


APOLLO SALES LTD SCAFFOLD QUICK STEP (STAIR TREAD) DESIGN CALCULATIONS AND TEST REPORT

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CALCULATION SHEET	Project : Apollo quick step (stair tread)			
	Element : Brief			
	Job Number : L0179	By : ec	Date: Jan 09	
	Document No : 001C	Checked :anw	Date: Jan 09	

Brief

To check the capacity of the new stair to the details as provided by Apollo Sales Ltd

Layout



Loading

The stair is designed for access loads

From BS From TG 20 scaffold design guide
For construction access stairs

$$w = 1 \text{ kN/m}^2$$

$$\text{or } W = 1.5 \text{ kN}$$

for public access stairs max is

$$w = 5 \text{ kN/m}^2$$

For conservative design assume two people on stair as a point load

$$W = 2 \text{ kN}$$

length of step is 1230mm

Properties

The properties of the folded plate step are


$$A = 633 \text{ mm}^2$$

$$I_x = 181961 \text{ mm}^4$$

$$I_y = 4589561 \text{ mm}^4$$

$$r_y = 85.2 \text{ mm}$$

$$Z = 4,958 \text{ mm}^3$$

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Model

The stair was modelled with in STRAP
a finite element analysis program

Loading -dead

The analysis program calculates the dead load and 10% is added for welds etc

Loading - live

From the udl of 5kN/m2

	total load is W=	5*A	A= step area
			= 1.23*0.225
			= 0.28m2
	=	5*0.28	
	=	1.40 kN	

from the point load requirement

	W=	2.00 kN	
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so design for a point load of 2kN

Factors of safety

From BS 5950 apply


	to dead	1.4	
	to live	1.60	

Results

Plank

	max moment M=	0.50 kNm	factored
	max shearV=	1.66 kN	factored

Rotation moment at supports	M=	0.10 kN	factored
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Plank -moment capacity

M= **0.5 kNm**

From manufacturer's guide steel is S235

from BS 5950

so $M_c = p_y Z$

= $235 \times 4.96 / 1E3$
= **1.17 kNm**
> **0.50**

see before
Z= 4.96cm³
 $p_y = 235 \text{N/mm}^2$

ok

Plank - shear capacity

V= **1.66 kN**


from BS5950

$P_v = 0.6 p_y A_v$

= $0.6 \times 235 \times 180 / 1000$
= **25.38 kN**
> **1.66**

$p_y = 235 \text{N/mm}^2$
 $A_v = N D t$
= $2 \times 45 \times 2$
= 180mm²

ok

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Rotation of support

From BS EN 12811-1 for the design of scaffold couplers

the characteristic moment capacity of a coupler is

$$M_t = 0.13 \text{ kNm} \quad \text{Annex C}$$

so applying material factor of 1.1

$$\begin{aligned} M_r &= 0.13/1.1 \\ &= \mathbf{0.12 \text{ kNm}} \end{aligned}$$


from above the unfactored moment is

$$M = 0.06 \text{ kNm} \quad \text{unfactored}$$

applying factor of safety of 1.5 in accordance with the scaffold code

$$\begin{aligned} \text{so } M &= 1.5 * 0.06 \\ &= \mathbf{0.09} \\ &< \mathbf{0.12} \quad \text{ok} \end{aligned}$$

so stair is sufficient for the required design loading

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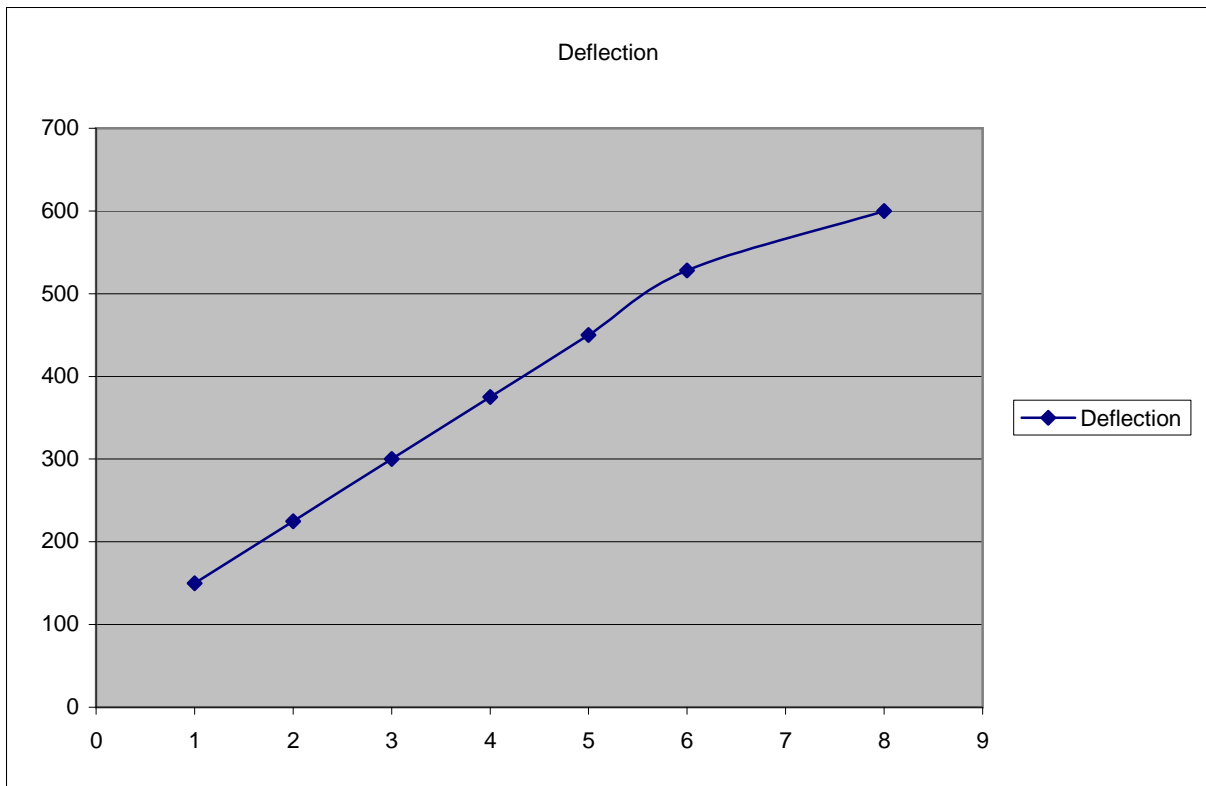
Description

The stair was tested to yield using weight applied to the tread and the deflections measured.




Result

Load	Deflection
150	1
225	2
300	3
375	4
450	5
528	6
600	8.0



The yield point is around 500kg or 5.0kN

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Check

check from previous calc predicted yield moment was 1.17kNm

$$M= W*(3L/8-2*0.4/4)$$

$$L= 1.2$$

$$= 5*(3*1.2/8-2*0.4)/4$$

$$= \quad \quad \quad \mathbf{1.25 \text{ kNm}}$$

so calculated capacity is conservative

ok

Summary

The step has been found to be adequate to carry the specified loads from the requisite standards and the test indicates that it is capable of carrying more than the maximum load predicted by the calculations