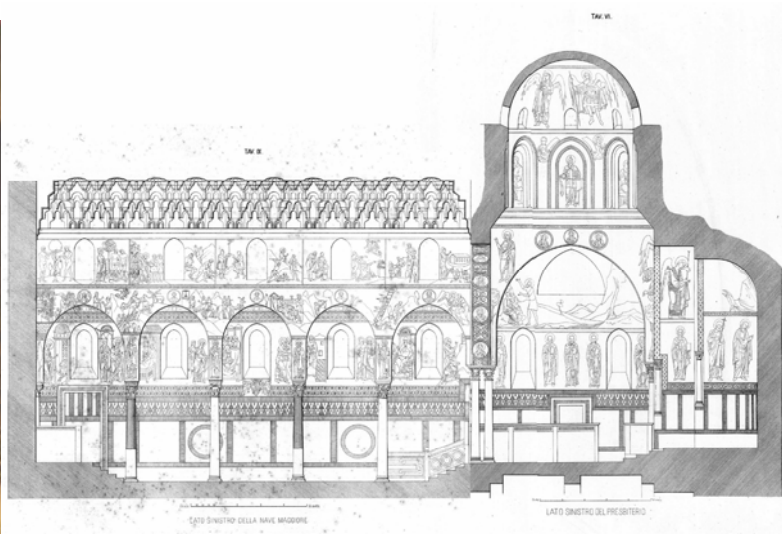
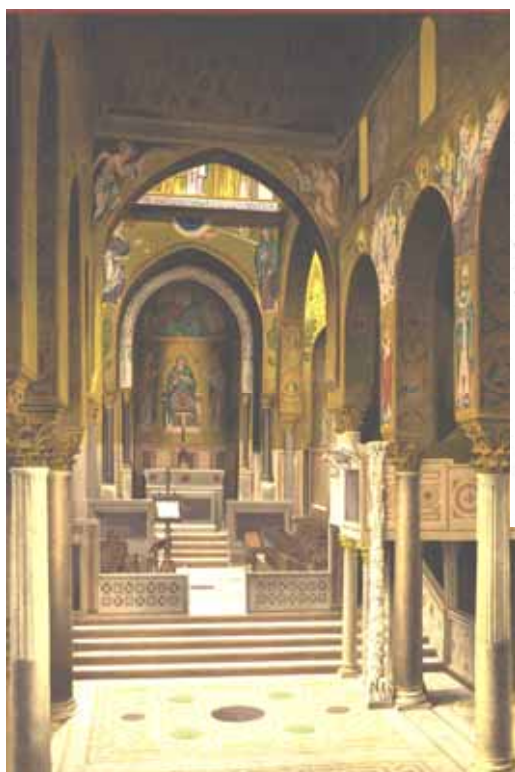


## TIMBERED ROOFS AND CEILINGS OF THE *PALATINA CHAPEL* IN PALERMO

### 1. The history of monument and its timbered roofs and ceilings

The king Roger, the first Sicilian Norman king, built inside the Royal Palace in Palermo, between the Greek and Pisan towers and on the ruins of a Byzantine church, the *St Peter's Basilica*, well-known as "*Palatina Chapel*". The church was consecrated in 1140<sup>1</sup>, but its construction is preceding, because in 1132<sup>2</sup> it was just a "parish church" (the second one in Palermo, after the Cathedral, during the Norman rule). In 1143 the building yard was still active, as documented by a mosaic inscription located in its dome tambour.

The Chapel, with a basilican plant, is diffusely characterized by a mosaic decoration on the walls, dome and apses; the floor is decorated with marble intarsia, as the walls base. The interior space is divided in a nave and two aisles, with two different wooden and painted ceilings: a first one, slightly inclined with little vaults perpendicular to the longitudinal axis in the aisles (called also "*navatine*"<sup>3</sup> or "*navatelle*"<sup>4</sup>, and a ceiling conformed with *muqarnas* above the nave.



**Fig. 1** – The interior spaces of Palatina Chapel and a longitudinal section, with wooden ceilings and mosaic and marble decoration (Amari M. and other authors).

<sup>1</sup> Look at Amari M. Boglino L., Carini I. Cavallari F. S., Terzi A., *La Cappella di S. Pietro della Reggia di Palermo*, Palermo 1889, nota 4.

<sup>2</sup> Amari M. and other authors, *cit.*

<sup>3</sup> Amari M. and other authors, *cit.*

<sup>4</sup> Look at Monneret de Villard U., *Le pitture musulmane al soffitto della Cappella Palatina in Palermo*, Palermo 1950.

In this monument, unique for its decorative apparatus, in past times the analysis and studies concern especially the mosaic cycle but also to the constructive aspects of wooden framings, in order to study wooden structures and wooden finishing and decorative apparatus, to know its peculiarities and perhaps also the possible correlations with coeval architectures; the objective difficulty, and sometimes the impossibility to the inspection of such wooden structures, limited technical knowledge to reductive examination of visible parts: [...] *disgraziatamente non mi è possibile dare notizie se non dell'aspetto quale ci appare da uno studio puramente esteriore, in quanto non ho potuto indagare l'intima struttura costruttiva: per conoscere questa si dovrebbe smontare parte del tetto. Speriamo che nel futuro, in occasione di qualche opera di riparazione, si provveda a riempire questa lacuna*<sup>5</sup>; with these words Ugo Monneret De Villard, wished at the second half of last century a greater attention for the material-technical aspects of wooden structures. Although an half century was passed, only now these conditions are realized, with the opening of a campaign of cognitive analysis, finalized to the monument restoration: and just in such direction this study would furnish a first report that allows the knowledge of constructive techniques employed during many centuries, and of restoration stratifications (repairs and consolidations, substitutions, congruous or incongruous additions), able to guide the maintenance and restoration interventions.

The availability offered by an ample and stable work plan, positioned in correspondence of ceiling intrados is an useful condition to the cognitive phases of relief and analysis, as to the restoration interventions; this condition allows besides the access, without the removal of precious painted boards, to wooden bearing structures, to garrets and hollow spaces for the inspection of extrados and to favour the restoration of wooden structures. These fortunate circumstances allows to start a complete documentation of the extraordinary wooden framings and of the interventions until today realized.

## **2. The material and constructive characters**

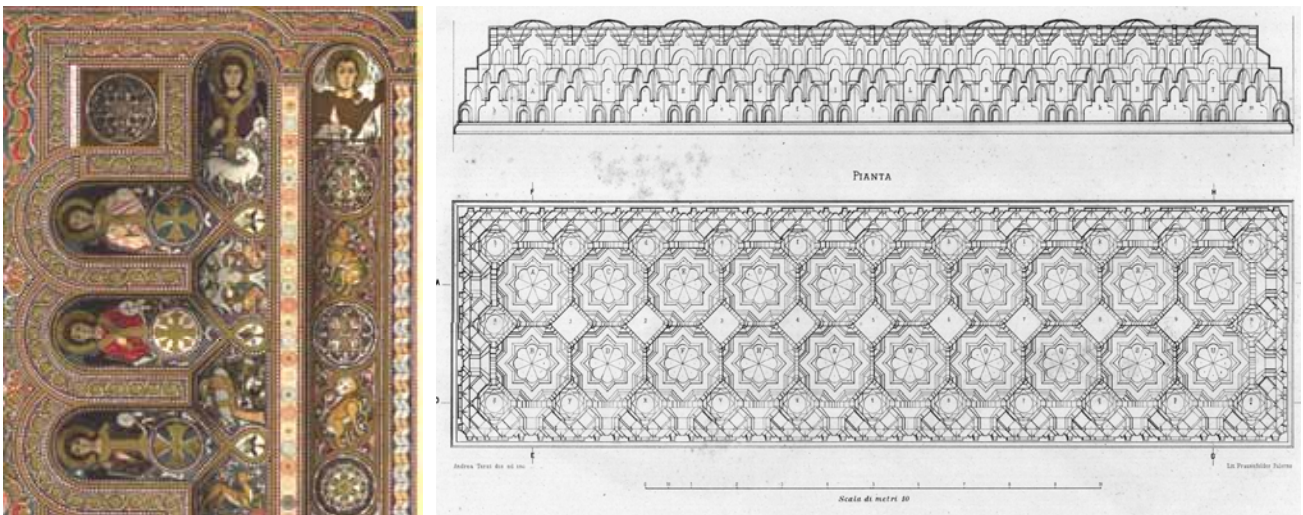
The *Palatina Chapel* ceilings, like other coeval and subsequent wooden structures of finishing and completion, don't have a structural function and were originally self-carried systems: in some parts, today, they are carried by special wooden or metallic structures, inserted during centuries as we will explain better after; these ceilings have an evident decorative function, because they hide the simple and plane overhanging coverage systems.

The wooden coverage of Chapel are constituted by different constructive systems: a very elaborate ceiling over the aisles; in the Presbytery, in the Diaconicon and in the Prothesis, instead, the coverages are realized by local stone (*biocalcarenite*) vaults, cut in small ashlar with thin mortar joints, a typical building character of the Norman architecture. The Diaconicon and the Prothesis are covered precisely by barrel vaults, while the Presbytery is characterized by a hemispheric dome, built on a tambour having a variable geometry, from a square plant to an octagonal and finally a circular one.

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<sup>5</sup> Monneret de Villard U., *cit.*, pag.27.

The side aisles above the wooden ceilings are covered by wooden-beam floors, realized through a simple beams frame, with overhanging boarding and coat of “*cocciopesto*” mortar. The gravel size is progressively various, from internal great size, to the external face with a thin aggregate of only beaten and smoothed *cocciopesto*. The roofs of aisles are realized at 5,40 mt, lower than the nave, and they have a breadth of 2,55 mt; the principal beam-frame, partly not original, is located to a approximate inter-axis of 50cm and wooden beams have an approximate section of 10x13cm; the boards have instead an approximate thickness of 3cm and a width of 50cm. The ceiling, below the beam-floor, is constituted by squared wooden joists, leaned toward the external walls. The side aisles ceilings have wooden barrel vaults between the main wooden frame, with an approximate rise of 10 cm, and the terminal parts concluded themselves with an hemi-dome profile. In the terminal zones of the same aisles, the ceiling frame has a 90° rotation, and has same wooden vaults of the structural parts closure.



**Fig. 2** – The wooden ceiling of an aisle (*navatina*), from above; the *muqarnas* ceiling of nave, in a longitudinal section and from above (Amari and other authors).

In correspondence of ceiling impost, a wooden hull-frame mediates the relationship among wooden and mosaic decorative apparatus. The ceiling curved surface, with a technique that is also traceable in the *muqarnas* ceiling, is realized by wooden laths, placed side by side and tilted forming the wanted curvature; it is fixed and supported by small curved wooden centrings, realized through wooden tablets put nearly and having staggered and spiked joints, with a curved and planed intrados.

The nave covering floor is constituted by 53 beams of various dimensions, approximately having section of 15x21 cm; the overhanging floorboard has an approximate thickness of 3 cm and each element is wide around 50 cm; the beams inter-axis is particularly small, approximately 30cm. An opening, located on the northern wall, permits the access to the existing hollow space between coverage-

floor and ceiling<sup>6</sup>: this circumstance has allowed - in a first phase - to get preliminary inspections and direct observations of nave ceiling without touching any element of coverage-floor or ceiling; in a second phase to realize the restoration interventions.

Particularly, with regard to the coverage-floor of nave, an easy inspection of the hollow space between ceiling and coverage-floor has allowed the masonry recognition inside this hollow space; it has not been modified by many building interventions, consisting in the addition of incongruous volumes and some demolitions, that instead interested the external façades of Chapel. We underline as, following the disappearance of Frederic II dynasty, the Norman Palace lost in time its importance and was often relegated to incongruous uses, that determined its twisting and the loss of some of volumetric and constructive original characters. Only beginning from the XVI century the Spanish Viceroy transferred again in the monument government functions, starting consequently an articulated plain of architectural reforms, that in few years modified the original architectures<sup>7</sup>. If internal spaces of the *Palatina Chapel* were involved by limited interventions, external volumes resulted largely sacrificed in their aspect and functions. The realization of new buildings hid external façades and the perception from the city side; this situation caused a notable decay and degradations, also in the relationship between monument and natural light; the lighting became indirect and limited, determining so the necessity to insert illumination systems using wax and oil, and so the combustion residual contributed to degradation of wooden ceiling paintings.

The masonries examination in the interior side underlines also a legible raising of these masonries, with a translation of the nave level coverage beam-frame, approximately estimated in 1,10 mt, in comparison of original level. At confirmation of this condition, we find a different masonry type and thickness, realized with squared *biocalcarenite* ashlar and then a chaotic masonry was superimposed, using shapeless stones derived by demolitions, and however with an evident geologic difference. Besides this, we found - below what appeared at a first sight as a large mortar joint between the two different masonries - a continuous wooden joist along the whole perimeter of nave ceiling vain; we hypothesize that it had the original function of ground-beam. This wooden element, having a thickness of 5,5cm, in our opinion is coeval to the Norman buildings and could show the original level of coverage beam-floor. The translation of coverage-floor, according to what today emerges, could have happened during one of the numerous restorations that interested in last centuries the *muqarnas* ceiling. The nave ceiling is realized, in fact, with a geometric alveolate motive (in Arabic, *muqarnas*) as predominant architectural element, in association with small reduced domes and wooden stalactites, in the plane central portion: the wooden *muqarnas* decoration, from the perimetric hull frame - ornamental motive already found and

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<sup>6</sup> This opening was attributed to the transformation that the northern aisle had between the 1786 and 1795, for the realization of the Astronomic Observatory staircase; look at Trizzino L., *La Palatina di Palermo*, Palermo 1983.

<sup>7</sup> Look at Di Fede M.S., *Il Palazzo Reale di Palermo tra XVI e XVII secolo*, Palermo 2000.

described treating of side aisles - develops along the four walls with following projecting parts, with a general height of around 2mt.

The *muqarnas* side covering supports the plane central portion, constituted by two series of ten lacunars, having a star-shaped octagonal conformation with, in the middle, a little reduced dome based on an octagonal plant. The octagons side is about 60cm, with however varying measures from a lacunar to another one, and the little reduced dome has a rise of about 25cm. The two series of lacunars are placed side by side by 2 further files, one for side, of 11 little domes planned on a squared base, and these domes are also present on smaller sides of the ceiling plane central area; these ones, have a base of around 50cm and a camber of around 20cm. The juxtaposition of base octagons in correspondence of the two main files above described, it determines squared fields of ceiling, from which wooden stalactites depart, formed by three pseudo-triangular partition, with vertex turned downward, having a varying height, between 40 and 55cm, with powerful profiles forming a remarkable game of masses and therefore of shades and lights [...] that produce a strong sense of modelling<sup>8</sup>.



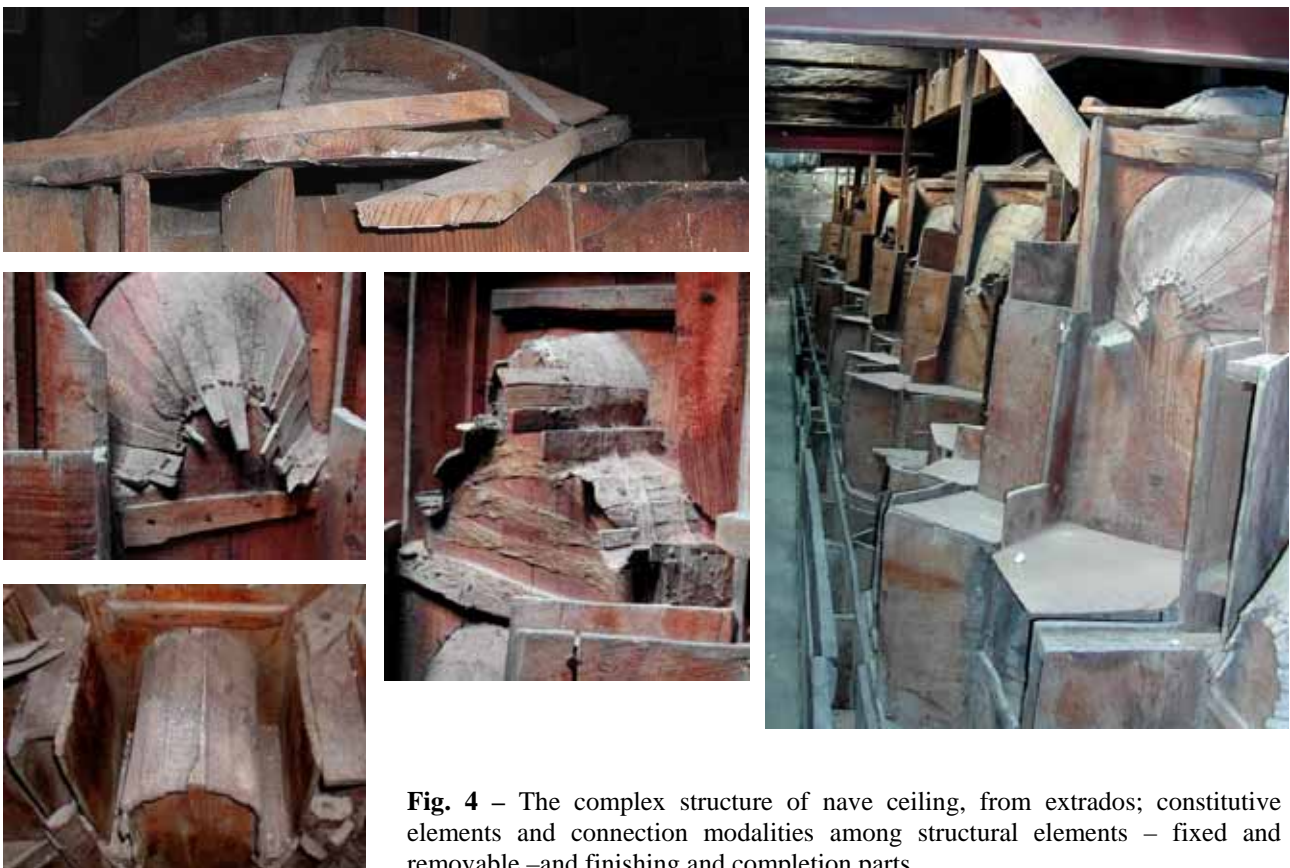
**Fig. 3** – The *muqarnas* ceiling of nave: a particular of walls decoration and plane central portion, with its star-shaped and octagonal lacunars and stalactites.

The ceiling today is supported by a system of 22 hemi-squared wooden beams (having each one approximately a section of 10,5x13cm); these beams are sustained by 2 wooden beams (*rompitratte*), constituted everyone by a couple of beams (about 20x5,5cm), mutually connected with filleted bar and bolts, that are supported once more by 4 steel beam (*NP16*, presenting an **I** section). The two wooden and the four steel beams are datable to the reinforcing intervention effected in 1939 by F. Valenti assisted by M. Guiotto, represented by G. Pignato in 1941. The hemi-squared wooden beams, set into perimetric masonries, they look more ancient; vertical wooden boards are connected with nails to these beams (wooden tie beam, called from the XVI century “*appenditori*”) and to the structures of *muqarnas* Norman ceiling above described, having the function to support the heaviest or damaged parts. The evident constructive difference between the ceiling system and these vertical wooden boards of support, the use of not medieval nails, together with the considerations already exposed about the translation of

<sup>8</sup> Monneret De Villard U., *cit.*, pag.27. (Our trad.)

coverage beam-floor, all these conditions show that the *muqarnas* ceiling constructive system was originally a self-carried structure and that only after numerous and stratified interventions some auxiliary elements of reinforcement were added, with the consequent translation of coverage beam-floor level.

Observing the *muqarnas* ceiling from extrados, rustic and not hidden, it's possible to analyze a complex wooden structure that reveals immediately the ability to realize with simplicity of materials an extraordinary intrados scenic machine; the executive complexity and static reliability are supported by "art rules", well known by categories of specialized woodworkers, concerning the choice of materials in the different structural parts, the connection modalities among structure elements and finishing and completion parts. The main structure is realized by the juxtaposition and riveting of wooden boards and battens to conform now the ceiling walls, now the faces of *muqarnas* decoration that with projecting parts develops along the four nave walls; tablets and wooden fillets are associated to boards, varying in width, length and section: these one are simply rectangular, or wedge-shaped, useful to conform the mixtilinear profiles, or to determine the opportune curvature of concave and convex parts, of barrel vaults, trunk-conic or fan-shaped portions.



**Fig. 4** – The complex structure of nave ceiling, from extrados; constitutive elements and connection modalities among structural elements – fixed and removable –and finishing and completion parts.

The central portion, that is supported by *muqarnas* structure, uses the same constructive criteria: for the constituent parts of wooden small and star-shaped octagonal domes, removable and having a squared plant – detachable, perhaps to allow a natural ventilation and an inspection of the hollow space created between ceiling and coverage beam-floor - were used small centrings realized with wooden boards,

curved and planed on intrados and having a simply sketch in correspondence of extrados; the structural fields are closed by wooden boards nailed to the same centrings. Besides the numerous and various riveting (for dimensions in length and section of nail head, often bent along faces to avoid the slip off) that bind structural elements, we find a diffused system of tackling and union of wooden elements by means of wooden fibres bandages and animal glue, useful to improve connection among planar elements juxtapositioned along thin edges. Reinforcement and connection elements are constituted by wooden boards and joists forcedly inserted e/o nailed inside cave sections; other ones constitute braces for some ceiling portions, the wedges and wooden chocks used for reinforce the loose parts.



**Fig. 5** – The articulated system that support the *muqarnas* ceiling, constituted by hemi-squared wooden beam with wooden tie rods and reinforcing wooden beams (*rompitratte*), NP16 steel beams.

### 3. The restorations during the centuries and the actual interventions

The wooden ceilings of *Palatina Chapel* had many restoration works; already in 1348 a document<sup>9</sup> mentioned the interventions superintended by the engineer Ughetto from Milan, successor of Thomas di Bonaccorso, into the *Green Room* and the same Chapel, because of the fire damages caused by Catalan faction into the Norman Palace, during an insurrection happened in the same year.

In 1478 restorations were effected at *muqarnas* ceiling, as an inscription that decorates the frame at the impost of the same ceiling relates; a further inscription located on an ovule of the northern wall has the date of 1553. The restorations mentioned in the epigraph of the ceiling frame of southern aisle are instead datable to 1482, and dated to 1499 the ones of the northern aisle. The already cited Ugo Monneret de Villard believed besides that the first lecture of the Arabic inscriptions, datable to 1798, had been facilitated by use of service scaffolds during the restoration executed in that period<sup>10</sup>.

The birth of tutelage Institutions started the necessary inspections and reparations on the monument, that articulated a long period of interventions and that particularly involved its wooden structures, the object

<sup>9</sup> Amari M. ed altri, *cit.*, nota 97 pag 18.

<sup>10</sup> Monneret De Villard. U., *cit.*, pag.22.

of this study. The first conservative intervention of nineteenth-century documented was executed by F. S. Cavallari, director of the *Sicilian Antiquities*: the technician disapproved the remaking of coverage beam-floor in left aisle, previously effected, executed in his opinion *not in a safety way*; he noticed disarrangements in wooden structures of nave and a lesion *in one of the principal arches that sustain the dome*; nevertheless, until then [...] *we didn't dare to propose those works and others less important, if before we didn't have the safety that those works were direct and performed by intelligent technicians...*, vice versa [...] *it was also better that time did its slow deterioration rather than we could deteriorate it for inexperience and for inopportune economy [...]*<sup>11</sup>.

In 1884 G. Patricolo, architect and director of restorations, did a recognition of structures and decorations, during which he noticed a consistent decay of left aisle ceiling, such to [...] *request ready and energetic interventions*; the technician attributed the cause to [...] *damages produced by water used for many years in the mosaic workers laboratory*. The nave ceiling resulted made heavy by a lot of rubbles, consequence of preceding building works, that Patricolo quickly cleared away, finally proposing to the *Regal Commissioner of Sicilian Museums and Excavations*, to ask to the *Public Instruction Office* the authorization and financing for the appropriate interventions<sup>12</sup>.

In 1887 Patricolo underlined as in the three wooden roofs [...] *the actual beams (...) are entirely almost worn-out and decayed, and no more able to sustain tiles so that a month back it was necessary to prop a part of nave coverage for prevent its fall. Besides this condition, we had to ascertain that from this side meteoric waters freely pour themselves above brick paving of ancient ceiling, ruining in a irreparable way the stupendous tempera paintings*<sup>13</sup>.

Following up the denouncements of Patricolo, that operated as a delegated member of *Sicilian Antiquities and Fine Arts Committee*, in 1890 a project - planned by the same architect with the consence of. A. Ramboldi and T. Di Chiara - was compiled for the Royal Administration and in representation of *Royal Civil Engineers*. The building works were realized urgently in 1891, because they had to be concluded *before* the arrival in Palermo of Royal Family for the National Exposure (realized in Palermo in the years 1891-92), *because it would be inconvenient to introduce in this fortunate recurrence propped walls [...]*.

Despite the executed interventions, in a report compiled in 1892 by Nicolò Mineo, engineer of Royal House, many damages were noticed to decorated ceiling of left aisle, provoked by meteoric waters infiltrations from coverage: [...] *rain infiltrating from the roof and passing through the board ceiling and through the attic paving of the first room of mosaics office directly created damages to aisle ceiling,*

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<sup>11</sup> Trizzino L., *cit.* (our trad.)

<sup>12</sup> This interventions would consist in: [...] *a) to demolish the whole floor set above the left aisle; b) to demolish the staircase that conducts to Astronomic Observatory, whose structures are a continuous threat and a cause of the monument downfall; c) to detach and preserve in a museum the frescos of P. Novelli painter from the Viceroy's Chapel (realized upon left aisle in the XVII century and in the meantime used as mosaic workers laboratory); d) to clear away utensils and installations of mosaic workers laboratory; e) to demolish the masonry roofing that covers the dome.* Trizzino L., *cit.* (our trad.)

<sup>13</sup> Trizzino L., *cit.* (our trad.)



*the structure of which is completely discovery [...]; besides this situation, all wooden coverings were judged in bad static conditions for ancientness and [...] for constructive system adopted, not able to protect and shelter treasures so much important and rare.*<sup>14</sup> In 1893 with the supervision of G. Patricolo and the assistance of F. Valenti the ancient coverage suffered remaking and reparations and the simply wooden structures were modified in iron-wooden coverage, with roof crystals skylights having a galvanized iron structure, in correspondence of southern aisle.

The following year, the same technician consolidated the frame that support nave ceiling, inserting squared pitch pine beams (as we said before, the so-called “*rompitratte*” wooden beams), and in that occasion were also acted restorations of pictorial patinas at intrados and structural consolidations of ceiling.

In 1948 the *Istituto Centrale del Restauro*, directed by C. Brandi, started a restoration yard that involved in first line the same students of the Institute; the repairs, extended until 1953, interested the whole wooden structures of ceilings (load bearing and finishing ones), from carpentry to decorated surfaces. Brandi intervention, unknown because never published in the ICR bulletins, but fully documented in Institute archive, faced in an organic way the ceilings problem of Palatina Chapel, with particular attention to pictorial lacunas. The photographic documentation, precedent to the restoration, testifies a disastrous condition of surfaces, with diffused lacunas, scaling, fissures and swellings of pictorial film; the restorations reconstructed these surfaces, reconfiguring the lacunas through water-colours effected with the dash technique through chromatic decomposition (“*rigatino*”), debugging proper by Brandi and subsequently broadly used in many painting restorations.

We set a particular attention to pictorial decoration of ceilings, because it results an *unicum* with wooden structure, contributing to constitute - together with the volumes determined by main frame - a complex game of forms and colours, in an expressive symbiosis that really makes the Palatina Chapel ceilings *a marvellous masterpiece of Islamic wooden carpentry*<sup>15</sup>. We would refer these considerations also to the by now accredited Islamic matrix of wooden paintings of Sicilian Norman epoch, acquisition certain for the Art History, as presence of Byzantine artists in Sicily about the mosaic decoration<sup>16</sup>.

The restorations of *Istituto Centrale del Restauro* is the last intervention on Palatina Chapel ceilings, while further interventions were executed in the coverage, often with choices not entirely addressed to maintenance of original characters, as the realization in 1959 of Sicilian Regional Assembly back-cafe, located above the right aisle<sup>17</sup>. We had to wait until the end of the eighty years of last century for resolve the problem of water infiltrations, with the demolition effected by Panormitan Cultural Patrimony Superintendence of all coverage structures and the realization of a roof with classical trusses in lamellar

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<sup>14</sup> (Our trad.)

<sup>15</sup> Monneret De Villard, *cit.*, pag 27. (Our trad.)

<sup>16</sup> Look at Andaloro M., *Strutture, tecniche, materiali nella Palermo Normanna* in AA.VV. *Federico II e la Sicilia*, Palermo 1998.

<sup>17</sup> In the Royal Palace of Palermo actually stay the offices of *Sicilian Regional Assembly*, a regional legislative organ with ample autonomy because of Sicily is a region having a special statute.

wood with overhanging translucent *poli-carbonate* plates, set at that time as provisional, but still today *in situ*.

The earthquake happened in September 2002, that interested the whole Tyrrhenian coast of Western Sicily, determined numerous disarrangements in the Royal Palace and in the Palatina Chapel; the Superintendence Offices and the *Regional Centre of Planning and Restoration* in synergy executed so the first urgent interventions, with the generous contribution of Mr. Reinhold Würth<sup>18</sup> - founder of the homonym German tools multinational - to provide a general intervention of repairs for the Chapel.

With a specific convention, stipulated in June 2003, a special restoration project was financed, planned by the just mentioned two Regional Institutes. The interventions began in March 2005 and they are today still in progress, realized by a temporary association of enterprises among the “Martino Solito restauratore s.r.l.” (group leader), “Consorzio C.B. ART” di Marina Furci, “Studio C.R.C. S.r.l.” di Paolo Pastorello, Carla Tomasi e Sergio Salvati.

The interventions in correspondence of ceilings decorated surfaces of Palatina Chapel started in June 2005 from the pictorial cycle of nave: the maintenance conditions of pictorial decoration, realized on conifer wooden supports, according to a rather complex modular and geometric scansion, appeared immediately problematic, both under the conservative aspect (because of the precarious state of preparatory and pictorial layers, but often cause of disarrangements and decays of wooden structure), both under the aesthetical aspect.

The iconographic lecture of decorations, in fact, in past with vivacious and lucent shades derived particularly by presence of refined gilding, looks today diminished and impoverished because of pictorial film diffused falls and because of a strong general shading. Gilded parts mostly suffer, almost entirely disappeared, perhaps also because of ancient restoration interventions. The general chromatic lowering of ceiling paintings seems caused by put on substances and changing colour in dark tonalities. Some areas (unfortunately very small) apparently save, still show in fact a vivacity and an extraordinary freshness for so ancient pictorial works (sec. XII) and in so precarious state of maintenance. The first cleaning phase, realized following a series of local colours consolidation interventions, put in evidence the necessity of a specific study of executive technique about repairs and materials used during the precedents restoration, of their interactions with constitutive materials and of decay macroscopic alteration derived.

The first cognitive and documental phase, propaedeutics to intervention, then executed on wooden ceilings, has regarded: **1)** survey of maintenance state of ceilings, with particular attention to adhesion defects of pictorial film and drawing up of a map using graphic bases ordered on forms; **2)** execution of samples related to consolidation and cleaning intervention, useful for the application of materials and different operational methodologies; **3)** photographic documentation of repairs related to precedent,

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<sup>18</sup> The authors would give a special thanks to *Würth srl* for the kindness and availability shown, consenting in this article the diffusion of images extracted by restoration archives.

during restorations and after conditions for testing the execution of consolidation and cleaning operation in correspondence of zones interested by samples. Besides, a close photographic campaign was executed for documenting particular lifting of pictorial film; **4)** collecting of samples useful for micro-chemical analysis, finalized to the individualization both of executive techniques and of original constitutive materials, both of materials used in old restoration; **5)** comparison among the data emerged by diagnostic investigations and what found through samples executed on surfaces. In order to scientifically support the anamnesis, contextually to the documentation it was realized a diagnostic campaign *in situ* and in laboratory.

Macroscopically, the following decay phenomena are noticed: **a)** incoherent and partially adherent superficial deposits: these are diffused on the whole surface; **b)** presence of overhanging substances: they particularly change in an evident way the original chromatism, and consist in fixative/protective/reviving products applied during the maintenance interventions that followed one another one in time: the pictorial surface is decidedly darkened, so much to seem for its brown aspect, almost a leather painting that not a wooden one. Nevertheless, with a close observation, we could notice that in correspondence of mouldings back-draft, particularly as regard ceiling more than walls, the colours maintain that vivacity and hulling that would characterize the Chapel decoration. These parts were probably saved, more because of hurried restoration than for operative choices, during the application of a repair fixative.

The results of analyses confirm the presence of various altered superficial layers, having a brown colour, referable to more interventions of maintenance. The thick layer essentially results composed by gum-arabic, but also it could be possible to find lamp-black and the presence of animal glue, small quantities of saponifying substances and oxalates (produced deriving by alteration of used organic substances). From the stratigraphical section of two champions it seems that part of these substances is penetrated up to the surface of wooden support through the pictorial film and the preparatory layers. It's difficult to date these interventions of maintenance, because the found materials are traditionally used.

After some researches by the I.C.R. archives, it results that during the restoration effected in 1948-53, a lot of white shellac was purchased. In a long list of materials bought for restorations, nevertheless it was also gum-arabic; **c)** defects of pictorial film adhesion: we notice in different zones particularly serious liftings of pictorial film, especially in correspondence of walls; **d)** defects in the adhesion of preparatory pictorial layers: layer separations are present, both between the gypsum preparatory layers and the glue one, and - more in depth - between the first one of these and the wooden support; **e)** falls of pictorial film: it represents a diffused phenomenon - often happened, surely already in ancient epoch - how we could notice for the numerous and most different remaking of painted parts; **f)** falls of preparatory layers: the diffused presence of dashes, a very diffused technique of pictorial reinstatement of surface, surely used by I.C.R., it testifies the gravity of decay phenomenon, already during repairs acted in 1948-1953.



**Fig. 6** – An original part of pictorial decoration, saved by the overhanging of protective and consolidation products and liftings of pictorial film.



**Fig. 7** – Liftings of preparatory layers and absence of the same preparatory layers e/o of colour, with integrations using the dash technique with chromatic decomposition (*rigatino*).

**g)** Diffused falls of gold-plated foil: traces of gilding are present especially in correspondence of ceiling, while on the walls this precious superficial finish entirely has almost disappeared. As we said about the falls of pictorial film, also in this case the decay is not surely recent; **h)** old repairs of preparatory layers: we already mentioned some repairs realized during the intervention campaign of the I.C.R., treating with dash technique. We notices besides the presence of repairs of lacking parts through application of cloth using natural material, then painted for imitate the original decoration; **i)** re-painting and retouches: we notice schematically, what follows: remaking with dash technique on new repairs that on

the preparatory original surface (and not only); diffused remaking of decorative elements, particularly of large part of decorated bands having a decoration white pearls on black ground, that frame the different panels; more ancient remaking of whole decorative and repetitive parts, particularly in the ceiling; remaking of decoration on natural cloth glued to wooden support; probable presence of diffused retouches in correspondence of pictorial film. . It's a datum also emerged by the micro-analytical investigations: we noticed the presence of a last veiling that could be a sign of restoration e/o maintenance interventions; located attacks of xylophagous insects.

Relatively to executive techniques and constitutive materials adopted, the results of stratigraphical and micro-analytical investigations - executed on some champions withdrawn in different zones of ceiling - allow to verify the presence of preparatory layers underlying the pictorial films, having with the following stratigraphy: **1)** gum-arabic executed perhaps as *primer* for useful preparation in following application of preparatory layers. It would be nevertheless a restoration product penetrated inside the pictorial surface, not present in all the examined champions; **2)** gypsum, animal glue, raw gypsum and wood sawdust preparation strata; **3)** traces of gum-arabic perhaps as preparation *primer* for following application of a second preparatory layer. Also in this case, it would be nevertheless a restoration product penetrated inside the pictorial surface, not present in all the examined champions; **4)** gypsum and animal glue preparation stratum; **5)** gypsum and few animal glue preparation stratum with traces of lamp-black particles and iron or lead oxides; not found in all the examined champions.

Relatively to pictorial film we mention: **1)** layer of animal glue and pigment (lamp-black, vermilion) probably given on the still fresh preparation, perhaps as a preparatory drawing; not found in all the examined champions; **2)** pictorial layer constituted by protein binder (egg yolk), white lead and kaolin, with traces of pigment; not found in all the examined champions; **3)** pictorial layer having protein binder (egg yolk) and pigment. Perhaps present also animal glue; among pigments we mention the presence of vermilion, litharge and minium as regards red colours, vermilion and white lead for the pink ones, arsenic trisulphide for the yellows ones, lapis-lazuli for the blue ones, white lead for the whites ones. The gold-plate foils, in the residual and limited portions, has allowed to individualize: **1)** probable *primer* constituted by animal glue or animal glue and oil with particles of lamp-black and iron or lead oxides; **2)** oil-resinous adhesive, having a brown-reddish colour; **3)** gold foil.

Restorations start after the preliminary diagnostic phase, initially as test phase and then, following micro-chemical analyses, as phase of verification and interventions. In different zones of ceilings, consolidation tests are executed with various predominantly organic materials. We notice that pictorial surface (pictorial film and preparatory layers) resulted very reactive to watery solutions both for consolidation that for cleaning. Discarded the use of an acrylic resin put in solution, resulting ineffective and difficult for its application in a punctual and circumscribed use, it was decided to proceed with greater concentrations of acrylic resin in emulsion for recover lifting of pictorial film and, more in depth, with the so-called *colletta* (traditional recipe with animal glue) for the elimination of adhesion

defects in preparatory layers, dehydrating quickly the interested zone through thermocautery and using easily evaporable alcoholic solutions.

As we said, the ceiling appears darkened and “out”, as regards its original colours: the substances used in old maintenance e/o restoration interventions, as well as superficial deposits like dusts, greasy dusts, smoke, etc..., all these conditions altered deeply the original chromatism. It’s possible to easily enough localize the remaking of pictorial film, both with “dash technique” both these that imitate the original ones, generally realized with water-colours and therefore in any moment - if necessary – removable; appears necessary also to individualize the more opportune operational methodology for eliminate, or however to lighten, that general brown tone that so much darkened painted surface. Besides, the micro-analytic investigations confirmed what empirically deduced by small cleaning tests: on the surface of ceiling we notice gum-arabic and, partly, also animal glue, clearly referable to products used for the application of fixed/revivifying/protective products. Various intervention systems have been tested using different products or mixtures of products, departing from principle that the use of organic substances as fixed/revivifying/protective products for repairing pictorial surface, generally were removed with watery solutions; vice-versa, the evident water incompatibility of preparatory layer containing gypsum makes unadvisable the use of watery soaking mixtures, and for these reasons a punctual cleaning technique has been therefore debugging with solutions easily evaporable and controllable, applied both through Japanese paper and absorbent cotton.

The present article documents a research still applied and in progress, where we condense only the salient aspects that allow to appraise the *unicum* of this study-case for its historical, materical and constructive aspects and technical culture, and also the responsibility of technicians who can operate only after scientific investigation with analysis and tests of wooden parts of monument.



**Fig. 8** – Re-adhesion of preparatory strata and cleaning tests.