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CALCULATION SHEET

Date:	25.01.22	Total No. Sheets	
PROJECT:	Victoria Mill		
Client:	Opal access	By	ER 25.01.22

Brief: Verify helibar repair fixing to sandstone block displaced over time by weathering action.

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2. Loads
3. Narrative on research undertaken on resin fixings to sandstone (capacity of the fix)
4. Capacity of Helibar
5. Recommendations and conclusions

1.0 Information provided

14: North West Elevation: Coping Stone pinned, rebred of top level block, Spalling to be repaired

Comments:

370 x 6mm helical rods resined through coping blocks. Voids behind displaced block packed with mortar. Upon return larger gaps will be filled with Fosroc Renderock and skimmed with Lime mortar to finish. Review of method to be confirmed.





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The drill bits we used were 400mm. Debris sucked out. Hit1 injected right at the base of the hole, pretty much filled to the brim to overkill the fixing of the rebar. There will be at least 100mm of embedded rebar into the lower blocks but more than happy to go further if you suggest to do so. We just made safe onsite so your method will be used to finish. We will be using renderoc fosroc to fill the gaps, finishing with a aesthetic skim.

1.0 Loads

From the photograph provided the block looks to be a maximum of 450mm wide, 225 mm deep and 225mm high.

Weight of sandstone = $2323\text{kg/m}^2 \Rightarrow 22.8\text{kN/m}^2$

Therefore weight of block = $22.8 \times 0.45 \times 0.225 \times 0.225 = 0.52\text{kN}$

Design load = weight in kN x FOS = $0.52 \times 1.4 = 0.73\text{kN}$. Conservatively verify for the same notional horizontal load.



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2.0 Narrative on research undertaken on resin fixings to sandstone (capacity of the fix)

Suitability of the fix

In the absence of a calculable method to verify the fix into the sandstone a desktop study has been undertaken to determine the best form of fix and expectations of structural performance.

The most research into this matter comes from testing of climbing anchors in Australia. In extremely weathered sandstone performance of 8- 48kN pull out was achieved. (*Testing of Rock-Climbing Anchors in Weak Sandstone*)

Further research shows that an M10 anchor ridged anchor set into the rock 100mm with and epoxy resin has a capacity in excess of 25kN (*The Strength and reliability of Chemical Rock Climbing Anchors in Sandstone*)

The conclusions from this research are:

- the optimum depth of the anchorage fix is 100mm
- the best adhesive is an epoxy based resin – like Hilti HIT resins
- The fixings will be weakened by being too close together
- The holes must be cleaned
- The fixings will take significantly more resin than concrete due to the porous nature of the stone
- The anchor needs to be one with deep ridges on it –

Where the Helibars are embedded in brick work vertically they will have a greater capacity under pull out than the capacity of the sandstone.



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3.0 Capacity of Helibar

From the product information appended 0.2% proof stress for the 6mm bar = 840N/mm²

$$A = 3^2 \times \pi = 28.2 \text{ mm}^2$$

Conservatively assume $P_y = 176\text{N/mm}^2$ transverse and 190N/mm^2 longitudinal

(from data for grade 305 stainless steel)

Therefore, shear capacity per rod $28.2 \times 0.9 \times 176/1\text{E}3 = 4.4\text{kN}$

Tensile capacity of rod = $28.2 \times 0.9 \times 190 /1\text{E}3 = 4.8\text{kN}$

4.0 Recommendations and conclusions

1. The helibar and the fix into the brickwork and sandstone are both capable of carrying the imposed loads by a minimum factor of safety of $4.4/0.52 = 8$ based upon only one fix.
2. The proposal to stitch the stonework with Helibar in all three dimensions increases the factor of safety and is advisable to account for any unforeseen actions.
3. The products proposed are all manufactured for the express purpose of remedial works to masonry , and filling of the angular gaps will reinstate the compressive strength of the masonry.
4. Relaying and levelling the parapet capping would require substantial and disproportionate costs in terms of safe access, lifting and possible Highways and building user implications.



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