Leo Gilbride

From: Leo Gilbride
Sent: Wednesday, August 09, 2006 12:42 PM
To: Laine Adair
Cc: AAI Archive
Subject: (226-30) GENWAL Main West Retreat Analysis--Preliminary Results
Attachments: Figures 4-30.pdf; Figure 1.pdf; Figure 2.pdf; Figure 3.pdf

Laine,

I have prepared this email to summarize our preliminary analytical results for the proposed retreat mining sequence in the Main West barriers at GENWAL. We analyzed ground conditions using (1) the NIOSH ARMPS empirical design method and (2) the same LAMODEL stress and convergence model used in our Jul-20, 2006 analysis. Figure 1 shows the modeled areas.

ARMPS Modeling

The ARMPS method is an empirical design method developed by NIOSH based on 250 pillar retreat case histories. The database contains numerous cases representing ground conditions in the western U.S. and mining depths up to 2,000 ft, which makes the method relevant for conditions at GENWAL. The method computes a Stability Factor (SF) based on the ratio of pillar strength to pillar load averaged over the pillars within the active mining zone (near the edge of the gob). Lower SFs are supposed to indicate lower safety margins. Figure 2 plots the SFs as a function of mining depth for all the ARMPS case histories. The plot distinguishes between "satisfactory" and "unsatisfactory" case histories, where "unsatisfactory" case histories involved the following types of ground failures: excessive squeezing, bumps, and/or roof failure. The historical retreat panels in the 1st North Left block at GENWAL are computed to have a SF of 0.37 at a depth of 1,750 ft. Figure 3a shows the ARMPS model geometry used to compute the SF. The ARMPS database shows that industry experience is mixed for mines reporting similar SFs (0.16 to 1.05) at comparable depths (1,500 to 2,000 ft). Of these cases, slightly more than half were successful, while the remainder encountered ground control problems.

A SF of 0.53 is computed for the proposed retreat sequence in the Main West barriers under the deepest cover (Figure 3b). The ARMPS method recommends basing the depth of cover on sustained cover, and not on peak cover if the peak cover occurs over a limited area. Over Main West, 2,000 ft is the maximum sustained cover that is appropriate for the ARMPS calculation. Although a narrow ridge increases cover to 2,200 ft, this is too limited an area to significantly affect abutment loads in the ARMPS calculation. Elsewhere in the barriers and mains, a higher SF is computed. A SF of 0.67 is computed for pillaring east of the existing Main West seals (XC 118-119).

The ARMPS method recommends designing pillars for a 0.90 SF (for intermediate-strength roof) if site-specific data are not otherwise available. The authors of ARMPS suggest that the method is increasingly conservative at depth and that site-specific experience should be used to establish design SFs whenever possible. At GENWAL good success has been achieved at SFs below 0.90. Retreat conditions in the 1st North Left block were generally successful with a SF of 0.37, suggesting that a SF of about 0.40 is a reasonable lower limit for retreat mining at GENWAL. This is considered a lower limit because occasional problems with peeling top coal were encountered in the 1st North Left block. This required skipping pillars on retreat in some locations. Top coal is currently mined to minimize this risk and is not expected to be a problem in Main West.

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The lowest SF for the proposed retreat sequence in Main West barriers is 0.53 under the deepest cover, which is approximately 43% higher than the "satisfactory" SF of 0.37 for the 1st North Left block. Implications are that the proposed retreat sequence in Main West will be successful in terms of ground control, even under the deepest cover (2,200 ft).

LAMODEL Modeling

The Main West retreat sequence was modeled in 9 steps, as shown in Figures 4 through 30. The model includes the actual variable depth of cover ranging from 1,200 to 2,200 ft, as shown on the map in Figure 1. The figures present modeled (1) vertical stress, (2) coal yielding, and (3) roof-to-floor convergence. Results show that convergence will be less than 2.0 inches in and around the active pillaring sections in the barriers. Results of the 1st North Left back-analysis model, discussed in the Jul-20, 2006 letter, concluded that convergence less than 2.0 inches is indicative of stable roof and pillar conditions in the model. Conclusions from LAMODEL corroborate the ARMPS results, principally that convergence can be adequately controlled with the proposed mine plan and that ground conditions should be generally good on retreat in the barriers, even under the deepest cover (2,200 ft).

The model predicts relatively high convergence during pillaring east of the existing Main West seals (XC 118-119) due to relatively large abutment loads around the wide gob area. This retreat block is approximately 1,400 to 1,600 ft deep. Model results show convergence in excess of 2.0 inches in and around the active pillaring areas, suggesting some risk for accelerated ground deterioration and increased reliance on ground support (i.e., bolts and mesh, and mobile roof support). The amount of convergence and ground squeezing is sensitive to the extraction sequence and the rate of extraction. A constant and relatively rapid rate of pillaring is beneficial for controlling the risk of excessive squeezing and bumping. The overall level of geotechnical risk is not considered excessive given GENWAL's history and favorable ground conditions. The mining plan and pillar layout as proposed are considered viable. The plan affords the contingency to leave occasional pillars for protection during retreat if conditions warrant, thus providing additional control of the geotechnical risk.

We can prepare a letter report to present these results at your discretion. In the meantime, please contact me at any point if you wish to discuss these results and recommendations.

Sincerely,

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Principal

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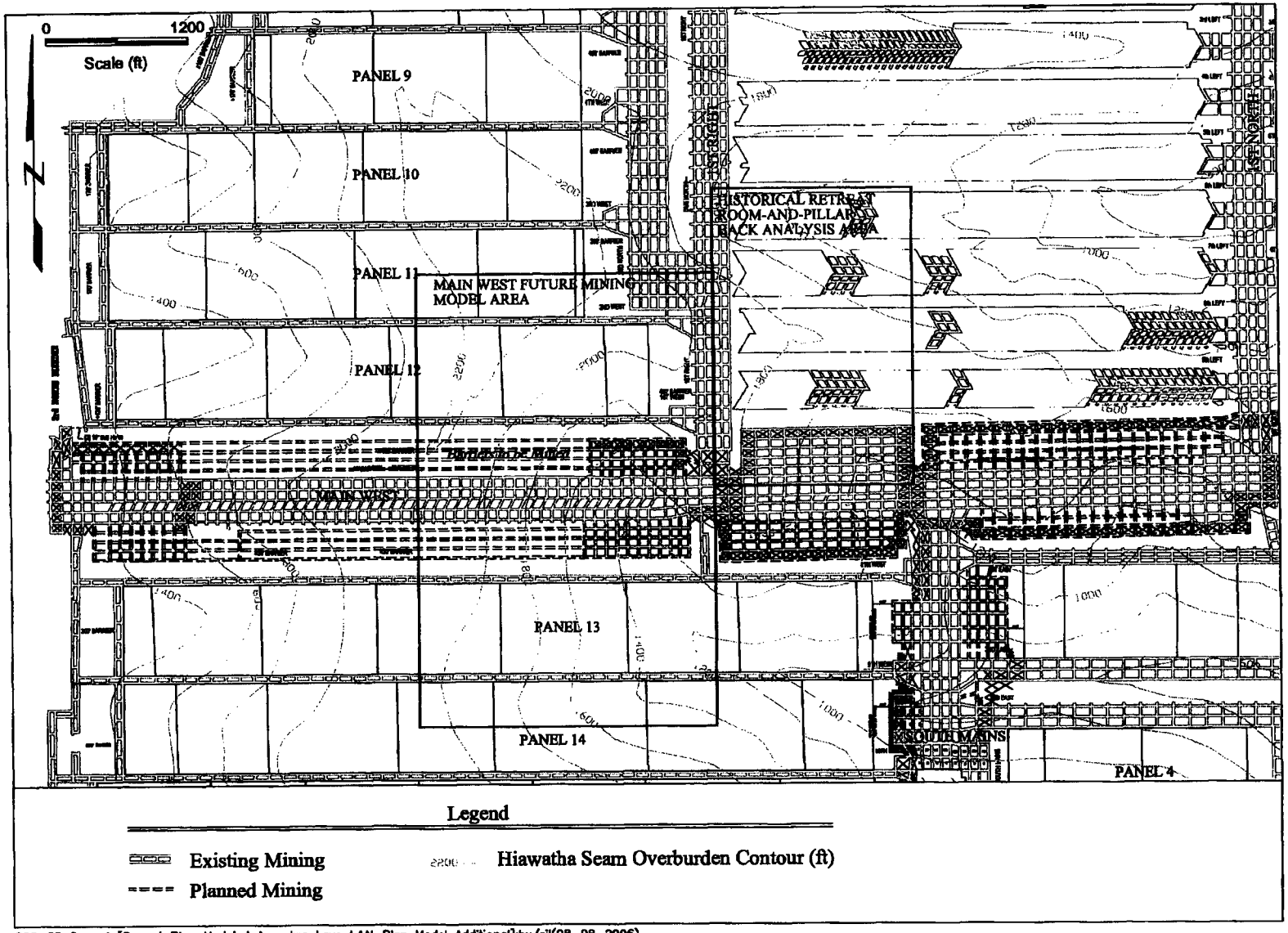

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Figure 1. Main West Location Map Showing Exisitng and Future Mining and Modeled Areas

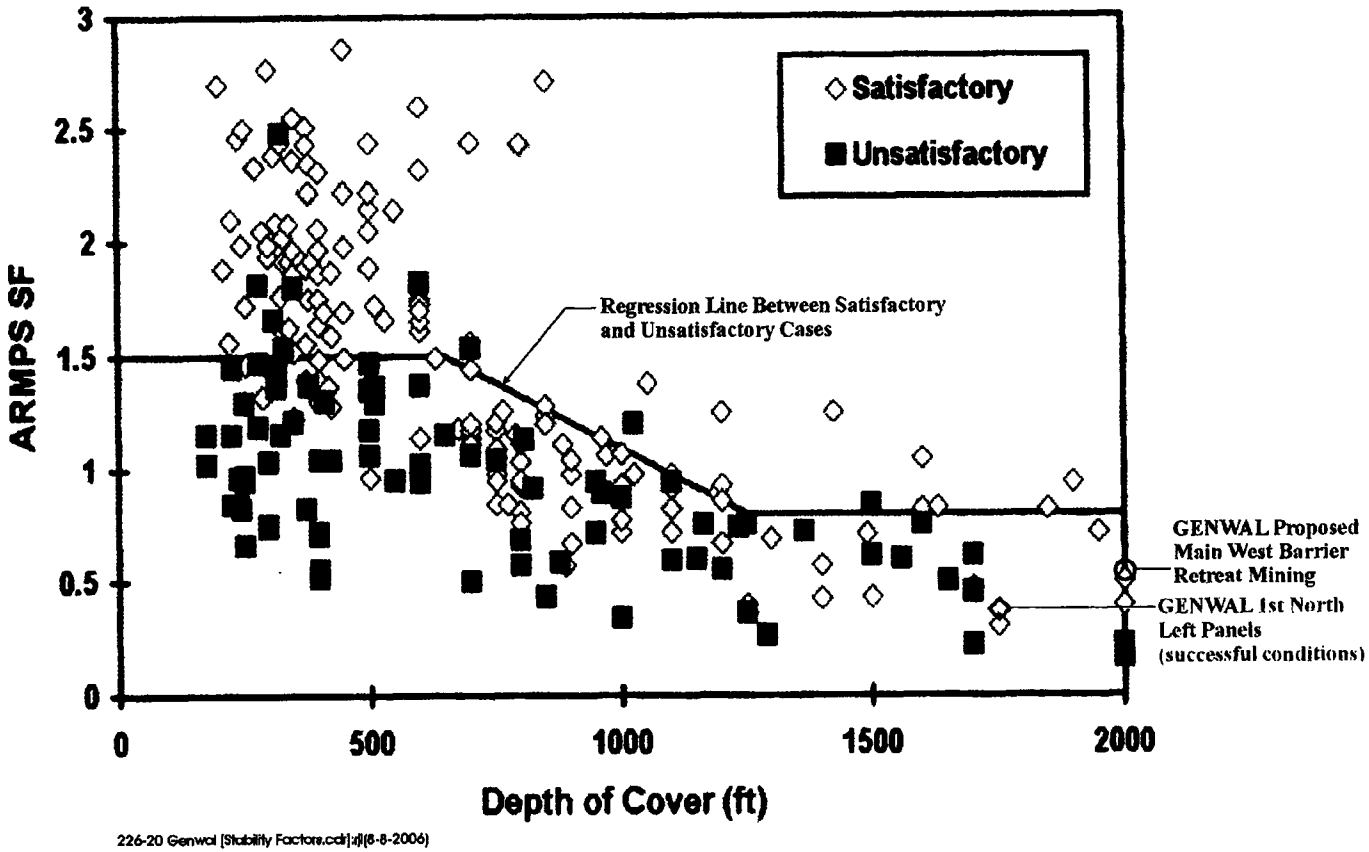

Figure 2. Comparison of GENWAL Past and Proposed Retreat Mining Stability Factors with ARMPS Case Histories

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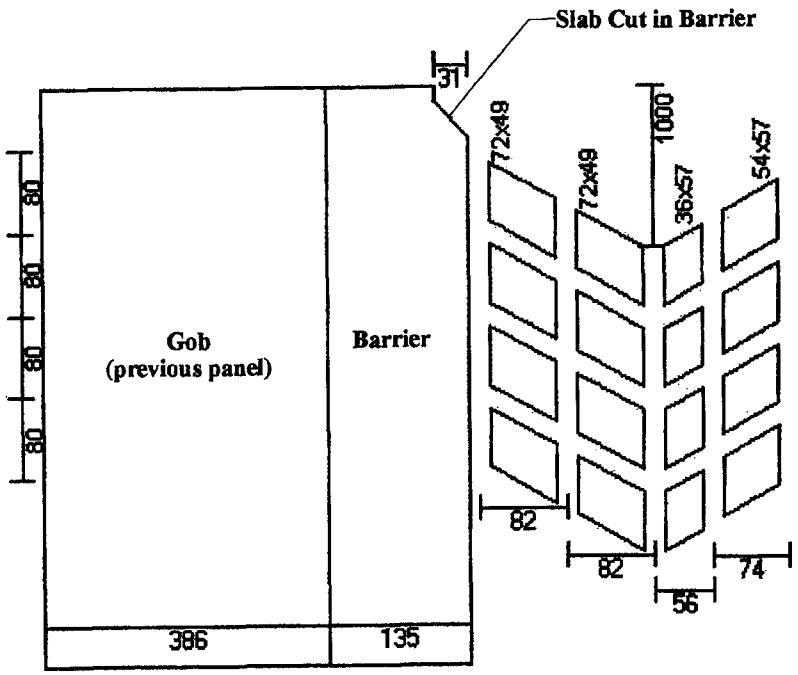
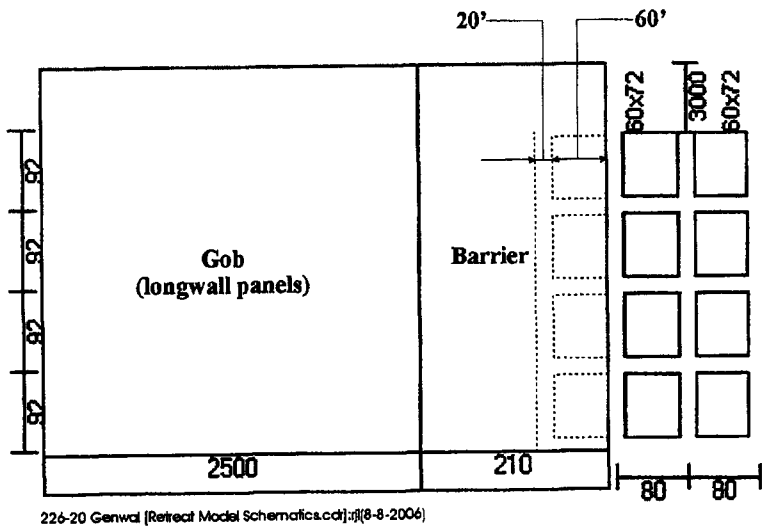
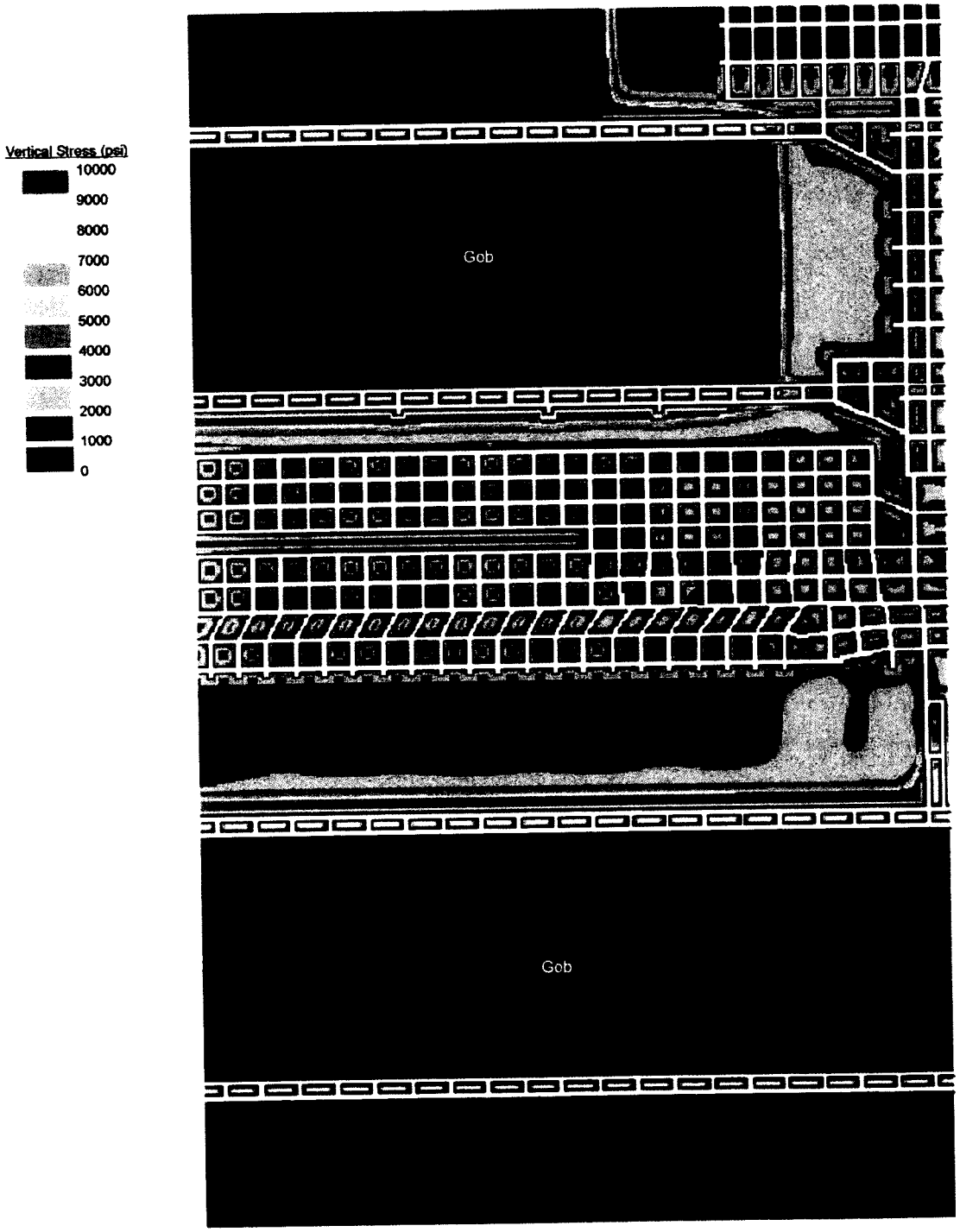


a) 1st North Left Typical Panel Retreat Geometry



b) Main West Proposed Retreat Geometry

Figure 3. ARMPS Retreat Model Schematics



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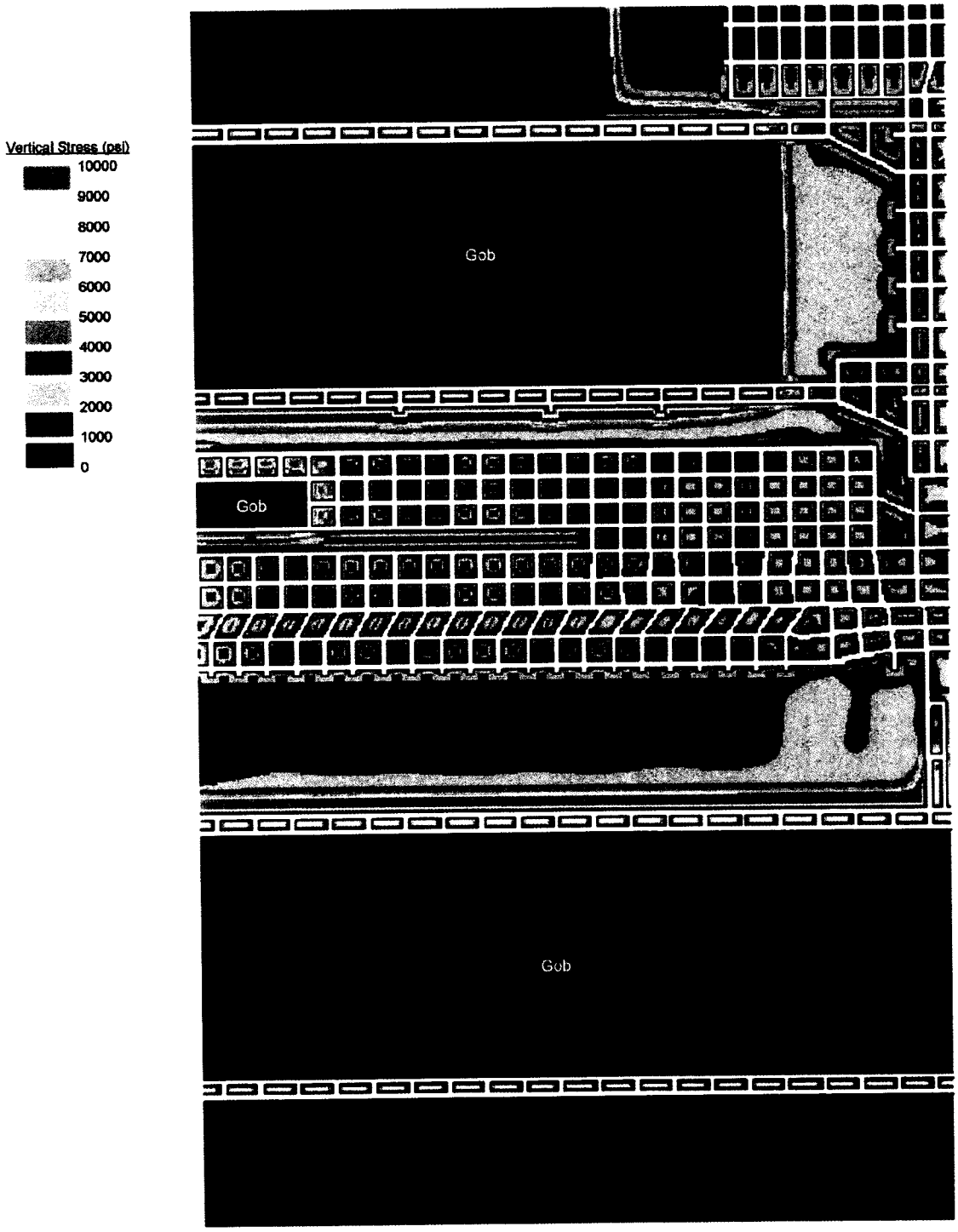

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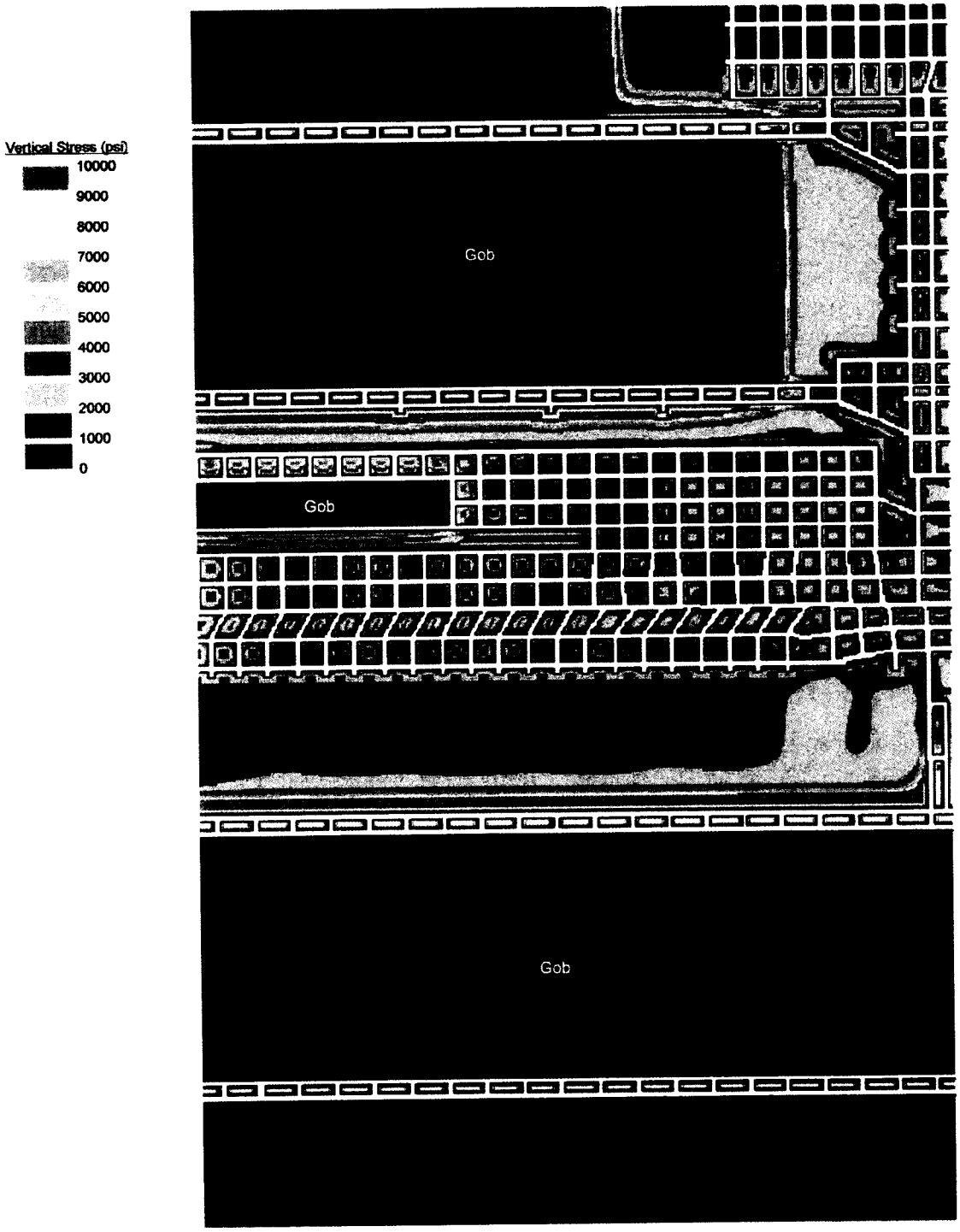

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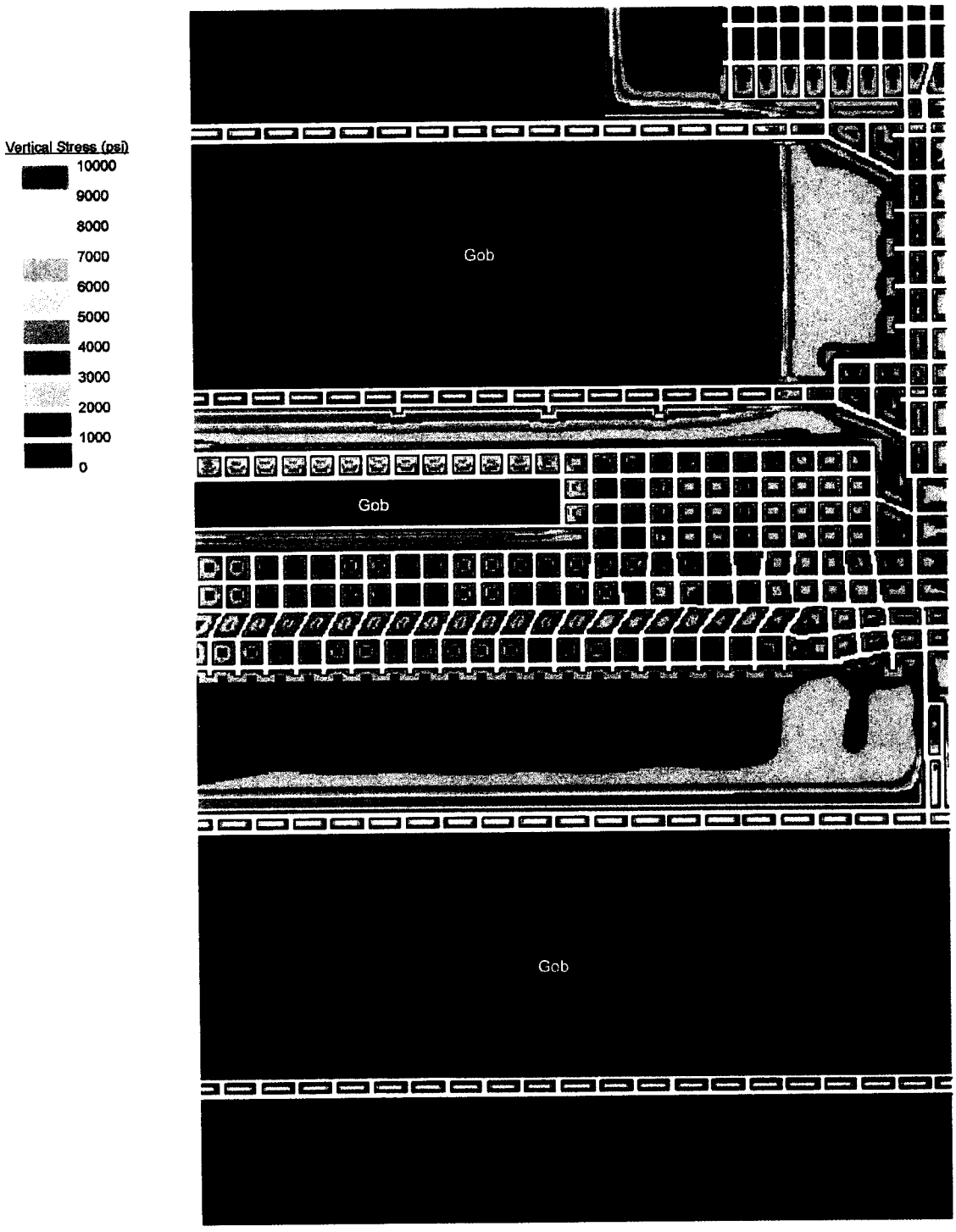

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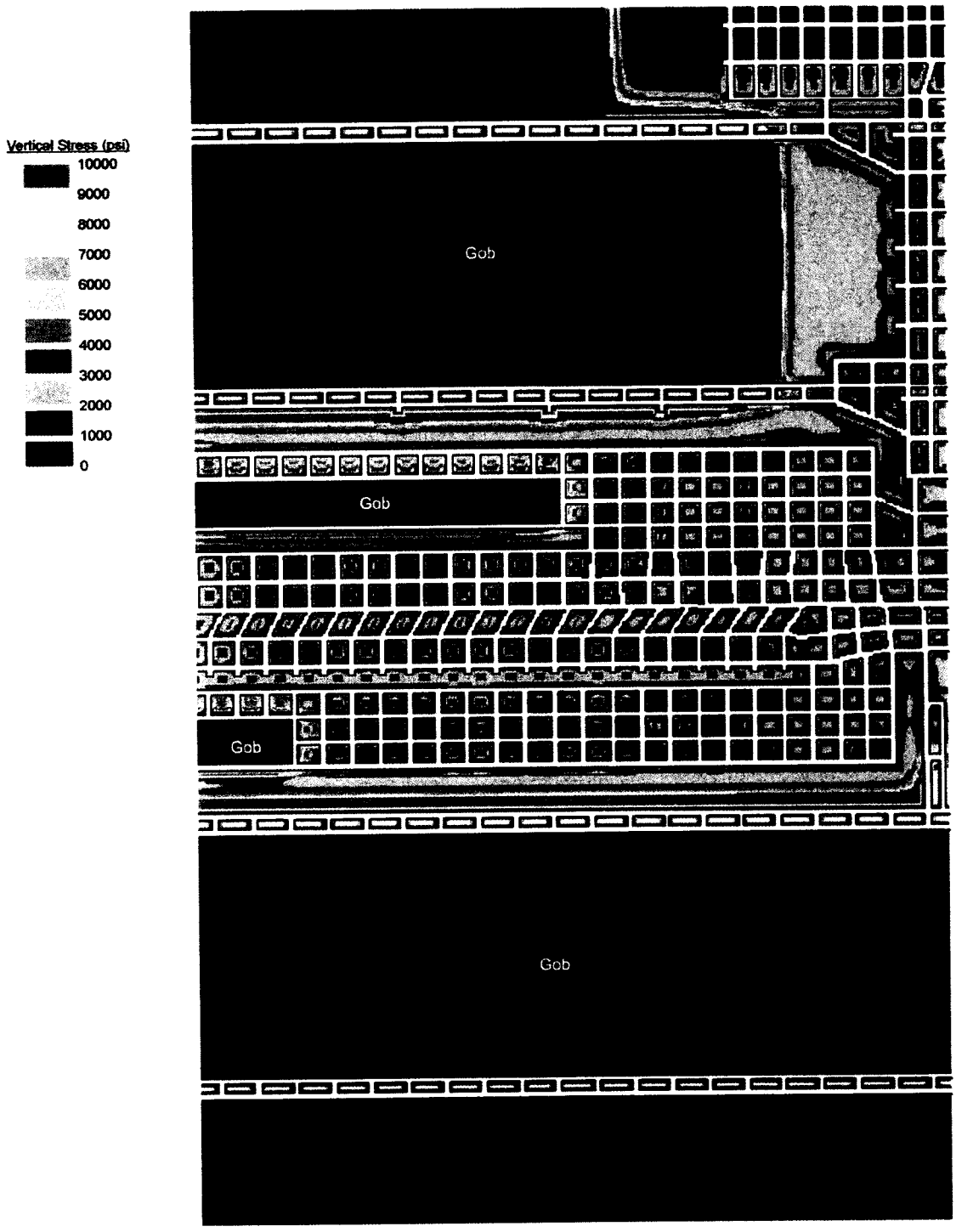

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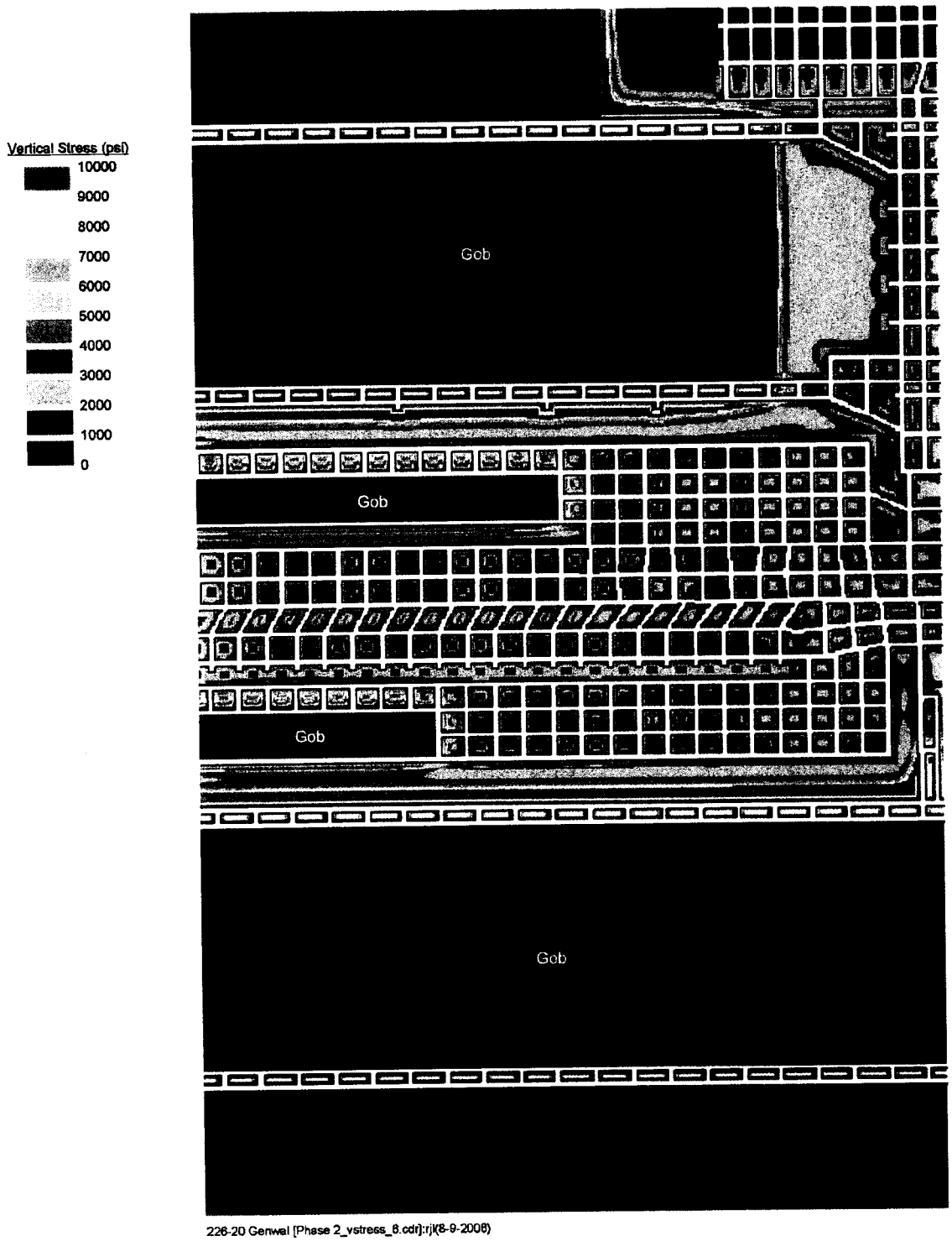

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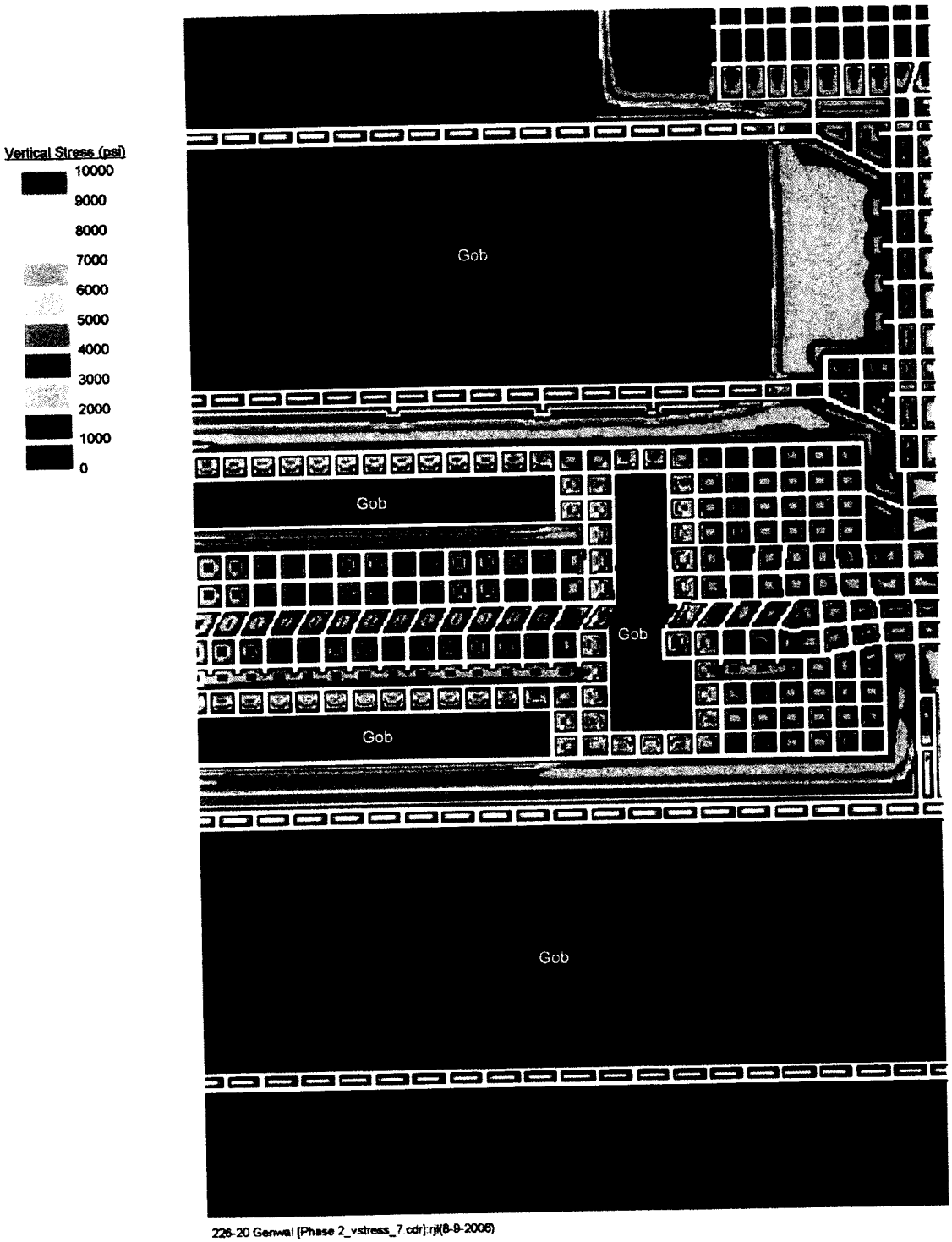
Vertical Stress (psi)
10000
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8000
7000
6000
5000
4000
3000
2000
1000
0
Gob
Gob
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Gob
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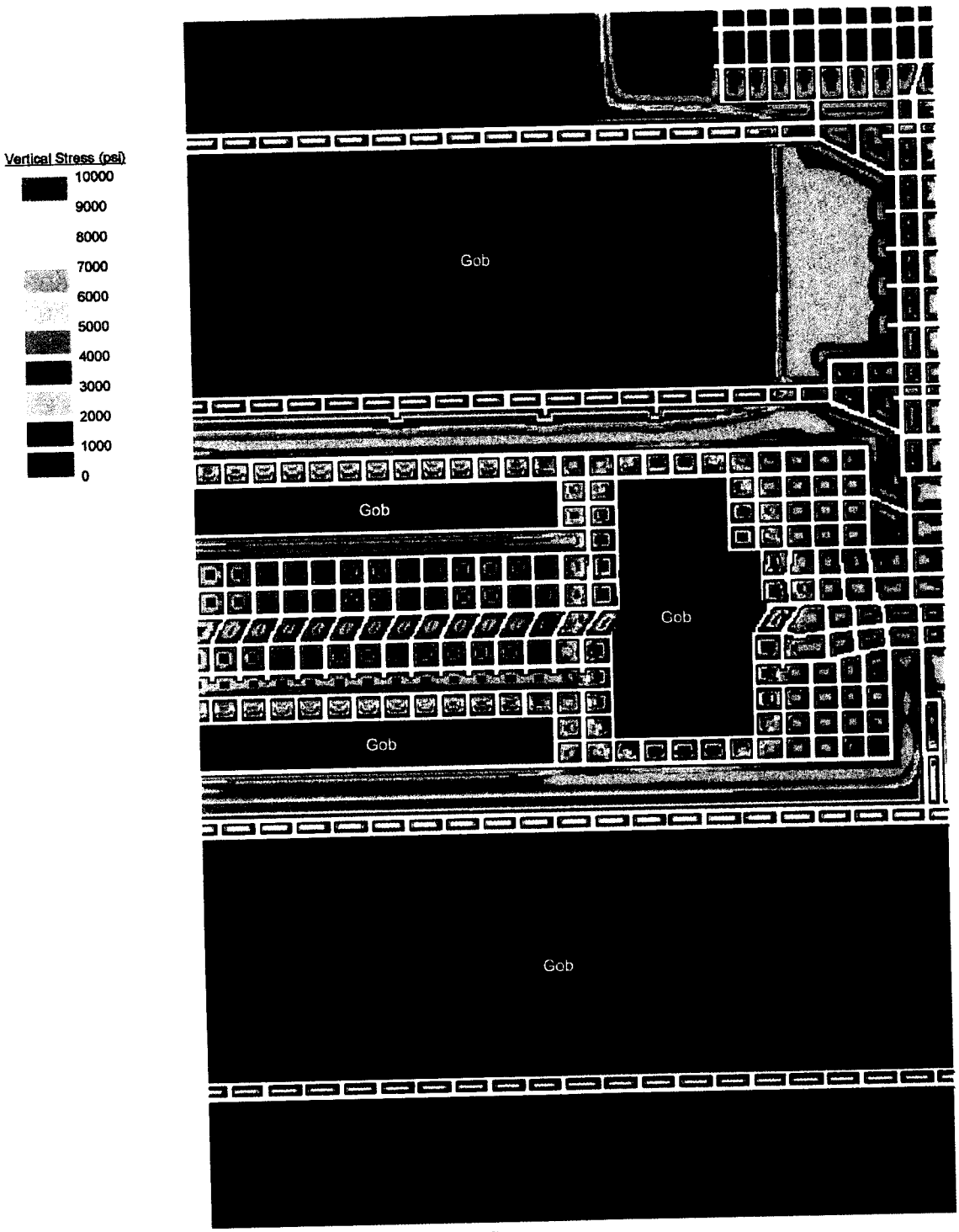

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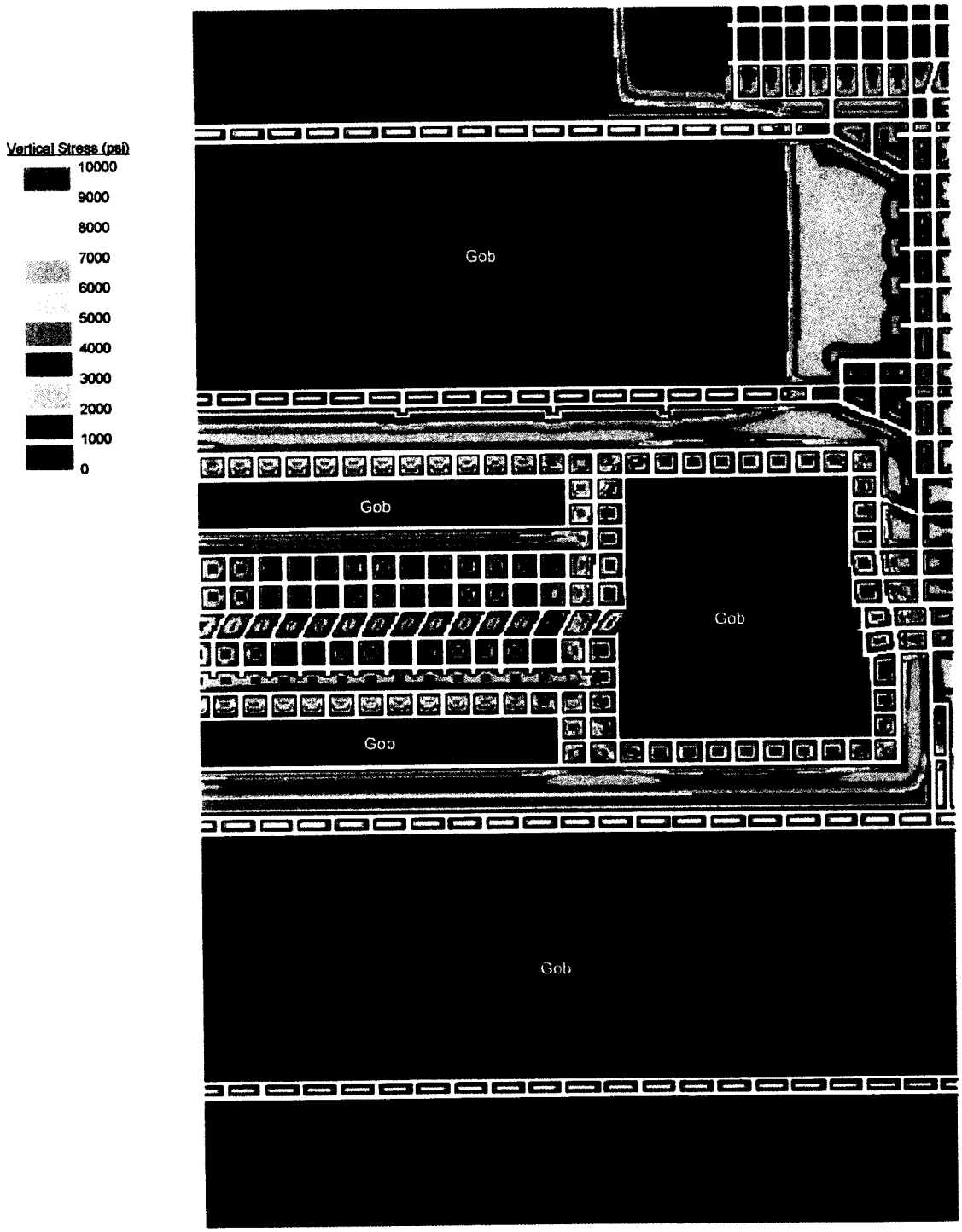

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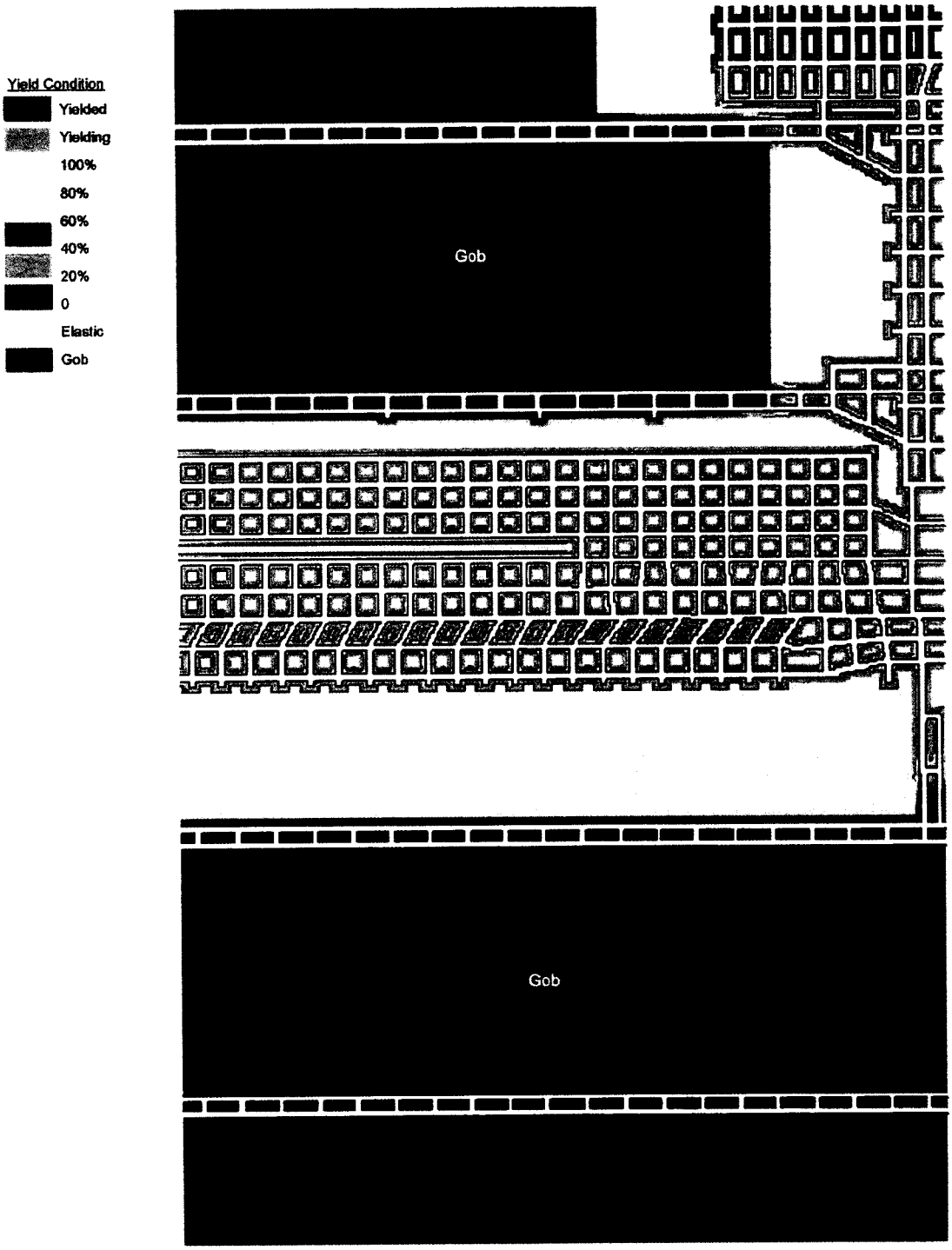

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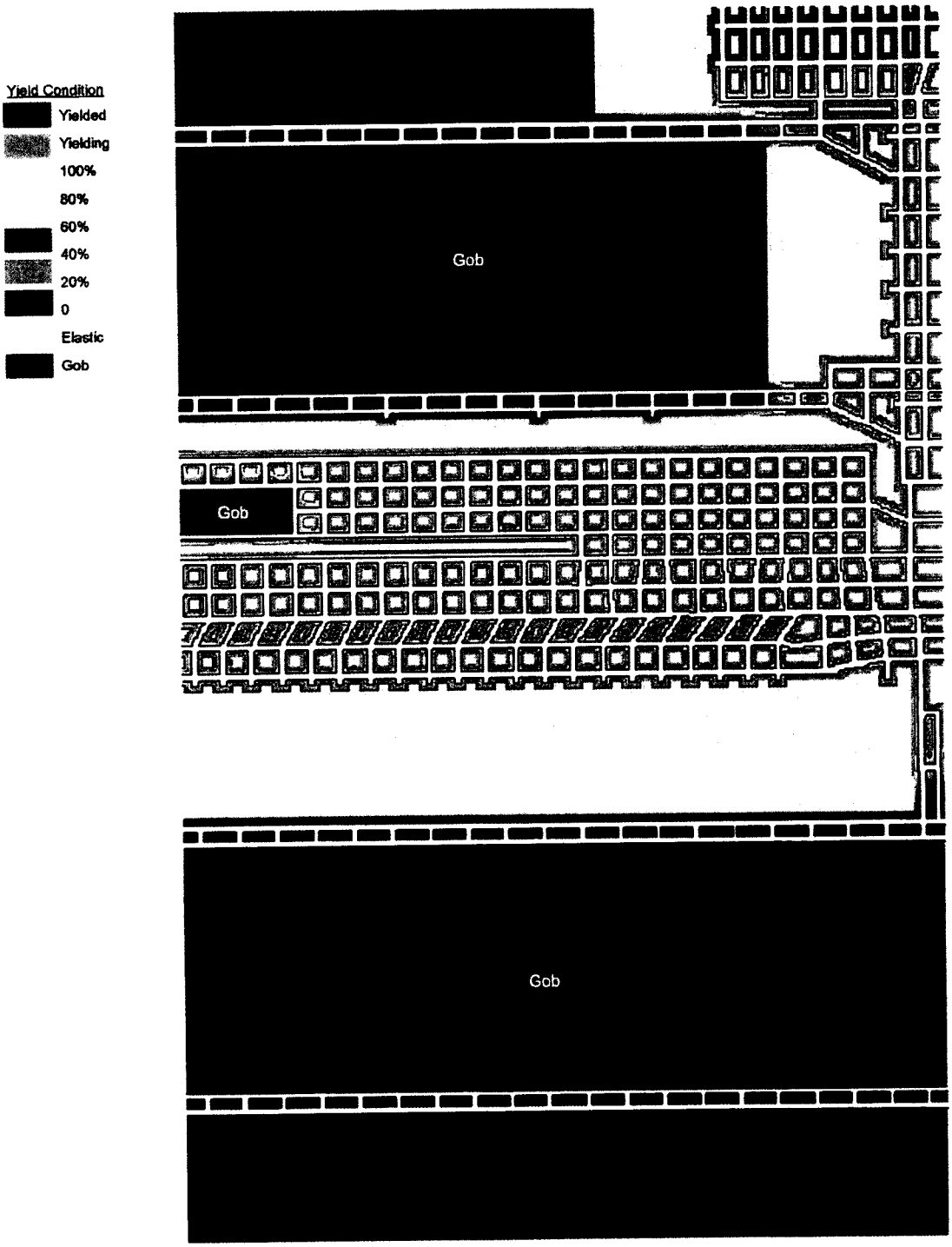

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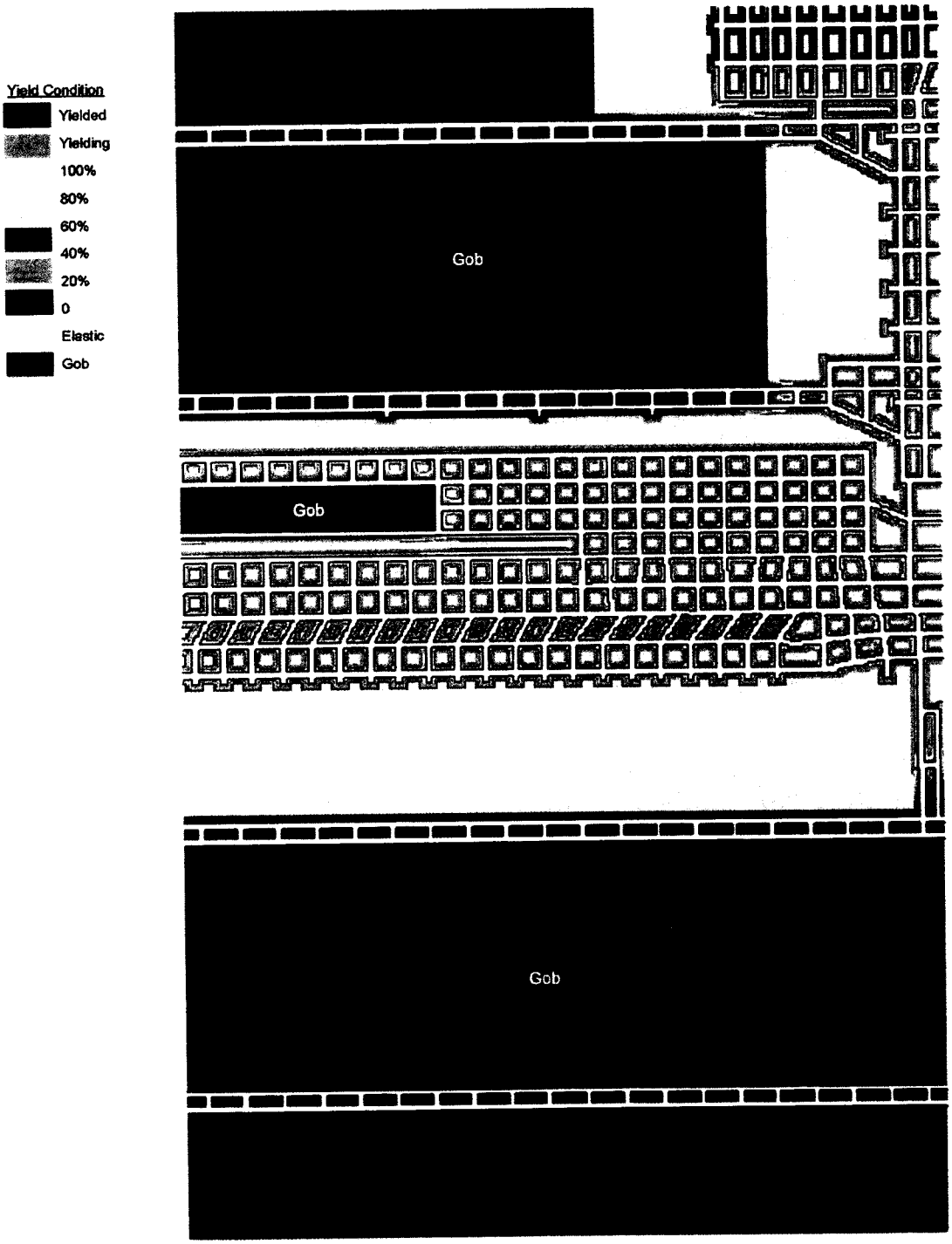

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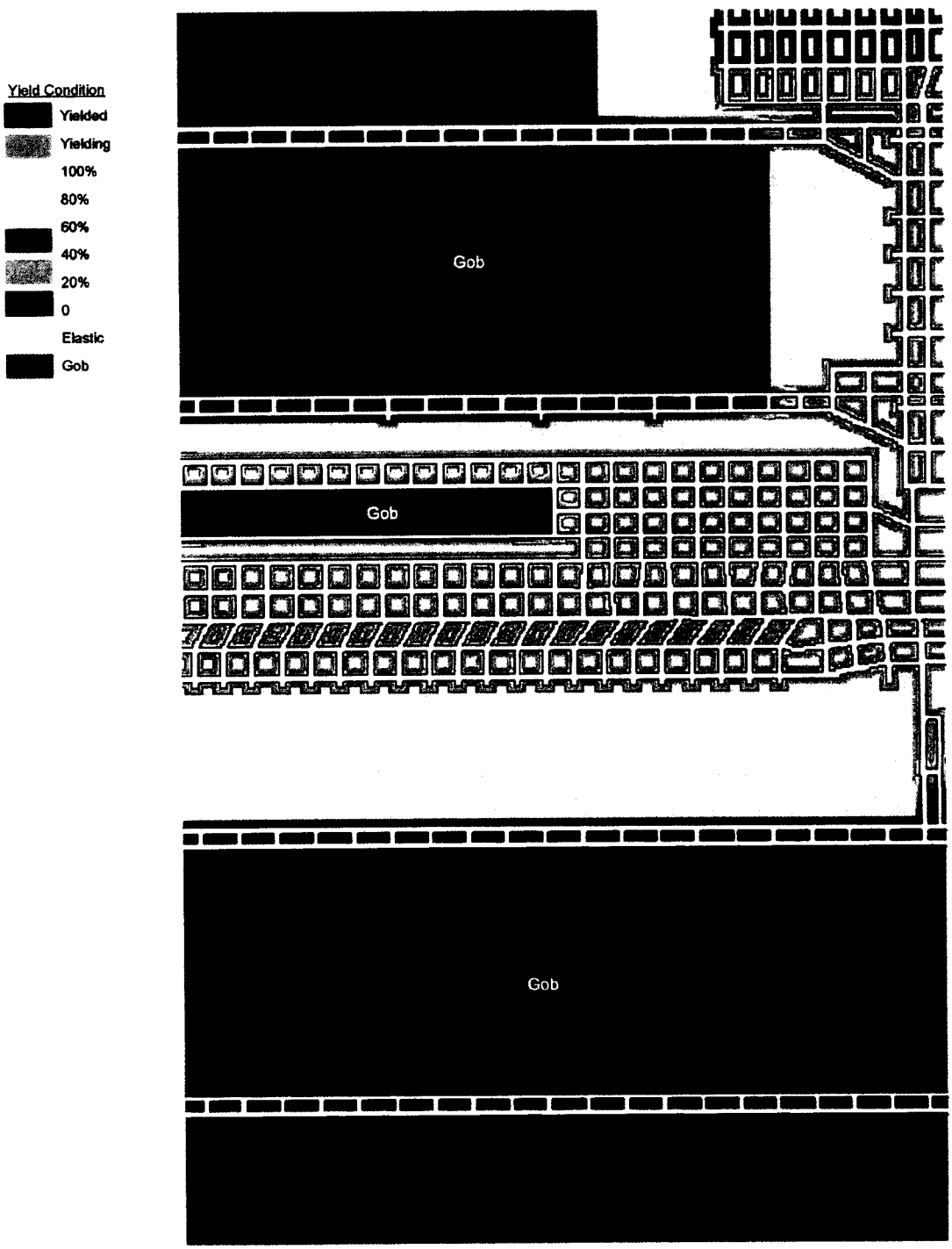

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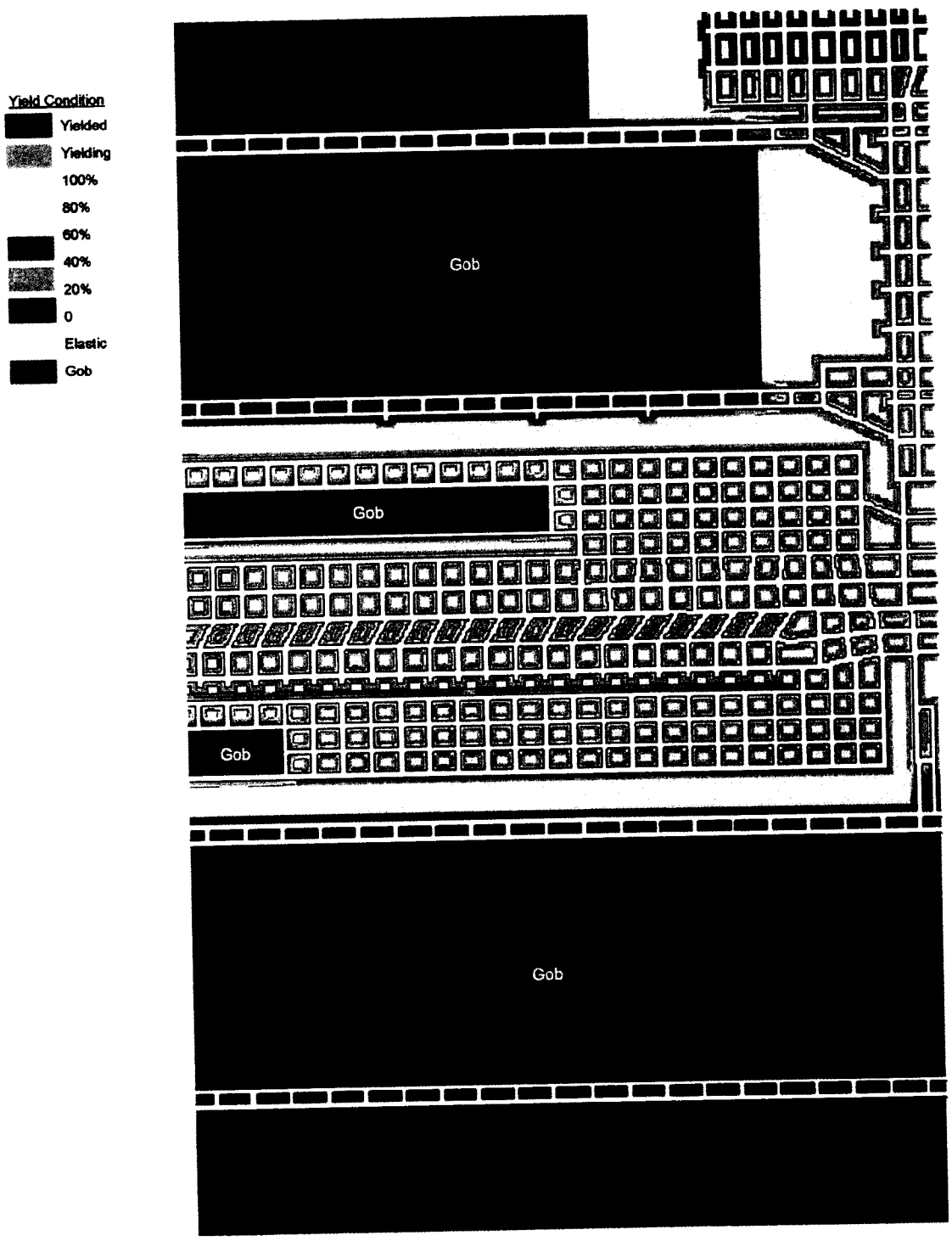

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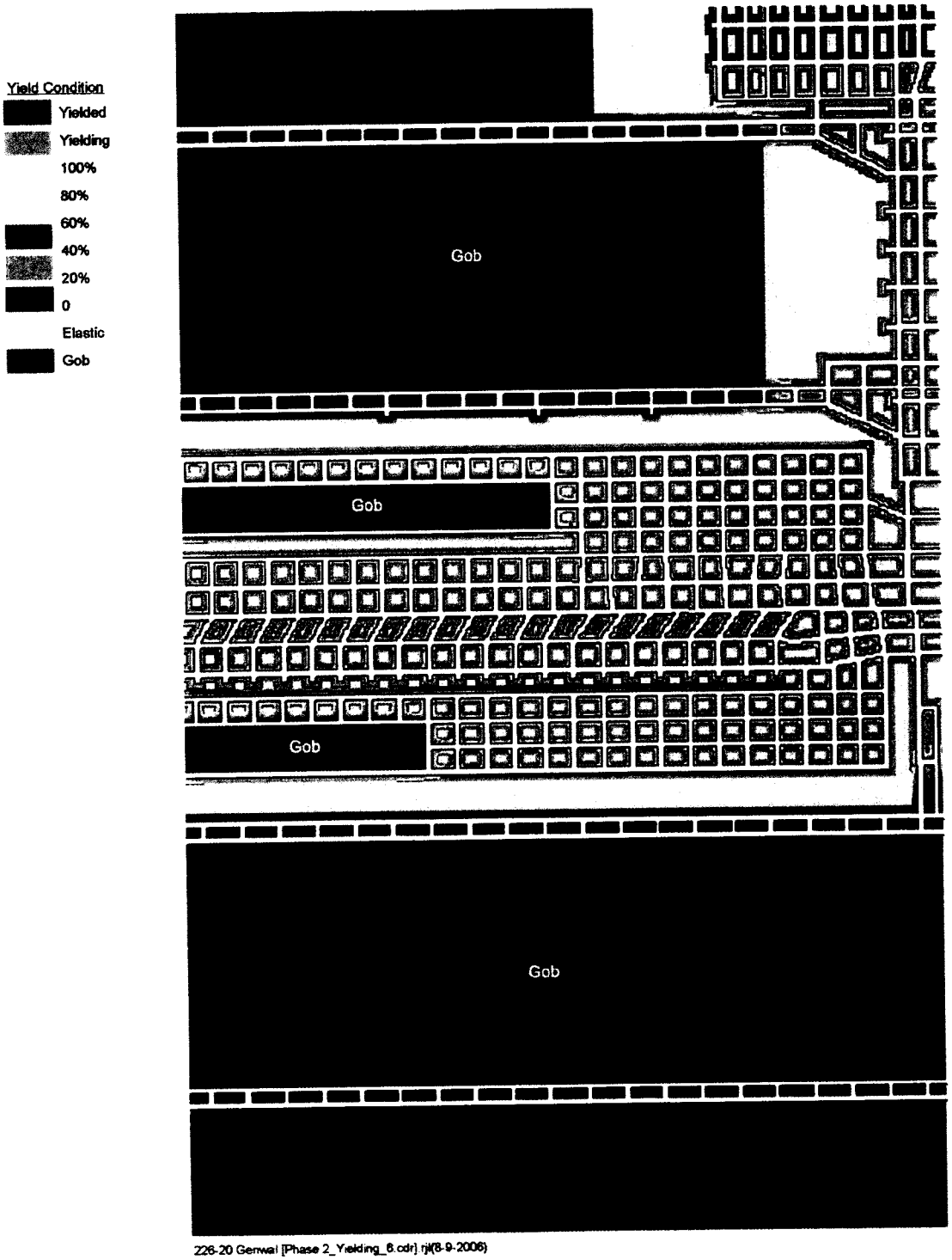

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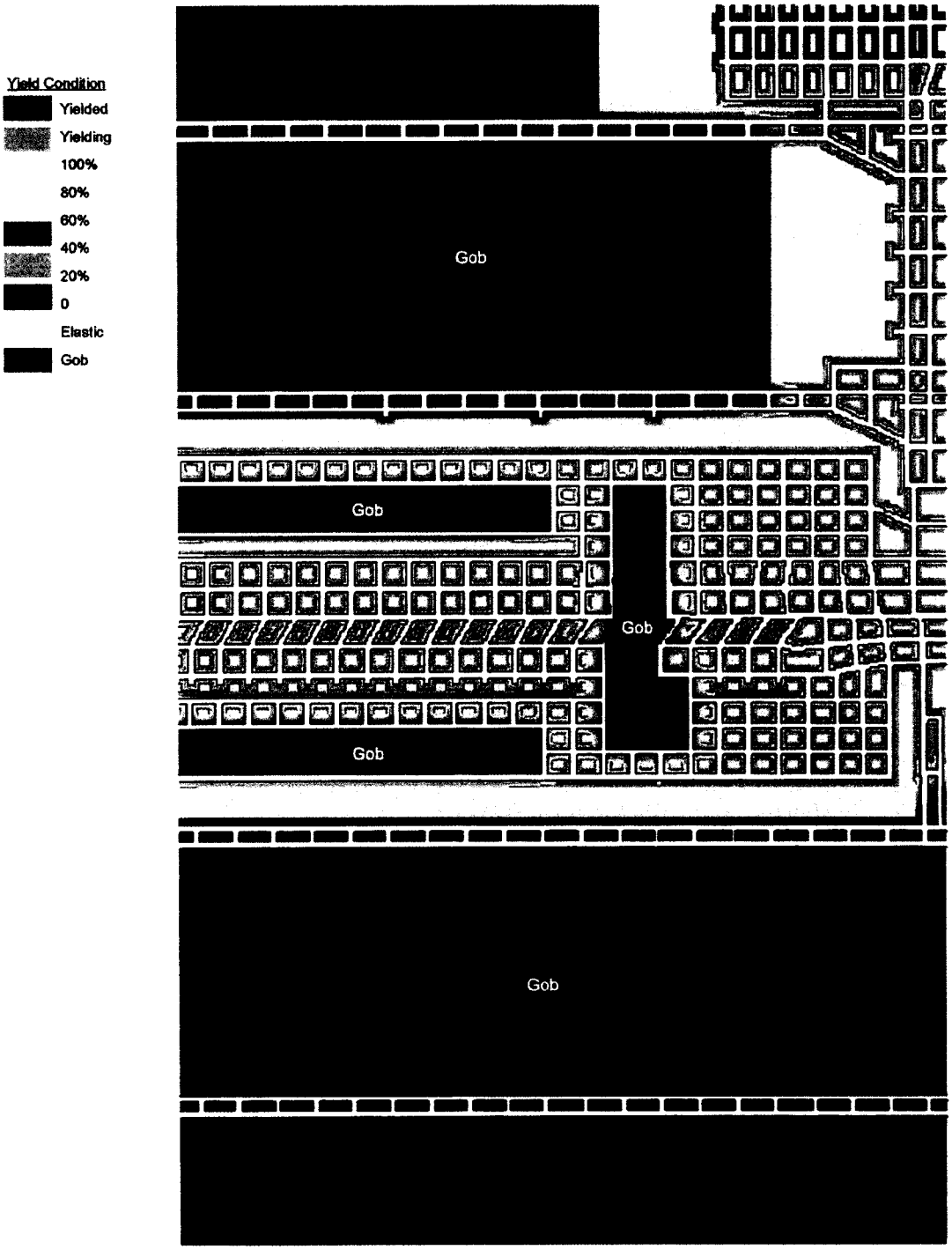

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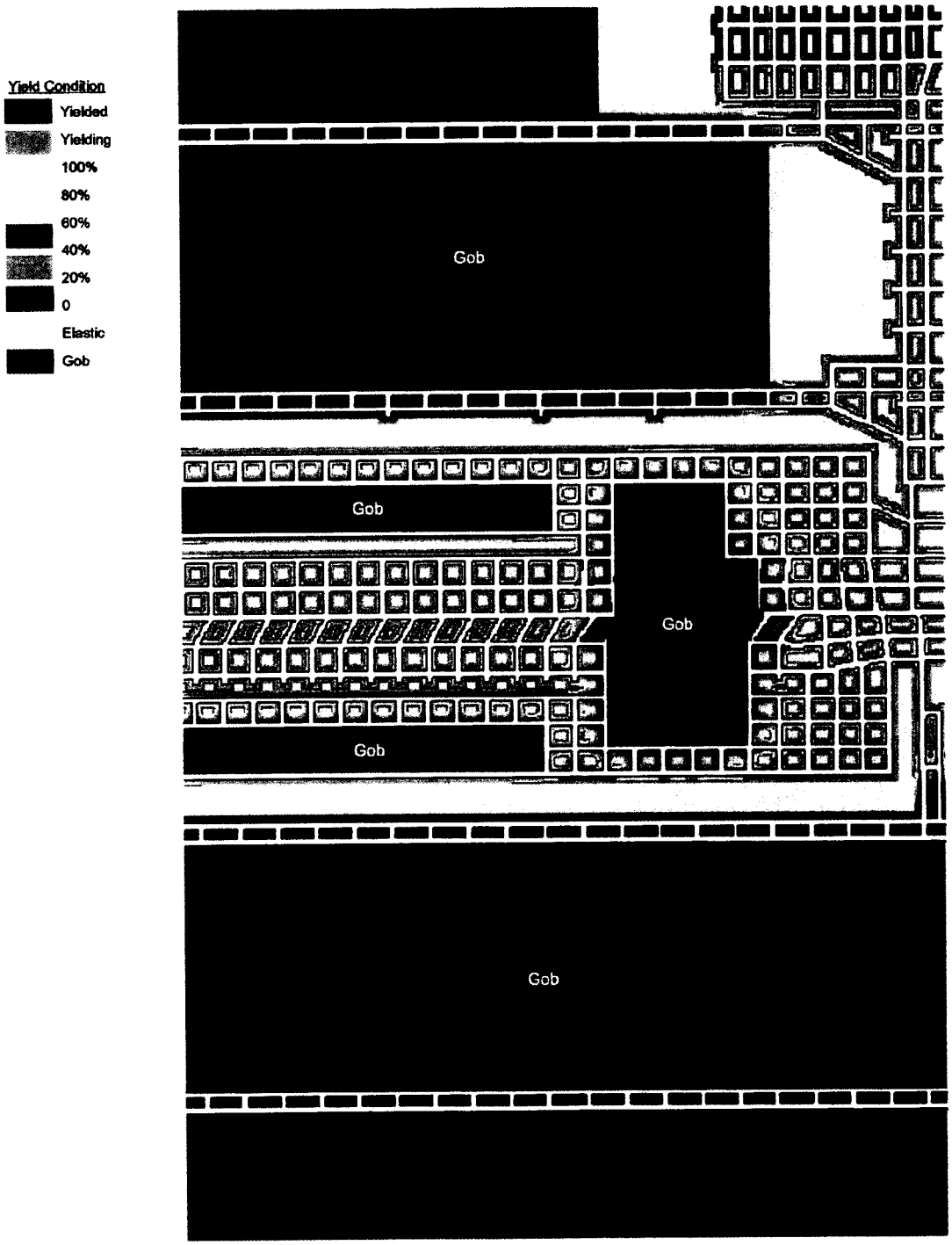
Yield Condition
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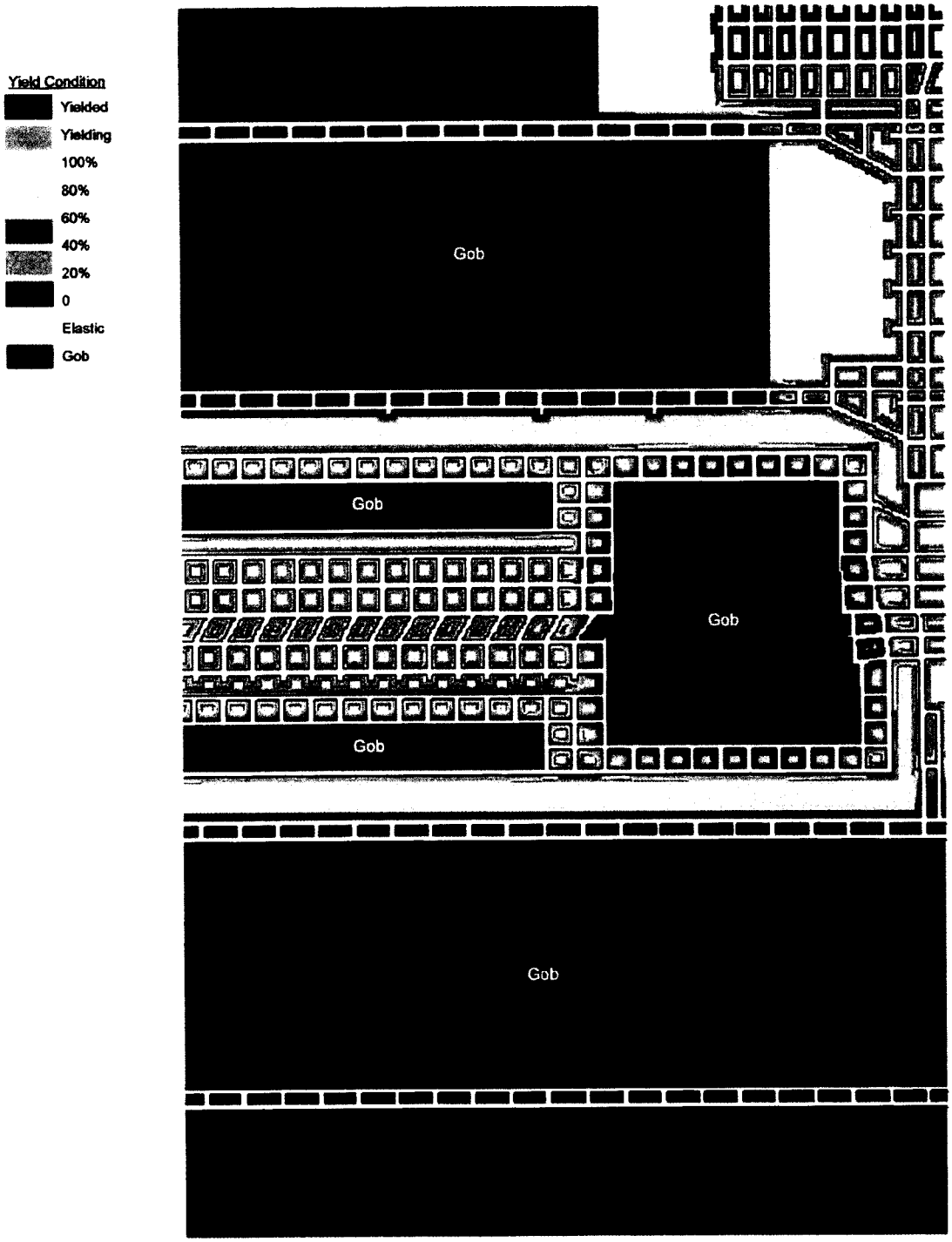

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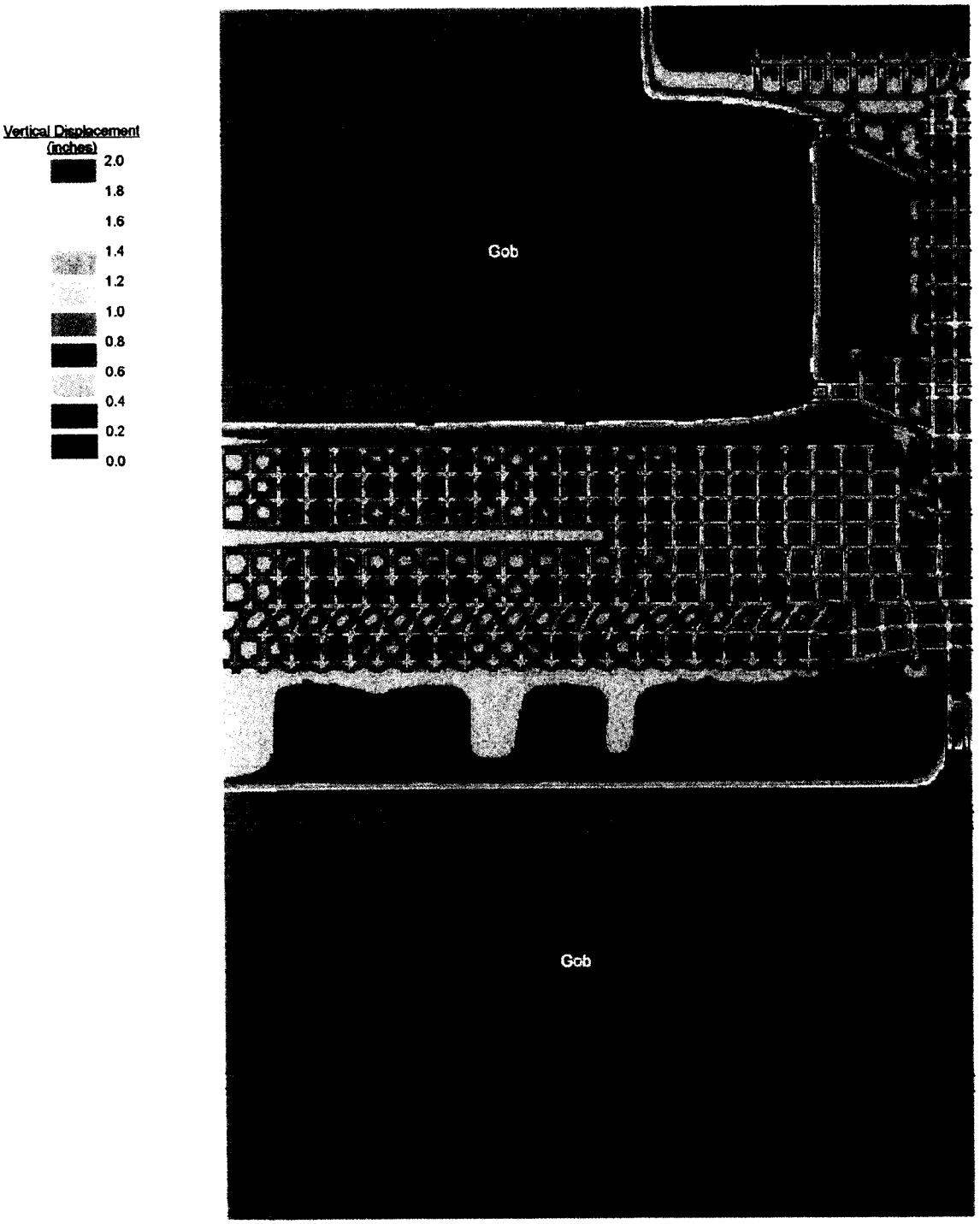

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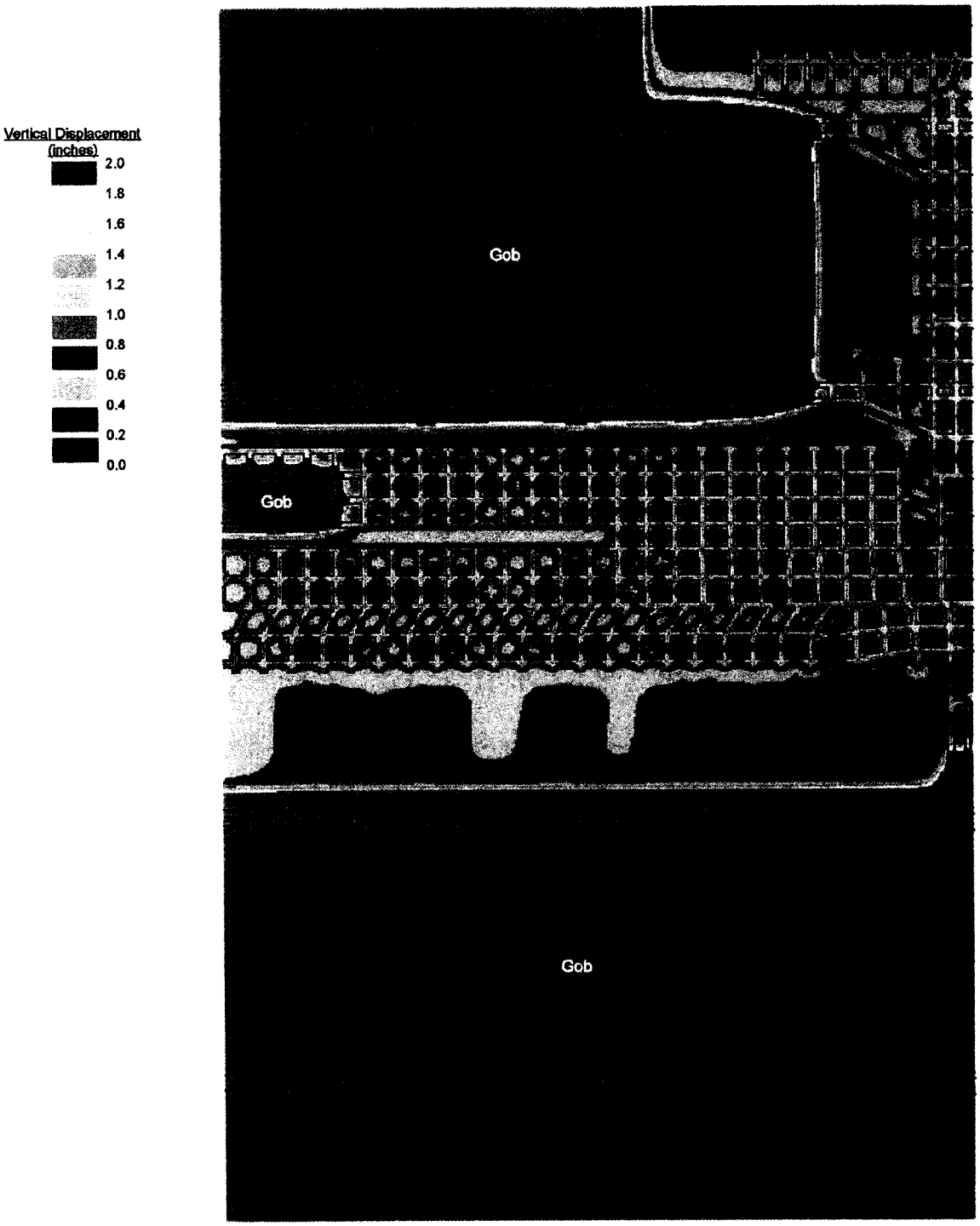

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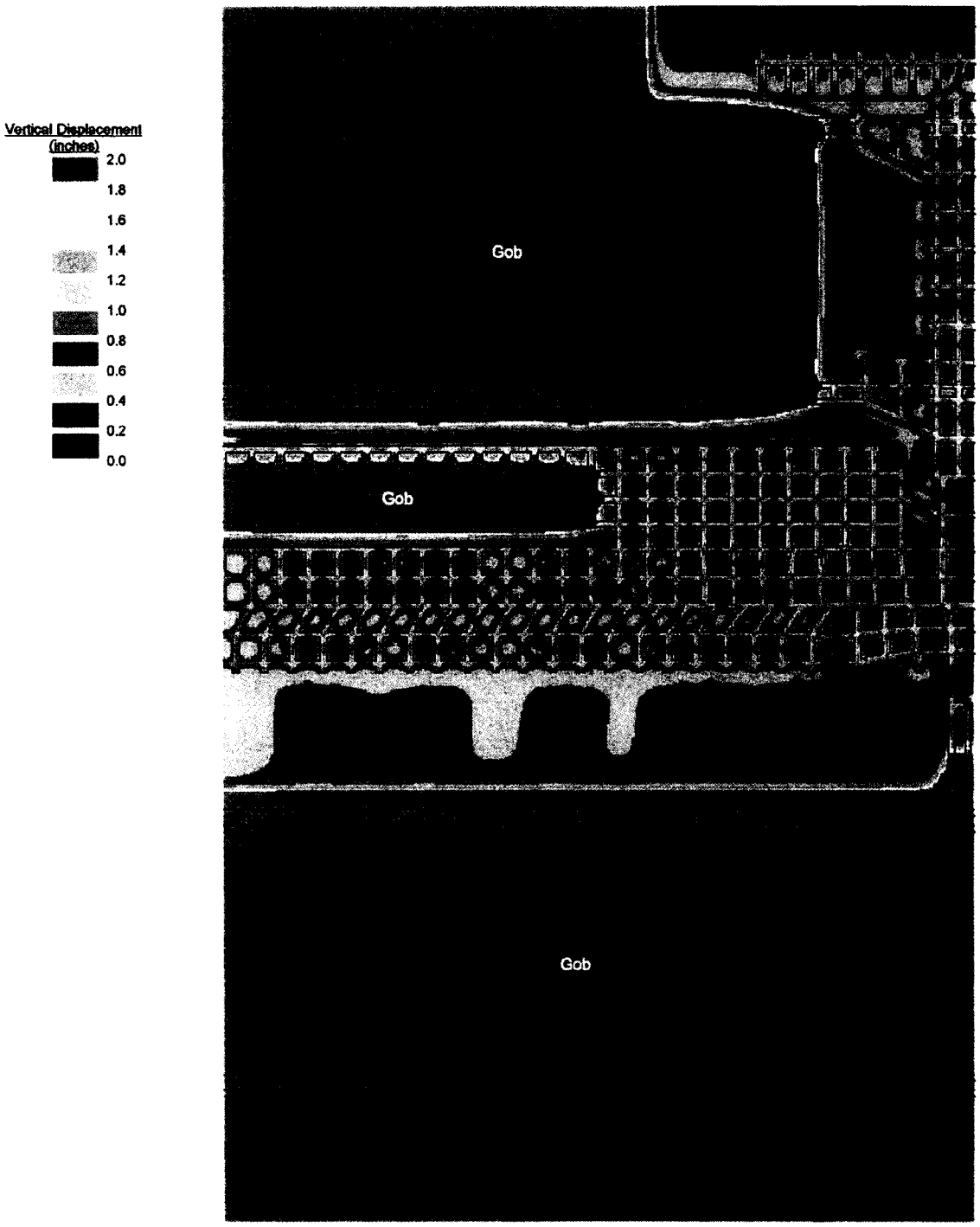

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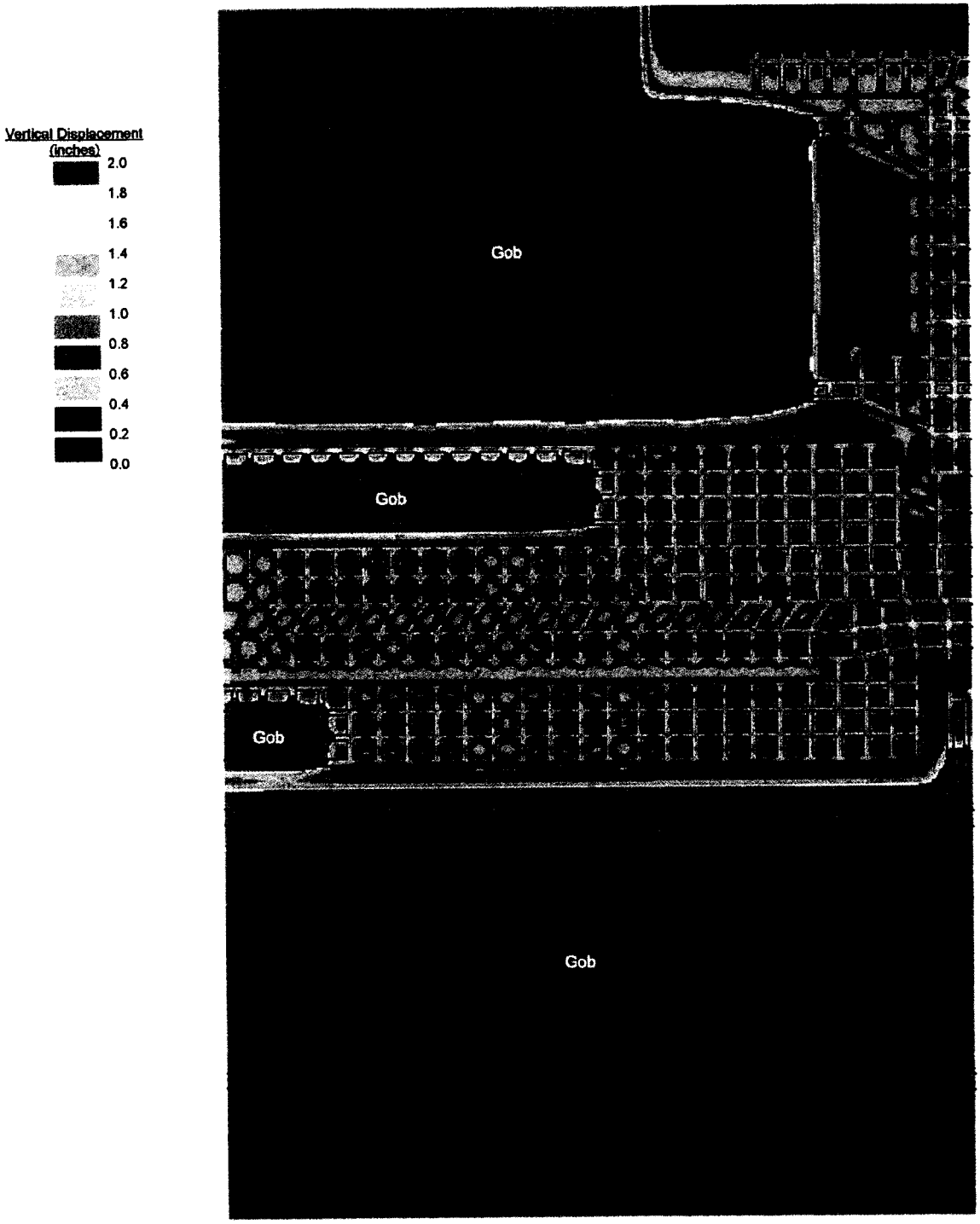

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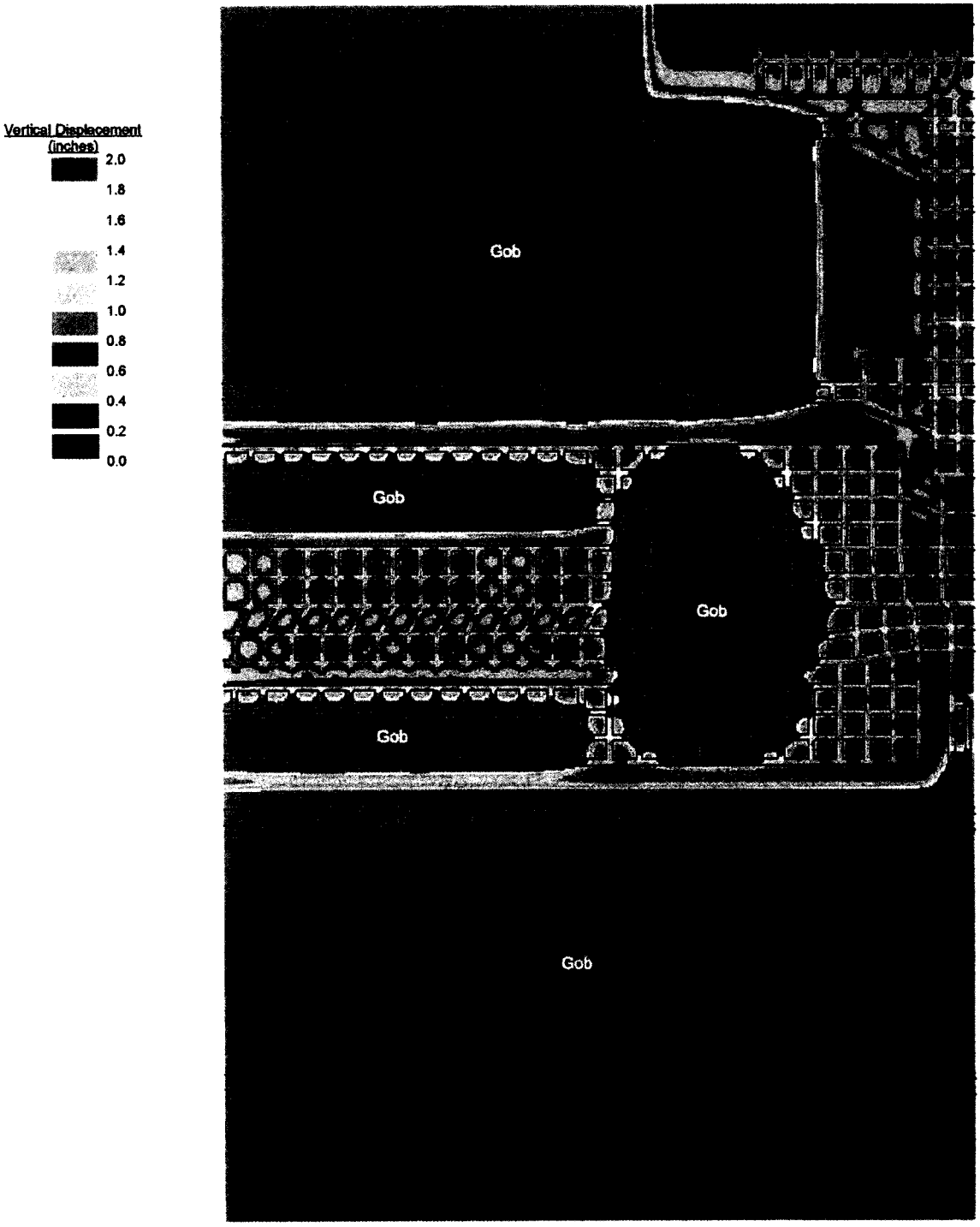
AAI000164



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