Advanced Car Seating Restraint Systems

The Ohio State University
Center for Automotive Research (CAR)

Prof. Necip Berme (Mechanical & Bio-Medical Engineering)

Prof. Reinhart Butter (Industrial Design)

NHTSA Contact:
Joseph N. Kanianthra, Ph.D. (Mech.Eng.)
Associate Administrator for Vehicle Safety Research

VRTC Contact:
Aloke Kumar Prasad (Mech.Eng.)
Defects Analysis and Crashworthiness Division

Project Description

This project, proposed through OSU's Center for Automotive Research & Intelligent Transportation (CAR-IT) and funded by NHTSA seeks to:

- improve the convenience, effectiveness and use of restraint systems (seat belts) in cars and light trucks.
- emphasis is on belt systems integrated into seats, but does include the evaluation and design of alternative restraints and seating, both ergonomically and structurally.

The interdisciplinary research team began working in Autumn 03 and shall deliver its
- findings,
- recommendations, and
- concepts by the end of 2004 - extended to April 2005

Briefings by representatives from NHTSA and VRTC at the Vehicle Research and Test Center in East Liberty, Ohio, clarified the agencys' primary interests and objectives in regard to approach and expectations (e.g deliverables).

Research Overview of Completed Phases

1.0 Pertinent Context and Synergetic Effects

2.0 Project Structure and Approach

2.1 Findings Based on Reference Material & Provided Studies
2.2 Patent Research of Seat Restraint Systems
2.3 Select Conceptual Car Seat Designs
2.4 Examples of Related Seat Restraint Systems
2.5 Initial General Design Criteria

3.0 Design Concept Generation & Evaluation

3.1 Belt Restraint System Addressing Lower Buckle Access
3.2 Belt Restraint System Addressing Upper Buckle Access
3.3 Active Seat Concepts

4.0 Design Studies

4.1 Concept 1
4.2 Concept 2
4.3 Concept 3.
4.4 Concept 4

Research Contents of Tentatively Final Phase

5.0 Assessment and Pursuit of Selected Concept(s)

5.1.0 Focused research of crucial concept components
5.1.1 Lap presenters
5.1.2 Belt configuration and buckling
5.1.3 Headrest with integrated D-rings
5.1.4 Ergonomics of seat contours

5.2.0 Concept development with emphasis on component integration
5.2.1 Principal lap presenter solutions
5.2.2 Headrest with integrated or synchronized D-rings
5.2.3 Generic belt configurations
5.2.4 Generic buckle concepts
5.2.5 Ergonomic seat cushion considerations

5.1.0 Focused research of crucial concept components:

To recap the reasons for the selection of the pursued concepts the following parameters were briefly discussed:

- Lap presenters
- Belt configuration and buckling
- Headrest with integrated D-rings
- Ergonomics of seat contours

A breadboard model demonstrated the basic configuration, dimensions, and mechanical functions of the four above listed features.

The model was to be further refined, finished, and photographically documented for future presentations, and/or the report.

5.2.1 Principal lap presenter solutions

Concept 1 - curved sliding pusher

Presenter/buckle in position for easy access and egress

Presenter/buckle in position for easy reach

5.2.1 Principal lap presenter solutions

Concept 1 - curved sliding pusher

Initial assessment of buckling procedure (with ca. 95 percentile user)

1

2

3 >>

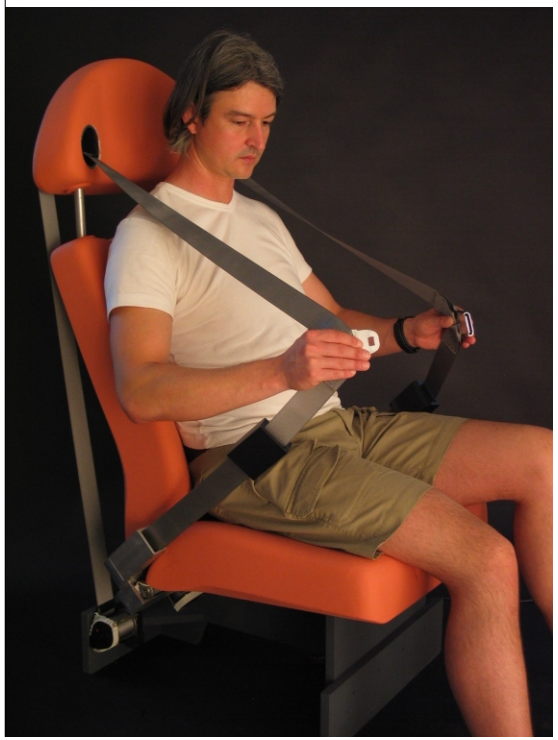
5.2.1 Principal lap presenter solutions (continued)

Concept 1 - curved sliding pusher

Initial assessment of buckling procedure (with ca. 95 percentile user)

>> 4

5



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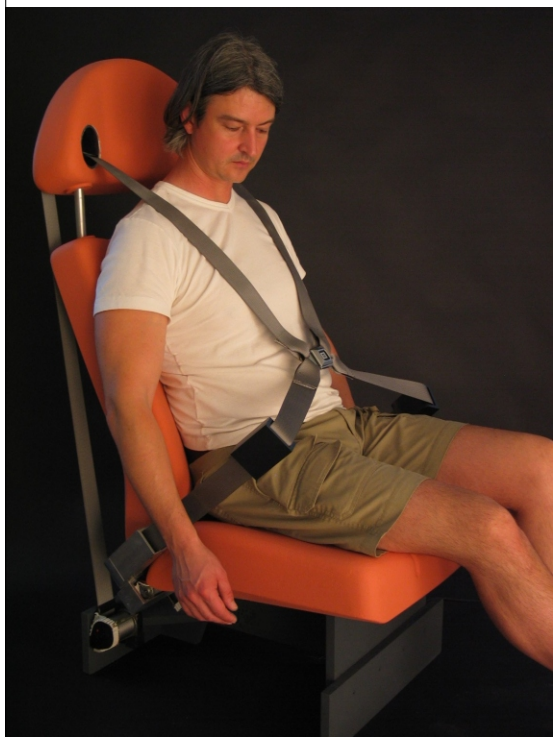
5.2.1 Principal lap presenter solutions (continued)

Concept 1 - curved sliding pusher

Initial assessment of buckling procedure (with ca. 95 percentile user)

>> 7



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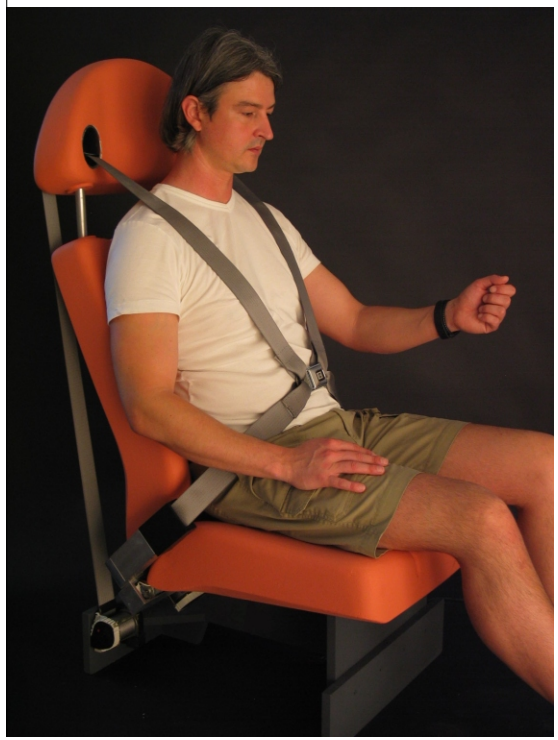
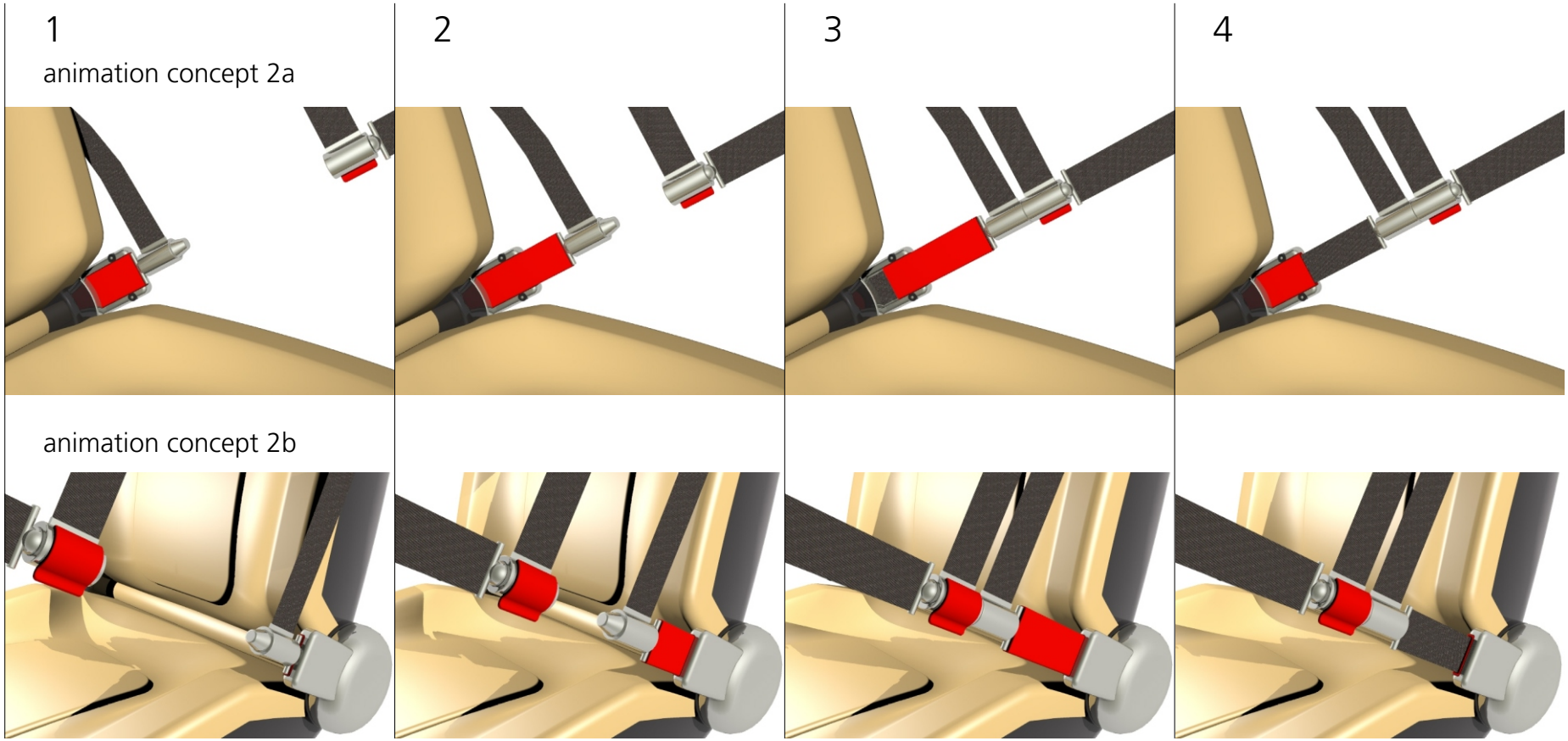


5.2.1 Principal lap presenter solutions

Concept 2 - straight sliding pusher

Optional concept as variation with limited extension
(Excerpt from the animation on attached CD from two views)



5.2.1 Principal lap presenter solutions

Concept 3 - pivoting arm

Optional concept based on mechanically simple non-sliding action

Horizontal resting position (vertical belt hindering accsess/egress)

Vertical resting position (vertical belt twisting problem)

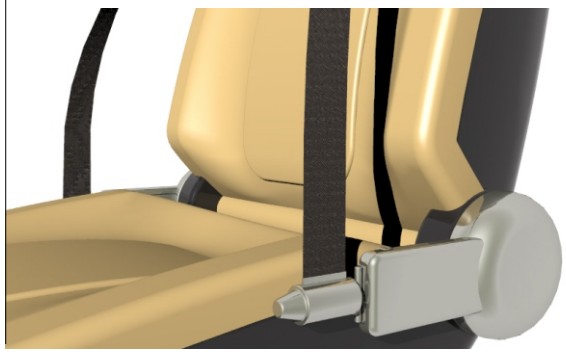
5.2.1 Principal lap presenter solutions

Concept 3 - pivoting arm

Optional concept based on non-sliding, possibly combined with minimally sliding action
(Excerpt from the animation on attached CD)

1

animation concept 3



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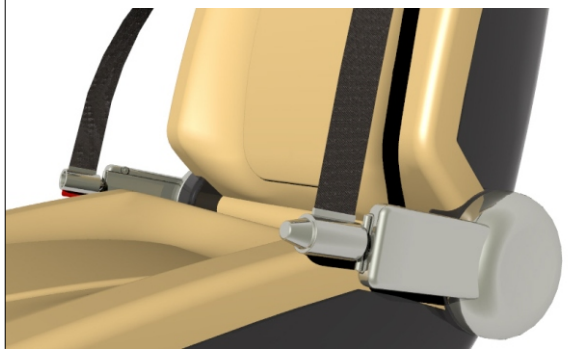


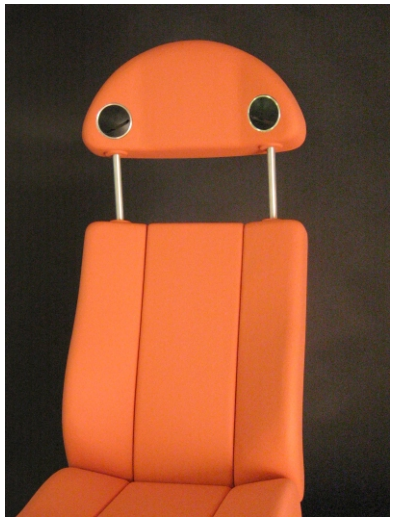
3

5.2.2 Headrest with integrated or synchronized D-rings

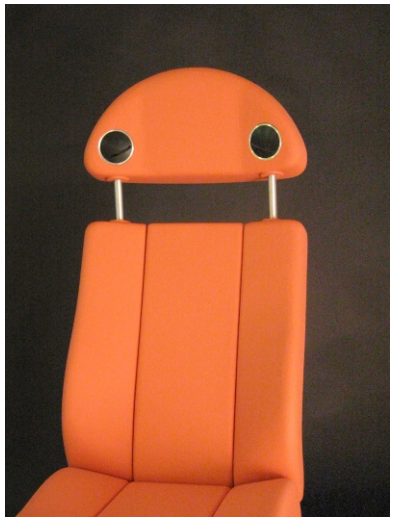
Concept 1 - fully integrated D-rings

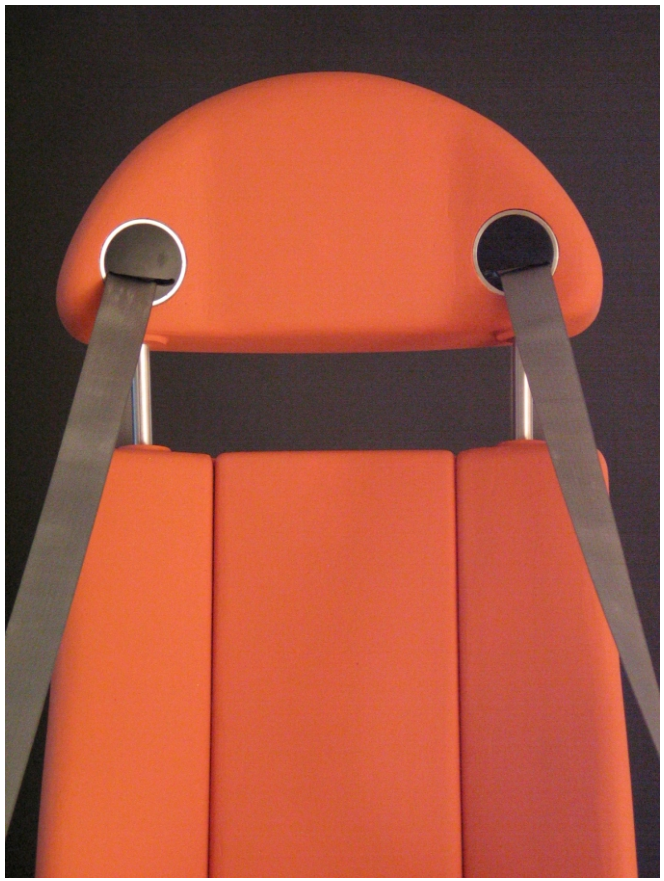
D-rings positioned in adjustable headrest allow for optimal location regardless of users' height

e.g. tall male



e.g. tall female



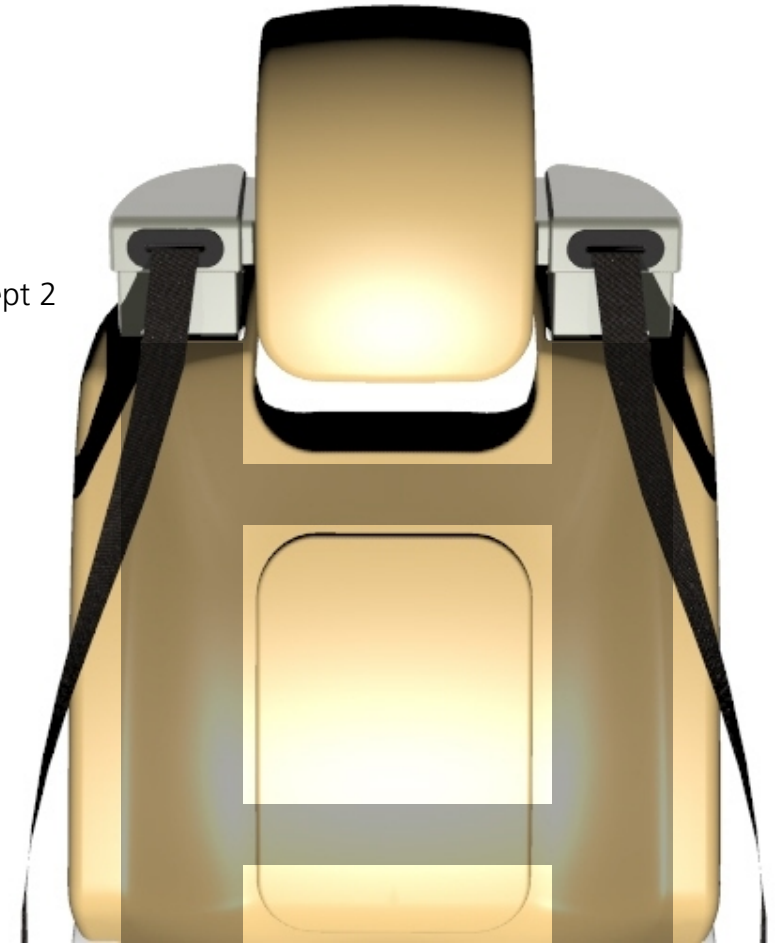


5.2.2 Headrest with integrated or synchronized D-rings

Concept 2 - visually separated D-rings

Styling variation of headrest integrated position
(Excerpt from the animation on attached CD)

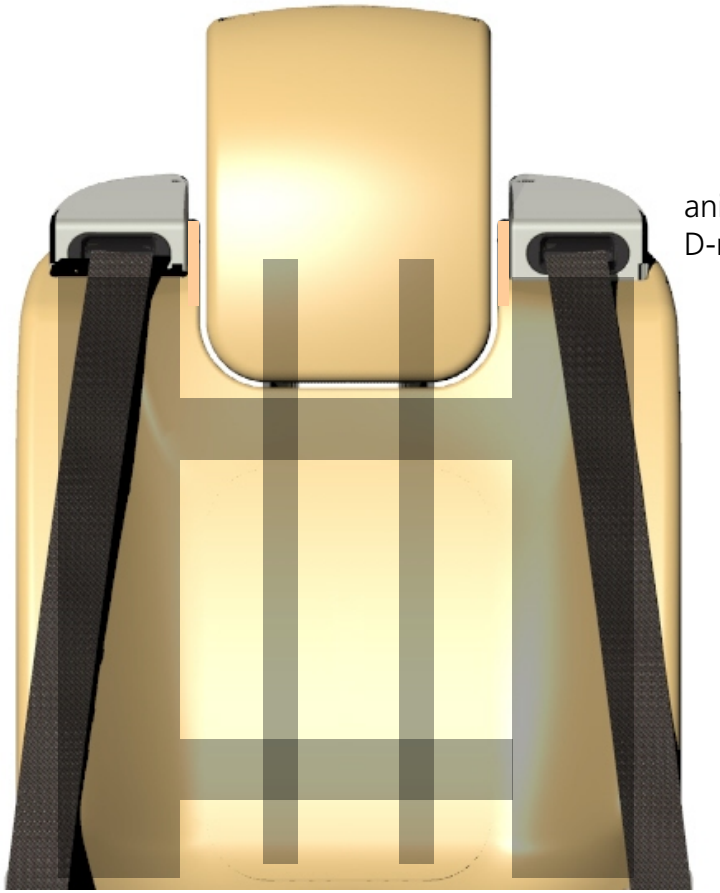
animation
D-ring concept 2



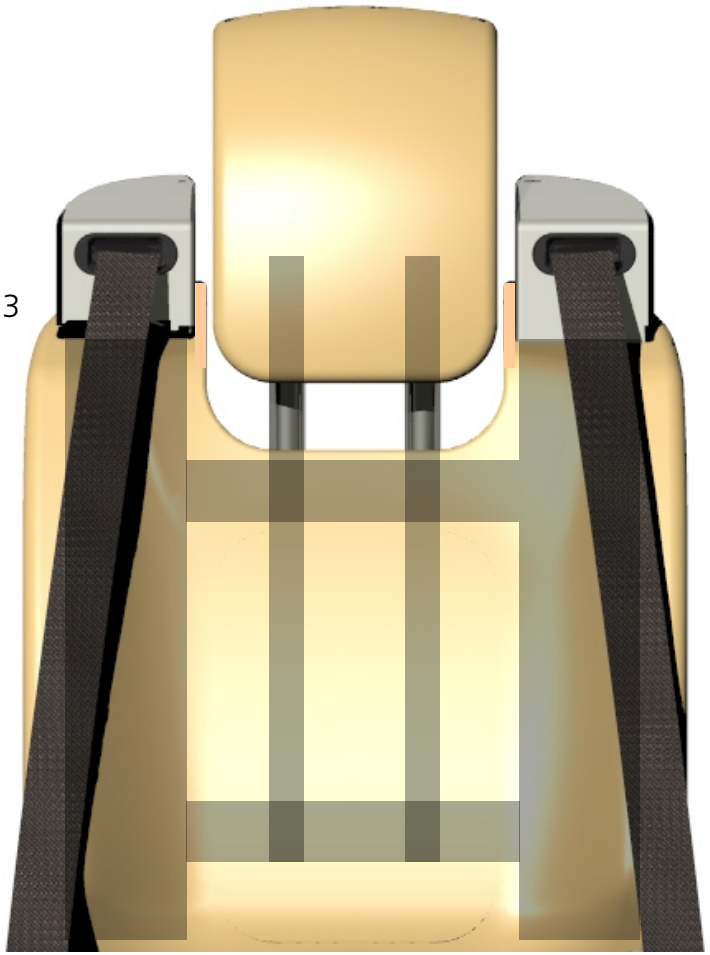
5.2.2 Headrest with integrated or synchronized D-rings

Concept 3 - independently moving D-rings

Functional variation of headrest independent position
(Excerpt from the animation on attached CD)

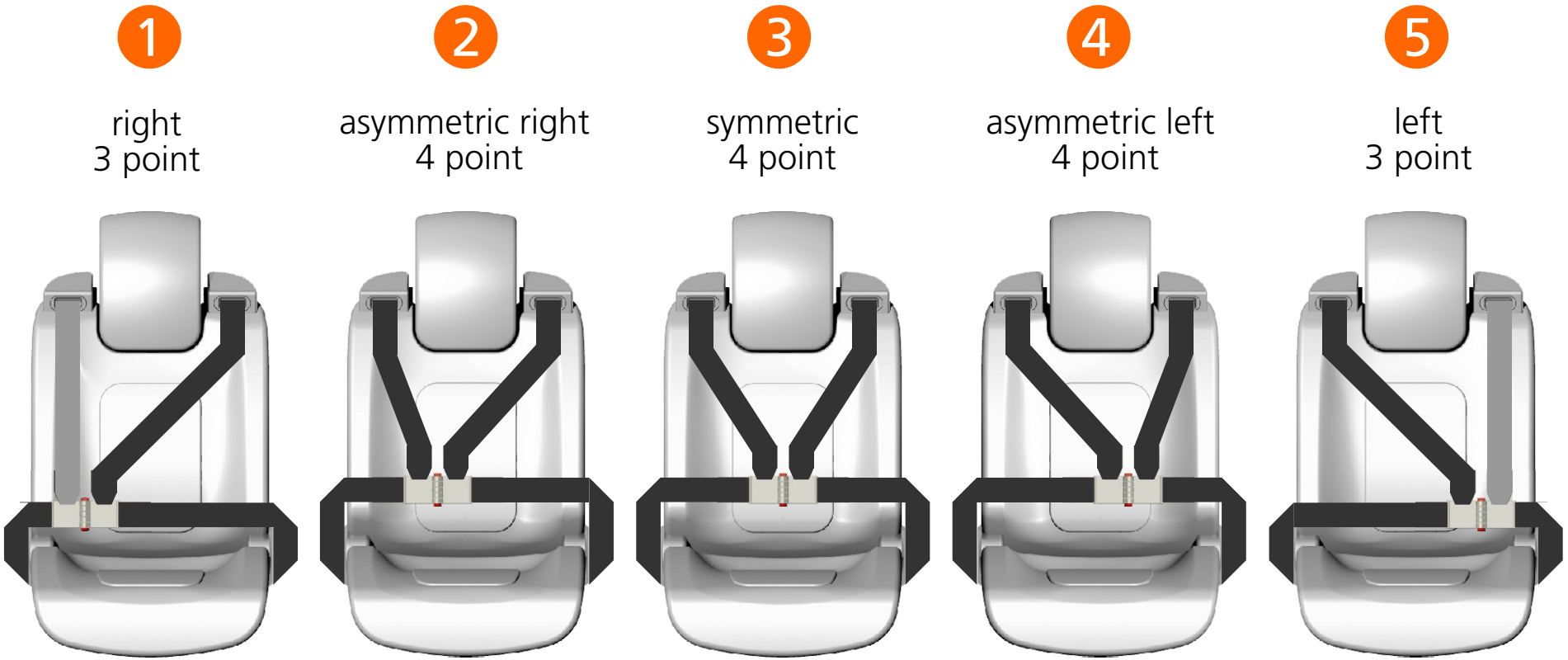


animation
D-ring concept 3



5.2.3 Generic belt configurations

Five different buckling options, depending on users' wearing preferences and safety needs.
(Position two and four possibly advantageous for females).



5.2.3 Generic belt configurations

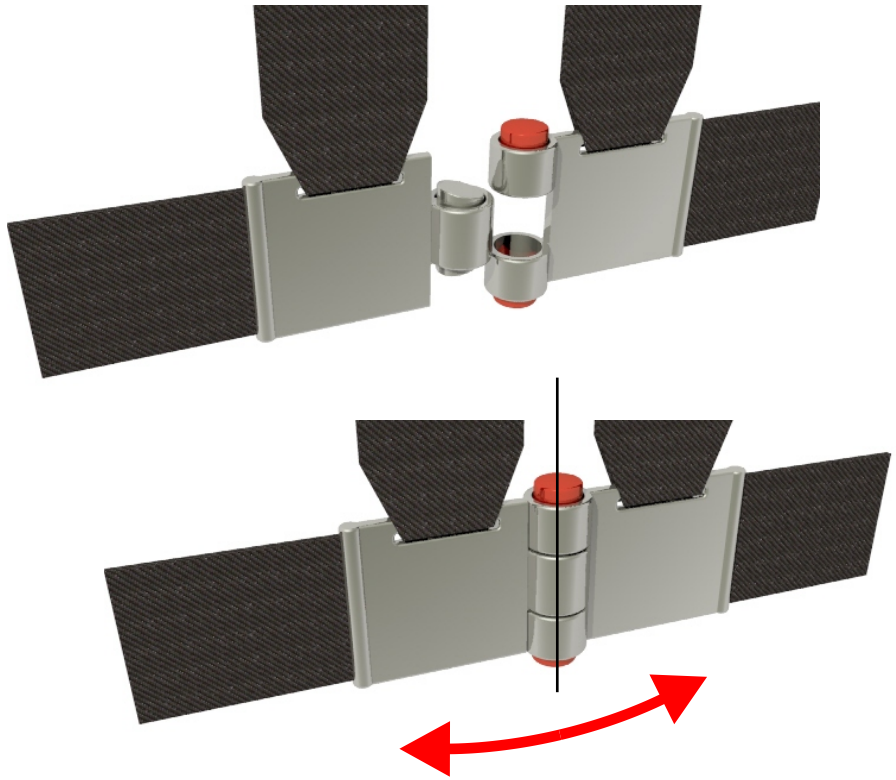
Initial assessment of buckling options (with ca. 95 percentile user)

1	2	3	4	5
right 3 point	asymmetric right 4 point	symmetric 4 point	asymmetric left 4 point	left 3 point

5.2.4 Generic buckle concepts

Option 1

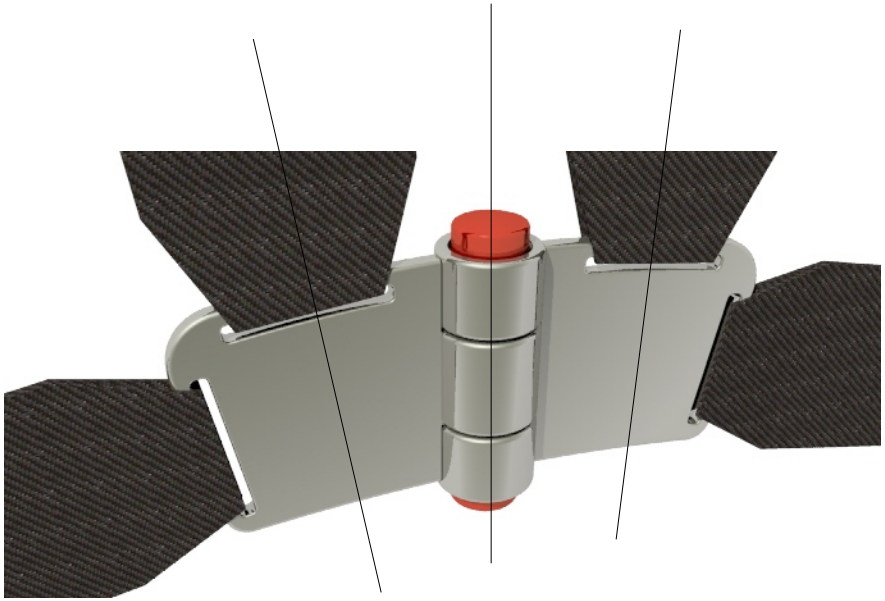
- One hand, index finger and thumb release
- Hinge joint allows passive waist size adjustability



5.2.4 Generic buckle concepts

Option 2

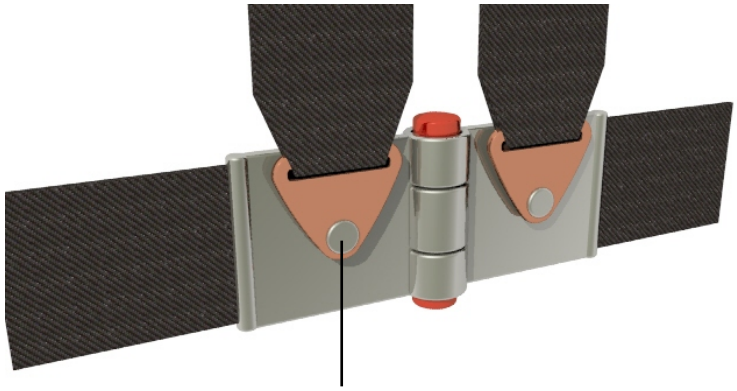
- One hand, index finger and thumb release
- Hinge joint allows passive waist size adjustability
- Angled belt connections offer better ergonomic fit

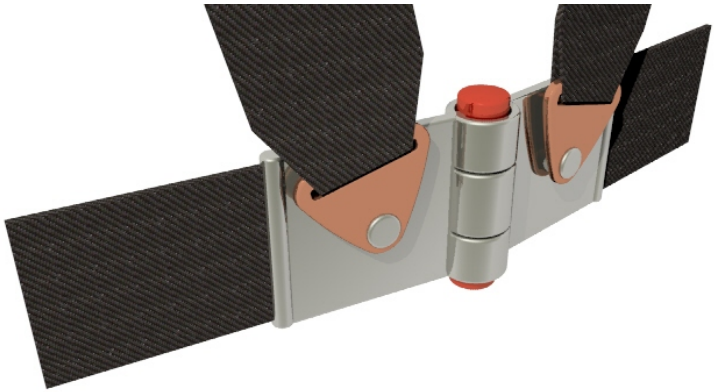


5.2.4 Generic buckle concepts

Option 3

- One hand, index finger and thumb release
- Hinge joint allows passive waist size adjustability
- Hinged belt connectors offer alignment with upper belt for body fit

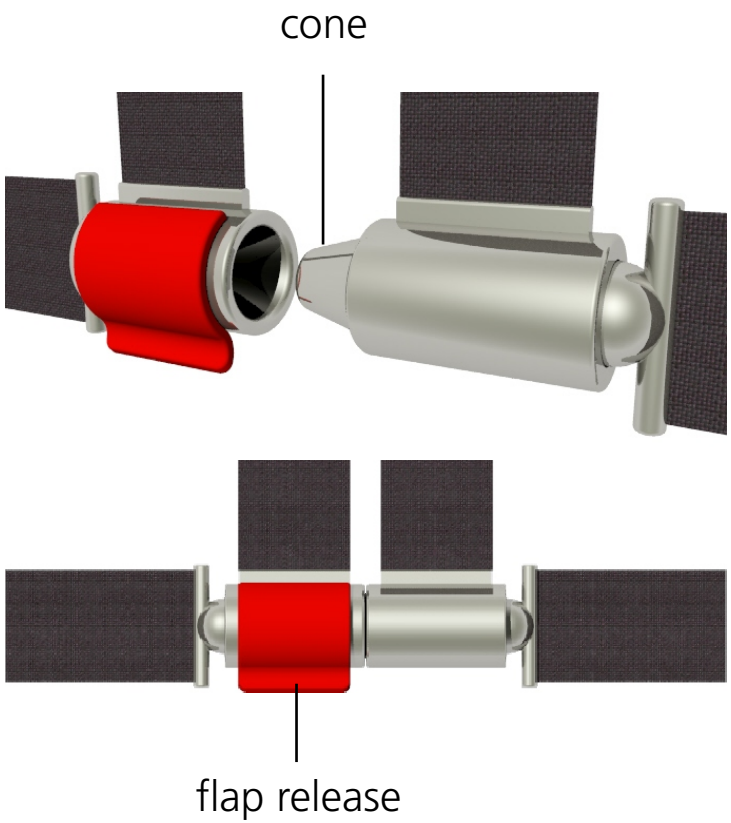




5.2.4 Generic buckle concepts

Option 4

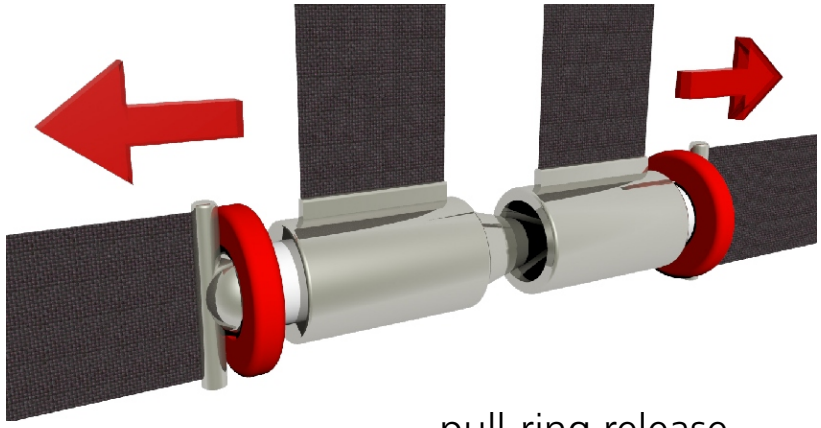
- One hand, one finger flap release
- Cone allows easier connectivity
- Spherically attached belt connectors offer superior belt fit



5.2.4 Generic buckle concepts

Option 5

- Two hands, two finger pull-ring release
- Cone allows easier connection
- Spherically attached belt connectors offer superior belt fit

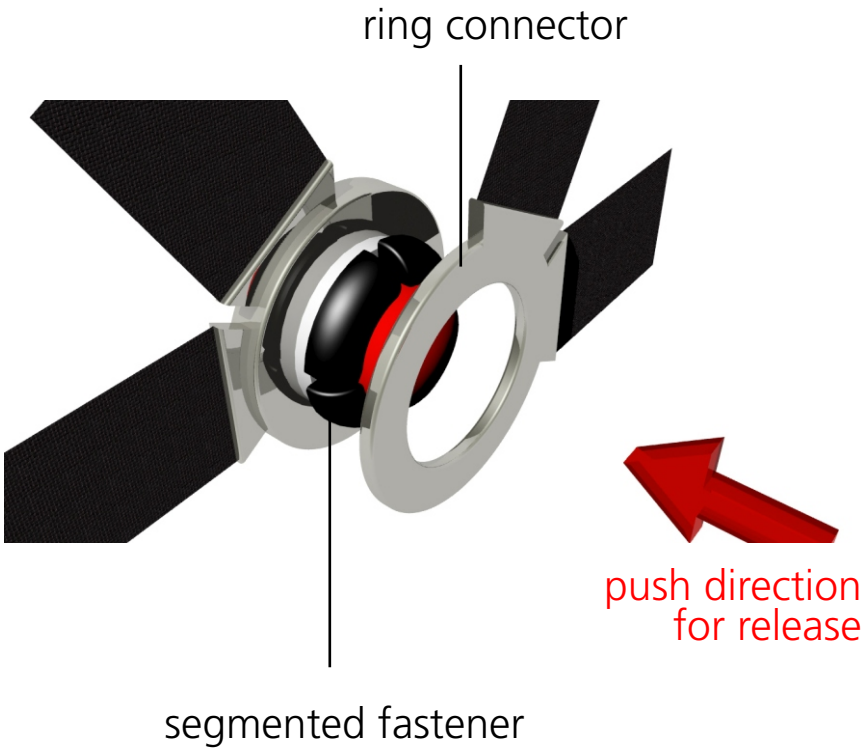


pull-ring release

5.2.4 Generic buckle concepts

Option 6

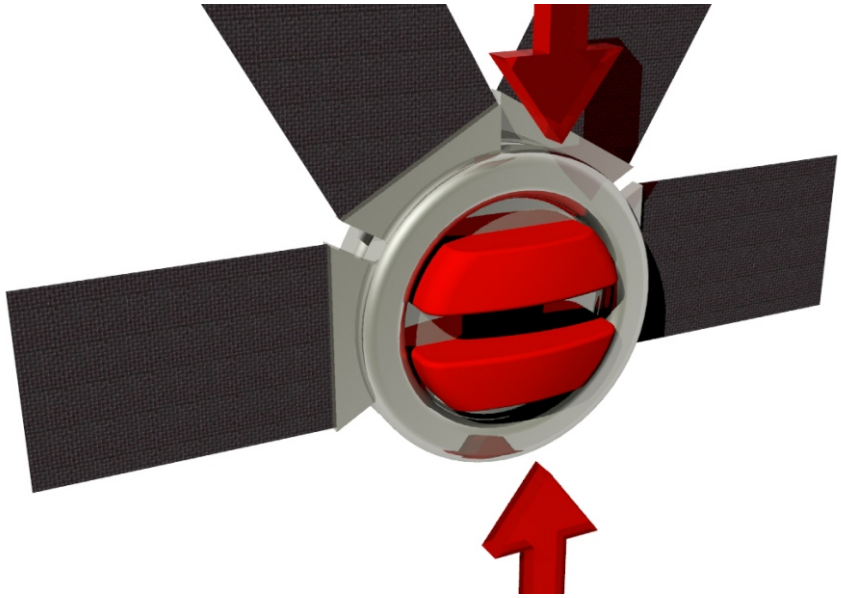
- One hand, one finger push button release
- Ring configuration allows compact design



5.2.4 Generic buckle concepts

Option 7

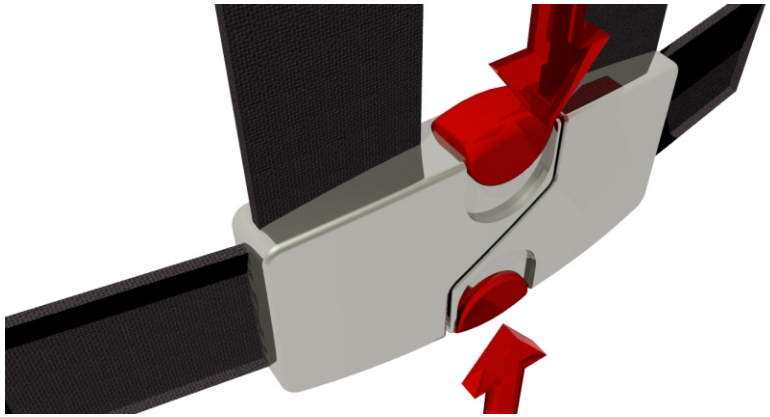
- One hand, two fingers squeeze release
- Ring configuration allows compact design



5.2.4 Generic buckle concepts

Option 8

- One hand, two fingers squeeze release
- Curved buckle shape offers optimum body fit



5.2.5 Ergonomic seat cushion considerations

- Seat-pan flattening towards front
- Backrest flattening towards top
- Total width 20 inch minimum
- Generously dimensioned headrest

Project Assessment and Recommendations for Continuation

The project as tentatively completed still requires safety and convenience oriented testing in actual settings. A separate proposal is being submitted to allow the study to be prepared and conducted starting in Summer 2005.

Independent of this testing phase a number of sub-projects were identified with the benefit of adding to the significance and usefulness of the current outcome of the study.

- One specific example for such project centers around the subject of belt buckles, both in terms of mechanical configuration and user-friendly design. The purpose of the various buckle concepts as shown in this report is only proof of possibilities, still requiring intense ergonomic research and design refinement.

- Another example worth investigating is the layout and form of seat cushions for an emerging generation of different bodied users, and the functional integration of safer seats into future car interiors (e.g. crossover vehicles).

- Further research subjects appropriate for government involvement and adding to the safety of automotive transportation are imaginable and viable for conduct at OSU.

Credits

Collaborating Companies:

- Ford Motor Corp.
- JCI
- TRW

Research Associates:

- Gert-Dieter Tuzar (GRA)
- Mike Dietrich