Southern Equipment Centre Ltd

• 61 Benmore Street
• PO Box 5091
• Invercargill
• New Zealand
• Phone: 03 215 8001
• Fax: 03 215 8066
• Email: info@sec.co.nz
• Website: www.sec.co.nz

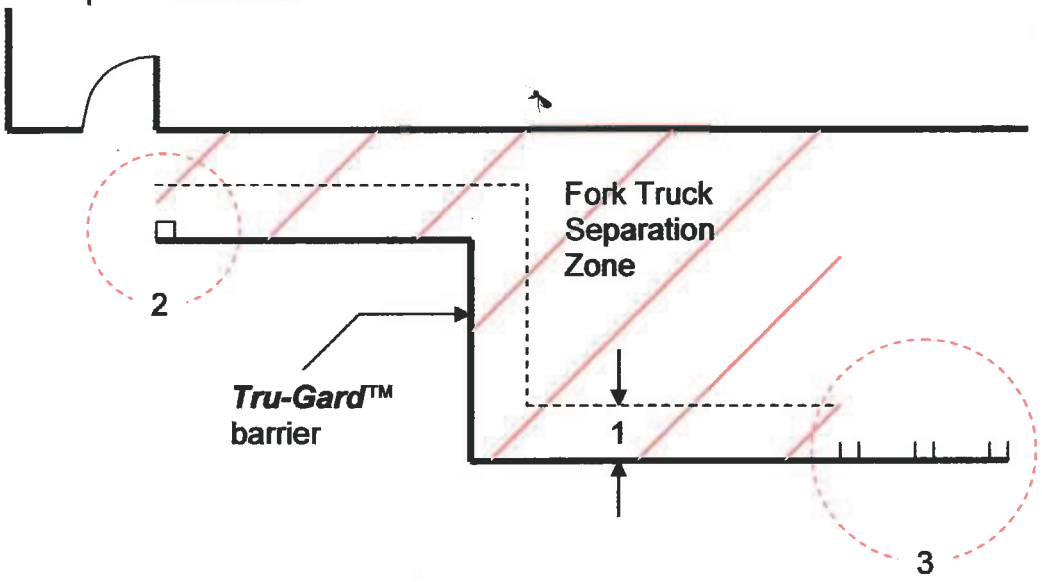
Certificate No. : 0407567-1
File No. : NW/04/5567
Date : 26/07/04

After analysis of the Tru-Gard barrier system I am satisfied that the barrier system is fit-for-purpose as described below:

Installation of *Tru-Gard*™ Barrier Systems to create Fork Truck Separation Zones

When installed to the following specifications, the barrier system has been designed to stop a total mass of 4 metric tonnes moving at a speed of 3.5 km/hr.

Example of installation



Notes:

1. The barrier system is designed to stop the chassis and main body of the fork truck only. Dependant on fork truck attachments and loads an extra safety distance from the barrier may be advisable.
2. Where protection is required to the barrier end, a strengthened barrier support is required, with 6 M16 bolts in the foot.
3. If standard barrier supports are used, a distance of three supports or one barrier length (2.4 m) is required before the Fork Truck Separation Zone begins.

Otherwise, the barrier is to be installed using standard barrier supports with 4 M16 TRU-BOLTS in the support foot. When using this system to protect personnel, a full written survey is required.

Signed : ..... Date : 26/07/04

Matthew Bishop, B.E. (Hons), Mech.
Southern Equipment Centre Ltd.

Executive Summary

Prepared for Tru-Bilt Industries Ltd by SEC Ltd, April 2004

Energy absorption of Tru-Bilt barrier system

The barrier's ability to stop a fork truck is dependant on the kinetic energy of the fork truck and the properties and dimensions of the barrier. The kinetic energy of the fork truck is determined by the mass and velocity of the fork truck. It is worth noting that the speed of the fork truck is related to the kinetic energy by a squared relationship, e.g. doubling the speed will quadruple the kinetic energy.

To determine whether the barrier will absorb the kinetic energy of the fork truck a finite element analysis (FEA) was performed using the ANSYS program. The results of the analysis showed that the barrier's energy absorption or energy rating is related to the number of barrier sections installed and the structure of the barrier support. The analysis steps undertaken are summarized below:

1. A two-support barrier installation has an energy rating of 560 J. This is too low to provide a useful rating. The reason for the low energy rating is that the strength along the barrier is not utilised.
2. To investigate an installation that better utilised the barrier strength, an installation with at least three supports either side of the impact zone was analysed. This had an energy rating of 2608 J, due to the axial strength of the barrier being used to spread the impact over more supports. It was determined that approximately 2500 J would be an adequate energy rating (equivalent to a 4000 kg total mass fork truck travelling at 3.5 km/hr.
3. Where a three support barrier overrun would not be possible, a sufficiently strong support would be required. The analysis of a standard support with a 4 mm backing plate gave an energy rating of 2270 J at 100mm. This indicates the required energy rating will be met.
4. To determine whether a reinforced post at corners would be required, an analysis set was carried out. The results indicated that the corner is a strong part of the installation and is not in need of support.
5. Using the values in the above steps, engineering calculations determined the number of bolts needed in the supports. For the normal supports, 4 M16 Tru-Bolts are required and for the reinforced supports, 6 M16 Tru-Bolts are required.

The following supporting documents are the result of the above analysis steps:

- Summary of Ansys analysis
- Two-support analysis
- 7 support analysis
- Reinforced support analysis
- Corner analysis
- Engineering drawing of supports, including bolt patterns and reinforcement.
- Copy of Design Certificate

Summary of Ansys Analysis

By Matthew Bishop, SEC Ltd.
for Tru-Bilt Industries Ltd.

Kinetic Energy of fork truck

Forklift Mass	**4000**	**3000**	**2000**	kg
Velocity	**3.5**	**4.1**	**5**	km/hr
	0.97	1.14	1.39	m/s
Kinetic Energy	**1890.432**	**1945.602**	**1929.0123**	J

Ansys Results

Two Support Analysis

	Analysed	Extrapolated	
Displacement	35	100	mm
Force	11130	31800	N
Energy	312	**891**	J

7 Support Analysis

	Analysed	Extrapolated	
Displacement	100	100	mm
Force	26055	26055	N
Energy	1976	**1976**	J

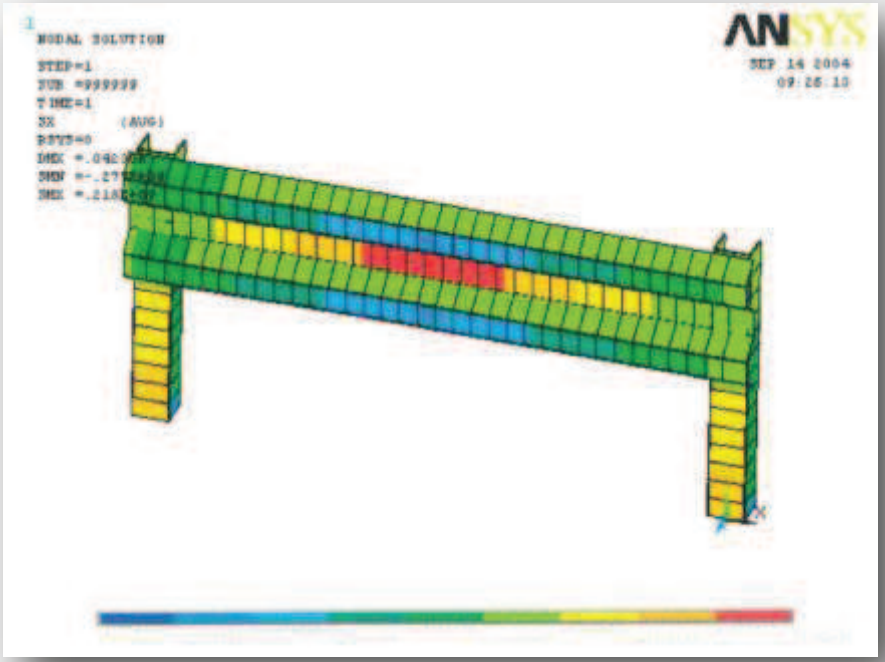
Reinforced Support Analysis

	Analysed	Extrapolated	
Displacement	100	100	mm
Force	25216	25216	N
Energy	2269	**2269**	J

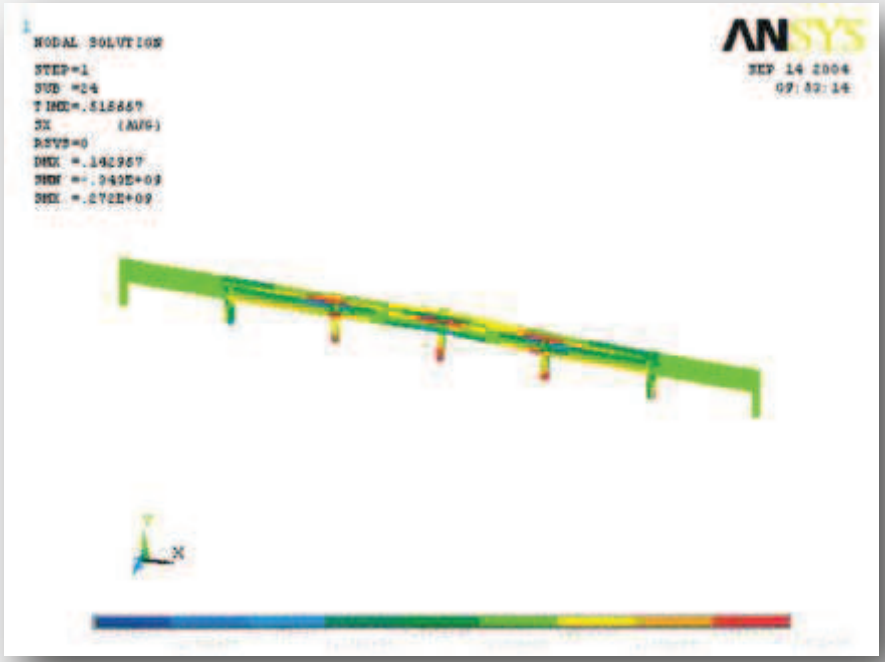
Corner Analysis

	Analysed	Extrapolated	
Displacement	25	100	mm
Force	176658	706632	N
Energy	2964	**11856**	J

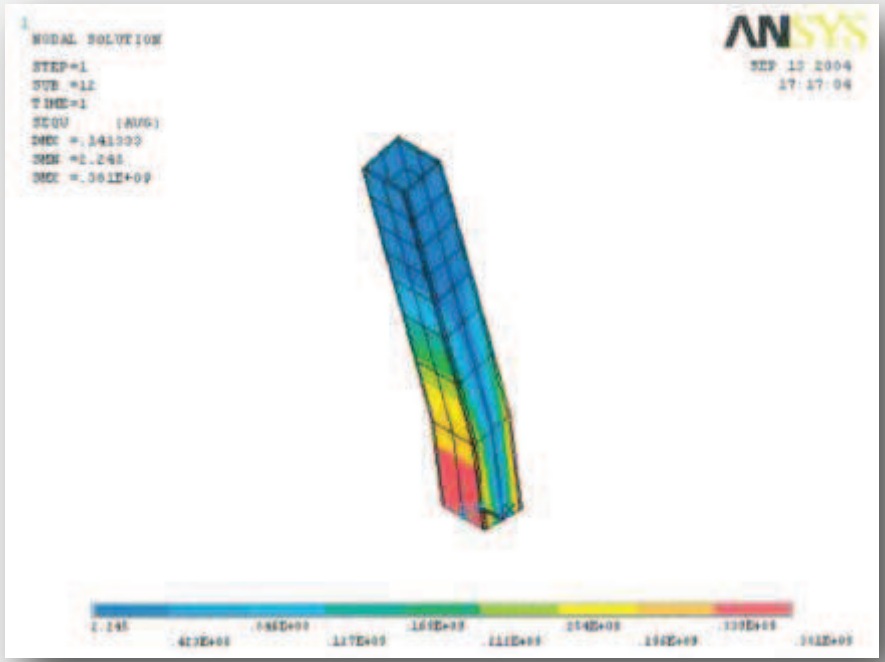
Two Support Analysis



Seven Support Analysis



Reinforced Support Analysis



Corner Analysis