21CSI®

Unique Tools for Complex Systems®

AmmoSIM – Ammunition Simulation for Front Line and Command Units

Presented to: ICCRTS 2007

Presented by: Mr. Warren Noll

6/20/2007

About 21CSI

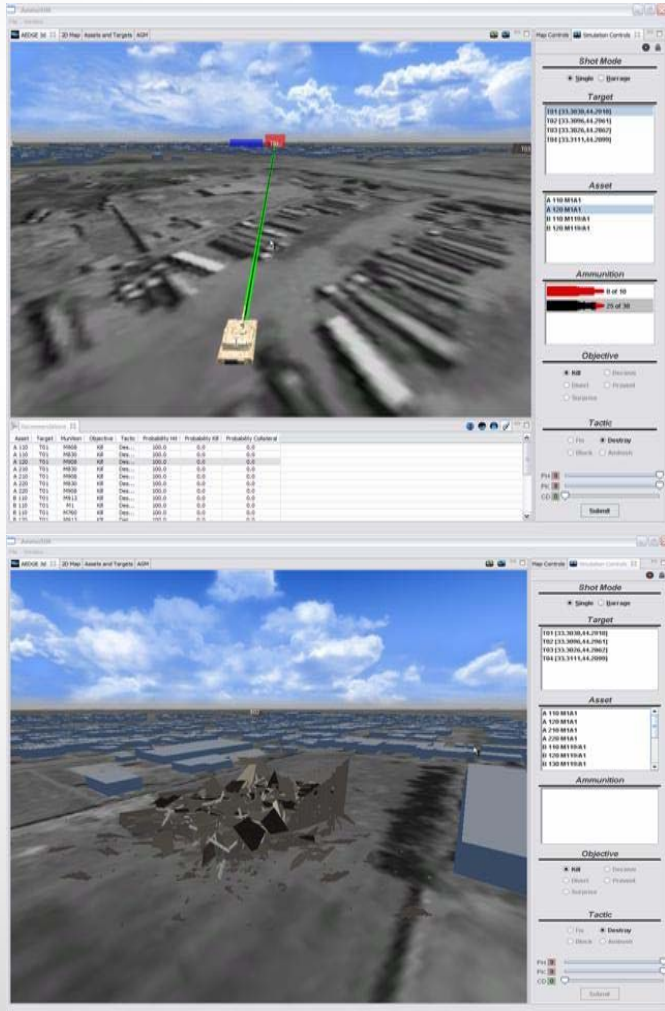
- Pioneer in Agent-based Decision Support Systems (DSS) and Situational Awareness for military applications
  - Over 30 decision support tools across spectrum of missions
    - Military force protection and C^2
    - Transportation & logistics management
    - Energy assurance
    - Data mining/characterization
  - Patented, open architected, COTS software technology
- Customers
  - DoD – acquisition
    - USMC/PP&O, Army/SMDC, Navy/PEO-IWS, PEOC4I, …
  - DoD – research & development
    - ONR, AFRL, DARPA, AFOSR, ARL, NSWC, NRL, …
  - NIST, DoE, Industry, Universities

Company Profile

- Founded in 1996
- Over 140 employees strong
- **DoD success story**
- **100% Commercialization Index 5 years running**
- **Selected in 2005 and 2006 as an Inc. 500 company**
- **Tibbetts awardee for 2006**
- Offices in HI, WA, CA, CO, NE, MO, IN, VA, RI
- Top Secret Facility Clearance

AmmoSIM - Ammunition Simulation

- **Platoon and C2 battlestaff Urban Tactical Decision Aid (UTDA)**
  - Provides a planning and executing DSS for MOUT operations
- **On-the-fly simulation tool for an urban environment**
  - Predicts/validates weapons effects and employment against targets
  - Models effects on the target and surrounding area and displays the trajectory
  - Barrage mode simulates employment effects of multiple munitions on a target
  - Models rubble effects, infrastructure degradation, blast effects, and WMD/HAZMAT effluent patterns

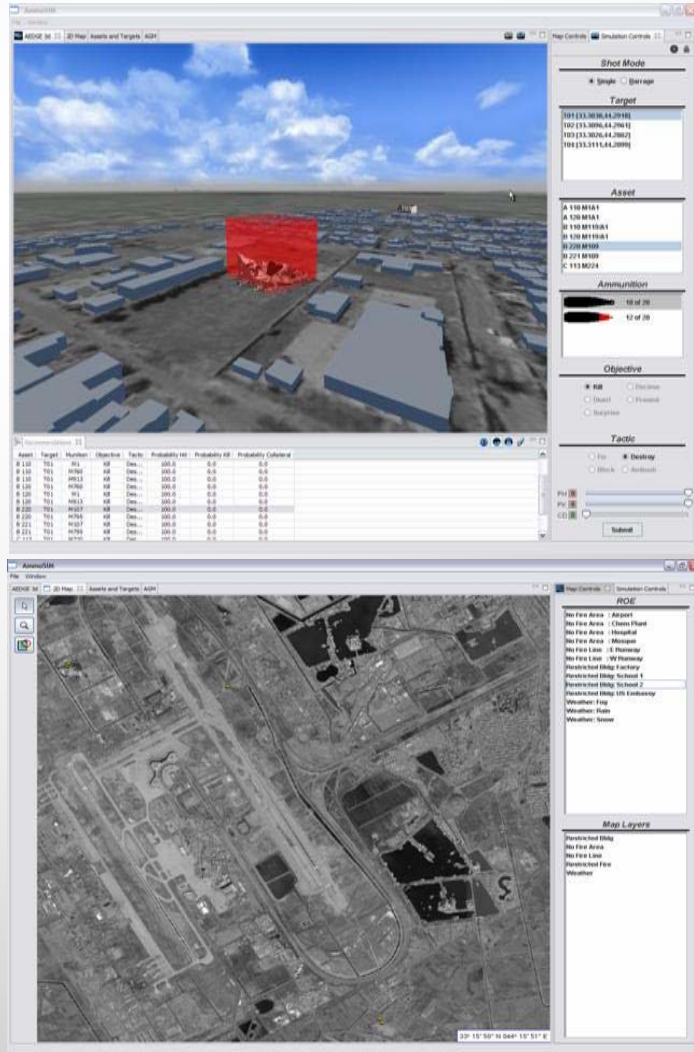


AmmoSIM Project Objective

- AmmoSIM product provides a fielded graphical lethality and vulnerability analysis tool using a synthetic ***3D urban terrain environment***
- AmmoSIM tactical decision aids:
  - (1) *Single Shot Mode – p*latoon level weapons effects analysis and recommendations
  - (2) *Barrage Mode* – multiple weapons effects on buildings and structures for command center battlestaff
- Embedded intelligent agents support training, operations, and visualization using combat terrain information systems

AmmoSIM UTDA Concept

- Platoon and C2 battlestaff Urban Tactical Decision Aid (UTDA) for planning and executing MOUT operations
- On-the-fly simulation tool for an urban environment to predict/validate weapons effects and employment against targets
  - Models the effects of the selected munition on the target and surrounding area and displays the trajectory
  - Barrage mode simulates employment effects of multiple munitions on a target
  - Models rubble effects, infrastructure degradation, blast effects, and WMD/HAZMAT effluent patterns

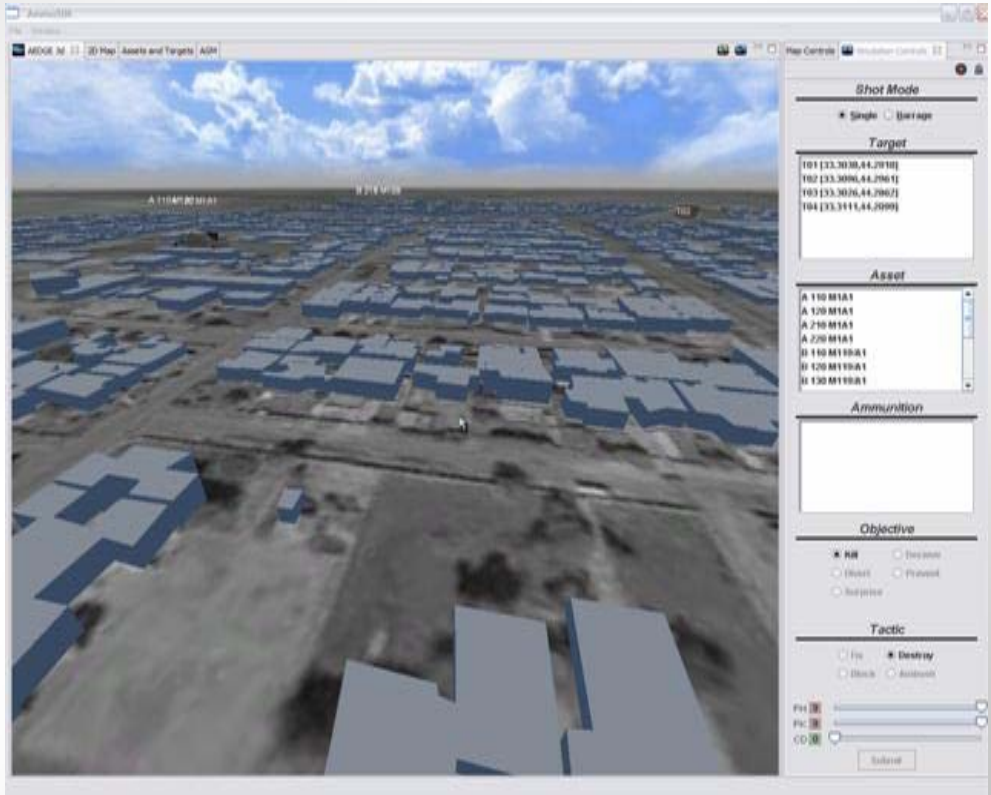


Three Tiered Functional Capability

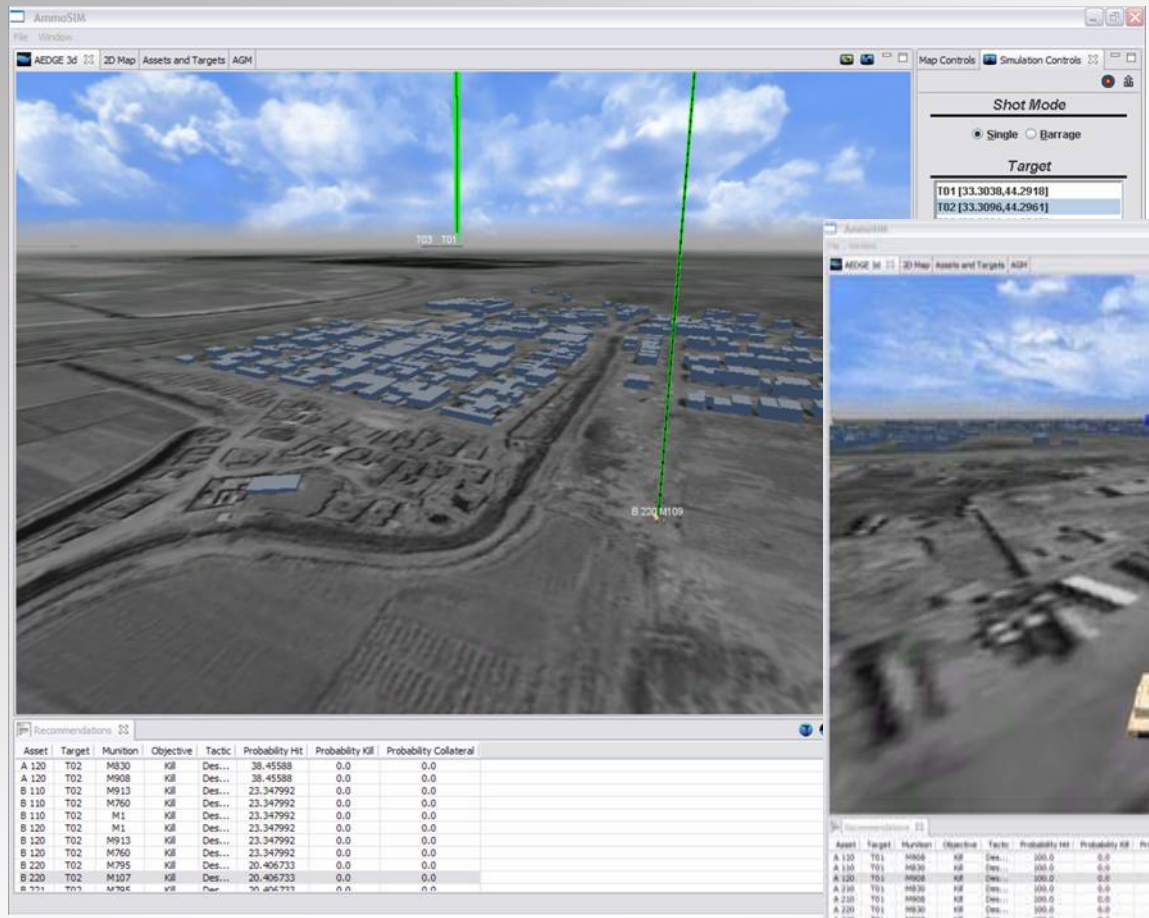
- Situation Analysis
  - Visualize solutions for weapon system on target
  - Provides desired effect probabilities & visualization
- Target Effects
  - Building damage assessment & visualization
  - Enemy asset damage assessment & visualization
- After Effects
  - Plume analysis
  - Movement restrictions/new avenues

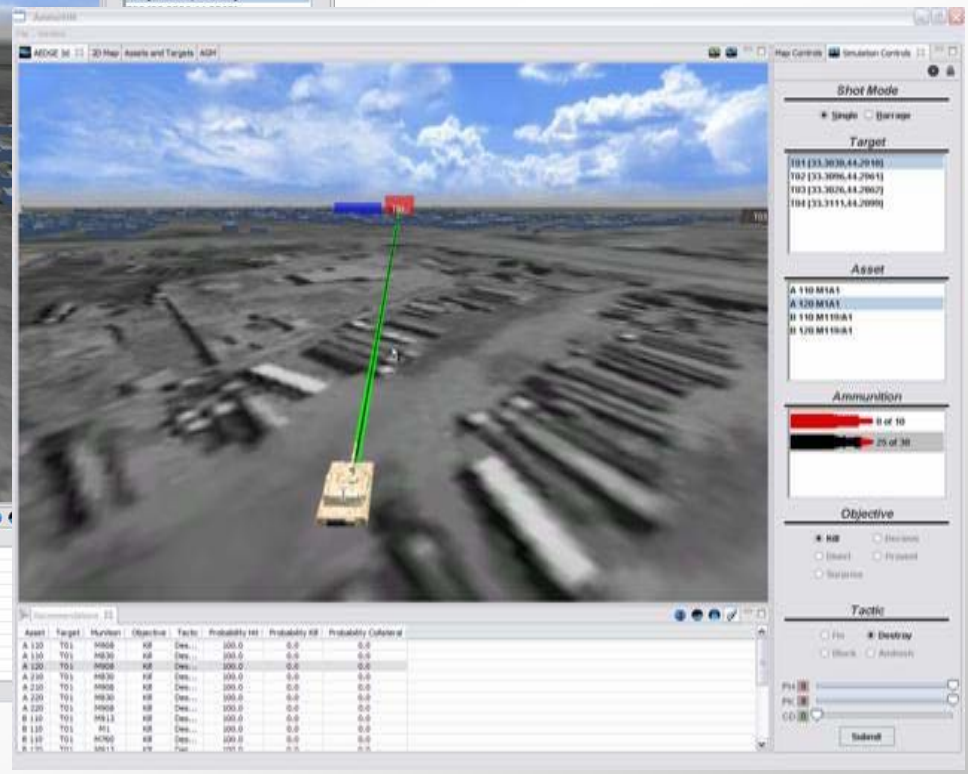
Asset and Target Location

- Asset and Target
  - 2D and 3D visualization
  - Attack guidance matrix
  - User defined targets
- Collaboration
  - Real-time updates
  - Visual space sharing
- GIS
  - DTSS
  - DTED and other height data
  - TEC GIS data
  - C/JMTK
  - Other GIS Databases



Trajectory

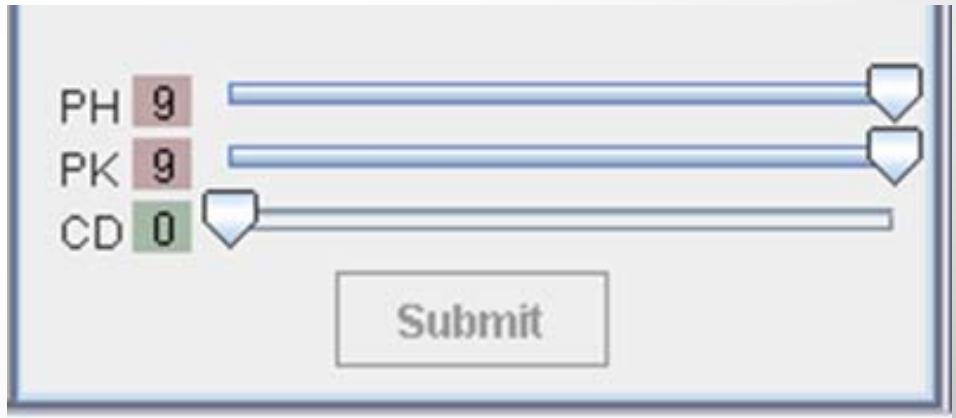




- 3D display
- JMEM data
- Circular Error Probable (CEP) display
- Firing solution recommendation
- Guided and unguided munition

Desired Effects

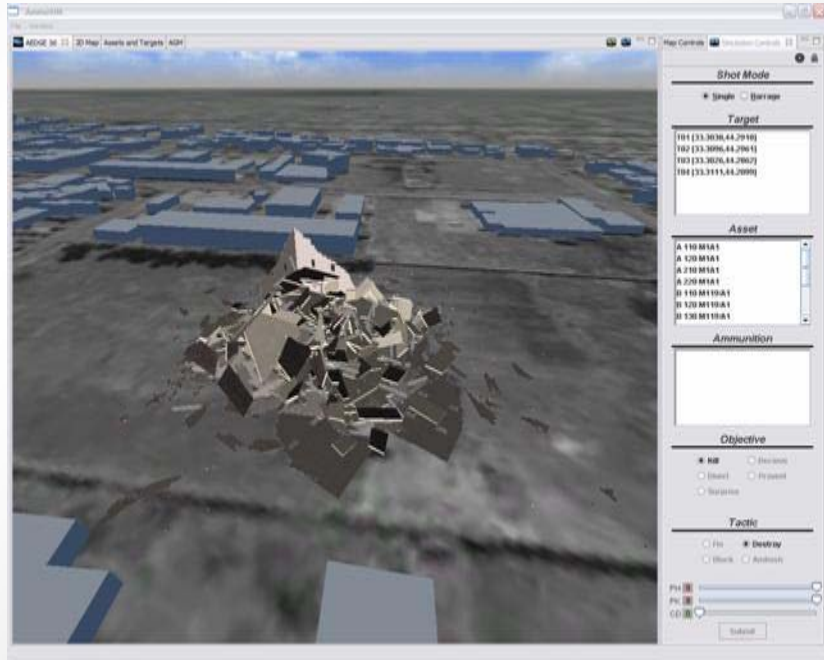
- JTCG/ME approved probability calculations for PH,PK,CD
  - Delivery Accuracy Munition Characteristic*
- Included subsystems
  - BAM
  - NABK
  - BEEM
  - MEVA
  - SWE API
- JMEM data
  - Munition characteristics



*PKAD – Physical model Knowledge Acquisition Document

Rubblization

- Included methods
  - BAM
  - BEEM
  - World Wide Construction DB
- New research
  - 1st principles numerical model
  - Visualization of debris field
  - Desired effects prediction
  - Cumulative munition effects
  - Variable geometry & construction of structures



What Will AmmoSIM Do for You?

- Urban Terrain Visualization & Trajectory Analysis
- Scene Generation
- Front-end GUI & Complete Visualization
- 1st Principles Rubble Model
- Munitions Effects
- Multiple Building Damage Effects

Urban Terrain Visualization & Trajectory Analysis

- ROE visualization
- Visual trajectory and CEP display
- Intelligent agent alerts of possible collateral damage
- Firing solution recommendations
  - Location recommendations
  - Munition recommendations

Scene Generation

- GIS database driven display
  - DTED
  - DTSS
  - Other GIS sources
- Display can be tailored
  - Area of operation (full city)
  - Designated area (city block)
  - Target location (individual building)
- Future plans include real-time updates
  - Lidar
  - Satellite
  - Forward observations

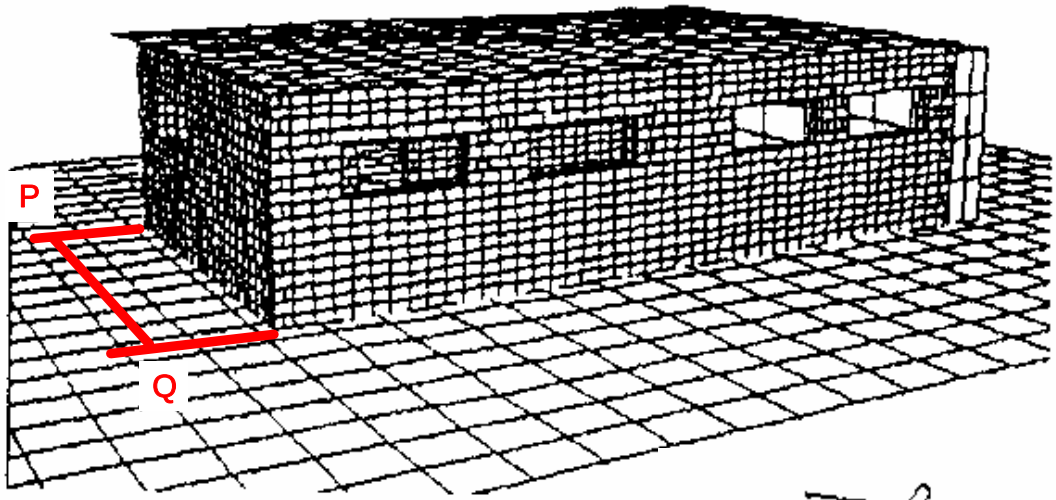
Front-end GUI & Complete Visualization

- Planned front-end JWS component communication
- Real-time collaboration
  - Warfighter with warfighter
  - Warfighter with command and control
- Interconnected 2D and 3D displays
- Interactive alerts and overlays
- Firing solution recommendations
- Desired effects display

Rubblization Model

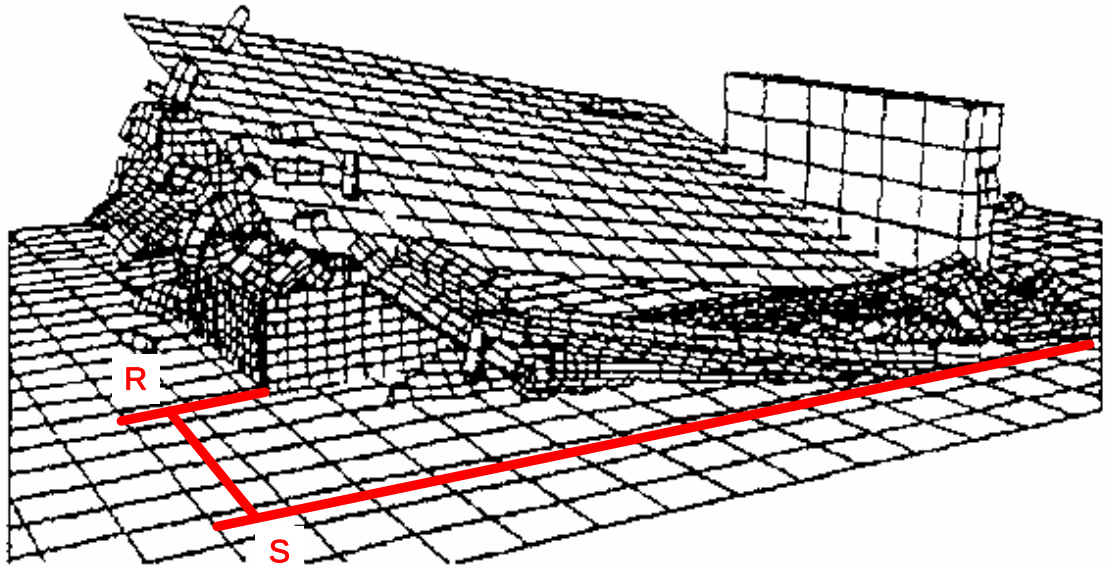
- Real-time rubble characterization
- Blast & debris field estimate calculation
- Variable geometry & construction of structures
- Cumulative munition effects
- Desired effects prediction

Numerical Rubblization Model



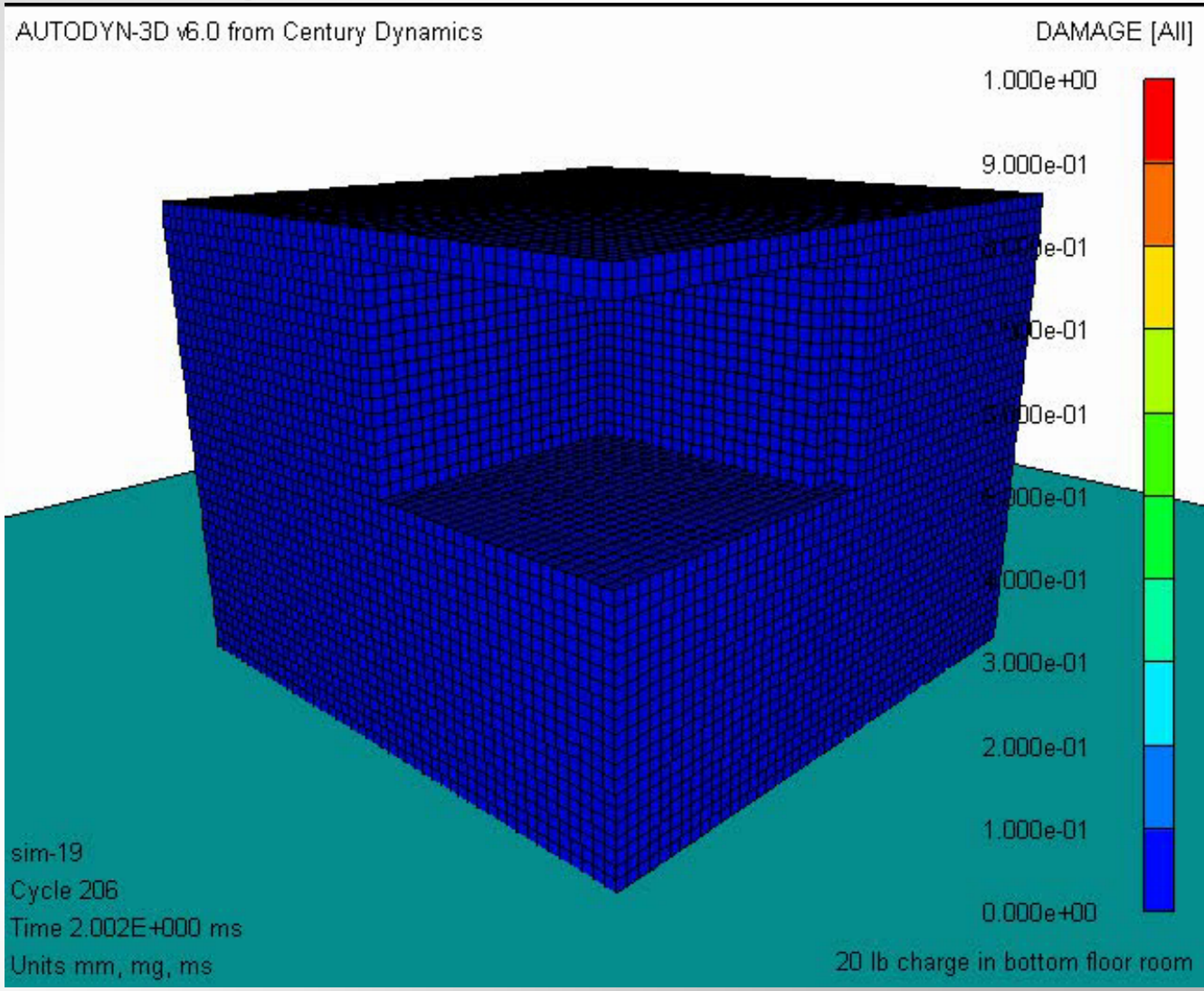
- Currently only brick and mortar construction analyzed, further extensions to other building types are planned
- BAM assessment tool and World building construction database utilized

- Rubble pile modeled for both collateral damage and movement restriction
- Currently only total destruction considered, partial rubblization is planned



Collateral Damage & Rubble Evaluation

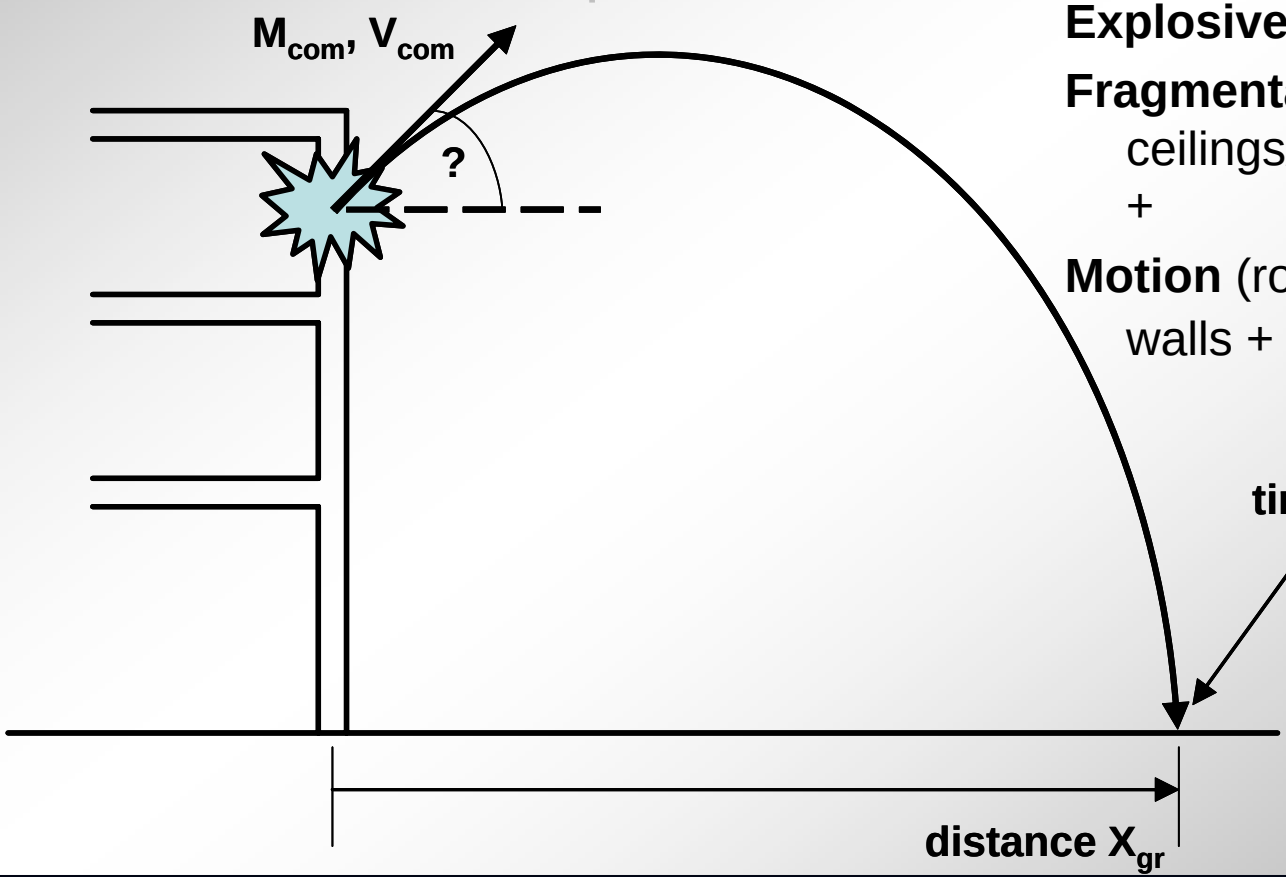
- Simulated in Autodyn (FEA)*
- Scatter and collapse effects
- Numerical model calculates the debris field instantly from first principles model
- Debris field will then be estimated for visualization



*FEA – Finite Element Analysis

First-Principles-Based Model

- Model incorporates blast and collapse effects
- Model uses energy conservation to calculate the horizontal extent of the rubble pile.



Explosive energy =

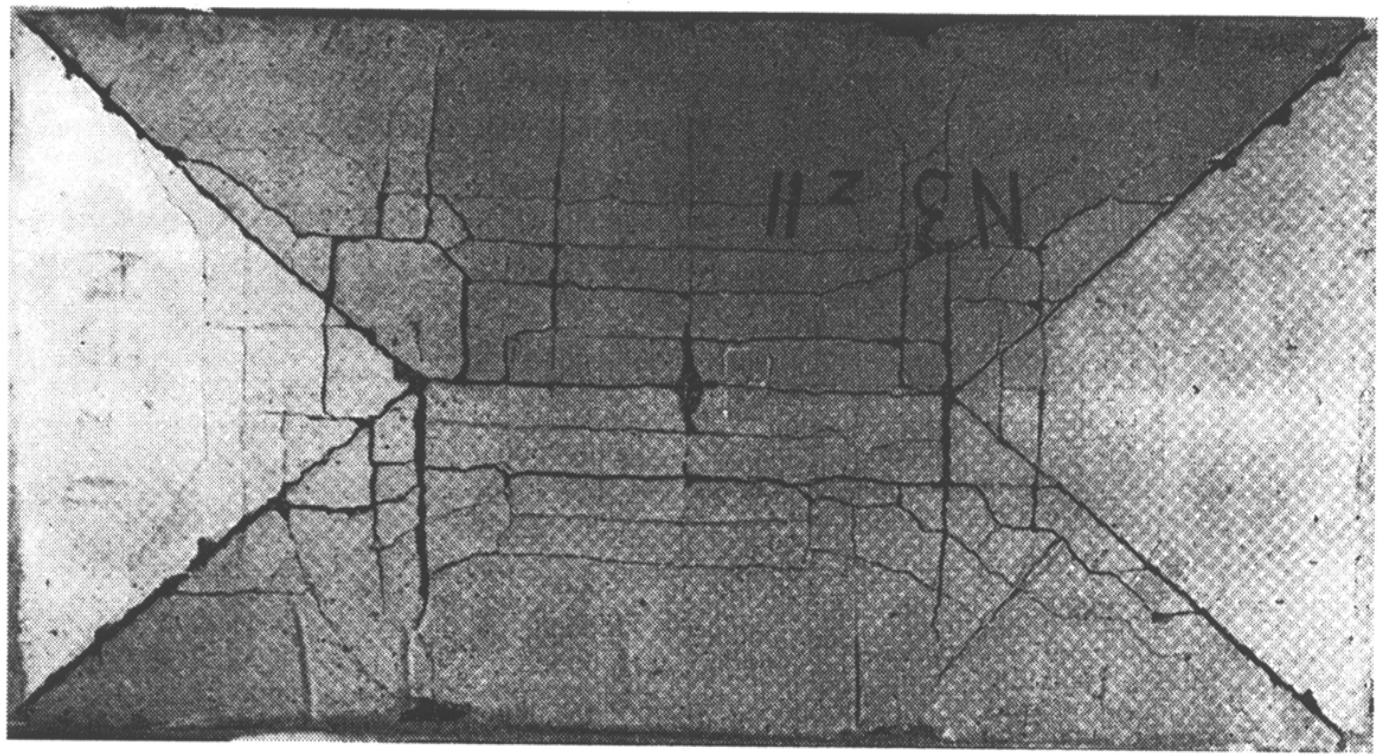
Fragmentation (roof + ceilings/floors + walls + floor) +

Motion (roof + ceilings/floors + walls + floor)

Predicting Building Collapse

- We are working on predicting the explosive force needed to destroy a building – single shot and cumulative effects
- Work is based on our first principles model

Failure Collapse Mode of Rectangular Concrete Slab Under Impulsive Load



Munition Effects

- Multiple asset options
- Multiple munition selections
- Multiple volley and aim points
- Surface-to-surface & air-to-surface munition
- Contained material effects
- Structural degradation per hit
- Accounts for total hits on a target

Multiple Building Damage Effects

- Blast effects can be propagated to surrounding buildings
- Building collapse effects on surrounding buildings
- Collateral damage due to CEP effects

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