CHALLENGES OF A LARGE TURNKEY TRANSPORT PROJECT

PART 2

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In a previous article, we examined the technical challenges facing a heavy lift engineer on large turnkey projects. However, they do not end there, and once the dust has settled on the engineering, attention turns to the operations themselves.

Regardless of the extent of engineering and planning that is carried out, site work retains the capacity to raise additional potential issues for the heavy lift engineer. The source of these are numerous: environmental, third parties, suppliers, local authorities, not to mention the presence of chance or luck.

Turnkey heavy lift operations are multi-faceted with many interfaces, such that a small issue can often escalate into a serious one. For example, a vessel can quickly slip into demurrage rates awaiting a critical task ashore such as site moves or cargo inspection. With so many dependencies to manage, site work on heavy lift projects is always challenging and plans need to be regularly updated to account for what happens during operations.

Where port operations are involved, sea and land-based personnel and equipment are required to work together, posing their own set of challenges.

If we define a port as both the operating berth and the wider jurisdiction which the port has control over then operations can be split into two broad categories.
1. Getting the vessel in and out to the berth
2. Cargo operations at the berth

There are a multitude of questions the heavy lift engineer needs to ask when planning arrival/departure operations in a port.
- Where is the berth within the port?
- Is the berth tidal? (i.e. can it be used at any state of tide)
- Is access to the berth tidal? (i.e. can transit occur at any state of tide)
- Is the berth in a basin, and is there a lock or direct entrance to navigate?
- How long are passage times? (Often ports may have speed limits and long approaches so you cannot assume a particular cruising speed when assessing arrival/departure timings)
- Availability and requirements for support tugs and pilots
- Any simultaneous ops going on? (ferry/cruise ship arrivals, major construction projects etc etc)
- Draught and Air Draught restrictions?

While not exhaustive, the list above does capture the main operational considerations. By way of example, carrying out shipments in the South West of England, you will need to be aware of large tidal ranges in the region and how that impacts accessibility to berths further up the estuary system. Appledore in Devon, for example, has a spring tide range of 7.2m and berths will 'dry-up' at certain times of the day.

Operations at this port need to be carefully planned as there are several factors to consider. For example, a certain tide level will be required to enter the estuary, coupled with tide levels required for entering the dock. Due to the distances involved it is usually not possible for docking operations to happen on the same tide, therefore a lay-by berth and mooring arrangement would be required to allow the vessel to lay-up in preparation for the next tide. Any vessel that is required to stay in the estuary will need to be cleared by both owners and class to be able to sit on the mud when the berth dries out. This is also known as 'taking the bottom'.

Ports like this may have periods of the month where it is not possible for certain vessels to enter or exit due to tide requirements. Therefore, part of the planning process is to consider loading and securing time and allow for delays if possible, to ensure that there is still a window for the loaded vessel to depart.

Berths inside basins also have a similar restriction. Often locks cannot open until certain stages of the tide due to the requirement to equalise the water levels inside and out. Therefore, arrival timings need to be considered to ensure that access is available on arrival. In many cases, the required tide will occur during the hours of darkness which will require an additional set of mitigations put in place to cover the risk associated with working in low light.

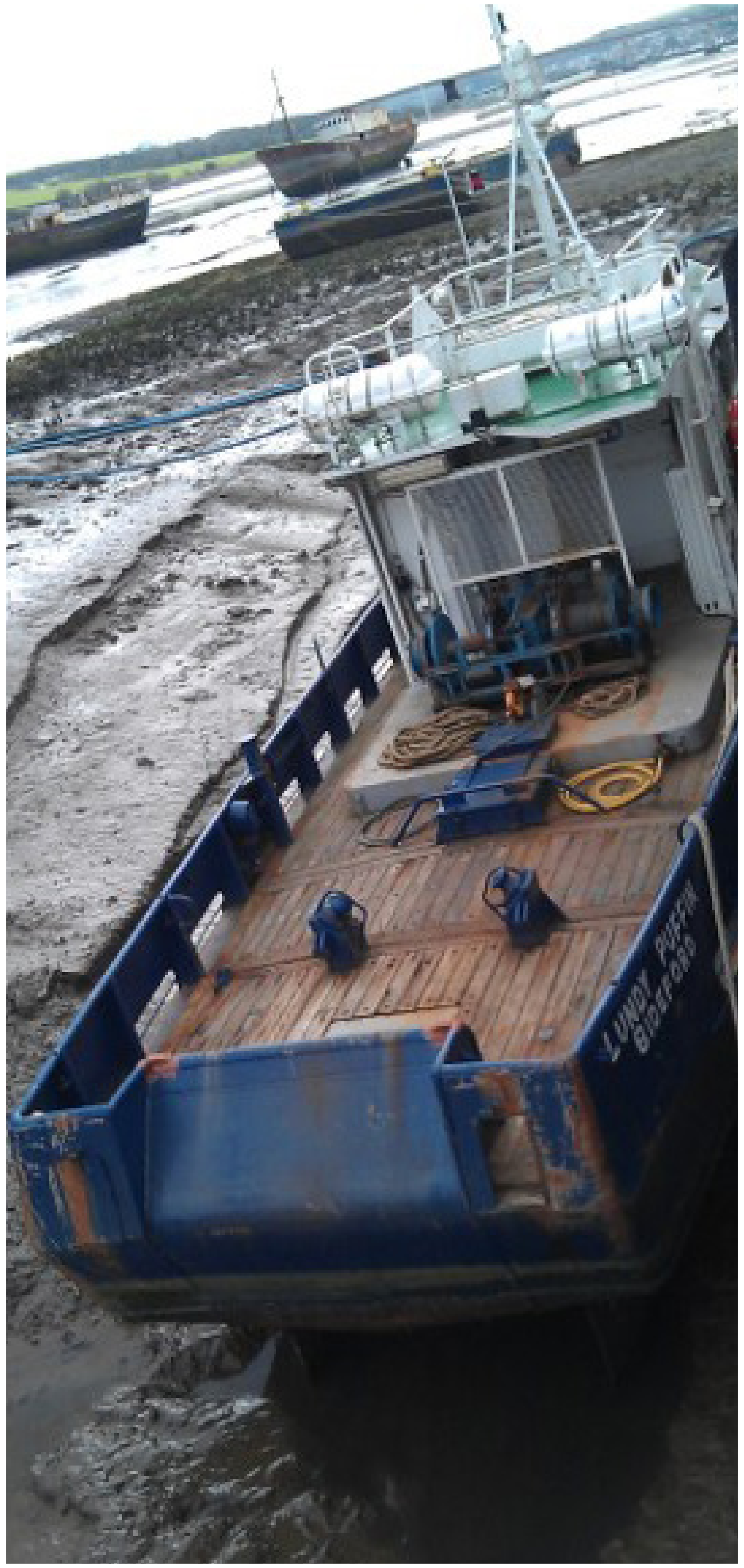
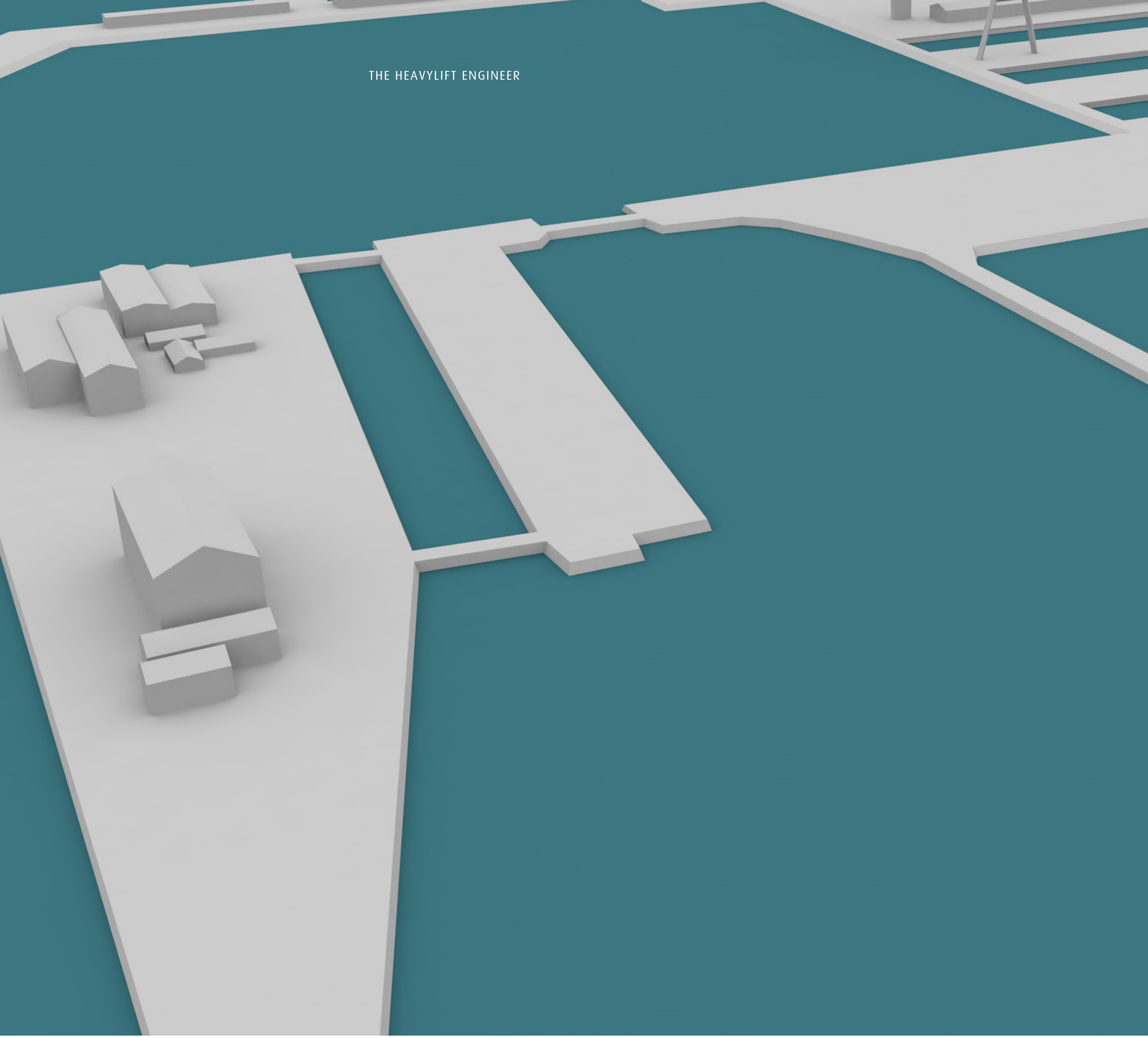


fig. 04/ harbour tug shown 'dried out' at low tide



HOW DO
LOCKS AND DIRECT ENTRANCES WORK?

It is important to understand how different entrance systems into basins work in order to be able to determine working windows.

These are two of the most typical entrance types. Actual operation of the gates etc may differ but the principles remain the same.

Locks

Locks have a minimum of 2 gates, one that is sea facing and one that is internal. Locks work by equalising the water inside the lock to either the sea or the basin water level. Locks allow a greater range of access tides as they allow a discrepancy between the internal level and the sea level. They will still need a certain level of water to operate to allow the vessel to clear the sill and reduce pressure on the internal gate, but the operating range will typically be higher than a direct entrance.

Operating steps
Stage 01
Water outside of lock equalised with water level inside (can be achieved by pumping in/out of lock but normally achieved by sluice gates)
Stage 02
With water levels equalised external gate can be opened and vessel enters the lock
Stage 03
Outer gate is closed
Stage 04
Water level inside lock is equalised with the level inside the basin usually by means of pumping
Stage 05
With water levels equalised internal gate can be opened and vessel enters the basin

Direct entrances

As the name would suggest, direct entrances connect the basin directly with the sea. Their operating principles are the same as the locks, water levels need to be equalised before opening. The key difference is that the operating range is typically a lot less because tides that match the basin level directly will occur less often. This includes both lower tides and higher tides. Increasing the basin level beyond standard levels can be just as damaging as reducing it.
This also means direct entrance transit operations need to be timed very carefully as the direct entrance can only be opened/closed for short windows of time.

Direct entrances maybe wider than locks, meaning they are the only option for vessels of a certain size. Using a direct entrance does carry more inherent risk.

Operating steps
Stage 01
Vessel awaits water outside of direct entrance to be equalised with water level inside. This is normally based on the external tide level. Pumping to change levels in basins is possible but can be time consuming and expensive
Stage 02
Water levels are equalised. This is typically in and around high water (slack tide)
Stage 03
With water levels equalised the entrance can be opened, and vessel enters the basin directly
Stage 04
With water levels remaining fairly consistent the vessel enters the basin and entrance is closed

Whilst inside a port jurisdiction, currents are often stronger and sea-room limited, therefore the vessels' crew is reliant on the local knowledge of the pilots and help from support tugs. It is important to know beforehand what the port's requirements are for pilotage, tugs and chart provision as some ports will have mandatory stipulations, but others may have exemptions. Failure to pre-book services could lead to vessels not being allowed into the Port and resultant delays and impact to operations.

On longer projects keeping consistent port personnel can be a challenge, as often ports rely on 'rack pilots' who may not be available to attend planning meetings and would have to get into the job 'cold' on the morning of the operation. That pilot may or may not have had any specific experience with the type of work required on the project. Some Port authorities can accommodate project pilots, which assists greatly in the planning and executing of more complex marine operations. By engaging with the port early and ensuring they understand the project requirements it will increase the possibility of these types of arrangements being put in place.

The services of tugs are often at a premium in ports as they try to handle large volumes of traffic with a finite resource. Managing the schedule between competing requirements is a massive challenge and one that must be managed by early booking of tugs, regular dialogue with the port and being aware of alternatives in the local vicinity.

Finally, will the vessel (and cargo) fit? Bridges and power lines can restrict the overall height and sandbanks and dock sills can restrict the floating draught. Canal systems can be particularly challenging as the draught and height restrictions have very little tolerance as the vessels try to avoid grounding but still be able to fit under low bridges.

Some berths will be dedicated to cargo handling with the infrastructure in place for heavy lift operations. But where this is not the case either through age, design or differing primary purpose then the use of heavy lift equipment needs to be carefully planned.

Historic berths can offer a lot of challenges. Ground bearing loads may be limited, resulting in additional equipment or inventive load-spreading solutions.

In addition, bollards may be unrated or just unsuitable. This can be solved by carrying out proof load tests in line with expected loading during operations. Industry standard guidelines also recommend that bollards are tested in the direction they will be loaded in practice, so testing can often involve both marine craft and shore-based solutions, therefore any testing needs to be identified early and plant hired accordingly. Unfavourable results could mean further engineering is required so early identification of issues is essential.

Newer berths, even those that have been designed for handling heavy lift cargoes, can still offer challenges due to the large variety of cargoes that qualify as "heavy lift". Quay edge details, bollard positions, lighting tower locations, service ducts and others can all create their own set of issues.

Site inspections are essential when dealing with an unfamiliar quay. Being forewarned is key to ensuring there are no delays. This allows the heavy lift engineer to source any additional equipment or services that maybe required to deal with the issue. For example, additional load spreading material might be needed to go over drainage channels or quayside furniture may need to be temporarily removed.

In conclusion, the heavy lift engineer faces many operational challenges to ensure a project is delivered successfully and whilst this article concentrates on the issues working in around ports and port infrastructure, there are also the issues around cargo handling, loading operations and securing operations to be considered as well.

fig. 05/ a layered load spreading arrangement underneath crane outriggers, required to meet allowable ground loading at the port.

fig. 06/ sand used to level the ground due to presence of drainage channel