Late-Gothic architecture is rich by its variety in shape and constructive backgrounds. The English heritage is quite distant from the examples found in France or those from Germany and surroundings or those from the Iberian Peninsula. Yet, due to international contacts in detail mutual influences may be recognised, like English influences in Portugal, or French in Spain.

The specific kind of vault geometry in the Late Gothic period, to be presented here, has certain characteristics, which makes it ideal for a rational analysis and description. Throughout central Europe we may find examples with varying patterns, called “reticulated vaulting” (German: Netzgewölbe, Sterngewölbe). Early examples of this development of the ordinary Gothic cross ribbed vault, can be found around 1385, in the St. Vitus Cathedral in Prague, which was at that time renovated by Peter Parler. The summit of development of the Netzgewölbe are the Schlingrippengewölbe, which show a rib system of spatial loops and, projected on the floor plan, a circular vault pattern. Benedikt Ried built, around 1500, in the Prague castle some of the most remarkable loop rib vaults.¹

As subject for case studies on the Netzgewölbe figure the cloisters of two monasteries, Kloster Hirsau and Kloster Alpirsbach in the German Black Forest.² Both monasteries were initially built in the Romanesque

¹ Muk [8].
² Both surveys were done by the author on behalf of the German preservation authority Landesamt für Denkmalpflege Baden-Württemberg, Aussenstelle Karlsruhe. The work, aiming mainly at the (theoretical) reconstruction of lost vaults, was done in a research team in preparation of main publications on the two Monasteries (Schreiner [13] and Landesdenkmalamt BW [6]). Many insights, plans and data were due to team members, mainly O. Teschauer, A. Seeliger-Zeiss, U. Knapp (measured drawings of Alpirsbach cloister) and R. Hajdu (photographic documentation of the rib cross elements in Hirsau). Of special importance for understanding the geometric construction of the Prinzipalbogen were personal contacts with Werner Müller (+ 2005). Complete results in Tomlow [14] and Tomlow [16].
style. Kloster Hirsau, may be regarded as of major importance, both because of its big dimensions, as well as since its name stands for an own building style (Hirsauer Bauschule), also applied on the Alpirsbach parts of Romanesque times. The Netzgewölbe of the monastery cloister in Hirsau date from 1482–1495 and that of Alpirsbach from 1480–approx. 1495.4 Both cloisters are typical examples of a renewing phase of the Romanesque monasteries, with the aim to substitute the formerly open and windy cloisters by a glassed and vaulted cloister. A certain degree of economic and political stability favoured this process, in which also church building activity in southern Germany increased. (For details, see the pictorial evidences at the end of the chapter.)

From a design theoretical point of view, one could define the Gothic style as one of "intelligent adaptation".5 Whereas in Romanesque times, vaults were bound to fit in a rigid grid system, with, as the single element, a square vault plan, the Gothic building master could choose the proportion between the width and length of a vault part. This choice option may lead to intelligent use, when the proportions of vault parts were chosen in such a way, that static equilibrium was established between neighbouring vaults of different span.

Why was the Romanesque vault bound to a square plan? The reason was that the semi circle Roman arch had a fixed proportion of height compared to span in a ratio 1:2. If the radius of one of the arches would be enlarged, instantly problems would occur to define the vault’s shape. The ogival Gothic arch—of Arabic source—had the possibility to vary both span and height. The same was possible for the crossing rib.6 So we have a maximum of freedom for a shape, ready to be used for any kind of purpose. More important was that any of the possible shapes was strictly defined by rules of geometry.

In Late-Gothic times (15th C.) only a reduced number of sciences could be judged to be "exact". Most writings were trivial, speculative,

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3 Schreiner [13].
4 Landesdenkmalamt BW [6], p. 396.
5 One has to remember here that the word “Gothic” as well as “stile tedesco” (German style) stand for a barbaric attitude, with clearly negative meaning, as compared to the Italian classic antique tradition, with its strong symmetrical features. However, exactly the freedom in design favoured the structural inventions of the Gothic style.
6 Already in Roman and Romanesque times the ellipse was part of the shapes of a groin vault. It is a vault produced by the intersection at right angles of two barrel vaults. The diagonal curves are ellipses. One may observe that the ellipse as a geometric shape was not necessarily known by the builders, since it results from the Roman arch shape of the barrel vault during building, resulting in a logical connection.