Fermilab

Particle Physics Division
Mechanical Department Engineering Note

Number:	MD-ENG-036
Date:	February 16, 2004
Project Reference:	"R" Concrete Shielding Block, WBS 1.1.2.3.2.1.2.3.32, UID 74970
Project:	NuMI
Title:	"R" Concrete Shielding Block Inclination Anchor
Author(s):	Andy Stefanik A. Stefanik
Reviewer(s):	Ang Lee
Key Words:	target pile shielding, concrete shielding block, R-block
Abstract Summary:	The "R" concrete shielding blocks must be tilted at a slight angle for installation and removal. This anchor will be used with standard rigging equipment to incline the block at the required angle. Block weight is carried by anchors that were embedded in the block when it was made. This anchor is only used to incline the block. See section 2.0 in the EN for further discussion.
Applicable Codes:	

FERMILAB ENGINEERING NOTE

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SUBJECT: "R" Shielding Block
Lifting it at 3.34349° beamline angle

NAME: AMS

DATE: 2/16/04

REVISION DATE:

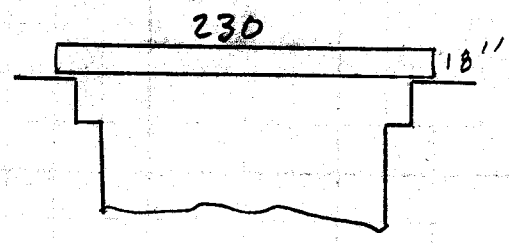
1.0 Geometry

See Appendix A.

2.0 Discussion

The "R" shielding block was designed in FESS. It is designed to be lifted by two pick points on the 230" x 36" face or on the 18" x 36" face.

Most of the "R" shielding blocks will be installed on the 36" wide face. The ends of the block bear on the target hall pit walkways as shown below:



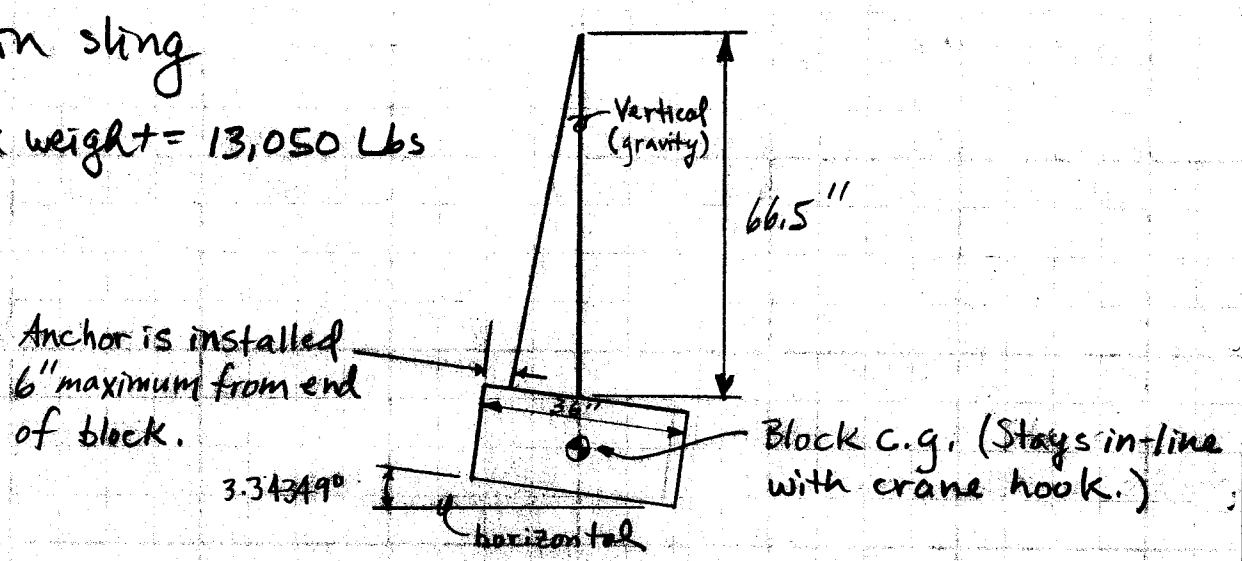
The walkways are inclined at an angle of 3.34349°. The block is shown inclined at the angle in the App A sketch. The block is design for this inclined position.

To minimize the gaps between installed blocks, the block must be held at the 3.34349° angle while being installed. This will be accomplished by the standard rigging technique of using a sling to incline the block with respect to gravity. This sling is shown on the App A sketch.

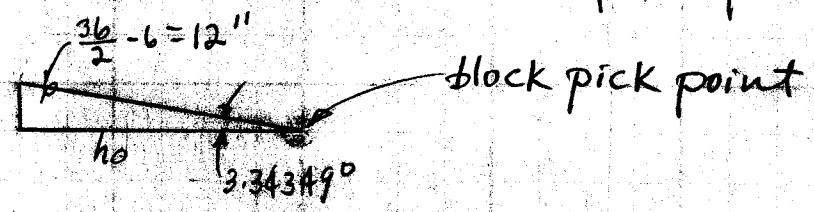
The purpose of this calc is to determine the force in the sling used to incline the block and to size the anchor that will be installed in the block for this sling.

3.0 Force in sling

"R" block weight = 13,050 Lbs



Anchor horizontal offset from block pick point:



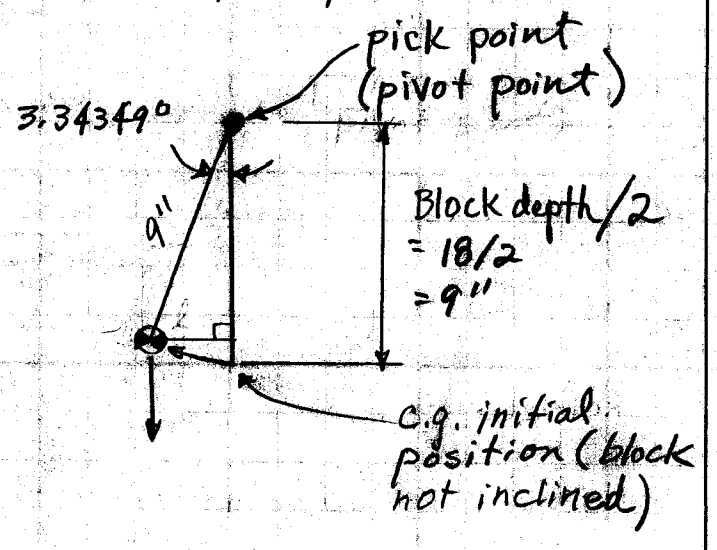
Horizontal offset ≡ ho = 12 cos(3.34349°) = 11.98", use 12"

Fv ≡ Vertical force applied to the anchor to incline the block

Lever arm for block c.g. from block pick point at inclination angle:

$\sin 3.34349° = \frac{\text{lever arm}}{9''}$

lever arm = 0.525"



$\overset{+}{\circlearrowright}\Sigma M$ pick point $= 0 = 12'' F_V - 0.525''(13{,}050 \text{ Lbs})$

$12 F_V = 6{,}851.25$

$F_V = 571$ Lbs, Use <u>600 Lbs</u>

4.0 Anchor

Hilti drop-in, 5/8" HDI

The R-blocks are made with concrete that has a minimum compressive strength of 5,000 psi.

Capacities of Hilti 5/8" HDI:

Capacity = Allowable Load · f_A · f_R

$f_A = 1$ for shear & tension — There is only one anchor. Rebar is about 2" below concrete surface. Anchor depth is 2 9/16".

$f_{RN} = 0.8$, $f_{RV} = 0.65$ } Assume 5" minimum edge distance

Use Hilti data for 4,000 psi concrete.

Tension = 2,920 Lbs (1)(0.8) = 2,336 Lbs

Shear = 3,250 Lbs (1)(0.65) = 2,112 Lbs

Check combined loading:

Tension – 600 Lbs x 2 = 1,200 Lbs

Shear – 1,200 Lbs – Arbitrarily make equal to tension to illustrate acceptability.

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0$$

$$\left(\frac{1,200}{2,336}\right)^{5/3} + \left(\frac{1,200}{2,112}\right)^{5/3} \overset{?}{\leq} 1.0$$

$$0.33 + 0.39 \overset{?}{\leq} 1.0$$

$$0.72 < 1.0 \quad \underline{OK}$$

5.0 Hoist ring

A 3/8"-16 swivel hoist ring will be used to incline the "R" block.

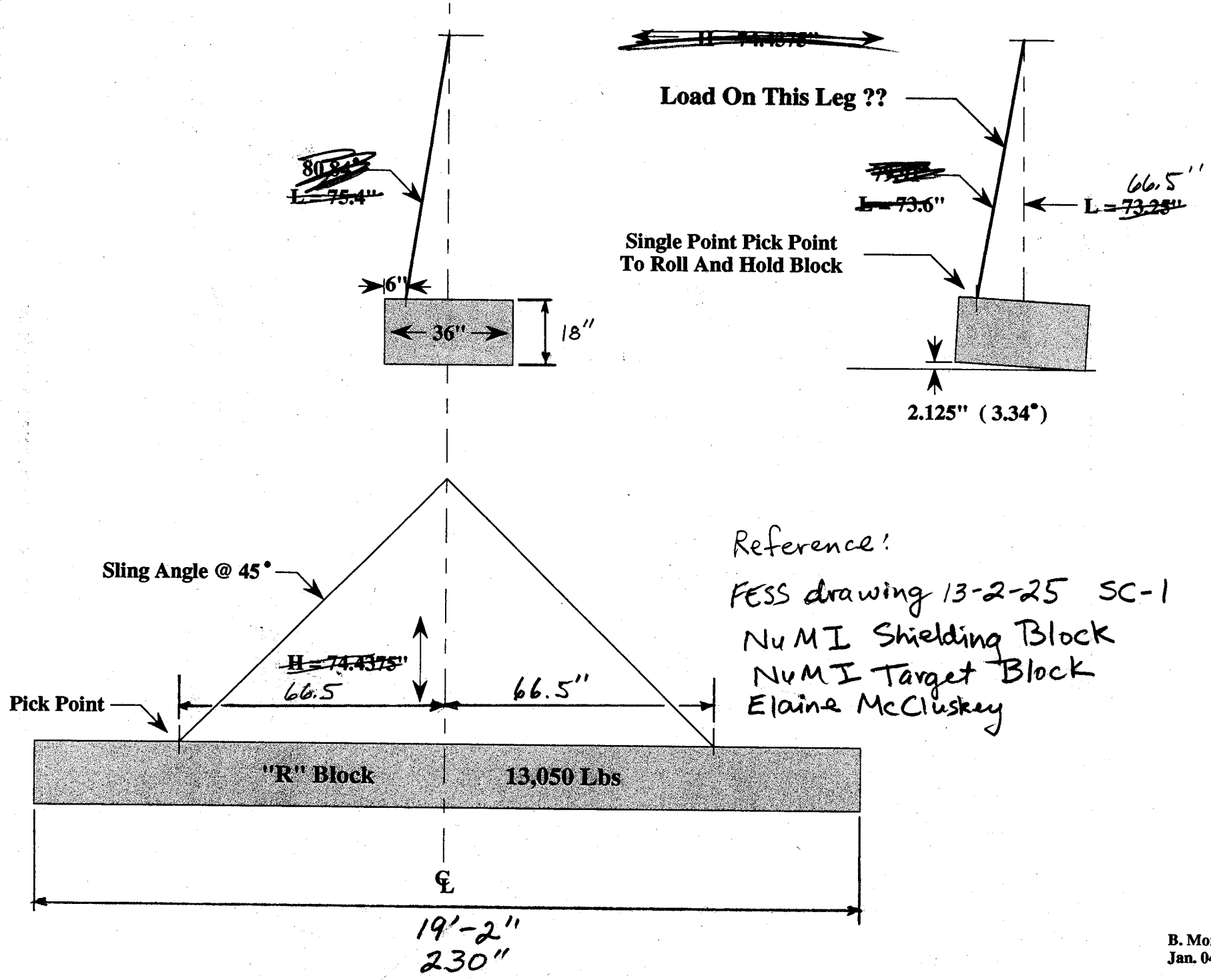
Capacity of 3/8"-16 swivel hoist ring = 1,000 Lbs

1,000 Lb capacity > 600 Lb Load OK

1,000 Lb capacity < Anchor capacities:

2,336 Lbs tension
2,112 Lbs shear
~1,200 Lbs combined loading

Note: A 3/8"-16 by 5/8"-11 bushing is installed in the Hilti drop-in anchor so a higher capacity hoist ring can not be used.



Reference:
FESS drawing 13-2-25 SC-1
NuMI Shielding Block
NuMI Target Block
Elaine McCluskey

Appendix A

B. Morrison
Jan. 04