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13. SUPPLEMENTARY NOTES					
14. ABSTRACT 2D AutoDyn analyses of cylinder impact on ceramic plate have been conducted to identify the mesh size needed to capture detail crack growth in ceramic tiles Steel 4340 is used for the projectile and AutoDyn SiC material properties are used for the ceramic tile Mesh sensitivity analysis is performed using four different square mesh sizes: 0.50-mm x 0.50-mm square mesh 0.40-mm x 0.40-mm square mesh 0.30-mm x 0.30-mm square mesh 0.20-mm x 0.20-mm square mesh Results shows that 0.20-mm mesh size provides a fracture pattern that may be considered acceptable for analysis A conico-cylinder projectile is also used to study the fracture behavior with 0.20-mm mesh size We will develop 3D FEMs for further AutoDyn analyses An undergraduate student is working in the Summer 2013 session, and we are planning to recruit a graduate student in the Fall					
15. SUBJECT TERMS 2D AutoDyn modeling, cylinder impact, conico-cylinder impact, fracture pattern, mesh sensitivity					
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UU			UU	15	Shridhar Yarlagadda
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (include area code) 302-831-4941

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**MONTHLY REPORT
MAY 2013**

**MODELING AND SIMULATION OF CERAMIC
ARRAYS TO IMPROVE BALLISTIC
PERFORMANCE**

Monthly Report for May 2013



ABSTRACT

- ☐ 2D AutoDyn analyses of cylinder impact on ceramic plate have been conducted to identify the mesh size needed to capture detail crack growth in ceramic tiles
- ☐ Steel 4340 is used for the projectile and AutoDyn SiC material properties are used for the ceramic tile
- ☐ Mesh sensitivity analysis is performed using four different square mesh sizes:
 - ☐ 0.50-mm x 0.50-mm square mesh
 - ☐ 0.40-mm x 0.40-mm square mesh
 - ☐ 0.30-mm x 0.30-mm square mesh
 - ☐ 0.20-mm x 0.20-mm square mesh
- ☐ Results shows that 0.20-mm mesh size provides a fracture pattern that may be considered acceptable for analysis
- ☐ A conico-cylinder projectile is also used to study the fracture behavior with 0.20-mm mesh size
- ☐ We will develop 3D FEMs for further AutoDyn analyses
- ☐ An undergraduate student is working in the Summer 2013 session, and we are planning to recruit a graduate student in the Fall 2013 session

SUBJECT TERMS

- ☐ 2D AutoDyn modeling, cylinder impact, conico-cylinder impact, fracture pattern, mesh sensitivity

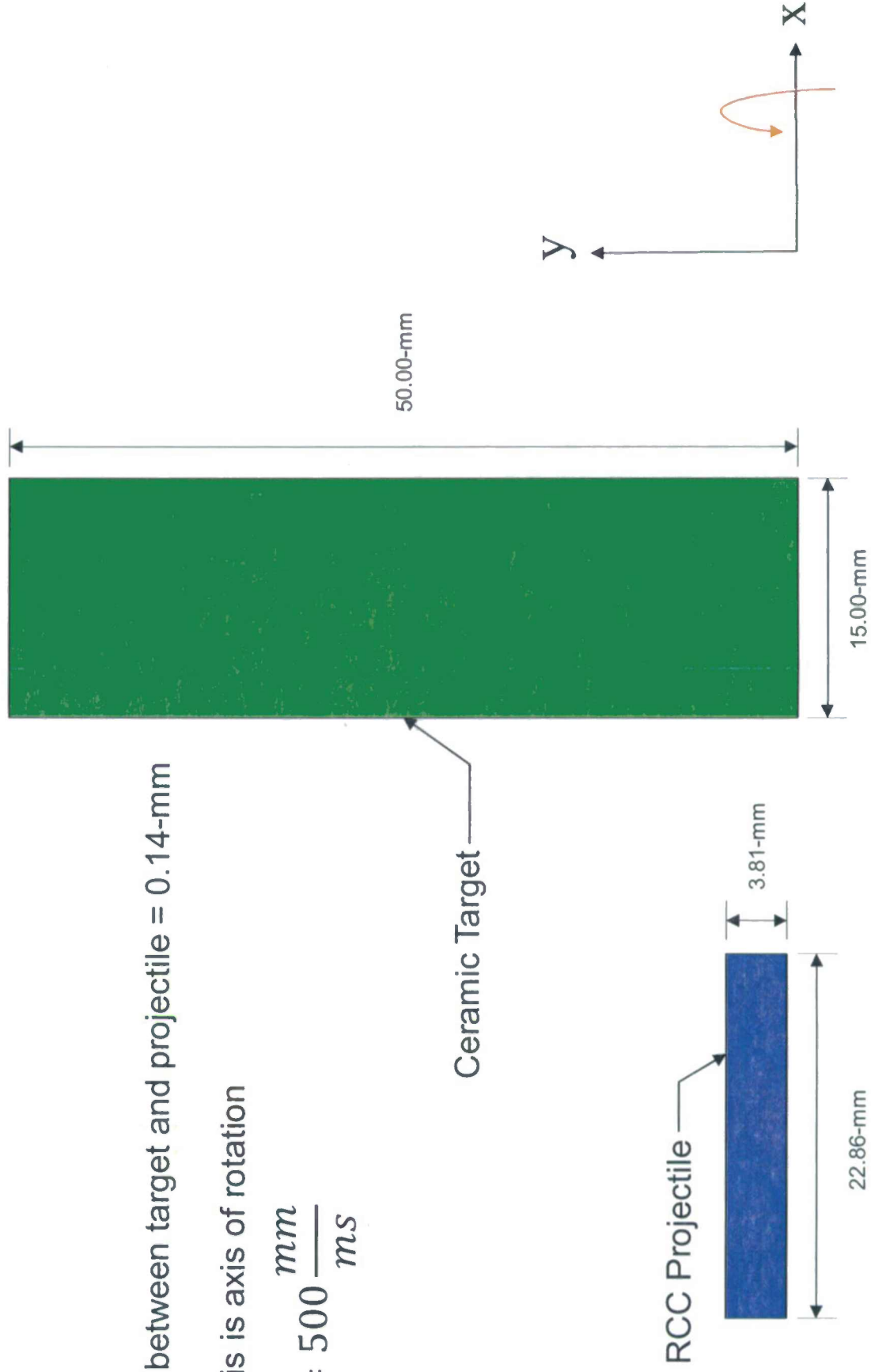
Axi-Symmetric Model Geometry



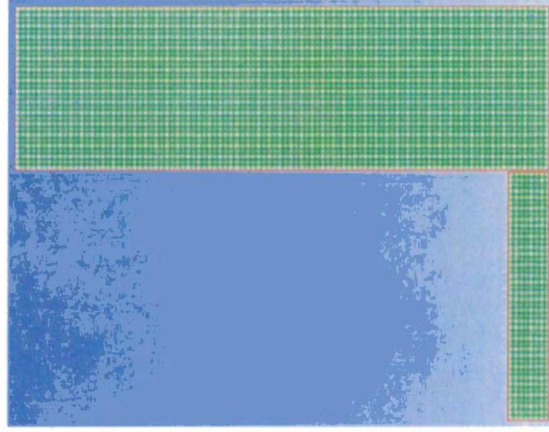
Gap between target and projectile = 0.14-mm

X-axis is axis of rotation

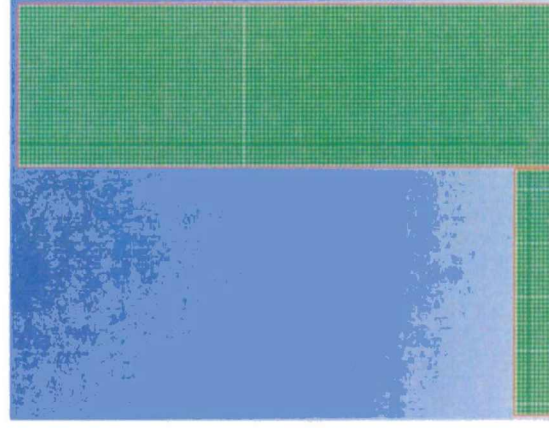
$$V_P = 500 \frac{\text{mm}}{\text{ms}}$$



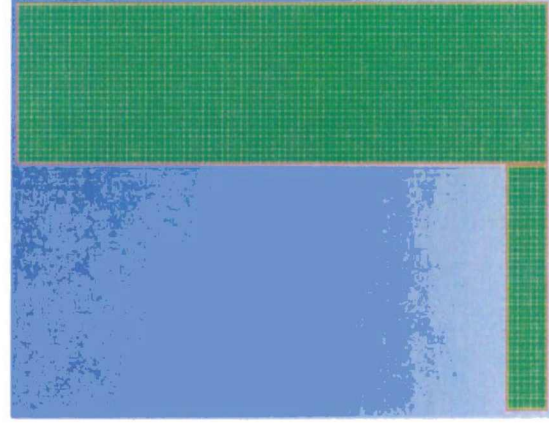
Different Mesh Sizes Investigated



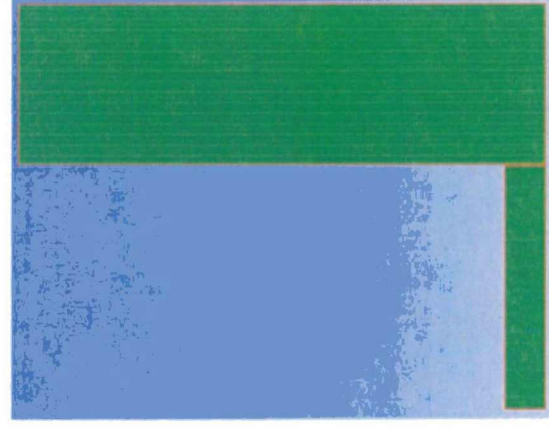
0.50-mm



0.40-mm

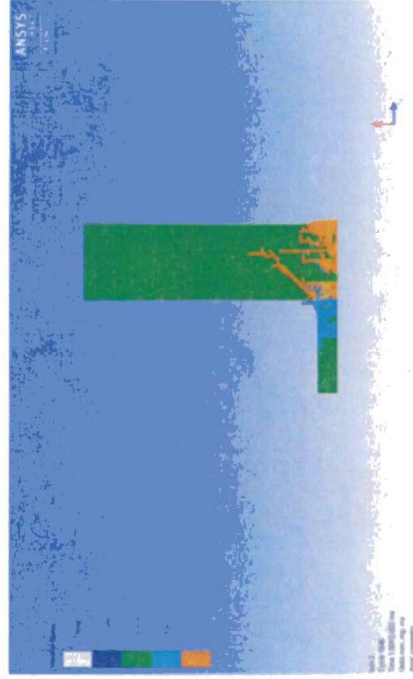


0.30-mm

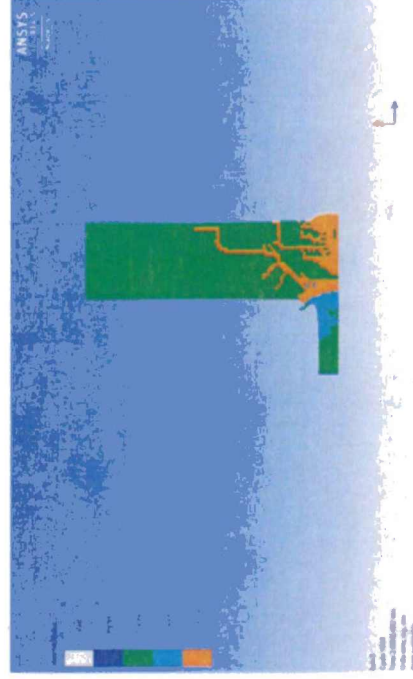


0.20-mm

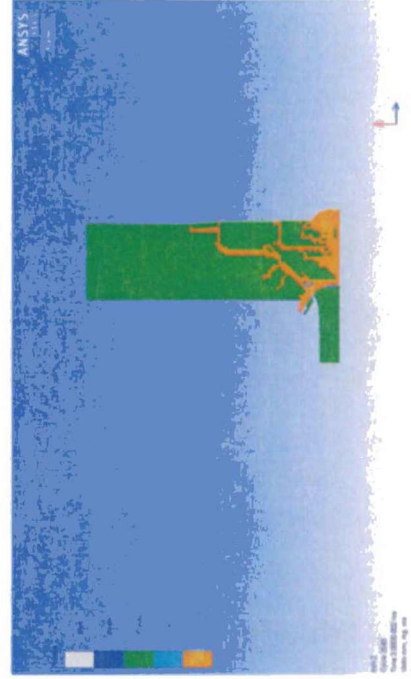
Fracture Pattern for 0.50-mm Mesh



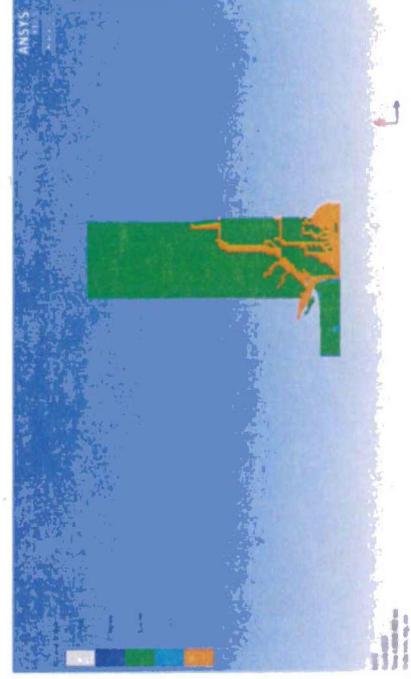
0.010-ms



0.020-ms

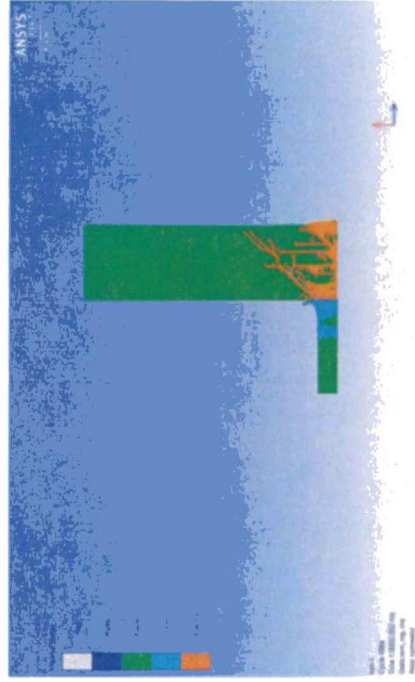


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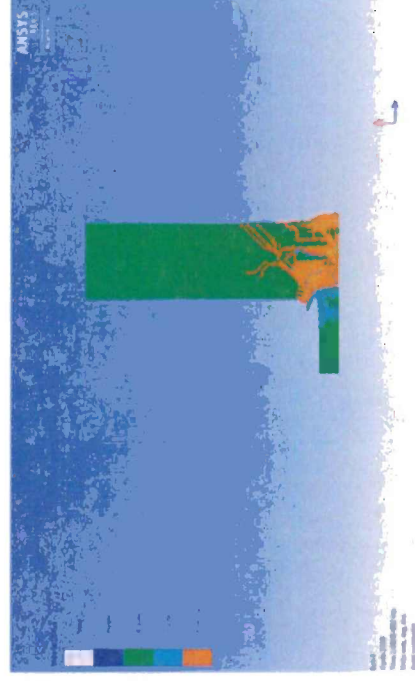


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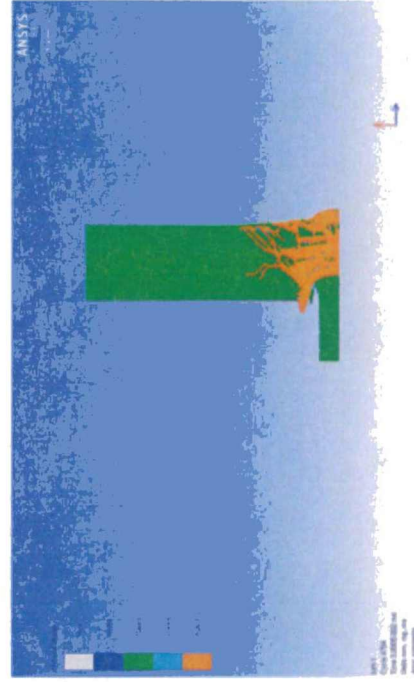
Fracture Pattern for 0.40-mm Mesh



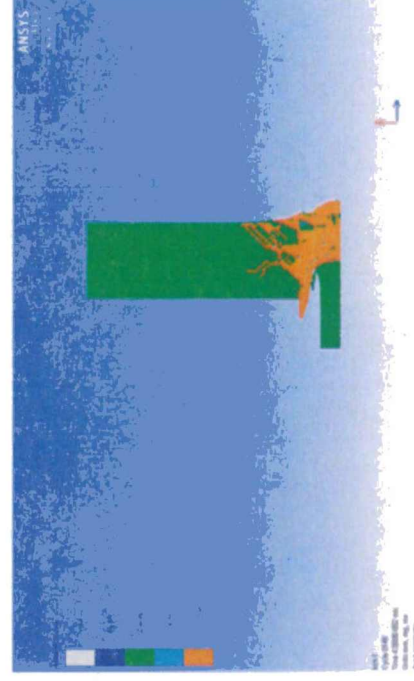
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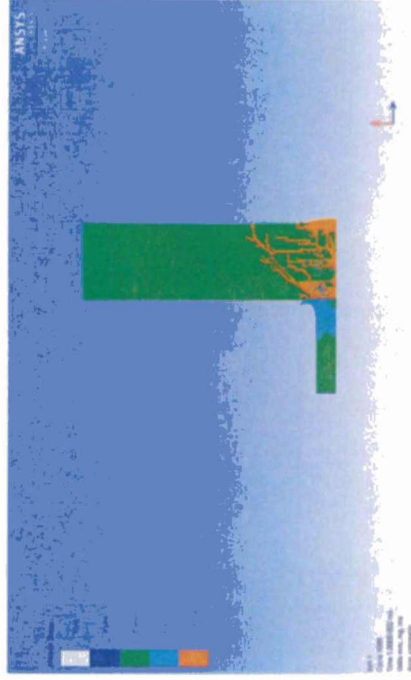


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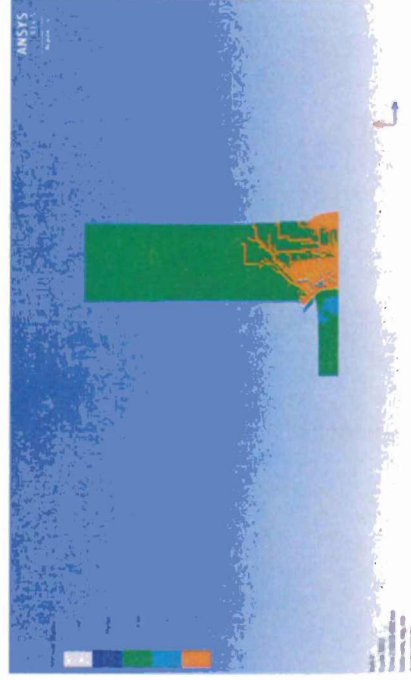


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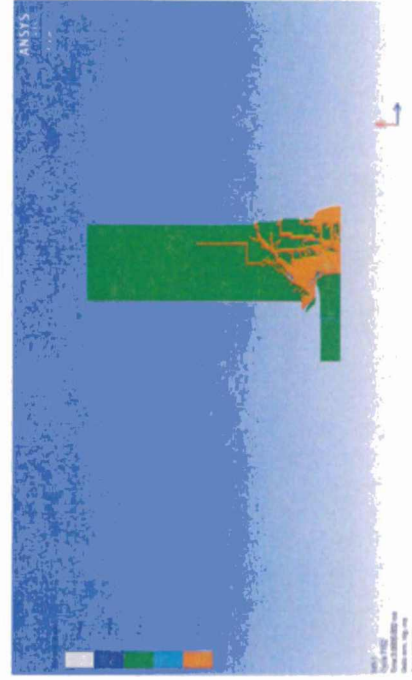
Fracture Pattern for 0.30-mm Mesh



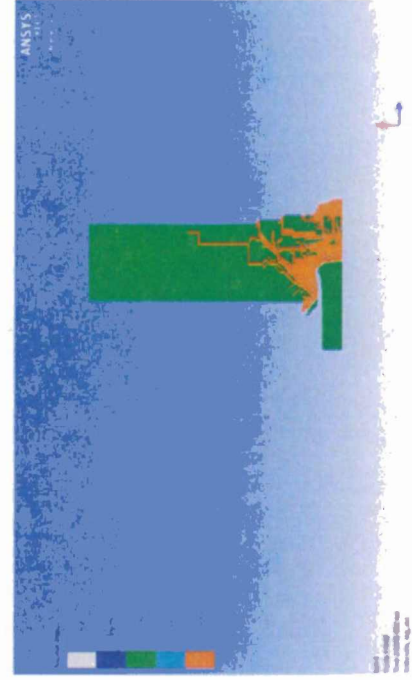
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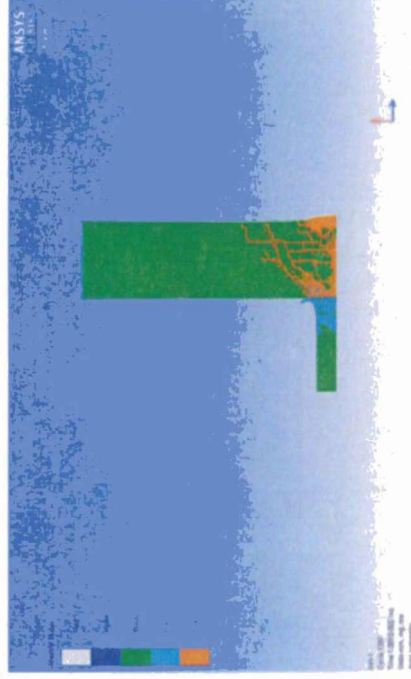


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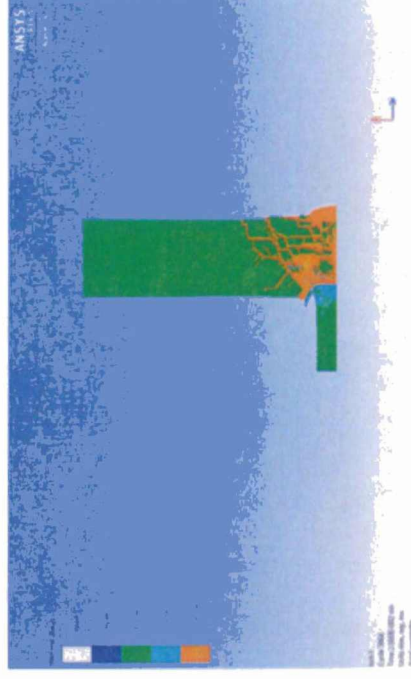


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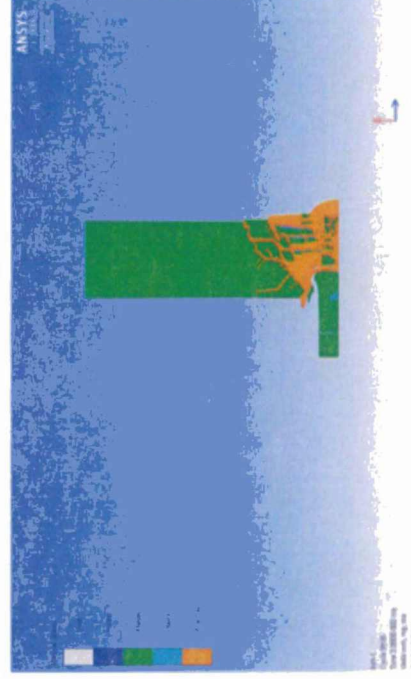
Fracture Pattern for 0.20-mm Mesh



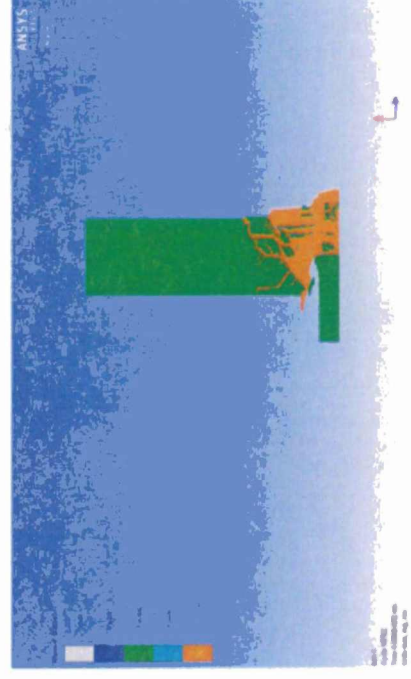
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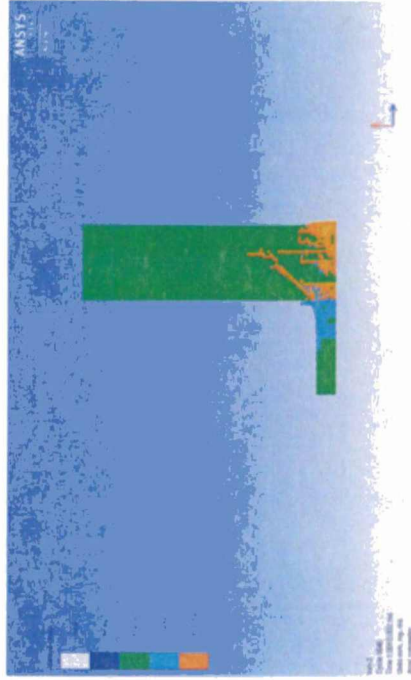
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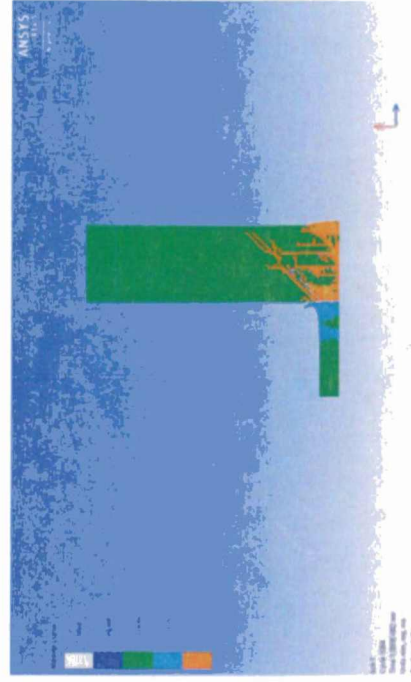
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Fracture Patterns for All Mesh Sizes

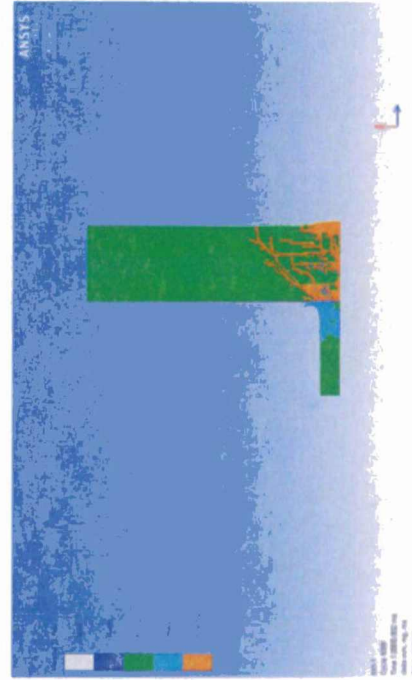
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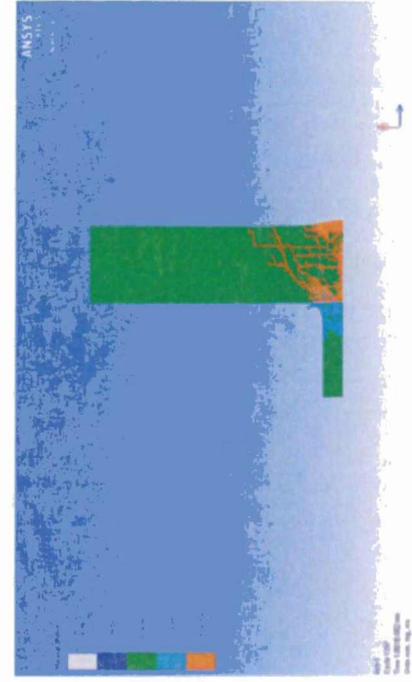
0.50-mm



0.40-mm



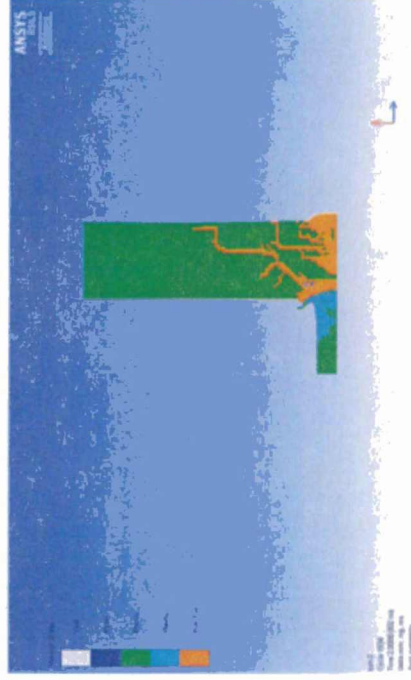
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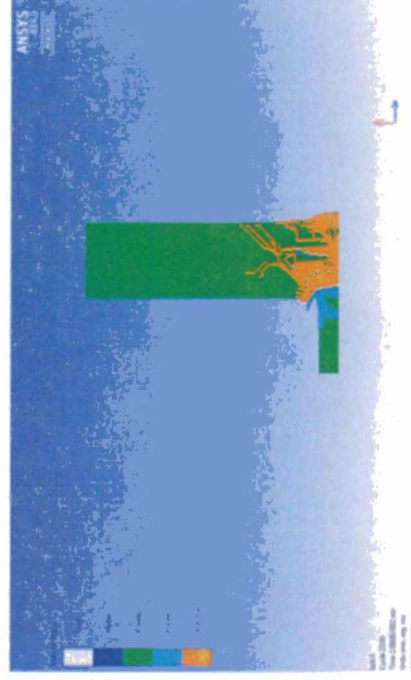
0.20-mm

Fracture Patterns for All Mesh Sizes

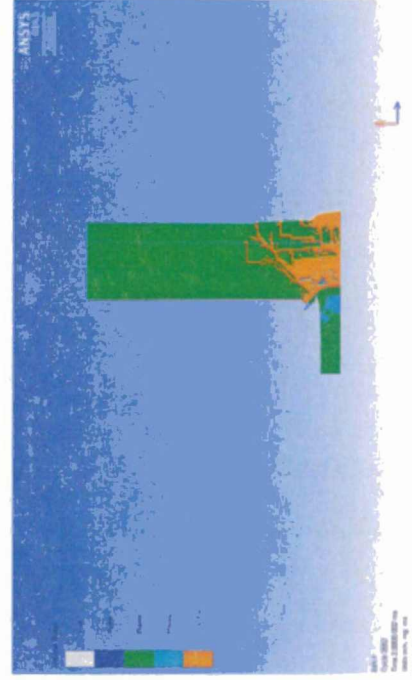
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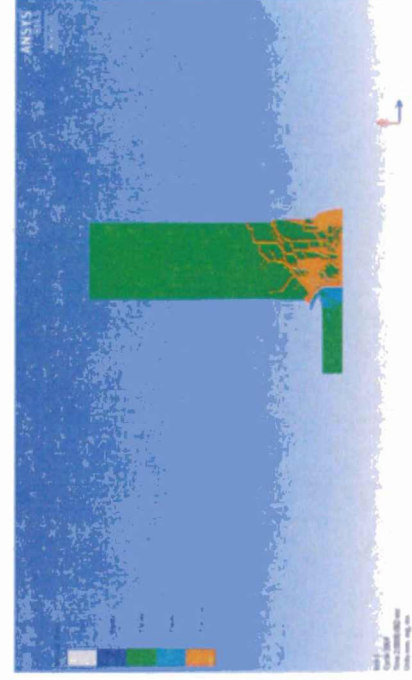
0.50-mm



0.40-mm



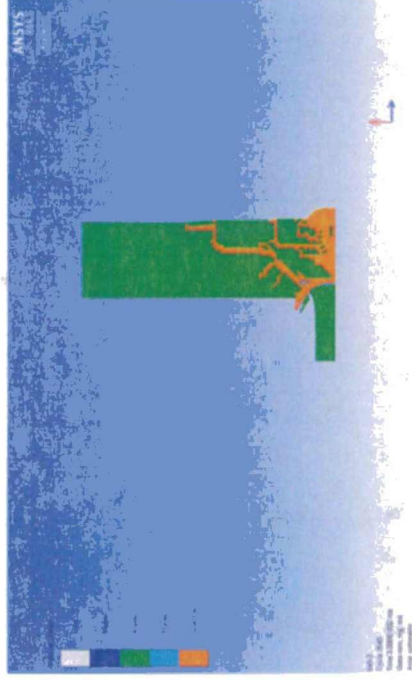
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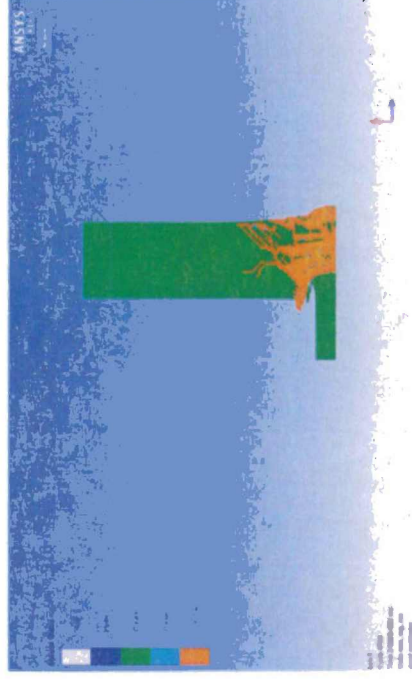
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Fracture Patterns for All Mesh Sizes

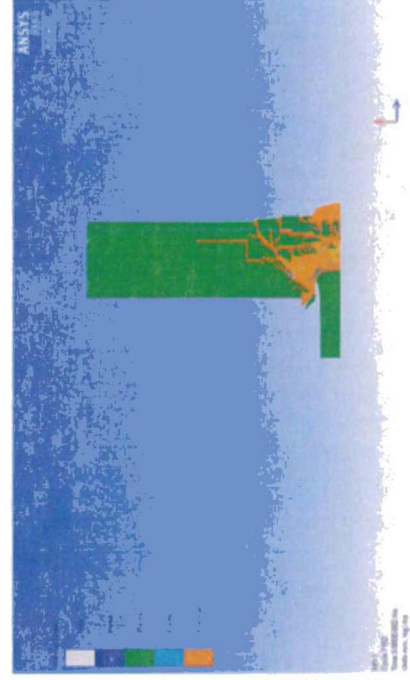
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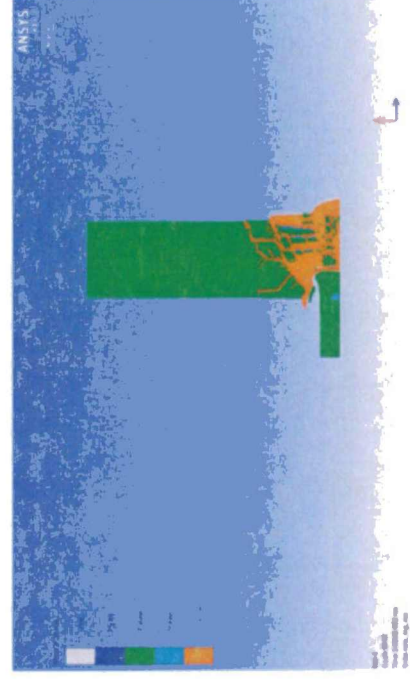
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0.40-mm



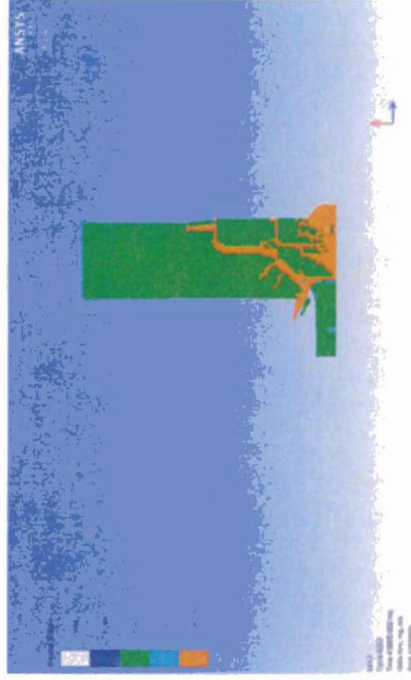
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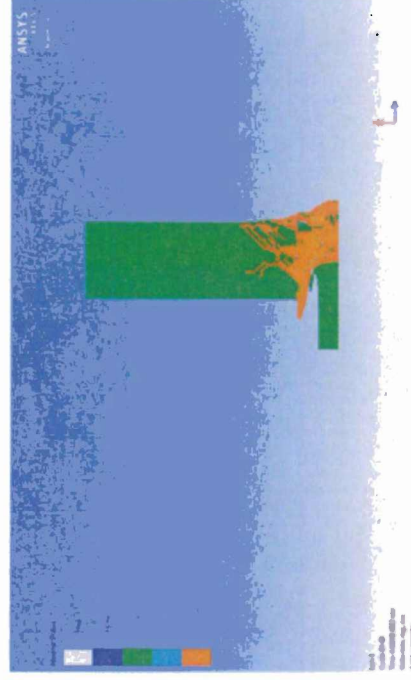
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Fracture Patterns for All Mesh Sizes

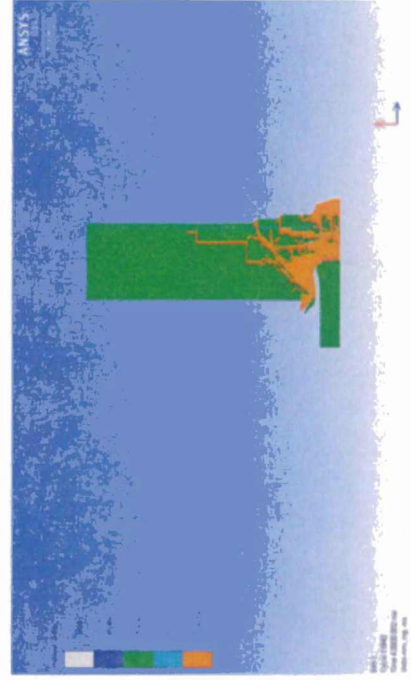
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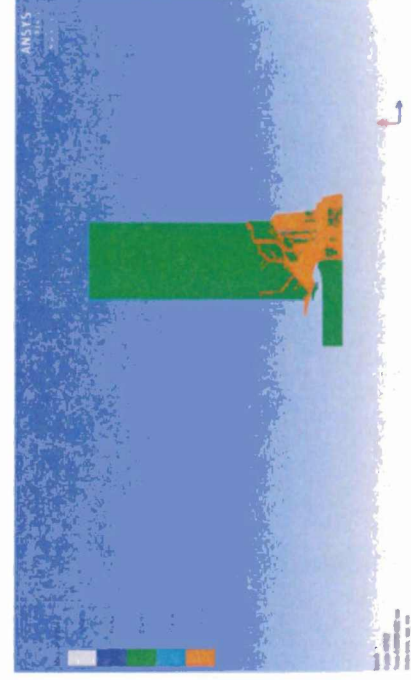
0.50-mm



0.40-mm



0.30-mm



0.20-mm

Axi-Symmetric Model Geometry



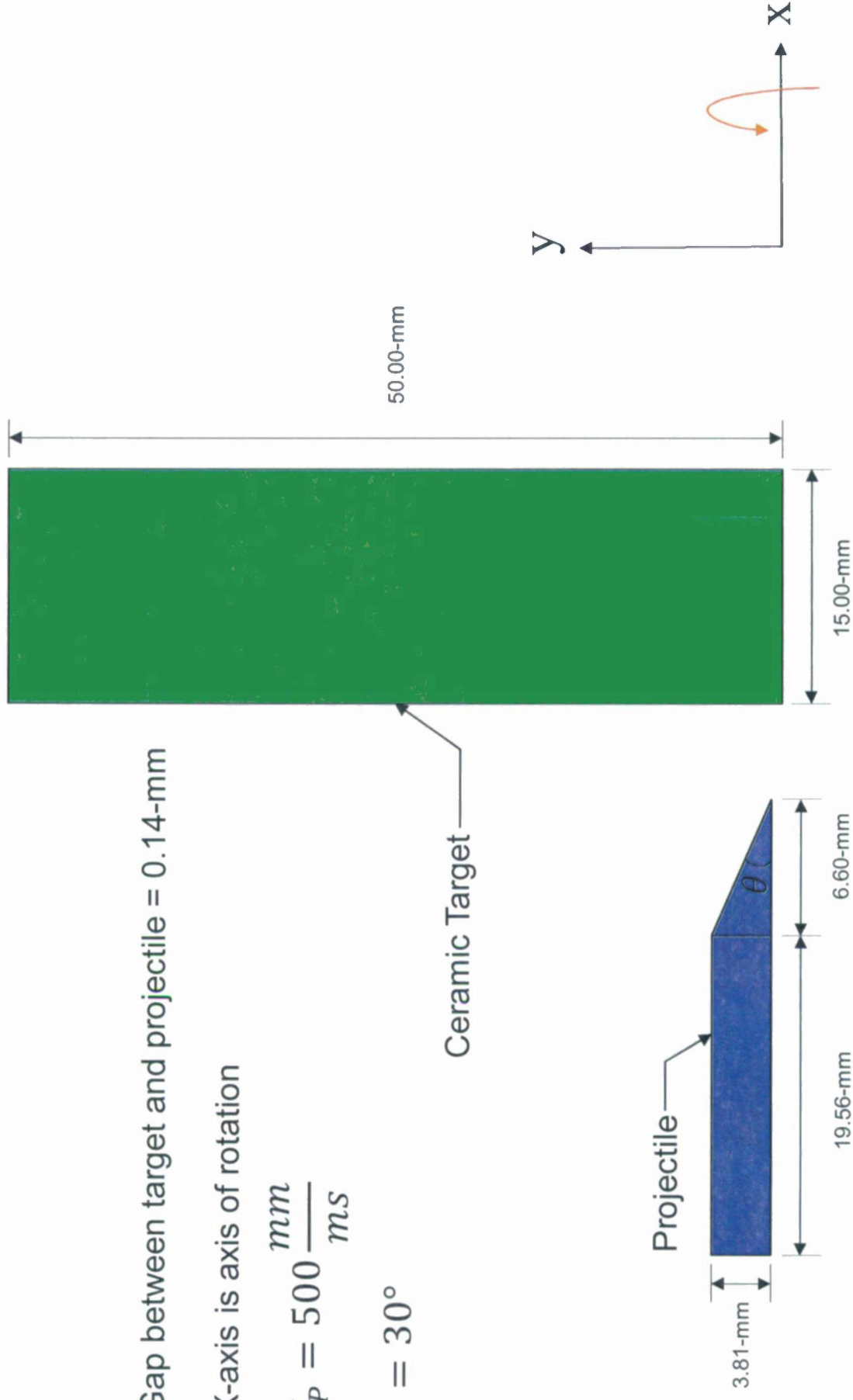
Gap between target and projectile = 0.14-mm

X-axis is axis of rotation

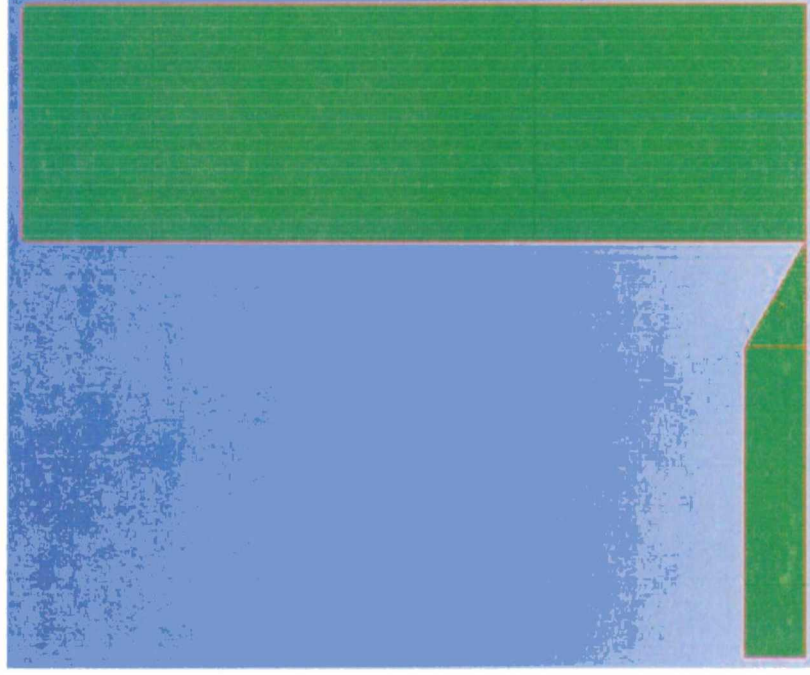
$$V_P = 500 \frac{mm}{ms}$$

$$\theta = 30^\circ$$

Ceramic Target

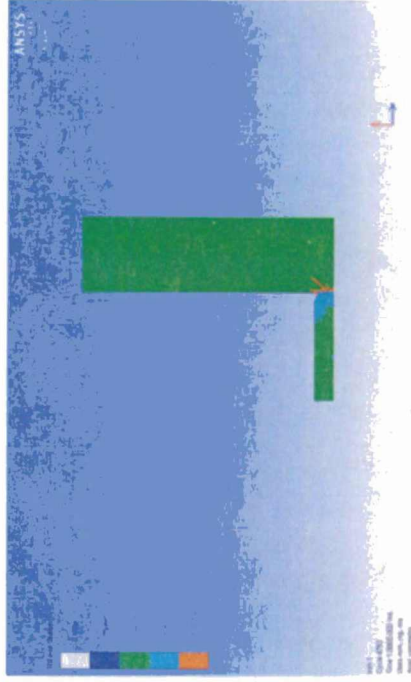


Mesh Size Investigated

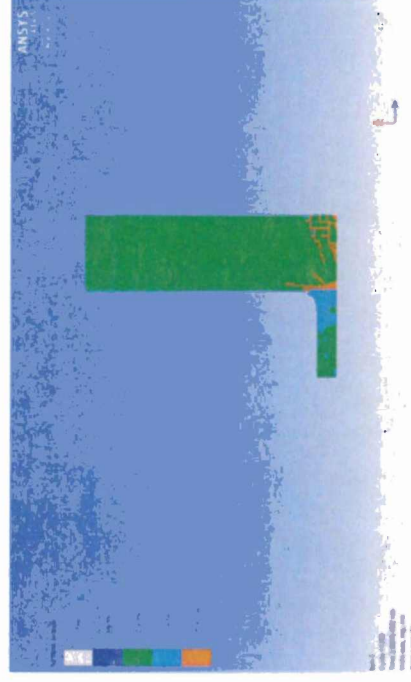


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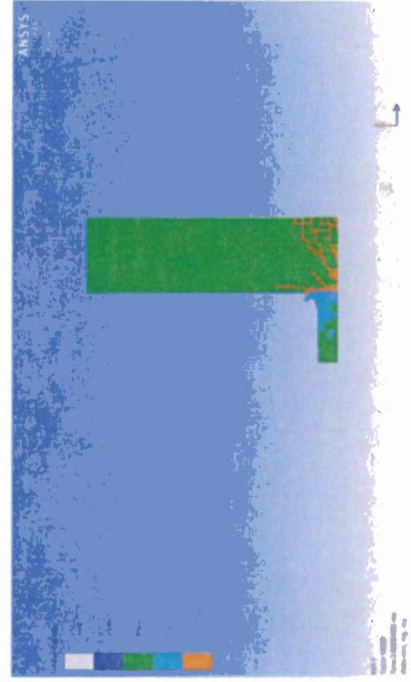
Fracture Pattern for 0.20-mm Mesh



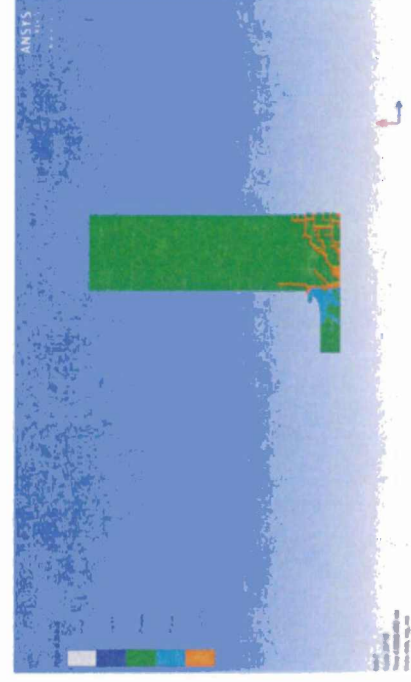
0.010-mm



0.020-mm



0.030-mm



0.040-mm