7. Neck and Body of the Guitar

"*For those who are new to guitars: The neck is the long, thin object to which the rest of the guitar is attached."* Yes, that is it, in a nutshell – we certainly may agreement with P. Day here. The rest of the instrument, the body, will be analyzed later. First, let's talk about this long, thin object:

7.1 The Guitar Neck

The neck of the guitar has two main functions: with its fretboard, it serves as a platform for fingering the strings, and it accommodates the tension of the strings. In the case of medium-gauge strings, a pull of 700 N is generated, and in the case of heavy gauge, it may be up to 850 N. This is about the same weight as that of a person (71 and 87 kg, respectively). To prevent the neck from warping under this load, it is reinforced by means of a lightly bent steel rod (known as a **truss rod**) that runs the length of the neck. On one side, the truss rod ends in an externally accessible nut that facilitates adjustment of the effective length, and thus also adjustment of the neck relief. Only those with sufficient experience should undertake adjustments, as the truss rod may break. Occasionally, there are poorly placed truss rods that develop a life of their own and start to buzz. The problem is not so much the resulting soft background noise, but in the fact that vibration energy is lost (dissipated).

The part of the neck that faces the strings is most often formed of a glued-on **fretboard** of about 3 – 5 mm thickness. In the case of Fender, the neck is traditionally made of **maple**, with the fretboard of **rosewood**. However, there are also necks without a separate fretboard (pioneered early on by Fender) – the frets then being embedded directly in this "one-piece maple neck"), or maple necks with a separate maple fretboard (maple cap). Gibson, the other big name in guitars, traditionally manufactures the neck out of **mahogany**, and the fretboard out of rosewood or **ebony**. Many manufacturers also produce specially designed guitars (Custom Designs, Custom Shop Models, Signature Models, Artist Models, etc.), and there are necks made from alternative materials (e.g. carbon fiber, aluminum, walnut, exotic hardwoods, and many others), as well.

In the case of necks with a separate fretboard, the truss rod can be inserted from the front – which is not possible in the case of one-piece necks. For the latter, a groove is milled into the rear of the neck. After the truss rod has been inserted, the groove is covered over with walnut or similar wood. Also available are guitar necks *with* a separate fretboard into which the truss rod has been inserted in this manner. In addition to the decorative appearance of this option, the manufacturer may argue that it improves the sound.

Guitar types may be manufactured for many years (decades), but they are not necessarily always made in the same way. Even the Gibson Les Paul, which was the prototype for mahogany-necks, was made with a maple neck in 1976 [13]. Moreover the construction of the neck underwent changes: originally it was made from a single piece of wood, but for some periods this was switched to a three-part build. The single-piece neck is sometimes said to produce a better sound, whereas the multi-piece neck is regarded as having better shape retention. However, such judgments should be used with caution, as there are single piece necks that retain their shape well, and multi-piece necks producing a good sound.

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At the upper end of the neck (the so so-called headstock or peghead), we find 6 tuners (or machine heads) that the strings are wound on to; the strings then run via the **nut** to the bridge. To assure a secure contact between nut and strings, the headstock is recessed a bit to the rear, or positioned at an angle relative to the neck. This typically makes for a bend-angle of the strings of 5 – 15°, creating a force pressing the strings to the neck of 9 – 26% of the tension force.

A bend angle of 15° will certainly be sufficient to guarantee a solid string-to-nut contact – but 5° is relatively little. For this reason, many manufacturers mount small T-shaped string retainers ("string trees") between nut and tuners – these increase the bend angle for individual strings. In this, always a compromise between good contact and little friction needs to be found. So-called staggered tuners may lend support here: they feature a length of the tuner shaft that varies depending on the associated string.

At its end opposite to the headstock, the neck is connected to the guitar body. Customary are bolted (bolt-on neck) or glued (set-neck) connections. Since the neck is excited to vibrate via nut (or fret) and via bridge/guitar-body, the connection between neck and body must not dissipate any significant amount of vibration energy. This interface therefore needs to be given highest attention. In addition, mechanical stability is to be considered. To "defuse" this system-immanent weak-point, some guitars feature a neck-though construction: the piece of wood the neck is made from runs the full length of the guitar from headstock to end pin. "Wings" are glued to this center section to form the actual body. This is a good solution – as long as the neck does not break. In that unfortunate case, a bolt-on neck would be much preferable because the neck can be easily exchanged.

More expensive guitars often sport a neck-**binding** consisting of a narrow ornamental strip running along the rim of the fretboard. Multi-layer binding is sometimes called "**purfling**". Binding will upgrade the looks of a guitar, any effects on the sound are extremely likely to be negligible. We did, however, not test this by measurements.

The surface of the neck pointing towards the strings is given a slightly convex shape in the direction perpendicular to the strings; the backside is of half-round shape (**Fig. 7.1**). The profile is V-, U-, D-, or C-shaped – or whatever other designation the marketing departments come up with. Objective criteria for good or bad neck profiles can only be determined at the extremes – in the end, every guitarist needs to decide individually what feels good to him or her, and lets him or her play well. If – as taught for classical playing styles – the thumb is placed behind the neck, V-profiles are not likely to please: these are more suitable for players whose thumb traverses the whole neck circumference and sticks out over the fretboard.

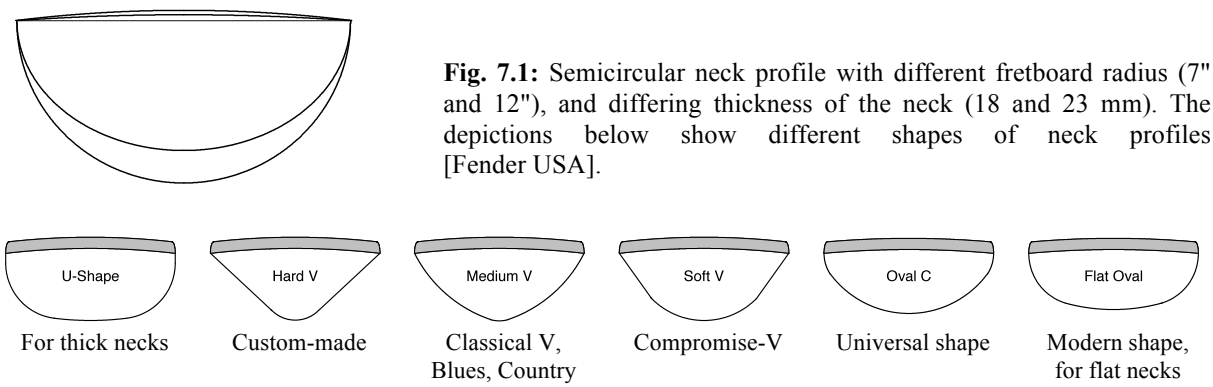

Fig. 7.1: Semicircular neck profile with different fretboard radius (7" and 12"), and differing thickness of the neck (18 and 23 mm). The depictions below show different shapes of neck profiles [Fender USA].

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The **round of the fretboard** is defined as the radius of the transverse contact circle. A stronger round (= smaller radius) matches better with the flexion of the fingers and makes playing chords easier, while a flatter fretboard facilitates string-bending (in the direction of the frets). Again, it will be a subjective decision which fretboard-radius is seen as an optimum. As a standard, guitar manufacturers offer dimensions from 7.25" (18.4 cm, for example vintage Fender), via 12" (30.5 cm, e.g. Gibson) up to more than 16" (40.6 cm). Occasionally, fretboards with a "compound radius" are found: the radius changes along the neck e.g. from 11" – 14".

In combination with the profile, the **thickness of the neck** is specified at the 1st and the 12th fret. There are slender necks with a thickness of 1.8 – 2.0 cm, and 'baseball bats" of 2.3 – 2.5 cm (or even more). Our fingers and hands sense already very small differences. The width of the neck is not standardized, either: it varies (measured at the nut) between 1 5/8" and 1 7/8" (4.1 and 4.8 cm). Narrow necks are advantageous for short fingers but require more precise fingering. Towards the higher frets, the neck usually gets wider: at the 12th fret, we typically find a width of 5.1 – 5.5 cm. All these measurements hold for 6-string guitars; for 7- and 12-string guitars, the width of the neck at the 1st fret will be about 4.8 cm.

The graphs in Fig. 7.1 show the round of the fretboard – but this should not be seen as a purely cylindric round. Rather, there is slight concave curvature also in the direction of the strings. Pressing the down the string at the same time at the first and last fret will not make the string touch the frets in the in-between area – a distance of a few tenths of a millimeter will be retained. Small divergences may be corrected by dressing the frets and/or adjusting the truss-rod, larger deviations require sanding down (honing) the fretboard and installation of new frets – a task for the luthier, not for your DIY "Tim-Taylor-Home-Improvement"-approach.

As the interface between musician and instrument, the neck is of central importance for playing the guitar. A **bent neck** hampers playing or even renders it impossible. *Bent* implies here that the surface of the fretboard diverges from its optimum shape (**Fig. 7.2**). A twisted neck (right-hand figure) may lead to laying down the guitar in its final resting place – but in rare exceptional cases it is the expression of a special art of guitar construction (Lace guitars).

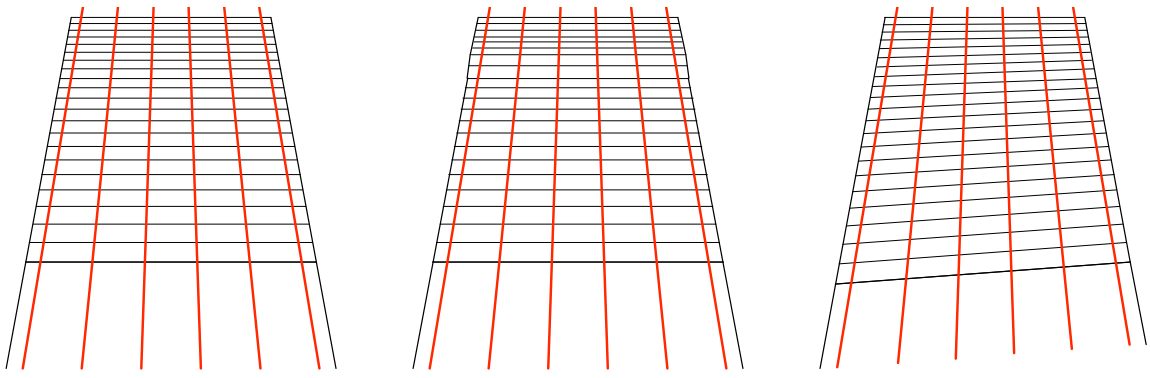

Fig. 7.2: Fretboard (schematically), seen from its headstock-end. The neck shown on the left is in good order, the other two necks are warped and twisted, respectively.

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