Photogrammetry dimensional control survey of a manifold – Fugro 2016

Photogrammetry for accurate dimensional control in the offshore industry : a light technology for an ambitious project

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If usual measuring systems are able to provide the necessary data to meet the expected accuracy, there are projects where measurement conditions, the amount of assets to control and the flexibility of staff and equipment require the implementation of a versatile technology.

Fugro offers a comprehensive dimensional control service specialising in precision 3D surveys. Fabrication of assets such as manifolds, well trees, jackets, pipeline jumpers and closing spools require strict adherence to design tolerances. In the onshore and offshore environments, Fugro dimensional control surveyors can use the latest robotic total stations, 3D laser scanners or photogrammetry packages to measure distinct elements of the asset throughout fabrication. Commercial and proprietary software are used to calculate the size, shape and location of the asset and to determine complex relationships between components, such as out-of-roundness and out-of-plane. The survey report

provides a record of dimensions needed to confirm design tolerances were maintained during fabrication and to document critical dimensions for contract compliance and use during offshore installation.

By the end of spring 2016, Fugro had been asked to **control nearly 200 subsea structures**, fabricated at the same time in 5 different locations, in Africa and Europe. Soon to be deployed on an ambitious ultra-deep offshore project, these structures are complex and heavy assets, up to 145 tons each, 15 m large, and 10 m high.

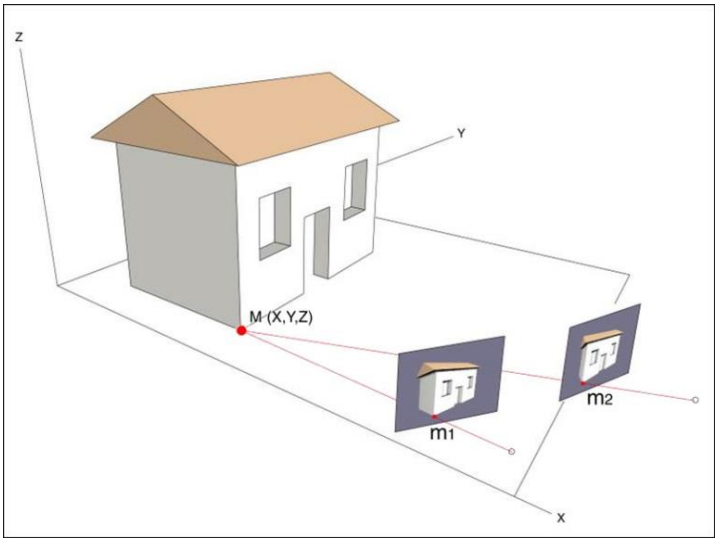
Given the complexity of the structures to be surveyed, the level of accuracy required and the difficult field conditions that could be met, we have decided to implement and adapt **photogrammetry methodology,** to overcome its main disadvantage compared to the other techniques (processing time), ensuring **a complete chain** that could lead to **a final report in few days**, wherever the structure is located.

Main benefits using photogrammetry are :

- High reactivity for photos acquisition
- Fabrication control and offset measurement at the same time
- Possibility for extra dimensional information after field work
- Accurate solution : from 0.02 mm to few millimeters depending on the size of the equipment
- Possibility to perform measurements in dynamic configuration (from a hanging basket under a crane, a drone, a ROV, a car, etc.).
- Possibility to remotely control the survey and perform measurements in different environment (high or low pressure, underwater, etc.).

The raw data is a full photo coverage of the structure to be surveyed, with a high stereoscopic overlap.

Software processing results is the determination of the relative position and orientation of each picture. Common points are identified on each image. A line of sight is set from the camera location to the point on the object. It is the intersection of these rays that determines the three-dimensional location of the point.



Accuracy depends on image resolution and the way rays intersect, which mainly depends on the way the structure is photographed. **It's not enough to know how to use a camera**: the operator must have a good photogrammetry processing background, to know how to photograph the structure and to manage any problems related to bad field conditions (lighting condition, range conditions, size of the structure related to accuracy, etc.).

Accurate : For the project, offsets and fabrication dimensions have to be measured with an accuracy better than 2 mm, but focusing on particular pieces, results had to reach an accuracy of 0,3 mm. Furthermore, metrology tools, used for the determination of some particular points of interest, have to be calibrated within 0,1 mm. The use of high resolution calibrated cameras and the implementation of a dedicated field strategy have led to the processing of several hundred pictures per structure and the **delivery of reports that meet the requirements**.

Local : to deal with local content requirement, local Fugro surveyors have been trained by a photogrammetry expert and dedicated field procedures have been given, assuring mobilization within 48h and a productive relationship with client's local teams.

Versatile : Fugro have to deal with very different field conditions at the same time : hot and sunny outdoor construction yards in Africa, dense building blocks, indoor surveys with close range and poor light conditions in Europe. Some structures were already mounted on piles, 20 m high. Others are so close to each other that it is nearly impossible to walk around them. Using a crane, pictures can be taken from a basket, flying around the structure, focusing on points of interest, while **ensuring the maximum level of safety**.

When using a man-lift is not possible, telescopic mast and remote control devices are used to reach the best point of view and ensure a full 3D coverage of each item.

Each time, the survey is **completed with a minimum of interference with other operations**, and a full photo archive is recorded in such a way that any visible item can be measured, even those that are not asked.

In the hours following the survey, a QC is done concerning image resolution and sharpness, stereo coverage and Points of Interest redundancy, and photo dataset sent to the processing office for backup and processing.

Regarding its many advantages, photogrammetry is now one of the best techniques for accurate dimensional control of offshore assets, especially since the last camera resolution, workstations capacities and software ease of use, make it very accessible. However, dimensional control expertise is still essential, to ensure a fine processing of the dataset, and to finally provide the correct information with the correct analysis.

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Fugro photogrammetry dimensional survey key points :

- 195 structures to survey (130 structures in 6 months)
- 5 different yards
- 80.000 high resolution pictures
- 1 Tb of data recorded on the field.

More information about Fugro dimensional control solutions : Click here !