reality in a study which investigates the physical responses of scaffold workers while walking on elevated planks. The subjects in this study will be immersed in a virtual environment that will provide the illusion of being elevated thirty feet above the ground, but in reality the subject will be walking safely on the floor in the laboratory. This paper describes the current project using virtual reality and ideas for future projects using virtual reality.

Computer Simulation of ROPS Testing in ASAE S519—Harris JR, Mucino V, Etherton JR, Snyder KA, Means KH

The American Society of Agricultural Engineers (ASAE) is one professional society which has developed a standard for certification testing of rollover protective structures (ROPS) on agricultural tractors. Certification of a ROPS can be performed following static procedures in the current standard, ASAE S519. This research simulates rollovers about the rear axle and compares ROPS stress levels with stress levels found during simulated ASAE S519 static testing.

The ROPS modeled in this simulation is representative of one that might be found on small tractors (~50 hp PTO) operated on a hillside. Modeling has been performed using finite element techniques. Variables describing the ROPS construction, such as part dimensions and materials, have been parameterized to allow rapid simulation of a variety of ROPS prototypes. Additional variables include the ground slope and the tractor's initial rotational velocity. For the current research, slope angles of 10, 30, and 60 degrees were examined. Initial rotational velocities included 1, 3, and 4 rad/sec. A slope angle of 60 degrees matches the slope recommended in ASAE S519 rear field upset tests. An initial rotational velocity of 4 rad/sec, when converted to a pure translation, is in excess of the speed recommended for the ASAE S519 rear field upset test.

Initial analyses began the rear rollover model at 90 degrees to the ground plane since ROPS-ground contact occurs in the final 90 degrees of rollover. Furthermore, this initial position served to conserve computer time and storage space. For these simulations, it was observed that ground-impact induced stress levels recorded during rear rollovers were on average 19.4% lower than stress levels recorded during simulated static ASAE S519 testing. However, these simulations failed to identify slope angle as a major contributor to ROPS stress. The rear rollover model was modified to initiate the rollover at the point of no return, when the tractor center of gravity is vertically above the rear axle. Starting the simulation at this point will model the energy transfer during the overturn, from potential to kinetic, more accurately than the previous simulation. Preliminary examination of these data suggests the new simulation identifies a more pronounced slope angle effect on ROPS stress.

Future work will include development of models for side rollovers based upon knowledge gained in rear rollover simulation work.

Session 23: Agricultural Injuries

The Ohio Agricultural Safety Promotion System (ASPS), 1994-1997—Eicher LC, Bean TL, McCaslin NL, Nieto R, Owens M, Nolan J, Rodriguez J, Wessel P

Many farms in the United States continue to be family-run operations. However, over the last fifty years, there has been an increase in the number of corporate agricultural operations that rely on non-family labor. Since the farm crisis of the late 1970's and early 1980's, this trend has accelerated with an increasing number of family farms either "down-sizing" to become part-time farming operations or "up-sizing" to become family corporations. There has also been a trend for operations that have remained primarily family-run businesses to become increasingly reliant on non-family labor to remain competitive and to meet production demands. Furthermore, more and more states now require that agricultural employers carry workers' compensation coverage on their employees.

These circumstances afford an ideal opportunity to reduce the agricultural death and injury rate by working with agricultural organizations (The Ohio Farm Bureau, The Ohio Pork Producers Council, and the Ohio Division of the National Organization of Independent Business) who have workers' compensation programs. A random selection of farms was conducted from a population of 1,700 employers. The Ohio State University provided safety information and training materials for employers to provide short, frequent safety training for their employees. Half of these individuals are in the treatment group, half in the control group. A representative sample (90) of employers in both the treatment and control groups were selected for on-farm inspections of worker protection equipment, shielding, etc. A pre- and post-safety awareness test was also developed and administered to both the treatment and control groups. In addition, accident history prior to the one-year testing period was collected to document pre-treatment accident rate. This approach will validate the use of employer training programs in the agricultural industry for improving cognitive, attitudinal, and behavioral characteristics of employers and employees in farming operations.

Livestock-Related Injuries Associated with Cattle Handling in Oklahoma—Huhnke RL, Hubert DJ, Harp SL

A 1993 study by the USDA's National Agricultural Statistics Service showed 26% of the work-related injuries that occurred on U.S. farms were sustained while working and handling livestock. A 1994 NIOSH farm injury study conducted in Oklahoma revealed that greater than 75% of all lost-time injuries were from handling beef, sheep, and swine. An important consideration in this investigation of livestock-related injuries is whether (and if so, how) handling equipment and working facilities contributed to the sustained injuries. The purpose of this study was to assess the hazards associated with animal handling in a cow-calf operation. This research was funded by the Southwest Center for Agricultural Health, Injury Prevention, and Education at the University of Texas Health Center at Tyler.

Over 6000 Oklahoma cow-calf operators were identified through a random sample from the population of more than 60,000 operators. Individuals identified were mailed injury survey cards inquiring whether they or an individual associated with their operation were injured while working cattle during 1996. In addition, producers were asked whether they would be willing to participate in a voluntary personal interview. Based on the information obtained from the initial mailing, researchers identified willing participants and potential candidates for interviews. Selected individuals were then interviewed by either a county agriculture extension agent or one of the researchers. All in-person interviews were completed within about a two-month period ending May 15, 1997.