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Benelux

RAPPORT VERIFICATION DEVELOPPEMENT ATTRACTION
REPORT OF DESIGN REVIEW ATTRACTION
P-BE-12-10-700 633-01 REV 1

Client / Client : IRRI bvba Réf/Ref client: DITS (Dinner In The Sky)

Exécutée par / Executed by: D. Debruyne

Date vérification / Date: 07/12/2012

Vérification basée sur / Verification based upon:

☒ EN 13814 Fairground & amusement park machinery and structures -Safety,

☒ Autres/others:

- EN 1991-1: *Eurocode 1 - Actions on structures*
- EN 1991-1-3 - *Eurocode 1 - Actions on structures - Part 1-3 - General actions - Snow loads* (2003)
- EN 1991-1-4: *Eurocode 1 - Actions on structures - Part 1-4 - General actions - Wind actions* (2005)
- EN 1993-1-1: *Eurocode 3 - Design of steel structures - Part 1-1 - General rules and rules for buildings* (May 2005)
- EN 1993-1-8: *Eurocode 3 - Design of steel structures - Part 1-8: Design of joints* (May 2005)
- EN 1993-1-9: *Eurocode 3 - Design of steel structures - Part 1-9: Fatigue* (May 2005)

Données générales d'attraction / *General information attraction*

1	FR	Nom d'attraction	DITS (Dinner In The Sky)
	UK	*Attraction name*	
2	FR	Constructeur	IRRI bvba
	UK	*Manufacturer*	
3	FR	Année	2012
	UK	*Year*	
4	FR	Identification	
	UK	*Identification*	
5	FR	*Référence dossier*	IRRI0126-R-001-03B_compl.pdf IRRI0126-R-001-04.pdf EITS-DITS-126_CR_01A.pdf EITS-DITS-126_CR_02A.pdf
	UK	*Reference file*	

Liste des plans / List of drawings

The drawings are contained in annex 1 of "IRRI0126-R-001-03B_compl.pdf".
REV1: The drawings are contained in annex 1 of " EITS-DITS-126_CR_01A.pdf".

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Observations / observations

1. Description

The ride consists of a metal frame forming a rectangular table accommodating a maximum of 22 sitting persons. In the centre of the table there is an isle in which 1 or 2 guiding persons can walk. All persons are held onto their seats in such a way that they cannot free themselves. The table is connected to the spreader which in its turn is suspended from a crane. The spreader also provides shelter from bad weather conditions.
The whole structure is lifted to a height of 50 to 60 m by a >90 ton mobile crane.

2. Calculations

The dimensions and calculations were already checked by TÜV Rheinland. The current revision therefore only focuses on the conformity of the calculations and assumptions with EN13814.

The basic frame was modeled and calculated with the finite element method. The remainder of the construction was calculated with analytical formulas.

No fatigue checks are made in the report because an estimated total number of load cycles of 18E3 is used. According to DIN 4112 fatigue calculations are necessary when the number of load cycles exceeds 2E4. According to EN 13814 §5.6.1 the limiting number of cycles is 1E4, so fatigue calculations are required. However, due to the very low number of load cycles the limiting stress range value for even the worst detail category according to EN 1993-1-9 ($\Delta\sigma_C$ = 36 MPa) is still $\Delta\sigma_R$ = 92 MPa (with m = 5). No stresses of this magnitude are found in the calculation report.

In the static calculations no mention is made of load combination factors. However, the load partial safety coefficients are already contained in the design resistances of the materials. According to EN 13814 a partial safety factor of 1.1 on permanent loads and 1.35 on variable loads is required, and the design resistance is determined as $\min(f_y/1.1;f_u/1.35)$, see EN13814 §5.6.2. Even when a conservative value of 1.35 for all loads is applied the static stresses never exceed the design resistances of the applied materials.

The design resistances of the applied materials are slightly on the conservative side compared to EN13814.

The compression in the spreader due to inclination of the cables are very low and will not result in buckling of the structure.

The effect of snow loading on the spreader was not checked. If a conservative calculation is performed on the section 50x30x3 supporting a loaded area of 1.5 m x 1.5 m a static bending stress of 120 MPa is found, which is well below the design resistance.
No impact or vibration factors are taken into account due to the low accelerations of the crane.

For the separate document containing the results of the movable seat a total of 4 load situations are considered. Only the first load case LS1 represent loading according to the standard. The other load cases are very conservative and serve only to prove the strength of the construction.

3. Loads

The following loads have been considered in the report:

- Dead load of the structure
- Live load of passengers (0.75 kN x 22)
- Snow load: 0.3 kN/m² (reduced value because the table descends every hour)
- Wind load: 0.25 kN/m² with operational stop when wind speeds exceed 20 m/s.

The snow load is low, especially for certain countries. If for example the ride is to be used in Scandinavian countries or near the alpine region, high snow ground loads apply. In such cases it is the responsibility of the crane operator to check the loading of the ride. If snow loads in excess of 0.3 kN/m² are found then the ride should be stopped and the snow removed from the spreader.
REV1: No mention of removal of snow from the spreader was found in the operations manual for the DITS-ride. A remark was added to the punch list indicating it is advisable to add this check to the checklist of the operators.

For the wind load it is not clear from the report where the wind will be measured. If the wind is measured at the top of the crane, the applied wind values differ slightly from the values calculated according to EN 1993-1-4. If, however, the wind is measured at ground level then the values in the report are very low. A remark was added to the punch list requesting additional information.
REV1: The revised report clearly states the wind will be measured with an anemometer placed at the top of the boom of the crane. Therefore the measured wind speed will always be higher than the actual wind speed for the ride.
The report does not take into account the additional loading of the cables due to wind pressing down on the spreader. This will results in lower safety factors for the cables and

shackles from the spreader to the hook of the crane. However, the structure still satisfies the requirements.

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Conclusion / *Conclusion*

X	FR	Avis favorable
	UK	*Positive conclusion*
	FR	Avis défavorable
	UK	*Negative conclusion*
	FR	Pas de conclusion possible par manque d'information / observations dans ce rapport
	UK	*No conclusion possible by lack of information / observations made in this report*

Rapport vérifié par / report verified by :		
	Place:	Ghent
	Date:	07/12/2012
	Nom / Name:	D. Debruyne
	Function:	Senior Approval Engineer