Grid calculations for Traverse 1 and 2

This document has been created in conjunction with Traverse production and the graphs, charts and information commissioned through Addison Conservation and Design. C/O John Addison, January 2012

The document includes explanations to achieving Safe Working Loads (SWL), Uniformly Distributed Loads (UDL) and Point Loadings (P) in both venues and should be used as a reference guide when needed.

Index –

How to work out Working Loads on 127mm x 76mm I-Beams/Girders

1. Working out a **Safe working load** for a **Girder**. (127mm x 76mm I beam)

    - **W** = Weight
    - **L** = Girder Length

    Equation is as follows –

    - (See graph, however) **W** over **L** = **SWL** for the girder, this weight can be **uniformly distributed** over the **entire span** of the girder.

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2. Working out a **Point Load** on a **Girder** (127mm x 76mm I beam)

    - **W** = weight
    - **L** = Girder Length
    - **P** = Point Load

    Equation is as follows –

    - Work out **SWL** by looking at graph (**W** over **L**)
    - **SWL** divided by 2 = **P**

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3. Working out a **Point Load** with a **Loaded Counterweight and Hemp** rig in place

    - **P** = Point load
    - **F** = Counterweight/hemp sets additional weight
    - **L** = Girder Length

    Equation is as follows –

    - Work out girders **SWL** by looking at graph (**W** over **L**)
    - **SWL** minus **F** divided by 2 = **P**

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4. Working out a **Point Load** where there is **already point load** on **Counterweight** or **Hempset.**

- **P =** Point Load
- **F =** Point Load on counterweight/hempset
- **L =** Length of Girder

Equation is as follows

- Work out girders **SWL** by looking at graph (**W** over **L**)
- **SWL** divided by **2** minus **F = P**

***Important Note* -** Where the I-Beams are **twinned** (e.g. above flying system) the final calculation for **Point Loading** or **Uniformly Distributed Load** can be **doubled**. In the event that an item is hung from 1 half of the twinned pair (i.e. off centre) this should be calculated using the single girder equation.

On stage Grid/Girders (127mm x 76mm I-Beams)

- The following studies use equations 1, 2 and 3 from the previous page.

Case Study 1 – Traverse 1, above main stage girders (Grid) - **Fully laden fly bars**

- Traverse 1's on stage **Twinned Girders** are a length of 7.5m (span of girder between fixings)
- **Twinned Girder SWL 1500kg** as per graph (appendix iii)
- Existing UDL on girder = 950kg*
- Leftover payload of **550kg**, divide by **2** for single girder use = **275kg Point load**
  for twinned girder use = **550kg Point load**

*This assumes 8 Counterweight bars maxed at 250kg and 11 hemps maxed at 100kg, totalling 3000kg, each girder (4 in total) has 750kg Payload plus an addition 200kg of flying equipment).

Case Study 2 – Traverse 1, above main stage girders (Grid) **- Empty fly bars**

- Traverse 1's on stage **Twinned Girders** are a length of 7.5m (span of girder between fixings)
- **Twinned Girder SWL 1500kg** as per graph (appendix iii)
- Existing UDL on girder = 200kg*
- Leftover Payload = **1300kg**, divide by **2** for single girder use = **650kg Point load**
  for twinned girder use = **1300Kg Point load**

* Weight of the header pulley blocks, hemp bars and steel wire spans into consideration (200kg)

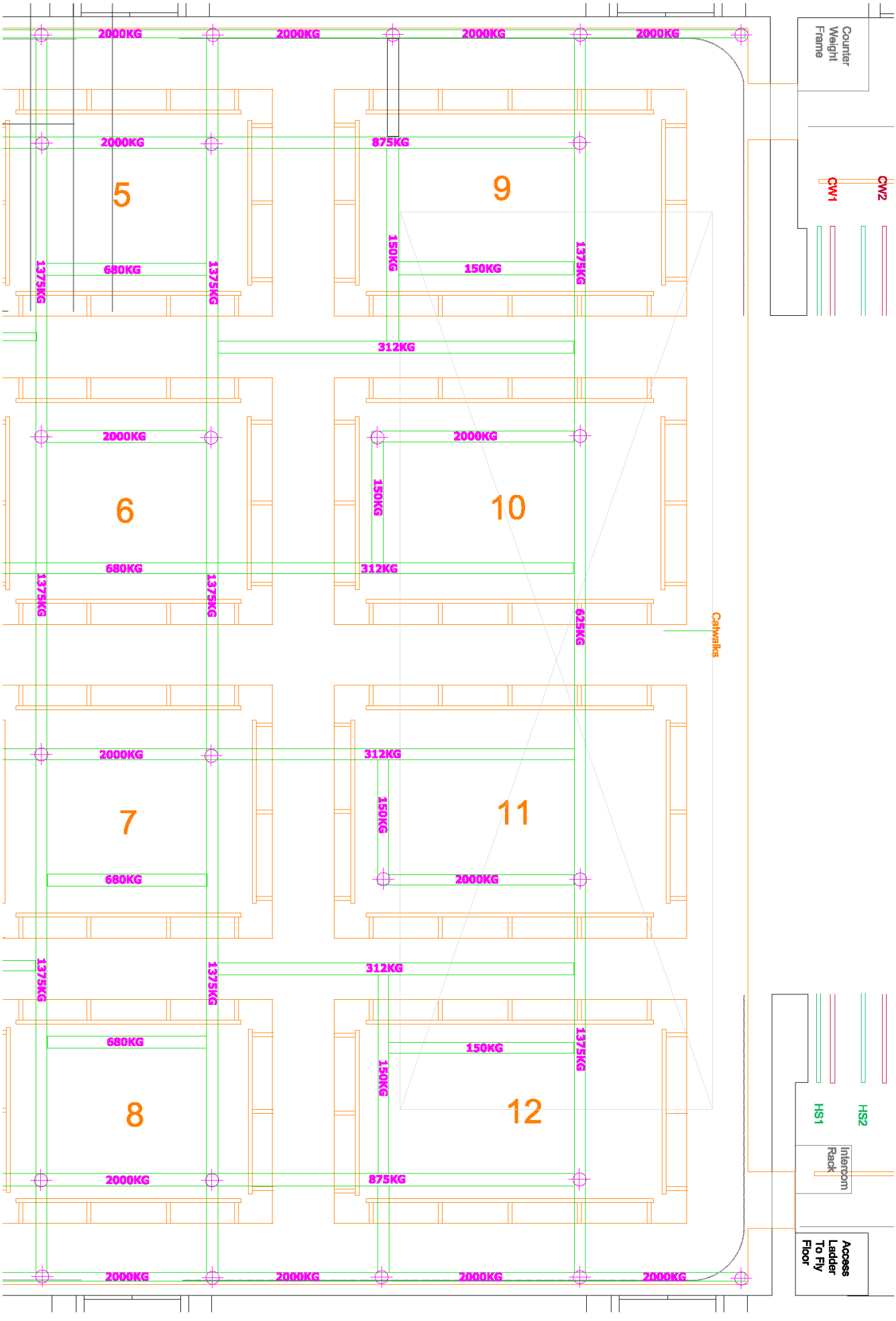
Case Study 3 – Traverse 1, above main stage Girders (Grid) – **Average setup for fly bars**

- Traverse 1's on stage **Twinned Girders** are a length of 7.5m (span of girder between fixings)
- **Twinned Girder SWL 1500kg** as per graph (appendix iii)
- Existing UDL on girder = 675kg*
- Leftover payload = **825kg**, divide by 2 for single girder use = **412kg Point load**
  for twinned girder use = **824kg Point load**

*standard set up – 4 lx Bars – legs – borders – cyc etc… plus weight of existing flying equipment

Traverse 1 – FOH Point load Calculations

Important Note generally for a UDL Calculation; the Point load numbers can be doubled between wall/ceiling fixtures.



T2 SWL Explained

The Cross Hair symbol on the ground plan below indicates the approximate position of a fixed upright.

All SWL's are calculated for 48.3mm Scaffold with a wall thickness of 3.2mm spanning between said symbols.

These measurements are for POINT LOADING only, for uniformly distributed loads these SWL's can generally be doubled for scaff lengths up to 4.0m

Any temporary bar; Aluminium, Steel or otherwise rigged within this grid system shall be given a minimum Safe Working POINT load of 60KG unless attached directly to the upright positions themselves.

Please note that if your show requires more than **1500kg suspension** with Electrical/Scenery combined external assessment may be required.

Scaffold Assemblies all forms

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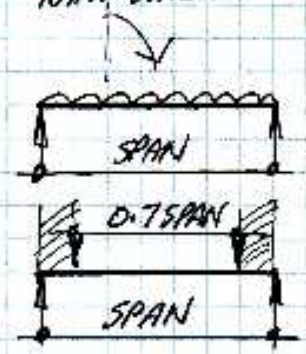
TRAVERSE THEATRE
EDINBURGH

LOAD CHART FOR SCAFF.

Drg No SK/1 Job No 11/475
Rev — Scale —
Drawn by JDA Date DEC 11
Checked by — Date —

48·3mm ϕ
3·2mm WALL



SPAN (M)	CASE 1, 1a SAFE LOADS (kg) NO DEFLECTION CONTROL	CASE 1, 1a SAFE LOADS (kg) DEFLECTION MAX L/200	CASE 2 SAFE LOADS (kg) NO DEFLECTION CONTROL	CASE 2 SAFE LOADS (kg) DEFLECTION MAX L/200
1·0	600	600	300	300
1·5	400	400	200	200
2·0	300	220	150	150
2·5	240	145	120	90
3·0	200	100	100	60
3·5	170	75	85	46
4·0	150	57	75	35
4·5	130	45	65	28
5·0	120	35	60	23

NOTE SAFE LOADS MAY BE REDUCED BY STRENGTH OF THE FIXINGS FOR TUBE. CHECK SPECIFIC CASES OF APPLIED LOADS OVER 200kg.

NOTE : THESE FIGURES ASSUME NO OTHER LOADS ON TUBE. REDUCE SWL IF OTHER

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LOAD CHART FOR SCAFF

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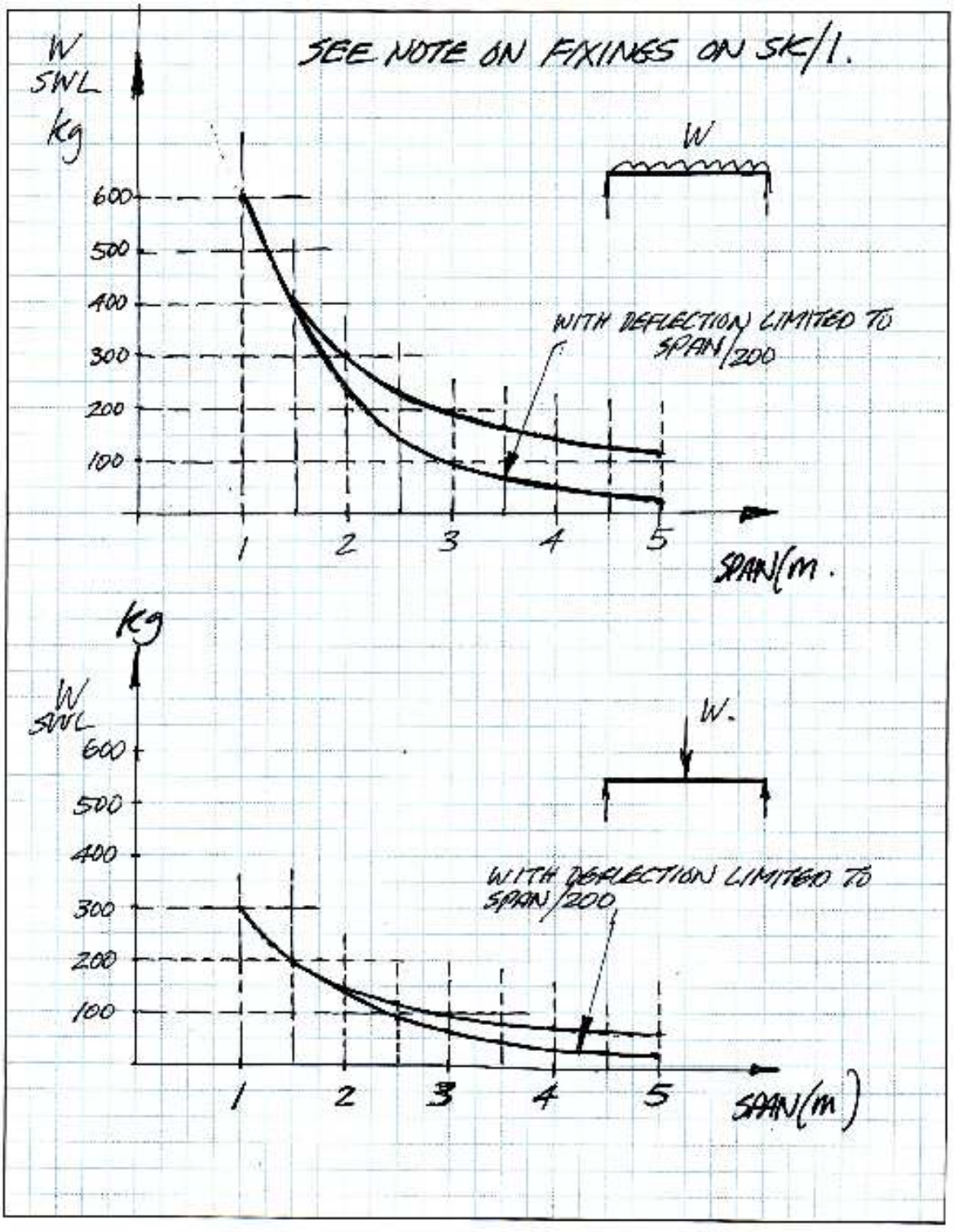

I-Beam assemblies (127mm x76mm I-Beam)

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LOAD CHART FOR 127X76 I

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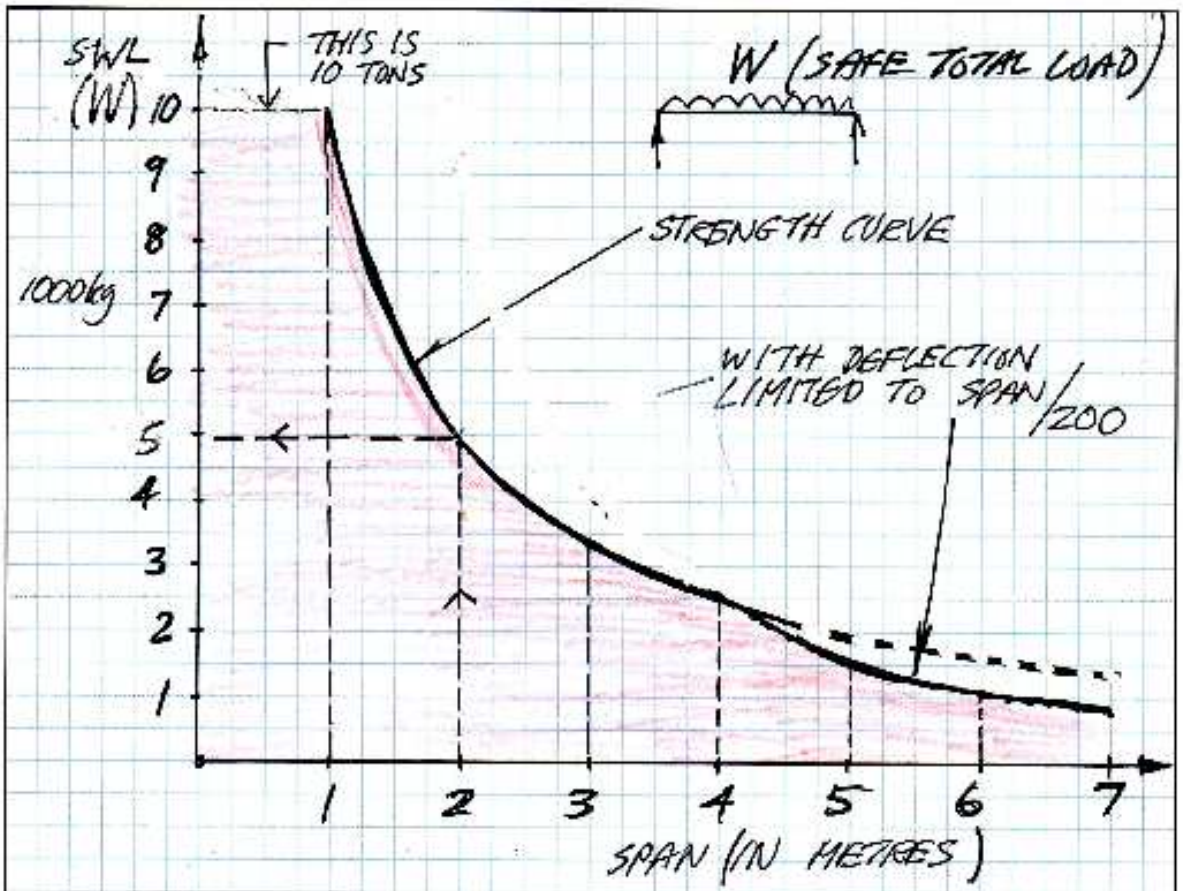


FOR 127X76 I SECTION IN ALL ASSEMBLIES

NOTES

(1) IF THE LOAD IS A POINT LOAD, TAKE SWL AS HALF OF THE ABOVE, IF IT'S AT MIDSPAN.

(2) IF THERE IS A LOAD ON THE BEAM ALREADY AND IT IS A UDL (SPREAD) LOAD THEN THE ALLOWED POINT LOAD IS W (FROM ABOVE) MINUS THE TOTAL EXISTING LOAD, DIVIDED BY TWO.

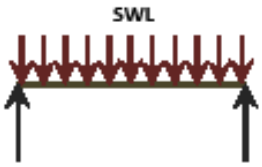
(3) IF THE EXISTING LOAD IS A POINT LOAD, THE ALLOWED POINT LOAD IS HALF W (FROM ABOVE) MINUS THE EXISTING LOAD.

I-Beam assemblies (127mm x76mm I-Beam)

Title				addison conservation + design		
TRAVERSE THEATRE EDINBURGH LOAD CHART FOR 127x76I						
Date Jan'12	Drawn JDA	Checked	Scale	Drawing No 11-475/SK 3	Rev	Status

SUMMARY OF LOAD CALCULATIONS

To assess the capacity of 127x76I use the graph as follows

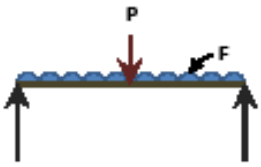


Take **W** from the graph for the span in metres.

Eg for 2m span, SWL=5000kg

Take **W** from the graph for the span in metres and **halve it**.

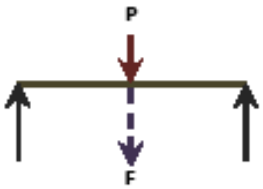
Eg for 2m span, SWL=5000/2 = 2500kg



F – total existing load in kg

$$P = \tfrac{1}{2}(W - F)$$

Eg If F is 1500kg and L=2m, P=½(5000 - 1500)=1750kg



F – total existing load in kg

$$P = {}^{W}/_{2} - F$$

Eg If F is 1500kg and L=2m, P=$^{5000}/_{2}$ - 1500=1000kg

Hi, I reckon I've cracked fig 3.
OK

It is representing our on stage girders with F being any weight we add to them….
F IS WHATEVER IS THERE JUST NOW OR WHATEVER TOTAL IS THERE BEFORE ANY NEW RIG COMES IN.
P IS WHAT YOU ARE PERMITTED TO ADD AFTER DOING A CALCULATION.

I'd like to clarify what the dotted line in the strength curve indicates on your graph, as our girders have a 5.5m span; it's almost the difference of a tonne of weight between the full line and the dotted line…
YES THE DIFFERENCE FOR THIS IS FOR A 5.5M SPAN IS 500KG FOR A UDL.
THE SMALLER PERMITTED LOAD IS TO KEEP THE DEFLECTION WITHIN 5500÷200=28mm approx.
ANY DEFLECTION HIGHER THAN THIS COULD REPRESENT TOO MUCH BOUNCE AND VIBRATION. THE BEAM COULD TAKE 1750KG RATHER THAN 1250KG IN STRENGTH BUT WOULD DEFLECT NEARLY 40MM.

Also I'm surprised that the 'twinned' girders above the stage don't have a stronger rating than their single I beam counterparts front of house? Can you clarify this?
IF A BEAM IS DOUBLED, THE PERMITTED LOAD IS AUTOMATICALLY DOUBLED UNLESS THE LOAD IS OFF CENTRE TO THE PAIR.
MY GRAPH IS FOR A SINGLE 127x76H SECTION.

SO FOR A DOUBLE BEAM WITH A SHARED POINT LOAD ON A 5.5M SPAN, THE SAFE LOAD WOULD BE CALCULATED AS FOLLOWS

FROM THE GRAPH FOR A 5.5M SPAN AND A LIMITED DEFLECTION, THE SWL IS 1250KG FOR ONE BEAM LOADED AS A UDL.
HOWEVER IT'S A POINT LOAD SO WE HAVE TO TAKE HALF. IE 625KG.

HOWEVER WE HAVE TWO BEAMS SO MULTIPLY BY 2X625 = 1250KG

IF IT WAS A UDL THE TOTAL SWL WOULD BE 2 X 1250= 2500KG.

Hi here's some comments in CAPS

Thanks for this – this is great.. I think as a rule and for the sake of telling visiting companies how much they can hang - I am going to add an additional safety factor by making a 2m span; UDL 2.5t and a Point load 1t, but it is great to know how much can be hung to an extreme.
YES YOU CAN COMBINE LOADS THIS WAY. FOR A 2M SPAN THE CALCULATION IS;- THE INTENDED UDL PLUS TWICE THE INTENDED POINT LOAD AT THE CENTRE MUST BE LESS THAN OR EQUAL TO 5000KG (5T)

However just to clarify on your digital diagrams;

Fig 1; (top) is UDL/Spread load YES
Fig 2; is Point load on centre YES

Fig 3;
I'm having trouble with what F represents… is it F IS THE EXISTING UDL ON THE SPAN P IS THE MAX POINT LOAD YOU ARE PERMITTED TO HANG ON THIS SPAN WHEN F IS THERE ALREADY

Fig 4; is this a point load where there are other point loads in place on other spans?
F IS THE EXISTING POINT LOAD ON THIS SPAN.
P IS THE MAX POINT LOAD YOU ARE PERMITTED TO HANG ON THIS SPAN WHEN F IS THERE ALREADY AS A POINT LOAD.

THERE ARE ANOTHER TWO DIAGRAMS WE COULD ADD. THIS IS WHERE YOU WOULD BE ASSESSING WHAT LOAD AS A UDL COULD BE APPLIED ON TOP OF WHAT'S THERE ALREADY.

FIG 5
AS FIG 3, BUT WITH P AS A UDL
P = W - F

FIG 6
AS FIG 4, BUT WITH P AS A UDL
P = W - 2F
