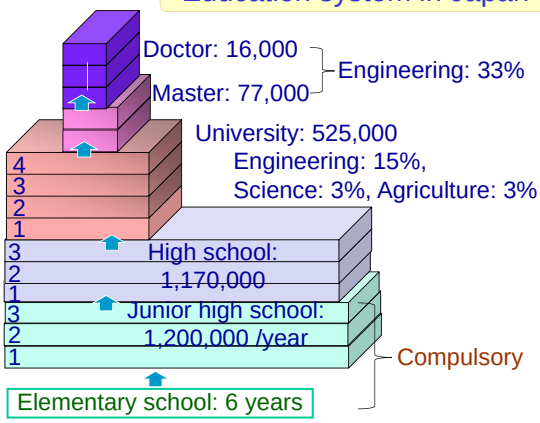
Education in Japanese university

Toyohashi University of Technology
Ken-ichiro Mori

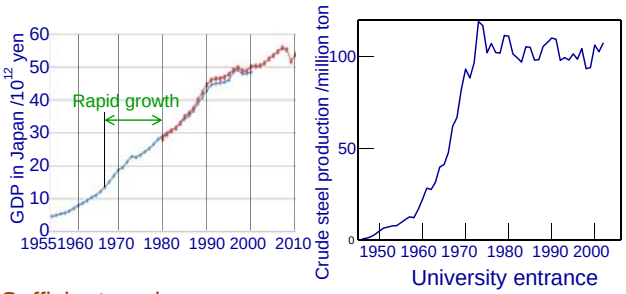

Forming processes


Education system in Japan



Development of Japanese industry

Faculty of Engineering: 3 times larger



Sufficient engineers
Superior readers
No conscription: 22-23 years old

University entrance
Japan: 55%(2007)
Russia: 25%（2005)
Diploma: 89%

Japanese university

	Number of universities	Number of students	Number of postgraduate students
National	86	620,000	154,000
Prefectural	95	140,000	14,000
Private	599	2,130,000	94,000
Total	780	2,890,000	263,000

National: Tokyo, Kyoto, Osaka, Tohoku, Nagoya, Kyushu
Private: Waseda, Keio

National universities are leading for education of high-level engineers: cheaper tuition fee, high-level professors, wealthy facilities

Engineering education in laboratory

Staff: 1 professor, 1 associate professor or lecturer, 1 research associate

Bachelor: 4 years
- 1-3rd years: class, teaching
- 4th year: belonging to laboratories (research and not practice)

Master: 2 years, many

3 year research work: good training of engineers, 24-25 years old

Doctor: 3 years, few, 27-30 years old course, paper

Research work in laboratory



Equipment making

Research work in laboratory



Stamping

Research work in laboratory




Forming

Measurement

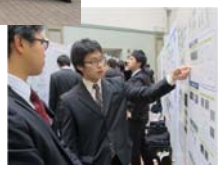
Simulation

Mixture of students

Presentation

Japanese conference

Final presentation

1. Engineering education system in Japanese universities
2. Laboratory education
3. Publication of papers
4. Toyohashi University of Technology
5. Frontier Forming System Laboratory

Research policy

Entry: to decide research topics
Originality, background, co-operation, target

Work: students, supervising, judgment,
Good results, new finding

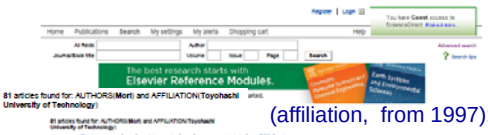
Exit: publishing of papers
Research impact

Publication and database of research papers

Proceedings (conference) papers:
Easy reviewing, not high quality
Knowledge exchange
Journal papers:
Hard reviewing, authorized, high quality, high citation

International: English, Internet search (from 2000)

Scopus, web of knowledge: journals and proceedings
Science Direct: Elsevier, only journals (impact factor), biggest database



(affiliation, from 1997): 65 (81)

Siltation

Hot to write journal papers

Readers feels interesting

Introduction:
Background, initiation, importance, references of journal papers
Results:
High quality figures than text (1st and 2nd figures): not lengthy
Balance: originality and results
Checking, polishing, long time
Fighting

1. Engineering education system in Japanese universities
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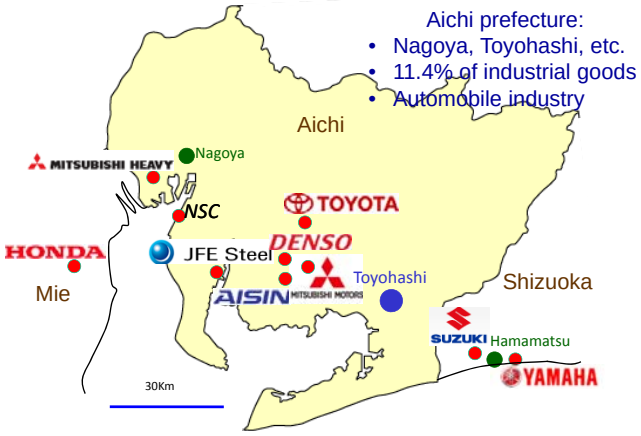
Toyohashi University of Technology

Population: 380,000
Area: 630 km^2

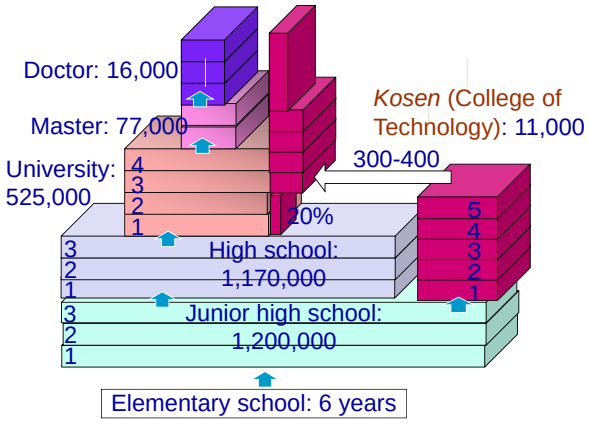
Industries near Toyohashi



Toyohashi University of Technology

National university
Found in 1976
Number of students: 2,194
International: 184
Academic staff:199
5 departments, 1 research institute and 6 research centers
Area: 355,606 m^2

Feature in Toyohashi University of Technology



Number of students

Undergraduate course	1,146 (63)
Master course	917 (70)
Doctoral course	119 (40)
Research students, other non-degree students	12 (11)
Total	2,194 (84)

( ): Number of international students

Foreign students

Country	Number	Country	Number
Asia		South America	
India	2	Colombia	2
Indonesia	24	Brazil	1
Vietnam	24	Europe	
Cambodia	1	Uzbekistan	1
Sri Lanka	2	Albania	1
Thailand	1	Bosnia and Herzegovina	1
Korea	9	Middle East	
China	21	Palestinian Territories	1
Nepal	1	Afghanistan	2
Bangladesh	9	Africa	
Malaysia	54	Egypt	1
Myanmar	5	Morocco	1
Mongolia	6	Zimbabwe	1
Laos	10	Guinea	1
		Algeria	1
		Tanzania	1
		Total	184

Robot contest

Departments

Mechanical Engineering

- Mechanical Systems Design Course
- Material and Manufacturing Course
- System Control and Robotics Course
- Environment and Energy Course

Electrical & Electronic Information Engineering

- Electronic Materials Course
- Electrical Systems Course
- Integrated Electronics Course
- Information and Communication Systems Course

Computer Science & Engineering

- Computer and Information Science Course
- Information and Systems Science Course

Environmental & Life Sciences

- Sustainable Development Course
- Life and Materials Science Course

Architecture & Civil Engineering

- Architecture and Building Science Course
- Civil and Environmental Engineering Course

Laboratories for Department of Mechanical Engineering

Mechanical Systems Design Course

- Material and Structural Mechanics Laboratory
- Machine Dynamics Laboratory
- Frontier Forming System Laboratory
- MEMS/NEMS Processing Laboratory

Material and Manufacturing Course

- Materials Function Control Laboratory
- Laboratory for Materials Strength & Characterization in 3D/4D
- Thin Film Laboratory
- Interface and Surface Fabrication Laboratory

System Control and Robotics Course

- Robotics and Mechatronics Laboratory
- Instrumentation Systems Laboratory
- System and Control Engineering Laboratory
- Industrial Systems Engineering Laboratory

Environment and Energy Course

- Energy Conversion Engineering Laboratory
- Thermo-Fluid Engineering Laboratory
- Natural Energy Conversion Science Laboratory
- Energy Conservation Engineering Laboratory

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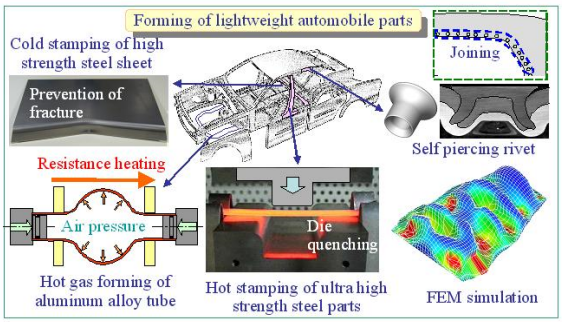
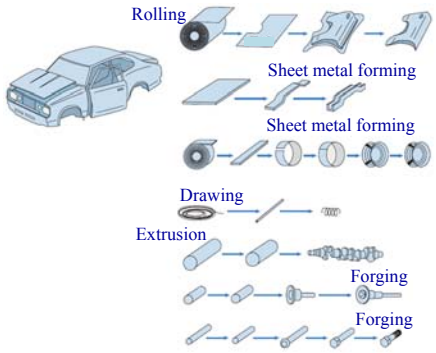
Frontier Forming System Laboratory

Novel Processes: high strength steel, aluminium alloy, titanium alloy, magnesium alloy



Forming processes using plastic deformation



Members

Staff	Student
Professor, Associate professor, Research associate	Doctor: 4 Master, 2nd year: 8 Master, 1st year: 8 Undergraduate 4th year: 9

3+29=32

Research Topics

1) Development of forming processes of lightweight metals
- 1 shot hot stamping of ultra-high strength steel parts
- Improvement of formability in hot stamping
- Warm and hot punching of ultra-high strength steel sheets using resistance heating
- Hot stamping of titanium alloy sheets
- Improvement of springback in bending of ultra-high strength steel sheets using servo press
- Prevention of fracture in stretch flanging of ultra-high strength steel sheets
- Prevention of wrinkling in shrinkage flanging of ultra-high strength steel sheets
- Improvement of quality of sheared edge in punching of ultra-high strength steel sheets
- Prevention of seizure in deep drawing and ironing of ultra-high strength steel sheets
- Punching process including thickening of hole edge of ultra-high strength steel sheet
- Self-pierce riveting of high strength steel and aluminium alloy sheets
- Mechanical clinching of high strength steel and aluminium alloy sheets
- Prevention of seizure in ironing of aluminium alloy and stainless steel cups
- Local thickening of steel wheel disk
- Hot forging of aluminium alloy billet having die quenching
- Cold deep drawing of magnesium alloy sheet

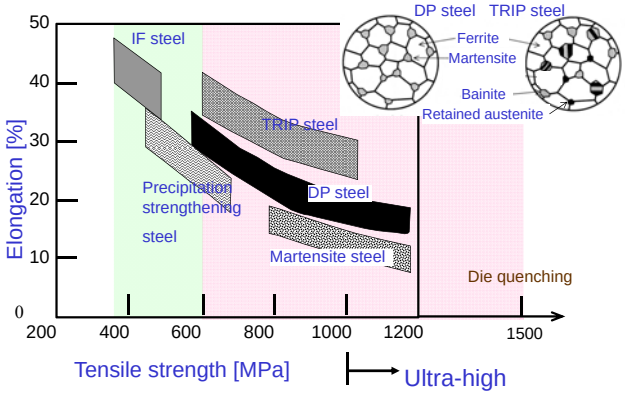
2) Development of forming processes of lightweight parts
- Gas forming of aluminium alloy and quenchable steel tubes using resistance heating
- Forming of tailor blanks having local thickening for stamping
- Improvement of formability by oscillation of internal pressure in pulsating hydroforming of tube

3) Development of new forming processes
- Automatic re-lubrication in forging of plates by load oscillation
- Consolidation of iron powder by extrusion
- In-situ measurement during stamping using borescope

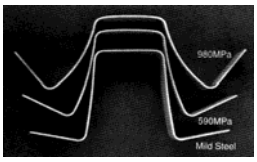
Specific strength for various sheet metals

Sheet	Tensile strength	Specific gravity	Strength-to-specific gravity ratio
Ultra high strength steel	980 - 1470MPa	7.8	126 - 188MPa
High strength steel	490-790MPa	7.8	63-101MPa
Mild steel SPCC	340MPa	7.8	44MPa
Aluminium alloy A6061(T6)	310MPa	2.7	115MPa

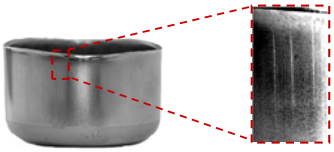
Various high strength steel sheets



Problems in stamping of high strength steel sheets



Large springback



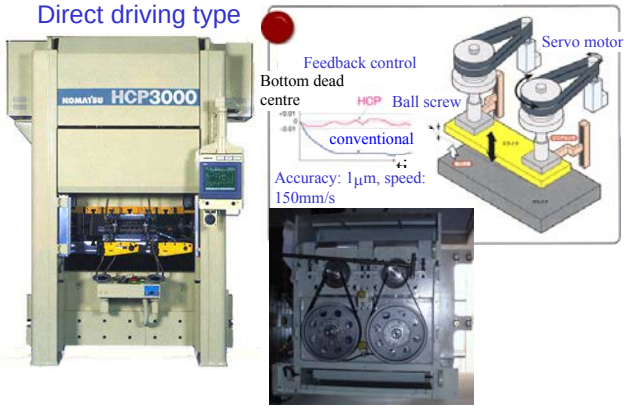
Seizure

Fracture

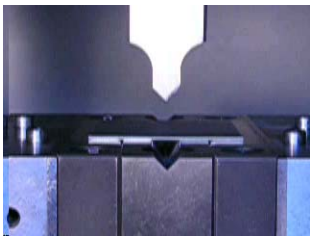
Small ductility

800kN CNC Servo Press

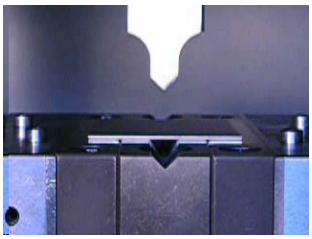
Direct driving type



Deformation behaviour in V-shaped bending



(a) SPCC

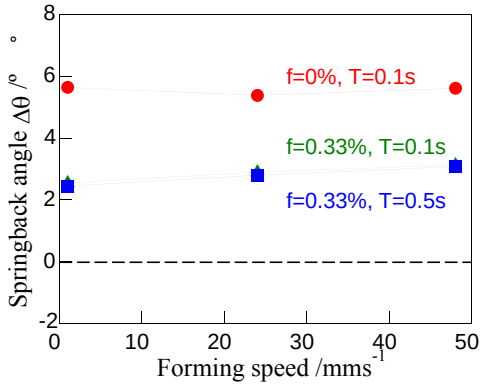


(b) SPFC980Y

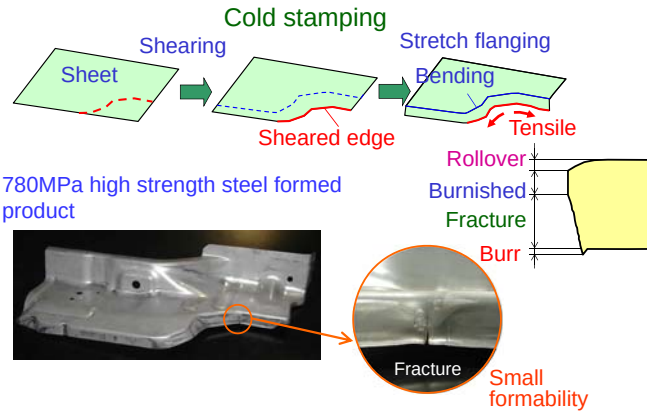
v=24mm/s, f=0%, T=0.5s

3 times slower

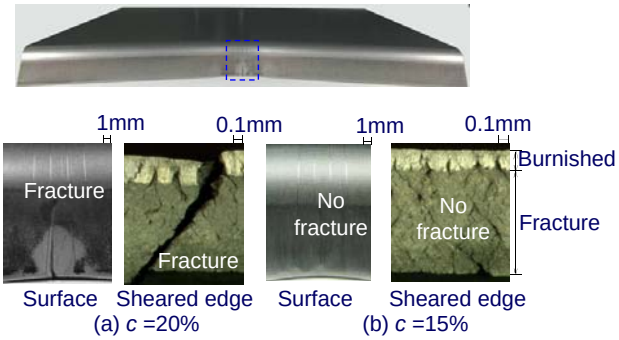
Effects of bottoming and holding time at bottom dead centre for SPFC980Y



Fracture in stretch flanging of high strength steel sheets

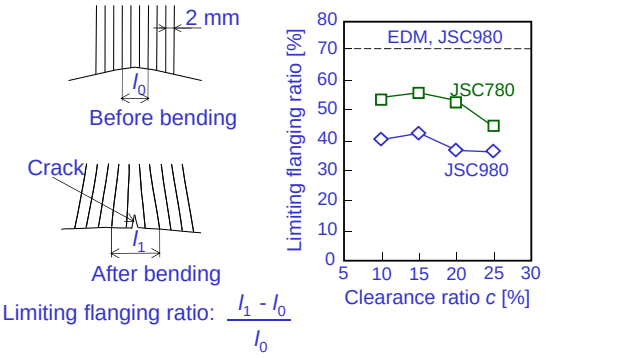


Effect of clearance ratio on occurrence of fracture for JSC980

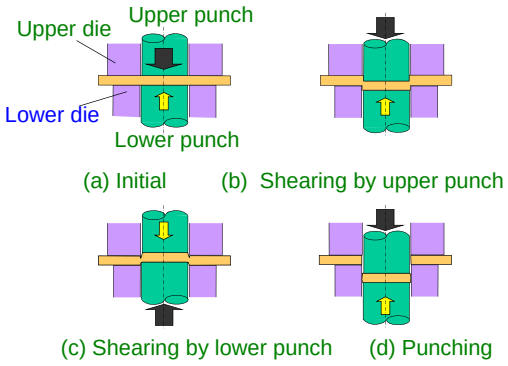


K. Mori, Y. Abe, Y. Suzui, Improvement of stretch flangeability of ultra high strength steel sheet by smoothing of sheared edge, Journal of Materials Processing Technology, 210-4 (2010), 653-659.

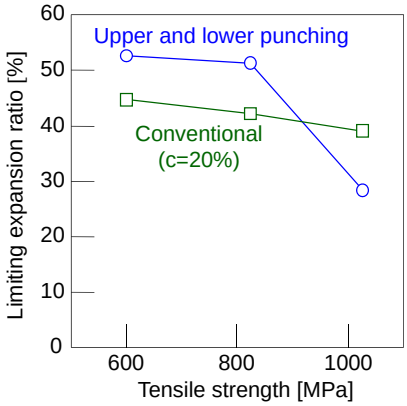
Relationship between limiting flanging ratio and clearance ratio



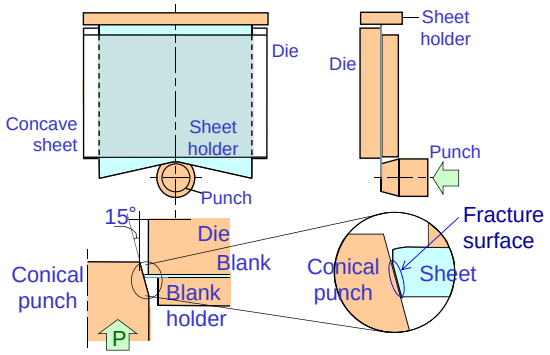
Improvement of stretch flangeability by upper and lower punching



Relationship between limiting expansion ratio and tensile strength

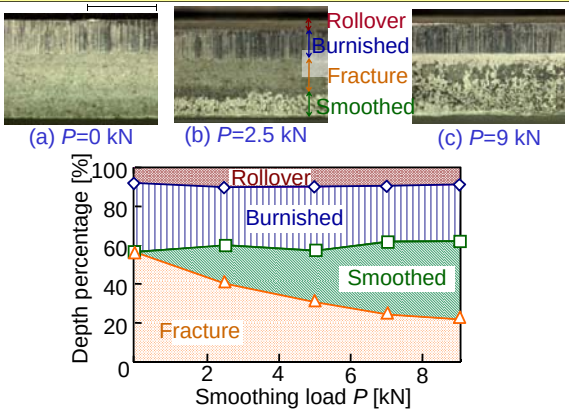


Smoothing of fracture surface on sheared edge with conical punch

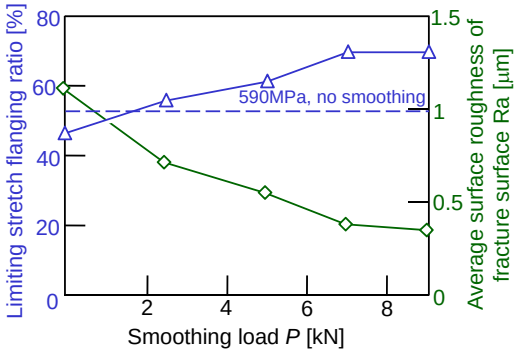


K. Mori, Y. Abe, Y. Ikeda, Improvement of formability for expansion of punched hole of ultra-high strength steel sheets by smoothing of sheared edge, Steel Research International, Special Edition, (2011), 604-609.

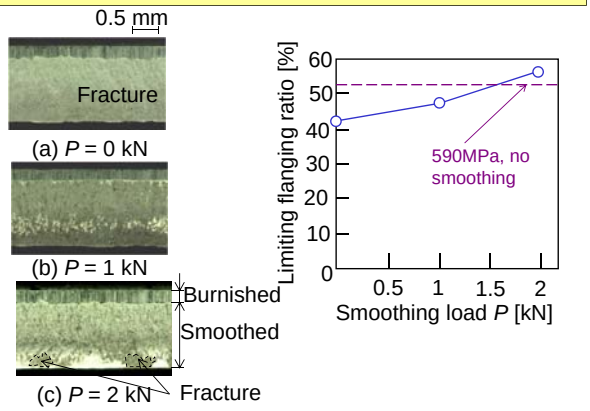
Sheared edge after smoothing for JSC780 and *c*=20%



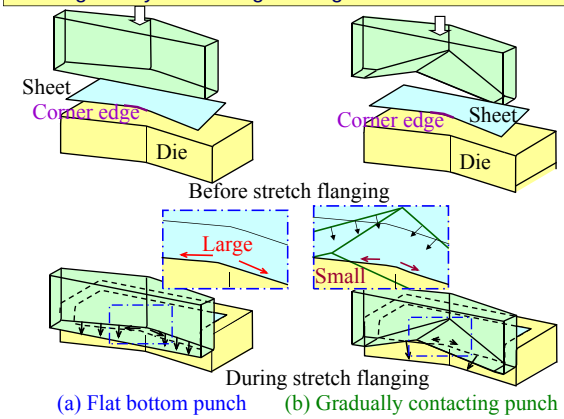
Improvement of limiting stretch flanging ratio for JSC780 and *c*=20%



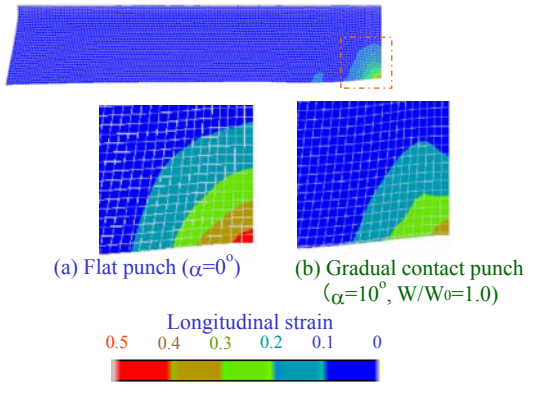
Sheared edge before and after smoothing for JSC980Y and *c*=15%



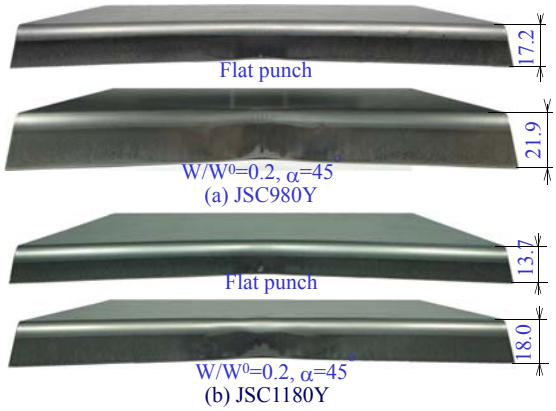
Gradually contacting punch for improving stretch flangeability of ultra-high strength steel sheets



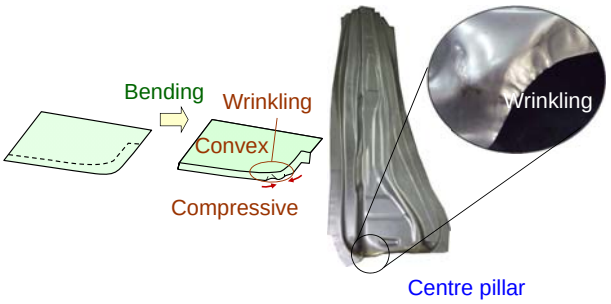
Distribution of longitudinal strain by gradually contacting punch



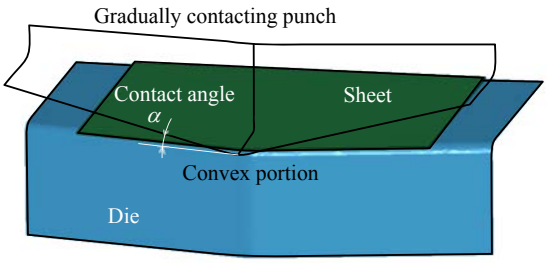
Improvement of limiting flange height by gradually contacting punch



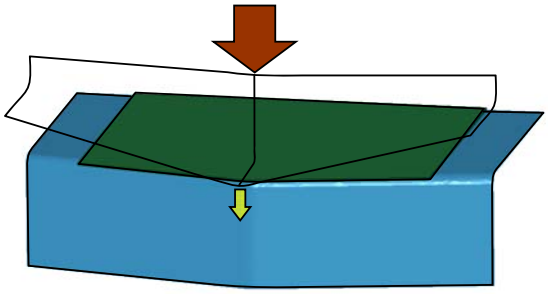
Shrink flanging of high strength steel sheets



Gradually contacting punch for improving shrink flangeability of ultra-high strength steel sheets

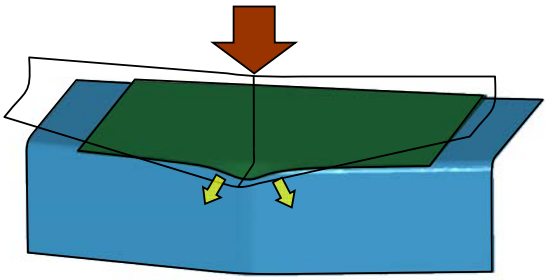


Gradually contacting punch for improving shrink flangeability of ultra-high strength steel sheets



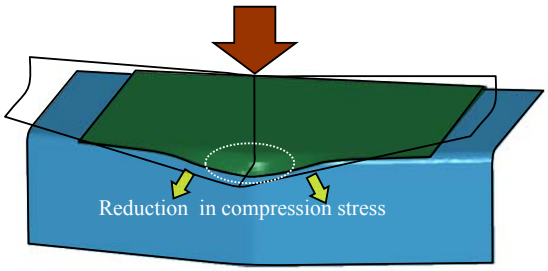
Before flanging

Gradually contacting punch for improving shrink flangeability of ultra-high strength steel sheets



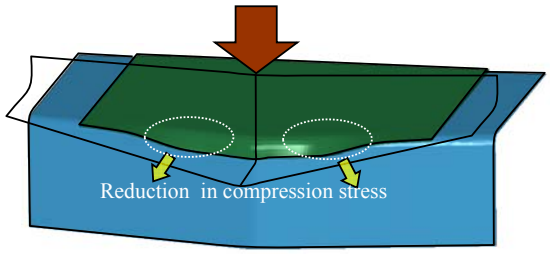
Flanging in corner

Gradually contacting punch for improving shrink flangeability of ultra-high strength steel sheets



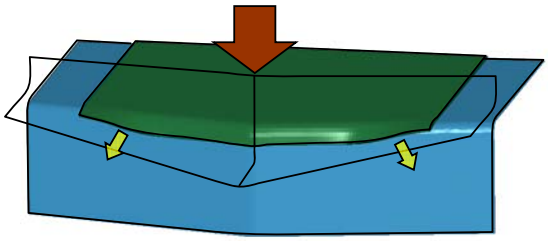
Flanging in corner

Gradually contacting punch for improving shrink flangeability of ultra-high strength steel sheets



Flanging in side potion

Gradually contacting punch for improving shrink flangeability of ultra-high strength steel sheets



Flanging in side potion

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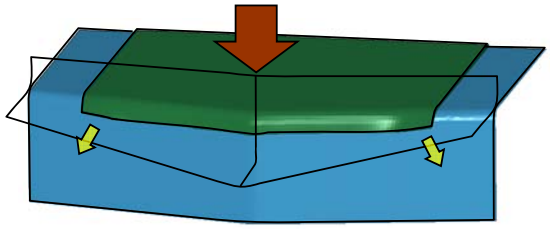

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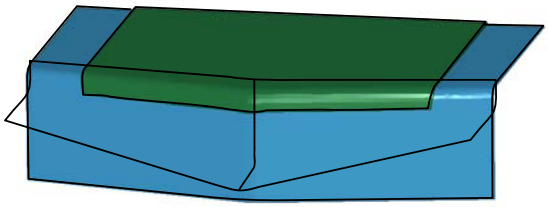
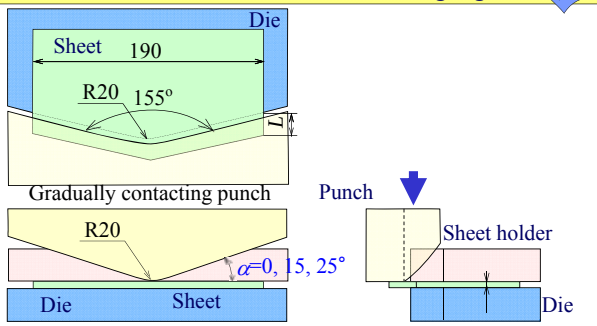


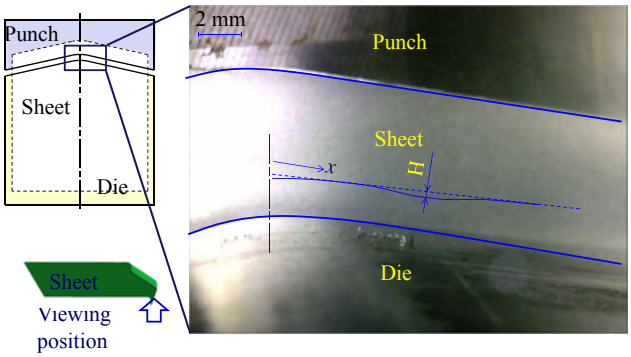
After flanging

Conditions of shrink flanging

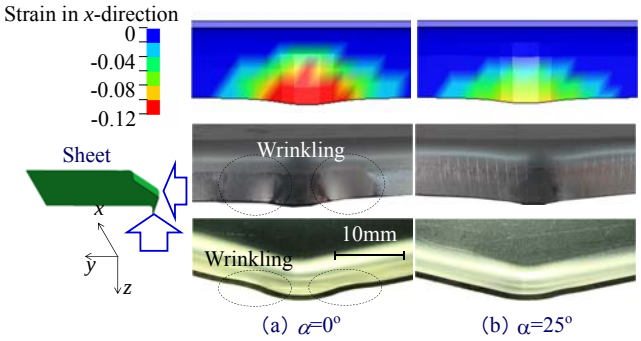


Sheet	Thickness t [mm[	Tensile strength [MPa]	Elongation [%]
JSC590R	1.02	609	23
JSC980Y	1.02	1053	12
	1.22	1051	13
JSC1180Y	1.22	1215	8.0

In-situ measurement of wrinkling during shrink flanging using borescope for α=0° and JSC1180Y



Sheets after shrink flanging for JSC980Y



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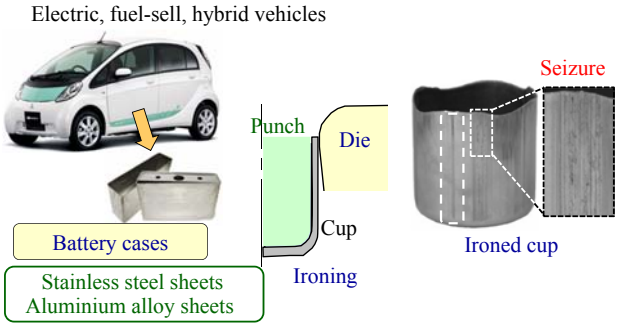
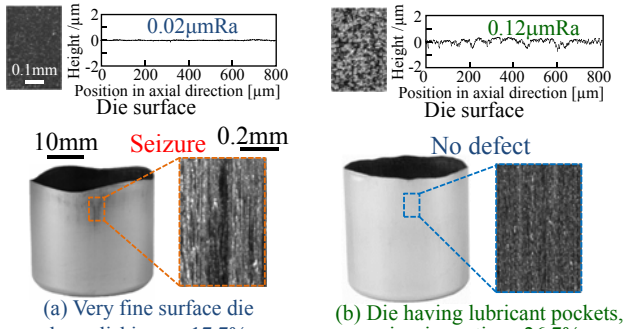
- Improvement of formability by oscillation of internal pressure in pulsating hydroforming of tube

3) Development of new forming processes
- Automatic re-lubrication in forging of plates by load oscillation
- Consolidation of iron powder by extrusion
- In-situ measurement during stamping using borescope

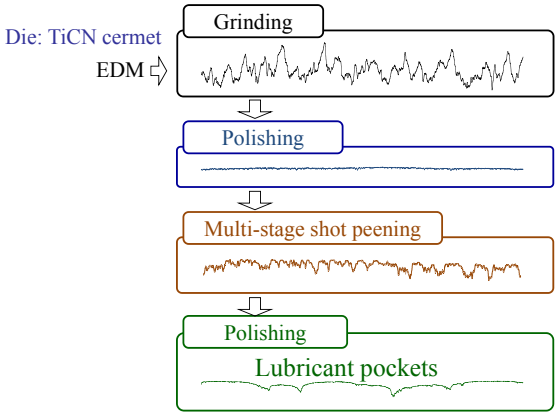
Prevention of seizure in ironing of stacnless steel drawn cup by surface textured die having lubricant pockets



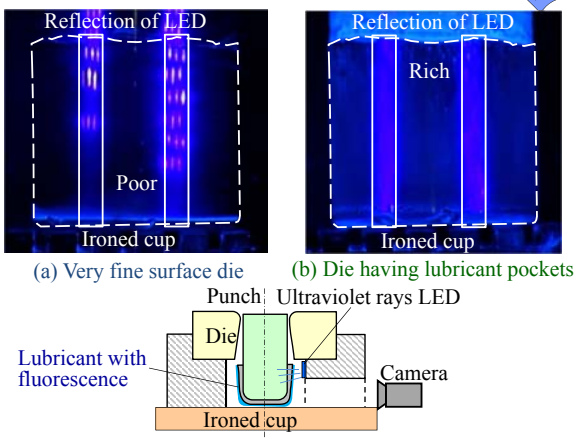
Ironed cups by die having lubricant pockets and very fine surface die for SUS430 (Choleric additive lubricant)



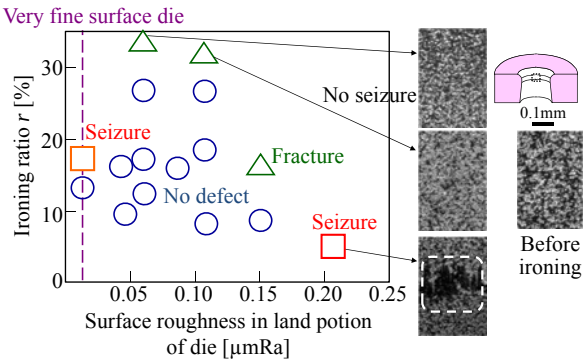
Die having lubricant pockets of TiCN cermet



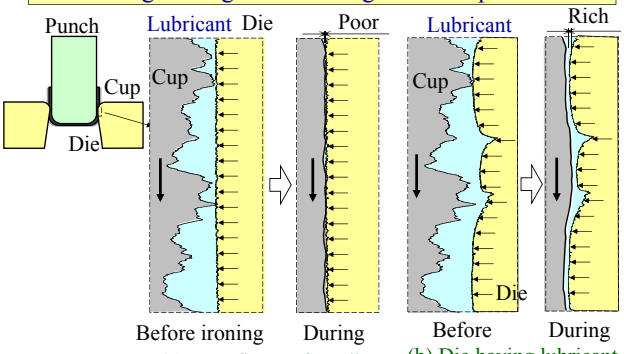
Remained lubricant on cup surface after ironing



Ironing limit of die having lubricant pockets



Summary: lubricant mechanism during ironing of die having lubricant pockets



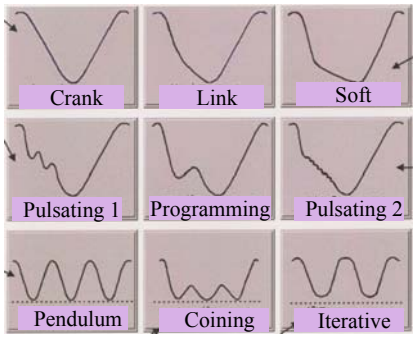
Research Topics

1) Development of forming processes of lightweight metals
- 1 shot hot stamping of ultra-high strength steel parts
- Improvement of formability in hot stamping
- Warm and hot punching of ultra-high strength steel sheets using resistance heating
- Hot stamping of titanium alloy sheets
- Improvement of springback in bending of ultra-high strength steel sheets using servo press
- Prevention of fracture in stretch flanging of ultra-high strength steel sheets
- Prevention of wrinkling in shrinkage flanging of ultra-high strength steel sheets
- Improvement of quality of sheared edge in punching of ultra-high strength steel sheets
- Prevention of seizure in deep drawing and ironing of ultra-high strength steel sheets
- Punching process including thickening of hole edge of ultra-high strength steel sheet
- Self-pierce riveting of high strength steel and aluminium alloy sheets
- Mechanical clinching of high strength steel and aluminium alloy sheets
- Prevention of seizure in ironing of aluminium alloy and stainless steel cups
- Local thickening of steel wheel disk
- Hot forging of aluminium alloy billet having die quenching
- Cold deep drawing of magnesium alloy sheet

2) Development of forming processes of lightweight parts
- Gas forming of aluminium alloy and quenchable steel tubes using resistance heating
- Forming of tailor blanks having local thickening for stamping
- Improvement of formability by oscillation of internal pressure in pulsating hydroforming of tube

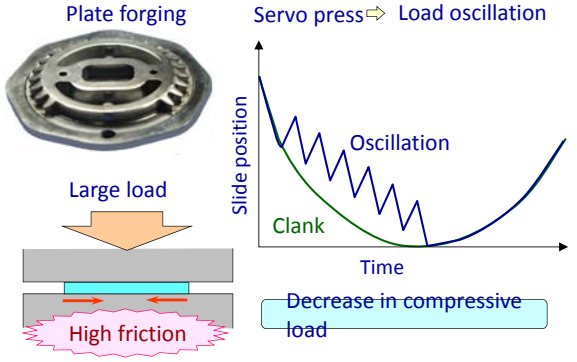
3) Development of new forming processes
- Automatic re-lubrication in forging of plates by load oscillation
- Consolidation of iron powder by extrusion
- In-situ measurement during stamping using borescope

Motions of mechanical servo press



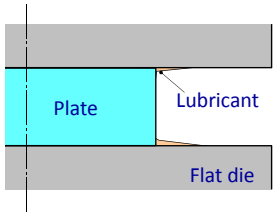
Amada SDE

Reduction of friction in plate forging by load oscilla

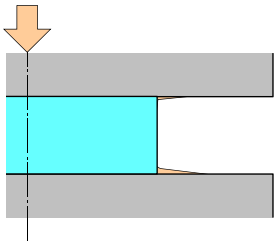


Toyohashi Univ. of

Automatic re-lublication by load oscillation



Automatic re-lublication by load oscillation



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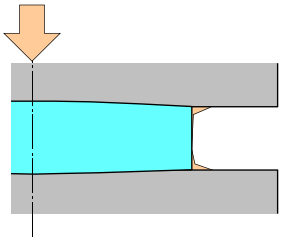
Automatic re-lublication by load oscillation



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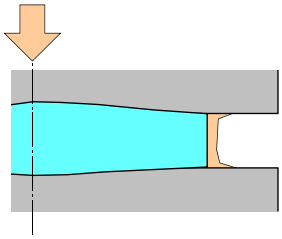
Automatic re-lublication by load oscillation



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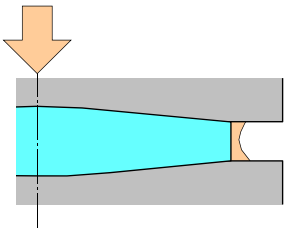
Automatic re-lublication by load oscillation



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Automatic re-lublication by load oscillation

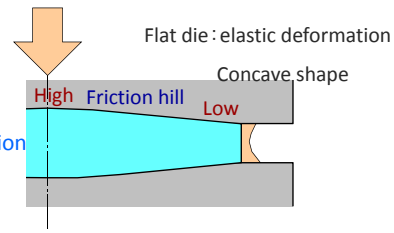


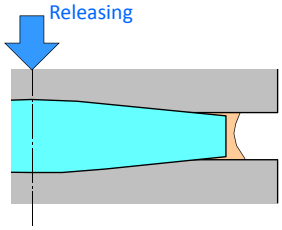
Plate:

plastic deformation

Convex shape

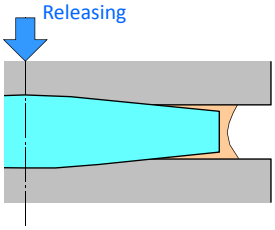
Loading

Automatic re-lublication by load oscillation



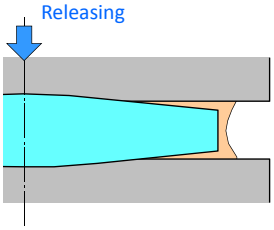
Releasing

Automatic re-lublication by load oscillation



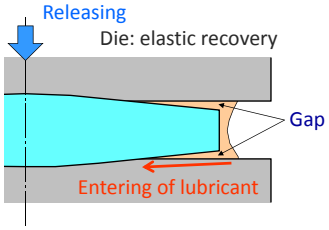
Releasing

Automatic re-lublication by load oscillation



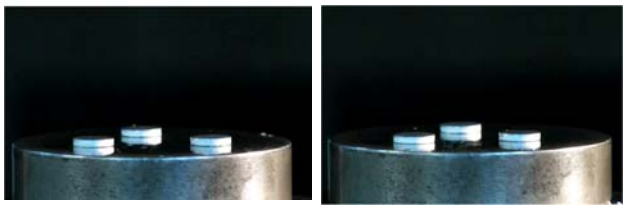
Releasing

Automatic re-lublication by load oscillation



Releasing

Load oscillation in compression using servo press



(a) No oscillation (b) Oscillation

Variations of compressive load with stroke using servo press with and without load oscillation

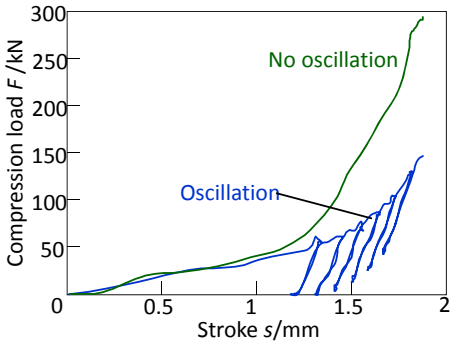
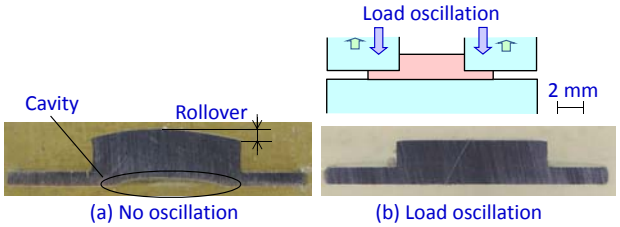


Plate forging of stainless steel SUS403 plate



(a) No oscillation (b) Load oscillation

Reduction in thickness: 63%

One day of student in laboratory

10 : 00 come

12 : 00 Lunch, break

15 : 00 Break

18 : 00 Dinner

Return

Experiment preparation

Experiment

Meeting, data treatment

Class

Newspaper

E-mail

Student rooms

30 students:
3 room

D2-401

D2-402

D2-408

Student rooms

April: Party

New members party

Robot contest

July: Sports

July: Barbecue

Laboratory tour

Year-end party and graduation ceremony

December

February

Thank you very much