DEGUTALE TEMPLE – METAL ELEMENTS

Report of the Institute of Conservation (IoC), University of Applied Arts Vienna

Fig. 1: Degutale temple

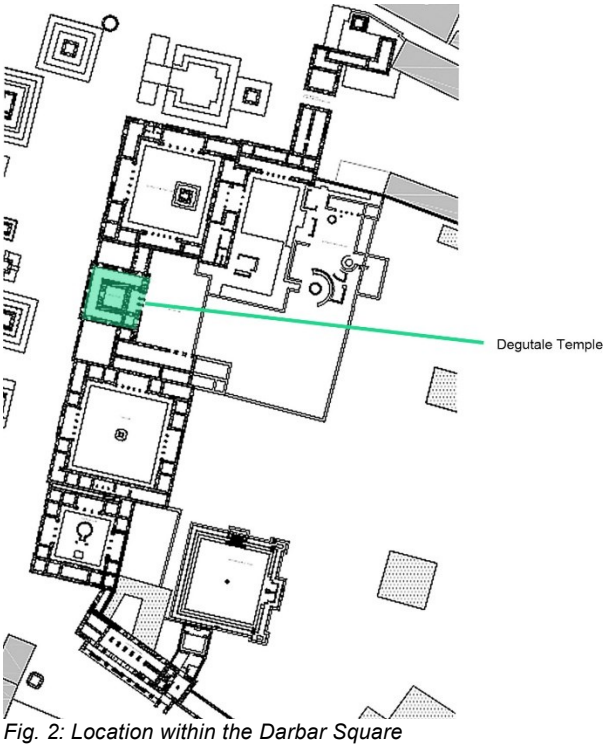

Fig. 2: Location within the Darbar Square

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Data Sheet

Description

Degutale Temple is the tallest Hindu temple located at Patan Darbar Square and was rebuilt in the 17th century during the reign of Siddhinarasimha Malla. The temple is part of the Palace complex and houses the ancestor deity of the Malla kings in the form of a Linga. As the Taleju temples within the Palace Complex, the Degutale is similar in rituals. The multi-tiered temple has a rectangular base with a four-floor high structure in a residential form made out of timber and brick, with three roofs on top.
The roofs are covered with approximately 250 slabs, from which around 90 are fire gilded. The others are made of solely copper and are mounted beneath the visible gilded slabs. They are further decorated with carved sculptures and gilded metal elements, like pinnacles, which are placed on top.
On the first, second, and third floor, the one-meter-thick wall encloses a two-meter-wide ambulatory; the remaining square in the centre is built solid. The sanctum room has a square form and one side length measures about 4.7 meters. The sanctum is entered via a golden door with a torana, both made out of a wooden core with gilded copper plates on top, which is facing the Darbar Square. In the framework of two campaigns six pinnacles, the golden door and the torana as well as roof slabs were conserved by the team of the IoC.

Names	Degutale, Degu Taleju, Degutaleju	
Dated	Rebuilt 1661	
Measurements (H x W x D)	29.63 x 13.27 x 13.27 m	
Materials/Technology	Architecture	Timber, brick, mud
	Pinnacles	Gilded copper, iron
	Golden Door and Torana	Wooden substructure, iron, gilded copper
	Roof slabs	(Gilded) copper
Interventions (IoC)	Survey	2022
	Conservation	2022, 2023
Team (IoC)	Gabriela Krist, Marina Paric, Franziska Marinovic, Katharina Mendl, Katharina Fuchs	
Academic Research (IoC)	-	

Survey: Materials and Technology

Pinnacles
- four in total
- each pinnacle composed of six individual parts stacked on top of a cylindrical base
- forged and fire gilded copper
- top part of each pinnacle has an iron loop for the attachment at the roof

Golden Door and Torana
- substructure is made of wood
- chased and fire gilded copper sheets are mounted on the wood with iron nails
- metal pieces are connected with iron nails and rivets
- iron chains are fixed on the back of the torana

Roof slabs
- fire gilded metal slabs are placed above pure copper slabs, which act as substructure
- iron nails and rivets connect the pieces with each other

Fig. 3: The overall construction and individual parts of the pinnacle

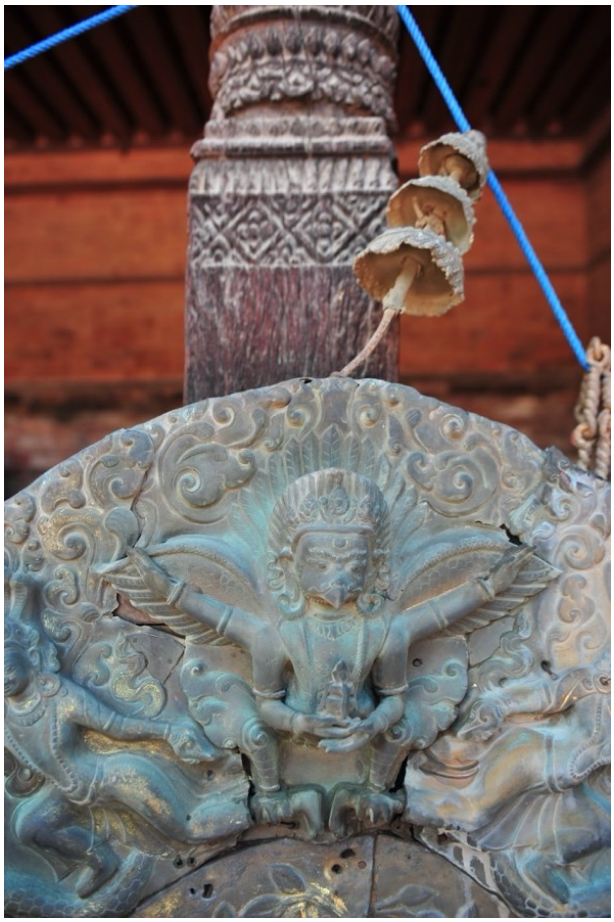


Fig. 4: Detail of torana

Fig. 5: Detail of torana

Fig. 6: Some copper sheets were already "restored"

Previous (Conservation) Interventions

1938	reconstruction/repair after earthquake 1934
1969	renovation work
1999	restoration of the roof (reported as par of the International Campaign for the Safeguarding of the Cultural Heritage in the Kathmandu Valley)

Survey: Condition and Causes of Decay

Pinnacles

- heavy corrosion on exposed copper parts due to environmental pollutants (particularly in conjunction with rainwater)
- selective corrosion on areas with damaged fire gilding (e.g., microcracks, unburnished parts of the porous fire-gilded surface) that are directly exposed to rain, whereas surfaces on the undersides of the parts are often fully intact
- mechanical damage: deformations and holes in some parts
- surfaces covered with dust, grime and bird droppings

Golden Door

- wooden support is heavily weathered and shows signs of fungus attack
- wood shows cracks (e.g., shrinking), brittleness, missing parts and deformations
- metal shows cracks, scratches, deformations and corrosion
- the fire gilding is partly reduced and bare copper is exposed
- surfaces are covered with dust and dirt as well as pigeon droppings

Torana

- bright green corrosion products mainly accumulated in crevices and overall dark brown copper oxide on copper surfaces, corrosion due to reaction of the surface with environmental pollutants
- iron chains on the backside rusted, due to high humidity
- gilded surface mostly weathered off, only few areas with fully intact gilding left
- slight mechanical damage such as deformation
- surface covered with accumulation of dirt and dust as well as bird droppings

Fig. 7: Soiled and corroded surfaces

Fig. 8: Deformations and cracks

Fig. 9 and Fig. 10: Examples of corrosion: Dark brown copper oxide

Fig. 11: Gilded surface lost in great parts

Fig. 12: Surface covered with dirt

Conservation (IoC)

Pinnacles (2022 and 2023)

- Dry cleaning with rough brushes in different sizes
- Wet cleaning with water, surfactant and different brushes and sponges
- Reducing copper corrosion on the fire gilded surface with citric acid and rough brushes
- Holes were closed with epoxy resin and carbon-fibre
- Polishing the surface with cotton towels
- Regilding of areas with bare copper with gold leaves using oil size (Mixtion)

Fig. 13: Wet cleaning

Fig. 14:: Preparing the resin for closing the hole

Fig. 15: Hole with backing made out of carbon fibre

Fig. 16: Polishing the surface

Torana (2022)

- Dry cleaning with rough brushes of different sizes
- Wet cleaning of metal parts with water, different brushes and sponges
- Reducing of copper corrosion on the fire gilded surface with citric acid (3% in water) and rough brushes
- Reducing of rust on iron chains with micromotor (iron brushes)
- Polishing of the surface with micromotor (brass brushes, nylon brushes)
- Coating of iron chains with a layer of microcrystalline wax

Golden Door (2023)
- Dry cleaning
- Wet cleaning with water and surfactant
- Reducing corrosion with a gel-pad with citiric acid (10%), gel was applied with a wooden spatula and removed when turned yellow, surface was rinsed with water afterwards
- Partial dismantling of metal elements from wooden support

Roof slabs (2023)
- Dry cleaning
- Wet cleaning with water and surfactant
- Removing thick dirt layers with bone scratchers and scalpel
- Cleaning of fire gilded copper with citric acid (5% in water), partly soaked cotton wool patches were applied
- Aligning of elements with hammer and templates
- Closing of cracks with epoxy resin and carbon fibre

Fig. 17: During wet cleaning of the torana (left already cleaned)

Fig. 18: Polishing the surface

Fig. 19: Iron chains after conservation

Conservation Materials* and Recipes used:
- Epoxy resin Akepox 2010
- woven carbon fibre
- microcrystalline wax Tecero 30410
- Gold leaf: Dukaten-Doppelgold (Erich Dungl Blattgoldschlägerei GmbH)
- Oil size: Mixtion

* Product / technical data sheets can be found in the supplement [A]

Before and after Conservation

Fig. 20: Pinnacles before conservation

Fig. 21: Pinnacles after conservation

Fig. 22: Torana before conservation

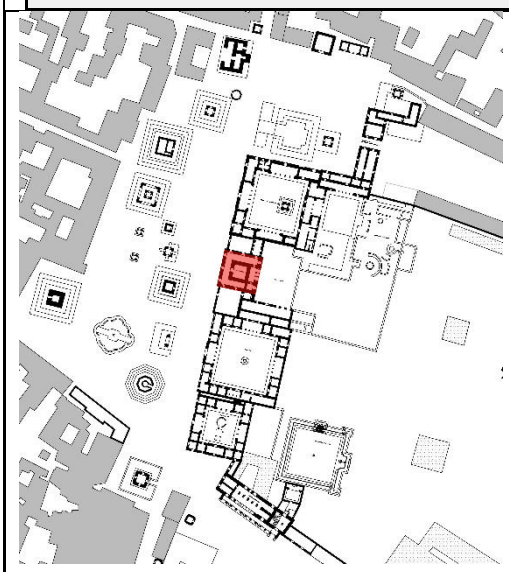
Fig. 23: Torana after conservation

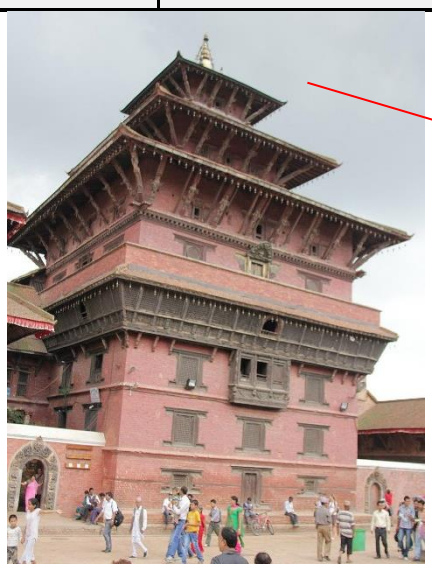
Supplements

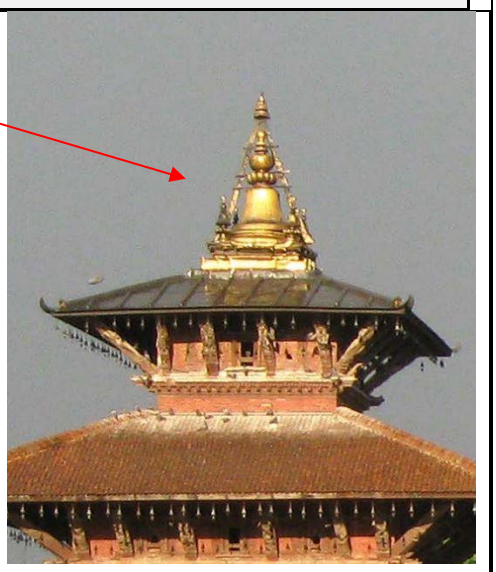
[A] All product / technical data sheets can be found in this additional document.

Photo Credits

GENERAL INFORMATION		
Object / Monument Degutale Temple, rooftop	**Orientation** Northwest towards Yogarendra Pillar	**Size (H x L x W)** -
Date of Production 17th century	**Location** Patan Durbar Square, part of the Royal Palace	
Material and Technology - finial (one big and four small pinnacles, top piece, base of pinnacles (around 80-90 piece)): Copper repoussé, fire-gilded - wooden support structure - roof slabs (around 160 piece) and semi-round shaped rib elements (*nāgvaḥ,* around 40 piece, 4 piece with repoussé head): Copper sheet, partly chased - wrought iron chains for cast bronze bells and as mounting substructure of the four small pinnacles		
Date of the last Treatment Conservation 2022 and 2023: see short report	**Institutions of the last Treatment** IoC	







EVALUATION	
Date of Evaluation May 2024	**Evaluation done by** Meral Hietz, Katharina Mendl
Recent Damages:	
☐ Stability Problems	☐ Major ☐ Medium ☐ Minor
Comment:	

☐ Broken / - into several Pieces	☐ Many ☐ Some ☐ Few	
Comment:		
☐ Loose / Missing Parts	☐ Many ☐ Some ☐ Few	
Comment:		
☒ Cracks / Holes	☐ Many ☐ Some ☒ Few	
Comment: all cracks have been glued with epoxy resin and carbon fibre last year		
☐ Deformation / Dents	☐ Major ☐ Medium ☐ Minor	
Comment: reshaped last year by local craftsmen		
☒ Abrasion / Worn out Gilding	☐ Major ☐ Medium ☒ Minor	- Some pinnacle elements - Big one on top sides and lotus elements - pinnacle base consisting of profiled elements with downward and upward curved ends (kulāṃ) partially shows w.o.g. on top sides - heads of some of the *nāgvaḥ*
Comment:		
☒ Corrosion	☐ Major ☐ Medium ☒ Minor	- Green patina on roof slabs (roof surface) and worn of *nāgvaḥ*
Comment: pinnacle below umbrella and umbrella are very bright gold, also gold on the cupola is well preserved		
☐ Soiling	☐ Dust	☐ Heavy ☐ Medium ☐ Light - Not yet

	☐ Dirt	☐ Heavy - Not yet ☐ Medium ☐ Light
	☐ Blood	☐ Heavy ☐ Medium ☐ Light
Comment:		

Evaluation of the Condition

☒ good

☐ satisfactory

☐ unsatisfactory

Conclusion

The condition of the copper roof elements and the pinnacle finial of the Degutaleju temple were judged to be good. The conservation of all the elements took place in the previous year and they were only assembled and installed this year.

The implement technical measures (e.g. reshaping of deformations, replication of missing parts, replacement of loose elements, riveting of copper sheet patches to close cracks) were carried out by the local coppersmiths and have proved to be stable.

The surface treatments carried out by the IoC in 2022 and 2023 are in good condition. It is expected that the gilded surface will darken over time, particularly in areas of worn gilding.

Deposits (soiling, bird droppings) that accumulate on the surface over time are a major cause of corrosive reactions. In this respect, maintenance is the key to the long-term preservation of the Degutaleju roof and finial. Regular cleaning and removal of bird droppings must be considered by the local community as the most important factor in long-term conservation. Where citric acid is used to chemically reduce corrosion, it is essential that the surface is thoroughly rinsed after cleaning, as acidic residues accelerate corrosive reactions.

PHOTO DOCUMENTATION

Fig. 1: Big pinnacle of Degutaleju (right) after dry/wet and chemical cleaning, 2023

Fig. 2: Four small pinnacles after applying leaf gold with oil based size, 2023

Fig. 3: Pinnacle base slabs after cleaning, reshaping and closing cracks, 2023

Fig. 4: Large crack in the pinnacle glued with epoxy resin and a fitted copper sheet, 2023

Fig. 5: Copper roof slabs after conservation, 2023

Fig. 6: *Nāgvaḥ* after conservation, 2023

Fig. 7: Iron chains *nāgvaḥ* after removal of corrosion and application of wax, 2023

Fig. 8: Copper sheets, top piece and repoussé decoration of the roof after conservation, 2022

Fig. 9: Assembly of the *kulāṃ* and *mikhāphusi* base of the pinnacles, May 2024 (© Bikash)

Fig. 10: Assembly of the large pinnacle, 2024 (© Bikash)

Fig. 11: Pinnacles and base assembled, E-side, May 2024

Fig. 12: Pinnacles and base assembled, E-side, May 2024

Fig. 13: Finial and roof sheets assembled, N-side, May 2024

Fig. 14: Finial and roof sheets assembled, W-side, May 2024

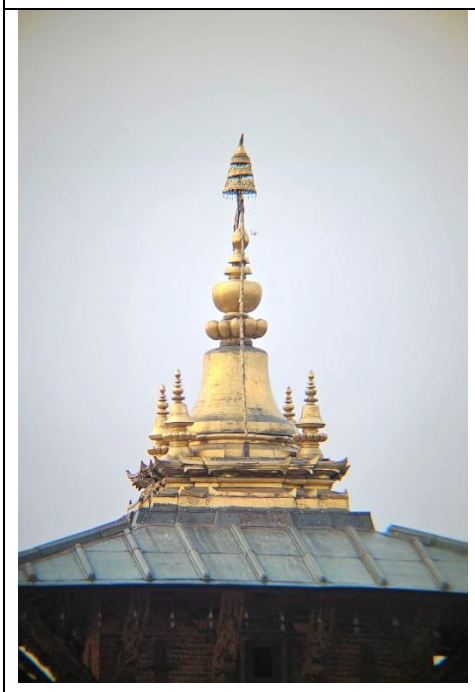


Fig. 15: Finial and roof, S-side, May 2024

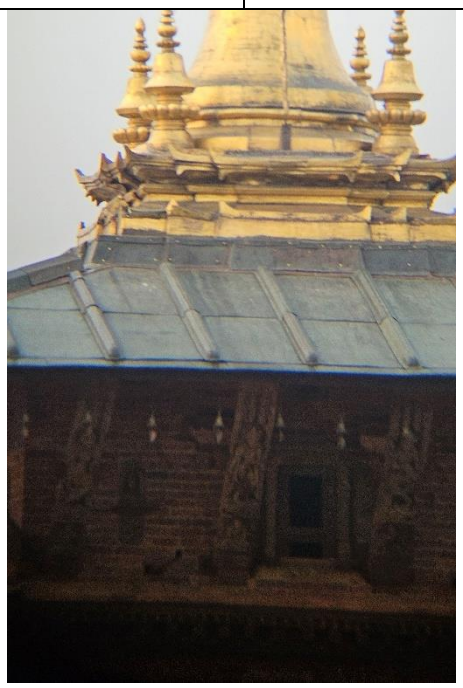
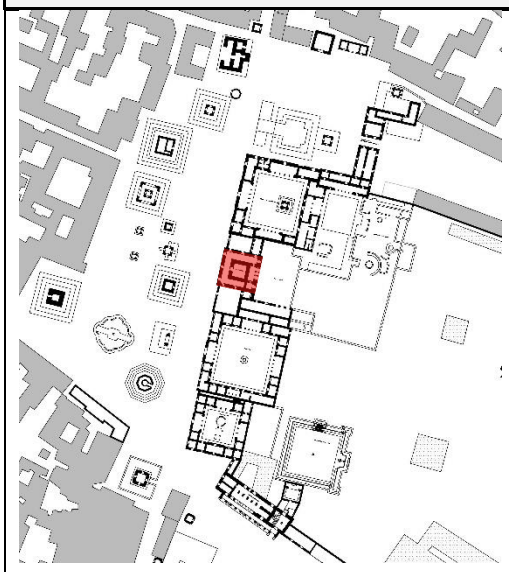


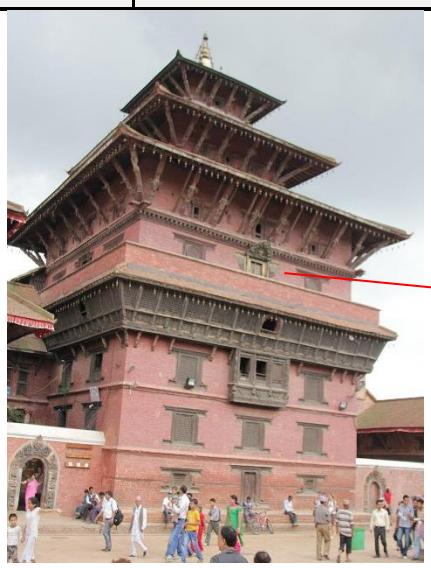
Fig. 16: Roof sheets and pinnacle base, S-side

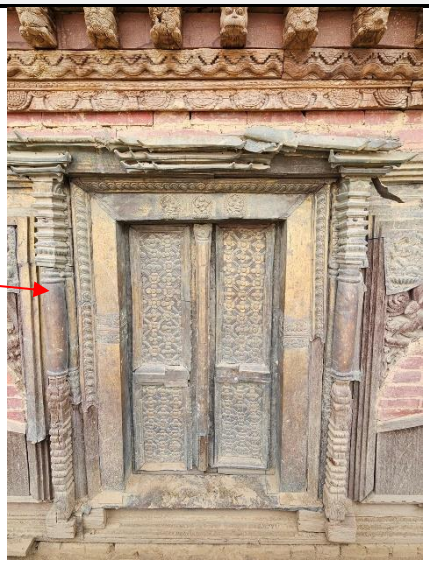
Fig. 17: Roof edge, May 2024

Fig. 18: Degutaleju (left) next to South and North Taleju, S-side, May 2024

GENERAL INFORMATION		
Object / Monument Golden door, torana and window Degutaleju Temple, fourth floor	**Orientation** Door and torana: Northwest towards Yogarendra Pillar Window: South towards Mulchowk	**Size (H x L x W)** Door: 132 x 76 x 13 cm Torana: 110 x 140 x 25 cm Window: 73 x 73 x 0,8 cm
Date of Production 17th century	**Location** Patan Durbar Square, part of the Royal Palace	
Material and Technology - Wooden support structure - Copper sheet repoussé, fire gilded - mounted with iron and copper nails - red secondary paint on the window		
Date of the last Treatment Conservation 2022 and 2023: see short report	**Institutions of the last Treatment** IoC	







EVALUATION	
Date of Evaluation May 2024	**Evaluation done by** Meral Hietz, Katharina Mendl
Recent Damages:	
☐ Stability Problems	☐ Major ☐ Medium ☐ Minor
Comment:	

☐ Broken / - into several Pieces	☐ Many ☐ Some ☐ Few	
Comment:		
☒ Loose / Missing Parts	☐ Many ☒ Some ☒ Few	Torana: - around 20 nails are missing - top piece (tiny pinnacle on top of the umbrella) is missing Door: - lower area and base copper sheets are missing - sheets on the side and middle areas on the frame left and right of the door are missing too Window: - 2 cracks
Comment:		
☒ Cracks / Holes	☐ Many ☒ Some ☒ Few	Torana: - around 25 cracks Door: - Some small cracks all over the copper sheets Window: - 2 cracks
Comment: all cracks have been glued with epoxy resin and carbon fibre last year		
☒ Deformation / Dents	☐ Major ☐ Medium ☒ Minor	Torana: - umbrella on top - right Makara's snout - along the right upper edge Door: - some d., especially in the centre of the door on the baffle plate and on the step plate Window: - some minor deformations
Comment: reshaped last year by local craftsmen		
☒ Abrasion / Worn out Gilding	☐ Major ☐ Medium ☒ Minor	Torana: - most gilding worn out → around 70-80% Door:

			- whole surface shows some abraded areas with w.o.g., especially on the upper frame with the three deities, the four deities on the side and the centre baffle plate of the door Window: - secondary paint on top of the gilded copper sheet
Comment:			
☒ Corrosion	☐ Major ☒ Medium ☐ Minor		Torana: - darkening in w.o.g. areas - slight green corrosion in indentations - iron nails corroding Door: - darkening of w.o.g. areas - green corrosion especially on the lower area of the door
Comment: pinnacle below umbrella and umbrella are very bright gold, also gold on the cupola is well preserved			
☒ Soiling	☒ Dust	☐ Heavy ☒ Medium ☐ Light	Torana: - dust all over the surface Door: - overall on the surface Window: - overall on the surface
	☐ Dirt	☐ Heavy ☐ Medium ☐ Light	Door: - dirt accumulation due to the construction work, especially in the lower areas
	☐ Blood	☐ Heavy ☐ Medium ☐ Light	
Comment:			

Evaluation of the Condition

☐ good

☒ satisfactory

☐ unsatisfactory

Conclusion

The condition of the golden door, the torana on the west side and the window on the south side on the fourth floor of the Degutaleju temple were judged to be satisfactory. Conservation work on the torana began in 2022 and on the door and window in 2023, but was not completed.

The implement technical measures (e.g. reshaping of deformations, replication of missing parts, replacement of loose elements, riveting of copper sheet patches to close cracks, replacing missing nails with brass rods) is still to be carried out by local coppersmiths.

The surface treatments carried out by the IoC on some elements in 2022 and 2023 are generally in good condition, but much dust has accumulated on the surface due to the surrounding construction work and missing dust covers. It is expected that the gilded surface, which has been cleaned with citric acid, will darken over time, particularly in areas of worn gilding.

Deposits (soiling, bird droppings) that accumulate on the surface over time are a major cause of corrosive reactions. In this respect, maintenance is the key to the long-term preservation of the Degutaleju metal elements. Regular cleaning and removal of bird droppings must be considered by the local community as the most important factor in long-term conservation. Where citric acid is used to chemically reduce corrosion, it is essential that the surface is thoroughly rinsed after cleaning, as acidic residues accelerate corrosive reactions. It is recommended that the copper sheet metal elements of the door are dismounted for reshaping and cleaning. All iron nails should be replaced with brass or copper nails. Some abraded areas should be retouched with oil gilding.

PHOTO DOCUMENTATION

Fig. 1: Golden door on the fourth floor after cleaning, 2023

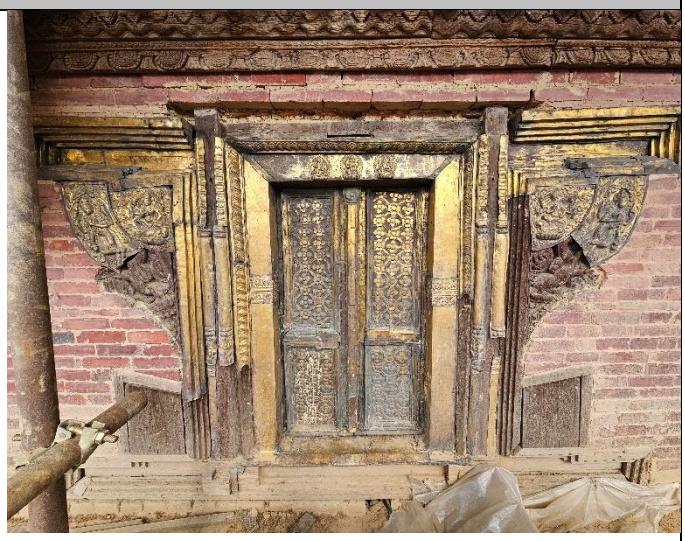


Fig. 2: Golden door on the fourth floor in May 2024

Fig. 3: Missing elements in the lower area of the door, May 2024

Fig. 4: Missing nails and iron nails for fixing the copper sheets to the door, May 2024

Fig. 5: Deformation on the baffle plate in the centre of the door, May 2024

Fig. 6: Abraded areas / worn out gilding on the copper sheet repousse on the sides of the door, May 2024

Fig. 7: Abraded areas / worn out gilding on the upper frame of the door, May 2024

Fig. 8: Abraded areas / worn out gilding on the copper sheet repousse on the sides of the door, May 2024

Fig. 9: Partial green corrosion on some door elements, May 2024

Fig. 10: Door covered in dust from construction work, May 2024

Fig. 11: Torana after cleaning and chemical removal of copper corrosion, 2022

Fig. 12. Torana stored in shed behind the palace garden, May 2024

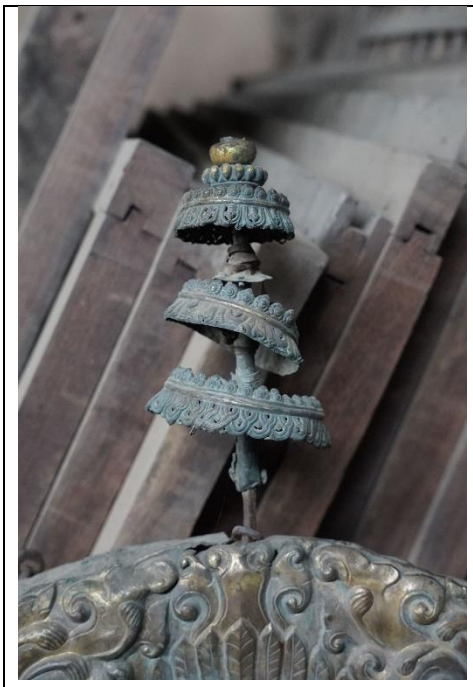


Fig. 13: Missing small pinnacle on top of the umbrella and deformations, May 2024

Fig. 14: Deformation on the Makara's snout, May 2024

Fig. 15: Darkening due to worn out gilding over the entire surface, May 2024

Fig. 16: Cracks in the Torana's copper sheet repousse, May 2024

Fig. 17: Cracks in the Torana's copper sheet repousse, May 2024

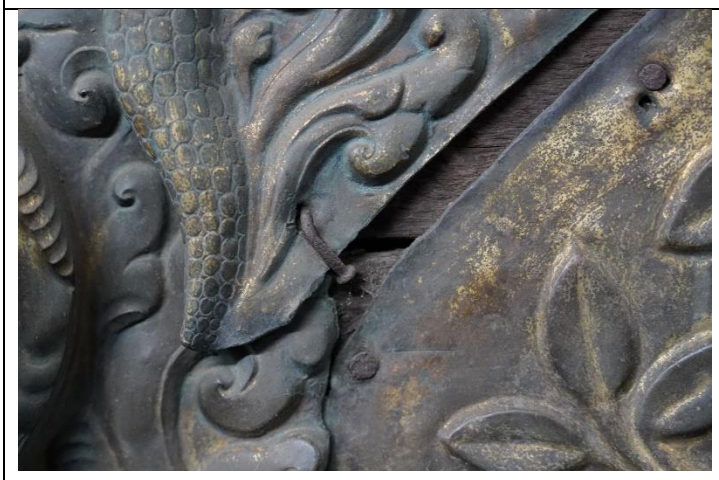


Fig. 18: Iron nails for fixing the copper sheets to the torana, May 2024

Fig. 19: Dust, abraded areas and tika residues on the torana, May 2024

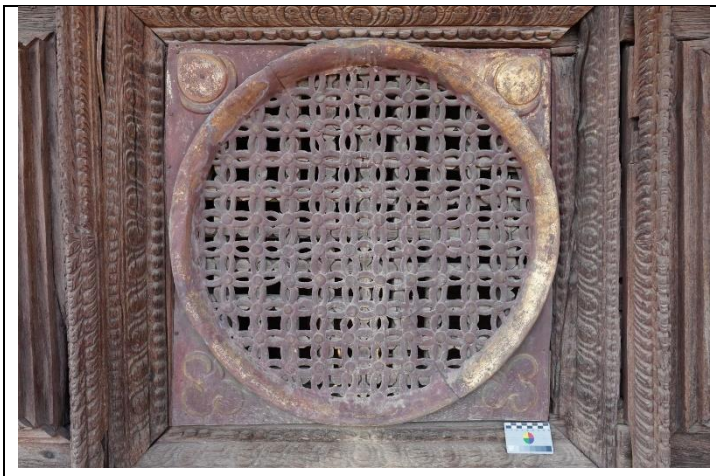


Fig. 20: Condition of the window after partial removal of the secondary paint on the fire-gilded surface, May 2024

Fig. 21: Window covered in dust from construction work, May 2024

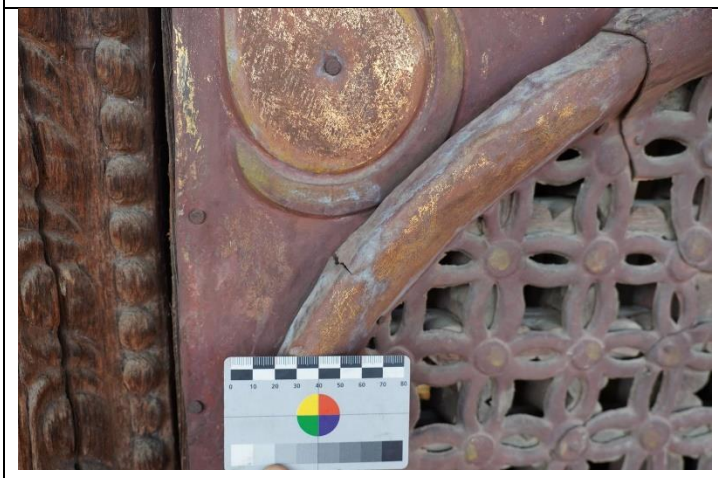


Fig. 22: Crack in the copper sheet repousse of the window, May 2024

Fig. 23: Detail of the gilding beneath the secondary red painting, May 2024

[A] Product Data Sheets – Links[1] to Suppliers/Manufacturers

AEROSIL® 200
https://products.evonik.com/assets/or/ld/AEROSIL_200_TDS_DE_DE_TDS_PV_52043839_de_DE_WORLD.pdf

Aviva Silikat Grundierung
https://www.adler-lacke.com/Canto/tmb/aviva-silikat-grundierung_tmb_4079_de.pdfA
Alkylbenzyldimethylammonium chloride
https://www.sigmaaldrich.com/AT/en/sds/mm/8.14858?userType=anonymous

Klucel™ EF
https://www.kremer-pigmente.com/elements/resources/products/files/63701-63713.pdf

Aviva Tirokat-Color, Adler
https://www.adler-lacke.com/Canto/tmb/aviva-tirokat-color_tmb_4087_de.pdf

Mixtion Le Franc, Kremer
https://shop.kremerpigments.com/elements/resources/products/files/98000e.pdf

Waxes, Deffner und Johann
https://deffner-johann.de/media/datasheets/4186000/EN/Zusatzinformation_Wachse_DE_DJ.PDF

Injection mortar HFX
https://productdata.hilti.com/APQ_HC_RAW/ASSET_DOC_7567931.pdf

Kölner Classic Ölmixtion 3h; 12h; 24h
https://www.kolner-vergolderprodukte.de/produkte/koelner-oelmixtion/

KSE 500 E
https://media.remmers.com/celum/export/documents/Remmers_0715_KSE-500-E-_Technisches-Merkblatt_de_DE_26355.pdf

Lascaux 498 20 X acrylic adhesive
https://deffner-johann.de/media/datasheets/2051100/DE/2051100_Technisches%20Datenblatt_Lascaux%20Acrylkleber%20498%2020%20X_DE_DJ.pdf

Marble dust
https://www.kremer-pigmente.com/elements/resources/products/files/58500-58580_59001-59690.pdf

Natural hydraulic lime
https://www.preservationworks.us/wp-content/uploads/2019/10/NHL-Datasheet-Lafarge-23.5.pdf

Plextol B-500 (acrylic dispersion)
https://deffner-johann.de/media/datasheets/2556500/DE/2556500_Technical%20Data%20Sheet_Acrylic%20Dispersion%20B%20500_EN_DJ.pdf

Primal® SF 016
https://deffner-johann.de/media/datasheets/2543001/DE/2543001_Technical_Data_Sheet_Primal_SF_016_DJ_EN.pdf

AKEPOX® 2010
https://data.akemi.de/fileadmin/user_upload/products/productdocuments/TMB/Akepox_2010_TMB_D.pdf

[1] All links were last accessed on 13 May 2025.

EPO-TEK® 301-1
https://www.epotek.com/docs/en/Datasheet/301-1.pdf

Titebond Wood Glue
http://sds.franklini.com/msds/1411.042k0nmo0020.pdf

Paraloid™ B-72, Kremer
https://www.kremer-pigmente.com/elements/resources/products/files/67400-67409.pdf

Keim Granital®
https://www.keim.com/documents/de-AT/723/TM_Granital_DE-AT.pdf