Attachment H
Shielding Requirements Around the Intersection of AP2 and 8 GeV Beam Lines",
by C.M. Bhat (April 7, 1994)

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Shielding Requirements Around the Intersection of AP2 and 8GeV Beam Lines

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The 8GeV beam line from Booster to MI and the AP2 beam line from the pbar source to MI intersect one below the other at an angle of about 49°. In the present design the 8GeV beam line at this location is at an elevation of 715.724ft and the floor of AP2 beam line tunnel is at 726ft elevation with a 4.5ft soil in between them. With the berm thickness of 13ft above the AP2 beam line, there will be a total soil shielding of about 17.5ft above the 8GeV beam line. This amount of radiation shielding will not meet the PSAR requirements for the 8GeV beam line. Hence here we have estimated total optimum amount of steel shielding to be added to meet PASR requirements.

Following assumptions will go into our radiation shielding evaluations:

-In the direction of the beam from Booster to MI we assume

An Accidental loss of 5.7E16p@8GeV/accident,

An Operational loss of 1.0E19p@8GeV/Year (with 6000 hours of operation per year).

-The necessary shielding criteria is 24.5ft of earth equivalent.

-1ft of steel shielding adds a soil equivalent of 2.89ft.

Because of the geometry of these two tunnels, an estimation of optimum shielding becomes solving a three dimensional problem. For this purpose a computer program is written which takes into account the correct geometry of the both beam line tunnels and the relative angles between them. We assume that the berm elevation is at 747ft everywhere. Hence the total shielding to be added directly under the AP2 beam line is 3.7ft of steel and it should decrease as a function of angle. We decided to split the steel shielding into two layers to meet the civil construction requirements as shown in Figures 1 and 2. We suggest to add a steel shielding of 1ft thickness under the AP2 beam line and the remaining 2.75ft above the AP2 beam line (see figure 2).

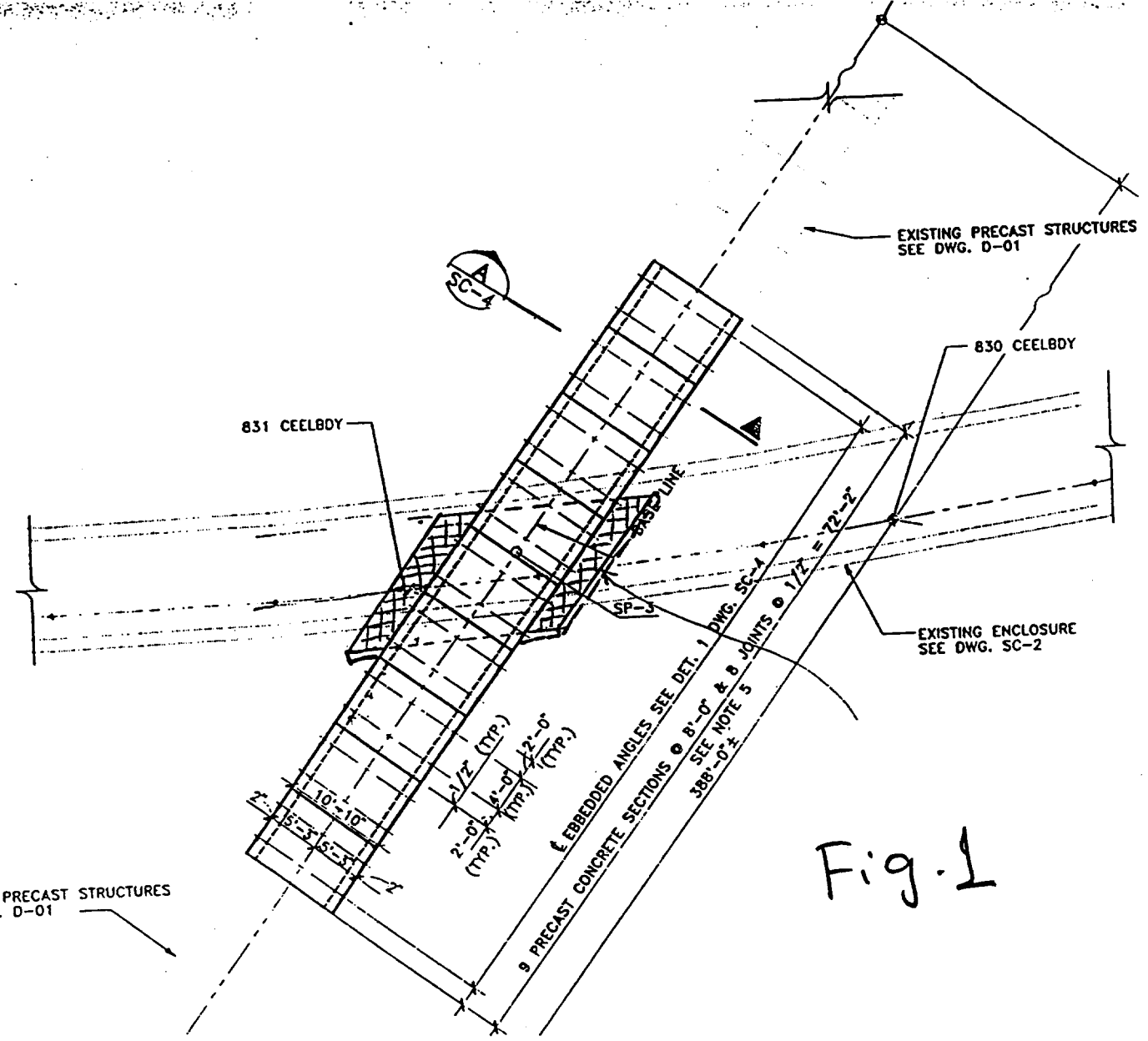
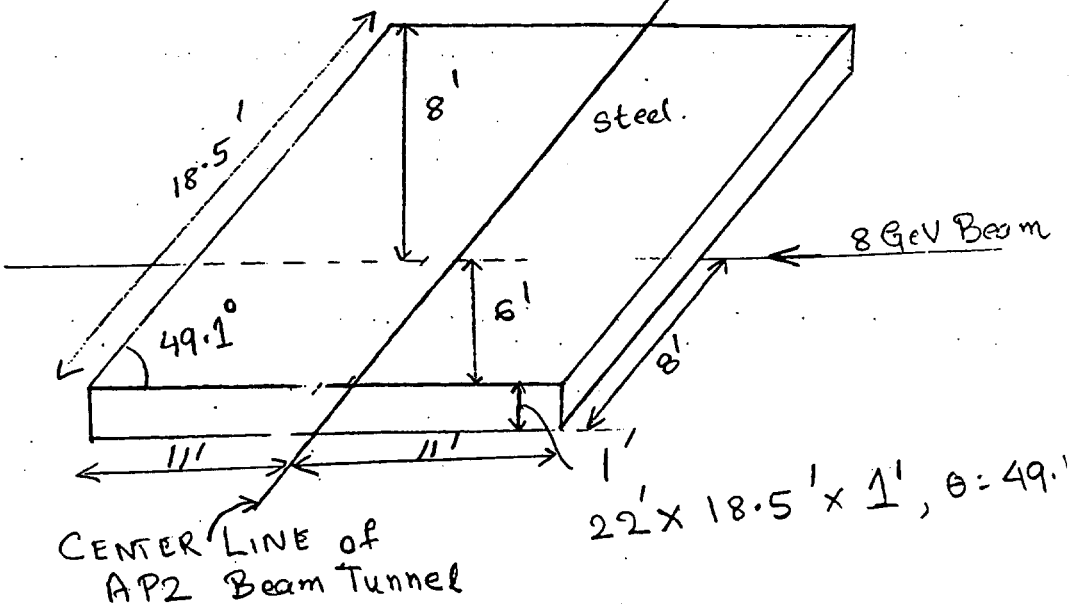


Fig. 1

Steel under AP2 Beam Tunnel.



22' x 18.5' x 1', θ = 49.1°

Minimum Requirement-

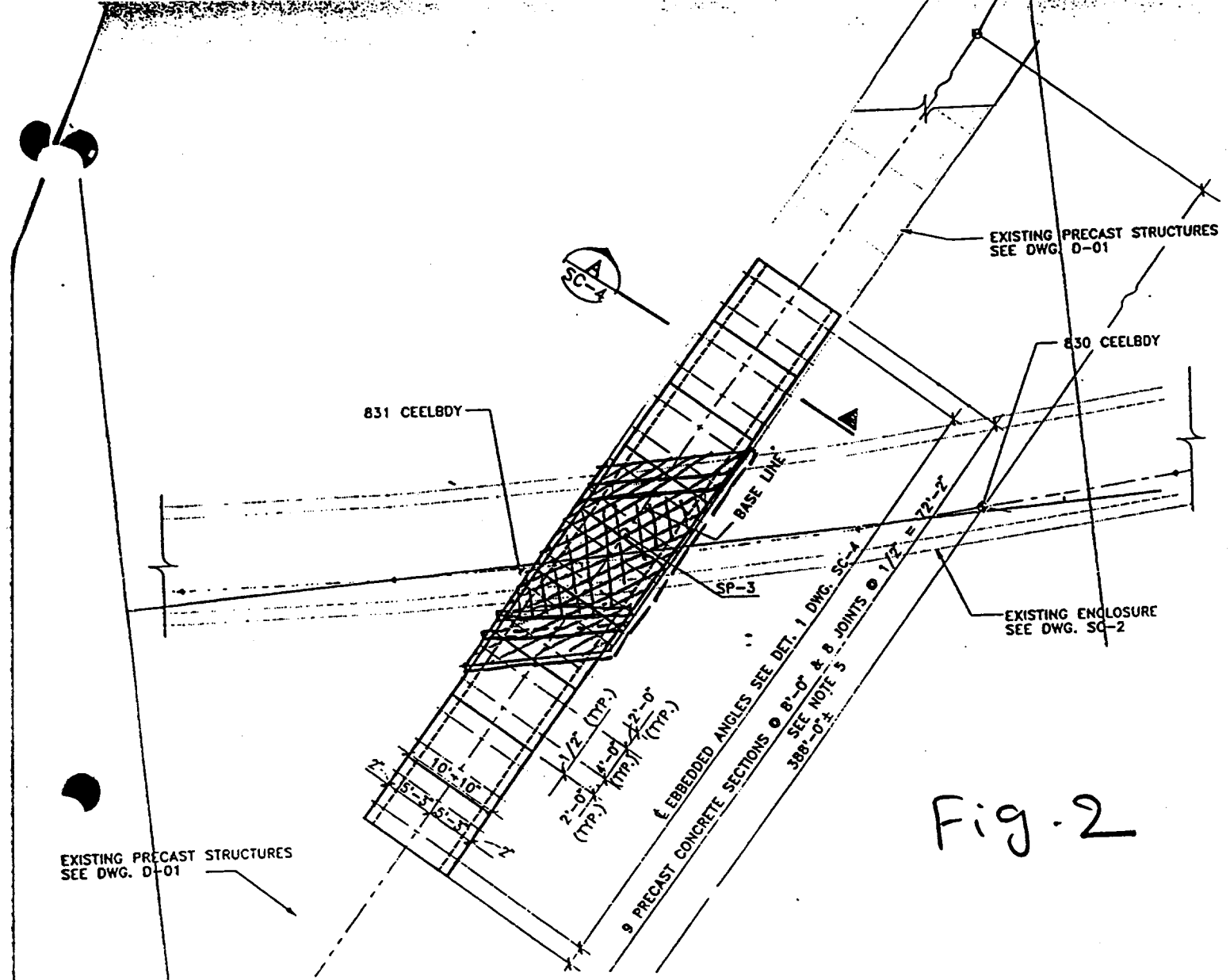
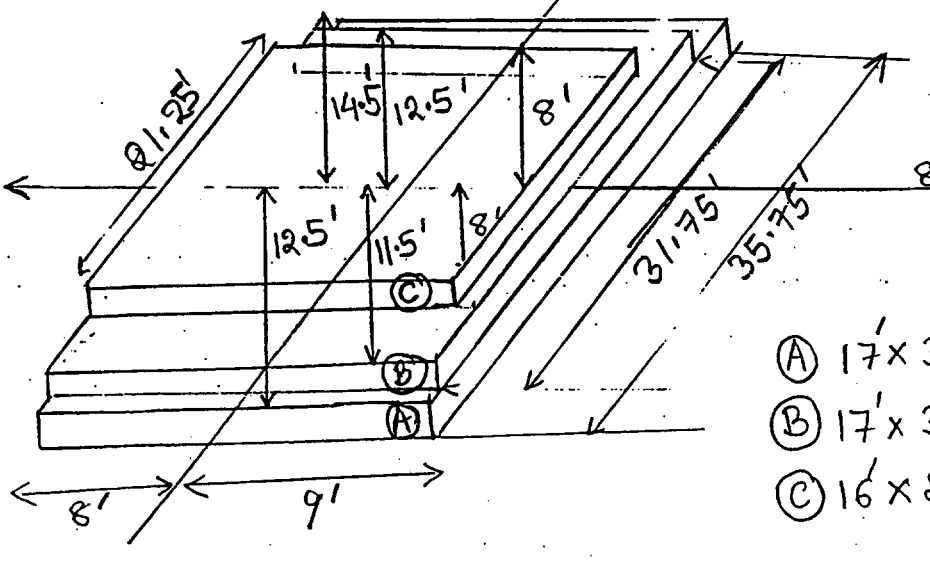


Fig. 2

Steel Above AP2 Beam line tunnel



Minimum Requirement-

(A) 17' x 35.75' x 1', θ = 49°
(B) 17' x 31.75' x 1' "
(C) 16' x 21.25' x .75' "