

# The Science behind the tone wings and why they work

## The Miracle of Sound Making and Hearing

### Miracle #1 (making of sound)

*As if without a thought*, you abstract musical concepts from concrete things, encode those abstractions into a drum beat or a rhythm (or a complex drum solo) and fire neurons in your brain that tell/instruct your trained arm muscles and hands holding the drum sticks, to construct a pattern of motions with foreknowledge of force, energy and determination, placement of the drum stick' tips on the drum head in a series of hits, passes and combinations (holding all that in a set by your brain to a tempo and volume) to create a beat, groove, drum pass to form a sound! Hit it....

### Miracle #2 (hearing the sound)

The sound reverberates through the surrounding air molecules until those sound waves enter your and your hearer's ears, causing their eardrums to flutter and pulse, which triggers their neurons to fire, thus detecting, decoding, and assigning meaning and the significance, complexity, or otherwise skill level at which the drum sound is being made.

*You've effectively shared a musical thought in the form of a drum beat/rhythm with another soul, all within fractions of moments and with little conscious effort. Not all miracles are rare.*

So, while you could, in theory, model the sound of an instrument to create a perfect sound, you cannot do this in practice because the problem is just too complex (no, we still can't model a violin). Stradivarius and his brethren of top instrument makers used many of the most powerful computers known to mankind – our own brains – all working together to find perfection.

## THE WHY of Tonewings

Proven scientific physics of multi-frequency resonances, impulse response filtering, energy transmission, and power leveling; along with the skills of a dedicated craftsman to achieve that instrument's voice can make for something special. That instrument's voice.

However, some vibrations that occur in a drum shell, guitar top, or soundboard of a piano often result in undesirable overlays of vibrations; commonly referred to as overtones. This could have a detrimental effect on the sound perceived by the listener. Imbalance of volumes, uneven duration of tones, and dissonant or dull timbres are sometimes thought of as negatives and are criticized by drummers (musicians) and listeners alike.

Types of materials can also play a factor in determining its voice. Types of metals or acrylics used, origin or geographic location, age, type of woods, etc. Wood density also matters, as density affects the instrument's vibrational efficiency and therefore, the sound quality.

Finishes on those materials also matter. By the late 17th century, the popularity of renowned luthier Antonio Stradivari's instruments had spread throughout Europe. It was rumored that his violins' particular sound quality or voice was due to a secret varnish formula he had developed. In 2006 Professor Joseph Nagyvary at Texas A&M University confirmed that the chemical treatments Stradivari used—which included ingredients such as salts of copper, iron and chromium—could indeed have played a role in affecting the violin's resonance.

**Tonewings** work at this same confluence of physics and craftsmanship and will let you modify the sound of your instrument; regardless of the material type, finish, or design intricacy.

## **THE HOW of Tonewings**

You can't easily alter the sound box or sound hole of your instrument. And why would you do that anyway? Likewise, the materials of a drum shell can't easily be changed. But you can add **Tonewings** to modify the voice of that instrument.

With the installation of the **Tonewings** (number or size of the wings), you can differentiate the vibrations of the drum shell, guitar top, or piano soundboard, to resolve or reduce any irregularities and continue to incorporate and implement individual wishes for the sound. In other words, you can alter your instrument's voice.

We achieve differentiation by attaching **Tonewings** to the drum shell, acoustic instrument top, or the soundboard of pianos. Although the process and the mechanics of installations are a bit different for all of the instruments, the concept, and the results are very similar.

For drums, **Tonewings** are attached inside the shell, directly under the lug, utilizing the same or slightly longer hardware (bolt/screw). Please see detailed installation instructions and samples provided on our website. Other installation options are available.

Due to the weight (added mass) and the material selected (Bell Brass) in the construction of **Tonewings** along with very unique and strategically placed cut-out or relief points (F-holes, cuts, and slits); cause excessive vibrations in the drum shell to be absorbed and processed. Energy deposited from the drum is received and collected in the **Tonewing**; but not canceled or shifted, *In fact, the **Tonewing** actually breaks up the sound wave and/or overtone, making it easier to identify the actual sonic voice of the instrument.* - Kevin Watkins K-Wat drums.

Then alternatively, this energy is poured back into the drum shell in a very settled and uniform way. Previous over-energized areas of the drum shell are shifted to those areas that were previously underutilized (did not vibrate enough). The result is a gain of additional energy, resulting in a very balanced output of frequencies. This significantly improves the sound quality or voice of the instrument. You can hear the positive changes in sound immediately after **Tonewings** are installed. The results create a drum (or other instrument) with a more focused and more controlled voice with fewer overtones and more punch.

## **Resonance frequencies and Mass application**

*“if you want to find the secrets of the universe, think in terms of energy, frequency, and vibration.”- Nikola Tesla*

Resonance frequency is the natural frequency where a medium vibrates at the highest amplitude. Resonance frequency is usually denoted as  $f_0$ , Resonance is witnessed in objects in equilibrium with acting forces and could keep vibrating for a long time under perfect conditions.

Acoustic resonance is a phenomenon in which an acoustic system amplifies sound waves whose frequency matches one of its own natural frequencies of vibration. Acoustic resonance is an important consideration for instrument builders as most acoustic instruments such as the length of the tube in a flute, the string and body of a violin, and the shape of a drum use resonators. Acoustic resonance is also important for hearing.

## **THE Physics**

Even a Small change in the geometry, Mass, or stiffness distribution will influence the Value of the resonance frequencies. Hence another reason why **Tonewings** are effective in influencing the instrument build after the fact, changing an existing instrument into something different, with different sound qualities, addressing imperfections or irregularities in the wooden drums, and enhancing the sound properties of any metal (or drum shell made out of any other material) drum.

Additionally, as the law of physics would dictate, Mass will also equal an addition of surface area, it would depend on the material type and amount of Mass represented. With **Tonewings** in mind and what we are trying to cover; the addition of **Tonewings** to any soundboard, be it drum shell, guitar top, or grand piano, in essence, we are enlarging that instrument' soundboard, making it greater (bigger) or messier (heavier) than it already is. Why do pianists prefer, for example, a Yamaha C9 vs C6, due to the sound it produces, due to the size of the soundboard it possesses, and the sound quality, nuances, and volume it puts out. Why some of the more sought-after drums are

made out of cast or solid metals, mass, and sound qualities they are able to put out. **Tonewings** contribute to both examples, mass as a weight and mass as a surface area, and in none of the instances do tonewings take away or diminish your instrument, on the contrary, they help to make it bigger, messier, and with better sound.

In one of the above-described occasions of Mass/surface area applications, we had installed onto Yamaha C6 our **Tonewings** piano system with magnets, they go on easily with very predicted placing on the soundboard (area of most active energy production, to both absorb and disperse and otherwise shift due to mass added), the piano was well played without any significant or obvious dead-spots or irregularities.

After the installation, the instrument took on the form of a bigger self, with nuances and characteristics of Yamaha C7 and C9 being heard coming out of it, on the lower spectrum and added with high notes played; in sound quality and clarity, pronunciation and notes separation as well.

Later, at the time of tuning (regular occurrence) had to be treated/tuned as though it was a bigger instrument than it actually is, although some of the differences (improvements) progressively got better!!!

Science wins again!