

Structural Report:
G-Deck Access System
Client: LDS Hire & Sales Limited
Reference: 1425-R1a
Date: May 2015

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1 Introduction

This report and calculation package has been produced to show that the G-Deck Access system is compliant with the requirements of BS EN 12811 and BS EN 13374 when used in accordance with the manufacturers user guide.

The system has been subjected to rigorous physical testing at Lloyds British on three separate occasions to date and the findings of these tests are used where appropriate within this report. Tests in TR03 were specified.

Lloyds reference	Date	Reference in this report
232501.1	October 2013	TR01
246430.1	November 2014	TR02
252308.1	April 2015	TR03

Table 1-1 Test Report References

232501.1 October 2013 TR01
 246430.1 November 2014 TR02
 252308.1 April 2015 TR03

Table 1-1 Test Report References

The report discusses the suitability of the platform unit for imposed loads, and the resistance of the raised deck to notional horizontal forces. The handrail system is shown to be capable of withstanding the load requirements of BS EN 12811 and BS EN 13374, and it is also demonstrated that it meets the geometric requirements of these Codes.

2 Working Platform

The requirements of the working platform are set by BS EN 12811-1:2003, and both the uniformly distributed and concentrated loads stated in this Code have been investigated. Due to the variable nature of the geometry of the deck it was not considered possible to check the partial area loads as these are calculated based on known 'bay' dimensions. In accordance with the Code, platform deflections are checked against a permissible allowance of $L/100$.

2.1 Platform Unit

2.1.1 Uniformly Distributed Load

Test report TR01 details the test of the platform unit taken through to failure. ULS failure occurred due to weld failure at 1980 kg/m^2 which equates to 19.4 kN/m^2 . Permanent deformation of the platform was observed after 50% of the ULS load, equaling 9.7 kN/m^2 . Therefore based on this testing and preventing plastic action from forming, the SLS loading is equal to $9.7 / 1.1 / 1.5 = 5.9 \text{ kN/m}^2$ (600 Kg/m^2) In TR02 the platform was loaded to the deflection limit (measured at the centre of the deck) of $L/100 = 9.95 \text{ mm}$, and the load found to cause this level of deflection was 580 Kg on the $1 \text{ m} \times 1 \text{ m}$ platform, therefore equating to 5.7 kN/m^2 .



Figure 2-1 Maximum Deflection Test

(Source: Lloyds British test report)

It can be seen therefore that by combining the findings of the reports the maximum allowable loading with respect to the platform unit is 5.7 kN/m², which falls within LC5 of EN 12811. Allowing the deflection criteria to be exceeded by a nominal amount, this can be increased to 5.9 kN/m².

2.1.2 Concentrated Loads

BS EN 12811 requires a 1.5kN load to be applied over an area of 0.5m x 0.5m, and a 1.0kN load to be applied over an area of 0.2m x 0.2m. Both were tested as detailed in TR02 and the platform was found to be capable of withstanding these loads whilst remaining within the allowable deflection limits. The applied loads fall within LC3 of EN 12811.



Figure 2-2 Concentrated Load Test
(Source: Lloyds British test report)

2.2 Support Posts

2.2.1 Gravity Loads

2.2.1.1 Platform Height 1.8m

As detailed in TR03 the platform was tested at a height of 1.8m under an imposed load of 2.5kN/m^2 (SLS). The applied load was increased to represent the ULS. It is known from previous testing that the $1\text{m} \times 1\text{m}$ platform units are capable of withstanding this loading (see 2.1.1). The test was carried out to assess the deck for stability under the imposed load. No instability of the deck was observed during this test. Lateral deflection at the head of the posts varied between approximately 2mm and 6mm under the full ULS loading. As discussed in section 2.2.2 this amount of horizontal deflection is considered acceptable.

2.2.1.2 Platform Height 3.6m

At the upper platform height of 3.6m the platform is to be braced into the surrounding structure at 2m intervals as detailed in the user guide. One horizontal brace is provided at mid height on a 2m x 2m grid, which means the post in the centre of the grid is unrestrained for its full height. As the platform is braced laterally the notional horizontal forces are accommodated and the posts need only carry the vertical applied loads.

The self weight of the deck per post is as follows:

Platform unit: 12 Kg

Horizontals: $(2 \text{ Kg}/2) \times 4 = 4 \text{ Kg}$

Post: $7 \text{ Kg} \times 2 \text{ Lifts} = 14 \text{ Kg}$

30 Kg or 0.29 kN

As shown in Appendix A the permissible axial force on the post at $H =$

$3.6\text{m} = 6.34\text{kN}$. $6.34 - 0.29 = 6.05\text{kN}$ residual capacity for axial load. Therefore if the deck is rigidly braced into the surrounding structure in accordance with the guide the capacity at $h = 3.6\text{m}$ would be 6 kN/m^2 which exceeds the platform safe working load.

2.2.2 Horizontal Loads

BS EN 12811-1:2003 cl 6.2.3 sets the requirement for a notional horizontal working load of 2.5% of the imposed load or a minimum of 0.3kN per bay. Testing as detailed in TR03 showed that under a 2.5 kN/m^2 SLS load the min 2.5% load was critical over the 0.3kN minimum. The test was extended to cover 5% and 7.5% NHF. The imposed load was present on the deck (at ULS) throughout the horizontal loading tests.

The following results are relevant to the case where horizontal braces between posts are provided on a 2m x 2m grid. The tested deck was 4m x 2m, load parallel refers to loads parallel to the 4m face.

NHF	Δ - Outer	Δ - Centre	Δ - Outer
2.5%	5.39	5.07	4.74
5.0%	9.78	9.46	9.05
7.5%	13.75	14.15	14.11

Figure 2-3 NHF Parallel Deflections

NHF	Δ - Outer	Δ - Inner	Δ - Centre	Δ - Inner	Δ - Outer
2.5%	9.05	9.16	8.25	9.39	9.35
5.0%	14.86	16.10	14.12	17.75	18
7.5%	19.78	19.26	15.71	23.05	20.76

Figure 2-4 NHF Perpendicular Deflections

No instability was observed during the testing. Permanent lean on the outer posts with load parallel was in the region of 1.5mm, and with load perpendicular in a range between 0.3 to 5.3mm.

There are no limits stated in BS EN 12811 with respect to a lateral deflection. Typical values of H/300 are commonly stated for building structures¹ with values as low as H/100 where the structure is less liable to be affected by horizontal movement².

Adopting H/100 with a platform height of 1800mm, it can be seen that 18mm is the maximum permissible horizontal movement. In both parallel and perpendicular cases the deflections at 2.5% NHF as required by the code are within acceptable limits. Approximate actual ratios are H/360 (parallel) and H/200 (perpendicular).

If the platform was loaded to the maximum of 5.9 kN/m² the lateral load at 2.5% would be 0.32 kN at the head of each post: $(5.9 \times 1.65 \times (2\text{m} \times 2\text{m}) \times 0.025) / 3 \text{ posts} = 0.32 \text{ kN}$.

This value falls between the 5% and 7.5% of the tested percentages of 2.5 kN/m², and therefore the lateral movement can be estimated from the results. It is considered based on the test evidence that the deck would be capable of withstanding a lateral 2.5% of 5.9 kN/m² with lateral movement remaining acceptable.

3 Handrail

3.1 Geometry

As shown in Figure 3-2 when a handrail is formed using the horizontal braces and the handrail posts, the requirements of BS EN 12811-1:2003 and BS EN 13374:2013 are complied with as follows:

Clause	Requirement
Requirements of BS EN 12811:2003	
5.5.2	Principle guardrail to be 1000mm or more above platform.
5.5.3 and Fig 3.	Gaps between intermediate guardrails to be not greater than 470mm.
5.5.4	Tops of toe boards shall be 150mm above the working platform.
Requirements of BS EN 13374:2013 (Class A)	
5.1.3	Principle guardrail to be 1000mm or more above platform.
5.1.4	Tops of toe boards shall be a minimum of 150mm above the working platform.
5.2.1	The inclination of the edge protection from the platform shall not exceed 15°. Gaps between the guardrails shall not exceed 470mm.

Figure 3-1 Geometric Requirements

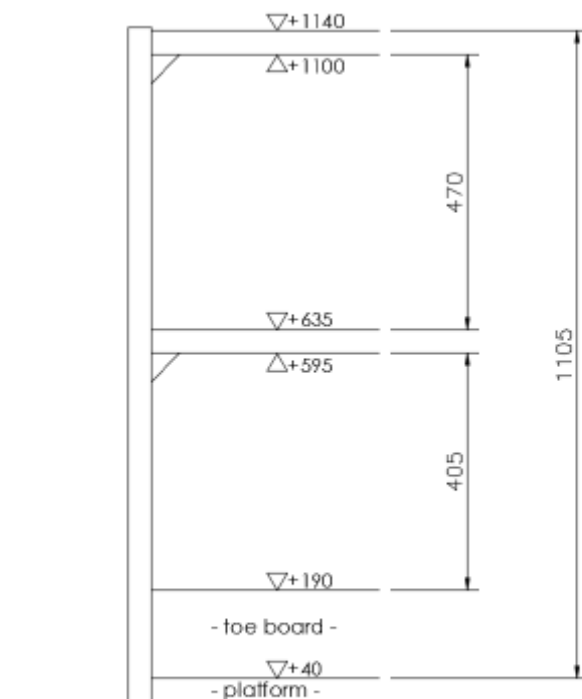


Figure 3-2 Handrail Geometry

3.2 Testing

Reports TR02 and TR03 detail the testing carried out on the handrail system.

3.2.1 BS EN 12811-1

The requirements of BS EN 12811-1:2003 can be summarised into a horizontal load of 0.3 kN, and vertical loads of 1.25 kN and -0.3 kN (uplift). The 1.25 kN is considered as the accidental case. TR02 shows that the horizontal members acting as guardrails are capable of withstanding these loads whilst remaining within the allowable deflection limits.

3.2.2 BS EN 13374

BS EN 13374 requires a series of combination loads to be considered, with the basic loads that form the combinations very similar to the loads required by BS EN 12811-1. The loading on the horizontal guardrails is considered acceptable by inspection of the testing carried out in TR02. Appendix B shows the consideration of the loading combinations and the derivation of the worst case to be carried forward for testing. TR03 describes how this condition was tested and found to be acceptable. By inspection the system is therefore capable of resisting the parallel loads required in cl 6.3.6 via the posts acting as vertical cantilevers.

4 Summary.

- The system complies with the requirements of BS EN 12811-1:2003 to Load Class 3, and to the handrail requirements of the same code.
- The system can accommodate a safe imposed load of 5.9 kN/m² or 600 Kg/m².
- The edge protection complies with the requirements of a Class A system in accordance with BS EN 13374:2003