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HMS Victory new monitoring survey methodology

Appendix to Client report

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### HMS Victory new movement monitoring survey methodology.

#### Glossary of terms

Base location pin – pin added to the Dist Pro4 to enable accurate repositioning on datum plate

Beam measuring point – plate identifying beam and deck for measurements with Leica Messfix

Circular prism – Target prism reflector for use with Leica TPS 700 series 2" 'total station' Datum plate – Plate from which measurements are taken using the Disto Pro4

**Deck measuring point** – Brass screw on deck vertically beneath Beam measuring point **Deep datum** – Stable external datum against which movement of HMS *Victory* is related

Dual strut - Independent support for Leica reflector pole

Ground plate - Heavy temporary survey point for level surveying

Half-beam target point – target plate that can be accurately repositioned for half-beam Measurements

Leica Disto Pro4 – Hand-held laser distance measuring instrument Leica DNA03 digital level – Automatic precision digital instrument for measuring

changes in elevation of Target sockets and Deck measuring points

Leica Messfix – Telescopic instrument for measuring distance between Deck measuring point and Beam measuring point

**Leica TPS 700 series 2" 'total station' -** Automatic precision digital instrument for measuring changes in coordinates of the Onboard fixed point and Target sockets around No.2 Dry Dock.

Levelling/target plug - Plug for screwing into Target socket for levelling survey

Onboard fixed point - Copper nail in the deck close to the bow on the Middle gun deck

Prism adaptor - Plug for screwing into Target socket to hold Circular prism

Reflector pole – Leica telescopic pole with precision scale for locating Circular prism on Levelling/target plug

**Special bar code level staff** – Shortened (1.6m) bar code staff for use with Leica DNA03 digital level

**Special short tripod** –Leica universal instrument tripod specially shortened for new HMS *Victory* survey

**Staff steady** – Non-proprietary tool to help hold levelling staff vertical and steady during level surveying

**Target plates -** Plate to which measurements are made using the Disto Pro4 **Target sockets -** Precision stainless steel socket installed around the edge of No.2 Dry Dock and in the keel support along the floor of No.2 Dry Dock

Tripod star - Leica tripod support for smooth and vulnerable surfaces



#### 1. Relating onboard fixed point to stable land datum.

The datum are accessed by removing the cast sluice cover. A 'Perspex' dust cap protects the top of each **target socket**.

- 1. Screw a **BRE levelling/target plug** (with small steel sighting pin removed) hand tight into the **target socket** at Datum 1.
- 2. Set up the Leica TPS 700 total station on its tripod over Datum D1 using the laser plumb targeted on the small hole in the target plug. Use the Distance height meter to measure the instrument height. Enter the coordinates of the datum and height of instrument above the datum into the total station. The coordinates may be the true coordinates of Datum 1 or fictitious, i.e. E1000.000, N1000.000. Whichever is used must remain as constants for every survey.
- 3. Screw the prism adaptor hand tight into the target socket at Datum 2 and set the circular prism on the prism adaptor to face directly toward the total station on Datum 1. If it is not possible to achieve a direct line of sight between the total station and the circular prism set directly on the datum, set the prism on the reflector pole and the point of the reflector pole in the small hole in the target plug screwed hand tight in the datum socket. Use the dual strut to support the reflector pole and carefully set to vertical using the circular bubble.
- 4. Enter the height of the reflector into the total station. If the circular prism is used directly on the datum socket, enter a height of 0.052m (52mm). If the circular prism is used on the reflector pole, enter the height indicated on the pole. Sight the total station in the centre of the circular prism and enter the bearing between the datum in to the total station (this may be a true bearing, if known, or 0.00000 degrees). Whichever is used <u>must</u> remain a constant for every survey.
- 5. Activate the total station measurement to record the height, distance and coordinates of Datum 2 in relation to Datum 1.
- Set the prism on the reflector pole and the point of the reflector pole on the onboard fixed point (small indent on the head of the copper nail located close to forward most gun port on the starboard side of the middle gun deck). Aim circular prism at the total station.
- 7. Enter the height of the reflector indicated on the pole into the total station. Sight the total station in the centre of the circular prism and activate the total station measurement to record the height, distance and coordinates of the onboard fixed point in relation to Datum 1.
- 8. Repeat procedures 1.1 1.7 using Datum 2 to set up the total station. Enter the coordinates of Datum 2 as calculated from Datum 1 in order to check the base line. Record the height, distance and coordinates of the onboard fixed point in relation to Datum 2.

#### 2. Settlement of deck measuring points on the Middle gun deck.

The **deck measuring points** are located directly beneath the associated **beam measuring points** set on the underside of beams 5, 9, 13, 16, 20, 24, 28 and 30 along the port and starboard side of the Middle gun deck.

- 1. Set the Leica DNA03 digital level on the special short tripod on the starboard side of the Middle gun deck at about ¼ the distance from the onboard fixed point in the bow area towards the stern. The tripod star should be used to secure the legs of the tripod and prevent slippage and damage to the decking. Take care to position digital level such that the nearest deck measuring points are outside the minimum focusing range of the instrument (check manual). The level should be set in the 'line levelling' mode.
- Position the base pin of the special bar code level staff on the onboard fixed point (copper nail). Use the staff illuminator to down light\* the bar coding at the sighting elevation.

#### Notes.

A staff steady of the type suggested to FSL DO is very helpful and greatly improves operative efficiency and survey accuracy.

- \* This is a Health and Safety issue. The staff illuminator has a bright halogen light source which is best directed downward to protect the operative from potential eye damage.
- 3. Enter the 'back sight' identification information and elevation of the onboard fixed point (average value obtained from Procedure 1) into the digital level, sight and focus on the staff and record reading.
- 4. Reposition the level staff onto the deck measuring point beneath beam 5. Enter 'intermediate' sight identification information into the digital level, sight and focus on the staff and record reading. Repeat this for other deck measuring points working toward 'midships.
- 5. Choose the nearest beam position to 'midships. Enter 'foresight' sight identification information into the digital level, sight and focus on the staff and record reading.
- 6. Repeat procedures 2.1 2.5 with the level set up about  $\frac{3}{4}$  the distance from the onboard fixed point in the bow area towards the stern. The 'back sight' is now the 'midships deck measuring point and 'foresight' will be the deck measuring point beneath beam 30.
- 7. Repeat procedures 2.1 2.6 along the port side of the Middle gun deck.

This concludes Procedure 2. For maximum accuracy and checking of errors, both port and starboard legs of the survey may be 'closed' by reversing the process to return to the onboard fixed point.



#### 3. Measurement of deck to beam distance.

This procedure covers the measurement of the distance between the **deck measuring points** located directly beneath the associated **beam measuring points** on the underside of beams 5, 9, 13, 16, 20, 24, 28 and 30 along the port and starboard side of the Middle gun deck and at similar locations on the Upper gun deck, the Lower gun deck and the Orlop deck.

- Position the Leica Messfix telescopic rule on the deck measuring point and extend the telescopic rule to touch the beam measuring point above. Record the distance displayed.
- Repeat procedure 3.1 for all similar positions on the Middle gun deck, the Lower and Upper gun decks and the Orlop deck.

#### 4. Measurement of beam spread

This procedure covers the measurement of distance between points established on the inside of the hull immediately below - or as close as practical to - the beam positions 5, 9, 13, 16, 20, 24, 28 and 30 on the Middle gun deck, the Lower and Upper gun decks and the Orlop deck. Alternatively, 'half-beam' measurements may be necessary.

1. Position the Leica Disto pro4 with the base location pin (see Additional requirements) seated in the indent of the beam measurement Datum plate. Activate and centre laser beam and centre on the Target plate. The use of a small rod or bipod steady may aid in this operation (see Additional requirements). Activate the measurement routine and record the distance. Where 'half-beam' measurements are necessary, the Half-beam target point and location plate will be used.

## 5. Measurement of movement at the top of Dry Dock No.2.

This procedure covers the measurement of movement of nine **target sockets** located in the stone blocks which form the edge of No. 2 Dry Dock.

- Repeat procedures 1.1 1.5. Use the special short tripod to set the Leica TPS 700 total station as low as practical over Datum 1.
- Screw the prism adaptor hand tight into the target socket at the head of the dock (top of the access stairs) and set the circular prism on the prism adaptor to face directly toward the total station on Datum 1.
- 3. Activate the total station measurement to record the height, distance and coordinates of the target socket in relation to Datum 1.
- Repeat procedures 5.2 5.3 for the four target sockets along the dock edge on the public arena (starboard) side of HMS Victory.
- Use the special short tripod to set the Leica TPS 700 total station as low as practical on the cobbled area off the port bow of HMS Victory in a location that gives

- a clear sight of both Datum 1 and Datum 2 and the four target sockets along the dock edge on the picnic area (port) side of HMS *Victory*.
- 6. Screw the **prism adaptor** hand tight into the **target socket** at Datum 1 and set the **circular prism** on the prism adaptor to face directly toward the **total station**. Enter the coordinates and height (0.052m) of the circular prism on Datum 1.
- 7. Repeat procedure 5.3 for Datum 2. The total station will calculate its own position in relation to the datum.
- 8. Repeat procedure 5.4 for the four target sockets along the dock edge on the picnic area (port) side of HMS *Victory*. The total station will calculate the position of the four target sockets along the dock edge on the picnic area (port) side of HMS *Victory* in relation to the datum.

## 6. Measurement of vertical movement of the keel support.

This procedure covers the measurement of vertical movement of the Portland stone keel support along the bottom of No. 2 Dry Dock.

- Set the Leica DNA03 digital level on the normal tripod between Datum 1 and the target socket at the head of the dock (top of the access stairs). The level should be set in the 'line levelling' mode.
- 2. Screw a **levelling/target plug** (with small steel sighting pin removed) hand tight into the **target socket** at Datum 1.
- 3. Position the 4m dual face aluminium level staff on the levelling/target plug. Use a staff steady (see Additional requirements and procedure 2.2) to improve operator efficiency and survey accuracy.
- 4. Enter the 'back sight' identification information and elevation of Datum 1 into the digital level, sight and focus on the staff and record reading.
- Enter 'foresight' sight identification information for the target socket at the head of the dock (top of the access stairs) into the digital level, sight and focus on the staff and record reading.
- 6. Reposition the digital level down the stairs such that a reading can be obtained on the bottom of the staff. Enter the 'back sight' identification information, sight and focus on the staff and record reading.
- 7. Place the **ground plate** further down the stairs and reposition the level staff such that a reading can be on the top of the staff, enter this 'change point' identification information, sight and focus on the staff, record reading. Repeat this 'hopscotch' standard line levelling procedure (6.5-6.7) to reach the floor of the dock.
- 8. Screw a **BRE levelling/target plug** into the forward-most target socket located horizontally on the starboard face of the keel support. Position the lowest section of the dual face aluminium level staff on the levelling/target plug.

- 9. Enter 'foresight' identification information for this target socket, sight and focus on the staff and record reading.
- 10. Reposition the level about 'midships, enter 'back sight' identification information for this same target socket and record reading.
- 11. Enter 'intermediate' identification information for the next two target sockets and record readings.
- 12. Finally, enter 'foresight' identification information for the final target socket, sight and focus on the staff and record reading.

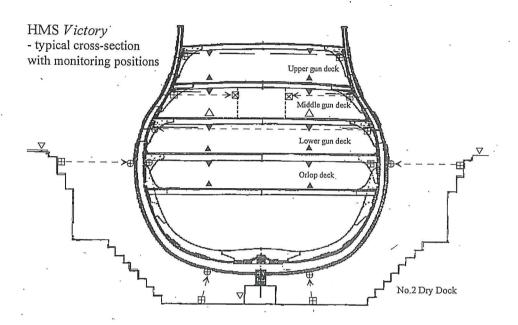
This concludes Procedure 6. For maximum accuracy and checking of errors, the survey may be 'closed' by reversing the process to return to Datum 1.

#### 7. Measurement of external hull positions within No.2 Dry Dock.

This procedure covers the measurement of movement of **Target plates** on the outside of the hull of HMS *Victory* in relation to **Datum plates** located on the walls of No.2 Dry Dock.

Position the Leica Disto pro4 with the base location pin (see Additional requirements) seated in the indent of the beam measurement Datum plate secured to the stone face of the dock. Activate and centre laser beam and centre on the Target plate located on an adjacent part of the hull. The use of a small rod or bi-pod steady may aid in this operation (see Additional requirements). Activate the measurement routine and record the distance.





- ▼ Target socket
   △ Deck measuring point measured directly against onboard fixed point
- △ Deck measuring point
   ▼ Beam measuring point
   ⊕ Datum plate

- ⊞ Target plate
- ⋈ Half-beam target point

Figure 1. Typical cross-section of HMS Victory with suggested measuring positions.

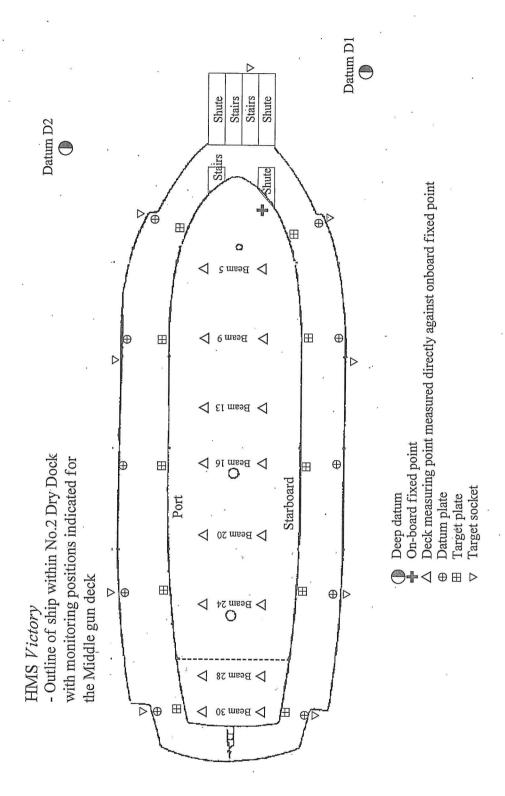


Figure 2. Outline of HMS Victory within No. Dry Dock with the approximate positions of the installed Deep datum, Target sockets around the edge of the dock and the onboard fixed point.