Fermilab

Particle Physics Division
Mechanical Department Engineering Note

Number: MD-ENG-03-008

Date: June 11, 2003

Project Reference: Target Pile Shielding, WBS 1.1.2.

Project: NuMI

Title: Setup to rip (cut lengthwise) long CCSS slabs and protect personnel during a release of stored energy if a slab fractures while being cut

Author(s): Andy Stefanik *Andy Stefanik*

Reviewer(s): Ang Lee *Ang Lee*

Bob Morrison (Abstract only) *Bob Morrison*

Key Words: target pile shielding, CCSS, stored energy, slab fracture, steel cutting

Abstract Summary: The fracture of CCSS slab V4148E P0 0 was examined to obtain information that could be helpful in protecting personnel during a release of stored energy if a slab fractures while being ripped. A rough estimate for the motive force applied to the fractured slab was obtained by calculations (Appendix D). The result of the calculations is that the force applied to the slab that moved the farthest is about 0.54 times its weight. I rounded this computed factor to 1 to cover some of the uncertainty in the calculation. I do not consider rounding the result of 0.54 to 1 as applying a safety factor to the result. I consider 1 to be the basic result. I used the calculated ratio, 1, along with a coefficient of friction of 0.5 and a safety factor of 4 to calculate how heavy a stop, i.e., the stands and a pile of steel, has to be to keep a fractured slab from moving towards personnel.

It is very important to remember that the plan stated above is based on information gleaned from photographs taken after the fracture but before anything was reportedly moved. The results appear reasonable based on the photographs and also on the size of the steel piles.

The biggest slab remaining to be ripped for the NuMI project is V4148E P1 0, the "mate" to the fractured slab. As a further precaution to the above plan, the welder and other personnel shall stay clear of this slab after a pinch point forms until the slab is ripped into two pieces. If the cutting torch stops, the welder and other personnel can approach the slab to restart the cutting operation but must be made aware that a partially cut slab with a pinch point can fracture as it cools due to increasing pressure at the pinch point as the material cools and shrinks. We have decided to pursue this course because we believe it is very likely that slab V4148E P1 0 will fracture when it is ripped. If it does, personnel will be a safe distance away from it and we will test the plan proposed to protect the welder and other personnel.

I've told the cutting-crew chief that he can cross cut slab V4148E P1 0 into two or more pieces and then rip the shorter pieces for safety reasons. He and I agree that we will rip this slab without cross cutting it so we can test the safety plan if the slab fractures. Testing the proposed safety plan will benefit future cutting operations.

The job Hazard Analysis will be revised to include a copy of this cover sheet and appropriate information from pages 1, 2, and 3.

Applicable Codes: Not applicable.

FERMILAB
ENGINEERING NOTE

SECTION	PROJECT	SERIAL-CATEGORY	PAGE
	NuMI		

SUBJECT: Setup to rip (cut lengthwise) long CCSS slabs and protect personnel during a release of stored energy if a slab fractures while being cut

NAME: A. M. Stefanik

DATE: 6/11/03 REVISION DATE:

Index

Appendices

FERMILAB ENGINEERING NOTE	SECTION	PROJECT NuMI	SERIAL-CATEGORY	PAGE 1
SUBJECT		NAME AMS		
		DATE 6/11/03	REVISION DATE	

1.0 A CCSS (continuous cast salvage steel) slab fractured while being cut at the Fermilab railhead. The incident is described in "Failure of Support System During Cutting of Steel May 30, 2003", written by Eric McHugh. See Appendix A.

2.0 The purpose of this note is to document a new cutting setup for ripping long CCSS slabs for the NuMI project.

3.0 Design Basis – Worked out with Bob Morrison and Dave Pushka.

3.1 Sketch is on page 2.

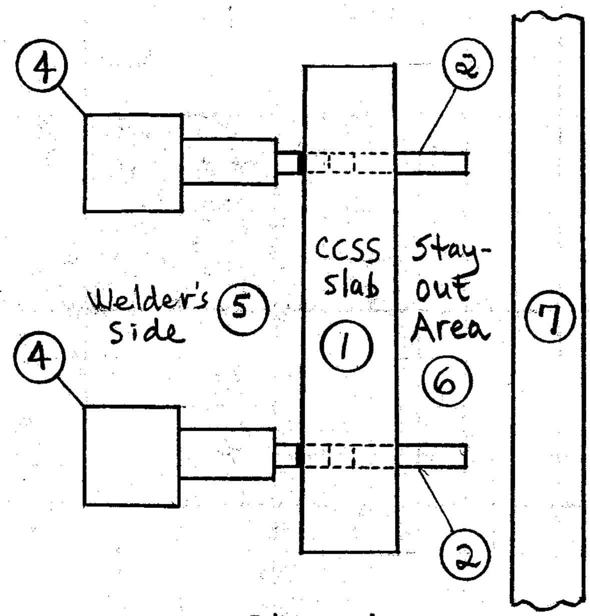
3.2 Notes:

① CCSS slab sitting on rip cut stands.

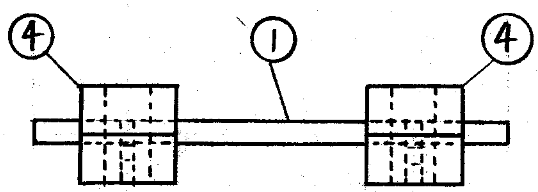
② CCSS Rip Cut Stand. See Appendix B for dimensions. The cutout allows the torch to travel past the stand without cutting it. Stand weight ≐ 5,000 Lbs.

③ The "ear" on the CCSS Rip Cut stand is on the welder's side of the slab. The slab is placed against the ear to eliminate impact loading. Shims can be placed between an ear and the slab.

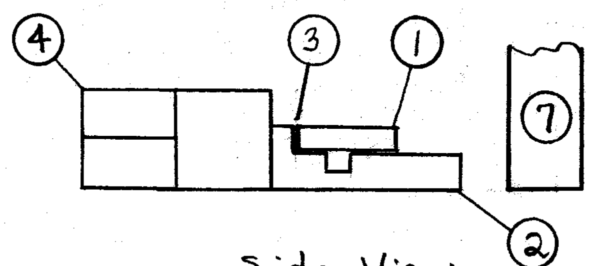
SUBJECT | NAME AMS | DATE 6/11/03 | REVISION DATE



Plan View



Elevation View



Side View

(4) Pile of steel in contact with CCSS Rip Cut Stand, item (2). Two piles of steel are required; one at each stand. The weight of the piles and stands keep a fractured slab from sliding towards the welder. The amount of weight needed for this job is calculated in §4.0. The steel blocks used to build these piles measure 52.5" x 52.5" x 26.25" and weigh 20,000 pounds each.

⑤ Welder's side: The welder and other support personnel approach the slab only from this side of a slab. In general, personnel stay away from the slab while it is being cut. The welder, and support personnel only approach the slab to inspect the cutting operation and adjust the cutting torch.

⑥ Stay-out area: Personnel are prohibited from entering the stay-out area while a slab is being cut. The stay-out area extends along the entire length and ends of the slab. The end of a slab can be approached to relieve a pinch point after stopping the cut. However, the cutting crew shall be made aware that a partially cut slab with a pinch point can fracture as it cools due to increasing pressure at the pinch point as the material cools and shrinks.

⑦ Concrete shielding block wall

4.0 Amount of weight needed to keep a fractured slab from sliding toward personnel –

4.1 The amount of stored energy in any CCSS slab is unknown. I was able to calculate one useful piece of information from my analysis of fractured CCSS slab V4148 PO 0: an estimate of the force applied to the cut slab that moved the farthest. The force was approximately one-half the weight of the cut slab itself. The calculations are in Appendix D.

From the calculations in Appendix D:

$$\frac{\text{motive force}}{\text{cut slab weight}} = \frac{7{,}745 \text{ Lbs}}{14{,}250 \text{ Lbs}} = 0.54$$

So, I'm going to say as a rule-of-thumb that the motive force that accelerates a cut slab is equal to its own weight.

In the case of slab V4148E PO 0:

- motive force applied to uncut slab = 14,250 Lbs (rule-of-thumb estimate)
- $\therefore \frac{\text{motive force}}{\text{cut slab weight}} = \frac{14{,}250}{14{,}250} = 1 > 0.54$
- $\frac{\text{design motive force}}{\text{calculated motive force}} = \frac{14{,}250}{7{,}745} = 1.8$
- ∴ The motive force obtained using the rule-of-thumb is 1.8 times greater than the calculated motive force.

4.2 Size the pile of steel

Dimensions of the largest slab to be ripped are 9.11" x 24.25" x 235".

Its weight is (9.11)(24.25)(235)(0.283) = 14,700 Lbs

∴ Motive force = 14,700 Lbs (rule-of-thumb estimate)

Coefficient of friction between the pile of steel and the stands with the ground is 0.5. See Appendix C.

∴ Minimum weight needed = $\frac{14,700 \text{ Lbs}}{0.5}$ = 29,400 Lbs

Use a safety factor of 4.

∴ Total weight required = 4(29,400 Lbs) = 117,600 Lbs

Pile weight = 117,600 − 2(5,000) = 107,600 Lbs
(5,000 ↑ stand weight)

The pile will be built using steel blocks that weigh 20,000 Lbs each.

Number of blocks needed = $\frac{107,600}{20,000}$ = 5.4

Use 3 - 20,000 blocks at each stand.

Total weight = 2(3)(20,000) + 10,000 = 130,000 Lbs > 107,600 Lbs ok

Appendix A

Failure of Support System During Cutting of Steel May 30, 2003

Event:

On Friday, May 30, 2003, a welder of the Technical Division Machine Shop group was cutting a 9.11"x19'4"x49", 29,000lb piece of steel using a MAPP gas and Oxygen cutting rig at the Railhead. The steel was supported by magnet stands and bottle jacks approximately 18" off of the ground (Figure 1). The cut was along the length (19'4") of the steel creating two equal pieces. Approximately 16" from the completion of the cut, the steel fractured and one 9.11"x19'4"x24.5", 14,500lb piece of steel fell 18" to the ground. No one was injured and the only property damage was a broken bottle jack.

Action/Conditions that may have contributed to the incident:

When cutting, the media gradually bows due to heating and cooling. This created a "pinch point" or pressure point in the steel, which is exaggerated in Figure 2. This is a normal phenomenon according to the welder involved. Near the completion of the cut, the pressure increased resulting in the fracturing of the last 16" of steel. The magnet stands and bottle jacks failed to support the release of lateral energy created when the steel fractured.

Another condition that may have contributed to the incident was the magnet stands and bottle jacks were not adequate to support the steel in case an event such as this one occurred.

The vendor of the steel was contacted prior to the operation to determine the appropriate grade of steel for the tasks to be performed. There were six other cuts similar to this one. Each of the other cuts caused a similar bowing resulting in a "pinch point" of the steel with no incident.

Figure 1

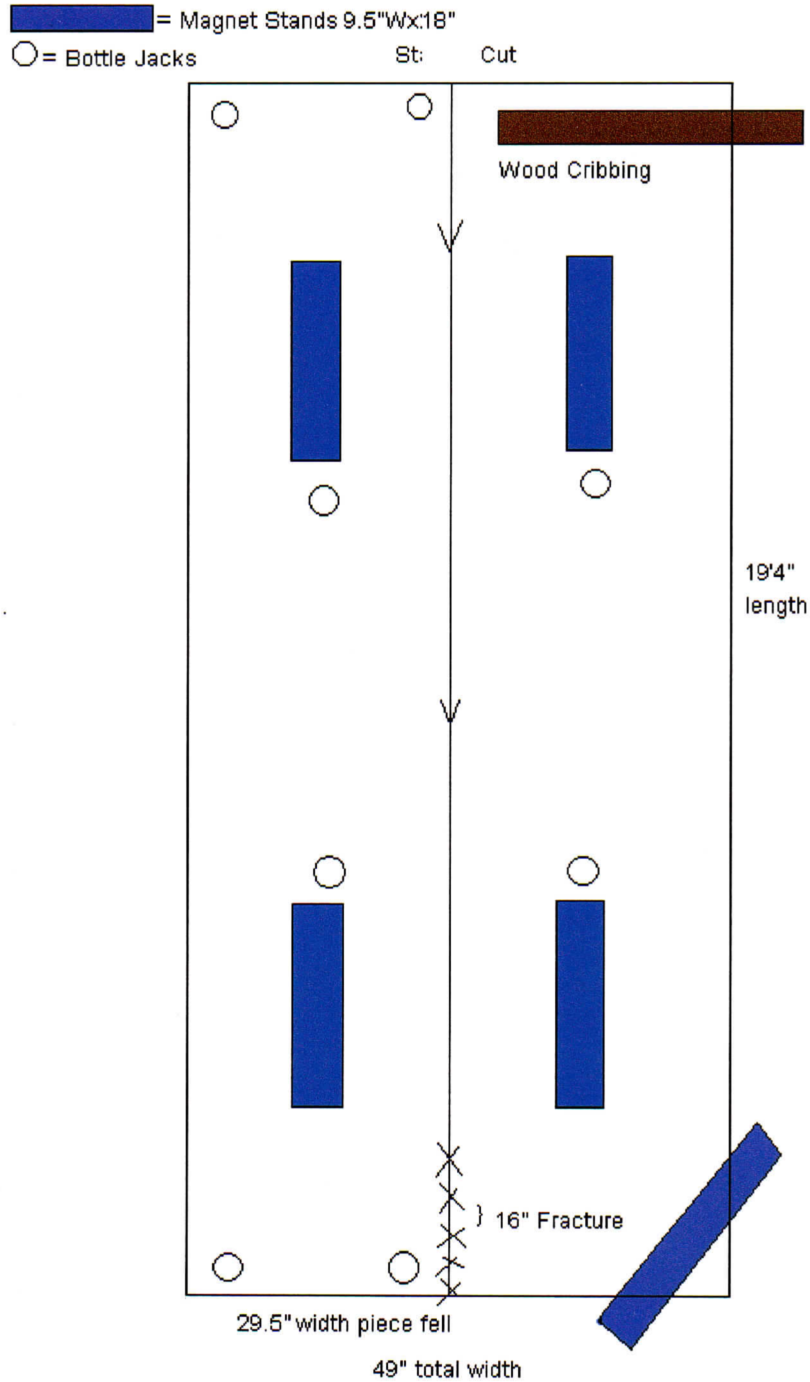
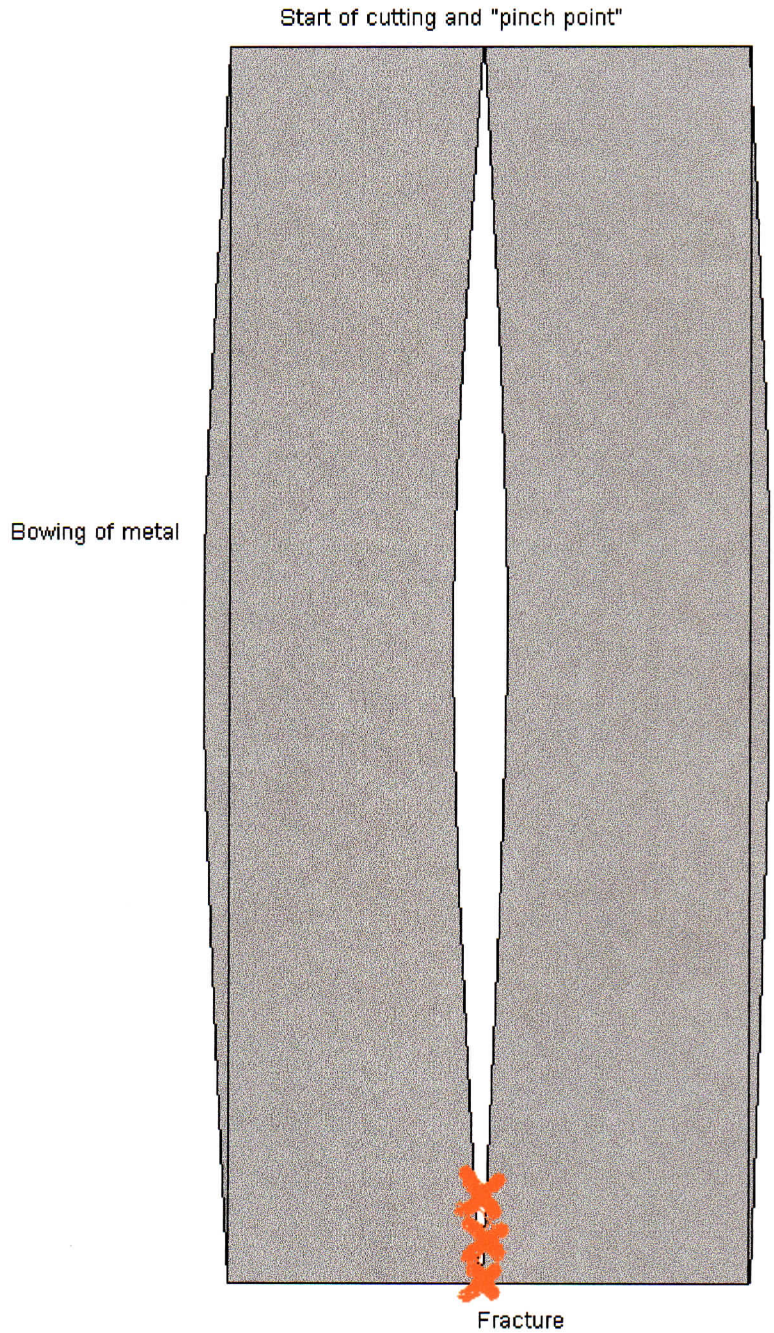

= Magnet Stands 9.5"Wx18"
= Bottle Jacks
St: Cut
Wood Cribbing
19'4"
length
} 16" Fracture
29.5" width piece fell
49" total width

Figure 2



Exaggeration of "pinch point" and warping of steel

Lessons Learned:

- The magnet stands and bottle jacks could not support the release of lateral energy, though they were adequate for the amount of vertical force.
- A Job Hazard Analysis was written, but did not included provisions for this type of incident.
- "Pinch points" occur when cutting steel, especially with longer cuts.

Corrective Actions:

- Redesign the platform on which cuts are made to be able to support this type of release of energy.
- Write the JHA to include this type of phenomenon.

Recommended actions for other sections:

- Contact the vendor of the steel and be sure that the grade of steel will be adequate for the operations and tasks.
- Consider engineering reviews whenever a job is being performed with unpredictable materials.
- Write JHA's carefully to include all possible hazards.
- Be sure supports are adequate and can account for unpredictable occurrences such as the fracture force from a "pinch point."
- Be aware that "pinch points" can and do occur when cutting steel, especially longer cuts.

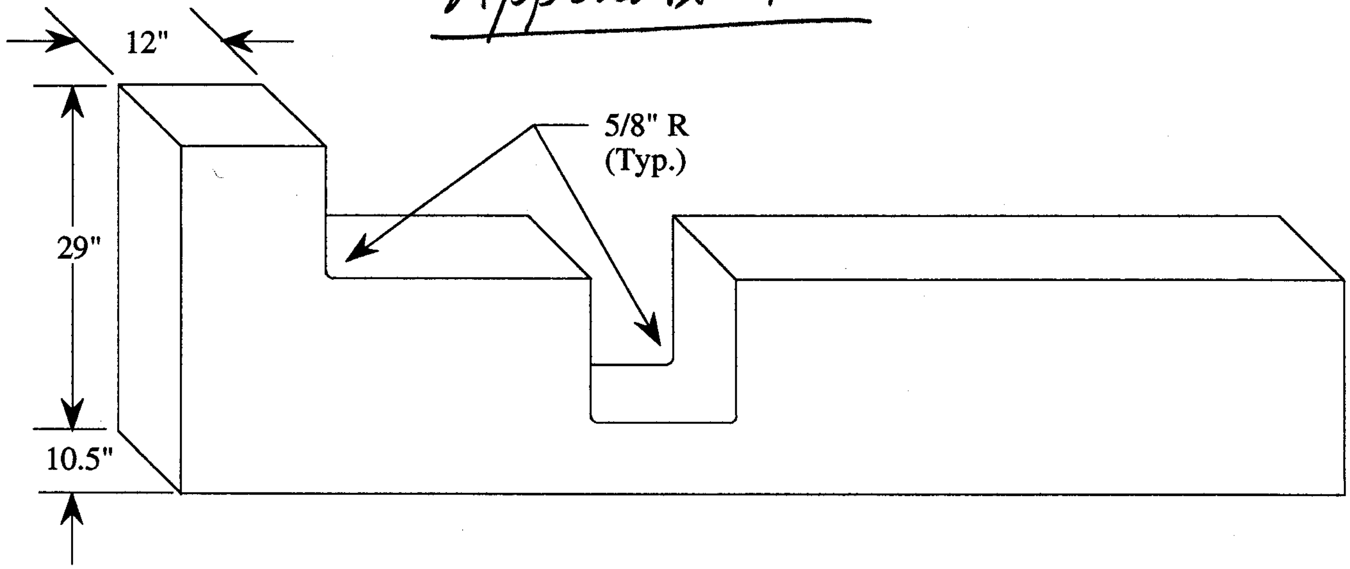
Contact: Eric McHugh PPD/ES&H x2399

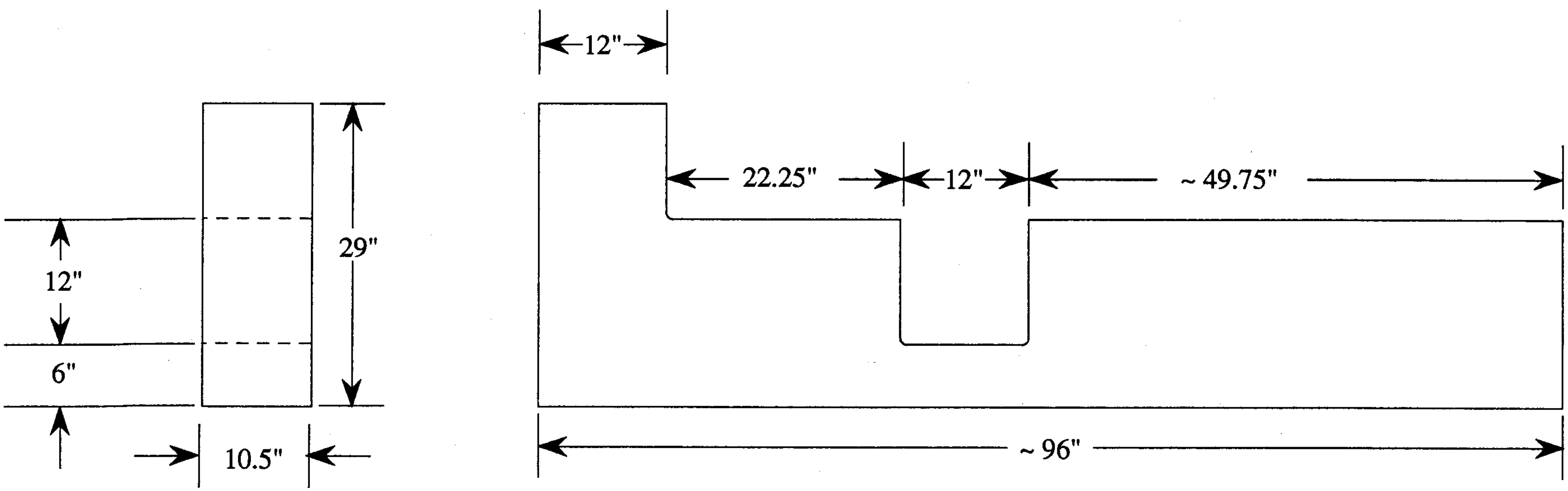
B. Morrison
06-2003

Railhead CCSS kip Cutting Stand

Widest CCSS block to cut = 56"
Stand weight = 5160 lbs.

Appendix B





Appendix C

Effect of Sliding Velocity It has generally been observed [th]at coefficients of friction reduce on dry surfaces as sliding [vel]ocity increases. (See results of railway brake-shoe tests [bel]ow.) Dokos measured this reduction in friction for mild steel [on] medium steel. Values are for the average of four tests with [hig]h contact pressures (*Trans. ASME*, 1946; see footnotes to [Ta]ble 3.2.1).

Sliding velocity,							
in/s	0.0001	0.001	0.01	0.1	1	10	100
f	0.53	0.48	0.39	0.31	0.23	0.19	0.18

Effect of Surface Finish The degree of surface roughness has been found to influence the coefficient of friction. Burwell evaluated this effect for conditions of boundary or greasy friction (*Jour. SAE*, 1942; see footnotes to Table 3.2.1). The values listed in the table below, are for sliding coefficients of friction, hard steel on hard steel.

Solid Lubricants In certain applications solid lubricants are used successfully. Boyd and Robertson with pressures ranging from 50,000 to 400,000 lb/in² (344,700 to 2,757,000 kN/m²)

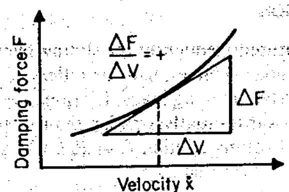


Fig. 3.2.4 Positive damping. Damping force increases as velocity increases.

found sliding coefficients of friction f for hard steel on hard steel as follows: powdered mica, 0.305; powdered soapstone, 0.306; lead iodide, 0.071; silver sulfate, 0.054; graphite, 0.058; molybdenum disulfide, 0.033; tungsten disulfide, 0.037; stearic acid, 0.029 (*Trans. ASME*, 1945; see footnotes to Table 3.2.1).

Coefficients of Static Friction for Special Cases

Masonry and Earth Dry masonry on brickwork, 0.6–0.7; timber on polished stone, 0.40; iron on stone, 0.3 to 0.7; masonry on dry clay, 0.51; masonry on moist clay, 0.33.

Earth on Earth Dry sand, clay, mixed earth, 0.4 to 0.7; damp clay, 1.0; wet clay, 0.31; shingle and gravel, 0.8 to 1.1.

Natural Cork On cork, 0.59; on pine with grain, 0.49; on glass, 0.52; on dry steel, 0.45; on wet steel, 0.69; on hot steel, 0.64; on oiled steel, 0.45; water-soaked cork on steel, 0.56; oil-soaked cork on steel, 0.42.

Coefficients of Sliding Friction for Special Cases

Soapy Wood Lesley gives for wood on wood, copiously lubricated with tallow, stearine, and soft soap (as used in launching practice), a starting coefficient of friction equal to 0.036, diminishing to an average value of 0.019 for the first 50 ft of motion of the ship. Rennie gives 0.0385 for wood on wood, lubricated with soft soap, under a load of 56 lb/in².

Asbestos-Fabric Brake Material The coefficient of sliding friction f of asbestos fabric against a cast-iron brake drum, according to Taylor and Holt (*NBS*, 1940) is 0.35 to 0.40 when at normal temperature. It drops somewhat with rise in brake temperature up to 300°F. (149°C) With a further increase in brake temperature from 300 to 500°F (149 to 260°C) the value of f may show an increase caused by disruption of the brake surface.

Steel Tires on Steel Rails (Galton)

Speed mi/h	Start	6.8	13.5	27.3	40.9	54.4	60
Values of f	0.242	0.088	0.072	0.07	0.057	0.038	0.027

Railway Brake Shoes on Steel Tires Galton and Westinghouse give, for cast-iron brakes, the following values for f, which decrease rapidly with the speed of the rim; the coefficient f decreases also with time, as the temperature of the shoe increases.

Speed, mi/h	10	20	30	40	50	60
f, when brakes were applied	0.32	0.21	0.18	0.13	0.10	0.06
f, after 5 s	0.21	0.17	0.11	0.10	0.07	0.05
f, after 12 s		0.13	0.10	0.08	0.06	0.05

Schmidt and Schrader confirm the marked decrease in the coefficient of friction with the increase of rim speed. They also show an irregular slight decrease in the value of f with higher shoe pressure on the wheel, but they did not find the drop in friction after a prolonged application of the brakes. Their observations are as follows:

Speed, mi/h	20	30	40	50	60
Coefficient of friction	0.25	0.23	0.19	0.17	0.16

Wood Brake Blocks According to Klein, f is practically constant for velocities from 200 to 4,000 ft/min (61 to 1219 m/min) and for pressures from 7 to 142 lb/in² (48.3 to 979 kN/m²). The following values of f are for wood on lengthwise fiber brake blocks carefully machined:

	Beech	*Oak*	*Poplar*
Cast iron	0.29–0.37	0.30–0.34	0.35–0.40
Wrought iron	0.54	0.51–0.40	0.65–0.60

	Elm	*Willow*
Cast iron	0.36–0.37	0.46–0.47
Wrought iron	0.60–0.49	0.63–0.60

	Surface					
	Superfinished	Ground	Ground	Ground	Ground	Grit-blasted
Roughness, microinches	2	7	20	50	65	55
Mineral oil	0.128	0.189	0.360	0.372	0.378	0.212
Mineral oil + 2% oleic acid	0.116	0.170	0.249	0.261	0.230	0.164
Oleic acid	0.099	0.163	0.195	0.222	0.238	0.195
Mineral oil + 2% sulfonated sperm oil	0.095	0.137	0.175	0.251	0.197	0.165

FERMILAB ENGINEERING NOTE	SECTION Appendix D	PROJECT NuMI	SERIAL-CATEGORY	PAGE 1
SUBJECT Fracture of CCSS slab V4148E P00		NAME AMS		
		DATE 6/11/03	REVISION DATE	

1.0 Material: CCSS. Chemistry is on page 4.

2.0 Slab and part dimensions are on page 5.

3.0 Slab edge straightness dimensions are on page 6.

4.0 Photo of site after energy release is on page 7.

5.0 Time required for the slab to free-fall from its initial position to the ground:

Note: The fact that the stand and two jacks are in their initial positions indicate that the slab probably moved some amount vertically upward until it cleared the stand laterally. The slab landed on the base of the third jack.

$$y = V_{y0} t - \frac{1}{2} g t^2$$

$$y = -27.5'' = -2.3 \text{ ft} \quad (\text{Stand height})$$

$$V_{y0} = 0$$

$$-2.3 \text{ ft} = 0 - \frac{1}{2}\left(32.2 \frac{\text{ft}}{\text{s}^2}\right) t^2$$

$$t \doteq 0.4 \text{ s}$$

FERMILAB ENGINEERING NOTE	SECTION	PROJECT NuMI	SERIAL-CATEGORY	PAGE 2
SUBJECT		NAME AMS		
		DATE 6/11/03	REVISION DATE	

6.0 Maximum lateral velocity

$$X = X_0 + \frac{1}{2}(V_{x0} + V_{xf})t$$

$X_0 = 0 \qquad V_{x0} = 0$

$X = 16.625'' \doteq 1.4'$ → Initially the slab ℄ was aligned the the stand ℄. In the final position, the slab is almost touching the side of the stand. Slab width = 24.25". Stand width = 9.0"

$1.4\,ft = 0 + \frac{1}{2}(0 + V_{xf})\,0.4s$

$V_x = 7\ ft/s$

7.0 Slab lateral acceleration

$V_x = V_{x0} + a_x t$

$7\frac{ft}{s} = 0 + a_x(0.4s)$

$a_x = 17.5\ ft/s^2$

8.0 Work done on the slab

$W = \frac{1}{2}m(V_{xf}^2 - V_{x0}^2)$

Slab wt $= (9.11'' \times 24.25'' \times 228'')\ 0.283\ \frac{Lbs}{in^3} = 14{,}250\ Lbs$

$m = 14{,}250\ Lbs \times \frac{s^2}{32.2\,ft} = 442.5\ \frac{Lbs\text{-}s^2}{ft}$ ≈ (slugs)

$W = \frac{1}{2}\left(442.5\ \frac{Lbs\text{-}s^2}{ft}\right)(7^2 - 0^2)\ \frac{ft^2}{s^2} = 10{,}840\ ft\text{-}Lbs$

9.0 Constant force acting on the slab

$F = ma_x$

$= 442.5 \frac{Lbs\text{-}s^2}{ft}\left(17.5 \frac{ft}{s^2}\right) = 7{,}745\ Lbs$

Note: $W = F \cdot d = 7{,}745\ Lbs\,(1.4\ ft) = 10{,}840\ ft\text{-}Lbs$

10.0 Compare F to the cut slab weight

$\frac{7{,}745\ Lbs}{14{,}250\ Lbs} = 0.54$

BUSINESS PLANNING DEPARTMENT
SLAB CHEMISTRY REPORT

08/05/02 11:22

C	MN	P	S	SI	CU	ING	CUT	LOC	TT	ID	UNIT	MANIFEST	RPT BY	SEQ
0.082	00.350	.087	.007	0.373	0.284			T		V4148EP00	0	AR612		004

NI	CR	MO	SN	AL	N	V	B	TI	CB	CO	PB	AS	SB
00.11	00.84	0.003	.002	0.042	.005	0.005	.0001	0.004	0.002	0.003	.000	.002	.0070

W	TA	ZR	SE	TE	O2	H2	GE	CA	MG	CB-TA	BI	CE	SAL	GONOGO
0.00	.000	.001	.00	.00	0000	00.0	.0000	.001	.000	0.000	.000	.000	.000	

C	MN	P	S	SI	CU	ING	CUT	LOC	TT	ID	UNIT	MANIFEST	RPT BY	SEQ
0.091	00.340	.061	.007	0.251	0.192			B		V4148EP00	0	AR612		005

NI	CR	MO	SN	AL	N	V	B	TI	CB	CO	PB	AS	SB
00.08	00.57	0.003	.006	0.039	.005	0.003	.0001	0.003	0.001	0.003	.000	.002	.0060

W	TA	ZR	SE	TE	O2	H2	GE	CA	MG	CB-TA	BI	CE	SAL	GONOGO
0.00	.000	.001	.00	.00	0000	00.0	.0000	.001	.000	0.000	.000	.000	.000	

R 12/02

SLAB-ID	THICK	WIDTH	LGT	WEIGHT	GRADE	S-DTE	DS	S	TP	URC	STT	RSN	PC1	PC2
V4148E P0 0 (D)	09.11	048.75	461	058002	IMX9	07 29	HY	0	3	29	4			

CAR NUM	TRK	BAY	M	ML	LOC	LOAD	CC-R-A	TST1	TST2	A	ORDER	ITEM	SCH	LIN
K003 000000	HY	000	1	6	1	0000	C I I	0300		0	00095	000	000	000

SLAB REJECTED FOR 38 HEAT M45989 SPRGRD IMX9 0

Topout Rail
AMS 9/17/02

R 11/02

SLAB-ID	THICK	WIDTH	LGT	WEIGHT	GRADE	S-DTE	DS	S	TP	URC	STT	RSN	PC1	PC2
V4148E T0 0 (D)	09.11	048.75	461	058002	IMX9	07 29	HY	0	3	29	4			

CAR NUM	TRK	BAY	M	ML	LOC	LOAD	CC-R-A	TST1	TST2	A	ORDER	ITEM	SCH	LIN
K003 000000	HY	000	1	6	1	0000	C I I	0300		0	00095	000	000	000

SLAB REJECTED FOR 38 HEAT M45989 SPRGRD IMX9 0

Topout Rail
AMS 9/17/02

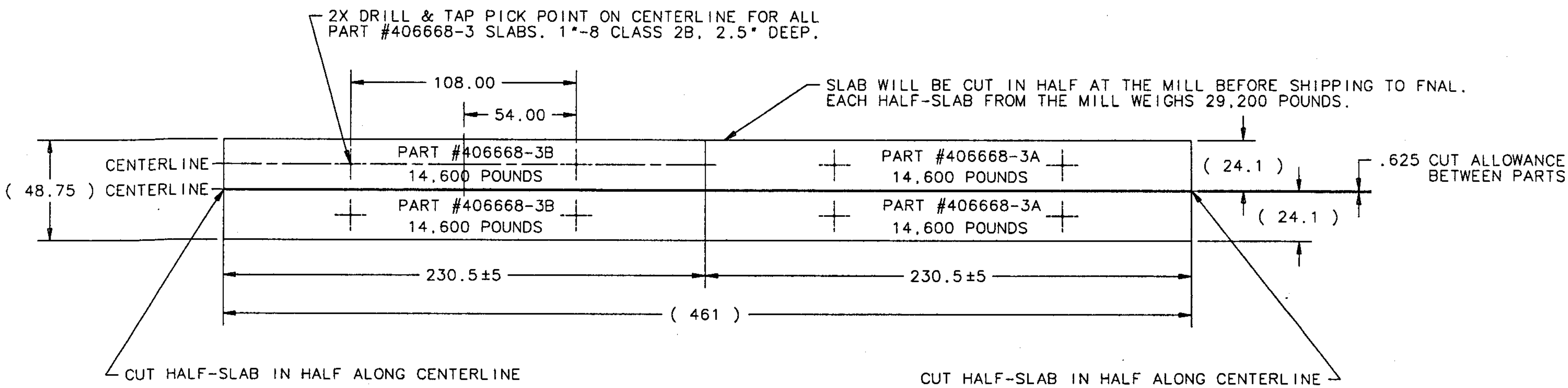
2 slabs

903/9/963

9/12 LTT

4
AMS
6/11/03

CUT 4 PARTS FROM 9.11" MILL SLAB V4148E PO 0 (48.75" WIDE, 461" LONG, 58,400 POUNDS)

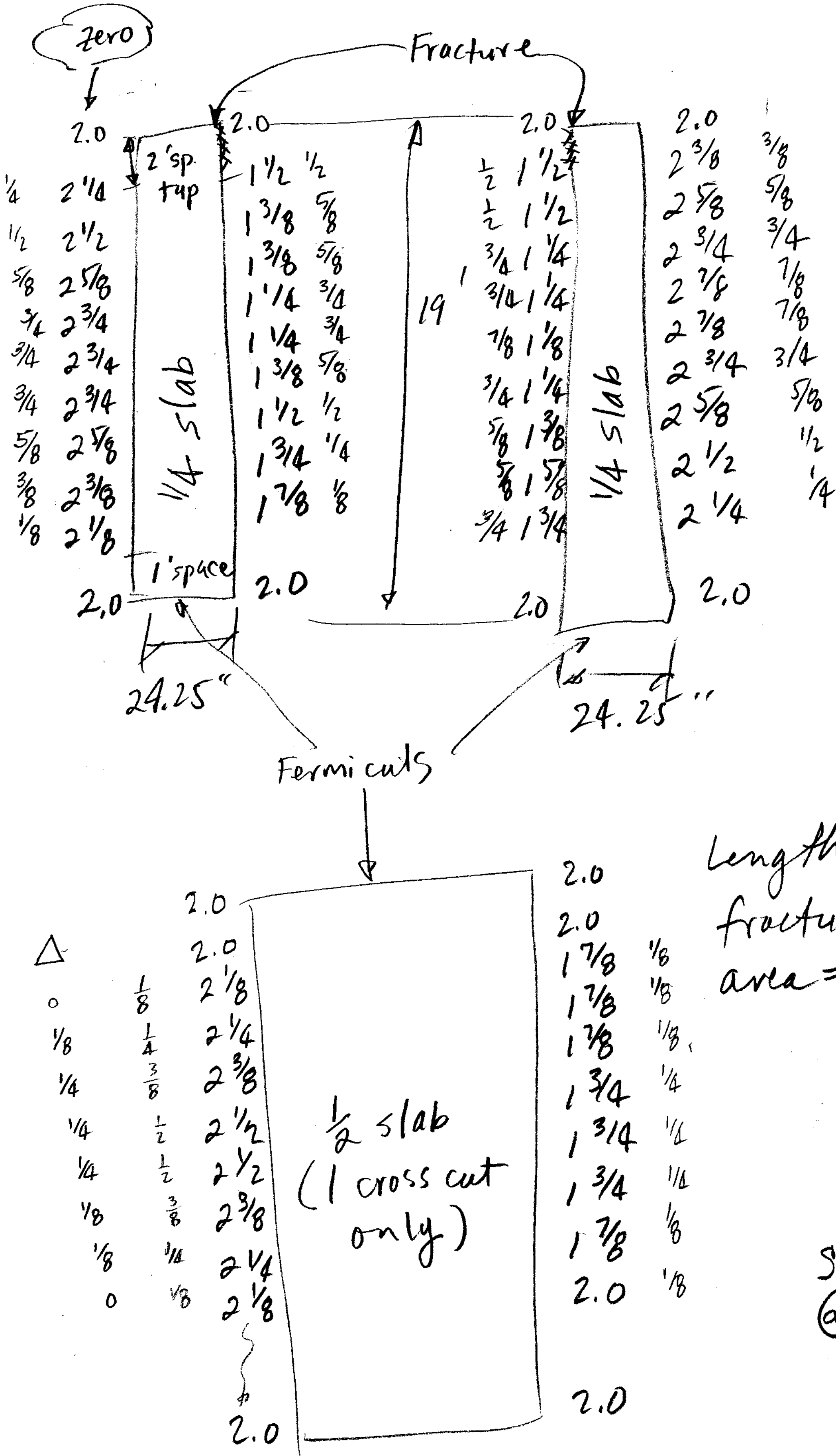


Plotted by stefanik on 11-Jun-03 , File: CCSS_CUT_SKETCH_2.pff

5
AMS
6/11/03

AMS
6/11/03

Dimensions measured by Bob Morrison.



Length of fractured area = 16"

27½"x9" Stand dims @ top surface

Appendix E

Conversation with John Risser

US Steel – Non Prime Products

412-433-3984

John provided the following information regarding the fractured slab:

The additives chromium, copper, silicon, nickel, and molybdenum make the CCSS slabs susceptible to cracking. These high strength elements can cause a slab to crack if not preheated to 200 °F, particularly early in the morning or on a cold day. These elements should be trace amounts, i.e., less than 0.01%, for flame cutting. Nickel and chromium are what really caused the slab to crack. This is a silicon-aluminum killed steel.

I asked John about slab behavior during cutting and about the pinch point that can form as the cut progresses. He referred me to the mill for questions about cutting.

Notes:

The percentage of these elements in slabs V4148E P0 0 and V4148E T0 0 are: Cr – 0.57 to 0.84; Cu – 0.192 to 0.284; Si – 0.251 to 0.373; Ni – 0.08 to 0.11; Mo – 0.003.

Fermilab P.O. #547763

PURCHASE REQUISITION Mike Yeoward - X3529 1 of 2

Appendix F

Requisition

Requisition Number (Filled in by System)	Oracle Preparer (Filled in by System)	Date	Request Originator:	Extension: 4131 MS: 219
159168	Cm X-6774		Andy Stefanik	
Division/Section Approval		Date	NEPA Approval	
Business Office Approval		Date		
Directorate Approval		Date		

Requisition Header

Description (of entire requisition): NuMI Target Hall - CCSS Material

Note to Approver:

Previous PO: 537877

Requisition Entry Defaults

Requester	Deliver-To-Location (not Mail Station)	Note to buyer (i.e. Previous PO)	
Andy Stefanik	Fermilab Railhead	Vendor holds slabs/FOB Fermilab. Fermilab arranges shipping when acceptable slabs beome available. U.S. short ton = 2,000 pounds.	
Suggested Vendor	Suggested Vendor Site	Suggested Vendor Contact	Suggested Vendor Telephone #
U.S. Steel - Non-Prime Products	Gary Works	John Risser	412-433-3984
Reference #	Need-By-Date	Charge Account (Budget Code/Cost Element)	UN Number (Chemical #) / Hazard Class
	March 14, 2003	YBD/74243, 74770, 74755, 74301	

Justification (To Approver):

Note to Receiver:

Total of Requisition: $142,000.00

Requisition Lines

Line #	Line Type	PO Line Category	Description (Start with a Noun) (240 Characters Maximum, Enter Additional Description in Cell Below Line Item)	Quantity	Unit of Measure	Price Per Unit	Extended Price	Charge Account/ Cost Element	Split Coding Qty's %
1	Deliverable		Carbon steel intermix slabs, sheet & plate grades; steel grade suitable for welding, burning & tapping; IF grade not acceptable; 0.33 maximum carbon content; 1.2 maximum	Up to 800	U.S. Short ton	$175.00	$140,000.00	YBD/74243 YBD/74770 YBD/74755 YDE/74301	43.6 19 37 0.4
1			manganese content; negligible alloy content; 9.11 inches nominal thickness; width & length are as-cast dimensions						
1			of available slabs. USS provides Fermilab the size & chemistry report for each available slab. Fermilab selects slabs based on the reports.						