

THE BASIS OF THE GOTHIC STYLE

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A building is more than an assemblage of materials to provide a shelter for man. It is an expression of the society that created it, its forms shaped by the outlook, values, orientation and maturity of the society, and reflecting the nature, strengths and weaknesses of the various aspects of the society.

It in turn shapes and directs the society in its role as a container for its activities and as a physical expression of its culture. The impact of a building often lasts far beyond the ideas expressed in and by it, as the architecture of Imperial Rome has even today an effect upon the Italian people by recalling to them the achievements of the past and allowing them to share vicariously in its grandeur and achievements rather than to use their own efforts to develop an architecture and culture relevant to their own time.

As our society becomes more urban, buildings form an ever increasing percentage of our physical environment. Their role as a physical container of our activities, forming a constant concrete referent to our actions and thoughts, increases the need for a stronger understanding of their effect upon the society, and an ability to express well in them the philosophy, outlook, and feelings of our society. A clear understanding of the role of buildings in history can help us greatly toward a better understanding of the problem.

Our knowledge of the architecture of the past must often be reinterpreted as our understanding of it grows, and as we gain historical perspective and escape many of the biases of previous periods.

Our understanding of the Gothic period has changed from an outright rejection during the Renaissance, of the emotionality expressed in it, to a structuralistic explanation concurrent with the development of structural theory and the technological age. Today, because of the subsequent development and expansion of the social sciences, we are able to reinterpret the development of this architecture on a broader basis and, with a greater knowledge of the range and importance of the many factors that contributed to its development, obtain a fuller and more accurate understanding of it.

The development of the Gothic spirit in the late Romanesque period was a result of the change and development of European society from the eighth through the eleventh century, and of the final renaissance and reconstitution of the culture following the ending of Roman influence in Europe and the assimilation of eastern invaders into the society.

The establishment of the kingdom of France by Hugh Capet in 987 A.D. initiated a process of checking the power of the feudal barons over the people. Combined with the growth of independent cities, this caused a change in the structure of society which added impetus to the development and crystallization of its institutions and conceptual patterns.

The development of Christianity continued and great strides were made in the relation of its theology and practice to the society of its time. The harmony of its philosophy with the life of the people reached a level unequalled in the history of European society. Its process of educating men to the ethos "not based on might or right, but on conviction and the communality of moral attitude"¹ had largely been accomplished by the eleventh century and all of Europe moved on the basis of Christian morals. There were, of course, men whose actions were diametrically opposed to this doctrine, but few dared to profess openly a doctrine differing from that of the church.

By the eleventh century feudalism had become general, with order and stability established over much of Europe, while the growth of the power of kings acted as a control upon the power of the barons. Society was organized upon the basis of sovereignty and personal loyalty and obligations, based upon the Christian ethic. Secular government was centered on small local political spheres, as the low technological level and difficulty of communication hindered centralization.

While the political power remained in the hands of local barons, the power of the church, centered in Rome, grew, establishing uniformity of doctrine and giving impetus to the development of a common religious, philosophical and moral system throughout Europe. The monasteries, which preserved the remains of the Roman civilization through the period of confusion following the fall of Rome, and which were the developers of the Romanesque architecture, had been federalized by the Cluny brotherhood. The return to stricter religious principles and reform of the clergy from their earthly ways prompted a return to religious zeal by the people,

The monasteries under the control of Cluny followed a common policy, treating their serfs as human beings, with justice and kindness, and introduced Christian ideals into the relations among the people. The church tempered brutality and transformed chivalry by the introduction into it of religious ideals, transferring emphasis from self to mankind.²

The rebuilding of a social order in Europe caused a change away from many concepts carried over from the Roman culture. The independent existence of the individual was starting to be felt and a new spirit permeated the society, based upon the value and dignity of the individual man. The establishment of cities, often by feudal nobles as a means of augmenting their income by increased land rentals, permitted people to live separated from ties to the land, giving them freedom of movement and prospects of economic independence,

Scholasticism was applying logic to philosophy, and man was beginning to realize his capacity to control his environment, and the potential growth of his understanding of himself and of nature. With the growth of philosophical schools, a blending of the feudal sense of personal worth with the philosophical doctrine of the reality of the individual caused a flourishing of means of personal expression.³ *Chansons de geste*, epic poetry, frescoes, sculpture and stained glass, as well as architecture, reached a state of mature and creative development.

During the Romanesque period man recognized the concept of God as the highest power, unapproachable and judging, while in the Gothic period he thought more in terms of the approachability and love of God, and his closeness to man through Christ and his suffering.⁴ This change appears and is expressed in the cathedrals in the change from a frontality and formality of the parts to an obliqueness, as in the arrangement of pier clusters; a change from independent special units to a unification of the space; and through a greater continuity and interdependence of the various parts of the cathedral in an attempt to symbolize the disappearance of the boundary between God and man.

Gothic architecture is an outgrowth of Romanesque architecture and not an independent phenomenon in so much as the society of the twelfth and thirteenth centuries is an outgrowth of that of the preceding centuries. It is the expression of a later, more mature and stable society, building upon the achievements of its predecessor, a society in which a more mature and sophisticated understanding of God, man, and their relation was to lead to a new and stronger architectural expression of religion through the building of the Gothic cathedrals.

As a culture or society changes and matures, so its spiritual needs change and evolve along with the other spheres of the society. These changes in spiritual needs, along with changes occurring in

other sectors of society, caused a failure of the old Romanesque architecture to express the needs of the changed religion. The realization of these changes, whether conscious or unconscious, set the stage for the development of a new architecture, expressive of the changed society.

This spirit of optimism and faith in man's powers, the existence of religion in harmony with the age, the general renaissance of culture and the growing strength, widening economic base, and maturity of the society formed the conceptual framework for the medieval architects or master masons to develop a new architecture. As the evolution of these new social concepts was a gradual one, so the evolution of the Gothic style from the Romanesque was a process of continuous evolution, not revolution within one building.

No one building or one architect can be credited with the development of the Gothic style, as the process of obtaining a new and relevant vocabulary of expression and the experimental combination of this vocabulary was a continuum from the late Romanesque through the high Gothic period. If any single date or building is cited in relation to the beginning of the Gothic period, it can be understood only as a point where enough of these features have been combined to make an expression which, although not complete or mature, can be understood to be developing in a direction different from the previous style.

The 1140 A.D. addition to the abbey church of St. Denis under Abbot Suger is most often given as the first clear expression of the Gothic spirit.⁵ In this church, of much importance as the burial place of the kings of France, the ribbed vault was combined with windows of greatly increased size, filled with stained glass and forming walls of light pierced by vertical piers which reached up to support the vaults, to create a clear expression of the new religious spirit. As many of the characteristics of the mature Gothic style, such as flying buttresses, which were not added to this church for over a hundred years, were not yet developed, the expression was not complete but had been visualized and expressed in part.



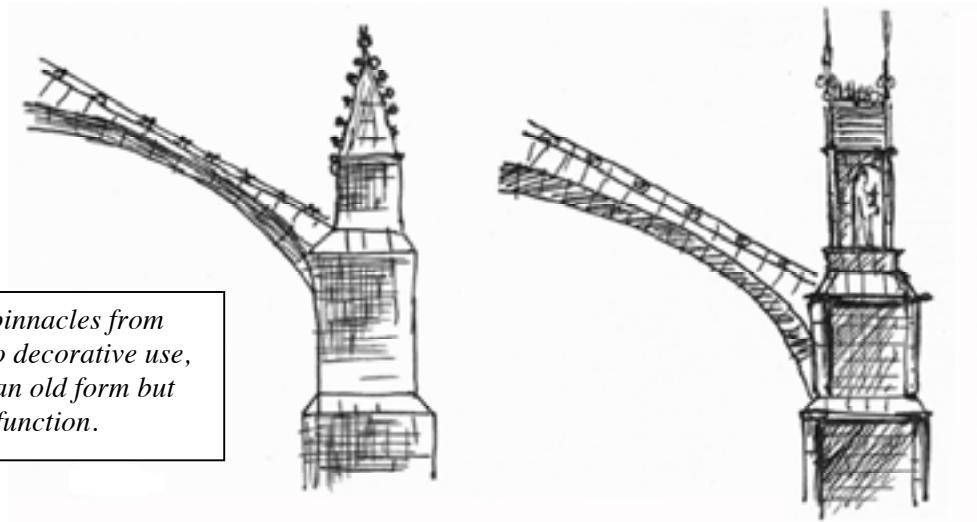
Abbey church, St. Denis

The basis of the Gothic style was not the rib-vault, the flying buttresses, the cruciform plan or stained glass, all of which existed previous to the development of the style, and which alone, or combined without direction, could not create Gothic architecture, but was the religious vision or philosophical concept which under laid the development of the style, and which gave direction, unity, and spirit to the recombination of these elements with the existent Romanesque church to create the expression of this new concept.



Abbey church, St. Denis

There was obviously a strong interrelation between the structural development and the aesthetic expression in the Gothic cathedral, though the relation was quite complex, with both factors being contributors as well as receptors. There were many instances where a development that was originally structural innovation lost its function and became structurally redundant as its aesthetic possibilities were developed, as in the case of pinnacles, whose weight originally helped to deflect downward the thrust of the vaults, but which later became lightened as their aesthetic possibilities became known.



Change in pinnacles from structural to decorative use, preserving an old form but with a new function.

On the other hand, such items as flying buttresses, whose original adoption was on aesthetic grounds, made important structural contributions as their overall potential was developed. Though we often credit the master builders with knowledge of structural theory which it is doubtful that they possessed, the development of the essential features were not arbitrary or

independent inventions, but were based on principles gradually deduced intuitively from practice, and determined by the mechanics governing the structure, as well as by a finely creative aesthetic sense.

The structural development of the rib-vault is usually credited with having permitted the development of the Gothic style. As alternative structural systems, easier to construct and superior in operation to the rib-vault, were available to the medieval builders, which would have permitted the same development structurally, the use of the rib-vault was not necessary and the use of it could only be based on its aesthetic superiority.

The use of the vault to enclose space developed from a principally structural use at its origin to one largely aesthetic by the Gothic period. The use of the vault originated in the dry Mediterranean countries and in the Near East, where wood was scarce, as it permitted the use of unit masonry to span large distances. Originally it formed ceiling, structure, and weather membrane, but as its use spread to regions of heavier rainfall and more severe weather fluctuations, additional weatherproofing was needed.

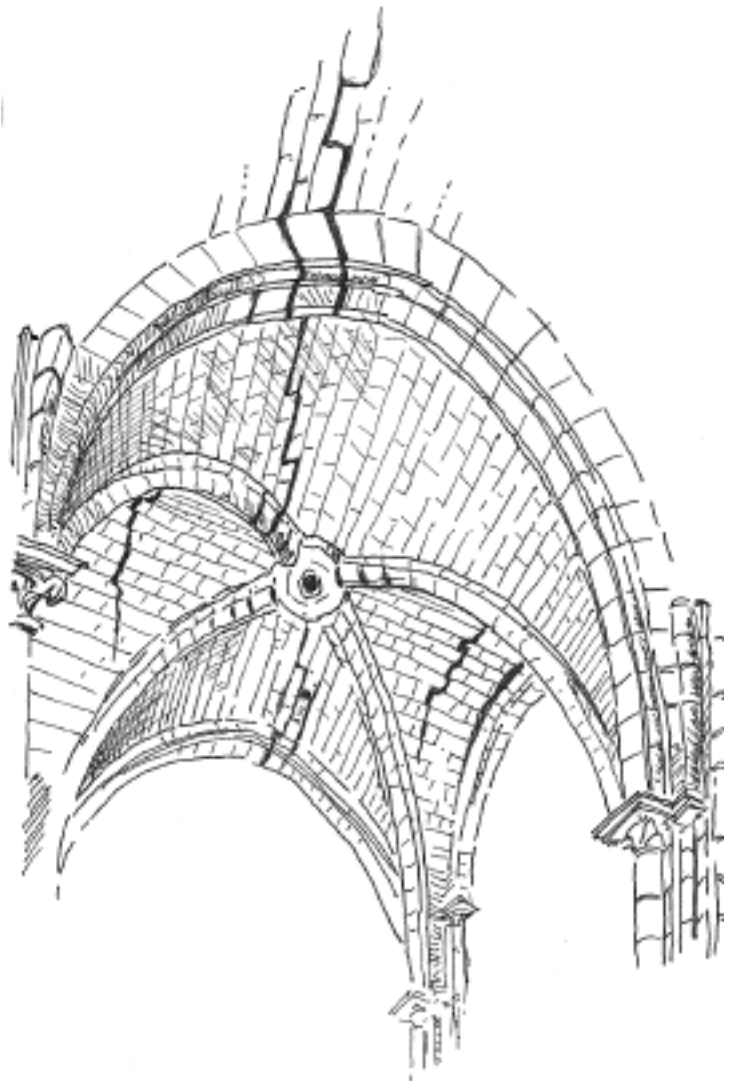
The Romans made frequent use of the arch and its vault and dome derivatives, using them in small construction covered with rubble fill and topped with a tile roof, and in large construction, such as the Pantheon, as an independent dome sheathed in metal.

The Byzantines continued the development of the dome, and by the Romanesque period vaulting, though of a low degree of sophistication, was again used in the West, usually as a tunnel or square bay vault protected from the weather by a separate wood truss roof system above it.

By the Gothic period, then, the vault had come to be used merely as a method of spanning interior spaces . . . as a ceiling rather than as a structurally complete roofing system.

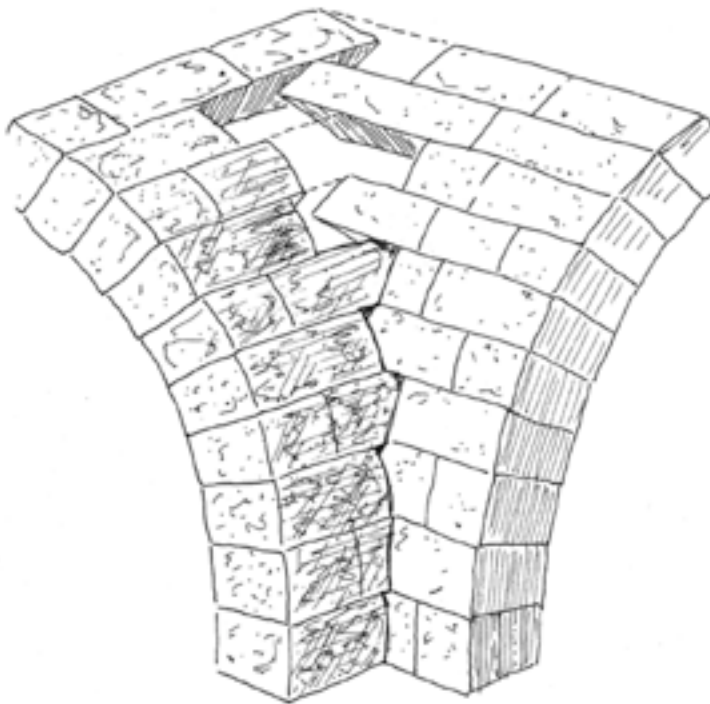
Typical fissuring in gothic vaulting, usually caused by differential settling of piers or pulling away of side walls. Lack of cracking at intersection of webs indicates the strength of the intersections in relation to the cells themselves.

(after Pol Abraham)



The use of stone ribs structurally to stiffen the wood centering during the construction of the vault itself had been used by the Romans as early as 125 A.D. in the cellar vaults of the Villa Sette Bassi near Rome, and in the Forum at Aries in 310 A.D., though in the finished work they were covered with plaster and were not expressed aesthetically.⁶ The use of ribs for aesthetic effect and for stiffening of the finished vault was used at a much earlier date, as in the Pantheon in 27 B.C., and later in Hagia Sophia in 537 A.D.

The ribs did have a function in the construction phase, though not of the degree of importance as its aesthetic function in the completed structure. The maintaining of an even curvature of a vault and prevention of deflection as the wood centering was loaded during construction had long been a problem, which was to a large degree solved by the use of the stone ribs to stiffen the centering. The use of ribs also lessened the need for precision fitting of the adjacent sections of the vault by covering the joint.

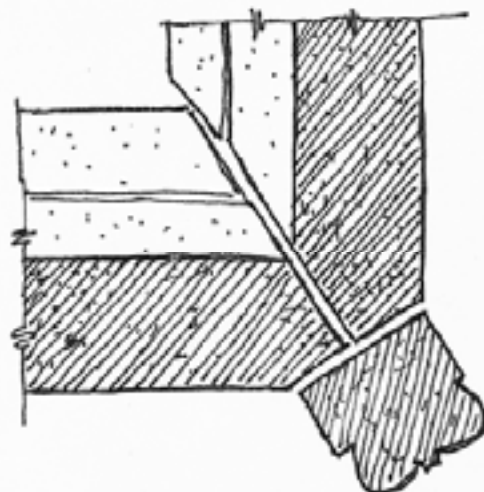


Interlocking voussoirs (after Viollet-le-Duc), showing difficulty of joining vaulting panels, as web courses lack mutual conformity, especially in higher courses.

Although at times they actually added stiffening, the ribs usually did not function structurally in the completed vault, as can be seen in such cases as San Giles, Gloucester, and Moissac, where the ribs were actually separated from and of different curvature from the vault, with the gaps being

filled with rubble.⁷ Also, in many instances where the building was damaged during the war, the vault shell has remained in place while the ribs have fallen, or ribs have remained in the absence of the vaulting cells, indicating that they were structurally independent systems.

Section through vaulting, showing joining of two webs, with the use of the stone rib to cover joint and brace centering during construction.



During the late phase of the Gothic style, the ribs were often designed as flying ribs, often separate from the vault for several feet, as in the choir of the Cathedral of Freiberg and other buildings.

Rib vaults also are said to have permitted the lightening of the vault itself by adding stiffness to the system. Actually, the intersection of the vault cells, where the ribs were added, were not the weakest part of the system, as earlier thought, but due to their three dimensional nature were actually the strongest, as observation of vaults shows that the actual stress crackage of vaults usually takes place in the shell itself, rather than at the intersections of the shells.⁸

The lightening of the vault actually developed with the increasing sophistication of the builders in making possible the construction of vault shells with two-directional curvature, giving a structurally stable vault with a much smaller thickness. The primary objective of using the ribs seems to have been “its appearance of immaterial lightness, rather than any actual lightness.”⁹

The use of the ribs, then, was not a structural necessity, and usually contributed nothing to the gathering and transfer of forces to the shafts and piers. They did, however, have an important aesthetic function in addition to their use in construction, in that they maintained the continuity of the lines of the shafts and piers and appeared to gather the forces to them, while seeming to support the vaults.

*St. Barbara,
Kuttenberg. 1512.
Change of use of
ribs from
expression of
structural function
to a purely
decorative use.*

Flying buttresses, pinnacles, rose windows, elimination of the wall, verticality, partiality and fragmentation of space, and the effect of growth were all possible with the groin vault or, in a less developed aesthetic system, with any other type of vaulting; and, to some extent, even with the truss. The use of the pointed arch did allow the lightening of the vaulting and lessening of the horizontal thrust, permitting the greater heights of the cathedrals, but the rib seems only a means of achieving aesthetic unity of the design.



The use of it may have helped them to visualize and grasp the spirit they were attempting to portray, and to develop and refine the expression of it, as well as to help them to intuitively grasp the true structural principles of the system, allowing further development of it, but was not a necessity to its development.

In buildings with spans of the magnitude of those in the Gothic cathedrals, a pure truss roof system, such as those used in Early Christian basilicas, formed a lighter and more easily constructed structural system. The problem of permanence of the wood didn't seem to be a problem when used in well ventilated spaces above the ground, as attested by the excellent condition of the many English medieval buildings with intricate wood truss systems.

The use of a truss system instead of vaulting would have lessened the need for the elaborate buttressing system which had to be developed as the height of the Gothic cathedrals increased, as only stiffening would have been necessary for the walls, and there would have been no horizontal thrust from the vault to restrain externally. Even the openness of the Gothic walls would have been easily attainable with the truss, as longitudinal arches at the top of the clearstory wall would have gathered the load and spread it to the piers in the same fashion as the actual roof loads in the Gothic cathedrals were resolved.

Many of the transitional and early Gothic churches were built originally without vaulting, employing only a flat wood ceiling fastened to the underside of the truss system. St. Etienne at Caen, in 1065, was built with a flat ceiling, and St. Trinite, in 1059 A.D., was built with a flat nave ceiling and groin vaulted side aisles.¹⁰ Both had their flat ceilings replaced with vaulting in the second decade of the twelfth century.

The fact that many churches later added vaulting in place of the original truss system, even with it not planned in the original building, and the often concealing of the truss by covering the lower member with coffering indicates that the truss was felt to be inadequate aesthetically.

Earlier experiments, such as made in San Zeno Maggiore at Verona, Italy, in 921 A.D., where a split wood tunnel vault was used, indicate that attempts were being made, even at that time, to improve upon the aesthetic and spatial qualities of the existing wood roofing system.

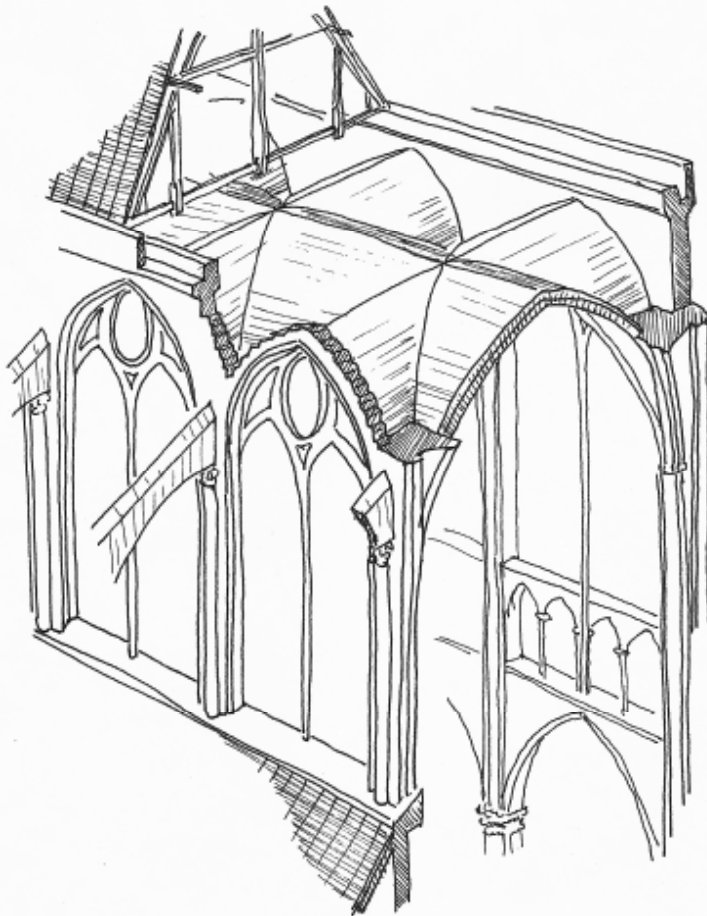
*Basilica of St. Zeno, Verona.
Diaphragm arches perform tying
function, bracing nave walls.
Double wood vaulted ceiling painted
to match wall color used in attempt
to improve aesthetic quality of the
wood truss roof.*



The use of stone vaulting maintained the continuity of the wall material and prevented the abrupt change of color and direction which occurred with the truss system. The apparent lightness, appeal and novelty of the curved form, and the visible strength and apparent simplicity of the vault in contrast with the truss added to the appeal of vaulting.

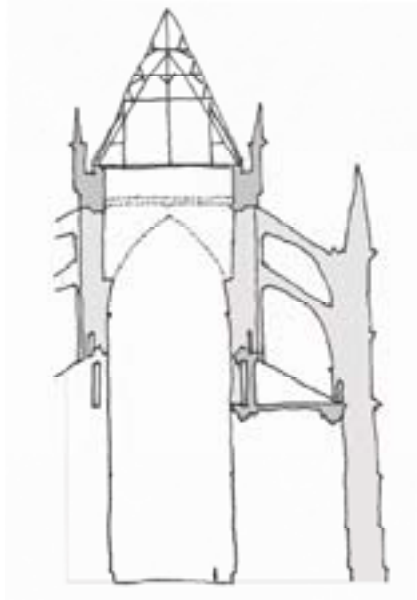
Functionally, the use of the vault had several disadvantages, in that it created an extra weight to be carried by the walls and formed an outward thrust which had to be restrained either by the use of internalities, thick walls, or external buttresses. In addition, they were of considerable extra expense and created many technical problems. The development of the cross vault or groin vault improved upon the tunnel vault structurally by concentrating the forces at the corners of the bay, permitting the reduction of the walls between the corners of the bay and an increase in the allowable window sizes.

There were several advantages to the use of a stone vaulted ceiling in connection with a wood roof structure, though the use of the wooden truss roof alone continued. The use of the vault permitted a more fireproof building, perhaps maintaining structural integrity even if the roof burned off, as sometimes occurred. It formed a tie and bracing between the walls of the nave, though diaphragm arches used in many Early Christian churches performed this function adequately, though in a less aesthetically pleasing fashion compared to the vault.



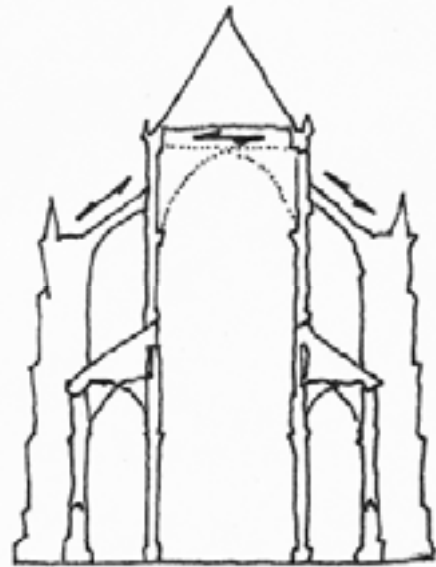
View of construction of cathedral, showing relationship between the roof system, vaulting, longitudinal wall arches and exposed buttressing. (after Fitchen)

Many of the advantages attributed to the vault are not as great upon analysis as they first appear. The vault's function of tying the walls together was even in the high Gothic cathedrals performed by the great wood roof structure in conjunction with the buttress system for many years until the completion of the vaulting, which was one of the last phases in the construction, usually carried out as time and money permitted, after the completion of the roof gave weather protection to the interior and made it useable for services.



a) Relation in the cathedral between roof structure and masonry before construction of the vaulting.

b) Bracing function of the roof and buttresses before construction of the vaulting.



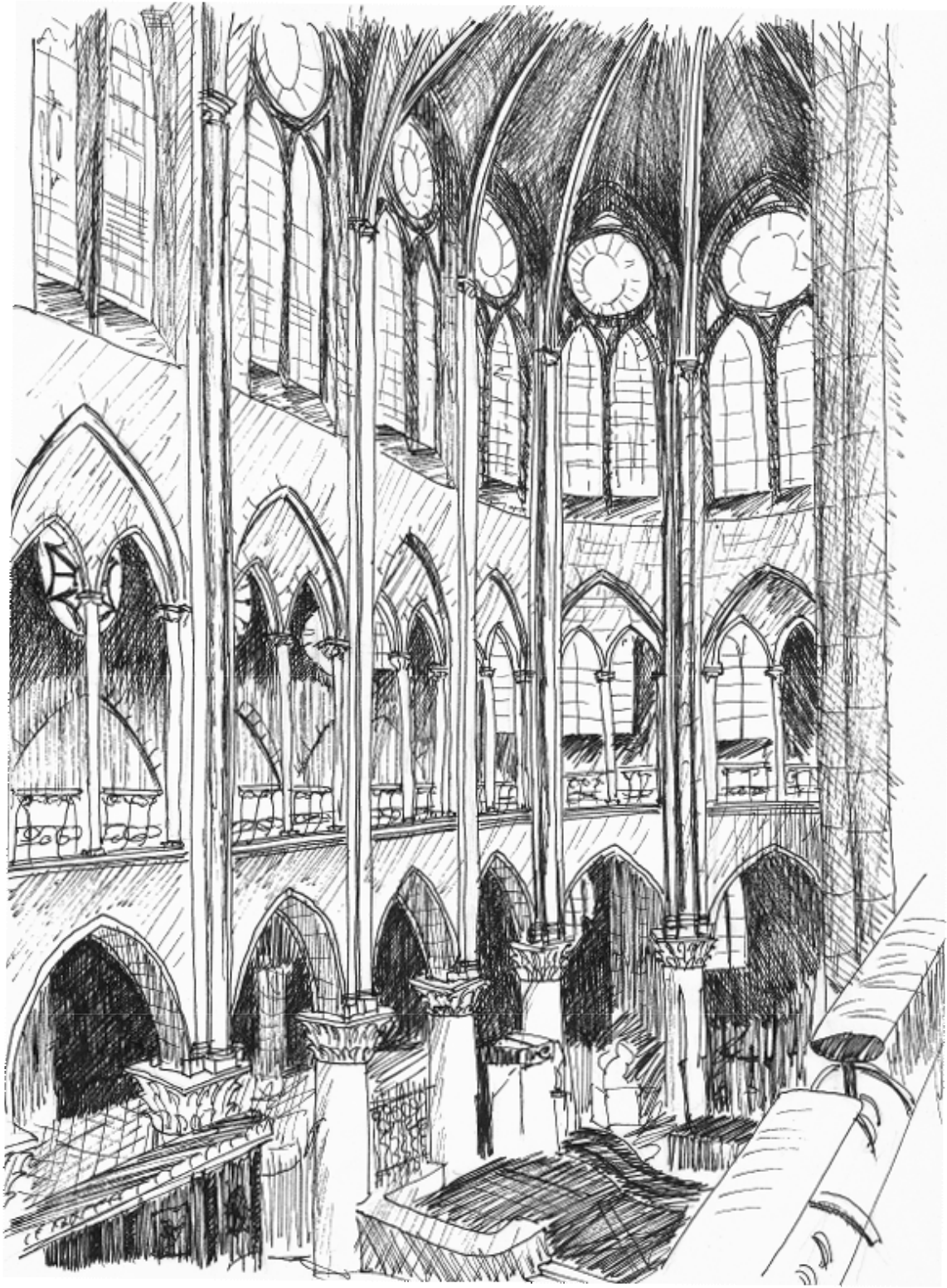
Abbot Suger, in his account of the building of the choir of St. Denis, gives an account of a strong windstorm which occurred after the roof was on but before the vaulting had been built, during which the walls trembled and the roof shook, but held fast,¹¹ indicating that the truss performed all necessary structural functions, although not specifically designed for that purpose.

In the development of the Gothic style the use of large areas of stained glass windows was as important to the expression of the Gothic spirit as the use of the rib-vault. The idea of light and luminosity was quite important in the theology and metaphysics of the eleventh century. As we can expect in a society where the existence of light and cleanliness was rare, hard to obtain and costly, glass, light and luminosity came to stand for all that was clean, pure and Godlike.

All that was good was identified with light, evil and the unknown with darkness; thus we often hear reference to the illumination of the world through Christianity, the light of reason, illumination of the mind, light of God, divine radiance, etc. Light was conceived of as the form that all things have in common, the simple that imparts unity to all, the underlying harmony in all things.¹² "As an aesthetic value, light, like unison in music, thus fulfills that longing for ultimate concord, that reconciliation of the multiple into the one, which is the essence of the medieval experience of beauty as it is the essence of its faith."¹³

Suger, deeply involved in the problems of the metaphysics of light from his studies of theology, prompted the installation of stained glass in St. Denis. His aim was not that of lightening the interior, as is often concluded from the study of cathedrals in which the original windows were replaced with lighter, more transparent ones in the eighteenth and nineteenth centuries; as much as luminosity, as can be felt in the darker windows of the twelfth and thirteenth centuries. He was not trying to bring the light of the outside world into the church as much as to express the penetration of the light of God into all matter and to express the Universe of God outside.

This desire to dissolve the walls of the building into a luminous shell involved the use of a structural system that did not need continuous bearing on the side walls. As adequate methods alternative to rib-vaulting existed, the use of the rib-vault, though a sufficient means of obtaining this, was not a necessary factor in the development of this aspect of the Gothic expression.



Interior expression of the gothic spirit. Notre Dame de Paris.

The expression of the Gothic spirit on the exterior of the cathedrals lagged far behind that of the interior. The introduction of flying buttresses was not made until much later than that of the vaults on the interior, the inclusion of flying buttresses on the nave of Notre Dame at Paris occurring in 1180, and the addition of buttresses at Noyon occurring in the fifteenth century for the choir and the eighteenth century for the nave.¹⁴ Notre Dame at Paris also had flying buttresses added to the choir at a much later date.



Mature exterior expression of the gothic spirit.

Notre Dame de Paris.

The fact that buttresses were added to these and other cathedrals long after their completion indicates, as in the later addition of vaulting to many churches, that their inclusion was more for aesthetic enhancement than as a structural necessity.

At the time of their introduction, means had already been devised for the resolution of the thrusts of the vaults within the walls themselves, or through concealed buttresses over the side aisles, as in the Abbey aux Dames at Caen.¹⁵ Their exposure was more an attempt to align the exterior of the cathedral with the Gothic form of high relief and to increase the feeling of interpenetration of the interior and exterior by moving the true wall plane far back of the apparent exterior faces of the buttresses. It was not until the use of flying buttresses was long established as an aesthetically superior means of performing an already solved structural function that their use became a structural necessity as the increasing height of the cathedrals increased the needed depth of buttressing.

We cannot read into the actions of the medieval builders a conscious attempt to create merely a pure structural system which has been refined to the point that every part of the building has a structural purpose, and that the combination of these parts is the best and only possible way to solve this structural problem. A Gothic cathedral is not a piece of structural exhibitionism, but is in fact a building which contains many elements which we have given structural meaning, but which often are structurally redundant and duplicatory of other systems within the building.

Looked at historically, structure does not dictate architectural form. There have been far too many changes in architectural form clearly caused by something else, such as those of the early Renaissance, and far too many not even accompanied by changes in the structural system, such as those of the Baroque, for such a view to be plausible. Architectural change is the resultant of many forces. Structure always limits, it usually facilitates, it often inspires, sometimes it is merely incidental in , architectural change. The primary cause of change must surely be looked for in society; it might be termed 'social use' and it includes the ideas, even the aesthetic ideas, which arise from that use and which either exploit and develop the existing structural tradition, invent a new one or even revert to an old one.¹⁶

The cathedral is, then, an attempt, and a highly successful one, to give physical and aesthetic expression to a new life concept, a solution in which the aesthetic expression is the end and the structural one the means, one in which a beautiful expression of a fulfillment of human needs is desired, whether structural purity is possible or not. From the Gothic builders we can learn to approach building not as an end in itself, but as a means of answering human needs in the context of expressing always a more harmonious and clear relationship between man and his environment, both physical and cultural.

NOTES

1. Quotation of Dvorak by Paul Frankl, *Gothic Architecture*.
2. Maurice DeWulf, *Philosophy and Civilization in the Middle Ages*.
3. DeWulf, *ibid*.
4. Frankl, *ibid*.
5. Frankl, *ibid*.
6. Frankl, *ibid*.
7. Frankl, *ibid*.
8. Otto Simson, *The Gothic Cathedral*.
9. John Fitchen, *The Construction of Gothic Cathedrals*.
10. Frankl, *ibid*.
11. Simson, *ibid*.
12. Simson, *ibid*. p. 54.
13. Simson, *ibid*. p. 54.
14. Frankl, *ibid*.
15. Frankl, *ibid*. p. 56.
16. Andrew Boyd, *Chinese Architecture and Town Planning*.

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