IMIA Short Paper
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Launching Girders: A Checklist for Risk Engineers

Aim and Scope: This short paper, with its appendix, is primarily intended to provide Risk Engineers with a simple reference tool to promote enquiries into the training, operational practices, safety and equipment associated with the use of launching girders (LGs) for viaduct and bridge construction. However, if it is known at an early stage that this equipment will be used, or that it is likely to be deployed, the checklist could also be used by insurers when considering the risks.

Usage of LGs: Launching girders are most commonly used for placing pre-cast post-tensioned concrete box segments to form viaducts and bridges and are especially useful for lofty structures in marine or congested urban conditions due to their ability to move themselves forward to the next span - hence they are particularly economic for multi-span structures. Curvature can be accommodated by moving laterally on cross-beams and modest gradients can also be accommodated. For most situations the balanced cantilever method is the favoured sequence of construction.

Description and Sequence: LGs are relatively large pieces of equipment, their size being based on the maximum spans and segment weights to be erected. A large LG might typically weigh in excess of 800 tonnes and be in the order of 150 to 180 metres in length (as a rule of thumb just over twice the length of the main spans unless intermediate temporary support systems are to be used). Regular inspection maintenance of this equipment to an approved schedule is fundamental to ensure trouble-free and safe operation. Once the LG is in place the basic steps for a typical span construction are:-

- Delivery of a segment to the LG (at deck level or from ground level)
- Pick-up and winching of segment into its approximate position
- Application of epoxy resin to segment faces to be joined
- Final positioning and temporary stressing for self-support (allowing the segment to be released from LG)
- Internal permanent post-tensioning sufficient to allow placing of the next segment
- Repetition for further segments until completion of the cantilevers
- Form and stress a concrete stitch at mid-span to complete the span
- Launch the LG to next span
- Final post-tensioning possibly continuous through more than one span

Launching the girder to the next span is usually a multi-stage process involving tie-downs, counterbalancing with pre-cast segments and winches and the use of temporary support legs but the precise procedure to be followed will vary from one piece of equipment to another and must be clearly set out in method statements, and preferably certified by an independent checking engineer.

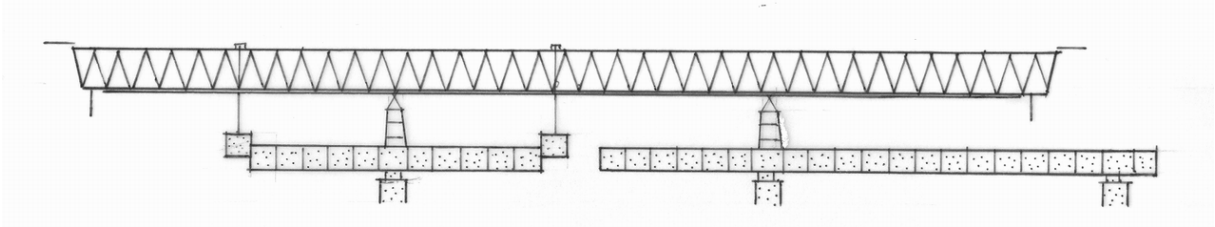

Fig.1 Launching girder in balanced cantilever mode

Insurance Aspects: For insurance purposes launching girders may be considered either as contractor's plant or temporary works and this can be an important factor when preparing the policy documents. However, whether treated as plant or temporary works, a failure can have very serious insurance implications including:-

- Injury or loss of life by operatives and members of the public
- Third party property damage
- Damage and delay to the contract works
- Clearance of debris

Claims can arise, and have arisen, either as a result of procedures not being strictly followed or due to failure of the equipment itself and hence the development of detailed procedural steps and their very strict implementation using experienced operatives is essential to reduce the risks to their lowest achievable level.

Training and Access: Operating and moving LGs is a specialised process requiring staff with extensive training and experience. Whilst main contractors might wish to allocate some staff to the erection process they should be under the direct command of a specialist from the manufacturer or a company specialising in this type of work. In addition to the task of lifting and placing the segments these workers need to receive training in several related operations including gluing and post-stressing of the segments together with the numerous safety requirements for standard construction such as ventilation requirements, working at height, PPE and communications. All trained staff (including resident site staff) who are permitted to access the LG working areas, should be clearly identifiable (usually by means of a "truss permit label" on their helmets) without which access to the fenced-off working areas above and below should be denied. In the case of shift-working a period of supervision hand-over is important to ensure on-going operations follow the correct sequence and the agreed procedures.

Detailing the Erection Procedures: Method statements, including risk assessments, should set out the procedural steps to be followed in detail and it is considered important for the manufacturer or specialist company to be directly involved in this process. Setting out the multi-stage operations is best undertaken by means of a general method statement which can then be developed into a more detailed and specific MS. These statements will invariably require diagrammatic as well as descriptive elements covering the erection sequence for each span and highlighting the particular stressing required at different times, as certified by the independent checking engineer.

The Checklist: The check-list is intended to cover most circumstances and it fully recognises that, in most cases, Risk Engineers are unlikely to have the level of experience and knowledge approaching that of the specialist operatives. Despite this it is important that they are able to arrive at some judgement as to the overall safety of the operation and the level of risk involved. Although it might be unrealistic to expect an unqualified affirmative response to each and every enquiry on the checklist it is considered that the responses, backed up by further discussions if necessary, should provide insurers with a good overall insight to the level of risk entailed from which proposals for safer operation might well be recommended.

Appendix 1

CHECKLIST FOR LAUNCHING GIRDERS

The following questions are compiled for Risk Engineers making enquiries on the usage of launching girders for segmental construction. If responses are not in the affirmative it is suggested that further detailed enquiries are made, leading, if deemed necessary, to recommendations in the Risk Engineer's report.

Part 1. **Working Methodology**

		YES	NO
1.	Are there restrictions for off-loading segments, for instance on seawalls, and if so are they being complied with?		
2.	Have land transportation arrangements for segments been developed and approved?		
3.	Are the interim storage arrangements for segments satisfactory?		
4.	Has a General Method Statement been approved which includes items 1-3 and the general method of employing the LG?		
5.	Has a Specific Method Statement covering safe use of launching girder for placing segments and moving the LG been approved? Does the MS include Risk Assessments?		
6.	Does the specific MS clearly cover in precise detail:- (i) launching sequence for moving the LG from span to span? (ii) lifting and placing segments on main-spans and end-spans? (iii) related tasks (e.g. temporary and permanent stressing, use of epoxy resin – see question 14.) both in words and diagrammatically?		
7.	Is the history and usage of the LG known? If so can assurance be provided that any structural modifications or any previous adverse incidents have not increased the risk of failure?		
8.	Will the manufacturer or specialist LG company provide operating staff? Can an assurance be given these staff members will remain throughout the whole period from assembly through to dismantling?		
9.	If the specialist staff is to be supplemented by the main contractor's general staff is the LG training of the supplementary staff considered to be adequate?		
10.	Has the resident site staff also been provided with training in LG operations?		
11.	Is the command structure fully developed and understood? Does the MS make it absolutely clear that no actions are to take place in the absence of the designated LG commander? Are all such actions fully documented in accordance with checklists developed with the MS?		
12.	If the LG is operating on shift-work are there adequate hand-over arrangements between commanders? Is an overlap time allowed for?		
13.	Is the commander always in radio communication with other LG operatives?		
14.	In addition to the training for operating the LG are the operatives fully trained in other relevant aspects (such as confined working space, PPE, post-stressing, working with epoxy resins, working		

	at height, evacuation and other emergencies)?		
15.	Is access to the high-level LG working area denied to other workers? Are LG workers clearly identified (e.g. by way of permits on helmets)		
16.	Are ground-level working areas fenced off for all but essential workers? Are safety nets deployed beneath working areas?		
17.	Are rain storm/high wind/typhoon/cyclone conditions fully covered in MS with wind-speeds specified for when to deploy tie-down anchorages?		
18.	Are all lock-down and stabilising procedures covered and complied with during off-work periods?		
19.	Is the LG required to work at gradients, e.g. for slip roads, and if so, was it designed for the gradient intended?		
20.	For lengthy girders or those in very exposed positions, does the LG have anemometers attached at both ends? And adequate lighting?		
21.	Is a lightning earthing system in place throughout the whole period on-site?		
22.	Does the site receive automatic weather updates or warnings?		
23.	Are local statutory testing requirements known for this type of equipment? Is a regular service, testing and maintenance schedule fully developed and complied with, including the keeping of records?		

Part 2. List of LG Equipment

	Numerous operating and safety facilities are available on modern LGs. Checking against the following list should give some further insight to the safe operating potential of the equipment:- (i) anemometers (ii) inclinometers (iii) lightning conductors (iv) adequate lighting system (v) inverter control system to prevent overload of capstan (vi) central control panel (vii) emergency stop buttons (viii) control system to prevent overload of capstan (ix) electrical and/or mechanical limit switches (to prevent mechanical impact) (x) load cells to monitor loading conditions (xi) winch safety braking (xii) overspeed detection system (xiii) hydraulic pressure switches and valves in winch circuits and motors (to control lifting pressures and oil pressures in circuits)		