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Timetables

Masonry buildings do not appear instantaneously. They take time to construct. The few that are documented give dates for only specific moments in the program, and seldom hint at what lies in between. In this chapter I will attempt to build timetables to describe the step by step construction process for twenty-two major buildings. These timetables will be derived from:

- Eight buildings with documents that exactly note the dates for specific events, such as the choir of Saint-Denis, the nave of Chartres, and the choir of Reims. The degree of precision of the 290 relevant documents is discussed in v.1:7-10.
- Other information with less precision, such as consecrations, have not been used to establish the timetables, but may occasionally be useful to verify or augment more firmly established data.
- Earlier construction timetables. The most useful was published forty years ago for Chartres cathedral after the most detailed professional survey ever undertaken of the stonework of a major cathedral.^{1a} It was from this that I prepared timetables for the choirs of Soissons and Reims in the 1980s.¹
- The most accurately dated capitals in the earlier volumes are where there is a mix of formals and foliates during the transition years of the 1170s.^{See ch. 3.} The decadic analysis of the capitals discussed in the first two volumes does give indicative dating for any zone of a building constructed around the 1170s, and in larger churches the many layers of capitals provide pegs on which we can hang the order of work in between.

In the last forty years scholars have not questioned either the use of timetables or the ordering of the various building tasks. Nor has there been any disagreement in discussions or at conferences. I therefore take it that the procedure described here and the general method of scheduling the construction for each building is in principle understood by my colleagues, and that we can agree that this is a reasonably valid approach to the specific issues I am examining.

The technical questions.

Estimating the construction on an annual basis compels one to think about church construction in a more realistic way.

Firstly, by determining the stages constructed in each year we get a sense for the amount of stone that would be completed in a building season on the average job. This will vary, of course, with size and available funds. Senlis and Braine, both smaller buildings, took less time than the very tall ones with flyers such as Reims and Paris. Work was also faster where rebuilding occurred within pre-existing walls, such as Canterbury and Le Mans, for they are so thick they take longer to erect than piers.¹⁰

The rate of construction varied enormously from building to building. Smaller ones with thin walls like Braine and Saint-Remi could have been erected more quickly than vast structures like Reims and Chartres. Thick walls would have been particularly slow due to the time needed for the infilling mortar to set.

Secondly, there were often complicating factors, such as the crypt under the choir of Chartres that needed two years more work compared to the nave. Work on the choir was further retarded by the fall of the land towards the east and the many roofs and complex flyers over the double aisles.

Thirdly, one is easily mesmerized by the broad dating in most histories. Long periods are often left between different levels by using simple phrases like 'in the 1190s' or 'second quarter of the century'. If we wish to think in a more detailed way these are misleading. I have found that by thinking carefully about the time needed to lay a course of stones or carve the shafts the timetables became considerably more accurate.

Fourthly, the detail makes it hard to gloss over the time needed for crypts, flyers and delays while mortar hardened under arches and vaults.

Fifthly, instead of conceiving a building as having an approximate and usually singular date, we will come to see it as the builders saw it, as a process, in which each stage of construction took a definite time and there were necessary pauses and interruptions that had a considerable impact on design and chronology.

By introducing this level of precision a set of propositions can be developed for rates of construction for walls, vaults and arches that may then be applied elsewhere.

Modified for height

In a detailed costing of Chartres I compiled with Ken Greene, a quantity surveyor, we came up with rates for walling that reflected the added cost that came with tall buildings.¹¹ It included scaffolding, slow rate of cranes, the labour to carry up mortar, and the general difficulties of working at great heights rather than on the ground.

Where constructed with the walls, flyers slow up the work considerably because of the additional lifting and scaffolding. Formwork had to be constructed for arches in both directions, plus the supports for gangways, cranes and working platforms. Together, these would have clogged the area with an intersecting lattice of timber struts and posts.

In addition the development of large and tall windows supported on piers that grew smaller and smaller over time meant that the masonry had to be well-cut and reinforced. Add to that the time needed for mortar in the many layers of arches to set, and it is no wonder that tall clerestories were slower to build than the aisles.

In the dollars of 35 years ago we estimated costs for a cubic metre of masonry at \$425 per at ground level, \$520 at triforium and \$715 in the roof cornice.¹² As most of the cost is labour, these figures reflect the greater effort needed as the building rose. For a building as tall as Chartres this equated to a twenty percent increase in costs and time at the level of the aisle capitals and thirty percent in the triforium and a huge seventy percent by the time work reached the roof.

Though Chartres cost as much to erect the lower 50 courses to the arcade arches as it took to the top of the triforium, this did not necessarily mean it took a great deal more time. In earlier construction massive walls continued from the ground to the roof with little reduction in thickness, but from 1120 onwards an effort was made to reduce the thickness of the upper walls and rely on the quality of the ashlar to maintain stability.

I concluded that on a course by course analysis where 5 courses may have been laid each year in the aisles they might be laying only 4 in the clerestory. Approximate as this is, it shows that in any construction schedule we need to leave more time for the upper stories than we would for the same height in the lower.

Detailed analysis of some major buildings.

The intention of this study is to date each layer of capitals in the major buildings. I wish to demonstrate that construction sequences can be assessed in a meaningful way without having to write a monograph on every building. By showing there was a fairly regular rate of construction in those buildings we can date, then we can, with appropriate modifications, apply that rate to other buildings.

These charts form an essential foundation for the later analysis of the individual masters in volume 7. The inaccuracies will be present, but one hopes they will be small. I will not burden this section with too many footnotes as the medieval documents are to be found at the end of volume 2, and the reasoning behind the dates given for specific groups of capitals are contained in earlier volumes. It is hoped that this will provide a basis for refining the dates of the capitals presented in the earlier books.

The first set of charts will be for works that have precise dates for specific parts, like the Chartres nave and narthex, the narthex and choir of Saint-Denis and the choirs of Reims, Laon, Soissons, and Canterbury.

I have made adjustments for relative size, so that Laon and Noyon that are less than 30 meters high take less time than Chartres or Reims that are more, and where courses are larger as in Chartres or Reims, or smaller as in the Soissons south transept.

It was the number of courses that determined speed of erection rather than size, and I presume this was determined by the available stone.

Most projects involved some degree of complexity, more in others like Saint-Martin-des-Champs, Etampes and Soissons. In some cases the high vaults and their flyers were installed with the walls and flyers as at Chartres, or some time afterwards as in Paris, Sens and, possibly, Reims.

There is evidence for prolonged pauses in the construction, such as Sens, Etampes and the Notre-Dame-de-Châlons nave. Causes may have been dilatory funding, an irregular construction process as at Saint-Martin-des-Champs, or high taxation during the crusades.^{See ch. 4.} I cannot adjust for unknown variations in cash-flow, though I did make an attempt at Chartres to differentiate monies spent in each campaign.^{James 975.}

Chartres nave

We start with Chartres as it is the only church with sufficient depth in its analysis to establish the amount constructed in each campaign. Every one has been illustrated in detailed isometrics. I understand people avoiding such work as altogether the 32 of these drawings took a full year to prepare. Yet it was the only way to determine the sequence of work across such a complex building.

They clearly show which parts could be built at the same time and which parts had to be built before others. It took many trips to the cathedral to get the sequence of construction in right order. Though scholars have illustrated other buildings such as Laon¹³ and Meaux¹⁴ in simple isometrics, such schematics give only a conceptual understanding of work achieved in large blocks of time. None provide the detail that a builder would appreciate.

The timetable for Chartres is derived from the toichological evidence published in *The Contractors*, and not from the style of the capitals. There is a real possibility that the cathedral was completed somewhat earlier than I had envisioned.^{Prache, 1990.} Colette Manhes-Delambre's analysis of the Le Breton poem celebrating the completion of the 'great vaults' of Chartres suggests it was penned between 1214 and 1217.¹⁵

I have checked her conclusions against the process of construction and conclude that it would have been possible to have substantially completed the nave vaults by 1217, though from the complexity of the program, and its size, an earlier date would have been extremely unlikely.

There are just over 100 courses of stonework from the lowest exposed footings to the roof cornice. Between 1194 and 1217 this works out at an average of 4½ courses per year. When you consider that this was all round the building involving some 2,800 stones in each course or more than 12,000 per campaign, or about one stone per mason per day, it was a massive achievement.

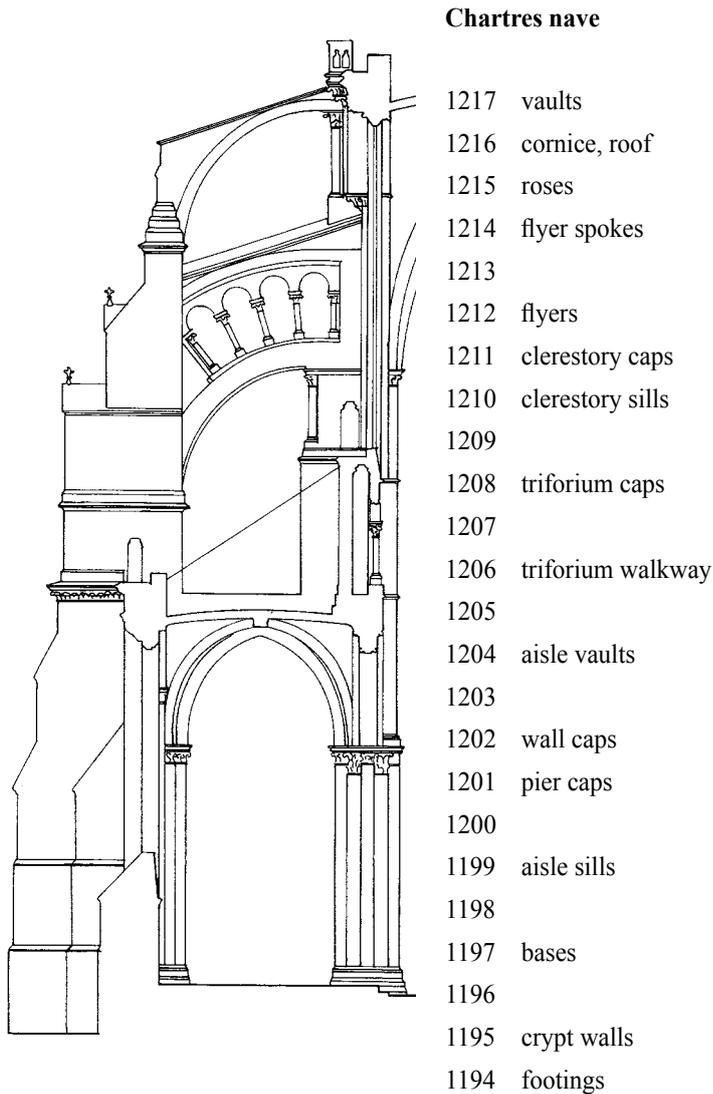
The chart shows the courses and the dates set out from the analysis in *The Contractors* [r]. It has been summarised on an annual basis alongside a section of the nave on the next page.

The dendrochronological analysis of the wooden tie beams over the nave aisle capitals arrived at a date of 1202.ⁿ This fits exactly the date suggested in *The Contractors* for this level of the work. There are some 25 courses from the floor to these ties laid over five years. Above that there are a further 64 courses to the cornice laid over the next fifteen. **This is five courses per year in the lower work reducing to four in the upper.**

This is what we should expect as the upper courses were slower to erect since lifting and scaffolding would have taken longer, while the clerestory level was a maze of criss-crossing arches and their supports. Though the openness of the design reduced the mass of stonework, a lot more care was required to maintain stability as the work rose.

Footings for a major building would seldom take less than a year, more if the foundation material was clay or alluvial. Large trenches had to be dug and the water was kept out, and then back-filled with rubble and mortar, possibly with *spolia* from the older work. Only then would the walls begin to rise out of the ground.

Dates, courses	elements erected, outside and in	dates, masters
1218	vault completed	1218 Olive
1218	strip formwork, cells filled	
1218	setting time	
1218	walkway, continued	
1217	101 cornice, bosses	1217 Bronze
1217	99 roof beams, roof trusses	
1217	98 formwork, ribs	
1217	97 vault formwork	
1216	96	1216 Jade
1216	95	
1216	94	
1216	93	
1215	92 centre of clerestory rose	1215 Ruby
1215	91	
1215	90	
1215	89	
1214	88	1214 Scarlet
1214	87	
1214	86	
1214	85	
1213	84	1213 Bronze
1213	83	
1213	82	
1213	81	1212 Ruby
1212	80	
1212	79	
1212	78 lower flyer arch	1211 Scarlet
1212	77 clerestory impost	
1212	76 clerestory capitals	
1211	75	
1211	74	1211 Rose
1211	73 walkway corbels	
1211	72	
1210	71	1210 Ruby/Cobalt
1210	70 walkway torus	
1210	69 plinth, clerestory sill	
1210	68 clerestory walkway	
1209	67	1209 Olive
1209	66 clerestory string	
1209	65	
1209	64	
1208	63	1208 Scarlet
1208	62	
1208	61 triforium caps	
1208	60	
1207	59 triforium corbel	1207 Bronze
1207	58	
1207	57	
1207	56	
1206	55	1206 Ruby/Cobalt
1206	54 external walkway	
1206	53 triforium string	
1206	52 cornice triforium footing	
1206	51	
1205	50	1205 Bronze
1205	49	
1205	48 cells, fill over	
1205	47	
1204	46	1204 Rose
1204	45	
1204	44 aisle rib formwork	
1204	43	
1203	42 aisle vaults	1203 Cobalt
1203	41	
1203	40 arcade arches	
1203	39	
1202	38 tie beam	1202 Ruby
1202	37 aisle impost	
1202	36 capitals	
1202	35 aisle capitals	
1202	34	
1201	33	1201 Bronze
1201	32	
1201	31	
1201	30	
1201	29	
1200	28	1200 Scarlet
1200	27	
1200	26	
1200	25 aisle window sill	
1200	24	
1199	23	1999 Ruby
1199	22	
1199	21	
1199	20	
1199	19 window external drip	1198 Bronze
1198	18	
1198	17	
1198	16	
1198	15 internal string	
1198	14	
1197	13	1197 Olive
1197	12 buttress string course	
1197	11	
1197	10	
1197	9 aisle torus	
1196	8 plinth	1196 Rose
1196	7 floor level	
1196	6	
1196	5	
1196	4	
1195	3	
1195	2	1195 Bonze
1195	1 average visible course west	
1195	0	
1195	-1 foundations	
1194	-2	1194 Scarlet
1194	-3	
1194	-4 demolition, planning	



Chartres cathedral interior of nave

Chartres narthex

We know the date that fire of 1134 instigated the rebuilding at Chartres, and can work forward in time from that. I assume that work proceeded in a steady way so we could estimate a date for each of the more important stages to within a year or two. Naturally, the further we travel from the initial starting point the less accurate the chronology becomes.

For the capitals in the western towers of Chartres we can work forwards from the fire to estimate their earliest dates.³⁵ For the Royal Portal we have to work backwards from where the stonework over the top of the portal ties in with that over the south tower, which was campaign 'I' in 1142, illustrated over the page.³⁶ The campaigns identified in volume 4 and discussed in my SAEL article,ⁿ are noted with a '#' sign.

The different designs for the portals implicit in the five anomalies in its carving suggest that some sculpture was being carved while the north tower was being built, and well before it was erected.ⁿ

In this estimate I have assumed that the phases for the portal coincided with the appropriate stages in the construction of the towers (see sketches in volume 4 and 6). The rare connections between capitals in the towers

and work in the portals suggests that the carvers were independent of the building teams.

- 1134 #A, WN tower, ground floor and entry into the crypt, shafts bases inside the room.
- 1135 #B, WN tower, entries from south, their (a-) capitals and arches, windows to west and north. Within the stairs to tread 20±.
- 1136 #C, WN tower, aisle capitals and starts the vault. Within the stairs to tread 30±.

Phase 1 of the sculpture in which the lower south lintel was carved for a wider door.

- 1137 #D, WN tower, complete the vault and the arches over the external arcade with their capitals. Within the stairs to tread 67±.
Phase 2 of the sculpture in which the upper southern lintel was carved for a narrower door.

- 1138 #E, WN tower, the cornice under level (1) and the jambs of the openings into that level with their capitals. Within the stairs to tread 97±.
Phase 3 of the sculpture in which the bottom lintel on the north and the lower archivolts on the south were planned for tympani that were to have been narrower and taller. This is the first indication that there were to be three portals. All the portal bases were carved, and only those against the north tower installed. Some column figures for the left door carved. Group 1 of colonnettes carved, but height of portal probably not finalised.

- 1139 #F, WN tower to the domical vault on squinch arches and the cornice over level (1) windows. Within the north stairs to tread 121±. WS tower begun with the footings and lowest courses. The entry into the crypt to its sixth tread. The thresholds and the bases to the portals laid. Those on the north were not placed in alignment with those on the south.³⁷
Phase 4 of the sculpture: the second lintel on the north with the adjustments for misalignments in the jambs, some of its archivolts and the column-figures. The north tympanum was meant to have been wider and shorter.

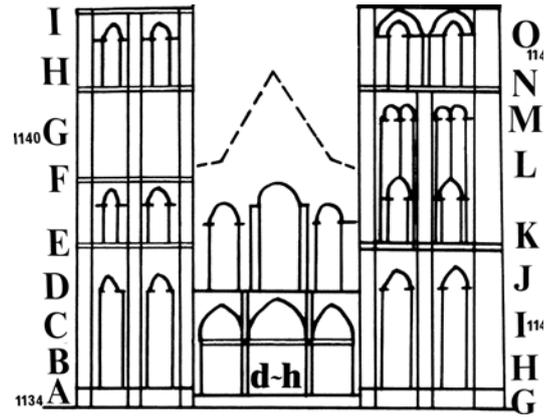
Group 3 of the intermediate colonnettes around the south door carved. Placement: the north lintel was erected with the figures on the left. The misalignment in the northern pier bases was corrected.³⁹

- 1140 #G, WN tower vault completed with twenty courses of blank walling and reduced buttresses. Within the north stairs to tread 140±. WS tower continued to just above ground level. This stage of the north tower and the crypt of the south were contemporary, as may be confirmed by the presence of the same range of masons marks on the stones at both levels.³⁸

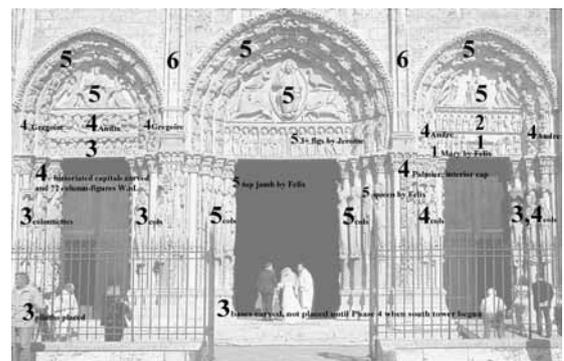
Phase 5 of sculpture: most of the tympani and central archivolts, and the uppermost archivolts in the north. Last of the column-figures and Group 2 of the intermediate colonnettes may have carved at this time, with the historiated capitals. A palm-tree capital was carved for the inside face of the portal by Master Palmier.⁴⁰

Placement: the southern figures were erected with the wall of the WS tower, the south lintels were placed on their piers and the central jamb figures placed.

- 1141 #H, WN tower, a small campaign up to the cornice of level (2) with the sills to the openings. WS tower, north entry capitals and arches, windows to west and south with the adjacent door (now closed). These stones



Chartres cathedral west elevation with campaigns marked



Chartres cathedral west portal with selected campaigns numbered

display another group of masons marks that connects this level with the uppermost courses in the north tower. Within the south stairs to tread 24±.

Phase 6 of the portal sculpture: possibly the last elements such as the uppermost archivolt figures and drip moulds.

Placement: the tympani and many archivolts were erected and bonded into the WS tower. This is the latest date for the completion of the Royal Portal sculpture though some erection could still have been achieved in the next year.

- 1142 #I, WN tower, a small campaign with the capitals over the openings to level (2). Work continued to complete this level over the next couple of years. WS tower, ground floor vaults with their capitals. The walling over the portals to three courses above the southern archivolts. Within the south stairs to tread 37±.
Walling over the portal with cornice under the triplet windows.

The rest of the work on this tower is estimated on the assumption that it continued at more or less the same pace until interrupted by the Second Crusade, after which work continued into the 60s.

The rate of construction was around fifteen courses per year for the north on its own, around a dozen courses when both were being built at the same time, and then somewhat less as the building rose in height. On this basis the spire could have been begun in 1159 and, considering the estimates made for other spires, completed about 1163.^{v.5:1758.}

Chartres narthex

1164±	complete
1163	spire
1162	spire
1161	spire
1160	spire
1159	arcade
1158	cornice, heads
1157	caps
1156	octagon
1155±	level 2 caps, arches
1154)
1153)
1152)
1151	<i>Crusaders Recession</i>
1150)
1149)
1148)
1147	level 2 cornice, openings
1146	ext arcade arches
1145	level 1 vault caps, interior caps over windows
1144	level 1 cornice, openings and caps over triplet windows
1143	WS external arcade caps, sills to western triplet windows
1142	WS vault caps, portal complete, wall over portals
1141	WN level 2 cornice, WS north entry caps, sculpture phase 6, cornice and wall over
1140	WN level 2, WS to above bases sculpture phase 5, three tympani carved and erected
1139	WN domical vault, WS crypt entry, sculpture phase 4, portal bases laid
1138	WN level 1 cornice, caps, sculpture phase 3, left embrasure erected
1137	WN outer arcade capitals, sculpture phase 2
1136	WN vault, sculpture phase 1
1135	WN, south entry to capitals
1134	foundation

Saint-Denis narthex

We may extrapolate the latest dates for each level of the narthex capitals by working backwards from the upper chapel consecration on June 9, 1140. The narthex construction history is involved as there are capitals on seven levels within a tangle of arches and ribs each of which has to be supported on formwork that remained in place until the mortar had set.

The portal capitals would have been carved first, then the upper and lower capitals of the aisles, the central vessel and then those over the openings just under the central vault and, after the vaults were completed, the capitals for the chapel of Saint Romanus. These would have been carved at least six months before the dedication to allow the vaults to be set up and the centring struck.

If the process of construction had been uninterrupted and we allowed for pauses while the mortar set under arches and vaults,⁴³ we can work back from the chapel's dedication to provide the earliest likely dates for each group of capitals.

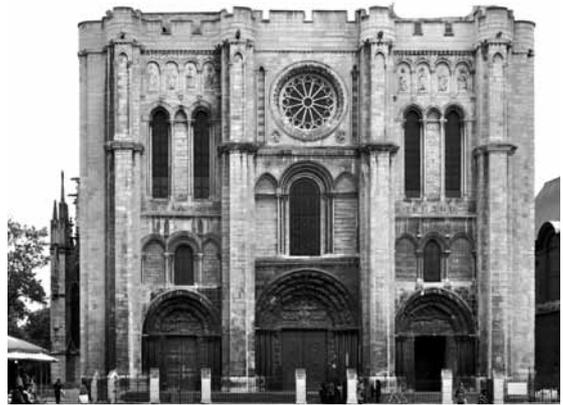
It may be thought that because Suger does not mention it, and because the general opinion is that it was a sustained building operation, there would have been only one contractor. However, just note that the impostes and arch profiles change between levels, and there are distinct stages to the design of the stairs. Without delving into all the changed details here is one obvious design alteration over the XN2 pier.^{v-1224-25} The capital underneath was placed at 45° whereas the impost is set square. The capital would have logically supported another arch alongside the rib. The impost supports an arch flanking the doubleau. There is also a change in impost profile at this level. There was clearly a new template for a new design, and therefore a probable change in contractors.

Multiple contracting is also apparent in the capitals, for if one builder had had control of the entire works we should expect that the same carvers would have worked on many levels. In fact, this is noticeably not the case. Every level of the work was carved by a different group of men – a sure sign of discontinuous contracting. Nearly every break occurs where we would expect it, at the arches where time was needed while the mortar set.

The dates at Saint-Denis are particularly important for the hundreds of capitals in good condition that are exceptionally well-preserved. Crosby found that the narthex capitals had avoided restoration as they had been covered in plaster.⁴⁴ For this we are incredibly fortunate.

Working backwards the capitals could have been carved in this order:

- Late in 1139, under ribs and openings in the upper chapel and vault.
- 1137, over the side 'window' openings into the towers, followed by setting time for the central vault ribs and cells.
- 1136, upper capitals of the central vessel, complete aisle vaults.
- 1133-34, capitals for aisle ribs and arches, and the adjacent windows followed by the aisle vaults.
- 1131-32, carve and erect the west portals which had to be complete before the aisles could be vaulted. Restorations have removed much of the toichological evidence that facilitated the analysis at Chartres, but my impression is that all the sculpture would have been commissioned early in the work and carved and erected over a three-year period.
- 1130 piers laid out and bases with facets carved.
- 1129, fairly deep footings through silt.



Saint-Denis west elevation of narthex



Saint-Denis cross section through narthex with dates

We can say from these two analyses that unless Saint-Denis was built very slowly and therefore begun long before 1130, and unless Chartres was also constructed slowly and the portal not finished until later in the 1140s, the carving of the Chartres portals was begun five years after Saint-Denis was completed. The appeal of the three-door arrangement at Saint-Denis may have inspired the clergy at Chartres to squeeze three doors into the central space.

Confirmation may lie in the concave facets on the original Saint-Denis pier bases that are now under the floor.⁴⁵ The present bases are new, following the raising of the narthex floor last century. The facets on the originals are extremely rare, and are found only in the earliest parts of the north tower at Chartres and the castle at Etampes.⁴⁶

There are approximately 80 courses from the original level of the bases to the top of the chapel and three layers of vaults. Allowing for the delays in setting up the arches and pauses while the mortar sets, building the cells and then filling over the top, **it would have taken roughly 8 courses per year.**

At Chartres they built over eighty courses in seven years in the north tower, including the entries to the crypt and two layers of vaults. Taking the vaults into account, this is more than a dozen courses a year, and the tower being a single rectangular cell it would naturally have been faster than the more complex six-bay narthex at Saint-Denis.

Saint-Denis narthex

- 1140 complete vault, dedicate
- 1139 chapel walls and ribs
- 1138 vault over the central space
- 1137 clerestory windows
- 1136 capitals to central space
- 1135 aisle vaults
- 1134 aisle capitals and arches
- 1133 aisle rib capitals and ribs arches, aisle windows
- 1132 erect western doors, sculpture phase III
- 1131 carve sculpture phase II
- 1130 carve sculpture phase I
- 1129 excavation and footings

Saint-Denis choir

Suger laid the foundation stone for the choir in July 1140.³ This could only have been done after the footings had been dug to a firm foundation through the soft loam of the area, a task that would have taken some time.

Many historians follow Frankl in believing that Suger built a three-storey choir,^{Frankl,2000,309,n3} yet how many admit to understanding construction principles or have had direct experience of building? How many have lifted stones or carried mortar across gangways elevated high above the ground? Yet all those who do build and carve, and do supervise architecture, and all the masons I have spoken to in detail on this subject over the last forty years all agree that Suger could not have built above the aisle vaults.^{Avista} There is general agreement in the trade that only on rare occasions would as many as a dozen courses be laid in a year in a tightly constricted multi-level space like this.

There is nothing in the stonework above the vaults to show anything was laid over them in the 1140s.⁴ Crosby himself acknowledged “Even



Saint-Denis crypt

my own enthusiasm for Suger’s abilities questions the possibility of his erecting such a complex structure, especially one so novel, in such a short time”.⁵

The storm described by Suger refers, I believe, to the ambulatory vaults, not the high vaults. After the storm the cells were then laid over the ribs fairly quickly and a roof provided for the grand consecration in June 1144.

Suger’s words have been discussed by many, including Panofsky⁶ and Crosby.⁷ These were “from the crypt below to the summit of the vaults above, elaborated with the variety of so many arches and columns, including even the consummation of the roof”. I translate these words to read “... to the summit of the vaults above (*those of the crypt - i.e. the vaults of the ambulatory*), elaborated with the variety of so many arches and columns including even the consummation of the (*temporary*) roof (*at the level of the aisle vaults*)”.

“So many arches and columns” describes the ambulatory with words that could not have been used to describe the simpler ribs and walls of a main vault, and if he is referring to the main roof this “even” is curious, as roofs were usually erected before the high vaults to keep out the rain and carry the lifting gear. But there are precedents for building a temporary roof at the level of the aisle vaults to allow ritual to continue while the upper parts were being completed.⁸

This is why I cannot agree that Suger built the whole four-storey choir and the roof and the high vaults in four years. To test my opinion I set out a construction timetable course by course on a monthly basis [r]. The numbers in the third column refer to the courses.

Stones were not laid every month as delays were essential in erecting arches and vaults to allow the mortar to harden. Three months is a fair time to allow for this. Sometimes a few blocks can be laid alongside the lower edges of an arch while the mortar was setting, but only a few as once the formwork was struck the arch would settle and a gap could be opened up between it and any adjacent ashlar.

Allowing for pauses in the construction for setting the mortar, and for one course every month, starting with the first stone laid in July 1140 and for the consecration four years later, we get a very reasonable construction schedule. Not only that, but the miracle of the storm occurred on exactly the date noted by Suger.⁹ For me, this timetable has removed all doubt on the matter.

Even for this relatively small building without the upper stories, **Suger was building 8 or 9 courses per year.** As will be seen, the almost matching Soissons south transept managed less than six. To have built the proposed gallery and clerestory would have raised Suger’s construction rate to around 15 courses per year, a rapidity not even marginally reflected in any other building in this study except the simple rectangle of the north tower at Chartres

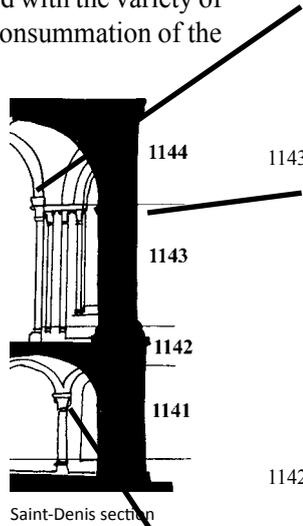
However, if this chronology is wrong and Suger had performed another miracle, the changes make only moderate differences to the dating of the capitals.

The monthly timetable may be annualised with the earliest date at the bottom, and this format will be used in the rest of this study [r2].

Saint-Denis monthly building schedule.

The numbers in the third column refer to courses. Arranged by date downwards.

	June		complete roof and consecrate
	May		roof over aisle vaults
	April	36	cornice, start roof
	March	35	
	February		cells over ribs
1144	January	34	miracle of the storm while setting
	December	33	setting time
	November		set up ambulatory ribs
	October		vault formwork
	September	32	
	August	31	
	July	30	pier capitals
	June	29	upper aisle wall capitals
	May	28	
	April	27	
	March	26	setting time
	February	25	setting time
	January		arches setting time
	December		aisle window arches
	November	24	aisle wall capitals
	October	23	
	September	22	
	August	21	
	July	20	
	June	19	
	May	18	
	April	17	
	March	16	aisle sills
	February	15	
1142	January	14	
	December		fill over crypt vault
	November	13	
	October	12	
	September		crypt vault
	August		formwork erected for crypt vault
	July	11	
	June	10	
	May	9	
	April	8	setting time
	March		crypt arches setting time
	February		crypt capitals and arches
1141	January	7	
	December	6	
	November	5	
	October	4	
	September	3	
	August	2	
	July	1	foundation stone laid
	June		footings
1140	??		footings



Saint-Denis choir

1144	vault, roof
1143	piers capitals
1142	wall capitals
1141	vault
1140	crypt capitals
1139	
1138	footings

Soissons cathedral south transept and choir

Where the south was closer in feeling and scale to Saint-Remi begun a dozen years earlier, the changes to the choir created a colossal space of great height. The gallery was eliminated, the triforium doubled in height, and the high vault springing pushed well into the clerestory so they were for the first time set well above the sills of the full-width windows. It has long been understood that Soissons predates Chartres, with opinions summarised by Crossley.^[2000,321-22] By studying the construction course by course its story can be made more precise and its relationship with Chartres becomes more interesting.

In the table on the next page the left three columns are for the transept, the right three for the choir. In each the courses lie on the left column, then locations and on the right the dates. As with Saint-Denis and Chartres, I have enlarged it to include the coursing. This makes the timing more reliable by setting a pace for the work, and has made it significantly easier to align the works in the transept with that in the choir. Were there to be different sizes of crews or different cash flows this system would not have worked as well, but for an averaging system it is better than anything else. After fitting the construction into the known dates **the average progress of the south transept was 5 to 6 courses per year.**

It is believed that the south transept was begun as a cameo addition to the earlier church.^{Barnes, 1969} The analysis in the *Template-makers* showed that every course in the aisle walls of the choir was tied in with and dependent on the rate of construction of the south transept.^{James, 1989, 134-35} This showed that work on the wall bases of the choir began only a few years after the start of the transept. The course by course table indicates footings were being dug by 1180 [marked 1, next page], and that the choir walls had been raised to the level of the sills by the time the gallery capitals were carved [2]. The decadic range for these capitals suggests a date around 1182, and those in the upper levels point to a year or two later.^{v.1:495}

The choir was planned for an aisle that encompassed both the two lower stories of the transept [3]. The capitals all indicate a date in the early 1180s, and into the rest of the decade for the upper capitals in the transept,ⁿ yet the capitals of the choir piers indicate the later 1190s, as do those in the choir triforium. How do we sort out this situation?

I propose that the walls of old choir lay along the line of today's drum piers, and that the external walls of the new choir were built as a bracelet around the old choir. The space between the new wall and the old choir could, until it was demolished, have housed the various chapels referred to in the documents.ⁿ This was a not uncommon way to extend the church, thereby drawing endowments that would help to pay for new construction.ⁿ

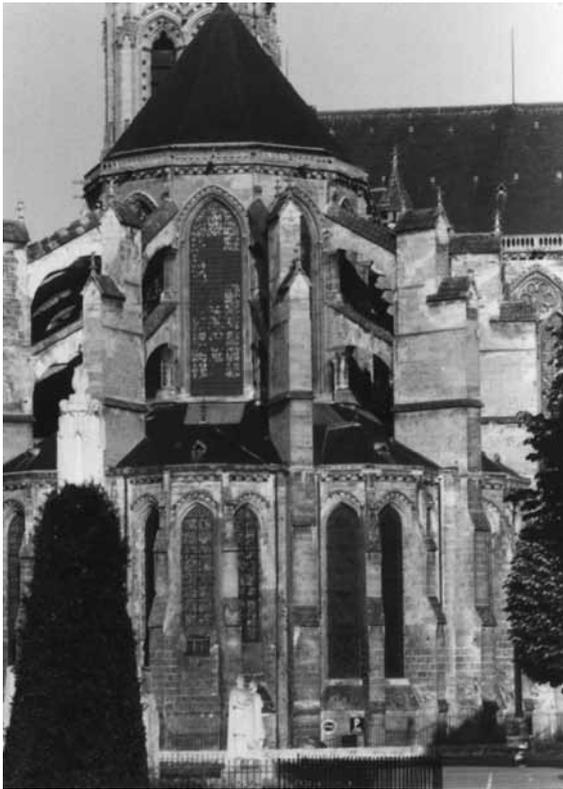
The annual processions around the choir noted in 1190 could have occurred in this space between the new wall and the old church.ⁿ Meantime, services would have been continued in the old choir.

When the outer walls could not be raised any further around 1185, work on the external walls stopped for seven years while they pressed ahead to complete the transept. That was vaulted by 1192 [4].^{repeats v.1:559-61} The chaplaincy for the upper transept chapel of Saint-Jacques could have been installed in 1190,ⁿ and it was two years later that Guillaume gave money to decorate the altar.ⁿ I propose that this altar was inside the hemicycle of the south transept under its high vault, and that the altar had been moved here so that the old choir could be demolished [5].

Moving the altar into the transept would have been at the same time



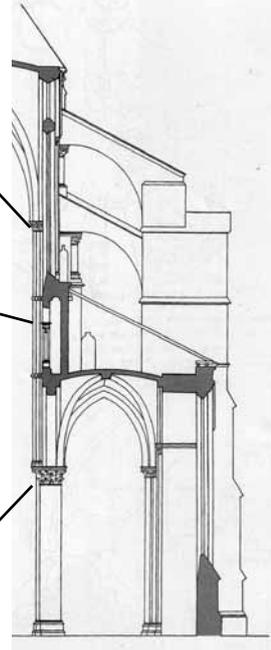
Soissons cathedral south transept



Soissons cathedral choir

stalls, complete	1212
roof, vault	98 1210
cornice	96 1210
	94 1210
	92 1209
	90 1209
	88 1208
	86 1208
window capital	84 1208
	82 1207
	80 1207
	78 1206
	76 1206
	74 1206
	72 1205
clerestory capital	70 1205
	68 1204
torus, plinth	66 1204
walkway, sill	64 1204
	62 1203
clerestory string	60 1203
	58 1202
	56 1202
triforium capitals	54 1202
	52 1201
	50 1201
	48 1200
plinth, torus	46 1200
triforium string	44 1200
	42 1199
	40 1199
	38 1198
	36 1198
	34 1198
	32 1197
	30 1197
impost	28 1196
pier capital	26 1196
	24 1196
	22 1195
	20 1195
	18 1195
	16 1195
	14 1195
	12 1195
	10 1194
	8 1194
	6 1194
	4 1193
	2 1193
	0 1193
	-2 1192

7



Piers and whole of internal wall of choir to the roof

South transept from foundations to roof and vault

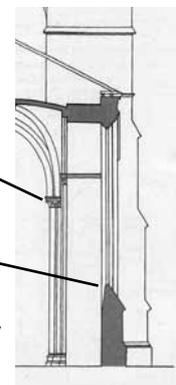
5

vault, completion	1191
cornice, roof	76 1190
	74 1190
	72 1190
	70 1189
	68 1189
	66 1189
window capitals	64 1188
	62 1188
	60 1188
	58 1187
clerestory sill	56 1187
	54 1186
clerestory cap, string	52 1186
	50 1186
triforium capital	48 1185
	46 1185
triforium string	44 1185
	42 1184
gallery vault	40 1184
	38 1184
gallery capitals	36 1183
	34 1183
	32 1182
	30 1182
	28 1182
gallery torus, string	26 1181
	24 1181
	22 1181
	20 1180
aislevault	18 1180
	16 1180
	14 1179
aisle capital	12 1179
	10 1179
	8 1178
	6 1178
	4 1177
torus	2 1177
floor	0 1177
footings ?	-2 1176

torus	1191
floor plinths	1190
demolition, footings	1189
old choir still in place	1186

4

External walls of choir



2

old choir still in place	30 1186
window capital	28 1185
	26 1185
aisle capital	24 1185
	22 1184
	20 1184
	18 1183
	16 1183
aisle sill	14 1183
	12 1182
	10 1182
	8 1181
aisle string	6 1181
	4 1181
	2 1180
plinths	0 1180
	-2 1179
footings	-4 1179

1

DRAWN

as the remains of Bishop Josselin were translated to Longpont where the choir was well and truly finished by then.ⁿ

This would help resolve Dany Sandron's difficulty in reconciling "la délicatesse du bras sud au gigantisme du chœur".^{p.87} To have been completed as it was originally designed as a 'minuet' to its intended neighbour suggests that the clergy were totally aware of the difference, and saw some liturgical or aesthetic benefit from the separation. In a sense, the south became a chapel to the rest of the church [r2]. It may, as Carl Barnes suggested, have reflected the proportions of the opposite north transept built a century earlier.^{Barnes, 1967, 125}

By 1185 the external walls of the choir had already been constructed to the height of the aisle capitals, or those of the windows a few courses further up. On the south wall of the choir progress may have been much faster to support the wall of the transept triforium.^{Canon Hubert} The foliage in the capitals of the drum piers are in the mode of the 1190s. Drums were quick to build and may have taken only a year or two [6]. The platform over the vaults would then have been ready to receive the triforium by the end of the decade, which was when the piers at Chartres were being capped.

With the demolition of the ancient structure the way was clear to erect the tall thin drums, carve their capitals around 1197, vault over the aisles and then continue the almost 100 courses to the roof cornice.

Working at the same pace as at Chartres, around 4 courses per year in the upper parts, the vaults could have been in place ready for occupation in 1212 as attested by the plaque still attached to the south wall [7]. Thus the choir needed twenty-seven years from footings to completion, excluding the six-year pause while the south transept was being completed.

It would remain an open question whether the vaults were erected after occupation or before, but it makes little difference to either the pace of work or the completion of the first tall-clerestory choir in France with its double-tiered flyers. This was finished in time to inspire the masters at Chartres to create their tall clerestory, a decision that I believe was made in 1210.ⁿ It places the start of the Soissons ambulatory fifteen or so years earlier than Chartres, and the tall triforium and clerestory six years earlier.

When we adjust for the pause, the Chartres nave took the same number of years for almost the same number of courses.

La Sainte-Chapelle

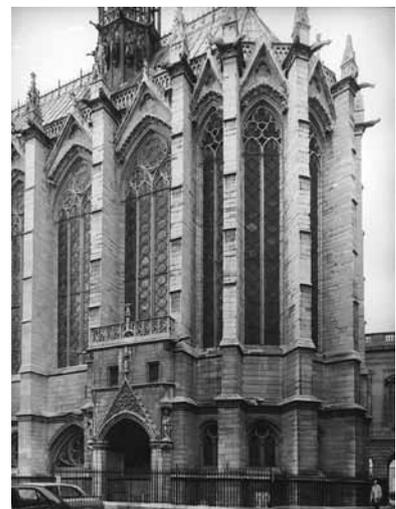
A small building, though tall, with all the resources of the crown available for its construction. There are some 90 courses between the ground floor and the roof cornice. Knowing that it was completed and dedicated in 1246, and making an uncertain assumption that it was not begun until the Crown of Thorns arrived in 1239, the construction rate would have been a dozen courses per year.

It could have been started earlier on the presumption that the Crown was on the way, or later. Nevertheless a dozen courses was fast, and seems to have been the maximum under medieval conditions of scaffolding, mortar and stability with height.

The intricate capitals would have been carved by the best sculptors while the other masons were intent on the walls and piers, though the mouldings around the windows and vaults were far from simple, and would also have required the best men.



Soissons cathedral, south transept from the north



La Sainte-Chapelle from south-east

Reims choir

The documents tell us it took 30 years to complete. They note that the “canons took possession of the sanctuary” in 1241. Allowing for a short pause while the city was in revolt against its bishop, this timetable could have followed a similar pattern as the Chartres nave.

A comparison between Reims and Chartres shows that the additional time needed to build the arches and capitals of the dado would have been about the same needed to build the walls around the crypt at Chartres.

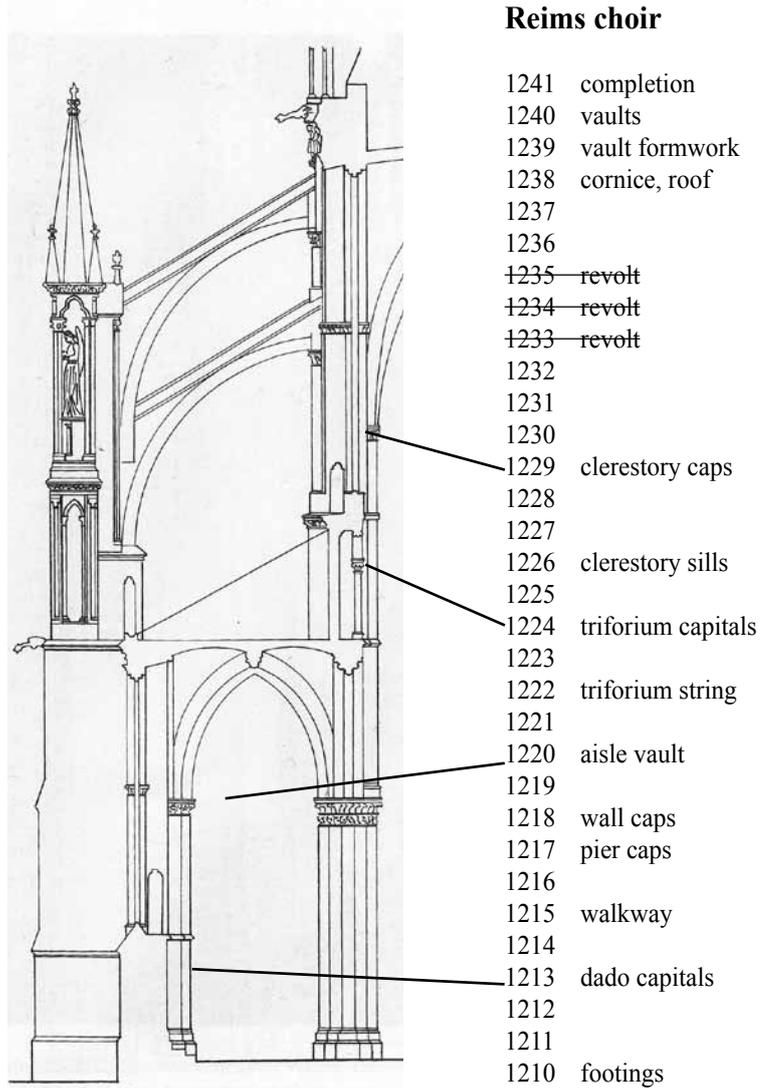
The consecration by Alberic in 1215 may have been for altars in the chapels which could have been installed under roofs at the window walkway level.

The course heights are larger at Reims than any other major building. There are only 90 courses from the ground to the roof. The choir was built between 1210 and 1240, and incorporating delays caused by the revolt, the construction period was 27 years. **The lower courses were laid at the rate of 4 per year, and the upper above the triforium at just over 3.** Quite a slow rate per course, though fairly average per metre as they were large blocks and the building was more massively constructed than any other in the region. This suggests that the revolt occurred between the two flyer arches, about level with the middle of the clerestory roses.

This timetable assumes that the high vaults were completed before the choir was occupied in 1241, though it is possible that the vault and the flyers were installed afterwards, in which case the timetable for the earlier parts could have taken three or more years longer.

An interesting question is posed from Villard de Honnecourt’s drawing of the clerestory.¹⁷ In section V64 he shows a design for the flyer supports that is quite different to what we have today.¹⁸ It looks like a preliminary design. The elevation of the windows in V62 shows no flyers, but only a seating for them built against the walls. This suggests the clerestory walls were in place but not the flyers.

It means he would have been in Reims some time before the flyers had been redesigned, which would have been in 1238 or later.^{James, 1989, 198-9}



Reims cathedral, choir chapels

Paris, Notre-Dame choir

The encasing walls of the ambulatory were built first, leaving the original apse in place for the next dozen years, as in Noyon and many other places. A roof would have been erected between the two so that the space could be used.³⁴

There are two styles of capitals in the choir walls. One is clearly of the 1140s by masters who had been working on the Saint-Denis choir and Saint-Germain-des-Prés. The other has a completely different feel to them in the manner of the piers from the 1160s. There are less than 35 of the former (mostly the smaller capitals) and less than 30 of the latter. This suggests that the capitals were being carved when work was abandoned, possibly in a hurry. I have earlier suggested that this happened when the king called the in 1145.^{ch.03a} The earlier capitals may have been left in the shed, waiting to be placed, when the funds were withdrawn.

Hearsay reported that work recommenced in 1163, and the style of the capitals more or less bear that out. Torigny visiting in 1178 wrote that ‘the apse is about finished except for the great roof’. We could presume that at that time the upper walls of the clerestory were well under way, and the cornice about to be laid. The next three years were taken up in completing the cornice, building the roof and its timber ceiling, and erecting the stalls ready for the consecration in 1182.

Murray has convincingly argued that the flyers we see today were original.^{Murray, 1998} He dates them to the 1170s. However, for the reasons I gave earlier I believe the walls were erected to the cornice and the choir roofed, and that in the 1220s when the clerestory windows were enlarged the roof was raised and the vaults erected with the flyers that support them.^{v.1:81}

By the 20s the nave had been completed to the clerestory with its vaults while the choir still had a timber ceiling. I would guess that the altar was moved into the crossing when they resumed work on the choir.

The rate of construction was 5 to 6 courses per year.

Summary of construction rates based on documents.

From here on the rates of construction are not based on any certain documentation. In the buildings already discussed only the Chartres towers and perhaps La Saint-Chapelle exceeded a rate of 10 courses per year. The two smallest projects, both in Saint-Denis, rose at a rate of 8 to 9 courses.

The others, being Chartres, Soissons, Reims and Paris, were large, involved greater plan areas and rose at 3 to 6 courses per year, with most in the middle range. The Soissons south transept was a little faster, but then it was a small job.

I therefore intend to use the upper rate on smaller works, and the lower rate on larger ones. Without apology I will adjust the rates where there are other factors, especially when affected by the time-lines of the carvers.

Laon choir

Laon has a lighter construction than Chartres, and is not as tall, though it does have a gallery as well as triforium. It seems from the documents that work may have been begun under Gautier de Montagne, which means any time after 1145 when he became dean and before his death as bishop 29 years later.¹⁹



Paris cathedral clerestory from the east

Paris Notre-Dame choir

flyers and vaults
1225 enlarge windows

PAUSE

1182 consecration
1181
1180 roof
1179 cornice
1178
1177
1176 clerestory caps
1175
1174 roses
1173
1172 vault
1171 gallery
1170
1169
1168 aisle vault
1167
1166 pier caps
1165
1164 footings
1163 demolition

PAUSE

1146 some aisle caps
1145
1144
1143
1142 footings

The style of the capitals and the toichological evidence shows that construction of the first stage stopped at the clerestory sills just above the triforium of the choir, and somewhat lower in the eastern transept walls.²⁰ Services would have been held in that space, one presumes under a temporary roof. Work on the clerestory was not resumed until the square eastern extension had been built to this level, after which the whole of the choir from crossing to eastern wall was continued to the cornice and roof, and was vaulted.

The choir gallery is entirely the work of the mid-60s from the style of the capitals, as is the triforium.

Scholars who write that the choir of Laon is from the 60s and the extension from the 80s give the impression that there was a 20-year gap between the two campaigns on the choir, whereas one followed close on the other. This is shown in the timetable [b]. There is no reason to assume that the gift of the Chermizy quarry dates the extension.²¹

Though the capitals in the eastern section of the choir, in both the aisles and gallery, are in the style of the 80s, work would have begun on the foundations before that. The chart shows there was only a short pause of a year or two between completing the clerestory around the ambulatory and deciding to pull down the hemicycle and extend the choir seven bays to the east with a great rose. The discussions that would have been involved around this decision would have occurred close to 1168, and may be why work on the choir stopped at the level of the clerestory sills.

Within a couple of years the transepts had been laid out and the first bays of the nave begun. From here both transepts and nave, and the eastern extension of the choir were built more or less together. They remained so close in tandem that when it came to building the great rose windows, those on the eastern and western walls were erected at the same time.ⁿ

The first act in extending the choir occurred just after Gauthier's death. It may have been prompted by the change in bishops in 1174, or it may

Laon cathedral

		east + west
		completion
		1195 vaults
		1194
		1193 roof
north trans		1192 cornice
		1191
		completion
1189	vaults	1190 window caps
1188		1189 rose windows
1187	roof	1188 clerestory sills
1186	cornice	1187 triforium
1185		1186 vaults
1184	windows	1185 gallery caps
1183	north rose	1184
1182	clerestory sills	1183 aisle vault
1181	triforium	1182 wall caps
1180	vaults	1181 pier caps
1179	gallery caps	1180
1178		1179 dado
1177	aisle vault	1178
1176	wall caps	1177
1175	north doors	1176 footings
1174	dado	
1173		
1172	external steps	
1171		
1170	footings	

Laon choir

1169	temp roof
1168	clerestory sills
1167	triforium
1166	vault
1165	gallery caps
1164	
1163	aisle vault
1162	wall caps
1161	pier caps
1160	
1159	dado
1158	
1157	
1156	footings

Laon cathedral, north transept and choir



have been the last act of an exceptional administrator. It was in any case implied in the noble spaces of the transepts and the first bays of the nave that were being set out and excavated while he was still bishop. With that decision came the simplification of the design for the nave piers that occurs west of the third bay.

In the adjoining charts I have included the timetables for the choir and the north transept which indicates that the north rose should be dated to around 1183. The eastern extension and the bays supporting the western towers follow similar timetables. Except for the extension, these dates are not dramatically different to those established by the decadic timing in volume 1, nor to those proposed by Clark and King.²²

Sens cathedral choir

The capitals in the dado and in the aisle walls indicate that the work began around 1130, while the clerestory flyers and cornice are the work of the later 60s. Severens would like the commencement to be ten years later from stylistic comparisons with Burgundy and the Loire, whereas the carving mannerisms of the masons who worked on the choir dado capitals clearly indicate the early 30s.^{Severens 1970.}

What facts do we have? Two documents tell us that work was begun by Henry Sanglier who was bishop between 1122 and 1144, and that the stalls were nearing completion when Henry died. After that we read of a consecration in 1164 and that “the greater part remains incomplete”^{v.1:1596}

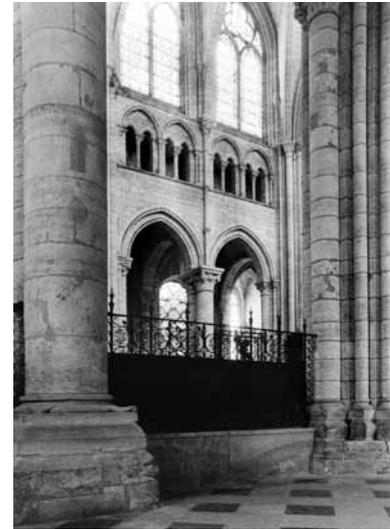
In the left hand chart I have set out a timetable similar to that of the other churches of this size already discussed. It shows that to construct the clerestory and the main roof over the stalls by the mid-40s, the foundations would have had to be dated to the year of Henry’s investiture. This is not impossible as other newly appointed senior clergy began building immediately after their appointments: one thinks of Nivelon de Chérizy in Soissons and Pierre de Celles in Saint-Remi.

Such an early date would justify the original intention to build groin vaults round the ambulatory, but leaves a number of uncomfortable consequences such as the 1125 date for the dado capitals, the 1140 date for the flyer supports,ⁿ details in the cornice just above that that are closest to those in Canterbury,ⁿ and the style of all the capitals above the level of the gallery string course being related to other work from the 1150s and 60s.

The alternative timetable in the right hand chart is for building up to the gallery level between 1130 and 1144, and then leaving the work under a temporary roof. This places the decision to use rib vaults in the aisles to around 1139,ⁿ and comfortably leaves the flyers and high vaults to some time later.

By working backwards from a possible *terminus ante quem* dedication of 1164 at a rate of 5 courses per year showed that work would have recommenced in the choir around 1153 after a delay of nine years, presumably caused by financial limitations from the crusade. This accords well with the style of the capitals that come from ten or more years later than those in the ambulatory.

Building the stalls before the choir had been finished points to a decision to open the choir to services under a temporary roof. This would relieve pressure on having to complete the whole of the choir first and allow funds to be concentrated on extending the work into the central bays of the nave.



Sens cathedral interior

Sens choir with pause

- 1164 completed
- 1163 choir vaults
- 1162
- 1161 roof
- 1160 cornice
- 1159 flyers
- 1158
- 1157 walls
- 1156 clerestory sills
- 1155 clerestory caps
- 1154 gallery caps
- 1153 gallery walls

Sens choir early start

- 1144 stalls
- 1143 roof
- 1142 cornice
- 1141 flyers
- 1140
- 1139 walls
- 1138 clerestory sills
- 1137 clerestory caps
- 1136 gallery caps
- 1135 gallery walls
- 1134 gallery walkway
- 1133 socle wall
- 1132
- 1131 aisle rib vault
- 1130 wall caps
- 1129 pier caps
- 1128
- 1127
- 1126
- 1125 dado
- 1124
- 1123
- 1122 footings

PAUSE (crusader recession?)

- 1144 stalls
- 1143 temporary roof
- 1142 gallery walkway
- 1141 socle wall
- 1140
- 1139 aisle rib vault
- 1138 wall caps
- 1137 pier caps (groin vault)
- 1136
- 1135
- 1134
- 1133 dado
- 1132
- 1131
- 1130 footings

IDIRAJT

Noyon cathedral choir

The timetable was constructed by working back from the calculations for the capitals of the 70s in vol. 1. Working backwards in time suggests the footings were commenced in 1159/60, with an assumption of 4 or 5 courses per year. The foundations would have been laid just after the translation of the relics that may have been moved out of the way so that builders could have a clear access to the site.^{Noted in error as 1167 instead of 1157 in v.5:972.} The dates in vol 5 are somewhat confused because I had not at the time of printing composed this timetable.

This is a decade later than Seymour suggested for the choir,²³ and a little later than Bony²⁴ and Polk,²⁵ though all would agree with the nave being primarily the work of the 70s.

To understand the history one has to consider a major anomaly in the construction schedule of the aisle and the gallery. The capitals of the gallery arcade are from the mid-70s, while those from the wall opposite seem at least 5 years earlier. There are four different plans for the piers on the ground floor and four quite different plans in the gallery and many differences in the profiles.

Among the aisle capitals four different teams were involved: in the arcade drums, the crossing piers, the ambulatory and the adjacent chapels.²⁶

The simplest construction sequence that satisfies all these anomalies is that the ambulatory chapels and their vaults were built first, followed by the gallery wall above that braced by the flyers set over the chapel vaults. This formed a free-standing bracelet shown in the section of only the outer walls and chapels [r1]. It was presumably built around an earlier choir that was kept in use while the outer parts were being built. The suggested chronology for each level, working from the dates originating from the carvers of the capitals, are noted on the section.

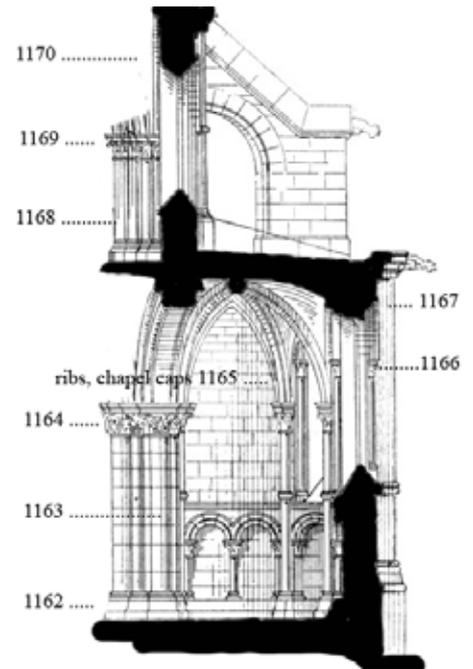
After some ten years while the outer parts were being built, the old choir could be demolished around 1171. There was then a flurry of activity to complete the hemicycle arcade and its vaults, as quickly as possible, and over that to build the arcade of the gallery and its vaults. These campaigns included the pair of piers on the ground floor nearest the crossing and the adjacent bays of both transepts.

The style of the gallery capitals establishes the date for this zone, and by working backwards using the same rate of construction as elsewhere, and allowing for the eccentricities of the construction program, the extraordinary capitals around the ambulatory walls should be dated within a year or so of 1164.

This meant a moderate construction rate of four or five courses per year, presumably with small teams of masons. In this case the footings may have been commenced in 1159/60, and the high vault built around 1183. Considering the progress in the nave, and the lithic evidence where the masonry of the choir is bonded into the transepts, the completion of the choir is unlikely to have been later.

In all respects the choir was a slow and complex structure to build, made more so by the need to work around the old apsidiole. By contrast the rest of the building was relatively straightforward and its construction followed the normal sequence adopted elsewhere.

Being one of the last works of the period, coming after Laon and the Soissons south transept, after Paris and Senlis, it is relatively old-fashioned, even some might say cumbersome, and would not have justified the ink expended on it but for the mistaken belief that it had been conceived ten years earlier.



Section through chapels, Noyon cathedral choir

Noyon cathedral choir

	completion
1183	vaults
1182	roof
1181	cornice
1180	
1179	
1178	flyers
1177	
1176	blind triforium, clerestory
1175	
1174	gallery vaults
1173	gallery piers
1172	aisle vaults
	ambulatory piers
1171	remove old apsidiole
1170	
	gallery wall, flyers
1168	
1169	gallery piers bays 1-2,
1167	aisle piers bays 1-2
	remove part of old choir
	chapel vaults
1166	chapel windows
1165	chapel caps, ribs
1164	ambulatory wall caps
1163	dado
1162	
1161	
1160	footings