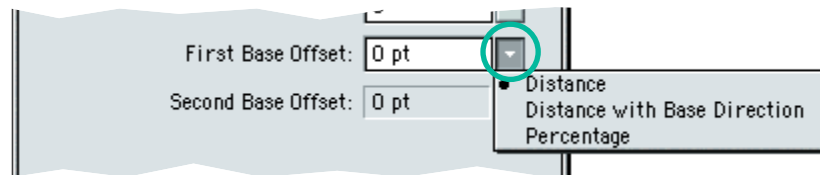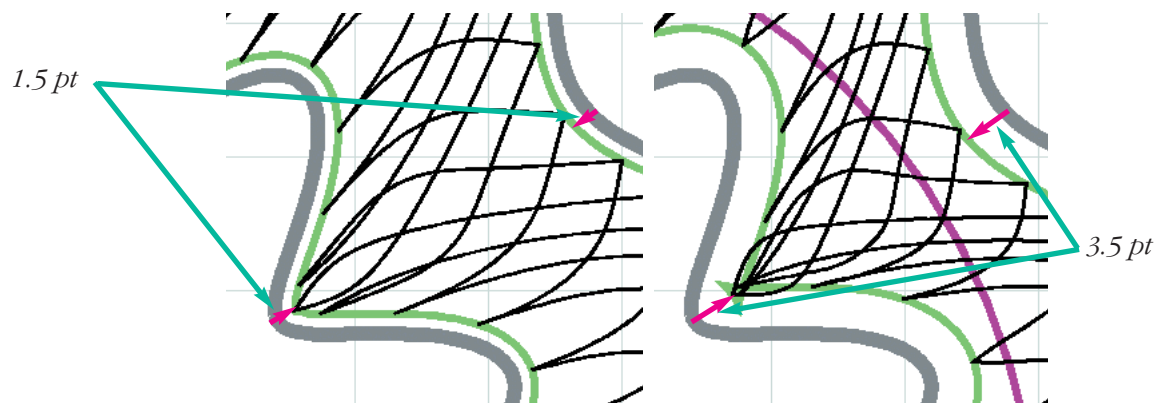
■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to points of content element path at maximum and minimum positions of vertical pencil movements. When **First Base Offset** and **Second Base Offset** attributes are set to '0' pencil and path of content element touches paths of base elements. There are three different choices for type of these attributes that could be selected from pop-up menu beside numeric value field:

```
First Base Offset: 0 pt    ▼
                              ● Distance
Second Base Offset: 0 pt        Distance with Base Direction
                                Percentage
```
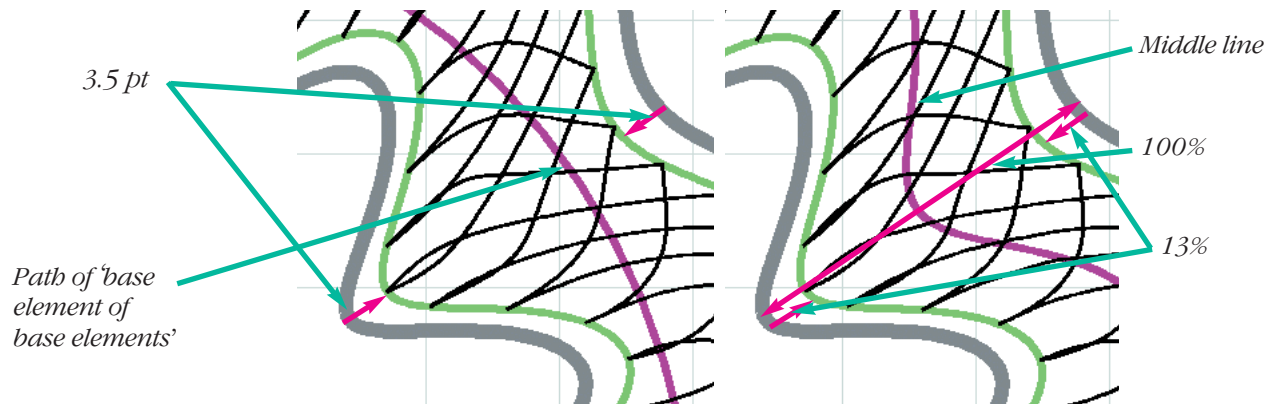
◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on second picture. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.

*Base offset attributes with **Distance** option and values set to '1.5 pt' (left) and '3.5 pt' (right)*
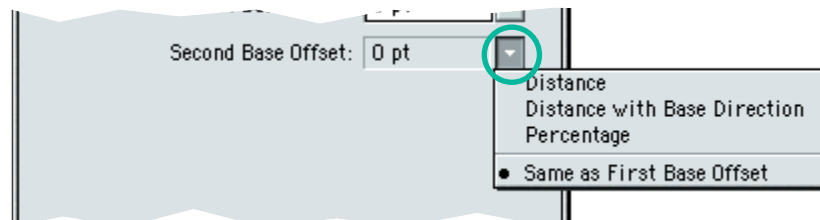
◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units as well. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and could be used to avoid effects of path of content element intersecting itself.

*Base offset attributes: with **Distance With Base Direction** option and values set to '3.5 pt' (left); with **Percentage** option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one more option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be edited from keyboard). Other options are identical to that of **First Base Offset** attribute pop-up menu and allow you to specify desired value by hand (as **Distance**, **Distance With Base Direction** or **Percentage** offset types).

CHAPTER 8: STAR

Path of **Star** content element is created by connecting points set alternatively on paths of its base elements with straight line segments. As result you get star-like shape if base paths are circular or saw-like shape of base paths are linear. Star points are set at regular interval controlled by **Frequency** attribute.

Base paths

Star points
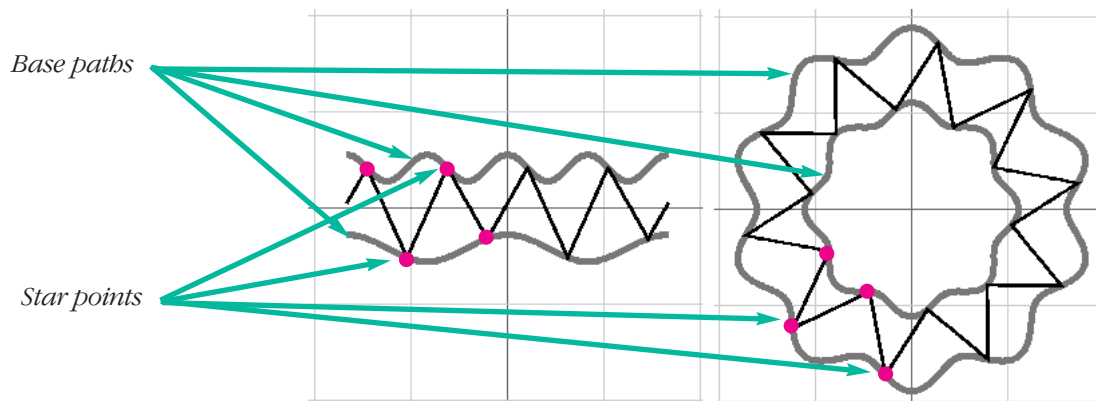
***Star** content element: with linear and circular base paths*

Star content element could be used for any purpose in guilloche designs, but due to creation specifics and lack of smoothness, these elements are not frequently used. Typical application for **Star** content elements could be found in ribbon like design parts (where they are used in Step & Repeat Sets with relatively small **Number of Steps** like '*2*' or '*4*'). Paths of **Star** content elements are shown with color on example below.
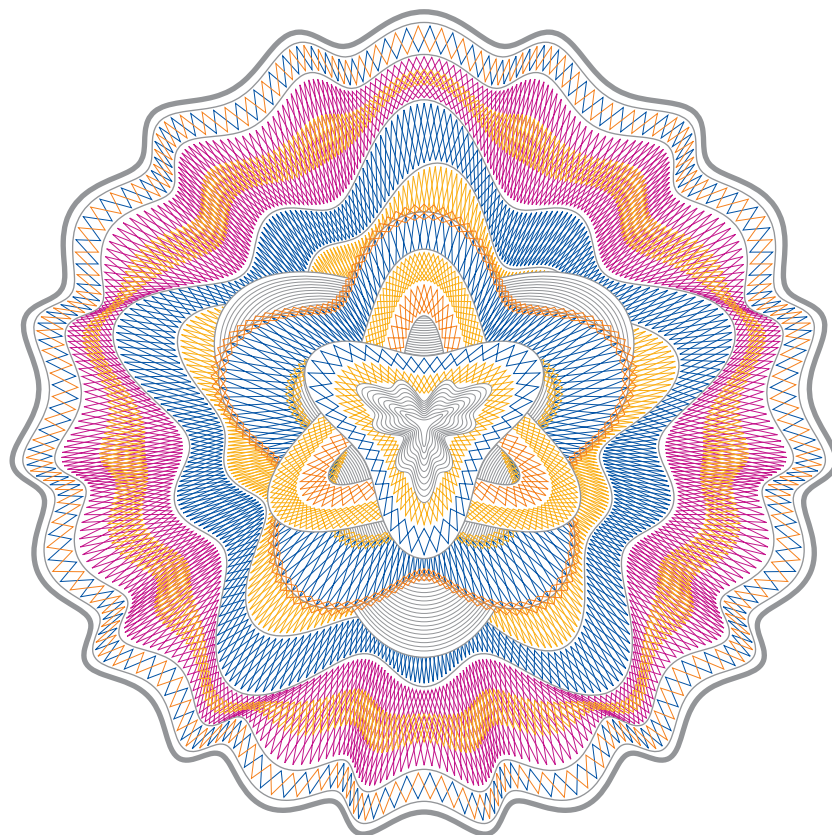
TYPE ATTRIBUTES

**Type** panel of **Excentro Control** inspector has four attribute fields for content elements of **Star** type:
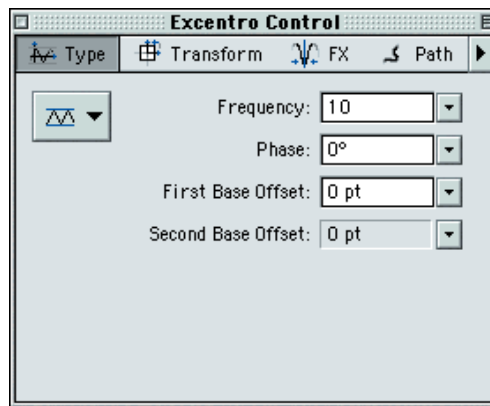

■ **Frequency** defines number of points path of **Star** element consists of. The points are placed alternatively on paths of base elements at equal intervals. To make shape of content element more suitable for guilloche design you should set this value as high as highest **Frequency** attribute of its parent elements.
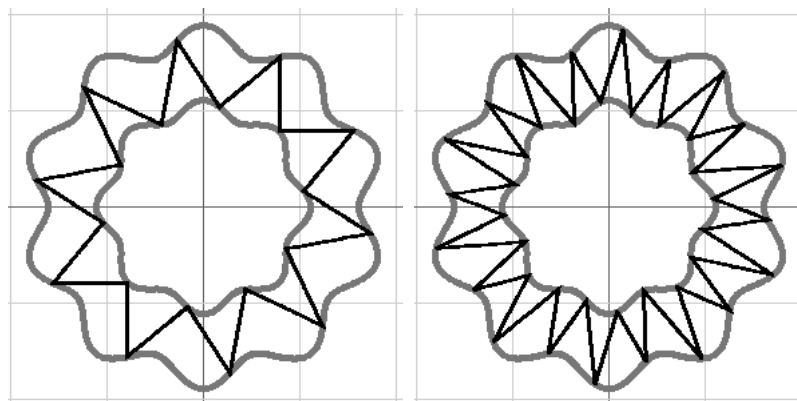
*Star paths with **Frequency** set to '10' and '20'*

■ **Phase** attribute controls starting position for star points. This value is expressed in degrees "°" from [−180°; 180°] interval. By creating Step & Repeat Set that covers whole [−180°; 180°] interval of **Phase** attribute you can create effect of filling space between base paths with uniform vector texture.
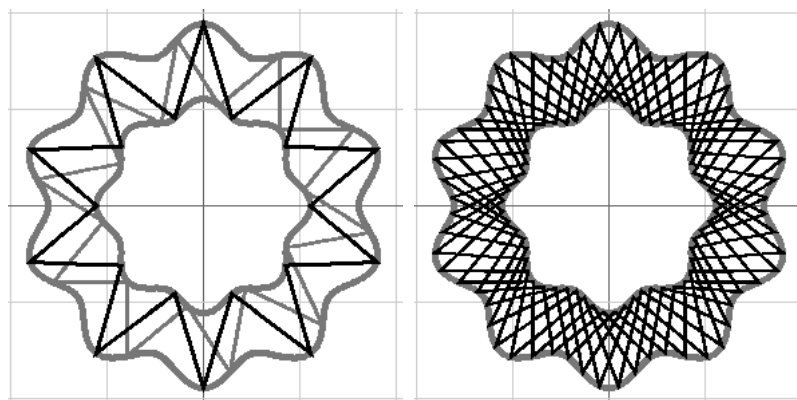

*'90°' modification of **Phase** attribute and 'texture' effect with Step & Repeat Set*

■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to star points of content element. When **First Base Offset** and **Second Base Offset** attributes are set to '*0*' star points of content element are placed directly on base paths. There are three different choices of type for these attributes that could be selected from pop-up menu beside numeric value field:
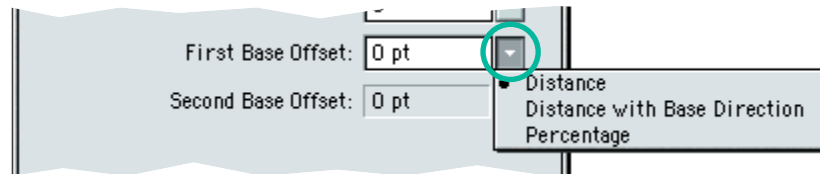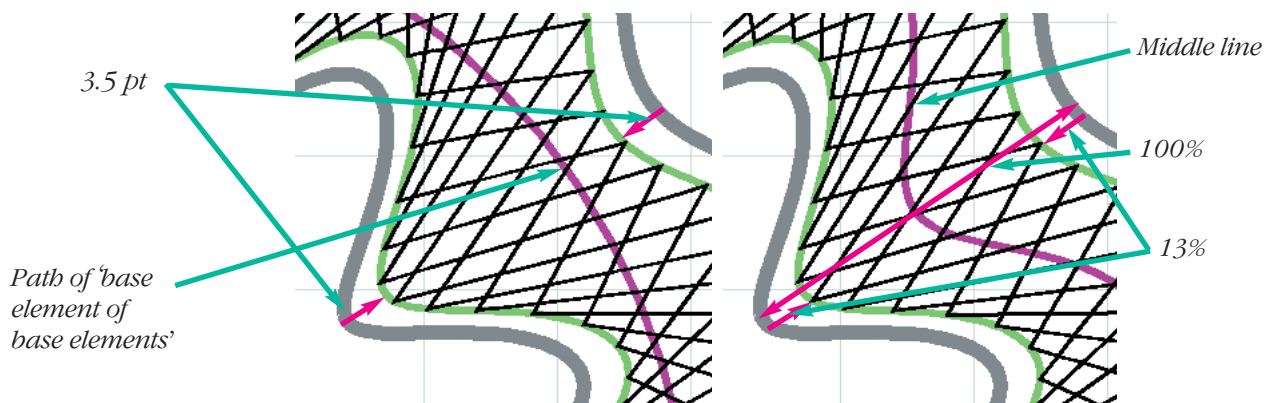

◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on following illustration. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.
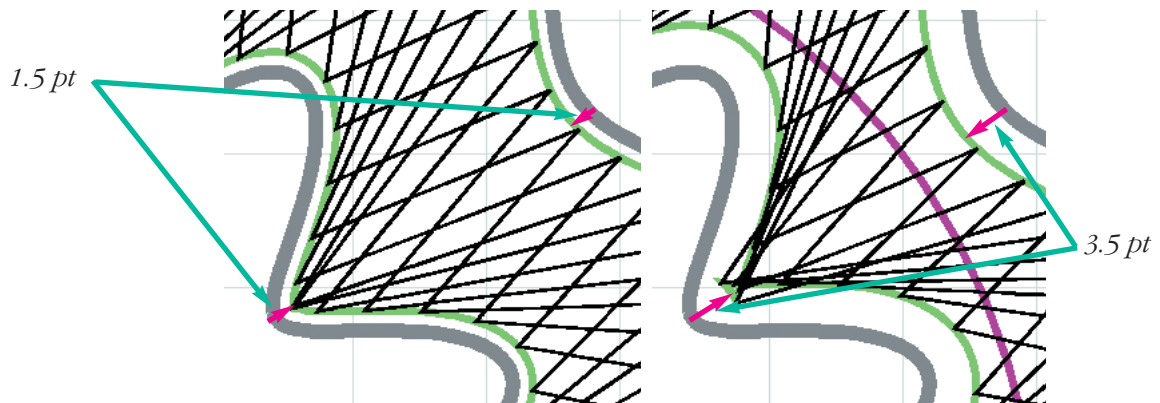
*Base offset attributes with **Distance** option and values set to '1.5 pt' (left) and '3.5 pt' (right)*

◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units too. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and it could be used to avoid effects of path of content element intersecting itself.
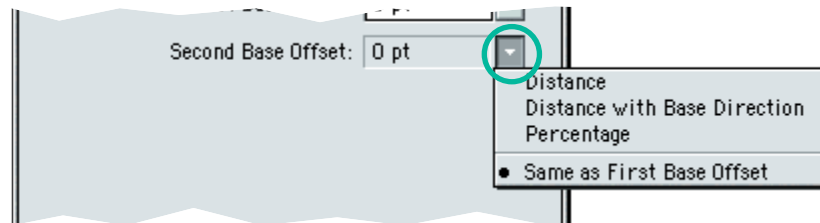

*Base offset attributes: with **Distance With Base Direction** option and values set to '3.5 pt' (left); with **Percentage** option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one more option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be changed from keyboard).

Second Base Offset: 0 pt

Distance
Distance with Base Direction
Percentage
• Same as First Base Offset

Other options from **Second Base Offset** attribute pop-up menu are identical to that of **First Base Offset** pop-up menu and allow you to enter any desired value by hand (as **Distance**, **Distance With Base Direction** or **Percentage** offset types described above).

CHAPTER 9: NOTCH

Path of **Notch** content element consists of segments of paths of its base elements connected with straight line segments. You may think about **Notch** content element as pencil movement along first or second base paths with sudden jumps at regular intervals from one base path to another. Number of segments is controlled by **Frequency** attribute of **Notch** element.
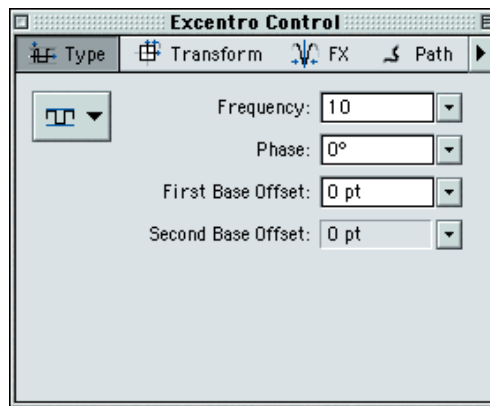

Base paths

Break points
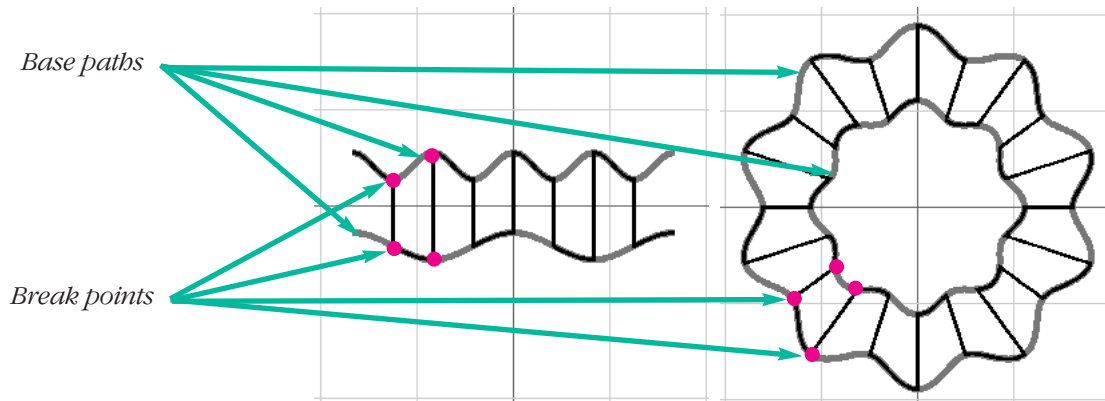
***Notch** content element: between linear and circular base paths*

Unlike other content elements **Notch** content elements are not frequently used in Step & Repeat Sets that modify **Phase** attribute: because of their segmented shape it would be difficult to tell one path of the set from another path. Typical application for **Notch** content elements could be found in thin ribbon like design parts, for example on external borders of design. Paths of **Notch** content elements are shown with color on example below.
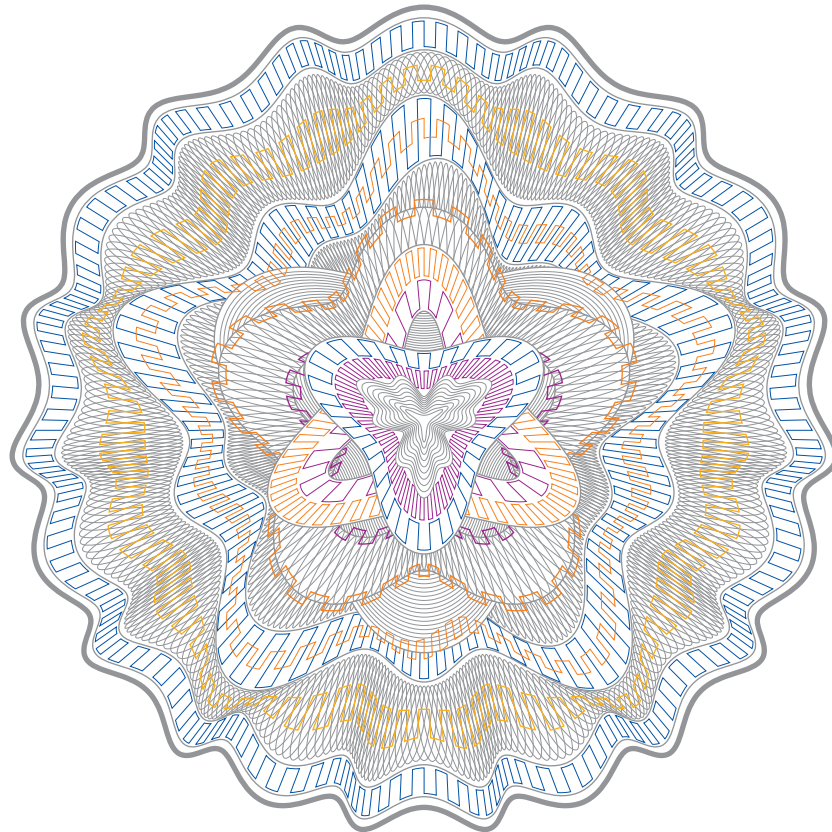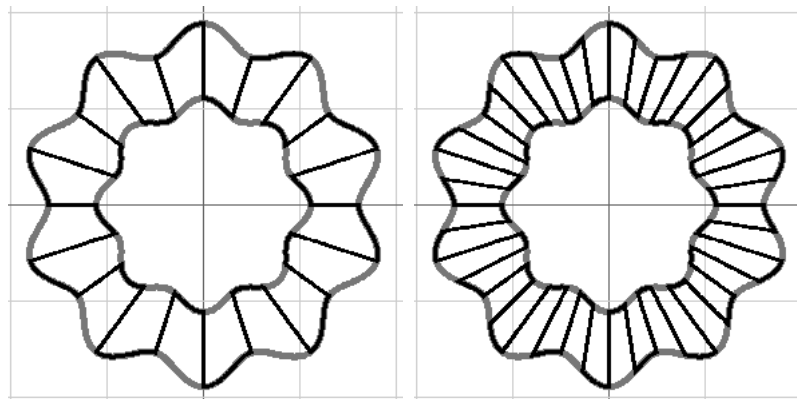
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has four attribute fields for content elements of **Notch** type:


■ **Frequency** defines number of segments path of **Notch** content element consists of. It is a number of times pencil switches from one base path to another and back again while it draws path of this content element. To make shape of the path more interesting you should set this value to or above highest **Frequency** attribute of its base elements.
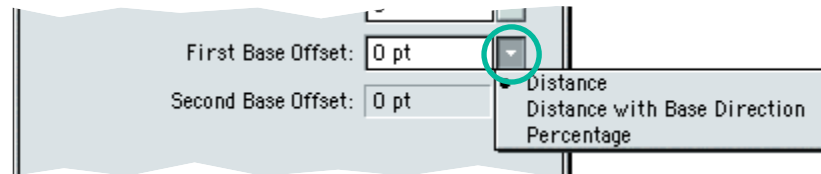

*Notch paths with **Frequency** set to '10' and '20'*

■ **Phase** attribute controls position of path segments. This value is expressed in degrees '°' from [−180°; 180°] interval.
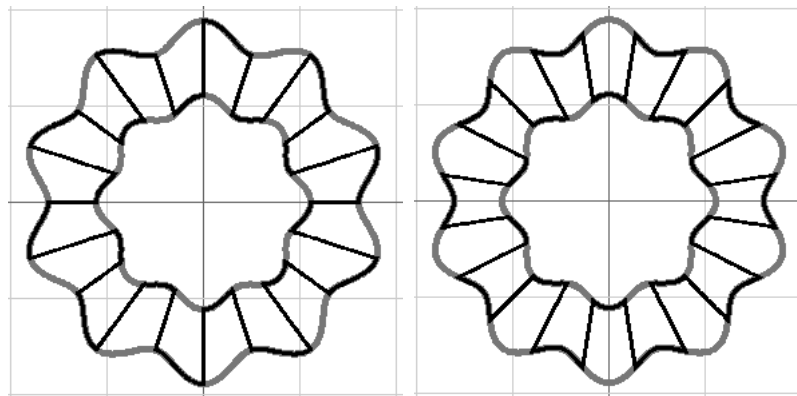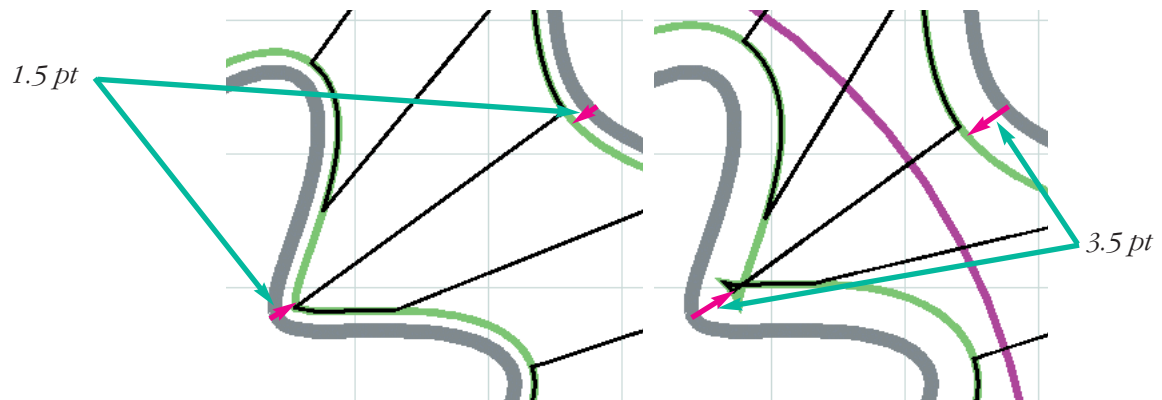

*Notch paths with **Phase** attribute set to '0°' and '90°'*

■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to path segments of content element. When **First Base Offset** and **Second Base Offset** attributes are set to '*0*' path segments of content element lie directly on paths of base elements. There are three different choices for type of these attributes that could be selected from pop-up menu beside numeric value field:
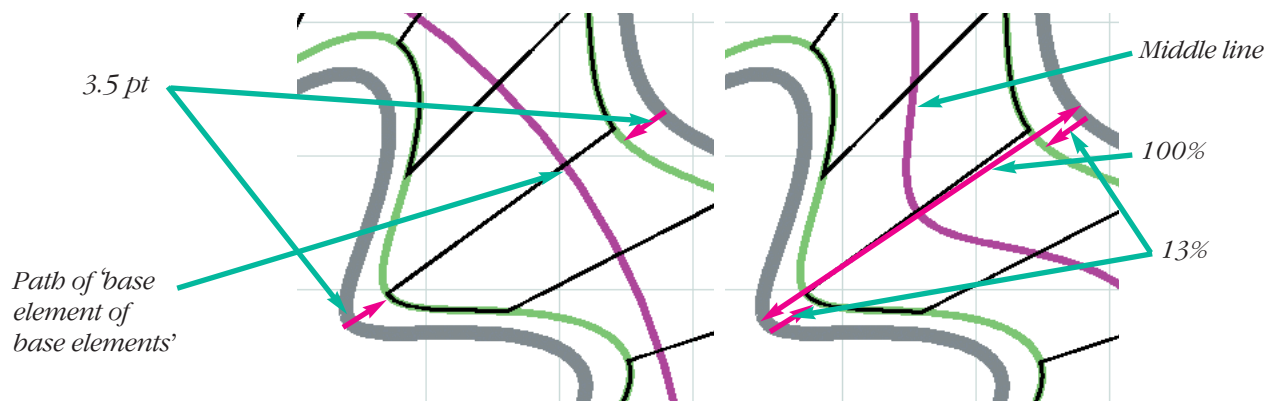

◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on second picture. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.

*Base offset attributes with **Distance** option and values set to '1.5 pt' (left) and '3.5 pt' (right)*

◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units as well. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and could be used to avoid effects of path of content element intersecting itself.

*Base offset attributes: with **Distance With Base Direction** option and values set to '3.5 pt' (left); with **Percentage** option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one more option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be edited from keyboard). Other options are identical to that of **First Base Offset** attribute pop-up menu and allow you to specify desired value by hand (as **Distance**, **Distance With Base Direction** or **Percentage** offset types).

CHAPTER 10: BLEND

Path of **Blend** content element is a graphic representation for effect of merging paths of its base elements one into another. When path of **Blend** content element is positioned close to one of its base paths its shape resembles this path. When path of **Blend** content element is positioned between base paths its shape resembles middle line between the paths. Shape and position of **Blend** content element are defined by **Ratio** attribute.
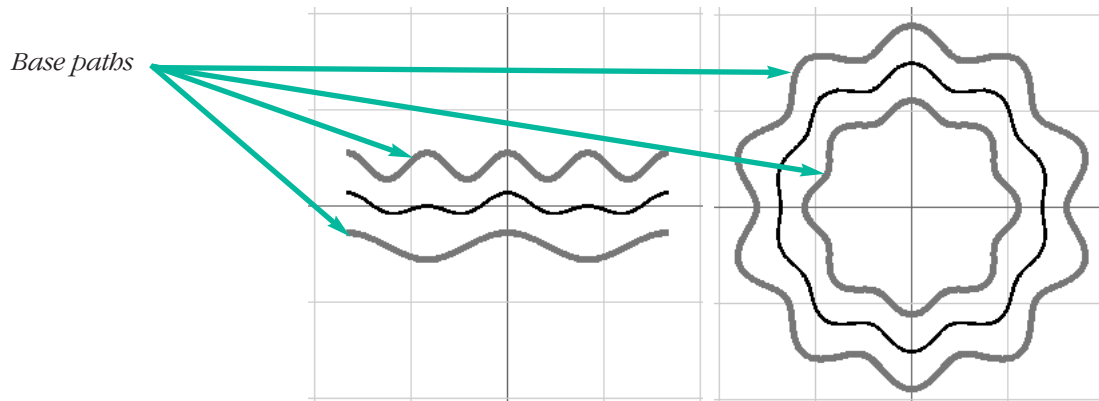
Base paths

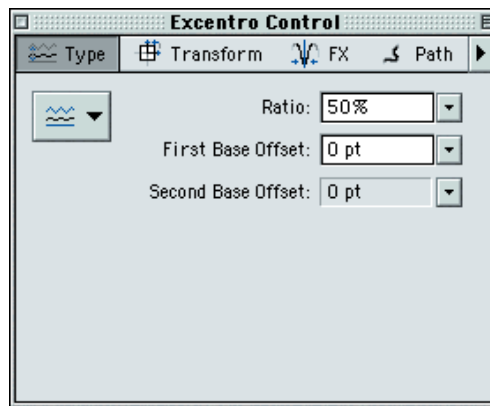***Blend** content element: between linear and circular base paths*

Blend content elements are very popular in guilloche designs. However, they are mostly used in central parts or in thin ribbon-like areas of designs. Example below shows typical applications of this content elements and their Step & Repeat Sets modifications. Paths of **Blend** content elements are shown with color.
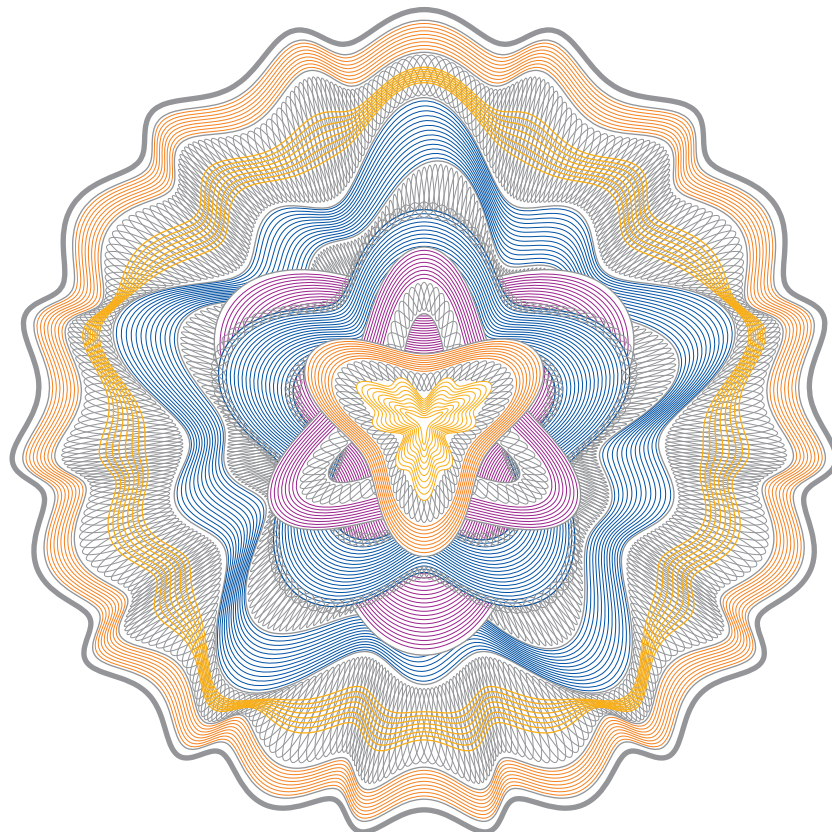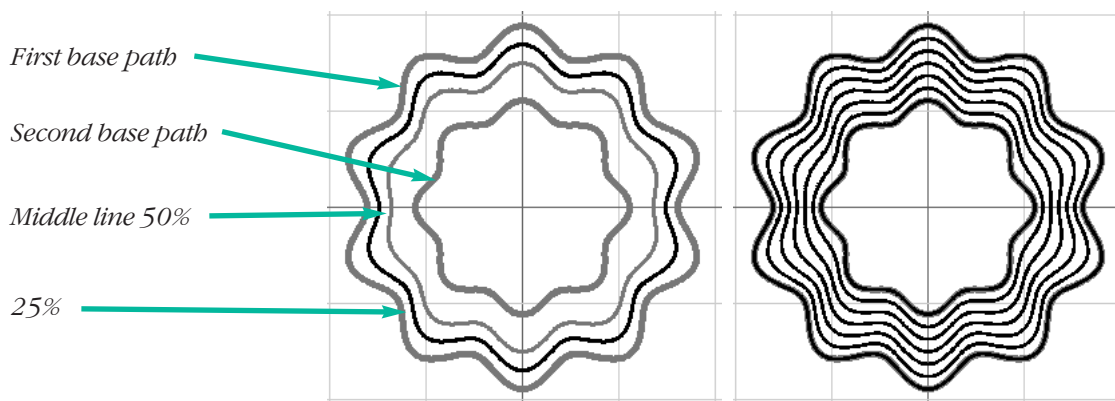
TYPE ATTRIBUTES

Type panel of **Excentro Control** inspector has three attribute fields for content elements of **Blend** type:
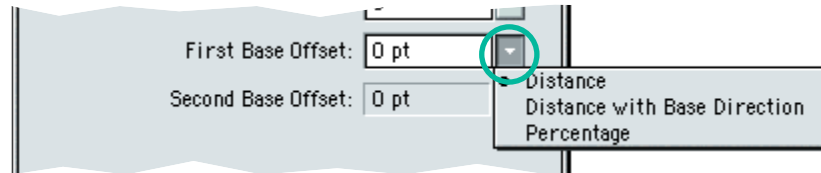

■ **Ratio** attribute controls position of path of **Blend** content element between paths of its base elements. This attribute also defines shape of **Blend** content element path in respect to how close it resembles path of first or second base elements. The value is expressed in percents ('*%*') and defines proportion in which points of content element path divide distance between base paths. When value of **Ratio** attribute is set to '*0%*', path of **Blend** content element is coincides with path of first base element; when value of **Ratio** attribute is set to '*100%*', path of **Blend** content element is coincides with path of second base element. Value of '*50%*' defines middle line between base paths. By creating Step & Repeat Set that covers whole [0%; 100%] interval of **Ratio** attribute values you can create effect of filling space between base paths with uniform vector texture.

First base path

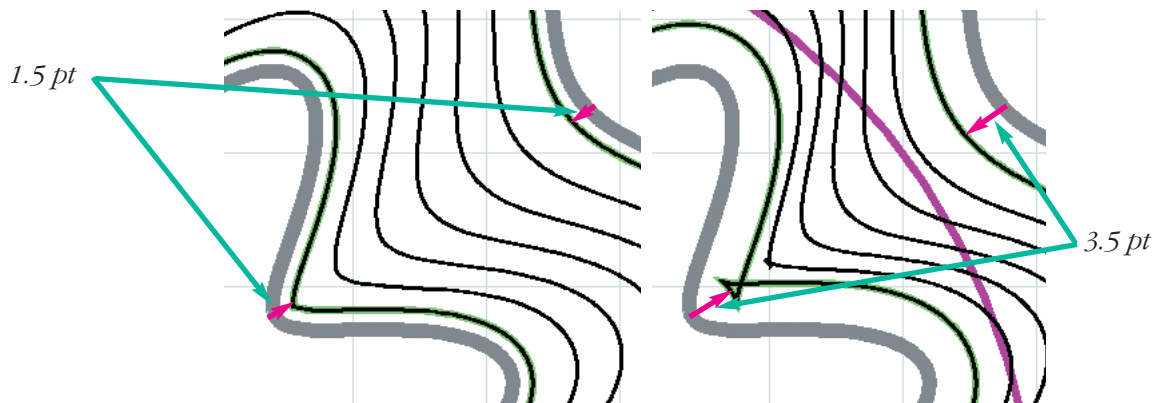*Second base path*

Middle line 50%

25%

***Blend** content elements paths with **Ratio** attribute set to '50%' (gray) and '25%' (black); 'texture' effect with Step & Repeat Set that modifies **Ratio** attribute*

■ **First Base Offset** and **Second Base Offset** attributes control distance from base paths to paths of **Blend** content element with minimum ('*0%*') and maximum ('*100%*') values of **Ratio** attribute. When **First Base Offset** and **Second Base Offset** attributes are set to '*0*' these paths are identical to paths of first and second base elements. Positions of paths with other **Ratio** attribute values are scaled proportionally to fit into space between base paths remaining after these base offset modifications. There are three different choices for type of offset attributes that could be selected from pop-up menus beside numeric value field:
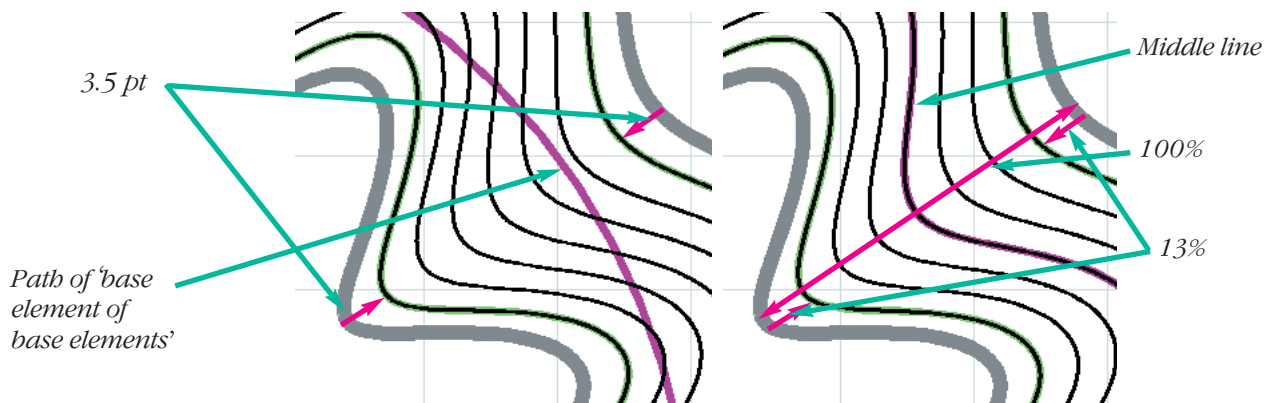
◆ **Distance** offset attributes type sets absolute offset value from base paths expressed in application wide measurement units. This distance is calculated in orthogonal direction to base path (the direction that is at right angle to tangent line to base path in that point). When this distance value is larger than certain amount that depends on shape of base path this option would cause path of content element intersect itself as shown on second picture. To avoid this effect you can either change attributes and shape of base path or use **Distance With Base Direction** or **Percentage** options for this offset attribute.

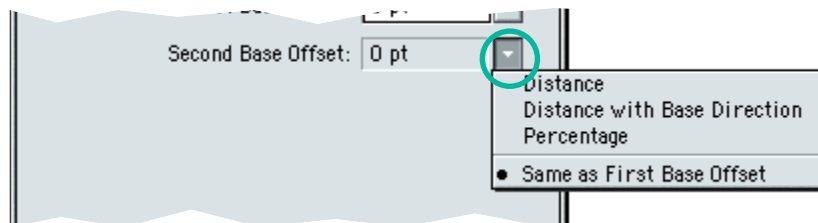*Base offset attributes with **Distance** option and values set to '1.5 pt' (left) and '3.5 pt' (right)*

◆ **Distance With Base Direction** offset attributes type sets offset value in application wide measurement units as well. But in this case the offset distance is calculated in orthogonal direction to path of *base element of this base element*. This option allows for different 'less sharp' direction angles and could be used to avoid effects of path of content element intersecting itself.

*Base offset attributes: with **Distance With Base Direction** option and values set to '3.5 pt' (left); with **Percentage** option and values set to '13%' (right)*

◆ **Percentage** offset attributes type could be used to calculate offset values as percentage of distance between two base paths. Direction of offsets is set in orthogonal direction to middle line between base paths that also eliminates effects of path of content element intersecting itself.

For **Second Base Offset** attribute you have one more option that could be selected from pop-up menu beside its numeric field: **Same as First Base Offset**. This option could be used to set **Second Base Offset** value automatically to same value as **First Base Offset** attribute (in this case value in **Second Base Offset** numeric field can not be changed from keyboard).

Other options from **Second Base Offset** attribute pop-up menu are identical to that of **First Base Offset** pop-up menu and allow you to enter any desired value by hand (as **Distance**, **Distance With Base Direction** or **Percentage** offset types described above).