

DEVELOPMENT OF VAULT CONSTRUCTION DURING
CRUSADE PERIOD
IN LEBANON AND SYRIA

KALAYAN

37 35

Developement of Vault Construction

during ~~PERIOD~~
 C R U S A D E ~~PERIOD~~

in Lebanon and Syria

Haroutune K. Kalayan
 BSCE 1946

Introduction

In the spring of 1936 I was called on to survey the plans of Crasade castles in Lebanon and Syria: - The castles of Markab, Belfort, Soubeibé Kleiat, Tripoli, Safita, Saida.

Since the August of 1935 I was on the staff for the consolidation of Crac Des Chevaliers. One of the main problems was to be able to differentiate the successive peroids of Crusade construction and the difference between the Arab and Crusade construction. the differentiating characteristics already known were the following- Crusade Mason Marks, drafted stone dressing (bossage) , - but the use of these by Arabs , Romans, and preromans was a factor of confusion in differentiation, so I was obliged to look for other differentiating factors.

The tools used by the syrian stone dressers have been the same all through the Greek, Roman, Arab, Byzantine and present peroid, - e.i, an edge of ~~12x14~~ 12-15 cm. with conical teeth, called "Shahouta" in present days.

In Djibeil the period before the Greek is characterised by the use of straight edge stone dressing instrument, but beginning with the fourth century B.C. the conical teeth appears and continues to present days.

Crusade first installations which are characterised by the use of drafted stones for the outside elevations, bear the trace of straight edge instrument, and all inside stones with smooth cut bear the same trace. (see photo. N° 22, 23).

The differentiation through instrument traces fail when the construction is of sand-stone as in Tripoli, Saida, and Tartous, or of basalt as in Markab. The failure of tool traces turned my attention on the different ways of goined vault construction, and specially, on the corners of cross-vault intersection ~~corners~~, which was different for each period and could be followed step by step in its change through the crusade period. This change has been, in the use of small rectangular blocks as goined arch voussoirs. The blocks being too small for a stereotomied dressing are used as they are at the intersection of cross-vaulting, the fear of their stability and ^{their} shape has suggested the use of doubleau arches which in turn has suggested the use of ribs so paving the way to the Gothic Architecture.

In the following pages I will try to summarise the steps that the ^r goined vault construction has passed through in Syria and Lebanon during the Crusade peroid. the chronology of successive steps are determined after the tools used in stone dressing and by the advance of the concept of stability of cross-vaulting.

^
^ . ^

In 1942 I was responsible as "Conducteur de travaux" for the consolidation and excavation of Sahyoun Castle. Sahyoun was interesting because of its precrusade- Byzantine remains. In Sahyoun one could easily see and differentiate several types of construction and planning.

The excavation of Sahyoun showed that (see plan N° 1) the Byzantine castle had several defence lines and sliding door system of defence, and had semicircular towers. All these evidences, put in doubt the theory that the Crusades had adopted the Byzantine form of defence castle construction and later had developed it on. Sahyoun castle of Byzantine peroid is as developed in form and defence conception as any late peroid Crusade Castle.

It can be stated that the Crusades had started with their own way of defence and construction irrespective of Byzantine, that in their first vault construction they have made no use of small rectangular blocs, which was very much in use by the Byzantine masons, ^{the Crusaders have} but used large stereotomied blocs for

their vaults. Immediately after, they have adopted the form in use in syria and have developed it in their own line .

The similarity between the Byzantine defence form and the late peroid Crasade one, suggest that the source of defence developement has ~~the~~ been Byzantine.

References

- Paul Deschamps -- Crac Des Chevaliers 1934
- Camille Enlart -- Les Monuments des Croisés
- Auguste Choisy -- Histoire de L'Architecture tome second
- Violet le Duc -- Dictionnaire de l'architecture

I..... Characteristics of first Crusade installation

The first construction by the crusaders is of drafted stones, the dressing instrument used has a straight edge. most of the stones bear mason marks (see photo. N° .9.10....) . In plan all of them are rectangular towers with internal stairs covered with large blocs of stone (note vaulted) . there are no defences in the lower storeys , all defence is on the coronation of the tower.

Vaulting..... (a) Large stereotomied stone-s are used as voussoirs. The vaults are either semicircular or two centered (Crac, Sahyoun) . The springing points are usually one or two stone course higher than any opening on the wall; this latter betrays their ignorance of cross-vaulting at any level of which they were so excellent masters towards the end of crusade period.

(b) The period immediately following the part "a" shows a marked influence of Byzantine defence system. The isolated towers are connected to form a continuous ring form defence line. First usage of small rectangular blocs for vaulting. Again drafted masonry for outside elevations, and smooth cut for inside. Tool used ~~is~~ ^{had a} ~~again~~ straight edge.

Vaulting -- they have been more daring in goined vault construction, starting the springing points of the arches where ever they like. The openings on the walls are covered with a cross vaulting, care is taken to make the intesecting vaults of the same height, and ~~are~~ inclined upward placing their highest

common point at a level higher than the adjoining points, thus creating a downward thrust towards the walls.

Where wall is lacking, a stereotomied large stone arc is constructed to bear the downward thrust.

(see plan N° 2 and photo. N° 1, 2, 3, 4, 5, 6, 7, 8, 9!...)

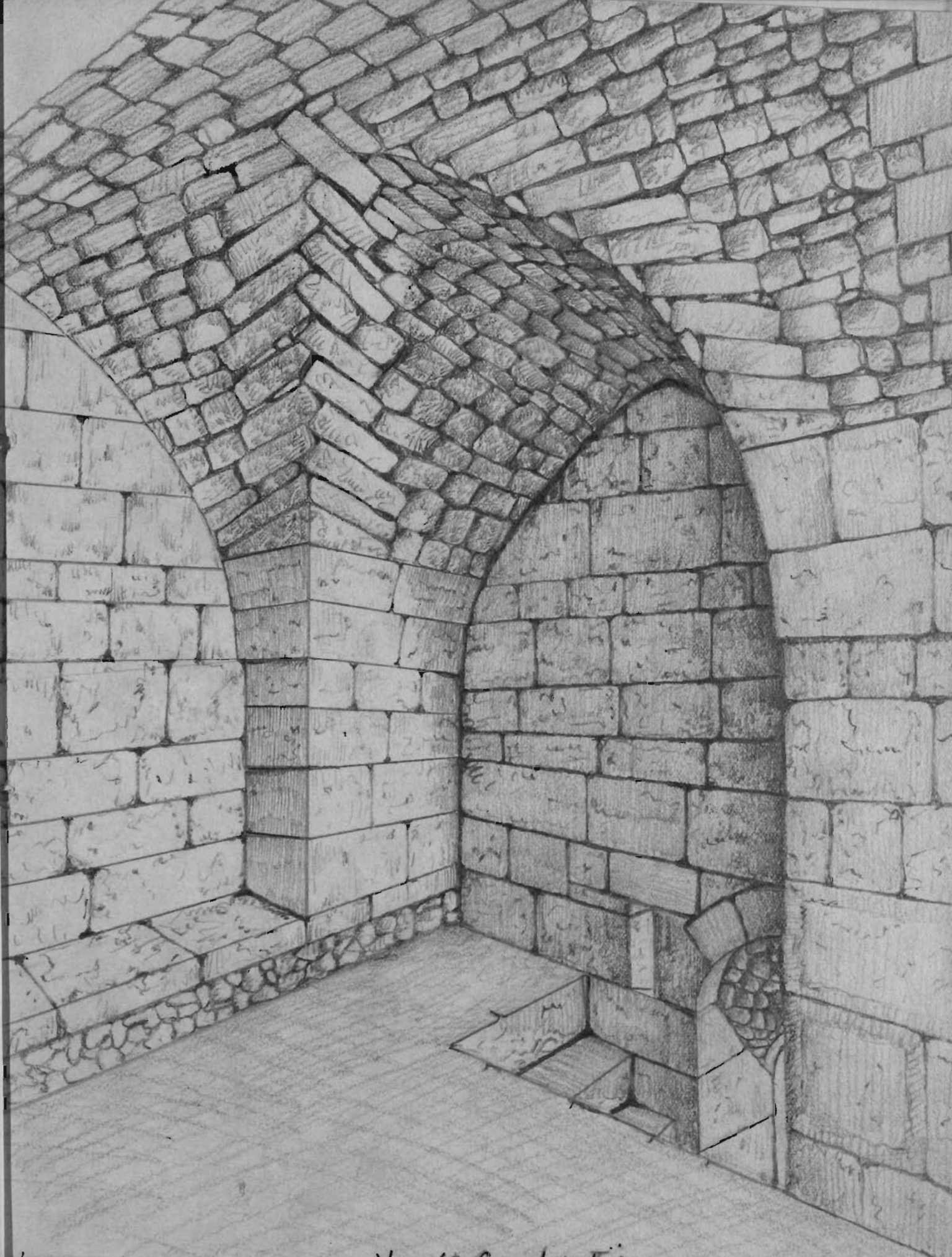
the use of the arc (doubleau) suggest that the first of such vaulting has been developed in rectangular towers and later where the wall is lacking an arc is constructed. every cross-vaulting whether large or small has to finish on the center line of main vault. In some of these construction the arc protrudes out of the level of vault and ^{end} at springing points ends with a moulding, thus marking the starting point of the idea of ribbed construction.

The tools used has straight edge.

(see plan N° 2 and photo. N° .22:23.....)

(C) This peroid consists of reconstructions and change in plan. this fact might suggest that it is probably after an earth quake which might be that of 1157-58. During this peroid the stones used are both smooth and drafted, first appearance of battered walls with smooth cut. instrument used has a straight edge.

Vaulting..... During this peroid the conception of the stability of vault construction has advanced, so that it is not necessary any more to terminate the cross-vaulting on the middle line

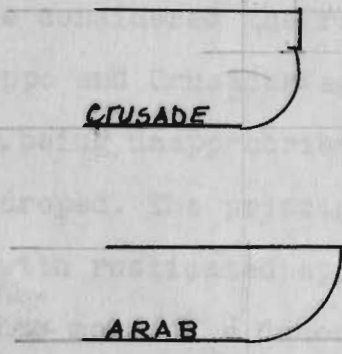


Vault Construction
Djibouti - H Kalayan

of the longitudinal one, but the top lines of cross-vaults has to be inclined downwards to the wall, that is, their concept of stability does not admit a level cross-vaulting.

First appearance of corbellement, used for W.C. s prutruding out on the elevation ; which later on develops as a defence system. The difference between an Arab corbellement and that of a Crusade one besides the instrument used, is the form given to the lower circular part . An arab

corbellement is a quarter of of a circle with a straight part or without, While a Crusade Corbellement is always more than a quarter of a circle and always with a straight part.



(see the sketch. →)

Another system used for W.C.s is a double wall , an excellent example is the tower P. of Crac des Chevaliers, which has been taken as a defence system by all previous descriptions. The plan of the previous sanitary installations is well seen in the lower floor of tower P.

During this first peroid the way of construction of goined arch cornrs is shown on the sketch ajoined and photo. NO ...19...20...21.....

The end date of this peroid was most probably the earth quake of 1170 reported by Abu El Faradj. because the peroid succeeding is a replaning peroid , preserving

most of the walls of this period and discarding some, perhaps or most probably, ^{those are} the walls damaged from the earth quake of 1170.

II Characteristics of second installations.

Second period has a whole change of defence conception. Battered walls are ~~essential~~ considered essential for defence. This might be considered the result of alliance between Emir of Aleppo and Crusaders against Homs. The use of drafted stones, being unappropriate for a battered wall defence, is dropped. The principal entrance walls are constructed with rusticated appareillage (Saida, Crac, Beaufort) which has more of a decorative value than defence. This period is characterised by gigantic planings, there is balanced symmetry in elevation (Crac Southern part inner castle, Main entrance of sea castle Saida). The section on plan N° 3 shows part of a construction during this period in Crac, all is of one planning.

Vaulting..... Stability of vaulting is advanced. cross-vaultings are ~~of~~ level. But the intersecting vaults must be of the same height. Double ^{arcs} ~~arcs~~ which were to support the downward longitudinal thrust, have disappeared with the factor ^{of} its existence. They are not afraid of having a continuous joined in elevation on

gained arch corners (see photo N^o. 11.12.13.14.) . At the beginning of this period every effort has been done to have the intersecting vaults at right angles, but later on the intersection could be of any angle, on the condition that the top lines of the vaults must be at the same height. Care is taken to make ~~and~~ use and preserve the previous walls which is natural in defence point of view, so the walls not taken into account are most probably the walls destroyed by the earth quake of 1170.

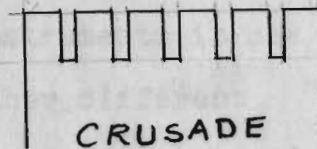
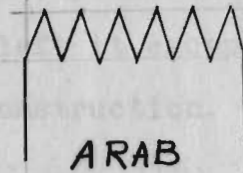
Tools used has a straight edge.

After execution of the plans of this period there has been some additional construction again with straight edge tool dressed stones, but the stability of vaulting is advanced so as to have cross vaulting at any level. (see plan N^o. 3... Cross hatched in red) the solution given to the corners of gained arches is shown in photo. N^o. 17.18.... which is transitory step to the solution of the next period.

this period falls between 1170 and the beginning of XIII century. the end of this period is marked by the use of teeth instruments for the dressing of stones teeth tool has started in France with the XII century. Choisy page 261 " L' époque gothique n'a pas seulement ses procédés, elle possède un outillage qui lui est propre: les outils ordinaires, aux premiers temps de la période romane, étaient à tranchant lisse; l'outils des tailleurs de pierre à partir du 12^e siècle est la laie;" Its appearance in this country most probably is with the third or fourth Crusade.

III Characteristics of Third installations.

This period starts with the use of teeth instruments. The shape of the teeth are straight. This form being strange to the form used in Syria and Lebanon, it can be stated that large teeth instrument was an imported one. There has been a variation in the width of teeth but keeping them always straight and not conical as was the usage in Syria and Lebanon all through to present period. A comparison sketch is drawn in the adjoining figure. It is during this period that the ribbed construction starts with rectangular form (in Tartous) and develops into decorative gothic form (Crac, Tartous, Markab,) later on.



Vaulting..... During this period the Crusade ~~masons~~ Masons are master of vaulting, they can vault any oblong form without recurring to rectangular form. The solution given to the gined arch corners during this period is shown in the photo. N° .17.18 . This form is later on adopted by the native masons ^{and} was still in use in Deir el Kamar and Beit ed Dine. The subdivision of this period can be done through use of coursed and uncoursed masonry, uncoursed one is used at later period.

With this period again starts the Byzantine idea of concentric successive defence system, and most of the outer castles are constructed with teeth instruments. So With uncoursed masonry constructed with good mortar, and successive defence line system where the defence (loop holes) placed as low as possible, Crusades are there ~~with~~ where the Byzantines had left it except for the development in goined arch construction.

" " "

Conclusions

We tried to show that the instruments in use with the Crusade masons were altogether different of those in use in Syria by the natives, which leads us ~~the~~ to the statement that the Crusaders have not employed ~~any~~ native massive skilled labour.

We have tried to show that the ribbed construction had started with the doubleau arc construction, which was dictated by the stability of vault intersections. Who has been responsible for the development of vault construction? It is difficult to answer; but an examination of teeth dressed stone construction ribbed vaults, show that the form of first period, "high middle point form," (saloons of Crac, Belfort,) but later forms are of the latest development, So I am lead to conclude that the development has been in Syria, to which new masons with new tools were ignorant, but later on learnt from those in Syria and on their return to Europe, they were able to build the fan forms, sure of their sta-

bility. The difference of tools , and the timidity of arab vault constructors immediately following crusade peroid, shows that the developement is done by the crusaders alone, on the other hand lack of similar devalopement in Europe would suggest a native tutor, perhaps the search must more in nothern syria than southern.

Beyrouth 26 of may 1946

H. Kalayan

H. Kalayan
May/46



Photo N° 1 and 2 showing the solutions given
to the goined arch corners.

First peroid "B"



Photo 2 and 3 showing the "Doubleau arc of stereotomied
blocs.

First peroid "B"



Photo 5 and 6 showing goined corner and top point
solution
First peroid "B"

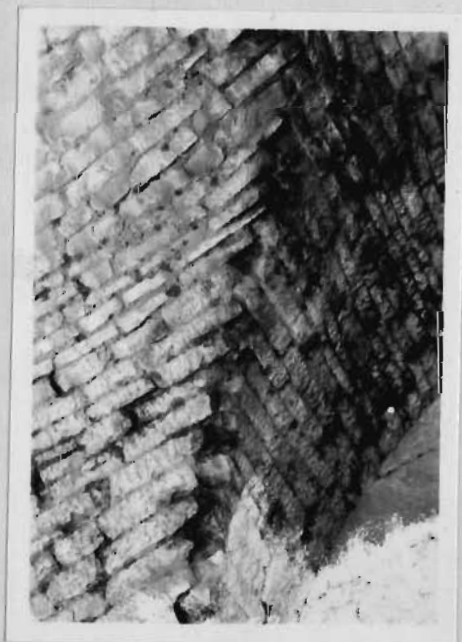


Photo 7 showing faillur of first peroid B solution



Photo N° 8 first peroid "C " showing the projection
out of doubleau arcs.



photo N° 9 and 10 showing crusader form of drafted
stones and a mason mark.



photo 11, 12, 13, and 14 showing second period early vault and goined corners.



photo n° 15 and 16 showing late second period vault
construction and gabled arch corner solution.

Брото



Photo 17 and 18 showing third period vault construction and gained arch corner solution.



Photo 19 showing the double W.C.s of Tower P Crac
protruding stones on the top of the arcs are
the tie stones between two walls.



Photo N° 20 showing crasaders
corbellement used as W.C. and
and construction of drafted and
smooth stone.



Photo N° 21 showing arab
corbellement used as defence;
note the difference with the
previous one.

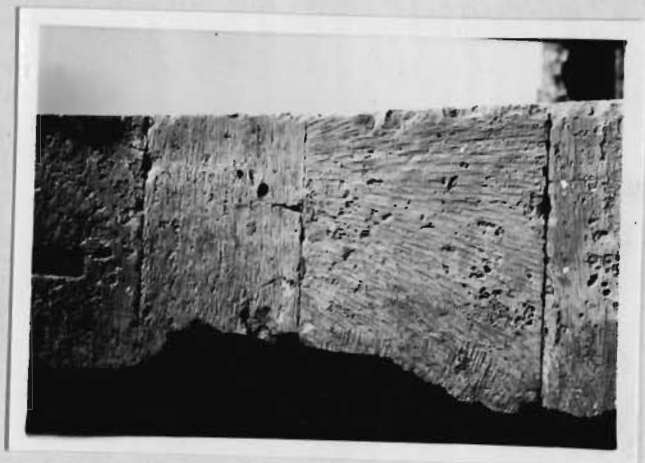


Photo N° 22 and 23 showing straight edge dressed stones of crusaders peroid.



Photo N° 24 and 25 showing teeth edge dressed stones of Crusaders peroid, note the difference in the width of teeth.



Photo N° 26 showing a "Shahouta dressed stone " arab construction of Crusaders peroid.



Photo N° 27 showing an Arab goined vault construction of XIV century, Tower of Lions tripoli, note the use of Crusaders solution for the goined arch corner and timidity in cross vaulting expressed by the use of stereotommed arc.



Photo N° 28 An example of rusticated stone construction early second period.



Photo N° 29 example of battered wall early second period.



Photo N° 30 example of uncoursed latest Crusaders masonry.



photo N° 31 showing goined vault construction of late first period "C" where doubleau is altogether detached from the vault.

