Constructing the narthex of Saint-Denis

DRAFT PAPER for discussion

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Can we agree on a starting date?

I am amazed that people are still unsure when Abbot Suger began the foundations and why some time before 1130 still appears to be uncertain.

Panofsky in 1946 suggested that "plans ... were under way as early as 1125",#1 from a document that has since been subject to many different interpretations, leading Sumner Crosby and others to prefer the mid-1130s.#2

In 1998 Lindy Grant reopened the possibility that the narthex could have been started earlier.#2a

Ten years later I wrote "Delay from slow-setting mortar is probably the reason that each layer (of capitals was) carved by different teams.... Working back from (the consecration of 1140) the minimum time needed for construction and mortar-setting dates for each layer of capitals .....". For those in the portals I estimated 1130 with an earlier date for the footings. #3

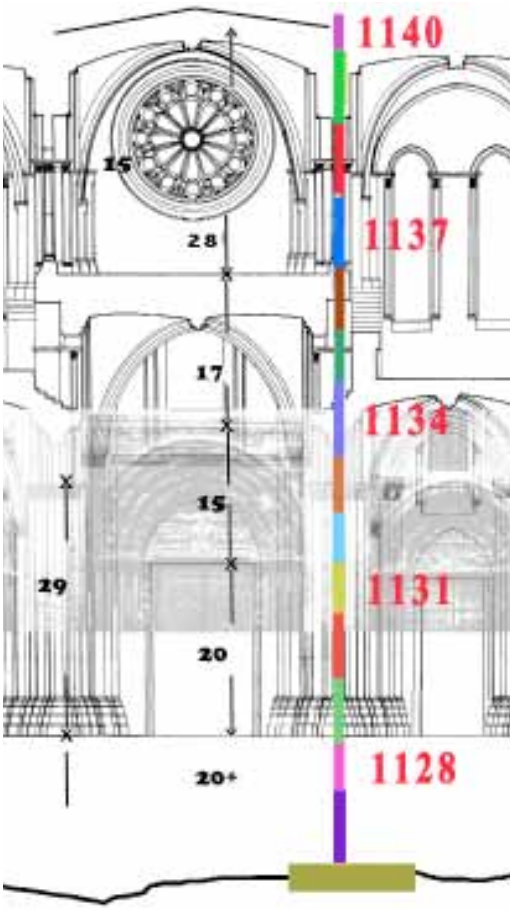
In 2011, Clark and Waldman signalled "the recovery of the priory at Argenteuil in 1129 .... (as being) closely linked to the plans to enlarge the abbey church",#4 though this may have just added to the available funds and speeded up works already in progress.

In 2012, I suggested that the time required to dig and build deep footings through silt and marle to a firm foundation indicate a start around 1126/27.#5

In 2020, Moulin considered the commencement of the narthex as "l'apport financier exceptionnel de 1125 pourrait alors correspondre à l'abandon de l'idée d'une simple amélioration de l'entrée de l'église ou profit d'un véritable agrandissement du bâtiment. Ce changement de parti se concrétisa sans doute en 1128, lorsque s'acheva la réforme de la communauté."#6

Considering mortar setting times and the toichological evidence set out below, I suggest that a dozen campaigns were required to the first plinths at an average of 6-7 courses per year. Footings would have been at least 2.5 metres deep, probably more. As funding was slow in the early years #6x I would allow three years to set out, dig and pour footings that were at least five metres wide.

Therefore, I would settle on an estimate of 1126±1 for the start of the works. The carving of the portal sculpture could then be dated to 1129±1, and could have been completed in one operation, stored in the shed and gradually placed as needed over three campaigns.



How much and how many?

Without becoming mathematical, Moulin's calculations suggest they laid 450 stones per course or about 3,000 per campaign.#7 He then suggests two weeks were left between courses, but as a large proportion were delicate and difficult to place, two weeks between courses may be an underestimate. The delays from setting times for arches and the erection and dismantling of formwork were not included, but that was carpentry by men who need not have been part of the building team.

If we calculated on the generous side, the erection of seven courses in

each campaign would have occupied 14 weeks.#8 This is a most interesting calculation. It suggests that at Saint-Denis a campaign may have lasted less then 4 months before the men left. Then what? Did they go home? move to the next job? bring in the harvest or go sailing?

Can we ascertain how many masons were needed? Walls and arches are not sculpture that required more skilled *imagiers*.#9 Most of the ashlar blocks could have been carved in a day, but at least a third required careful and detailed carving with exactly-formed profiles that would have taken longer. Especially plinths and imposts. For these I would estimate an average of two days each.

Therefore, there would have been 40 masons on the job to produce enough stones for the time they were on site.#10 Some were skilled, some apprentices.

Men were also needed for cartage (about 6 deliveries a day) and erection (four teams could have placed seven or eight stones a day). Mortar for thick walls and fill over the vaults was heavy work, and had to be mixed by hand and carried along planks and up ladders. And of course, the ever-present carpenters for scaffolding, cranes, centring and formwork, and smiths for tools and a host of other jobs. I would not be surprised to find 150 men on site, at least half of whom could have been local.#12

What limited the work to eight courses?

Medieval mortar was slow to set, especially in thick walls.#11 In addition they had to wait for arches to settle before they could be loaded. Setting time constrained all construction and set limits to each campaign. It could delay the works for many months, even a year if the weather was bad. At Saint-Denis some seven courses was all that could be constructed in a season. Setting time determined that the narthex could not have been built in less than thirteen years,

Consequently, a team could work at a number of jobs in a year, each taking no more than a few months. Intermittent contracting was unavoidable. We could imagine many, perhaps hundreds, of builders on the move, individually or in caravans, singly or with families, crisscrossing the lanes of northern France, taking up their tools in one place after the other, never resident for long.#12a

This bred men who were adaptable, but like factory workers, not party to the finished product. They did what they could, to the best they could, and always adapting to the situation as they found it. Their job was not to complete a work from scratch, but to start with whatever they were given and raise their part in small increments. This explains why contiguous contracting was not possible, and permanent workshops impractical in most circumstances.#11a

These technical limitations were normal, to be found in all buildings, and though some churches were large enough and sufficiently complex for the master to put his men to work on another part while they waited for the mortar to set elsewhere, everyone would have taken these necessary pauses for granted. It was a given aspect of the builder's trade.

What would the men have done during this time? The carpenters could have stripped the centring, just as they had built it, but there was nothing for the masons to do but leave the site and find another job.

I came to realise this at Chartres fifty years ago and have written about it continuously since then [box]. It upset academic historians, yet not professional architects and builders: for them it was a natural conclusion.

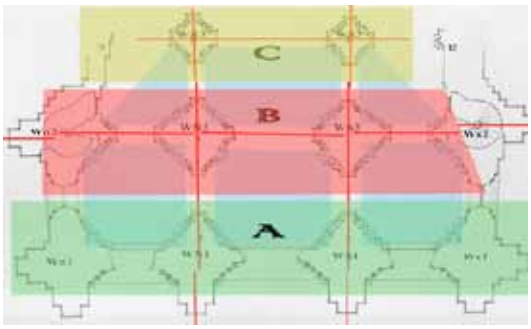
It is only now that the tide of opinion may be changing, and it seems time to approach the most discussed work of the period, the narthex of Saint-Denis, in a new way.

Anomalies are the key to unravelling the building program, and some of those I will investigate in the following pages.

Where have I discussed mulltiple contracting before?

"The Contractors of Chartres", *The Architectural Association Quarterly,* iv 1972, 42-53.
*Chartres, les constructeur*s, Chartres, iii vols. Trans. D. Manoury, 1977-82
The contractors of Chartres, Wyong, ii vols. 1979-81
Chartres: the masons who built a legend, Routledge, London, 1982.
"An examination of some anomalies in the ascension and incarnation portals of Chartres Cathedral", *Gesta*, xxv 1986, 101-108.
"La construction de la façade occidentale de la cathédrale de Senlis", *La Cathédrale Notre Dame de Senlis au XII*e *Siècl*e, Paris 1987, 109-118.
*The Template-makers of the Paris Basi*n, Leura, 1989.
"Etude des anomalies dans les portails de l'ascension et de l'incarnation a la cathédral de Chartres", *Bulletin de la société archéologique d'Eure-et-Loir*, xxvii 1990, 110-123.
"Evidence for flying buttresses before 1180", *Journal of the Society of Architectural Historians,* li 1992, 261-287.
"Multiple contracting in the Saint-Denis chevet", *Gesta,* xxxxii 1993, 42-62.
"Chartres a eu de la chance, les Parisiens étaient occupés", *Monde médiéval et société chartraine,* Paris 1997, 39-62.
"Could Suger have built the choir of Saint-Denis in four years?", *Avista Forum Journal,* x 1998, 23-25
The Creation of Gothic Architecture - an Illustrated Thesaurus: The Ark of God, vols 1-5, London and Hartley Vale, 2002-08.
"La construction du narthex de la cathédrale de Chartres", *Bulletin de la Société Archéologique d'Eure-et-Loir*, lxxxvii 2006, 3-20
"The peaked arch, and the earliest domical rib vaults in the Paris Basin", *Avista Forum Journal,* xv 2005, 3-7
"The Contractors of Chartres forty-five years later", 2011 COGA
Master Carver Series , 2010-2013, COGA
"Boundaries that delineate periods in art-history between 1090 and 1180" *Avista Forum Journal,* 22 2012, 23-46
The Royal Portal Series COGA, in pregress 2020-2021
Building campaigns and design changes in Notre-Dame d'Etampes, in preparation after building the model.

The layout



In the plan [r1] the parts are identified by location, with upper case used for piers and lower case for walls.#13 To do a full analysis into the templates we would need an accurate survey of the dimensions, but to indicate they were the work of many masters it may be enough to note the following.#13x.

The axes: In the west the buttresses between the portals do not align on the pier centres, especially in the north. The axis between the W2 buttresses are offset to the west, and were set out in the footings below ground level for different bay dimensions. I would surmise that the sub-floor courses of the exterior buttresses may have been at a lower level than the plinths on the interior and the misalignments and some clear joints and corbels on the exterior suggest they were not in the same campaigns.#13z Very careful measurements and an analysis of the geometry used for the templates may make this clearer.

In the second bay the newel of the north stair is aligned on the axis through the piers whereas the newel through the south stair is aligned on the middle of the external buttress. Either stair could have been adjusted to align consistently on either, so the inconsistency reflects different attitudes to structure.

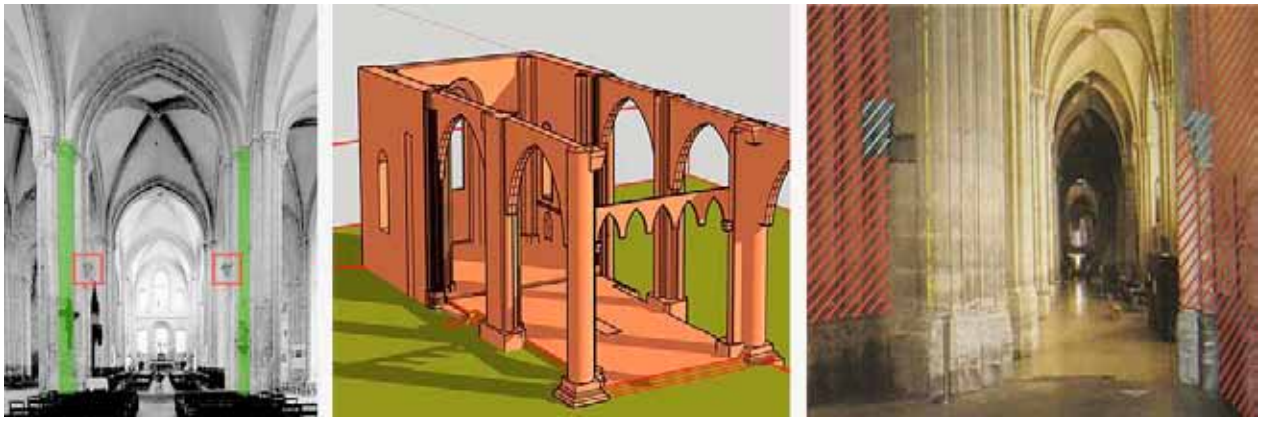
The stairs: The details in the circular stairs are one of the best indicators of where to locate changed masters. The items to look for are the relationship between the tread and the newel, the number of risers per turn and the relationship between the face of the tread and the centre of the newel, and I would expect dimensions and detailing in the stairs to be slightly different. Also, changes to the diameter of the stair shaft, the design of the slot windows, and the doors.#12y

The arch over the entry into the stairs is round in the north with small voussoires, and segmented in the south with larger stones. Together all these small items will indicate where there were changes in the templates and whether one side was a little ahead of the other.

The east walls: The outer walls in the eastern bay are different on each side and neither are designed to support ribs [r2]. The north has an additional shaft with a second recess and a window while the south has only one intermediate shaft. There are round arches on the north and pointed on the south, and a continuous impost only on the south. Apart from these differences there are inclined sutures across the lower part of the north wall and only the upper part of the south.

The capitals at the eastern entrance to the south aisle were to support something,#12x but the shafts above them are coursed into the walls without any indication that an arch was intended across this wide opening [b]. There

Etampes Notre-Dame with similar isolated capitals in the entry to the choir, (a-) level, marked with red square. Centre, our model of Etampes with suggested timber element between these capitals. Right, Saint-Denis south narthex entry into nave, two capitals shaded blue with similar possibilities (Moulin, Fig. 59).



was a similar situation in the almost contemporary church of Notre-Dame in Etampes at the entrance to the choir from the mid-1120s.#15 We could imagine them inserting a screen or timber beam over these capitals to carry an image such as a cross to visually separate the narthex from the nave.

The piers: From the arrangement of shafts the piers divide into four categories: the walls in the western bay, the central piers, the eastern piers and the adjacent walls, none of which mesh easily with their opposite numbers [next page]. I would expect the plinths and torus mouldings to reflect the changes in plan templates. Since the floor level was raised we cannot know except for the unusual torus on the inside of the west wall.#14

The squashed relationship between the north portal and the Wn1 shafts is unique. It looks as if the north wall was made thicker than the south and the next master was not able to fit two responds against the north jamb [red query].

The multitude of significant anomalies would have come from the many masters employed, and are reflected in the details in the box, next page.

Conclusion: Even without the original bases to guide us, we can see that the lowest courses were laid out to a number of templates, and consequently by a number of builders.

The inconsistencies in only the first courses show so many anomalies that it may not be necessary to continue this a detailed investigation any further. At least, until we can visit the site and take detailed measurements and properly investigate the templates and the differences between them.

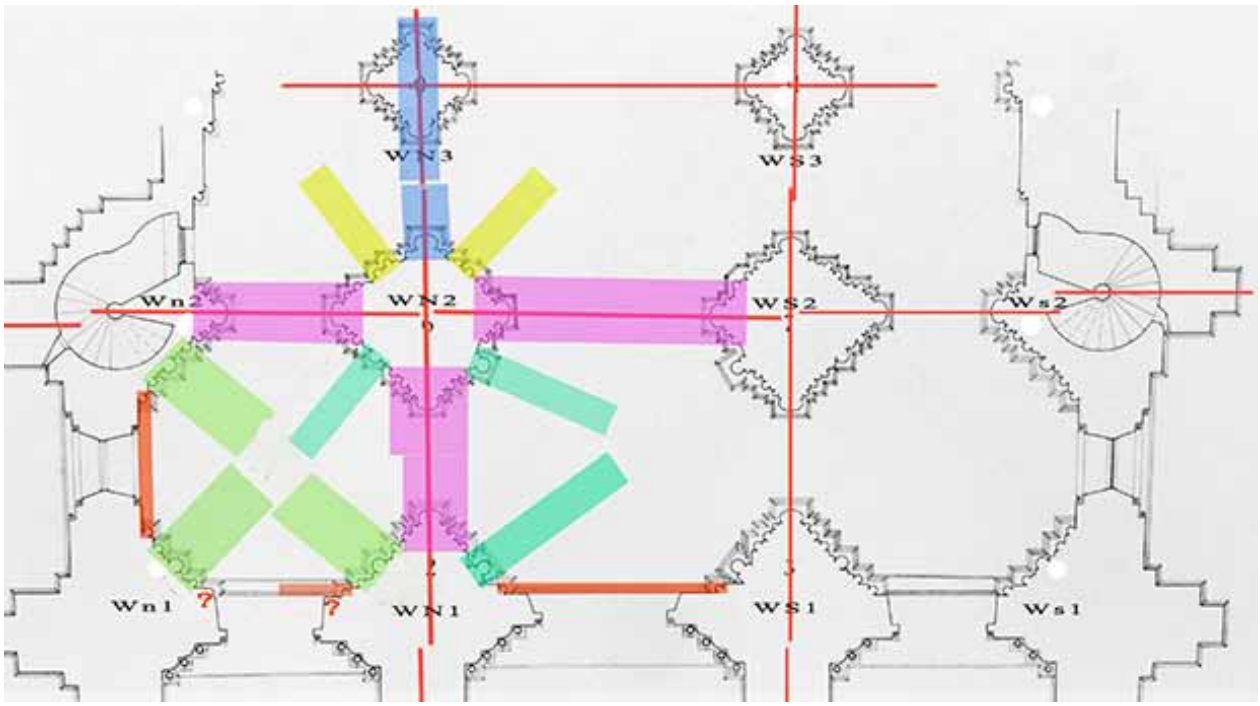
Order of work: I would hazard a guess that three masters were involved on the interior. The W1 piers were first with the portal, the W2 piers and walls were next with one of the stairs, and the eastern piers last. My reasoning is that Suger may have been eager to have the portals visible as soon as he could, and that the presence of existing buildings to the east may have delayed work at that end.

The misalignment of the axes suggests there may have been as many as two more levels of decision-making on the exterior buttresses, probably determined in the footings. Careful and detailed measurements and sonic echoes are needed to enable us to seek the initial ratios used in the set out.

During the time that funds were limited before 1130, many gangs could have been employed on the lowest courses, each for a few months and possibly more than one crew each year. Under these circumstances the limits to each master's contribution may have been financial rather than the constraints of mortar.#12z

Uncomfortable as multiple contracting may be to some people, consider just two items: it took more than 13 years to construct and consequently the builders erected one course every fortnight, It therefore follows that the teams spent less than four months on site each campaign. The changes in the detailing, the dimensions and the elements that define the campaigns show that the same men did not immediately return, though they may have later. How this may affect our understanding of employment, travel and roles has yet to be unravelled.

In a first estimate (without being on site) I will refer to the first three campaigns above ground level as A, B and C. The order could be different, as could the physical connections between the shafts, the stairs and the buttresses. This is only a preliminary assessment before making a proper on-site post-covid survey.



Plan of narthex with nomenclature for each pier. The assembly of shafts are noted in colours to show one possible arrangement, though there could be others.

The doubleau supports: The shafts under all the transverse arches are tri-lobe, a bit like a bulbous balloon but some have one flanking shaft, some two and some none.

WN2e blue is wider than its opposite number WN3w, triple+singles, a difference that is fudged in the arches.

Wn2s-WN2n pink match as triple+doubles. But then there is no shaft for the respond to the east to match the one on the other side of the stair door.

WN2s pink is wider than on the north side, yet is still the same format of triple+doubles.

However WN2w is triple+triples.

Wn3e opposite is also triple+triple on the south side but with two singles on the north. You can see that the two pink bands do not match. We can juggle their intentions as we wish, but if widened the adjacent three-fold rib shaft would not match its opposite number.

The rib shafts: The above is based on the assumption that the ribs in light green in WN1ne, Wn1ne and Wn2sw are all three-fold. If their flanking shafts had been used for responds there would have been a shaft missing in the central pier WN2n. Whichever way we work the order there is one shaft missing.

This is confusing for the single rib shaft in the aisle that comes from a single support in WN2nw, darker green. If that was meant to be three-fold too, then that would change what is shown in Wn2 against the stairs, and would leave the doubleau in WN1 on the west wall with an unusable shaft.

In the central W1-2 bay the rib shafts are single. WN1se points to its opposite number, but WN2sw points towards the rib on the far side of the opposite aisle, Ws1ne. This is taken from the orientation of the shaft itself as the bases are new and may not be trustworthy.

There are three schemes for the ribs in the W2 piers. They do not match the schemes in the walls.

There was no provision for rib shafts in the east aisle walls, presumably no aisle vaults were intended.

Look up at the imposts to see how these shafts get organised at the level of the vaults. There is a neat clarity in the central vessel, but nowhere for one of the arches on the north to sit. Look at the panoramas in COGA.#

Anomalies in the portal

Seeing the portals completed one has the impression that it was a singular operation, whereas construction was a process in which a number of builders assembled each other's work, and often got it wrong. Particularly the *imagiers* work that was often manhandled by the building gangs when they got to it.

A number of significant changes were made to the portal after the sculpture had been carved. They can be seen in spite of the multitude of restorations #15x The major visible changes are in the jamb panels. They indicate that the heights of all the doors were meant to be a little different to what we have today. The changes suggest the input from a number of masters each with their own methods, just as was found at Chartres ten years later.#16

The central door: The *bas-reliefs* in the jambs were designed for a taller portal that would have given the entry a more centralised appearance, more in keeping with contemporary triple portals. In the left jamb [b1] the figure has lost the canopy, though one stump is still visible under the chest of the eagle in the impost. In the right jamb the situation is similar [b2]. In both, the impost was adjusted to make room for the head that pokes up into it. Taken on average, the height lost was about 14 cm.

Also, note the chopped capital in [r], the badly executed join in blue, another join in pink and an inserted piece in orange. A seriously compromised area that needs closer invesigation.#16x

Saint-Denis narthex central portal left jamb, the stub of the canopy is just under the breast of the bird..

Saint-Denis narthex central portal right jamb. Details of the left foliate panel is shown above.

The carving of the side panels was accurate and expensive work. It stands to reason they would have been carved in the correct lengths to fit under the proposed tympani. At the time of carving this height would have been some 14 cm more than at present. The reduction in height would therefore have been made after the jambs were carved and about the time they were erected.

The adjustment in the centre happened as the lateral doors were being placed [r1]. The diagram shows how the section between the central and north portals may have looked at this stage. The impost under the north archivolts is two courses lower than the impost in the centre. Follow the line under 'a'. It lies above the impost of the north portal and below the capitals of the centre.

This meant that the masons on the lateral portals could erect the tympani and the multitude of small stones that make up the archivolts 'b', while the capitals were being installed in the centre. The buttress would have been paused at 'c' to allow this to happen, and the available space would have been useful to manoeuver materials while erecting the lateral archivolts.

While the upper parts of the side portals were being placed the capitals and imposts in the middle would have been erected. Meanwhile, no more masonry would be placed on the buttress 'c' until the side voussoires had been installed and at least the lowest voussoires in the centre.

This shows that the fourth row of central archivolts 'd' would not have been placed until after the lateral portal had been completed. Only then could the ashlar of the pier that was needed to stabilise the arches be raised above 'c'.

It was during this complex operation that the height of the central door was altered and the upper *bas-reliefs* cut back. This was done with care on a bench before they were erected.

Altering the height had more to do with geometry than appearance. The master had to give instructions to his men, and he did this through the ratios he used to create the templates. No two men used the same geometric system, so the change in height has to indicate one or more changes in masters.

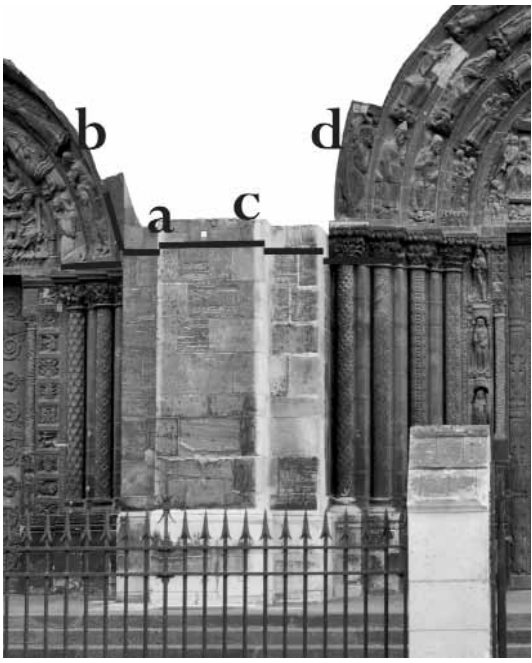
The lateral doors: In the uppermost course of the jambs in both lateral portals there are strange out-of-character figures, lounging in the sun or playing games. These have nothing to so with the solemnity of the rest of the portal which has the most carefully considered liturgical and symbolic meaning.

On the right portal the jambs were reduced in height. The upper part of the frame was lost when the enclosing circlet was cut through [r2]. The entire top of this stone is missing. Since it would have been designed to match the stone at the bottom, it would have had some creature above the circlet that may itself have been finished with a carved frame. This would have added to the height of the portal.

The bottom course of the left portal has little figures like those in the upper. Was it possible that the upper panel was like the bottom? If so, there would have been a framing strip along the top, and this door would also have been a little taller. In fact, by appearances and without being able to make measurements, it looks as if it could have been the same height as the centre.

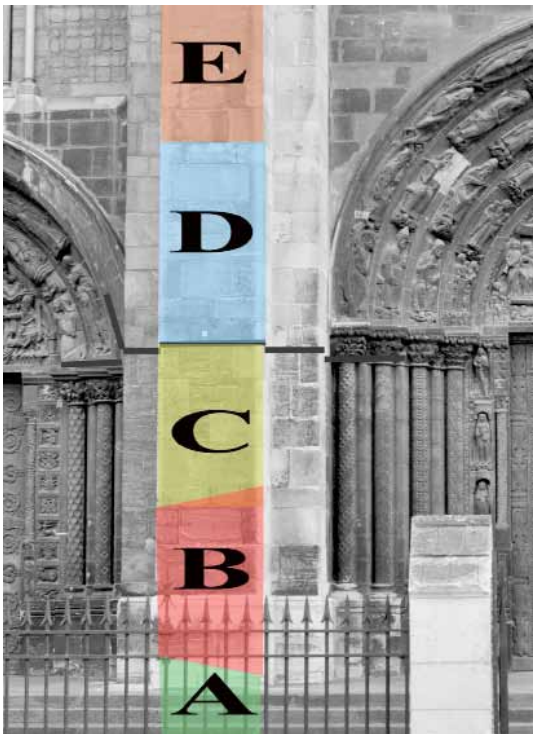
If this was the case, the carving for both doorways was designed to suit a different situation to what we have today. As at Chartres, the most logical explanation is that more than one contractor was responsible for the erection of sculpture that had been completed some time before, and that either they were not told how tall the openings were to be or they were unable to measure what was needed.#16z

Continuing with the earlier estimate, the 19 courses under the capitals could have been the work of campaigns-A, B and C, the next seven courses to the crown of the side portal would be D and the next to the top of the central door, E [r3].



Saint-Denis portal construction, order of work

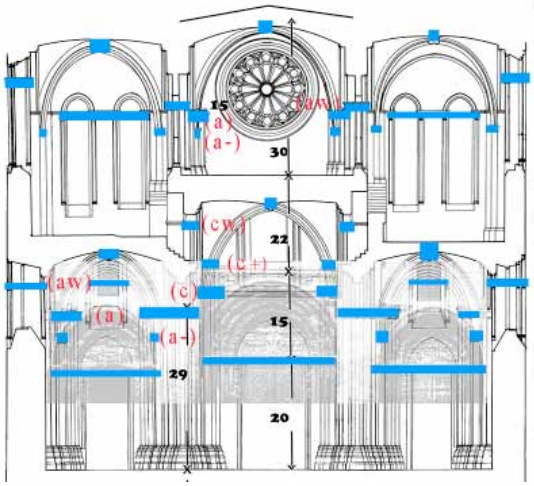

Upper panel left jamb, south door.



Possible construction sequence of western portals

THIS SECTION NEEDS ANOTHER PAGE OF ILLUSTRATIONS FOR EACH ITEM

The capitals and imposts



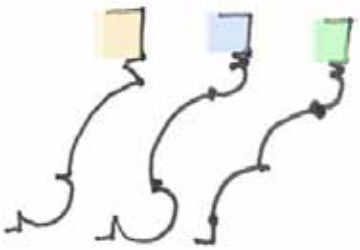
There are eleven bands of capitals [r1]. The characteristics of each lower band follow a consistent morphology. Some, such as the (a-) level under the ribs, are so consistent across a number of carvers that the master could have insisted that each carver follow a common arrangement of multiple hanging fronds. Some bands are without any apparent oversight so that the variety of designs is looser.

Yet each group of capitals is distinct, with little evidence that the same carvers appeared more than once. I have looked for similar capitals in other churches, and have linked them in COGA.#17 This has been especially important as the dates in Saint-Denis can establish fixed moments in time that help date other buildings with the same capitals.

The imposts pose a complex history of their own and need to be assessed on site. Sometimes a master would make a copy of an earlier impost to maintain unity throughout the job, but most of the time he would use whatever profile he was used to.

To illustrate one complexity, this impost in the WN2se has three profiles [r2]. They are coloured in the sections as in the image [r3]. The junction yellow-blue is covered by a little cartouche in the centre of the splayed part, the other blue-green junction is "lost" in the corner.

Juggling formwork and voussoires: The intersection between the two upper portal phases and three levels of vaulting arches deserves a little explanation. This is the WS1 pier seen from the north east [b]. The figure shows the necessary stages in building 5 levels of arches.



A – Spring of arch over lateral doorways, scaffolding and formwork, without yet placing any load on the voussoire arches. This is 'b' top p.7 r1.

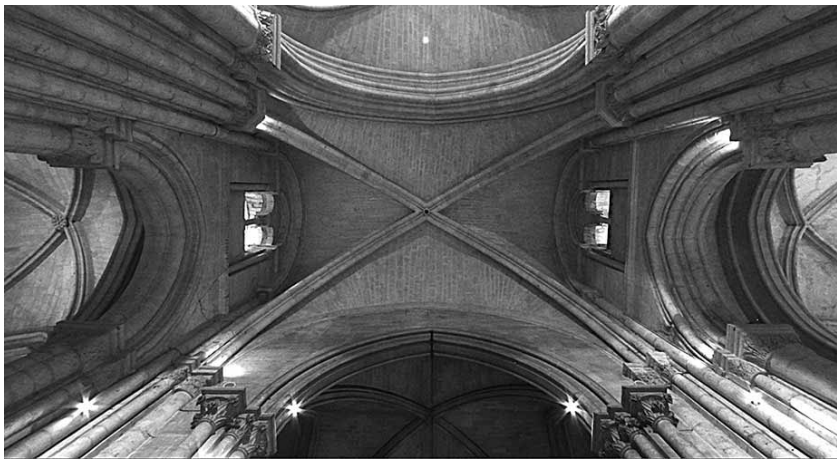
B – Start of arch over central portal with capitals under aisle ribs. May have included the lower courses of the archivolts that did not require formwork. Some 5 courses. On the walls this included the bottom window course.

C – Formwork for and erect ribs in aisles. Build arcade capitals and formwork, window sills. Central tympanum now fully erected. 4 to 5 courses.

D – Formwork for arcade arch and lay voussoires, arches over windows, build aisle cells. In the centre and in east bay build shafts to support the rib capitals. Lay string course under the west walkway. 5 courses.

E – Formwork for central ribs and east doubleau; walkway capitals and responds with arch across west window. 6-7 courses.

These campaigns describe multiple arch construction, but not necessarily the campaigns that may not have been in lock step. It shows that the number of items in the vaults would affect the rate of construction as a whole.



The eastern central bay

Gardner and Moulin#17 have both interpreted what they find in the east central bay to mean that construction was far more advanced around the high vaults in the west, and retarded in the bay next to the nave. In their proposals this left a 'hole' in the works between the floor of the upper chapel and the (a+) capitals over the W3 piers [b1].

When drawn, this implies a sharp drop on the east side of the W2 bay. The obvious differences between the western and eastern bays are:

- The respond shafts of the eastern central bay continue to well above the rib springing, unlike the west where they stop at the arcade level.
- The eastern capitals are at a lower level than in the western bay.
- The openings into the tower chapels are different.
- The vaulting details are quite unlike anything in the west.

Such a 'hole' would have delayed the upper works by some 15 courses and a number of vaults, the work of more than two years. More importantly, the upper chapel in its entirety would have been delayed while the east caught up, and that had to be fast if Suger was to have his opening in time. Can you imagine Suger permitting such a delay?

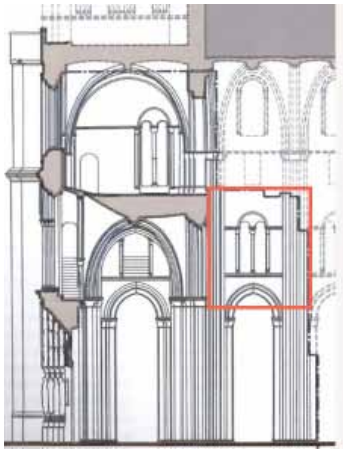
The listed differences point to a change in template-makers above the level of the aisle capitals. This is not enough reason to postulate a hole in the works at this level. More importantly, in the next level both bays of the upper chapel were built together and there is not sign of a vertical joint between the bays.

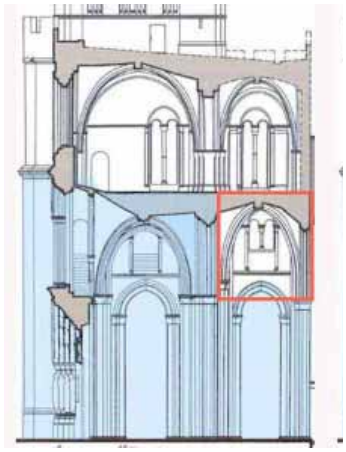
Drawing [b1] is from Moulin, and the red square marks the 'hole' in the works. Under it I have shown what an enormous impact such a procedure would have on the completion of the upper chapel [b2]. How could they catch up in time to be ready for the dedication in 1140?

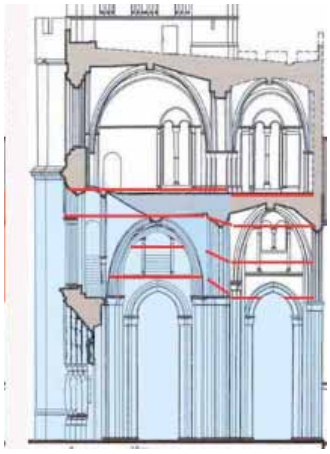
In the third drawing [b3] I have marked the way in which the junctions between the campaigns could have appeared if the east was just a few courses lower than the west, and remained those few courses lower for their entire height. It continues the process begun in the very first courses where the W3 plinths were far behind those in the west; an imbalance was probably continued all the way to the top.

This suits the different layout for the capitals and the ribs, for the lower arch on the east, for the change in the plans for the openings, the higher level for the string course, the pushing of the respond capitals high into the vaults.

As these campaigns progressed the completion of the massive vault over the west-central bay could have slowed down the work in the west giving the east a little time to catch up. In other words, there was no delay in the works as a whole, but only a small step between campaigns.#19







Consequences

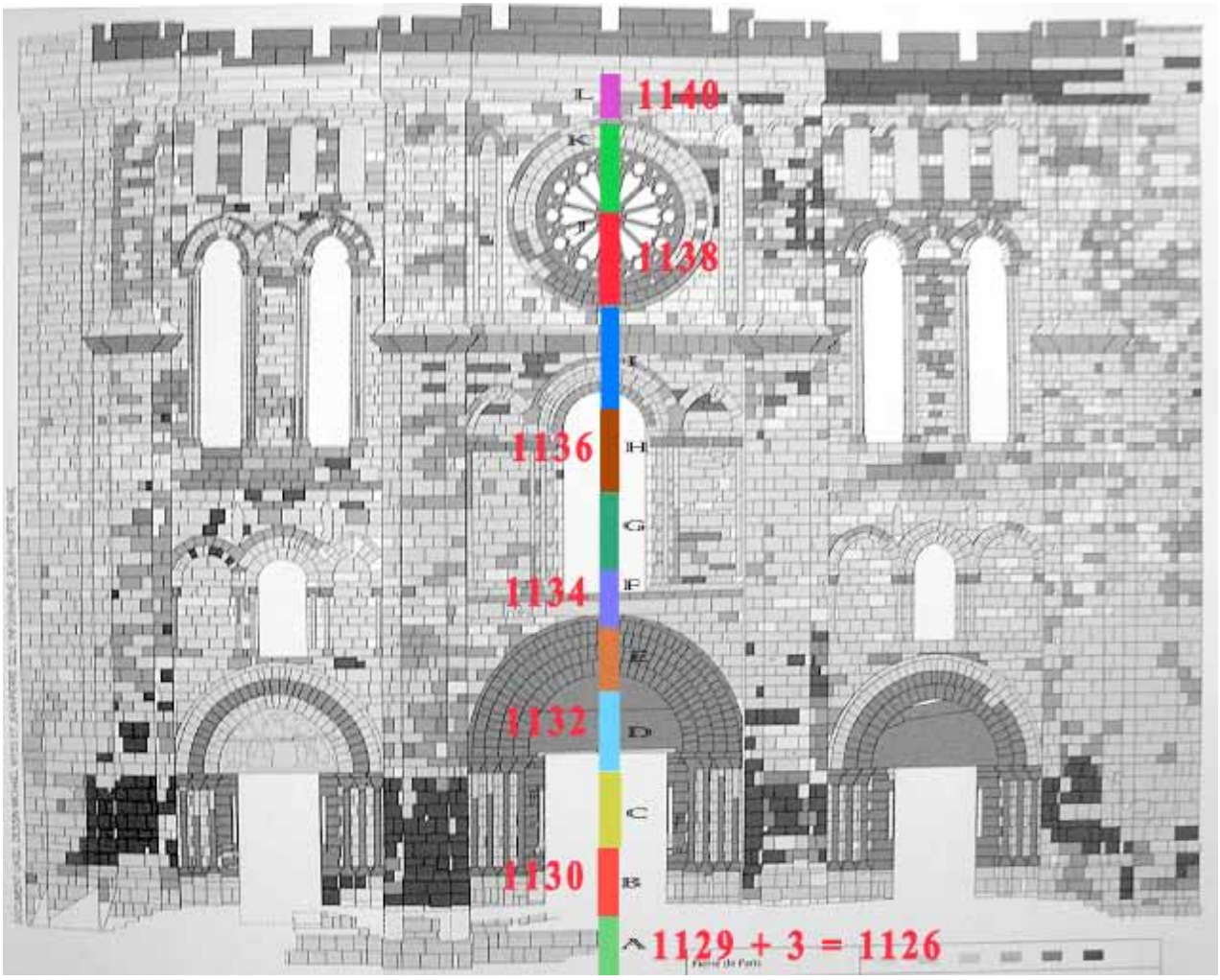
Instead of burying ourselves in details on the upper works where we do not have full access to the building and lack the necessary data, I will attempt to apply the consequences of our theory on the entire construction process.

We could list all the campaigns and make a stab at linking each with work on the building, but at this stage of knowledge it will be sufficient to show that dividing the number of courses by the number of years, and adding a bit extra for the slower work in the early years and another three for the footings, I would conclude that between 5 and 8 courses were achieved in each campaign.

With so many builders each appearing for a few months and then moving on while the mortar set and while the client gathered his finances, it is no wonder that Suger makes no mention of the builders. He talks of glaziers and goldsmiths, but not masons or carpenters. Panofsky bewails this omission,#20 as do many others. But this is no more than the inevitable reticence that would follow trying to guide such rapid and accidental turnover of contractors.

In the drawing I have colour-coded each campaign and estimated dates by working backwards from the dedication at the top. I presumed a short campaign in the early part of 1140 for dismantling the formwork under the cells of the upper chapel, plastering the underside of the vault, and building the roof.

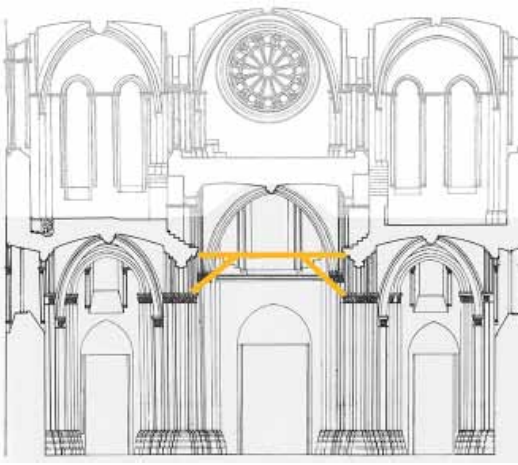
The others fit quite neatly into the details of the interior elements and on the facade. In conclusion, we look to a starting date of 1126, within a year.



the opening into the upper chapel. That opening had to be completed before the upper apel could be built. The design of that vault, rib profiles are unlike any others in the narthex.

O). The variety of openings between the central space and the second level stem from a variety of templates. The widths are not the same, some are arcaded and some have a vertical finish to the sills and some are stepped.

The steps lead to a level that is about midway between the springing and the boss. Is this how the men gained access to the underside of the vault in order to build it between the ribs, and the plaster and paint the surface? It meant the scaffolding could be well above the floor and not get in the way of pilgrims. Also, if the steps to the next level were delayed this would have been the only access into the vaulting space from the stable floor of the towers.



After all, we would not want to wait 12 years before using the space, would we? So I expect the scaffolding would have left as much of the space free as they could and there would be a temporary ceiling above that. Enclosed.

They did the same in Chartres to gain access to the vaults so that the floor space of the choir would be undisturbed by "the rougher sort". Contractors, chapter X.

So, do you think we can call it a Builders Access Stair?

The internal openings from the east bay have central shafts. They are not centralised on the openings but a are misaligned to the east. This is obvious on the south side where the astragal has been shifted eastward relative to the abacus. The plate arches over it are carved to suit the misalignment. Which came first, the shift in the columntvv

join visible west side of (c) walkway over the stairs
arch over these apitals is Soissonaise manner, pointed mould andangled side roll with scooped
prfiles of string courses to north andwest differ.a

The imposts and vault layout

G). In the aisles the ribs are placed lower than the arcade arches so the arch is round. In the centre they spring from the same level so the ribs are pointed. In the upper chapel there is a third arrangement with stilted responds not used elsewhere.

H). The vaults in the central western bay disclose the problems in the bases. The capitals under the ribs against the west wall are at 45°. while those in the piers are true to the direction of the ribs.

P). The vaulting profiles are similar only in being complex to suit the complexity of the piers, Beyond that some have round sections and some pointed, and some have the

Fig 63 ignores the vault already started in the east bay and the respond over the opening that is built into the wall. Within the upper chapel the coursing is even across both bays, as are the twin openings on each side.

L). From a stylistic perspective Gardner saw the possibility of different architects in the crypt and western chapels (p.575)

M). There are a dozen different designs for the windows. In the tower for example, the sill on the north face of the north tower are different to shoes on the west, and the sills in the two western windows in the south differ. Some have level sills and some slope, some jambs are rebated and some are pointed.

Q). Some courses below the location of the change he notes changes between his two builders. (p.579R)

about the level of the (aw) caps the buttresses on the north side east bay were eliminated with a long glacis over 15 courses, to the sills of the tower windows. it simplified the complexity of the external plan in this part.